

Free Pascal supplied units :
Reference guide.

Reference guide for standard Free Pascal units.
Document version 1.9
May 2003

Michaël Van Canneyt
Florian Klämpfl

Contents

1	The CRT unit.	28
1.1	Types, Variables, Constants	28
1.2	Procedures and Functions	30
	AssignCrt	30
	CursorBig	30
	ClrEol	30
	ClrScr	31
	CursorOff	31
	CursorOn	32
	Delay	32
	DelLine	32
	GotoXY	33
	HighVideo	33
	InsLine	34
	KeyPressed	34
	LowVideo	35
	NormVideo	35
	NoSound	35
	ReadKey	36
	Sound	37
	TextBackground	37
	TextColor	37
	TextMode	38
	WhereX	38
	WhereY	38
	Window	39
2	The DOS unit.	40
2.1	Types, Variables, Constants	40
	Constants	40
	File attributes	40

	fmXXXX	40
	Other	41
	Types	41
	Variables	43
2.2	Function list by category	43
	File handling	43
	Directory and disk handling	44
	Process handling	44
	System information	44
2.3	Functions and Procedures	45
	AddDisk	45
	DiskFree	45
	DiskSize	46
	DosExitCode	47
	DosVersion	47
	EnvCount	48
	EnvStr	48
	Exec	49
	FExpand	49
	FindClose	49
	FindFirst	50
	FindNext	50
	FSearch	51
	FSplit	51
	GetCBreak	52
	GetDate	52
	GetEnv	53
	GetFAttr	53
	GetFTime	54
	GetIntVec	55
	GetLongName	55
	GetShortName	55
	GetTime	55
	GetVerify	56
	Intr	56
	Keep	57
	MSDos	57
	PackTime	57
	SetCBreak	58
	SetDate	58

SetFAttr	58
SetFTime	59
SetIntVec	59
SetTime	59
SetVerify	59
SwapVectors	60
UnPackTime	60
3 The DXELOAD unit	61
3.1 Introduction	61
3.2 Constants, types and variables	61
Constants	61
Types	61
3.3 Functions and Procedures	61
dx_load	61
4 The EMU387 unit	63
4.1 Functions and procedures	63
npxsetup	63
5 The GETOPTS unit.	64
5.1 Types, Constants and variables :	64
Constants	64
Types	64
Variables	65
5.2 Procedures and functions	65
GetLongOpts	65
Getopt	65
6 The GPM unit	68
6.1 Introduction	68
6.2 Constants, types and variables	68
constants	68
Types	69
Variables	70
6.3 Functions and procedures	70
Gpm_AnyDouble	70
Gpm_AnySingle	71
Gpm_AnyTriple	71
Gpm_Close	71
Gpm_FitValues	71

Gpm_FitValuesM	71
Gpm_GetEvent	72
Gpm_GetLibVersion	73
Gpm_GetServerVersion	73
Gpm_GetSnapshot	73
Gpm_LowerRoi	74
Gpm_Open	74
Gpm_PopRoi	74
Gpm_PushRoi	74
Gpm_RaiseRoi	75
Gpm_Repeat	75
Gpm_StrictDouble	75
Gpm_StrictSingle	75
Gpm_StrictTriple	76
7 The GO32 unit	77
7.1 Introduction	77
7.2 Protected mode memory organization	77
What is DPMI	77
Selectors and descriptors	77
FPC specialities	78
DOS memory access	78
I/O port access	78
Processor access	78
Interrupt redirection	78
Handling interrupts with DPMI	79
Protected mode interrupts vs. Real mode interrupts	79
Creating own interrupt handlers	79
Disabling interrupts	79
Hardware interrupts	79
Software interrupts	81
Real mode callbacks	83
7.3 Types, Variables and Constants	84
Constants	84
Constants returned by get_run_mode	84
Processor flags constants	84
Predefined types	84
Variables.	86
7.4 Functions and Procedures	86
allocate_ldt_descriptors	86

allocate_memory_block	88
copyfromdos	88
copytodos	88
create_code_segment_alias_descriptor	89
disable	89
dosmemfillchar	89
dosmemfillword	90
dosmemget	91
dosmemmove	91
dosmempur	91
enable	92
free_ldt_descriptor	92
free_memory_block	92
free_rm_callback	92
get_cs	93
get_descriptor_access_rights	93
get_ds	93
get_linear_addr	93
get_meminfo	94
get_next_selector_increment_value	95
get_page_size	95
get_pm_interrupt	95
get_rm_callback	96
get_rm_interrupt	98
get_run_mode	99
get_segment_base_address	99
get_segment_limit	100
get_ss	100
global_dos_alloc	100
global_dos_free	102
inportb	102
inportl	102
inportw	102
lock_code	103
lock_data	103
lock_linear_region	103
outportb	104
outportl	104
outportw	104
realintr	105

seg_fillchar	105
seg_fillword	106
segment_to_descriptor	106
seg_move	107
set_descriptor_access_rights	107
set_pm_interrupt	107
set_rm_interrupt	108
set_segment_base_address	109
set_segment_limit	109
tb_size	109
transfer_buffer	110
unlock_code	110
unlock_data	110
unlock_linear_region	110
8 The GRAPH unit.	111
8.1 Introduction	111
Requirements	111
A word about mode selection	111
8.2 Constants, Types and Variables	116
Types	116
8.3 Function list by category	116
Initialization	116
screen management	117
Color management	117
Drawing primitives	118
Filled drawings	118
Text and font handling	119
8.4 Functions and procedures	119
Arc	119
Bar	119
Bar3D	119
Circle	120
ClearDevice	120
ClearViewPort	120
CloseGraph	120
DetectGraph	120
DrawPoly	121
Ellipse	121
FillEllipse	121

FillPoly	121
FloodFill	121
GetArcCoords	122
GetAspectRatio	122
GetBkColor	122
GetColor	122
GetDefaultPalette	122
GetDriverName	122
GetFillPattern	123
GetFillSettings	123
GetGraphMode	123
GetImage	123
GetLineSettings	123
GetMaxColor	123
GetMaxMode	124
GetMaxX	124
GetMaxY	124
GetModeName	124
GetModeRange	124
GetPalette	125
GetPaletteSize	125
GetPixel	125
GetTextSettings	125
GetViewSettings	125
GetX	125
GetY	126
GraphDefaults	126
GraphErrorMsg	126
GraphResult	126
ImageSize	127
InitGraph	127
InstallUserDriver	127
InstallUserFont	128
Line	128
LineRel	128
LineTo	128
MoveRel	128
MoveTo	129
OutText	129
OutTextXY	129

PieSlice	129
PutImage	129
PutPixel	130
Rectangle	130
RegisterBGIDriver	130
RegisterBGIFont	130
RestoreCRTMode	130
Sector	131
SetActivePage	131
SetAllPalette	131
SetAspectRatio	131
SetBkColor	131
SetColor	132
SetFillPattern	132
SetFillStyle	132
SetGraphBufSize	132
SetGraphMode	133
SetLineStyle	133
SetPalette	133
SetRGBPalette	133
SetTextJustify	134
SetTextStyle	134
SetUserCharSize	135
SetViewPort	135
SetVisualPage	135
SetWriteMode	135
TextHeight	135
TextWidth	136
8.5 Target specific issues	136
DOS	136
WINDOWS	136
LINUX	136
9 The HEAPTRC unit.	137
9.1 Purpose	137
9.2 Usage	137
9.3 Constants, Types and variables	138
9.4 Functions and procedures	139
DumpHeap	139
MarkHeap	139

SetExtraInfo	140
SetHeapTraceOutput	141
10 The IPC unit.	142
10.1 Types, Constants and variables :	142
Variables	142
Constants	142
Types	143
10.2 Functions and procedures	147
ftok	147
msgget	147
msgsnd	147
msgrcv	148
msgctl	148
semget	151
semop	151
semctl	152
shmget	156
shmat	157
shmdt	157
shmctl	157
11 The KEYBOARD unit	160
11.1 Constants, Type and variables	160
Constants	160
Types	162
11.2 Functions and Procedures	163
DoneKeyboard	163
FunctionKeyName	163
GetKeyboardDriver	164
GetKeyEvent	164
GetKeyEventChar	165
GetKeyEventCode	165
GetKeyEventFlags	166
GetKeyEventShiftState	166
GetKeyEventUniCode	167
InitKeyBoard	167
IsFunctionKey	167
KeyEventToString	168
PollKeyEvent	168
PollShiftStateEvent	169

PutKeyEvent	169
SetKeyboardDriver	170
ShiftStateToString	171
TranslateKeyEvent	171
TranslateKeyEventUniCode	171
11.3 Keyboard scan codes	171
11.4 Writing a keyboard driver	172
12 The LINUX unit.	178
12.1 Type, Variable and Constant declarations	178
Types	178
Variables	181
Constants	182
12.2 Function list by category	186
File Input/Output routines	186
General File handling routines	186
Pipes, FIFOs and streams	187
Directory handling routines	187
Process handling	187
Signals	188
System information	188
Terminal functions	189
Port input/output	189
Utility routines	190
12.3 Functions and procedures	190
Access	190
Alarm	191
AssignPipe	192
AssignStream	192
BaseName	194
CFMakeRaw	194
CFSetISpeed	195
CFSetOSpeed	195
Chown	195
Chmod	196
Clone	197
CloseDir	199
CreateShellArgV	199
DirName	200
Dup	200

Dup2	201
EpochToLocal	202
Execl	202
Execle	203
Execlp	204
Execv	205
Execve	205
Execvp	206
FD_ZERO	207
FD_Clr	207
FD_IsSet	208
FD_Set	208
fdClose	208
fdFlush	208
fdOpen	209
fdRead	210
fdSeek	211
fdTruncate	211
fdWrite	211
FExpand	212
FLock	212
FNMatch	212
FSearch	213
FSplit	213
FSSStat	214
FStat	215
Fcntl	216
Fcntl	216
Fork	217
FRename	217
GetDate	218
GetDateTime	218
GetDomainName	219
GetEGid	219
GetEUid	220
GetEnv	220
GetEpochTime	220
GetFS	221
GetGid	221
GetHostName	222

GetLocalTimezone	222
GetPid	222
GetPPid	223
GetPriority	223
GetTime	224
GetTimeOfDay	224
GetTimeOfDay	224
GetTimezoneFile	225
GetUid	225
Glob	225
GlobFree	226
IOCtl	226
IOperm	227
IsATTY	227
S_ISBLK	227
S_ISCHR	228
S_ISDIR	228
S_ISFIFO	228
S_ISLNK	228
S_ISREG	229
S_ISSOCK	229
Kill	229
LStat	230
Link	231
LocalToEpoch	232
MkFifo	232
MMap	232
MUnMap	234
NanoSleep	234
Nice	235
Octal	235
OpenDir	236
pause	237
PClose	237
POpen	237
ReadDir	238
ReadLink	239
ReadPort	240
ReadPortB	240
ReadPortL	240

ReadPortW	241
ReadTimezoneFile	241
SeekDir	241
Select	241
SelectText	242
SetPriority	243
Shell	243
SigAction	244
SigPending	245
SigProcMask	245
SigRaise	245
SigSuspend	246
Signal	246
StringToPPchar	247
SymLink	248
SysInfo	249
TCDrain	250
TCFlow	250
TCFlush	251
TCGetAttr	251
TCGetPGrp	252
TCSendBreak	252
TCSetAttr	252
TCSetPGrp	253
TTYName	253
TellDir	253
Umask	253
Uname	254
UnLink	254
Utime	254
WaitPid	255
WritePort	256
WritePortB	256
WritePortL	256
WritePortW	257
13 The MATH unit	258
13.1 Constants and types	258
13.2 Function list by category	259
Min/max determination	259

Angle conversion	259
Trigonometric functions	259
Hyperbolic functions	260
Exponential and logarithmic functions	260
Number converting	260
Statistical functions	260
Geometrical functions	261
13.3 Functions and Procedures	261
arccos	261
arcosh	261
arcsin	262
arctan2	263
arsinh	263
artanh	264
ceil	264
cosh	265
cotan	265
cycletorad	265
degtograd	266
degtorad	266
floor	267
frexp	267
gradtodeg	268
gradtorad	268
hypot	269
intpower	269
ldexp	270
lnxpl	270
log10	271
log2	271
logn	272
max	272
maxIntValue	273
maxvalue	273
mean	274
meanandstddev	275
min	276
minIntValue	276
minvalue	277
momentskewkurtosis	278

norm	278
popnstddev	279
popnvariance	280
power	280
radtcycle	281
radtodeg	281
radtograd	282
randg	282
sincos	283
sinh	283
stddev	284
sum	285
sumofsquares	285
sumsandsquares	286
tan	287
tanh	287
totalvariance	288
variance	288
14 The MMX unit	290
14.1 Variables, Types and constants	290
14.2 Functions and Procedures	291
Emms	291
15 The MOUSE unit	292
15.1 Constants, Types and Variables	292
Constants	292
Types	293
Variables	293
15.2 Functions and procedures	293
DetectMouse	293
DoneMouse	294
GetMouseButtons	294
GetMouseDriver	295
GetMouseEvent	295
GetMouseX	295
GetMouseY	296
HideMouse	296
InitMouse	297
PollMouseEvent	297
PutMouseEvent	297

SetMouseDriver	298
SetMouseXY	298
ShowMouse	299
15.3 Writing a custom mouse driver	299
16 The MsMouse unit	302
16.1 Constants, types and variables	302
16.2 Functions and procedures	303
GetLastButtonPress	303
GetLastButtonRelease	304
GetMouseState	305
HideMouse	306
InitMouse	306
LPressed	307
MPressed	307
RPressed	307
SetMouseAscii	307
SetMouseHideWindow	308
SetMousePos	309
SetMouseShape	310
SetMouseSpeed	311
SetMouseWindow	312
SetMouseXRange	312
SetMouseYRange	313
ShowMouse	313
17 The Objects unit.	314
17.1 Constants	314
17.2 Types	315
17.3 Procedures and Functions	316
NewStr	316
DisposeStr	317
Abstract	317
RegisterObjects	317
RegisterType	317
LongMul	319
LongDiv	319
17.4 TRect	319
TRect.Empty	320
TRect.Equals	321
TRect.Contains	321

TRect.Copy	321
TRect.Union	322
TRect.Intersect	322
TRect.Move	323
TRect.Grow	323
TRect.Assign	324
17.5 TObject	324
TObject.Init	325
TObject.Free	325
TObject.Done	325
17.6 TStream	326
TStream.Get	327
TStream.StrRead	327
TStream.GetPos	328
TStream.GetSize	328
TStream.ReadStr	329
TStream.Open	330
TStream.Close	330
TStream.Reset	330
TStream.Flush	330
TStream.Truncate	331
TStream.Put	331
TStream.StrWrite	331
TStream.WriteStr	331
TStream.Seek	332
TStream.Error	332
TStream.Read	332
TStream.Write	333
TStream.CopyFrom	333
17.7 TDosStream	334
TDosStream.Init	334
TDosStream.Done	335
TDosStream.Close	335
TDosStream.Truncate	335
TDosStream.Seek	336
TDosStream.Open	337
TDosStream.Read	337
TDosStream.Write	338
17.8 TBufStream	338
TBufStream.Init	338

TBufStream.Done	339
TBufStream.Close	339
TBufStream.Flush	339
TBufStream.Truncate	340
TBufStream.Seek	340
TBufStream.Open	340
TBufStream.Read	341
TBufStream.Write	341
17.9 TMemoryStream	341
TMemoryStream.Init	342
TMemoryStream.Done	342
TMemoryStream.Truncate	342
TMemoryStream.Read	343
TMemoryStream.Write	343
17.10 TCollection	344
TCollection.Init	344
TCollection.Load	345
TCollection.Done	345
TCollection.At	346
TCollection.IndexOf	346
TCollection.GetItem	347
TCollection.LastThat	347
TCollection.FirstThat	348
TCollection.Pack	349
TCollection.FreeAll	350
TCollection.DeleteAll	351
TCollection.Free	351
TCollection.Insert	352
TCollection.Delete	352
TCollection.AtFree	353
TCollection.FreeItem	354
TCollection.AtDelete	354
TCollection.ForEach	355
TCollection.SetLimit	356
TCollection.Error	356
TCollection.AtPut	356
TCollection.AtInsert	356
TCollection.Store	357
TCollection.PutItem	358
17.11 TSortedCollection	358

TSortedCollection.Init	359
TSortedCollection.Load	359
TSortedCollection.KeyOf	359
TSortedCollection.IndexOf	360
TSortedCollection.Compare	360
TSortedCollection.Search	361
TSortedCollection.Insert	362
TSortedCollection.Store	363
17.12 TStringCollection	363
TStringCollection.GetItem	363
TStringCollection.Compare	364
TStringCollection.FreeItem	364
TStringCollection.PutItem	365
17.13 TStrCollection	365
TStrCollection.GetItem	365
TStrCollection.Compare	365
TStrCollection.FreeItem	366
TStrCollection.PutItem	366
17.14 TUnSortedStrCollection	367
TUnSortedStrCollection.Insert	367
17.15 TResourceCollection	368
TResourceCollection.KeyOf	368
TResourceCollection.GetItem	368
TResourceCollection.FreeItem	369
TResourceCollection.PutItem	369
17.16 TResourceFile	369
TResourceFile Fields	369
TResourceFile.Init	370
TResourceFile.Done	370
TResourceFile.Count	370
TResourceFile.KeyAt	370
TResourceFile.Get	370
TResourceFile.SwitchTo	371
TResourceFile.Flush	371
TResourceFile.Delete	371
TResourceFile.Put	371
17.17 TStringList	371
TStringList.Load	372
TStringList.Done	372
TStringList.Get	372

17.18	TStrListMaker	372
	TStrListMaker.Init	373
	TStrListMaker.Done	373
	TStrListMaker.Put	373
	TStrListMaker.Store	373
18	The PORTS unit	374
18.1	Introduction	374
18.2	Types, constants and variables	374
	Types	374
	variables	375
19	The PRINTER unit.	376
19.1	Types, Constants and variables :	376
19.2	Procedures and functions	376
	AssignLst	376
20	The SOCKETS unit.	378
20.1	Types, Constants and variables :	378
20.2	Functions and Procedures	379
	Accept	379
	Accept	381
	Accept	381
	Accept	381
	Bind	381
	Bind	382
	Connect	382
	Connect	383
	Connect	383
	Connect	383
	GetPeerName	384
	GetSocketName	385
	GetSocketOptions	385
	Listen	385
	Recv	386
	Send	386
	SetSocketOptions	387
	Shutdown	387
	Sock2File	387
	Sock2Text	388
	Socket	388

SocketPair	388
Str2UnixSockAddr	388
21 The STRINGS unit.	389
21.1 Functions and procedures.	389
StrAlloc	389
StrCat	389
StrComp	390
StrCopy	390
StrDispose	391
StrECopy	391
StrEnd	392
StrIComp	392
StrLCat	393
StrLComp	393
StrLCopy	394
StrLen	394
StrLIComp	395
StrLower	395
StrMove	396
StrNew	396
StrPas	397
StrPCopy	397
StrPos	398
StrRScan	398
StrScan	398
StrUpper	399
22 The SYSUTILS unit.	400
22.1 Constants and types	400
22.2 Function list by category	403
String functions	403
Formatting strings	404
File input/output routines	405
File handling routines	405
Date/time routines	406
22.3 Miscellaneous conversion routines	407
22.4 Date and time functions	407
Date and time formatting characters	407
TDateTime	408
Date	408

DateTimeToFileDate	409
DateTimeToStr	409
DateTimeToString	410
DateTimeToSystemTime	411
DateTimeToTimeStamp	411
DateToStr	412
DayOfWeek	412
DecodeDate	413
DecodeTime	413
EncodeDate	414
EncodeTime	414
FileDateToDateTime	415
FormatDateTime	415
IncMonth	416
IsLeapYear	416
MSecsToTimeStamp	417
Now	418
StrToDate	418
StrToDateTime	419
StrToTime	419
SystemTimeToDateTime	420
Time	420
TimeStampToDateTime	421
TimeStampToMSecs	421
TimeToStr	422
22.5 Disk functions	422
AddDisk (Linux only)	422
CreateDir	423
DiskFree	423
DiskSize	424
GetCurrentDir	424
RemoveDir	425
SetCurrentDir	425
22.6 File handling functions	425
ChangeFileExt	425
DeleteFile	426
DoDirSeparators	426
ExpandFileName	427
ExpandUNCFileName	427
ExtractFileDir	428

ExtractFileDrive	428
ExtractFileExt	429
ExtractFileName	429
ExtractFilePath	429
ExtractRelativePath	429
FileAge	430
FileClose	431
FileCreate	431
FileExists	432
FileGetAttr	432
FileGetDate	433
FileOpen	434
FileRead	434
FileSearch	435
FileSeek	435
FileSetAttr (Not on Linux)	436
FileSetDate (Not on Linux)	436
FileTruncate	436
FileWrite	437
FindClose	437
FindFirst	437
FindNext	438
GetDirs	438
RenameFile	439
SetDirSeparators	439
22.7 PChar functions	440
Introduction	440
StrAlloc	441
StrBufSize	441
StrDispose	441
StrPCopy	442
StrPLCopy	442
StrPas	442
22.8 String handling functions	442
AdjustLineBreaks	442
AnsiCompareStr	443
AnsiCompareText	444
AnsiExtractQuotedStr	445
AnsiLastChar	445
AnsiLowerCase	446

AnsiQuotedStr	446
AnsiStrComp	446
AnsiStrIComp	447
AnsiStrLastChar	448
AnsiStrLComp	449
AnsiStrLIComp	449
AnsiStrLower	450
AnsiStrUpper	451
AnsiUpperCase	452
AppendStr	452
AssignStr	453
BCDToInt	453
CompareMem	454
CompareStr	454
CompareText	455
DisposeStr	456
FloatToStr	456
FloatToStrF	457
FloatToText	458
FmtStr	459
Format	459
FormatBuf	465
FormatFloat	465
IntToHex	466
IntToStr	467
IsValidIdent	468
LastDelimiter	468
LeftStr	469
LoadStr	469
LowerCase	469
NewStr	470
QuotedStr	470
RightStr	470
StrFmt	471
StrLFmt	471
StrToFloat	472
StrToInt	473
StrToIntDef	473
TextToFloat	474
Trim	475

TrimLeft	476
TrimRight	476
UpperCase	477
23 The TYPINFO unit	478
23.1 Constants, Types and variables	478
Constants	478
types	478
23.2 Function list by category	481
Examining published property information	481
Getting or setting property values	482
Auxiliary functions	482
23.3 Functions and Procedures	483
FindPropInfo	483
GetEnumName	484
GetEnumProp	484
GetEnumValue	485
GetFloatProp	485
GetInt64Prop	486
GetMethodProp	487
GetObjectProp	489
GetObjectPropClass	490
GetOrdProp	490
GetPropInfo	491
GetPropInfos	492
GetPropList	493
GetPropValue	494
GetSetProp	494
GetStrProp	495
GetTypeData	496
GetVariantProp	496
IsPublishedProp	496
IsStoredProp	497
PropIsType	498
PropType	499
SetEnumProp	500
SetFloatProp	500
SetInt64Prop	500
SetMethodProp	501
SetObjectProp	501

SetOrdProp	502
SetPropValue	502
SetSetProp	502
SetStrProp	503
SetToString	503
SetVariantProp	504
StringToSet	504
24 The VIDEO unit	505
24.1 Constants, Type and variables	506
Constants	506
Types	507
Variables	508
24.2 Functions and Procedures	509
ClearScreen	509
DefaultErrorHandler	510
DoneVideo	510
GetCapabilities	511
GetCursorType	512
GetLockScreenCount	512
GetVideoDriver	513
GetVideoMode	513
GetVideoModeCount	514
GetVideoModeData	515
InitVideo	515
LockScreenUpdate	516
SetCursorPos	516
SetCursorType	517
SetVideoDriver	517
SetVideoMode	518
UnlockScreenUpdate	518
UpdateScreen	519
24.3 Writing a custom video driver	519

About this guide

This document describes all constants, types, variables, functions and procedures as they are declared in the units that come standard with Free Pascal.

Throughout this document, we will refer to functions, types and variables with `typewriter` font. Functions and procedures have their own subsections, and for each function or procedure we have the following topics:

Declaration The exact declaration of the function.

Description What does the procedure exactly do ?

Errors What errors can occur.

See Also Cross references to other related functions/commands.

The cross-references come in two flavors:

- References to other functions in this manual. In the printed copy, a number will appear after this reference. It refers to the page where this function is explained. In the on-line help pages, this is a hyperlink, on which you can click to jump to the declaration.
- References to Unix manual pages. (For Linux related things only) they are printed in `typewriter` font, and the number after it is the Unix manual section.

The chapters are ordered alphabetically. The functions and procedures in most cases also, but don't count on it. Use the table of contents for quick lookup.

Chapter 1

The CRT unit.

This chapter describes the CRT unit for Free Pascal, both under DOS LINUX and WINDOWS. The unit was first written for DOS by Florian klämpfl. The unit was ported to LINUX by Mark May¹, and enhanced by Michaël Van Canneyt and Peter Vreman. It works on the LINUX console, and in xterm and rxvt windows under X-Windows. The functionality for both is the same, except that under LINUX the use of an early implementation (versions 0.9.1 and earlier of the compiler) the crt unit automatically cleared the screen at program startup.

There are some caveats when using the CRT unit:

- Programs using the CRT unit will *not* be usable when input/output is being redirected on the command-line.
- For similar reasons they are not usable as CGI-scripts for use with a webserver.
- The use of the CRT unit and the graph unit may not always be supported.
- On LINUX or other unix OSes , executing other programs that expect special terminal behaviour (using one of the special functions in the linux unit) will not work. The terminal is set in RAW mode, which will destroy most terminal emulation settings.

This chapter is divided in two sections.

- The first section lists the pre-defined constants, types and variables.
- The second section describes the functions which appear in the interface part of the CRT unit.

1.1 Types, Variables, Constants

Color definitions :

```
Black = 0;  
Blue = 1;  
Green = 2;  
Cyan = 3;  
Red = 4;  
Magenta = 5;  
Brown = 6;
```

¹Current e-mail address mmay@dnaco.net

```

LightGray = 7;
DarkGray = 8;
LightBlue = 9;
LightGreen = 10;
LightCyan = 11;
LightRed = 12;
LightMagenta = 13;
Yellow = 14;
White = 15;
Blink = 128;

```

Miscellaneous constants

```

TextAttr: Byte = $07;
TextChar: Char = ' ';
CheckBreak: Boolean = True;
CheckEOF: Boolean = False;
CheckSnow: Boolean = False;
DirectVideo: Boolean = False;
LastMode: Word = 3;
WindMin: Word = $0;
WindMax: Word = $184f;
ScreenWidth = 80;
ScreenHeight = 25;

```

Some variables for compatibility with Turbo Pascal. However, they're not used by Free Pascal.

```

var
  checkbreak : boolean;
  checkeof : boolean;
  checksnow : boolean;

```

The following constants define screen modes on a DOS system:

```

Const
  bw40 = 0;
  co40 = 1;
  bw80 = 2;
  co80 = 3;
  mono = 7;

```

The TextAttr variable controls the attributes with which characters are written to screen.

```

var TextAttr : byte;

```

The DirectVideo variable controls the writing to the screen. If it is True, the the cursor is set via direct port access. If False, then the BIOS is used. This is defined under DOS only.

```

var DirectVideo : Boolean;

```

The Lastmode variable tells you which mode was last selected for the screen. It is defined on DOS only.

```

var lastmode : Word;

```

1.2 Procedures and Functions

AssignCrt

Declaration: `Procedure AssignCrt (Var F: Text);`

Description: `AssignCrt` Assigns a file F to the console. Everything written to the file F goes to the console instead. If the console contains a window, everything is written to the window instead.

Errors: None.

See also: [Window \(39\)](#)

Listing: `crtex/ex1.pp`

```

Program Example1;
uses Crt;

{ Program to demonstrate the AssignCrt function. }

var
  F : Text;
begin
  AssignCrt(F);
  Rewrite(F); { Don't forget to open for output! }
  WriteLn(F, 'This is written to the Assigned File ');
  Close(F);
end.

```

CursorBig

Declaration: `Procedure CursorBig ;`

Description: Makes the cursor a big rectangle. Not implemented on LINUX.

Errors: None.

See also: [CursorOn \(32\)](#), [CursorOff \(31\)](#)

ClrEol

Declaration: `Procedure ClrEol ;`

Description: `ClrEol` clears the current line, starting from the cursor position, to the end of the window. The cursor doesn't move

Errors: None.

See also: [DelLine \(32\)](#), [InsLine \(34\)](#), [ClrScr \(31\)](#)

Listing: `crtex/ex9.pp`

```

Program Example9;
uses Crt;

{ Program to demonstrate the ClrEol function. }
var

```

```
I,J : integer;

begin
  For I:=1 to 15 do
    For J:=1 to 80 do
      begin
        gotoxy(j,i);
        Write(j mod 10);
      end;
    Window(5,5,75,12);
    Write('This line will be cleared from ',
          ' here till the right of the window');
    GotoXY(27,WhereY);
    ReadKey;
    ClrEol;
    WriteLn;
  end.
```

ClrScr

Declaration: `Procedure ClrScr ;`

Description: `ClrScr` clears the current window (using the current colors), and sets the cursor in the top left corner of the current window.

Errors: None.

See also: [Window \(39\)](#)

Listing: `crtex/ex8.pp`

```
Program Example8;
uses Crt;

{ Program to demonstrate the ClrScr function. }

begin
  Writeln('Press any key to clear the screen');
  ReadKey;
  ClrScr;
  Writeln('Have fun with the cleared screen');
end.
```

CursorOff

Declaration: `Procedure CursorOff ;`

Description: Switches the cursor off (i.e. the cursor is no longer visible). Not implemented on LINUX.

Errors: None.

See also: [CursorOn \(32\)](#), [CursorBig \(30\)](#)

CursorOn

Declaration: `Procedure CursorOn ;`

Description: Switches the cursor on. Not implemented on LINUX.

Errors: None.

See also: [CursorBig \(30\)](#), [CursorOff \(31\)](#)

Delay

Declaration: `Procedure Delay (DTime: Word);`

Description: Delay waits a specified number of milliseconds. The number of specified seconds is an approximation, and may be off a lot, if system load is high.

Errors: None

See also: [Sound \(37\)](#), [NoSound \(35\)](#)

Listing: `crtex/ex15.pp`

```
Program Example15;  
uses Crt;  
  
{ Program to demonstrate the Delay function. }  
var  
    i : longint;  
begin  
    WriteLn( 'Counting Down' );  
    for i:=10 downto 1 do  
        begin  
            WriteLn(i);  
            Delay(1000); {Wait one second}  
        end;  
    WriteLn( 'BOOM!!! ' );  
end.
```

DelLine

Declaration: `Procedure DelLine ;`

Description: DelLine removes the current line. Lines following the current line are scrolled 1 line up, and an empty line is inserted at the bottom of the current window. The cursor doesn't move.

Errors: None.

See also: [ClrEol \(30\)](#), [InsLine \(34\)](#), [ClrScr \(31\)](#)

Listing: `crtex/ex11.pp`

```
Program Example10;  
uses Crt;  
  
{ Program to demonstrate the InsLine function. }  
  
begin
```

```
ClrScr;  
WriteLn;  
WriteLn('Line 1');  
WriteLn('Line 2');  
WriteLn('Line 2');  
WriteLn('Line 3');  
WriteLn;  
WriteLn('Oops, Line 2 is listed twice,',  
        ' let's delete the line at the cursor position');  
GotoXY(1,3);  
ReadKey;  
DelLine;  
GotoXY(1,10);  
end.
```

GotoXY

Declaration: `Procedure GotoXY (X: Byte; Y: Byte);`

Description: Positions the cursor at (X, Y), X in horizontal, Y in vertical direction relative to the origin of the current window. The origin is located at (1, 1), the upper-left corner of the window.

Errors: None.

See also: [WhereX \(38\)](#), [WhereY \(38\)](#), [Window \(39\)](#)

Listing: `crtex/ex6.pp`

```
Program Example6;  
uses Crt;  
  
{ Program to demonstrate the GotoXY function. }  
  
begin  
  ClrScr;  
  GotoXY(10,10);  
  Write('10,10');  
  GotoXY(70,20);  
  Write('70,20');  
  GotoXY(1,22);  
end.
```

HighVideo

Declaration: `Procedure HighVideo ;`

Description: HighVideo switches the output to highlighted text. (It sets the high intensity bit of the video attribute)

Errors: None.

See also: [TextColor \(37\)](#), [TextBackground \(37\)](#), [LowVideo \(35\)](#), [NormVideo \(35\)](#)

Listing: `crtex/ex14.pp`

```
Program Example14;  
uses Crt;  
  
{ Program to demonstrate the LowVideo, HighVideo, NormVideo functions. }  
  
begin  
  LowVideo;  
  WriteLn( 'This is written with LowVideo' );  
  HighVideo;  
  WriteLn( 'This is written with HighVideo' );  
  NormVideo;  
  WriteLn( 'This is written with NormVideo' );  
end.
```

InsLine

Declaration: `Procedure InsLine ;`

Description: `InsLine` inserts an empty line at the current cursor position. Lines following the current line are scrolled 1 line down, causing the last line to disappear from the window. The cursor doesn't move.

Errors: None.

See also: [ClrEol \(30\)](#), [DelLine \(32\)](#), [ClrScr \(31\)](#)

Listing: crtex/ex10.pp

```
Program Example10;  
uses Crt;  
  
{ Program to demonstrate the InsLine function. }  
  
begin  
  ClrScr;  
  WriteLn;  
  WriteLn( 'Line 1 ' );  
  WriteLn( 'Line 3 ' );  
  WriteLn;  
  WriteLn( 'Oops, forgot Line 2, let''s insert at the cursor postion' );  
  GotoXY(1,3);  
  ReadKey;  
  InsLine;  
  Write( 'Line 2 ' );  
  GotoXY(1,10);  
end.
```

KeyPressed

Declaration: `Function KeyPressed : Boolean;`

Description: The `KeyPressed` function scans the keyboard buffer and sees if a key has been pressed. If this is the case, `True` is returned. If not, `False` is returned. The `Shift`, `Alt`, `Ctrl` keys are not reported. The key is not removed from the buffer, and can hence still be read after the `KeyPressed` function has been called.

Errors: None.

See also: [ReadKey \(36\)](#)

Listing: `crtex/ex2.pp`

```
Program Example2;  
uses Crt;  
  
{ Program to demonstrate the KeyPressed function. }  
  
begin  
  WriteLn('Waiting until a key is pressed');  
  repeat  
    until KeyPressed;  
  { The key is not Read,  
    so it should also be outputted at the commandline }  
end.
```

LowVideo

Declaration: `Procedure LowVideo ;`

Description: `LowVideo` switches the output to non-highlighted text. (It clears the high intensity bit of the video attribute)

Errors: None.

See also: [TextColor \(37\)](#), [TextBackground \(37\)](#), [HighVideo \(33\)](#), [NormVideo \(35\)](#)

For an example, see [HighVideo \(33\)](#)

NormVideo

Declaration: `Procedure NormVideo ;`

Description: `NormVideo` switches the output to the defaults, read at startup. (The defaults are read from the cursor position at startup)

Errors: None.

See also: [TextColor \(37\)](#), [TextBackground \(37\)](#), [LowVideo \(35\)](#), [HighVideo \(33\)](#)

For an example, see [HighVideo \(33\)](#)

NoSound

Declaration: `Procedure NoSound ;`

Description: Stops the speaker sound. This call is not supported on all operating systems.

Errors: None.

See also: [Sound \(37\)](#)

Listing: `crtex/ex16.pp`

```
Program Example16;  
uses Crt;  
  
{ Program to demonstrate the Sound and NoSound function. }  
  
var  
  i : longint;  
begin  
  WriteLn('You will hear some tones from your speaker');  
  while (i < 15000) do  
    begin  
      inc(i, 500);  
      Sound(i);  
      Delay(100);  
    end;  
  WriteLn('Quiet now!');  
  NoSound; {Stop noise}  
end.
```

ReadKey

Declaration: `Function ReadKey : Char;`

Description: The ReadKey function reads 1 key from the keyboard buffer, and returns this. If an extended or function key has been pressed, then the zero ASCII code is returned. You can then read the scan code of the key with a second ReadKey call. **Remark.** Key mappings under Linux can cause the wrong key to be reported by ReadKey, so caution is needed when using ReadKey.

Errors: None.

See also: [KeyPressed \(34\)](#)

Listing: crtex/ex3.pp

```
Program Example3;  
uses Crt;  
  
{ Program to demonstrate the ReadKey function. }  
  
var  
  ch : char;  
begin  
  writeLn('Press Left/Right, Esc=Quit');  
  repeat  
    ch := ReadKey;  
    case ch of  
      #0 : begin  
          ch := ReadKey; {Read ScanCode}  
          case ch of  
            #75 : WriteLn('Left');  
            #77 : WriteLn('Right');  
          end;  
        end;  
      #27 : WriteLn('ESC');  
    end;  
  until ch = #27 {Esc}  
end.
```

Sound

Declaration: `Procedure Sound (hz : word);`

Description: Sounds the speaker at a frequency of `hz`. Under WINDOWS, a system sound is played and the frequency parameter is ignored. On other operating systems, this routine may not be implemented.

Errors: None.

See also: [NoSound \(35\)](#)

TextBackground

Declaration: `Procedure TextBackground (CL: Byte);`

Description: `TextBackground` sets the background color to `CL`. `CL` can be one of the predefined color constants.

Errors: None.

See also: [TextColor \(37\)](#), [HighVideo \(33\)](#), [LowVideo \(35\)](#), [NormVideo \(35\)](#)

Listing: `crtex/ex13.pp`

```
Program Example13;
uses Crt;

{ Program to demonstrate the TextBackground function. }

begin
  TextColor(White);
  WriteLn('This is written in with the default background color');
  TextBackground(Green);
  WriteLn('This is written in with a Green background');
  TextBackground(Brown);
  WriteLn('This is written in with a Brown background');
  TextBackground(Black);
  WriteLn('Back with a black background');
end.
```

TextColor

Declaration: `Procedure TextColor (CL: Byte);`

Description: `TextColor` sets the foreground color to `CL`. `CL` can be one of the predefined color constants.

Errors: None.

See also: [TextBackground \(37\)](#), [HighVideo \(33\)](#), [LowVideo \(35\)](#), [NormVideo \(35\)](#)

Listing: `crtex/ex12.pp`

```
Program Example12;
uses Crt;

{ Program to demonstrate the TextColor function. }

begin
  WriteLn('This is written in the default color');
end.
```

```
TextColor(Red);  
WriteLn('This is written in Red');  
TextColor(White);  
WriteLn('This is written in White');  
TextColor(LightBlue);  
WriteLn('This is written in Light Blue');  
end.
```

TextMode

Declaration: `procedure TextMode(Mode: Integer);`

Description: `TextMode` sets the textmode of the screen (i.e. the number of lines and columns of the screen). The lower byte is use to set the VGA text mode.

This procedure is only implemented on DOS.

Errors: None.

See also: [Window \(39\)](#)

WhereX

Declaration: `Function WhereX : Byte;`

Description: `WhereX` returns the current X-coordinate of the cursor, relative to the current window. The origin is (1,1), in the upper-left corner of the window.

Errors: None.

See also: [GotoXY \(33\)](#), [WhereY \(38\)](#), [Window \(39\)](#)

Listing: `crtex/ex7.pp`

```
Program Example7;  
uses Crt;  
  
{ Program to demonstrate the WhereX and WhereY functions. }  
  
begin  
  WriteLn('Cursor postion: X=',WhereX, ' Y=',WhereY);  
end.
```

WhereY

Declaration: `Function WhereY : Byte;`

Description: `WhereY` returns the current Y-coordinate of the cursor, relative to the current window. The origin is (1,1), in the upper-left corner of the window.

Errors: None.

See also: [GotoXY \(33\)](#), [WhereX \(38\)](#), [Window \(39\)](#)

Listing: `crtex/ex7.pp`

```
Program Example7;  
uses Crt;  
  
{ Program to demonstrate the WhereX and WhereY functions. }  
  
begin  
  WriteLn('Cursor position: X=',WhereX, ' Y=',WhereY);  
end.
```

Window

Declaration: `Procedure Window (X1, Y1, X2, Y2: Byte);`

Description: Window creates a window on the screen, to which output will be sent. (X1, Y1) are the coordinates of the upper left corner of the window, (X2, Y2) are the coordinates of the bottom right corner of the window. These coordinates are relative to the entire screen, with the top left corner equal to (1, 1) Further coordinate operations, except for the next Window call, are relative to the window's top left corner.

Errors: None.

See also: GotoXY (33), WhereX (38), WhereY (38), ClrScr (31)

Listing: crtex/ex5.pp

```
Program Example5;  
uses Crt;  
  
{ Program to demonstrate the Window function. }  
  
begin  
  ClrScr;  
  WriteLn('Creating a window from 30,10 to 50,20');  
  Window(30,10,50,20);  
  WriteLn('We are now writing in this small window we just created, we '+  
    'can''t get outside it when writing long lines like this one');  
  Write('Press any key to clear the window');  
  ReadKey;  
  ClrScr;  
  Write('The window is cleared, press any key to restore to fullscreen');  
  ReadKey;  
{ Full Screen is 80x25 }  
  Window(1,1,80,25);  
  Clrscr;  
  WriteLn('Back in Full Screen');  
end.
```

Chapter 2

The DOS unit.

This chapter describes the DOS unit for Free pascal. The DOS unit gives access to some operating system calls related to files, the file system, date and time. Except for the PALMOS target, this unit is available to all supported platforms.

The unit was first written for DOS by Florian Klämpfl. It was ported to LINUX by Mark May¹, and enhanced by Michaël Van Canneyt. The AMIGA version was ported by Nils Sjöholm.

Under non-DOS systems, some of the functionality is lost, as it is either impossible or meaningless to implement it. Other than that, the functionality for all operating systems is the same.

This chapter is divided in three sections:

- The first section lists the pre-defined constants, types and variables.
- The second section gives an overview of all functions available, grouped by category.
- The third section describes the functions which appear in the interface part of the DOS unit.

2.1 Types, Variables, Constants

Constants

The DOS unit implements the following constants:

File attributes

The File Attribute constants are used in `FindFirst` (50), `FindNext` (50) to determine what type of special file to search for in addition to normal files. These flags are also used in the `SetFAttr` (58) and `GetFAttr` (53) routines to set and retrieve attributes of files. For their definitions consult table (2.1).

fmXXXX

These constants are used in the `Mode` field of the `TextRec` record. Gives information on the filemode of the text I/O. For their definitions consult table (2.2).

¹Current e-mail address mmay@dnaco.net

Table 2.1: Possible file attributes

Constant	Description	Value
readonly	Read only file	\$01
hidden	Hidden file	\$02
sysfile	System file	\$04
volumeid	Volume label	\$08
directory	Directory	\$10
archive	Archive	\$20
anyfile	Any of the above special files	\$3F

Table 2.2: Possible mode constants

Constant	Description	Value
fmclosed	File is closed	\$D7B0
fminput	File is read only	\$D7B1
fmoutput	File is write only	\$D7B2
fminout	File is read and write	\$D7B3

Other

The following constants are not portable, and should not be used. They are present for compatibility only.

```
{Bitmasks for CPU Flags}
fcarry =    $0001;
fparity =   $0004;
fauxiliary = $0010;
fzero =     $0040;
fsign =     $0080;
foverflow  = $0800;
```

Types

The following string types are defined for easy handling of filenames :

```
ComStr  = String[255];    { For command-lines }
PathStr = String[255];    { For full path for file names }
DirStr  = String[255];    { For Directory and (DOS) drive string }
NameStr = String[255];    { For Name of file }
ExtStr  = String[255];    { For Extension of file }
```

```
SearchRec = Packed Record
  Fill : array[1..21] of byte;
  { Fill replaced with declarations below, for Linux}
  Attr : Byte; {attribute of found file}
  Time : LongInt; {last modify date of found file}
  Size : LongInt; {file size of found file}
  Reserved : Word; {future use}
  Name : String[255]; {name of found file}
```

```

SearchSpec: String[255]; {search pattern}
NamePos: Word; {end of path, start of name position}
End;

```

Under LINUX, the Fill array is replaced with the following:

```

SearchNum: LongInt; {to track which search this is}
SearchPos: LongInt; {directory position}
DirPtr: LongInt; {directory pointer for reading directory}
SearchType: Byte; {0=normal, 1=open will close}
SearchAttr: Byte; {attribute we are searching for}
Fill: Array[1..07] of Byte; {future use}

```

This is because the searching mechanism on Unix systems is substantially different from DOS's, and the calls have to be mimicked.

```

const
  filerecnamelength = 255;
type
  FileRec = Packed Record
    Handle,
    Mode,
    RecSize   : longint;
    _private  : array[1..32] of byte;
    UserData  : array[1..16] of byte;
    name      : array[0..filerecnamelength] of char;
  End;

```

FileRec is used for internal representation of typed and untyped files. Text files are handled by the following types :

```

const
  TextRecNameLength = 256;
  TextRecBufSize    = 256;
type
  TextBuf = array[0..TextRecBufSize-1] of char;
  TextRec = Packed Record
    Handle,
    Mode,
    bufsize,
    _private,
    bufpos,
    bufend   : longint;
    bufptr   : ^textbuf;
    openfunc,
    inoutfunc,
    flushfunc,
    closefunc : pointer;
    UserData  : array[1..16] of byte;
    name      : array[0..textrecnamelength-1] of char;
    buffer    : textbuf;
  End;

```

Remark that this is not binary compatible with the Turbo Pascal definition of TextRec, since the sizes of the different fields are different.

```

Registers = record
  case i : integer of
    0 : (ax,f1,bx,f2,cx,f3,dx,f4,bp,f5,si,
         f5i,di,f6,ds,f7,es,f8,flags,fs,gs : word);
    1 : (al,ah,f9,f10,bl,bh,f11,f12,
         cl,ch,f13,f14,dl,dh : byte);
    2 : (eax, ebx, ecx, edx, ebp, esi, edi : longint);
  End;

```

The registers type is used in the MSDos call.

```

DateTime = record
  Year: Word;
  Month: Word;
  Day: Word;
  Hour: Word;
  Min: Word;
  Sec: word;
  End;

```

The DateTime type is used in PackTime (57) and UnPackTime (60) for setting/reading file times with GetFTime (54) and SetFTime (59).

Variables

```

DosError : integer;

```

The DosError variable is used by the procedures in the DOS unit to report errors. It can have the following values :

- 2 File not found.
- 3 path not found.
- 5 Access denied.
- 6 Invalid handle.
- 8 Not enough memory.
- 10 Invalid environment.
- 11 Invalid format.
- 18 No more files.

Other values are possible, but are not documented.

2.2 Function list by category

What follows is a listing of the available functions, grouped by category. For each function there is a reference to the page where you can find the function.

File handling

Routines to handle files on disk.

Name	Description	Page
------	-------------	------

FExpand	Expand filename to full path	49
FindClose	Close finfirst/findnext session	49
FindFirst	Start find of file	50
FindNext	Find next file	50
FSearch	Search for file in a path	51
FSplit	Split filename in parts	51
GetFAttr	Return file attributes	53
GetFTime	Return file time	54
GetLongName	Convert short filename to long filename (DOS only)	55
GetShortName	Convert long filename to short filename (DOS only)	55
SetFAttr	Set file attributes	58
SetFTime	Set file time	59

Directory and disk handling

Routines to handle disk information.

Name	Description	Page
AddDisk	Add disk to list of disks (UNIX only)	45
DiskFree	Return size of free disk space	45
DiskSize	Return total disk size	46

Process handling

Functions to handle process information and starting new processes.

Name	Description	Page
DosExitCode	Exit code of last executed program	47
EnvCount	Return number of environment variables	48
EnvStr	Return environment string pair	48
Exec	Execute program	49
GetEnv	Return specified environment string	53

System information

Functions for retrieving and setting general system information such as date and time.

Name	Description	Page
DosVersion	Get OS version	47
GetCBreak	Get setting of control-break handling flag	52
GetDate	Get system date	52
GetIntVec	Get interrupt vector status	55
GetTime	Get system time	55

GetVerify	Get verify flag	56
Intr	Execute an interrupt	56
Keep	Keep process in memory and exit	57
MSDos	Execute MS-dos function call	57
PackTime	Pack time for file time	57
SetCBreak	Set control-break handling flag	58
SetDate	Set system date	58
SetIntVec	Set interrupt vectors	59
SetTime	Set system time	59
SetVerify	Set verify flag	59
SwapVectors	Swap interrupt vectors	60
UnPackTime	Unpack file time	60

2.3 Functions and Procedures

AddDisk

Declaration: `Procedure AddDisk (Const S : String);`

Description: `AddDisk` adds a filename `S` to the internal list of disks. It is implemented for systems which do not use DOS type drive letters. This list is used to determine which disks to use in the `DiskFree` (45) and `DiskSize` (46) calls. The `DiskFree` (45) and `DiskSize` (46) functions need a file on the specified drive, since this is required for the `statfs` system call. The names are added sequentially. The dos initialization code presets the first three disks to:

- `'.'` for the current drive,
- `'/fd0/.'` for the first floppy-drive (linux only).
- `'/fd1/.'` for the second floppy-drive (linux only).
- `'/'` for the first hard disk.

The first call to `AddDisk` will therefore add a name for the second harddisk, The second call for the third drive, and so on until 23 drives have been added (corresponding to drives `'D:'` to `'Z:'`)

Errors: None

See also: `DiskFree` (45), `DiskSize` (46)

DiskFree

Declaration: `Function DiskFree (Drive: byte) : int64;`

Description: `DiskFree` returns the number of free bytes on a disk. The parameter `Drive` indicates which disk should be checked. This parameter is 1 for floppy `a:`, 2 for floppy `b:`, etc. A value of 0 returns the free space on the current drive.

For UNIX only:

The `diskfree` and `disksize` functions need a file on the specified drive, since this is required for the `statfs` system call. These filenames are set in the initialization of the dos unit, and have been preset to :

- `'.'` for the current drive,

- `' /fd0/ . '` for the first floppy-drive (linux only).
- `' /fd1/ . '` for the second floppy-drive (linux only).
- `' / '` for the first hard disk.

There is room for 1-26 drives. You can add a drive with the [AddDisk \(45\)](#) procedure. These settings can be coded in `dos . pp`, in the initialization part.

Errors: -1 when a failure occurs, or an invalid drive number is given.

See also: [DiskSize \(46\)](#), [AddDisk \(45\)](#)

Listing: `dosex/ex6.pp`

```

Program Example6;
uses Dos;

{ Program to demonstrate the DiskSize and DiskFree function . }

begin
  WriteLn('This partition size has ',DiskSize(0),' bytes');
  WriteLn('Currently ',DiskFree(0),' bytes are free');
end.

```

DiskSize

Declaration: `Function DiskSize (Drive: byte) : int64;`

Description: `DiskSize` returns the total size (in bytes) of a disk. The parameter `Drive` indicates which disk should be checked. This parameter is 1 for floppy a:, 2 for floppy b:, etc. A value of 0 returns the size of the current drive.

For UNIX only:

The `diskfree` and `disksize` functions need a file on the specified drive, since this is required for the `statfs` system call. These filenames are set in the initialization of the dos unit, and have been preset to :

- `' . '` for the current drive,
- `' /fd0/ . '` for the first floppy-drive (linux only).
- `' /fd1/ . '` for the second floppy-drive (linux only).
- `' / '` for the first hard disk.

There is room for 1-26 drives. You can add a drive with the [AddDisk \(45\)](#) procedure. These settings can be coded in `dos . pp`, in the initialization part.

Errors: -1 when a failure occurs, or an invalid drive number is given.

See also: [DiskFree \(45\)](#), [AddDisk \(45\)](#)

For an example, see [DiskFree \(45\)](#).

DosExitCode

Declaration: `Function DosExitCode : Word;`

Description: `DosExitCode` contains (in the low byte) the exit-code of a program executed with the `Exec` call.

Errors: None.

See also: `Exec` (49)

Listing: `dosex/ex5.pp`

```

Program Example5;
uses Dos;

{ Program to demonstrate the Exec and DosExitCode function. }

begin
  {$IFDEF Unix}
    WriteLn( 'Executing /bin/lS -la ');
    Exec( '/bin/lS', '-la' );
  {$ELSE}
    WriteLn( 'Executing Dir' );
    Exec( GetEnv( 'COMSPEC' ), '/C dir' );
  {$ENDIF}
  WriteLn( 'Program returned with ExitCode ', Lo(DosExitCode));
end.

```

DosVersion

Declaration: `Function DosVersion : Word;`

Description: `DosVersion` returns the operating system or kernel version. The low byte contains the major version number, while the high byte contains the minor version number.

Portability: On systems where versions consists of more then two numbers, only the first two numbers will be returned. For example Linux version 2.1.76 will give you `DosVersion` 2.1. Some operating systems, such as `FREEBSD`, do not have system calls to return the kernel version, in that case a value of 0 will be returned.

Errors: None.

See also:

Listing: `dosex/ex1.pp`

```

Program Example1;
uses Dos;

{ Program to demonstrate the DosVersion function. }

var
  OS      : string[32];
  Version : word;
begin
  {$IFDEF LINUX}
    OS := 'Linux';
  {$ENDIF}

```

```
{ $ifdef FreeBSD }
  OS:= 'FreeBSD';
{ $endif }
{ $ifdef NetBSD }
  OS:= 'NetBSD';
{ $endif }
{ $ifdef Solaris }
  OS:= 'Solaris';
{ $endif }
{ $ifdef QNX }
  OS:= 'QNX';
{ $endif }

{ $IFDEF DOS }
  OS:= 'Dos';
{ $ENDIF }
  Version:= DosVersion;
  WriteLn('Current ',OS,' version is ',Lo(Version),'.',Hi(Version));
end.
```

EnvCount

Declaration: `Function EnvCount : longint;`

Description: `EnvCount` returns the number of environment variables.

Errors: None.

See also: [EnvStr \(48\)](#), [Dos:GetEnv \(53\)](#)

EnvStr

Declaration: `Function EnvStr (Index: integer) : string;`

Description: `EnvStr` returns the Index-th Name=Value pair from the list of environment variables. The index of the first pair is zero.

Errors: The length is limited to 255 characters.

See also: [EnvCount \(48\)](#), [Dos:GetEnv \(53\)](#)

Listing: `dosex/ex13.pp`

```
Program Example13;
uses Dos;

{ Program to demonstrate the EnvCount and EnvStr function. }

var
  i : Longint;
begin
  WriteLn('Current Environment is:');
  for i:=1to EnvCount do
    WriteLn(EnvStr(i));
end.
```

Exec

Declaration: Procedure Exec (const Path: pathstr; const ComLine: comstr);

Description: Exec executes the program in Path, with the options given by ComLine. After the program has terminated, the procedure returns. The Exit value of the program can be consulted with the DosExitCode function.

Errors: Errors are reported in DosError.

See also: DosExitCode (47)

For an example, see DosExitCode (47)

FExpand

Declaration: Function FExpand (const path: pathstr) : pathstr;

Description: FExpand takes its argument and expands it to a complete filename, i.e. a filename starting from the root directory of the current drive, prepended with the drive-letter or volume name (when supported).

Portability: On case sensitive file systems (such as UNIX and LINUX), the resulting name is left as it is, otherwise it is converted to uppercase.

Errors: FSplit (51)

See also:

Listing: dosex/ex5.pp

```
Program Example5;
uses Dos;

{ Program to demonstrate the Exec and DosExitCode function. }

begin
  {$IFDEF Unix}
    WriteLn('Executing /bin/lS -la');
    Exec('/bin/lS', '-la');
  {$ELSE}
    WriteLn('Executing Dir');
    Exec(GetEnv('COMSPEC'), '/C dir');
  {$ENDIF}
  WriteLn('Program returned with ExitCode ',Lo(DosExitCode));
end.
```

FindClose

Declaration: Procedure FindClose (Var F: SearchRec);

Description: FindClose frees any resources associated with the search record F.

This call is needed to free any internal resources allocated by the FindFirst (437) or FindNext (438) calls.

The LINUX implementation of the DOS unit therefore keeps a table of open directories, and when the table is full, closes one of the directories, and reopens another. This system is adequate but slow if you use a lot of searchrecs. So, to speed up the findfirst/findnext system, the FindClose call

was implemented. When you don't need a `searchrec` any more, you can tell this to the DOS unit by issuing a `FindClose` call. The directory which is kept open for this `searchrec` is then closed, and the table slot freed.

Portability: It is recommended to use the LINUX call `Glob` when looking for files on LINUX.

Errors: Errors are reported in `DosError`.

See also: `Glob` (225).

FindFirst

Declaration: `Procedure FindFirst (const Path: pathstr; Attr: word; var F: SearchRec);`

Description: `FindFirst` searches the file specified in `Path`. Normal files, as well as all special files which have the attributes specified in `Attr` will be returned.

It returns a `SearchRec` record for further searching in `F`. `Path` can contain the wildcard characters `?` (matches any single character) and `*` (matches 0 ore more arbitrary characters). In this case `FindFirst` will return the first file which matches the specified criteria. If `DosError` is different from zero, no file(s) matching the criteria was(were) found.

Portability: On OS/2, you cannot issue two different `FindFirst` calls. That is, you must close any previous search operation with `FindClose` (49) before starting a new one. Failure to do so will end in a Run-Time Error 6 (Invalid file handle)

Errors: Errors are reported in `DosError`.

See also: `FindNext` (50), `FindClose` (49)

Listing: `dosex/ex7.pp`

```

Program Example7;
uses Dos;

{ Program to demonstrate the FindFirst and FindNext function. }

var
  Dir : SearchRec;
begin
  FindFirst ( '*.*' , archive , Dir );
  WriteLn ( ' FileName '+Space(32), ' FileSize ':9);
  while ( DosError=0) do
    begin
      WriteLn ( Dir.Name+Space(40-Length ( Dir.Name)) , Dir.Size :9);
      FindNext ( Dir );
    end;
  FindClose ( Dir );
end.

```

FindNext

Declaration: `Procedure FindNext (var f: searchRec);`

Description: `FindNext` takes as an argument a `SearchRec` from a previous `FindNext` call, or a `FindFirst` call, and tries to find another file which matches the criteria, specified in the `FindFirst` call. If `DosError` is different from zero, no more files matching the criteria were found.

Errors: `DosError` is used to report errors.

See also: [FindFirst \(50\)](#), [FindClose \(49\)](#)

For an example, see [FindFirst \(50\)](#).

FSearch

Declaration: `Function FSearch (Path: pathstr; DirList: string) : pathstr;`

Description: `FSearch` searches the file `Path` in all directories listed in `DirList`. The full name of the found file is returned. `DirList` must be a list of directories, separated by semi-colons. When no file is found, an empty string is returned.

Portability: On UNIX systems, `DirList` can also be separated by colons, as is customary on those environments.

Errors: None.

See also: [FExpand \(49\)](#)

Listing: `dosex/ex10.pp`

```

Program Example10;
uses Dos;

{ Program to demonstrate the FSearch function. }

var
  s : string;
begin
  s:=FSearch(ParamStr(1),GetEnv('PATH'));
  if s='' then
    WriteLn(ParamStr(1),' not Found in PATH')
  else
    WriteLn(ParamStr(1),' Found in PATH at ',s);
end.

```

FSplit

Declaration: `Procedure FSplit (path: pathstr; var dir: dirstr; var name: namestr; var ext: extstr);`

Description: `FSplit` splits a full file name into 3 parts : A Path, a Name and an extension (in `ext`.) The extension is taken to be all letters after the *last* dot (.). For DOS, however, an exception is made when `LFNSupport=False`, then the extension is defined as all characters after the *first* dot.

Errors: None.

See also: [FSearch \(51\)](#)

Listing: `dosex/ex12.pp`

```

Program Example12;
uses Dos;

{ Program to demonstrate the FSplit function. }

```

```
var
  Path,Name,Ext : string;
begin
  FSplit(ParamStr(1),Path,Name,Ext);
  WriteLn('Splitted ',ParamStr(1),' in:');
  WriteLn('Path      : ',Path);
  WriteLn('Name       : ',Name);
  WriteLn('Extension : ',Ext);
end.
```

GetCBreak

Declaration: Procedure GetCBreak (var breakvalue: boolean);

Description: GetCBreak gets the status of CTRL-Break checking under DOS and AMIGA. When BreakValue is false, then DOS only checks for the CTRL-Break key-press when I/O is performed. When it is set to True, then a check is done at every system call.

Portability: Under non-DOS and non-AMIGA operating systems, BreakValue always returns True.

Errors: None

See also: SetCBreak (58)

GetDate

Declaration: Procedure GetDate (var year, month, mday, wday: word);

Description: GetDate returns the system's date. Year is a number in the range 1980..2099.mday is the day of the month, wday is the day of the week, starting with Sunday as day 0.

Errors: None.

See also: GetTime (55),SetDate (58)

Listing: dosex/ex2.pp

```
Program Example2;
uses Dos;

{ Program to demonstrate the GetDate function. }

const
  DayStr:array [0..6] of string [3]=( 'Sun', 'Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat' );
  MonthStr:array [1..12] of string [3]=( 'Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun',
                                         'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec' );

var
  Year,Month,Day,WDay : word;
begin
  GetDate(Year,Month,Day,WDay);
  WriteLn('Current date');
  WriteLn(DayStr[WDay],', ',Day,', ',MonthStr[Month],', ',Year,', ');
end.
```

GetEnv

Declaration: `Function GetEnv (EnvVar: String) : String;`

Description: `Getenv` returns the value of the environment variable `EnvVar`. When there is no environment variable `EnvVar` defined, an empty string is returned.

Portability: Under some operating systems (such as UNIX), case is important when looking for `EnvVar`.

Errors: None.

See also: `EnvCount` (48), `EnvStr` (48)

Listing: `dosex/ex14.pp`

```

Program Example14;
uses Dos;

{ Program to demonstrate the GetEnv function. }

begin
  WriteLn('Current PATH is ',GetEnv('PATH'));
end.

```

GetFAttr

Declaration: `Procedure GetFAttr (var F; var Attr: word);`

Description: `GetFAttr` returns the file attributes of the file-variable `f`. `F` can be a untyped or typed file, or of type `Text`. `f` must have been assigned, but not opened. The attributes can be examined with the following constants :

- `ReadOnly`
- `Hidden`
- `SysFile`
- `VolumeId`
- `Directory`
- `Archive`

Under LINUX, supported attributes are:

- `Directory`
- `ReadOnly` if the current process doesn't have access to the file.
- `Hidden` for files whose name starts with a dot (`'.'`).

Errors: Errors are reported in `DosError`

See also: `SetFAttr` (58)

Listing: `dosex/ex8.pp`

```

Program Example8;
uses Dos;

{ Program to demonstrate the GetFAttr function. }

```

```

var
  Attr : Word;
  f    : File;
begin
  Assign(f, ParamStr(1));
  GetFAttr(f, Attr);
  WriteLn('File ', ParamStr(1), ' has attribute ', Attr);
  if (Attr and archive) <> 0 then WriteLn(' - Archive ');
  if (Attr and directory) <> 0 then WriteLn(' - Directory ');
  if (Attr and readonly) <> 0 then WriteLn(' - Read-Only ');
  if (Attr and sysfile) <> 0 then WriteLn(' - System ');
  if (Attr and hidden) <> 0 then WriteLn(' - Hidden ');
end.

```

GetFTime

Declaration: Procedure GetFTime (var F; var Time: longint);

Description: GetFTime returns the modification time of a file. This time is encoded and must be decoded with UnPackTime. F must be a file type, which has been assigned, and opened.

Errors: Errors are reported in DosError

See also: SetFTime (59), PackTime (57), UnPackTime (60)

Listing: dosex/ex9.pp

```

Program Example9;
uses Dos;

{ Program to demonstrate the GetFTime function. }

Function L0(w: word): string;
var
  s : string;
begin
  Str(w, s);
  if w < 10 then
    L0 := '0' + s
  else
    L0 := s;
end;

var
  f    : File;
  Time : Longint;
  DT   : DateTime;
begin
  Assign(f, ParamStr(1));
  Reset(f);
  GetFTime(f, Time);
  Close(f);
  UnPackTime(Time, DT);
  Write('File ', ParamStr(1), ' is last modified on ');
  Writeln(L0(DT.Month), '-', L0(DT.Day), '-', DT.Year,
          ' at ', L0(DT.Hour), ':', L0(DT.Min));
end.

```

GetIntVec

Declaration: `Procedure GetIntVec (IntNo: byte; var Vector: pointer);`

Description: `GetIntVec` returns the address of interrupt vector `IntNo`.

Portability: This call does nothing, it is present for compatibility only.

Errors: None.

See also: [SetIntVec \(59\)](#)

GetLongName

Declaration: `function GetLongName(var p : String) : boolean;`

Description: This function is only implemented in the GO32V2 version of Free Pascal.

`GetLongName` changes the filename `p` to a long filename if the DOS call to do this is successful. The resulting string is the long file name corresponding to the short filename `p`.

The function returns `True` if the DOS call was successful, `False` otherwise.

This function should only be necessary when using the DOS extender under Windows 95 and higher.

Errors: If the DOS call was not successful, `False` is returned.

See also: [GetShortName \(55\)](#)

GetShortName

Declaration: `function GetShortName(var p : String) : boolean;`

Description: This function is only implemented in the GO32V2 version of Free Pascal.

`GetShortName` changes the filename `p` to a short filename if the DOS call to do this is successful. The resulting string is the short file name corresponding to the long filename `p`.

The function returns `True` if the DOS call was successful, `False` otherwise.

This function should only be necessary when using the DOS extender under Windows 95 and higher.

Errors: If the DOS call was not successful, `False` is returned.

See also: [GetLongName \(55\)](#)

GetTime

Declaration: `Procedure GetTime (var hour, minute, second, sec100: word);`

Description: `GetTime` returns the system's time. Hour is on a 24-hour time scale. `sec100` is in hundredths of a second.

Portability: Certain operating systems (such as AMIGA), always set the `sec100` field to zero.

Errors: None.

See also: [GetDate \(52\)](#), [SetTime \(59\)](#)

Listing: `dosex/ex3.pp`

```
Program Example3;  
uses Dos;  
  
{ Program to demonstrate the GetTime function. }  
  
Function L0(w: word): string;  
var  
  s : string;  
begin  
  Str(w,s);  
  if w<10 then  
    L0:= '0'+s  
  else  
    L0:=s;  
end;  
  
var  
  Hour,Min,Sec,HSec : word;  
begin  
  GetTime(Hour,Min,Sec,HSec);  
  WriteLn('Current time');  
  WriteLn(L0(Hour),':',L0(Min),':',L0(Sec));  
end.
```

GetVerify

Declaration: Procedure GetVerify (var verify: boolean);

Description: GetVerify returns the status of the verify flag under DOS. When Verify is True, then DOS checks data which are written to disk, by reading them after writing. If Verify is False, then data written to disk are not verified.

Portability: Under non-DOS systems (excluding OS/2 applications running under vanilla DOS), Verify is always True.

Errors: None.

See also: SetVerify ([59](#))

Intr

Declaration: Procedure Intr (IntNo: byte; var Regs: registers);

Description: Intr executes a software interrupt number IntNo (must be between 0 and 255), with processor registers set to Regs. After the interrupt call returned, the processor registers are saved in Regs.

Portability: Under non-DOS operating systems, this call does nothing.

Errors: None.

See also: MSDos ([57](#)), see the LINUX unit.

Keep

Declaration: `Procedure Keep (ExitCode: word);`

Description: `Keep` terminates the program, but stays in memory. This is used for TSR (Terminate Stay Resident) programs which catch some interrupt. `ExitCode` is the same parameter as the `Halt` function takes.

Portability: This call does nothing, it is present for compatibility only.

Errors: None.

See also: `Halt ()`

MSDos

Declaration: `Procedure MSDos (var regs: registers);`

Description: `MSDos` executes an operating system. This is the same as doing a `Intr` call with the interrupt number for an os call.

Portability: Under non-DOS operating systems, this call does nothing. On DOS systems, this calls interrupt \$21.

Errors: None.

See also: `Intr (56)`

PackTime

Declaration: `Procedure PackTime (var T: datetime; var P: longint);`

Description: `UnPackTime` converts the date and time specified in `T` to a packed-time format which can be fed to `SetFTime`.

Errors: None.

See also: `SetFTime (59)`, `FindFirst (50)`, `FindNext (50)`, `UnPackTime (60)`

Listing: dosex/ex4.pp

```

Program Example4;
uses Dos;

{ Program to demonstrate the PackTime and UnPackTime functions. }

var
  DT   : DateTime;
  Time : longint;
begin
  with DT do
    begin
      Year:=1998;
      Month:=11;
      Day:=11;
      Hour:=11;
      Min:=11;
      Sec:=11;
    end;
  PackTime(DT, Time);
  WriteLn('Packed Time : ', Time);

```

```
UnPackTime(Time,DT);
WriteLn('Unpacked Again: ');
with DT do
begin
  WriteLn('Year  ',Year);
  WriteLn('Month ',Month);
  WriteLn('Day   ',Day);
  WriteLn('Hour  ',Hour);
  WriteLn('Min   ',Min);
  WriteLn('Sec   ',Sec);
end;
end.
```

SetCBreak

Declaration: `Procedure SetCBreak (breakvalue: boolean);`

Description: `SetCBreak` sets the status of CTRL-Break checking. When `BreakValue` is `false`, then DOS only checks for the CTRL-Break key-press when I/O is performed. When it is set to `True`, then a check is done at every system call.

Portability: Under non-DOS and non-AMIGA operating systems, this call does nothing.

Errors: None.

See also: [GetCBreak \(52\)](#)

SetDate

Declaration: `Procedure SetDate (year,month,day: word);`

Description: `SetDate` sets the system's internal date. `Year` is a number between 1980 and 2099.

Portability: On a LINUX machine, there must be root privileges, otherwise this routine will do nothing. On other UNIX systems, this call currently does nothing.

Errors: None.

See also: [Dos:GetDate \(52\)](#), [SetTime \(59\)](#)

SetFAttr

Declaration: `Procedure SetFAttr (var F; Attr: word);`

Description: `SetFAttr` sets the file attributes of the file-variable `F`. `F` can be a untyped or typed file, or of type `Text`. `F` must have been assigned, but not opened. The attributes can be a sum of the following constants:

- `ReadOnly`
- `Hidden`
- `SysFile`
- `VolumeId`
- `Directory`
- `Archive`

Portability: Under UNIX like systems (such as LINUX and BEOS) the call exists, but is not implemented, i.e. it does nothing.

Errors: Errors are reported in `DosError`.

See also: [GetFAttr \(53\)](#)

SetFTime

Declaration: `Procedure SetFTime (var F; Time: longint);`

Description: `SetFTime` sets the modification time of a file, this time is encoded and must be encoded with `PackTime`. `F` must be a file type, which has been assigned, and opened.

Portability: Under UNIX like systems (such as LINUX and BEOS) the call exists, but is not implemented, i.e. it does nothing.

Errors: Errors are reported in `DosError`

See also: [GetFTime \(54\)](#), [PackTime \(57\)](#), [UnPackTime \(60\)](#)

SetIntVec

Declaration: `Procedure SetIntVec (IntNo: byte; Vector: pointer);`

Description: `SetIntVec` sets interrupt vector `IntNo` to `Vector`. `Vector` should point to an interrupt procedure.

Portability: This call does nothing, it is present for compatibility only.

Errors: None.

See also: [GetIntVec \(55\)](#)

SetTime

Declaration: `Procedure SetTime (hour, minute, second, sec100: word);`

Description: `SetTime` sets the system's internal clock. The `Hour` parameter is on a 24-hour time scale.

Portability: On a LINUX machine, there must be root privileges, otherwise this routine will do nothing. On other UNIX systems, this call currently does nothing.

Errors: None.

See also: [Dos:GetTime \(55\)](#), [SetDate \(58\)](#)

SetVerify

Declaration: `Procedure SetVerify (verify: boolean);`

Description: `SetVerify` sets the status of the verify flag under DOS. When `Verify` is `True`, then DOS checks data which are written to disk, by reading them after writing. If `Verify` is `False`, then data written to disk are not verified.

Portability: Under non-DOS operating systems (excluding OS/2 applications running under vanilla dos), `Verify` is always `True`.

Errors: None.

See also: [SetVerify \(59\)](#)

SwapVectors

Declaration: `Procedure SwapVectors ;`

Description: `SwapVectors` swaps the contents of the internal table of interrupt vectors with the current contents of the interrupt vectors. This is called typically in before and after an `Exec` call.

Portability: Under certain operating systems, this routine may be implemented as an empty stub.

Errors: None.

See also: [Exec \(49\)](#), [SetIntVec \(59\)](#)

UnPackTime

Declaration: `Procedure UnPackTime (p: longint; var T: datetime);`

Description: `UnPackTime` converts the file-modification time in `p` to a `DateTime` record. The file-modification time can be returned by `GetFTime`, `FindFirst` or `FindNext` calls.

Errors: None.

See also: [GetFTime \(54\)](#), [FindFirst \(50\)](#), [FindNext \(50\)](#), [PackTime \(57\)](#)

For an example, see [PackTime \(57\)](#).

Chapter 3

The DXELOAD unit

3.1 Introduction

The `dxeload` unit was implemented by Pierre Müller for DOS, it allows to load a DXE file (an object file with 1 entry point) into memory and return a pointer to the entry point.

It exists only for DOS.

3.2 Constants, types and variables

Constants

The following constant is the magic number, found in the header of a DXE file.

```
DXE_MAGIC = $31455844;
```

Types

The following record describes the header of a DXE file. It is used to determine the magic number of the DXE file and number of relocations that must be done when the object file is loaded in memory.

```
dx_header = record
  magic,
  symbol_offset,
  element_size,
  nrelocs      : longint;
end;
```

3.3 Functions and Procedures

`dx_load`

Declaration: `function dx_load(filename : string) : pointer;`

Description: `dx_load` loads the contents of the file `filename` into memory. It performs the necessary relocations in the object code, and returns then a pointer to the entry point of the code.

Errors: If an error occurs during the load or relocations, `Nil` is returned.

For an example, see the `emu387` unit in the RTL.

Chapter 4

The EMU387 unit

The `emu387` unit was written by Pierre Müller for DOS. It sets up the coprocessor emulation for FPC under DOS. It is not necessary to use this unit on other OS platforms because they either simply do not run on a machine without coprocessor, or they provide the coprocessor emulation themselves.

It shouldn't be necessary to use the function in this unit, it should be enough to place this unit in the `uses` clause of your program to enable the coprocessor emulation under DOS. The unit initialization code will try and load the coprocessor emulation code and initialize it.

4.1 Functions and procedures

npxsetup

Declaration: `procedure npxsetup(prog_name : string);`

Description: `npxsetup` checks whether a coprocessor is found. If not, it loads the file `wmemu387.dxe` into memory and initializes the code in it.

If the environment variable `387` is set to `N`, then the emulation will be loaded, even if there is a coprocessor present. If the variable doesn't exist, or is set to any other value, the unit will try to detect the presence of a coprocessor unit.

The function searches the file `wmemu387.dxe` in the following way:

- 1.If the environment variable `EMU387` is set, then it is assumed to point at the `wmemu387.dxe` file.
- 2.if the environment variable `EMU387` does not exist, then the function will take the path part of `prog_name` and look in that directory for the file `wmemu387.dxe`.

It should never be necessary to call this function, because the initialization code of the unit contains a call to the function with as an argument `paramstr(0)`. This means that you should deliver the file `wmemu387.dxe` together with your program.

Errors: If there is an error, an error message is printed to standard error, and the program is halted, since any floating-point code is bound to fail anyhow.

Chapter 5

The GETOPTS unit.

This document describes the GETOPTS unit for Free Pascal. It was written for LINUX by Michaël Van Canneyt. It now also works for all supported platforms.

The getopt unit provides a mechanism to handle command-line options in a structured way, much like the GNU getopt mechanism. It allows you to define the valid options for your program, and the unit will then parse the command-line options for you, and inform you of any errors.

The chapter is divided in 2 sections:

- The first section lists types, constants and variables from the interface part of the unit.
- The second section describes the functions defined in the unit.

5.1 Types, Constants and variables :

Constants

No_Argument=0 : Specifies that a long option does not take an argument.

Required_Argument=1 : Specifies that a long option needs an argument.

Optional_Argument=2 : Specifies that a long option optionally takes an argument.

EndOfOptions=#255 : Returned by getopt, getlongopts to indicate that there are no more options.

Types

```
TOption = record
  Name      : String;
  Has_arg   : Integer;
  Flag      : PChar;
  Value     : Char;
end;
POption = ^TOption;
```

The option type is used to communicate the long options to GetLongOpts. The Name field is the name of the option. Has_arg specifies if the option wants an argument, Flag is a pointer to a char, which is set to Value, if it is non-nil. POption is a pointer to a Option record. It is used as an argument to the GetLongOpts function.

Variables

`OptArg: String` Is set to the argument of an option, if the option needs one.

`Optind: Longint` Is the index of the current `paramstr()`. When all options have been processed, `optind` is the index of the first non-option parameter. This is a read-only variable. Note that it can become equal to `paramcount+1`

`OptErr: Boolean` Indicates whether `getopt()` prints error messages.

`OptOpt: Char` In case of an error, contains the character causing the error.

5.2 Procedures and functions

GetLongOpts

Declaration: `Function GetLongOpts (Shortopts : String, LongOpts : POption; var Longint : Longint) : Char;`

Description: Returns the next option found on the command-line, taking into account long options as well. If no more options are found, returns `EndOfOptions`. If the option requires an argument, it is returned in the `OptArg` variable. `ShortOptions` is a string containing all possible one-letter options. (see [Getopt \(65\)](#) for its description and use) `LongOpts` is a pointer to the first element of an array of `Option` records, the last of which needs a name of zero length. The function tries to match the names even partially (i.e. `-app` will match e.g. the `append` option), but will report an error in case of ambiguity. If the option needs an argument, set `Has_arg` to `Required_argument`, if the option optionally has an argument, set `Has_arg` to `Optional_argument`. If the option needs no argument, set `Has_arg` to zero. Required arguments can be specified in two ways :

1. Pasted to the option : `-option=value`
2. As a separate argument : `-option value`

Optional arguments can only be specified through the first method.

Errors: see [Getopt \(65\)](#), [getopt \(3\)](#)

See also: [Getopt](#)

Getopt

Declaration: `Function Getopt (Shortopts : String) : Char;`

Description: Returns the next option found on the command-line. If no more options are found, returns `EndOfOptions`. If the option requires an argument, it is returned in the `OptArg` variable. `ShortOptions` is a string containing all possible one-letter options. If a letter is followed by a colon (:), then that option needs an argument. If a letter is followed by 2 colons, the option has an optional argument. If the first character of `shortoptions` is a '+' then options following a non-option are regarded as non-options (standard Unix behavior). If it is a '-', then all non-options are treated as arguments of a option with character #0. This is useful for applications that require their options in the exact order as they appear on the command-line. If the first character of `shortoptions` is none of the above, options and non-options are permuted, so all non-options are behind all options. This allows options and non-options to be in random order on the command line.

Errors: Errors are reported through giving back a '?' character. `OptOpt` then gives the character which caused the error. If `OptErr` is `True` then `getopt` prints an error-message to `stdout`.

See also: [GetLongOpts \(65\)](#), [getopt \(3\)](#)

Listing: optex/optex.pp

```

program testopt;

{ Program to depmonstrate the getopt function.  }

{
  Valid calls to this program are
  optex --verbose --add me --delete you
  optex --append --create child
  optex -ab -c me -d you
  and so on
}
uses getopt;

var c : char;
    optionindex : Longint;
    theopts : array[1..7] of TOption;

begin
  with theopts[1] do
    begin
      name:= 'add';
      has_arg:=1;
      flag:= nil;
      value:=#0;
    end;
  with theopts[2] do
    begin
      name:= 'append';
      has_arg:=0;
      flag:= nil;
      value:=#0;
    end;
  with theopts[3] do
    begin
      name:= 'delete';
      has_arg:=1;
      flag:= nil;
      value:=#0;
    end;
  with theopts[4] do
    begin
      name:= 'verbose';
      has_arg:=0;
      flag:= nil;
      value:=#0;
    end;
  with theopts[5] do
    begin
      name:= 'create';
      has_arg:=1;
      flag:= nil;
      value:= 'c';
    end;
  with theopts[6] do
    begin
      name:= 'file';
      has_arg:=1;

```

```

    flag:=nil;
    value:=#0;
end;
with theopts[7] do
  begin
    name:='';
    has_arg:=0;
    flag:=nil;
  end;
c:=#0;
repeat
  c:=getlongopts('abc:d:012',@theopts[1],optionindex);
  case c of
    '1','2','3','4','5','6','7','8','9' :
      begin
        writeln('Got optind : ',c)
      end;
    #0 : begin
        write('Long option : ',theopts[optionindex].name);
        if theopts[optionindex].has_arg>0 then
          writeln(' With value : ',optarg)
        else
          writeln
        end;
    'a' : writeln('Option a. ');
    'b' : writeln('Option b. ');
    'c' : writeln('Option c : ',optarg);
    'd' : writeln('Option d : ',optarg);
    '?',':' : writeln('Error with opt : ',optopt);
  end; { case }
until c=endofoptions;
if optind<=paramcount then
  begin
    write('Non options : ');
    while optind<=paramcount do
      begin
        write(paramstr(optind),' ');
        inc(optind)
      end;
    writeln
  end
end.

```

Chapter 6

The GPM unit

6.1 Introduction

The GPM unit implements an interface to filelibgpm, the console program for mouse handling. This unit was created by Peter Vreman, and is only available on LINUX.

When this unit is used, your program is linked to the C libraries, so you must take care of the C library version. Also, it will only work with version 1.17 or higher of the libgpm library.

6.2 Constants, types and variables

constants

The following constants are used to denote filenames used by the library:

```
_PATH_VARRUN = '/var/run/';  
_PATH_DEV    = '/dev/';  
GPM_NODE_DIR = _PATH_VARRUN;  
GPM_NODE_DIR_MODE = 0775;  
GPM_NODE_PID  = '/var/run/gpm.pid';  
GPM_NODE_DEV  = '/dev/gpmctl';  
GPM_NODE_CTL  = GPM_NODE_DEV;  
GPM_NODE_FIFO = '/dev/gpmdata';
```

The following constants denote the buttons on the mouse:

```
GPM_B_LEFT    = 4;  
GPM_B_MIDDLE  = 2;  
GPM_B_RIGHT   = 1;
```

The following constants define events:

```
GPM_MOVE = 1;  
GPM_DRAG = 2;  
GPM_DOWN = 4;  
GPM_UP   = 8;  
GPM_SINGLE = 16;  
GPM_DOUBLE = 32;
```

```
GPM_TRIPLE = 64;
GPM_MFLAG = 128;
GPM_HARD = 256;
GPM_ENTER = 512;
GPM_LEAVE = 1024;
```

The following constants are used in defining margins:

```
GPM_TOP = 1;
GPM_BOT = 2;
GPM_LFT = 4;
GPM_RGT = 8;
```

Types

The following general types are defined:

```
TGpmEtype = longint;
TGpmMargin = longint;
```

The following type describes an event; it is passed in many of the gpm functions.

```
PGpmEvent = ^TGpmEvent;
TGpmEvent = record
  buttons : byte;
  modifiers : byte;
  vc : word;
  dx : word;
  dy : word;
  x : word;
  y : word;
  EventType : TGpmEType;
  clicks : longint;
  margin : TGpmMargin;
end;
TGpmHandler=function(var event:TGpmEvent;clientdata:pointer):longint;cdecl;
```

The following types are used in connecting to the gpm server:

```
PGpmConnect = ^TGpmConnect;
TGpmConnect = record
  eventMask : word;
  defaultMask : word;
  minMod : word;
  maxMod : word;
  pid : longint;
  vc : longint;
end;
```

The following type is used to define *regions of interest*

```
PGpmRoi = ^TGpmRoi;
TGpmRoi = record
```

```

xMin : integer;
xMax : integer;
yMin : integer;
yMax : integer;
minMod : word;
maxMod : word;
eventMask : word;
owned : word;
handler : TGpmHandler;
clientdata : pointer;
prev : PGpmRoi;
next : PGpmRoi;
end;

```

Variables

The following variables are imported from the gpm library

```

gpm_flag          : longint;cvar;external;
gpm_fd            : longint;cvar;external;
gpm_hflag         : longint;cvar;external;
gpm_morekeys     : Longbool;cvar;external;
gpm_zerobased    : Longbool;cvar;external;
gpm_visiblepointer : Longbool;cvar;external;
gpm_mx           : longint;cvar;external;
gpm_my           : longint;cvar;external;
gpm_timeout      : TTimeVal;cvar;external;
_gpm_buf         : array[0..0] of char;cvar;external;
_gpm_arg         : ^word;cvar;external;
gpm_handler      : TGpmHandler;cvar;external;
gpm_data         : pointer;cvar;external;
gpm_roi_handler  : TGpmHandler;cvar;external;
gpm_roi_data     : pointer;cvar;external;
gpm_roi          : PGpmRoi;cvar;external;
gpm_current_roi  : PGpmRoi;cvar;external;
gpm_consolefd    : longint;cvar;external;
Gpm_HandleRoi    : TGpmHandler;cvar;external;

```

6.3 Functions and procedures

Gpm_AnyDouble

Declaration: `function Gpm_AnyDouble(EventType : longint) : boolean;`

Description: `Gpm_AnyDouble` returns True if `EventType` contains the `GPM_DOUBLE` flag, False otherwise.

Errors: None.

See also: `Gpm_StrictSingle` (75), `Gpm_AnySingle` (71), `Gpm_StrictDouble` (75), `Gpm_StrictTriple` (76), `Gpm_AnyTriple` (71)

Gpm_AnySingle

Declaration: `function Gpm_AnySingle(EventType : longint) : boolean;`

Description: `Gpm_AnySingle` returns `True` if `EventType` contains the `GPM_SINGLE` flag, `False` otherwise.

Errors:

See also: `Gpm_StrictSingle` (75), `Gpm_AnyDouble` (70), `Gpm_StrictDouble` (75), `Gpm_StrictTriple` (76), `Gpm_AnyTriple` (71)

Gpm_AnyTriple

Declaration: `function Gpm_AnyTriple(EventType : longint) : boolean;`

Description:

Errors:

See also: `Gpm_StrictSingle` (75), `Gpm_AnyDouble` (70), `Gpm_StrictDouble` (75), `Gpm_StrictTriple` (76), `Gpm_AnySingle` (71)

Gpm_Close

Declaration: `function Gpm_Close:longint;cdecl;external;`

Description: `Gpm_Close` closes the current connection, and pops the connection stack; this means that the previous connection becomes active again.

The function returns `-1` if the current connection is not the last one, and it returns `0` if the current connection is the last one.

Errors: None.

See also: `Gpm_Open` (74)

for an example, see `Gpm_GetEvent` (72).

Gpm_FitValues

Declaration: `function Gpm_FitValues(var x,y:longint):longint;cdecl;external;`

Description: `Gpm_fitValues` changes `x` and `y` so they fit in the visible screen. The actual mouse pointer is not affected by this function.

Errors: None.

See also: `Gpm_FitValuesM` (71),

Gpm_FitValuesM

Declaration: `function Gpm_FitValuesM(var x,y:longint; margin:longint):longint;cdecl;external;`

Description: `Gpm_FitValuesM` changes `x` and `y` so they fit in the margin indicated by `margin`. If `margin` is `-1`, then the values are fitted to the screen. The actual mouse pointer is not affected by this function.

Errors: None.

See also: `Gpm_FitValues` (71),

Gpm_GetEvent

Declaration: `function Gpm_GetEvent(var Event:TGpmEvent):longint;cdecl;external;`

Description: `Gpm_GetEvent` Reads an event from the file descriptor `gpm_fd`. This file is only for internal use and should never be called by a client application.

It returns 1 on succes, and -1 on failue.

Errors: On error, -1 is returned.

See also: `seeflGpm_GetSnapshotGpmGetSnapshot`

Listing: gpmex/gpmex.pp

```

program gpmex;

{
  Example program to demonstrate the use of the gpm unit.
}

uses gpm;

var
  connect : TGPMConnect;
  event : tgpmevent;

begin
  connect.EventMask:=GPM_MOVE or GPM_DRAG or GPM_DOWN or GPM_UP;
  connect.DefaultMask:=0;
  connect.MinMod:=0;
  connect.MaxMod:=0;
  if Gpm_Open(connect,0)=-1 then
    begin
      WriteLn('No mouse handler present. ');
      Halt(1);
    end;
  WriteLn('Click right button to end. ');
  Repeat
    gpm_getevent(Event);
    With Event do
      begin
        Write('Pos = (',X,',',Y,') Buttons : ( ');
        if (buttons and Gpm_b_left)<>0 then
          write('left ');
        if (buttons and Gpm_b_right)<>0 then
          write('right ');
        if (buttons and Gpm_b_middle)<>0 then
          Write('middle ');
        Write(') Event : ');
        Case EventType and $F of
          GPM_MOVE: write('Move');
          GPM_DRAG: write('Drag');
          GPM_DOWN: write('Down');
          GPM_UP: write('Up');
        end;
        WriteLn;
      end;
    Until (Event.Buttons and gpm_b_right)<>0;
  gpm_close;

```

end.

Gpm_GetLibVersion

Declaration: `function Gpm_GetLibVersion(var where:longint):pchar;cdecl;external;`

Description: `Gpm_GetLibVersion` returns a pointer to a version string, and returns in `where` an integer representing the version. The version string represents the version of the gpm library.

The return value is a `pchar`, which should not be deallocated, i.e. it is not on the heap.

Errors: None.

See also: `Gpm_GetServerVersion` (73)

Gpm_GetServerVersion

Declaration: `function Gpm_GetServerVersion(var where:longint):pchar;cdecl;external;`

Description: `Gpm_GetServerVersion` returns a pointer to a version string, and returns in `where` an integer representing the version. The version string represents the version of the gpm server program.

The return value is a `pchar`, which should not be deallocated, i.e. it is not on the heap.

Errors: If the gpm program is not present, then the function returns `Nil`

See also: `Gpm_GetLibVersion` (73)

Gpm_GetSnapshot

Declaration: `function Gpm_GetSnapshot(var Event:TGpmEvent):longint;cdecl;external;`

Description: `Gpm_GetSnapshot` returns the picture that the server has of the current situation in `Event`. This call will not read the current situation from the mouse file descriptor, but returns a buffered version. The meaning of the fields is as follows:

x,ycurrent position of the cursor.

dx,dysize of the window.

vcnumber of the virtual console.

modifierskeyboard shift state.

buttonsbuttons which are currently pressed.

clicksnumber of clicks (0,1 or 2).

The function returns the number of mouse buttons, or -1 if this information is not available.

Errors: None.

See also: `Gpm_GetEvent` (72)

Gpm_LowerRoi

Declaration: `function Gpm_LowerRoi(which:PGpmRoi; after:PGpmRoi):PGpmRoi;cdecl;external;`

Description: `Gpm_LowerRoi` lowers the region of interest which after `after`. If `after` is `Nil`, the region of interest is moved to the bottom of the stack.

The return value is the new top of the region-of-interest stack.

Errors: None.

See also: [Gpm_RaiseRoi \(75\)](#), [Gpm_PopRoi \(74\)](#), [Gpm_PushRoi \(74\)](#)

Gpm_Open

Declaration: `function Gpm_Open(var Conn:TGpmConnect; Flag:longint):longint;cdecl;external;`

Description: `Gpm_Open` opens a new connection to the mouse server. The connection is described by the fields of the `conn` record:

EventMaskA bitmask of the events the program wants to receive.

DefaultMaskA bitmask to tell the library which events get their default treatment (text selection).

minModthe minimum amount of modifiers needed by the program.

maxModthe maximum amount of modifiers needed by the program.

if `Flag` is 0, then the application only receives events that come from its own terminal device. If it is negative it will receive all events. If the value is positive then it is considered a console number to which to connect.

The return value is -1 on error, or the file descriptor used to communicate with the client. Under an X-Term the return value is -2.

Errors: On Error, the return value is -1.

See also: [Gpm_Open \(74\)](#)

for an example, see [Gpm_GetEvent \(72\)](#).

Gpm_PopRoi

Declaration: `function Gpm_PopRoi(which:PGpmRoi):PGpmRoi;cdecl;external;`

Description: `Gpm_PopRoi` pops the topmost region of interest from the stack. It returns the next element on the stack, or `Nil` if the current element was the last one.

Errors: None.

See also: [Gpm_RaiseRoi \(75\)](#), [Gpm_LowerRoi \(74\)](#), [Gpm_PushRoi \(74\)](#)

Gpm_PushRoi

Declaration: `function Gpm_PushRoi(x1:longint; y1:longint; X2:longint; Y2:longint; mask:longint; fun:TGpmHandler; xtradata:pointer):PGpmRoi;cdecl;external;`

Description: `Gpm_PushRoi` puts a new *region of interest* on the stack. The region of interest is defined by a rectangle described by the corners $(X1, Y1)$ and $(X2, Y2)$.

The `mask` describes which events the handler `fun` will handle; `ExtraData` will be put in the `xtradata` field of the `TGPM_Roi` record passed to the fun handler.

Errors: None.

See also: [Gpm_RaiseRoi \(75\)](#), [Gpm_PopRoi \(74\)](#), [Gpm_LowerRoi \(74\)](#)

Gpm_RaiseRoi

Declaration: `function Gpm_RaiseRoi(which:PGpmRoi; before:PGpmRoi):PGpmRoi;cdecl;external;`

Description: `Gpm_RaiseRoi` raises the *region of interest* which till it is on top of region `before`. If `before` is nil then the region is put on top of the stack. The returned value is the top of the stack.

Errors: None.

See also: [Gpm_PushRoi \(74\)](#), [Gpm_PopRoi \(74\)](#), [Gpm_LowerRoi \(74\)](#)

Gpm_Repeat

Declaration: `function Gpm_Repeat(millisecond:longint):longint;cdecl;external;`

Description: `Gpm_Repeat` returns 1 if no mouse event arrives in the next `millisecond` milliseconds, it returns 0 otherwise.

Errors: None.

See also: [Gpm_GetEvent \(72\)](#)

Gpm_StrictDouble

Declaration: `function Gpm_StrictDouble(EventType : longint) : boolean;`

Description: `Gpm_StrictDouble` returns true if `EventType` contains only a doubleclick event, False otherwise.

Errors: None.

See also: [Gpm_StrictSingle \(75\)](#), [Gpm_AnyTriple \(71\)](#), [Gpm_AnyDouble \(70\)](#), [Gpm_StrictTriple \(76\)](#), [Gpm_AnySingle \(71\)](#)

Gpm_StrictSingle

Declaration: `function Gpm_StrictSingle(EventType : longint) : boolean;`

Description: `Gpm_StrictSingle` returns True if `EventType` contains only a singleclick event, False otherwise.

Errors: None.

See also: [Gpm_AnyTriple \(71\)](#), [Gpm_StrictDouble \(75\)](#), [Gpm_AnyDouble \(70\)](#), [Gpm_StrictTriple \(76\)](#), [Gpm_AnySingle \(71\)](#)

Gpm_StrictTriple

Declaration: `function Gpm_StrictTriple(EventType : longint) : boolean;`

Description: `Gpm_StrictTriple` returns true if `EventType` contains only a triple click event, False otherwise.

Errors: None.

See also: `Gpm_AnyTriple` ([71](#)), `Gpm_StrictDouble` ([75](#)), `Gpm_AnyDouble` ([70](#)), `Gpm_StrictSingle` ([75](#)), `Gpm_AnySingle` ([71](#))

Chapter 7

The GO32 unit

This chapter of the documentation describe the GO32 unit for the Free Pascal compiler under DOS. It was donated by Thomas Schatzl (tom_at_work@geocities.com), for which my thanks. This unit was first written for DOS by Florian Kl"ampfl. This chapter is divided in four sections. The first two sections are an introduction to the GO32 unit. The third section lists the pre-defined constants, types and variables. The last section describes the functions which appear in the interface part of the GO32 unit.

7.1 Introduction

These docs contain information about the GO32 unit. Only the GO32V2 DPMI mode is discussed by me here due to the fact that new applications shouldn't be created with the older GO32V1 model. The go32v2 version is much more advanced and better. Additionally a lot of functions only work in DPMI mode anyway. I hope the following explanations and introductions aren't too confusing at all. If you notice an error or bug send it to the FPC mailing list or directly to me. So let's get started and happy and error free coding I wish you.... Thomas Schatzl, 25. August 1998

7.2 Protected mode memory organization

What is DPMI

The DOS Protected Mode Interface helps you with various aspects of protected mode programming. These are roughly divided into descriptor handling, access to DOS memory, management of interrupts and exceptions, calls to real mode functions and other stuff. Additionally it automatically provides swapping to disk for memory intensive applications. A DPMI host (either a Windows DOS box or CWSDPMI.EXE) provides these functions for your programs.

Selectors and descriptors

Descriptors are a bit like real mode segments; they describe (as the name implies) a memory area in protected mode. A descriptor contains information about segment length, its base address and the attributes of it (i.e. type, access rights, ...). These descriptors are stored internally in a so-called descriptor table, which is basically an array of such descriptors. Selectors are roughly an index into this table. Because these 'segments' can be up to 4 GB in size, 32 bits aren't sufficient anymore to describe a single memory location like in real mode. 48 bits are now needed to do this, a 32 bit address and a 16 bit sized selector. The GO32 unit provides the tseginfo record to store such a

pointer. But due to the fact that most of the time data is stored and accessed in the %ds selector, FPC assumes that all pointers point to a memory location of this selector. So a single pointer is still only 32 bits in size. This value represents the offset from the data segment base address to this memory location.

FPC specialities

The %ds and %es selector MUST always contain the same value or some system routines may crash when called. The %fs selector is preloaded with the DOSMEMSELECTOR variable at startup, and it MUST be restored after use, because again FPC relies on this for some functions. Luckily we asm programmers can still use the %gs selector for our own purposes, but for how long? See also: [get_cs \(93\)](#), [get_ds \(93\)](#), [gett_ss \(100\)](#), [allocate_ldt_descriptors \(86\)](#), [free_ldt_descriptor \(92\)](#), [segment_to_descriptor \(106\)](#), [get_next_selector_increment_value \(95\)](#), [get_segment_base_address \(99\)](#), [set_segment_base_address \(109\)](#), [set_segment_limit \(109\)](#), [create_code_segment_alias_descriptor \(89\)](#)

DOS memory access

DOS memory is accessed by the predefined `dosmemselector` selector; the GO32 unit additionally provides some functions to help you with standard tasks, like copying memory from heap to DOS memory and the likes. Because of this it is strongly recommended to use them, but you are still free to use the provided standard memory accessing functions which use 48 bit pointers. The third, but only thought for compatibility purposes, is using the `mem[]`-arrays. These arrays map the whole 1 Mb DOS space. They shouldn't be used within new programs. To convert a segment:offset real mode address to a protected mode linear address you have to multiply the segment by 16 and add its offset. This linear address can be used in combination with the DOSMEMSELECTOR variable. See also: [dosmemget \(91\)](#), [dosmempout \(91\)](#), [dosmemmove \(91\)](#), [dosmemfillchar \(89\)](#), [dosmemfillword \(90\)](#), `mem[]`-arrays, [seg_move \(107\)](#), [seg_fillchar \(105\)](#), [seg_fillword \(106\)](#).

I/O port access

The I/O port access is done via the various [inportb \(102\)](#), [outportb \(104\)](#) functions which are available. Additionally Free Pascal supports the Turbo Pascal `PORT[]`-arrays but it is by no means recommended to use them, because they're only for compatibility purposes. See also: [outportb \(104\)](#), [inportb \(102\)](#), `PORT[]`-arrays

Processor access

These are some functions to access various segment registers (%cs, %ds, %ss) which makes your work a bit easier. See also: [get_cs \(93\)](#), [get_ds \(93\)](#), [get_ss \(100\)](#)

Interrupt redirection

Interrupts are program interruption requests, which in one or another way get to the processor; there's a distinction between software and hardware interrupts. The former are explicitly called by an 'int' instruction and are a bit comparable to normal functions. Hardware interrupts come from external devices like the keyboard or mouse. Functions that handle hardware interrupts are called handlers.

Handling interrupts with DPMI

The interrupt functions are real-mode procedures; they normally can't be called in protected mode without the risk of a protection fault. So the DPMI host creates an interrupt descriptor table for the application. Initially all software interrupts (except for int 31h, 2Fh and 21h function 4Ch) or external hardware interrupts are simply directed to a handler that reflects the interrupt in real-mode, i.e. the DPMI host's default handlers switch the CPU to real-mode, issue the interrupt and switch back to protected mode. The contents of general registers and flags are passed to the real mode handler and the modified registers and flags are returned to the protected mode handler. Segment registers and stack pointer are not passed between modes.

Protected mode interrupts vs. Real mode interrupts

As mentioned before, there's a distinction between real mode interrupts and protected mode interrupts; the latter are protected mode programs, while the former must be real mode programs. To call a protected mode interrupt handler, an assembly 'int' call must be issued, while the other is called via the `realintr()` or `intr()` function. Consequently, a real mode interrupt then must either reside in DOS memory (<1MB) or the application must allocate a real mode callback address via the `get_rm_callback()` function.

Creating own interrupt handlers

Interrupt redirection with FPC pascal is done via the `set_pm_interrupt()` for protected mode interrupts or via the `set_rm_interrupt()` for real mode interrupts.

Disabling interrupts

The GO32 unit provides the two procedures `disable()` and `enable()` to disable and enable all interrupts.

Hardware interrupts

Hardware interrupts are generated by hardware devices when something unusual happens; this could be a keypress or a mouse move or any other action. This is done to minimize CPU time, else the CPU would have to check all installed hardware for data in a big loop (this method is called 'polling') and this would take much time. A standard IBM-PC has two interrupt controllers, that are responsible for these hardware interrupts: both allow up to 8 different interrupt sources (IRQs, interrupt requests). The second controller is connected to the first through IRQ 2 for compatibility reasons, e.g. if controller 1 gets an IRQ 2, he hands the IRQ over to controller 2. Because of this up to 15 different hardware interrupt sources can be handled. IRQ 0 through IRQ 7 are mapped to interrupts 8h to Fh and the second controller (IRQ 8 to 15) is mapped to interrupt 70h to 77h. All of the code and data touched by these handlers MUST be locked (via the various locking functions) to avoid page faults at interrupt time. Because hardware interrupts are called (as in real mode) with interrupts disabled, the handler has to enable them before it returns to normal program execution. Additionally a hardware interrupt must send an EOI (end of interrupt) command to the responsible controller; this is accomplished by sending the value 20h to port 20h (for the first controller) or A0h (for the second controller). The following example shows how to redirect the keyboard interrupt.

Listing: go32ex/keyclick.pp

```
{$ASMMODE ATT}
{$MODE FPC}
```

uses

```
crt ,
```

```

    go32;

const
    kbdint = $9;

var
    oldint9_handler : tseginfo;
    newint9_handler : tseginfo;

    clickproc : pointer;
    backupDS : Word; external name '___v2prt0_ds_alias';

procedure int9_handler; assembler;
asm
    cli
    pushl %ds
    pushl %es
    pushl %fs
    pushl %gs
    pushal
    movw %cs:backupDS, %ax
    movw %ax, %ds
    movw %ax, %es
    movw dosmemselector, %ax
    movw %ax, %fs
    call *clickproc
    popal
    popl %gs
    popl %fs
    popl %es
    popl %ds
    ljmp %cs:oldint9_handler
end;
procedure int9_dummy; begin end;

procedure clicker;
begin
    sound(500); delay(10); nosound;
end;
procedure clicker_dummy; begin end;

procedure install_click;
begin
    clickproc := @clicker;
    lock_data(clickproc, sizeof(clickproc));
    lock_data(dosmemselector, sizeof(dosmemselector));

    lock_code(@clicker,
        longint(@clicker_dummy) - longint(@clicker));
    lock_code(@int9_handler,
        longint(@int9_dummy) - longint(@int9_handler));
    newint9_handler.offset := @int9_handler;
    newint9_handler.segment := get_cs;
    get_pm_interrupt(kbdint, oldint9_handler);
    set_pm_interrupt(kbdint, newint9_handler);
end;

procedure remove_click;

```

```

begin
    set_pm_interrupt(kbdint, oldint9_handler);
    unlock_data(dosmemselector, sizeof(dosmemselector));
    unlock_data(clickproc, sizeof(clickproc));

    unlock_code(@clicker,
                longint(@clicker_dummy)-longint(@clicker));
    unlock_code(@int9_handler,
                longint(@int9_dummy)-longint(@int9_handler));
end;

var
    ch : char;

begin
    install_click;
    WriteLn('Enter any message. Press return when finished');
    while (ch <> #13) do begin
        ch := readkey; write(ch);
    end;
    remove_click;
end.

```

Software interrupts

Ordinarily, a handler installed with `set_pm_interrupt` (107) only services software interrupts that are executed in protected mode; real mode software interrupts can be redirected by `set_rm_interrupt` (108). See also `set_rm_interrupt` (108), `get_rm_interrupt` (98), `set_pm_interrupt` (107), `get_pm_interrupt` (95), `lock_data` (103), `lock_code` (103), `enable` (92), `disable` (89), `outportb` (104) Executing software interrupts Simply execute a `realintr()` call with the desired interrupt number and the supplied register data structure. But some of these interrupts require you to supply them a pointer to a buffer where they can store data to or obtain data from in memory. These interrupts are real mode functions and so they only can access the first Mb of linear address space, not FPC's data segment. For this reason FPC supplies a pre-initialized DOS memory location within the GO32 unit. This buffer is internally used for DOS functions too and so its contents may change when calling other procedures. Its size can be obtained with `tb_size` (109) and its linear address via `transfer_buffer` (110). Another way is to allocate a completely new DOS memory area via the `global_dos_alloc` (100) function for your use and supply its real mode address. See also: `tb_size` (109), `transfer_buffer` (110), `global_dos_alloc` (100), `global_dos_free` (102), `realintr` (105) The following examples illustrate the use of software interrupts.

Listing: go32ex/softint.pp

```

uses
    go32;

var
    r : trealregs;

begin
    r.ah := $30;
    r.al := $01;
    realintr($21, r);
    WriteLn('DOS v', r.al, '.', r.ah, ' detected');
end.

```

Listing: go32ex/rmpmint.pp

```

uses
    crt ,
    go32;

var
    r : trealregs;
    axreg : Word;

    oldint21h : tseginfo;
    newint21h : tseginfo;
procedure int21h_handler; assembler;
asm
    cmpw $0x3001, %ax
    jne .LCallOld
    movw $0x3112, %ax
    iret

.LCallOld:
    ljmp %cs:oldint21h
end;

procedure resume;
begin
    Writeln;
    Write('--- press any key to resume ---'); readkey;
    gotoxy(1, wherey); clreol;
end;

begin
    clrscr;
    Writeln('Executing real mode interrupt');
    resume;
    r.ah := $30; r.al := $01; realintr($21, r);
    Writeln('DOS v', r.al, '.', r.ah, ' detected');
    resume;
    Writeln('Executing protected mode interrupt without our own',
            ' handler');
    Writeln;
    asm
        movb $0x30, %ah
        movb $0x01, %al
        int $0x21
        movw %ax, axreg
    end;
    Writeln('DOS v', r.al, '.', r.ah, ' detected');
    resume;
    Writeln('As you can see the DPML hosts default protected mode',
            ' handler');
    Writeln('simply redirects it to the real mode handler');
    resume;
    Writeln('Now exchanging the protected mode interrupt with our ',
            ' own handler');
    resume;

    newint21h.offset := @int21h_handler;
    newint21h.segment := get_cs;
    get_pm_interrupt($21, oldint21h);

```

```

set_pm_interrupt($21, newint21h);

Writeln( 'Executing real mode interrupt again' );
resume;
r.ah := $30; r.al := $01; realintr($21, r);
Writeln( 'DOS v', r.al, '.', r.ah, ' detected' );
Writeln;
Writeln( 'See, it didn''t change in any way.' );
resume;
Writeln( 'Now calling protected mode interrupt' );
resume;
asm
    movb $0x30, %ah
    movb $0x01, %al
    int $0x21
    movw %ax, axreg
end;
Writeln( 'DOS v', lo(axreg), '.', hi(axreg), ' detected' );
Writeln;
Writeln( 'Now you can see that there''s a distinction between ',
    'the two ways of calling interrupts...' );
set_pm_interrupt($21, oldint21h);
end.

```

Real mode callbacks

The callback mechanism can be thought of as the converse of calling a real mode procedure (i.e. interrupt), which allows your program to pass information to a real mode program, or obtain services from it in a manner that's transparent to the real mode program. In order to make a real mode callback available, you must first get the real mode callback address of your procedure and the selector and offset of a register data structure. This real mode callback address (this is a segment:offset address) can be passed to a real mode program via a software interrupt, a DOS memory block or any other convenient mechanism. When the real mode program calls the callback (via a far call), the DPMI host saves the registers contents in the supplied register data structure, switches into protected mode, and enters the callback routine with the following settings:

- interrupts disabled
- %CS:%EIP = 48 bit pointer specified in the original call to `get_rm_callback` (96)
- %DS:%ESI = 48 bit pointer to real mode SS:SP
- %ES:%EDI = 48 bit pointer of real mode register data structure.
- %SS:%ESP = locked protected mode stack
- All other registers undefined

The callback procedure can then extract its parameters from the real mode register data structure and/or copy parameters from the real mode stack to the protected mode stack. Recall that the segment register fields of the real mode register data structure contain segment or paragraph addresses that are not valid in protected mode. Far pointers passed in the real mode register data structure must be translated to virtual addresses before they can be used with a protected mode program. The callback procedure exits by executing an IRET with the address of the real mode register data structure in %ES:%EDI, passing information back to the real mode caller by modifying the contents of the real mode register data structure and/or manipulating the contents of the real mode stack. The callback

procedure is responsible for setting the proper address for resumption of real mode execution into the real mode register data structure; typically, this is accomplished by extracting the return address from the real mode stack and placing it into the %CS:%EIP fields of the real mode register data structure. After the IRET, the DPMI host switches the CPU back into real mode, loads ALL registers with the contents of the real mode register data structure, and finally returns control to the real mode program. All variables and code touched by the callback procedure MUST be locked to prevent page faults. See also: `get_rm_callback` (96), `free_rm_callback` (92), `lock_code` (103), `lock_data` (103)

7.3 Types, Variables and Constants

Constants

Constants returned by `get_run_mode`

Tells you under what memory environment (e.g. memory manager) the program currently runs.

```
rm_unknown = 0; { unknown }
rm_raw     = 1; { raw (without HIMEM) }
rm_xms     = 2; { XMS (for example with HIMEM, without EMM386) }
rm_vcpi    = 3; { VCPI (for example HIMEM and EMM386) }
rm_dpml    = 4; { DPMI (for example \dos box or 386Max) }
```

Note: GO32V2 *always* creates DPMI programs, so you need a suitable DPMI host like CWS-DPMI.EXE or a Windows DOS box. So you don't need to check it, these constants are only useful in GO32V1 mode.

Processor flags constants

They are provided for a simple check with the flags identifier in the `trealregs` type. To check a single flag, simply do an AND operation with the flag you want to check. It's set if the result is the same as the flag value.

```
const carryflag = $001;
parityflag      = $004;
auxcarryflag    = $010;
zeroflag        = $040;
signflag        = $080;
trapflag        = $100;
interruptflag   = $200;
directionflag   = $400;
overflowflag    = $800;
```

Predefined types

```
type tmeminfo = record
    available_memory : Longint;
    available_pages  : Longint;
    available_lockable_pages : Longint;
    linear_space     : Longint;
    unlocked_pages   : Longint;
    available_physical_pages : Longint;
    total_physical_pages : Longint;
```

```

    free_linear_space : Longint;
    max_pages_in_paging_file : Longint;
    reserved : array[0..2] of Longint;
end;
```

Holds information about the memory allocation, etc. NOTE: The value of a field is -1 (0ffffffh) if

Table 7.1: Record description

Record entry	Description
available_memory	Largest available free block in bytes.
available_pages	Maximum unlocked page allocation in pages
available_lockable_pages	Maximum locked page allocation in pages.
linear_space	Linear address space size in pages.
unlocked_pages	Total number of unlocked pages.
available_physical_pages	Total number of free pages.
total_physical_pages	Total number of physical pages.
free_linear_space	Free linear address space in pages.
max_pages_in_paging_file	Size of paging file/partition in pages.

the value is unknown, it's only guaranteed, that available_memory contains a valid value. The size of the pages can be determined by the get_page_size() function.

```

type
trealregs = record
  case Integer of
    1: { 32-bit }
      (EDI, ESI, EBP, Res, EBX, EDX, ECX, EAX: Longint;
       Flags, ES, DS, FS, GS, IP, CS, SP, SS: Word);
    2: { 16-bit }
      (DI, DI2, SI, SI2, BP, BP2, R1, R2: Word;
       BX, BX2, DX, DX2, CX, CX2, AX, AX2: Word);
    3: { 8-bit }
      (stuff: array[1..4] of Longint;
       BL, BH, BL2, BH2, DL, DH, DL2, DH2, CL,
       CH, CL2, CH2, AL, AH, AL2, AH2: Byte);
    4: { Compat }
      (RealEDI, RealESI, RealEBP, RealRES, RealEBX,
       RealEDX, RealECX, RealEAX: Longint;
       RealFlags, RealES, RealDS, RealFS, RealGS,
       RealIP, RealCS, RealSP, RealSS: Word);
  end;
registers = trealregs;
```

These two types contain the data structure to pass register values to a interrupt handler or real mode callback.

```

type tseginfo = record
  offset : Pointer; segment : Word; end;
```

This record is used to store a full 48-bit pointer. This may be either a protected mode selector:offset address or in real mode a segment:offset address, depending on application. See also: Selectors and descriptors, DOS memory access, Interrupt redirection

Variables.

```
var dosmemselector : Word;
```

Selector to the DOS memory. The whole DOS memory is automatically mapped to this single descriptor at startup. This selector is the recommended way to access DOS memory.

```
var int31error : Word;
```

This variable holds the result of a DPMI interrupt call. Any nonzero value must be treated as a critical failure.

7.4 Functions and Procedures

allocate_ldt_descriptors

Declaration: `Function allocate_ldt_descriptors (count : Word) : Word;`

Description: Allocates a number of new descriptors. Parameters:

count: specifies the number of requested unique descriptors.

Return value: The base selector. Notes: The descriptors allocated must be initialized by the application with other function calls. This function returns descriptors with a limit and size value set to zero. If more than one descriptor was requested, the function returns a base selector referencing the first of a contiguous array of descriptors. The selector values for subsequent descriptors in the array can be calculated by adding the value returned by the `get_next_selector_increment_value` (95) function.

Errors: Check the `int31error` variable.

See also: `free_ldt_descriptor` (92), `get_next_selector_increment_value` (95), `segment_to_descriptor` (106), `create_code_segment_alias_descriptor` (89), `set_segment_limit` (109), `set_segment_base_address` (109)

Listing: `go32ex/seldes.pp`

```
{ $mode delphi }
uses
    crt ,
    go32;

const
    maxx = 80;
    maxy = 25;
    bytespercell = 2;
    screensize = maxx * maxy * bytespercell;

    linB8000 = $B800 * 16;

type
    string80 = string[80];

var
    text_save : array[0..screensize-1] of byte;
    text_oldx , text_oldy : Word;

    text_sel : Word;
```

```

procedure status(s : string80);
begin
    gotoxy(1, 1); clreol; write(s); readkey;
end;

procedure selinfo(sel : Word);
begin
    gotoxy(1, 24);
    clreol; writeln('Descriptor base address : $',
        hexstr(get_segment_base_address(sel), 8));
    clreol; write('Descriptor limit : ', get_segment_limit(sel));
end;

function makechar(ch : char; color : byte) : Word;
begin
    result := byte(ch) or (color shl 8);
end;

begin
    seg_move(dosmemselector, linB8000, get_ds, longint(@text_save),
        screensize);
    text_oldx := wherex; text_oldy := wherey;
    seg_fillword(dosmemselector, linB8000, screensize div 2,
        makechar(' ', Black or (Black shl 4)));
    status('Creating selector ''text_sel'' to a part of ' +
        'text screen memory');
    text_sel := allocate_ldt_descriptors(1);
    set_segment_base_address(text_sel,
        linB8000 + bytespercell * maxx * 1);
    set_segment_limit(text_sel, screensize - 1 - bytespercell *
        maxx * 3);
    selinfo(text_sel);

    status('and clearing entire memory selected by ''text_sel'' +
        ' descriptor');
    seg_fillword(text_sel, 0, (get_segment_limit(text_sel)+1) div 2,
        makechar(' ', LightBlue shl 4));

    status('Notice that only the memory described by the ' +
        ' descriptor changed, nothing else');

    status('Now reducing it''s limit and base and setting it''s ' +
        'described memory');
    set_segment_base_address(text_sel,
        get_segment_base_address(text_sel) + bytespercell * maxx);
    set_segment_limit(text_sel,
        get_segment_limit(text_sel) - bytespercell * maxx * 2);
    selinfo(text_sel);
    status('Notice that the base addr increased by one line but ' +
        'the limit decreased by 2 lines');
    status('This should give you the hint that the limit is ' +
        'relative to the base');
    seg_fillword(text_sel, 0, (get_segment_limit(text_sel)+1) div 2,
        makechar(#176, LightMagenta or Brown shl 4));

    status('Now let''s get crazy and copy 10 lines of data from ' +
        'the previously saved screen');

```

```

seg_move(get_ds, longint(@text_save), text_sel,
         maxx * bytespercell * 2, maxx * bytespercell * 10);

status('At last freeing the descriptor and restoring the old '+
      ' screen contents..');
status('I hope this little program may give you some hints on '+
      'working with descriptors');
free_ldt_descriptor(text_sel);
seg_move(get_ds, longint(@text_save), dosmemselector,
         linB8000, screensize);
gotoxy(text_oldx, text_oldy);
end.

```

allocate_memory_block

Declaration: `Function allocate_memory_block (size:Longint) : Longint;`

Description: Allocates a block of linear memory. Parameters:

size: Size of requested linear memory block in bytes.

Returned values: `blockhandle` - the memory handle to this memory block. Linear address of the requested memory. Notes: **WARNING:** According to my DPMI docs this function is not implemented correctly. Normally you should also get a `blockhandle` to this block after successful operation. This handle can then be used to free the memory block afterwards or use this handle for other purposes. Since the function isn't implemented correctly, and doesn't return a `blockhandle`, the block can't be deallocated and is hence unusable ! This function doesn't allocate any descriptors for this block, it's the applications responsibility to allocate and initialize for accessing this memory.

Errors: Check the `int31error` variable.

See also: [free_memory_block \(92\)](#)

copyfromdos

Declaration: `Procedure copyfromdos (var addr; len : Longint);`

Description: Copies data from the pre-allocated DOS memory transfer buffer to the heap. Parameters:

addr: data to copy to.

len: number of bytes to copy to heap.

Notes: Can only be used in conjunction with the DOS memory transfer buffer.

Errors: Check the `int31error` variable.

See also: [tb_size \(109\)](#), [transfer_buffer \(110\)](#), [copytodods \(88\)](#)

copytodods

Declaration: `Procedure copytodods (var addr; len : Longint);`

Description: Copies data from heap to the pre-allocated DOS memory buffer. Parameters:

addr: data to copy from.

len: number of bytes to copy to DOS memory buffer.

Notes: This function fails if you try to copy more bytes than the transfer buffer is in size. It can only be used in conjunction with the transfer buffer.

Errors: Check the `int31error` variable.

See also: `tb_size` (109), `transfer_buffer` (110), `copyfromdos` (88)

create_code_segment_alias_descriptor

Declaration: `Function create_code_segment_alias_descriptor (seg : Word) : Word;`

Description: Creates a new descriptor that has the same base and limit as the specified descriptor. Parameters:

seg: Descriptor.

Return values: The data selector (alias). Notes: In effect, the function returns a copy of the descriptor. The descriptor alias returned by this function will not track changes to the original descriptor. In other words, if an alias is created with this function, and the base or limit of the original segment is then changed, the two descriptors will no longer map the same memory.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (86), `set_segment_limit` (109), `set_segment_base_address` (109)

disable

Declaration: `Procedure disable ;`

Description: Disables all hardware interrupts by execution a CLI instruction. Parameters: None.

Errors: None.

See also: `enable` (92)

dosmemfillchar

Declaration: `Procedure dosmemfillchar (seg, ofs : Word; count : Longint; c : char);`

Description: Sets a region of DOS memory to a specific byte value. Parameters:

seg: real mode segment.

ofs: real mode offset.

count: number of bytes to set.

c: value to set memory to.

Notes: No range check is performed.

Errors: None.

See also: `dosmempout` (91), `dosmemget` (91), `dosmemmove` (91), `dosmemmove`, `dosmemfillword` (90), `seg_move` (107), `seg_fillchar` (105), `seg_fillword` (106)

Listing: `go32ex/textmess.pp`

```

uses
    crt ,
    go32;

const
    columns = 80;
    rows = 25;
    screensize = rows*columns*2;

    text = '! Hello world !';

var
    textofs : Longint;
    save_screen : array[0..screensize-1] of byte;
    curx , cury : Integer;

begin
    randomize;
    dosmemget($B800, 0 , save_screen , screensize);
    curx := wherex; cury := wherey;
    gotoxy(1 , 1); Write(text);
    textofs := screensize + length(text)*2;
    dosmemmove($B800, 0 , $B800, textofs , length(text)*2);
    dosmemfillchar($B800, 0 , screensize , #0);
    while (not keypressed) do begin
        dosmemfillchar($B800, textofs + random(length(text))*2 + 1 ,
            1, char(random(255)));
        dosmemmove($B800, textofs , $B800,
            random(columns)*2+random(rows)*columns*2,
            length(text)*2);
        delay(1);
    end;
    readkey;
    readkey;
    dosmempu($B800, 0 , save_screen , screensize);
    gotoxy(curx , cury);
end.

```

dosmemfillword

Declaration: Procedure dosmemfillword (seg,ofs : Word; count : Longint; w : Word);

Description: Sets a region of DOS memory to a specific word value. Parameters:

seg: real mode segment.

ofs: real mode offset.

count: number of words to set.

w: value to set memory to.

Notes: No range check is performed.

Errors: None.

See also: dosmempu (91), dosmemget (91), dosmemmove (91), dosmemfillchar (89), seg_move (107), seg_fillchar (105), seg_fillword (106)

dosmemget

Declaration: `Procedure dosmemget (seg : Word; ofs : Word; var data; count : Longint);`

Description: Copies data from the DOS memory onto the heap. Parameters:

seg: source real mode segment.

ofs: source real mode offset.

data: destination.

count: number of bytes to copy.

Notes: No range checking is performed.

Errors: None.

See also: [dosmempup \(91\)](#), [dosmemmove \(91\)](#), [dosmemfillchar \(89\)](#), [dosmemfillword \(90\)](#), [seg_move \(107\)](#), [seg_fillchar \(105\)](#), [seg_fillword \(106\)](#)

For an example, see [global_dos_alloc \(100\)](#).

dosmemmove

Declaration: `Procedure dosmemmove (sseg, sofs, dseg, dofs : Word; count : Longint);`

Description: Copies count bytes of data between two DOS real mode memory locations. Parameters:

sseg: source real mode segment.

sofs: source real mode offset.

dseg: destination real mode segment.

dofs: destination real mode offset.

count: number of bytes to copy.

Notes: No range check is performed in any way.

Errors: None.

See also: [dosmempup \(91\)](#), [dosmemget \(91\)](#), [dosmemfillchar \(89\)](#), [dosmemfillword \(90\)](#), [seg_move \(107\)](#), [seg_fillchar \(105\)](#), [seg_fillword \(106\)](#)

For an example, see [seg_fillchar \(105\)](#).

dosmempup

Declaration: `Procedure dosmempup (seg : Word; ofs : Word; var data; count : Longint);`

Description: Copies heap data to DOS real mode memory. Parameters:

seg: destination real mode segment.

ofs: destination real mode offset.

data: source.

count: number of bytes to copy.

Notes: No range checking is performed.

Errors: None.

See also: [dosmemget \(91\)](#), [dosmemmove \(91\)](#), [dosmemfillchar \(89\)](#), [dosmemfillword \(90\)](#), [seg_move \(107\)](#), [seg_fillchar \(105\)](#), [seg_fillword \(106\)](#)

For an example, see [global_dos_alloc \(100\)](#).

enable

Declaration: `Procedure enable ;`

Description: Enables all hardware interrupts by executing a STI instruction. Parameters: None.

Errors: None.

See also: [disable \(89\)](#)

free_ldt_descriptor

Declaration: `Function free_ldt_descriptor (des : Word) : boolean;`

Description: Frees a previously allocated descriptor. Parameters:

des: The descriptor to be freed.

Return value: `True` if successful, `False` otherwise. Notes: After this call this selector is invalid and must not be used for any memory operations anymore. Each descriptor allocated with [allocate_ldt_descriptors \(86\)](#) must be freed individually with this function, even if it was previously allocated as a part of a contiguous array of descriptors.

Errors: Check the `int31error` variable.

See also: [allocate_ldt_descriptors \(86\)](#), [get_next_selector_increment_value \(95\)](#)

For an example, see [allocate_ldt_descriptors \(86\)](#).

free_memory_block

Declaration: `Function free_memory_block (blockhandle : Longint) : boolean;`

Description: Frees a previously allocated memory block. Parameters:

`blockhandle`: the handle to the memory area to free.

Return value: `True` if successful, `false` otherwise. Notes: Frees memory that was previously allocated with [allocate_memory_block \(88\)](#). This function doesn't free any descriptors mapped to this block, it's the application's responsibility.

Errors: Check `int31error` variable.

See also: [allocate_memory_block \(88\)](#)

free_rm_callback

Declaration: `Function free_rm_callback (var intaddr : tseginfo) : boolean;`

Description: Releases a real mode callback address that was previously allocated with the [get_rm_callback \(96\)](#) function. Parameters:

intaddr: real mode address buffer returned by [get_rm_callback \(96\)](#).

Return values: `True` if successful, `False` if not

Errors: Check the `int31error` variable.

See also: [set_rm_interrupt \(108\)](#), [get_rm_callback \(96\)](#)

For an example, see [get_rm_callback \(96\)](#).

get_cs

Declaration: `Function get_cs : Word;`

Description: Returns the cs selector. Parameters: None. Return values: The content of the cs segment register.

Errors: None.

See also: [get_ds \(93\)](#), [get_ss \(100\)](#)

For an example, see [set_pm_interrupt \(107\)](#).

get_descriptor_access_rights

Declaration: `Function get_descriptor_access_rights (d : Word) : Longint;`

Description: Gets the access rights of a descriptor. Parameters:

`d` selector to descriptor.

Return value: Access rights bit field.

Errors: Check the `int31error` variable.

See also: [set_descriptor_access_rights \(107\)](#)

get_ds

Declaration: `Function get_ds : Word;`

Description: Returns the ds selector. Parameters: None. Return values: The content of the ds segment register.

Errors: None.

See also: [get_cs \(93\)](#), [get_ss \(100\)](#)

get_linear_addr

Declaration: `Function get_linear_addr (phys_addr : Longint; size : Longint) : Longint;`

Description: Converts a physical address into a linear address. Parameters:

phys_addr: physical address of device.

size: Size of region to map in bytes.

Return value: Linear address that can be used to access the physical memory. Notes: It's the applications responsibility to allocate and set up a descriptor for access to the memory. This function shouldn't be used to map real mode addresses.

Errors: Check the `int31error` variable.

See also: [allocate_ldt_descriptors \(86\)](#), [set_segment_limit \(109\)](#), [set_segment_base_address \(109\)](#)

get_meminfo

Declaration: `Function get_meminfo (var meminfo : tmeminfo) : boolean;`

Description: Returns information about the amount of available physical memory, linear address space, and disk space for page swapping. Parameters:

meminfo: buffer to fill memory information into.

Return values: Due to an implementation bug this function always returns `False`, but it always succeeds. Notes: Only the first field of the returned structure is guaranteed to contain a valid value. Any fields that are not supported by the DPML host will be set by the host to `-1 (0FFFFFFFH)` to indicate that the information is not available. The size of the pages used by the DPML host can be obtained with the `get_page_size (95)` function.

Errors: Check the `int31error` variable.

See also: `get_page_size (95)`

Listing: go32ex/meminfo.pp

```

uses
    go32;

var
    meminfo : tmeminfo;

begin
    get_meminfo(meminfo);
    if (int31error <> 0) then begin
        Writeln('Error getting DPML memory information... Halting');
        Writeln('DPML error number : ', int31error);
    end else begin
        with meminfo do begin
            Writeln('Largest available free block : ',
                available_memory div 1024, ' kbytes');
            if (available_pages <> -1) then
                Writeln('Maximum available unlocked pages : ',
                    available_pages);
            if (available_lockable_pages <> -1) then
                Writeln('Maximum lockable available pages : ',
                    available_lockable_pages);
            if (linear_space <> -1) then
                Writeln('Linear address space size : ',
                    linear_space*get_page_size div 1024, ' kbytes');
            if (unlocked_pages <> -1) then
                Writeln('Total number of unlocked pages : ',
                    unlocked_pages);
            if (available_physical_pages <> -1) then
                Writeln('Total number of free pages : ',
                    available_physical_pages);
            if (total_physical_pages <> -1) then
                Writeln('Total number of physical pages : ',
                    total_physical_pages);
            if (free_linear_space <> -1) then
                Writeln('Free linear address space : ',
                    free_linear_space*get_page_size div 1024,
                    ' kbytes');
            if (max_pages_in_paging_file <> -1) then
                Writeln('Maximum size of paging file : ',

```

```
max_pages_in_paging_file*get_page_size div 1024,  
    ' kbytes ');  
    end;  
end;  
end.
```

get_next_selector_increment_value

Declaration: Function `get_next_selector_increment_value` : `Word`;

Description: Returns the selector increment value when allocating multiple subsequent descriptors via `allocate_ldt_descriptors` (86). Parameters: None. Return value: Selector increment value. Notes: Because `allocate_ldt_descriptors` (86) only returns the selector for the first descriptor and so the value returned by this function can be used to calculate the selectors for subsequent descriptors in the array.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (86), `free_ldt_descriptor` (92)

get_page_size

Declaration: Function `get_page_size` : `Longint`;

Description: Returns the size of a single memory page. Return value: Size of a single page in bytes. Notes: The returned size is typically 4096 bytes.

Errors: Check the `int31error` variable.

See also: `get_meminfo` (94)

For an example, see `get_meminfo` (94).

get_pm_interrupt

Declaration: Function `get_pm_interrupt` (`vector` : `byte`; `var intaddr` : `tseginfo`) : `boolean`;

Description: Returns the address of a current protected mode interrupt handler. Parameters:

vector: interrupt handler number you want the address to.

intaddr: buffer to store address.

Return values: `True` if successful, `False` if not. Notes: The returned address is a protected mode selector:offset address.

Errors: Check the `int31error` variable.

See also: `set_pm_interrupt` (107), `set_rm_interrupt` (108), `get_rm_interrupt` (98)

For an example, see `set_pm_interrupt` (107).

get_rm_callback

Declaration: Function `get_rm_callback (pm_func : pointer; const reg : trealregs; var rmc_b: tseginfo) : boolean;`

Description: Returns a unique real mode `segment:offset` address, known as a "real mode callback," that will transfer control from real mode to a protected mode procedure. Parameters:

pm_func: pointer to the protected mode callback function.

reg: supplied registers structure.

rmc_b: buffer to real mode address of callback function.

Return values: `True` if successful, otherwise `False`. **Notes:** Callback addresses obtained with this function can be passed by a protected mode program for example to an interrupt handler, device driver, or TSR, so that the real mode program can call procedures within the protected mode program or notify the protected mode program of an event. The contents of the supplied `regs` structure is not valid after function call, but only at the time of the actual callback.

Errors: Check the `int31error` variable.

See also: `free_rm_callback` (92)

Listing: `go32ex/callback.pp`

```
{$ASMMODE ATT}
{$MODE FPC}

uses
    crt ,
    go32;

const
    mouseint = $33;

var
    mouse_regs    : trealregs; external name '___v2prt0_rmc_b_regs';
    mouse_seginfo : tseginfo;

var
    mouse_numbuttons : longint;

    mouse_action : word;
    mouse_x, mouse_y : Word;
    mouse_b : Word;

    userproc_installed : Longbool;
    userproc_length : Longint;
    userproc_proc : pointer;

procedure callback_handler; assembler;
asm
    pushw %ds
    pushl %eax
    movw %es, %ax
    movw %ax, %ds

    cml $1, USERPROC_INSTALLED
    jne .LNoCallback
    pushal
```

```

    movw DOSmemSELECTOR, %ax
    movw %ax, %fs
    call *USERPROC_PROC
    popal
.LNoCallback:

    popl %eax
    popw %ds

    pushl %eax
    movl (%esi), %eax
    movl %eax, %es: 42(%edi)
    addw $4, %es:46(%edi)
    popl %eax
    iret
end;
procedure mouse_dummy; begin end;

procedure textuserproc;
begin
    mouse_b := mouse_regs.bx;
    mouse_x := (mouse_regs.cx shr 3) + 1;
    mouse_y := (mouse_regs.dx shr 3) + 1;
end;

procedure install_mouse(userproc : pointer; userproclen : longint);
var r : treatregs;
begin
    r.eax := $0; realintr(mouseint, r);
    if (r.eax <> $FFFF) then begin
        Writeln('No Microsoft compatible mouse found');
        Writeln('A Microsoft compatible mouse driver is necessary ',
            'to run this example');
        halt;
    end;
    if (r.bx = $ffff) then mouse_numbuttons := 2
    else mouse_numbuttons := r.bx;
    Writeln(mouse_numbuttons, ' button Microsoft compatible mouse ',
        ' found. ');
    if (userproc <> nil) then begin
        userproc_proc := userproc;
        userproc_installed := true;
        userproc_length := userproclen;
        lock_code(userproc_proc, userproc_length);
    end else begin
        userproc_proc := nil;
        userproc_length := 0;
        userproc_installed := false;
    end;
    lock_data(mouse_x, sizeof(mouse_x));
    lock_data(mouse_y, sizeof(mouse_y));
    lock_data(mouse_b, sizeof(mouse_b));
    lock_data(mouse_action, sizeof(mouse_action));

    lock_data(userproc_installed, sizeof(userproc_installed));
    lock_data(userproc_proc, sizeof(userproc_proc));

    lock_data(mouse_regs, sizeof(mouse_regs));

```

```

lock_data(mouse_seginfo, sizeof(mouse_seginfo));
lock_code(@callback_handler,
          longint(@mouse_dummy)-longint(@callback_handler));
get_rm_callback(@callback_handler, mouse_regs, mouse_seginfo);
r.eax := $0c; r.ecx := $7f;
r.edx := longint(mouse_seginfo.offset);
r.es := mouse_seginfo.segment;
realintr(mouseint, r);
r.eax := $01;
realintr(mouseint, r);
end;

procedure remove_mouse;
var
    r : trealregs;
begin
    r.eax := $02; realintr(mouseint, r);
    r.eax := $0c; r.ecx := 0; r.edx := 0; r.es := 0;
    realintr(mouseint, r);
    free_rm_callback(mouse_seginfo);
    if (userproc_installed) then begin
        unlock_code(userproc_proc, userproc_length);
        userproc_proc := nil;
        userproc_length := 0;
        userproc_installed := false;
    end;
    unlock_data(mouse_x, sizeof(mouse_x));
    unlock_data(mouse_y, sizeof(mouse_y));
    unlock_data(mouse_b, sizeof(mouse_b));
    unlock_data(mouse_action, sizeof(mouse_action));

    unlock_data(userproc_proc, sizeof(userproc_proc));
    unlock_data(userproc_installed, sizeof(userproc_installed));

    unlock_data(mouse_regs, sizeof(mouse_regs));
    unlock_data(mouse_seginfo, sizeof(mouse_seginfo));
    unlock_code(@callback_handler,
              longint(@mouse_dummy)-longint(@callback_handler));
    fillchar(mouse_seginfo, sizeof(mouse_seginfo), 0);
end;

begin
    install_mouse(@textuserproc, 400);
    Writeln('Press any key to exit...');
    while (not keypressed) do begin
        gotoxy(1, wherey);
        write('MouseX : ', mouse_x:2, ' MouseY : ', mouse_y:2,
             ' Buttons : ', mouse_b:2);
    end;
    remove_mouse;
end.

```

get_rm_interrupt

Declaration: Function `get_rm_interrupt` (vector : byte; var intaddr : tseginfo)
: boolean;

Description: Returns the contents of the current machine's real mode interrupt vector for the specified interrupt.

Parameters:

vector: interrupt vector number.

intaddr: buffer to store real mode `segment:offset` address.

Return values: `True` if successful, `False` otherwise. Notes: The returned address is a real mode segment address, which isn't valid in protected mode.

Errors: Check the `int31error` variable.

See also: [set_rm_interrupt \(108\)](#), [set_pm_interrupt \(107\)](#), [get_pm_interrupt \(95\)](#)

get_run_mode

Declaration: `Function get_run_mode : Word;`

Description: Returns the current mode your application runs with. Return values: One of the constants used by this function.

Errors: None.

See also: constants returned by [get_run_mode \(99\)](#)

Listing: `go32ex/getrunmd.pp`

```

uses
    go32;

begin
    case (get_run_mode) of
        rm_unknown :
            WriteLn('Unknown environment found');
        rm_raw :
            WriteLn('You are currently running in raw mode ',
                '(without HIMEM)');
        rm_xms :
            WriteLn('You are currently using HIMEM.SYS only');
        rm_vcpi :
            WriteLn('VCPI server detected. You''re using HIMEM and ',
                'EMM386');
        rm_dpml :
            WriteLn('DPML detected. You''re using a DPML host like ',
                'a windows DOS box or CWSDPML');
    end;
end.

```

get_segment_base_address

Declaration: `Function get_segment_base_address (d : Word) : Longint;`

Description: Returns the 32-bit linear base address from the descriptor table for the specified segment. Parameters:

d: selector of the descriptor you want the base address of.

Return values: Linear base address of specified descriptor.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (86), `set_segment_base_address` (109), `allocate_ldt_descriptors` (86), `set_segment_limit` (109), `get_segment_limit` (100)

For an example, see `allocate_ldt_descriptors` (86).

get_segment_limit

Declaration: `Function get_segment_limit (d : Word) : Longint;`

Description: Returns a descriptors segment limit. Parameters:

d: selector.

Return value: Limit of the descriptor in bytes.

Errors: Returns zero if descriptor is invalid.

See also: `allocate_ldt_descriptors` (86), `set_segment_limit` (109), `set_segment_base_address` (109), `get_segment_base_address` (99),

get_ss

Declaration: `Function get_ss : Word;`

Description: Returns the ss selector. Parameters: None. Return values: The content of the ss segment register.

Errors: None.

See also: `get_ds` (93), `get_cs` (93)

global_dos_alloc

Declaration: `Function global_dos_alloc (bytes : Longint) : Longint;`

Description: Allocates a block of DOS real mode memory. Parameters:

bytes: size of requested real mode memory.

Return values: The low word of the returned value contains the selector to the allocated DOS memory block, the high word the corresponding real mode segment value. The offset value is always zero. This function allocates memory from DOS memory pool, i.e. memory below the 1 MB boundary that is controlled by DOS. Such memory blocks are typically used to exchange data with real mode programs, TSRs, or device drivers. The function returns both the real mode segment base address of the block and one descriptor that can be used by protected mode applications to access the block. This function should only be used for temporary buffers to get real mode information (e.g. interrupts that need a data structure in ES:(E)DI), because every single block needs a unique selector. The returned selector should only be freed by a `global_dos_free` (102) call.

Errors: Check the `int31error` variable.

See also: `global_dos_free` (102)

Listing: `go32ex/buffer.pp`

```

uses
    go32;

procedure dosalloc(var selector : word;
    var segment : word; size : longint);
var
    res : longint;
begin
    res := global_dos_alloc(size);
    selector := word(res);
    segment := word(res shr 16);
end;

procedure dosfree(selector : word);
begin
    global_dos_free(selector);
end;

type
    VBEInfoBuf = packed record
        Signature : array[0..3] of char;
        Version : Word;
        reserved : array[0..505] of byte;
    end;

var
    selector ,
    segment : Word;

    r : treatregs;
    infobuf : VBEInfoBuf;

begin
    fillchar(r, sizeof(r), 0);
    fillchar(infobuf, sizeof(VBEInfoBuf), 0);
    dosalloc(selector, segment, sizeof(VBEInfoBuf));
    if (int31error <> 0) then begin
        Writeln('Error while allocating real mode memory, halting');
        halt;
    end;
    infobuf.Signature := 'VBE2';
    dosmemput(segment, 0, infobuf, sizeof(infobuf));
    r.ax := $4f00; r.es := segment;
    realintr($10, r);
    dosmemget(segment, 0, infobuf, sizeof(infobuf));
    dosfree(selector);
    if (r.ax <> $4f) then begin
        Writeln('VBE BIOS extension not available, function call ',
            'failed');
        halt;
    end;
    if (infobuf.signature[0] = 'V') and
        (infobuf.signature[1] = 'E') and
        (infobuf.signature[2] = 'S') and
        (infobuf.signature[3] = 'A') then begin
        Writeln('VBE version ', hi(infobuf.version), '.',
            lo(infobuf.version), ' detected');
    end;

```

end.

global_dos_free

Declaration: `Function global_dos_free (selector :Word) : boolean;`

Description: Frees a previously allocated DOS memory block. Parameters:

selector: selector to the DOS memory block.

Return value: `True` if successful, `False` otherwise. Notes: The descriptor allocated for the memory block is automatically freed and hence invalid for further use. This function should only be used for memory allocated by `global_dos_alloc` (100).

Errors: Check the `int31error` variable.

See also: `global_dos_alloc` (100)

For an example, see `global_dos_alloc` (100).

inportb

Declaration: `Function inportb (port : Word) : byte;`

Description: Reads 1 byte from the selected I/O port. Parameters:

port: the I/O port number which is read.

Return values: Current I/O port value.

Errors: None.

See also: `outportb` (104), `inportw` (102), `inportl` (102)

inportl

Declaration: `Function inportl (port : Word) : Longint;`

Description: Reads 1 longint from the selected I/O port. Parameters:

port: the I/O port number which is read.

Return values: Current I/O port value.

Errors: None.

See also: `outportb` (104), `inportb` (102), `inportw` (102)

inportw

Declaration: `Function inportw (port : Word) : Word;`

Description: Reads 1 word from the selected I/O port. Parameters:

port: the I/O port number which is read.

Return values: Current I/O port value.

Errors: None.

See also: `outportw` (104), `inportb` (102), `inportl` (102)

lock_code

Declaration: `Function lock_code (functionaddr : pointer; size : Longint) : boolean;`

Description: Locks a memory range which is in the code segment selector. Parameters:

functionaddr: address of the function to be locked.

size: size in bytes to be locked.

Return values: True if successful, False otherwise.

Errors: Check the `int31error` variable.

See also: [lock_linear_region \(103\)](#), [lock_data \(103\)](#), [unlock_linear_region \(110\)](#), [unlock_data \(110\)](#), [unlock_code \(110\)](#)

For an example, see [get_rm_callback \(96\)](#).

lock_data

Declaration: `Function lock_data (var data; size : Longint) : boolean;`

Description: Locks a memory range which resides in the data segment selector. Parameters:

data: address of data to be locked.

size: length of data to be locked.

Return values: True if successful, False otherwise.

Errors: Check the `int31error` variable.

See also: [lock_linear_region \(103\)](#), [lock_code \(103\)](#), [unlock_linear_region \(110\)](#), [unlock_data \(110\)](#), [unlock_code \(110\)](#)

For an example, see [get_rm_callback \(96\)](#).

lock_linear_region

Declaration: `Function lock_linear_region (linearaddr, size : Longint) : boolean;`

Description: Locks a memory region to prevent swapping of it. Parameters:

linearaddr: the linear address of the memory are to be locked.

size: size in bytes to be locked.

Return value: True if successful, False otherwise.

Errors: Check the `int31error` variable.

See also: [lock_data \(103\)](#), [lock_code \(103\)](#), [unlock_linear_region \(110\)](#), [unlock_data \(110\)](#), [unlock_code \(110\)](#)

outportb

Declaration: Procedure outportb (port : Word; data : byte);

Description: Sends 1 byte of data to the specified I/O port. Parameters:

port: the I/O port number to send data to.

data: value sent to I/O port.

Return values: None.

Errors: None.

See also: inportb (102), outportl (104), outportw (104)

Listing: go32ex/outport.pp

uses

```
crt ,
go32;
```

begin

```
outportb ($61, $ff);
delay (50);
outportb ($61, $0);
```

end.

outportl

Declaration: Procedure outportl (port : Word; data : Longint);

Description: Sends 1 longint of data to the specified I/O port. Parameters:

port: the I/O port number to send data to.

data: value sent to I/O port.

Return values: None.

Errors: None.

See also: inportl (102), outportw (104), outportb (104)

For an example, see outportb (104).

outportw

Declaration: Procedure outportw (port : Word; data : Word);

Description: Sends 1 word of data to the specified I/O port. Parameters:

port: the I/O port number to send data to.

data: value sent to I/O port.

Return values: None.

Errors: None.

See also: inportw (102), outportl (104), outportb (104)

For an example, see outportb (104).

realintr

Declaration: Function `realintr (intrnr: Word; var regs : trealregs) : boolean;`

Description: Simulates an interrupt in real mode. Parameters:

intrnr: interrupt number to issue in real mode.

regs: registers data structure.

Return values: The supplied registers data structure contains the values that were returned by the real mode interrupt. `True` if successful, `False` if not. **Notes:** The function transfers control to the address specified by the real mode interrupt vector of `intrnr`. The real mode handler must return by executing an `IRET`.

Errors: Check the `int31error` variable.

See also:

Listing: `go32ex/flags.pp`

```

uses
    go32;

var
    r : trealregs;

begin
    r.ax := $5300;
    r.bx := 0;
    realintr($15, r);
    if ((r.flags and carryflag)=0) then begin
        Writeln('APM v', (r.ah and $f), '.',
            (r.al shr 4), (r.al and $f), ' detected');
    end else
        Writeln('APM not present');
end.

```

seg_fillchar

Declaration: Procedure `seg_fillchar (seg : Word; ofs : Longint; count : Longint; c : char);`

Description: Sets a memory area to a specific value. Parameters:

seg: selector to memory area.

ofs: offset to memory.

count: number of bytes to set.

c: byte data which is set.

Return values: None. **Notes:** No range check is done in any way.

Errors: None.

See also: `seg_move` (107), `seg_fillword` (106), `dosmemfillchar` (89), `dosmemfillword` (90), `dosmemget` (91), `dosmemput` (91), `dosmemmove` (91)

Listing: `go32ex/vgasel.pp`

```

uses
    go32;

var
    vgasel : Word;
    r : treatregs;

begin
    r.eax := $13; realintr($10, r);
    vgasel := segment_to_descriptor($A000);
    seg_fillchar(vgasel, 0, 64000, #15);
    readln;
    r.eax := $3; realintr($10, r);

end.

```

seg_fillword

Declaration: Procedure `seg_fillword` (`seg` : Word; `ofs` : Longint; `count` : Longint; `w` : Word);

Description: Sets a memory area to a specific value. Parameters:

seg: selector to memory area.

ofs: offset to memory.

count: number of words to set.

w: word data which is set.

Return values: None. Notes: No range check is done in any way.

Errors: None.

See also: [seg_move \(107\)](#), [seg_fillchar \(105\)](#), [dosmemfillchar \(89\)](#), [dosmemfillword \(90\)](#), [dosmemget \(91\)](#), [dosmemput \(91\)](#), [dosmemmove \(91\)](#)

For an example, see [allocate_ldt_descriptors \(86\)](#).

segment_to_descriptor

Declaration: Function `segment_to_descriptor` (`seg` : Word) : Word;

Description: Maps a real mode segment (paragraph) address onto a descriptor that can be used by a protected mode program to access the same memory. Parameters:

seg: the real mode segment you want the descriptor to.

Return values: Descriptor to real mode segment address. Notes: The returned descriptors limit will be set to 64 kB. Multiple calls to this function with the same segment address will return the same selector. Descriptors created by this function can never be modified or freed. Programs which need to examine various real mode addresses using the same selector should use the function [allocate_ldt_descriptors \(86\)](#) and change the base address as necessary.

Errors: Check the `int31error` variable.

See also: [allocate_ldt_descriptors \(86\)](#), [free_ldt_descriptor \(92\)](#), [set_segment_base_address \(109\)](#)

For an example, see [seg_fillchar \(105\)](#).

seg_move

Declaration: `Procedure seg_move (sseg : Word; source : Longint; dseg : Word; dest : Longint; count : Longint);`

Description: Copies data between two memory locations. Parameters:

sseg: source selector.

source: source offset.

dseg: destination selector.

dest: destination offset.

count: size in bytes to copy.

Return values: None. **Notes:** Overlapping is only checked if the source selector is equal to the destination selector. No range check is done.

Errors: None.

See also: [seg_fillchar \(105\)](#), [seg_fillword \(106\)](#), [dosmemfillchar \(89\)](#), [dosmemfillword \(90\)](#), [dosmemget \(91\)](#), [dosmempu \(91\)](#), [dosmemmove \(91\)](#)

For an example, see [allocate_ldt_descriptors \(86\)](#).

set_descriptor_access_rights

Declaration: `Function set_descriptor_access_rights (d : Word; w : Word) : Longint;`

Description: Sets the access rights of a descriptor. Parameters:

d: selector.

w: new descriptor access rights.

Return values: This function doesn't return anything useful.

Errors: Check the `int31error` variable.

See also: [get_descriptor_access_rights \(93\)](#)

set_pm_interrupt

Declaration: `Function set_pm_interrupt (vector : byte; const intaddr : tseginfo) : boolean;`

Description: Sets the address of the protected mode handler for an interrupt. Parameters:

vector: number of protected mode interrupt to set.

intaddr: selector:offset address to the interrupt vector.

Return values: `True` if successful, `False` otherwise. **Notes:** The address supplied must be a valid `selector:offset` protected mode address.

Errors: Check the `int31error` variable.

See also: [get_pm_interrupt \(95\)](#), [set_rm_interrupt \(108\)](#), [get_rm_interrupt \(98\)](#)

Listing: `go32ex/intpm.pp`

```

uses
    crt ,
    go32;

const
    int1c = $1c;

var
    oldint1c : tseginfo;
    newint1c : tseginfo;

    int1c_counter : Longint;

    int1c_ds : Word; external name '___v2prt0_ds_alias';

procedure int1c_handler; assembler;
asm
    cli
    pushw %ds
    pushw %ax
    movw %cs:int1c_ds , %ax
    movw %ax, %ds
    incl int1c_counter
    popw %ax
    popw %ds
    sti
    iret
end;

var i : Longint;

begin
    newint1c.offset := @int1c_handler;
    newint1c.segment := get_cs;
    get_pm_interrupt(int1c , oldint1c);
    WriteLn('-- Press any key to exit --');
    set_pm_interrupt(int1c , newint1c);
    while (not keypressed) do begin
        gotoxy(1, wherey);
        write('Number of interrupts occured : ', int1c_counter);
    end;
    set_pm_interrupt(int1c , oldint1c);
end.

```

set_rm_interrupt

Declaration: Function set_rm_interrupt (vector : byte; const intaddr : tseginfo)
: boolean;

Description: Sets a real mode interrupt handler. Parameters:

vector: the interrupt vector number to set.

intaddr: address of new interrupt vector.

Return values: True if successful, otherwise False. **Notes:** The address supplied MUST be a real mode segment address, not a selector:offset address. So the interrupt handler must either

reside in DOS memory (below 1 Mb boundary) or the application must allocate a real mode callback address with `get_rm_callback` (96).

Errors: Check the `int31error` variable.

See also: `get_rm_interrupt` (98), `set_pm_interrupt` (107), `get_pm_interrupt` (95), `get_rm_callback` (96)

set_segment_base_address

Declaration: `Function set_segment_base_address (d : Word; s : Longint) : boolean;`

Description: Sets the 32-bit linear base address of a descriptor. Parameters:

d: selector.

s: new base address of the descriptor.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (86), `get_segment_base_address` (99), `allocate_ldt_descriptors` (86), `set_segment_limit` (109), `get_segment_base_address` (99), `get_segment_limit` (100)

set_segment_limit

Declaration: `Function set_segment_limit (d : Word; s : Longint) : boolean;`

Description: Sets the limit of a descriptor. Parameters:

d: selector.

s: new limit of the descriptor.

Return values: Returns `True` if successful, else `False`. Notes: The new limit specified must be the byte length of the segment - 1. Segment limits bigger than or equal to 1MB must be page aligned, they must have the lower 12 bits set.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (86), `set_segment_base_address` (109), `get_segment_limit` (100), `set_segment_limit` (109)

For an example, see `allocate_ldt_descriptors` (86).

tb_size

Declaration: `Function tb_size : Longint;`

Description: Returns the size of the pre-allocated DOS memory buffer. Parameters: None. Return values: The size of the pre-allocated DOS memory buffer. Notes: This block always seems to be 16k in size, but don't rely on this.

Errors: None.

See also: `transfer_buffer` (110), `copyfromdos` (88) `copytodos` (88)

transfer_buffer

Declaration: `Function transfer_buffer : Longint;`

Description: `transfer_buffer` returns the offset of the transfer buffer.

Errors: None.

See also: `tb_size` (109)

unlock_code

Declaration: `Function unlock_code (functionaddr : pointer; size : Longint) : boolean;`

Description: Unlocks a memory range which resides in the code segment selector. Parameters:

functionaddr: address of function to be unlocked.

size: size bytes to be unlocked.

Return value: `True` if successful, `False` otherwise.

Errors: Check the `int31error` variable.

See also: `unlock_linear_region` (110), `unlock_data` (110), `lock_linear_region` (103), `lock_data` (103), `lock_code` (103)

For an example, see `get_rm_callback` (96).

unlock_data

Declaration: `Function unlock_data (var data; size : Longint) : boolean;`

Description: Unlocks a memory range which resides in the data segment selector. Parameters:

data: address of memory to be unlocked.

size: size bytes to be unlocked.

Return values: `True` if successful, `False` otherwise.

Errors: Check the `int31error` variable.

See also: `unlock_linear_region` (110), `unlock_code` (110), `lock_linear_region` (103), `lock_data` (103), `lock_code` (103)

For an example, see `get_rm_callback` (96).

unlock_linear_region

Declaration: `Function unlock_linear_region (linearaddr, size : Longint) : boolean;`

Description: Unlocks a previously locked linear region range to allow it to be swapped out again if needed.

Parameters:

linearaddr: linear address of the memory to be unlocked.

size: size bytes to be unlocked.

Return values: `True` if successful, `False` otherwise.

Errors: Check the `int31error` variable.

See also: [unlock_data \(110\)](#), [unlock_code \(110\)](#), [lock_linear_region \(103\)](#), [lock_data \(103\)](#), [lock_code \(103\)](#)

Chapter 8

The GRAPH unit.

This document describes the GRAPH unit for Free Pascal, for all platforms. The unit was first written for DOS by Florian klämpfl, but was later completely rewritten by Carl-Eric Codere to be completely portable.

This chapter is divided in 4 sections.

- The first section gives an introduction to the graph unit.
- The second section lists the pre-defined constants, types and variables.
- The second section describes the functions which appear in the interface part of the GRAPH unit.
- The last part describes some system-specific issues.

8.1 Introduction

Requirements

The unit Graph exports functions and procedures for graphical output. It requires at least a VGA-compatible Card or a VGA-Card with software-driver (min. **512Kb** video memory).

A word about mode selection

The graph unit was implemented for compatibility with the old Turbo Pascal graph unit. For this reason, the mode constants as they were defined in the Turbo Pascal graph unit are retained.

However, since

1. Video cards have evolved very much
2. Free Pascal runs on multiple platforms

it was decided to implement new mode and graphic driver constants, which are more independent of the specific platform the program runs on.

In this section we give a short explanation of the new mode system. the following drivers were defined:

```

D1bit = 11;
D2bit = 12;
D4bit = 13;
D6bit = 14; { 64 colors Half-brite mode - Amiga }
D8bit = 15;
D12bit = 16; { 4096 color modes HAM mode - Amiga }
D15bit = 17;
D16bit = 18;
D24bit = 19; { not yet supported }
D32bit = 20; { not yet supported }
D64bit = 21; { not yet supported }

lowNewDriver = 11;
highNewDriver = 21;

```

Each of these drivers specifies a desired color-depth.

The following modes have been defined:

```

detectMode = 30000;
m320x200 = 30001;
m320x256 = 30002; { amiga resolution (PAL) }
m320x400 = 30003; { amiga/atari resolution }
m512x384 = 30004; { mac resolution }
m640x200 = 30005; { vga resolution }
m640x256 = 30006; { amiga resolution (PAL) }
m640x350 = 30007; { vga resolution }
m640x400 = 30008;
m640x480 = 30009;
m800x600 = 30010;
m832x624 = 30011; { mac resolution }
m1024x768 = 30012;
m1280x1024 = 30013;
m1600x1200 = 30014;
m2048x1536 = 30015;

lowNewMode = 30001;
highNewMode = 30015;

```

These modes start at 30000 because Borland specified that the mode number should be ascending with increasing X resolution, and the new constants shouldn't interfere with the old ones.

The above constants can be used to set a certain color depth and resolution, as demonstrated in the following example:

Listing: graphex/inigraph1.pp

```

Program inigraph1;

{ Program to demonstrate static graphics mode selection }

uses graph;

const
  TheLine = 'We are now in 640 x 480 x 256 colors!'+
            ' (press <Return> to continue)';

```

```

var
  gd, gm, lo, hi, error, tw, th: integer;
  found: boolean;

begin
  { We want an 8 bit mode }
  gd := D8bit;
  gm := m640x480;
  initgraph(gd, gm, '');
  { Make sure you always check graphresult! }
  error := graphResult;
  if (error <> grOk) Then
    begin
      writeln('640x480x256 is not supported!');
      halt(1);
    end;
  { We are now in 640x480x256 }
  setColor(cyan);
  rectangle(0,0,getmaxx,getmaxy);
  { Write a nice message in the center of the screen }
  setTextStyle(defaultFont, horizDir, 1);
  tw:=TextWidth(TheLine);
  th:=TextHeight(TheLine);
  outTextXY((getMaxX - TW) div 2,
            (getMaxY - TH) div 2, TheLine);
  { Wait for return }
  readln;
  { Back to text mode }
  closegraph;
end.

```

If other modes than the ones above are supported by the graphics card, you will not be able to select them with this mechanism.

For this reason, there is also a 'dynamic' mode number, which is assigned at run-time. This number increases with increasing X resolution. It can be queried with the `getmoderange` call. This call will return the range of modes which are valid for a certain graphics driver. The numbers are guaranteed to be consecutive, and can be used to search for a certain resolution, as in the following example:

Listing: graphex/inigraph2.pp

```

Program inigraph2;

{ Program to demonstrate dynamic graphics mode selection }

uses graph;

const
  TheLine = 'We are now in 640 x 480 x 256 colors!'+
            ' (press <Return> to continue)';

var
  th, tw, gd, gm, lo, hi, error: integer;
  found: boolean;

begin
  { We want an 8 bit mode }

```

```

gd := D8bit;
{ Get all available resolutions for this bitdepth }
getmoderange(gd,lo,hi);
{ If the highest available mode number is -1,
  no resolutions are supported for this bitdepth }
if hi = -1 then
  begin
    writeln('no 8 bit modes supported!');
    halt
  end;
found := false;
{ Search all resolutions for 640x480 }
for gm := lo to hi do
  begin
    initgraph(gd,gm,'');
    { Make sure you always check graphresult! }
    error := graphResult;
    if (error = grOk) and
      (getmaxx = 639) and (getmaxy = 479) then
      begin
        found := true;
        break;
      end;
  end;
if not found then
  begin
    writeln('640x480x256 is not supported!');
    halt(1)
  end;
{ We are now in 640x480x256 }
setColor(cyan);
rectangle(0,0,getmaxx,getmaxy);
{ Write a nice message in the center of the screen }
setTextStyle(defaultFont,hORIZDIR,1);
TW:=TextWidth(TheLine);
TH:=TextHeight(TheLine);
outTextXY((getMaxX - TW) div 2,
          (getMaxY - TH) div 2,TheLine);
{ Wait for return }
readln;
{ Back to text mode }
closegraph;
end.

```

Thus, the `getmoderange` function can be used to detect all available modes and drivers, as in the following example:

Listing: `graphex/modrange.pp`

Program `GetModeRange_Example`;

```
{ This program demonstrates how to find all available graph modes }
```

```
uses graph;
```

```
const
```

```
{ Currently, only 4, 8, 15 and 16 bit modes are supported
  but this may change in the future }
gdnames: array[D4bit..D16bit] of string[6] =
```

```

('4 bit', '6 bit', '8 bit', '12 bit', '15 bit', '16 bit');

var
  t: text;
  line : string;
  gd, c, low, high, res: integer;
begin
  assign(t, 'modes.txt');
  rewrite(t);
  close(t);
  for gd := D4bit to D16bit do
    begin
      { Get the available mode numbers for this driver }
      getModeRange(gd, low, high);
      append(t);
      write(t, gdnames[gd]);
      WriteIn(t, ': low modenr = ', low, ', high modenr = ', high);
      close(t);
      { If high is -1,
        no resolutions are supported for this bitdepth }
      if high = -1 then
        begin
          append(t);
          writeln(t, ' No modes supported!');
          writeln(t);
          close(t);
        end
      else
        { Enter all supported resolutions for this bitdepth
          and write their characteristics to the file }
        for c := low to high do
          begin
            append(t);
            writeln(t, ' testing mode nr ', c);
            close(t);
            initgraph(gd, c, '');
            res := graphresult;
            append(t);
            { An error occurred when entering the mode? }
            if res <> grok then
              writeln(t, grapherrormsg(res))
            else
              begin
                write(t, 'maxx: ', getmaxx, ', maxy: ', getmaxy);
                WriteIn(t, ', maxcolor: ', getmaxcolor);
                closegraph;
              end;
              writeln(t);
              close(t);
            end;
          append(t);
          writeln(t);
          close(t);
        end;
      WriteIn('All supported modes are listed in modes.txt files');
    end.

```

8.2 Constants, Types and Variables

Types

```

ArcCoordsType = record
  X,Y,Xstart,Ystart,Xend,Yend : Integer;
end;
FillPatternType = Array [1..8] of Byte;
FillSettingsType = Record
  Pattern,Color : Word
end;
LineStyleType = Record
  LineStyle,Pattern, Width : Word;
end;
PaletteType = Record
  Size : Byte;
  Colors : array[0..MAXcolor] of shortint;
end;
PointType = Record
  X,Y : Integer;
end;
TextSettingsType = Record
  Font,Direction, CharSize, Horiz, Vert : Word
end;
ViewPortType = Record
  X1,Y1,X2,Y2 : Integer;
  Clip : Boolean
end;

```

8.3 Function list by category

What follows is a listing of the available functions, grouped by category. For each function there is a reference to the page where you can find the function.

Initialization

Initialization of the graphics screen.

Name	Description	Page
ClearDevice	Empty the graphics screen	120
CloseGraph	Finish drawing session, return to text mode	120
DetectGraph	Detect graphical modes	120
GetAspectRatio	Get aspect ratio of screen	122
GetModeRange	Get range of valid modes for current driver	124
GraphDefaults	Set defaults	126
GetDriverName	Return name of graphical driver	122
GetGraphMode	Return current or last used graphics mode	123
GetMaxMode	Get maximum mode for current driver	124

GetModeName	Get name of current mode	124
GraphErrorMsg	String representation of graphical error	126
GraphResult	Result of last drawing operation	126
InitGraph	Initialize graphics drivers	127
InstallUserDriver	Install a new driver	127
RegisterBGIDriver	Register a new driver	130
RestoreCRTMode	Go back to text mode	130
SetGraphBufSize	Set buffer size for graphical operations	132
SetGraphMode	Set graphical mode	133

screen management

General drawing screen management functions.

Name	Description	Page
ClearViewPort	Clear the current viewport	120
GetImage	Copy image from screen to memory	123
GetMaxX	Get maximum X coordinate	124
GetMaxY	Get maximum Y coordinate	124
GetX	Get current X position	125
GetY	Get current Y position	126
ImageSize	Get size of selected image	127
GetViewSettings	Get current viewport settings	125
PutImage	Copy image from memory to screen	129
SetActivePage	Set active video page	131
SetAspectRatio	Set aspect ratio for drawing routines	131
SetViewPort	Set current viewport	135
SetVisualPage	Set visual page	135
SetWriteMode	Set write mode for screen operations	135

Color management

All functions related to color management.

Name	Description	Page
GetBkColor	Get current background color	122
GetColor	Get current foreground color	122
GetDefaultPalette	Get default palette entries	122
GetMaxColor	Get maximum valid color	123
GetPaletteSize	Get size of palette for current mode	125
GetPixel	Get color of selected pixel	125
GetPalette	Get palette entry	125

SetAllPalette	Set all colors in palette	131
SetBkColor	Set background color	131
SetColor	Set foreground color	132
SetPalette	Set palette entry	133
SetRGBPalette	Set palette entry with RGB values	133

Drawing primitives

Functions for simple drawing.

Name	Description	Page
Arc	Draw an arc	119
Circle	Draw a complete circle	120
DrawPoly	Draw a polygone with N points	121
Ellipse	Draw an ellipse	121
GetArcCoords	Get arc coordinates	122
GetLineSettings	Get current line drawing settings	123
Line	Draw line between 2 points	128
LineRel	Draw line relative to current position	128
LineTo	Draw line from current position to absolute position	128
MoveRel	Move cursor relative to current position	128
MoveTo	Move cursor to absolute position	129
PieSlice	Draw a pie slice	129
PutPixel	Draw 1 pixel	130
Rectangle	Draw a non-filled rectangle	130
Sector	Draw a sector	131
SetLineStyle	Set current line drawing style	133

Filled drawings

Functions for drawing filled regions.

Name	Description	Page
Bar3D	Draw a filled 3D-style bar	119
Bar	Draw a filled rectangle	119
FloodFill	Fill starting from coordinate	121
FillEllipse	Draw a filled ellipse	121
FillPoly	Draw a filled polygone	121
GetFillPattern	Get current fill pattern	123
GetFillSettings	Get current fill settings	123
SetFillPattern	Set current fill pattern	132
SetFillStyle	Set current fill settings	132

Text and font handling

Functions to set texts on the screen.

Name	Description	Page
GetTextSettings	Get current text settings	125
InstallUserFont	Install a new font	128
OutText	Write text at current cursor position	129
OutTextXY	Write text at coordinates X,Y	129
RegisterBGIFont	Register a new font	130
SetTextJustify	Set text justification	134
SetTextStyle	Set text style	134
SetUserCharSize	Set text size	135
TextHeight	Calculate height of text	135
TextWidth	Calculate width of text	136

8.4 Functions and procedures

Arc

Declaration: `Procedure Arc (X,Y : Integer; start,stop, radius : Word);`

Description: `Arc` draws part of a circle with center at (X,Y) , radius `radius`, starting from angle `start`, stopping at angle `stop`. These angles are measured counterclockwise.

Errors: None.

See also: [Circle \(120\)](#), [Ellipse \(121\)](#) [GetArcCoords \(122\)](#), [PieSlice \(129\)](#), [Sector \(131\)](#)

Bar

Declaration: `Procedure Bar (X1,Y1,X2,Y2 : Integer);`

Description: Draws a rectangle with corners at $(X1,Y1)$ and $(X2,Y2)$ and fills it with the current color and fill-style.

Errors: None.

See also: [Bar3D \(119\)](#), [Rectangle \(130\)](#)

Bar3D

Declaration: `Procedure Bar3D (X1,Y1,X2,Y2 : Integer; depth : Word; Top : Boolean);`

Description: Draws a 3-dimensional Bar with corners at $(X1,Y1)$ and $(X2,Y2)$ and fills it with the current color and fill-style. `Depth` specifies the number of pixels used to show the depth of the bar. If `Top` is true; then a 3-dimensional top is drawn.

Errors: None.

See also: [Bar \(119\)](#), [Rectangle \(130\)](#)

Circle

Declaration: `Procedure Circle (X,Y : Integer; Radius : Word);`

Description: Circle draws part of a circle with center at (X,Y), radius radius.

Errors: None.

See also: Ellipse (121), Arc (119) GetArcCoords (122), PieSlice (129), Sector (131)

ClearDevice

Declaration: `Procedure ClearDevice ;`

Description: Clears the graphical screen (with the current background color), and sets the pointer at (0,0)

Errors: None.

See also: ClearViewPort (120), SetBkColor (131)

ClearViewPort

Declaration: `Procedure ClearViewPort ;`

Description: Clears the current viewport. The current background color is used as filling color. The pointer is set at (0,0)

Errors: None.

See also: ClearDevice (120), SetViewPort (135), SetBkColor (131)

CloseGraph

Declaration: `Procedure CloseGraph ;`

Description: Closes the graphical system, and restores the screen modus which was active before the graphical modus was activated.

Errors: None.

See also: InitGraph (127)

DetectGraph

Declaration: `Procedure DetectGraph (Var Driver, Modus : Integer);`

Description: Checks the hardware in the PC and determines the driver and screen-modus to be used. These are returned in Driver and Modus, and can be fed to InitGraph. See the InitGraph for a list of drivers and modi.

Errors: None.

See also: InitGraph (127)

DrawPoly

Declaration: Procedure DrawPoly (NumberOfPoints : Word; Var PolyPoints;

Description: Draws a polygone with NumberOfPoints corner points, using the current color and line-style. PolyPoints is an array of type PointType.

Errors: None.

See also: Bar (119), seepBar3D, Rectangle (130)

Ellipse

Declaration: Procedure Ellipse (X,Y : Integer; Start,Stop,XRadius,YRadius : Word);

Description: Ellipse draws part of an ellipse with center at (X,Y). XRadius and Yradius are the horizontal and vertical radii of the ellipse. Start and Stop are the starting and stopping angles of the part of the ellipse. They are measured counterclockwise from the X-axis (3 o'clock is equal to 0 degrees). Only positive angles can be specified.

Errors: None.

See also: Arc (119) Circle (120), FillEllipse (121)

FillEllipse

Declaration: Procedure FillEllipse (X,Y : Integer; Xradius,YRadius: Word);

Description: Ellipse draws an ellipse with center at (X,Y). XRadius and Yradius are the horizontal and vertical radii of the ellipse. The ellipse is filled with the current color and fill-style.

Errors: None.

See also: Arc (119) Circle (120), GetArcCoords (122), PieSlice (129), Sector (131)

FillPoly

Declaration: Procedure FillPoly (NumberOfPoints : Word; Var PolyPoints);

Description: Draws a polygone with NumberOfPoints corner points and fills it using the current color and line-style. PolyPoints is an array of type PointType.

Errors: None.

See also: Bar (119), seepBar3D, Rectangle (130)

FloodFill

Declaration: Procedure FloodFill (X,Y : Integer; BorderColor : Word);

Description: Fills the area containing the point (X,Y), bounded by the color BorderColor.

Errors: None

See also: SetColor (132), SetBkColor (131)

GetArcCoords

Declaration: `Procedure GetArcCoords (Var ArcCoords : ArcCoordsType);`

Description: `GetArcCoords` returns the coordinates of the latest `Arc` or `Ellipse` call.

Errors: None.

See also: `Arc` ([119](#)), `Ellipse` ([121](#))

GetAspectRatio

Declaration: `Procedure GetAspectRatio (Var Xasp, Yasp : Word);`

Description: `GetAspectRatio` determines the effective resolution of the screen. The aspect ration can the be calculated as `Xasp/Yasp`.

Errors: None.

See also: `InitGraph` ([127](#)), `SetAspectRatio` ([131](#))

GetBkColor

Declaration: `Function GetBkColor : Word;`

Description: `GetBkColor` returns the current background color (the palette entry).

Errors: None.

See also: `GetColor` ([122](#)), `SetBkColor` ([131](#))

GetColor

Declaration: `Function GetColor : Word;`

Description: `GetColor` returns the current drawing color (the palette entry).

Errors: None.

See also: `GetColor` ([122](#)), `SetBkColor` ([131](#))

GetDefaultPalette

Declaration: `Procedure GetDefaultPalette (Var Palette : PaletteType);`

Description: Returns the current palette in `Palette`.

Errors: None.

See also: `GetColor` ([122](#)), `GetBkColor` ([122](#))

GetDriverName

Declaration: `Function GetDriverName : String;`

Description: `GetDriverName` returns a string containing the name of the current driver.

Errors: None.

See also: `GetModeName` ([124](#)), `InitGraph` ([127](#))

GetFillPattern

Declaration: Procedure GetFillPattern (Var FillPattern : FillPatternType);

Description: GetFillPattern returns an array with the current fill-pattern in FillPattern

Errors: None

See also: SetFillPattern ([132](#))

GetFillSettings

Declaration: Procedure GetFillSettings (Var FillInfo : FillSettingsType);

Description: GetFillSettings returns the current fill-settings in FillInfo

Errors: None.

See also: SetFillPattern ([132](#))

GetGraphMode

Declaration: Function GetGraphMode : Integer;

Description: GetGraphMode returns the current graphical modus

Errors: None.

See also: InitGraph ([127](#))

GetImage

Declaration: Procedure GetImage (X1,Y1,X2,Y2 : Integer, Var Bitmap;

Description: GetImage Places a copy of the screen area (X1,Y1) to X2,Y2 in BitMap

Errors: Bitmap must have enough room to contain the image.

See also: ImageSize ([127](#)), PutImage ([129](#))

GetLineSettings

Declaration: Procedure GetLineSettings (Var LineInfo : LineSettingsType);

Description: GetLineSettings returns the current Line settings in LineInfo

Errors: None.

See also: SetLineStyle ([133](#))

GetMaxColor

Declaration: Function GetMaxColor : Word;

Description: GetMaxColor returns the maximum color-number which can be set with SetColor. Contrary to Turbo Pascal, this color isn't always guaranteed to be white (for instance in 256+ color modes).

Errors: None.

See also: SetColor ([132](#)), GetPaletteSize ([125](#))

GetMaxMode

Declaration: `Function GetMaxMode : Word;`

Description: `GetMaxMode` returns the highest modus for the current driver.

Errors: None.

See also: `InitGraph` ([127](#))

GetMaxX

Declaration: `Function GetMaxX : Word;`

Description: `GetMaxX` returns the maximum horizontal screen length

Errors: None.

See also: `GetMaxY` ([124](#))

GetMaxY

Declaration: `Function GetMaxY : Word;`

Description: `GetMaxY` returns the maximum number of screen lines

Errors: None.

See also: `GetMaxY` ([124](#))

GetModeName

Declaration: `Function GetModeName (Var modus : Integer) : String;`

Description: Returns a string with the name of modus `Modus`

Errors: None.

See also: `GetDriverName` ([122](#)), `InitGraph` ([127](#))

GetModeRange

Declaration: `Procedure GetModeRange (Driver : Integer;
LoModus, HiModus: Integer);`

Description: `GetModeRange` returns the Lowest and Highest modus of the currently installed driver. If no modes are supported for this driver, `HiModus` will be -1.

Errors: None.

See also: `InitGraph` ([127](#))

GetPalette

Declaration: Procedure GetPalette (Var Palette : PaletteType);

Description: GetPalette returns in Palette the current palette.

Errors: None.

See also: GetPaletteSize (125), SetPalette (133)

GetPaletteSize

Declaration: Function GetPaletteSize : Word;

Description: GetPaletteSize returns the maximum number of entries in the current palette.

Errors: None.

See also: GetPalette (125), SetPalette (133)

GetPixel

Declaration: Function GetPixel (X,Y : Integer) : Word;

Description: GetPixel returns the color of the point at (X,Y)

Errors: None.

See also:

GetTextSettings

Declaration: Procedure GetTextSettings (Var TextInfo : TextSettingsType);

Description: GetTextSettings returns the current text style settings : The font, direction, size and placement as set with SetTextStyle and SetTextJustify

Errors: None.

See also: SetTextStyle (134), SetTextJustify (134)

GetViewSettings

Declaration: Procedure GetViewSettings (Var ViewPort : ViewPortType);

Description: GetViewSettings returns the current viewport and clipping settings in ViewPort.

Errors: None.

See also: SetViewPort (135)

GetX

Declaration: Function GetX : Integer;

Description: GetX returns the X-coordinate of the current position of the graphical pointer

Errors: None.

See also: GetY (126)

GetY

Declaration: `Function GetY : Integer;`

Description: `GetY` returns the Y-coordinate of the current position of the graphical pointer

Errors: None.

See also: [GetX \(125\)](#)

GraphDefaults

Declaration: `Procedure GraphDefaults ;`

Description: `GraphDefaults` resets all settings for viewport, palette, foreground and background pattern, line-style and pattern, filling style, filling color and pattern, font, text-placement and text size.

Errors: None.

See also: [SetViewPort \(135\)](#), [SetFillStyle \(132\)](#), [SetColor \(132\)](#), [SetBkColor \(131\)](#), [SetLineStyle \(133\)](#)

GraphErrorMsg

Declaration: `Function GraphErrorMsg (ErrorCode : Integer) : String;`

Description: `GraphErrorMsg` returns a string describing the error `ErrorCode`. This string can be used to let the user know what went wrong.

Errors: None.

See also: [GraphResult \(126\)](#)

GraphResult

Declaration: `Function GraphResult : Integer;`

Description: `GraphResult` returns an error-code for the last graphical operation. If the returned value is zero, all went well. A value different from zero means an error has occurred. besides all operations which draw something on the screen, the following procedures also can produce a `GraphResult` different from zero:

- [InstallUserFont \(128\)](#)
- [SetLineStyle \(133\)](#)
- [SetWriteMode \(135\)](#)
- [SetFillStyle \(132\)](#)
- [SetTextJustify \(134\)](#)
- [SetGraphMode \(133\)](#)
- [SetTextStyle \(134\)](#)

Errors: None.

See also: [GraphErrorMsg \(126\)](#)

ImageSize

Declaration: `Function ImageSize (X1,Y1,X2,Y2 : Integer) : Word;`

Description: `ImageSize` returns the number of bytes needed to store the image in the rectangle defined by (X1,Y1) and (X2,Y2).

Errors: None.

See also: `GetImage` ([123](#))

InitGraph

Declaration: `Procedure InitGraph (var GraphDriver,GraphModus : integer;
const PathToDriver : string);`

Description: `InitGraph` initializes the graph package. `GraphDriver` has two valid values: `GraphDriver=0` which performs an auto detect and initializes the highest possible mode with the most colors. 1024x768x64K is the highest possible resolution supported by the driver, if you need a higher resolution, you must edit `MODES.PPI`. If you need another mode, then set `GraphDriver` to a value different from zero and `graphmode` to the mode you wish (VESA modes where 640x480x256 is 101h etc.). `PathToDriver` is only needed, if you use the BGI fonts from Borland.

Errors: None.

See also: Introduction, (page [111](#)), `DetectGraph` ([120](#)), `CloseGraph` ([120](#)), `GraphResult` ([126](#))

Example:

```
var
  gd,gm : integer;
  PathToDriver : string;
begin
  gd:=detect; { highest possible resolution }
  gm:=0; { not needed, auto detection }
  PathToDriver:='C:\PP\BGI'; { path to BGI fonts,
                             drivers aren't needed }

  InitGraph(gd,gm,PathToDriver);
  if GraphResult<>grok then
    halt; ..... { whatever you need }
  CloseGraph; { restores the old graphics mode }
end.
```

InstallUserDriver

Declaration: `Function InstallUserDriver (DriverPath : String;
AutoDetectPtr: Pointer) : Integer;`

Description: `InstallUserDriver` adds the device-driver `DriverPath` to the list of .BGI drivers. `AutoDetectPtr` is a pointer to a possible auto-detect function.

Errors: None.

See also: `InitGraph` ([127](#)), `InstallUserFont` ([128](#))

InstallUserFont

Declaration: `Function InstallUserFont (FontPath : String) : Integer;`

Description: `InstallUserFont` adds the font in `FontPath` to the list of fonts of the .BGI system.

Errors: None.

See also: `InitGraph` ([127](#)), `InstallUserDriver` ([127](#))

Line

Declaration: `Procedure Line (X1,Y1,X2,Y2 : Integer);`

Description: `Line` draws a line starting from `(X1, Y1)` to `(X2, Y2)`, in the current line style and color. The current position is put to `(X2, Y2)`

Errors: None.

See also: `LineRel` ([128](#)), `LineTo` ([128](#))

LineRel

Declaration: `Procedure LineRel (DX,DY : Integer);`

Description: `LineRel` draws a line starting from the current pointer position to the point `(DX, DY, relative` to the current position, in the current line style and color. The Current Position is set to the endpoint of the line.

Errors: None.

See also: `Line` ([128](#)), `LineTo` ([128](#))

LineTo

Declaration: `Procedure LineTo (DX,DY : Integer);`

Description: `LineTo` draws a line starting from the current pointer position to the point `(DX, DY, relative` to the current position, in the current line style and color. The Current position is set to the end of the line.

Errors: None.

See also: `LineRel` ([128](#)), `Line` ([128](#))

MoveRel

Declaration: `Procedure MoveRel (DX,DY : Integer);`

Description: `MoveRel` moves the pointer to the point `(DX, DY)`, relative to the current pointer position

Errors: None.

See also: `MoveTo` ([129](#))

MoveTo

Declaration: `Procedure MoveTo (X,Y : Integer;`

Description: `MoveTo` moves the pointer to the point (X, Y) .

Errors: None.

See also: `MoveRel` ([128](#))

OutText

Declaration: `Procedure OutText (Const TextString : String);`

Description: `OutText` puts `TextString` on the screen, at the current pointer position, using the current font and text settings. The current position is moved to the end of the text.

Errors: None.

See also: `OutTextXY` ([129](#))

OutTextXY

Declaration: `Procedure OutTextXY (X,Y : Integer; Const TextString : String);`

Description: `OutText` puts `TextString` on the screen, at position (X, Y) , using the current font and text settings. The current position is moved to the end of the text.

Errors: None.

See also: `OutText` ([129](#))

PieSlice

Declaration: `Procedure PieSlice (X,Y : Integer;
Start,Stop,Radius : Word);`

Description: `PieSlice` draws and fills a sector of a circle with center (X, Y) and radius `Radius`, starting at angle `Start` and ending at angle `Stop`.

Errors: None.

See also: `Arc` ([119](#)), `Circle` ([120](#)), `Sector` ([131](#))

PutImage

Declaration: `Procedure PutImage (X1,Y1 : Integer; Var Bitmap; How : word) ;`

Description: `PutImage` Places the bitmap in `Bitmap` on the screen at $(X1, Y1)$. `How` determines how the bitmap will be placed on the screen. Possible values are :

- CopyPut
- XORPut
- ORPut
- AndPut
- NotPut

Errors: None

See also: [ImageSize \(127\)](#), [GetImage \(123\)](#)

PutPixel

Declaration: `Procedure PutPixel (X,Y : Integer; Color : Word);`

Description: Puts a point at (X,Y) using color Color

Errors: None.

See also: [GetPixel \(125\)](#)

Rectangle

Declaration: `Procedure Rectangle (X1,Y1,X2,Y2 : Integer);`

Description: Draws a rectangle with corners at (X1, Y1) and (X2, Y2), using the current color and style.

Errors: None.

See also: [Bar \(119\)](#), [Bar3D \(119\)](#)

RegisterBGIDriver

Declaration: `Function RegisterBGIDriver (Driver : Pointer) : Integer;`

Description: Registers a user-defined BGI driver

Errors: None.

See also: [InstallUserDriver \(127\)](#), [RegisterBGIFont \(130\)](#)

RegisterBGIFont

Declaration: `Function RegisterBGIFont (Font : Pointer) : Integer;`

Description: Registers a user-defined BGI driver

Errors: None.

See also: [InstallUserFont \(128\)](#), [RegisterBGIDriver \(130\)](#)

RestoreCRTMode

Declaration: `Procedure RestoreCRTMode ;`

Description: Restores the screen modus which was active before the graphical modus was started.

To get back to the graph mode you were last in, you can use `SetGraphMode (GetGraphMode)`

Errors: None.

See also: [InitGraph \(127\)](#)

Sector

Declaration: `Procedure Sector (X,Y : Integer;
Start,Stop,XRadius,YRadius : Word);`

Description: `Sector` draws and fills a sector of an ellipse with center (X, Y) and radii `XRadius` and `YRadius`, starting at angle `Start` and ending at angle `Stop`.

Errors: None.

See also: [Arc \(119\)](#), [Circle \(120\)](#), [PieSlice \(129\)](#)

SetActivePage

Declaration: `Procedure SetActivePage (Page : Word);`

Description: Sets `Page` as the active page for all graphical output.

Errors: None.

See also:

SetAllPalette

Declaration: `Procedure SetAllPalette (Var Palette);`

Description: Sets the current palette to `Palette`. `Palette` is an untyped variable, usually pointing to a record of type `PaletteType`

Errors: None.

See also: [GetPalette \(125\)](#)

SetAspectRatio

Declaration: `Procedure SetAspectRatio (Xasp,Yasp : Word);`

Description: Sets the aspect ratio of the current screen to `Xasp/Yasp`.

Errors: None

See also: [InitGraph \(127\)](#), [GetAspectRatio \(122\)](#)

SetBkColor

Declaration: `Procedure SetBkColor (Color : Word);`

Description: Sets the background color to `Color`.

Errors: None.

See also: [GetBkColor \(122\)](#), [SetColor \(132\)](#)

SetColor

Declaration: `Procedure SetColor (Color : Word);`

Description: Sets the foreground color to `Color`.

Errors: None.

See also: [GetColor \(122\)](#), [SetBkColor \(131\)](#)

SetFillPattern

Declaration: `Procedure SetFillPattern (FillPattern : FillPatternType,
Color : Word);`

Description: `SetFillPattern` sets the current fill-pattern to `FillPattern`, and the filling color to `Color`.
The pattern is an 8x8 raster, corresponding to the 64 bits in `FillPattern`.

Errors: None

See also: [GetFillPattern \(123\)](#), [SetFillStyle \(132\)](#)

SetFillStyle

Declaration: `Procedure SetFillStyle (Pattern,Color : word);`

Description: `SetFillStyle` sets the filling pattern and color to one of the predefined filling patterns. `Pattern` can be one of the following predefined constants :

- `EmptyFill` Uses backgroundcolor.
- `SolidFill` Uses filling color
- `LineFill` Fills with horizontal lines.
- `ltSlashFill` Fills with lines from left-under to top-right.
- `SlashFill` Idem as previous, thick lines.
- `BkSlashFill` Fills with thick lines from left-Top to bottom-right.
- `LtBkSlashFill` Idem as previous, normal lines.
- `HatchFill` Fills with a hatch-like pattern.
- `XHatchFill` Fills with a hatch pattern, rotated 45 degrees.
- `InterLeaveFill`
- `WideDotFill` Fills with dots, wide spacing.
- `CloseDotFill` Fills with dots, narrow spacing.
- `UserFill` Fills with a user-defined pattern.

Errors: None.

See also: [SetFillPattern \(132\)](#)

SetGraphBufSize

Declaration: `Procedure SetGraphBufSize (BufSize : Word);`

Description: `SetGraphBufSize` is a dummy function which does not do anything; it is no longer needed.

Errors: None.

See also:

SetGraphMode

Declaration: `Procedure SetGraphMode (Mode : Integer);`

Description: `SetGraphMode` sets the graphical mode and clears the screen.

Errors: None.

See also: `InitGraph` ([127](#))

SetLineStyle

Declaration: `Procedure SetLineStyle (LineStyle,Pattern,Width : Word);`

Description: `SetLineStyle` sets the drawing style for lines. You can specify a `LineStyle` which is one of the following pre-defined constants:

- `SolidLn=0`; draws a solid line.
- `DottedLn=1`; Draws a dotted line.
- `CenterLn=2`; draws a non-broken centered line.
- `DashedLn=3`; draws a dashed line.
- `UserBitLn=4`; Draws a User-defined bit pattern.

If `UserBitLn` is specified then `Pattern` contains the bit pattern. In all another cases, `Pattern` is ignored. The parameter `Width` indicates how thick the line should be. You can specify one of the following pre-defined constants:

- `NormWidth=1`
- `ThickWidth=3`

Errors: None.

See also: `GetLineSettings` ([123](#))

SetPalette

Declaration: `Procedure SetPalette (ColorNr : Word; NewColor : ShortInt);`

Description: `SetPalette` changes the `ColorNr`-th entry in the palette to `NewColor`

Errors: None.

See also: `SetAllPalette` ([131](#)), `SetRGBPalette` ([133](#))

SetRGBPalette

Declaration: `Procedure SetRGBPalette (ColorNr,Red,Green,Blue : Integer);`

Description: `SetRGBPalette` sets the `ColorNr`-th entry in the palette to the color with RGB-values `Red`, `Green` `Blue`.

Errors: None.

See also: `SetAllPalette` ([131](#)), `SetPalette` ([133](#))

SetTextJustify

Declaration: Procedure SetTextJustify (Horizontal,Vertical : Word);

Description: SetTextJustify controls the placement of new text, relative to the (graphical) cursor position. Horizontal controls horizontal placement, and can be one of the following pre-defined constants:

- LeftText=0; Text is set left of the pointer.
- CenterText=1; Text is set centered horizontally on the pointer.
- RightText=2; Text is set to the right of the pointer.

Vertical controls the vertical placement of the text, relative to the (graphical) cursor position. Its value can be one of the following pre-defined constants :

- BottomText=0; Text is placed under the pointer.
- CenterText=1; Text is placed centered vertically on the pointer.
- TopText=2; Text is placed above the pointer.

Errors: None.

See also: OutText ([129](#)), OutTextXY ([129](#))

SetTextStyle

Declaration: Procedure SetTextStyle (Font,Direction,Magnitude : Word);

Description: SetTextStyle controls the style of text to be put on the screen. pre-defined constants for Font are:

```
DefaultFont    = 0;
TriplexFont    = 1;
SmallFont      = 2;
SansSerifFont = 3;
GothicFont     = 4;
ScriptFont     = 5;
SimpleFont     = 6;
TSCRFont       = 7;
LCOMFont       = 8;
EuroFont       = 9;
BoldFont       = 10;
```

Pre-defined constants for Direction are :

- HorizDir=0;
- VertDir=1;

Errors: None.

See also: GetTextSettings ([125](#))

SetUserCharSize

Declaration: `Procedure SetUserCharSize (Xasp1, Xasp2, Yasp1, Yasp2 : Word);`

Description: Sets the width and height of vector-fonts. The horizontal size is given by $Xasp1/Xasp2$, and the vertical size by $Yasp1/Yasp2$.

Errors: None.

See also: [SetTextStyle \(134\)](#)

SetViewPort

Declaration: `Procedure SetViewPort (X1, Y1, X2, Y2 : Integer; Clip : Boolean);`

Description: Sets the current graphical viewport (window) to the rectangle defined by the top-left corner $(X1, Y1)$ and the bottom-right corner $(X2, Y2)$. If `Clip` is true, anything drawn outside the viewport (window) will be clipped (i.e. not drawn). Coordinates specified after this call are relative to the top-left corner of the viewport.

Errors: None.

See also: [GetViewSettings \(125\)](#)

SetVisualPage

Declaration: `Procedure SetVisualPage (Page : Word);`

Description: `SetVisualPage` sets the video page to page number `Page`.

Errors: None

See also: [SetActivePage \(131\)](#)

SetWriteMode

Declaration: `Procedure SetWriteMode (Mode : Integer);`

Description: `SetWriteMode` controls the drawing of lines on the screen. It controls the binary operation used when drawing lines on the screen. `Mode` can be one of the following pre-defined constants:

- `CopyPut=0;`
- `XORPut=1;`

Errors: None.

See also:

TextHeight

Declaration: `Function TextHeight (S : String) : Word;`

Description: `TextHeight` returns the height (in pixels) of the string `S` in the current font and text-size.

Errors: None.

See also: [TextWidth \(136\)](#)

TextWidth

Declaration: `Function TextWidth (S : String) : Word;`

Description: `TextWidth` returns the width (in pixels) of the string `S` in the current font and text-size.

Errors: None.

See also: `TextHeight` ([135](#))

8.5 Target specific issues

In what follows we describe some things that are different on the various platforms:

DOS

WINDOWS

LINUX

Chapter 9

The HEAPTRC unit.

This chapter describes the HEAPTRC unit for Free Pascal. It was written by Pierre Muller. It is system independent, and works on all supported systems.

9.1 Purpose

The HEAPTRC unit can be used to debug your memory allocation/deallocation. It keeps track of the calls to `getmem/freemem`, and, implicitly, of `New/Dispose` statements.

When the program exits, or when you request it explicitly. It displays the total memory used, and then dumps a list of blocks that were allocated but not freed. It also displays where the memory was allocated.

If there are any inconsistencies, such as memory blocks being allocated or freed twice, or a memory block that is released but with wrong size, this will be displayed also.

The information that is stored/displayed can be customized using some constants.

9.2 Usage

All that you need to do is to include `heaptrc` in the `uses` clause of your program. Make sure that it is the first unit in the clause, otherwise memory allocated in initialization code of units that precede the `heaptrc` unit will not be accounted for, causing an incorrect memory usage report.

If you use the `-gh` switch, the compiler will insert the unit by itself, so you don't have to include it in your `uses` clause.

The following example shows how to use the `heaptrc` unit.

Listing: `heapex/heapex.pp`

```
Program heapex;
```

```
{ Program used to demonstrate the usage of heaptrc unit }
```

```
Uses heaptrc;
```

```
Var P1 : ^Longint;  
      P2 : Pointer;  
      I : longint;
```

```

begin
  New(P1);
  // causes previous allocation not to be de-allocated
  New(P1);
  Dispose(P1);
  For l:=1 to 10 do
    begin
      GetMem (P2,128);
      // When l is even, deallocate block. We loose 5 times 128
      // bytes this way.
      If (l mod 2) = 0 Then FreeMem(P2,128);
    end;
  GetMem(P2,128);
  // This will provoke an error and a memory dump
  Freemem (P2,64);
end.

```

This is the memory dump shown when running this program:

```

Marked memory at 0040FA50 invalid
Wrong size : 128 allocated 64 freed
  0x00408708
  0x0040CB49
  0x0040C481
Call trace for block 0x0040FA50 size 128
  0x0040CB3D
  0x0040C481

```

If you use the `lineinfo` unit (or use the `-gl` switch) as well, then `heaptrc` will also give you the filenames and line-numbers of the procedures in the backtrace:

```

Marked memory at 00410DA0 invalid
Wrong size : 128 allocated 64 freed
  0x004094B8
  0x0040D8F9  main,  line 25 of heapex.pp
  0x0040D231
Call trace for block 0x00410DA0 size 128
  0x0040D8ED  main,  line 23 of heapex.pp
  0x0040D231

```

If lines without filename/line-number occur, this means there is a unit which has no debug info included.

9.3 Constants, Types and variables

The `FillExtraInfoType` is a procedural type used in the `SetExtraInfo` (140) call.

```

type
  FillExtraInfoType = procedure(p : pointer);

```

The following typed constants allow to fine-tune the standard dump of the memory usage by `DumpHeap` (139):

```

const
  tracesize = 8;
  quicktrace : boolean = true;
  HaltOnError : boolean = true;
  keepreleased : boolean = false;
  add_tail : boolean = true;
  usecrc : boolean = true

```

Tracesize specifies how many levels of calls are displayed of the call stack during the memory dump. If you specify `keepreleased:=True` then half the `TraceSize` is reserved for the `GetMem` call stack, and the other half is reserved for the `FreeMem` call stack. For example, the default value of 8 will cause eight levels of call frames to be dumped for the `getmem` call if `keepreleased` is `False`. If `KeepReleased` is `true`, then 4 levels of call frames will be dumped for the `GetMem` call and 4 frames will be dumped for the `FreeMem` call. If you want to change this value, you must recode the `heaptrc` unit.

`Quicktrace` determines whether the memory manager checks whether a block that is about to be released is allocated correctly. This is a rather time consuming search, and slows program execution significantly, so by default it is set to `False`.

If `HaltOnError` is set to `True` then an illegal call to `FreeMem` will cause the memory manager to execute a `halt(1)` instruction, causing a memory dump. By Default it is set to `True`.

If `keepreleased` is set to `true`, then a list of freed memory blocks is kept. This is useful if you suspect that the same memory block is released twice. However, this option is very memory intensive, so use it sparingly, and only when it's really necessary.

If `add_tail` is `True` (the default) then a check is also performed on the memory location just behind the allocated memory.

If `usecrc` is `True` (the default) then a `crc` check is performed on locations before and after the allocated memory. This is useful to detect memory overwrites.

9.4 Functions and procedures

DumpHeap

Declaration: `procedure DumpHeap;`

Description: `DumpHeap` dumps to standard output a summary of memory usage. It is called automatically by the `heaptrc` unit when your program exits (by installing an exit procedure), but it can be called at any time

Errors: None.

See also: [MarkHeap \(139\)](#)

MarkHeap

Declaration: `procedure MarkHeap;`

Description: `MarkHeap` marks all memory blocks with a special signature. You can use this if you think that you corrupted the memory.

Errors: None.

See also: [DumpHeap \(139\)](#)

SetExtraInfo

Declaration: `procedure SetExtraInfo(size : longint;func : FillExtraInfoType);`

Description: You can use `SetExtraInfo` to store extra info in the blocks that the `heaptrc` unit reserves when tracing `getmem` calls. `Size` indicates the size (in bytes) that the trace mechanism should reserve for your extra information. For each call to `getmem`, `func` will be called, and passed a pointer to the memory reserved.

When dumping the memory summary, the extra info is shown as `Longint` values.

Errors: You can only call `SetExtraInfo` if no memroy has been allocated yet. If memory was already allocated prior to the call to `SetExtraInfo`, then an error will be displayed on standard error output, and a `DumpHeap` (139) is executed.

See also: `DumpHeap` (139),`SetHeapTraceOutput` (141)

Listing: `heapex/setinfo.pp`

Program `heapex;`

{ Program used to demonstrate the usage of heaptrc unit }

Uses `heaptrc;`

Var `P1 : ^Longint;`
`P2 : Pointer;`
`I : longint;`
`Marker : Longint;`

Procedure `SetMarker (P : pointer);`

Type `PLongint = ^Longint;`

begin
`PLongint(P)^:=Marker;`
end;

Procedure `Part1;`

begin
// Blocks allocated here are marked with \$FFAAFFAA = -5570646
`Marker := $FFAAFFAA;`
`New(P1);`
`New(P1);`
`Dispose(P1);`
`For I:=1 to 10 do`
`begin`
`GetMem (P2,128);`
`If (I mod 2) = 0 Then FreeMem(P2,128);`
`end;`
`GetMem(P2,128);`
end;

Procedure `Part2;`

begin
// Blocks allocated here are marked with \$FAFAFAFA = -84215046
`Marker := $FAFAFAFA;`
`New(P1);`

```
New(P1);  
Dispose(P1);  
For I:=1 to 10 do  
  begin  
    GetMem (P2,128);  
    If (I mod 2) = 0 Then FreeMem(P2,128);  
    end;  
  GetMem(P2,128);  
end;  
  
begin  
  SetExtraInfo(SizeOf(Marker), @SetMarker);  
  Writeln ( 'Part 1 ' );  
  part1;  
  Writeln ( 'Part 2 ' );  
  part2;  
end.
```

SetHeapTraceOutput

Declaration: Procedure SetHeapTraceOutput(const name : string);

Description: SetHeapTraceOutput sets the filename into which heap trace info will be written. By default information is written to standard output, this function allows you to redirect the information to a file with full filename name.

Errors: If the file cannot be written to, errors will occur when writing the trace.

See also: SetExtraInfo ([140](#))

Chapter 10

The IPC unit.

This chapter describes the IPC unit for Free Pascal. It was written for LINUX by Michaël Van Canneyt. It gives all the functionality of system V Inter-Process Communication: shared memory, semaphores and messages. It works only on the LINUX operating system.

The chapter is divided in 2 sections:

- The first section lists types, constants and variables from the interface part of the unit.
- The second section describes the functions defined in the unit.

10.1 Types, Constants and variables :

Variables

```
Var
  IPCError : longint;
```

The `IPCError` variable is used to report errors, by all calls.

Constants

Many constants here are provided for completeness only, and should under normal circumstances not be used by the programmer.

```
Const
  IPC_CREAT = 1 shl 9; { create if key is nonexistent }
  IPC_EXCL  = 2 shl 9; { fail if key exists }
  IPC_NOWAIT = 4 shl 9; { return error on wait }
```

These constants are used in the various `xxxget` calls.

```
IPC_RMID = 0;    { remove resource }
IPC_SET  = 1;    { set ipc_perm options }
IPC_STAT = 2;    { get ipc_perm options }
IPC_INFO = 3;    { see ipcs }
```

These constants can be passed to the various `xxxctl` calls.

```

const
MSG_NOERROR = 1 shl 12;
MSG_EXCEPT = 2 shl 12;
MSGMNI = 128;
MSGMAX = 4056;
MSGMNB = 16384;

```

These constants are used in the messaging system, they are not for use by the programmer.

```

const
SEM_UNDO = $1000;
GETPID = 11;
GETVAL = 12;
GETALL = 13;
GETNCNT = 14;
GETZCNT = 15;
SETVAL = 16;
SETALL = 17;

```

These constants call be specified in the `semop` (151) call.

```

SEMMNI = 128;
SEMMSL = 32;
SEMMNS = (SEMMNI * SEMMSL);
SEMOPM = 32;
SEMVMX = 32767;

```

These constanst are used internally by the semaphore system, they should not be used by the programmer.

```

const
SHM_R      = 4 shl 6;
SHM_W      = 2 shl 6;
SHM_RDONLY = 1 shl 12;
SHM_RND     = 2 shl 12;
SHM_REMAP  = 4 shl 12;
SHM_LOCK   = 11;
SHM_UNLOCK = 12;

```

These constants are used in the `shmctl` (157) call.

Types

The following two types are provided because they are needed. One they they should be defined in the system unit, however.

```

Type
PULong = ^Cardinal;
PWord  = ^Word;

```

```

Type
TKey   = Longint;

```

TKey is the type returned by the `ftok` (147) key generating function.

```

type
  PIPC_Perm = ^TIPC_Perm;
  TIPC_Perm = record
    key : TKey;
    uid,
    gid,
    cuid,
    cgid,
    mode,
    seq : Word;
  end;

```

The TIPC_Perm structure is used in all IPC systems to specify the permissions.

```

Type
  PSHMid_DS = ^TSHMid_ds;
  TSHMid_ds = record
    shm_perm : TIPC_Perm;
    shm_segsz : longint;
    shm_atime : longint;
    shm_dtime : longint;
    shm_ctime : longint;
    shm_cpid : word;
    shm_lpid : word;
    shm_nattch : integer;
    shm_npages : word;
    shm_pages : Pointer;
    attaches : pointer;
  end;

```

The TSHMid_ds structure is used in the `shmctl` (157) call to set or retrieve settings concerning shared memory.

```

type
  PSHMinfo = ^TSHMinfo;
  TSHMinfo = record
    shmmax : longint;
    shmmmin : longint;
    shmmni : longint;
    shmseg : longint;
    shmall : longint;
  end;

```

The TSHMinfo record is used by the shared memory system, and should not be accessed by the programmer directly.

```

type
  PMSG = ^TMSG;
  TMSG = record
    msg_next : PMSG;
    msg_type : Longint;
    msg_spot : PChar;
    msg_stime : Longint;
    msg_ts : Integer;
  end;

```

The TMSG record is used in the handling of message queues. There should be few cases where the programmer needs to access this data.

```

type
  PMSQid_ds = ^TMSQid_ds;
  TMSQid_ds = record
    msg_perm    : TIPC_perm;
    msg_first   : PMsg;
    msg_last    : PMsg;
    msg_stime   : Longint;
    msg_rtime   : Longint;
    msg_ctime   : Longint;
    wwait      : Pointer;
    rwait      : pointer;
    msg_cbytes  : word;
    msg_qnum    : word;
    msg_qbytes  : word;
    msg_lspid   : word;
    msg_lrpid   : word;
  end;

```

The TMSQid_ds record is returned by the `msgctl` (148) call, and contains all data about a message queue.

```

PMSGbuf = ^TMSGbuf;
TMSGbuf = record
  mtype : longint;
  mtext : array[0..0] of char;
end;

```

The TMSGbuf record is a record containing the data of a record. you should never use this record directly, instead you should make your own record that follows the structure of the TMSGbuf record, but that has a size that is big enough to accomodate your messages. The `mtype` field should always be present, and should always be filled.

```

Type
  PMSGinfo = ^TMSGinfo;
  TMSGinfo = record
    msgpool : Longint;
    msgmap  : Longint;
    msgmax  : Longint;
    msgmnb  : Longint;
    msgmni  : Longint;
    msgssz  : Longint;
    msgtql  : Longint;
    msgseg  : Word;
  end;

```

The TMSGinfo record is used internally by the message queue system, and should not be used by the programmer directly.

```

Type
  PSEMid_ds = ^PSEMid_ds;
  TSEMid_ds = record

```

```

sem_perm : tipc_perm;
sem_otime : longint;
sem_ctime : longint;
sem_base      : pointer;
sem_pending   : pointer;
sem_pending_last : pointer;
undo          : pointer;
sem_nsems    : word;
end;

```

The `TSEMids` structure is returned by the `semctl` (152) call, and contains all data concerning a semaphore.

Type

```

PSEMbuf = ^TSEMbuf;
TSEMbuf = record
    sem_num : word;
    sem_op  : integer;
    sem_flg : integer;
end;

```

The `TSEMbuf` record is used in the `semop` (151) call, and is used to specify which operations you want to do.

Type

```

PSEMinfo = ^TSEMinfo;
TSEMinfo = record
    semmap : longint;
    semmni : longint;
    semmns : longint;
    semmnu : longint;
    semmsl : longint;
    semopm : longint;
    semume : longint;
    semusz : longint;
    semvmx : longint;
    semaem : longint;
end;

```

The `TSEMinfo` record is used internally by the semaphore system, and should not be used directly.

Type

```

PSEMun = ^TSEMun;
TSEMun = record
    case longint of
        0 : ( val : longint );
        1 : ( buf : PSEMids );
        2 : ( arr : PWord );
        3 : ( padbuf : PSEMinfo );
        4 : ( padpad : pointer );
    end;
end;

```

The `TSEMun` variant record (actually a C union) is used in the `semctl` (152) call.

10.2 Functions and procedures

ftok

Declaration: `Function ftok (Path : String; ID : char) : TKey;`

Description: `ftok` returns a key that can be used in a `semget` (151), `shmget` (156) or `msgget` (147) call to access a new or existing IPC resource.

`Path` is the name of a file in the file system, `ID` is a character of your choice. The `ftok` call does the same as it's C counterpart, so a pascal program and a C program will access the same resource if they use the same `Path` and `ID`

Errors: `ftok` returns -1 if the file in `Path` doesn't exist.

See also: `semget` (151), `shmget` (156), `msgget` (147)

For an example, see `msgctl` (148), `semctl` (152), `shmctl` (157).

msgget

Declaration: `Function msgget(key: TKey; msgflg:longint):longint;`

Description: `msgget` returns the ID of the message queue described by `key`. Depending on the flags in `msgflg`, a new queue is created.

`msgflg` can have one or more of the following values (combined by ORs):

IPC_CREATThe queue is created if it doesn't already exist.

IPC_EXCLIf used in combination with `IPC_CREAT`, causes the call to fail if the queue already exists. It cannot be used by itself.

Optionally, the flags can be ORed with a permission mode, which is the same mode that can be used in the file system.

Errors: On error, -1 is returned, and `IPCError` is set.

See also: `ftok` (147), `msgsnd` (147), `msgrcv` (148), `msgctl` (148), `semget` (2)

For an example, see `msgctl` (148).

msgsnd

Declaration: `Function msgsnd(msqid:longint; msgp: PMSGBuf; msgsz: longint; msgflg:longint): Boolean;`

Description: `msgsnd` sends a message to a message queue with ID `msqid`. `msgp` is a pointer to a message buffer, that should be based on the `TMSGBuf` type. `msgsz` is the size of the message (NOT of the message buffer record !)

The `msgflg` can have a combination of the following values (ORed together):

0No special meaning. The message will be written to the queue. If the queue is full, then the process is blocked.

IPC_NOWAITIf the queue is full, then no message is written, and the call returns immediatly.

The function returns `True` if the message was sent successfully, `False` otherwise.

Errors: In case of error, the call returns `False`, and `IPCError` is set.

See also: `msgget` (147), `msgrcv` (148), `seefmsgctl`

For an example, see `msgctl` (148).

msgrcv

Declaration: `Function msgrcv(msgid:longint; msgp: PMSGBuf; msgsz: longint; msgtyp:longint; msgflg:longint): Boolean;`

Description: `msgrcv` retrieves a message of type `msgtyp` from the message queue with ID `msgid`. `msgtyp` corresponds to the `mtype` field of the `TMSGbuf` record. The message is stored in the `MSGbuf` structure pointed to by `msgp`.

The `msgflg` parameter can be used to control the behaviour of the `msgrcv` call. It consists of an ORed combination of the following flags:

0No special meaning.

IPC_NOWAITif no messages are available, then the call returns immediately, with the `ENOMSG` error.

MSG_NOERRORif the message size is wrong (too large), no error is generated, instead the message is truncated. Normally, in such cases, the call returns an error (`E2BIG`)

The function returns `True` if the message was received correctly, `False` otherwise.

Errors: In case of error, `False` is returned, and `IPCError` is set.

See also: `msgget` (147), `msgsnd` (147), `msgctl` (148)

For an example, see `msgctl` (148).

msgctl

Declaration: `Function msgctl(msgid:longint; cmd: longint; buf: PMSQid_ds): Boolean;`

Description: `msgctl` performs various operations on the message queue with id `ID`. Which operation is performed, depends on the `cmd` parameter, which can have one of the following values:

IPC_STATIn this case, the `msgctl` call fills the `TMSQid_ds` structure with information about the message queue.

IPC_SETIn this case, the `msgctl` call sets the permissions of the queue as specified in the `ipc_perm` record inside `buf`.

IPC_RMIDIf this is specified, the message queue will be removed from the system.

`buf` contains the data that are needed by the call. It can be `Nil` in case the message queue should be removed.

The function returns `True` if successful, `False` otherwise.

Errors: On error, `False` is returned, and `IPCError` is set accordingly.

See also: `msgget` (147), `msgsnd` (147), `msgrcv` (148)

Listing: `ipcex/msgtool.pp`

```

program msgtool;

Uses ipc;

Type
  PMyMsgBuf = ^TMyMsgBuf;
  TMyMsgBuf = record
    mtype : Longint;
    mtext : string[255];
  end;

Procedure DoError (Const Msg : string);

begin
  WriteLn (msg, 'returned an error : ', ipccerror);
  halt (1);
end;

Procedure SendMessage (Id : Longint;
  Var Buf : TMyMsgBuf;
  MType : Longint;
  Const MText : String);

begin
  WriteLn ( 'Sending message. ');
  Buf.mtype:=mtype;
  Buf.Mtext:=mtext;
  If not msgsnd (Id, PMsgBuf (@Buf), 256, 0) then
    DoError ('msgsnd ');
end;

Procedure ReadMessage (ID : Longint;
  Var Buf : TMyMsgBuf;
  MType : longint);

begin
  WriteLn ( 'Reading message. ');
  Buf.MType:=MType;
  If msgrcv (ID, PMSGBuf (@Buf), 256, mtype, 0) then
    WriteLn ( 'Type : ', buf.mtype, ' Text : ', buf.mtext)
  else
    DoError ( 'msgrcv ');
end;

Procedure RemoveQueue ( ID : Longint);

begin
  If msgctl (id, IPC_RMID, Nil) then
    WriteLn ( 'Removed Queue with id ', Id);
end;

Procedure ChangeQueueMode (ID, mode : longint);

Var QueueDS : TMSQid_ds;

begin
  If Not msgctl (Id, IPC_STAT, @QueueDS) then
    DoError ( 'msgctl : stat ');

```

```

WriteIn ( 'Old permissions : ',QueueDS.msg_perm.mode);
QueueDS.msg_perm.mode:=Mode;
if msgctl (ID,IPC_SET,@QueueDS) then
  WriteIn ( 'New permissions : ',QueueDS.msg_perm.mode)
else
  DoError ( 'msgctl : IPC_SET');
end;

procedure usage;

begin
  WriteIn ( 'Usage : msgtool s(end) <type> <text> (max 255 characters)');
  WriteIn ( '          r(eceive) <type>');
  WriteIn ( '          d(etele)');
  WriteIn ( '          m(ode) <decimal mode>');
  halt(1);
end;

Function StrToInt (S : String): longint;

Var M : longint;
    C : Integer;

begin
  val (S,M,C);
  If C<>0 Then DoError ( 'StrToInt : '+S);
  StrToInt:=M;
end;

Var
  Key : TKey;
  ID : longint;
  Buf : TMyMsgBuf;

begin
  If Paramcount<1 then Usage;
  key :=Ftok( '.', 'M');
  ID:=msgget(key,IPC_CREAT or 438);
  If ID<0 then DoError ( 'MsgGet');
  Case upCase(Paramstr(1)[1]) of
    'S' : If ParamCount<>3 then
      Usage
    else
      SendMessage (id,Buf, StrToInt(Paramstr(2)), paramstr(3));
    'R' : If ParamCount<>2 then
      Usage
    else
      ReadMessage (id,buf, strtoint(Paramstr(2)));
    'D' : If ParamCount<>1 then
      Usage
    else
      RemoveQueue (ID);
    'M' : If ParamCount<>2 then
      Usage
    else
      ChangeQueueMode (id, strtoint(paramstr(2)));
  else
    Usage

```

```

    end;
end.

```

semget

Declaration: `Function semget(key:Tkey; nsems:longint; semflg:longint): longint;`

Description: `msgget` returns the ID of the semaphore set described by `key`. Depending on the flags in `semflg`, a new queue is created.

`semflg` can have one or more of the following values (combined by ORs):

IPC_CREATThe queue is created if it doesn't already exist.

IPC_EXCLIf used in combination with `IPC_CREAT`, causes the call to fail if the set already exists. It cannot be used by itself.

Optionally, the flags can be ORed with a permission mode, which is the same mode that can be used in the file system.

if a new set of semaphores is created, then there will be `nsems` semaphores in it.

Errors: On error, -1 is returned, and `IPCError` is set.

See also: `ftok` (147), `semop` (151), `semctl` (152)

semop

Declaration: `Function semop(semid:longint; sops: pointer; nsops: cardinal): Boolean;`

Description: `semop` performs a set of operations on a message queue. `sops` points to an array of type `TSEMbuf`. The array should contain `nsops` elements.

The fields of the `TSEMbuf` structure

```

TSEMbuf = record
    sem_num : word;
    sem_op  : integer;
    sem_flg : integer;

```

should be filled as follows:

sem_numThe number of the semaphore in the set on which the operation must be performed.

sem_opThe operation to be performed. The operation depends on the sign of `sem_op`

1. A positive number is simply added to the current value of the semaphore.
2. If 0 (zero) is specified, then the process is suspended until the specified semaphore reaches zero.
3. If a negative number is specified, it is subtracted from the current value of the semaphore. If the value would become negative then the process is suspended until the value becomes big enough, unless `IPC_NOWAIT` is specified in the `sem_flg`.

sem_flgOptional flags: if `IPC_NOWAIT` is specified, then the calling process will never be suspended.

The function returns `True` if the operations were successful, `False` otherwise.

Errors: In case of error, `False` is returned, and `IPCError` is set.

See also: `semget` (151), `semctl` (152)

semctl

Declaration: `Function semctl(semid:longint; semnum:longint; cmd:longint; var arg:tsemun): longint;`

Description: `semctl` performs various operations on the semaphore `semnum` with semaphore set id `ID`.

The `arg` parameter supplies the data needed for each call. This is a variant record that should be filled differently, according to the command:

```
Type
  TSEMun = record
    case longint of
      0 : ( val : longint );
      1 : ( buf : PSEMids );
      2 : ( arr : PWord );
      3 : ( padbuf : PSEminfo );
      4 : ( padpad : pointer );
    end;
```

Which operation is performed, depends on the `cmd` parameter, which can have one of the following values:

IPC_STATIn this case, the `arg` record should have its `buf` field set to the address of a `TSEMids` record. The `semctl` call fills this `TSEMids` structure with information about the semaphore set.

IPC_SETIn this case, the `arg` record should have its `buf` field set to the address of a `TSEMids` record. The `semctl` call sets the permissions of the queue as specified in the `ipc_perm` record.

IPC_RMIDIf this is specified, the semaphore set is removed from the system.

GETALLIn this case, the `arr` field of `arg` should point to a memory area where the values of the semaphores will be stored. The size of this memory area is `SizeOf(Word) * Number of semaphores in the set`. This call will then fill the memory array with all the values of the semaphores.

GETCNTThis will fill the `val` field of the `arg` union with the number of processes waiting for resources.

GETPID`semctl` returns the process ID of the process that performed the last `semop` (151) call.

GETVAL`semctl` returns the value of the semaphore with number `semnum`.

GETZCNT`semctl` returns the number of processes waiting for semaphores that reach value zero.

SETALLIn this case, the `arr` field of `arg` should point to a memory area where the values of the semaphores will be retrieved from. The size of this memory area is `SizeOf(Word) * Number of semaphores in the set`. This call will then set the values of the semaphores from the memory array.

SETVALThis will set the value of semaphore `semnum` to the value in the `val` field of the `arg` parameter.

The function returns -1 on error.

Errors: The function returns -1 on error, and `IPCError` is set accordingly.

See also: `semget` (151), `semop` (151)

Listing: `ipcx/semtool.pp`

```

Program semtool;

{ Program to demonstrat the use of semaphores }

Uses ipc;

Const MaxSemValue = 5;

Procedure DoError (Const Msg : String);

begin
  WriteLn ( 'Error : ',msg, ' Code : ',IPCError);
  Halt(1);
end;

Function getsemval (ID,Member : longint) : longint;

Var S : TSEMun;

begin
  GetSemVal:= SemCtl(id ,member,GETVAL,S);
end;

Procedure DispVal (ID,member : longint);

begin
  writeln ( 'Value for member ',member, ' is ',GetSemVal(ID,Member));
end;

Function GetMemberCount (ID : Longint) : longint;

Var opts : TSEMun;
    semds : TSEMids;

begin
  opts.buf:=@semds;
  If semctl(Id,0,IPC_STAT,opts)<>-1 then
    GetMemberCount:=semds.sem_nsems
  else
    GetMemberCount:=-1;
end;

Function OpenSem (Key : TKey) : Longint;

begin
  OpenSem:=semget(Key,0,438);
  If OpenSem=-1 then
    DoError ( 'OpenSem' );
end;

Function CreateSem (Key : TKey; Members : Longint) : Longint;

Var Count : Longint;
    Semopts : TSemun;

begin
  If members>semmsl then
    DoError ( 'Sorry , maximum number of semaphores in set exceeded' );

```

```

WriteIn ('Trying to create a new semaphore set with ',members,' members. ');
CreateSem:=semget(key,members,IPC_CREAT or IPC_Excl or 438);
If CreateSem=-1 then
  DoError ('Semaphore set already exists. ');
Semopts.val:=MaxSemValue; { Initial value of semaphores }
For Count:=0 to Members-1 do
  semctl(CreateSem,count,setval,semopts);
end;

```

```

Procedure lockSem (ID,Member: Longint);

```

```

Var lock : TSEMbuf;

```

```

begin
  With lock do
    begin
      sem_num:=0;
      sem_op:=-1;
      sem_flg:=IPC_NOWAIT;
    end;
    if (member<0) or (member>GetMemberCount(ID)-1) then
      DoError ('semaphore member out of range ');
    if getsemval(ID,member)=0 then
      DoError ('Semaphore resources exhausted (no lock) ');
    lock.sem_num:=member;
    WriteIn ('Attempting to lock member ',member,' of semaphore ',ID);
    if not semop(Id,@lock,1) then
      DoError ('Lock failed ')
    else
      WriteIn ('Semaphore resources decremented by one ');
      dispval(ID,Member);
    end;

```

```

Procedure UnlockSem (ID,Member: Longint);

```

```

Var Unlock : TSEMbuf;

```

```

begin
  With Unlock do
    begin
      sem_num:=0;
      sem_op:=1;
      sem_flg:=IPC_NOWAIT;
    end;
    if (member<0) or (member>GetMemberCount(ID)-1) then
      DoError ('semaphore member out of range ');
    if getsemval(ID,member)=MaxSemValue then
      DoError ('Semaphore not locked ');
    Unlock.sem_num:=member;
    WriteIn ('Attempting to unlock member ',member,' of semaphore ',ID);
    if not semop(Id,@unlock,1) then
      DoError ('Unlock failed ')
    else
      WriteIn ('Semaphore resources incremented by one ');
      dispval(ID,Member);
    end;

```

```

Procedure RemoveSem (ID : longint);

```

```

var S : TSemun;

begin
  If semctl(Id,0,IPC_RMID,s)<>-1 then
    WriteLn ( 'Semaphore removed')
  else
    DoError ( 'Couldn''t remove semaphore');
end;

Procedure ChangeMode (ID,Mode : longint);

Var rc : longint;
    opts : TSEMun;
    semds : TSEMids;

begin
  opts.buf:=@semds;
  If not semctl (Id,0,IPC_STAT,opts)<>-1 then
    DoError ( 'Couldn''t stat semaphore');
  WriteLn ( 'Old permissions were : ',semds.sem_perm.mode);
  semds.sem_perm.mode:=mode;
  If semctl(id,0,IPC_SET,opts)<>-1 then
    WriteLn ( 'Set permissions to ',mode)
  else
    DoError ( 'Couldn''t set permissions');
end;

Procedure PrintSem (ID : longint);

Var l,cnt : longint;

begin
  cnt:=getmembercount(ID);
  WriteLn ( 'Semaphore ',ID,' has ',cnt,' Members');
  For l:=0 to cnt-1 Do
    DispVal(id,l);
end;

Procedure USage;

begin
  WriteLn ( 'Usage : semtool c(reate) <count>');
  WriteLn ( '          l(ock) <member>');
  WriteLn ( '          u(nlock) <member>');
  WriteLn ( '          d(etele)');
  WriteLn ( '          m(ode) <mode>');
  halt(1);
end;

Function StrToInt (S : String): longint;

Var M : longint;
    C : Integer;

begin
  val (S,M,C);

```

```

    If C<>0 Then DoError ( ' StrToInt : '+S);
    StrToInt:=M;
end;

Var Key : Tkey;
    ID : Longint;

begin
    If ParamCount<1 then Usage;
    key:=ftok ('.', 's');
    Case UpCase(Paramstr (1)[1]) of
        'C' : begin
            if paramcount<>2 then usage;
            CreateSem (key, strtoint(paramstr (2)));
            end;
        'L' : begin
            if paramcount<>2 then usage;
            ID:=OpenSem (key);
            LockSem (ID, strtoint (paramstr (2)));
            end;
        'U' : begin
            if paramcount<>2 then usage;
            ID:=OpenSem (key);
            UnLockSem (ID, strtoint (paramstr (2)));
            end;
        'M' : begin
            if paramcount<>2 then usage;
            ID:=OpenSem (key);
            ChangeMode (ID, strtoint (paramstr (2)));
            end;
        'D' : Begin
            ID:=OpenSem(Key);
            RemoveSem(Id);
            end;
        'P' : begin
            ID:=OpenSem(Key);
            PrintSem (Id);
            end;
    else
        Usage
    end;
end.

```

shmget

Declaration: Function shmget(key: Tkey; Size:longint; flag:longint):longint;

Description: shmget returns the ID of a shared memory block, described by key. Depending on the flags in flag, a new memory block is created.

flag can have one or more of the following values (combined by ORs):

IPC_CREATThe queue is created if it doesn't already exist.

IPC_EXCLIf used in combination with IPC_CREAT, causes the call to fail if the queue already exists. It cannot be used by itself.

Optionally, the flags can be ORed with a permission mode, which is the same mode that can be used in the file system.

if a new memory block is created, then it will have size `Size` semaphores in it.

Errors: On error, -1 is returned, and `IPCError` is set.

See also:

shmat

Declaration: `Function shmat (shmid:longint; shmaddr:pchar; shmflg:longint):pchar;`

Description: `shmat` attaches a shared memory block with identified `shmid` to the current process. The function returns a pointer to the shared memory block.

If `shmaddr` is `Nil`, then the system chooses a free unmapped memory region, as high up in memory space as possible.

If `shmaddr` is non-nil, and `SHM_RND` is in `shmflg`, then the returned address is `shmaddr`, rounded down to `SHMLBA`. If `SHM_RND` is not specified, then `shmaddr` must be a page-aligned address.

The parameter `shmflg` can be used to control the behaviour of the `shmat` call. It consists of a `ORed` combination of the following constants:

SHM_RNDThe suggested address in `shmaddr` is rounded down to `SHMLBA`.

SHM_RDONLYthe shared memory is attached for read access only. Otherwise the memory is attached for read-write. The process then needs read-write permissions to access the shared memory.

Errors: If an error occurs, -1 is returned, and `IPCError` is set.

See also: `shmget` (156), `shmdt` (157), `shmctl` (157)

For an example, see `shmctl` (157).

shmdt

Declaration: `Function shmdt (shmaddr:pchar):boolean;`

Description: `shmdt` detaches the shared memory at address `shmaddr`. This shared memory block is unavailable to the current process, until it is attached again by a call to `shmat` (157).

The function returns `True` if the memory block was detached successfully, `False` otherwise.

Errors: On error, `False` is returned, and `IPCError` is set.

See also: `shmget` (156), `shmat` (157), `shmctl` (157)

shmctl

Declaration: `Function shmctl(shmid:longint; cmd:longint; buf: pshmid_ds): Boolean;`

Description: `shmctl` performs various operations on the shared memory block identified by identifier `shmid`.

The `buf` parameter points to a `TSHMid_ds` record. The `cmd` parameter is used to pass which operation is to be performed. It can have one of the following values :

IPC_STAT`shmctl` fills the `TSHMid_ds` record that `buf` points to with the available information about the shared memory block.

IPC_SETapplies the values in the `ipc_perm` record that `buf` points to, to the shared memory block.

IPC_RMID the shared memory block is destroyed (after all processes to which the block is attached, have detached from it).

If successful, the function returns `True`, `False` otherwise.

Errors: If an error occurs, the function returns `False`, and `IPCError` is set.

See also: `shmget` (156), `shmat` (157), `shmdt` (157)

Listing: `ipccex/shmtool.pp`

```

Program shmtool;

uses ipc, strings;

Const SegSize = 100;

var key : Tkey;
    shmId, cNtr : longint;
    segptr : pchar;

Procedure USage;

begin
  Writeln ( 'Usage : shmtool w(rite) text' );
  writeln ( '          r(ead)' );
  writeln ( '          d(elete)' );
  writeln ( '          m(ode change) mode' );
  halt(1);
end;

Procedure Writeshm (ID : Longint; ptr : pchar; S : string);

begin
  strcpy ( ptr, S );
end;

Procedure Readshm (ID : longint; ptr : pchar);

begin
  Writeln ( 'Read : ', ptr );
end;

Procedure removeshm (ID : Longint);

begin
  shmctl ( ID, IPC_RMID, Nil );
  writeln ( 'Shared memory marked for deletion' );
end;

Procedure CHangeMode (ID : longint; mode : String);

Var m : word;
    code : integer;
    data : TSHMid_ds;

begin
  val ( mode, m, code );
  if code <> 0 then

```

```

usage;
If Not shmctl (shmctl,IPC_STAT,@data) then
  begin
    writeln ('Error : shmctl : ',ipcerror);
    halt(1);
  end;
writeln ('Old permissions : ',data.shm_perm.mode);
data.shm_perm.mode:=m;
If Not shmctl (shmctl,IPC_SET,@data) then
  begin
    writeln ('Error : shmctl : ',ipcerror);
    halt(1);
  end;
writeln ('New permissions : ',data.shm_perm.mode);
end;

begin
  if paramcount<1 then usage;
  key := ftok ('.', 'S');
  shmctl := shmget(key,segsz,IPC_CREAT or IPC_EXCL or 438);
  If shmctl=-1 then
    begin
      Writeln ('Shared memory exists. Opening as client');
      shmctl := shmget(key,segsz,0);
      If shmctl = -1 then
        begin
          Writeln ('shmget : Error !',ipcerror);
          halt(1);
        end
      end
    else
      Writeln ('Creating new shared memory segment. ');
      segptr:=shmat(shmctl,nil,0);
      if longint(segptr)=-1 then
        begin
          Writeln ('Shmat : error !',ipcerror);
          halt(1);
        end;
      case upcase(paramstr(1)[1]) of
        'W' : writeshm (shmctl,segptr,paramstr(2));
        'R' : readshm (shmctl,segptr);
        'D' : removeshm(shmctl);
        'M' : changemode (shmctl,paramstr(2));
      else
        begin
          writeln (paramstr(1));
          usage;
        end;
      end;
    end.

```

Chapter 11

The KEYBOARD unit

The KeyBoard unit implements a keyboard access layer which is system independent. It can be used to poll the keyboard state and wait for certain events. Waiting for a keyboard event can be done with the `GetKeyEvent` (164) function, which will return a driver-dependent key event. This key event can be translated to a interpretable event by the `TranslateKeyEvent` (171) function. The result of this function can be used in the other event examining functions.

A custom keyboard driver can be installed using the `SetKeyboardDriver` (170) function. The current keyboard driver can be retrieved using the `GetKeyboardDriver` (164) function. The last section of this chapter demonstrates how to make a keyboard driver.

11.1 Constants, Type and variables

Constants

The following constants define some error constants, which may be returned by the keyboard functions.

```
errKbdBase          = 1010;
errKbdInitError     = errKbdBase + 0;
errKbdNotImplemented = errKbdBase + 1;
```

The following constants denote special keyboard keys. The first constants denote the function keys:

```
const
  kbdF1      = $FF01;
  kbdF2      = $FF02;
  kbdF3      = $FF03;
  kbdF4      = $FF04;
  kbdF5      = $FF05;
  kbdF6      = $FF06;
  kbdF7      = $FF07;
  kbdF8      = $FF08;
  kbdF9      = $FF09;
  kbdF10     = $FF0A;
  kbdF11     = $FF0B;
  kbdF12     = $FF0C;
  kbdF13     = $FF0D;
  kbdF14     = $FF0E;
```

```

kbdF15      = $FF0F;
kbdF16      = $FF10;
kbdF17      = $FF11;
kbdF18      = $FF12;
kbdF19      = $FF13;
kbdF20      = $FF14;

```

Constants \$15 till \$1F are reserved for future function keys. The following constants denote the cursor movement keys:

```

kbdHome     = $FF20;
kbdUp       = $FF21;
kbdPgUp     = $FF22;
kbdLeft     = $FF23;
kbdMiddle   = $FF24;
kbdRight    = $FF25;
kbdEnd      = $FF26;
kbdDown     = $FF27;
kbdPgDn     = $FF28;

kbdInsert   = $FF29;
kbdDelete   = $FF2A;

```

Constants \$2B till \$2F are reserved for future keypad keys. The following flags are also defined:

```

kbASCII     = $00;
kbUnicode   = $01;
kbFnKey     = $02;
kbPhys      = $03;
kbReleased  = $04;

```

They can be used to check what kind of data a key event contains. The following shift-state flags can be used to determine the shift state of a key (i.e. which of the SHIFT, ALT and CTRL keys were pressed simultaneously with a key):

```

kbLeftShift = 1;
kbRightShift = 2;
kbShift     = kbLeftShift or kbRightShift;
kbCtrl      = 4;
kbAlt       = 8;

```

The following constant strings are used in the key name functions `FunctionKeyName` (163) and `KeyEventToString` (168):

```

SShift      : Array [1..3] of string[5] = ('SHIFT', 'CTRL', 'ALT');
LeftRight   : Array [1..2] of string[5] = ('LEFT', 'RIGHT');
UnicodeChar : String = 'Unicode character ';
SScanCode   : String = 'Key with scancode ';
SUnknownFunctionKey : String = 'Unknown function key : ';
SAnd        : String = 'AND';
SKeypad     : Array [0..($FF2F-kbdHome)] of string[6] =
  ('Home', 'Up', 'PgUp', 'Left',
   'Middle', 'Right', 'End', 'Down',
   'PgDn', 'Insert', 'Delete', '',
   '', '', '', '');

```

They can be changed to localize the key names when needed.

Types

The `TKeyEvent` type is the base type for all keyboard events:

```
TKeyEvent = Longint;
```

The key stroke is encoded in the 4 bytes of the `TKeyEvent` type. The various fields of the key stroke encoding can be obtained by typecasting the `TKeyEvent` type to the `TKeyRecord` type:

```
TKeyRecord = packed record
  KeyCode : Word;
  ShiftState, Flags : Byte;
end;
```

The structure of a `TKeyRecord` structure is explained in table (11.1). The shift-state can be

Table 11.1: Structure of `TKeyRecord`

Field	Meaning
KeyCode	Depending on <code>flags</code> either the physical representation of a key (under DOS scancode, ascii code pair), or the translated ASCII/unicode character.
ShiftState	Shift-state when this key was pressed (or shortly after)
Flags	Determine how to interpret <code>KeyCode</code>

checked using the various shift-state constants, and the flags in the last byte can be checked using one of the `kbASCII`, `kbUniCode`, `kbFnKey`, `kbPhys`, `kbReleased` constants.

If there are two keys returning the same char-code, there's no way to find out which one was pressed (Gray+ and Simple+). If it needs to be known which was pressed, the untranslated keycodes must be used, but these are system dependent. System dependent constants may be defined to cover those, with possibly having the same name (but different value).

The `TKeyboardDriver` record can be used to install a custom keyboard driver with the `SetKeyboardDriver` (170) function:

Type

```
TKeyboardDriver = Record
  InitDriver : Procedure;
  DoneDriver : Procedure;
  GetKeyEvent : Function : TKeyEvent;
  PollKeyEvent : Function : TKeyEvent;
  GetShiftState : Function : Byte;
  TranslateKeyEvent : Function (KeyEvent: TKeyEvent): TKeyEvent;
  TranslateKeyEventUniCode: Function (KeyEvent: TKeyEvent): TKeyEvent;
end;
```

The various fields correspond to the different functions of the keyboard unit interface. For more information about this record see section 11.4, page 172

11.2 Functions and Procedures

DoneKeyboard

Declaration: Procedure DoneKeyboard;

Description: DoneKeyboard de-initializes the keyboard interface if the keyboard driver is active. If the keyboard driver is not active, the function does nothing.

This will cause the keyboard driver to clear up any allocated memory, or restores the console or terminal the program was running in to its initial state before the call to InitKeyBoard (167). This function should be called on program exit. Failing to do so may leave the terminal or console window in an unusable state. Its exact action depends on the platform on which the program is running.

Errors: None.

See also: InitKeyBoard (167)

For an example, see most other functions.

FunctionKeyName

Declaration: Function FunctionKeyName (KeyCode : Word) : String;

Description: FunctionKeyName returns a string representation of the function key with code KeyCode. This can be an actual function key, or one of the cursor movement keys.

Errors: In case KeyCode does not contain a function code, the SUnknownFunctionKey string is returned, appended with the KeyCode.

See also: ShiftStateToString (171) KeyEventToString (168)

Listing: kbdex/ex8.pp

```

Program Example8;

{ Program to demonstrate the FunctionKeyName function. }

Uses keyboard;

Var
  K : TKeyEvent;

begin
  InitKeyboard;
  WriteLn('Press function keys, press "q" to end. ');
  Repeat
    K:=GetKeyEvent;
    K:=TranslateKeyEvent(K);
    If IsFunctionKey(k) then
      begin
        Write('Got function key : ');
        WriteLn(FunctionKeyName(TKeyRecord(K).KeyCode));
      end;
  Until (GetKeyEventChar(K)= 'q ');
  DoneKeyboard;
end.

```

GetKeyboardDriver

Declaration: `Procedure GetKeyboardDriver (Var Driver : TKeyboardDriver);`

Description: `GetKeyboardDriver` returns in `Driver` the currently active keyboard driver. This function can be used to enhance an existing keyboard driver.

For more information on getting and setting the keyboard driver section [11.4](#), page [172](#).

Errors: None.

See also: [SetKeyboardDriver \(170\)](#)

GetKeyEvent

Declaration: `function GetKeyEvent: TKeyEvent;`

Description: `GetKeyEvent` returns the last keyevent if one was stored in `PendingKeyEvent`, or waits for one if none is available. A non-blocking version is available in [PollKeyEvent \(168\)](#).

The returned key is encoded as a `TKeyEvent` type variable, and is normally the physical key scan code, (the scan code is driver dependent) which can be translated with one of the translation functions [TranslateKeyEvent \(171\)](#) or [TranslateKeyEventUnicode \(171\)](#). See the types section for a description of how the key is described.

Errors: If no key became available, 0 is returned.

See also: [PutKeyEvent \(169\)](#), [PollKeyEvent \(168\)](#), [TranslateKeyEvent \(171\)](#), [TranslateKeyEventUnicode \(171\)](#)

Listing: kbDEX/ex1.pp

```

program example1;

{ This program demonstrates the GetKeyEvent function }

uses keyboard;

Var
  K : TKeyEvent;

begin
  InitKeyBoard;
  Writeln ('Press keys , press "q" to end. ');
  Repeat
    K:=GetKeyEvent;
    Write ('Got key event with ');
    Case GetKeyEventFlags(K) of
      kbASCII      : Writeln ('ASCII key ');
      kbUnicode    : Writeln ('Unicode key ');
      kbFnKey      : Writeln ('Function key ');
      kbPhys       : Writeln ('Physical key ');
      kbReleased  : Writeln ('Released key event ');
    end;
    K:=TranslateKeyEvent(K);
    Writeln ('Got key : ', KeyEventToString(K));
  Until ( GetKeyEventChar(K)='q ');
  DoneKeyBoard;
end.

```

GetKeyEventChar

Declaration: `function GetKeyEventChar(KeyEvent: TKeyEvent): Char;`

Description: `GetKeyEventChar` returns the charcode part of the given `KeyEvent`, if it contains a translated character key keycode. The charcode is simply the ascii code of the character key that was pressed.

It returns the null character if the key was not a character key, but e.g. a function key.

Errors: None.

See also: [GetKeyEventUnicode \(167\)](#), [GetKeyEventShiftState \(166\)](#), [GetKeyEventFlags \(166\)](#), [GetKeyEventCode \(165\)](#), [GetKeyEvent \(164\)](#)

For an example, see [GetKeyEvent \(164\)](#)

GetKeyEventCode

Declaration: `function GetKeyEventCode(KeyEvent: TKeyEvent): Word;`

Description: `GetKeyEventCode` returns the translated function keycode part of the given `KeyEvent`, if it contains a translated function key.

If the key pressed was not a function key, the null character is returned.

Errors: None.

See also: [GetKeyEventUnicode \(167\)](#), [GetKeyEventShiftState \(166\)](#), [GetKeyEventFlags \(166\)](#), [GetKeyEventChar \(165\)](#), [GetKeyEvent \(164\)](#)

Listing: `kbdex/ex2.pp`

Program `Example2;`

{ Program to demonstrate the GetKeyEventCode function. }

Uses `keyboard;`

Var

`K : TKeyEvent;`

begin

`InitKeyBoard;`

`WriteLn('Press function keys, or press "q" to end.');`

Repeat

`K:=GetKeyEvent;`

`K:=TranslateKeyEvent(K);`

If `(GetKeyEventFlags(K)<>KbfnKey)` **then**

`WriteLn('Not a function key')`

else

begin

`Write('Got key (',GetKeyEventCode(K));`

`WriteLn(') : ',KeyEventToString(K));`

`end;`

Until `(GetKeyEventChar(K)='q');`

`DoneKeyboard;`

end.

GetKeyEventFlags

Declaration: `function GetKeyEventFlags(KeyEvent: TKeyEvent): Byte;`

Description: `GetKeyEventFlags` returns the flags part of the given `KeyEvent`.

Errors: None.

See also: `GetKeyEventUniCode` (167), `GetKeyEventShiftState` (166), `GetKeyEventCode` (165), `GetKeyEventChar` (165), `GetKeyEvent` (164)

For an example, see `GetKeyEvent` (164)

GetKeyEventShiftState

Declaration: `function GetKeyEventShiftState(KeyEvent: TKeyEvent): Byte;`

Description: `GetKeyEventShiftState` returns the shift-state values of the given `KeyEvent`. This can be used to detect which of the modifier keys `Shift`, `Alt` or `Ctrl` were pressed. If none were pressed, zero is returned.

Note that this function does not always return expected results; In a unix X-Term, the modifier keys do not always work.

Errors: None.

See also: `GetKeyEventUniCode` (167), `GetKeyEventFlags` (166), `GetKeyEventCode` (165), `GetKeyEventChar` (165), `GetKeyEvent` (164)

Listing: `kbdex/ex3.pp`

Program `Example3`;

{ Program to demonstrate the GetKeyEventShiftState function. }

Uses `keyboard`;

Var

`K` : `TKeyEvent`;
`S` : `Byte`;

begin

`InitKeyBoard`;

Write ('Press keys combined with CTRL/SHIFT/ALT');

Writeln (' , or press "q" to end.');

Repeat

`K:=GetKeyEvent`;

`K:=TranslateKeyEvent(K)`;

`S:=GetKeyEventShiftState(K)`;

If (`S=0`) **then**

Writeln ('No special keys pressed')

else

begin

Writeln ('Detected special keys : ', `ShiftStateToString(K, False)`);

Writeln ('Got key : ', `KeyEventToString(K)`);

end;

Until (`GetKeyEventChar(K)='q'`);

`DoneKeyboard`;

end.

GetKeyEventUnicode

Declaration: `function GetKeyEventUnicode(KeyEvent: TKeyEvent): Word;`

Description: `GetKeyEventUnicode` returns the unicode part of the given `KeyEvent` if it contains a translated unicode character.

Errors: None.

See also: [GetKeyEventShiftState \(166\)](#), [GetKeyEventFlags \(166\)](#), [GetKeyEventCode \(165\)](#), [GetKeyEventChar \(165\)](#), [GetKeyEvent \(164\)](#)

No example available yet.

InitKeyboard

Declaration: `procedure InitKeyboard;`

Description: `InitKeyboard` initializes the keyboard driver. If the driver is already active, it does nothing. When the driver is initialized, it will do everything necessary to ensure the functioning of the keyboard, including allocating memory, initializing the terminal etc.

This function should be called once, before using any of the keyboard functions. When it is called, the [DoneKeyboard \(163\)](#) function should also be called before exiting the program or changing the keyboard driver with [SetKeyboardDriver \(170\)](#).

Errors: None.

See also: [DoneKeyboard \(163\)](#), [SetKeyboardDriver \(170\)](#)

For an example, see most other functions.

IsFunctionKey

Declaration: `function IsFunctionKey(KeyEvent: TKeyEvent): Boolean;`

Description: `IsFunctionKey` returns `True` if the given key event in `KeyEvent` was a function key or not.

Errors: None.

See also: [GetKeyEvent \(164\)](#)

Listing: `kbdex/ex7.pp`

```

program example1;

{ This program demonstrates the GetKeyEvent function }

uses keyboard;

Var
  K : TKeyEvent;

begin
  InitKeyboard;
  WriteIn('Press keys, press "q" to end. ');
  Repeat
    K:=GetKeyEvent;

```

```

K:=TranslateKeyEvent(K);
if IsFunctionKey(K) then
    writeln('Got function key : ',KeyEventToString(K))
else
    writeln('not a function key. ');
until (GetKeyEventChar(K)='q');
DoneKeyBoard;
end.

```

KeyEventToString

Declaration: `Function KeyEventToString(KeyEvent : TKeyEvent) : String;`

Description: `KeyEventToString` translates the key event in `KeyEvent` to a human-readable description of the pressed key. It will use the constants described in the constants section to do so.

Errors: If an unknown key is passed, the scancode is returned, prefixed with the `SScanCode` string.

See also: `FunctionKeyName` (163), `ShiftStateToString` (171)

For an example, see most other functions.

PollKeyEvent

Declaration: `function PollKeyEvent: TKeyEvent;`

Description: `PollKeyEvent` checks whether a key event is available, and returns it if one is found. If no event is pending, it returns 0.

Note that this does not remove the key from the pending keys. The key should still be retrieved from the pending key events list with the `GetKeyEvent` (164) function.

Errors: None.

See also: `PutKeyEvent` (169), `GetKeyEvent` (164)

Listing: `kbdex/ex4.pp`

```

program example4;

{ This program demonstrates the PollKeyEvent function }

uses keyboard;

Var
    K : TKeyEvent;

begin
    InitKeyBoard;
    writeln('Press keys , press "q" to end. ');
    Repeat
        K:=PollKeyEvent;
        if k<>0 then
            begin
                K:=GetKeyEvent;
                K:=TranslateKeyEvent(K);
                writeln;
            end

```

```
    WriteLn('Got key : ',KeyEventToString(K));
  end
else
  write(' ');
Until (GetKeyEventChar(K)='q');
DoneKeyBoard;
end.
```

PollShiftStateEvent

Declaration: `function PollShiftStateEvent: TKeyEvent;`

Description: `PollShiftStateEvent` returns the current shiftstate in a keyevent. This will return 0 if there is no key event pending.

Errors: None.

See also: [PollKeyEvent \(168\)](#), [GetKeyEvent \(164\)](#)

Listing: `kbdex/ex6.pp`

```
program example6;

{ This program demonstrates the PollShiftStateEvent function }

uses keyboard;

Var
  K : TKeyEvent;

begin
  InitKeyBoard;
  WriteLn('Press keys, press "q" to end. ');
  Repeat
    K:=PollKeyEvent;
    If k<>0 then
      begin
        K:=PollShiftStateEvent;
        WriteLn('Got shift state : ',ShiftStateToString(K,False));
        // Consume the key.
        K:=GetKeyEvent;
        K:=TranslateKeyEvent(K);
      end
    else
      write(' ');
  Until (GetKeyEventChar(K)='q');
  DoneKeyBoard;
end.
```

PutKeyEvent

Declaration: `procedure PutKeyEvent(KeyEvent: TKeyEvent);`

Description: `PutKeyEvent` adds the given `KeyEvent` to the input queue. Please note that depending on the implementation this can hold only one value, i.e. when calling `PutKeyEvent` multiple times, only the last pushed key will be remembered.

Errors: None

See also: [PollKeyEvent \(168\)](#), [GetKeyEvent \(164\)](#)

Listing: `kbdex/ex5.pp`

```

program example5;

{ This program demonstrates the PutKeyEvent function }

uses keyboard;

Var
  K,k2 : TKeyEvent;

begin
  InitKeyBoard;
  WriteLn( 'Press keys , press "q" to end.' );
  K2:=0;
  Repeat
    K:=GetKeyEvent;
    If k<>0 then
      begin
        if (k2 mod 2)=0 then
          K2:=K+1
        else
          K2:=0;
        K:=TranslateKeyEvent(K);
        WriteLn( 'Got key : ',KeyEventToString(K));
        if (K2<>0) then
          begin
            PutKeyEvent(k2);
            K2:=TranslateKeyEvent(K2);
            WriteLn( 'Put key : ',KeyEventToString(K2))
          end
        end
      until ( GetKeyEventChar(K)= 'q' );
  DoneKeyBoard;
end.

```

SetKeyboardDriver

Declaration: `Function SetKeyboardDriver (Const Driver : TKeyboardDriver) : Boolean;`

Description: `SetKeyBoardDriver` sets the keyboard driver to `Driver`, if the current keyboard driver is not yet initialized. If the current keyboard driver is initialized, then `SetKeyboardDriver` does nothing. Before setting the driver, the currently active driver should be disabled with a call to `DoneKeyboard (163)`.

The function returns `True` if the driver was set, `False` if not.

For more information on setting the keyboard driver, see section [11.4](#), page [172](#).

Errors: None.

See also: [GetKeyboardDriver \(164\)](#), [DoneKeyboard \(163\)](#).

ShiftStateToString

Declaration: `Function ShiftStateToString(KeyEvent : TKeyEvent; UseLeftRight : Boolean) : String;`

Description: `ShiftStateToString` returns a string description of the shift state of the key event `KeyEvent`. This can be an empty string.

The shift state is described using the strings in the `SShift` constant.

Errors: None.

See also: [FunctionKeyName \(163\)](#), [KeyEventToString \(168\)](#)

For an example, see [PollShiftStateEvent \(169\)](#).

TranslateKeyEvent

Declaration: `function TranslateKeyEvent(KeyEvent: TKeyEvent): TKeyEvent;`

Description: `TranslateKeyEvent` performs ASCII translation of the `KeyEvent`. It translates a physical key to a function key if the key is a function key, and translates the physical key to the ordinal of the ascii character if there is an equivalent character key.

Errors: None.

See also: [TranslateKeyEventUnicode \(171\)](#)

For an example, see [GetKeyEvent \(164\)](#)

TranslateKeyEventUnicode

Declaration: `function TranslateKeyEventUnicode(KeyEvent: TKeyEvent): TKeyEvent;`

Description: `TranslateKeyEventUnicode` performs Unicode translation of the `KeyEvent`. It is not yet implemented for all platforms.

Errors: If the function is not yet implemented, then the `ErrorCode` of the `system` unit will be set to `errKbdNotImplemented`

See also:

No example available yet.

11.3 Keyboard scan codes

Special physical keys are encoded with the DOS scan codes for these keys in the second byte of the `TKeyEvent` type. A complete list of scan codes can be found in table (11.2). This is the list of keys that is used by the default key event translation mechanism. When writing a keyboard driver, either these constants should be returned by the various key event functions, or the `TranslateKeyEvent` hook should be implemented by the driver. A list of scan codes for special keys and combinations with the `SHIFT`, `ALT` and `CTRL` keys can be found in table (11.3); They are for quick reference only.

11.4 Writing a keyboard driver

Writing a keyboard driver means that hooks must be created for most of the keyboard unit functions. The `TKeyboardDriver` record contains a field for each of the possible hooks:

```
TKeyboardDriver = Record
  InitDriver : Procedure;
  DoneDriver : Procedure;
  GetKeyEvent : Function : TKeyEvent;
  PollKeyEvent : Function : TKeyEvent;
  GetShiftState : Function : Byte;
  TranslateKeyEvent : Function (KeyEvent: TKeyEvent): TKeyEvent;
  TranslateKeyEventUnicode: Function (KeyEvent: TKeyEvent): TKeyEvent;
end;
```

The meaning of these hooks is explained below:

InitDriver Called to initialize and enable the driver. Guaranteed to be called only once. This should initialize all needed things for the driver.

DoneDriver Called to disable and clean up the driver. Guaranteed to be called after a call to `initDriver`. This should clean up all things initialized by `InitDriver`.

GetKeyEvent Called by `GetKeyEvent` (164). Must wait for and return the next key event. It should NOT store keys.

PollKeyEvent Called by `PollKeyEvent` (168). It must return the next key event if there is one. Should not store keys.

GetShiftState Called by `PollShiftStateEvent` (169). Must return the current shift state.

TranslateKeyEvent Should translate a raw key event to a correct key event, i.e. should fill in the `shiftstate` and convert function key scancodes to function key keycodes. If the `TranslateKeyEvent` is not filled in, a default translation function will be called which converts the known scancodes from the tables in the previous section to a correct keyevent.

TranslateKeyEventUnicode Should translate a key event to a unicode key representation.

Strictly speaking, only the `GetKeyEvent` and `PollKeyEvent` hooks must be implemented for the driver to function correctly.

The following unit demonstrates how a keyboard driver can be installed. It takes the installed driver, and hooks into the `GetKeyEvent` function to register and log the key events in a file. This driver can work on top of any other driver, as long as it is inserted in the `uses` clause *after* the real driver unit, and the real driver unit should set the driver record in its initialization section.

Listing: `kbdex/logkeys.pp`

```
unit logkeys;

interface

Procedure StartKeyLogging;
Procedure StopKeyLogging;
Function IsKeyLogging : Boolean;
Procedure SetKeyLogFileName (FileName : String);
```

implementation

```
uses sysutils , keyboard;
```

```
var
  NewKeyboardDriver ,
  OldKeyboardDriver : TKeyboardDriver;
  Active , Logging : Boolean;
  LogFileName : String;
  KeyLog : Text;
```

```
Function TimeStamp : String;
```

```
begin
  TimeStamp := FormatDateTime( 'hh:nn:ss ', Time ());
end;
```

```
Procedure StartKeyLogging;
```

```
begin
  Logging := True;
  WriteLn(KeyLog, 'Start logging keystrokes at: ', TimeStamp);
end;
```

```
Procedure StopKeyLogging;
```

```
begin
  WriteLn(KeyLog, 'Stop logging keystrokes at: ', TimeStamp);
  Logging := False;
end;
```

```
Function IsKeyLogging : Boolean;
```

```
begin
  IsKeyLogging := Logging;
end;
```

```
Function LogGetKeyEvent : TKeyEvent;
```

```
Var
  K : TKeyEvent;

begin
  K := OldkeyboardDriver . GetKeyEvent ();
  If Logging then
    begin
      Write(KeyLog, TimeStamp, ': Key event: ');
      WriteLn(KeyLog, KeyEventToString( TranslateKeyEvent(K)));
    end;
  LogGetKeyEvent := K;
end;
```

```
Procedure LogInitKeyboard;
```

```
begin
  OldKeyboardDriver . InitDriver ();
  Assign (KeyLog, logFileName);
  Rewrite(KeyLog);
```

```

    Active := True;
    StartKeyLogging;
end;

Procedure LogDoneKeyBoard;

begin
    StopKeyLogging;
    Close (KeyLog);
    Active := False;
    OldKeyBoardDriver.DoneDriver ();
end;

Procedure SetKeyLogFileName (FileName : String);

begin
    If Not Active then
        LogFileName := FileName;
end;

Initialization
    GetKeyboardDriver (OldKeyBoardDriver);
    NewKeyBoardDriver := OldKeyBoardDriver;
    NewKeyBoardDriver.GetKeyEvent := @LogGetKeyEvent;
    NewKeyBoardDriver.InitDriver := @LogInitKeyboard;
    NewKeyBoardDriver.DoneDriver := @LogDoneKeyboard;
    LogFileName := 'keyboard.log';
    Logging := False;
    SetKeyboardDriver (NewKeyBoardDriver);
end.

```

The following program demonstrates the use of the unit:

Listing: kbdex/ex9.pp

```

program example9;

{ This program demonstrates the logkeys unit }

uses keyboard, logkeys;

Var
    K : TKeyEvent;

begin
    InitKeyBoard;
    WriteLn ('Press keys, press "q" to end, "s" toggles logging. ');
    Repeat
        K := GetKeyEvent;
        K := TranslateKeyEvent (K);
        WriteLn ('Got key : ', KeyEventToString (K));
        if GetKeyEventChar (K) = 's' then
            if IsKeyLogging then
                StopKeyLogging
            else
                StartKeyLogging;
        Until ( GetKeyEventChar (K) = 'q' );
    DoneKeyBoard;
end.

```

Note that with a simple extension of this unit could be used to make a driver that is capable of recording and storing a set of keyboard strokes, and replaying them at a later time, so a 'keyboard macro' capable driver. This driver could sit on top of any other driver.

Table 11.2: Physical keys scan codes

Code	Key	Code	Key	Code	Key
00	NoKey	3D	F3	70	ALT-F9
01	ALT-Esc	3E	F4	71	ALT-F10
02	ALT-Space	3F	F5	72	CTRL-PrtSc
04	CTRL-Ins	40	F6	73	CTRL-Left
05	SHIFT-Ins	41	F7	74	CTRL-Right
06	CTRL-Del	42	F8	75	CTRL-end
07	SHIFT-Del	43	F9	76	CTRL-PgDn
08	ALT-Back	44	F10	77	CTRL-Home
09	ALT-SHIFT-Back	47	Home	78	ALT-1
0F	SHIFT-Tab	48	Up	79	ALT-2
10	ALT-Q	49	PgUp	7A	ALT-3
11	ALT-W	4B	Left	7B	ALT-4
12	ALT-E	4C	Center	7C	ALT-5
13	ALT-R	4D	Right	7D	ALT-6
14	ALT-T	4E	ALT-GrayPlus	7E	ALT-7
15	ALT-Y	4F	end	7F	ALT-8
16	ALT-U	50	Down	80	ALT-9
17	ALT-I	51	PgDn	81	ALT-0
18	ALT-O	52	Ins	82	ALT-Minus
19	ALT-P	53	Del	83	ALT-Equal
1A	ALT-LftBrack	54	SHIFT-F1	84	CTRL-PgUp
1B	ALT-RgtBrack	55	SHIFT-F2	85	F11
1E	ALT-A	56	SHIFT-F3	86	F12
1F	ALT-S	57	SHIFT-F4	87	SHIFT-F11
20	ALT-D	58	SHIFT-F5	88	SHIFT-F12
21	ALT-F	59	SHIFT-F6	89	CTRL-F11
22	ALT-G	5A	SHIFT-F7	8A	CTRL-F12
23	ALT-H	5B	SHIFT-F8	8B	ALT-F11
24	ALT-J	5C	SHIFT-F9	8C	ALT-F12
25	ALT-K	5D	SHIFT-F10	8D	CTRL-Up
26	ALT-L	5E	CTRL-F1	8E	CTRL-Minus
27	ALT-SemiCol	5F	CTRL-F2	8F	CTRL-Center
28	ALT-Quote	60	CTRL-F3	90	CTRL-GreyPlus
29	ALT-OpQuote	61	CTRL-F4	91	CTRL-Down
2B	ALT-BkSlash	62	CTRL-F5	94	CTRL-Tab
2C	ALT-Z	63	CTRL-F6	97	ALT-Home
2D	ALT-X	64	CTRL-F7	98	ALT-Up
2E	ALT-C	65	CTRL-F8	99	ALT-PgUp
2F	ALT-V	66	CTRL-F9	9B	ALT-Left
30	ALT-B	67	CTRL-F10	9D	ALT-Right
31	ALT-N	68	ALT-F1	9F	ALT-end
32	ALT-M	69	ALT-F2	A0	ALT-Down
33	ALT-Comma	6A	ALT-F3	A1	ALT-PgDn
34	ALT-Period	6B	ALT-F4	A2	ALT-Ins
35	ALT-Slash	6C	ALT-F5	A3	ALT-Del
37	ALT-GreyAst	6D	ALT-F6	A5	ALT-Tab
3B	F1	6E	ALT-F7		
3C	F2	6F	ALT-F8		

Table 11.3: Special keys scan codes

Key	Code	SHIFT-Key	CTRL-Key	Alt-Key
NoKey	00			
F1	3B	54	5E	68
F2	3C	55	5F	69
F3	3D	56	60	6A
F4	3E	57	61	6B
F5	3F	58	62	6C
F6	40	59	63	6D
F7	41	5A	64	6E
F8	42	5A	65	6F
F9	43	5B	66	70
F10	44	5C	67	71
F11	85	87	89	8B
F12	86	88	8A	8C
Home	47		77	97
Up	48		8D	98
PgUp	49		84	99
Left	4B		73	9B
Center	4C		8F	
Right	4D		74	9D
end	4F		75	9F
Down	50		91	A0
PgDn	51		76	A1
Ins	52	05	04	A2
Del	53	07	06	A3
Tab	8	0F	94	A5
GreyPlus			90	4E

Chapter 12

The LINUX unit.

This chapter describes the LINUX unit for Free Pascal. The unit was written by Michaël van Canneyt. It works only on the Linux operating system. This chapter is divided in 3 sections:

- The first section lists all constants, types and variables, as listed in the interface section of the LINUX unit.
- The second section gives an overview of all available functions, grouped by category.
- The third section describes all procedures and functions in the LINUX unit.

12.1 Type, Variable and Constant declarations

Types

PGlob and TGlob are 2 types used in the Glob ([225](#)) function:

```
PGlob = ^TGlob;  
TGlob = record  
  Name : PChar;  
  Next : PGlob;  
end;
```

The following types are used in the signal-processing procedures.

```
tfpreg = record  
  significand: array[0..3] of word;  
  exponent: word;  
end;  
  
pfpstate = ^tfpstate;  
tfpstate = record  
  cw, sw, tag, ipoff, cssel, dataoff, dataset: cardinal;  
  st: array[0..7] of tfpreg;  
  status: cardinal;  
end;  
  
PSigContextRec = ^SigContextRec;  
SigContextRec = record
```

```

gs, __gsh: word;
fs, __fsh: word;
es, __esh: word;
ds, __dsh: word;
edi: cardinal;
esi: cardinal;
ebp: cardinal;
esp: cardinal;
ebx: cardinal;
edx: cardinal;
ecx: cardinal;
eax: cardinal;
trapno: cardinal;
err: cardinal;
eip: cardinal;
cs, __csh: word;
eflags: cardinal;
esp_at_signal: cardinal;
ss, __ssh: word;
fpstate: pfpstate;
oldmask: cardinal;
cr2: cardinal;
end;

```

The above records contain information about the processor state and process state at the moment a signal is sent to your program.

The records below are used in catching signals.

```

TSigAction = procedure(Sig: Longint; SigContext: SigContextRec);cdecl;
SignalHandler = Procedure ( Sig : Integer);cdecl;

PSignalHandler = SignalHandler;
SignalRestorer = Procedure;cdecl;
PSignalrestorer = SignalRestorer;
SigActionRec = packed record
  Handler : record
    case byte of
      0: (Sh: SignalHandler);
      1: (Sa: TSigAction);
    end;
  Sa_Mask : SigSet;
  Sa_Flags : Longint;
  Sa_restorer : SignalRestorer; { Obsolete - Don't use }
end;
PSigActionRec = ^SigActionRec;

```

Stat is used to store information about a file. It is defined in the syscalls unit.

```

stat = record
  dev : word;
  pad1 : word;
  ino : longint;
  mode : word;
  nlink : word;

```

```

uid      : word;
gid      : word;
rdev     : word;
pad2     : word;
size     : longint;
blksize  : Longint;
blocks   : Longint;
atime    : Longint;
unused1  : longint;
mtime    : Longint;
unused2  : longint;
ctime    : Longint;
unused3  : longint;
unused4  : longint;
unused5  : longint;
end;
```

Statfs is used to store information about a filesystem. It is defined in the syscalls unit.

```

statfs = record
  fstype   : longint;
  bsize    : longint;
  blocks   : longint;
  bfree    : longint;
  bavail   : longint;
  files    : longint;
  ffree    : longint;
  fsid     : longint;
  namelen  : longint;
  spare    : array [0..6] of longint;
end
```

Dir and PDir are used in the [OpenDir \(236\)](#) and [ReadDir \(238\)](#) functions.

```

TDir =record
  fd       : integer;
  loc      : longint;
  size     : integer;
  buf      : pdirent;
  nextoff  : longint;
  dd_max   : integer;
  lock     : pointer;
end;
PDir =^TDir;
```

Dirent, PDirent are used in the [ReadDir \(238\)](#) function to return files in a directory.

```

PDirent = ^Dirent;
Dirent = Record
  ino,
  off   : longint;
  reclen : word;
  name  : string[255]
end;
```

Termio and Termios are used with `ioctl()` calls for terminal handling.

```

Const  NCCS = 19;
        NCC = 8;

Type termio = record
c_iflag, { input mode flags }
c_oflag, { output mode flags }
c_cflag, { control mode flags }
c_lflag : Word; { local mode flags }
c_line : Word; { line discipline - careful, only High byte in use}
c_cc : array [0..NCC-1] of char; { control characters }
end;
termios = record
  c_iflag,          { input mode flags }
  c_oflag,          { output mode flags }
  c_cflag,          { control mode flags }
  c_lflag : Cardinal; { local mode flags }
  c_line : char;    { line discipline }
  c_cc : array [0..NCCS-1] of char; { control characters }
end;

```

`Utimbuf` is used in the `Utime` (254) call to set access and modification time of a file.

```

utimbuf = record
  actime, modtime : Longint;
end;

```

For the `Select` (241) call, the following 4 types are needed:

```

FDSet = Array [0..31] of longint;
PFDSets = ^FDSet;
TimeVal = Record
  sec, usec : Longint;
end;
PTimeVal = ^TimeVal;

```

The `timespec` record is needed in the `Nanosleep` (234) function:

```

timespec = packed record
  tv_sec, tv_nsec : longint;
end;

```

The `Uname` (254) function uses the `utsname` to return information about the current kernel :

```

utsname = record
  sysname, nodename, release,
  version, machine, domainname : Array[0..64] of char;
end;

```

Its elements are null-terminated C style strings, you cannot access them directly !

Variables

`Linuxerror` is the variable in which the procedures in the linux unit report errors.

```
LinuxError : Longint;
```

StdErr Is a Text variable, corresponding to Standard Error or diagnostic output. It is connected to file descriptor 2. It can be freely used, and will be closed on exit.

```
StdErr : Text;
```

Constants

Constants for setting/getting process priorities :

```
Prio_Process = 0;
Prio_PGrp    = 1;
Prio_User    = 2;
```

For testing access rights:

```
R_OK = 4;
W_OK = 2;
X_OK = 1;
F_OK = 0;
```

For signal handling functions :

```
SA_NOCLDSTOP = 1;
SA_SHIRQ     = $04000000;
SA_STACK     = $08000000;
SA_RESTART   = $10000000;
SA_INTERRUPT = $20000000;
SA_NOMASK    = $40000000;
SA_ONESHOT   = $80000000;
```

```
SIG_BLOCK   = 0;
SIG_UNBLOCK = 1;
SIG_SETMASK = 2;
SIG_DFL     = 0 ;
SIG_IGN     = 1 ;
SIG_ERR     = -1;
```

```
SIGHUP = 1;
SIGINT  = 2;
SIGQUIT = 3;
SIGILL  = 4;
SIGTRAP = 5;
SIGABRT = 6;
SIGIOT  = 6;
SIGBUS  = 7;
SIGFPE  = 8;
SIGKILL = 9;
SIGUSR1 = 10;
SIGSEGV = 11;
SIGUSR2 = 12;
SIGPIPE = 13;
```

```
SIGALRM = 14;
SIGTERM = 15;
SIGSTKFLT = 16;
SIGCHLD = 17;
SIGCONT = 18;
SIGSTOP = 19;
SIGTSTP = 20;
SIGTTIN = 21;
SIGTTOU = 22;
SIGURG = 23;
SIGXCPU = 24;
SIGXFSZ = 25;
SIGVTALRM = 26;
SIGPROF = 27;
SIGWINCH = 28;
SIGIO = 29;
SIGPOLL = SIGIO;
SIGPWR = 30;
SIGUNUSED = 31;
```

For file control mechanism :

```
F_GetFd = 1;
F_SetFd = 2;
F_GetFl = 3;
F_SetFl = 4;
F_GetLk = 5;
F_SetLk = 6;
F_SetLkW = 7;
F_GetOwn = 8;
F_SetOwn = 9;
```

For Terminal handling :

```
TCGETS = $5401 ;
TCSETS = $5402 ;
TCSETSW = $5403 ;
TCSETSF = $5404 ;
TCGETA = $5405 ;
TCSETA = $5406 ;
TCSETAW = $5407 ;
TCSETAF = $5408 ;
TCSBRK = $5409 ;
TCXONC = $540A ;
TCFLSH = $540B ;
TIOCEXCL = $540C ;
TIOCNXCL = $540D ;
TIOCSCTTY = $540E ;
TIOCGPGRP = $540F ;
TIOCSPGRP = $5410 ;
TIOCOUTQ = $5411 ;
TIOCSTI = $5412 ;
TIOCGWINSZ = $5413 ;
TIOCSWINSZ = $5414 ;
```

```

TIOCMGET = $5415 ;
TIOCMBIS = $5416 ;
TIOCMBIC = $5417 ;
TIOCMSET = $5418 ;
TIOCGSOFTCAR = $5419 ;
TIOCSSOFTCAR = $541A ;
FIONREAD = $541B ;
TIOCINQ = FIONREAD;
TIOCLINUX = $541C ;
TIOCCONS = $541D ;
TIOCGSERIAL = $541E ;
TIOCSSERIAL = $541F ;
TIOCPKT = $5420 ;
FIONBIO = $5421 ;
TIOCNOTTY = $5422 ;
TIOCSETD = $5423 ;
TIOCGETD = $5424 ;
TCSBRKP = $5425 ;
TIOCTTYGSTRUCT = $5426 ;
FIONCLEX = $5450 ;
FIOCLEX = $5451 ;
FIOASYNC = $5452 ;
TIOCSERCONFIG = $5453 ;
TIOCSERGWILD = $5454 ;
TIOCSERSWILD = $5455 ;
TIOCGLOCKTRMIO = $5456 ;
TIOCSLOCKTRMIO = $5457 ;
TIOCSERGSTRUCT = $5458 ;
TIOCSERGETLSR = $5459 ;
TIOCSERGETMULTI = $545A ;
TIOCSERSETMULTI = $545B ;
TIOCMWAIT = $545C ;
TIOCGICOUNT = $545D ;
TIOCPKT_DATA = 0;
TIOCPKT_FLUSHREAD = 1;
TIOCPKT_FLUSHWRITE = 2;
TIOCPKT_STOP = 4;
TIOCPKT_START = 8;
TIOCPKT_NOSTOP = 16;
TIOCPKT_DOSTOP = 32;

```

Other than that, all constants for setting the speed and control flags of a terminal line, as described in the `termios(2)` man page, are defined in the linux unit. It would take too much place to list them here. To check the mode field of a `stat` record, you can use the following constants :

```

{ Constants to check stat.mode }
STAT_IFMT = $f000; {00170000}
STAT_IFSOCK = $c000; {0140000}
STAT_IFLNK = $a000; {0120000}
STAT_IFREG = $8000; {0100000}
STAT_IFBLK = $6000; {0060000}
STAT_IFDIR = $4000; {0040000}
STAT_IFCHR = $2000; {0020000}
STAT_IFIFO = $1000; {0010000}

```

```

STAT_ISUID = $0800; {0004000}
STAT_ISGID = $0400; {0002000}
STAT_ISVTX = $0200; {0001000}
{ Constants to check permissions }
STAT_IRWXO = $7;
STAT_IROTH = $4;
STAT_IWOTH = $2;
STAT_IXOTH = $1;
STAT_IRWXG = STAT_IRWXO shl 3;
STAT_IRGRP = STAT_IROTH shl 3;
STAT_IWGRP = STAT_IWOTH shl 3;
STAT_IXGRP = STAT_IXOTH shl 3;
STAT_IRWXU = STAT_IRWXO shl 6;
STAT_IRUSR = STAT_IROTH shl 6;
STAT_IWUSR = STAT_IWOTH shl 6;
STAT_IXUSR = STAT_IXOTH shl 6;

```

You can test the type of a filesystem returned by a `FStat` (214) call with the following constants:

```

fs_old_ext2 = $ef51;
fs_ext2     = $ef53;
fs_ext      = $137d;
fs_iso      = $9660;
fs_minix    = $137f;
fs_minix_30 = $138f;
fs_minix_V2 = $2468;
fs_msdos    = $4d44;
fs_nfs      = $6969;
fs_proc     = $9fa0;
fs_xia      = $012FD16D;

```

the `Flock` (212) call uses the following mode constants :

```

LOCK_SH = 1;
LOCK_EX = 2;
LOCK_UN = 8;
LOCK_NB = 4;

```

The `MMap` (232) function uses the following constants to specify access to mapped memory:

```

PROT_READ = $1; { page can be read }
PROT_WRITE = $2; { page can be written }
PROT_EXEC = $4; { page can be executed }
PROT_NONE = $0; { page can not be accessed }

```

and the following constants to specify the type of mapping.

```

MAP_SHARED = $1; { Share changes }
MAP_PRIVATE = $2; { Changes are private }
MAP_TYPE = $f; { Mask for type of mapping }
MAP_FIXED = $10; { Interpret addr exactly }
MAP_ANONYMOUS = $20; { don't use a file }

```

12.2 Function list by category

What follows is a listing of the available functions, grouped by category. For each function there is a reference to the page where you can find the function.

File Input/Output routines

Functions for handling file input/output.

Name	Description	Page
Dup	Duplicate a file handle	200
Dup2	Copy one file handle to another	201
Fcntl	General file control	216
fdClose	Close file descriptor	208
fdFlush	Flush file descriptor	208
fdOpen	Open new file descriptor	209
fdRead	Read from file descriptor	210
fdSeek	Position in file	211
fdTruncate	Truncate file	211
fdWrite	Write to file descriptor	211
GetFS	Get file descriptor of pascal file	221
Select	Wait for input from file descriptor	241
SelectText	Wait for input from pascal file	242

General File handling routines

Functions for handling files on disk.

Name	Description	Page
Access	Check access rights on file	190
BaseName	Return name part of file	194
Chown	Change owner of file	195
Chmod	Change access rights on file	196
DirName	Return directory part of file	200
FSplit	Split filename in parts	213
FExpand	Return full-grown filename	212
FLock	Set lock on a file	212
FNMatch	Match filename to searchpattern	212
FSearch	Search for a file in a path	213
FSStat	Return filesystem information	214
FStat	Return file information	215
FRename	Rename file	217
LStat	Return information on a link	230

Link	Create a link	231
ReadLink	Read contents of a symbolic link	239
SymLink	Create a symbolic link	248
Umask	Set the file creation mask	253
UnLink	Remove a file	254
Utime	Change file timestamps	254

Pipes, FIFOs and streams

Functions for creating and managing pipes.

Name	Description	Page
AssignPipe	Create a pipe	192
AssignStream	Create pipes to program's input and output	192
MkFifo	Make a fifo	232
PClose	Close a pipe	237
POpen	Open a pipe for to program's input or output	237

Directory handling routines

Functions for reading and searching directories.

Name	Description	Page
CloseDir	Close directory handle	199
Glob	Return files matching a search expression	225
GlobFree	Free result of Glob	226
OpenDir	Open directory for reading	236
ReadDir	Read directory entry	238
SeekDir	Seek directory	241
TellDir	Seek directory	253

Process handling

Functions for managing processes and programs.

Name	Description	Page
Clone	Create a thread	197
Exec1	Execute process with command-line list	202
Execle	Execute process with command-line list and environment	203
Exec1p	Search in path and execute process with command list	204
Execv	Execute process	205
Execve	Execute process with environment	205
Execvp	Search in path and execute process	206

Fork	Spawn child process	217
GetEGid	Get effective group id	219
GetEnv	Get environment variable	220
GetEUid	Get effective user id	220
GetGid	Get group id	221
GetPid	Get process id	222
GetPPid	Get parent process id	223
GetPriority	Get process priority	223
GetUid	Get user id	225
Nice	Change priority of process	235
SetPriority	Change priority of process	243
Shell	Execute shell command	243
WaitPid	Wait for child process to terminate	255

Signals

Functions for managing and responding to signals.

Name	Description	Page
Alarm	Send alarm signal to self	191
Kill	Send arbitrary signal to process	229
pause	Wait for signal to arrive	237
SigAction	Set signal action	244
Signal	Set signal action	246
SigPending	See if signals are waiting	245
SigProcMask	Set signal processing mask	245
SigRaise	Send signal to self	245
SigSuspend	Sets signal mask and waits for signal	246
NanoSleep	Waits for a specific amount of time	234

System information

Functions for retrieving system information such as date and time.

Name	Description	Page
GetDate	Return system date	218
GetDateTime	Return system date and time	218
GetDomainName	Return system domain name	219
GetEpochTime	Return epoch time	220
GetHostName	Return system host name	222
GetLocalTimezone	Return system timezone	222
GetTime	Return system time	224

GetTimeOfDay	Return system time	224
GetTimezoneFile	Return name of timezone file	225
ReadTimezoneFile	Read timezone file contents	241
SysInfo	Return general system information	249
Uname	Return system information	254

Terminal functions

Functions for controlling the terminal to which the process is connected.

Name	Description	Page
CFMakeRaw	Set terminal to raw mode	194
CFSetISpeed	Set terminal reading speed	195
CFSetOSpeed	Set terminal writing speed	195
IOCtl	General IO control call	226
IsATTY	See if filedescriptor is a terminal	227
TCDrain	Wait till all output was written	250
TCFlow	Suspend transmission or receipt of data	250
TCFlush	Discard data written to terminal	251
TCGetAttr	Get terminal attributes	251
TCGetPGrp	Return PID of foreground process	252
TCSendBreak	Send data for specific time	252
TCSetAttr	Set terminal attributes	252
TCSetPGrp	Set foreground process	253
TTYName	Name of tty file	253

Port input/output

Functions for reading and writing to the hardware ports.

Name	Description	Page
IOperm	Set permissions for port access	227
ReadPort	Read data from port	240
ReadPortB	Read 1 byte from port	240
ReadPortL	Read 4 bytes from port	240
ReadPortW	Read 2 bytes from port	241
WritePort	Write data to port	256
WritePortB	Write 1 byte to port	256
WritePortL	Write 4 bytes to port	256
WritePortW	Write 2 bytes to port	257

Utility routines

Auxiliary functions that are useful in connection with the other functions.

Name	Description	Page
CreateShellArgV	Create an array of pchars from string	199
EpochToLocal	Convert epoch time to local time	202
FD_Clr	Clear item of select filedescriptors	207
FD_IsSet	Check item of select filedescriptors	208
FD_Set	Set item of select filedescriptors	208
FD_ZERO	Clear all items in select filedescriptors	207
LocalToEpoch	Convert local time to epoch time	232
MMap	Map a file into memory	232
MUnMap	Unmap previously mapped memory file	234
Octal	Convert octal to digital	235
S_ISBLK	Check file mode for block device	227
S_ISCHR	Check file mode for character device	228
S_ISDIR	Check file mode for directory	228
S_ISFIFO	Check file mode for FIFO	228
S_ISLNK	Check file mode for symboloc link	228
S_ISREG	Check file mode for regular file	229
S_ISSOCK	Check file mode for socket	229
StringToPPchar	Create an array of pchars from string	247

12.3 Functions and procedures

Access

Declaration: `Function Access (Path : Pathstr; Mode : integer) : Boolean;`

Description: Tests user's access rights on the specified file. Mode is a mask existing of one or more of

R_OKUser has read rights.

W_OKUser has write rights.

X_OKUser has execute rights.

F_OKUser has search rights in the directory where the file is.

The test is done with the real user ID, instead of the effective user ID. If access is denied, or an error occurred, false is returned.

Errors: `LinuxError` is used to report errors:

sys_eaccessThe requested access is denied, either to the file or one of the directories in its path.

sys_einvalMode was incorrect.

sys_enoentA directory component in `Path` doesn't exist or is a dangling symbolic link.

sys_enotdirA directory component in `Path` is not a directory.

sys_enomemInsufficient kernel memory.

sys_eloopPath has a circular symbolic link.

See also: Chown (195), Chmod (196), Access (2)

Listing: linuxex/ex26.pp

Program Example26;

{ Program to demonstrate the Access function. }

Uses linux;

begin

if Access ('/etc/passwd',W_OK) **then**

begin

WriteLn ('Better check your system.');

WriteLn ('I can write to the /etc/passwd file !');

end;

end.

Alarm

Declaration: Function Alarm(Sec : longint) : Longint;

Description: Alarm schedules an alarm signal to be delivered to your process in Sec seconds. When Sec seconds have elapsed, Linux will send a SIGALRM signal to the current process. If Sec is zero, then no new alarm will be set. Whatever the value of Sec, any previous alarm is cancelled.

The function returns the number of seconds till the previously scheduled alarm was due to be delivered, or zero if there was none.

Errors: None

Listing: linuxex/ex59.pp

Program Example59;

{ Program to demonstrate the Alarm function. }

Uses linux;

Procedure AlarmHandler(Sig : longint);**cdecl;**

begin

WriteLn ('Got to alarm handler');

end;

begin

WriteLn('Setting alarm handler');

 Signal(SIGALRM, @AlarmHandler);

WriteLn ('Scheduling Alarm in 10 seconds');

 Alarm(10);

WriteLn ('Pausing');

 Pause;

WriteLn ('Pause returned');

end.

AssignPipe

Declaration: `Function AssignPipe(var pipe_in,pipe_out:longint):boolean; Function AssignPipe(var pipe_in,pipe_out:text):boolean; Function AssignPipe(var pipe_in,pipe_out:file):boolean;`

Description: AssignPipe creates a pipe, i.e. two file objects, one for input, one for output. What is written to Pipe_out, can be read from Pipe_in.

This call is overloaded. The in and out pipe can take three forms: an typed or untyped file, a text file or a file descriptor.

If a text file is passed then reading and writing from/to the pipe can be done through the usual `Readln(Pipe_in,...)` and `Writeln (Pipe_out,...)` procedures.

The function returns `True` if everything went successfully, `False` otherwise.

Errors: In case the function fails and returns `False`, `LinuxError` is used to report errors:

`sys_emfile` Too many file descriptors for this process.

`sys_emfile` The system file table is full.

See also: `POpen` (237), `MkFifo` (232), `pipe` (2)

Listing: linuxex/ex36.pp

Program Example36;

{ Program to demonstrate the AssignPipe function. }

Uses linux;

Var pipi ,pipo : Text;
s : **String**;

```
begin
  Writeln ('Assigning Pipes. ');
  If Not assignpipe(pipi ,pipo) then
    Writeln('Error assigning pipes !',LinuxError);
  Writeln ('Writing to pipe , and flushing. ');
  Writeln (pipo, 'This is a textstring '); close(pipo);
  Writeln ('Reading from pipe. ');
  While not eof(pipi) do
    begin
      Readln (pipi ,s);
      Writeln ('Read from pipe : ',s);
    end;
  close (pipi);
  writeln ('Closed pipes. ');
  writeln
end.
```

AssignStream

Declaration: `Function AssignStream(Var StreamIn,Streamout:text; Const Prog:String) : longint; Function AssignStream(var StreamIn, StreamOut, StreamErr: Text; const prog: String): LongInt;`

Description: `AssignStream` creates a 2 or 3 pipes, i.e. two (or three) file objects, one for input, one for output, (and one for standard error) the other ends of these pipes are connected to standard input and output (and standard error) of `Prog`. `Prog` is the name of a program (including path) with options, which will be executed.

What is written to `StreamOut`, will go to the standard input of `Prog`. Whatever is written by `Prog` to its standard output can be read from `StreamIn`. Whatever is written by `Prog` to its standard error read from `StreamErr`, if present.

Reading and writing happens through the usual `Readln(StreamIn, ...)` and `Writeln(StreamOut, ...)` procedures.

Remark: You should *not* use `Reset` or `Rewrite` on a file opened with `POpen`. This will close the file before re-opening it again, thereby closing the connection with the program.

The function returns the process ID of the spawned process, or -1 in case of error.

Errors: In case of error (return value -1) `LinuxError` is used to report errors:

`sys_emfile` Too many file descriptors for this process.

`sys_emfile` The system file table is full.

Other errors include the ones by the `fork` and `exec` programs

See also: `AssignPipe` (192), `POpen` (237), `pipe` (2)

Listing: `linuxex/ex38.pp`

Program `Example38`;

{ Program to demonstrate the AssignStream function. }

Uses `linux`;

Var `Si, So` : `Text`;
`S` : **String**;
`i` : `longint`;

begin

```

if not (paramstr(1) = '-son') then
  begin
    Writeln ('Calling son');
    Assignstream (Si, So, './ex38 -son');
    if linuxerror <> 0 then
      begin
        writeln ('AssignStream failed !');
        halt(1);
      end;
    Writeln ('Speaking to son');
    For i:=1 to 10 do
      begin
        writeln (so, 'Hello son !');
        if ioreult <> 0 then writeln ('Can''t speak to son...');
      end;
    For i:=1 to 3 do writeln (so, 'Hello chap !');
    close (so);
    while not eof(si) do
      begin
        readln (si, s);
        writeln ('Father: Son said : ', S);
      end;
  end;

```

```
    Writeln ( 'Stopped conversation' );
    Close ( Si );
    Writeln ( 'Put down phone' );
end
Else
begin
Writeln ( 'This is the son ' );
While not eof ( input ) do
begin
    readln ( s );
    if pos ( 'Hello son ! ', S ) <> 0 then
        Writeln ( 'Hello Dad ! ' )
    else
        writeln ( 'Who are you ? ' );
    end;
close ( output );
end
end.
```

BaseName

Declaration: `Function BaseName (Const Path; Const Suf : Pathstr) : Pathstr;`

Description: Returns the filename part of Path, stripping off Suf if it exists. The filename part is the whole name if Path contains no slash, or the part of Path after the last slash. The last character of the result is not a slash, unless the directory is the root directory.

Errors: None.

See also: [DirName \(200\)](#), [FExpand \(212\)](#), [Basename \(1\)](#)

Listing: linuxex/ex48.pp

Program Example48;

```
{ Program to demonstrate the BaseName function. }
```

Uses linux;

Var S : **String**;

```
begin
    S:=FExpand(Paramstr(0));
    Writeln ( 'This program is called : ', Basename(S, ''));
end.
```

CFMakeRaw

Declaration: `Procedure CFMakeRaw (var Tios:TermIOS);`

Description: CFMakeRaw Sets the flags in the Termios structure Tios to a state so that the terminal will function in Raw Mode.

Errors: None.

See also: [CFSetOSpeed \(195\)](#), [CFSetISpeed \(195\)](#), [termios \(2\)](#)

For an example, see [TCGetAttr \(251\)](#).

CFSetISpeed

Declaration: Procedure CFSetISpeed (var Tios:TermIOS;Speed:Longint);

Description: CFSetISpeed Sets the input baudrate in the TermIOS structure Tios to Speed.

Errors: None.

See also: CFSetOSpeed (195), CFMakeRaw (194), termios (2)

CFSetOSpeed

Declaration: Procedure CFSetOSpeed (var Tios:TermIOS;Speed:Longint);

Description: CFSetOSpeed Sets the output baudrate in the Termios structure Tios to Speed.

Errors: None.

See also: CFSetISpeed (195), CFMakeRaw (194), termios (2)

Chown

Declaration: Function Chown (Path : Pathstr;NewUid,NewGid : Longint) : Boolean;

Description: Chown sets the User ID and Group ID of the file in Path to NewUid, NewGid. The function returns True if the call was successful, False if the call failed.

Errors: Errors are returned in LinuxError.

sys_epermThe effective UID doesn't match the ownership of the file, and is not zero. Owner or group were not specified correctly.

sys_eaccessOne of the directories in Path has no search (=execute) permission.

sys_enoentA directory entry in Path does not exist or is a symbolic link pointing to a non-existent directory.

sys_enotdirA directory entry in OldPath or NewPath is not a directory.

sys_enomemInsufficient kernel memory.

sys_erofsThe file is on a read-only filesystem.

sys_eloopPath has a reference to a circular symbolic link, i.e. a symbolic link, whose expansion points to itself.

See also: Chmod (196), Access (190), Chown (()) 2

Listing: linuxex/ex24.pp

Program Example24;

{ Program to demonstrate the Chown function. }

Uses linux;

Var UID,GID : Longint;
F : Text;

begin

WriteLn ('This will only work if you are root.');

```

Write ('Enter a UID : ');readln(UID);
Write ('Enter a GID : ');readln(GID);
Assign (f, 'test.txt');
Rewrite (f);
Writeln (f, 'The owner of this file should become : ');
Writeln (f, 'UID : ',UID);
Writeln (f, 'GID : ',GID);
Close (F);
if not Chown ('test.txt',UID,GID) then
  if LinuxError=Sys_EPERM then
    Writeln ('You are not root !')
  else
    Writeln ('Chmod failed with exit code : ',LinuxError)
  else
    Writeln ('Changed owner successfully !');
end.

```

Chmod

Declaration: Function Chmod (Path : Pathstr;NewMode : Longint) : Boolean;

Description: Chmod Sets the Mode bits of the file in Path to NewMode. Newmode can be specified by 'or'-ing the following:

- S_ISUID**Set user ID on execution.
- S_ISGID**Set Group ID on execution.
- S_ISVTX**Set sticky bit.
- S_IRUSR**Read by owner.
- S_IWUSR**Write by owner.
- S_IXUSR**Execute by owner.
- S_IRGRP**Read by group.
- S_IWGRP**Write by group.
- S_IXGRP**Execute by group.
- S_IROTH**Read by others.
- S_IWOTH**Write by others.
- S_IXOTH**Execute by others.
- S_IRWXO**Read, write, execute by others.
- S_IRWXG**Read, write, execute by groups.
- S_IRWXU**Read, write, execute by user.

Errors: Errors are returned in LinuxError.

sys_epermThe effective UID doesn't match the ownership of the file, and is not zero. Owner or group were not specified correctly.

sys_eaccessOne of the directories in Path has no search (=execute) permission.

sys_enoentA directory entry in Path does not exist or is a symbolic link pointing to a non-existent directory.

sys_enotdirA directory entry in OldPath or NewPath is nor a directory.

sys_enomemInsufficient kernel memory.

sys_erofsThe file is on a read-only filesystem.

sys_eloopPath has a reference to a circular symbolic link, i.e. a symbolic link, whose expansion points to itself.

See also: Chown (195), Access (190), Chmod (12), Octal (235)

Listing: linuxex/ex23.pp

Program Example23;

```
{ Program to demonstrate the Chmod function. }
```

Uses linux;

Var F : Text;

begin

```
  { Create a file }
  Assign ( f, 'testex21' );
  Rewrite ( F );
  Writeln ( f, '#!/bin/sh' );
  Writeln ( f, 'echo Some text for this file' );
  Close ( F );
  { Octal() makes the correct number from a
    number that LOOKS octal }
  Chmod ( 'testex21', octal (777));
  { File is now executable }
  execl ( './testex21' );
```

end.

Clone

Declaration: TCloneFunc=function(args:pointer):longint; cdecl; Clone(func:TCloneFunc;sp:pointer;flags

Description: Clone creates a child process which is a copy of the parent process, just like Fork (217) does. In difference with Fork, however, the child process shares some parts of it's execution context with its parent, so it is suitable for the implementation of threads: many instances of a program that share the same memory.

When the child process is created, it starts executing the function Func, and passes it Args. The return value of Func is either the explicit return value of the function, or the exit code of the child process.

The sp pointer points to the memory reserved as stack space for the child process. This address should be the top of the memory block to be used as stack.

The Flags determine the behaviour of the Clone call. The low byte of the Flags contains the number of the signal that will be sent to the parent when the child dies. This may be bitwise OR'ed with the following constants:

CLONE_VMParent and child share the same memory space, including memory (un)mapped with subsequent mmap calls.

CLONE_FSParent and child have the same view of the filesystem; the chroot, chdir and umask calls affect both processes.

CLONE_FILESthe file descriptor table of parent and child is shared.

CLONE_SIGHANDthe parent and child share the same table of signal handlers. The signal masks are different, though.

CLONE_PIDParent and child have the same process ID.

Clone returns the process ID in the parent process, and -1 if an error occurred.

Errors: On error, -1 is returned to the parent, and no child is created.

sys_eagainToo many processes are running.

sys_enomemNot enough memory to create child process.

See also: Fork (217), clone (2)

Listing: linuxex/ex71.pp

```

program TestC { lone };

uses
  Linux , Errors , crt ;

const
  Ready : Boolean = false ;
  aChar : Char    = 'a' ;

function CloneProc ( Arg : Pointer ) : LongInt ; Cdecl ;
begin
  WriteLn ( 'Hello from the clone ' , PChar ( Arg ) ) ;
  repeat
    Write ( aChar ) ;
    Select ( 0 , 0 , 0 , 0 , 600 ) ;
  until Ready ;
  WriteLn ( 'Clone finished . ' ) ;
  CloneProc := 1 ;
end ;

var
  PID : LongInt ;

procedure MainProc ;
begin
  WriteLn ( 'cloned process PID : ' , PID ) ;
  WriteLn ( 'Press <ESC> to kill ... ' ) ;
  repeat
    Write ( ' . ' ) ;
    Select ( 0 , 0 , 0 , 0 , 300 ) ;
    if KeyPressed then
      case ReadKey of
        #27 : Ready := true ;
        'a' : aChar := 'A' ;
        'A' : aChar := 'a' ;
        'b' : aChar := 'b' ;
        'B' : aChar := 'B' ;
      end ;
    until Ready ;
  WriteLn ( 'Ready . ' ) ;
end ;

const
  StackSize = 16384 ;
  theFlags = CLONE_VM + CLONE_FS + CLONE_FILES + CLONE_SIGHAND ;
  aMsg      : PChar = 'Oops !' ;

```

```

var
  theStack : Pointer;
  ExitStat : LongInt;

begin
  GetMem( theStack , StackSize );
  PID := Clone( @CloneProc,
               Pointer( LongInt(theStack)+StackSize),
               theFlags,
               aMsg);
  if PID < 0 then
    WriteLn('Error : ', LinuxError, ' when cloning.')
  else
    begin
      MainProc;
      case WaitPID(0, @ExitStat, Wait_Untraced or wait_clone) of
        -1: WriteLn('error: ', LinuxError, '; ', StrError(LinuxError));
        0: WriteLn('error: ', LinuxError, '; ', StrError(LinuxError));
      else
        WriteLn('Clone exited with: ', ExitStat shr 8);
      end;
    end;
  FreeMem( theStack , StackSize );
end.

```

CloseDir

Declaration: `Function CloseDir (p:pdir) : integer;`

Description: `CloseDir` closes the directory pointed to by `p`. It returns zero if the directory was closed successfully, -1 otherwise.

Errors: Errors are returned in `LinuxError`.

See also: `OpenDir` (236), `ReadDir` (238), `SeekDir` (241), `TellDir` (253), `closedir` (3)

For an example, see `OpenDir` (236).

CreateShellArgV

Declaration: `function CreateShellArgV(const prog:string):ppchar; function CreateShellArgV(const prog:Ansistring):ppchar;`

Description: `CreateShellArgV` creates an array of 3 `PChar` pointers that can be used as arguments to `ExecVE` the first elements in the array will contain `/bin/sh`, the second will contain `-c`, and the third will contain `prog`.

The function returns a pointer to this array, of type `PPChar`.

Errors: None.

See also: `Shell` (243)

Listing: `linuxex/ex61.pp`

```

Program ex61;

{ Example program to demonstrate the CreateShellArgV function }

uses linux;

Var
  S: String;
  PP : PPchar;
  I : longint;

begin
  S:= 'script -a -b -c -d -e fghijk';
  PP:=CreateShellArgV(S);
  I:=0;
  If PP<>Nil then
    While PP[i]<>Nil do
      begin
        WriteLn ( 'Got : " ',PP[i],'"');
        Inc(i);
      end;
    end.

```

DirName

Declaration: `Function DirName (Const Path : Pathstr) : Pathstr;`

Description: Returns the directory part of Path. The directory is the part of Path before the last slash, or empty if there is no slash. The last character of the result is not a slash, unless the directory is the root directory.

Errors: None.

See also: [BaseName \(194\)](#), [FExpand \(212\)](#), [Dirname \(1\)](#)

Listing: linuxex/ex47.pp

```

Program Example47;

{ Program to demonstrate the DirName function. }

Uses linux;

Var S : String;

begin
  S:=FExpand(Paramstr(0));
  WriteLn ( 'This program is in directory : ',Dirname(S));
end.

```

Dup

Declaration: `Function Dup(oldfile:longint;var newfile:longint):Boolean; Function Dup(var oldfile,newfile:text):Boolean; Function Dup(var oldfile,newfile:file):Boolean;`

Description: Makes `NewFile` an exact copy of `OldFile`, after having flushed the buffer of `OldFile` in case it is a Text file or untyped file. Due to the buffering mechanism of Pascal, this has not the same functionality as the `dup (2)` call in C. The internal Pascal buffers are not the same after this call, but when the buffers are flushed (e.g. after output), the output is sent to the same file. Doing an `lseek` will, however, work as in C, i.e. doing a `lseek` will change the fileposition in both files.

The function returns `False` in case of an error, `True` if successful.

Errors: In case of errors, `Linuxerror` is used to report errors.

`sys_ebadf` `OldFile` hasn't been assigned.

`sys_emfile` Maximum number of open files for the process is reached.

See also: [Dup2 \(201\)](#), [Dup \(2\)](#)

Listing: `linuxex/ex31.pp`

```

program Example31;

{ Program to demonstrate the Dup function. }

uses linux;

var f : text;

begin
  if not dup (output, f) then
    Writeln ('Dup Failed !');
    writeln ('This is written to stdout. ');
    writeln (f, 'This is written to the dup file , and flushed'); flush(f);
    writeln
  end.

```

Dup2

Declaration: `Function Dup2(oldfile,newfile:longint):Boolean;` `Function Dup2(var oldfile,newfile:text)`
`Function Dup2(var oldfile,newfile:file):Boolean;`

Description: Makes `NewFile` an exact copy of `OldFile`, after having flushed the buffer of `OldFile` in the case of text or untyped files.

`NewFile` can be an assigned file. If `newfile` was open, it is closed first. Due to the buffering mechanism of Pascal, this has not the same functionality as the `dup2 (2)` call in C. The internal Pascal buffers are not the same after this call, but when the buffers are flushed (e.g. after output), the output is sent to the same file. Doing an `lseek` will, however, work as in C, i.e. doing a `lseek` will change the fileposition in both files.

The function returns `True` if succesful, `false` otherwise.

Errors: In case of error, `Linuxerror` is used to report errors.

`sys_ebadf` `OldFile` hasn't been assigned.

`sys_emfile` Maximum number of open files for the process is reached.

See also: [Dup \(200\)](#), [Dup2 \(2\)](#)

Listing: `linuxex/ex32.pp`

```

program Example31;

{ Program to demonstrate the Dup function. }

uses linux;

var f : text;
    i : longint;

begin
  Assign (f, 'text.txt');
  Rewrite (F);
  For i:=1 to 10 do writeln (F, 'Line : ', i);
  if not dup2 (output, f) then
    Writeln ('Dup2 Failed !');
  writeln ('This is written to stdout. ');
  writeln (f, 'This is written to the dup file , and flushed');
  flush(f);
  writeln;
  { Remove file . Comment this if you want to check flushing. }
  Unlink ('text.txt');
end.

```

EpochToLocal

Declaration: Procedure EpochToLocal (Epoch : Longint; var Year, Month, Day, Hour, Minute, Second : Word);

Description: Converts the epoch time (=Number of seconds since 00:00:00 , January 1, 1970, corrected for your time zone) to local date and time.

This function takes into account the timzeone settings of your system.

Errors: None

See also: [GetEpochTime \(220\)](#), [LocalToEpoch \(232\)](#), [GetTime \(224\)](#), [GetDate \(218\)](#)

Listing: linuxex/ex3.pp

```

Program Example3;

{ Program to demonstrate the EpochToLocal function. }

Uses linux;

Var Year, month, day, hour, minute, seconds : Word;

begin
  EpochToLocal (GetEpochTime, Year, month, day, hour, minute, seconds);
  Writeln ('Current date : ', Day:2, '/', Month:2, '/', Year:4);
  Writeln ('Current time : ', Hour:2, ':', minute:2, ':', seconds:2);
end.

```

Execl

Declaration: Procedure Execl (Path : pathstr);

Description: Replaces the currently running program with the program, specified in `path`. Path is split into a command and its options. The executable in `path` is NOT searched in the path. The current environment is passed to the program. On success, `execl` does not return.

Errors: Errors are reported in `LinuxError`:

sys_eaccessFile is not a regular file, or has no execute permission. A component of the path has no search permission.

sys_epermThe file system is mounted *noexec*.

sys_e2bigArgument list too big.

sys_enoexecThe magic number in the file is incorrect.

sys_enoentThe file does not exist.

sys_enomemNot enough memory for kernel, or to split command line.

sys_enotdirA component of the path is not a directory.

sys_eloopThe path contains a circular reference (via symlinks).

See also: `Execve` (205), `Execv` (205), `Execvp` (206), `Execle` (203), `Execlp` (204), `Fork` (217), `execvp` (3)

Listing: `linuxex/ex10.pp`

Program `Example10`;

{ Program to demonstrate the Execl function. }

Uses `linux` , `strings`;

begin

{ Execute 'ls -l', with current environment. }

{ 'ls' is NOT looked for in PATH environment variable. }

`Execl ('/bin/ls -l');`

end.

Execle

Declaration: `Procedure Execle (Path : pathstr, Ep : ppchar);`

Description: Replaces the currently running program with the program, specified in `path`. Path is split into a command and its options. The executable in `path` is searched in the path, if it isn't an absolute filename. The environment in `ep` is passed to the program. On success, `execle` does not return.

Errors: Errors are reported in `LinuxError`:

sys_eaccessFile is not a regular file, or has no execute permission. A component of the path has no search permission.

sys_epermThe file system is mounted *noexec*.

sys_e2bigArgument list too big.

sys_enoexecThe magic number in the file is incorrect.

sys_enoentThe file does not exist.

sys_enomemNot enough memory for kernel, or to split command line.

sys_enotdirA component of the path is not a directory.

sys_eloopThe path contains a circular reference (via symlinks).

See also: [Execve \(205\)](#), [Execv \(205\)](#), [Execvp \(206\)](#), [Execl \(202\)](#), [Execlp \(204\)](#), [Fork \(217\)](#), [execvp \(3\)](#)

Listing: linuxex/ex11.pp

Program Example11;

{ Program to demonstrate the Execl function. }

Uses linux , strings ;

begin

{ Execute 'ls -l', with current environment. }
{ 'ls' is NOT looked for in PATH environment variable. }
{ envp is defined in the system unit. }
 Execl ('/bin/ls -l',envp);

end.

Execlp

Declaration: Procedure Execlp (Path : pathstr);

Description: Replaces the currently running program with the program, specified in path. Path is split into a command and it's options. The executable in path is searched in the path, if it isn't an absolute filename. The current environment is passed to the program. On success, `execlp` does not return.

Errors: Errors are reported in `LinuxError`:

sys_eaccessFile is not a regular file, or has no execute permission. A component of the path has no search permission.

sys_epermThe file system is mounted *noexec*.

sys_e2bigArgument list too big.

sys_enoexecThe magic number in the file is incorrect.

sys_enoentThe file does not exist.

sys_enomemNot enough memory for kernel, or to split command line.

sys_enotdirA component of the path is not a directory.

sys_eloopThe path contains a circular reference (via symlinks).

See also: [Execve \(205\)](#), [Execv \(205\)](#), [Execvp \(206\)](#), [Execl \(203\)](#), [Execl \(202\)](#), [Fork \(217\)](#), [execvp \(3\)](#)

Listing: linuxex/ex12.pp

Program Example12;

{ Program to demonstrate the Execlp function. }

Uses linux , strings ;

begin

{ Execute 'ls -l', with current environment. }
{ 'ls' is looked for in PATH environment variable. }
{ envp is defined in the system unit. }
 Execlp ('ls -l',envp);

end.

Execv

Declaration: Procedure Execv (Path : pathstr; args : ppchar);

Description: Replaces the currently running program with the program, specified in path. It gives the program the options in args. This is a pointer to an array of pointers to null-terminated strings. The last pointer in this array should be nil. The current environment is passed to the program. On success, execv does not return.

Errors: Errors are reported in LinuxError:

sys_eaccessFile is not a regular file, or has no execute permission. A component of the path has no search permission.

sys_epermThe file system is mounted *noexec*.

sys_e2bigArgument list too big.

sys_enoexecThe magic number in the file is incorrect.

sys_enoentThe file does not exist.

sys_enomemNot enough memory for kernel.

sys_enotdirA component of the path is not a directory.

sys_eloopThe path contains a circular reference (via symlinks).

See also: Execve (205), Execvp (206), Execl (203), Execl (202), Execlp (204), Fork (217), execv (3)

Listing: linuxex/ex8.pp

Program Example8;

{ Program to demonstrate the Execv function. }

Uses linux , strings;

Const Arg0 : PChar = '/bin/lS';
Arg1 : Pchar = '-l';

Var PP : PPchar;

begin

GetMem (PP,3*SizeOf(Pchar));

PP[0]:=Arg0;

PP[1]:=Arg1;

PP[3]:=Nil;

{ Execute '/bin/lS -l', with current environment }

Execv ('/bin/lS',pp);

end.

Execve

Declaration: Procedure Execve(Path:pchar;args:ppchar;ep:ppchar); Procedure Execve (Path : pathstr; args,ep : ppchar);

Description: Replaces the currently running program with the program, specified in path. It gives the program the options in args, and the environment in ep. They are pointers to an array of pointers to null-terminated strings. The last pointer in this array should be nil. On success, execve does not return.

Errors: Errors are reported in `LinuxError`:

eaccessFile is not a regular file, or has no execute permission. A component of the path has no search permission.

sys_ epermThe file system is mounted *noexec*.

sys_ e2bigArgument list too big.

sys_ enoexecThe magic number in the file is incorrect.

sys_ enoentThe file does not exist.

sys_ enomemNot enough memory for kernel.

sys_ enotdirA component of the path is not a directory.

sys_ eloopThe path contains a circular reference (via symlinks).

See also: `Execve` (205), `Execv` (205), `Execvp` (206) `Execl` (203), `Execl` (202), `Execvp` (204), `Fork` (217), `execve` (2)

Listing: `linuxex/ex7.pp`

Program `Example7`;

{ Program to demonstrate the Execve function. }

Uses `linux` , `strings`;

Const `Arg0` : `PChar` = `'/bin/lS'`;
 `Arg1` : `Pchar` = `'-l'`;

Var `PP` : `PPchar`;

begin

GetMem (`PP`, `3 * SizeOf(Pchar)`);

`PP[0]` := `Arg0`;

`PP[1]` := `Arg1`;

`PP[3]` := `Nil`;

{ Execute '/bin/lS -l', with current environment }

{ Env is defined in system.inc }

`ExecVe` (`'/bin/lS'`, `pp`, `envp`);

end.

Execvp

Declaration: `Procedure Execvp (Path : pathstr; args : ppchar);`

Description: Replaces the currently running program with the program, specified in `path`. The executable in `path` is searched in the path, if it isn't an absolute filename. It gives the program the options in `args`. This is a pointer to an array of pointers to null-terminated strings. The last pointer in this array should be `nil`. The current environment is passed to the program. On success, `execvp` does not return.

Errors: Errors are reported in `LinuxError`:

sys_ eaccessFile is not a regular file, or has no execute permission. A component of the path has no search permission.

sys_ epermThe file system is mounted *noexec*.

sys_e2bigArgument list too big.
sys_enoexecThe magic number in the file is incorrect.
sys_enoentThe file does not exist.
sys_enomemNot enough memory for kernel.
sys_enotdirA component of the path is not a directory.
sys_eloopThe path contains a circular reference (via symlinks).

See also: Execve (205), Execv (205), Execle (203), Execl (202), Execlp (204), Fork (217), execvp (3)

Listing: linux/ex9.pp

Program Example9;

{ Program to demonstrate the Execvp function. }

Uses linux , strings ;

Const Arg0 : PChar = 'ls' ;
 Arg1 : Pchar = '-l' ;

Var PP : PPchar ;

begin

GetMem (PP, 3* **SizeOf** (Pchar)) ;
 PP[0] := Arg0 ;
 PP[1] := Arg1 ;
 PP[3] := **Nil** ;
{ Execute 'ls -l', with current environment. }
{ 'ls' is looked for in PATH environment variable. }
{ Env is defined in the system unit. }
 Execvp ('ls', pp, envp) ;

end.

FD_ZERO

Declaration: Procedure FD_ZERO (var fds: fdSet) ;

Description: FD_ZERO clears all the filedescriptors in the file descriptor set fds.

Errors: None.

See also: Select (241), SelectText (242), GetFS (221), FD_Clr (207), FD_Set (208), FD_IsSet (208)

For an example, see Select (241).

FD_Clr

Declaration: Procedure FD_Clr (fd: longint; var fds: fdSet) ;

Description: FD_Clr clears file descriptor fd in filedescriptor set fds.

Errors: None.

See also: Select (241), SelectText (242), GetFS (221), FD_ZERO (207), FD_Set (208), FD_IsSet (208)

For an example, see Select (241).

FD_IsSet

Declaration: `Function FD_IsSet (fd:longint;var fds:fdSet) : boolean;`

Description: `FD_Set` Checks whether file descriptor `fd` in filedescriptor set `fds` is set.

Errors: None.

See also: [Select \(241\)](#), [SelectText \(242\)](#), [GetFS \(221\)](#), [FD_ZERO \(207\)](#), [FD_Clr \(207\)](#), [FD_Set \(208\)](#)

For an example, see [Select \(241\)](#).

FD_Set

Declaration: `Procedure FD_Set (fd:longint;var fds:fdSet);`

Description: `FD_Set` sets file descriptor `fd` in filedescriptor set `fds`.

Errors: None.

See also: [Select \(241\)](#), [SelectText \(242\)](#), [GetFS \(221\)](#), [FD_ZERO \(207\)](#), [FD_Clr \(207\)](#), [FD_IsSet \(208\)](#)

For an example, see [Select \(241\)](#).

fdClose

Declaration: `Function fdClose (fd:longint) : boolean;`

Description: `fdClose` closes a file with file descriptor `fd`. The function returns `True` if the file was closed successfully, `False` otherwise.

Errors: Errors are returned in `LinuxError`

See also: [fdOpen \(209\)](#), [fdRead \(210\)](#), [fdWrite \(211\)](#), [fdTruncate \(211\)](#), [fdFlush \(208\)](#), [seefdSeek](#)

For an example, see [fdOpen \(209\)](#).

fdFlush

Declaration: `Function fdFlush (fd:Longint) : boolean;`

Description: `fdflush` flushes the Linux kernel file buffer, so the file is actually written to disk. This is NOT the same as the internal buffer, maintained by Free Pascal. The function returns `True` if the call was successful, `false` if an error occurred.

Errors: Errors are returned in `LinuxError`.

See also: [fdOpen \(209\)](#), [fdClose \(208\)](#), [fdRead \(210\)](#), [fdWrite \(211\)](#), [fdTruncate \(211\)](#), [fdSeek \(211\)](#)

For an example, see [fdRead \(210\)](#).

fdOpen

Declaration: `Function fdOpen(PathName:String;flags:longint):longint; Function fdOpen(PathName:Pchar ;flags:longint):longint; Function fdOpen(PathName:String;flags,mode:longint):longint; Function fdOpen(PathName:Pchar ;flags,mode:longint):longint;`

Description: `fdOpen` opens a file in `PathName` with flags `flags` One of the following:

Open_RdOnlyFile is opened Read-only.

Open_WrOnlyFile is opened Write-only.

Open_RdWrFile is opened Read-Write.

The flags may beOR-ed with one of the following constants:

Open_AccmodeFile is opened

Open_CreatFile is created if it doesn't exist.

Open_ExclIf the file is opened with `Open_Creat` and it already exists, the call will fail.

Open_NoCttyIf the file is a terminal device, it will NOT become the process' controlling terminal.

Open_TruncIf the file exists, it will be truncated.

Open_Appendthe file is opened in append mode. *Before each write*, the file pointer is positioned at the end of the file.

Open_NonBlockThe file is opened in non-blocking mode. No operation on the file descriptor will cause the calling process to wait till.

Open_NDelayIdem as `Open_NonBlock`

Open_SyncThe file is opened for synchronous IO. Any write operation on the file will not return untill the data is physically written to disk.

Open_NoFollowif the file is a symbolic link, the open fails. (LINUX 2.1.126 and higher only)

Open_Directoryif the file is not a directory, the open fails. (LINUX 2.1.126 and higher only)

`PathName` can be of type `PChar` or `String`. The optional mode argument specifies the permissions to set when opening the file. This is modified by the `umask` setting. The real permissions are `Mode` and not `umask`. The return value of the function is the filedescriptor, or a negative value if there was an error.

Errors: Errors are returned in `LinuxError`

See also: `fdClose` (208), `fdRead` (210), `fdWrite` (211), `fdTruncate` (211), `fdFlush` (208), `fdSeek` (211)

Listing: `linuxex/ex19.pp`

Program `Example19;`

{ Program to demonstrate the fdOpen, fdwrite and fdCLose functions. }

Uses `linux;`

Const `Line : String[80] = 'This is easy writing !';`

Var `FD : Longint;`

begin

`FD:=fdOpen ('Test.dat',Open_WrOnly or Open_Creat);`

`if FD>0 then`

`begin`

`if length(Line)<>fdwrite (FD,Line[1],Length(Line)) then`

```

        WriteLn ('Error when writing to file !');
        fdClose(FD);
    end;
end.

```

fdRead

Declaration: Function `fdRead (fd:longint;var buf;size:longint) : longint;`

Description: `fdRead` reads at most `size` bytes from the file descriptor `fd`, and stores them in `buf`. The function returns the number of bytes actually read, or -1 if an error occurred. No checking on the length of `buf` is done.

Errors: Errors are returned in `LinuxError`.

See also: `fdOpen` (209), `fdClose` (208), `fdWrite` (211), `fdTruncate` (211), `fdFlush` (208), `fdSeek` (211)

Listing: linuxex/ex20.pp

Program Example20;

{ Program to demonstrate the fdRead and fdTruncate functions. }

Uses linux;

Const Data : **string**[10] = '12345687890';

Var FD : Longint;
 I : longint;

begin

FD:=fdOpen('test.dat',open_wronly or open_creat,octal(666));

if fd>0 **then**

begin

{ Fill file with data }

for I:=1 **to** 10 **do**

if fdWrite (FD,Data[I],10)<>10 **then**

begin

writeLn ('Error when writing !');

halt(1);

end;

 fdClose(FD);

 FD:=fdOpen('test.dat',open_rdonly);

{ Read data again }

if FD>0 **then**

begin

For I:=1 **to** 5 **do**

if fdRead (FD,Data[I],10)<>10 **then**

begin

WriteLn ('Error when Reading !');

Halt(2);

end;

 fdClose(FD);

{ Truncating file at 60 bytes }

{ For truncating , file must be open or write }

 FD:=fdOpen('test.dat',open_wronly,octal(666));

if FD>0 **then**

```
begin
  if not fdTruncate(FD,60) then
    Writeln('Error when truncating !');
    fdClose (FD);
  end;
end;
end;
end.
```

fdSeek

Declaration: `Function fdSeek (fd,Pos,SeekType:longint) : longint;`

Description: `fdSeek` sets the current fileposition of file `fd` to `Pos`, starting from `SeekType`, which can be one of the following:

Seek_Set `Pos` is the absolute position in the file.

Seek_Cur `Pos` is relative to the current position.

Seek_end `Pos` is relative to the end of the file.

The function returns the new fileposition, or -1 if an error occurred.

Errors: Errors are returned in `LinuxError`.

See also: [fdOpen \(209\)](#), [fdWrite \(211\)](#), [fdClose \(208\)](#), [fdRead \(210\)](#),[fdTruncate \(211\)](#), [fdFlush \(208\)](#)

For an example, see [fdOpen \(209\)](#).

fdTruncate

Declaration: `Function fdTruncate (fd,size:longint) : boolean;`

Description: `fdTruncate` sets the length of a file in `fd` on `size` bytes, where `size` must be less than or equal to the current length of the file in `fd`. The function returns `True` if the call was successful, `false` if an error occurred.

Errors: Errors are returned in `LinuxError`.

See also: [fdOpen \(209\)](#), [fdClose \(208\)](#), [fdRead \(210\)](#),[fdWrite \(211\)](#),[fdFlush \(208\)](#), [fdSeek \(211\)](#)

fdWrite

Declaration: `Function fdWrite (fd:longint;var buf;size:longint) : longint;`

Description: `fdWrite` writes at most `size` bytes from `buf` to file descriptor `fd`. The function returns the number of bytes actually written, or -1 if an error occurred.

Errors: Errors are returned in `LinuxError`.

See also: [fdOpen \(209\)](#), [fdClose \(208\)](#), [fdRead \(210\)](#),[fdTruncate \(211\)](#), [fdSeek \(211\)](#), [fdFlush \(208\)](#)

FExpand

Declaration: `Function FExpand (Const Path: Pathstr) : pathstr;`

Description: Expands `Path` to a full path, starting from `root`, eliminating directory references such as `.` and `..` from the result.

Errors: None

See also: [BaseName \(194\)](#), [DirName \(200\)](#)

Listing: `linuxex/ex45.pp`

Program `Example45;`

`{ Program to demonstrate the FExpand function. }`

Uses `linux;`

begin

`WriteLn ('This program is in : ',FExpand(Paramstr(0)));`

end.

FLock

Declaration: `Function Flock (fd,mode : longint) : boolean;` `Function Flock (var T : text;mode : longint) : boolean;` `Function Flock (var F : File;mode : longint) : boolean;`

Description: `FLock` implements file locking. it sets or removes a lock on the file `F`. `F` can be of type `Text` or `File`, or it can be a LINUX filedescriptor (a `longint`) `Mode` can be one of the following constants :

LOCK_SH sets a shared lock.

LOCK_EX sets an exclusive lock.

LOCK_UN unlocks the file.

LOCK_NB This can be OR-ed together with the other. If this is done the application doesn't block when locking.

The function returns `True` if successful, `False` otherwise.

Errors: If an error occurs, it is reported in `LinuxError`.

See also: [Fcntl \(216\)](#), [flock \(2\)](#)

FNMatch

Declaration: `Function FNMatch(const Pattern,Name:string):Boolean;`

Description: `FNMatch` returns `True` if the filename in `Name` matches the wildcard pattern in `Pattern`, `False` otherwise.

`Pattern` can contain the wildcards `*` (match zero or more arbitrary characters) or `?` (match a single character).

Errors: None.

See also: [FSearch \(213\)](#), [FExpand \(212\)](#)

Listing: linuxex/ex69.pp

Program Example69;

```
{ Program to demonstrate the FNMatch function. }
```

Uses linux;

```
Procedure TestMatch(Pattern,Name : String);
```

```
begin
```

```
  Write ('"',Name,'" ');
```

```
  If FNMatch (Pattern,Name) then
```

```
    Write ('matches')
```

```
  else
```

```
    Write ('does not match');
```

```
  WriteLn(' ',Pattern,' ".');
```

```
end;
```

```
begin
```

```
  TestMatch('*','FileName');
```

```
  TestMatch('.*','FileName');
```

```
  TestMatch('*a*','FileName');
```

```
  TestMatch('?ile*','FileName');
```

```
  TestMatch('?','FileName');
```

```
  TestMatch('.?','FileName');
```

```
  TestMatch('?a*','FileName');
```

```
  TestMatch('??*me?','FileName');
```

```
end.
```

FSearch

Declaration: Function FSearch (Path : pathstr;DirList : string) : Pathstr;

Description: Searches in DirList, a colon separated list of directories, for a file named Path. It then returns a path to the found file.

Errors: An empty string if no such file was found.

See also: BaseName (194), DirName (200), FExpand (212), FNMatch (212)

Listing: linuxex/ex46.pp

Program Example46;

```
{ Program to demonstrate the FSearch function. }
```

Uses linux, strings;

```
begin
```

```
  WriteLn ('ls is in : ',FSearch ('ls',strpas(Getenv('PATH'))));
```

```
end.
```

FSplit

Declaration: Procedure FSplit(const Path:PathStr;
Var Dir:DirStr;Var Name:NameStr;Var Ext:ExtStr);

Description: `FSplit` splits a full file name into 3 parts : A `Path`, a `Name` and an extension (in `ext`). The extension is taken to be all letters after the last dot (.).

Errors: None.

See also: `FSearch` (213)

Listing: linuxex/ex67.pp

```

Program Example67;

uses Linux;

{ Program to demonstrate the FSplit function. }

var
  Path,Name,Ext : string;

begin
  FSplit(ParamStr(1),Path,Name,Ext);
  WriteLn(' Split ',ParamStr(1), ' in: ');
  WriteLn(' Path      : ',Path);
  WriteLn(' Name      : ',Name);
  WriteLn(' Extension: ',Ext);
end.

```

FSStat

Declaration: `Function FSStat (Path : Pathstr; Var Info : statfs) : Boolean; Function FSStat (Fd:longint;Var Info:stat) : Boolean;`

Description: Return in `Info` information about the filesystem on which the file `Path` resides, or on which the file with file descriptor `fd` resides. `Info` is of type `statfs`. The function returns `True` if the call was succesfull, `False` if the call failed.

Errors: `LinuxError` is used to report errors.

sys_enotdirA component of `Path` is not a directory.
sys_einvalInvalid character in `Path`.
sys_enoent`Path` does not exist.
sys_eaccessSearch permission is denied for component in `Path`.
sys_eloopA circular symbolic link was encountered in `Path`.
sys_eioAn error occurred while reading from the filesystem.

See also: `FStat` (215), `LStat` (230), `statfs` (2)

Listing: linuxex/ex30.pp

```

program Example30;

{ Program to demonstrate the FSStat function. }

uses linux;

var s : string;
    info : statfs;

```

```

begin
  writeln ('Info about current partition : ');
  s:= '.';
  while s<>'q' do
    begin
      if not fsstat (s,info) then
        begin
          writeln('Fstat failed. Errno : ',linuxerror);
          halt (1);
        end;
      writeln;
      writeln ('Result of fsstat on file '''s, '''.');
      writeln ('fstype   : ',info.fstype);
      writeln ('bsize    : ',info.bsize);
      writeln ('bfree   : ',info.bfree);
      writeln ('bavail  : ',info.bavail);
      writeln ('files   : ',info.files);
      writeln ('ffree   : ',info.ffree);
      writeln ('fsid    : ',info.fsid);
      writeln ('Namelen : ',info.namelen);
      write ('Type name of file to do fsstat. (q quits) : ');
      readln (s)
    end;
  end.

```

FStat

Declaration: Function FStat(Path:Pathstr;Var Info:stat):Boolean; Function FStat(Fd:longint;Var Info:stat):Boolean; Function FStat(var F:Text;Var Info:stat):Boolean; Function FStat(var F:File;Var Info:stat):Boolean;

Description: FStat gets information about the file specified in one of the following:

Patha file on the filesystem.

Fda valid file descriptor.

Fan opened text file or untyped file.

and stores it in Info, which is of type stat. The function returns True if the call was succesfull, False if the call failed.

Errors: LinuxError is used to report errors.

sys_enoentPath does not exist.

See also: FSStat (214), LStat (230), stat (2)

Listing: linuxex/ex28.pp

```

program example28;

{ Program to demonstrate the FStat function. }

uses linux;

var f : text;
    i : byte;

```

```

    info : stat;

begin
  { Make a file }
  assign (f, 'test.fil');
  rewrite (f);
  for i:=1 to 10 do writeln (f, 'Testline # ', i);
  close (f);
  { Do the call on made file. }
  if not fstat ('test.fil', info) then
    begin
      writeln('Fstat failed. Errno : ', linuxerror);
      halt (1);
    end;
  writeln;
  writeln ('Result of fstat on file ''test.fil''.');
  writeln ('Inode   : ', info.ino);
  writeln ('Mode    : ', info.mode);
  writeln ('nlink   : ', info.nlink);
  writeln ('uid     : ', info.uid);
  writeln ('gid     : ', info.gid);
  writeln ('rdev    : ', info.rdev);
  writeln ('Size    : ', info.size);
  writeln ('Blksize : ', info.blksize);
  writeln ('Blocks  : ', info.blocks);
  writeln ('atime   : ', info.atime);
  writeln ('mtime   : ', info.mtime);
  writeln ('ctime   : ', info.ctime);
  { Remove file }
  erase (f);
end.

```

Fcntl

Declaration: `Function Fcntl(Fd:longint;Cmd:Integer):integer; Function Fcntl(var Fd:Text;Cmd:Integer)`

Description: Read a file's attributes. `Fd` is an assigned file, or a valid file descriptor. `Cmd` specifies what to do, and is one of the following:

F_GetFd Read the `close_on_exec` flag. If the low-order bit is 0, then the file will remain open across `execve` calls.

F_GetFl Read the descriptor's flags.

F_GetOwn Get the Process ID of the owner of a socket.

Errors: `LinuxError` is used to report errors.

`sys_ebadf` `Fd` has a bad file descriptor.

See also: [Fcntl \(216\)](#), [Fcntl \(2\)](#)

Fcntl

Declaration: `Procedure Fcntl (Fd : text, Cmd : Integer; Arg : longint); Procedure Fcntl (Fd:longint;Cmd:longint;Arg:Longint);`

Description: Read or Set a file's attributes. `Fd` is an assigned file or a valid file descriptor. `Cmd` specifies what to do, and is one of the following:

F_SetFd Set the `close_on_exec` flag of `Fd`. (only the least significant bit is used).

F_GetLk Return the `flock` record that prevents this process from obtaining the lock, or set the `l_type` field of the lock if there is no obstruction. `Arg` is a pointer to a `flock` record.

F_SetLk Set the lock or clear it (depending on `l_type` in the `flock` structure). if the lock is held by another process, an error occurs.

F_GetLkw Same as for **F_Setlk**, but wait until the lock is released.

F_SetOwn Set the Process or process group that owns a socket.

Errors: `LinuxError` is used to report errors.

sys_ebadf `Fd` has a bad file descriptor.

sys_eagain or **sys_eaccess** For **F_SetLk**, if the lock is held by another process.

See also: `Fcntl` (216), `Fcntl` (2), `seefLock`

Fork

Declaration: `Function Fork : Longint;`

Description: `Fork` creates a child process which is a copy of the parent process. `Fork` returns the process ID in the parent process, and zero in the child's process. (you can get the parent's PID with `GetPPid` (223)).

Errors: On error, -1 is returned to the parent, and no child is created.

sys_eagain Not enough memory to create child process.

See also: `Execve` (205), `Clone` (197), `fork` (2)

FRename

Declaration: `Function FRename (OldName, NewName : Pchar) : Boolean;` `Function FRename (OldName, NewName : String) : Boolean;`

Description: `FRename` renames the file `OldName` to `NewName`. `NewName` can be in a different directory than `OldName`, but it cannot be on another partition (device). Any existing file on the new location will be replaced.

If the operation fails, then the `OldName` file will be preserved.

The function returns `True` on success, `False` on failure.

Errors: On error, errors are reported in `LinuxError`. Possible errors include:

sys_eisdir `NewName` exists and is a directory, but `OldName` is not a directory.

sys_exdev `NewName` and `OldName` are on different devices.

sys_enotempty or **sys_eexist** `NewName` is an existing, non-empty directory.

sys_ebusy `OldName` or `NewName` is a directory and is in use by another process.

sys_einval `NewName` is part of `OldName`.

sys_emlink `OldPath` or `NewPath` already have the maximum amount of links pointing to them.

sys_enotdir part of `OldName` or `NewName` is not directory.

sys_efault For the `pchar` case: One of the pointers points to an invalid address.

sys_eaccessaccess is denied when attempting to move the file.

sys_enametoolongEither OldName or NewName is too long.

sys_enoenta directory component in OldName or NewName didn't exist.

sys_enomemnot enough kernel memory.

sys_erofsNewName or OldName is on a read-only file system.

sys_elooptoo many symbolic links were encountered trying to expand OldName or NewName

sys_enospthe filesystem has no room for the new directory entry.

See also: [UnLink \(254\)](#)

GetDate

Declaration: Procedure GetDate (Var Year, Month, Day : Word) ;

Description: Returns the current date.

Errors: None

See also: [GetEpochTime \(220\)](#), [GetTime \(224\)](#), [GetDateTime \(218\)](#), [EpochToLocal \(202\)](#)

Listing: linuxex/ex6.pp

```

Program Example6;

{ Program to demonstrate the GetDate function. }

Uses linux;

Var Year, Month, Day : Word;

begin
  GetDate (Year, Month, Day);
  WriteLn ( 'Date : ', Day:2, ' / ', Month:2, ' / ', Year:4);
end.

```

GetDateTime

Declaration: Procedure GetDateTime(Var Year, Month, Day, hour, minute, second:Word) ;

Description: Returns the current date and time. The time is corrected for the local time zone. This procedure is equivalent to the [GetDate \(218\)](#) and [GetTime](#) calls.

Errors: None

See also: [GetEpochTime \(220\)](#), [GetTime \(224\)](#), [EpochToLocal \(202\)](#), [GetDate \(218\)](#)

Listing: linuxex/ex60.pp

```

Program Example6;

{ Program to demonstrate the GetDateTime function. }

Uses linux;

Var Year, Month, Day, Hour, min, sec : Word;

```

```
begin
  GetDateTime (Year, Month, Day, Hour, min, sec);
  WriteIn ( 'Date : ',Day:2, '/',Month:2, '/',Year:4);
  WriteIn ( 'Time : ',Hour:2, ':',Min:2, ':',Sec:2);
end.
```

GetDomainName

Declaration: `Function GetDomainName : String;`

Description: Get the domain name of the machine on which the process is running. An empty string is returned if the domain is not set.

Errors: None.

See also: `GetHostName` (222), `seemGetdomainname2`

Listing: linuxex/ex39.pp

Program Example39;

{ Program to demonstrate the GetDomainName function. }

Uses linux;

```
begin
  WriteIn ( 'Domain name of this machine is : ',GetDomainName);
end.
```

GetEGid

Declaration: `Function GetEGid : Longint;`

Description: Get the effective group ID of the currently running process.

Errors: None.

See also: `GetGid` (221), `getegid` (2)

Listing: linuxex/ex18.pp

Program Example18;

{ Program to demonstrate the GetGid and GetEGid functions. }

Uses linux;

```
begin
  writeln ( 'Group Id = ',getgid, ' Effective group Id = ',getegid);
end.
```

GetEuid

Declaration: `Function GetEuid : Longint;`

Description: Get the effective user ID of the currently running process.

Errors: None.

See also: [GetEuid \(20\)](#), [geteuid \(2\)](#)

Listing: linuxex/ex17.pp

Program Example17;

{ Program to demonstrate the GetUid and GetEuid functions. }

Uses linux;

begin

`writeln ('User Id = ',getuid, ' Effective user Id = ',geteuid);`

end.

GetEnv

Declaration: `Function GetEnv (P : String) : PChar;`

Description: Returns the value of the environment variable in P. If the variable is not defined, nil is returned. The value of the environment variable may be the empty string. A PChar is returned to accommodate for strings longer than 255 bytes, TERMCAP and LS_COLORS, for instance.

Errors: None.

See also: [sh \(1\)](#), [csh \(1\)](#)

Listing: linuxex/ex41.pp

Program Example41;

{ Program to demonstrate the GetEnv function. }

Uses linux;

begin

`writeln ('Path is : ',Getenv('PATH'));`

end.

GetEpochTime

Declaration: `Function GetEpochTime : longint;`

Description: returns the number of seconds since 00:00:00 gmt, january 1, 1970. it is adjusted to the local time zone, but not to DST.

Errors: no errors

See also: [EpochToLocal \(202\)](#), [GetTime \(224\)](#), [time \(2\)](#)

Listing: linuxex/ex1.pp

Program Example1;

{ Program to demonstrate the GetEpochTime function. }

Uses linux;

begin

Write ('Secs past the start of the Epoch (00:00 1/1/1980) : ');

Writeln (GetEpochTime);

end.

GetFS

Declaration: `Function GetFS (Var F : Any File Type) : Longint;`

Description: `GetFS` returns the file selector that the kernel provided for your file. In principle you don't need this file selector. Only for some calls it is needed, such as the `Select` (241) call or so.

Errors: In case the file was not opened, then -1 is returned.

See also: `Select` (241)

Listing: linuxex/ex34.pp

Program Example33;

{ Program to demonstrate the SelectText function. }

Uses linux;

Var tv : TimeVal;

begin

Writeln ('Press the <ENTER> to continue the program.');

{ Wait until File descriptor 0 (=Input) changes }

 SelectText (Input, nil);

{ Get rid of <ENTER> in buffer }

readln;

Writeln ('Press <ENTER> key in less than 2 seconds...');

 tv.sec:=2;

 tv.usec:=0;

if SelectText (Input, @tv) > 0 **then**

Writeln ('Thank you !')

else

Writeln ('Too late !');

end.

GetGid

Declaration: `Function GetGid : Longint;`

Description: Get the real group ID of the currently running process.

Errors: None.

See also: [GetEGid \(219\)](#), [getgid \(2\)](#)

Listing: linuxex/ex18.pp

Program Example18;

{ Program to demonstrate the GetGid and GetEGid functions. }

Uses linux;

```
begin
  writeln ( 'Group Id = ',getgid, ' Effective group Id = ',getegid);
end.
```

GetHostName

Declaration: `Function GetHostName : String;`

Description: Get the hostname of the machine on which the process is running. An empty string is returned if hostname is not set.

Errors: None.

See also: [GetDomainName \(219\)](#), [seemGethostname2](#)

Listing: linuxex/ex40.pp

Program Example40;

{ Program to demonstrate the GetHostName function. }

Uses linux;

```
begin
  Writeln ( 'Name of this machine is : ',GetHostName);
end.
```

GetLocalTimezone

Declaration: `procedure GetLocalTimezone(timer:longint;var leap_correct,leap_hit:longint);`
`procedure GetLocalTimezone(timer:longint);`

Description: GetLocalTimezone returns the local timezone information. It also initializes the TZSeconds variable, which is used to correct the epoch time to local time.

There should never be any need to call this function directly. It is called by the initialization routines of the Linux unit.

See also: [GetTimezoneFile \(225\)](#), [ReadTimezoneFile \(241\)](#)

GetPid

Declaration: `Function GetPid : Longint;`

Description: Get the Process ID of the currently running process.

Errors: None.

See also: [GetPPid \(223\)](#), [getpid \(2\)](#)

Listing: linuxex/ex16.pp

Program Example16;

{ Program to demonstrate the GetPid, GetPPid function. }

Uses linux;

begin

WriteIn ('Process Id = ',getpid, ' Parent process Id = ',getppid);
end.

GetPPid

Declaration: `Function GetPPid : Longint;`

Description: Get the Process ID of the parent process.

Errors: None.

See also: [GetPid \(222\)](#), [getppid \(2\)](#)

Listing: linuxex/ex16.pp

Program Example16;

{ Program to demonstrate the GetPid, GetPPid function. }

Uses linux;

begin

WriteIn ('Process Id = ',getpid, ' Parent process Id = ',getppid);
end.

GetPriority

Declaration: `Function GetPriority (Which,Who : Integer) : Integer;`

Description: GetPriority returns the priority with which a process is running. Which process(es) is determined by the Which and Who variables. Which can be one of the pre-defined `Prio_Process`, `Prio_PGrp`, `Prio_User`, in which case Who is the process ID, Process group ID or User ID, respectively.

Errors: Error checking must be done on `LinuxError`, since a priority can be negative.

sys_esrchNo process found using which and who.

sys_einvalWhich was not one of `Prio_Process`, `Prio_Grp` or `Prio_User`.

See also: [SetPriority \(243\)](#), [Nice \(235\)](#), [Getpriority \(2\)](#)

For an example, see [Nice \(235\)](#).

GetTime

Declaration: `procedure GetTime(var hour,min,sec,msec,usec:word); procedure GetTime(var hour,min,sec,sec100:word); procedure GetTime(var hour,min,sec:word);`

Description: Returns the current time of the day, adjusted to local time. Upon return, the parameters are filled with

hourHours since 00:00 today.

minminutes in current hour.

secseconds in current minute.

sec100hundreds of seconds in current second.

msecmilliseconds in current second.

usecmicroseconds in current second.

Errors: None

See also: [GetEpochTime \(220\)](#), [GetDate \(218\)](#), [GetDateTime \(218\)](#), [EpochToLocal \(202\)](#)

Listing: `linuxex/ex5.pp`

Program Example5;

```
{ Program to demonstrate the GetTime function. }
```

Uses linux;

Var Hour, Minute, Second : Word;

begin

```
  GetTime (Hour, Minute, Second);
```

```
  WriteLn ('Time : ',Hour:2,':',Minute:2,':',Second:2);
```

```
end.
```

GetTimeOfDay

Declaration: `Procedure GetTimeOfDay(var tv:timeval);`

Description: `GetTimeOfDay` returns the number of seconds since 00:00, January 1 1970, GMT in a `timeval` record. This time NOT corrected any way, not taking into account timezones, daylight savings time and so on.

It is simply a wrapper to the kernel system call. To get the local time, [GetTime \(224\)](#).

Errors: None.

See also: [GetTime \(224\)](#), [GetTimeOfDay \(224\)](#)

GetTimeOfDay

Declaration: `Function GetTimeOfDay:longint;`

Description: `GetTimeOfDay` returns the number of seconds since 00:00, January 1 1970, GMT. This time NOT corrected any way, not taking into account timezones, daylight savings time and so on.

It is simply a wrapper to the kernel system call. To get the local time, [GetTime \(224\)](#).

Errors: None.

See also: [GetTimeOfDay \(224\)](#), [GetTime \(224\)](#)

GetTimezoneFile

Declaration: `function GetTimezoneFile:string;`

Description: `GetTimezoneFile` returns the location of the current timezone file. The location of file is determined as follows:

- 1.If `/etc/timezone` exists, it is read, and the contents of this file is returned. This should work on Debian systems.
- 2.If `/usr/lib/zoneinfo/localtime` exists, then it is returned. (this file is a symlink to the timezone file on SuSE systems)
- 3.If `/etc/localtime` exists, then it is returned. (this file is a symlink to the timezone file on RedHat systems)

Errors: If no file was found, an empty string is returned.

See also: `ReadTimezoneFile` (241)

GetUid

Declaration: `Function GetUid : Longint;`

Description: Get the real user ID of the currently running process.

Errors: None.

See also: `GetEUid` (220), `getuid` (2)

Listing: `linuxex/ex17.pp`

Program `Example17;`

{ Program to demonstrate the GetUid and GetEUid functions. }

Uses `linux;`

begin

`writeLn ('User Id = ',getuid,' Effective user Id = ',geteuid);`

end.

Glob

Declaration: `Function Glob (Const Path : Pathstr) : PGlob;`

Description: `Glob` returns a pointer to a glob structure which contains all filenames which exist and match the pattern in `Path`. The pattern can contain wildcard characters, which have their usual meaning.

Errors: Returns nil on error, and `LinuxError` is set.

sys_enomemNo memory on heap for glob structure.

othersAs returned by the `opendir` call, and `sys_readdir`.

See also: `GlobFree` (226), `Glob` (3)

Listing: `linuxex/ex49.pp`

```
Program Example49;

{ Program to demonstrate the Glob and GlobFree functions. }

Uses linux;

Var G1,G2 : PGlob;

begin
  G1:=Glob ('*');
  if LinuxError=0 then
    begin
      G2:=G1;
      Writeln ('Files in this directory : ');
      While g2<>Nil do
        begin
          Writeln (g2^.name);
          g2:=g2^.next;
        end;
      GlobFree (g1);
    end;
end.
```

GlobFree

Declaration: `Procedure GlobFree (Var P : Pglob);`

Description: Releases the memory, occupied by a pglob structure. P is set to nil.

Errors: None

See also: [Glob \(225\)](#)

For an example, see [Glob \(225\)](#).

IOctl

Declaration: `Procedure IOctl (Handle, Ndx: Longint; Data: Pointer);`

Description: This is a general interface to the Unix/ LINUX ioctl call. It performs various operations on the filedescriptor `Handle`. `Ndx` describes the operation to perform. `Data` points to data needed for the `Ndx` function. The structure of this data is function-dependent, so we don't elaborate on this here. For more information on this, see various manual pages under linux.

Errors: Errors are reported in `LinuxError`. They are very dependent on the used function, that's why we don't list them here

See also: [ioctl \(2\)](#)

Listing: `linuxex/ex54.pp`

```
Program Example54;

uses Linux;

{ Program to demonstrate the IOctl function. }
```

```

var
  tios : Termios;
begin
  IOCtl(1,TCGETS,@tios);
  WriteLn('Input Flags : $',hexstr(tios.c_iflag,8));
  WriteLn('Output Flags : $',hexstr(tios.c_oflag,8));
  WriteLn('Line Flags : $',hexstr(tios.c_lflag,8));
  WriteLn('Control Flags: $',hexstr(tios.c_cflag,8));
end.

```

IOperm

Declaration: Function IOperm (From,Num : Cardinal; Value : Longint) : boolean;

Description: IOperm sets permissions on Num ports starting with port From to Value. The function returns True if the call was successful, False otherwise. *Remark:*

- This works ONLY as root.
- Only the first 0x03ff ports can be set.
- When doing a Fork (217), the permissions are reset. When doing a Execve (205) they are kept.

Errors: Errors are returned in LinuxError

See also: ioperm(2)

IsATTY

Declaration: Function IsATTY (var f) : Boolean;

Description: Check if the filehandle described by f is a terminal. f can be of type

1. longint for file handles;
2. Text for text variables such as input etc.

Returns True if f is a terminal, False otherwise.

Errors: No errors are reported

See also: IOCtl (226), TTYName (253)

S_ISBLK

Declaration: Function S_ISBLK (m:integer) : boolean;

Description: S_ISBLK checks the file mode m to see whether the file is a block device file. If so it returns True.

Errors: FStat (215), S_ISLNK (228), S_ISREG (229), S_ISDIR (228), S_ISCHR (228), S_ISFIFO (228), S_ISSOCK (229)

See also: ISLNK.

S_ISCHR

Declaration: `Function S_ISCHR (m:integer) : boolean;`

Description: `S_ISCHR` checks the file mode `m` to see whether the file is a character device file. If so it returns `True`.

Errors: `FStat` (215), `S_ISLNK` (228), `S_ISREG` (229), `S_ISDIR` (228), `S_ISBLK` (227), `S_ISFIFO` (228), `S_ISSOCK` (229)

See also: `ISLNK`.

S_ISDIR

Declaration: `Function S_ISDIR (m:integer) : boolean;`

Description: `S_ISDIR` checks the file mode `m` to see whether the file is a directory. If so it returns `True`

Errors: `FStat` (215), `S_ISLNK` (228), `S_ISREG` (229), `S_ISCHR` (228), `S_ISBLK` (227), `S_ISFIFO` (228), `S_ISSOCK` (229)

See also: `ISLNK`.

S_ISFIFO

Declaration: `Function S_ISFIFO (m:integer) : boolean;`

Description: `S_ISFIFO` checks the file mode `m` to see whether the file is a fifo (a named pipe). If so it returns `True`.

Errors: `FStat` (215), `S_ISLNK` (228), `S_ISREG` (229), `S_ISDIR` (228), `S_ISCHR` (228), `S_ISBLK` (227), `S_ISSOCK` (229)

See also: `ISLNK`.

S_ISLNK

Declaration: `Function S_ISLNK (m:integer) : boolean;`

Description: `S_ISLNK` checks the file mode `m` to see whether the file is a symbolic link. If so it returns `True`

Errors: `FStat` (215), `S_ISREG` (229), `S_ISDIR` (228), `S_ISCHR` (228), `S_ISBLK` (227), `S_ISFIFO` (228), `S_ISSOCK` (229)

See also:

Listing: `linuxex/ex53.pp`

Program `Example53;`

`{ Program to demonstrate the S_ISLNK function. }`

Uses `linux;`

Var `Info : Stat;`

begin

if `LStat (paramstr(1), info) then`

```

begin
if S_ISLNK(info.mode) then
  Writeln ('File is a link');
if S_ISREG(info.mode) then
  Writeln ('File is a regular file');
if S_ISDIR(info.mode) then
  Writeln ('File is a directory');
if S_ISCHR(info.mode) then
  Writeln ('File is a character device file');
if S_ISBLK(info.mode) then
  Writeln ('File is a block device file');
if S_ISFIFO(info.mode) then
  Writeln ('File is a named pipe (FIFO)');
if S_ISSOCK(info.mode) then
  Writeln ('File is a socket');
end;
end.

```

S_ISREG

Declaration: Function S_ISREG (m:integer) : boolean;

Description: S_ISREG checks the file mode m to see whether the file is a regular file. If so it returns True

Errors: FStat (215), S_ISLNK (228), S_ISDIR (228), S_ISCHR (228), S_ISBLK (227), S_ISFIFO (228), S_ISSOCK (229)

See also: ISLNK.

S_ISSOCK

Declaration: Function S_ISSOCK (m:integer) : boolean;

Description: S_ISSOCK checks the file mode m to see whether the file is a socket. If so it returns True.

Errors: FStat (215), S_ISLNK (228), S_ISREG (229), S_ISDIR (228), S_ISCHR (228), S_ISBLK (227), S_ISFIFO (228)

See also: ISLNK.

Kill

Declaration: Function Kill (Pid : Longint; Sig : Integer) : Integer;

Description: Send a signal Sig to a process or process group. If Pid>0 then the signal is sent to Pid, if it equals -1, then the signal is sent to all processes except process 1. If Pid<-1 then the signal is sent to process group -Pid. The return value is zero, except in case three, where the return value is the number of processes to which the signal was sent.

Errors: LinuxError is used to report errors:

sys_einvalAn invalid signal is sent.

sys_esrchThe Pid or process group don't exist.

sys_epermThe effective userid of the current process doesn't math the one of process Pid.

See also: SigAction (244), Signal (246), Kill (2)

LStat

Declaration: `Function LStat (Path : Pathstr; Var Info : stat) : Boolean;`

Description: `LStat` gets information about the link specified in `Path`, and stores it in `Info`, which is of type `stat`. Contrary to `FStat`, it stores information about the link, not about the file the link points to. The function returns `True` if the call was successful, `False` if the call failed.

Errors: `LinuxError` is used to report errors.

`sys_enoent`Path does not exist.

See also: `FStat` (215), `FSStat` (214), `stat` (2)

Listing: `linuxex/ex29.pp`

```

program example29;

{ Program to demonstrate the LStat function. }

uses linux;

var f : text;
    i : byte;
    info : stat;

begin
  { Make a file }
  assign (f, 'test.fil');
  rewrite (f);
  for i:=1 to 10 do writeln (f, 'Testline # ', i);
  close (f);
  { Do the call on made file. }
  if not fstat ('test.fil', info) then
    begin
      writeln ('Fstat failed. Errno : ', linuxerror);
      halt (1);
    end;
  writeln;
  writeln ('Result of fstat on file ''test.fil''.');
  writeln ('Inode   : ', info.ino);
  writeln ('Mode    : ', info.mode);
  writeln ('nlink   : ', info.nlink);
  writeln ('uid     : ', info.uid);
  writeln ('gid     : ', info.gid);
  writeln ('rdev    : ', info.rdev);
  writeln ('Size    : ', info.size);
  writeln ('Blksize : ', info.blksize);
  writeln ('Blocks  : ', info.blocks);
  writeln ('atime   : ', info.atime);
  writeln ('mtime   : ', info.mtime);
  writeln ('ctime   : ', info.ctime);

  if not SymLink ('test.fil', 'test.lnk') then
    writeln ('Link failed ! Errno : ', linuxerror);

  if not lstat ('test.lnk', info) then
    begin
      writeln ('LStat failed. Errno : ', linuxerror);
      halt (1);
    end;

```

```

    end;
    writeln;
    writeln ('Result of fstat on file ''test.lnk''.');
    writeln ('Inode   : ',info.ino);
    writeln ('Mode    : ',info.mode);
    writeln ('nlink   : ',info.nlink);
    writeln ('uid     : ',info.uid);
    writeln ('gid     : ',info.gid);
    writeln ('rdev    : ',info.rdev);
    writeln ('Size    : ',info.size);
    writeln ('Blksize : ',info.blksize);
    writeln ('Blocks  : ',info.blocks);
    writeln ('atime   : ',info.atime);
    writeln ('mtime   : ',info.mtime);
    writeln ('ctime   : ',info.ctime);
    { Remove file and link }
    erase (f);
    unlink ('test.lnk');
end.

```

Link

Declaration: Function Link (OldPath,NewPath : pathstr) : Boolean;

Description: Link makes NewPath point to the same file als OldPath. The two files then have the same inode number. This is known as a 'hard' link. The function returns True if the call was succesfull, False if the call failed.

Errors: Errors are returned in LinuxError.

sys_exdevOldPath and NewPath are not on the same filesystem.

sys_epermThe filesystem containing oldpath and newpath doesn't support linking files.

sys_eaccessWrite access for the directory containing Newpath is disallowed, or one of the directories in OldPath or NewPath has no search (=execute) permission.

sys_enoentA directory entry in OldPath or NewPath does not exist or is a symbolic link pointing to a non-existent directory.

sys_enotdirA directory entry in OldPath or NewPath is nor a directory.

sys_enomemInsufficient kernel memory.

sys_erofsThe files are on a read-only filesystem.

sys_eexistNewPath already exists.

sys_emlinkOldPath has reached maximal link count.

sys_eloopOldPath or NewPath has a reference to a circular symbolic link, i.e. a symbolic link, whose expansion points to itself.

sys_enospcThe device containing NewPath has no room for anothe entry.

sys_epermOldPath points to . or .. of a directory.

See also: SymLink (248), UnLink (254), Link (2)

Listing: linuxex/ex21.pp

: pserver:mazen@cvs.freepascal.org:/FPC/CVS

LocalToEpoch

Declaration: `Function LocalToEpoch (Year,Month,Day,Hour,Minute,Second : Word) : longint;`

Description: Converts the Local time to epoch time (=Number of seconds since 00:00:00 , January 1, 1970).

Errors: None

See also: [GetEpochTime \(220\)](#), [EpochToLocal \(202\)](#), [GetTime \(224\)](#), [GetDate \(218\)](#)

Listing: linuxex/ex4.pp

Program Example4;

{ Program to demonstrate the LocalToEpoch function. }

Uses linux;

Var year , month , day , hour , minute , second : Word;

begin

```

Write ( 'Year      : '); readln (Year);
Write ( 'Month     : '); readln (Month);
Write ( 'Day       : '); readln (Day);
Write ( 'Hour      : '); readln (Hour);
Write ( 'Minute    : '); readln (Minute);
Write ( 'Seonds   : '); readln (Second);
Write ( 'This is  : ');
Write ( LocalToEpoch (year , month , day , hour , minute , second ));
Writeln ( ' seconds past 00:00 1/1/1980 ');

```

end.

MkFifo

Declaration: `Function MkFifo (PathName: String; Mode : Longint) : Boolean;`

Description: `MkFifo` creates named a named pipe in the filesystem, with name `PathName` and mode `Mode`.

Errors: `LinuxError` is used to report errors:

sys_emfile Too many file descriptors for this process.

sys_enfile The system file table is full.

See also: [POpen \(237\)](#), [MkFifo \(232\)](#), `mkfifo` (4)

MMap

Declaration: `Function MMap (const m : tmmmapargs) : longint;`

Description: `MMap` maps or unmaps files or devices into memory. The different fields of the argument `m` determine what and how the `mmap` maps this:

address Address where to `mmap` the device. This address is a hint, and may not be followed.

size Size (in bytes) of area to be mapped.

prot Protection of mapped memory. This is a OR-ed combination of the following constants:

PROT_EXECThe memory can be executed.

PROT_READThe memory can be read.

PROT_WRITEThe memory can be written.

PROT_NONEThe memory can not be accessed.

flagsContains some options for the mmap call. It is an OR-ed combination of the following constants:

MAP_FIXEDDo not map at another address than the given address. If the address cannot be used, MMap will fail.

MAP_SHAREDShare this map with other processes that map this object.

MAP_PRIVATECreate a private map with copy-on-write semantics.

MAP_ANONYMOUSfd does not have to be a file descriptor.

One of the options MAP_SHARED and MAP_PRIVATE must be present, but not both at the same time.

fdFile descriptor from which to map.

offsetOffset to be used in file descriptor fd.

The function returns a pointer to the mapped memory, or a -1 in case of an error.

Errors: On error, -1 is returned and LinuxError is set to the error code:

Sys_EBADFfd is not a valid file descriptor and MAP_ANONYMOUS was not specified.

Sys_EACCESSMAP_PRIVATE was specified, but fd is not open for reading. Or MAP_SHARED was asked and PROT_WRITE is set, fd is not open for writing

Sys_EINVALOne of the record fields Start, length or offset is invalid.

Sys_ETXTBUSYMAP_DENYWRITE was set but the object specified by fd is open for writing.

Sys_EAGAINfd is locked, or too much memory is locked.

Sys_ENOMEMNot enough memory for this operation.

See also: MUnMap (234), mmap (2)

Listing: linuxex/ex66.pp

Program Example66;

{ Program to demonstrate the MMap function. }

Uses linux;

Var S : String;

fd, Len : Longint;

args : tmmapargs;

P : PChar;

begin

S:= 'This is a string'#0;

Len:=Length(S);

fd:=fdOpen('testfile.txt',Open_wrOnly or open_creat);

If fd=-1 then

 Halt(1);

If fdWrite(fd,S[1],Len)=-1 then

 Halt(2);

fdClose(fd);

fdOpen('testfile.txt',Open_rdOnly);

if fd=-1 then

```

    Halt (3);
    args.address:=0;
    args.offset:=0;
    args.size:=Len+1;
    args.fd:=Fd;
    args.flags:=MAP_PRIVATE;
    args.prot:=PROT_READ or PROT_WRITE;
    P:=Pchar(mmap(args));
    If longint(P)=-1 then
        Halt (4);
    WriteLn('Read in memory :',P);
    fdclose(fd);
    if Not MUnMap(P,Len) Then
        Halt(LinuxError);
end.

```

MUnMap

Declaration: `function MUnMap (P : Pointer; Size : Longint) : Boolean;`

Description: `MUnMap` unmaps the memory block of size `Size`, pointed to by `P`, which was previously allocated with `MMap` (232).

The function returns `True` if successful, `False` otherwise.

Errors: In case of error the function returns `False` and `LinuxError` is set to an error value. See `MMap` (232) for possible error values.

See also: `MMap` (232), `munmap` (2)

For an example, see `MMap` (232).

NanoSleep

Declaration: `Function NanoSleep(const req : timespec;var rem : timespec) : longint;`

Description: `NanoSleep` suspends the process till a time period as specified in `req` has passed. Then the function returns. If the call was interrupted (e.g. by some signal) then the function may return earlier, and `rem` will contain the remaining time till the end of the intended period. In this case the return value will be -1, and `LinuxError` will be set to `EINTR`

If the function returns without error, the return value is zero.

Errors: If the call was interrupted, -1 is returned, and `LinuxError` is set to `EINTR`. If invalid time values were specified, then -1 is returned and `LinuxError` is set to `EINVAL`.

See also: `Pause` (??), `Alarm` (191)

Listing: `linuxex/ex70.pp`

Program `Example70;`

`{ Program to demonstrate the StringToPPchar function. }`

Uses `linux;`

Var `S : String;`

```

P : PPChar;
I : longint;

begin
  // remark whitespace at end.
  S:= 'This is a string with words. ';
  P:=StringToPPChar(S);
  I:=0;
  While P[i]<>Nil do
    begin
      WriteLn('Word ',i,' : ',P[i]);
      Inc(I);
    end;
  FreeMem(P, i*SizeOf(Pchar));
end.

```

Nice

Declaration: Procedure Nice (N : Integer);

Description: Nice adds -N to the priority of the running process. The lower the priority numerically, the less the process is favored. Only the superuser can specify a negative N, i.e. increase the rate at which the process is run.

Errors: Errors are returned in LinuxError

sys_epermA non-superuser tried to specify a negative N, i.e. do a priority increase.

See also: GetPriority (223), SetPriority (243), Nice (2)

Listing: linuxex/ex15.pp

Program Example15;

{ Program to demonstrate the Nice and Get/SetPriority functions. }

Uses linux;

```

begin
  writeln ('Setting priority to 5');
  setpriority (prio_process ,getpid ,5);
  writeln ('New priority = ',getpriority (prio_process ,getpid));
  writeln ('Doing nice 10');
  nice (10);
  writeln ('New Priority = ',getpriority (prio_process ,getpid));
end.

```

Octal

Declaration: Function Octal(l:longint):longint;

Description: Octal will convert a number specified as an octal number to it's decimal value.

This is useful for the Chmod (196) call, where permissions are specified as octal numbers.

Errors: No checking is performed whether the given number is a correct Octal number. e.g. specifying 998 is possible; the result will be wrong in that case.

See also: Chmod ([196](#)).

Listing: linuxex/ex68.pp

Program Example68;

{ Program to demonstrate the Octal function. }

Uses linux;

begin

Writeln ('Mode 777 : ', Octal (777));

Writeln ('Mode 644 : ', Octal (644));

Writeln ('Mode 755 : ', Octal (755));

end.

OpenDir

Declaration: Function OpenDir (f:pchar) : pdir; Function OpenDir (f:string) : pdir;

Description: OpenDir opens the directory f, and returns a pdir pointer to a Dir record, which can be used to read the directory structure. If the directory cannot be opened, nil is returned.

Errors: Errors are returned in LinuxError.

See also: CloseDir ([199](#)), ReadDir ([238](#)), SeekDir ([241](#)), TellDir ([253](#)), opendir (3)

Listing: linuxex/ex35.pp

Program Example35;

*{ Program to demonstrate the
 OpenDir, ReadDir, SeekDir and TellDir functions. }*

Uses linux;

Var TheDir : PDir;

 ADirent : PDirent;

 Entry : Longint;

begin

 TheDir:=OpenDir(' ./.');

Repeat

 Entry:=TellDir (TheDir);

 ADirent:=ReadDir (TheDir);

If ADirent<>Nil **then**

With ADirent^ **do**

begin

Writeln ('Entry No : ', Entry);

Writeln ('Inode : ', ino);

Writeln ('Offset : ', off);

Writeln ('Reclen : ', reclen);

Writeln ('Name : ', pchar(@name[0]));

end;

Until ADirent=Nil;

Repeat

Write ('Entry No. you would like to see again (-1 to stop): ');

```

ReadLn ( Entry );
If Entry <> -1 then
  begin
    SeekDir ( TheDir, Entry );
    ADirent := ReadDir ( TheDir );
    If ADirent <> Nil then
      With ADirent ^ do
        begin
          Writeln ( 'Entry No : ', Entry );
          Writeln ( 'Inode   : ', ino );
          Writeln ( 'Offset  : ', off );
          Writeln ( 'Reclen  : ', reclen );
          Writeln ( 'Name    : ', pchar (@name[0]));
        end;
      end;
    Until Entry = -1;
    CloseDir ( TheDir );
  end.

```

pause

Declaration: Procedure Pause;

Description: Pause puts the process to sleep and waits until the application receives a signal. If a signal handler is installed for the received signal, the handler will be called and after that pause will return control to the process.

Errors: None.

For an example, see Alarm ([191](#)).

PClose

Declaration: Function PClose (Var F : FileType) : longint;

Description: PClose closes a file opened with POpen. It waits for the command to complete, and then returns the exit status of the command.

Errors: LinuxError is used to report errors. If it is different from zero, the exit status is not valid.

See also: POpen ([237](#))

For an example, see POpen ([237](#))

POpen

Declaration: Procedure POpen (Var F : FileType; Cmd : pathstr; rw : char);

Description: Popen runs the command specified in Cmd, and redirects the standard in or output of the command to the other end of the pipe F. The parameter rw indicates the direction of the pipe. If it is set to 'W', then F can be used to write data, which will then be read by the command from stdin. If it is set to 'R', then the standard output of the command can be read from F. F should be reset or rewritten prior to using it. F can be of type Text or File. A file opened with POpen can be closed with Close, but also with PClose ([237](#)). The result is the same, but PClose returns the exit status of the command Cmd.

Errors: Errors are reported in `LinuxError` and are essentially those of the `Execve`, `Dup` and `AssignPipe` commands.

See also: [AssignPipe \(192\)](#), [popen \(3\)](#), [PClose \(237\)](#)

Listing: `linuxex/ex37.pp`

Program `Example37`;

```
{ Program to demonstrate the Popen function. }

uses linux;

var f : text;
    i : longint;

begin
  writeln ('Creating a shell script to which echoes its arguments');
  writeln ('and input back to stdout');
  assign (f, 'test21a');
  rewrite (f);
  writeln (f, '#!/bin/sh');
  writeln (f, 'echo this is the child speaking.... ');
  writeln (f, 'echo got arguments \*"$*\"*');
  writeln (f, 'cat');
  writeln (f, 'exit 2');
  writeln (f);
  close (f);
  chmod ('test21a', octal (755));
  popen (f, './test21a arg1 arg2', 'W');
  if linuxerror <> 0 then
    writeln ('error from POpen : Linuxerror : ', Linuxerror);
  for i:=1 to 10 do
    writeln (f, 'This is written to the pipe, and should appear on stdout. ');
  Flush(f);
  Writeln ('The script exited with status : ', PClose (f));
  writeln;
  writeln ('Press <return> to remove shell script. ');
  readln;
  assign (f, 'test21a');
  erase (f)
end.
```

ReadDir

Declaration: `Function ReadDir (p:pdirent) : pdirent;`

Description: `ReadDir` reads the next entry in the directory pointed to by `p`. It returns a `pdirent` pointer to a structure describing the entry. If the next entry can't be read, `Nil` is returned.

Errors: Errors are returned in `LinuxError`.

See also: [CloseDir \(199\)](#), [OpenDir \(236\)](#), [SeekDir \(241\)](#), [TellDir \(253\)](#), [readdir \(3\)](#)

For an example, see [OpenDir \(236\)](#).

ReadLink

Declaration: `Function ReadLink(name, linkname:pchar; maxlen:longint):longint; Function ReadLink(name:pathstr):pathstr;`

Description: `ReadLink` returns the file the symbolic link name is pointing to. The first form of this function accepts a buffer `linkname` of length `maxlen` where the filename will be stored. It returns the actual number of characters stored in the buffer.

The second form of the function returns simply the name of the file.

Errors: On error, the first form of the function returns -1; the second one returns an empty string. `LinuxError` is set to report errors:

SYS_ENOTDIRA part of the path in `Name` is not a directory.

SYS_EINVAL`maxlen` is not positive, or the file is not a symbolic link.

SYS_ENAMETOOLONGA pathname, or a component of a pathname, was too long.

SYS_ENOENTthe link name does not exist.

SYS_EACCESSNo permission to search a directory in the path

SYS_ELOOPToo many symbolic links were encountered in translating the pathname.

SYS_EIOAn I/O error occurred while reading from the file system.

SYS_EFAULTThe buffer is not part of the process's memory space.

SYS_ENOMEMNot enough kernel memory was available.

See also: `SymLink` (248)

Listing: `linuxex/ex62.pp`

Program `Example62;`

```
{ Program to demonstrate the ReadLink function. }
```

Uses `linux;`

```
Var F : Text;
    S : String;
```

```
begin
  Assign (F, 'test.txt');
  Rewrite (F);
  Writeln (F, 'This is written to test.txt');
  Close(f);
  { new.txt and test.txt are now the same file }
  if not SymLink ('test.txt', 'new.txt') then
    writeln ('Error when symlinking !');
  S:=ReadLink('new.txt');
  If S='' then
    Writeln ('Error reading link !')
  Else
    Writeln ('Link points to : ',S);
  { Now remove links }
  If not Unlink ('new.txt') then
    Writeln ('Error when unlinking !');
  If not Unlink ('test.txt') then
    Writeln ('Error when unlinking !');
end.
```

ReadPort

Declaration: Procedure ReadPort (Port : Longint; Var Value : Byte); Procedure ReadPort (Port : Longint; Var Value : Word); Procedure ReadPort (Port : Longint; Var Value : Longint);

Description: ReadPort reads one Byte, Word or Longint from port Port into Value.

Note that you need permission to read a port. This permission can be set by the root user with the IOperm (227) call.

Errors: In case of an error (not enough permissions read this port), runtime 216 (*Access Violation*) will occur.

See also: IOperm (227), ReadPortB (240), ReadPortW (241), ReadPortL (240), WritePort (256), WritePortB (256), WritePortL (256), WritePortW (257)

ReadPortB

Declaration: Procedure ReadPortB (Port : Longint; Var Buf; Count: longint); Function ReadPortB (Port : Longint): Byte;

Description: The procedural form of ReadPortB reads Count bytes from port Port and stores them in Buf. There must be enough memory allocated at Buf to store Count bytes.

The functional form of ReadPortB reads 1 byte from port B and returns the byte that was read.

Note that you need permission to read a port. This permission can be set by the root user with the IOperm (227) call.

Errors: In case of an error (not enough permissions read this port), runtime 216 (*Access Violation*) will occur.

See also: IOperm (227), ReadPort (240), ReadPortW (241), ReadPortL (240), WritePort (256), WritePortB (256), WritePortL (256), WritePortW (257)

ReadPortL

Declaration: function ReadPortL (Port : Longint): LongInt; Procedure ReadPortL (Port : Longint; Var Buf; Count: longint);

Description: The procedural form of ReadPortL reads Count longints from port Port and stores them in Buf. There must be enough memory allocated at Buf to store Count Longints.

The functional form of ReadPortB reads 1 longint from port B and returns the longint that was read.

Note that you need permission to read a port. This permission can be set by the root user with the IOperm (227) call.

Errors: In case of an error (not enough permissions read this port), runtime 216 (*Access Violation*) will occur.

See also: IOperm (227), ReadPort (240), ReadPortW (241), ReadPortB (240), WritePort (256), WritePortB (256), WritePortL (256), WritePortW (257)

ReadPortW

Declaration: `Procedure ReadPortW (Port : Longint; Var Buf; Count: longint); function ReadPortW (Port : Longint): Word;`

Description: The procedural form of `ReadPortB` reads `Count` words from port `Port` and stores them in `Buf`. There must be enough memory allocated at `Buf` to store `Count` words.

The functional form of `ReadPortB` reads 1 word from port `B` and returns the word that was read.

Note that you need permission to read a port. This permission can be set by the root user with the `IOperm` (227) call.

Errors: In case of an error (not enough permissions read this port), runtime 216 (*Access Violation*) will occur.

See also: `IOperm` (227), `ReadPort` (240), `ReadPortB` (240), `ReadPortL` (240), `WritePort` (256), `WritePortB` (256), `WritePortL` (256), `WritePortW` (257)

ReadTimezoneFile

Declaration: `procedure ReadTimezoneFile(fn:string);`

Description: `ReadTimezoneFile` reads the timezone file `fn` and initializes the local time routines based on the information found there.

There should be no need to call this function. The initialization routines of the linux unit call this routine at unit startup.

Errors: None.

See also: `GetTimezoneFile` (225), `GetLocalTimezone` (222)

SeekDir

Declaration: `Procedure SeekDir (p:pdir;off:longint);`

Description: `SeekDir` sets the directory pointer to the `off`-th entry in the directory structure pointed to by `p`.

Errors: Errors are returned in `LinuxError`.

See also: `CloseDir` (199), `ReadDir` (238), `OpenDir` (236), `TellDir` (253), `seekdir` (3)

For an example, see `OpenDir` (236).

Select

Declaration: `Function Select (N : Longint; var readfds,writefds,exceptfds : PFDset; Var Timeout) : Longint;`

Description: `Select` checks one of the file descriptors in the `FDsets` to see if its status changed. `readfds`, `writefds` and `exceptfds` are pointers to arrays of 256 bits. If you want a file descriptor to be checked, you set the corresponding element in the array to 1. The other elements in the array must be set to zero. Three arrays are passed : The entries in `readfds` are checked to see if characters become available for reading. The entries in `writefds` are checked to see if it is OK to write to them, while entries in `exceptfds` are checked to see if an exception occurred on them. You can use the functions `FD_ZERO` (207), `FD_Clr` (207), `FD_Set` (208), `FD_IsSet` (208) to manipulate the individual elements of a set. The pointers can be nil. `N` is the largest index of a nonzero entry plus 1. (= the largest file-descriptor + 1). `TimeOut` can be used to set a time limit. If `TimeOut` can be two types :

1. `TimeOut` is of type `PTime` and contains a zero time, the call returns immediately. If `TimeOut` is `Nil`, the kernel will wait forever, or until a status changed.
2. `TimeOut` is of type `Longint`. If it is `-1`, this has the same effect as a `Timeout` of type `PTime` which is `Nil`. Otherwise, `TimeOut` contains a time in milliseconds.

When the `TimeOut` is reached, or one of the file descriptors has changed, the `Select` call returns. On return, it will have modified the entries in the array which have actually changed, and it returns the number of entries that have been changed. If the timeout was reached, and no descriptor changed, zero is returned; The arrays of indexes are undefined after that. On error, `-1` is returned.

Errors: On error, the function returns `-1`, and Errors are reported in `LinuxError` :

SYS_EBADF An invalid descriptor was specified in one of the sets.

SYS_EINTR A non blocked signal was caught.

SYS_EINVAL `N` is negative or too big.

SYS_ENOMEM `Select` was unable to allocate memory for its internal tables.

See also: `SelectText` (242), `GetFS` (221), `FD_ZERO` (207), `FD_Clr` (207), `FD_Set` (208), `FD_IsSet` (208)

Listing: `linuxex/ex33.pp`

Program `Example33`;

{ Program to demonstrate the Select function. }

Uses `linux`;

Var `FDS` : `FDSset`;

begin

`FD_Zero (FDS);`

`FD_Set (0, FDS);`

`Writeln ('Press the <ENTER> to continue the program. ');`

{ Wait until File descriptor 0 (=Input) changes }

`Select (1, @FDS, nil, nil, nil);`

{ Get rid of <ENTER> in buffer }

`readln;`

`Writeln ('Press <ENTER> key in less than 2 seconds... ');`

`FD_Zero (FDS);`

`FD_Set (0, FDS);`

`if Select (1, @FDS, nil, nil, 2000) > 0 then`

`Writeln ('Thank you !')`

{ FD_ISSET(0, FDS) would be true here. }

`else`

`Writeln ('Too late !');`

`end.`

SelectText

Declaration: `Function SelectText (var T : Text; TimeOut : PTime) : Longint;`

Description: `SelectText` executes the `Select` (241) call on a file of type `Text`. You can specify a timeout in `TimeOut`. The `SelectText` call determines itself whether it should check for read or write, depending on how the file was opened : With `Reset` it is checked for reading, with `Rewrite` and `Append` it is checked for writing.

Errors: See [Select \(241\)](#). `SYS_EBADF` can also mean that the file wasn't opened.

See also: [Select \(241\)](#), [GetFS \(221\)](#)

SetPriority

Declaration: `Function SetPriority (Which,Who,Prio : Integer) : Integer;`

Description: `SetPriority` sets the priority with which a process is running. Which process(es) is determined by the `Which` and `Who` variables. `Which` can be one of the pre-defined `Prio_Process`, `Prio_PGrp`, `Prio_User`, in which case `Who` is the process ID, Process group ID or User ID, respectively. `Prio` is a value in the range -20 to 20.

Errors: Error checking must be done on `LinuxError`, since a priority can be negative.

`sys_esrch`No process found using `which` and `who`.

`sys_einval``Which` was not one of `Prio_Process`, `Prio_Grp` or `Prio_User`.

`sys_epermA` process was found, but neither its effective or real user ID match the effective user ID of the caller.

`sys_eaccess`A non-superuser tried to a priority increase.

See also: [GetPriority \(223\)](#), [Nice \(235\)](#), [Setpriority \(2\)](#)

For an example, see [Nice \(235\)](#).

Shell

Declaration: `Function Shell (Command : String) : Longint;`

Description: `Shell` invokes the bash shell (`/bin/sh`), and feeds it the command `Command` (using the `-c` option). The function then waits for the command to complete, and then returns the exit status of the command, or 127 if it could not complete the [Fork \(217\)](#) or [Execve \(205\)](#) calls.

Errors: Errors are reported in `LinuxError`.

See also: [POpen \(237\)](#), [Fork \(217\)](#), [Execve \(205\)](#), [system \(3\)](#)

Listing: `linuxex/ex56.pp`

```

program example56;

uses linux;

{ Program to demonstrate the Shell function }

Var S : Longint;

begin
  WriteLn ('Output of ls -l *.pp');
  S:=Shell ('ls -l *.pp');
  WriteLn ('Command exited with status : ',S);
end.

```

SigAction

Declaration: Procedure SigAction (SigNum : Integer; Var Act,OldAct : PSigActionRec);

Description: Changes the action to take upon receipt of a signal. Act and Oldact are pointers to a SigActionRec record. SigNum specifies the signal, and can be any signal except **SIGKILL** or **SIGSTOP**. If Act is non-nil, then the new action for signal SigNum is taken from it. If OldAct is non-nil, the old action is stored there. Sa_Handler may be SIG_DFL for the default action or SIG_IGN to ignore the signal. Sa_Mask Specifies which signals should be ignored during the execution of the signal handler. Sa_Flags Specifies a series of flags which modify the behaviour of the signal handler. You can 'or' none or more of the following :

SA_NOCLDSTOPIf signum is **SIGCHLD** do not receive notification when child processes stop.

SA_ONESHOT or **SA_RESETHAND**Restore the signal action to the default state once the signal handler has been called.

SA_RESTARTFor compatibility with BSD signals.

SA_NOMASK or **SA_NODEFER**Do not prevent the signal from being received from within its own signal handler.

Errors: LinuxError is used to report errors.

sys_einvalan invalid signal was specified, or it was **SIGKILL** or **SIGSTOP**.

sys_efaultAct , OldAct point outside this process address space

sys_eintrSystem call was interrupted.

See also: SigProcMask (245), SigPending (245), SigSuspend (246), Kill (229), Sigaction (2)

Listing: linuxex/ex57.pp

Program example57;

{ Program to demonstrate the SigAction function. }

```
{
do a kill -USR1 pid from another terminal to see what happens.
replace pid with the real pid of this program.
You can get this pid by running 'ps'.
}
```

uses Linux;

Var

oa,na : PSigActionRec;

Procedure DoSig(sig : Longint); **cdecl**;

begin

 writeln('Receiving signal: ',sig);

end;

begin

 new(na);

 new(oa);

 na^.Handler.sh:=@DoSig;

 na^.Sa_Mask:=0;

 na^.Sa_Flags:=0;

 na^.Sa_Restorer:=Nil;

```

SigAction (SigUsrc1 ,na ,oa);
if LinuxError <> 0 then
  begin
    writeln ('Error: ', linuxerror , '. ');
    halt (1);
  end;
WriteLn ('Send USR1 signal or press <ENTER> to exit');
readLn;
end.

```

SigPending

Declaration: Function SigPending : SigSet;

Description: Sigpending allows the examination of pending signals (which have been raised while blocked.) The signal mask of pending signals is returned.

Errors: None

See also: SigAction (244), SigProcMask (245), SigSuspend (246), Signal (246), Kill (229), Sigpending (2)

SigProcMask

Declaration: Procedure SigProcMask (How : Integer; SSet, OldSSet : PSigSet);

Description: Changes the list of currently blocked signals. The behaviour of the call depends on How :

SIG_BLOCKThe set of blocked signals is the union of the current set and the SSet argument.

SIG_UNBLOCKThe signals in SSet are removed from the set of currently blocked signals.

SIG_SETMASKThe list of blocked signals is set so SSet.

If OldSSet is non-nil, then the old set is stored in it.

Errors: LinuxError is used to report errors.

sys_efaultSSet or OldSSet point to an address outside the range of the process.

sys_eintrSystem call was interrupted.

See also: SigAction (244), SigPending (245), SigSuspend (246), Kill (229), Sigprocmask (2)

SigRaise

Declaration: Procedure SigRaise (Sig : integer);

Description: SigRaise sends a Sig signal to the current process.

Errors: None.

See also: Kill (229), GetPid (222)

Listing: linuxex/ex65.pp

```

Program example64;

{ Program to demonstrate the SigRaise function.}

uses Linux;

Var
    oa,na : PSigActionRec;

Procedure DoSig(sig : Longint);cdecl;

begin
    writeln('Receiving signal: ',sig);
end;

begin
    new(na);
    new(oa);
    na^.handler.sh:=@DoSig;
    na^.Sa_Mask:=0;
    na^.Sa_Flags:=0;
    na^.Sa_Restorer:=Nil;
    SigAction(SigUsr1,na,oa);
    if LinuxError<>0 then
        begin
            writeln('Error: ',linuxerror, '.');
            halt(1);
        end;
    writeln('Sending USR1 (',sigusr1,') signal to self. ');
    SigRaise(sigusr1);
end.

```

SigSuspend

Declaration: `Procedure SigSuspend (Mask : SigSet);`

Description: SigSuspend temporarily replaces the signal mask for the process with the one given in Mask, and then suspends the process until a signal is received.

Errors: None

See also: SigAction (244), SigProcMask (245), SigPending (245), Signal (246), Kill (229), SigSuspend (2)

Signal

Declaration: `Function Signal (SigNum : Integer; Handler : SignalHandler) : SignalHandler;`

Description: Signal installs a new signal handler for signal SigNum. This call has the same functionality as the SigAction call. The return value for Signal is the old signal handler, or nil on error.

Errors: LinuxError is used to report errors :

SIG_ERRAn error occurred.

See also: SigAction (244), Kill (229), Signal (2)

Listing: linuxex/ex58.pp

Program example58;

```
{ Program to demonstrate the Signal function.}

{
do a kill -USR1 pid from another terminal to see what happens.
replace pid with the real pid of this program.
You can get this pid by running 'ps'.
}

uses Linux;

Procedure DoSig(sig : Longint); cdecl;

begin
  writeln('Receiving signal: ',sig);
end;

begin
  SigNal(SigUsr1,@DoSig);
  if LinuxError <> 0 then
    begin
      writeln('Error: ',linuxerror, '.');
      halt(1);
    end;
  writeln('Send USR1 signal or press <ENTER> to exit');
  readln;
end.
```

StringToPPchar

Declaration: `Function StringToPPChar(Var S:String):ppchar;`

Description: `StringToPPChar` splits the string `S` in words, replacing any whitespace with zero characters. It returns a pointer to an array of `pchars` that point to the first letters of the words in `S`. This array is terminated by a `Nil` pointer.

The function does *not* add a zero character to the end of the string unless it ends on whitespace.

The function reserves memory on the heap to store the array of `PChar`; The caller is responsible for freeing this memory.

This function can be called to create arguments for the various `Exec` calls.

Errors: None.

See also: `CreateShellArgV` (199), `Execve` (205), `Execv` (205)

Listing: linuxex/ex70.pp

Program Example70;

```
{ Program to demonstrate the StringToPPchar function. }

Uses linux;

Var S : String;
```

```

P : PPChar;
I : longint;

begin
  // remark whitespace at end.
  S:= 'This is a string with words. ';
  P:=StringToPPChar(S);
  I:=0;
  While P[I]<>Nil do
    begin
      WriteLn('Word ',I,' : ',P[I]);
      Inc(I);
    end;
  FreeMem(P, I*SizeOf(Pchar));
end.

```

SymLink

Declaration: `Function SymLink (OldPath,NewPath : pathstr) : Boolean;`

Description: `SymLink` makes `NewPath` point to the file in `OldPath`, which doesn't necessarily exist. The two files DO NOT have the same inode number. This is known as a 'soft' link. The permissions of the link are irrelevant, as they are not used when following the link. Ownership of the file is only checked in case of removal or renaming of the link. The function returns `True` if the call was successful, `False` if the call failed.

Errors: Errors are returned in `LinuxError`.

sys_epermThe filesystem containing `oldpath` and `newpath` doesn't support linking files.

sys_eaccessWrite access for the directory containing `NewPath` is disallowed, or one of the directories in `OldPath` or `NewPath` has no search (=execute) permission.

sys_enoentA directory entry in `OldPath` or `NewPath` does not exist or is a symbolic link pointing to a non-existent directory.

sys_enotdirA directory entry in `OldPath` or `NewPath` is not a directory.

sys_enomemInsufficient kernel memory.

sys_erofsThe files are on a read-only filesystem.

sys_eexist`NewPath` already exists.

sys_eloop`OldPath` or `NewPath` has a reference to a circular symbolic link, i.e. a symbolic link, whose expansion points to itself.

sys_enospcThe device containing `NewPath` has no room for another entry.

See also: [Link \(231\)](#), [UnLink \(254\)](#), [ReadLink \(239\)](#), [SymLink \(2\)](#)

Listing: `linuxex/ex22.pp`

Program `Example22;`

`{ Program to demonstrate the SymLink and UnLink functions. }`

Uses `linux;`

Var `F : Text;`
`S : String;`

```
begin
  Assign (F, 'test.txt');
  Rewrite (F);
  Writeln (F, 'This is written to test.txt');
  Close(f);
  { new.txt and test.txt are now the same file }
  if not SymLink ('test.txt', 'new.txt') then
    writeln ('Error when symlinking !');
  { Removing test.txt still leaves new.txt
    Pointing now to a non-existent file ! }
  If not Unlink ('test.txt') then
    Writeln ('Error when unlinking !');
  Assign (f, 'new.txt');
  { This should fail, since the symbolic link
    points to a non-existent file ! }
  {$i-}
  Reset (F);
  {$i+}
  If IOResult=0 then
    Writeln ('This shouldn't happen');
  { Now remove new.txt also }
  If not Unlink ('new.txt') then
    Writeln ('Error when unlinking !');
end.
```

SysInfo

Declaration: `Function SysInfo(var Info:TSysinfo):Boolean;`

Description: `SysInfo` returns system information in `Info`. Returned information in `Info` includes:

- uptime**Number of seconds since boot.
- loads**1, 5 and 15 minute load averages.
- totalram**total amount of main memory.
- freeram**amount of free memory.
- sharedram**amount of shared memory
- bufferram**amount of memory used by buffers.
- totalswapt**total amount of swap space.
- freeswap**amount of free swap space.
- procs**number of current processes.

Errors: None.

See also: `Uname` ([254](#))

Listing: linuxex/ex64.pp

program Example64;

{ Example to demonstrate the SysInfo function }

Uses Linux;

```

Function Mb(L : Longint) : longint;

begin
  Mb:=L div (1024*1024);
end;

Var Info : TSysInfo;
      D,M,Secs,H : longint;

begin
  If Not SysInfo(Info) then
    Halt(1);
  With Info do
    begin
      D:=Uptime div (3600*24);
      UpTime:=UpTime mod (3600*24);
      h:=uptime div 3600;
      uptime:=uptime mod 3600;
      m:=uptime div 60;
      secs:=uptime mod 60;
      Writeln('Uptime : ',d,'days, ',h,' hours, ',m,' min, ',secs,' s. ');
      Writeln('Loads : ',Loads[1], '/',Loads[2], '/',Loads[3]);
      Writeln('Total Ram : ',Mb(totalram), 'Mb. ');
      Writeln('Free Ram : ',Mb(freeram), 'Mb. ');
      Writeln('Shared Ram : ',Mb(sharedram), 'Mb. ');
      Writeln('Buffer Ram : ',Mb(bufferram), 'Mb. ');
      Writeln('Total Swap : ',Mb(totalswap), 'Mb. ');
      Writeln('Free Swap : ',Mb(freeswap), 'Mb. ');
    end;
end.

```

TCDrain

Declaration: `Function TCDrain (Fd:longint) : Boolean;`

Description: `TCDrain` waits until all data to file descriptor `Fd` is transmitted.

The function returns `True` if the call was succesfull, `False` otherwise.

Errors: Errors are reported in `LinuxError`

See also: `termios` (2)

TCFlow

Declaration: `Function TCFlow (Fd,Act:longint) : Boolean;`

Description: `TCFlow` suspends/resumes transmission or reception of data to or from the file descriptor `Fd`, depending on the action `Act`. This can be one of the following pre-defined values:

TCOOFF suspend reception/transmission,

TCOON resume reception/transmission,

TCIOFF transmit a stop character to stop input from the terminal,

TCION transmit start to resume input from the terminal.

The function returns `True` if the call was succesfull, `False` otherwise.

Errors: Errors are reported in LinuxError.

See also: `termios(2)`

TCFlush

Declaration: `Function TCFlush (Fd,QSel:longint) : Boolean;`

Description: `TCFlush` discards all data sent or received to/from file descriptor `fd`. `QSel` indicates which queue should be discard. It can be one of the following pre-defined values :

TCIFLUSH input,
TCOFLUSH output,
TCIOFLUSH both input and output.

The function returns `True` if the call was succesfull, `False` otherwise.

Errors: Errors are reported in LinuxError.

See also: `termios(2)`

TCGetAttr

Declaration: `Function TCGetAttr (fd:longint;var tios:TermIOS) : Boolean;`

Description: `TCGetAttr` gets the terminal parameters from the terminal referred to by the file descriptor `fd` and returns them in a `TermIOS` structure `tios`. The function returns `True` if the call was succesfull, `False` otherwise.

Errors: Errors are reported in LinuxError

See also: `TCSetAttr(252)`, `termios(2)`

Listing: `linuxex/ex55.pp`

Program `Example55;`

`uses` `Linux;`

{ Program to demonstrate the TCGetAttr/TCSetAttr/CFMakeRaw functions. }

```

procedure ShowTermios(var tios:Termios);
begin
  WriteLn('Input Flags : $',hexstr(tios.c_iflag,8)+#13);
  WriteLn('Output Flags : $',hexstr(tios.c_oflag,8));
  WriteLn('Line Flags : $',hexstr(tios.c_lflag,8));
  WriteLn('Control Flags: $',hexstr(tios.c_cflag,8));
end;

var
  oldios ,
  tios : Termios;
begin
  WriteLn('Old attributes:');
  TCGetAttr(1,tios);
  ShowTermios(tios);
  oldios:=tios;

```

```

WriteLn('Setting raw terminal mode');
CFMakeRaw(tios);
TCSetAttr(1,TCSANOW,tios);
WriteLn('Current attributes:');
TCGetAttr(1,tios);
ShowTermios(tios);
TCSetAttr(1,TCSANOW,oldios);
end.

```

TCGetPGrp

Declaration: `Function TCGetPGrp (Fd:longint;var Id:longint) : boolean;`

Description: `TCGetPGrp` returns the process group ID of a foreground process group in `Id`. The function returns `True` if the call was successful, `False` otherwise.

Errors: Errors are reported in `LinuxError`.

See also: `termios (2)`

TCSendBreak

Declaration: `Function TCSendBreak (Fd,Duration:longint) : Boolean;`

Description: `TCSendBreak` Sends zero-valued bits on an asynchronous serial connection described by file-descriptor `Fd`, for duration `Duration`. The function returns `True` if the action was performed successfully, `False` otherwise.

Errors: Errors are reported in `LinuxError`.

See also: `termios (2)`

TCSetAttr

Declaration: `Function TCSetAttr (Fd:longint;OptAct:longint;var Tios:TermIOS) : Boolean;`

Description: `TCSetAttr` Sets the terminal parameters you specify in a `TermIOS` structure `Tios` for the terminal referred to by the file descriptor `Fd`. `OptAct` specifies an optional action when the set need to be done, this could be one of the following pre-defined values:

TCSANOW set immediately.

TCSADRAIN wait for output.

TCSAFLUSH wait for output and discard all input not yet read.

The function Returns `True` if the call was successful, `False` otherwise.

Errors: Errors are reported in `LinuxError`.

See also: `TCGetAttr (251)`, `termios (2)`

For an example, see `TCGetAttr (251)`.

TCSetsPGrp

Declaration: `Function TCSetsPGrp (Fd,Id:longint) : boolean;`

Description: `TCSetsPGrp` Sets the Process Group Id to `Id`. The function returns `True` if the call was successful, `False` otherwise.

Errors: Errors are returned in `LinuxError`.

See also: `TCGetPGrp` (252), `termios` (2)

For an example, see `TCGetPGrp` (252).

TTYName

Declaration: `Function TTYName (var f) : String;`

Description: Returns the name of the terminal pointed to by `f`. `f` must be a terminal. `f` can be of type:

1. `longint` for file handles;
2. Text for text variables such as `input` etc.

Errors: Returns an empty string in case of an error. `Linuxerror` may be set to indicate what error occurred, but this is uncertain.

See also: `IsATTY` (227), `IOctl` (226)

TellDir

Declaration: `Function TellDir (p:pdir) : longint;`

Description: `TellDir` returns the current location in the directory structure pointed to by `p`. It returns `-1` on failure.

Errors: Errors are returned in `LinuxError`.

See also: `CloseDir` (199), `ReadDir` (238), `SeekDir` (241), `OpenDir` (236), `telldir` (3)

For an example, see `OpenDir` (236).

Umask

Declaration: `Function Umask (Mask : Integer) : Integer;`

Description: Change the file creation mask for the current user to `Mask`. The current mask is returned.

Errors: None

See also: `Chmod` (196), `Umask` (2)

Listing: `linuxex/ex27.pp`

Program `Example27;`

{ Program to demonstrate the Umask function. }

Uses `linux;`

```

begin
  Writeln ( 'Old Umask was : ', Umask(Octal(111)));
  Writeln ( 'New Umask is  : ', Octal(111));
end.

```

Uname

Declaration: Procedure Uname (var unamerec:utsname);

Description: Uname gets the name and configuration of the current LINUX kernel, and returns it in unamerec.

Errors: LinuxError is used to report errors.

See also: GetHostName (222), GetDomainName (219), uname (2)

UnLink

Declaration: Function UnLink (Var Path) : Boolean;

Description: UnLink decreases the link count on file Path. Path can be of type PathStr or PChar. If the link count is zero, the file is removed from the disk. The function returns True if the call was succesfull, False if the call failed.

Errors: Errors are returned in LinuxError.

sys_eaccessYou have no write access right in the directory containing Path, or you have no search permission in one of the directory components of Path.

sys_epermThe directory containing pathname has the sticky-bit set and the process's effective uid is neither the uid of the file to be deleted nor that of the directory containing it.

sys_enoentA component of the path doesn't exist.

sys_enotdirA directory component of the path is not a directory.

sys_eisdirPath refers to a directory.

sys_enomemInsufficient kernel memory.

sys_erofsPath is on a read-only filesystem.

See also: Link (231), SymLink (248), Unlink (2)

For an example, see Link (231).

Utime

Declaration: Function Utime (path : pathstr; utim : utimbuf) : Boolean;

Description: Utime sets the access and modification times of a file. the utimbuf record contains 2 fields, actime, and modtime, both of type Longint. They should be filled with an epoch-like time, specifying, respectively, the last access time, and the last modification time. For some filesystem (most notably, FAT), these times are the same.

Errors: Errors are returned in LinuxError.

sys_eaccessOne of the directories in Path has no search (=execute) permission.

`sys_enoent` A directory entry in `Path` does not exist or is a symbolic link pointing to a non-existent directory.

Other errors may occur, but aren't documented.

See also: `GetEpochTime` (220), `Chown` (195), `Access` (190), `utime` (0 2)

Listing: `linuxex/ex25.pp`

Program `Example25`;

{ Program to demonstrate the UTime function. }

Uses `linux`;

Var `utim` : `utimbuf`;
 `year`, `month`, `day`, `hour`, `minute`, `second` : `Word`;

begin

```
{ Set access and modification time of executable source }
GetTime (hour, minute, second);
GetDate (year, month, day);
utim.actime := LocalToEpoch (year, month, day, hour, minute, second);
utim.modtime := utim.actime;
if not Utime ('ex25.pp', utim) then
  writeIn ('Call to UTime failed !')
else
  begin
    Write ('Set access and modification times to : ');
    Write (Hour:2, ':', minute:2, ':', second, ', ');
    WriteIn (Day:2, '/', month:2, '/', year:4);
  end;
```

end.

WaitPid

Declaration: `Function WaitPid (Pid : longint; Status : pointer; Options : Longint) : Longint;`

Description: `WaitPid` waits for a child process with process ID `Pid` to exit. The value of `Pid` can be one of the following:

Pid < -1 Causes `WaitPid` to wait for any child process whose process group ID equals the absolute value of `pid`.

Pid = -1 Causes `WaitPid` to wait for any child process.

Pid = 0 Causes `WaitPid` to wait for any child process whose process group ID equals the one of the calling process.

Pid > 0 Causes `WaitPid` to wait for the child whose process ID equals the value of `Pid`.

The `Options` parameter can be used to specify further how `WaitPid` behaves:

WNOHANG Causes `Waitpid` to return immediately if no child has exited.

WUNTRACED Causes `WaitPid` to return also for children which are stopped, but whose status has not yet been reported.

__WCLONE Causes `WaitPid` also to wait for threads created by the `Clone` (197) call.

Upon return, it returns the exit status of the process, or -1 in case of failure.

Errors: Errors are returned in `LinuxError`.

See also: [Fork \(217\)](#), [Execve \(205\)](#), [waitpid \(2\)](#)

For an example, see [Fork \(217\)](#).

WritePort

Declaration: `Procedure WritePort (Port : Longint; Value : Byte); Procedure WritePort (Port : Longint; Value : Word); Procedure WritePort (Port : Longint; Value : Longint);`

Description: `WritePort` writes `Value` – 1 byte, `Word` or `longint` – to port `Port`.

Note: You need permission to write to a port. This permission can be set with root permission with the `IOperm` call.

Errors: In case of an error (not enough permissions to write to this port), runtime 216 (*Access Violation*) will occur.

See also: [IOperm \(227\)](#), [WritePortB \(256\)](#), [WritePortL \(256\)](#), [WritePortW \(257\)](#), [ReadPortB \(240\)](#), [ReadPortL \(240\)](#), [ReadPortW \(241\)](#)

WritePortB

Declaration: `Procedure WritePortB (Port : Longint; Value : Byte); Procedure WritePortB (Port : Longint; Var Buf; Count: longint);`

Description: The first form of `WritePortB` writes 1 byte to port `Port`. The second form writes `Count` bytes from `Buf` to port `Port`.

Note: You need permission to write to a port. This permission can be set with root permission with the `IOperm` call.

Errors: In case of an error (not enough permissions to write to this port), runtime 216 (*Access Violation*) will occur.

See also: [IOperm \(227\)](#), [WritePort \(256\)](#), [WritePortL \(256\)](#), [WritePortW \(257\)](#), [ReadPortB \(240\)](#), [ReadPortL \(240\)](#), [ReadPortW \(241\)](#)

WritePortL

Declaration: `Procedure WritePortL (Port : Longint; Value : Longint); Procedure WritePortL (Port : Longint; Var Buf; Count: longint);`

Description: The first form of `WritePortB` writes 1 byte to port `Port`. The second form writes `Count` bytes from `Buf` to port `Port`.

Note: You need permission to write to a port. This permission can be set with root permission with the `IOperm` call.

Errors: In case of an error (not enough permissions to write to this port), runtime 216 (*Access Violation*) will occur.

See also: [IOperm \(227\)](#), [WritePort \(256\)](#), [WritePortB \(256\)](#), [WritePortW \(257\)](#), [ReadPortB \(240\)](#), [ReadPortL \(240\)](#), [ReadPortW \(241\)](#)

WritePortW

Declaration: Procedure WritePortW (Port : Longint; Var Buf; Count: longint); Procedure WritePortW (Port : Longint; Value : Word);

Description: The first form of WritePortB writes 1 byte to port Port. The second form writes Count bytes from Buf to port Port.

Note: You need permission to write to a port. This permission can be set with root permission with the IOperm call.

Errors: In case of an error (not enough permissions to write to this port), runtime 216 (*Access Violation*) will occur.

See also: IOperm ([227](#)), WritePort ([256](#)), WritePortL ([256](#)), WritePortB ([256](#)), ReadPortB ([240](#)), ReadPortL ([240](#)), ReadPortW ([241](#))

Chapter 13

The MATH unit

This chapter describes the `math` unit. The `math` unit was initially written by Florian Klämpfl. It provides mathematical functions which aren't covered by the system unit.

This chapter starts out with a definition of all types and constants that are defined, after which an overview is presented of the available functions, grouped by category, and the last part contains a complete explanation of each function.

The following things must be taken into account when using this unit:

1. This unit is compiled in Object Pascal mode so all `integers` are 32 bit.
2. Some overloaded functions exist for data arrays of integers and floats. When using the address operator (`@`) to pass an array of data to such a function, make sure the address is typecasted to the right type, or turn on the 'typed address operator' feature. failing to do so, will cause the compiler not be able to decide which function you want to call.

13.1 Constants and types

The following types are defined in the `math` unit:

```
Type
  Float = Extended;
  PFloat = ^Float
```

All calculations are done with the `Float` type. This allows to recompile the unit with a different float type to obtain a desired precision. The pointer type is used in functions that accept an array of values of arbitrary length.

```
Type
  TPaymentTime = (PTEndOfPeriod, PTStartOfPeriod);
```

`TPaymentTime` is used in the financial calculations.

```
Type
  EInvalidArgument = Class(EMathError);
```

The `EInvalidArgument` exception is used to report invalid arguments.

13.2 Function list by category

What follows is a listing of the available functions, grouped by category. For each function there is a reference to the page where you can find the function.

Min/max determination

Functions to determine the minimum or maximum of numbers:

Name	Description	Page
max	Maximum of 2 values	272
maxIntValue	Maximum of an array of integer values	273
maxvalue	Maximum of an array of values	273
min	Minimum of 2 values	276
minIntValue	Minimum of an array of integer values	276
minvalue	Minimum of an array of values	277

Angle conversion

Name	Description	Page
cycleto rad	convert cycles to radians	265
degtograd	convert degrees to grads	266
degtorad	convert degrees to radians	266
gradtodeg	convert grads to degrees	268
gradtorad	convert grads to radians	268
radto cycle	convert radians to cycles	281
radtodeg	convert radians to degrees	281
radto grad	convert radians to grads	282

Trigonometric functions

Name	Description	Page
arccos	calculate reverse cosine	261
arcsin	calculate reverse sine	262
arctan2	calculate reverse tangent	263
cotan	calculate cotangent	265
sincos	calculate sine and cosine	283
tan	calculate tangent	287

Hyperbolic functions

Name	Description	Page
arcosh	calculate reverse hyperbolic cosine	261
arsinh	calculate reverse hyperbolic sine	263
artanh	calculate reverse hyperbolic tangent	264
cosh	calculate hyperbolic cosine	265
sinh	calculate hyperbolic sine	283
tanh	calculate hyperbolic tangent	287

Exponential and logarithmic functions

Name	Description	Page
intpower	Raise float to integer power	269
ldexp	Calculate $2^p x$	270
lnxp1	calculate $\log(x+1)$	270
log10	calculate 10-base log	271
log2	calculate 2-base log	271
logn	calculate N-base log	272
power	raise float to arbitrary power	280

Number converting

Name	Description	Page
ceil	Round to infinity	264
floor	Round to minus infinity	267
frexp	Return mantissa and exponent	267

Statistical functions

Name	Description	Page
mean	Mean of values	274
meanandstddev	Mean and standard deviation of values	275
momentskewkurtosis	Moments, skew and kurtosis	278
popnstddev	Population standard deviation	279
popnvariance	Population variance	280
randg	Gaussian distributed random value	282
stddev	Standard deviation	284
sum	Sum of values	285
sumofsquares	Sum of squared values	285

sumsandsquares	Sum of values and squared values	286
totalvariance	Total variance of values	288
variance	variance of values	288

Geometrical functions

Name	Description	Page
hypot	Hypotenuse of triangle	269
norm	Euclidian norm	278

13.3 Functions and Procedures

arccos

Declaration: `Function arccos(x : float) : float;`

Description: `Arccos` returns the inverse cosine of its argument `x`. The argument `x` should lie between -1 and 1 (borders included).

Errors: If the argument `x` is not in the allowed range, an `EInvalidArgument` exception is raised.

See also: `arcsin` ([262](#)), `arcosh` ([261](#)), `arsinh` ([263](#)), `artanh` ([264](#))

Listing: `mathex/ex1.pp`

Program `Example1;`

{ Program to demonstrate the arccos function. }

Uses `math;`

Procedure `WriteRadDeg(X : float);`

begin

`WriteLn(X:8:5, ' rad = ', radtodeg(x):8:5, ' degrees.')`

end;

begin

`WriteRadDeg (arccos (1));`

`WriteRadDeg (arccos (sqrt (3)/2));`

`WriteRadDeg (arccos (sqrt (2)/2));`

`WriteRadDeg (arccos (1/2));`

`WriteRadDeg (arccos (0));`

`WriteRadDeg (arccos (-1));`

end.

arcosh

Declaration: `Function arcosh(x : float) : float; Function arccosh(x : float) : float;`

Description: `Arcosh` returns the inverse hyperbolic cosine of its argument `x`. The argument `x` should be larger than 1.

The `arccosh` variant of this function is supplied for Delphi compatibility.

Errors: If the argument `x` is not in the allowed range, an `EInvalidArgument` exception is raised.

See also: `cosh` (265), `sinh` (283), `arcsin` (262), `arsinh` (263), `artanh` (264), `tanh` (287)

Listing: `mathex/ex3.pp`

Program `Example3`;

{ Program to demonstrate the arcosh function. }

Uses `math`;

begin

WriteLn (`arcosh (1)`);

WriteLn (`arcosh (2)`);

end.

arcsin

Declaration: `Function arcsin(x : float) : float;`

Description: `Arcsin` returns the inverse sine of its argument `x`. The argument `x` should lie between -1 and 1.

Errors: If the argument `x` is not in the allowed range, an `EInvalidArgument` exception is raised.

See also: `arccos` (261), `arcosh` (261), `arsinh` (263), `artanh` (264)

Listing: `mathex/ex2.pp`

Program `Example1`;

{ Program to demonstrate the arcsin function. }

Uses `math`;

Procedure `WriteRadDeg(X : float)`;

begin

WriteLn (`X:8:5, ' rad = ', radtodeg(x):8:5, ' degrees.'`)

end;

begin

WriteRadDeg (`arcsin (1)`);

WriteRadDeg (`arcsin (sqrt (3)/2)`);

WriteRadDeg (`arcsin (sqrt (2)/2)`);

WriteRadDeg (`arcsin (1/2)`);

WriteRadDeg (`arcsin (0)`);

WriteRadDeg (`arcsin (-1)`);

end.

arctan2

Declaration: `Function arctan2(x,y : float) : float;`

Description: `arctan2` calculates $\arctan(y/x)$, and returns an angle in the correct quadrant. The returned angle will be in the range $-\pi$ to π radians. The values of `x` and `y` must be between -2^{64} and 2^{64} , moreover `x` should be different from zero.

On Intel systems this function is implemented with the native intel `fpatan` instruction.

Errors: If `x` is zero, an overflow error will occur.

See also: [arccos \(261\)](#), [arcosh \(261\)](#), [arsinh \(263\)](#), [artanh \(264\)](#)

Listing: `mathex/ex6.pp`

Program `Example6;`

`{ Program to demonstrate the arctan2 function. }`

Uses `math;`

Procedure `WriteRadDeg(X : float);`

begin

`WriteLn(X:8:5, ' rad = ', radtodeg(x):8:5, ' degrees.')`

end;

begin

`WriteRadDeg (arctan2 (1,1));`

end.

arsinh

Declaration: `Function arsinh(x : float) : float; Function arcsinh(x : float) : float;`

Description: `arsinh` returns the inverse hyperbolic sine of its argument `x`.

The `arcsinh` variant of this function is supplied for Delphicompatibility.

Errors: None.

See also: [arcosh \(261\)](#), [arccos \(261\)](#), [arcsin \(262\)](#), [artanh \(264\)](#)

Listing: `mathex/ex4.pp`

Program `Example4;`

`{ Program to demonstrate the arsinh function. }`

Uses `math;`

begin

`WriteLn (arsinh (0));`

`WriteLn (arsinh (1));`

end.

artanh

Declaration: `Function artanh(x : float) : float; Function arctanh(x : float) : float;`

Description: `artanh` returns the inverse hyperbolic tangent of its argument `x`, where `x` should lie in the interval `[-1,1]`, borders included.

The `arctanh` variant of this function is supplied for Delphi compatibility.

Errors: In case `x` is not in the interval `[-1,1]`, an `EInvalidArgument` exception is raised.

See also: [arcosh \(261\)](#), [arccos \(261\)](#), [arcsin \(262\)](#), [artanh \(264\)](#)

Errors:

See also:

Listing: `mathex/ex5.pp`

```

Program Example5;

{ Program to demonstrate the artanh function. }

Uses math;

begin
  Writeln(artanh(0));
  Writeln(artanh(0.5));
end.

```

ceil

Declaration: `Function ceil(x : float) : longint;`

Description: `Ceil` returns the lowest integer number greater than or equal to `x`. The absolute value of `x` should be less than `maxint`.

Errors: If the absolute value of `x` is larger than `maxint`, an overflow error will occur.

See also: [floor \(267\)](#)

Listing: `mathex/ex7.pp`

```

Program Example7;

{ Program to demonstrate the Ceil function. }

Uses math;

begin
  Writeln(Ceil(-3.7)); // should be -3
  Writeln(Ceil(3.7)); // should be 4
  Writeln(Ceil(-4.0)); // should be -4
end.

```

cosh

Declaration: `Function cosh(x : float) : float;`

Description: `Cosh` returns the hyperbolic cosine of its argument `x`.

Errors: None.

See also: [arcosh \(261\)](#), [sinh \(283\)](#), [arsinh \(263\)](#)

Listing: `mathex/ex8.pp`

```
Program Example8;
{ Program to demonstrate the cosh function. }

Uses math;

begin
  WriteLn (Cosh(0));
  WriteLn (Cosh(1));
end.
```

cotan

Declaration: `Function cotan(x : float) : float;`

Description: `Cotan` returns the cotangent of its argument `x`. `x` should be different from zero.

Errors: If `x` is zero then a overflow error will occur.

See also: [tanh \(287\)](#)

Listing: `mathex/ex9.pp`

```
Program Example9;
{ Program to demonstrate the cotan function. }

Uses math;

begin
  writeln (cotan (pi / 2));
  WriteLn (cotan (pi / 3));
  WriteLn (cotan (pi / 4));
end.
```

cycletorad

Declaration: `Function cycletorad(cycle : float) : float;`

Description: `Cycletorad` transforms its argument `cycle` (an angle expressed in cycles) to radians. (1 cycle is 2π radians).

Errors: None.

See also: [degtograd \(266\)](#), [degtorad \(266\)](#), [radtoodeg \(281\)](#), [radtoograd \(282\)](#), [radto cycle \(281\)](#)

Listing: mathex/ex10.pp

Program Example10;*{ Program to demonstrate the cycletorad function. }***Uses** math;**begin****writeln**(cos(cycletorad(1/6))); *// Should print 1/2***writeln**(cos(cycletorad(1/8))); *// should be sqrt(2)/2***end.**

degtograd

Declaration: Function degtograd(deg : float) : float;

Description: Degtograd transforms it's argument deg (an angle in degrees) to grads.

(90 degrees is 100 grad.)

Errors: None.

See also: cycletorad ([265](#)), degtorad ([266](#)), radtodeg ([281](#)), radtograd ([282](#)), radtcycle ([281](#))**Listing:** mathex/ex11.pp

Program Example11;*{ Program to demonstrate the degtograd function. }***Uses** math;**begin****writeln**(degtograd(90));**writeln**(degtograd(180));**writeln**(degtograd(270))**end.**

degtorad

Declaration: Function degtorad(deg : float) : float;

Description: Degtorad converts it's argument deg (an angle in degrees) to radians.

(pi radians is 180 degrees)

Errors: None.

See also: cycletorad ([265](#)), degtograd ([266](#)), radtodeg ([281](#)), radtograd ([282](#)), radtcycle ([281](#))**Listing:** mathex/ex12.pp

Program Example12;*{ Program to demonstrate the degtorad function. }***Uses** math;

```
begin
  writeln(degtorad(45));
  writeln(degtorad(90));
  writeln(degtorad(180));
  writeln(degtorad(270));
  writeln(degtorad(360));
end.
```

floor

Declaration: `Function floor(x : float) : longint;`

Description: `Floor` returns the largest integer smaller than or equal to `x`. The absolute value of `x` should be less than `maxint`.

Errors: If `x` is larger than `maxint`, an overflow will occur.

See also: [ceil \(264\)](#)

Listing: `mathex/ex13.pp`

Program `Example13;`

{ Program to demonstrate the floor function. }

Uses `math;`

```
begin
  Writeln(Ceil(-3.7)); // should be -4
  Writeln(Ceil(3.7)); // should be 3
  Writeln(Ceil(-4.0)); // should be -4
end.
```

frexp

Declaration: `Procedure frexp(x : float; var mantissa : float; var exponent : integer);`

Description: `Frexp` returns the mantissa and exponent of its argument `x` in `mantissa` and `exponent`.

Errors: None

See also:

Listing: `mathex/ex14.pp`

Program `Example14;`

{ Program to demonstrate the frexp function. }

Uses `math;`

Procedure `dofrexp(Const X : extended);`

```
var man : extended;
    exp : longint;
```

```
begin
  man:=0;
  exp:=0;
  frexp(x,man,exp);
  write(x,' has ');
  Writeln('mantissa ',man,' and exponent ',exp);
end;
```

```
begin
  // dofrexp(1.00);
  dofrexp(1.02e-1);
  dofrexp(1.03e-2);
  dofrexp(1.02e1);
  dofrexp(1.03e2);
end.
```

gradtodeg

Declaration: `Function gradtodeg(grad : float) : float;`

Description: Gradtodeg converts its argument grad (an angle in grads) to degrees.

(100 grad is 90 degrees)

Errors: None.

See also: [cycletorad \(265\)](#), [degtograd \(266\)](#), [radtodeg \(281\)](#), [radtograd \(282\)](#), [radtcycle \(281\)](#), [gradtorad \(268\)](#)

Listing: mathex/ex15.pp

Program Example15;

{ Program to demonstrate the gradtodeg function. }

Uses math;

```
begin
  writeln(gradtodeg(100));
  writeln(gradtodeg(200));
  writeln(gradtodeg(300));
end.
```

gradtorad

Declaration: `Function gradtorad(grad : float) : float;`

Description: Gradtorad converts its argument grad (an angle in grads) to radians.

(200 grad is pi degrees).

Errors: None.

See also: [cycletorad \(265\)](#), [degtograd \(266\)](#), [radtodeg \(281\)](#), [radtograd \(282\)](#), [radtcycle \(281\)](#), [gradtodeg \(268\)](#)

Listing: mathex/ex16.pp

Program Example16;

```
{ Program to demonstrate the gradtorad function. }
```

Uses math;

begin

```
  writeln (gradtorad(100));
```

```
  writeln (gradtorad(200));
```

```
  writeln (gradtorad(300));
```

end.

hypot

Declaration: Function hypot(x,y : float) : float;

Description: Hypot returns the hypotenuse of the triangle where the sides adjacent to the square angle have lengths x and y.

The function uses Pythagoras' rule for this.

Errors: None.

See also:

Listing: mathex/ex17.pp

Program Example17;

```
{ Program to demonstrate the hypot function. }
```

Uses math;

begin

```
  Writeln (hypot(3,4)); // should be 5
```

end.

intpower

Declaration: Function intpower(base : float;exponent : longint) : float;

Description: Intpower returns base to the power exponent, where exponent is an integer value.

Errors: If base is zero and the exponent is negative, then an overflow error will occur.

See also: [power \(280\)](#)

Listing: mathex/ex18.pp

Program Example18;

```
{ Program to demonstrate the intpower function. }
```

Uses math;

```

Procedure DoIntpower (X : extended; Pow : Integer);

begin
  writeln(X:8:4, '^',Pow:2, '= ',intpower(X,pow):8:4);
end;

begin
  dointpower(0.0,0);
  dointpower(1.0,0);
  dointpower(2.0,5);
  dointpower(4.0,3);
  dointpower(2.0,-1);
  dointpower(2.0,-2);
  dointpower(-2.0,4);
  dointpower(-4.0,3);
end.

```

Idexp

Declaration: Function Idexp(x : float;p : longint) : float;

Description: Idexp returns $2^p x$.

Errors: None.

See also: Inxp1 (270), log10 (271),log2 (271),logn (272)

Listing: mathex/ex19.pp

```

Program Example19;

{ Program to demonstrate the Idexp function. }

Uses math;

begin
  writeln(Idexp(2,4):8:4);
  writeln(Idexp(0.5,3):8:4);
end.

```

Inxp1

Declaration: Function Inxp1(x : float) : float;

Description: Inxp1 returns the natural logarithm of 1+X. The result is more precise for small values of x. x should be larger than -1.

Errors: If $x \leq -1$ then an EInvalidArgument exception will be raised.

See also: Idexp (270), log10 (271),log2 (271),logn (272)

Listing: mathex/ex20.pp

```

Program Example20;

{ Program to demonstrate the Inxp1 function. }

```

Uses math;

```
begin
  writeln(lnxp1(0));
  writeln(lnxp1(0.5));
  writeln(lnxp1(1));
end.
```

log10

Declaration: Function log10(x : float) : float;

Description: Log10 returns the 10-base logarithm of X.

Errors: If x is less than or equal to 0 an 'invalid fpu operation' error will occur.

See also: ldexp (270), lnxp1 (270), log2 (271), logn (272)

Listing: mathex/ex21.pp

Program Example21;

```
{ Program to demonstrate the log10 function. }
```

Uses math;

```
begin
  Writeln(Log10(10):8:4);
  Writeln(Log10(100):8:4);
  Writeln(Log10(1000):8:4);
  Writeln(Log10(1):8:4);
  Writeln(Log10(0.1):8:4);
  Writeln(Log10(0.01):8:4);
  Writeln(Log10(0.001):8:4);
end.
```

log2

Declaration: Function log2(x : float) : float;

Description: Log2 returns the 2-base logarithm of X.

Errors: If x is less than or equal to 0 an 'invalid fpu operation' error will occur.

See also: ldexp (270), lnxp1 (270), log10 (271), logn (272)

Listing: mathex/ex22.pp

Program Example22;

```
{ Program to demonstrate the log2 function. }
```

Uses math;

```
begin
```

```
Writeln (Log2(2):8:4);
Writeln (Log2(4):8:4);
Writeln (Log2(8):8:4);
Writeln (Log2(1):8:4);
Writeln (Log2(0.5):8:4);
Writeln (Log2(0.25):8:4);
Writeln (Log2(0.125):8:4);
end.
```

logn

Declaration: `Function logn(n,x : float) : float;`

Description: Logn returns the n-base logarithm of X.

Errors: If x is less than or equal to 0 an 'invalid fpu operation' error will occur.

See also: [ldexp \(270\)](#), [lnxp1 \(270\)](#), [log10 \(271\)](#), [log2 \(271\)](#)

Listing: mathex/ex23.pp

Program Example23;

```
{ Program to demonstrate the logn function. }
```

Uses math;

begin

```
Writeln (Logn(3,4):8:4);
Writeln (Logn(2,4):8:4);
Writeln (Logn(6,9):8:4);
Writeln (Logn(exp(1),exp(1)):8:4);
Writeln (Logn(0.5,1):8:4);
Writeln (Logn(0.25,3):8:4);
Writeln (Logn(0.125,5):8:4);
end.
```

max

Declaration: `Function max(Int1,Int2:Cardinal):Cardinal; Function max(Int1,Int2:Integer):Integer;`

Description: Max returns the maximum of Int1 and Int2.

Errors: None.

See also: [min \(276\)](#), [maxIntValue \(273\)](#), [maxvalue \(273\)](#)

Listing: mathex/ex24.pp

Program Example24;

```
{ Program to demonstrate the max function. }
```

Uses math;

Var

```

A,B : Cardinal;

begin
  A:=1;b:=2;
  writeln(max(a,b));
end.

```

maxIntValue

Declaration: `function MaxIntValue(const Data: array of Integer): Integer;`

Description: `MaxIntValue` returns the largest integer out of the `Data` array.

This function is provided for Delphicompatibility, use the `maxvalue` (273) function instead.

Errors: None.

See also: `maxvalue` (273), `minvalue` (277), `minIntValue` (276)

Listing: `mathex/ex25.pp`

Program `Example25;`

```
{ Program to demonstrate the MaxIntValue function. }
```

```
{ Make sure integer is 32 bit }
{$mode objfpc}
```

Uses `math;`

Type

```
TExArray = Array[1..100] of Integer;
```

Var

```
l : Integer;
ExArray : TExArray;
```

begin

```
  Randomize;
  for l:=1 to 100 do
    ExArray[l]:=Random(l)-Random(100);
  WriteIn(MaxIntValue(ExArray));
```

end.

maxvalue

Declaration: `Function maxvalue(const data : array of float) : float;` `Function maxvalue(const data : array of Integer) : Integer;` `Function maxvalue(const data : PFloat; Const N : Integer) : float;` `Function maxvalue(const data : PInteger; Const N : Integer) : Integer;`

Description: `Maxvalue` returns the largest value in the `data` array with integer or float values. The return value has the same type as the elements of the array.

The third and fourth forms accept a pointer to an array of `N` integer or float values.

Errors: None.

See also: [maxIntValue \(273\)](#), [minvalue \(277\)](#), [minIntValue \(276\)](#)

Listing: mathex/ex26.pp

Program Example26;

{ Program to demonstrate the MaxValue function. }

{ Make sure integer is 32 bit }
{ \$mode objfpc }

Uses math;

Type

TEFloatArray = **Array**[1..100] of Float;
 TExIntArray = **Array**[1..100] of Integer;

Var

I : Integer;
 ExFloatArray : TEFloatArray;
 ExIntArray : TExIntArray;
 AFloatArray : PFloat;
 AIntArray : PInteger;

begin

Randomize;

AFloatArray := @ExFloatArray[1];

AIntArray := @ExIntArray[1];

for I:=1 **to** 100 **do**

 ExFloatArray[I] := (Random-~~Random~~)*100;

for I:=1 **to** 100 **do**

 ExIntArray[I] := Random(I)-Random(100);

Writeln ('Max Float : ', MaxValue(ExFloatArray):8:4);

Writeln ('Max Float (b) : ', MaxValue(AFloatArray,100):8:4);

Writeln ('Max Integer : ', MaxValue(ExIntArray):8);

Writeln ('Max Integer (b) : ', MaxValue(AIntArray,100):8);

end.

mean

Declaration: Function mean(const data : array of float) : float; Function mean(const data : PFloat; Const N : longint) : float;

Description: Mean returns the average value of data.

The second form accepts a pointer to an array of N values.

Errors: None.

See also: [meanandstddev \(275\)](#), [momentskewkurtosis \(278\)](#), [sum \(285\)](#)

Listing: mathex/ex27.pp

Program Example27;

{ Program to demonstrate the Mean function. }

Uses math;

Type

```
TExArray = Array[1..100] of Float;
```

Var

```
l : Integer;
ExArray : TExArray;
```

begin

```
Randomize;
for l:=1 to 100 do
  ExArray[l]:= (Random-Random)*100;
WriteIn( 'Max      : ', MaxValue(ExArray):8:4);
WriteIn( 'Min      : ', MinValue(ExArray):8:4);
WriteIn( 'Mean     : ', Mean(ExArray):8:4);
WriteIn( 'Mean (b) : ', Mean(@ExArray[1],100):8:4);
end.
```

meanandstddev

Declaration: Procedure meanandstddev(const data : array of float; var mean, stddev : float); procedure meanandstddev(const data : PFloat; Const N : Longint; var mean, stddev : float);

Description: meanandstddev calculates the mean and standard deviation of data and returns the result in mean and stddev, respectively. Stddev is zero if there is only one value.

The second form accepts a pointer to an array of N values.

Errors: None.

See also: mean (274), sum (285), sumofsquares (285), momentskewkurtosis (278)

Listing: mathex/ex28.pp

Program Example28;

{ Program to demonstrate the Meanandstddev function. }

Uses math;

Type

```
TExArray = Array[1..100] of Extended;
```

Var

```
l : Integer;
ExArray : TExArray;
Mean, stddev : Extended;
```

begin

```
Randomize;
for l:=1 to 100 do
  ExArray[l]:= (Random-Random)*100;
MeanAndStdDev(ExArray, Mean, StdDev);
WriteIn( 'Mean      : ', Mean:8:4);
WriteIn( 'StdDev    : ', StdDev:8:4);
MeanAndStdDev(@ExArray[1], 100, Mean, StdDev);
WriteIn( 'Mean (b) : ', Mean:8:4);
WriteIn( 'StdDev (b) : ', StdDev:8:4);
```

end.

min

Declaration: `Function min(Int1,Int2:Cardinal):Cardinal; Function min(Int1,Int2:Integer):Integer;`

Description: `min` returns the smallest value of `Int1` and `Int2`;

Errors: None.

See also: `max` ([272](#))

Listing: `mathex/ex29.pp`

Program `Example29;`

{ Program to demonstrate the min function. }

Uses `math;`

Var

`A,B : Cardinal;`

begin

`A:=1;b:=2;`

`writeln(min(a,b));`

end.

minIntValue

Declaration: `Function minIntValue(const Data: array of Integer): Integer;`

Description: `MinIntvalue` returns the smallest value in the `Data` array.

This function is provided for Delphicompatibility, use `minvalue` instead.

Errors: None

See also: `minvalue` ([277](#)), `maxIntValue` ([273](#)), `maxvalue` ([273](#))

Listing: `mathex/ex30.pp`

Program `Example30;`

{ Program to demonstrate the MinIntValue function. }

{ Make sore integer is 32 bit }

{ \$mode objfpc }

Uses `math;`

Type

`TExArray = Array[1..100] of Integer;`

Var

`I : Integer;`

`ExArray : TExArray;`

```

begin
  Randomize;
  for I:=1 to 100 do
    ExArray[i]:=Random(I)-Random(100);
  WriteLn(MinIntValue(ExArray));
end.

```

minvalue

Declaration: Function minvalue(const data : array of float) : float; Function minvalue(const data : array of Integer) : Integer; Function minvalue(const data : PFloat; Const N : Integer) : float; Function minvalue(const data : PInteger; Const N : Integer) : Integer;

Description: Minvalue returns the smallest value in the data array with integer or float values. The return value has the same type as the elements of the array.

The third and fourth forms accept a pointer to an array of N integer or float values.

Errors: None.

See also: [maxIntValue \(273\)](#), [maxvalue \(273\)](#), [minIntValue \(276\)](#)

Listing: mathex/ex31.pp

Program Example26;

```
{ Program to demonstrate the MinValue function. }
```

```
{ Make sure integer is 32 bit }
{$mode objfpc}
```

Uses math;

Type

```
TExFloatArray = Array[1..100] of Float;
TExIntArray = Array[1..100] of Integer;
```

Var

```
I : Integer;
ExFloatArray : TExFloatArray;
AFloatArray : PFloat;
ExIntArray : TExIntArray;
AIntArray : PInteger;
```

begin

```

Randomize;
AFloatArray:=@ExFloatArray[0];
AIntArray:=@ExIntArray[0];
for I:=1 to 100 do
  ExFloatArray[i]:=(Random-Random)*100;
for I:=1 to 100 do
  ExIntArray[i]:=Random(I)-Random(100);
WriteLn('Min Float      : ',MinValue(ExFloatArray):8:4);
WriteLn('Min Float   (b) : ',MinValue(AFloatArray,100):8:4);
WriteLn('Min Integer   : ',MinValue(ExIntArray):8);
WriteLn('Min Integer (b) : ',MinValue(AIntArray,100):8);

```

end.

momentskewkurtosis

Declaration: `procedure momentskewkurtosis(const data : array of float; var m1,m2,m3,m4,skew,kurtosis : float); procedure momentskewkurtosis(const data : PFloat; Const N : Integer; var m1,m2,m3,m4,skew,kurtosis : float);`

Description: `momentskewkurtosis` calculates the 4 first moments of the distribution of values in `data` and returns them in `m1,m2,m3` and `m4`, as well as the skew and kurtosis.

Errors: None.

See also: `mean` (274), `meanandstddev` (275)

Listing: `mathex/ex32.pp`

Program Example32;

{ Program to demonstrate the momentskewkurtosis function. }

Uses `math`;

Var

`DistArray : Array[1..1000] of float;`
`l : longint;`
`m1,m2,m3,m4,skew,kurtosis : float;`

begin

`randomize;`
`for l:=1 to 1000 do`
`distarray[l]:=random;`
`momentskewkurtosis(DistArray,m1,m2,m3,m4,skew,kurtosis);`

`Writeln('1st moment : ',m1:8:6);`
`Writeln('2nd moment : ',m2:8:6);`
`Writeln('3rd moment : ',m3:8:6);`
`Writeln('4th moment : ',m4:8:6);`
`Writeln('Skew : ',skew:8:6);`
`Writeln('kurtosis : ',kurtosis:8:6);`

end.

norm

Declaration: `Function norm(const data : array of float) : float; Function norm(const data : PFloat; Const N : Integer) : float;`

Description: `Norm` calculates the Euclidian norm of the array of `data`. This equals `sqrt(sumofsquares(data))`.

The second form accepts a pointer to an array of `N` values.

Errors: None.

See also: `sumofsquares` (285)

Listing: `mathex/ex33.pp`

```

Program Example33;

{ Program to demonstrate the norm function. }

Uses math;

Type
  TVector = Array[1..10] of Float;

Var
  AVector : Tvector;
  I : longint;

begin
  for I:=1 to 10 do
    Avector[I]:=Random;
  Writeln(Norm(AVector));
end.

```

popnstddev

Declaration: Function popnstddev(const data : array of float) : float; Function popnstddev(const data : PFloat; Const N : Integer) : float;

Description: Popnstddev returns the square root of the population variance of the values in the Data array. It returns zero if there is only one value.

The second form of this function accepts a pointer to an array of N values.

Errors: None.

See also: popnvariance (280), mean (274), meanandstddev (275), stddev (284), momentskewkurtosis (278)

Listing: mathex/ex35.pp

```

Program Example35;

{ Program to demonstrate the PopnStdDev function. }

Uses Math;

Type
  TExArray = Array[1..100] of Float;

Var
  I : Integer;
  ExArray : TExArray;

begin
  Randomize;
  for I:=1 to 100 do
    ExArray[I]:=(Random-Random)*100;
  Writeln( 'Max           : ',MaxValue(ExArray):8:4);
  Writeln( 'Min           : ',MinValue(ExArray):8:4);
  Writeln( 'Pop. stddev.   : ',PopnStdDev(ExArray):8:4);
  Writeln( 'Pop. stddev. (b) : ',PopnStdDev(@ExArray[1],100):8:4);
end.

```

popnvariance

Declaration: Function popnvariance(const data : array of float) : float; Function popnvariance(const data : PFloat; Const N : Integer) : float;

Description: Popnvariance returns the square root of the population variance of the values in the Data array. It returns zero if there is only one value.

The second form of this function accepts a pointer to an array of N values.

Errors: None.

See also: popnstddev (279), mean (274), meanandstddev (275), stddev (284), momentskewkurtosis (278)

Listing: mathex/ex36.pp

Program Example36;

{ Program to demonstrate the PopnVariance function. }

Uses math;

Type

TExArray = **Array**[1..100] of Float;

Var

I : Integer;
ExArray : TExArray;

begin

Randomize;

for I:=1 to 100 do

ExArray[I]:= (Random-~~Random~~)*100;

Writeln('Max : ',MaxValue(ExArray):8:4);

Writeln('Min : ',MinValue(ExArray):8:4);

Writeln('Pop. var. : ',PopnVariance(ExArray):8:4);

Writeln('Pop. var. (b) : ',PopnVariance(@ExArray[1],100):8:4);

end.

power

Declaration: Function power(base,exponent : float) : float;

Description: power raises base to the power power. This is equivalent to $\exp(\text{power} \cdot \ln(\text{base}))$. Therefore base should be non-negative.

Errors: None.

See also: intpower (269)

Listing: mathex/ex34.pp

Program Example34;

{ Program to demonstrate the power function. }

Uses Math;

```
procedure dopower(x,y : float);  
  
begin  
  writeln(x:8:6, '^',y:8:6, ' = ',power(x,y):8:6)  
end;  
  
begin  
  dopower(2,2);  
  dopower(2,-2);  
  dopower(2,0.0);  
end.
```

radto cycle

Declaration: `Function radto cycle(rad : float) : float;`

Description: `Radto cycle` converts its argument `rad` (an angle expressed in radians) to an angle in cycles.
(1 cycle equals 2 pi radians)

Errors: None.

See also: [degtograd \(266\)](#), [degtorad \(266\)](#), [radto deg \(281\)](#), [radto grad \(282\)](#), [cycleto rad \(265\)](#)

Listing: `mathex/ex37.pp`

Program `Example37;`

```
{ Program to demonstrate the radto cycle function. }
```

Uses `math;`

```
begin  
  writeln( radto cycle(2*pi):8:6);  
  writeln( radto cycle(pi):8:6);  
  writeln( radto cycle(pi/2):8:6);  
end.
```

radto deg

Declaration: `Function radto deg(rad : float) : float;`

Description: `Radto deg` converts its argument `rad` (an angle expressed in radians) to an angle in degrees.
(180 degrees equals pi radians)

Errors: None.

See also: [degtograd \(266\)](#), [degtorad \(266\)](#), [radto cycle \(281\)](#), [radto grad \(282\)](#), [cycleto rad \(265\)](#)

Listing: `mathex/ex38.pp`

Program `Example38;`

```
{ Program to demonstrate the radto deg function. }
```

Uses `math;`

```
begin
  writeln (rattodeg(2*pi):8:6);
  writeln (rattodeg(pi):8:6);
  writeln (rattodeg(pi/2):8:6);
end.
```

radto grad

Declaration: Function `radto grad(rad : float) : float;`

Description: `Radto deg` converts its argument `rad` (an angle expressed in radians) to an angle in grads.
(200 grads equals pi radians)

Errors: None.

See also: `degtograd` (266), `degtorad` (266), `radto cycle` (281), `radto deg` (281), `cycleto rad` (265)

Listing: `mathex/ex39.pp`

Program `Example39;`

{ Program to demonstrate the radto grad function. }

Uses `math;`

```
begin
  writeln (radto grad(2*pi):8:6);
  writeln (radto grad(pi):8:6);
  writeln (radto grad(pi/2):8:6);
end.
```

randg

Declaration: Function `randg(mean, stddev : float) : float;`

Description: `randg` returns a random number which - when produced in large quantities - has a Gaussian distribution with mean `mean` and standard deviation `stddev`.

Errors: None.

See also: `mean` (274), `stddev` (284), `meanandstddev` (275)

Listing: `mathex/ex40.pp`

Program `Example40;`

{ Program to demonstrate the randg function. }

Uses `Math;`

Type

`TExArray = Array[1..10000] of Float;`

Var

`l : Integer;`

```
ExArray : TExArray;  
Mean,stddev : Float;  
  
begin  
  Randomize;  
  for l:=1 to 10000 do  
    ExArray[l]:=Randg(1,0.2);  
  MeanAndStdDev(ExArray,Mean,StdDev);  
  WriteLn('Mean      : ',Mean:8:4);  
  WriteLn('StdDev    : ',StdDev:8:4);  
end.
```

sincos

Declaration: Procedure sincos(theta : float; var sinus,cosinus : float);

Description: Sincos calculates the sine and cosine of the angle theta, and returns the result in sinus and cosinus.

On Intel hardware, This calculation will be faster than making 2 calls to calculate the sine and cosine separately.

Errors: None.

See also: arcsin ([262](#)), arccos ([261](#)).

Listing: mathex/ex41.pp

Program Example41;

{ Program to demonstrate the sincos function. }

Uses math;

Procedure dosincos(Angle : Float);

Var

Sine,Cosine : Float;

begin

```
sincos(angle,sine,cosine);  
Write('Angle : ',Angle:8:6);  
Write(' Sine : ',sine:8:6);  
Write(' Cosine : ',cosine:8:6);
```

end;

begin

```
dosincos(pi);  
dosincos(pi/2);  
dosincos(pi/3);  
dosincos(pi/4);  
dosincos(pi/6);
```

end.

sinh

Declaration: Function sinh(x : float) : float;

Description: Sinh returns the hyperbolic sine of its argument x .

Errors:

See also: cosh (265), arsinh (263), tanh (287), artanh (264)

Listing: mathex/ex42.pp

```

Program Example42;

{ Program to demonstrate the sinh function. }

Uses math;

begin
  writeln(sinh(0));
  writeln(sinh(1));
  writeln(sinh(-1));
end.

```

stddev

Declaration: Function stddev(const data : array of float) : float; Function stddev(const data : PFloat; Const N : Integer) : float;

Description: Stddev returns the standard deviation of the values in Data. It returns zero if there is only one value.

The second form of the function accepts a pointer to an array of N values.

Errors: None.

See also: mean (274), meanandstddev (275), variance (288), totalvariance (288)

Listing: mathex/ex43.pp

```

Program Example40;

{ Program to demonstrate the stddev function. }

Uses Math;

Type
  TExArray = Array[1..10000] of Float;

Var
  I : Integer;
  ExArray : TExArray;

begin
  Randomize;
  for I:=1 to 10000 do
    ExArray[I]:=Randg(1,0.2);
  Writeln('StdDev      : ',StdDev(ExArray):8:4);
  Writeln('StdDev (b) : ',StdDev(@ExArray[0],10000):8:4);
end.

```

sum

Declaration: `Function sum(const data : array of float) : float; Function sum(const data : PFloat; Const N : Integer) : float;`

Description: `Sum` returns the sum of the values in the data array.

The second form of the function accepts a pointer to an array of N values.

Errors: None.

See also: `sumofsquares` (285), `sumsandsquares` (286), `totalvariance` (288) , `variance` (288)

Listing: `mathex/ex44.pp`

Program `Example44;`

{ Program to demonstrate the Sum function. }

Uses `math;`

Type

`TExArray = Array[1..100] of Float;`

Var

`I : Integer;`

`ExArray : TExArray;`

begin

`Randomize;`

`for I:=1 to 100 do`

`ExArray[I]:= (Random-Random)*100;`

`Writeln('Max : ',MaxValue(ExArray):8:4);`

`Writeln('Min : ',MinValue(ExArray):8:4);`

`Writeln('Sum : ',Sum(ExArray):8:4);`

`Writeln('Sum (b) : ',Sum(@ExArray[1],100):8:4);`

`end.`

sumofsquares

Declaration: `Function sumofsquares(const data : array of float) : float; Function sumofsquares(const data : PFloat; Const N : Integer) : float;`

Description: `Sumofsquares` returns the sum of the squares of the values in the data array.

The second form of the function accepts a pointer to an array of N values.

Errors: None.

See also: `sum` (285), `sumsandsquares` (286), `totalvariance` (288) , `variance` (288)

Listing: `mathex/ex45.pp`

Program `Example45;`

{ Program to demonstrate the SumOfSquares function. }

Uses `math;`

Type

```
TExArray = Array[1..100] of Float;
```

Var

```
l : Integer;
ExArray : TExArray;
```

begin

```
Randomize;
for l:=1 to 100 do
  ExArray[l]:= (Random-Random)*100;
WriteIn( 'Max           : ', MaxValue(ExArray):8:4);
WriteIn( 'Min           : ', MinValue(ExArray):8:4);
WriteIn( 'Sum squares   : ', SumOfSquares(ExArray):8:4);
WriteIn( 'Sum squares (b) : ', SumOfSquares(@ExArray[1],100):8:4);
end.
```

sumsandsquares

Declaration: Procedure sumsandsquares(const data : array of float; var sum,sumofsquares : float); Procedure sumsandsquares(const data : PFloat; Const N : Integer; var sum,sumofsquares : float);

Description: sumsandsquares calculates the sum of the values and the sum of the squares of the values in the data array and returns the results in sum and sumofsquares.

The second form of the function accepts a pointer to an array of N values.

Errors: None.

See also: sum (285), sumofsquares (285), totalvariance (288), variance (288)

Listing: mathex/ex46.pp

Program Example45;

```
{ Program to demonstrate the SumOfSquares function. }
```

Uses math;

Type

```
TExArray = Array[1..100] of Float;
```

Var

```
l : Integer;
ExArray : TExArray;
s,ss : float;
```

begin

```
Randomize;
for l:=1 to 100 do
  ExArray[l]:= (Random-Random)*100;
WriteIn( 'Max           : ', MaxValue(ExArray):8:4);
WriteIn( 'Min           : ', MinValue(ExArray):8:4);
SumsAndSquares(ExArray,S,SS);
WriteIn( 'Sum           : ', S:8:4);
WriteIn( 'Sum squares   : ', SS:8:4);
SumsAndSquares(@ExArray[1],100,S,SS);
```

```
WriteLn( 'Sum (b)           : ',S:8:4);  
WriteLn( 'Sum squares (b) : ',SS:8:4);  
end.
```

tan

Declaration: `Function tan(x : float) : float;`

Description: Tan returns the tangent of x .

Errors: If x (normalized) is $\pi/2$ or $3\pi/2$ then an overflow will occur.

See also: [tanh \(287\)](#), [arcsin \(262\)](#), [sincos \(283\)](#), [arccos \(261\)](#)

Listing: mathex/ex47.pp

Program Example47;

{ Program to demonstrate the Tan function. }

Uses math;

Procedure DoTan(Angle : Float);

begin

Write('Angle : ',RadToDeg(Angle):8:6);

WriteLn('Tangent : ',Tan(Angle):8:6);

end;

begin

DoTan(0);

DoTan(**Pi**);

DoTan(**Pi**/3);

DoTan(**Pi**/4);

DoTan(**Pi**/6);

end.

tanh

Declaration: `Function tanh(x : float) : float;`

Description: Tanh returns the hyperbolic tangent of x .

Errors: None.

See also: [arcsin \(262\)](#), [sincos \(283\)](#), [arccos \(261\)](#)

Listing: mathex/ex48.pp

Program Example48;

{ Program to demonstrate the Tanh function. }

Uses math;

begin

```
writeln (tanh (0));
writeln (tanh (1));
writeln (tanh (-1));
end.
```

totalvariance

Declaration: Function totalvariance(const data : array of float) : float; Function totalvariance(const data : PFloat; Const N : Integer) : float;

Description: TotalVariance returns the total variance of the values in the data array. It returns zero if there is only one value.

The second form of the function accepts a pointer to an array of N values.

Errors: None.

See also: variance (288), stddev (284), mean (274)

Listing: mathex/ex49.pp

Program Example49;

```
{ Program to demonstrate the TotalVariance function. }
```

Uses math;

Type

```
TExArray = Array[1..100] of Float;
```

Var

```
l : Integer;
ExArray : TExArray;
TV : float;
```

begin

```
Randomize;
for l:=1 to 100 do
  ExArray[l]:= (Random-Random)*100;
TV:=TotalVariance (ExArray);
Writeln ('Total variance      : ',TV:8:4);
TV:=TotalVariance (@ExArray[1],100);
Writeln ('Total Variance (b) : ',TV:8:4);
end.
```

variance

Declaration: Function variance(const data : array of float) : float; Function variance(const data : PFloat; Const N : Integer) : float;

Description: Variance returns the variance of the values in the data array. It returns zero if there is only one value.

The second form of the function accepts a pointer to an array of N values.

Errors: None.

See also: [totalvariance \(288\)](#), [stddev \(284\)](#), [mean \(274\)](#)

Listing: mathex/ex50.pp

Program Example50;

{ Program to demonstrate the Variance function. }

Uses math;

Type

TExArray = **Array**[1..100] of Float;

Var

I : Integer;

ExArray : TExArray;

V : float;

begin

Randomize;

for I:=1 **to** 100 **do**

 ExArray[I]:= (Random-~~Random~~)*100;

V:=Variance(ExArray);

Writeln('Variance : ',V:8:4);

V:=Variance(@ExArray[1],100);

Writeln('Variance (b) : ',V:8:4);

end.

Chapter 14

The MMX unit

This chapter describes the MMX unit. This unit allows you to use the MMX capabilities of the Free Pascal compiler. It was written by Florian Klämpfl for the I386 processor. It should work on all platforms that use the Intel processor.

14.1 Variables, Types and constants

The following types are defined in the MMX unit:

```
tmmxshortint = array[0..7] of shortint;  
tmmxbyte = array[0..7] of byte;  
tmmxword = array[0..3] of word;  
tmmxinteger = array[0..3] of integer;  
tmmxfixed = array[0..3] of fixed16;  
tmmxlongint = array[0..1] of longint;  
tmmxcardinal = array[0..1] of cardinal;  
{ for the AMD 3D }  
tmmxsingle = array[0..1] of single;
```

And the following pointers to the above types:

```
pmmxshortint = ^tmmxshortint;  
pmmxbyte = ^tmmxbyte;  
pmmxword = ^tmmxword;  
pmmxinteger = ^tmmxinteger;  
pmmxfixed = ^tmmxfixed;  
pmmxlongint = ^tmmxlongint;  
pmmxcardinal = ^tmmxcardinal;  
{ for the AMD 3D }  
pmmxsingle = ^tmmxsingle;
```

The following initialized constants allow you to determine if the computer has MMX extensions. They are set correctly in the unit's initialization code.

```
is_mmx_cpu : boolean = false;  
is_amd_3d_cpu : boolean = false;
```

14.2 Functions and Procedures

Emms

Declaration: Procedure Emms ;

Description: Emms sets all floating point registers to empty. This procedure must be called after you have used any MMX instructions, if you want to use floating point arithmetic. If you just want to move floating point data around, it isn't necessary to call this function, the compiler doesn't use the FPU registers when moving data. Only when doing calculations, you should use this function.

Errors: None.

See also: [Programmers guide](#)

Example:: Program MMXDemo;

```
uses mmx;
var
  d1 : double;
  a : array[0..10000] of double;
  i : longint;
begin
  d1:=1.0;
  {$mmx+}
  { floating point data is used, but we do _no_ arithmetic }
  for i:=0 to 10000 do
    a[i]:=d2; { this is done with 64 bit moves }
  {$mmx-}
  emms; { clear fpu }
  { now we can do floating point arithmetic again }
end.
```

Chapter 15

The MOUSE unit

The `Mouse` unit implements a platform independent mouse handling interface. It is implemented identically on all platforms supported by Free Pascal and can be enhanced with custom drivers, should this be needed. It is intended to be used only in text-based screens, for instance in conjunction with the keyboard and video unit. No support for graphical screens is implemented, and there are (currently) no plans to implement this.

15.1 Constants, Types and Variables

Constants

The following constants can be used when mouse drivers need to report errors:

```
const
  { We have an errorcode base of 1030 }
  errMouseButton      = 1030;
  errMouseInitError   = errMouseButton + 0;
  errMouseNotImplemented = errMouseButton + 1;
```

The following constants describe which action a mouse event describes

```
const
  MouseActionDown = $0001; { Mouse down event }
  MouseActionUp   = $0002; { Mouse up event }
  MouseActionMove = $0004; { Mouse move event }
```

The following constants describe the used buttons in a mouse event:

```
  MouseLeftButton  = $01; { Left mouse button }
  MouseRightButton = $02; { Right mouse button }
  MouseMiddleButton = $04; { Middle mouse button }
```

The mouse unit has a mechanism to buffer mouse events. The following constant defines the size of the event buffer:

```
MouseEventBufSize = 16;
```

Types

The `TMouseEvent` is the central type of the mouse unit, it is used to describe the mouse events:

```
PMouseEvent=^TMouseEvent;
TMouseEvent=packed record { 8 bytes }
  buttons : word;
  x,y      : word;
  Action   : word;
end;
```

The `Buttons` field describes which buttons were down when the event occurred. The `x, y` fields describe where the event occurred on the screen. The `Action` describes what action was going on when the event occurred. The `Buttons` and `Action` field can be examined using the above constants.

The following record is used to implement a mouse driver in the `SetMouseDriver` (298) function:

```
TMouseDriver = Record
  UseDefaultQueue : Boolean;
  InitDriver      : Procedure;
  DoneDriver      : Procedure;
  DetectMouse     : Function : Byte;
  ShowMouse       : Procedure;
  HideMouse       : Procedure;
  GetMouseX       : Function : Word;
  GetMouseY       : Function : Word;
  GetMouseButtons : Function : Word;
  SetMouseXY      : procedure (x,y:word);
  GetMouseEvent   : procedure (var MouseEvent:TMouseEvent);
  PollMouseEvent  : function (var MouseEvent: TMouseEvent):boolean;
  PutMouseEvent   : procedure (Const MouseEvent:TMouseEvent);
end;
```

Its fields will be explained in the section on writing a custom driver.

Variables

The following variables are used to keep the current position and state of the mouse.

```
MouseIntFlag : Byte; { Mouse in int flag }
MouseButtons : Byte; { Mouse button state }
MouseWhereX,
MouseWhereY  : Word; { Mouse position }
```

15.2 Functions and procedures

DetectMouse

Declaration: `Function DetectMouse:byte;`

Description: `DetectMouse` detects whether a mouse is attached to the system or not. If there is no mouse, then zero is returned. If a mouse is attached, then the number of mouse buttons is returned.

This function should be called after the mouse driver was initialized.

Errors: None.

See also: [InitMouse \(306\)](#), [DoneMouse \(294\)](#),

Listing: mouseex/ex1.pp

```

Program Example1;

{ Program to demonstrate the DetectMouse function. }

Uses mouse;

Var
  Buttons : Byte;

begin
  InitMouse;
  Buttons:=DetectMouse;
  If Buttons=0 then
    WriteIn('No mouse present. ')
  else
    WriteIn('Found mouse with ',Buttons, ' buttons. ');
  DoneMouse;
end.

```

DoneMouse

Declaration: Procedure DoneMouse;

Description: DoneMouse De-initializes the mouse driver. It cleans up any memory allocated when the mouse was initialized, or removes possible mouse hooks from memory. The mouse functions will not work after DoneMouse was called. If DoneMouse is called a second time, it will exit at once. InitMouse should be called before DoneMouse can be called again.

Errors: None.

See also: [DetectMouse \(293\)](#), [InitMouse \(306\)](#)

For an example, see most other mouse functions.

GetMouseButtons

Declaration: Function GetMouseButtons:word;

Description: GetMouseButtons returns the current button state of the mouse, i.e. it returns a or-ed combination of the following constants:

MouseLeftButtonWhen the left mouse button is held down.

MouseRightButtonWhen the right mouse button is held down.

MouseMiddleButtonWhen the middle mouse button is held down.

Errors: None.

See also: [GetMouseEvent \(295\)](#), [GetMouseX \(295\)](#), [GetMouseY \(296\)](#)

Listing: mouseex/ex2.pp

```

Program Example2;

{ Program to demonstrate the GetMouseButtons function. }

Uses mouse;

begin
  InitMouse;
  WriteLn('Press right mouse button to exit program');
  While (GetMouseButtons<>MouseRightButton) do ;
  DoneMouse;
end.

```

GetMouseDriver

Declaration: `Procedure GetMouseDriver(Var Driver : TMouseDriver);`

Description: `GetMouseDriver` returns the currently set mouse driver. It can be used to retrieve the current mouse driver, and override certain callbacks.

A more detailed explanation about getting and setting mouse drivers can be found in section [15.3](#), page [299](#).

Errors: None.

See also: [SetMouseDriver \(298\)](#)

For an example, see the section on writing a custom mouse driver, section [15.3](#), page [299](#)

GetMouseEvent

Declaration: `Procedure GetMouseEvent(var MouseEvent : TMouseEvent);`

Description: `GetMouseEvent` returns the next mouse event (a movement, button press or button release), and waits for one if none is available in the queue.

Some mouse drivers can implement a mouse event queue which can hold multiple events till they are fetched.; Others don't, and in that case, a one-event queue is implemented for use with `PollMouseEvent` ([297](#)).

Errors: None.

See also: [GetMouseButtons \(294\)](#), [GetMouseX \(295\)](#), [GetMouseY \(296\)](#)

GetMouseX

Declaration: `Function GetMouseX:word;`

Description: `GetMouseX` returns the current X position of the mouse. X is measured in characters, starting at 0 for the left side of the screen.

Errors: None.

See also: [GetMouseButtons \(294\)](#), [GetMouseEvent \(295\)](#), [GetMouseY \(296\)](#)

Listing: `mouseex/ex4.pp`

```
Program Example4;

{ Program to demonstrate the GetMouseX,GetMouseY functions. }

Uses mouse;

Var
  X,Y : Word;

begin
  InitMouse;
  WriteLn('Move mouse cursor to square 10,10 to end');
  Repeat
    X:=GetMouseX;
    Y:=GetMouseY;
    WriteLn('X,Y= ( ',X,' ',Y,' ) ');
  Until (X=9) and (Y=9);
  DoneMouse;
end.
```

GetMouseY

Declaration: `Function GetMouseY:word;`

Description: `GetMouseY` returns the current Y position of the mouse. Y is measured in characters, starting at 0 for the top of the screen.

Errors: None.

See also: `GetMouseButtons` ([294](#)), `GetMouseEvent` ([295](#)), `GetMouseX` ([295](#))

For an example, see `GetMouseX` ([295](#))

HideMouse

Declaration: `Procedure HideMouse;`

Description: `HideMouse` hides the mouse cursor. This may or may not be implemented on all systems, and depends on the driver.

Errors: None.

See also: `ShowMouse` ([313](#))

Listing: mouseex/ex5.pp

```
Program Example5;

{ Program to demonstrate the HideMouse function. }

Uses mouse;

Var
  Event : TMouseEvent;
  Visible : Boolean;
```

```

begin
  InitMouse;
  ShowMouse;
  Visible := True;
  WriteIn('Press left mouse button to hide/show, right button quits');
  Repeat
    GetMouseEvent(Event);
    With Event do
      If (Buttons=MouseLeftbutton) and
        (Action=MouseActionDown) then
        begin
          If Visible then
            HideMouse
          else
            ShowMouse;
            Visible := Not Visible;
          end;
        Until (Event.Buttons=MouseRightButton) and
          (Event.Action=MouseActionDown);
    DoneMouse;
end.

```

InitMouse

Declaration: `Procedure InitMouse;`

Description: `InitMouse` initializes the mouse driver. This will allocate any data structures needed for the mouse to function. All mouse functions can be used after a call to `InitMouse`.

A call to `InitMouse` must always be followed by a call to `DoneMouse` (294) at program exit. Failing to do so may leave the mouse in an unusable state, or may result in memory leaks.

Errors: None.

See also: `DoneMouse` (294), `DetectMouse` (293)

For an example, see most other functions.

PollMouseEvent

Declaration: `Function PollMouseEvent(var MouseEvent: TMouseEvent):boolean;`

Description: `PollMouseEvent` checks whether a mouse event is available, and returns it in `MouseEvent` if one is found. The function result is `True` in that case. If no mouse event is pending, the function result is `False`, and the contents of `MouseEvent` is undefined.

Note that after a call to `PollMouseEvent`, the event should still be removed from the mouse event queue with a call to `GetMouseEvent`.

Errors: None.

See also: `GetMouseEvent` (295), `PutMouseEvent` (297)

PutMouseEvent

Declaration: `Procedure PutMouseEvent(const MouseEvent: TMouseEvent);`

Description: `PutMouseEvent` adds `MouseEvent` to the input queue. The next call to `GetMouseEvent` (295) or `PollMouseEvent` will then return `MouseEvent`.

Please note that depending on the implementation the mouse event queue can hold only one value.

Errors: None.

See also: `GetMouseEvent` (295), `PollMouseEvent` (297)

SetMouseDriver

Declaration: `Procedure SetMouseDriver(Const Driver : TMouseDriver);`

Description: `SetMouseDriver` sets the mouse driver to `Driver`. This function should be called before `InitMouse` (306) is called, or after `DoneMouse` is called. If it is called after the mouse has been initialized, it does nothing.

For more information on setting the mouse driver, section 15.3, page 299.

Errors:

See also: `InitMouse` (306), `DoneMouse` (294), `GetMouseDriver` (295)

For an example, see section 15.3, page 299

SetMouseXY

Declaration: `Procedure SetMouseXY(x,y:word);`

Description: `SetMouseXY` places the mouse cursor on `X`, `Y`. `X` and `Y` are zero based character coordinates: `0,0` is the top-left corner of the screen, and the position is in character cells (i.e. not in pixels).

Errors: None.

See also: `GetMouseX` (295), `GetMouseY` (296)

Listing: mouseex/ex7.pp

```

Program Example7;

{ Program to demonstrate the SetMouseXY function. }

Uses mouse;

Var
  Event : TMouseEvent;

begin
  InitMouse;
  WriteLn('Click right mouse button to quit. ');
  SetMouseXY(40,12);
  Repeat
    If (GetMouseX>70) then
      SetMouseXY(10,GetMouseY);
    If (GetMouseY>20) then
      SetMouseXY(GetMouseX,5);
    GetMouseEvent(Event);
  Until (Event.Buttons=MouseRightButton) and
    (Event.Action=MouseActionDown);

```

```
DoneMouse;
end.
```

ShowMouse

Declaration: Procedure ShowMouse;

Description: ShowMouse shows the mouse cursor if it was previously hidden. The capability to hide or show the mouse cursor depends on the driver.

Errors: None.

See also: HideMouse ([306](#))

For an example, see HideMouse ([306](#))

15.3 Writing a custom mouse driver

The mouse has support for adding a custom mouse driver. This can be used to add support for mouses not supported by the standard Free Pascal driver, but also to enhance an existing driver for instance to log mouse events or to implement a record and playback function.

The following unit shows how a mouse driver can be enhanced by adding some logging capabilities to the driver.

Listing: mouseex/logmouse.pp

```
unit logmouse;

interface

Procedure StartMouseLogging;
Procedure StopMouseLogging;
Function IsMouseLogging : Boolean;
Procedure SetMouseLogFileName ( FileName : String );

implementation

uses sysutils ,Mouse;

var
  NewMouseDriver ,
  OldMouseDriver : TMouseDriver;
  Active ,Logging : Boolean;
  LogFileName : String;
  MouseLog : Text;

Function TimeStamp : String;

begin
  TimeStamp:=FormatDateTime ( 'hh:nn:ss ' ,Time ( ) );
end;

Procedure StartMouseLogging;
```

```

begin
  Logging:=True;
  WriteLn(MouseLog,'Start logging mouse events at: ',TimeStamp);
end;

Procedure StopMouseLogging;

begin
  WriteLn(MouseLog,'Stop logging mouse events at: ',TimeStamp);
  Logging:=False;
end;

Function IsMouseLogging : Boolean;

begin
  IsMouseLogging:=Logging;
end;

Procedure LogGetMouseEvent(Var Event : TMouseEvent);

Var
  M : TMouseEvent;

begin
  OldMouseDriver.GetMouseEvent(M);
  If Logging then
    begin
      Write(MouseLog,TimeStamp,' : Mouse ');
      With M do
        begin
          Case Action of
            MouseActionDown : Write(MouseLog,'down');
            MouseActionUp   : Write(MouseLog,'up');
            MouseActionMove  : Write(MouseLog,'move');
          end;
          Write(MouseLog,' event at ',X,', ',Y);
          If (Buttons<>0) then
            begin
              Write(MouseLog,' for buttons: ');
              If (Buttons and MouseLeftbutton)<>0 then
                Write(MouseLog,' Left ');
              If (Buttons and MouseRightbutton)<>0 then
                Write(MouseLog,' Right ');
              If (Buttons and MouseMiddlebutton)<>0 then
                Write(MouseLog,' Middle ');
            end;
          WriteLn(MouseLog);
        end;
      end;
    end;

Procedure LogInitMouse;

begin
  OldMouseDriver.InitDriver();
  Assign(MouseLog,logFileName);
  Rewrite(MouseLog);
  Active:=True;

```

```
    StartMouseLogging ;
end ;

Procedure LogDoneMouse ;

begin
    StopMouseLogging ;
    Close ( MouseLog ) ;
    Active := False ;
    OldMouseDriver . DoneDriver ( ) ;
end ;

Procedure SetMouseLogFileName ( FileName : String ) ;

begin
    If Not Active then
        LogFileName := FileName ;
    end ;

Initialization
    GetMouseDriver ( OldMouseDriver ) ;
    NewMouseDriver := OldMouseDriver ;
    NewMouseDriver . GetMouseEvent := @LogGetMouseEvent ;
    NewMouseDriver . InitDriver := @LogInitMouse ;
    NewMouseDriver . DoneDriver := @LogDoneMouse ;
    LogFileName := 'Mouse.log' ;
    Logging := False ;
    SetMouseDriver ( NewMouseDriver ) ;
end .
```

Chapter 16

The MsMouse unit

The msmouse unit provides basic mouse handling under DOS (Go32v1 and Go32v2) Some general remarks about the msmouse unit:

- For maximum portability, it is advisable to use the `mouse` unit; that unit is portable across platforms, and offers a similar interface. Under no circumstances should the two units be used together.
- The mouse driver does not know when the text screen scrolls. This results in unerased mouse cursors on the screen when the screen scrolls while the mouse cursor is visible. The solution is to hide the mouse cursor (using `HideMouse`) when you write something to the screen and to show it again afterwards (using `ShowMouse`).
- All Functions/Procedures that return and/or accept coordinates of the mouse cursor, always do so in pixels and zero based (so the upper left corner of the screen is (0,0)). To get the (column, row) in standard text mode, divide both x and y by 8 (and add 1 if you want to have it 1 based).
- The real resolution of graphic modes and the one the mouse driver uses can differ. For example, mode 13h (320*200 pixels) is handled by the mouse driver as 640*200, so you will have to multiply the X coordinates you give to the driver and divide the ones you get from it by 2 in that mode.
- By default the msmouse unit is compiled with the conditional define `MouseCheck`. This causes every procedure/function of the unit to check the `MouseFound` variable prior to doing anything. Of course this is not necessary, so if you are sure you are not calling any mouse unit procedures when no mouse is found, you can recompile the mouse unit without this conditional define.
- You will notice that several procedures/functions have longint sized parameters while only the lower 16 bits are used. This is because FPC is a 32 bit compiler and consequently 32 bit parameters result in faster code.

16.1 Constants, types and variables

The following constants are defined (to be used in e.g. the `GetLastButtonPress` (303) call).

```
LButton = 1; {left button}
RButton = 2; {right button}
MButton = 4; {middle button}
```

The following variable exist:

```
MouseFound: Boolean;
```

it is set to `True` or `False` in the unit's initialization code.

16.2 Functions and procedures

GetLastButtonPress

Declaration: `Function GetLastButtonPress (Button: Longint; Var x,y:Longint) : Longint;`

Description: `GetLastButtonPress` Stores the position where `Button` was last pressed in `x` and `y` and returns the number of times this button has been pressed since the last call to this function with `Button` as parameter. For `Button` you can use the `LButton`, `RButton` and `MButton` constants for resp. the left, right and middle button. With certain mouse drivers, checking the middle button when using a two-button mouse to gives and clears the stats of the right button.

Errors: None.

See also: `GetLastButtonRelease` (304)

Listing: `mmouseex/mouse5.pp`

{example for GetLastButtonPress and GetLastButtonRelease}

```
Uses MsMouse, Crt;
```

```
Var x, y, times: Longint;
    c: Char;
```

```
Begin
```

```
  If MouseFound Then
```

```
    Begin
```

```
      ClrScr;
```

```
      ShowMouse;
```

```
      WriteLn('Move the mouse and click the buttons (press escape to quit).');
```

```
      WriteLn('Press the L-key to see the stats for the left button.');
```

```
      WriteLn('Press the R-key to see the stats for the right button.');
```

```
      WriteLn('Press the M-key to see the stats for the middle button.');
```

```
      GotoXY(1,19);
```

```
      Write('Since the last call to GetLastButtonPress with this button as parameter, the');
```

```
      GotoXY(1,22);
```

```
      Write('Since the last call to GetLastButtonRelease with this button as parameter, the');
```

```
      Repeat
```

```
        If Keypressed Then
```

```
          Begin
```

```
            c := UpCase(Readkey);
```

```
            Case c Of
```

```
              'L':
```

```
                Begin
```

```
                  GotoXY(1, 20);
```

```
                  ClrEol;
```

```
                  times := GetLastButtonPress(LButton, x, y);
```

```
                  Write('left button has been pressed ',times,
                        ' times, the last time at (' ,x, ', ',y, ')');
```

```
                  times := GetLastButtonRelease(LButton, x, y);
```

```
                  GotoXY(1,23);
```

```
                  ClrEol;
```

```

        Write('left button has been released ',times,
              ' times, the last time at (' ,x, ',' ,y, ')')
    End;
'R':
    Begin
        GotoXY(1, 20);
        ClrEol;
        times := GetLastButtonPress(RButton, x, y);
        WriteIn('right button has been pressed ',times,
                ' times, the last time at (' ,x, ',' ,y, ')');
        times := GetLastButtonRelease(RButton, x, y);
        GotoXY(1,23);
        ClrEol;
        Write('right button has been released ',times,
              ' times, the last time at (' ,x, ',' ,y, ')')
    End;
'M':
    Begin
        GotoXY(1, 20);
        ClrEol;
        times := GetLastButtonPress(MButton, x, y);
        WriteIn('middle button has been pressed ',times,
                ' times, the last time at (' ,x, ',' ,y, ')');
        times := GetLastButtonRelease(MButton, x, y);
        GotoXY(1,23);
        ClrEol;
        Write('middle button has been released ',times,
              ' times, the last time at (' ,x, ',' ,y, ')')
    End
End
End;
Until (c = #27); {escape}
While KeyPressed do ReadKey;
GotoXY(1,24);
HideMouse
End
End.

```

GetLastButtonRelease

Declaration: Function GetLastButtonRelease (Button: Longint; Var x,y:Longint) : Longint;

Description: GetLastButtonRelease stores the position where Button was last released in x and y and returns the number of times this button has been released since the last call to this function with Button as parameter. For button you can use the LButton, RButton and MButton constants for resp. the left, right and middle button. With certain mouse drivers, checking the middle button when using a two-button mouse to gives and clears the stats of the right button.

Errors: None.

See also: GetLastButtonPress (303)

For an example, see GetLastButtonPress (303).

GetMouseState

Declaration: Procedure GetMouseState (Var x, y, buttons: Longint);

Description: GetMouseState Returns information on the current mouse position and which buttons are currently pressed. x and y return the mouse cursor coordinates in pixels. Buttons is a bitmask. Check the example program to see how you can get the necessary information from it.

Errors: None.

See also: LPressed (307), MPressed (307), RPressed (307), SetMousePos (309)

Listing: mmouseex/mouse3.pp

{example for GetMouseState, IsLPressed, IsRPressed and IsMPressed}

Uses MsMouse, Crt;

Var X, Y, State: Longint;

Begin

If MouseFound **Then**

Begin

ClrScr;

 ShowMouse;

GotoXY(5,24);

Write('Left button:');

GotoXY(30,24);

Write('Right button:');

GotoXY(55,24);

Write('Middle button:');

While KeyPressed **do** Readkey; *{clear keyboard buffer}*

Repeat

 GetMouseState(x, y, State);

GotoXY(20, 22);

Write('X: ',x:5, ' (column: ',(x div 8):2,') Y: ',y:5, ' (row: ',(y div 8):2,')');

GotoXY(18, 24); *{left button}*

If (State **and** LButton) = LButton **Then**

{or: "If LPressed Then". If you use this function, no call to GetMouseState is necessary}

Write('Down')

Else

Write('Up ');

GotoXY(44, 24); *{right button}*

If (State **and** RButton) = RButton **Then**

{or: "If RPressed Then"}

Write('Down')

Else

Write('Up ');

GotoXY(70, 24); *{middle button}*

If (State **and** MButton) = MButton **Then**

{or: "If MPressed Then"}

Write('Down')

Else

Write('Up ');

Until KeyPressed;

 HideMouse;

While KeyPressed **Do** Readkey

End

End.

HideMouse

Declaration: Procedure HideMouse ;

Description: HideMouse makes the mouse cursor invisible. Multiple calls to HideMouse will require just as many calls to ShowMouse to make the mouse cursor visible again.

Errors: None.

See also: ShowMouse (313), SetMouseHideWindow (308)

For an example, see ShowMouse (313).

InitMouse

Declaration: Procedure InitMouse ;

Description: InitMouse initializes the mouse driver sets the variable MouseFound depending on whether or not a mouse is found. This is automatically called at the start of your program. You should never have to call it, unless you want to reset everything to its default values.

Errors: None.

See also: MouseFound variable.

Listing: mmouseex/mouse1.pp

Program Mouse1;

{example for InitMouse and MouseFound}

Uses MsMouse;

Begin

If MouseFound **Then**

Begin

{go into graphics mode 13h}

Asm

 movl \$0x013, %eax

 pushl %ebp

int \$0x010

 popl %ebp

End;

 InitMouse;

 ShowMouse; *{otherwise it stays invisible}*

WriteIn('Mouse Found! (press enter to quit)');

Readln;

{back to text mode}

Asm

 movl \$3, %eax

 pushl %ebp

int \$0x010

 popl %ebp

End

End

End.

LPressed

Declaration: `Function LPressed : Boolean;`

Description: `LPressed` returns `True` if the left mouse button is pressed. This is simply a wrapper for the `GetMouseState` procedure.

Errors: None.

See also: `GetMouseState` (305), `MPressed` (307), `RPressed` (307)

For an example, see `GetMouseState` (305).

MPressed

Declaration: `Function MPressed : Boolean;`

Description: `MPressed` returns `True` if the middle mouse button is pressed. This is simply a wrapper for the `GetMouseState` procedure.

Errors: None.

See also: `GetMouseState` (305), `LPressed` (307), `RPressed` (307)

For an example, see `GetMouseState` (305).

RPressed

Declaration: `Function RPressed : Boolean;`

Description: `RPressed` returns `True` if the right mouse button is pressed. This is simply a wrapper for the `GetMouseState` procedure.

Errors: None.

See also: `GetMouseState` (305), `LPressed` (307), `MPressed` (307)

For an example, see `GetMouseState` (305).

SetMouseAscii

Declaration: `Procedure SetMouseAscii (Ascii: Byte);`

Description: `SetMouseAscii` sets the `Ascii` value of the character that depicts the mouse cursor in text mode. The difference between this one and `SetMouseShape` (310), is that the foreground and background colors stay the same and that the `Ascii` code you enter is the character that you will get on screen; there's no XOR'ing.

Errors: None

See also: `SetMouseShape` (310)

Listing: `mmouseex/mouse8.pp`

```

{example for SetMouseAscii}

{warning: no error checking is performed on the input}

Uses MsMouse, Crt;

Var ascii : Byte;
      x,y : Longint;

Begin
  If MouseFound Then
    Begin
      ClrScr;
      WriteLn('Press any mouse button to quit after you've entered an Ascii value. ');
      WriteLn;
      WriteLn('ASCII value of mouse cursor: ');
      ShowMouse;
      Repeat
        GotoXY(30,3);
        ClrEol;
        ReadLn(ascii);
        SetMouseAscii(ascii)
      Until ( GetLastButtonPress(LButton,x,y) <> 0) Or
             ( GetLastButtonPress(RButton,x,y) <> 0) Or
             ( GetLastButtonPress(MButton,x,y) <> 0);
      HideMouse
    End;
End.

```

SetMouseHideWindow

Declaration: Procedure SetMouseHideWindow (xmin,ymin,xmax,ymax: Longint);

Description: SetMouseHideWindow defines a rectangle on screen with top-left corner at (xmin,ymin) and botto-right corner at (xmax,ymax),which causes the mouse cursor to be turned off when it is moved into it. When the mouse is moved into the specified region, it is turned off until you call ShowMouse again. However, once you've called ShowMouse (313), you'll have to call SetMouseHideWindow again to redefine the hide window... This may be annoying, but it's the way it's implemented in the mouse driver. While xmin, ymin, xmax and ymax are Longint parameters, only the lower 16 bits are used.

Warning: it seems Win98 SE doesn't (properly) support this function, maybe this already the case with earlier versions too!

Errors: None.

See also: ShowMouse (313), HideMouse (306)

Listing: mmouseex/mouse9.pp

```

{example for SetMouseHideWindow}

{warning: when the mouse is moved into the specified region , it is turned off
until you call ShowMouse again. However, when you've called ShowMouse,
you'll have to call SetMouseHideWindow again to redefine the hide window...
It's not our fault , that's the way it 's implemented in the mouse driver.

```

Below you can find an example of how to define a "permanent" hide region with the cursor showing up again when you move it out of the region

Note: the mouse functions are zero-based, GotoXY is 1-based}

```

Uses MsMouse, Crt;

Var x, y, buttons: Longint;
      MouseOn: Boolean;

Begin
  If MouseFound Then
    Begin
      ClrScr;
      For y := 1 to 25 Do
        Begin
          GotoXY(20,y);
          Write('|');
          GotoXY(60,y);
          Write('|');
        End;
      MouseOn := true;
      GotoXY(30, 24);
      WriteIn('Press any key to quit');
      ShowMouse;
      SetMousePos(1,1);
      While KeyPressed Do Readkey;
      Repeat
        GetMouseState(x,y, buttons);
        If Not(MouseOn) And
          ((x <= 19*8) or (x >= 59*8)) Then
          Begin
            ShowMouse;
            MouseOn := true
          End;
        If MouseOn And (x > 19*8) And (x<59*8) Then
          Begin
            SetMouseHideWindow(20*8,0,60*8,25*8);
            MouseOn := false
          End;
      Until KeyPressed;
      While KeyPressed Do Readkey;
      HideMouse
    End
  End.

```

SetMousePos

Declaration: `Procedure SetMousePos (x,y:Longint);`

Description: `SetMosusePos` sets the position of the mouse cursor on the screen. `x` is the horizontal position in pixels, `y` the vertical position in pixels. The upper-left hand corner of the screen is the origin. While `x` and `y` are longints, only the lower 16 bits are used.

Errors: None.

See also: `GetMouseState` (305)

Listing: mmouseex/mouse4.pp

{example for SetMousePos}

Uses MsMouse, Crt;

Begin

If MouseFound **Then**

Begin

ShowMouse;

While KeyPressed **do** ReadKey;

Repeat

SetMousePos(Random(80*8), Random(25*8));

delay(100);

Until Keypressed;

HideMouse;

While KeyPressed **do** ReadKey;

End;

End.

SetMouseShape

Declaration: Procedure SetMouseShape (ForeColor,BackColor,Ascii: Byte);

Description: SetMouseShape defines how the mouse cursor looks in textmode The character and its attributes that are on the mouse cursor's position on screen are XOR'ed with resp. ForeColor, BackColor and Ascii. Set them all to 0 for a "transparent" cursor.

Errors: None.

See also: SetMouseAscii ([307](#))

Listing: mmouseex/mouse7.pp

{example for SetMouseShape}

{warning: no error checking is performed on the input}

{the Ascii value you enter is XOR'ed with the Ascii value of the character on the screen over which you move the cursor. To get a "transparent" cursor, use the Ascii value 0}

Uses MsMouse, Crt;

Var ascii, fc, bc: Byte;
x,y: Longint;

Begin

If MouseFound **Then**

Begin

ClrScr;

WriteLn('Press any mouse button to quit after you've entered a sequence of numbers.');

WriteLn;

WriteLn('ASCII value of mouse cursor:');

WriteLn('Foreground color:');

WriteLn('Background color:');

ShowMouse;

Repeat

```

    GotoXY(30,3);
    ClrEol;
    Readln(ascii);
    GotoXY(18,4);
    ClrEol;
    Readln(fc);
    GotoXY(19,5);
    ClrEol;
    Readln(bc);
    SetMouseShape(fc, bc, ascii)
  Until ( GetLastButtonPress(LButton,x,y) <> 0) Or
        ( GetLastButtonPress(RButton,x,y) <> 0) Or
        ( GetLastButtonPress(MButton,x,y) <> 0);
  HideMouse
End;
End.

```

SetMouseSpeed

Declaration: Procedure SetMouseSpeed (Horizontal, Vertical: Longint);

Description: SetMouseSpeed sets the mouse speed in mickeys per 8 pixels. A mickey is the smallest measurement unit handled by a mouse. With this procedure you can set how many mickeys the mouse should move to move the cursor 8 pixels horizontally or vertically. The default values are 8 for horizontal and 16 for vertical movement. While this procedure accepts longint parameters, only the low 16 bits are actually used.

Errors: None.

See also:

Listing: mmouseex/mouse10.pp

Uses MsMouse, Crt;

Var hor, vert: Longint;
x, y: Longint;

Begin

If MouseFound **Then**

Begin

ClrScr;

WriteLn('Click any button to quit after you've entered a sequence of numbers.');

WriteLn;

WriteLn('Horizontal mickey's per pixel:');

WriteLn('Vertical mickey's per pixel:');

 ShowMouse;

Repeat

GotoXY(32,3);

ClrEol;

ReadLn(hor);

GotoXY(30,4);

ClrEol;

ReadLn(vert);

 SetMouseSpeed(hor, vert);

Until (GetLastButtonPress(LButton,x,y) <> 0) **Or**

 (GetLastButtonPress(RButton,x,y) <> 0) **Or**

```

                (GetLastButtonPress (MButton , x , y) <> 0);
    End
End.

```

SetMouseWindow

Declaration: Procedure SetMouseWindow (xmin, ymin, xmax, ymax: Longint);

Description: SetMouseWindow defines a rectangle on screen with top-left corner at (xmin, ymin) and bottom-right corner at (xmax, ymax), out of which the mouse cursor can't move. This procedure is simply a wrapper for the SetMouseXRange (312) and SetMouseYRange (313) procedures. While xmin, ymin, xmax and ymax are Longint parameters, only the lower 16 bits are used.

Errors: None.

See also: SetMouseXRange (312), SetMouseYRange (313)

For an example, see SetMouseXRange (312).

SetMouseXRange

Declaration: Procedure SetMouseXRange (Min, Max: Longint);

Description: SetMouseXRange sets the minimum (Min) and maximum (Max) horizontal coordinates in between which the mouse cursor can move. While Min and Max are Longint parameters, only the lower 16 bits are used.

Errors: None.

See also: SetMouseYRange (313), SetMouseWindow (312)

Listing: mmouseex/mouse6.pp

{example for SetMouseXRange, SetMouseYRange and SetMouseWindow}

Uses MsMouse, Crt;

Begin

If MouseFound **Then**

Begin

 SetMouseXRange(20*8,50*8); *{character width and height = 8 pixels}*
 SetMouseYRange(10*8,15*8);

*{the two lines of code have exactly the same effect as
SetMouseWindow(20*8,10*8,50*8,15*8)}*

 WriteLn('Press any key to quit.');

 ShowMouse;

While KeyPressed **Do** ReadKey;

 Readkey;

While KeyPressed **Do** ReadKey;

 HideMouse

End

End.

SetMouseYRange

Declaration: `Procedure SetMouseYRange (Min, Max: Longint);`

Description: `SetMouseYRange` sets the minimum (`Min`) and maximum (`Max`) vertical coordinates in between which the mouse cursor can move. While `Min` and `Max` are `Longint` parameters, only the lower 16 bits are used.

Errors: None.

See also: `SetMouseXRange` (312), `SetMouseWindow` (312)

For an example, see `SetMouseXRange` (312).

ShowMouse

Declaration: `Procedure ShowMouse ;`

Description: `ShowMouse` makes the mouse cursor visible. At the start of your program, the mouse cursor is invisible.

Errors: None.

See also: `HideMouse` (306), `SetMouseHideWindow` (308)

Listing: `mmouseex/mouse2.pp`

{example for ShowMouse and HideMouse}

Uses `MsMouse`;

Begin

`ClrScr`;

`If MouseFound Then`

`Begin`

`WriteLn('Now you can see the mouse... (press enter to continue)');`

`ShowMouse`;

`ReadLn`;

`HideMouse`;

`WriteLn('And now you can''t... (press enter to quit)');`

`ReadLn`

`End`

`End.`

Chapter 17

The Objects unit.

This chapter documents the `objects` unit. The unit was implemented by many people, and was mainly taken from the FreeVision sources. It has been ported to all supported platforms.

The methods and fields that are in a `Private` part of an object declaration have been left out of this documentation.

17.1 Constants

The following constants are error codes, returned by the various stream objects.

```
CONST
  stOk          = 0; { No stream error }
  stError       = -1; { Access error }
  stInitError   = -2; { Initialize error }
  stReadError   = -3; { Stream read error }
  stWriteError  = -4; { Stream write error }
  stGetError    = -5; { Get object error }
  stPutError    = -6; { Put object error }
  stSeekError   = -7; { Seek error in stream }
  stOpenError   = -8; { Error opening stream }
```

These constants can be passed to constructors of file streams:

```
CONST
  stCreate      = $3C00; { Create new file }
  stOpenRead   = $3D00; { Read access only }
  stOpenWrite  = $3D01; { Write access only }
  stOpen       = $3D02; { Read/write access }
```

The following constants are error codes, returned by the collection list objects:

```
CONST
  coIndexError = -1; { Index out of range }
  coOverflow   = -2; { Overflow }
```

Maximum data sizes (used in determining how many data can be used).

```

CONST
  MaxBytes = 128*1024*1024;           { Maximum data size }
  MaxWords = MaxBytes DIV SizeOf(Word); { Max word data size }
  MaxPtrs = MaxBytes DIV SizeOf(Pointer); { Max ptr data size }
  MaxCollectionSize = MaxBytes DIV SizeOf(Pointer); { Max collection size }

```

17.2 Types

The following auxiliary types are defined:

```

TYPE
  { Character set }
  TCharSet = SET Of Char;
  PCharSet = ^TCharSet;

  { Byte array }
  TByteArray = ARRAY [0..MaxBytes-1] Of Byte;
  PByteArray = ^TByteArray;

  { Word array }
  TWordArray = ARRAY [0..MaxWords-1] Of Word;
  PWordArray = ^TWordArray;

  { Pointer array }
  TPointerArray = Array [0..MaxPtrs-1] Of Pointer;
  PPointerArray = ^TPointerArray;

  { String pointer }
  PString = ^String;

  { Filename array }
  AsciiZ = Array [0..255] Of Char;

  Sw_Word = Cardinal;
  Sw_Integer = LongInt;

```

The following records are used internally for easy type conversion:

```

TYPE
  { Word to bytes }
  WordRec = packed RECORD
    Lo, Hi: Byte;
  END;

  { LongInt to words }
  LongRec = packed RECORD
    Lo, Hi: Word;
  END;

  { Pointer to words }
  PtrRec = packed RECORD
    Ofs, Seg: Word;
  END;

```

The following record is used when streaming objects:

```
TYPE
  PStreamRec = ^TStreamRec;
  TStreamRec = Packed RECORD
    ObjType: Sw_Word;
    VmtLink: pointer;
    Load : Pointer;
    Store: Pointer;
    Next : PStreamRec;
  END;
```

The TPoint basic object is used in the TRect object (see section 17.4, page 319):

```
TYPE
  PPoint = ^TPoint;
  TPoint = OBJECT
    X, Y: Sw_Integer;
  END;
```

17.3 Procedures and Functions

NewStr

Declaration: Function NewStr (Const S: String): PString;

Description: NewStr makes a copy of the string S on the heap, and returns a pointer to this copy.

The allocated memory is not based on the declared size of the string passed to NewStr, but is based on the actual length of the string.

Errors: If not enough memory is available, an 'out of memory' error will occur.

See also: DisposeStr (317)

Listing: objectex/ex40.pp

Program ex40;

{ Program to demonstrate the NewStr function }

Uses Objects;

Var S : **String**;
P : PString;

begin

```
S:= 'Some really cute string';
WriteIn ('Memavail : ', Memavail);
P:= NewStr(S);
If P^<>S then
  WriteIn ('Oh-oh... Something is wrong !!');
  WriteIn ('Allocated string. Memavail : ', Memavail);
  DisposeStr(P);
  WriteIn ('Deallocated string. Memavail : ', Memavail);
end.
```

DisposeStr

Declaration: `Procedure DisposeStr (P: PString);`

Description: `DisposeStr` removes a dynamically allocated string from the heap.

Errors: None.

See also: `NewStr` (316)

For an example, see `NewStr` (316).

Abstract

Declaration: `Procedure Abstract;`

Description: When implementing abstract methods, do not declare them as `abstract`. Instead, define them simply as `virtual`. In the implementation of such abstract methods, call the `Abstract` procedure. This allows explicit control of what happens when an abstract method is called.

The current implementation of `Abstract` terminates the program with a run-time error 211.

Errors: None.

See also: Most abstract types.

RegisterObjects

Declaration: `Procedure RegisterObjects;`

Description: `RegisterObjects` registers the following objects for streaming:

1. `TCollection`, see section 17.10, page 344.
2. `TStringCollection`, see section 17.12, page 363.
3. `TStrCollection`, see section 17.13, page 365.

Errors: None.

See also: `RegisterType` (317)

RegisterType

Declaration: `Procedure RegisterType (Var S: TStreamRec);`

Description: `RegisterType` registers a new type for streaming. An object cannot be streamed unless it has been registered first. The stream record `S` needs to have the following fields set:

ObjType: Sw_WordThis should be a unique identifier. Each possible type should have its own identifier.

VmtLink: pointerThis should contain a pointer to the VMT (Virtual Method Table) of the object you try to register. You can get it with the following expression:

```
VmtLink: ofs(KindOf(MyType)^);
```

Load : Pointeris a pointer to a method that initializes an instance of that object, and reads the initial values from a stream. This method should accept as its sole argument a `PStream` type variable.

Store: Pointer is a pointer to a method that stores an instance of the object to a stream. This method should accept as its sole argument a `PStream` type variable.

Errors: In case of error (if a object with the same `ObjType`) is already registered), run-time error 212 occurs.

Listing: objectex/myobject.pp

```

Unit MyObject;

Interface

Uses Objects;

Type
  PMyObject = ^TMyObject;
  TMyObject = Object(TObject)
    Field : Longint;
    Constructor Init;
    Constructor Load (Var Stream : TStream);
    Destructor Done;
    Procedure Store (Var Stream : TStream);
    Function GetField : Longint;
    Procedure SetField (Value : Longint);
    end;

Implementation

Constructor TMyobject.Init;

begin
  Inherited Init;
  Field := -1;
end;

Constructor TMyobject.Load (Var Stream : TStream);

begin
  Stream.Read(Field, Sizeof(Field));
end;

Destructor TMyObject.Done;

begin
end;

Function TMyObject.GetField : Longint;

begin
  GetField := Field;
end;

Procedure TMyObject.SetField (Value : Longint);

begin
  Field := Value;
end;

```

```

Procedure TMyObject.Store (Var Stream : TStream);

begin
  Stream.Write(Field , SizeOf(Field));
end;

Const MyObjectRec : TStreamRec = (
  Objtype : 666;
  vmtlink : Ofs(TypeOf(TMyObject)^);
  Load : @TMyObject.Load;
  Store : @TMyObject.Store;
  );

begin
  RegisterObjects;
  RegisterType (MyObjectRec);
end.

```

LongMul

Declaration: `Function LongMul (X, Y: Integer): LongInt;`

Description: `LongMul` multiplies X with Y. The result is of type `Longint`. This avoids possible overflow errors you would normally get when multiplying X and Y that are too big.

Errors: None.

See also: [LongDiv \(319\)](#)

LongDiv

Declaration: `Function LongDiv (X: Longint; Y: Integer): Integer;`

Description: `LongDiv` divides X by Y. The result is of type `Integer` instead of type `Longint`, as you would get normally.

Errors: If Y is zero, a run-time error will be generated.

See also: [LongMul \(319\)](#)

17.4 TRect

The `TRect` object is declared as follows:

```

TRect = OBJECT
  A, B: TPoint;
  FUNCTION Empty: Boolean;
  FUNCTION Equals (R: TRect): Boolean;
  FUNCTION Contains (P: TPoint): Boolean;
  PROCEDURE Copy (R: TRect);
  PROCEDURE Union (R: TRect);
  PROCEDURE Intersect (R: TRect);
  PROCEDURE Move (ADX, ADY: Sw_Integer);
  PROCEDURE Grow (ADX, ADY: Sw_Integer);

```

```
PROCEDURE Assign (XA, YA, XB, YB: Sw_Integer);  
END;
```

TRect.Empty

Declaration: `Function TRect.Empty: Boolean;`

Description: `Empty` returns `True` if the rectangle defined by the corner points A, B has zero or negative surface.

Errors: None.

See also: `TRect.Equals` (321), `TRect.Contains` (321)

Listing: objectex/ex1.pp

Program ex1;

{ Program to demonstrate TRect.Empty }

Uses objects;

```
Var ARect, BRect : TRect;  
    P : TPoint;
```

```
begin
```

```
  With ARect.A do
```

```
    begin
```

```
      X:=10;
```

```
      Y:=10;
```

```
    end;
```

```
  With ARect.B do
```

```
    begin
```

```
      X:=20;
```

```
      Y:=20;
```

```
    end;
```

```
  { Offset B by (5,5) }
```

```
  With BRect.A do
```

```
    begin
```

```
      X:=15;
```

```
      Y:=15;
```

```
    end;
```

```
  With BRect.B do
```

```
    begin
```

```
      X:=25;
```

```
      Y:=25;
```

```
    end;
```

```
  { Point }
```

```
  With P do
```

```
    begin
```

```
      X:=15;
```

```
      Y:=15;
```

```
    end;
```

```
  Writeln ( 'A empty : ', ARect.Empty );
```

```
  Writeln ( 'B empty : ', BRect.Empty );
```

```
  Writeln ( 'A Equals B : ', ARect.Equals(BRect) );
```

```
  Writeln ( 'A Contains (15,15) : ', ARect.Contains(P) );
```

```
end.
```

TRect.Equals

Declaration: `Function TRect.Equals (R: TRect): Boolean;`

Description: `Equals` returns `True` if the rectangle has the same corner points `A,B` as the rectangle `R`, and `False` otherwise.

Errors: None.

See also: `Empty` (320), `Contains` (321)

For an example, see `TRect.Empty` (320)

TRect.Contains

Declaration: `Function TRect.Contains (P: TPoint): Boolean;`

Description: `Contains` returns `True` if the point `P` is contained in the rectangle (including borders), `False` otherwise.

Errors: None.

See also: `Intersect` (322), `Equals` (321)

TRect.Copy

Declaration: `Procedure TRect.Copy (R: TRect);`

Description: Assigns the rectangle `R` to the object. After the call to `Copy`, the rectangle `R` has been copied to the object that invoked `Copy`.

Errors: None.

See also: `Assign` (324)

Listing: `objectex/ex2.pp`

```
Program ex2;

{ Program to demonstrate TRect.Copy }

Uses objects;

Var ARect, BRect, CRect : TRect;

begin
  ARect.Assign(10,10,20,20);
  BRect.Assign(15,15,25,25);
  CRect.Copy(ARect);
  If ARect.Equals(CRect) Then
    WriteLn ('ARect equals CRect')
  Else
    WriteLn ('ARect does not equal CRect !');
end.
```

TRect.Union

Declaration: `Procedure TRect.Union (R: TRect);`

Description: `Union` enlarges the current rectangle so that it becomes the union of the current rectangle with the rectangle `R`.

Errors: None.

See also: `Intersect` ([322](#))

Listing: `objectex/ex3.pp`

```
Program ex3;
{ Program to demonstrate TRect.Union }

Uses objects;

Var ARect, BRect, CRect : TRect;

begin
  ARect.Assign(10,10,20,20);
  BRect.Assign(15,15,25,25);
  { CRect is union of ARect and BRect }
  CRect.Assign(10,10,25,25);
  { Calculate it explicitly }
  ARect.Union(BRect);
  If ARect.Equals(CRect) Then
    WriteIn ('ARect equals CRect')
  Else
    WriteIn ('ARect does not equal CRect !');
end.
```

TRect.Intersect

Declaration: `Procedure TRect.Intersect (R: TRect);`

Description: `Intersect` makes the intersection of the current rectangle with `R`. If the intersection is empty, then the rectangle is set to the empty rectangle at coordinate (0,0).

Errors: None.

See also: `Union` ([322](#))

Listing: `objectex/ex4.pp`

```
Program ex4;
{ Program to demonstrate TRect.Intersect }

Uses objects;

Var ARect, BRect, CRect : TRect;

begin
```

```
ARect.Assign(10,10,20,20);
BRect.Assign(15,15,25,25);
{ CRect is intersection of ARect and BRect }
CRect.Assign(15,15,20,20);
{ Calculate it explicitly }
ARect.Intersect(BRect);
If ARect.Equals(CRect) Then
  Writeln ('ARect equals CRect')
Else
  Writeln ('ARect does not equal CRect !');
BRect.Assign(25,25,30,30);
ARect.Intersect(BRect);
If ARect.Empty Then
  Writeln ('ARect is empty');
end.
```

TRect.Move

Declaration: Procedure TRect.Move (ADX, ADY: Sw_Integer);

Description: Move moves the current rectangle along a vector with components (ADX,ADY). It adds ADX to the X-coordinate of both corner points, and ADY to both end points.

Errors: None.

See also: Grow (323)

Listing: objectex/ex5.pp

Program ex5;

```
{ Program to demonstrate TRect.Move }
```

Uses objects;

Var ARect,BRect : TRect;

begin

```
ARect.Assign(10,10,20,20);
ARect.Move(5,5);
// Brect should be where new ARect is.
BRect.Assign(15,15,25,25);
If ARect.Equals(BRect) Then
  Writeln ('ARect equals BRect')
Else
  Writeln ('ARect does not equal BRect !');
```

end.

TRect.Grow

Declaration: Procedure TRect.Grow (ADX, ADY: Sw_Integer);

Description: Grow expands the rectangle with an amount ADX in the X direction (both on the left and right side of the rectangle, thus adding a length 2*ADX to the width of the rectangle), and an amount ADY in

the Y direction (both on the top and the bottom side of the rectangle, adding a length $2*ADY$ to the height of the rectangle).

ADX and ADY can be negative. If the resulting rectangle is empty, it is set to the empty rectangle at (0,0).

Errors: None.

See also: [Move \(323\)](#).

Listing: objectex/ex6.pp

```

Program ex6;

{ Program to demonstrate TRect.Grow }

Uses objects;

Var ARect, BRect : TRect;

begin
  ARect.Assign(10,10,20,20);
  ARect.Grow(5,5);
  // Brect should be where new ARect is.
  BRect.Assign(5,5,25,25);
  If ARect.Equals(BRect) Then
    WriteLn ('ARect equals BRect')
  Else
    WriteLn ('ARect does not equal BRect !');
end.

```

TRect.Assign

Declaration: `Procedure Trect.Assign (XA, YA, XB, YB: Sw_Integer);`

Description: Assign sets the corner points of the rectangle to (XA, YA) and (Xb, Yb).

Errors: None.

See also: [Copy \(321\)](#)

For an example, see [TRect.Copy \(321\)](#).

17.5 TObject

The full declaration of the TObject type is:

```

TYPE
  TObject = OBJECT
    CONSTRUCTOR Init;
    PROCEDURE Free;
    DESTRUCTOR Done;Virtual;
  END;
  PObject = ^TObject;

```

TObject.Init

Declaration: `Constructor TObject.Init;`

Description: Instantiates a new object of type `TObject`. It fills the instance up with Zero bytes.

Errors: None.

See also: [Free \(325\)](#), [Done \(325\)](#)

For an example, see [Free \(325\)](#)

TObject.Free

Declaration: `Procedure TObject.Free;`

Description: `Free` calls the destructor of the object, and releases the memory occupied by the instance of the object.

Errors: No checking is performed to see whether `self` is `nil` and whether the object is indeed allocated on the heap.

See also: [Init \(325\)](#), [Done \(325\)](#)

Listing: `objectex/ex7.pp`

```

program ex7;

{ Program to demonstrate the TObject.Free call }

Uses Objects;

Var O : PObject;

begin
  Writeln ( 'Memavail : ', Memavail );
  // Allocate memory for object.
  O:=New(PObject, Init);
  Writeln ( 'Memavail : ', Memavail );
  // Free memory of object.
  O^.free;
  Writeln ( 'Memavail : ', Memavail );
end.

```

TObject.Done

Declaration: `Destructor TObject.Done;Virtual;`

Description: `Done`, the destructor of `TObject` does nothing. It is mainly intended to be used in the `TObject.Free (325)` method.

The destructore `Done` does not free the memory occupied by the object.

Errors: None.

See also: [Free \(325\)](#), [Init \(325\)](#)

Listing: `objectex/ex8.pp`

```

program ex8;

{ Program to demonstrate the TObject.Done call }

Uses Objects;

Var O : PObject;

begin
  Writeln ( 'Memavail : ', Memavail );
  // Allocate memory for object.
  O:=New(PObject, Init);
  Writeln ( 'Memavail : ', Memavail );
  O^.Done;
  Writeln ( 'Memavail : ', Memavail );
end.

```

17.6 TStream

The TStream object is the ancestor for all streaming objects, i.e. objects that have the capability to store and retrieve data.

It defines a number of methods that are common to all objects that implement streaming, many of them are virtual, and are only implemented in the descendant types.

Programs should not instantiate objects of type TStream directly, but instead instantiate a descendant type, such as TDosStream, TMemoryStream.

This is the full declaration of the TStream object:

```

TYPE
  TStream = OBJECT (TObject)
    Status      : Integer; { Stream status }
    ErrorInfo   : Integer; { Stream error info }
    StreamSize  : LongInt; { Stream current size }
    Position    : LongInt; { Current position }
  FUNCTION Get: PObject;
  FUNCTION StrRead: PChar;
  FUNCTION GetPos: Longint; Virtual;
  FUNCTION GetSize: Longint; Virtual;
  FUNCTION ReadStr: PString;
  PROCEDURE Open (OpenMode: Word); Virtual;
  PROCEDURE Close; Virtual;
  PROCEDURE Reset;
  PROCEDURE Flush; Virtual;
  PROCEDURE Truncate; Virtual;
  PROCEDURE Put (P: PObject);
  PROCEDURE StrWrite (P: PChar);
  PROCEDURE WriteStr (P: PString);
  PROCEDURE Seek (Pos: LongInt); Virtual;
  PROCEDURE Error (Code, Info: Integer); Virtual;
  PROCEDURE Read (Var Buf; Count: Sw_Word); Virtual;
  PROCEDURE Write (Var Buf; Count: Sw_Word); Virtual;
  PROCEDURE CopyFrom (Var S: TStream; Count: Longint);

```

```
END;
PStream = ^TStream;
```

TStream.Get

Declaration: `Function TStream.Get : PObject;`

Description: `Get` reads an object definition from a stream, and returns a pointer to an instance of this object.

Errors: On error, `TStream.Status` is set, and `NIL` is returned.

See also: `Put` (331)

Listing: `objectex/ex9.pp`

Program `ex9;`

{ Program to demonstrate TStream.Get and TStream.Put }

Uses `Objects, MyObject;` *{ Definition and registration of TMyObject }*

Var `Obj : PMyObject;`
`S : PStream;`

begin

```
Obj:=New(PMyObject, Init);
Obj^.SetField($1111);
Writeln ('Field value : ',Obj^.GetField);
{ Since Stream is an abstract type, we instantiate a TMemoryStream }
S:=New(PMemoryStream, Init(100,10));
S^.Put(Obj);
Writeln ('Disposing object');
S^.Seek(0);
Dispose(Obj, Done);
Writeln ('Reading object');
Obj:=PMyObject(S^.Get);
Writeln ('Field Value : ',Obj^.GetField);
Dispose(Obj, Done);
```

end.

TStream.StrRead

Declaration: `Function TStream.StrRead: PChar;`

Description: `StrRead` reads a string from the stream, allocates memory for it, and returns a pointer to a null-terminated copy of the string on the heap.

Errors: On error, `Nil` is returned.

See also: `StrWrite` (331), `ReadStr` (329)

Listing: `objectex/ex10.pp`

Program `ex10;`

```
{
Program to demonstrate the TStream.StrRead TStream.StrWrite functions
```

```
}  
  
Uses objects;  
  
Var P : PChar;  
     S : PStream;  
  
begin  
  P:= 'Constant Pchar string';  
  Writeln ('Writing to stream : "',P,'"');  
  S:=New(PMemoryStream, Init(100,10));  
  S^. StrWrite (P);  
  S^. Seek(0);  
  P:= Nil;  
  P:=S^. StrRead;  
  Dispose (S,Done);  
  Writeln ('Read from stream : "',P,'"');  
  Freemem(P, Strlen(P)+1);  
end.
```

TStream.GetPos

Declaration: `TStream.GetPos : Longint; Virtual;`

Description: If the stream's status is `stOk`, `GetPos` returns the current position in the stream. Otherwise it returns `-1`

Errors: `-1` is returned if the status is an error condition.

See also: [Seek \(332\)](#), [GetSize \(328\)](#)

Listing: `objectex/ex11.pp`

```
Program ex11;  
  
{ Program to demonstrate the TStream.GetPos function }  
  
Uses objects;  
  
Var L : String;  
     S : PStream;  
  
begin  
  L:= 'Some kind of string';  
  S:=New(PMemoryStream, Init(100,10));  
  Writeln ('Stream position before write : ',S^.GetPos);  
  S^. WriteStr(@L);  
  Writeln ('Stream position after write : ',S^.GetPos);  
  Dispose(S,Done);  
end.
```

TStream.GetSize

Declaration: `Function TStream.GetSize: Longint; Virtual;`

Description: If the stream's status is `stOk` then `GetSize` returns the size of the stream, otherwise it returns `-1`.

Errors: -1 is returned if the status is an error condition.

See also: [Seek \(332\)](#), [GetPos \(328\)](#)

Listing: objectex/ex12.pp

```

Program ex12;

{ Program to demonstrate the TStream.GetSize function }

Uses objects;

Var L : String;
    S : PStream;

begin
  L:= 'Some kind of string';
  S:=New(PMemoryStream, Init(100,10));
  Writeln ( 'Stream size before write : ',S^.GetSize);
  S^.WriteStr(@L);
  Writeln ( 'Stream size after write : ',S^.GetSize);
  Dispose(S,Done);
end.

```

TStream.ReadStr

Declaration: `Function TStream.ReadStr: PString;`

Description: `ReadStr` reads a string from the stream, copies it to the heap and returns a pointer to this copy. The string is saved as a pascal string, and hence is NOT null terminated.

Errors: On error (e.g. not enough memory), `Nil` is returned.

See also: [StrRead \(327\)](#)

Listing: objectex/ex13.pp

```

Program ex13;

{
  Program to demonstrate the TStream.ReadStr TStream.WriteStr functions
}

Uses objects;

Var P : PString;
    L : String;
    S : PStream;

begin
  L:= 'Constant string line';
  Writeln ( 'Writing to stream : "',L,'"');
  S:=New(PMemoryStream, Init(100,10));
  S^.WriteStr(@L);
  S^.Seek(0);
  P:=S^.ReadStr;
  L:=P^;
  DisposeStr(P);

```

```
    DisPose (S,Done);  
    WriteLn ('Read from stream : " ',L, ' "');  
end.
```

TStream.Open

Declaration: `Procedure TStream.Open (OpenMode: Word); Virtual;`

Description: `Open` is an abstract method, that should be overridden by descendent objects. Since opening a stream depends on the stream's type this is not surprising.

Errors: None.

See also: [Close \(330\)](#), [Reset \(330\)](#)

For an example, see [TDosStream.Open \(337\)](#).

TStream.Close

Declaration: `Procedure TStream.Close; Virtual;`

Description: `Close` is an abstract method, that should be overridden by descendent objects. Since Closing a stream depends on the stream's type this is not surprising.

Errors: None.

See also: [Open \(330\)](#), [Reset \(330\)](#)

for an example, see [TDosStream.Open \(337\)](#).

TStream.Reset

Declaration: `PROCEDURE TStream.Reset;`

Description: `Reset` sets the stream's status to 0, as well as the `ErrorInfo`

Errors: None.

See also: [Open \(330\)](#), [Close \(330\)](#)

TStream.Flush

Declaration: `Procedure TStream.Flush; Virtual;`

Description: `Flush` is an abstract method that should be overridden by descendent objects. It serves to enable the programmer to tell streams that implement a buffer to clear the buffer.

Errors: None.

See also: [Truncate \(331\)](#)

for an example, see [TBufStream.Flush \(339\)](#).

TStream.Truncate

Declaration: `Procedure TStream.Truncate; Virtual;`

Description: `Truncate` is an abstract procedure that should be overridden by descendent objects. It serves to enable the programmer to truncate the size of the stream to the current file position.

Errors: None.

See also: [Seek \(332\)](#)

For an example, see [TDosStream.Truncate \(335\)](#).

TStream.Put

Declaration: `Procedure TStream.Put (P: PObject);`

Description: `Put` writes the object pointed to by `P`. `P` should be non-nil. The object type must have been registered with [RegisterType \(317\)](#).

After the object has been written, it can be read again with [Get \(327\)](#).

Errors: No check is done whether `P` is `Nil` or not. Passing `Nil` will cause a run-time error 216 to be generated. If the object has not been registered, the status of the stream will be set to `stPutError`.

See also: [Get \(327\)](#)

For an example, see [TStream.Get \(327\)](#);

TStream.StrWrite

Declaration: `Procedure TStream.StrWrite (P: PChar);`

Description: `StrWrite` writes the null-terminated string `P` to the stream. `P` can only be 65355 bytes long.

Errors: None.

See also: [WriteStr \(331\)](#), [StrRead \(327\)](#), [ReadStr \(329\)](#)

For an example, see [TStream.StrRead \(327\)](#).

TStream.WriteString

Declaration: `Procedure TStream.WriteString (P: PString);`

Description: `StrWrite` writes the pascal string pointed to by `P` to the stream.

Errors: None.

See also: [StrWrite \(331\)](#), [StrRead \(327\)](#), [ReadStr \(329\)](#)

For an example, see [TStream.ReadStr \(329\)](#).

TStream.Seek

Declaration: `PROCEDURE TStream.Seek (Pos: LongInt); Virtual;`

Description: `Seek` sets the position to `Pos`. This position is counted from the beginning, and is zero based. (i.e. `seek(0)` sets the position pointer on the first byte of the stream)

Errors: If `Pos` is larger than the stream size, `Status` is set to `StSeekError`.

See also: [GetPos \(328\)](#), [GetSize \(328\)](#)

For an example, see [TDosStream.Seek \(336\)](#).

TStream.Error

Declaration: `Procedure TStream.Error (Code, Info: Integer); Virtual;`

Description: `Error` sets the stream's status to `Code` and `ErrorInfo` to `Info`. If the `StreamError` procedural variable is set, `Error` executes it, passing `Self` as an argument.

This method should not be called directly from a program. It is intended to be used in descendent objects.

Errors: None.

See also:

TStream.Read

Declaration: `Procedure TStream.Read (Var Buf; Count: Sw_Word); Virtual;`

Description: `Read` is an abstract method that should be overridden by descendent objects.

`Read` reads `Count` bytes from the stream into `Buf`. It updates the position pointer, increasing its value with `Count`. `Buf` must be large enough to contain `Count` bytes.

Errors: No checking is done to see if `Buf` is large enough to contain `Count` bytes.

See also: [Write \(333\)](#), [ReadStr \(329\)](#), [StrRead \(327\)](#)

Listing: `objectex/ex18.pp`

```
program ex18;

{ Program to demonstrate the TStream.Read method }
```

```
Uses Objects;
```

```
Var Buf1, Buf2 : Array[1..1000] of Byte;
    I : longint;
    S : PMemoryStream;
```

```
begin
```

```
  For I:=1 to 1000 do
    Buf1[I]:=Random(1000);
  Buf2:=Buf1;
  S:=New(PMemoryStream, Init(100,10));
  S^.Write(Buf1, SizeOf(Buf1));
  S^.Seek(0);
```

```
For I:=1 to 1000 do
  Buf1[I]:=0;
S^.Read(Buf1, SizeOf(Buf1));
For I:=1 to 1000 do
  If Buf1[I]<>buf2[i] then
    Writeln ('Buffer differs at position ',I);
  Dispose(S,Done);
end.
```

TStream.Write

Declaration: Procedure TStream.Write (Var Buf; Count: Sw_Word); Virtual;

Description: Write is an abstract method that should be overridden by descendent objects.

Write writes Count bytes to the stream from Buf. It updates the position pointer, increasing it's value with Count.

Errors: No checking is done to see if Buf actually contains Count bytes.

See also: Read (332), WriteStr (331), StrWrite (331)

For an example, see TStream.Read (332).

TStream.CopyFrom

Declaration: Procedure TStream.CopyFrom (Var S: TStream; Count: Longint);

Description: CopyFrom reads Count bytes from stream S and stores them in the current stream. It uses the Read (332) method to read the data, and the Write (333) method to write in the current stream.

Errors: None.

See also: Read (332), Write (333)

Listing: objectex/ex19.pp

Program ex19;

{ Program to demonstrate the TStream.CopyFrom function }

Uses objects;

Var P : PString;
L : String;
S1,S2 : PStream;

begin

```
L:='Constant string line';
Writeln ('Writing to stream 1 : ',L,'');
S1:=New(PMemoryStream, Init(100,10));
S2:=New(PMemoryStream, Init(100,10));
S1^.WriteStr(@L);
S1^.Seek(0);
Writeln ('Copying contents of stream 1 to stream 2');
S2^.Copyfrom(S1^,S1^.GetSize);
S2^.Seek(0);
```

```

P:=S2^.ReadStr;
L:=P^;
DisposeStr(P);
Dispose (S1, Done);
Dispose (S2, Done);
Writeln ('Read from stream 2 : "',L,'"');
end.

```

17.7 TDosStream

TDosStream is a stream that stores its contents in a file. It overrides a couple of methods of TStream for this.

In addition to the fields inherited from TStream (see section 17.6, page 326), there are some extra fields, that describe the file. (mainly the name and the OS file handle)

No buffering in memory is done when using TDosStream. All data are written directly to the file. For a stream that buffers in memory, see section 17.8, page 338.

Here is the full declaration of the TDosStream object:

```

TYPE
  TDosStream = OBJECT (TStream)
    Handle: THandle; { DOS file handle }
    FName : AsciiZ; { AsciiZ filename }
    CONSTRUCTOR Init (FileName: FNameStr; Mode: Word);
    DESTRUCTOR Done; Virtual;
    PROCEDURE Close; Virtual;
    PROCEDURE Truncate; Virtual;
    PROCEDURE Seek (Pos: LongInt); Virtual;
    PROCEDURE Open (OpenMode: Word); Virtual;
    PROCEDURE Read (Var Buf; Count: Sw_Word); Virtual;
    PROCEDURE Write (Var Buf; Count: Sw_Word); Virtual;
  END;
  PDosStream = ^TDosStream;

```

TDosStream.Init

Declaration: Constructor Init (FileName: FNameStr; Mode: Word);

Description: Init instantiates an instance of TDosStream. The name of the file that contains (or will contain) the data of the stream is given in FileName. The Mode parameter determines whether a new file should be created and what access rights you have on the file. It can be one of the following constants:

- stCreate** Creates a new file.
- stOpenRead** Read access only.
- stOpenWrite** Write access only.
- stOpen** Read and write access.

Errors: On error, Status is set to stInitError, and ErrorInfo is set to the DOS error code.

See also: Done (335)

For an example, see TDosStream.Truncate (335).

TDosStream.Done

Declaration: `Destructor TDosStream.Done; Virtual;`

Description: Done closes the file if it was open and cleans up the instance of TDosStream.

Errors: None.

See also: [Init \(334\)](#), [Close \(335\)](#)

for an example, see e.g. [TDosStream.Truncate \(335\)](#).

TDosStream.Close

Declaration: `Procedure TDosStream.Close; Virtual;`

Description: Close closes the file if it was open, and sets Handle to -1. Contrary to [Done \(335\)](#) it does not clean up the instance of TDosStream

Errors: None.

See also: [TStream.Close \(330\)](#), [Init \(334\)](#), [Done \(335\)](#)

For an example, see [TDosStream.Open \(337\)](#).

TDosStream.Truncate

Declaration: `Procedure TDosStream.Truncate; Virtual;`

Description: If the status of the stream is stOK, then Truncate tries to truncate the stream size to the current file position.

Errors: If an error occurs, the stream's status is set to stError and ErrorInfo is set to the OS error code.

See also: [TStream.Truncate \(331\)](#), [GetSize \(328\)](#)

Listing: `objectex/ex16.pp`

```

Program ex16;

{ Program to demonstrate the TStream.Truncate method }

Uses Objects;

Var L : String;
    P : PString;
    S : PDosStream; { Only one with Truncate implemented. }

begin
  L := 'Some constant string';
  { Buffer size of 100 }
  S := New(PDosStream, Init('test.dat', stcreate));
  Writeln ('Writing "', L, '" to stream with handle ', S^.Handle);
  S^.WriteStr(@L);
  S^.WriteStr(@L);
  { Close calls flush first }
  S^.Close;

```

```

S^.Open (stOpen);
Writeln ( 'Size of stream is : ',S^.GetSize);
P:=S^.ReadStr;
L:=P^;
DisposeStr(P);
Writeln ( 'Read "',L,'" from stream with handle ',S^.Handle);
S^.Truncate;
Writeln ( 'Truncated stream. Size is : ',S^.GetSize);
S^.Close;
Dispose (S,Done);
end.

```

TDosStream.Seek

Declaration: `Procedure TDosStream.Seek (Pos: LongInt); Virtual;`

Description: If the stream's status is `stOK`, then `Seek` sets the file position to `Pos`. `Pos` is a zero-based offset, counted from the beginning of the file.

Errors: In case an error occurs, the stream's status is set to `stSeekError`, and the OS error code is stored in `ErrorInfo`.

See also: `TStream.Seek` ([332](#)), `GetPos` ([328](#))

Listing: `objectex/ex17.pp`

```

Program ex17;

{ Program to demonstrate the TStream.Seek method }

Uses Objects;

Var L : String;
    Marker : Word;
    P : PString;
    S : PDosStream;

begin
  L:='Some constant string';
  { Buffer size of 100 }
  S:=New(PDosStream,Init('test.dat',stcreate));
  Writeln ( 'Writing "',L,'" to stream. ');
  S^.WriteStr(@L);
  Marker:=S^.GetPos;
  Writeln ( 'Set marker at ',Marker);
  L:='Some other constant String';
  Writeln ( 'Writing "',L,'" to stream. ');
  S^.WriteStr(@L);
  S^.Close;
  S^.Open (stOpenRead);
  Writeln ( 'Size of stream is : ',S^.GetSize);
  Writeln ( 'Seeking to marker');
  S^.Seek(Marker);
  P:=S^.ReadStr;
  L:=P^;
  DisposeStr(P);
  Writeln ( 'Read "',L,'" from stream. ');

```

```

    S^.Close;
    Dispose (S,Done);
end.

```

TDosStream.Open

Declaration: `Procedure TDosStream.Open (OpenMode: Word); Virtual;`

Description: If the stream's status is `stOK`, and the stream is closed then `Open` re-opens the file stream with mode `OpenMode`. This call can be used after a `Close` (335) call.

Errors: If an error occurs when re-opening the file, then `Status` is set to `stOpenError`, and the OS error code is stored in `ErrorInfo`

See also: `TStream.Open` (330), `Close` (335)

Listing: `objectex/ex14.pp`

Program `ex14;`

{ Program to demonstrate the TStream.Close method }

Uses `Objects;`

Var `L : String;`
`P : PString;`
`S : PDosStream; { Only one with Close implemented. }`

begin

```

L:= 'Some constant string';
S:=New(PDosStream, Init('test.dat', stcreate));
WriteIn ('Writing "',L,'" to stream with handle ',S^.Handle);
S^.WriteStr(@L);
S^.Close;
WriteIn ('Closed stream. File handle is ',S^.Handle);
S^.Open (stOpenRead);
P:=S^.ReadStr;
L:=P^;
DisposeStr(P);
WriteIn ('Read "',L,'" from stream with handle ',S^.Handle);
S^.Close;
Dispose (S,Done);
end.

```

TDosStream.Read

Declaration: `Procedure TDosStream.Read (Var Buf; Count: Sw_Word); Virtual;`

Description: If the Stream is open and the stream status is `stOK` then `Read` will read `Count` bytes from the stream and place them in `Buf`.

Errors: In case of an error, `Status` is set to `StReadError`, and `ErrorInfo` gets the OS specific error, or 0 when an attempt was made to read beyond the end of the stream.

See also: `TStream.Read` (332), `Write` (338)

For an example, see `TStream.Read` (332).

TDosStream.Write

Declaration: `Procedure TDosStream.Write (Var Buf; Count: Sw_Word); Virtual;`

Description: If the Stream is open and the stream status is `stOK` then `Write` will write `Count` bytes from `Buf` and place them in the stream.

Errors: In case of an error, `Status` is set to `StWriteError`, and `ErrorInfo` gets the OS specific error.

See also: `TStream.Write` (333), `Read` (337)

For an example, see `TStream.Read` (332).

17.8 TBufStream

`Bufstream` implements a buffered file stream. That is, all data written to the stream is written to memory first. Only when the buffer is full, or on explicit request, the data is written to disk.

Also, when reading from the stream, first the buffer is checked if there is any unread data in it. If so, this is read first. If not the buffer is filled again, and then the data is read from the buffer.

The size of the buffer is fixed and is set when constructing the file.

This is useful if you need heavy throughput for your stream, because it speeds up operations.

TYPE

```
TBufStream = OBJECT (TDosStream)
  LastMode: Byte;          { Last buffer mode }
  BufSize  : Sw_Word;      { Buffer size }
  BufPtr   : Sw_Word;      { Buffer start }
  BufEnd   : Sw_Word;      { Buffer end }
  Buffer    : PByteArray;   { Buffer allocated }
  CONSTRUCTOR Init (FileName: FNameStr; Mode, Size: Word);
  DESTRUCTOR Done; Virtual;
  PROCEDURE Close; Virtual;
  PROCEDURE Flush; Virtual;
  PROCEDURE Truncate; Virtual;
  PROCEDURE Seek (Pos: LongInt); Virtual;
  PROCEDURE Open (OpenMode: Word); Virtual;
  PROCEDURE Read (Var Buf; Count: Sw_Word); Virtual;
  PROCEDURE Write (Var Buf; Count: Sw_Word); Virtual;
END;
PBufStream = ^TBufStream;
```

TBufStream.Init

Declaration: `Constructor Init (FileName: FNameStr; Mode, Size: Word);`

Description: `Init` instantiates an instance of `TBufStream`. The name of the file that contains (or will contain) the data of the stream is given in `FileName`. The `Mode` parameter determines whether a new file should be created and what access rights you have on the file. It can be one of the following constants:

stCreate Creates a new file.

stOpenRead Read access only.

stOpenWrite Write access only.

stOpenRead and write access.

The `Size` parameter determines the size of the buffer that will be created. It should be different from zero.

Errors: On error, `Status` is set to `stInitError`, and `ErrorInfo` is set to the DOS error code.

See also: `TDosStream.Init` (334), `Done` (339)

For an example see `TBufStream.Flush` (339).

TBufStream.Done

Declaration: `Destructor TBufStream.Done; Virtual;`

Description: `Done` flushes and closes the file if it was open and cleans up the instance of `TBufStream`.

Errors: None.

See also: `TDosStream.Done` (335), `Init` (338), `Close` (339)

For an example see `TBufStream.Flush` (339).

TBufStream.Close

Declaration: `Pocedure TBufStream.Close; Virtual;`

Description: `Close` flushes and closes the file if it was open, and sets `Handle` to -1. Contrary to `Done` (339) it does not clean up the instance of `TBufStream`

Errors: None.

See also: `TStream.Close` (330), `Init` (338), `Done` (339)

For an example see `TBufStream.Flush` (339).

TBufStream.Flush

Declaration: `Pocedure TBufStream.Flush; Virtual;`

Description: When the stream is in write mode, the contents of the buffer are written to disk, and the buffer position is set to zero.

When the stream is in read mode, the buffer position is set to zero.

Errors: Write errors may occur if the file was in write mode. see `Write` (341) for more info on the errors.

See also: `TStream.Close` (330), `Init` (338), `Done` (339)

Listing: `objectex/ex15.pp`

Program `ex15;`

{ Program to demonstrate the TStream.Flush method }

Uses `Objects;`

Var `L : String;`

```

P : PString;
S : PBufStream; { Only one with Flush implemented. }

begin
L:= 'Some constant string';
{ Buffer size of 100 }
S:=New(PBufStream, Init('test.dat', stcreate, 100));
Writeln ('Writing "', L, '" to stream with handle ', S^.Handle);
S^.WriteStr(@L);
{ At this moment, there is no data on disk yet. }
S^.Flush;
{ Now there is. }
S^.WriteStr(@L);
{ Close calls flush first }
S^.Close;
Writeln ('Closed stream. File handle is ', S^.Handle);
S^.Open (stOpenRead);
P:=S^.ReadStr;
L:=P^;
DisposeStr(P);
Writeln ('Read "', L, '" from stream with handle ', S^.Handle);
S^.Close;
Dispose (S, Done);
end.

```

TBufStream.Truncate

Declaration: Procedure TBufStream.Truncate; Virtual;

Description: If the status of the stream is stOK, then Truncate tries to flush the buffer, and then truncates the stream size to the current file position.

Errors: Errors can be those of Flush (339) or TDosStream.Truncate (335).

See also: TStream.Truncate (331), TDosStream.Truncate (335), GetSize (328)

For an example, see TDosStream.Truncate (335).

TBufStream.Seek

Declaration: Procedure TBufStream.Seek (Pos: LongInt); Virtual;

Description: If the stream's status is stOK, then Seek sets the file position to Pos. Pos is a zero-based offset, counted from the beginning of the file.

Errors: In case an error occurs, the stream's status is set to stSeekError, and the OS error code is stored in ErrorInfo.

See also: TStream.Seek (332), GetPos (328)

For an example, see TStream.Seek (332);

TBufStream.Open

Declaration: Procedure TBufStream.Open (OpenMode: Word); Virtual;

Description: If the stream's status is `stOK`, and the stream is closed then `Open` re-opens the file stream with mode `OpenMode`. This call can be used after a `Close` (339) call.

Errors: If an error occurs when re-opening the file, then `Status` is set to `stOpenError`, and the OS error code is stored in `ErrorInfo`

See also: `TStream.Open` (330), `Close` (339)

For an example, see `TDosStream.Open` (337).

TBufStream.Read

Declaration: `Procedure TBufStream.Read (Var Buf; Count: Sw_Word); Virtual;`

Description: If the Stream is open and the stream status is `stOK` then `Read` will read `Count` bytes from the stream and place them in `Buf`.

`Read` will first try to read the data from the stream's internal buffer. If insufficient data is available, the buffer will be filled before continuing to read. This process is repeated until all needed data has been read.

Errors: In case of an error, `Status` is set to `StReadError`, and `ErrorInfo` gets the OS specific error, or 0 when an attempt was made to read beyond the end of the stream.

See also: `TStream.Read` (332), `Write` (341)

For an example, see `TStream.Read` (332).

TBufStream.Write

Declaration: `Procedure TBufStream.Write (Var Buf; Count: Sw_Word); Virtual;`

Description: If the Stream is open and the stream status is `stOK` then `Write` will write `Count` bytes from `Buf` and place them in the stream.

`Write` will first try to write the data to the stream's internal buffer. When the internal buffer is full, then the contents will be written to disk. This process is repeated until all data has been written.

Errors: In case of an error, `Status` is set to `StWriteError`, and `ErrorInfo` gets the OS specific error.

See also: `TStream.Write` (333), `Read` (341)

For an example, see `TStream.Read` (332).

17.9 TMemoryStream

The `TMemoryStream` object implements a stream that stores its data in memory. The data is stored on the heap, with the possibility to specify the maximum amount of data, and the the size of the memory blocks being used.

TYPE

```
TMemoryStream = OBJECT (TStream)
  BlkCount: Sw_Word;      { Number of segments }
  BlkSize  : Word;       { Memory block size }
  MemSize  : LongInt;    { Memory alloc size }
```

```

    BlkList : PPointerArray; { Memory block list }
    CONSTRUCTOR Init (ALimit: Longint; ABlockSize: Word);
    DESTRUCTOR Done;
    PROCEDURE Truncate;
    PROCEDURE Read (Var Buf; Count: Sw_Word);
    PROCEDURE Write (Var Buf; Count: Sw_Word);
END;
PMemoryStream = ^TMemoryStream;

```

TMemoryStream.Init

Declaration: Constructor TMemoryStream.Init (ALimit: Longint; ABlockSize: Word);

Description: Init instantiates a new TMemoryStream object. The memorystreamobject will initially allocate at least ALimit bytes memory, divided into memory blocks of size ABlockSize. The number of blocks needed to get to ALimit bytes is rounded up.

By default, the number of blocks is 1, and the size of a block is 8192. This is selected if you specify 0 as the blocksize.

Errors: If the stream cannot allocate the initial memory needed for the memory blocks, then the stream's status is set to stInitError.

See also: Done ([342](#))

For an example, see e.g TStream.CopyFrom ([333](#)).

TMemoryStream.Done

Declaration: Destructor TMemoryStream.Done; Virtual;

Description: Done releases the memory blocks used by the stream, and then cleans up the memory used by the stream object itself.

Errors: None.

See also: Init ([342](#))

For an example, see e.g TStream.CopyFrom ([333](#)).

TMemoryStream.Truncate

Declaration: Procedure TMemoryStream.Truncate; Virtual;

Description: Truncate sets the size of the memory stream equal to the current position. It de-allocates any memory-blocks that are no longer needed, so that the new size of the stream is the current position in the stream, rounded up to the first multiple of the stream blocksize.

Errors: If an error occurs during memory de-allocation, the stream's status is set to stError

See also: TStream.Truncate ([331](#))

Listing: objectex/ex20.pp

```

Program ex20;

{ Program to demonstrate the TMemoryStream.Truncate method }

Uses Objects;

Var L : String;
    P : PString;
    S : PMemoryStream;
    I, InitMem : Longint;

begin
  InitMem := Memavail;
  L := 'Some constant string';
  { Buffer size of 100 }
  S := New(PMemoryStream, Init(1000,100));
  Writeln ('Free memory : ', Memavail);
  Writeln ('Writing 100 times "', L, '" to stream. ');
  For I := 1 to 100 do
    S^.WriteStr(@L);
  Writeln ('Finished. Free memory : ', Memavail);
  S^.Seek(100);
  S^.Truncate;
  Writeln ('Truncated at byte 100. Free memory : ', Memavail);
  Dispose (S, Done);
  Writeln ('Finished. Lost ', InitMem - Memavail, ' Bytes. ');
end.

```

TMemoryStream.Read

Declaration: Procedure Read (Var Buf; Count: Sw_Word); Virtual;

Description: Read reads Count bytes from the stream to Buf. It updates the position of the stream.

Errors: If there is not enough data available, no data is read, and the stream's status is set to stReadError.

See also: TStream.Read, Write (343)

For an example, see TStream.Read (332).

TMemoryStream.Write

Declaration: Procedure Write (Var Buf; Count: Sw_Word); Virtual;

Description: Write copies Count bytes from Buf to the stream. It updates the position of the stream.

If not enough memory is available to hold the extra Count bytes, then the stream will try to expand, by allocating as much blocks with size BlkSize (as specified in the constructor call Init (342)) as needed.

Errors: If the stream cannot allocate more memory, then the status is set to stWriteError

See also: TStream.Write (333), Read (343)

For an example, see TStream.Read (332).

17.10 TCollection

The TCollection object manages a collection of pointers or objects. It also provides a series of methods to manipulate these pointers or objects.

Whether or not objects are used depends on the kind of calls you use. All kinds come in 2 flavors, one for objects, one for pointers.

This is the full declaration of the TCollection object:

```

TYPE
  TItemList = Array [0..MaxCollectionSize - 1] Of Pointer;
  PItemList = ^TItemList;

  TCollection = OBJECT (TObject)
    Items: PItemList; { Item list pointer }
    Count: Sw_Integer; { Item count }
    Limit: Sw_Integer; { Item limit count }
    Delta: Sw_Integer; { Inc delta size }
    Constructor Init (ALimit, ADelta: Sw_Integer);
    Constructor Load (Var S: TStream);
    Destructor Done; Virtual;
    Function At (Index: Sw_Integer): Pointer;
    Function IndexOf (Item: Pointer): Sw_Integer; Virtual;
    Function GetItem (Var S: TStream): Pointer; Virtual;
    Function LastThat (Test: Pointer): Pointer;
    Function FirstThat (Test: Pointer): Pointer;
    Procedure Pack;
    Procedure FreeAll;
    Procedure DeleteAll;
    Procedure Free (Item: Pointer);
    Procedure Insert (Item: Pointer); Virtual;
    Procedure Delete (Item: Pointer);
    Procedure AtFree (Index: Sw_Integer);
    Procedure FreeItem (Item: Pointer); Virtual;
    Procedure AtDelete (Index: Sw_Integer);
    Procedure ForEach (Action: Pointer);
    Procedure SetLimit (ALimit: Sw_Integer); Virtual;
    Procedure Error (Code, Info: Integer); Virtual;
    Procedure AtPut (Index: Sw_Integer; Item: Pointer);
    Procedure AtInsert (Index: Sw_Integer; Item: Pointer);
    Procedure Store (Var S: TStream);
    Procedure PutItem (Var S: TStream; Item: Pointer); Virtual;
  END;
  PCollection = ^TCollection;

```

TCollection.Init

Declaration: Constructor TCollection.Init (ALimit, ADelta: Sw_Integer);

Description: Init initializes a new instance of a collection. It sets the (initial) maximum number of items in the collection to ALimit. ADelta is the increase size: The number of memory places that will be allocated in case ALimit is reached, and another element is added to the collection.

Errors: None.

See also: [Load \(345\)](#), [Done \(345\)](#)

For an example, see [TCollection.ForEach \(355\)](#).

TCollection.Load

Declaration: Constructor `TCollection.Load (Var S: TStream);`

Description: `Load` initializes a new instance of a collection. It reads from stream `S` the item count, the item limit count, and the increase size. After that, it reads the specified number of items from the stream.

Errors: Errors returned can be those of [GetItem \(347\)](#).

See also: [Init \(344\)](#), [GetItem \(347\)](#), [Done \(345\)](#).

Listing: `objectex/ex22.pp`

Program `ex22;`

`{ Program to demonstrate the TCollection.Load method }`

Uses `Objects, MyObject; { For TMyObject definition and registration }`

Var `C : PCollection;`
`M : PMyObject;`
`I : Longint;`
`S : PMemoryStream;`

begin

`C:=New(PCollection, Init(100,10));`

`For I:=1 to 100 do`

`begin`

`M:=New(PMyObject, Init);`

`M^.SetField(100-I);`

`C^.Insert(M);`

`end;`

`Writeln('Inserted ',C^.Count,' objects');`

`S:=New(PMemoryStream, Init(1000,10));`

`C^.Store(S^);`

`C^.FreeAll;`

`Dispose(C, Done);`

`S^.Seek(0);`

`C^.Load(S^);`

`Writeln('Read ',C^.Count,' objects from stream.');`

`Dispose(S, Done);`

`Dispose(C, Done);`

end.

TCollection.Done

Declaration: Destructor `TCollection.Done; Virtual;`

Description: `Done` frees all objects in the collection, and then releases all memory occupied by the instance.

Errors: None.

See also: [Init \(344\)](#), [FreeAll \(350\)](#)

For an example, see [TCollection.ForEach \(355\)](#).

TCollection.At

Declaration: `Function TCollection.At (Index: Sw_Integer): Pointer;`

Description: `At` returns the item at position `Index`.

Errors: If `Index` is less than zero or larger than the number of items in the collection, `seepErrorTCollection.Error` is called with `coIndexError` and `Index` as arguments, resulting in a run-time error.

See also: [Insert \(352\)](#)

Listing: `objectex/ex23.pp`

```

Program ex23;

{ Program to demonstrate the TCollection.At method }

Uses Objects, MyObject; { For TMyObject definition and registration }

Var C : PCollection;
      M : PMyObject;
      I : Longint;

begin
  C:=New(PCollection, Init(100,10));
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(100-I);
      C^.Insert(M);
    end;
  For I:=0 to C^.Count-1 do
    begin
      M:=C^.At(I);
      WriteLn('Object ',i,' has field : ',M^.GetField);
    end;
  C^.FreeAll;
  Dispose(C, Done);
end.
```

TCollection.IndexOf

Declaration: `Function TCollection.IndexOf (Item: Pointer): Sw_Integer; Virtual;`

Description: `IndexOf` returns the index of `Item` in the collection. If `Item` isn't present in the collection, -1 is returned.

Errors:

See also:

Listing: `objectex/ex24.pp`

```

Program ex24;

{ Program to demonstrate the TCollection.IndexOf method }

Uses Objects, MyObject; { For TMyObject definition and registration }
```

```
Var C : PCollection;
    M,Keep : PMyObject;
    I : Longint;

begin
  Randomize;
  C:=New(PCollection , Init(100,10));
  Keep:=Nil;
  For I:=1 to 100 do
    begin
      M:=New(PMyObject , Init);
      M^.SetField(I-1);
      If Random<0.1 then
        Keep:=M;
      C^.Insert(M);
    end;
  If Keep=Nil then
    begin
      Writeln ('Please run again. No object selected');
      Halt(1);
    end;
  Writeln ('Selected object has field : ',Keep^.GetField);
  Write ('Selected object has index : ',C^.IndexOf(Keep));
  Writeln (' should match it''s field. ');
  C^.FreeAll;
  Dispose(C,Done);
end.
```

TCollection.GetItem

Declaration: Function TCollection.GetItem (Var S: TStream): Pointer; Virtual;

Description: GetItem reads a single item off the stream S, and returns a pointer to this item. This method is used internally by the Load method, and should not be used directly.

Errors: Possible errors are the ones from TStream.Get (327).

See also: TStream.Get (327), seeplStoreTCollection.Store

TCollection.LastThat

Declaration: Function TCollection.LastThat (Test: Pointer): Pointer;

Description: This function returns the last item in the collection for which Test returns a non-nil result. Test is a function that accepts 1 argument: a pointer to an object, and that returns a pointer as a result.

Errors: None.

See also: FirstThat (348)

Listing: objectex/ex25.pp

Program ex21;

{ Program to demonstrate the TCollection.Foreach method }

```

Uses Objects,MyObject; { For TMyObject definition and registration }

Var C : PCollection;
      M : PMyObject;
      I : Longint;

Function CheckField (Dummy: Pointer;P : PMyObject) : Longint;

begin
  If P^.GetField<56 then
    Checkfield:=1
  else
    CheckField:=0;
end;

begin
  C:=New(PCollection ,Init(100,10));
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(I);
      C^.Insert(M);
    end;
  Writeln ('Inserted ',C^.Count,' objects');
  Writeln ('Last one for which Field<56 has index (should be 54) : ',
    C^.IndexOf(C^.LastThat(@CheckField)));
  C^.FreeAll;
  Dispose(C,Done);
end.

```

TCollection.FirstThat

Declaration: `Function TCollection.FirstThat (Test: Pointer): Pointer;`

Description: This function returns the first item in the collection for which `Test` returns a non-nil result. `Test` is a function that accepts 1 argument: a pointer to an object, and that returns a pointer as a result.

Errors: None.

See also: [LastThat \(347\)](#)

Listing: objectex/ex26.pp

Program ex21;

{ Program to demonstrate the TCollection.FirstThat method }

Uses Objects,MyObject; { For TMyObject definition and registration }

Var C : PCollection;
 M : PMyObject;
 I : Longint;

Function CheckField (Dummy: Pointer;P : PMyObject) : Longint;

begin
If P^.GetField>56 **then**

```

    Checkfield:=1
  else
    CheckField:=0;
end;

begin
  C:=New(PCollection , Init(100,10));
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(I);
      C^.Insert(M);
    end;
  Writeln ('Inserted ',C^.Count,' objects');
  Writeln ('first one for which Field>56 has index (should be 56) : ',
    C^.IndexOf(C^.FirstThat(@CheckField)));
  C^.FreeAll;
  Dispose(C,Done);
end.

```

TCollection.Pack

Declaration: Procedure TCollection.Pack;

Description: Pack removes all Nil pointers from the collection, and adjusts Count to reflect this change. No memory is freed as a result of this call. In order to free any memory, you can call SetLimit with an argument of Count after a call to Pack.

Errors: None.

See also: SetLimit ([356](#))

Listing: objectex/ex26.pp

Program ex21;

{ Program to demonstrate the TCollection.FirstThat method }

Uses Objects, MyObject; *{ For TMyObject definition and registration }*

Var C : PCollection;
 M : PMyObject;
 I : Longint;

Function CheckField (Dummy: Pointer; P : PMyObject) : Longint;

```

begin
  If P^.GetField>56 then
    Checkfield:=1
  else
    CheckField:=0;
end;

```

```

begin
  C:=New(PCollection , Init(100,10));
  For I:=1 to 100 do
    begin

```

```

    M:=New(PMyObject, Init);
    M^.SetField(I);
    C^.Insert(M);
    end;
    Writeln('Inserted ',C^.Count,' objects');
    Writeln('first one for which Field>56 has index (should be 56) : ',
           C^.IndexOf(C^.FirstThat(@CheckField)));
    C^.FreeAll;
    Dispose(C,Done);
end.

```

TCollection.FreeAll

Declaration: `Procedure TCollection.FreeAll;`

Description: `FreeAll` calls the destructor of each object in the collection. It doesn't release any memory occupied by the collection itself, but it does set `Count` to zero.

Errors:

See also: [DeleteAll \(351\)](#), [FreeItem \(354\)](#)

Listing: `objectex/ex28.pp`

Program `ex28;`

{ Program to demonstrate the TCollection.FreeAll method }

Uses `Objects,MyObject;` *{ For TMyObject definition and registration }*

Var `C : PCollection;`
 `M : PMyObject;`
 `I,InitMem : Longint;`

begin

`Randomize;`

`C:=New(PCollection, Init(120,10));`

`InitMem:=Memavail;`

`Writeln('Initial memory : ',InitMem);`

For `I:=1 to 100 do`

begin

`M:=New(PMyObject, Init);`

`M^.SetField(I-1);`

`C^.Insert(M);`

end;

`Writeln('Added 100 Items. Memory available : ',Memavail);`

`Write('Lost : ',Initmem-Memavail,' bytes.');`

`Write(' (Should be 100*',SizeOf(TMyObject));`

`Writeln('=',100*SizeOf(TMyObject),')');`

`C^.FreeAll;`

`Writeln('Freed all objects. Memory available : ',Memavail);`

`Writeln('Lost : ',Initmem-Memavail,' bytes.');`

`Dispose(C,Done);`

end.

TCollection.DeleteAll

Declaration: `Procedure TCollection.DeleteAll;`

Description: `DeleteAll` deletes all elements from the collection. It just sets the `Count` variable to zero. Contrary to `FreeAll` (350), `DeleteAll` doesn't call the destructor of the objects.

Errors: None.

See also: `FreeAll` (350), `Delete` (352)

Listing: `objectex/ex29.pp`

Program `ex29;`

```
{
  Program to demonstrate the TCollection.DeleteAll method
  Compare with example 28, where FreeAll is used.
}
```

Uses `Objects, MyObject; { For TMyObject definition and registration }`

```
Var C : PCollection;
      M : PMyObject;
      I, InitMem : Longint;
```

begin

```
  Randomize;
  C:=New(PCollection, Init(120,10));
  InitMem:=Memavail;
  Writeln ('Initial memory : ', InitMem);
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(I-1);
      C^.Insert(M);
    end;
  Writeln ('Added 100 Items. Memory available : ', Memavail);
  Write ('Lost : ', Initmem-Memavail, ' bytes. ');
  Write (' (Should be 100* ', SizeOf(TMyObject));
  Writeln ('=', 100*SizeOf(TMyObject), ') ');
  C^.DeleteAll;
  Writeln ('Deleted all objects. Memory available : ', Memavail);
  Writeln ('Lost : ', Initmem-Memavail, ' bytes. ');
  Dispose(C, Done);
```

end.

TCollection.Free

Declaration: `Procedure TCollection.Free (Item: Pointer);`

Description: `Free` Deletes `Item` from the collection, and calls the destructor `Done` of the object.

Errors: If the `Item` is not in the collection, `Error` will be called with `coIndexError`.

See also: `FreeItem` (354),

Listing: `objectex/ex30.pp`

```

Program ex30;

{ Program to demonstrate the TCollection.Free method }

Uses Objects, MyObject; { For TMyObject definition and registration }

Var C : PCollection;
      M : PMyObject;
      I, InitMem : Longint;

begin
  Randomize;
  C:=New(PCollection, Init(120,10));
  InitMem:=Memavail;
  Writeln ('Initial memory : ', InitMem);
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(I-1);
      C^.Insert(M);
    end;
  Writeln ('Added 100 Items. Memory available : ', Memavail);
  Write ('Lost : ', Initmem-Memavail, ' bytes. ');
  Write ('(Should be 100*', SizeOf(TMyObject));
  Writeln ('=', 100*SizeOf(TMyObject), ') ');
  With C^ do
    While Count>0 do Free(At(Count-1));
  Writeln ('Freed all objects. Memory available : ', Memavail);
  Writeln ('Lost : ', Initmem-Memavail, ' bytes. ');
  Dispose(C, Done);
end.

```

TCollection.Insert

Declaration: Procedure TCollection.Insert (Item: Pointer); Virtual;

Description: Insert inserts Item in the collection. TCollection inserts this item at the end, but descendent objects may insert it at another place.

Errors: None.

See also: AtInsert (356), AtPut (356),

TCollection.Delete

Declaration: Procedure TCollection.Delete (Item: Pointer);

Description: Delete deletes Item from the collection. It doesn't call the item's destructor, though. For this the Free (351) call is provided.

Errors: If the Item is not in the collection, Error will be called with coIndexError.

See also: AtDelete (354), Free (351)

Listing: objectex/ex31.pp

```

Program ex31;

{ Program to demonstrate the TCollection.Delete method }

Uses Objects, MyObject; { For TMyObject definition and registration }

Var C : PCollection;
      M : PMyObject;
      I, InitMem : Longint;

begin
  Randomize;
  C:=New(PCollection, Init(120,10));
  InitMem:=Memavail;
  Writeln ('Initial memory : ', InitMem);
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(I-1);
      C^.Insert(M);
    end;
  Writeln ('Added 100 Items. Memory available : ', Memavail);
  Write ('Lost : ', Initmem-Memavail, ' bytes. ');
  Write ('(Should be 100*', SizeOf(TMyObject));
  Writeln ('=', 100*SizeOf(TMyObject), ') ');
  With C^ do
    While Count>0 do Delete (At(Count-1));
  Writeln ('Freed all objects. Memory available : ', Memavail);
  Writeln ('Lost : ', Initmem-Memavail, ' bytes. ');
  Dispose(C, Done);
end.

```

TCollection.AtFree

Declaration: Procedure TCollection.AtFree (Index: Sw_Integer);

Description: AtFree deletes the item at position Index in the collection, and calls the item's destructor if it is not Nil.

Errors: If Index isn't valid then Error (356) is called with CoIndexError.

See also: Free (351), AtDelete (354)

Listing: objectex/ex32.pp

```

Program ex32;

{ Program to demonstrate the TCollection.AtFree method }

Uses Objects, MyObject; { For TMyObject definition and registration }

Var C : PCollection;
      M : PMyObject;
      I, InitMem : Longint;

begin
  Randomize;

```

```

C:=New(PCollection, Init(120,10));
InitMem:=Memavail;
Writeln('Initial memory : ',InitMem);
For I:=1 to 100 do
  begin
    M:=New(PMyObject, Init);
    M^.SetField(I-1);
    C^.Insert(M);
  end;
Writeln('Added 100 Items. Memory available : ',Memavail);
Write('Lost : ',InitMem-Memavail, ' bytes. ');
Write(' (Should be 100*',SizeOf(TMyObject));
Writeln('=',100*SizeOf(TMyObject), ') ');
With C^ do
  While Count>0 do AtFree(Count-1);
Writeln('Freed all objects. Memory available : ',Memavail);
Writeln('Lost : ',InitMem-Memavail, ' bytes. ');
Dispose(C,Done);
end.

```

TCollection.FreeItem

Declaration: Procedure TCollection.FreeItem (Item: Pointer); Virtual;

Description: FreeItem calls the destructor of Item if it is not nil.

This function is used internally by the TCollection object, and should not be called directly.

Errors: None.

See also: Free (353), see!AtFreeTCollection.AtFree

TCollection.AtDelete

Declaration: Procedure TCollection.AtDelete (Index: Sw_Integer);

Description: AtDelete deletes the pointer at position Index in the collection. It doesn't call the object's destructor.

Errors: If Index isn't valid then Error (356) is called with CoIndexError.

See also: Delete (352)

Listing: objectex/ex33.pp

Program ex33;

{ Program to demonstrate the TCollection.AtDelete method }

Uses Objects, MyObject; *{ For TMyObject definition and registration }*

```

Var C : PCollection;
      M : PMyObject;
      I, InitMem : Longint;

```

```

begin
  Randomize;

```

```

C:=New(PCollection, Init(120,10));
InitMem:=Memavail;
Writeln('Initial memory : ',InitMem);
For I:=1 to 100 do
  begin
    M:=New(PMyObject, Init);
    M^.SetField(I-1);
    C^.Insert(M);
  end;
Writeln('Added 100 Items. Memory available : ',Memavail);
Write('Lost : ',Initmem-Memavail, ' bytes. ');
Write(' (Should be 100*',SizeOf(TMyObject));
Writeln('=',100*SizeOf(TMyObject),') ');
With C^ do
  While Count>0 do AtDelete(Count-1);
Writeln('Freed all objects. Memory available : ',Memavail);
Writeln('Lost : ',Initmem-Memavail, ' bytes. ');
Dispose(C,Done);
end.

```

TCollection.ForEach

Declaration: Procedure TCollection.ForEach (Action: Pointer);

Description: ForEach calls Action for each element in the collection, and passes the element as an argument to Action.

Action is a procedural type variable that accepts a pointer as an argument.

Errors: None.

See also: FirstThat (348), LastThat (347)

Listing: objectex/ex21.pp

Program ex21;

{ Program to demonstrate the TCollection.ForEach method }

Uses Objects, MyObject; *{ For TMyObject definition and registration }*

Var C : PCollection;
 M : PMyObject;
 I : Longint;

Procedure PrintField (Dummy: Pointer; P : PMyObject);

```

begin
  Writeln('Field : ',P^.GetField);
end;

```

```

begin
  C:=New(PCollection, Init(100,10));
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(100-I);
      C^.Insert(M);
    end;
end;

```

```
    end;  
    WriteLn ( 'Inserted ', C^.Count, ' objects ');  
    C^.ForEach( @PrintField );  
    C^.FreeAll;  
    Dispose(C, Done);  
end.
```

TCollection.SetLimit

Declaration: Procedure TCollection.SetLimit (ALimit: Sw_Integer); Virtual;

Description: SetLimit sets the maximum number of elements in the collection. ALimit must not be less than Count, and should not be larger than MaxCollectionSize

Errors: None.

See also: Init ([344](#))

For an example, see Pack ([349](#)).

TCollection.Error

Declaration: Procedure TCollection.Error (Code, Info: Integer); Virtual;

Description: Error is called by the various TCollection methods in case of an error condition. The default behaviour is to make a call to RunError with an error of 212-Code.

This method can be overridden by descendent objects to implement a different error-handling.

Errors:

See also: Abstract ([317](#))

TCollection.AtPut

Declaration: Procedure TCollection.AtPut (Index: Sw_Integer; Item: Pointer);

Description: AtPut sets the element at position Index in the collection to Item. Any previous value is overwritten.

Errors: If Index isn't valid then Error ([356](#)) is called with CoIndexError.

See also:

For an example, see Pack ([349](#)).

TCollection.AtInsert

Declaration: Procedure TCollection.AtInsert (Index: Sw_Integer; Item: Pointer);

Description: AtInsert inserts Item in the collection at position Index, shifting all elements by one position. In case the current limit is reached, the collection will try to expand with a call to SetLimit

Errors: If Index isn't valid then Error ([356](#)) is called with CoIndexError. If the collection fails to expand, then coOverflow is passed to Error.

See also: [Insert \(352\)](#)

Listing: objectex/ex34.pp

```

Program ex34;

{ Program to demonstrate the TCollection.AtInsert method }

Uses Objects, MyObject; { For TMyObject definition and registration }

Var C : PCollection;
      M : PMyObject;
      I : Longint;

Procedure PrintField (Dummy: Pointer; P : PMyObject);

begin
  Writeln ( 'Field : ', P^.GetField);
end;

begin
  Randomize;
  C:=New(PCollection, Init(120,10));
  Writeln ( 'Inserting 100 records at random places. ');
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(I-1);
      If I=1 then
        C^.Insert(M)
      else
        With C^ do
          AtInsert(Random(Count),M);
      end;
      Writeln ( 'Values : ');
      C^.Foreach( @PrintField);
      Dispose(C, Done);
end.

```

TCollection.Store

Declaration: Procedure TCollection.Store (Var S: TStream);

Description: Store writes the collection to the stream S. It does this by writing the current Count, Limit and Delta to the stream, and then writing each item to the stream.

The contents of the stream are then suitable for instantiating another collection with [Load \(345\)](#).

Errors: Errors returned are those by TStream.Put ([331](#)).

See also: [Load \(345\)](#), [PutItem \(358\)](#)

For an example, see seepLoadTCollection.Load.

TCollection.PutItem

Declaration: Procedure TCollection.PutItem (Var S: TStream; Item: Pointer); Virtual;

Description: PutItem writes Item to stream S. This method is used internally by the TCollection object, and should not be called directly.

Errors: Errors are those returned by TStream.Put (331).

See also: Store (357), GetItem (347).

17.11 TSortedCollection

TSortedCollection is an abstract class, implementing a sorted collection. You should never use an instance of TSortedCollection directly, instead you should declare a descendent type, and override the Compare (360) method.

Because the collection is ordered, TSortedCollection overrides some TCollection methods, to provide faster routines for lookup.

The Compare (360) method decides how elements in the collection should be ordered. Since TCollection has no way of knowing how to order pointers, you must override the compare method.

Additionally, TCollection provides a means to filter out duplicates. if you set Duplicates to False (the default) then duplicates will not be allowed.

Here is the complete declaration of TSortedCollection

```

TYPE
  TSortedCollection = OBJECT (TCollection)
    Duplicates: Boolean; { Duplicates flag }
    Constructor Init (ALimit, ADelta: Sw_Integer);
    Constructor Load (Var S: TStream);
    Function KeyOf (Item: Pointer): Pointer; Virtual;
    Function IndexOf (Item: Pointer): Sw_Integer; Virtual;
    Function Compare (Key1, Key2: Pointer): Sw_Integer; Virtual;
    Function Search (Key: Pointer; Var Index: Sw_Integer): Boolean; Virtual;
    Procedure Insert (Item: Pointer); Virtual;
    Procedure Store (Var S: TStream);
  END;
  PSortedCollection = ^TSortedCollection;

```

In the subsequent examples, the following descendent of TSortedCollection is used:

Listing: objectex/mysortc.pp

```

Unit MySortC;

```

```

Interface

```

```

Uses Objects;

```

```

Type

```

```

  PMySortedCollection = ^TMySortedCollection;
  TMySortedCollection = Object (TSortedCollection)
    Function Compare (Key1, Key2 : Pointer): Sw_integer; virtual;
  end;

```

Implementation

Uses MyObject;

Function TMySortedCollection.Compare (Key1,Key2 : Pointer) : sw_integer;

begin

Compare:= PMyobject(Key1)^.GetField - PMyObject(Key2)^.GetField;

end;

end.

TSortedCollection.Init

Declaration: Constructor TSortedCollection.Init (ALimit, ADelta: Sw_Integer);

Description: Init calls the inherited constructor (see TCollection.Init (344)) and sets the Duplicates flag to false.

You should not call this method directly, since TSortedCollection is a abstract class. Instead, the descendent classes should call it via the inherited keyword.

Errors: None.

See also: Load (359), Done (345)

For an example, see

TSortedCollection.Load

Declaration: Constructor Load (Var S: TStream);

Description: Load calls the inherited constructor (see TCollection.Load (345)) and reads the Duplicates flag from the stream..

You should not call this method directly, since TSortedCollection is a abstract class. Instead, the descendent classes should call it via the inherited keyword.

Errors: None.

See also: Init (359), Done (345)

For an example, see TCollection.Load (345).

TSortedCollection.KeyOf

Declaration: Function TSortedCollection.KeyOf (Item: Pointer): Pointer; Virtual;

Description: KeyOf returns the key associated with Item. TSortedCollection returns the item itself as the key, descendent objects can override this method to calculate a (unique) key based on the item passed (such as hash values).

Keys are used to sort the objects, they are used to search and sort the items in the collection. If descendent types override this method then it allows possibly for faster search/sort methods based on keys rather than on the objects themselves.

Errors: None.

See also: [IndexOf \(360\)](#), [Compare \(360\)](#).

TSortedCollection.IndexOf

Declaration: `Function TSortedCollection.IndexOf (Item: Pointer): Sw_Integer; Virtual;`

Description: `IndexOf` returns the index of `Item` in the collection. It searches for the object based on its key. If duplicates are allowed, then it returns the index of last object that matches `Item`.

In case `Item` is not found in the collection, -1 is returned.

Errors: None.

See also: [Search \(361\)](#), [Compare \(360\)](#).

For an example, see [TCollection.IndexOf \(346\)](#)

TSortedCollection.Compare

Declaration: `Function TSortedCollection.Compare (Key1, Key2: Pointer): Sw_Integer; Virtual;`

Description: `Compare` is an abstract method that should be overridden by descendent objects in order to compare two items in the collection. This method is used in the [Search \(361\)](#) method and in the [Insert \(362\)](#) method to determine the ordering of the objects.

The function should compare the two keys of items and return the following function results:

Result < 0 If `Key1` is logically before `Key2` (`Key1 < Key2`)

Result = 0 If `Key1` and `Key2` are equal. (`Key1 = Key2`)

Result > 0 If `Key1` is logically after `Key2` (`Key1 > Key2`)

Errors: An 'abstract run-time error' will be generated if you call `TSortedCollection.Compare` directly.

See also: [IndexOf \(360\)](#), [Search \(361\)](#)

Listing: `objectex/mysortc.pp`

Unit `MySortC`;

Interface

Uses `Objects`;

Type

`PMySortedCollection = ^TMySortedCollection`;

`TMySortedCollection = Object(TSortedCollection)`

Function `Compare (Key1, Key2 : Pointer): Sw_integer; virtual;`
end;

Implementation

Uses `MyObject`;

Function `TMySortedCollection.Compare (Key1, Key2 : Pointer) : sw_integer;`

```
begin
  Compare:=PMyobject(Key1)^.GetField - PMyObject(Key2)^.GetField ;
end;

end.
```

TSortedCollection.Search

Declaration: Function TSortedCollection.Search (Key: Pointer; Var Index: Sw_Integer): Boolean;Virtual;

Description: Search looks for the item with key Key and returns the position of the item (if present) in the collection in Index.

Instead of a linear search as TCollection does, TSortedCollection uses a binary search based on the keys of the objects. It uses the **Compare** (360) function to implement this search.

If the item is found, Search returns True, otherwise False is returned.

Errors: None.

See also: IndexOf (346).

Listing: objectex/ex36.pp

Program ex36;

{ Program to demonstrate the TSortedCollection.Insert method }

Uses Objects, MyObject, MySortC;
{ For TMyObject, TMySortedCollection definition and registration }

Var C : PSortedCollection;
M : PMyObject;
I : Longint;

Procedure PrintField (Dummy: Pointer;P : PMyObject);

```
begin
  WriteLn ( 'Field : ',P^.GetField);
end;
```

```
begin
  Randomize;
  C:=New(PMySortedCollection, Init(120,10));
  C^.Duplicates:=True;
  WriteLn ( 'Inserting 100 records at random places. ');
  For I:=1 to 100 do
    begin
      M:=New(PMyObject, Init);
      M^.SetField(Random(100));
      C^.Insert(M)
    end;
  M:=New(PMyObject, Init);
  Repeat;
    Write ( 'Value to search for (-1 stops) : ');
```

```

read (I);
If I<>-1 then
  begin
    M^.SetField(i);
    If Not C^.Search (M,I) then
      Writeln ('No such value found')
    else
      begin
        Write ('Value ',PMyObject(C^.At(I))^ .GetField);
        Writeln (' present at position ',I);
      end;
    end;
  end;
Until I=-1;
Dispose(M, Done);
Dispose(C, Done);
end.

```

TSortedCollection.Insert

Declaration: `Procedure TSortedCollection.Insert (Item: Pointer); Virtual;`

Description: `Insert` inserts an item in the collection at the correct position, such that the collection is ordered at all times. You should never use `Atinsert` (356), since then the collection ordering is not guaranteed.

If `Item` is already present in the collection, and `Duplicates` is `False`, the item will not be inserted.

Errors: None.

See also: `AtInsert` (356)

Listing: `objectex/ex35.pp`

Program `ex35;`

{ Program to demonstrate the TSortedCollection.Insert method }

Uses `Objects, MyObject, MySortC;`

{ For TMyObject, TMySortedCollection definition and registration }

Var `C : PSortedCollection;`

`M : PMyObject;`

`I : Longint;`

Procedure `PrintField (Dummy: Pointer;P : PMyObject);`

begin

`Writeln ('Field : ',P^.GetField);`

end;

begin

`Randomize;`

`C:=New(PMySortedCollection, Init(120,10));`

`Writeln ('Inserting 100 records at random places.');`

For `I:=1 to 100 do`

begin

`M:=New(PMyObject, Init);`

```

    M^.SetField(Random(100));
    C^.Insert(M)
  end;
  Writeln('Values : ');
  C^.Foreach(@PrintField);
  Dispose(C, Done);
end.

```

TSortedCollection.Store

Declaration: Procedure TSortedCollection.Store (Var S: TStream);

Description: Store writes the collection to the stream S. It does this by calling the inherited TCollection.Store (357), and then writing the Duplicates flag to the stream.

After a Store, the collection can be loaded from the stream with the constructor Load (359)

Errors: Errors can be those of TStream.Put (331).

See also: Load (359)

For an example, see TCollection.Load (345).

17.12 TStringCollection

The TStringCollection object manages a sorted collection of pascal strings. To this end, it overrides the Compare (360) method of TSortedCollection, and it introduces methods to read/write strings from a stream.

Here is the full declaration of the TStringCollection object:

```

TYPE
  TStringCollection = OBJECT (TSortedCollection)
    Function GetItem (Var S: TStream): Pointer; Virtual;
    Function Compare (Key1, Key2: Pointer): Sw_Integer; Virtual;
    Procedure FreeItem (Item: Pointer); Virtual;
    Procedure PutItem (Var S: TStream; Item: Pointer); Virtual;
  END;
  PStringCollection = ^TStringCollection;

```

TStringCollection.GetItem

Declaration: Function TStringCollection.GetItem (Var S: TStream): Pointer; Virtual;

Description: GetItem reads a string from the stream S and returns a pointer to it. It doesn't insert the string in the collection.

This method is primarily introduced to be able to load and store the collection from and to a stream.

Errors: The errors returned are those of TStream.ReadStr (329).

See also: PutItem (365)

TStringCollection.Compare

Declaration: Function TStringCollection.Compare (Key1, Key2: Pointer): Sw_Integer;
Virtual;

Description: TStringCollection overrides the Compare function so it compares the two keys as if they were pointers to strings. The compare is done case sensitive. It returns the following results:

-1if the first string is alphabetically earlier than the second string.

0if the two strings are equal.

1if the first string is alphabetically later than the second string.

Errors: None.

See also: TSortedCollection.Compare ([360](#))

Listing: objectex/ex37.pp

```

Program ex37;

{ Program to demonstrate the TStringCollection.Compare method }

Uses Objects;

Var C : PStringCollection;
    S : String;
    I : longint;

begin
  Randomize;
  C:=New(PStringCollection, Init(120,10));
  C^.Duplicates:=True; { Duplicates allowed }
  Writeln ('Inserting 100 records at random places. ');
  For I:=1 to 100 do
    begin
      Str(Random(100),S);
      S:='String with value '+S;
      C^.Insert(NewStr(S));
    end;
  For I:=0 to 98 do
    With C^ do
      If Compare (At(i),At(I+1))=0 then
        Writeln ('Duplicate string found at position ',i);
    Dispose(C,Done);
end.
```

TStringCollection.FreeItem

Declaration: Procedure TStringCollection.FreeItem (Item: Pointer); Virtual;

Description: TStringCollection overrides FreeItem so that the string pointed to by Item is disposed from memory.

Errors: None.

See also: TCollection.FreeItem ([354](#))

TStringCollection.PutItem

Declaration: Procedure TStringCollection.PutItem (Var S: TStream; Item: Pointer); Virtual;

Description: PutItem writes the string pointed to by Item to the stream S.

This method is primarily used in the Load and Store methods, and should not be used directly.

Errors: Errors are those of TStream.WriteString (331).

See also: GetItem (363)

17.13 TStrCollection

The TStrCollection object manages a sorted collection of null-terminated strings (pchar strings). To this end, it overrides the Compare (360) method of TSortedCollection, and it introduces methods to read/write strings from a stream.

Here is the full declaration of the TStrCollection object:

```

TYPE
  TStrCollection = OBJECT (TSortedCollection)
    Function Compare (Key1, Key2: Pointer): Sw_Integer; Virtual;
    Function GetItem (Var S: TStream): Pointer; Virtual;
    Procedure FreeItem (Item: Pointer); Virtual;
    Procedure PutItem (Var S: TStream; Item: Pointer); Virtual;
  END;
  PStrCollection = ^TStrCollection;

```

TStrCollection.GetItem

Declaration: Function TStrCollection.GetItem (Var S: TStream): Pointer; Virtual;

Description: GetItem reads a null-terminated string from the stream S and returns a pointer to it. It doesn't insert the string in the collection.

This method is primarily introduced to be able to load and store the collection from and to a stream.

Errors: The errors returned are those of TStream.StrRead (327).

See also: PutItem (366)

TStrCollection.Compare

Declaration: Function TStrCollection.Compare (Key1, Key2: Pointer): Sw_Integer; Virtual;

Description: TStrCollection overrides the Compare function so it compares the two keys as if they were pointers to strings. The compare is done case sensitive. It returns

-1 if the first string is alphabetically earlier than the second string.

0 if the two strings are equal.

1 if the first string is alphabetically later than the second string.

Errors: None.

See also: `TSortedCollection.Compare` ([360](#))

Listing: `objectex/ex38.pp`

```

Program ex38;

{ Program to demonstrate the TStrCollection.Compare method }

Uses Objects, Strings;

Var C : PStrCollection;
     S : String;
     I : longint;
     P : Pchar;

begin
  Randomize;
  C:=New(PStrCollection, Init(120,10));
  C^.Duplicates:=True; { Duplicates allowed }
  Writeln ('Inserting 100 records at random places. ');
  For I:=1 to 100 do
    begin
      Str(Random(100),S);
      S:='String with value '+S;
      P:=StrAlloc(Length(S)+1);
      C^.Insert(StrPCopy(P,S));
    end;
  For I:=0 to 98 do
    With C^ do
      If Compare (At(I),At(I+1))=0 then
        Writeln ('Duplicate string found at position ',I);
  Dispose(C,Done);
end.

```

TStrCollection.FreeItem

Declaration: `Procedure TStrCollection.FreeItem (Item: Pointer); Virtual;`

Description: `TStrCollection` overrides `FreeItem` so that the string pointed to by `Item` is disposed from memory.

Errors: None.

See also: `TCollection.FreeItem` ([354](#))

TStrCollection.PutItem

Declaration: `Procedure TStrCollection.PutItem (Var S: TStream; Item: Pointer); Virtual;`

Description: `PutItem` writes the string pointed to by `Item` to the stream `S`.

This method is primarily used in the `Load` and `Store` methods, and should not be used directly.

Errors: Errors are those of `TStream.StrWrite` ([331](#)).

See also: `GetItem` ([365](#))

17.14 TUnSortedStrCollection

The TUnSortedStrCollection object manages an unsorted list of strings. To this end, it overrides the TStringCollection.Insert(??) method to add strings at the end of the collection, rather than in the alphabetically correct position.

Take care, the Search (361) and IndexOf (346) methods will not work on an unsorted string collection.

Here is the full declaration of the TUnSortedStrCollection object:

```
TYPE
  TUnSortedStrCollection = OBJECT (TStringCollection)
    Procedure Insert (Item: Pointer); Virtual;
  END;
  PUnSortedStrCollection = ^TUnSortedStrCollection;
```

TUnSortedStrCollection.Insert

Declaration: Procedure TUnSortedStrCollection.Insert (Item: Pointer); Virtual;

Description: Insert inserts a string at the end of the collection, instead of on its alphabetical place, resulting in an unsorted collection of strings.

Errors:

See also:

Listing: objectex/ex39.pp

Program ex39;

{ Program to demonstrate the TUnSortedStrCollection.Insert method }

Uses Objects, Strings;

```
Var C : PUnsortedStrCollection;
      S : String;
      I : longint;
      P : Pchar;
```

begin

Randomize;

 C:=**New**(PUnsortedStrCollection, Init(120,10));

WriteLn ('Inserting 100 records at random places.');

For I:=1 to 100 **do**

begin

Str(**Random**(100),S);

 S:='String with value '+S;

 C[^].**Insert**(**NewStr**(S));

end;

For I:=0 to 99 **do**

WriteLn (I:2, ': ', PString(C[^].**At**(i))[^]);

Dispose(C, Done);

end.

17.15 TResourceCollection

A `TResourceCollection` manages a collection of resource names. It stores the position and the size of a resource, as well as the name of the resource. It stores these items in records that look like this:

```

TYPE
  TResourceItem = packed RECORD
    Posn: LongInt;
    Size: LongInt;
    Key : String;
  End;
  PResourceItem = ^TResourceItem;

```

It overrides some methods of `TStringCollection` in order to accomplish this.

Remark that the `TResourceCollection` manages the names of the resources and their associated positions and sizes, it doesn't manage the resources themselves.

Here is the full declaration of the `TResourceCollection` object:

```

TYPE
  TResourceCollection = OBJECT (TStringCollection)
    Function KeyOf (Item: Pointer): Pointer; Virtual;
    Function GetItem (Var S: TStream): Pointer; Virtual;
    Procedure FreeItem (Item: Pointer); Virtual;
    Procedure PutItem (Var S: TStream; Item: Pointer); Virtual;
  END;
  PResourceCollection = ^TResourceCollection;

```

TResourceCollection.KeyOf

Declaration: `Function TResourceCollection.KeyOf (Item: Pointer): Pointer; Virtual;`

Description: `KeyOf` returns the key of an item in the collection. For resources, the key is a pointer to the string with the resource name.

Errors: None.

See also: `TStringCollection.Compare` (364)

TResourceCollection.GetItem

Declaration: `Function TResourceCollection.GetItem (Var S: TStream): Pointer; Virtual;`

Description: `GetItem` reads a resource item from the stream `S`. It reads the position, size and name from the stream, in that order. It DOES NOT read the resource itself from the stream.

The resulting item is not inserted in the collection. This call is mainly for internal use by the `TCollection.Load` (345) method.

Errors: Errors returned are those by `TStream.Read` (332)

See also: `TCollection.Load` (345), `TStream.Read` (332)

TResourceCollection.FreeItem

Declaration: Procedure TResourceCollection.FreeItem (Item: Pointer); Virtual;

Description: FreeItem releases the memory occupied by Item. It de-allocates the name, and then the resourceitem record.

It does NOT remove the item from the collection.

Errors: None.

See also: TCollection.FreeItem (354)

TResourceCollection.PutItem

Declaration: Procedure TResourceCollection.PutItem (Var S: TStream; Item: Pointer); Virtual;

Description: PutItem writes Item to the stream S. It does this by writing the position and size and name of the resource item to the stream.

This method is used primarily by the Store (357) method.

Errors: Errors returned are those by TStream.Write (333).

See also: Store (357)

17.16 TResourceFile

TYPE

```
TResourceFile = OBJECT (TObject)
    Stream : PStream; { File as a stream }
    Modified: Boolean; { Modified flag }
    Constructor Init (AStream: PStream);
    Destructor Done; Virtual;
    Function Count: Sw_Integer;
    Function KeyAt (I: Sw_Integer): String;
    Function Get (Key: String): PObject;
    Function SwitchTo (AStream: PStream; Pack: Boolean): PStream;
    Procedure Flush;
    Procedure Delete (Key: String);
    Procedure Put (Item: PObject; Key: String);
END;
PResourceFile = ^TResourceFile;
```

TResourceFile Fields

TResourceFile has the following fields:

Stream contains the (file) stream that has the executable image and the resources. It can be initialized by the Init (370) constructor call.

Modified is set to True if one of the resources has been changed. It is set by the SwitchTo (370), Delete (371) and Put (371) methods. Calling Flush (371) will clear the Modified flag.

TResourceFile.Init

Declaration: Constructor `TResourceFile.Init (AStream: PStream);`

Description: `Init` instantiates a new instance of a `TResourceFile` object. If `AStream` is not `nil` then it is considered as a stream describing an executable image on disk.

`Init` will try to position the stream on the start of the resources section, and read all resources from the stream.

Errors: None.

See also: [Done \(370\)](#)

TResourceFile.Done

Declaration: Destructor `TResourceFile.Done; Virtual;`

Description: `Done` cleans up the instance of the `TResourceFile` Object. If `Stream` was specified at initialization, then `Stream` is disposed of too.

Errors: None.

See also: [Init \(370\)](#)

TResourceFile.Count

Declaration: Function `TResourceFile.Count: Sw_Integer;`

Description: `Count` returns the number of resources. If no resources were read, zero is returned.

Errors: None.

See also: [Init \(370\)](#)

TResourceFile.KeyAt

Declaration: Function `TResourceFile.KeyAt (I: Sw_Integer): String;`

Description: `KeyAt` returns the key (the name) of the `I`-th resource.

Errors: In case `I` is invalid, `TCollection.Error` will be executed.

See also: [Get \(370\)](#)

TResourceFile.Get

Declaration: Function `TResourceFile.Get (Key: String): PObject;`

Description: `Get` returns a pointer to a instance of a resource identified by `Key`. If `Key` cannot be found in the list of resources, then `Nil` is returned.

Errors: Errors returned may be those by `TStream.Get`

See also:

TResourceFile.SwitchTo

Declaration: `Function TResourceFile.SwitchTo (AStream: PStream; Pack: Boolean): PStream;`

Description: `SwitchTo` switches to a new stream to hold the resources in. `AStream` will be the new stream after the call to `SwitchTo`.

If `Pack` is true, then all the known resources will be copied from the current stream to the new stream (`AStream`). If `Pack` is False, then only the current resource is copied.

The return value is the value of the original stream: `Stream`.

The `Modified` flag is set as a consequence of this call.

Errors: Errors returned can be those of `TStream.Read` (332) and `TStream.Write` (333).

See also: `Flush` (371)

TResourceFile.Flush

Declaration: `Procedure TResourceFile.Flush;`

Description: If the `Modified` flag is set to `True`, then `Flush` writes the resources to the stream `Stream`. It sets the `Modified` flag to true after that.

Errors: Errors can be those by `TStream.Seek` (332) and `TStream.Write` (333).

See also: `SwitchTo` (371)

TResourceFile.Delete

Declaration: `Procedure TResourceFile.Delete (Key: String);`

Description: `Delete` deletes the resource identified by `Key` from the collection. It sets the `Modified` flag to true.

Errors: None.

See also: `Flush` (371)

TResourceFile.Put

Declaration: `Procedure TResourceFile.Put (Item: PObject; Key: String);`

Description: `Put` sets the resource identified by `Key` to `Item`. If no such resource exists, a new one is created. The item is written to the stream.

Errors: Errors returned may be those by `TStream.Put` (331) and `TStream.Seek`

See also: `Get` (370)

17.17 TStringList

A `TStringList` object can be used to read a collection of strings stored in a stream. If you register this object with the `RegisterType` (317) function, you cannot register the `TStrListMaker` object.

This is the public declaration of the `TStringList` object:

```

TYPE
  TStrIndexRec = Packed RECORD
    Key, Count, Offset: Word;
  END;

  TStrIndex = Array [0..9999] Of TStrIndexRec;
  PStrIndex = ^TStrIndex;

  TStringList = OBJECT (TObject)
    Constructor Load (Var S: TStream);
    Destructor Done; Virtual;
    Function Get (Key: Sw_Word): String;
  END;
  PStringList = ^TStringList;

```

TStringList.Load

Declaration: Constructor `TstringList.Load (Var S: TStream);`

Description: The `Load` constructor reads the `TStringList` object from the stream `S`. It also reads the descriptions of the strings from the stream. The string descriptions are stored as an array of `TstrIndexrec` records, where each record describes a string on the stream. These records are kept in memory.

Errors: If an error occurs, a stream error is triggered.

See also: `Done` (372)

TStringList.Done

Declaration: Destructor `TstringList.Done; Virtual;`

Description: The `Done` destructor frees the memory occupied by the string descriptions, and destroys the object.

Errors: None.

See also: `Load` (372), `TObject.Done` (325)

TStringList.Get

Declaration: Function `TStringList.Get (Key: Sw_Word): String;`

Description: `Get` reads the string with key `Key` from the list of strings on the stream, and returns this string. If there is no string with such a key, an empty string is returned.

Errors: If no string with key `Key` is found, an empty string is returned. A stream error may result if the stream doesn't contain the needed strings.

See also: `TStrListMaker.Put` (373)

17.18 TStrListMaker

The `TStrListMaker` object can be used to generate a stream with strings, which can be read with the `TStringList` object. If you register this object with the `RegisterType` (317) function, you cannot register the `TStringList` object.

This is the public declaration of the `TStrListMaker` object:

```

TYPE
  TStrListMaker = OBJECT (TObject)
    Constructor Init (AStrSize, AIndexSize: Sw_Word);
    Destructor Done; Virtual;
    Procedure Put (Key: SwWord; S: String);
    Procedure Store (Var S: TStream);
  END;
  PStrListMaker = ^TStrListMaker;

```

TStrListMaker.Init

Declaration: Constructor TStrListMaker.Init (AStrSize, AIndexSize: SwWord);

Description: The Init constructor creates a new instance of the TStrListMaker object. It allocates AStrSize bytes on the heap to hold all the strings you wish to store. It also allocates enough room for AIndexSize key description entries (of the type TStrIndexrec).

AStrSize must be large enough to contain all the strings you wish to store. If not enough memory is allocated, other memory will be overwritten. The same is true for AIndexSize : maximally AIndexSize strings can be written to the stream.

Errors: None.

See also: TObject.Init ([325](#)), Done ([373](#))

TStrListMaker.Done

Declaration: Destructor TStrListMaker.Done; Virtual;

Description: The Done destructor de-allocates the memory for the index description records and the string data, and then destroys the object.

Errors: None.

See also: TObject.Done ([325](#)), Init ([373](#))

TStrListMaker.Put

Declaration: Procedure TStrListMaker.Put (Key: Sw_Word; S: String);

Description: Put adds they string S with key Key to the collection of strings. This action doesn't write the string to a stream. To write the strings to the stream, see the Store ([373](#)) method.

Errors: None.

See also: Store ([373](#)).

TStrListMaker.Store

Declaration: Procedure TStrListMaker.Store (Var S: TStream);

Description: Store writes the collection of strings to the stream S. The collection can then be read with the TStringList object.

Errors: A stream error may occur when writing the strings to the stream.

See also: TStringList.Load ([372](#)), Put ([373](#)).

Chapter 18

The PORTS unit

18.1 Introduction

The ports unit implements the `port` constructs found in Turbo Pascal. It uses classes and default array properties to do this.

The unit exists on LINUX, OS/2 and DOS. It is implemented only for compatibility with Turbo Pascal. It's usage is discouraged, because using ports is not portable programming, and the operating system may not even allow it (for instance WINDOWS).

Under LINUX, your program must be run as root, or the `IOPerm` call must be set in order to set appropriate permissions on the port access.

18.2 Types, constants and variables

Types

The following types are defined to implement the port access.

```
tport = class
  protected
    procedure writeport(p : longint; data : byte);
    function readport(p : longint) : byte;
  public
    property pp[w : longint] : byte read readport write writeport; default;
end;
```

```
tportw = class
  protected
    procedure writeport(p : longint; data : word);
    function readport(p : longint) : word;
  public
    property pp[w : longint] : word read readport write writeport; default;
end;
```

```
tportl = class
  Protected
    procedure writeport(p : longint; data : longint);
    function readport(p : longint) : longint;
```

```
Public
  property pp[w : Longint] : longint read readport write writeport;default;
end;
```

Each of these types allows access to the ports using respectively, a byte, a word or a longint sized argument.

Since there is a default property for each of this types, a sentence as

```
port[221]:=12;
```

Will result in the byte 12 being written to port 221, if port is defined as a variable of type tport

variables

The following variables are defined:

```
port,
portb : tport;
portw : tportw;
portl : tportl;
```

They allow access to the ports in a Turbo Pascal compatible way.

Chapter 19

The PRINTER unit.

This chapter describes the PRINTER unit for Free Pascal. It was written for DOS by Florian Klämpfl, and it was written for LINUX by Michaël Van Canneyt, and has been ported to WINDOWS and OS/2 as well. Its basic functionality is the same for all supported systems, although there are minor differences on LINUX.

The chapter is divided in 2 sections:

- The first section lists types, constants and variables from the interface part of the unit.
- The second section describes the functions defined in the unit.

19.1 Types, Constants and variables :

```
var
  lst : text;
```

Lst is the standard printing device.

On LINUX, Lst is set up using `AssignLst ('/tmp/PID.lst')`. You can change this behaviour at compile time, setting the `DefFile` constant.

19.2 Procedures and functions

AssignLst

Declaration: `Procedure AssignLst (Var F : text; ToFile : string[255]);`

Description: LINUX only.

Assigns to F a printing device. ToFile is a string with the following form:

- `'|filename options'` : This sets up a pipe with the program filename, with the given options, such as in the `popen()` call.
- `'filename'` : Prints to file filename. Filename can contain the string 'PID' (No Quotes), which will be replaced by the PID of your program. When closing lst, the file will be sent to lpr and deleted. (lpr should be in PATH)
- `'filename|'` : Idem as previous, only the file is NOT sent to lpr, nor is it deleted. (useful for opening /dev/printer or for later printing)

Errors: Errors are reported in Linuxerror.

See also: `lpr(1)`

Listing: `printex/printex.pp`

```
program testprn;  
  
uses printer;  
  
var i : integer;  
    f : text;  
  
begin  
  writeln ('Test of printer unit');  
  writeln ('Writing to lst...');  
  for i:=1 to 80 do writeln (lst, 'This is line ', i, '.'#13);  
  close (lst);  
  writeln ('Done. ');  
  {$ifdef Unix}  
  writeln ('Writing to pipe...');  
  assignlst (f, '|/usr/bin/lpr -m');  
  rewrite (f);  
  for i:=1 to 80 do writeln (f, 'This is line ', i, '.'#13);  
  close (f);  
  writeln ('Done. ')  
  {$endif}  
end.
```

Chapter 20

The SOCKETS unit.

This chapter describes the SOCKETS unit for Free Pascal. it was written for LINUX by Michaël Van Canneyt, and ported to WINDOWS by Florian Klämpfl. The chapter is divided in 2 sections:

- The first section lists types, constants and variables from the interface part of the unit.
- The second section describes the functions defined in the unit.

20.1 Types, Constants and variables :

The following constants identify the different socket types, as needed in the `Socket` (388) call.

```
SOCK_STREAM      = 1; { stream (connection) socket }
SOCK_DGRAM       = 2; { datagram (conn.less) socket }
SOCK_RAW         = 3; { raw socket }
SOCK_RDM         = 4; { reliably-delivered message }
SOCK_SEQPACKET  = 5; { sequential packet socket }
SOCK_PACKET      =10;
```

The following constants determine the socket domain, they are used in the `Socket` (388) call.

```
AF_UNSPEC        = 0;
AF_UNIX          = 1; { Unix domain sockets }
AF_INET          = 2; { Internet IP Protocol }
AF_AX25          = 3; { Amateur Radio AX.25 }
AF_IPX           = 4; { Novell IPX }
AF_APPLETALK     = 5; { Appletalk DDP }
AF_NETROM        = 6; { Amateur radio NetROM }
AF_BRIDGE        = 7; { Multiprotocol bridge }
AF_AAL5          = 8; { Reserved for Werner's ATM }
AF_X25           = 9; { Reserved for X.25 project }
AF_INET6         = 10; { IP version 6 }
AF_MAX           = 12;
```

The following constants determine the protocol family, they are used in the `Socket` (388) call.

```
PF_UNSPEC        = AF_UNSPEC;
PF_UNIX          = AF_UNIX;
```

```

PF_INET      = AF_INET;
PF_AX25     = AF_AX25;
PF_IPX      = AF_IPX;
PF_APPLETALK = AF_APPLETALK;
PF_NETROM   = AF_NETROM;
PF_BRIDGE   = AF_BRIDGE;
PF_AAL5     = AF_AAL5;
PF_X25      = AF_X25;
PF_INET6    = AF_INET6;
PF_MAX      = AF_MAX;

```

The following types are used to store different kinds of addresses for the `Bind` (381), `Recv` (386) and `Send` (386) calls.

```

TSockAddr = packed Record
  family:word;
  data :array [0..13] of char;
end;
TUnixSockAddr = packed Record
  family:word;
  path:array[0..108] of char;
end;
TInetSockAddr = packed Record
  family:Word;
  port :Word;
  addr :Cardinal;
  pad :array [1..8] of byte;
end;

```

The following type is returned by the `SocketPair` (388) call.

```
TSockArray = Array[1..2] of Longint;
```

20.2 Functions and Procedures

Accept

Declaration: `Function Accept (Sock:Longint;Var Addr;Var AddrLen:Longint) : Longint;`

Description: `Accept` accepts a connection from a socket `Sock`, which was listening for a connection. If a connection is accepted, a file descriptor is returned. On error `-1` is returned. The returned socket may NOT be used to accept more connections. The original socket remains open.

The `Accept` call fills the address of the connecting entity in `Addr`, and sets its length in `AddrLen`. `Addr` should be pointing to enough space, and `AddrLen` should be set to the amount of space available, prior to the call.

Errors: On error, `-1` is returned, and errors are reported in `SocketError`, and include the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_ENOTSOCKThe descriptor is not a socket.

SYS_EOPNOTSUPPThe socket type doesn't support the `Listen` operation.

SYS_EFAULT`Addr` points outside your address space.

SYS_EWOULDBLOCKThe requested operation would block the process.

See also: Listen (385), Connect (382)

Listing: sockex/socksvr.pp

```

Program server;

{
  Program to test Sockets unit by Michael van Canneyt and Peter Vreman
  Server Version, First Run sock_svr to let it create a socket and then
  sock_cli to connect to that socket
}

uses Linux, Sockets;
const
  SPath= 'ServerSoc';

Var
  FromName : string;
  Buffer    : string[255];
  S        : Longint;
  Sin, Sout : Text;

procedure perror (const S:string);
begin
  writeln (S, SocketError);
  halt(100);
end;

begin
  S:=Socket (AF_UNIX,SOCK_STREAM,0);
  if SocketError<>0 then
    Perror ('Server : Socket : ');
  UnLink(SPath);
  if not Bind(S,SPath) then
    PError ('Server : Bind : ');
  if not Listen (S,1) then
    PError ('Server : Listen : ');
  writeln('Waiting for Connect from Client, run now sock_cli in an other tty');
  if not Accept (S,FromName,Sin,Sout) then
    PError ('Server : Accept : '+fromname);
  Reset(Sin);
  ReWrite(Sout);
  writeln(Sout, 'Message From Server');
  Flush(SOut);
  while not eof(sin) do
    begin
      Readln(Sin, Buffer);
      writeln('Server : read : ',buffer);
    end;
  Unlink(SPath);
end.

```

Accept

Declaration: `Function Accept (Sock:longint;var addr:string;var SockIn,SockOut:text) : Boolean;`

Description: This is an alternate form of the `Accept (379)` command. It is equivalent to subsequently calling the regular `Accept (379)` function and the `Sock2Text (388)` function. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Accept (379)`.

See also: `Accept (379)`

Accept

Declaration: `Function Accept (Sock:longint;var addr:string;var SockIn,SockOut:File) : Boolean;`

Description: This is an alternate form of the `Accept (379)` command. It is equivalent to subsequently calling the regular `Accept (379)` function and the `Sock2File (387)` function. The `Addr` parameter contains the name of the unix socket file to be opened. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Accept (379)`.

See also: `Accept (379)`

Accept

Declaration: `Function Accept (Sock:longint;var addr:TInetSockAddr;var SockIn,SockOut:File) : Boolean;`

Description: This is an alternate form of the `Accept (379)` command. It is equivalent to subsequently calling the regular `Accept (379)` function and the `Sock2File (387)` function. The `Addr` parameter contains the parameters of the internet socket that should be opened. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Accept (379)`.

See also: `Accept (379)`

Bind

Declaration: `Function Bind (Sock:Longint;Var Addr;AddrLen:Longint) : Boolean;`

Description: `Bind` binds the socket `Sock` to address `Addr`. `Addr` has length `AddrLen`. The function returns `True` if the call was successful, `False` if not.

Errors: Errors are returned in `SocketError` and include the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_EINVALThe socket is already bound to an address,

SYS_EACCESSAddress is protected and you don't have permission to open it.

More errors can be found in the Unix man pages.

See also: `Socket (388)`

Bind

Declaration: `Function Bind (Sock:longint;const addr:string) : boolean;`

Description: This is an alternate form of the Bind command. This form of the Bind command is equivalent to subsequently calling `Str2UnixSockAddr (388)` and the regular `Bind (381)` function. The function returns `True` if successful, `False` otherwise.

Errors: Errors are those of the regular `Bind (381)` command.

See also: `Bind (381)`

Connect

Declaration: `Function Connect (Sock:Longint;Var Addr;AddrLen:Longint) : Longint;`

Description: `Connect` opens a connection to a peer, whose address is described by `Addr`. `AddrLen` contains the length of the address. The type of `Addr` depends on the kind of connection you're trying to make, but is generally one of `TSockAddr` or `TUnixSockAddr`.

The `Connect` function returns a file descriptor if the call was successful, `-1` in case of error.

Errors: On error, `-1` is returned and errors are reported in `SocketError`.

See also: `Listen (385)`, `Bind (381)`, `Accept (379)`

Listing: sockex/sockcli.pp

Program Client;

```
{
  Program to test Sockets unit by Michael van Canneyt and Peter Vreman
  Client Version, First Run sock_svr to let it create a socket and then
  sock_cli to connect to that socket
}
```

uses Sockets, Linux;

```
procedure PError(const S : string);
begin
  writeln(S, SocketError);
  halt(100);
end;
```

Var

```
Saddr   : String[25];
Buffer  : string [255];
S       : Longint;
Sin, Sout : Text;
i       : integer;
begin
  S:=Socket (AF_UNIX,SOCK_STREAM,0);
  if SocketError<>0 then
    PError('Client : Socket : ');
  Saddr:= 'ServerSoc';
  if not Connect (S,SAddr,Sin,Sout) then
    PError('Client : Connect : ');
  Reset(Sin);
```

```

ReWrite(Sout);
Buffer:= 'This is a textstring sent by the Client.';
for i:=1 to 10 do
  WriteLn(Sout, Buffer);
Flush(Sout);
ReadLn(SIn, Buffer);
WriteLn(Buffer);
Close(sout);
end.

```

Connect

Declaration: `Function Connect (Sock:longint;const addr:string;var SockIn,SockOut:text) : Boolean;`

Description: This is an alternate form of the `Connect` (382) command. It is equivalent to subsequently calling the regular `Connect` (382) function and the `Sock2Text` (388) function. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Connect` (382).

See also: `Connect` (382)

Connect

Declaration: `Function Connect (Sock:longint;const addr:string;var SockIn,SockOut:file) : Boolean;`

Description: This is an alternate form of the `Connect` (382) command. The parameter `addr` contains the name of the unix socket file to be opened. It is equivalent to subsequently calling the regular `Connect` (382) function and the `Sock2File` (387) function. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Connect` (382).

See also: `Connect` (382)

Connect

Declaration: `Function Connect (Sock:longint;const addr: TInetSockAddr;var SockIn,SockOut:file) : Boolean;`

Description: This is another alternate form of the `Connect` (382) command. It is equivalent to subsequently calling the regular `Connect` (382) function and the `Sock2File` (387) function. The `Addr` parameter contains the parameters of the internet socket to connect to. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Connect` (382).

See also: `Connect` (382)

Listing: `sockex/pfinger.pp`

```

program pfinger;

uses sockets, errors;

Var Addr : TInetSockAddr;
    S : Longint;
    Sin, Sout : Text;
    Line : string;

begin
    Addr.family:=AF_INET;
    { port 79 in network order }
    Addr.port:=79 shl 8;
    { localhost : 127.0.0.1 in network order }
    Addr.addr:=((1 shl 24) or 127);
    S:=Socket(AF_INET,SOCK_STREAM,0);
    If Not Connect (S,ADDR,SIN,SOUT) Then
        begin
            Writeln ('Couldn't connect to localhost');
            Writeln ('Socket error : ',strerror(SocketError));
            halt (1);
        end;
    rewrite (sout);
    reset (sin);
    writeln (sout, paramstr(1));
    flush (sout);
    while not eof(sin) do
        begin
            readln (Sin, line);
            writeln (line);
        end;
    Shutdown(s,2);
    close (sin);
    close (sout);
end.

```

GetPeerName

Declaration: Function GetPeerName (Sock:Longint;Var Addr;Var AddrLen:Longint) : Longint;

Description: GetPeerName returns the name of the entity connected to the specified socket Sock. The Socket must be connected for this call to work. Addr should point to enough space to store the name, the amount of space pointed to should be set in AddrLen. When the function returns successfully, Addr will be filled with the name, and AddrLen will be set to the length of Addr.

Errors: Errors are reported in SocketError, and include the following:

- SYS_EBADF**The socket descriptor is invalid.
- SYS_ENOBUFS**The system doesn't have enough buffers to perform the operation.
- SYS_ENOTSOCK**The descriptor is not a socket.
- SYS_EFAULT**Addr points outside your address space.
- SYS_ENOTCONN**The socket isn't connected.

See also: Connect (382), Socket (388), connect (2)

GetSocketName

Declaration: `Function GetSocketName (Sock:Longint;Var Addr;Var AddrLen:Longint) : Longint;`

Description: `GetSocketName` returns the current name of the specified socket `Sock`. `Addr` should point to enough space to store the name, the amount of space pointed to should be set in `AddrLen`. When the function returns successfully, `Addr` will be filled with the name, and `AddrLen` will be set to the length of `Addr`.

Errors: Errors are reported in `SocketError`, and include the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_ENOBUFSThe system doesn't have enough buffers to perform the operation.

SYS_ENOTSOCKThe descriptor is not a socket.

SYS_EFAULT`Addr` points outside your address space.

See also: `Bind` ([381](#))

GetSocketOptions

Declaration: `Function GetSocketOptions (Sock,Level,OptName:Longint;Var OptVal;optlen:longint) : Longint;`

Description: `GetSocketOptions` gets the connection options for socket `Sock`. The socket may be obtained from different levels, indicated by `Level`, which can be one of the following:

SOL_SOCKETFrom the socket itself.

XXXset `Level` to `XXX`, the protocol number of the protocol which should interpret the option.

For more information on this call, refer to the unix manual page `getsockopt (2)`.

Errors: Errors are reported in `SocketError`, and include the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_ENOTSOCKThe descriptor is not a socket.

SYS_EFAULT`OptVal` points outside your address space.

See also: `GetSocketOptions` ([385](#))

Listen

Declaration: `Function Listen (Sock,MaxConnect:Longint) : Boolean;`

Description: `Listen` listens for up to `MaxConnect` connections from socket `Sock`. The socket `Sock` must be of type `SOCK_STREAM` or `SOCK_SEQPACKET`. The function returns `True` if a connection was accepted, `False` if an error occurred.

Errors: Errors are reported in `SocketError`, and include the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_ENOTSOCKThe descriptor is not a socket.

SYS_EOPNOTSUPPThe socket type doesn't support the `Listen` operation.

See also: `Socket` ([388](#)), `Bind` ([381](#)), `Connect` ([382](#))

Recv

Declaration: `Function Recv (Sock:Longint;Var Addr;AddrLen,Flags:Longint) : Longint;`

Description: `Recv` reads at most `AddrLen` bytes from socket `Sock` into address `Addr`. The socket must be in a connected state. `Flags` can be one of the following:

- 1:** Process out-of band data.
- 4:** Bypass routing, use a direct interface.
- ??:** Wait for full request or report an error.

The function returns the number of bytes actually read from the socket, or -1 if a detectable error occurred.

Errors: Errors are reported in `SocketError`, and include the following:

- SYS_EBADF**The socket descriptor is invalid.
- SYS_ENOTCONN**The socket isn't connected.
- SYS_ENOTSOCK**The descriptor is not a socket.
- SYS_EFAULT**The address is outside your address space.
- SYS EMSGSIZE**The message cannot be sent atomically.
- SYS_EWOULDBLOCK**The requested operation would block the process.
- SYS_ENOBUFS**The system doesn't have enough free buffers available.

See also: `Send` ([386](#))

Send

Declaration: `Function Send (Sock:Longint;Var Addr;AddrLen,Flags:Longint) : Longint;`

Description: `Send` sends `AddrLen` bytes starting from address `Addr` to socket `Sock`. `Sock` must be in a connected state. The function returns the number of bytes sent, or -1 if a detectable error occurred. `Flags` can be one of the following:

- 1:** Process out-of band data.
- 4:** Bypass routing, use a direct interface.

Errors: Errors are reported in `SocketError`, and include the following:

- SYS_EBADF**The socket descriptor is invalid.
- SYS_ENOTSOCK**The descriptor is not a socket.
- SYS_EFAULT**The address is outside your address space.
- SYS EMSGSIZE**The message cannot be sent atomically.
- SYS_EWOULDBLOCK**The requested operation would block the process.
- SYS_ENOBUFS**The system doesn't have enough free buffers available.

See also: `Recv` ([386](#)), `send` ([2](#))

SetSocketOptions

Declaration: `Function SetSocketOptions (Sock,Level,OptName:Longint;Var OptVal;optlen:longint) : Longint;`

Description: `SetSocketOptions` sets the connection options for socket `Sock`. The socket may be manipulated at different levels, indicated by `Level`, which can be one of the following:

SOL_SOCKETTo manipulate the socket itself.

XXXset `Level` to `XXX`, the protocol number of the protocol which should interpret the option.

For more information on this call, refer to the unix manual page `setsockopt (2)`.

Errors: Errors are reported in `SocketError`, and include the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_ENOTSOCKThe descriptor is not a socket.

SYS_EFAULT`OptVal` points outside your address space.

See also: `GetSocketOptions` ([385](#))

Shutdown

Declaration: `Function Shutdown (Sock:Longint;How:Longint) : Longint;`

Description: `Shutdown` closes one end of a full duplex socket connection, described by `Sock`. `How` determines how the connection will be shut down, and can be one of the following:

0: Further receives are disallowed.

1: Further sends are disallowed.

2: Sending nor receiving are allowed.

On succes, the function returns 0, on error -1 is returned.

Errors: `SocketError` is used to report errors, and includes the following:

SYS_EBADFThe socket descriptor is invalid.

SYS_ENOTCONNThe socket isn't connected.

SYS_ENOTSOCKThe descriptor is not a socket.

See also: `Socket` ([388](#)), `Connect` ([382](#))

Sock2File

Declaration: `Procedure Sock2File (Sock:Longint;Var SockIn,SockOut:File);`

Description: `Sock2File` transforms a socket `Sock` into 2 Pascal file descriptors of type `File`, one for reading from the socket (`SockIn`), one for writing to the socket (`SockOut`).

Errors: None.

See also: `Socket` ([388](#)), `Sock2Text` ([388](#))

Sock2Text

Declaration: `Procedure Sock2Text (Sock:Longint;Var SockIn,SockOut: Text);`

Description: `Sock2Text` transforms a socket `Sock` into 2 Pascal file descriptors of type `Text`, one for reading from the socket (`SockIn`), one for writing to the socket (`SockOut`).

Errors: None.

See also: [Socket \(388\)](#), [Sock2File \(387\)](#)

Socket

Declaration: `Function Socket (Domain,SocketType,Protocol:Longint) : Longint;`

Description: `Socket` creates a new socket in domain `Domain`, from type `SocketType` using protocol `Protocol`. The `Domain`, `Socket` type and `Protocol` can be specified using predefined constants (see the section on constants for available constants) If succesfull, the function returns a socket descriptor, which can be passed to a subsequent [Bind \(381\)](#) call. If unsuccessful, the function returns -1.

Errors: Errors are returned in `SocketError`, and include the following:

SYS_EPROTONOSUPPORTThe protocol type or the specified protocol is not supported within this domain.

SYS_EMFILEThe per-process descriptor table is full.

SYS_ENFILEThe system file table is full.

SYS_EACCESSPermission to create a socket of the specified type and/or protocol is denied.

SYS_ENOBUFSInsufficient buffer space is available. The socket cannot be created until sufficient resources are freed.

See also: [SocketPair \(388\)](#), `socket (2)`

for an example, see [Accept \(379\)](#).

SocketPair

Declaration: `Function SocketPair (Domain,SocketType,Protocol:Longint;var Pair:TsockArray) : Longint;`

Description: `SocketPair` creates 2 sockets in domain `Domain`, from type `SocketType` and using protocol `Protocol`. The pair is returned in `Pair`, and they are indistinguishable. The function returns -1 upon error and 0 upon success.

Errors: Errors are reported in `SocketError`, and are the same as in [Socket \(388\)](#)

See also: [Str2UnixSockAddr \(388\)](#)

Str2UnixSockAddr

Declaration: `Procedure Str2UnixSockAddr(const addr:string;var t:TUnixSockAddr;var len:longint)`

Description: `Str2UnixSockAddr` transforms a Unix socket address in a string to a `TUnixSockAddr` structure which can be passed to the [Bind \(381\)](#) call.

Errors: None.

See also: [Socket \(388\)](#), [Bind \(381\)](#)

Chapter 21

The STRINGS unit.

This chapter describes the STRINGS unit for Free Pascal. This unit is system independent, and therefore works on all supported platforms.

Since the unit only provides some procedures and functions, there is only one section, which gives the declarations of these functions, together with an explanation.

21.1 Functions and procedures.

StrAlloc

Declaration: `Function StrAlloc (Len : Longint) : PChar;`

Description: `StrAlloc` reserves memory on the heap for a string with length `Len`, terminating #0 included, and returns a pointer to it.

Errors: If there is not enough memory, a run-time error occurs.

See also: `StrNew` (396), `StrPCopy` (397).

StrCat

Declaration: `Function StrCat (Dest,Source : PChar) : PChar;`

Description: Attaches `Source` to `Dest` and returns `Dest`.

Errors: No length checking is performed.

See also: `Concat` ()

Listing: stringex/ex11.pp

Program Example11;

Uses strings;

{ Program to demonstrate the StrCat function. }

Const P1 : PChar = 'This is a PChar String.';

Var P2 : PChar;

```
begin
  P2:= StrAlloc (StrLen(P1)*2+1);
  StrMove (P2,P1,StrLen(P1)+1); { P2=P1 }
  StrCat (P2,P1);                { Append P2 once more }
  WriteLn ( 'P2 : ',P2);
end.
```

StrComp

Declaration: Function StrComp (S1,S2 : PChar) : Longint;

Description: Compares the null-terminated strings S1 and S2. The result is

- A negative Longint when S1<S2.
- 0 when S1=S2.
- A positive Longint when S1>S2.

Errors: None.

See also: StrLComp (393), StrComp (392), StrLComp (395)

For an example, see StrLComp (393).

StrCopy

Declaration: Function StrCopy (Dest,Source : PChar) : PChar;

Description: Copy the null terminated string in Source to Dest, and returns a pointer to Dest. Dest needs enough room to contain Source, i.e. StrLen(Source)+1 bytes.

Errors: No length checking is performed.

See also: StrPCopy (397), StrLCopy (394), StrECopy (391)

Listing: stringex/ex4.pp

```
Program Example4;

Uses strings;

{ Program to demonstrate the StrCopy function. }

Const P : PChar = 'This is a PCHAR string.';

var PP : PChar;

begin
  PP:= StrAlloc(StrLen(P)+1);
  StrCopy (PP,P);
  If StrComp (PP,P)<>0 then
    WriteLn ( 'Oh-oh problems... ' )
  else
    WriteLn ( 'All is well : PP=',PP);
end.
```

StrDispose

Declaration: `Procedure StrDispose (P : PChar);`

Description: Removes the string in P from the heap and releases the memory.

Errors: None.

See also: `Dispose ()`, `StrNew (396)`

Listing: stringex/ex17.pp

Program Example17;

Uses strings;

{ Program to demonstrate the StrDispose function. }

Const P1 : PChar = 'This is a PChar string';

var P2 : PChar;

begin

WriteLn ('Before StrNew : Memory available : ', **MemAvail**);

 P2:=**StrNew** (P1);

WriteLn ('After StrNew : Memory available : ', **MemAvail**);

WriteLn ('P2 : ', P2);

StrDispose(P2);

WriteLn ('After StrDispose : Memory available : ', **MemAvail**);

end.

StrECopy

Declaration: `Function StrECopy (Dest,Source : PChar) : PChar;`

Description: Copies the Null-terminated string in Source to Dest, and returns a pointer to the end (i.e. the terminating Null-character) of the copied string.

Errors: No length checking is performed.

See also: `StrLCopy (394)`, `StrCopy (390)`

Listing: stringex/ex6.pp

Program Example6;

Uses strings;

{ Program to demonstrate the StrECopy function. }

Const P : PChar = 'This is a PCHAR string.';

Var PP : PChar;

begin

 PP:=**StrAlloc** (**StrLen**(P)+1);

If **Longint**(**StrECopy**(PP,P))–**Longint**(PP)<>**StrLen**(P) **then**

WriteLn('Something is wrong here !')

```
    else
      Writeln ( 'PP= ',PP);
end.
```

StrEnd

Declaration: `Function StrEnd (P : PChar) : PChar;`

Description: Returns a pointer to the end of P. (i.e. to the terminating null-character.)

Errors: None.

See also: [StrLen \(394\)](#)

Listing: stringex/ex7.pp

```
Program Example6;

Uses strings;

{ Program to demonstrate the StrEnd function. }

Const P : PChar = 'This is a PCHAR string.';

begin
  If Longint(StrEnd(P)) - Longint(P) <> StrLen(P) then
    Writeln ('Something is wrong here !')
  else
    Writeln ('All is well..');
end.
```

StrIComp

Declaration: `Function StrIComp (S1,S2 : PChar) : Longint;`

Description: Compares the null-terminated strings S1 and S2, ignoring case. The result is

- A negative Longint when S1 < S2.
- 0 when S1 = S2.
- A positive Longint when S1 > S2.

Errors: None.

See also: [StrLComp \(393\)](#), [StrComp \(390\)](#), [StrLIComp \(395\)](#)

Listing: stringex/ex8.pp

```
Program Example8;

Uses strings;

{ Program to demonstrate the StrLComp function. }

Const P1 : PChar = 'This is the first string.';
      P2 : PChar = 'This is the second string.';
```

```

Var L : Longint;

begin
  Write ( 'P1 and P2 are ');
  If StrComp (P1,P2)<>0 then write ( 'NOT ');
  write ( 'equal. The first ');
  L:=1;
  While StrLComp(P1,P2,L)=0 do inc (L);
  dec(L);
  Writeln (L, ' characters are the same. ');
end.

```

StrLCat

Declaration: `Function StrLCat (Dest,Source : PChar; MaxLen : Longint) : PChar;`

Description: Adds MaxLen characters from Source to Dest, and adds a terminating null-character. Returns Dest.

Errors: None.

See also: StrCat ([389](#))

Listing: stringex/ex12.pp

Program Example12;

Uses strings;

{ Program to demonstrate the StrLCat function. }

Const P1 : PChar = '1234567890';

Var P2 : PChar;

```

begin
  P2:=StrAlloc (StrLen(P1)*2+1);
  P2^:=#0; { Zero length }
  StrCat (P2,P1);
  StrLCat (P2,P1,5);
  Writeln ( 'P2 = ',P2);
end.

```

StrLComp

Declaration: `Function StrLComp (S1,S2 : PChar; L : Longint) : Longint;`

Description: Compares maximum L characters of the null-terminated strings S1 and S2. The result is

- A negative Longint when S1<S2.
- 0 when S1=S2.
- A positive Longint when S1>S2.

Errors: None.

See also: StrComp ([390](#)), StrlComp ([392](#)), StrLIComp ([395](#))

Listing: stringex/ex8.pp

```
Program Example8;

Uses strings;

{ Program to demonstrate the StrLComp function. }

Const P1 : PChar = 'This is the first string.';
        P2 : PChar = 'This is the second string.';

Var L : Longint;

begin
  Write ( 'P1 and P2 are ');
  If StrComp (P1,P2)<>0 then write ( 'NOT ');
  write ( 'equal. The first ');
  L:=1;
  While StrLComp(P1,P2,L)=0 do inc (L);
  dec(L);
  Writeln (L, ' characters are the same. ');
end.
```

StrLCopy

Declaration: Function StrLCopy (Dest,Source : PChar; MaxLen : Longint) : PChar;

Description: Copies MaxLen characters from Source to Dest, and makes Dest a null terminated string.

Errors: No length checking is performed.

See also: StrCopy ([390](#)), StrECopy ([391](#))

Listing: stringex/ex5.pp

```
Program Example5;

Uses strings;

{ Program to demonstrate the StrLCopy function. }

Const P : PChar = '123456789ABCDEF';

var PP : PChar;

begin
  PP:= StrAlloc(11);
  Writeln ( 'First 10 characters of P : ',StrLCopy (PP,P,10));
end.
```

StrLen

Declaration: Function StrLen (p : PChar) : Longint;

Description: Returns the length of the null-terminated string P.

Errors: None.

See also: `Length()`

Listing: `stringex/ex1.pp`

```

Program Example1;

Uses strings;

{ Program to demonstrate the StrLen function. }

Const P : PChar = 'This is a constant pchar string';

begin
  WriteLn ( 'P          : ',P);
  WriteLn ( 'length(P) : ',StrLen(P));
end.

```

StrLIComp

Declaration: `Function StrLIComp (S1,S2 : PChar; L : Longint) : Longint;`

Description: Compares maximum L characters of the null-terminated strings S1 and S2, ignoring case. The result is

- A negative `Longint` when $S1 < S2$.
- 0 when $S1 = S2$.
- A positive `Longint` when $S1 > S2$.

Errors: None.

See also: `StrLComp` (393), `StrComp` (390), `StrIComp` (392)

For an example, see `StrIComp` (392)

StrLower

Declaration: `Function StrLower (P : PChar) : PChar;`

Description: Converts P to an all-lowercase string. Returns P.

Errors: None.

See also: `UpCase()`, `StrUpper` (399)

Listing: `stringex/ex14.pp`

```

Program Example14;

Uses strings;

{ Program to demonstrate the StrLower and StrUpper functions. }

Const
  P1 : PChar = 'THIS IS AN UPPERCASE PCHAR STRING';
  P2 : PChar = 'this is a lowercase string';

```

```
begin
  Writeln ( 'Uppercase : ', StrUpper(P2));
  StrLower (P1);
  Writeln ( 'Lowercase : ',P1);
end.
```

StrMove

Declaration: Function StrMove (Dest,Source : PChar; MaxLen : Longint) : PChar;

Description: Copies MaxLen characters from Source to Dest. No terminating null-character is copied. Returns Dest.

Errors: None.

See also: StrLCopy ([394](#)), StrCopy ([390](#))

Listing: stringex/ex10.pp

```
Program Example10;

Uses strings;

{ Program to demonstrate the StrMove function. }

Const P1 : PCHAR = 'This is a pchar string.';

Var P2 : Pchar;

begin
  P2:= StrAlloc (StrLen(P1)+1);
  StrMove (P2,P1,StrLen(P1)+1); { P2:=P1 }
  Writeln ( 'P2 = ',P2);
end.
```

StrNew

Declaration: Function StrNew (P : PChar) : PChar;

Description: Copies P to the Heap, and returns a pointer to the copy.

Errors: Returns Nil if no memory was available for the copy.

See also: New (), StrCopy ([390](#)), StrDispose ([391](#))

Listing: stringex/ex16.pp

```
Program Example16;

Uses strings;

{ Program to demonstrate the StrNew function. }

Const P1 : PChar = 'This is a PChar string';
```

```
var P2 : PChar;

begin
  P2:=StrNew (P1);
  If P1=P2 then
    writeln ('This can''t be happening...')
  else
    writeln ('P2 : ',P2);
end.
```

StrPas

Declaration: `Function StrPas (P : PChar) : String;`

Description: Converts a null terminated string in P to a Pascal string, and returns this string. The string is truncated at 255 characters.

Errors: None.

See also: [StrPCopy \(397\)](#)

Listing: `stringex/ex3.pp`

```
Program Example3;

Uses strings;

{ Program to demonstrate the StrPas function. }

Const P : PChar = 'This is a PCHAR string';

var S : string;

begin
  S:=StrPas (P);
  Writeln ('S : ',S);
end.
```

StrPCopy

Declaration: `Function StrPCopy (Dest : PChar; Const Source : String) : PChar;`

Description: Converts the Pascal string in Source to a Null-terminated string, and copies it to Dest. Dest needs enough room to contain the string Source, i.e. `Length(Source)+1` bytes.

Errors: No length checking is performed.

See also: [StrPas \(397\)](#)

Listing: `stringex/ex2.pp`

```
Program Example2;

Uses strings;

{ Program to demonstrate the StrPCopy function. }
```

```

Const S = 'This is a normal string.';

Var P : Pchar;

begin
  p:= StrAlloc (length(S)+1);
  if StrPCopy (P,S)<>P then
    WriteLn ('This is impossible !!')
  else
    writeLn (P);
end.

```

StrPos

Declaration: `Function StrPos (S1,S2 : PChar) : PChar;`

Description: Returns a pointer to the first occurrence of S2 in S1. If S2 does not occur in S1, returns Nil.

Errors: None.

See also: `Pos ()`, `StrScan (398)`, `StrRScan (398)`

Listing: stringex/ex15.pp

Program Example15;

Uses strings;

{ Program to demonstrate the StrPos function. }

```

Const P : PChar = 'This is a PChar string.';
        S : Pchar = 'is';

```

```

begin
  WriteLn ('Position of ''is'' in P : ',longint(StrPos(P,S))–Longint(P));
end.

```

StrRScan

Declaration: `Function StrRScan (P : PChar; C : Char) : PChar;`

Description: Returns a pointer to the last occurrence of the character C in the null-terminated string P. If C does not occur, returns Nil.

Errors: None.

See also: `Pos ()`, `StrScan (398)`, `StrPos (398)`

For an example, see `StrScan (398)`.

StrScan

Declaration: `Function StrScan (P : PChar; C : Char) : PChar;`

Description: Returns a pointer to the first occurrence of the character C in the null-terminated string P. If C does not occur, returns Nil.

Errors: None.

See also: [Pos \(\)](#), [StrRScan \(398\)](#), [StrPos \(398\)](#)

Listing: stringex/ex13.pp

Program Example13;

Uses strings;

{ Program to demonstrate the StrScan and StrRScan functions. }

Const P : PChar = 'This is a PCHAR string.';
S : Char = 's' ;

begin

WriteLn ('P, starting from first 's' : ', **StrScan**(P,s));

WriteLn ('P, starting from last 's' : ', **StrRScan**(P,s));

end.

StrUpper

Declaration: `Function StrUpper (P : PChar) : PChar;`

Description: Converts P to an all-uppercase string. Returns P.

Errors: None.

See also: [Uppcase \(\)](#), [StrLower \(395\)](#)

For an example, see [StrLower \(395\)](#)

Chapter 22

The SYSUTILS unit.

This chapter describes the `sysutils` unit. The `sysutils` unit was largely written by Gertjan Schouten, and completed by Michaël Van Canneyt. It aims to be compatible to the Delphi `sysutils` unit, but in contrast with the latter, it is designed to work on multiple platforms. It is implemented on all supported platforms.

This chapter starts out with a definition of all types and constants that are defined, followed by an overview of functions grouped by functionality, and lastly the complete explanation of each function.

22.1 Constants and types

The following general-purpose types are defined:

```
tfilename = string;

tsyscharset = set of char;
tintegerset = set of 0..sizeof(integer)*8-1;

longrec = packed record
    lo,hi : word;
end;

wordrec = packed record
    lo,hi : byte;
end;

TMethod = packed record
    Code, Data: Pointer;
end;
```

The use and meaning of these types should be clear, so no extra information will be provided here.

The following general-purpose constants are defined:

```
const
    SecsPerDay = 24 * 60 * 60; // Seconds and milliseconds per day
    MSecsPerDay = SecsPerDay * 1000;
    DateDelta = 693594; // Days between 1/1/0001 and 12/31/1899
    Eoln = #10;
```

The following types are used frequently in date and time functions. They are the same on all platforms.

```

type
  TSystemTime = record
    Year, Month, Day: word;
    Hour, Minute, Second, MilliSecond: word;
  end ;

  TDateTime = double;

  TTimeStamp = record
    Time: integer;   { Number of milliseconds since midnight }
    Date: integer;   { One plus number of days since 1/1/0001 }
  end ;

```

The following type is used in the [FindFirst \(437\)](#), [FindNext \(438\)](#) and [FindClose \(437\)](#) functions. The win32 version differs from the other versions. If code is to be portable, that part shouldn't be used.

```

Type
  THandle = Longint;
  TSearchRec = Record
    Time, Size, Attr : Longint;
    Name : TFileName;
    ExcludeAttr : Longint;
    FindHandle : THandle;
    {$ifdef Win32}
    FindData : TWin32FindData;
    {$endif}
  end;

```

The following constants are file-attributes that need to be matched in the [findfirst](#) call.

```

Const
  faReadOnly    = $00000001;
  faHidden      = $00000002;
  faSysFile     = $00000004;
  faVolumeId    = $00000008;
  faDirectory   = $00000010;
  faArchive     = $00000020;
  faAnyFile     = $0000003f;

```

The following constants can be used in the [FileOpen \(434\)](#) call.

```

Const
  fmOpenRead    = $0000;
  fmOpenWrite   = $0001;
  fmOpenReadWrite = $0002;

```

The following constants can be used in the [FileSeek \(435\)](#) call.

```

Const
  fsFromBeginning = 0;

```

```

fsFromCurrent    = 1;
fsFromEnd       = 2;

```

The following variables are used in the case translation routines.

```

type
  TCaseTranslationTable = array[0..255] of char;
var
  UpperCaseTable: TCaseTranslationTable;
  LowerCaseTable: TCaseTranslationTable;

```

The initialization code of the `sysutils` unit fills these tables with the appropriate values. For the win32 and go32v2 versions, this information is obtained from the operating system.

The following constants control the formatting of dates. For the Win32 version of the `sysutils` unit, these constants are set according to the internationalization settings of Windows by the initialization code of the unit.

```

Const
  DateSeparator: char = '-';
  ShortDateFormat: string = 'd/m/y';
  LongDateFormat: string = 'dd" "mmmmmm" "yyyy';
  ShortMonthNames: array[1..12] of string[128] =
    ('Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun',
     'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec');
  LongMonthNames: array[1..12] of string[128] =
    ('January', 'February', 'March', 'April',
     'May', 'June', 'July', 'August',
     'September', 'October', 'November', 'December');
  ShortDayNames: array[1..7] of string[128] =
    ('Sun', 'Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat');
  LongDayNames: array[1..7] of string[128] =
    ('Sunday', 'Monday', 'Tuesday', 'Wednesday',
     'Thursday', 'Friday', 'Saturday');

```

The following constants control the formatting of times. For the Win32 version of the `sysutils` unit, these constants are set according to the internationalization settings of Windows by the initialization code of the unit.

```

Const
  ShortTimeFormat: string = 'hh:nn';
  LongTimeFormat: string = 'hh:nn:ss';
  TimeSeparator: char = ':';
  TimeAMString: string[7] = 'AM';
  TimePMString: string[7] = 'PM';

```

The following constants control the formatting of currencies and numbers. For the Win32 version of the `sysutils` unit, these constants are set according to the internationalization settings of Windows by the initialization code of the unit.

```

Const
  DecimalSeparator : Char = '.';
  ThousandSeparator : Char = ',';
  CurrencyDecimals : Byte = 2;

```

```

CurrencyString : String[7] = '$';
{ Format to use when formatting currency :
  0 = $1          1 = 1$          2 = $ 1          3 = 1 $
  4 = Currency string replaces decimal indicator.
      e.g. 1$50
}
CurrencyFormat : Byte = 1;
{ Same as above, only for negative currencies:
  0 = ($1)
  1 = -$1
  2 = $-1
  3 = $1-
  4 = (1$)
  5 = -1$
  6 = 1-$
  7 = 1$-
  8 = -1 $
  9 = -$ 1
  10 = $ 1-
}
NegCurrFormat : Byte = 5;

```

The following types are used in various string functions.

```

type
  PString = ^String;
  TFloatFormat = (ffGeneral, ffExponent, ffFixed, ffNumber, ffCurrency);

```

The following constants are used in the file name handling routines. Do not use a slash or backslash character directly as a path separator; instead use the `OsDirSeparator` character.

```

Const
  DirSeparators : set of char = ['/', '\'];
{$ifdef unix}
  OsDirSeparator = '/';
{$else}
  OsDirSeparator = '\';
{$endif}

```

22.2 Function list by category

What follows is a listing of the available functions, grouped by category. For each function there is a reference to the page where you can find the function.

String functions

Functions for handling strings.

Name	Description	Page
<code>AnsiCompareStr</code>	Compare two strings	443
<code>AnsiCompareText</code>	Compare two strings, case insensitive	444

AnsiExtractQuotedStr	Removes quotes from string	445
AnsiLastChar	Get last character of string	445
AnsiLowerCase	Convert string to all-lowercase	446
AnsiQuotedStr	Quotes a string	446
AnsiStrComp	Compare strings case-sensitive	446
AnsiStrIComp	Compare strings case-insensitive	447
AnsiStrLComp	Compare L characters of strings case sensitive	449
AnsiStrLComp	Compare L characters of strings case insensitive	449
AnsiStrLastChar	Get last character of string	448
AnsiStrLower	Convert string to all-lowercase	450
AnsiStrUpper	Convert string to all-uppercase	451
AnsiUpperCase	Convert string to all-uppercase	452
AppendStr	Append 2 strings	452
AssignStr	Assign value of strings on heap	453
CompareStr	Compare two strings case sensitive	454
CompareText	Compare two strings case insensitive	455
DisposeStr	Remove string from heap	456
IsValidIdent	Is string a valid pascal identifier	468
LastDelimiter	Last occurrence of character in a string	468
LeftStr	Get first N characters of a string	469
LoadStr	Load string from resources	469
LowerCase	Convert string to all-lowercase	469
NewStr	Allocate new string on heap	470
RightStr	Get last N characters of a string	470
StrAlloc	Allocate memory for string	441
StrBufSize	Reserve memory for a string	441
StrDispose	Remove string from heap	441
StrPas	Convert PChar to pascal string	442
StrPCopy	Copy pascal string	442
StrPLCopy	Copy N bytes of pascal string	442
UpperCase	Convert string to all-uppercase	477

Formatting strings

Functions for formatting strings.

Name	Description	Page
AdjustLineBreaks	Convert line breaks to line breaks for system	442
FormatBuf	Format a buffer	465
Format	Format arguments in string	459
FmtStr	Format buffer	459

QuotedStr	Quote a string	470
StrFmt	Format arguments in a string	471
StrLFmt	Format maximum L characters in a string	471
TrimLeft	Remove whitespace at the left of a string	476
TrimRight	Remove whitespace at the right of a string	476
Trim	Remove whitespace at both ends of a string	475

File input/output routines

Functions for reading/writing to file.

Name	Description	Page
FileCreate	Create a file and return handle	431
FileOpen	Open file end return handle	434
FileRead	Read from file	434
FileSeek	Set file position	435
FileTruncate	Truncate file length	436
FileWrite	Write to file	437
FileClose	Close file handle	431

File handling routines

Functions for file manipulation.

Name	Description	Page
AddDisk	Add sisk to list of disk drives	422
ChangeFileExt	Change extension of file name	425
CreateDir	Create a directory	423
DeleteFile	Delete a file	426
DiskFree	Free space on disk	423
DiskSize	Total size of disk	424
ExpandFileName	Create full file name	427
ExpandUNCFileName	Create full UNC file name	427
ExtractFileDir	Extract directory part of filename	428
ExtractFileDrive	Extract drive part of filename	428
ExtractFileExt	Extract extension part of filename	429
ExtractFileName	Extract name part of filename	429
ExtractFilePath	Extrct path part of filename	429
ExtractRelativePath	Construct relative path between two files	429
FileAge	Return file age	430
FileDateToDateTime	Convert file date to system date	415
FileExists	Determine whether a file exists on disk	432

FileGetAttr	Get attributes of file	432
FileGetDate	Get date of last file modification	433
FileSearch	Search for file in path	435
FileSetAttr	Get file attributes	436
FileSetDate	Get file dates	436
FindFirst	Start finding a file	437
FindNext	Find next file	438
GetCurrentDir	Return current working directory	424
RemoveDir	Remove a directory from disk	425
RenameFile	Rename a file on disk	439
SetCurrentDir	Set current working directory	425
SetDirSeparators	Set directory separator characters	439
FindClose	Stop searching a file	437
DoDirSeparators	Replace directory separator characters	426

Date/time routines

Functions for date and time handling.

Name	Description	Page
DateTimeToFileDate	Convert DateTime type to file date	409
DateTimeToStr	Construct string representation of DateTime	409
DateTimeToString	Construct string representation of DateTime	410
DateTimeToSystemTime	Convert DateTime to system time	411
DateTimeToTimeStamp	Convert DateTime to timestamp	411
DateToStr	Construct string representation of date	412
Date	Get current date	408
DayOfWeek	Get day of week	412
DecodeDate	Decode DateTime to year month and day	413
DecodeTime	Decode DateTime to hours, minutes and seconds	413
EncodeDate	Encode year, day and month to DateTime	414
EncodeTime	Encode hours, minutes and seconds to DateTime	414
FormatDateTime	Return string representation of DateTime	415
IncMonth	Add 1 to month	416
IsLeapYear	Determine if year is leap year	416
MSecsToTimeStamp	Convert nr of milliseconds to timestamp	417
Now	Get current date and time	418
StrToDateTime	Convert string to DateTime	419
StrToDate	Convert string to date	418
StrToTime	Convert string to time	419
SystemTimeToDateTime	Convert system time to datetime	420

TimeStampToDateTime	Convert time stamp to DateTime	421
TimeStampToMSecs	Convert Timestamp to number of milliseconds	421
TimeToStr	return string representation of Time	422
Time	Get current tyme	420

22.3 Miscellaneous conversion routines

Functions for various conversions.

Name	Description	Page
BCDToInt	Convert BCD number to integer	453
CompareMem	Compare two memory regions	454
FloatToStrF	Convert float to formatted string	457
FloatToStr	Convert float to string	456
FloatToText	Convert float to string	458
FormatFloat	Format a floating point value	465
GetDirs	Split string in list of directories	438
IntToHex	return hexadecimal representation of integer	466
IntToStr	return decumal representation of integer	467
StrToIntDef	Convert string to integer with default value	473
StrToInt	Convert string to integer	473
StrToFloat	Convert string to float	472
TextToFloat	Convert null-terminated string to float	474

22.4 Date and time functions

Date and time formatting characters

Various date and time formatting routines accept a format string, to format the date and or time. The following characters can be used to control the date and time formatting:

c : shortdateformat + ' ' + shorttimeformat

d : day of month

dd : day of month (leading zero)

ddd : day of week (abbreviation)

dddd : day of week (full)

dddddd : shortdateformat

ddddddd : longdateformat

m : month

mm : month (leading zero)

mmm : month (abbreviation)
mmmm : month (full)
y : year (four digits)
yy : year (two digits)
yyyy : year (with century)
h : hour
hh : hour (leading zero)
n : minute
nn : minute (leading zero)
s : second
ss : second (leading zero)
t : shorttimeformat
tt : longtimeformat
am/pm : use 12 hour clock and display am and pm accordingly
a/p : use 12 hour clock and display a and p accordingly
/ : insert date separator
: : insert time separator
"xx" : literal text
'xx' : literal text

TDateTime

Declaration: `TDateTime = Double;`

Description: Many functions return or require a `TDateTime` type, which contains a date and time in encoded form. The date and time are converted to a double as follows:

- The date part is stored in the integer part of the double as the number of days passed since January 1, 1900.
- The time part is stored in the fractional part of the double, as the number of milliseconds passed since midnight (00:00), divided by the total number of milliseconds in a day.

Date

Declaration: `Function Date: TDateTime;`

Description: `Date` returns the current date in `TDateTime` format. For more information about the `TDateTime` type, see [TDateTime \(408\)](#).

Errors: None.

See also: [Time \(420\)](#), [Now \(418\)](#), [TDateTime \(408\)](#).

Listing: sysutex/ex1.pp

```
Program Example1;  
  
{ This program demonstrates the Date function }  
  
uses sysutils;  
  
Var YY,MM,DD : Word;  
  
Begin  
  WriteLn ( 'Date : ',Date );  
  DecodeDate ( Date,YY,MM,DD);  
  WriteLn ( format ( 'Date is (DD/MM/YY): %d/%d/%d ',[dd,mm,yy] ));  
End.
```

DateTimeToFileDate

Declaration: `Function DateTimeToFileDate(DateTime : TDateTime) : Longint;`

Description: `DateTimeToFileDate` function converts a date/time indication in `TDateTime` format to a filedate function, such as returned for instance by the `FileAge` (430) function.

Errors: None.

See also: `Time` (420), `Date` (408), `FileDateToDateTime` (415), `DateTimeToSystemTime` (411), `Date-TimeToTimeStamp` (411)

Listing: sysutex/ex2.pp

```
Program Example2;  
  
{ This program demonstrates the DateTimeToFileDate function }  
  
Uses sysutils;  
  
Begin  
  WriteLn ( 'FileTime of now would be: ',DateTimeToFileDate (Now));  
End.
```

DateTimeToStr

Declaration: `Function DateTimeToStr(DateTime: TDateTime): string;`

Description: `DateTimeToStr` returns a string representation of `DateTime` using the formatting specified in `ShortDateTimeFormat`. It corresponds to a call to `FormatDateTime('c',DateTime)` (see section 22.4, page 407).

Errors: None.

See also: `FormatDateTime` (415), `TDateTime` (408).

Listing: sysutex/ex3.pp

```
Program Example3;

{ This program demonstrates the DateTimeToStr function }

Uses sysutils;

Begin
  WriteIn ( 'Today is : ', DateTimeToStr(Now));
  WriteIn ( 'Today is : ', FormatDateTime('c',Now));
End.
```

DateTimeToString

Declaration: Procedure DateTimeToString(var Result: string; const FormatStr: string; const DateTime: TDateTime);

Description: DateTimeToString returns in Result a string representation of DateTime using the formatting specified in FormatStr.

for a list of characters that can be used in the FormatStr formatting string, see section 22.4, page 407.

Errors: In case a wrong formatting character is found, an EConvertError is raised.

See also: FormatDateTime (415), section 22.4, page 407.

Listing: sysutex/ex4.pp

```
Program Example4;

{ This program demonstrates the DateTimeToString function }

Uses sysutils;

Procedure today (Fmt : string);

Var S : AnsiString;

begin
  DateTimeToString (S,Fmt,Date);
  WriteIn (S);
end;

Procedure Now (Fmt : string);

Var S : AnsiString;

begin
  DateTimeToString (S,Fmt,Time);
  WriteIn (S);
end;

Begin
  Today ( '"Today is " dddd dd mmmm y ');
  Today ( '"Today is " d mmm yy ');
  Today ( '"Today is " d/mmm/yy ');
```

```
Now ( ' ' 'The time is ' 'am/pmh:n:s' );  
Now ( ' ' 'The time is ' 'hh:nn:ssam/pm' );  
Now ( ' ' 'The time is ' 'tt' );  
End.
```

DateTimeToSystemTime

Declaration: Procedure DateTimeToSystemTime(DateTime: TDateTime; var SystemTime: TSystemTime);

Description: DateTimeToSystemTime converts a date/time pair in DateTime, with TDateTime format to a system time SystemTime.

Errors: None.

See also: DateTimeToFileDate (409), SystemTimeToDateTime (420), DateTimeToTimeStamp (411)

Listing: sysutex/ex5.pp

```
Program Example5;  
  
{ This program demonstrates the DateTimeToSystemTime function }  
  
Uses sysutils;  
  
Var ST : TSystemTime;  
  
Begin  
  DateTimeToSystemTime(Now,ST);  
  With St do  
    begin  
      WriteLn ( 'Today is      ',year,'/',month,'/',Day);  
      WriteLn ( 'The time is ',Hour,':',minute,':',Second,'.',',MilliSecond);  
    end;  
End.
```

DateTimeToTimeStamp

Declaration: Function DateTimeToTimeStamp(DateTime: TDateTime): TTimeStamp;

Description: DateTimeToSystemTime converts a date/time pair in DateTime, with TDateTime format to a TTimeStamp format.

Errors: None.

See also: DateTimeToFileDate (409), SystemTimeToDateTime (420), DateTimeToSystemTime (411)

Listing: sysutex/ex6.pp

```
Program Example6;  
  
{ This program demonstrates the DateTimeToTimeStamp function }  
  
Uses sysutils;  
  
Var TS : TTimeStamp;
```

```
Begin
  TS:=DateTimeToTimeStamp (Now);
  With TS do
    begin
      WriteIn ('Now is ',time,' millisecond past midnight');
      WriteIn ('Today is ',Date,' days past 1/1/0001');
    end;
End.
```

DateToStr

Declaration: `Function DateToStr(Date: TDateTime): string;`

Description: `DateToStr` converts `Date` to a string representation. It uses `ShortDateFormat` as its formatting string. It is hence completely equivalent to a `FormatDateTime('dddd', Date)`.

Errors: None.

See also: [TimeToStr \(422\)](#), [DateTimeToStr \(409\)](#), [FormatDateTime \(415\)](#), [StrToDate \(418\)](#)

Listing: `sysutex/ex7.pp`

```
Program Example7;

{ This program demonstrates the DateToStr function }

Uses sysutils;

Begin
  WriteIn(Format ('Today is: %s',[DateToStr(Date)]));
End.
```

DayOfWeek

Declaration: `Function DayOfWeek(DateTime: TDateTime): integer;`

Description: `DayOfWeek` returns the day of the week from `DateTime`. Sunday is counted as day 1, Saturday is counted as day 7. The result of `DayOfWeek` can serve as an index to the `LongDayNames` constant array, to retrieve the name of the day.

Errors: None.

See also: [Date \(408\)](#), [DateToStr \(412\)](#)

Listing: `sysutex/ex8.pp`

```
Program Example8;

{ This program demonstrates the DayOfWeek function }

Uses sysutils;

Begin
  WriteIn ('Today 's day is ',LongDayNames[DayOfWeek(Date)]);
End.
```

DecodeDate

Declaration: Procedure DecodeDate(Date: TDateTime; var Year, Month, Day: word);

Description: DecodeDate decodes the Year, Month and Day stored in Date, and returns them in the Year, Month and Day variables.

Errors: None.

See also: EncodeDate ([414](#)), DecodeTime ([413](#)).

Listing: sysutex/ex9.pp

Program Example9;

{ This program demonstrates the DecodeDate function }

Uses sysutils;

Var YY,MM,DD : Word;

Begin

 DecodeDate (Date,YY,MM,DD);

 Writeln (Format ('Today is %d/%d/%d' ,[dd,mm,yy]));

End.

DecodeTime

Declaration: Procedure DecodeTime(Time: TDateTime; var Hour, Minute, Second, MilliSecond: word);

Description: DecodeDate decodes the hours, minutes, second and milliseconds stored in Time, and returns them in the Hour, Minute and Second and MilliSecond variables.

Errors: None.

See also: EncodeTime ([414](#)), DecodeDate ([413](#)).

Listing: sysutex/ex10.pp

Program Example10;

{ This program demonstrates the DecodeTime function }

Uses sysutils;

Var HH,MM,SS,MS: Word;

Begin

 DecodeTime (Time,HH,MM,SS,MS);

 Writeln (format ('The time is %d:%d:%d.%d' ,[hh,mm,ss,ms]));

End.

EncodeDate

Declaration: `Function EncodeDate(Year, Month, Day :word): TDateTime;`

Description: `EncodeDate` encodes the `Year`, `Month` and `Day` variables to a date in `TDateTime` format. It does the opposite of the `DecodeDate` (413) procedure.

The parameters must lie within valid ranges (boundaries included):

Year must be between 1 and 9999.

Month must be within the range 1-12.

Day must be between 1 and 31.

Errors: In case one of the parameters is out of its valid range, 0 is returned.

See also: `EncodeTime` (414), `DecodeDate` (413).

Listing: `sysutex/ex11.pp`

Program `Example11;`

{ This program demonstrates the EncodeDate function }

Uses `sysutils;`

Var `YY,MM,DD : Word;`

Begin

`DecodeDate (Date ,YY,MM,DD);`

`WriteLn ('Today is : ',FormatDateTime ('dd mmm yyyy ',EncodeDate(YY,Mm,Dd)));`

End.

EncodeTime

Declaration: `Function EncodeTime(Hour, Minute, Second, MilliSecond:word): TDateTime;`

Description: `EncodeTime` encodes the `Hour`, `Minute`, `Second`, `MilliSecond` variables to a `TDateTime` format result. It does the opposite of the `DecodeTime` (413) procedure.

The parameters must have a valid range (boundaries included):

Hour must be between 0 and 23.

Minute,second must both be between 0 and 59.

Millisecond must be between 0 and 999.

Errors: In case one of the parameters is outside of its valid range, 0 is returned.

See also: `EncodeDate` (414), `DecodeTime` (413).

Listing: `sysutex/ex12.pp`

Program `Example12;`

{ This program demonstrates the EncodeTime function }

Uses `sysutils;`

Var `Hh,MM,SS,MS : Word;`

```
Begin
  DeCodeTime ( Time, Hh, MM, SS, MS);
  WriteLn ( 'Present Time is : ', FormatDateTime ( 'hh:mm:ss ', EncodeTime ( HH, MM, SS, MS)));
End.
```

FileDateToDateTime

Declaration: `Function FileDateToDateTime(Filedate : Longint) : TDateTime;`

Description: `FileDateToDateTime` converts the date/time encoded in `filedate` to a `TDateTime` encoded form. It can be used to convert date/time values returned by the `FileAge` (430) or `FindFirst` (437)/`FindNext` (438) functions to `TDateTime` form.

Errors: None.

See also: `DateTimeToFileDate` (409)

Listing: `sysutex/ex13.pp`

Program `Example13;`

```
{ This program demonstrates the FileDateToDateTime function }
```

Uses `sysutils;`

Var

```
  ThisAge : Longint;
```

Begin

```
  Write ( 'ex13.pp created on : ');
```

```
  ThisAge := FileAge ( 'ex13.pp' );
```

```
  WriteLn ( DateTimeToStr ( FileDateToDateTime ( ThisAge )));
```

End.

FormatDateTime

Declaration: `Function FormatDateTime(FormatStr: string; DateTime: TDateTime):string;`

Description: `FormatDateTime` formats the date and time encoded in `DateTime` according to the formatting given in `FormatStr`. The complete list of formatting characters can be found in section 22.4, page 407.

Errors: On error (such as an invalid character in the formatting string), and `EConvertError` exception is raised.

See also: `DateTimeToStr` (409), `DateToStr` (412), `TimeToStr` (422), `StrToDateTime` (419)

Listing: `sysutex/ex14.pp`

Program `Example14;`

```
{ This program demonstrates the FormatDateTime function }
```

Uses `sysutils;`

```
Var ThisMoment : TDateTime;  
  
Begin  
  ThisMoment:=Now;  
  Writeln ( 'Now : ',FormatDateTime( 'hh:nn',ThisMoment));  
  Writeln ( 'Now : ',FormatDateTime( 'DD MM YYYY',ThisMoment));  
  Writeln ( 'Now : ',FormatDateTime( 'c',ThisMoment));  
End.
```

IncMonth

Declaration: Function IncMonth(const DateTime: TDateTime; NumberOfMonths: integer): TDateTime;

Description: IncMonth increases the month number in DateTime with NumberOfMonths. It wraps the result as to get a month between 1 and 12, and updates the year accordingly. NumberOfMonths can be negative, and can be larger than 12 (in absolute value).

Errors: None.

See also: Date ([408](#)), Time ([420](#)), Now ([418](#))

Listing: sysutex/ex15.pp

Program Example15;

```
{ This program demonstrates the IncMonth function }
```

Uses sysutils;

Var ThisDay : TDateTime;

```
Begin  
  ThisDay:=Date;  
  Writeln ( 'ThisDay : ',DateToStr(ThisDay));  
  Writeln ( '6 months ago : ',DateToStr(IncMonth(ThisDay,-6)));  
  Writeln ( '6 months from now : ',DateToStr(IncMonth(ThisDay,6)));  
  Writeln ( '12 months ago : ',DateToStr(IncMonth(ThisDay,-12)));  
  Writeln ( '12 months from now : ',DateToStr(IncMonth(ThisDay,12)));  
  Writeln ( '18 months ago : ',DateToStr(IncMonth(ThisDay,-18)));  
  Writeln ( '18 months from now : ',DateToStr(IncMonth(ThisDay,18)));  
End.
```

IsLeapYear

Declaration: Function IsLeapYear(Year: Word): boolean;

Description: IsLeapYear returns True if Year is a leap year, False otherwise.

Errors: None.

See also: IncMonth ([416](#)), Date ([408](#))

Listing: sysutex/ex16.pp

```

Program Example16;

{ This program demonstrates the IsLeapYear function }

Uses sysutils;

Var YY,MM,dd : Word;

Procedure TestYear (Y : Word);

begin
  WriteLn (Y,' is leap year : ',IsLeapYear(Y));
end;

Begin
  DeCodeDate (Date ,YY,mm,dd );
  TestYear (yy);
  TestYear (2000);
  TestYear (1900);
  TestYear (1600);
  TestYear (1992);
  TestYear (1995);
End.

```

MSecsToTimeStamp

Declaration: `Function MSecsToTimeStamp(MSecs: Comp): TTimeStamp;`

Description: `MSecsToTimeStamp` converts the given number of milliseconds to a `TTimeStamp` date/time notation.

Use `TTimeStamp` variables if you need to keep very precise track of time.

Errors: None.

See also: `TimeStampToMSecs` ([421](#)), `DateTimeToTimeStamp` ([411](#)),

Listing: sysutex/ex17.pp

```

Program Example17;

{ This program demonstrates the MSecsToTimeStamp function }

Uses sysutils;

Var MS : Comp;
    TS : TTimeStamp;
    DT : TDateTime;

Begin
  TS:=DateTimeToTimeStamp(Now);
  WriteLn ('Now in days since 1/1/0001 : ',TS.Date);
  WriteLn ('Now in millisecs since midnight : ',TS.Time);
  MS:=TimeStampToMSecs(TS);
  WriteLn ('Now in millisecs since 1/1/0001 : ',MS);
  MS:=MS-1000*3600*2;
  TS:=MSecsToTimeStamp(MS);
  DT:=TimeStampToDateTime(TS);

```

```
    WriteLn ( 'Now minus 1 day : ',DateTimeToStr(DT));  
End.
```

Now

Declaration: Function Now: TDateTime;

Description: Now returns the current date and time. It is equivalent to Date+Time.

Errors: None.

See also: Date ([408](#)), Time ([420](#))

Listing: sysutex/ex18.pp

Program Example18;

```
{ This program demonstrates the Now function }
```

Uses sysutils;

Begin

```
    WriteLn ( 'Now : ',DateTimeToStr(Now));  
End.
```

StrToDate

Declaration: Function StrToDate(const S: string): TDateTime;

Description: StrToDate converts the string S to a TDateTime date value. The Date must consist of 1 to three digits, separated by the DateSeparator character. If two numbers are given, they are supposed to form the day and month of the current year. If only one number is given, it is supposed to represent the day of the current month. (This is *not supported in Delphi*)

The order of the digits (y/m/d, m/d/y, d/m/y) is determined from the ShortDateFormat variable.

Errors: On error (e.g. an invalid date or invalid character), an EConvertError exception is raised.

See also: StrToTime ([419](#)), DateToStr ([412](#))n TimeToStr ([422](#)).

Listing: sysutex/ex19.pp

Program Example19;

```
{ This program demonstrates the StrToDate function }
```

Uses sysutils;

Procedure TestStr (S : String);

begin

```
    WriteLn (S, ' : ',DateToStr(StrToDate(S)));  
end;
```

Begin

```
    WriteLn ( 'ShortDateFormat ',ShortDateFormat );
```

```
TestStr( DateTimeToStr( Date ));
TestStr( '05/05/1999' );
TestStr( '5/5' );
TestStr( '5' );
End.
```

StrToDateTime

Declaration: `Function StrToDateTime(const S: string): TDateTime;`

Description: `StrToDateTime` converts the string `S` to a `TDateTime` date and time value. The Date must consist of 1 to three digits, separated by the `DateSeparator` character. If two numbers are given, they are supposed to form the day and month of the current year. If only one number is given, it is supposed to represent the day of the current month. (This is *not supported in Delphi*)

The order of the digits (y/m/d, m/d/y, d/m/y) is determined from the ShortDateFormat variable.

Errors: On error (e.g. an invalid date or invalid character), an `EConvertError` exception is raised.

See also: [StrToDate \(418\)](#), [StrToTime \(419\)](#), [DateTimeToStr \(409\)](#)

Listing: `sysutex/ex20.pp`

Program `Example20;`

```
{ This program demonstrates the StrToDateTime function }
```

Uses `sysutils;`

Procedure `TestStr (S : String);`

```
begin
  WriteLn ( S, ' : ', DateTimeToStr( StrToDateTime( S ) ) );
end;
```

Begin

```
  WriteLn ( 'ShortDateFormat ', ShortDateFormat );
  TestStr ( DateTimeToStr( Now ) );
  TestStr ( '05-05-1999 15:50' );
  TestStr ( '5-5 13:30' );
  TestStr ( '5 1:30PM' );
```

End.

StrToTime

Declaration: `Function StrToTime(const S: string): TDateTime;`

Description: `StrToTime` converts the string `S` to a `TDateTime` time value. The time must consist of 1 to 4 digits, separated by the `TimeSeparator` character. If two numbers are given, they are supposed to form the hour and minutes.

Errors: On error (e.g. an invalid date or invalid character), an `EConvertError` exception is raised.

See also: [StrToDate \(418\)](#), [StrToDateTime \(419\)](#), [TimeToStr \(422\)](#)

Listing: sysutex/ex21.pp

Program Example21;

{ This program demonstrates the StrToTime function }

Uses sysutils;

Procedure TestStr (S : **String**);

begin

Writeln (S, ' : ', **TimeToStr**(**StrToTime**(S)));
end;

Begin

teststr (**TimeToStr**(**Time**));
 teststr ('12:00');
 teststr ('15:30');
 teststr ('3:30PM');

End.

SystemTimeToDateTime

Declaration: Function SystemTimeToDateTime(const SystemTime: TSystemTime): TDateTime;

Description: SystemTimeToDateTime converts a TSystemTime record to a TDateTime style date/time indication.

Errors: None.

See also: [DateTimeToSystemTime \(411\)](#)

Listing: sysutex/ex22.pp

Program Example22;

{ This program demonstrates the SystemTimeToDateTime function }

Uses sysutils;

Var ST : TSystemTime;

Begin

DateTimeToSystemTime(**Now**, ST);

With St **do**

begin

Writeln ('Today is ', year, '/', month, '/', Day);

Writeln ('The time is ', Hour, ':', minute, ':', Second, '.', MilliSecond);

end;

Writeln ('Converted : ', **DateTimeToStr**(**SystemTimeToDateTime**(ST)));

End.

Time

Declaration: Function Time: TDateTime;

Description: `Time` returns the current time in `TDateTime` format. The date part of the `TDateTimeValue` is set to zero.

Errors: None.

See also: `Now` (418), `Date` (408)

Listing: `sysutex/ex23.pp`

Program `Example23`;

{ This program demonstrates the Time function }

Uses `sysutils`;

Begin

WriteLn ('The time is : ', `TimeToStr(Time)`);

End.

TimeStampToDateTime

Declaration: `Function TimeStampToDateTime(const TimeStamp: TTimeStamp): TDateTime;`

Description: `TimeStampToDateTime` converts `TimeStamp` to a `TDateTime` format variable. It is the inverse operation of `DateTimeToTimeStamp` (411).

Errors: None.

See also: `DateTimeToTimeStamp` (411), `TimeStampToMSecs` (421)

Listing: `sysutex/ex24.pp`

Program `Example24`;

{ This program demonstrates the TimeStampToDateTime function }

Uses `sysutils`;

Var `TS` : `TTimeStamp`;

`DT` : `TDateTime`;

Begin

`TS:=DateTimeToTimeStamp (Now);`

With `TS` **do**

begin

WriteLn ('Now is ', `time`, ' millisecond past midnight');

WriteLn ('Today is ', `Date`, ' days past 1/1/0001');

end;

`DT:=TimeStampToDateTime(TS);`

WriteLn ('Together this is : ', `DateTimeToStr(DT)`);

End.

TimeStampToMSecs

Declaration: `Function TimeStampToMSecs(const TimeStamp: TTimeStamp): comp;`

Description: `TimeStampToMSecs` converts `TimeStamp` to the number of seconds since 1/1/0001.

Use `TTimeStamp` variables if you need to keep very precise track of time.

Errors: None.

See also: `MSecsToTimeStamp` (417), `TimeStampToDateTime` (421)

For an example, see `MSecsToTimeStamp` (417).

TimeToStr

Declaration: `Function TimeToStr(Time: TDateTime): string;`

Description: `TimeToStr` converts the time in `Time` to a string. It uses the `ShortTimeFormat` variable to see what formatting needs to be applied. It is therefore entirely equivalent to a `FormatDateTime('t', Time)` call.

Errors: None.

See also:

Listing: `sysutex/ex25.pp`

Program `Example25;`

{ This program demonstrates the TimeToStr function }

Uses `sysutils;`

Begin

`WriteLn ('The current time is : ', TimeToStr (Time));`

End.

22.5 Disk functions

AddDisk (Linux only)

Declaration: `Function AddDisk (Const Path : String) : Longint;`

Description: On Linux both the `DiskFree` (45) and `DiskSize` (46) functions need a file on the specified drive, since `is` is required for the `statfs` system call.

These filenames are set in `drivestr[0..26]`, and the first 4 have been preset to :

Disk 0 ' .' default drive - hence current directory is used.

Disk 1 ' /fd0/ .' floppy drive 1.

Disk 2 ' /fd1/ .' floppy drive 2.

Disk 3 ' / C: equivalent of DOS is the root partition.

Drives 4..26 can be set by your own applications with the `AddDisk` call.

The `AddDisk` call adds `Path` to the names of drive files, and returns the number of the disk that corresponds to this drive. If you add more than 21 drives, the count is wrapped to 4.

Errors: None.

See also: `DiskFree` (423), `DiskSize` (424)

CreateDir

Declaration: `Function CreateDir(Const NewDir : String) : Boolean;`

Description: `CreateDir` creates a new directory with name `NewDir`. If the directory doesn't contain an absolute path, then the directory is created below the current working directory.

The function returns `True` if the directory was successfully created, `False` otherwise.

Errors: In case of an error, the function returns `False`.

See also: [RemoveDir \(425\)](#)

Listing: `sysutex/ex26.pp`

Program `Example26;`

```
{ This program demonstrates the CreateDir and RemoveDir functions }  
{ Run this program twice in the same directory }
```

Uses `sysutils;`

Begin

```
  If Not FileExists ('NewDir') then  
    If Not CreateDir ('NewDir') Then  
      WriteLn ('Failed to create directory !')  
    else  
      WriteLn ('Created "NewDir" directory')  
  Else  
    If Not RemoveDir ('NewDir') Then  
      WriteLn ('Failed to remove directory !')  
    else  
      WriteLn ('Removed "NewDir" directory');
```

End.

DiskFree

Declaration: `Function DiskFree(Drive : Byte) : Int64;`

Description: `DiskFree` returns the free space (in bytes) on disk `Drive`. `Drive` is the number of the disk drive:

0for the current drive.

1for the first floppy drive.

2for the second floppy drive.

3for the first hard-disk partition.

4-26for all other drives and partitions.

Remark Under LINUX, and Unix in general, the concept of disk is different than the DOS one, since the filesystem is seen as one big directory tree. For this reason, the `DiskFree` and `DiskSize` ([46](#)) functions must be mimicked using filenames that reside on the partitions. For more information, see [AddDisk \(422\)](#)

Errors: On error, `-1` is returned.

See also: [DiskSize \(424\)](#), [AddDisk \(422\)](#)

Listing: `sysutex/ex27.pp`

```
Program Example27;  
  
{ This program demonstrates the DiskFree function }  
  
Uses sysutils;  
  
Begin  
  Write ( 'Size of current disk      : ', DiskSize(0));  
  Writeln ( ' (= ', DiskSize(0) div 1024, 'k) ' );  
  Write ( 'Free space of current disk : ', Diskfree(0));  
  Writeln ( ' (= ', Diskfree(0) div 1024, 'k) ' );  
End.
```

DiskSize

Declaration: `Function DiskSize(Drive : Byte) : Int64;`

Description: `DiskSize` returns the size (in bytes) of disk `Drive`. `Drive` is the number of the disk drive:

- 0**for the current drive.
- 1**for the first floppy drive.
- 2**for the second floppy drive.
- 3**for the first hard-disk parttion.
- 4-26**for all other drives and partitions.

Remark Under LINUX, and Unix in general, the concept of disk is different than the DOS one, since the filesystem is seen as one big directory tree. For this reason, the `DiskFree` (45) and `DiskSize` functions must be mimicked using filenames that reside on the partitions. For more information, see `AddDisk` (422)

Errors: On error, -1 is returned.

See also: `DiskFree` (423), `AddDisk` (422)

For an example, see `DiskFree` (423).

GetCurrentDir

Declaration: `Function GetCurrentDir : String;`

Description: `GetCurrentDir` returns the current working directory.

Errors: None.

See also: `SetCurrentDir` (425), `DiskFree` (45), `DiskSize` (46)

Listing: `sysutex/ex28.pp`

```
Program Example28;  
  
{ This program demonstrates the GetCurrentDir function }  
  
Uses sysutils;
```

```
Begin  
  WriteLn ( 'Current Directory is : ',GetCurrentDir);  
End.
```

RemoveDir

Declaration: `Function RemoveDir(Const Dir : String) : Boolean;`

Description: `RemoveDir` removes directory `Dir` from the disk. If the directory is not absolute, it is appended to the current working directory.

Errors: In case of error (e.g. the directory isn't empty) the function returns `False`. If successful, `True` is returned.

See also:

For an example, see `CreateDir` (423).

SetCurrentDir

Declaration: `Function SetCurrentDir(Const NewDir : String) : Boolean;`

Description: `SetCurrentDir` sets the current working directory of your program to `NewDir`. It returns `True` if the function was successful, `False` otherwise.

Errors: In case of error, `False` is returned.

See also: `GetCurrentDir` (424)

Listing: `sysutex/ex29.pp`

Program `Example29;`

{ This program demonstrates the SetCurrentDir function }

Uses `sysutils;`

```
Begin  
  If SetCurrentDir ( '.. ' ) Then  
    WriteLn ( 'Now in directory ',GetCurrentDir)  
  else  
    WriteLn ( 'Change directory to .. failed. ');  
End.
```

22.6 File handling functions

ChangeFileExt

Declaration: `Function ChangeFileExt(const FileName, Extension: string): string;`

Description: `ChangeFileExt` changes the file extension in `FileName` to `Extension`. The extension `Extension` includes the starting `.` (dot). The previous extension of `FileName` are all characters after the last `.`, the `.` character included.

If `FileName` doesn't have an extension, `Extension` is just appended.

Errors: None.

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#), [ExpandFileName \(427\)](#)

DeleteFile

Declaration: `Function DeleteFile(Const FileName : String) : Boolean;`

Description: `DeleteFile` deletes file `FileName` from disk. The function returns `True` if the file was successfully removed, `False` otherwise.

Errors: On error, `False` is returned.

See also: [FileCreate \(431\)](#), [FileExists \(432\)](#)

Listing: `sysutex/ex31.pp`

Program `Example31;`

{ This program demonstrates the DeleteFile function }

Uses `sysutils;`

Var

`Line : String;`
`F, I : Longint;`

Begin

`F := FileCreate('test.txt');`
`Line := 'Some string line.' #10;`
For `I := 1 to 10 do`
 `FileWrite (F, Line[I], Length(Line));`
 `FileClose(F);`
 `DeleteFile('test.txt');`

End.

DoDirSeparators

Declaration: `Procedure DoDirSeparators(Var FileName : String);`

Description: This function replaces all directory separators ' and '/' to the directory separator character for the current system.

Errors: None.

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#)

Listing: `sysutex/ex32.pp`

Program `Example32;`

{ This program demonstrates the DoDirSeparators function }
{ \$H+ }

Uses `sysutils;`

Procedure `Testit (F : String);`

```
begin
  Writeln ( 'Before : ',F);
  DoDirSeparators (F);
  Writeln ( 'After : ',F);
end;

Begin
  Testit ( GetCurrentDir);
  Testit ( 'c:\pp\bin\win32' );
  Testit ( '/usr/lib/fpc' );
  Testit ( '\usr\lib\fpc' );
End.
```

ExpandFileName

Declaration: `Function ExpandFileName(Const FileName : string): String;`

Description: `ExpandFileName` expands the filename to an absolute filename. It changes all directory separator characters to the one appropriate for the system first.

Errors: None.

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#), [ExtractFileDir \(428\)](#), [ExtractFileDrive \(428\)](#), [ExtractFileExt \(429\)](#), [ExtractRelativePath \(429\)](#)

Listing: `sysutex/ex33.pp`

Program Example33;

{ This program demonstrates the ExpandFileName function }

Uses sysutils;

Procedure Testit (F : **String**);

```
begin
  Writeln (F, ' expands to : ',ExpandFileName(F));
end;
```

```
Begin
  Testit ('ex33.pp');
  Testit (ParamStr(0));
  Testit ('/pp/bin/win32/ppc386');
  Testit ('\pp\bin\win32\ppc386');
  Testit ('. ');
End.
```

ExpandUNCFileName

Declaration: `Function ExpandUNCFileName(Const FileName : string): String;`

Description: `ExpandUNCFileName` runs [ExpandFileName \(427\)](#) on `FileName` and then attempts to replace the driveletter by the name of a shared disk.

Errors:

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#), [ExtractFileDir \(428\)](#), [ExtractFileDrive \(428\)](#), [ExtractFileExt \(429\)](#), [ExtractRelativePath \(429\)](#)

ExtractFileDir

Declaration: `Function ExtractFileDir(Const FileName : string): string;`

Description: `ExtractFileDir` returns only the directory part of `FileName`, not including a driveletter. The directory name has NO ending directory separator, in difference with [ExtractFilePath \(429\)](#).

Errors: None.

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#), [ExtractFileDir \(428\)](#), [ExtractFileDrive \(428\)](#), [ExtractFileExt \(429\)](#), [ExtractRelativePath \(429\)](#)

Listing: `sysutex/ex34.pp`

Program `Example34;`

```
{ This program demonstrates the ExtractFileName function }  
{$H+}
```

```
Uses sysutils;
```

```
Procedure Testit(F : String);
```

```
begin
```

```
  WriteIn ( 'FileName      : ',F);  
  WriteIn ( 'Has Name     : ',ExtractFileName(F));  
  WriteIn ( 'Has Path     : ',ExtractFilePath(F));  
  WriteIn ( 'Has Extension : ',ExtractFileExt(F));  
  WriteIn ( 'Has Directory : ',ExtractFileDir(F));  
  WriteIn ( 'Has Drive    : ',ExtractFileDrive(F));
```

```
end;
```

```
Begin
```

```
  Testit ( Paramstr(0));  
  Testit ( '/usr/local/bin/mysql' );  
  Testit ( 'c:\pp\bin\win32\ppc386.exe' );  
  Testit ( '/pp/bin/win32/ppc386.exe' );
```

```
End.
```

ExtractFileDrive

Declaration: `Function ExtractFileDrive(const FileName: string): string;`

Description: `Extract`

Errors:

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#), [ExtractFileDir \(428\)](#), [ExtractFileDrive \(428\)](#), [ExtractFileExt \(429\)](#), [ExtractRelativePath \(429\)](#)

For an example, see [ExtractFileDir \(428\)](#).

ExtractFileExt

Declaration: `Function ExtractFileExt(const FileName: string): string;`

Description: `ExtractFileExt` returns the extension (including the `.` (dot) character) of `FileName`.

Errors: None.

See also: `ExtractFileName` (429), `ExtractFilePath` (429), `ExtractFileDir` (428), `ExtractFileDrive` (428), `ExtractFileExt` (429), `ExtractRelativePath` (429)

For an example, see `ExtractFileDir` (428).

ExtractFileName

Declaration: `Function ExtractFileName(const FileName: string): string;`

Description: `ExtractFileName` returns the filename part from `FileName`. The filename consists of all characters after the last directory separator character (`'/'` or `'\'`) or drive letter.

The full filename can always be reconstructed by concatenating the result of `ExtractFilePath` (429) and `ExtractFileName`.

Errors: None.

See also: `ExtractFileName` (429), `ExtractFilePath` (429), `ExtractFileDir` (428), `ExtractFileDrive` (428), `ExtractFileExt` (429), `ExtractRelativePath` (429)

For an example, see `ExtractFileDir` (428).

ExtractFilePath

Declaration: `Function ExtractFilePath(const FileName: string): string;`

Description: `ExtractFilePath` returns the path part (including driveletter) from `FileName`. The path consists of all characters before the last directory separator character (`'/'` or `'\'`), including the directory separator itself. In case there is only a drive letter, that will be returned.

The full filename can always be reconstructed by concatenating the result of `ExtractFilePath` and `ExtractFileName` (429).

Errors: None.

See also: `ExtractFileName` (429), `ExtractFilePath` (429), `ExtractFileDir` (428), `ExtractFileDrive` (428), `ExtractFileExt` (429), `ExtractRelativePath` (429)

For an example, see `ExtractFileDir` (428).

ExtractRelativePath

Declaration: `Function ExtractRelativePath(Const BaseName, DestName : String): String;`

Description: `ExtractRelativePath` constructs a relative path to go from `BaseName` to `DestName`. If `DestName` is on another drive (Not on Linux) then the whole `Destname` is returned.

Note: This function does not exist in the Delphi unit.

Errors: None.

See also: [ExtractFileName \(429\)](#), [ExtractFilePath \(429\)](#), [ExtractFileDir \(428\)](#), [ExtractFileDrive \(428\)](#), [ExtractFileExt \(429\)](#),

Listing: sysutex/ex35.pp

Program Example35;

{ This program demonstrates the ExtractRelativePath function }

Uses sysutils;

Procedure Testit (FromDir, ToDir : **String**);

begin

Write ('From "', FromDir, '" to "', ToDir, '" via " ');

Writeln (ExtractRelativePath (FromDir, ToDir), ' ');

end;

Begin

 Testit ('/pp/src/compiler', '/pp/bin/win32/ppc386');

 Testit ('/pp/bin/win32/ppc386', '/pp/src/compiler');

 Testit ('e:/pp/bin/win32/ppc386', 'd:/pp/src/compiler');

 Testit ('e:\pp\bin\win32\ppc386', 'd:\pp\src\compiler');

End.

FileAge

Declaration: Function FileAge(Const FileName : String): Longint;

Description: FileAge returns the last modification time of file FileName. The FileDate format can be transformed to TDateTime format with the FileDateToDateTime ([415](#)) function.

Errors: In case of errors, -1 is returned.

See also: [FileDateToDateTime \(415\)](#), [FileExists \(432\)](#), [FileGetAttr \(432\)](#)

Listing: sysutex/ex36.pp

Program Example36;

{ This program demonstrates the FileAge function }

Uses sysutils;

Var S : TDateTime;

 fa : Longint;

Begin

 fa := FileAge ('ex36.pp');

If Fa <> -1 **then**

begin

 S := FileDateToDateTime (fa);

Writeln ('!' 'm from ', DateTimeToStr (S))

end;

End.

FileClose

Declaration: `Procedure FileClose(Handle : Longint);`

Description: `FileClose` closes the file handle `Handle`. After this call, attempting to read or write from the handle will result in an error.

Errors: None.

See also: [FileCreate \(431\)](#), [FileWrite \(437\)](#), [FileOpen \(434\)](#), [FileRead \(434\)](#), [FileTruncate \(436\)](#), [FileSeek \(435\)](#)

For an example, see [FileCreate \(431\)](#)

FileCreate

Declaration: `Function FileCreate(Const FileName : String) : Longint;`

Description: `FileCreate` creates a new file with name `FileName` on the disk and returns a file handle which can be used to read or write from the file with the [FileRead \(434\)](#) and [FileWrite \(437\)](#) functions.

If a file with name `FileName` already existed on the disk, it is overwritten.

Errors: If an error occurs (e.g. disk full or non-existent path), the function returns -1.

See also: [FileClose \(431\)](#), [FileWrite \(437\)](#), [FileOpen \(434\)](#), [FileRead \(434\)](#), [FileTruncate \(436\)](#), [FileSeek \(435\)](#)

Listing: sysutex/ex37.pp

Program Example37;

{ This program demonstrates the FileCreate function }

Uses sysutils;

Var I,J,F : Longint;

Begin

```

F:=FileCreate ('test.dat');
If F=-1 then
  Halt(1);
For I:=0 to 100 do
  FileWrite(F,I,SizeOf(i));
FileClose(f);
F:=FileOpen ('test.dat',fmOpenRead);
For I:=0 to 100 do
  begin
    FileRead (F,J,SizeOf(J));
    If J<>I then
      WriteLn ('Mismatch at file position ',I)
    end;
  FileSeek(F,0,fsFromBeginning);
  Randomize;
  Repeat
    FileSeek(F,Random(100)*4,fsFromBeginning);
    FileRead (F,J,SizeOf(J));
    WriteLn ('Random read : ',j);
  Until J>80;

```

```
FileClose (F);
F:=FileOpen ('test.dat',fmOpenWrite);
l:=50*SizeOf(Longint);
If FileTruncate(F,l) then
  WriteLn('Successfully truncated file to ',l,' bytes. ');
FileClose(F);
End.
```

FileExists

Declaration: `Function FileExists(Const FileName : String) : Boolean;`

Description: `FileExists` returns `True` if a file with name `FileName` exists on the disk, `False` otherwise.

Errors: None.

See also: [FileAge \(430\)](#), [FileGetAttr \(432\)](#), [FileSetAttr \(436\)](#)

Listing: `sysutex/ex38.pp`

Program `Example38;`

```
{ This program demonstrates the FileExists function }
```

Uses `sysutils;`

Begin

```
  If FileExists (ParamStr(0)) Then
    WriteLn ('All is well, I seem to exist. ');
End.
```

FileGetAttr

Declaration: `Function FileGetAttr(Const FileName : String) : Longint;`

Description: `FileGetAttr` returns the attribute settings of file `FileName`. The attribute is a OR-ed combination of the following constants:

faReadOnlyThe file is read-only.

faHiddenThe file is hidden. (On LINUX, this means that the filename starts with a dot)

faSysFileThe file is a system file (On LINUX, this means that the file is a character, block or FIFO file).

faVolumeIdVolume Label. Not possible under LINUX.

faDirectoryFile is a directory.

faArchivefile is an archive. Not possible on LINUX.

Errors: In case of error, -1 is returned.

See also: [FileSetAttr \(436\)](#), [FileAge \(430\)](#), [FileGetDate \(433\)](#).

Listing: `sysutex/ex40.pp`

```

Program Example40;

{ This program demonstrates the FileGetAttr function }

Uses sysutils;

Procedure Testit (Name : String);

Var F : Longint;

Begin
  F := FileGetAttr(Name);
  If F <> -1 then
    begin
      Writeln ('Testing : ', Name);
      If (F and faReadOnly) <> 0 then
        Writeln ('File is ReadOnly');
      If (F and faHidden) <> 0 then
        Writeln ('File is hidden');
      If (F and faSysFile) <> 0 then
        Writeln ('File is a system file');
      If (F and faVolumeID) <> 0 then
        Writeln ('File is a disk label');
      If (F and faArchive) <> 0 then
        Writeln ('File is artchive file');
      If (F and faDirectory) <> 0 then
        Writeln ('File is a directory');
      end
    else
      Writeln ('Error reading attribites of ', Name);
    end;

  begin
    testit ('ex40.pp');
    testit (ParamStr(0));
    testit ('.');
    testit ('/');
  End.

```

FileGetDate

Declaration: `Function FileGetDate(Handle : Longint) : Longint;`

Description: `FileGetdate` returns the filetime of the opened file with filehandle `Handle`. It is the same as `FileAge` (430), with this difference that `FileAge` only needs the file name, while `FileGetDate` needs an open file handle.

Errors: On error, -1 is returned.

See also: `FileAge` (430)

Listing: `sysutex/ex39.pp`

```

Program Example39;

{ This program demonstrates the FileGetDate function }

```

```
Uses sysutils;  
  
Var F,D : Longint;  
  
Begin  
  F:=FileCreate('test.dat');  
  D:=FileGetDate(D);  
  WriteLn('File created on ',DateTimeToStr(FileDateToDateTime(D)));  
  FileClose(F);  
  DeleteFile('test.dat');  
End.
```

FileOpen

Declaration: `Function FileOpen(Const FileName : string; Mode : Integer) : Longint;`

Description: `FileOpen` opens a file with name `FileName` with mode `Mode`. `Mode` can be one of the following constants:

fmOpenReadThe file is opened for reading.

fmOpenWriteThe file is opened for writing.

fmOpenReadWriteThe file is opened for reading and writing.

If the file has been successfully opened, it can be read from or written to (depending on the `Mode` parameter) with the `FileRead` (434) and `FileWrite` functions.

Remark that you cannot open a file if it doesn't exist yet, i.e. it will not be created for you. If you want to create a new file, or overwrite an old one, use the `FileCreate` (431) function.

Errors: On Error, -1 is returned.

See also: `FileClose` (431), `FileWrite` (437), `FileCreate` (431), `FileRead` (434), `FileTruncate` (436), `FileSeek` (435)

For an example, see `FileOpen` (434)

FileRead

Declaration: `Function FileRead(Handle : Longint; Var Buffer; Count : longint) : Longint;`

Description: `FileRead` reads `Count` bytes from file-handle `Handle` and stores them into `Buffer`. `Buffer` must be at least `Count` bytes long. No checking on this is performed, so be careful not to overwrite any memory. `Handle` must be the result of a `FileOpen` (434) call.

Errors: On error, -1 is returned.

See also: `FileClose` (431), `FileWrite` (437), `FileCreate` (431), `FileOpen` (434), `FileTruncate` (436), `FileSeek` (435)

For an example, see `FileCreate` (431)

FileSearch

Declaration: `Function FileSearch(Const Name, DirList : String) : String;`

Description: `FileSearch` looks for the file `Name` in `DirList`, where `dirlist` is a list of directories, separated by semicolons or colons. It returns the full filename of the first match found.

Errors: On error, an empty string is returned.

See also: [ExpandFileName \(427\)](#), [FindFirst \(437\)](#)

Listing: `sysutex/ex41.pp`

Program `Example41;`

{ Program to demonstrate the FileSearch function. }

Uses `Sysutils;`

Const

```
{ $ifdef unix }
  FN = 'find';
  P = './bin:/usr/bin';
{ $else }
  FN = 'find.exe';
  P = 'c:\dos;c:\windows;c:\windows\system;c:\windows\system32';
{ $endif }
```

begin

```
  WriteLn ('find is in : ',FileSearch (FN,P));
end.
```

FileSeek

Declaration: `Function FileSeek(Handle,Offset,Origin : Longint) : Longint;`

Description: `FileSeek` sets the file pointer on position `Offset`, starting from `Origin`. `Origin` can be one of the following values:

fsFromBeginning`Offset` is relative to the first byte of the file. This position is zero-based. i.e. the first byte is at offset 0.

fsFromCurrent`Offset` is relative to the current position.

fsFromEnd`Offset` is relative to the end of the file. This means that `Offset` can only be zero or negative in this case.

If successful, the function returns the new file position, relative to the beginning of the file.

Remark: The abovementioned constants do not exist in Delphi.

Errors: On error, -1 is returned.

See also: [FileClose \(431\)](#), [FileWrite \(437\)](#), [FileCreate \(431\)](#), [FileOpen \(434\)](#), [FileRead \(434\)](#), [FileTruncate \(436\)](#)

Listing: `sysutex/ex42.pp`

```

Program Example42;

{ This program demonstrates the FileSetAttr function }

Uses sysutils;

Begin
  If FileSetAttr ('ex40.pp',faReadOnly or faHidden)=0 then
    WriteLn ('Successfully made file hidden and read-only.')
  else
    WriteLn ('Couldn''t make file hidden and read-only. ');
End.

```

For an example, see [FileCreate \(431\)](#)

FileSetAttr (Not on Linux)

Declaration: `Function FileSetAttr(Const Filename : String; Attr: longint) : Longint;`

Description: `FileSetAttr` sets the attributes of `FileName` to `Attr`. If the function was successful, 0 is returned, -1 otherwise.

`Attr` can be set to an OR-ed combination of the pre-defined `faXXX` constants.

Errors: On error, -1 is returned (always on linux).

See also: [FileGetAttr \(432\)](#), [FileGetDate \(433\)](#), [FileSetDate \(436\)](#).

FileSetDate (Not on Linux)

Declaration: `Function FileSetDate(Handle, Age : Longint) : Longint;`

Description: `FileSetDate` sets the file date of the file with handle `Handle` to `Age`, where `Age` is a DOS date-and-time stamp value.

The function returns zero of successful.

Errors: On Linux, -1 is always returned, since this is impossible to implement. On Windows and DOS, a negative error code is returned.

See also:

FileTruncate

Declaration: `Function FileTruncate(Handle, Size: Longint) : boolean;`

Description: `FileTruncate` truncates the file with handle `Handle` to `Size` bytes. The file must have been opened for writing prior to this call. The function returns `True` is successful, `False` otherwise.

Errors: On error, the function returns `False`.

See also: [FileClose \(431\)](#), [FileWrite \(437\)](#), [FileCreate \(431\)](#), [FileOpen \(434\)](#), [FileRead \(434\)](#), [FileSeek \(435\)](#)

For an example, see [FileCreate \(431\)](#).

FileWrite

Declaration: `Function FileWrite(Handle : Longint; Var Buffer; Count : Longint) : Longint;`

Description: `FileWrite` writes `Count` bytes from `Buffer` to the file with handle `Handle`. Prior to this call, the file must have been opened for writing. `Buffer` must be at least `Count` bytes large, or a memory access error may occur.

The function returns the number of bytes written, or -1 in case of an error.

Errors: In case of error, -1 is returned.

See also: [FileClose \(431\)](#), [FileCreate \(431\)](#), [FileOpen \(434\)](#) [FileRead \(434\)](#), [FileTruncate \(436\)](#), [FileSeek \(435\)](#)

For an example, see [FileCreate \(431\)](#).

FindClose

Declaration: `Procedure FindClose(Var F : TSearchrec);`

Description: `FindClose` ends a series of [FindFirst \(437\)](#)/[FindNext \(438\)](#) calls, and frees any memory used by these calls. It is *absolutely* necessary to do this call, or huge memory losses may occur.

Errors: None.

See also: [FindFirst \(437\)](#), [FindNext \(438\)](#).

For an example, see [FindFirst \(437\)](#).

FindFirst

Declaration: `Function FindFirst(Const Path : String; Attr : Longint; Var Rslt : TSearchRec) : Longint;`

Description: `FindFirst` looks for files that match the name (possibly with wildcards) in `Path` and attributes `Attr`. It then fills up the `Rslt` record with data gathered about the file. It returns 0 if a file matching the specified criteria is found, a nonzero value (-1 on linux) otherwise.

The `Rslt` record can be fed to subsequent calls to `FindNext`, in order to find other files matching the specifications.

remark: A `FindFirst` call must *always* be followed by a [FindClose \(437\)](#) call with the same `Rslt` record. Failure to do so will result in memory loss.

Errors: On error the function returns -1 on linux, a nonzero error code on Windows.

See also: [FindClose \(49\)](#)[FindCloseSys](#), [FindNext \(438\)](#).

Listing: `sysutex/ex43.pp`

Program `Example43;`

`{ This program demonstrates the FindFirst function }`

Uses `SysUtils;`

Var `Info : TSearchRec;`

```
    Count : Longint;  
  
Begin  
    Count:=0;  
    If FindFirst ( '/* ',faAnyFile and faDirectory ,Info)=0 then  
        begin  
            Repeat  
                Inc(Count);  
                With Info do  
                    begin  
                        If (Attr and faDirectory) = faDirectory then  
                            Write('Dir : ');  
                            WriteLn (Name:40, Size:15);  
                        end;  
                    Until FindNext(info)<>0;  
                end;  
            FindClose(Info);  
            WriteLn ( 'Finished search. Found ',Count, ' matches ');  
  
End.
```

FindNext

Declaration: Function FindNext(Var Rslt : TSearchRec) : Longint;

Description: FindNext finds a next occurrence of a search sequence initiated by FindFirst. If another record matching the criteria in Rslt is found, 0 is returned, a nonzero constant is returned otherwise.

remark: The last FindNext call must *always* be followed by a FindClose call with the same Rslt record. Failure to do so will result in memory loss.

Errors: On error (no more file is found), a nonzero constant is returned.

See also: FindFirst ([437](#)), FindClose ([49](#))

For an example, see FindFirst ([437](#))

GetDirs

Declaration: Function GetDirs(Var DirName : String; Var Dirs : Array of pchar)
: Longint;

Description: GetDirs splits DirName in a null-byte separated list of directory names, Dirs is an array of PChars, pointing to these directory names. The function returns the number of directories found, or -1 if none were found. DirName must contain only OSDirSeparator as Directory separator chars.

Errors: None.

See also: ExtractRelativePath ([429](#))

Listing: sysutex/ex45.pp

Program Example45;

```
{ This program demonstrates the GetDirs function }  
{ $H+ }
```

```
Uses sysutils;

Var Dirs : Array[0..127] of pchar;
    I,Count : longint;
    Dir,NewDir : String;

Begin
  Dir:=GetCurrentDir;
  Writeln ('Dir : ',Dir);
  NewDir:='';
  count:=GetDirs (Dir , Dirs );
  For I:=0 to Count-1 do
    begin
      NewDir:=NewDir+'/' +StrPas ( Dirs [ I ] );
      Writeln (NewDir);
    end;
End.
```

RenameFile

Declaration: Function RenameFile(Const OldName, NewName : String) : Boolean;

Description: RenameFile renames a file from OldName to NewName. The function returns True if successful, False otherwise.

Remark: you cannot rename across disks or partitions.

Errors: On Error, False is returned.

See also: DeleteFile ([426](#))

Listing: sysutex/ex44.pp

Program Example44;

{ This program demonstrates the RenameFile function }

```
Uses sysutils;
```

```
Var F : Longint;
    S : String;
```

```
Begin
  S:='Some short file.';
  F:=FileCreate ('test.dap');
  FileWrite(F,S[1],Length(S));
  FileClose(F);
  If RenameFile ('test.dap','test.dat') then
    Writeln ('Successfully renamed files.');
```

```
End.
```

SetDirSeparators

Declaration: Function SetDirSeparators(Const FileName : String) : String;

Description: SetDirSeparators returns FileName with all possible DirSeparators replaced by OSDirSeparator.

Errors: None.

See also: [ExpandFileName \(427\)](#), [ExtractFilePath \(429\)](#), [ExtractFileDir \(428\)](#)

Listing: sysutex/ex47.pp

Program Example47;

{ This program demonstrates the SetDirSeparators function }

Uses sysutils;

Begin

WriteLn (SetDirSeparators (' /pp\bin /win32\ppc386 '));

End.

22.7 PChar functions

Introduction

Most PChar functions are the same as their counterparts in the STRINGS unit. The following functions are the same :

1. [StrCat \(389\)](#) : Concatenates two PChar strings.
2. [StrComp \(390\)](#) : Compares two PChar strings.
3. [StrCopy \(390\)](#) : Copies a PChar string.
4. [StrECopy \(391\)](#) : Copies a PChar string and returns a pointer to the terminating null byte.
5. [StrEnd \(392\)](#) : Returns a pointer to the terminating null byte.
6. [StrLComp \(392\)](#) : Case insensitive compare of 2 PChar strings.
7. [StrLCat \(393\)](#) : Appends at most L characters from one PChar to another PChar.
8. [StrLComp \(393\)](#) : Case sensitive compare of at most L characters of 2 PChar strings.
9. [StrLCopy \(394\)](#) : Copies at most L characters from one PChar to another.
10. [StrLen \(394\)](#) : Returns the length (exclusive terminating null byte) of a PChar string.
11. [StrLComp \(395\)](#) : Case insensitive compare of at most L characters of 2 PChar strings.
12. [StrLower \(395\)](#) : Converts a PChar to all lowercase letters.
13. [StrMove \(396\)](#) : Moves one PChar to another.
14. [StrNew \(396\)](#) : Makes a copy of a PChar on the heap, and returns a pointer to this copy.
15. [StrPos \(398\)](#) : Returns the position of one PChar string in another?
16. [StrRScan \(398\)](#) : returns a pointer to the last occurrence of on PChar string in another one.
17. [StrScan \(398\)](#) : returns a pointer to the first occurrence of on PChar string in another one.
18. [StrUpper \(399\)](#) : Converts a PChar to all uppercase letters.

The subsequent functions are different from their counterparts in STRINGS, although the same examples can be used.

StrAlloc

Declaration: `Function StrAlloc(Size: cardinal): PChar;`

Description: `StrAlloc` reserves memory on the heap for a string with length `Len`, terminating #0 included, and returns a pointer to it.

Additionally, `StrAlloc` allocates 4 extra bytes to store the size of the allocated memory. Therefore this function is NOT compatible with the `StrAlloc` (389) function of the `Strings` unit.

Errors: None.

See also: `StrBufSize` (441), `StrDispose` (441), `StrAlloc` (389)

For an example, see `StrBufSize` (441).

StrBufSize

Declaration: `Function StrBufSize(var Str: PChar): cardinal;`

Description: `StrBufSize` returns the memory allocated for `Str`. This function ONLY gives the correct result if `Str` was allocated using `StrAlloc` (441).

Errors: If no more memory is available, a runtime error occurs.

See also: `StrAlloc` (441), `StrDispose` (441).

Listing: `sysutex/ex46.pp`

Program `Example46;`

```
{ This program demonstrates the StrBufSize function }  
{ $H+ }
```

Uses `sysutils;`

Const `S = 'Some nice string';`

Var `P : Pchar;`

Begin

```
  P:= StrAlloc (Length(S)+1);  
  StrPCopy(P,S);  
  Write (P, ' has length ',length(S));  
  Writeln (' and buffer size ',StrBufSize(P));  
  StrDispose(P);
```

End.

StrDispose

Declaration: `Procedure StrDispose(var Str: PChar);`

Description: `StrDispose` frees any memory allocated for `Str`. This function will only function correctly if `Str` has been allocated using `StrAlloc` (441) from the `SYSUTILS` unit.

Errors: If an invalid pointer is passed, or a pointer not allocated with `StrAlloc`, an error may occur.

See also: `StrBufSize` (441), `StrAlloc` (441), `StrDispose` (391)

For an example, see `StrBufSize` (441).

StrPCopy

Declaration: `Function StrPCopy(Dest: PChar; Source: string): PChar;`

Description: `StrPCopy` Converts the Ansistring in `Source` to a Null-terminated string, and copies it to `Dest`. `Dest` needs enough room to contain the string `Source`, i.e. `Length(Source)+1` bytes.

Errors: No checking is performed to see whether `Dest` points to enough memory to contain `Source`.

See also: [StrPLCopy \(442\)](#), [StrPCopy \(397\)](#)

For an example, see [StrPCopy \(397\)](#).

StrPLCopy

Declaration: `Function StrPLCopy(Dest: PChar; Source: string; MaxLen: cardinal): PChar;`

Description: `StrPLCopy` Converts maximally `MaxLen` characters of the Ansistring in `Source` to a Null-terminated string, and copies it to `Dest`. `Dest` needs enough room to contain the characters.

Errors: No checking is performed to see whether `Dest` points to enough memory to contain `L` characters of `Source`.

Errors:

See also: [StrPCopy \(442\)](#).

StrPas

Declaration: `Function StrPas(Str: PChar): string;`

Description: Converts a null terminated string in `Str` to an Ansistring, and returns this string. This string is NOT truncated at 255 characters as is the

Errors: None.

See also: [StrPas \(397\)](#).

For an example, see [StrPas \(397\)](#).

22.8 String handling functions

AdjustLineBreaks

Declaration: `Function AdjustLineBreaks(const S: string): string;`

Description: `AdjustLineBreaks` will change all `#13` characters with `#13#10` on WINDOWS NT and DOS. On LINUX, all `#13#10` character pairs are converted to `#10` and single `#13` characters also.

Errors: None.

See also: [AnsiCompareStr \(443\)](#), [AnsiCompareText \(444\)](#)

Listing: `sysutex/ex48.pp`

Program Example48;

{ This program demonstrates the AdjustLineBreaks function }

Uses sysutils;

Const

S = 'This is a string'#13'with embedded'#10'linefeed and'+
#13'CR characters';

Begin

WriteLn (AdjustLineBreaks(S));

End.

AnsiCompareStr

Declaration: `Function AnsiCompareStr(const S1, S2: string): integer;`

Description: `AnsiCompareStr` compares two strings and returns the following result:

<0if S1<S2.

0if S1=S2.

>0if S1>S2.

the comparison takes into account Ansi characters, i.e. it takes care of strange accented characters. Contrary to `AnsiCompareText` (444), the comparison is case sensitive.

Errors: None.

See also: `AdjustLineBreaks` (442), `AnsiCompareText` (444)

Listing: sysutex/ex49.pp

Program Example49;

{ This program demonstrates the AnsiCompareStr function }
{ \$H+ }

Uses sysutils;

Procedure TestIt (S1,S2 : **String**);

Var R : Longint;

begin

 R:=**AnsiCompareStr**(S1,S2);

Write ('',S1, ' is ');

If R<0 **then**

write ('less than ')

else If R=0 **then**

Write ('equal to ')

else

Write ('larger than ');

WriteLn ('',S2, '');

end;

```
Begin
  Testit('One string', 'One smaller string');
  Testit('One string', 'one string');
  Testit('One string', 'One string');
  Testit('One string', 'One tall string');
End.
```

AnsiCompareText

Declaration: `Function AnsiCompareText(const S1, S2: string): integer;`

Description:

Description: `AnsiCompareText` compares two strings and returns the following result:

```
<0if S1<S2.
0if S1=S2.
>0if S1>S2.
```

the comparison takes into account Ansi characters, i.e. it takes care of strange accented characters. Contrary to `AnsiCompareStr` (443), the comparison is case insensitive.

Errors: None.

See also: `AdjustLineBreaks` (442), `AnsiCompareText` (444)

Listing: `sysutex/ex50.pp`

Program Example49;

```
{ This program demonstrates the AnsiCompareText function }
{$H+}
```

Uses sysutils;

Procedure TestIt (S1,S2 : **String**);

Var R : Longint;

```
begin
  R:=AnsiCompareText(S1,S2);
  Write ('"',S1, '" is ');
  If R<0 then
    write ('less than ')
  else If R=0 then
    Write ('equal to ')
  else
    Write ('larger than ');
  WriteLn ('"',S2, '"');
end;

Begin
  Testit('One string', 'One smaller string');
  Testit('One string', 'one string');
  Testit('One string', 'One string');
  Testit('One string', 'One tall string');
End.
```

AnsiExtractQuotedStr

Declaration: `Function AnsiExtractQuotedStr(var Src: PChar; Quote: Char): string;`

Description: `AnsiExtractQuotedStr` Returns `Src` as a string, with `Quote` characters removed from the beginning and end of the string, and double `Quote` characters replaced by a single `Quote` characters. As such, it reverses the action of `AnsiQuotedStr` (446).

Errors: None.

See also: `AnsiQuotedStr` (446)

Listing: `sysutex/ex51.pp`

Program `Example51;`

{ This program demonstrates the AnsiQuotedStr function }

Uses `sysutils;`

Var `S : AnsiString;`

Begin

`S := 'He said "Hello" and walked on';`

`S := AnsiQuotedStr(Pchar(S), '''');`

`Writeln (S);`

`Writeln (AnsiExtractQuotedStr(Pchar(S), ''''));`

End.

AnsiLastChar

Declaration: `Function AnsiLastChar(const S: string): PChar;`

Description: This function returns a pointer to the last character of `S`. Since multibyte characters are not yet supported, this is the same as `@S[Length(S)]`.

Errors: None.

See also: `AnsiStrLastChar` (448)

Listing: `sysutex/ex52.pp`

Program `Example52;`

{ This program demonstrates the AnsiLastChar function }

Uses `sysutils;`

Var `S : AnsiString;`

`L : Longint;`

Begin

`S := 'This is an ansistring.';`

`Writeln ('Last character of S is : ', AnsiLastChar(S));`

`L := Longint (AnsiLastChar(S)) - Longint (@S[1]) + 1;`

`Writeln ('Length of S is : ', L);`

End.

AnsiLowerCase

Declaration: `Function AnsiLowerCase(const s: string): string;`

Description: `AnsiLowerCase` converts the string `S` to lowercase characters and returns the resulting string. It takes into account the operating system language settings when doing this, so special characters are converted correctly as well.

Remark On linux, no language setting is taken in account yet.

Errors: None.

See also: `AnsiUpperCase` (452), `AnsiStrLower` (450), `AnsiStrUpper` (451)

Listing: `sysutex/ex53.pp`

Program `Example53;`

{ This program demonstrates the AnsiLowerCase function }

Uses `sysutils;`

Procedure `Testit (S : String);`

begin

`WriteLn (S, ' -> ', AnsiLowerCase(S))`
end;

Begin

`Testit('AN UPPERCASE STRING');`
`Testit('Some mixed STring');`
`Testit('a lowercase string');`

End.

AnsiQuotedStr

Declaration: `Function AnsiQuotedStr(const S: string; Quote: char): string;`

Description: `AnsiQuotedString` quotes the string `S` and returns the result. This means that it puts the `Quote` character at both the beginning and end of the string and replaces any occurrence of `Quote` in `S` with `2 Quote` characters. The action of `AnsiQuotedString` can be reversed by `AnsiExtractQuotedStr` (445).

Errors: None.

See also: `AnsiExtractQuotedStr` (445)

For an example, see `AnsiExtractQuotedStr` (445)

AnsiStrComp

Declaration: `Function AnsiStrComp(S1, S2: PChar): integer;`

Description: `AnsiStrComp` compares 2 `PChar` strings, and returns the following result:

`<0`if `S1<S2`.

`0`if `S1=S2`.

>0if S1>S2.

The comparison of the two strings is case-sensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: [AnsiCompareText \(444\)](#), [AnsiCompareStr \(443\)](#)

Listing: sysutex/ex54.pp

Program Example54;

{ This program demonstrates the AnsiStrComp function }

Uses sysutils;

Procedure TestIt (S1,S2 : Pchar);

Var R : Longint;

begin

R:=AnsiStrComp(S1,S2);

Write ('"',S1, '" is ');

If R<0 **then**

write ('less than ');

else If R=0 **then**

Write ('equal to ');

else

Write ('larger than ');

WriteIn ('"',S2, '"');

end;

Begin

 Testit('One string','One smaller string');

 Testit('One string','one string');

 Testit('One string','One string');

 Testit('One string','One tall string');

End.

AnsiStrIComp

Declaration: Function AnsiStrIComp(S1, S2: PChar): integer;

Description: AnsiStrIComp compares 2 PChar strings, and returns the following result:

<0if S1<S2.

0if S1=S2.

>0if S1>S2.

The comparison of the two strings is case-insensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: [AnsiCompareText \(444\)](#), [AnsiCompareStr \(443\)](#)

Listing: sysutex/ex55.pp

```
Program Example55;

{ This program demonstrates the AnsiStrComp function }

Uses sysutils;

Procedure TestIt (S1,S2 : Pchar);

Var R : Longint;

begin
  R:=AnsiStrComp(S1,S2);
  Write ( '',S1, ' is ' );
  If R<0 then
    write ( 'less than ' )
  else If R=0 then
    Write ( 'equal to ' )
  else
    Write ( 'larger than ' );
  Writeln ( '',S2, '' );
end;

Begin
  Testit('One string ', 'One smaller string ');
  Testit('One string ', 'one string ');
  Testit('One string ', 'One string ');
  Testit('One string ', 'One tall string ');
End.
```

AnsiStrLastChar

Declaration: function AnsiStrLastChar(Str: PChar): PChar;

Declaration: AnsiStrLastChar returns a pointer to the last character of Str. Since multibyte characters are not yet supported, this is the same as StrEnd(Str)-1.

Errors: None.

See also: [AnsiLastChar \(445\)](#)

Listing: sysutex/ex58.pp

```
Program Example58;

{ This program demonstrates the AnsiStrLastChar function }

Uses sysutils;

Var P : Pchar;
    L : Longint;

Begin
  P:='This is an PChar string.';
  Writeln ( 'Last character of P is : ',AnsiStrLastChar(P));
  L:=Longint(AnsiStrLastChar(P))-Longint(P)+1;
  Writeln ( 'Length of P ( ',P, ' ) is : ',L);
```

End.

AnsiStrLComp

Declaration: Function AnsiStrLComp(S1, S2: PChar; MaxLen: cardinal): integer;

Description: AnsiStrLComp compares the first MaxLen characters of 2 PChar strings, S1 and S2, and returns the following result:

<0if S1<S2.

0if S1=S2.

>0if S1>S2.

The comparison of the two strings is case-sensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: AnsiCompareText ([444](#)), AnsiCompareStr ([443](#))

Listing: sysutex/ex56.pp

Program Example56;

{ This program demonstrates the AnsiStrLComp function }

Uses sysutils;

Procedure TestIt (S1,S2 : Pchar; L : longint);

Var R : Longint;

begin

R:=AnsiStrLComp(S1,S2,L);

Write ('First ',L,' characters of "',S1,'" are ');

If R<0 **then**

write ('less than ');

else if R=0 **then**

Write ('equal to ');

else

Write ('larger than ');

Writeln ('those of "',S2,'"');

end;

Begin

Testit('One string','One smaller string',255);

Testit('One string','One String',4);

Testit('One string','1 string',0);

Testit('One string','One string.',9);

End.

AnsiStrLIComp

Declaration: Function AnsiStrLIComp(S1, S2: PChar; MaxLen: cardinal): integer;

Description: `AnsiStrLIComp` compares the first `Maxlen` characters of 2 `PChar` strings, `S1` and `S2`, and returns the following result:

```
<0if S1<S2.  
0if S1=S2.  
>0if S1>S2.
```

The comparison of the two strings is case-insensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: `AnsiCompareText` (444), `AnsiCompareStr` (443)

Listing: `sysutex/ex57.pp`

Program `Example57`;

```
{ This program demonstrates the AnsiStrLIComp function }
```

Uses `sysutils`;

Procedure `TestIt` (`S1,S2` : `Pchar`; `L` : `longint`);

Var `R` : `Longint`;

begin

```
R:=AnsiStrLIComp(S1,S2,L);  
Write ('First ',L,' characters of "',S1,'" are ');  
If R<0 then  
  write ('less than ')  
else If R=0 then  
  Write ('equal to ')  
else  
  Write ('larger than ');  
WriteLn ('those of "',S2,'"');
```

end;

Begin

```
Testit ('One string ', 'One smaller string ',255);  
Testit ('ONE STRING ', 'one String ',4);  
Testit ('One string ', '1 STRING ',0);  
Testit ('One STRING ', 'one string.',9);
```

End.

AnsiStrLower

Declaration: `Function AnsiStrLower(Str: PChar): PChar;`

Description: `AnsiStrLower` converts the `PChar Str` to lowercase characters and returns the resulting `pchar`. Note that `Str` itself is modified, not a copy, as in the case of `AnsiLowerCase` (446). It takes into account the operating system language settings when doing this, so special characters are converted correctly as well.

Remark On linux, no language setting is taken in account yet.

Errors: None.

See also: [AnsiStrUpper \(451\)](#), [AnsiLowerCase \(446\)](#)

Listing: sysutex/ex59.pp

Program Example59;

{ This program demonstrates the AnsiStrLower function }

Uses sysutils;

Procedure Testit (S : Pchar);

begin

WriteLn (S, ' -> ', AnsiStrLower(S))
end;

Begin

 Testit ('AN UPPERCASE STRING');
 Testit ('Some mixed STring');
 Testit ('a lowercase string');

End.

AnsiStrUpper

Declaration: Function AnsiStrUpper(Str: PChar): PChar;

Description: AnsiStrUpper converts the PChar Str to uppercase characters and returns the resulting string. Note that Str itself is modified, not a copy, as in the case of [AnsiUpperCase \(452\)](#). It takes into account the operating system language settings when doing this, so special characters are converted correctly as well.

Remark On linux, no language setting is taken in account yet.

Errors: None.

See also: [AnsiUpperCase \(452\)](#), [AnsiStrLower \(450\)](#), [AnsiLowerCase \(446\)](#)

Listing: sysutex/ex60.pp

Program Example60;

{ This program demonstrates the AnsiStrUpper function }

Uses sysutils;

Procedure Testit (S : Pchar);

begin

WriteLn (S, ' -> ', AnsiStrUpper(S))
end;

Begin

 Testit ('AN UPPERCASE STRING');
 Testit ('Some mixed STring');
 Testit ('a lowercase string');

End.

AnsiUpperCase

Declaration: `Function AnsiUpperCase(const s: string): string;`

Description: `AnsiUpperCase` converts the string `S` to uppercase characters and returns the resulting string. It takes into account the operating system language settings when doing this, so special characters are converted correctly as well.

Remark On linux, no language setting is taken in account yet.

Errors: None.

See also: `AnsiStrUpper` (451), `AnsiStrLower` (450), `AnsiLowerCase` (446)

Listing: `sysutex/ex61.pp`

Program `Example60;`

{ This program demonstrates the AnsiUpperCase function }

Uses `sysutils;`

Procedure `Testit (S : String);`

begin

`WriteLn (S, ' -> ',AnsiUpperCase(S))`

end;

Begin

`Testit ('AN UPPERCASE STRING');`

`Testit ('Some mixed SString');`

`Testit ('a lowercase string');`

End.

AppendStr

Declaration: `Procedure AppendStr(var Dest: String; const S: string);`

Description: `AppendStr` appends `S` to `Dest`.

This function is provided for Delphi compatibility only, since it is completely equivalent to `Dest := Dest+S`.

Errors: None.

See also: `AssignStr` (453), `NewStr` (316), `DisposeStr` (317)

Listing: `sysutex/ex62.pp`

Program `Example62;`

{ This program demonstrates the AppendStr function }

Uses `sysutils;`

Var `S : AnsiString;`

Begin

`S:= 'This is an ';`

`AppendStr(S, 'AnsiString');`

`WriteLn ('S = "',S, '"');`

End.

AssignStr

Declaration: `Procedure AssignStr(var P: PString; const S: string);`

Description: `AssignStr` allocates S to P. The old value of P is disposed of.

This function is provided for Delphi compatibility only. `AnsiStrings` are managed on the heap and should be preferred to the mechanism of dynamically allocated strings.

Errors: None.

See also: `NewStr` (316), `AppendStr` (452), `DisposeStr` (317)

Listing: `sysutex/ex63.pp`

Program Example63;

```
{ This program demonstrates the AssignStr function }  
{ $H+ }
```

Uses sysutils;

Var P : PString;

Begin

```
P:=NewStr('A first AnsiString');  
WriteLn ( 'Before : P = "',P^,'"');  
AssignStr(P,'A Second ansistring');  
WriteLn ( 'After : P = "',P^,'"');  
DisposeStr(P);
```

End.

BCDToInt

Declaration: `Function BCDToInt(Value: integer): integer;`

Description: `BCDToInt` converts a BCD coded integer to a normal integer.

Errors: None.

See also: `StrToInt` (473), `IntToStr` (467)

Listing: `sysutex/ex64.pp`

Program Example64;

```
{ This program demonstrates the BCDToInt function }
```

Uses sysutils;

Procedure Testit (L : longint);

begin

```
WriteLn ( L, ' -> ',BCDToInt(L));  
end;
```

Begin

```
Testit(10);  
Testit(100);  
Testit(1000);
```

End.

CompareMem

Declaration: `Function CompareMem(P1, P2: Pointer; Length: cardinal): integer;`

Description: `CompareMem` compares, byte by byte, 2 memory areas pointed to by `P1` and `P2`, for a length of `L` bytes.

It returns the following values:

<0 if at some position the byte at `P1` is less than the byte at the same position at `P2`.

0 if all `L` bytes are the same.

3

Errors:

See also:

CompareStr

Declaration: `Function CompareStr(const S1, S2: string): Integer;`

Description: `CompareStr` compares two strings, `S1` and `S2`, and returns the following result:

<0 if `S1`<`S2`.

0 if `S1`=`S2`.

>0 if `S1`>`S2`.

The comparison of the two strings is case-sensitive. The function does not take internationalization settings into account, it simply compares ASCII values.

Errors: None.

See also: [AnsiCompareText \(444\)](#), [AnsiCompareStr \(443\)](#), [CompareText \(455\)](#)

Listing: `sysutex/ex65.pp`

Program `Example65`;

```
{ This program demonstrates the CompareStr function }  
{ $H+ }
```

Uses `sysutils`;

Procedure `TestIt (S1,S2 : String)`;

Var `R : Longint`;

begin

`R:=CompareStr(S1,S2)`;

Write ('' ,S1, ' is ');

If `R<0` **then**

`write` ('less than ')

else If `R=0` **then**

`Write` ('equal to ')

else

`Write` ('larger than ');

Writeln ('' ,S2, '');

end;

```
Begin
  Testit('One string', 'One smaller string');
  Testit('One string', 'one string');
  Testit('One string', 'One string');
  Testit('One string', 'One tall string');
End.
```

CompareText

Declaration: `Function CompareText(const S1, S2: string): integer;`

Description: `CompareText` compares two strings, `S1` and `S2`, and returns the following result:

```
<0if S1<S2.
0if S1=S2.
>0if S1>S2.
```

The comparison of the two strings is case-insensitive. The function does not take internationalization settings into account, it simply compares ASCII values.

Errors: None.

See also: [AnsiCompareText \(444\)](#), [AnsiCompareStr \(443\)](#), [CompareStr \(454\)](#)

Listing: `sysutex/ex66.pp`

Program Example66;

```
{ This program demonstrates the CompareText function }
{$H+}
```

Uses sysutils;

Procedure TestIt (S1,S2 : **String**);

Var R : Longint;

```
begin
  R:=CompareText(S1,S2);
  Write ('"',S1,'" is ');
  If R<0 then
    write ('less than ')
  else If R=0 then
    Write ('equal to ')
  else
    Write ('larger than ');
  Writeln ('"',S2,'"');
end;
```

```
Begin
  Testit('One string', 'One smaller string');
  Testit('One string', 'one string');
  Testit('One string', 'One string');
  Testit('One string', 'One tall string');
End.
```

DisposeStr

Declaration: `Procedure DisposeStr(S: PString);`

Description: `DisposeStr` removes the dynamically allocated string `S` from the heap, and releases the occupied memory.

This function is provided for Delphi compatibility only. `AnsiStrings` are managed on the heap and should be preferred to the mechanism of dynamically allocated strings.

Errors: None.

See also: [NewStr \(316\)](#), [AppendStr \(452\)](#), [AssignStr \(453\)](#)

For an example, see [DisposeStr \(317\)](#).

FloatToStr

Declaration: `Function FloatToStr(Value: Extended): String;`

Description: `FloatToStr` converts the floating point variable `Value` to a string representation. It will choose the shortest possible notation of the two following formats:

Fixed format will represent the string in fixed notation,

Decimal format will represent the string in scientific notation.

(more information on these formats can be found in [FloatToStrF \(457\)](#)) `FloatToStr` is completely equivalent to a `FloatToStrF(Value, ffGeneral, 15, 0);` call.

Errors: None.

See also: [FloatToStrF \(457\)](#), [FormatFloat \(465\)](#), [StrToFloat \(472\)](#)

Listing: `sysutex/ex67.pp`

Program `Example67;`

{ This program demonstrates the FloatToStr function }

Uses `sysutils;`

Procedure `Testit (Value : Extended);`

begin

WriteLn (Value, ' -> ', **FloatToStr**(Value));

WriteLn (-Value, ' -> ', **FloatToStr**(-Value));

end;

Begin

Testit (0.0);

Testit (1.1);

Testit (1.1e-3);

Testit (1.1e-20);

Testit (1.1e-200);

Testit (1.1e+3);

Testit (1.1e+20);

Testit (1.1e+200);

End.

FloatToStrF

Declaration: `Function FloatToStrF(Value: Extended; format: TFloatFormat; Precision, Digits: Integer): String;`

Description: `FloatToStrF` converts the floating point number value to a string representation, according to the settings of the parameters `Format`, `Precision` and `Digits`.

The meaning of the `Precision` and `Digits` parameter depends on the `Format` parameter. The format is controlled mainly by the `Format` parameter. It can have one of the following values:

ffcurrency Money format. Value is converted to a string using the global variables `CurrencyString`, `CurrencyFormat` and `NegCurrencyFormat`. The `Digits` parameter specifies the number of digits following the decimal point and should be in the range -1 to 18. If `Digits` equals -1, `CurrencyDecimals` is assumed. The `Precision` parameter is ignored.

ffExponent Scientific format. Value is converted to a string using scientific notation: 1 digit before the decimal point, possibly preceded by a minus sign if Value is negative. The number of digits after the decimal point is controlled by `Precision` and must lie in the range 0 to 15.

ffFixed Fixed point format. Value is converted to a string using fixed point notation. The result is composed of all digits of the integer part of Value, preceded by a minus sign if Value is negative. Following the integer part is `DecimalSeparator` and then the fractional part of Value, rounded off to `Digits` numbers. If the number is too large then the result will be in scientific notation.

ffGeneral General number format. The argument is converted to a string using `ffExponent` or `ffFixed` format, depending on which one gives the shortest string. There will be no trailing zeroes. If Value is less than 0.00001 or if the number of decimals left of the decimal point is larger than `Precision` then scientific notation is used, and `Digits` is the minimum number of digits in the exponent. Otherwise `Digits` is ignored.

ffnumber Is the same as `ffFixed`, except that thousand separators are inserted in the resultig string.

Errors: None.

See also: `FloatToStr` (456), `FloatToText` (458)

Listing: `sysutex/ex68.pp`

Program `Example68`;

{ This program demonstrates the FloatToStrF function }

Uses `sysutils`;

Const `Fmt : Array [TFloatFormat] of string[10] =`
 (`'general'`, `'exponent'`, `'fixed'`, `'number'`, `'Currency'`);

Procedure `Testit (Value : Extended);`

Var `I, J : longint;`
 `FF : TFloatFormat;`

begin

For `I:=5 to 15 do`

For `J:=1 to 4 do`

For `FF:=ffgeneral to ffcurrency do`

begin

Write (`Value`, `'(Prec: ', I:2, ', Dig: ', J, ', fmt: ', Fmt[ff], '): '`);

Writeln (`FloatToStrf(Value, FF, I, J)`);

```

    Write (-Value, '(Prec: ', I:2, ', Dig: ', J, ', fmt : ', Fmt[ff], ') : ');
    Writeln (FloatToStrf(-Value, FF, I, J));
end;

end;

Begin
  Testit (1.1);
  Testit (1.1E1);
  Testit (1.1E-1);
  Testit (1.1E5);
  Testit (1.1E-5);
  Testit (1.1E10);
  Testit (1.1E-10);
  Testit (1.1E15);
  Testit (1.1E-15);
  Testit (1.1E100);
  Testit (1.1E-100);
End.

```

FloatToText

Declaration: Function FloatToText(Buffer : Pchar; Value: Extended; Format: TFloatFormat; Precision, Digits: Integer): Longint;

Description: FloatToText converts the floating point variable Value to a string representation and stores it in Buffer. The conversion is governed by format, Precision and Digits. more information on these parameters can be found in FloatToStrF (457). Buffer should point to enough space to hold the result. No checking on this is performed.

The result is the number of characters that was copied in Buffer.

Errors: None.

See also: FloatToStr (456), FloatToStrF (457)

Listing: sysutex/ex69.pp

Program Example68;

```
{ This program demonstrates the FloatToStrF function }
```

Uses sysutils;

```
Const Fmt : Array [TFloatFormat] of string[10] =
    ('general', 'exponent', 'fixed', 'number', 'Currency');
```

```
Procedure Testit (Value : Extended);
```

```
Var I, J : longint;
    FF : TFloatFormat;
    S : ShortString;
```

```
begin
```

```
  For I:=5 to 15 do
```

```
    For J:=1 to 4 do
```

```
      For FF:=ffgeneral to ffcurrency do
```

```
        begin
```

```
          Write (Value, '(Prec: ', I:2, ', Dig: ', J, ', fmt : ', Fmt[ff], ') : ');
```

```
    SetLength(S, FloatToText (@S[1], Value, FF, I, J));
    Writeln (S);
    Write (-Value, '(Prec: ', I:2, ', Dig: ', J, ', fmt : ', Fmt[ff], ') : ');
    SetLength(S, FloatToText (@S[1], -Value, FF, I, J));
    Writeln (S);
end;

Begin
  Testit (1.1);
  Testit (1.1E1);
  Testit (1.1E-1);
  Testit (1.1E5);
  Testit (1.1E-5);
  Testit (1.1E10);
  Testit (1.1E-10);
  Testit (1.1E15);
  Testit (1.1E-15);
  Testit (1.1E100);
  Testit (1.1E-100);
End.
```

FmtStr

Declaration: Procedure (Var Res: String; Const Fmt : String; Const args: Array of const);

Description: FmtStr calls Format (459) with Fmt and Args as arguments, and stores the result in Res. For more information on how the resulting string is composed, see Format (459).

Errors: In case of error, a EConvertError exception is raised.

See also: Format (459), FormatBuf (465).

Listing: sysutex/ex70.pp

Program Example70;

{ This program demonstrates the FmtStr function }

Uses sysutils;

Var S : AnsiString;

Begin

S:= '';

FmtStr (S, 'For some nice examples of fomatting see %s.', ['Format']);

Writeln (S);

End.

Format

Declaration: Function Format(Const Fmt : String; const Args : Array of const) : String;

Description: Format replaces all placeholders in `fmt` with the arguments passed in `args` and returns the resulting string. A placeholder looks as follows:

```
'%' [Index ':' ] [ '-' ] [Width] [ '.' Precision ] ArgType
```

elements between single quotes must be typed as shown without the quotes, and elements between square brackets [] are optional. The meaning of the different elements is shown below:

'%' starts the placeholder. If you want to insert a literal % character, then you must insert two of them : %%.

Index ':' takes the Index-th element in the argument array as the element to insert.

'-' tells Format to left-align the inserted text. The default behaviour is to right-align inserted text. This can only take effect if the Width element is also specified.

Width the inserted string must have at least have Width characters. If not, the inserted string will be padded with spaces. By default, the string is left-padded, resulting in a right-aligned string. This behaviour can be changed by the '-' character.

'.' **Precision** Indicates the precision to be used when converting the argument. The exact meaning of this parameter depends on ArgType.

The Index, Width and Precision parameters can be replaced by *, in which case their value will be read from the next element in the Args array. This value must be an integer, or an `EConvertError` exception will be raised.

The argument type is determined from ArgType. It can have one of the following values (case insensitive):

D Decimal format. The next argument in the Args array should be an integer. The argument is converted to a decimal string,. If precision is specified, then the string will have at least Precision digits in it. If needed, the string is (left) padded with zeroes.

E scientific format. The next argument in the Args array should be a Floating point value. The argument is converted to a decimal string using scientific notation, using `FloatToStrF` (457), where the optional precision is used to specify the total number of decimals. (default a value of 15 is used). The exponent is formatted using maximally 3 digits.

In short, the E specifier formats it's argument as follows:

```
FloatToStrF(Argument, ffExponent, Precision, 3)
```

F fixed point format. The next argument in the Args array should be a floating point value. The argument is converted to a decimal string, using fixed notation (see `FloatToStrF` (457)). Precision indicates the number of digits following the decimal point.

In short, the F specifier formats it's argument as follows:

```
FloatToStrF(Argument, ffFixed, ffixed, 9999, Precision)
```

G General number format. The next argument in the Args array should be a floating point value. The argument is converted to a decimal string using fixed point notation or scientific notation, depending on which gives the shortest result. Precision is used to determine the number of digits after the decimal point.

In short, the G specifier formats it's argument as follows:

```
FloatToStrF(Argument, ffGeneral, Precision, 3)
```

M Currency format. the next argument in the varArgs array must be a floating point value. The argument is converted to a decimal string using currency notation. This means that fixed-point notation is used, but that the currency symbol is appended. If precision is specified, then then it overrides the `CurrencyDecimals` global variable used in the `FloatToStrF` (457)

In short, the M specifier formats it's argument as follows:

```
FloatToStrF(Argument, ffCurrency, 9999, Precision)
```

NNumber format. This is the same as fixed point format, except that thousand separators are inserted in the resulting string.

PPointer format. The next argument in the `Args` array must be a pointer (typed or untyped). The pointer value is converted to a string of length 8, representing the hexadecimal value of the pointer.

SString format. The next argument in the `Args` array must be a string. The argument is simply copied to the result string. If `Precision` is specified, then only `Precision` characters are copied to the result string.

Xhexadecimal format. The next argument in the `Args` array must be an integer. The argument is converted to a hexadecimal string with just enough characters to contain the value of the integer. If `Precision` is specified then the resulting hexadecimal representation will have at least `Precision` characters in it (with a maximum value of 32).

Errors: In case of error, an `EConversionError` exception is raised. Possible errors are:

- 1.Errors in the format specifiers.
- 2.The next argument is not of the type needed by a specifier.
- 3.The number of arguments is not sufficient for all format specifiers.

See also: `FormatBuf` (465)

Listing: `sysutex/ex71.pp`

Program `example71`;

```
{ $mode objfpc }
```

```
{ This program demonstrates the Format function }
```

Uses `sysutils`;

```
Var P : Pointer;
      fmt, S : string;
```

Procedure `TestInteger`;

begin

Try

```
  Fmt:= '%d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%%' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%10d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  fmt:= '%.4d' ; S:=Format ( fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%10.4d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%0:d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%0:10d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%0:10.4d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%0:-10d' ; S:=Format ( Fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%0:-10.4d' ; S:=Format ( fmt, [10]); writeln (Fmt:12, ' => ', s);
  Fmt:= '%-*.*d' ; S:=Format ( fmt, [4, 5, 10]); writeln (Fmt:12, ' => ', s);
```

except

On E : Exception **do**

begin

Writeln ('Exception caught : ', E.Message);

end;

end;

```

    writeln ('Press enter ');
    readln;
end;

Procedure TestHexaDecimal;

begin
  try
    Fmt:= '%x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%10x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%10.4x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%0:x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%0:10x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%0:10.4x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%0:-10x'; S:=Format (Fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%0:-10.4x'; S:=Format (fmt,[10]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%-*.*x'; S:=Format (fmt,[4,5,10]); writeln(Fmt:12, ' => ',s);
  except
    On E : Exception do
      begin
        Writeln ('Exception caught : ',E.Message);
      end;
  end;
  writeln ('Press enter ');
  readln;
end;

Procedure TestPointer;

begin
  P:=Pointer(1234567);
  try
    Fmt:= '[0x%p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%10p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%10.4p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%0:p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%0:10p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%0:10.4p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%0:-10p]'; S:=Format (Fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '[0x%0:-10.4p]'; S:=Format (fmt,[P]); writeln(Fmt:12, ' => ',s);
    Fmt:= '%-*.*p'; S:=Format (fmt,[4,5,P]); writeln(Fmt:12, ' => ',s);
  except
    On E : Exception do
      begin
        Writeln ('Exception caught : ',E.Message);
      end;
  end;
  writeln ('Press enter ');
  readln;
end;

Procedure TestString;

begin
  try
    Fmt:= '%s'; S:=Format(fmt,['This is a string']); Writeln(fmt:12, '=> ',s);
    fmt:= '%0:s'; s:=Format(fmt,['This is a string']); Writeln(fmt:12, '=> ',s);
    fmt:= '%0:18s'; s:=Format(fmt,['This is a string']); Writeln(fmt:12, '=> ',s);
  
```

```

    fmt:= '%0:-18s';s:=Format(fmt,['This is a string']);Writeln(fmt:12,'=>',s);
    fmt:= '%0:18.12s';s:=Format(fmt,['This is a string']);Writeln(fmt:12,'=>',s);
    fmt:= '%-*.*s';s:=Format(fmt,[18,12,'This is a string']);Writeln(fmt:12,'=>',s);
except
  On E : Exception do
    begin
      Writeln ('Exception caught : ',E.Message);
    end;
end;
writeln ('Press enter');
readln;
end;

Procedure TestExponential;

begin
  Try
    Fmt:= '%e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%10e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%10.4e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:10e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:10.4e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:-10e';S:=Format (Fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:-10.4e';S:=Format (fmt,[1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%-*.*e';S:=Format (fmt,[4,5,1.234]);writeln (Fmt:12,' =>',s);
  except
    On E : Exception do
      begin
        Writeln ('Exception caught : ',E.Message);
      end;
    end;
  writeln ('Press enter');
  readln;
end;

Procedure TestNegativeExponential;

begin
  Try
    Fmt:= '%e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%10e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%10.4e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:10e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:10.4e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:-10e';S:=Format (Fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%0:-10.4e';S:=Format (fmt,[ -1.234]);writeln (Fmt:12,' =>',s);
    Fmt:= '%-*.*e';S:=Format (fmt,[4,5,-1.234]);writeln (Fmt:12,' =>',s);
  except
    On E : Exception do
      begin
        Writeln ('Exception caught : ',E.Message);
      end;
    end;
  writeln ('Press enter');
  readln;
end;

```

```
Procedure TestSmallExponential;
```

```
begin
```

```
  Try
```

```
    Fmt:= '%[e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[10e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[10.4e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:10e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:10.4e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:-10e]'; S:=Format (Fmt,[0.0123]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:-10.4e]'; S:=Format (Fmt,[0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[-*.e]'; S:=Format (Fmt,[4,5,0.01234]); writeln (Fmt:12, ' => ',s);
```

```
  except
```

```
    On E : Exception do
```

```
      begin
```

```
        Writeln ('Exception caught : ',E.Message);
```

```
      end;
```

```
  end;
```

```
  writeln ('Press enter');
```

```
  readln;
```

```
end;
```

```
Procedure TestSmallNegExponential;
```

```
begin
```

```
  Try
```

```
    Fmt:= '%[e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[10e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[10.4e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:10e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:10.4e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:-10e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[0:-10.4e]'; S:=Format (Fmt,[-0.01234]); writeln (Fmt:12, ' => ',s);
    Fmt:= '%[-*.e]'; S:=Format (Fmt,[4,5,-0.01234]); writeln (Fmt:12, ' => ',s);
```

```
  except
```

```
    On E : Exception do
```

```
      begin
```

```
        Writeln ('Exception caught : ',E.Message);
```

```
      end;
```

```
  end;
```

```
  writeln ('Press enter');
```

```
  readln;
```

```
end;
```

```
begin
```

```
  TestInteger;
```

```
  TestHexadecimal;
```

```
  TestPointer;
```

```
  TestExponential;
```

```
  TestNegativeExponential;
```

```
  TestSmallExponential;
```

```
  TestSmallNegExponential;
```

```
  teststring;
```

```
end.
```

FormatBuf

Declaration: `Function FormatBuf(Var Buffer; BufLen : Cardinal; Const Fmt; fmtLen : Cardinal; Const Args : Array of const) : Cardinal;`

Description: Format

Errors:

See also:

Listing: `sysutex/ex72.pp`

Program Example72;

{ This program demonstrates the FormatBuf function }

Uses sysutils;

Var

S : ShortString;

Const

Fmt : ShortString = 'For some nice examples of fomatting see %s.';

Begin

S := '';

SetLength(S, **FormatBuf** (S[1], 255, Fmt[1], **Length**(Fmt), ['Format']));

Writeln (S);

End.

FormatFloat

Declaration: `Function FormatFloat(Const format: String; Value: Extended): String;`

Description: FormatFloat formats the floating-point value given by Value using the format specifications in Format. The format specifier can give format specifications for positive, negative or zero values (separated by a semicolon).

If the format specifier is empty or the value needs more than 18 digits to be correctly represented, the result is formatted with a call to `FloatToStrF` (457) with the `ffGeneral` format option.

The following format specifiers are supported:

0 is a digit place holder. If there is a corresponding digit in the value being formatted, then it replaces the 0. If not, the 0 is left as-is.

is also a digit place holder. If there is a corresponding digit in the value being formatted, then it replaces the #. If not, it is removed. by a space.

. determines the location of the decimal point. Only the first '.' character is taken into account. If the value contains digits after the decimal point, then it is replaced by the value of the `DecimalSeparator` character.

, determines the use of the thousand separator character in the output string. If the format string contains one or more ',' characters, then thousand separators will be used. The `ThousandSeparator` character is used.

E+ determines the use of scientific notation. If 'E+' or 'E-' (or their lowercase counterparts) are present then scientific notation is used. The number of digits in the output string is determined by the number of 0 characters after the 'E+'

;This character separates sections for positive, negative, and zero numbers in the format string.

Errors: If an error occurs, an exception is raised.

See also: [FloatToStr \(456\)](#)

Listing: sysutex/ex89.pp

Program Example89;

{ This program demonstrates the FormatFloat function }

Uses sysutils;

Const

```
NrFormat=9;
FormatStrings : Array[1..NrFormat] of string = (
    ' ',
    '0',
    '0.00',
    '#.##',
    '#,##0.00',
    '#,##0.00;(#,##0.00)',
    '#,##0.00;;Zero',
    '0.000E+00',
    '#.###E-0');
NrValue = 5;
FormatValues : Array[1..NrValue] of Double =
    (1234, -1234, 0.5, 0, -0.5);

Width = 12;
FWidth = 20;
```

Var

```
I, J : Integer;
S : String;
```

begin

```
Write ('Format' : FWidth);
For I:=1 to NrValue do
    Write (FormatValues[i] : Width : 2);
Writeln;
For I:=1 to NrFormat do
    begin
        Write (FormatStrings[i] : FWidth);
        For J:=1 to NrValue do
            begin
                S:=FormatFloat (FormatStrings[I], FormatValues[j]);
                Write (S : Width);
            end;
        Writeln;
    end;
```

End.

IntToHex

Declaration: `Function IntToHex(Value: integer; Digits: integer): string;`

Description: `IntToHex` converts `Value` to a hexadecimal string representation. The result will contain at least `Digits` characters. If `Digits` is less than the needed number of characters, the string will NOT be truncated. If `Digits` is larger than the needed number of characters, the result is padded with zeroes.

Errors: None.

See also: `IntToStr` ([467](#)), `StrToInt`

Listing: `sysutex/ex73.pp`

Program `Example73`;

{ This program demonstrates the IntToHex function }

Uses `sysutils`;

Var `I` : `longint`;

Begin

For `I:=0 to 31 do`

begin

Writeln (`IntToHex(1 shl I,8)`);

Writeln (`IntToHex(15 shl I,8)`)

end;

End.

IntToStr

Declaration: `Function IntToStr(Value: integer): string;`

Description: `IntToStr` covers `Value` to its string representation. The resulting string has only as much characters as needed to represent the value. If the value is negative a minus sign is prepended to the string.

Errors: None.

See also: `IntToHex` ([466](#)), `StrToInt` ([473](#))

Listing: `sysutex/ex74.pp`

Program `Example74`;

{ This program demonstrates the IntToStr function }

Uses `sysutils`;

Var `I` : `longint`;

Begin

For `I:=0 to 31 do`

begin

Writeln (`IntToStr(1 shl I)`);

Writeln (`IntToStr(15 shl I)`);

end;

End.

IsValidIdent

Declaration: `Function IsValidIdent(const Ident: string): boolean;`

Description: `IsValidIdent` returns `True` if `Ident` can be used as a component name. It returns `False` otherwise. `Ident` must consist of a letter or underscore, followed by a combination of letters, numbers or underscores to be a valid identifier.

Errors: None.

See also:

Listing: `sysutex/ex75.pp`

Program `Example75;`

{ This program demonstrates the IsValidIdent function }

Uses `sysutils;`

Procedure `Testit (S : String);`

begin

Write ('', S, ' is ');

If not IsValidIdent(S) **then**

Write ('NOT ');

Writeln ('a valid identifier');

end;

Begin

Testit ('_MyObj');

Testit ('My__Obj1');

Testit ('My_1_Obj');

Testit ('1MyObject');

Testit ('My@Object');

Testit ('M123');

End.

LastDelimiter

Declaration: `Function LastDelimiter(const Delimiters, S: string): Integer;`

Description: `LastDelimiter` returns the *last* occurrence of any character in the set `Delimiters` in the string `S`.

Errors:

See also:

Listing: `sysutex/ex88.pp`

Program `example88;`

{ This program demonstrates the LastDelimiter function }

uses `SysUtils;`

begin

Writeln (LastDelimiter (' \.:', 'c:\filename.ext'));

end.

LeftStr

Declaration: `Function LeftStr(const S: string; Count: integer): string;`

Description: `LeftStr` returns the `Count` leftmost characters of `S`. It is equivalent to a call to `Copy(S, 1, Count)`.

Errors: None.

See also: [RightStr \(470\)](#), [TrimLeft \(476\)](#), [TrimRight \(476\)](#), [Trim \(475\)](#)

Listing: `sysutex/ex76.pp`

Program `Example76;`

{ This program demonstrates the LeftStr function }

Uses `sysutils;`

Begin

```
WriteLn ( LeftStr ( 'abcdefghijklmnopqrstuvwxy', 20));
WriteLn ( LeftStr ( 'abcdefghijklmnopqrstuvwxy', 15));
WriteLn ( LeftStr ( 'abcdefghijklmnopqrstuvwxy', 1));
WriteLn ( LeftStr ( 'abcdefghijklmnopqrstuvwxy', 200));
```

End.

LoadStr

Declaration: `Function LoadStr(Ident: integer): string;`

Description: This function is not yet implemented. resources are not yet supported.

Errors:

See also:

LowerCase

Declaration: `Function LowerCase(const s: string): string;`

Description: `LowerCase` returns the lowercase equivalent of `S`. Ansi characters are not taken into account, only ASCII codes below 127 are converted. It is completely equivalent to the lowercase function of the system unit, and is provided for compatibility only.

Errors: None.

See also: [AnsiLowerCase \(446\)](#), [UpperCase \(477\)](#), [AnsiUpperCase \(452\)](#)

Listing: `sysutex/ex77.pp`

Program `Example77;`

{ This program demonstrates the LowerCase function }

Uses `sysutils;`

Begin

```
WriteLn ( LowerCase( 'THIS WILL COME out all LoWeRcAsE !' ));
```

End.

NewStr

Declaration: `Function NewStr(const S: string): PString;`

Description: `NewStr` assigns a new dynamic string on the heap, copies `S` into it, and returns a pointer to the newly assigned string.

This function is obsolete, and shouldn't be used any more. The `AnsiString` mechanism also allocates anisstrings on the heap, and should be preferred over this mechanism.

Errors: If not enough memory is present, an `EOutOfMemory` exception will be raised.

See also: `AssignStr` (453), `DisposeStr` (456)

For an example, see `AssignStr` (453).

QuotedStr

Declaration: `Function QuotedStr(const S: string): string;`

Description: `QuotedStr` returns the string `S`, quoted with single quotes. This means that `S` is enclosed in single quotes, and every single quote in `S` is doubled. It is equivalent to a call to `AnsiQuotedStr(s, "'')`.

Errors: None.

See also: `AnsiQuotedStr` (446), `AnsiExtractQuotedStr` (445).

Listing: `sysutex/ex78.pp`

Program `Example78;`

{ This program demonstrates the QuotedStr function }

Uses `sysutils;`

Var `S : AnsiString;`

Begin

`S:= 'He said ''Hello'' and walked on';`

`Writeln (S);`

`Writeln (' becomes');`

`Writeln (QuotedStr(S));`

End.

RightStr

Declaration: `Function RightStr(const S: string; Count: integer): string;`

Description: `RightStr` returns the `Count` rightmost characters of `S`. It is equivalent to a call to `Copy(S, Length(S)+1-Count, Count)`

If `Count` is larger than the actual length of `S` only the real length will be used.

Errors: None.

See also: `LeftStr` (469), `Trim` (475), `TrimLeft` (476), `TrimRight` (476)

Listing: `sysutex/ex79.pp`

Program Example79;

{ This program demonstrates the RightStr function }

Uses sysutils;

Begin

```

  WriteLn ( RightStr( 'abcdefghijklmnopqrstuvwxy',20));
  WriteLn ( RightStr( 'abcdefghijklmnopqrstuvwxy',15));
  WriteLn ( RightStr( 'abcdefghijklmnopqrstuvwxy',1));
  WriteLn ( RightStr( 'abcdefghijklmnopqrstuvwxy',200));

```

End.

StrFmt

Declaration: Function StrFmt(Buffer, Fmt : PChar; Const args: Array of const) : Pchar;

Description: StrFmt will format fmt with Args, as the Format (459) function does, and it will store the result in Buffer. The function returns Buffer. Buffer should point to enough space to contain the whole result.

Errors: for a list of errors, see Format (459).

See also: StrLFmt (471), FmtStr (459), Format (459), FormatBuf (465)

Listing: sysutex/ex80.pp

Program Example80;

{ This program demonstrates the StrFmt function }

Uses sysutils;

Var S : AnsiString;

Begin

```

  SetLength(S,80);
  WriteLn ( StrFmt (@S[1], 'For some nice examples of fomatting see %s.', ['Format']));

```

End.

StrLFmt

Declaration: Function StrLFmt(Buffer : PChar; Maxlen : Cardinal; Fmt : PChar; Const args: Array of const) : Pchar;

Description: StrLFmt will format fmt with Args, as the Format (459) function does, and it will store maximally Maxlen characters of the result in Buffer. The function returns Buffer. Buffer should point to enough space to contain MaxLen characters.

Errors: for a list of errors, see Format (459).

See also: StrFmt (471), FmtStr (459), Format (459), FormatBuf (465)

Listing: sysutex/ex81.pp

```

Program Example80;

{ This program demonstrates the StrFmt function }

Uses sysutils;

Var S : AnsiString;

Begin
  SetLength(S,80);
  WriteIn (StrLFmt (@S[1],80,'For some nice examples of fomating see %s.', ['Format']));
End.

```

StrToFloat

Declaration: `Function StrToFloat(Const S : String) : Extended;`

Description: `StrToFloat` converts the string `S` to a floating point value. `S` should contain a valid stroing representation of a floating point value (either in decimal or scientific notation). If the string contains a decimal value, then the decimal separator character can either be a `'.'` or the value of the `DecimalSeparator` variable.

Errors: If the string `S` doesn't contain a valid floating point string, then an exception will be raised.

See also: `TextToFloat` (474), `FloatToStr` (456), `FormatFloat` (465), `StrToInt` (473)

Listing: `sysutex/ex90.pp`

```

Program Example90;

{ This program demonstrates the StrToFloat function }
{$mode objfpc}
{$h+ }

Uses SysUtils;

Const
  NrValues = 5;
  TestStr : Array[1..NrValues] of string =
    ('1,1', '-0,2', '1,2E-4', '0', '1E4');

Procedure Testit;

Var
  I : Integer;
  E : Extended;

begin
  WriteIn ('Using DecimalSeparator : ', DecimalSeparator);
  For I:=1 to NrValues do
    begin
      WriteIn ('Converting : ', TestStr[I]);
      Try
        E:=StrToFloat(TestStr[I]);
        WriteIn ('Converted value : ', E);
      except

```

```
    On E : Exception do
      Writeln('Exception when converting : ',E.Message);
    end;
  end;
end;

Begin
  DecimalSeparator:=',';
  Testit;
  DecimalSeparator:= '.';
  Testit;
End.
```

StrToInt

Declaration: `Function StrToInt(const s: string): integer;`

Description: `StrToInt` will convert the string `Sto` an integer. If the string contains invalid characters or has an invalid format, then an `EConvertError` is raised.

To be successfully converted, a string can contain a combination of numerical characters, possibly preceded by a minus sign (-). Spaces are not allowed.

Errors: In case of error, an `EConvertError` is raised.

See also: [IntToStr \(467\)](#), [StrToIntDef \(473\)](#)

Listing: `sysutex/ex82.pp`

Program `Example82;`

```
{ $mode objfpc }
```

```
{ This program demonstrates the StrToInt function }
```

```
Uses sysutils;
```

```
Begin
```

```
  Writeln ( StrToInt('1234'));
```

```
  Writeln ( StrToInt('-1234'));
```

```
  Writeln ( StrToInt('0'));
```

```
  Try
```

```
    Writeln ( StrToInt('12345678901234567890'));
```

```
  except
```

```
    On E : EConvertError do
```

```
      Writeln ('Invalid number encountered');
```

```
  end;
```

```
End.
```

StrToIntDef

Declaration: `Function StrToIntDef(const S: string; Default: integer): integer;`

Description: `StrToIntDef` will convert a string to an integer. If the string contains invalid characters or has an invalid format, then `Default` is returned.

To be successfully converted, a string can contain a combination of numerical characters, possibly preceded by a minus sign (-). Spaces are not allowed.

Errors: None.

See also: [IntToStr \(467\)](#), [StrToInt \(473\)](#)

Listing: sysutex/ex83.pp

```

Program Example82;

{$mode objfpc}

{ This program demonstrates the StrToInt function }

Uses sysutils;

Begin
  WriteLn ( StrToIntDef( '1234' ,0));
  WriteLn ( StrToIntDef( '-1234' ,0));
  WriteLn ( StrToIntDef( '0' ,0));
  Try
    WriteLn ( StrToIntDef( '12345678901234567890' ,0));
  except
    On E : EConvertError do
      WriteLn ( 'Invalid number encountered' );
  end;
End.

```

TextToFloat

Declaration: `Function TextToFloat(Buffer: PChar; Var Value: Extended): Boolean;`

Description: `TextToFloat` converts the string in `Buffer` to a floating point value. `Buffer` should contain a valid string representation of a floating point value (either in decimal or scientific notation). If the buffer contains a decimal value, then the decimal separator character can either be a '.' or the value of the `DecimalSeparator` variable.

The function returns `True` if the conversion was successful.

Errors: If there is an invalid character in the buffer, then the function returns `False`

See also: [StrToFloat \(472\)](#), [FloatToStr \(456\)](#), [FormatFloat \(465\)](#)

Listing: sysutex/ex91.pp

```

Program Example91;

{ This program demonstrates the TextToFloat function }
{$mode objfpc}
{$h+ }

Uses SysUtils;

Const
  NrValues = 5;
  TestStr : Array[1..NrValues] of pchar =
    ( '1,1' , '-0,2' , '1,2E-4' , '0' , '1E4' );

Procedure Testit;

```

```
Var
  I : Integer;
  E : Extended;

begin
  Writeln('Using DecimalSeparator : ',DecimalSeparator);
  For I:=1 to NrValues do
    begin
      Writeln('Converting : ',TestStr[i]);
      If TextToFloat(TestStr[i],E) then
        Writeln('Converted value : ',E)
      else
        Writeln('Unable to convert value. ');
    end;
end;

Begin
  DecimalSeparator:=',';
  Testit;
  DecimalSeparator:= '.';
  Testit;
End.
```

Trim

Declaration: `Function Trim(const S: string): string;`

Description: Trim strips blank characters (spaces) at the beginning and end of S and returns the resulting string. Only #32 characters are stripped.

If the string contains only spaces, an empty string is returned.

Errors: None.

See also: [TrimLeft \(476\)](#), [TrimRight \(476\)](#)

Listing: `sysutex/ex84.pp`

Program Example84;

{ This program demonstrates the Trim function }

Uses sysutils;
{H+}

Procedure Testit (S : **String**);

```
begin
  Writeln ('"',Trim(S),'"');
end;
```

```
Begin
  Testit (' ha ha what gets lost ? ');
  Testit (#10#13'haha ');
  Testit (' ');
End.
```

TrimLeft

Declaration: `Function TrimLeft(const S: string): string;`

Description: `TrimLeft` strips blank characters (spaces) at the beginning of `S` and returns the resulting string. Only #32 characters are stripped.

If the string contains only spaces, an empty string is returned.

Errors: None.

See also: [Trim \(475\)](#), [TrimRight \(476\)](#)

Listing: `sysutex/ex85.pp`

Program `Example85;`

{ This program demonstrates the TrimLeft function }

Uses `sysutils;`
`{ $H+ }`

Procedure `Testit (S : String);`

begin
 `WriteLn ('"', TrimLeft(S), '"');`
end;

Begin
 `Testit (' ha ha what gets lost ? ');`
 `Testit (#10#13'haha ');`
 `Testit (' ');`
End.

TrimRight

Declaration: `Function TrimRight(const S: string): string;`

Description: `Trim` strips blank characters (spaces) at the end of `S` and returns the resulting string. Only #32 characters are stripped.

If the string contains only spaces, an empty string is returned.

Errors: None.

See also: [Trim \(475\)](#), [TrimLeft \(476\)](#)

Listing: `sysutex/ex86.pp`

Program `Example86;`

{ This program demonstrates the TrimRight function }

Uses `sysutils;`
`{ $H+ }`

Procedure `Testit (S : String);`

begin

```
    WriteLn ( '', TrimRight(S), '' );  
end;  
  
Begin  
    Testit ( ' ha ha what gets lost ? ' );  
    Testit (#10#13'haha ');  
    Testit ( '          ');  
End.
```

UpperCase

Declaration: `Function UpperCase(const s: string): string;`

Description: `UpperCase` returns the uppercase equivalent of `S`. Ansi characters are not taken into account, only ASCII codes below 127 are converted. It is completely equivalent to the `UpCase` function of the system unit, and is provided for compatibility only.

Errors: None.

See also: [AnsiLowerCase \(446\)](#), [LowerCase \(469\)](#), [AnsiUpperCase \(452\)](#)

Errors:

See also:

Listing: `sysutex/ex87.pp`

Program `Example87;`

{ This program demonstrates the UpperCase function }

Uses `sysutils;`

Begin

```
    WriteLn (UpperCase('this will come OUT ALL uPpErCaSe !'));  
End.
```

Chapter 23

The TYPINFO unit

The `TypeInfo` unit contains many routines which can be used for the querying of the Run-Time Type Information (RTTI) which is generated by the compiler for classes that are compiled under the `{ $M+ }` switch. This information can be used to retrieve or set property values for published properties for totally unknown classes. In particular, it can be used to stream classes. The `TPersistent` class in the `Classes` unit is compiled in the `{ $M+ }` state and serves as the base class for all classes that need to be streamed.

The unit should be compatible to the Delphi 5 unit with the same name. The only calls that are still missing are the Variant calls, since Free Pascal does not support the variant type yet.

The examples in this chapter use a `rttiobj` file, which contains an object that has a published property of all supported types. It also contains some auxiliary routines and definitions.

23.1 Constants, Types and variables

Constants

The following constants are used in the implementation section of the unit.

```
BooleanIdents: array[Boolean] of String = ('False', 'True');  
DotSep: String = '.';
```

The following constants determine the access method for the `Stored` identifier of a property as used in the `PropProcs` field of the `TPropInfo` record:

```
ptField = 0;  
ptStatic = 1;  
ptVirtual = 2;  
ptConst = 3;
```

The following typed constants are used for easy selection of property types.

```
tkAny = [Low(TTypeKind)..High(TTypeKind)];  
tkMethods = [tkMethod];  
tkProperties = tkAny - tkMethods - [tkUnknown];
```

types

The following pointer types are defined:

```

PShortString = ^ShortString;
PByte        = ^Byte;
PWord        = ^Word;
PLongint     = ^Longint;
PBoolean     = ^Boolean;
PSingle      = ^Single;
PDouble      = ^Double;
PExtended    = ^Extended;
PComp        = ^Comp;
PFixed16     = ^Fixed16;
Variant      = Pointer;

```

The TTypeKind determines the type of a property:

```

TTypeKind = (tkUnknown, tkInteger, tkChar, tkEnumeration,
             tkFloat, tkSet, tkMethod, tkSString, tkLString, tkAString,
             tkWString, tkVariant, tkArray, tkRecord, tkInterface,
             tkClass, tkObject, tkWChar, tkBool, tkInt64, tkQWord,
             tkDynArray, tkInterfaceRaw);
tkString = tkSString;

```

tkString is an alias that is introduced for Delphi compatibility.

If the property is an ordinal type, then TOrdType determines the size and sign of the ordinal type:

```

TOrdType = (otSByte, otUByte, otSWord, otUWord, otSLong, otULong);

```

The size of a float type is determined by TFloatType:

```

TFloatType = (ftSingle, ftDouble, ftExtended, ftComp, ftCurr,
             ftFixed16, ftFixed32);

```

A method property (e.g. an event) can have one of several types:

```

TMethodKind = (mkProcedure, mkFunction, mkConstructor, mkDestructor,
              mkClassProcedure, mkClassFunction);

```

The kind of parameter to a method is determined by TParamFlags:

```

TParamFlags = set of (pfVar, pfConst, pfArray, pfAddress, pfReference, pfOut);

```

Interfaces are described further with TntfFlags:

```

TIntfFlags = set of (ifHasGuid, ifDispInterface, ifDispatch);

```

The following defines a set of TTypeKind:

```

TTypeKinds = set of TTypeKind;

```

The TypeInfo function returns a pointer to a TTypeInfo record:

```

TTypeInfo = record
  Kind : TTypeKind;
  Name : ShortString;
end;
PTypeInfo = ^TTypeInfo;
PPTypeInfo = ^PTypeInfo;

```

Note that the Name is stored with as much bytes as needed to store the name, it is not padded to 255 characters. The type data immediately follows the TTypeInfo record as a TTypeData record:

```

PTypeData = ^TTypeData;
TTypeData = packed record
case TTypeKind of
  tkUnknown,tkLString,tkWString,tkAString,tkVariant:
    ();
  tkInteger,tkChar,tkEnumeration,tkWChar:
    (OrdType : TOrdType;
     case TTypeKind of
       tkInteger,tkChar,tkEnumeration,tkBool,tkWChar : (
         MinValue,MaxValue : Longint;
         case TTypeKind of
           tkEnumeration: (
             BaseType : PTypeInfo;
             NameList : ShortString
           )
         );
       tkSet: (
         CompType : PTypeInfo
       )
     );
  tkFloat: (
    FloatType : TFloatType
  );
  tkSString:
    (MaxLength : Byte);
  tkClass:
    (ClassType : TClass;
     ParentInfo : PTypeInfo;
     PropCount : SmallInt;
     UnitName : ShortString
    );
  tkMethod:
    (MethodKind : TMethodKind;
     ParamCount : Byte;
     ParamList : array[0..1023] of Char
     {in reality ParamList is a array[1..ParamCount] of:
    record
      Flags : TParamFlags;
      ParamName : ShortString;
      TypeName : ShortString;
    end;
    followed by
     ResultType : ShortString}
    );
  tkInt64:
    (MinInt64Value, MaxInt64Value: Int64);
  tkQWord:
    (MinQWordValue, MaxQWordValue: QWord);
  tkInterface:
    ();
end;

```

If the `TypeInfo` kind is `tkClass`, then the property information follows the `UnitName` string, as an array of `TPropInfo` records.

The `TPropData` record is not used, but is provided for completeness and compatibility with Delphi.

```
TPropData = packed record
  PropCount : Word;
  PropList : record end;
end;
```

The `TPropInfo` record describes one published property of a class:

```
PPropInfo = ^TPropInfo;
TPropInfo = packed record
  PropType : PTypeInfo;
  GetProc : Pointer;
  SetProc : Pointer;
  StoredProc : Pointer;
  Index : Integer;
  Default : Longint;
  NameIndex : SmallInt;
  PropProcs : Byte;
  Name : ShortString;
end;
```

The `Name` field is stored not with 255 characters, but with just as many characters as required to store the name.

```
TProcInfoProc = procedure(PropInfo : PPropInfo) of object;
```

The following pointer and array types are used for typecasts:

```
PPropList = ^TPropList;
TPropList = array[0..65535] of PPropInfo;
```

23.2 Function list by category

What follows is a listing of the available functions, grouped by category. For each function there is a reference to the page where the function can be found.

Examining published property information

Functions for retrieving or examining property information

Name	Description	Page
<code>FindPropInfo</code>	Getting property type information, With error checking.	483
<code>GetPropInfo</code>	Getting property type information, No error checking.	491
<code>GetPropInfos</code>	Find property information of a certain kind	??
<code>GetObjectPropClass</code>	Return the declared class of an object property	490
<code>GetPropList</code>	Get a list of all published properties	493

IsPublishedProp	Is a property published	496
IsStoredProp	Is a property stored	497
PropIsType	Is a property of a certain kind	498
PropType	Return the type of a property	499

Getting or setting property values

Functions to set or set a property's value.

Name	Description	Page
GetEnumProp	Return the value of an enumerated type property	484
GetFloatProp	Return the value of a float property	485
GetInt64Prop	Return the value of an Int64 property	486
GetMethodProp	Return the value of a procedural type property	487
GetObjectProp	Return the value of an object property	489
GetOrdProp	Return the value of an ordinal type property	490
GetPropValue	Return the value of a property as a variant	494
GetSetProp	Return the value of a set property	494
GetStrProp	Return the value of a string property	495
GetVariantProp	Return the value of a variant property	496
SetEnumProp	Set the value of an enumerated type property	??
SetFloatProp	Set the value of a float property	??
SetInt64Prop	Set the value of an Int64 property	??
SetMethodProp	Set the value of a procedural type property	??
SetObjectProp	Set the value of an object property	??
SetOrdProp	Set the value of an ordinal type property	??
SetPropValue	Set the value of a property through a variant	??
SetSetProp	Set the value of a set property	??
SetStrProp	Set the value of a string property	??
SetVariantProp	Set the value of a variant property	??

Auxiliary functions

Name	Description	Page
GetEnumName	Get an enumerated type element name	484
GetEnumValue	Get ordinal number of an enumerated type, based on the name.	485
GetTypeData	Skip type name and return a pointer to the type data	496
SetToString	Convert a set to its string representation	503
StringToSet	Convert a string representation of a set to a set	504

23.3 Functions and Procedures

FindPropInfo

Declaration: `Function FindPropInfo(AClass:TClass;const PropName: string): PPropInfo;`
`Function FindPropInfo(Instance: TObject; const PropName: string):`
`PPropInfo;`

Description: `FindPropInfo` examines the published property information of a class and returns a pointer to the property information for property `PropName`. The class to be examined can be specified in one of two ways:

AClass class pointer.

Instance an instance of the class to be investigated.

If the property does not exist, a `EPropertyError` exception will be raised. The `GetPropInfo` (491) function has the same function as the `FindPropInfo` function, but returns `Nil` if the property does not exist.

Errors: Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: `GetPropInfo` (491), `GetPropList` (493), `GetPropInfos` (492)

Listing: typinfex/ex14.pp

Program example13;

{ This program demonstrates the FindPropInfo function }

{\$mode objfpc}

uses

rttiobj, typinfo, sysutils;

Var

O : TMyTestObject;

PT : PTypeData;

PI : PPropInfo;

I, J : Longint;

PP : PPropList;

pri : PPropInfo;

begin

O:=TMyTestObject.Create;

PI:=FindPropInfo(O, 'BooleanField');

Writeln('FindPropInfo(Instance, BooleanField) : ', PI^.Name);

PI:=FindPropInfo(O.ClassType, 'ByteField');

Writeln('FindPropInfo(Class, ByteField) : ', PI^.Name);

Write('FindPropInfo(Class, NonExistingProp) : ');

Try

PI:=FindPropInfo(O, 'NonExistingProp');

except

On E: Exception do

Writeln('Caught exception "', E.ClassName, '" with message : ', E.Message);

end;

O.Free;

end.

GetEnumName

Declaration: `Function GetEnumName(TypeInfo : PTypeInfo; Value : Integer) : string;`

Description: `GetEnumName` scans the type information for the enumeration type described by `TypeInfo` and returns the name of the enumeration constant for the element with ordinal value equal to `Value`.

If `Value` is out of range, the first element of the enumeration type is returned. The result is lower-cased, but this may change in the future.

This can be used in combination with `GetOrdProp` to stream a property of an enumerated type.

Errors: No check is done to determine whether `TypeInfo` really points to the type information for an enumerated type.

See also: `GetOrdProp` (490), `GetEnumValue` (485)

Listing: typinfex/ex9.pp

```

program example9;

{ This program demonstrates the GetEnumName, GetEnumValue functions }

{$mode objfpc}

uses rttiobj, typinfo;

Var
  O : TMyTestObject;
  TI : PTypeInfo;

begin
  O := TMyTestObject.Create;
  TI := GetPropInfo(O, 'MyEnumField')^.PropType;
  Writeln ('GetEnumName      : ', GetEnumName(TI, Ord(O.MyEnumField)));
  Writeln ('GetEnumValue(mefirst) : ', GetEnumName(TI, GetEnumValue(TI, 'mefirst')));
  O.Free;
end.

```

GetEnumProp

Declaration: `Function GetEnumProp(Instance: TObject; const PropInfo: PPropInfo): string;`
`Function GetEnumProp(Instance: TObject; const PropName: string): string;`

Description: `GetEnumProp` returns the value of an property of an enumerated type and returns the name of the enumerated value for the object `Instance`. The property whose value must be returned can be specified by its property info in `PropInfo` or by its name in `PropName`

Errors: No check is done to determine whether `PropInfo` really points to the property information for an enumerated type. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: `SetEnumProp` (500) `GetOrdProp` (490), `GetStrProp` (495), `GetInt64Prop` (486), `GetMethodProp` (487), `GetSetProp` (494), `GetObjectProp` (489), `GetEnumProp` (484)

Listing: typinfex/ex2.pp

```

program example2;

{ This program demonstrates the GetEnumerator function }

{$mode objfpc}

uses rttiobj ,typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;
  TI : PTypeInfo;

begin
  O:=TMyTestObject.Create;
  PI:=GetPropInfo(O, 'MyEnumField');
  TI:=PI^.PropType;
  Writeln('Enum property      : ');
  Writeln('Value                : ',GetEnumerator(TI, Ord(O.MyEnumField)));
  Writeln('Get (name)              : ',GetEnumerator(O, 'MyEnumField'));
  Writeln('Get (propinfo)         : ',GetEnumerator(O, PI));
  GetEnumerator(O, 'MyEnumField', 'meFirst');
  Writeln('Set (name, meFirst)    : ',GetEnumerator(TI, Ord(O.MyEnumField)));
  GetEnumerator(O, PI, 'meSecond');
  Writeln('Set (propinfo, meSecond) : ',GetEnumerator(TI, Ord(O.MyEnumField)));
  O.Free;
end.

```

GetEnumeratorValue

Declaration: Function GetEnumeratorValue(TypeInfo : PTypeInfo; const Name : string) : Integer;

Description: GetEnumeratorValue scans the type information for the enumeration type described by TypeInfo and returns the ordinal value for the element in the enumerated type that has identifier Name. The identifier is searched in a case-insensitive manner.

This can be used to set the value of enumerated properties from a stream.

Errors: If Name is not found in the list of enumerated values, then -1 is returned. No check is done whether TypeInfo points to the type information for an enumerated type.

See also: GetEnumeratorName (484), SetOrdProp (502)

For an example, see GetEnumeratorName (484).

GetFloatProp

Declaration: Function GetFloatProp(Instance : TObject; PropInfo : PPropInfo) : Extended;
 Procedure SetFloatProp(Instance: TObject; const PropName: string;
 Value: Extended);

Description: GetFloatProp returns the value of the float property described by PropInfo or with name Propname for the object Instance. All float types are converted to extended.

Errors: No checking is done whether Instance is non-nil, or whether PropInfo describes a valid float property of Instance. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: SetFloatProp (500), GetOrdProp (490), GetStrProp (495), GetInt64Prop (486), GetMethodProp (487), GetSetProp (494), GetObjectProp (489), GetEnumProp (484)

Listing: typinfex/ex4.pp

```

program example4;

{ This program demonstrates the GetFloatProp function }

{$mode objfpc}

uses rttiobj, typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;

begin
  O:=TMyTestObject.Create;
  Writeln('Real property : ');
  PI:=GetPropInfo(O, 'RealField');
  Writeln('Value           : ',O.RealField);
  Writeln('Get (name)         : ',GetFloatProp(O, 'RealField'));
  Writeln('Get (propinfo)      : ',GetFloatProp(O, PI));
  SetFloatProp(O, 'RealField',system.PI);
  Writeln('Set (name, pi)       : ',O.RealField);
  SetFloatProp(O, PI,exp(1));
  Writeln('Set (propinfo,e)    : ',O.RealField);
  Writeln('Extended property : ');
  PI:=GetPropInfo(O, 'ExtendedField');
  Writeln('Value           : ',O.ExtendedField);
  Writeln('Get (name)         : ',GetFloatProp(O, 'ExtendedField'));
  Writeln('Get (propinfo)      : ',GetFloatProp(O, PI));
  SetFloatProp(O, 'ExtendedField',system.PI);
  Writeln('Set (name, pi)       : ',O.ExtendedField);
  SetFloatProp(O, PI,exp(1));
  Writeln('Set (propinfo,e)    : ',O.ExtendedField);
  O.Free;
end.

```

GetInt64Prop

Declaration: Function GetInt64Prop(Instance: TObject; PropInfo: PPropInfo): Int64;
 Function GetInt64Prop(Instance: TObject; const PropName: string):
 Int64;

Description: *Publishing of Int64 properties is not yet supported by Free Pascal. This function is provided for Delphi compatibility only at the moment.*

GetInt64Prop returns the value of the property of type Int64 that is described by PropInfo or with name Propname for the object Instance.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid `Int64` property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception

See also: [SetInt64Prop \(500\)](#), [GetOrdProp \(490\)](#), [GetStrProp \(495\)](#), [GetFloatProp \(485\)](#), [GetMethodProp \(487\)](#), [GetSetProp \(494\)](#), [GetObjectProp \(489\)](#), [GetEnumProp \(484\)](#)

Listing: `typinfex/ex15.pp`

```

program example15;

{ This program demonstrates the GetInt64Prop function }

{$mode objfpc}

uses rttiobj , typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;

begin
  O:=TMyTestObject.Create;
  Writeln('Int64 property : ');
  PI:=GetPropInfo(O, 'Int64Field');
  Writeln('Value           : ',O.Int64Field);
  Writeln('Get (name)         : ',GetInt64Prop(O, 'Int64Field'));
  Writeln('Get (propinfo)      : ',GetInt64Prop(O, PI));
  SetInt64Prop(O, 'Int64Field',12345);
  Writeln('Set (name,12345)    : ',O.Int64Field);
  SetInt64Prop(O, PI,54321);
  Writeln('Set (propinfo ,54321) : ',O.Int64Field);
  O.Free;
end.

```

GetMethodProp

Declaration: `Function GetMethodProp(Instance : TObject;PropInfo : PPropInfo) : TMethod;`
`Function GetMethodProp(Instance: TObject; const PropName: string): TMethod;`

Description: `GetMethodProp` returns the method the property described by `PropInfo` or with name `Propname` for object `Instance`. The return type `TMethod` is defined in the `SysUtils` unit as:

```

TMethod = packed record
  Code, Data: Pointer;
end;

```

`Data` points to the instance of the class with the method `Code`.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid method property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception

See also: [SetMethodProp \(501\)](#), [GetOrdProp \(490\)](#), [GetStrProp \(495\)](#), [GetFloatProp \(485\)](#), [GetInt64Prop \(486\)](#), [GetSetProp \(494\)](#), [GetObjectProp \(489\)](#), [GetEnumProp \(484\)](#)

Listing: typinfex/ex6.pp

```

program example6;

{ This program demonstrates the GetMethodProp function }

{$mode objfpc}

uses rttiobj , typinfo , sysutils ;

Type
  TNotifyObject = Class(TObject)
    Procedure Notification1 (Sender : TObject);
    Procedure Notification2 (Sender : TObject);
  end;

Procedure TNotifyObject.Notification1 (Sender : TObject);

begin
  Write ('Received notification 1 of object with class: ');
  Writeln (Sender.ClassName);
end;

Procedure TNotifyObject.Notification2 (Sender : TObject);

begin
  Write ('Received notification 2 of object with class: ');
  Writeln (Sender.ClassName);
end;

Var
  O : TMyTestObject;
  PI : PPropInfo;
  NO : TNotifyObject;
  M : TMethod;

Procedure PrintMethod (Const M : TMethod);

begin
  If (M.Data=Pointer(NO)) Then
    If (M.Code=Pointer(@TNotifyObject.Notification1)) then
      Writeln (' Notification1 ')
    else If (M.Code=Pointer(@TNotifyObject.Notification2)) then
      Writeln (' Notification2 ')
    else
      begin
        Write ('Unknown method adress (data: ');
        Write (hexStr (Longint(M.data) ,8));
        Writeln (',code: ', hexstr (Longint(M.Code) ,8) , ')');
      end;
end;

begin
  O:=TMyTestObject.Create;
  NO:=TNotifyObject.Create;
  O.NotifyEvent:=@NO.Notification1;
  PI:=GetPropInfo(O, 'NotifyEvent');
  Writeln ('Method property : ');

```

```

Write ( ' Notifying                : ');
O. Notify ;
Write ( 'Get (name)                 : ');
M:=GetMethodProp(O, 'NotifyEvent ');
PrintMethod(M);
Write ( ' Notifying                : ');
O. Notify ;
Write ( 'Get (propinfo)             : ');
M:=GetMethodProp(O, PI);
PrintMethod(M);
M.Data:=No;
M.Code:=Pointer(@NO.Notification2);
SetMethodProp(O, 'NotifyEvent ',M);
Write ( 'Set (name,Notification2)    : ');
M:=GetMethodProp(O, PI);
PrintMethod(M);
Write ( ' Notifying                : ');
O. Notify ;
Write ( 'Set (propinfo , Notification1) : ');
M.Data:=No;
M.Code:=Pointer(@NO.Notification1);
SetMethodProp(O, PI,M);
M:=GetMethodProp(O, PI);
PrintMethod(M);
Write ( ' Notifying                : ');
O. Notify ;
O. Free;
end.

```

GetObjectProp

Declaration: Function GetObjectProp(Instance: TObject; const PropName: string): TObject;
 Function GetObjectProp(Instance: TObject; const PropName: string; MinClass:TClass): TObject;
 Function GetObjectProp(Instance: TObject; PropInfo: PPropInfo; MinClass: TClass): TObject;

Description: GetObjectProp returns the object which the property described by PropInfo with name Propname points to for object Instance.

If MinClass is specified, then if the object is not descendent of class MinClass, then Nil is returned.

Errors: No checking is done whether Instance is non-nil, or whether PropInfo describes a valid method property of Instance. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: SetMethodProp (501), GetOrdProp (490), GetStrProp (495), GetFloatProp (485), GetInt64Prop (486), GetSetProp (494), GetObjectProp (489), GetEnumerator (484)

Listing: typinfex/ex5.pp

```

program example5;

{ This program demonstrates the GetObjectProp function }

```

```

{$mode objfpc}

uses rttiobj, typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;
  NO1, NO2 : TNamedObject;

begin
  O := TMyTestObject.Create;
  NO1 := TNamedObject.Create;
  NO1.ObjectName := 'First named object';
  NO2 := TNamedObject.Create;
  NO2.ObjectName := 'Second named object';
  O.ObjField := NO1;
  Writeln('Object property : ');
  PI := GetPropInfo(O, 'ObjField');
  Write('Property class      : ');
  Writeln(GetObjectPropClass(O, 'ObjField').ClassName);
  Write('Value                : ');
  Writeln((O.ObjField as TNamedObject).ObjectName);
  Write('Get (name)              : ');
  Writeln((GetObjectProp(O, 'ObjField') as TNamedObject).ObjectName);
  Write('Get (propinfo)         : ');
  Writeln((GetObjectProp(O, PI, TObj) as TNamedObject).ObjectName);
  SetObjectProp(O, 'ObjField', NO2);
  Write('Set (name, NO2)        : ');
  Writeln((O.ObjField as TNamedObject).ObjectName);
  SetObjectProp(O, PI, NO1);
  Write('Set (propinfo, NO1)   : ');
  Writeln((O.ObjField as TNamedObject).ObjectName);
  O.Free;
end.

```

GetObjectPropClass

Declaration: Function GetObjectPropClass(Instance: TObj; const PropName: string): TClass;

Description: GetObjectPropClass returns the declared class of the property with name PropName. This may not be the actual class of the property value.

Errors: No checking is done whether Instance is non-nil. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: SetMethodProp (501), GetOrdProp (490), GetStrProp (495), GetFloatProp (485), GetInt64Prop (486)

For an example, see GetObjectProp (489).

GetOrdProp

Declaration: Function GetOrdProp(Instance : TObj; PropInfo : PPropInfo) : Longint;
Function GetOrdProp(Instance: TObj; const PropName: string): Longint;

Description: `GetOrdProp` returns the value of the ordinal property described by `PropInfo` or with name `PropName` for the object `Instance`. The value is returned as a longint, which should be typecasted to the needed type.

Ordinal properties that can be retrieved include:

Integers and subranges of integersThe value of the integer will be returned.

Enumerated types and subranges of enumerated typesThe ordinal value of the enumerated type will be returned.

SetsIf the base type of the set has less than 31 possible values. If a bit is set in the return value, then the corresponding element of the base ordinal class of the set type must be included in the set.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid ordinal property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: `SetOrdProp` (502), `GetStrProp` (495), `GetFloatProp` (485), `GetInt64Prop` (486), `GetMethodProp` (487), `GetSetProp` (494), `GetObjectProp` (489), `GetEnumProp` (484)

Listing: `typinfex/ex1.pp`

```

program example1;

{ This program demonstrates the GetOrdProp function }

{$mode objfpc}

uses rttiobj , typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;

begin
  O:=TMyTestObject.Create;
  Writeln( 'Boolean property      : ');
  Writeln( 'Value                  : ',O.BooleanField);
  Writeln( 'Ord(Value)              : ',Ord(O.BooleanField));
  Writeln( 'Get (name)              : ',GetOrdProp(O, 'BooleanField'));
  PI:=GetPropInfo(O, 'BooleanField');
  Writeln( 'Get (propinfo)           : ',GetOrdProp(O, PI));
  SetOrdProp(O, 'BooleanField',Ord(False));
  Writeln( 'Set (name, false)         : ',O.BooleanField);
  SetOrdProp(O, PI,Ord(True));
  Writeln( 'Set (propinfo, true)      : ',O.BooleanField);
  O.Free;
end.

```

GetPropInfo

Declaration: `Function GetPropInfo(AClass: TClass; const PropName: string; AKinds: TTypeKinds) : PPropInfo;`
`Function GetPropInfo(AClass: TClass; const PropName: string): PPropInfo;`
`Function GetPropInfo(Instance: TObject; const PropName: string): PPropInfo;`
`Function GetPropInfo(Instance: TObject; const PropName: string; AKinds: TTypeKinds) : PPropInfo;`

```
Function GetPropInfo(TypeInfo: PTypeInfo;const PropName: string) :
PPropInfo;
Function GetPropInfo(TypeInfo: PTypeInfo;const PropName: string; AKinds
: TTypeKinds) : PPropInfo;
```

Description: `GetPropInfo` returns a pointer to the `TPropInfo` record for a the `PropName` property of a class. The class to examine can be specified in one of three ways:

InstanceAn instance of the class.

AClassA class pointer to the class.

TypeInfoA pointer to the type information of the class.

In each of these three ways, if `AKinds` is specified, if the property has `TypeKind` which is not included in `Akinds`, `Nil` will be returned.

Errors: If the property `PropName` does not exist, `Nil` is returned.

See also: `GetPropInfos` (492),`GetPropList` (493)

For an example, see most of the other functions.

GetPropInfos

Declaration: `Procedure GetPropInfos(TypeInfo: PTypeInfo;PropList: PPropList);`

Description: `GetPropInfos` stores pointers to the property information of all published properties of a class with class info `TypeInfo` in the list pointed to by `PropList`. The `PropList` pointer must point to a memory location that contains enough space to hold all properties of the class and its parent classes.

Errors: No checks are done to see whether `PropList` points to a memory area that is big enough to hold all pointers.

See also: `GetPropInfo` (491),`GetPropList` (493)

Listing: `typinfex/ex12.pp`

Program `example12;`

{ This program demonstrates the GetPropInfos function }

uses

`rttiobj , typinfo ;`

Var

`O : TMyTestObject;`

`PT : PTypeData;`

PI : PTypeInfo;

`I ,J : Longint;`

`PP : PPropList;`

`pri : PPropInfo;`

begin

`O:=TMyTestObject.Create;`

PI:=O.ClassInfo;

`PT:=GetTypeData(PI);`

```

WriteIn( 'Property Count : ',PT^.PropCount);
GetMem (PP,PT^.PropCount*SizeOf( Pointer ));
GetPropInfos(PI,PP);
For I:=0 to PT^.PropCount-1 do
  begin
    With PP^[i]^ do
      begin
        Write( 'Property ',i+1:3,' : ',name:30);
        writeln( ' Type: ',TypeNames[typinfo.PropType(O,Name)]);
      end;
    end;
  FreeMem(PP);
  O.Free;
end.

```

GetPropList

Declaration: Function `GetPropList`(TypeInfo : PTypeInfo; TypeKinds : TTypeKinds; PropList : PPropList) : Integer;

Description: `GetPropList` stores pointers to property information of the class with class info `TypeInfo` for properties of kind `TypeKinds` in the list pointed to by `PropList`. `PropList` must contain enough space to hold all properties.

The function returns the number of pointers that matched the criteria and were stored in `PropList`.

Errors: No checks are done to see whether `PropList` points to a memory area that is big enough to hold all pointers.

See also: `GetPropInfos` (492), `GetPropInfo` (491)

Listing: typinfex/ex13.pp

Program example13;

{ This program demonstrates the GetPropList function }

uses

rttiobj , typinfo ;

Var

O : TMyTestObject;

PT : PTypeData;

PI : PTypeInfo;

I , J : Longint;

PP : PPropList;

pri : PPropInfo;

begin

O:=TMyTestObject.Create;

PI:=O.ClassInfo;

PT:=GetTypeData(**PI**);

WriteIn('Total property Count : ',PT^.PropCount);

GetMem (PP,PT^.PropCount***SizeOf**(Pointer));

J:=GetPropList(**PI**,OrdinalTypes,PP);

WriteIn('Ordinal property Count : ',J);

For I:=0 **to** J-1 **do**

```

begin
  With PP^[i]^ do
    begin
      Write('Property ',i+1:3,' : ',name:30);
      writeln('  Type: ',TypeNames[typinfo.PropType(O,Name)]);
    end;
  end;
  FreeMem(PP);
  O.Free;
end.

```

GetPropValue

Declaration: Function GetPropValue(Instance: TObject; const PropName: string): Variant;
 Function GetPropValue(Instance: TObject; const PropName: string; PreferStrings: Boolean): Variant;

Description: Due to missing Variant support, GetPropValue is not yet implemented. The declaration is provided for compatibility with Delphi.

Errors:

See also:

GetSetProp

Declaration: Function GetSetProp(Instance: TObject; const PropInfo: PPropInfo; Brackets: Boolean): string;
 Function GetSetProp(Instance: TObject; const PropName: string): string;
 Function GetSetProp(Instance: TObject; const PropName: string; Brackets: Boolean): string;

Description: GetSetProp returns the contents of a set property as a string. The property to be returned can be specified by its name in PropName or by its property information in PropInfo.

The returned set is a string representation of the elements in the set as returned by [SetToString \(503\)](#). The Brackets option can be used to enclose the string representation in square brackets.

Errors: No checking is done whether Instance is non-nil, or whether PropInfo describes a valid ordinal property of Instance. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: [SetSetProp \(502\)](#), [GetStrProp \(495\)](#), [GetFloatProp \(485\)](#), [GetInt64Prop \(486\)](#), [GetMethodProp \(487\)](#)

Listing: typinfex/ex7.pp

```

program example7;

{ This program demonstrates the GetSetProp function }

{$mode objfpc}

uses rttiobj, typinfo;

```

```

Var
  O : TMyTestObject;
  PI : PPropInfo;

Function SetAsString (ASet : TMyEnums) : String;

Var
  i : TmyEnum;

begin
  result := '';
  For i := mefirst to methird do
    If i in ASet then
      begin
        If (Result <> '') then
          Result := Result + ', ';
          Result := Result + MyEnumNames[ i ];
        end;
      end;
end;

Var
  S : TMyEnums;

begin
  O := TMyTestObject.Create;
  O.SetField := [ mefirst, meSecond, meThird ];
  Writeln ( 'Set property      : ' );
  Writeln ( 'Value                    : ', SetAsString ( O.SetField ) );
  Writeln ( 'Ord ( Value )              : ', Longint ( O.SetField ) );
  Writeln ( 'Get ( name )                : ', GetSetProp ( O, 'SetField' ) );
  PI := GetPropInfo ( O, 'SetField' );
  Writeln ( 'Get ( propinfo )            : ', GetSetProp ( O, PI, false ) );
  S := [ meFirst, meThird ];
  SetOrdProp ( O, 'SetField', Integer ( S ) );
  Write ( 'Set ( name, [ mefirst, methird ] : ' );
  Writeln ( SetAsString ( O.SetField ) );
  S := [ meSecond ];
  SetOrdProp ( O, PI, Integer ( S ) );
  Write ( 'Set ( propinfo, [ meSecond ]    : ' );
  Writeln ( SetAsString ( O.SetField ) );
  O.Free;
end.

```

GetStrProp

Declaration: `Function GetStrProp (Instance : TObject; PropInfo : PPropInfo) : Ansistring;`
`Function GetStrProp (Instance: TObject; const PropName: string): string;`

Description: `GetStrProp` returns the value of the string property described by `PropInfo` or with name `PropName` for object `Instance`.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid string property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: `SetStrProp` (503), `GetOrdProp` (490), `GetFloatProp` (485), `GetInt64Prop` (486), `GetMethodProp` (487)

Listing: typinfex/ex3.pp

```

program example3;

{ This program demonstrates the GetStrProp function }

{$mode objfpc}

uses rttiobj, typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;

begin
  O:=TMyTestObject.Create;
  PI:=GetPropInfo(O, 'AnsiStringField');
  Writeln('String property : ');
  Writeln('Value           : ',O.AnsiStringField);
  Writeln('Get (name)           : ',GetStrProp(O, 'AnsiStringField'));
  Writeln('Get (propinfo)        : ',GetStrProp(O, PI));
  SetStrProp(O, 'AnsiStringField', 'First');
  Writeln('Set (name, ''First'')   : ',O.AnsiStringField);
  SetStrProp(O, PI, 'Second');
  Writeln('Set (propinfo, ''Second'') : ',O.AnsiStringField);
  O.Free;
end.

```

GetTypeData

Declaration: `Function GetTypeData(TypeInfo : PTypeInfo) : PTypeData;`

Description: `GetTypeData` returns a pointer to the `TTypeData` record that follows after the `TTypeInfo` record pointed to by `TypeInfo`. It essentially skips the `Kind` and `Name` fields in the `TTypeInfo` record.

Errors: None.

See also:

GetVariantProp

Declaration: `Function GetVariantProp(Instance : TObject; PropInfo : PPropInfo) : Variant;`

Description: Due to missing `Variant` support, the `GetVariantProp` function is not yet implemented. Provided for Delphi compatibility only.

Errors:

See also: `SetVariantProp` (504)

IsPublishedProp

Declaration: `Function IsPublishedProp(AClass: TClass; const PropName: string) : Boolean;`

```
Function IsPublishedProp(Instance: TObject; const PropName: string):
Boolean;
```

Description: `IsPublishedProp` returns true if a class has a published property with name `PropName`. The class can be specified in one of two ways:

AClass A class pointer to the class.

Instance An instance of the class.

Errors: No checks are done to ensure `Instance` or `AClass` are valid pointers. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: `IsStoredProp` (497), `PropsType` (498)

Listing: `typinfex/ex10.pp`

```
program example10;

{ This program demonstrates the IsPublishedProp function }

{$mode objfpc}

uses rttiobj , typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;

begin
  O:=TMyTestObject.Create;
  Writeln('Property tests      : ');
  Write('IsPublishedProp(O, BooleanField)      : ');
  Writeln(IsPublishedProp(O, 'BooleanField'));
  Write('IsPublishedProp(Class, BooleanField) : ');
  Writeln(IsPublishedProp(O.ClassType, 'BooleanField'));
  Write('IsPublishedProp(O, SomeField)          : ');
  Writeln(IsPublishedProp(O, 'SomeField'));
  Write('IsPublishedProp(Class, SomeField)      : ');
  Writeln(IsPublishedProp(O.ClassType, 'SomeField'));
  O.Free;
end.
```

IsStoredProp

Declaration: `Function IsStoredProp(Instance : TObject; PropInfo : PPropInfo) : Boolean;`
`Function IsStoredProp(Instance: TObject; const PropName: string): Boolean;`

Description: `IsStoredProp` returns `True` if the `Stored` modifier evaluates to `True` for the property described by `PropInfo` or with name `PropName` for object `Instance`. It returns `False` otherwise. If the function returns `True`, this indicates that the property should be written when streaming the object `Instance`.

If there was no `stored` modifier in the declaration of the property, `True` will be returned.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: [IsPublishedProp \(496\)](#), [ProplsType \(498\)](#)

Listing: typinfex/ex11.pp

```

program example11;

{ This program demonstrates the IsStoredProp function }

{$mode objfpc}

uses rttiobj , typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;

begin
  O:=TMyTestObject.Create;
  WriteIn( 'Stored tests      : ');
  Write( 'IsStoredProp(O, StoredIntegerConstFalse)      : ');
  WriteIn( IsStoredProp(O, 'StoredIntegerConstFalse' ));
  Write( 'IsStoredProp(O, StoredIntegerConstTrue)      : ');
  WriteIn( IsStoredProp(O, 'StoredIntegerConstTrue' ));
  Write( 'IsStoredProp(O, StoredIntegerMethod)          : ');
  WriteIn( IsStoredProp(O, 'StoredIntegerMethod' ));
  Write( 'IsStoredProp(O, StoredIntegerVirtualMethod) : ');
  WriteIn( IsStoredProp(O, 'StoredIntegerVirtualMethod' ));
  O.Free;
end.

```

ProplsType

Declaration: Function PropIsType(AClass: TClass; const PropName: string; TypeKind: TTypeKind): Boolean;
 Function PropIsType(Instance: TObject; const PropName: string; TypeKind: TTypeKind): Boolean;

Description: PropIsType returns True if the property with name PropName has type TypeKind. It returns False otherwise. The class to be examined can be specified in one of two ways:

AClassA class pointer.

InstanceAn instance of the class.

Errors: No checks are done to ensure Instance or AClass are valid pointers. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: [IsPublishedProp \(496\)](#), [IsStoredProp \(497\)](#), [PropType \(499\)](#)

Listing: typinfex/ex16.pp

```

program example16;

{ This program demonstrates the ProplsType function }

{$mode objfpc}

uses rttiobj , typinfo;

```

```

Var
  O : TMyTestObject;

begin
  O:=TMyTestObject.Create;
  Writeln('Property tests      : ');
  Write(' PropIsType(O, BooleanField , tkBool)      : ');
  Writeln(PropIsType(O, ' BooleanField ', tkBool));
  Write(' PropIsType(Class, BooleanField , tkBool) : ');
  Writeln(PropIsType(O.ClassType, ' BooleanField ', tkBool));
  Write(' PropIsType(O, ByteField , tkString)      : ');
  Writeln(PropIsType(O, ' ByteField ', tkString));
  Write(' PropIsType(Class, ByteField , tkString) : ');
  Writeln(PropIsType(O.ClassType, ' ByteField ', tkString));
  O.Free;
end.

```

PropType

Declaration: Function PropType(AClass: TClass; const PropName: string): TTypeKind;
 Function PropType(Instance: TObject; const PropName: string): TTypeKind;

Description: PropType returns the type of the property PropName for a class. The class to be examined can be specified in one of 2 ways:

AClassA class pointer.

InstanceAn instance of the class.

Errors: No checks are done to ensure Instance or AClass are valid pointers. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: IsPublishedProp (496), IsStoredProp (497), PropIsType (498)

Listing: typinfex/ex17.pp

```

program example17;

{ This program demonstrates the PropType function }

{$mode objfpc}

uses rttiobj , typinfo ;

Var
  O : TMyTestObject;

begin
  O:=TMyTestObject.Create;
  Writeln('Property tests      : ');
  Write(' PropType(O, BooleanField)      : ');
  Writeln(TypeNames[ PropType(O, ' BooleanField ')]);
  Write(' PropType(Class, BooleanField) : ');
  Writeln(TypeNames[ PropType(O.ClassType, ' BooleanField ')]);
  Write(' PropType(O, ByteField)      : ');
  Writeln(TypeNames[ PropType(O, ' ByteField ')]);
  Write(' PropType(Class, ByteField)   : ');

```

```
    WriteIn (TypeNames[ PropType (O. ClassType , 'ByteField ' )]);  
    O. Free ;  
end.
```

SetEnumProp

Declaration: Procedure SetEnumProp(Instance: TObject; const PropInfo: PPropInfo;
const Value: string);
Procedure SetEnumProp(Instance: TObject; const PropName: string; const
Value: string);

Description: SetEnumProp sets the property described by PropInfo or with name PropName to Value. Value must be a string with the name of the enumerate value, i.e. it can be used as an argument to GetEnumValue (485).

Errors: No checks are done to ensure Instance or PropInfo are valid pointers. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: GetEnumProp (484), SetStrProp (503), SetFloatProp (500), SetInt64Prop (500), SetMethodProp (501).

For an example, see GetEnumProp (484).

SetFloatProp

Declaration: Procedure SetFloatProp(Instance : TObject; PropInfo : PPropInfo; Value
: Extended);
Procedure SetFloatProp(Instance: TObject; const PropName: string;
Value: Extended);

Description: SetFloatProp assigns Value to the property described by PropInfo or with name Propname for the object Instance.

Errors: No checking is done whether Instance is non-nil, or whether PropInfo describes a valid float property of Instance. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: GetFloatProp (485), SetOrdProp (502), SetStrProp (503), SetInt64Prop (500), SetMethodProp (501)

For an example, see GetFloatProp (485).

SetInt64Prop

Declaration: Procedure SetInt64Prop(Instance: TObject; PropInfo: PPropInfo; const
Value: Int64);
Procedure SetInt64Prop(Instance: TObject; const PropName: string;
const Value: Int64);

Description: SetInt64Prop assigns Value to the property of type Int64 that is described by PropInfo or with name Propname for the object Instance.

Errors: No checking is done whether Instance is non-nil, or whether PropInfo describes a valid Int64 property of Instance. Specifying an invalid property name in PropName will result in an EPropertyError exception.

See also: [GetInt64Prop \(486\)](#), [GetMethodProp \(487\)](#), [SetOrdProp \(502\)](#), [SetStrProp \(503\)](#), [SetFloatProp \(500\)](#)

For an example, see [GetInt64Prop \(486\)](#).

SetMethodProp

Declaration: `Procedure SetMethodProp(Instance : TObject; PropInfo : PPropInfo; const Value : TMethod);`
`Procedure SetMethodProp(Instance: TObject; const PropName: string; const Value: TMethod);`

Description: `SetMethodProp` assigns `Value` to the method the property described by `PropInfo` or with name `Propname` for object `Instance`.

The type `TMethod` of the `Value` parameter is defined in the `SysUtils` unit as:

```
TMethod = packed record
  Code, Data: Pointer;
end;
```

`Data` should point to the instance of the class with the method `Code`.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid method property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: [GetMethodProp \(487\)](#), [SetOrdProp \(502\)](#), [SetStrProp \(503\)](#), [SetFloatProp \(500\)](#), [SetInt64Prop \(500\)](#)

For an example, see [GetMethodProp \(487\)](#).

SetObjectProp

Declaration: `Procedure SetObjectProp(Instance: TObject; PropInfo: PPropInfo; Value: TObject);`
`Procedure SetObjectProp(Instance: TObject; const PropName: string; Value: TObject);`

Description: `SetObjectProp` assigns `Value` to the the object property described by `PropInfo` or with name `Propname` for the object `Instance`.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid method property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: [GetObjectProp \(489\)](#), [SetOrdProp \(502\)](#), [SetStrProp \(503\)](#), [SetFloatProp \(500\)](#), [SetInt64Prop \(500\)](#), [SetMethodProp \(501\)](#)

For an example, see [GetObjectProp \(489\)](#).

SetOrdProp

Declaration: `Procedure SetOrdProp(Instance : TObject; PropInfo : PPropInfo; Value : Longint);`
`Procedure SetOrdProp(Instance: TObject; const PropName: string; Value: Longint);`

Description: `SetOrdProp` assigns `Value` to the the ordinal property described by `PropInfo` or with name `Propname` for the object `Instance`.

Ordinal properties that can be set include:

Integers and subranges of integersThe actual value of the integer must be passed.

Enumerated types and subranges of enumerated typesThe ordinal value of the enumerated type must be passed.

Subrange typesof integers or enumerated types. Here the ordinal value must be passed.

SetsIf the base type of the set has less than 31 possible values. For each possible value; the corresponding bit of `Value` must be set.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid ordinal property of `Instance`. No range checking is performed. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: `GetOrdProp` (490), `SetStrProp` (503), `SetFloatProp` (500), `SetInt64Prop` (500), `SetMethodProp` (501)

For an example, see `GetOrdProp` (490).

SetPropValue

Declaration: `Procedure SetPropValue(Instance: TObject; const PropName: string; const Value: Variant);`

Description: Due to missing `Variant` support, this function is not yet implemented; it is provided for Delphi compatibility only.

Errors:

See also:

SetSetProp

Declaration: `Procedure SetSetProp(Instance: TObject; const PropInfo: PPropInfo; const Value: string);`
`Procedure SetSetProp(Instance: TObject; const PropName: string; const Value: string);`

Description: `SetSetProp` sets the property specified by `PropInfo` or `PropName` for object `Instance` to `Value`. `Value` is a string which contains a comma-separated list of values, each value being a string-representation of the enumerated value that should be included in the set. The value should be accepted by the `StringToSet` (504) function.

The value can be formed using the `SetToString` (503) function.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid ordinal property of `Instance`. No range checking is performed. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: [GetSetProp \(494\)](#), [SetOrdProp \(502\)](#), [SetStrProp \(503\)](#), [SetFloatProp \(500\)](#), [SetInt64Prop \(500\)](#), [SetMethodProp \(501\)](#), [SetToString \(503\)](#), [StringToSet \(504\)](#)

For an example, see [GetSetProp \(494\)](#).

SetStrProp

Declaration: `procedure SetStrProp(Instance : TObject; PropInfo : PPropInfo; const Value : Ansistring);`
`Procedure SetStrProp(Instance: TObject; const PropName: string; const Value: AnsiString);`

Description: `SetStrProp` assigns `Value` to the string property described by `PropInfo` or with name `Propname` for object `Instance`.

Errors: No checking is done whether `Instance` is non-nil, or whether `PropInfo` describes a valid string property of `Instance`. Specifying an invalid property name in `PropName` will result in an `EPropertyError` exception.

See also: [GetStrProp \(495\)](#), [SetOrdProp \(502\)](#), [SetFloatProp \(500\)](#), [SetInt64Prop \(500\)](#), [SetMethodProp \(501\)](#)

For an example, see [GetStrProp \(495\)](#)

SetToString

Declaration: `function SetToString(PropInfo: PPropInfo; Value: Integer) : String;`
`function SetToString(PropInfo: PPropInfo; Value: Integer; Brackets: Boolean) : String;`

Description: `SetToString` takes an integer representation of a set (as received e.g. by `GetOrdProp`) and turns it into a string representing the elements in the set, based on the type information found in the `PropInfo` property information. By default, the string representation is not surrounded by square brackets. Setting the `Brackets` parameter to `True` will surround the string representation with brackets.

The function returns the string representation of the set.

Errors: No checking is done to see whether `PropInfo` points to valid property information.

See also: [GetEnumName \(484\)](#), [GetEnumValue \(485\)](#), [StringToSet \(504\)](#)

Listing: `typinfex/ex18.pp`

```

program example18;

{ This program demonstrates the SetToString function }

{$mode objfpc}

uses rttiobj , typinfo;

Var
  O : TMyTestObject;
  PI : PPropInfo;
  I : longint;

```

```

begin
  O:=TMyTestObject.Create;
  PI:=GetPropInfo(O,'SetField');
  O.SetField:=[mefirst,meSecond,meThird];
  I:=GetOrdProp(O,PI);
  WriteLn('Set property to string : ');
  WriteLn('Value : ',SetToString(PI,I,False));
  O.SetField:=[mefirst,meSecond];
  I:=GetOrdProp(O,PI);
  WriteLn('Value : ',SetToString(PI,I,True));
  I:=StringToSet(PI,'mefirst');
  SetOrdProp(O,PI,I);
  I:=GetOrdProp(O,PI);
  WriteLn('Value : ',SetToString(PI,I,False));
  I:=StringToSet(PI,'[mesecond, methird]');
  SetOrdProp(O,PI,I);
  I:=GetOrdProp(O,PI);
  WriteLn('Value : ',SetToString(PI,I,True));
  O.Free;
end.

```

SetVariantProp

Declaration: Procedure SetVariantProp(Instance : TObject; PropInfo : PPropInfo; Const Value: Variant);
 Procedure SetVariantProp(Instance: TObject; const PropName: string; const Value: Variant);

Description: Due to missing Variant support, this function is not yet implemented. Provided for Delphi compatibility only.

Errors:

See also:

StringToSet

Declaration: function StringToSet(PropInfo: PPropInfo; const Value: string): Integer;

Description: StringToSet converts the string representation of a set in Value to a integer representation of the set, using the property information found in PropInfo. This property information should point to the property information of a set property. The function returns the integer representation of the set. (i.e, the set value, typecast to an integer)

The string representation can be surrounded with square brackets, and must consist of the names of the elements of the base type of the set. The base type of the set should be an enumerated type. The elements should be separated by commas, and may be surrounded by spaces. each of the names will be fed to the [GetEnumValue \(485\)](#) function.

Errors: No checking is done to see whether PropInfo points to valid property information. If a wrong name is given for an enumerated value, then an EPropertyError will be raised.

See also: [GetEnumName \(484\)](#), [GetEnumValue \(485\)](#), [SetToString \(503\)](#)

For an example, see [SetToString \(503\)](#).

Chapter 24

The VIDEO unit

The Video unit implements a screen access layer which is system independent. It can be used to write on the screen in a system-independent way, which should be optimal on all platforms for which the unit is implemented.

The working of the Video is simple: After calling `InitVideo` (515), the array `VideoBuf` contains a representation of the video screen of size `ScreenWidth*ScreenHeight`, going from left to right and top to bottom when walking the array elements: `VideoBuf[0]` contains the character and color code of the top-left character on the screen. `VideoBuf[ScreenWidth]` contains the data for the character in the first column of the second row on the screen, and so on.

To write to the 'screen', the text to be written should be written to the `VideoBuf` array. Calling `UpdateScreen` (519) will then cp the text to the screen in the most optimal way. (an example can be found further on).

The color attribute is a combination of the foreground and background color, plus the blink bit. The bits describe the various color combinations:

bits 0-3 The foreground color. Can be set using all color constants.

bits 4-6 The background color. Can be set using a subset of the color constants.

bit 7 The blinking bit. If this bit is set, the character will appear blinking.

Each possible color has a constant associated with it, see page 506 for a list of constants.

The contents of the `VideoBuf` array may be modified: This is 'writing' to the screen. As soon as everything that needs to be written in the array is in the `VideoBuf` array, calling `UpdateScreen` will copy the contents of the array screen to the screen, in a manner that is as efficient as possible.

The updating of the screen can be prohibited to optimize performance; To this end, the `LockScreenUpdate` (516) function can be used: This will increment an internal counter. As long as the counter differs from zero, calling `UpdateScreen` (519) will not do anything. The counter can be lowered with `UnlockScreenUpdate` (518). When it reaches zero, the next call to `UpdateScreen` (519) will actually update the screen. This is useful when having nested procedures that do a lot of screen writing.

The video unit also presents an interface for custom screen drivers, thus it is possible to override the default screen driver with a custom screen driver, see the `SetVideoDriver` (517) call. The current video driver can be retrieved using the `GetVideoDriver` (513) call.

Remark: The video unit should *not* be used together with the crt unit. Doing so will result in very strange behaviour, possibly program crashes.

24.1 Constants, Type and variables

Constants

The following constants describe colors that can be used as foreground and background colors.

```
Black      = 0;
Blue      = 1;
Green     = 2;
Cyan      = 3;
Red       = 4;
Magenta   = 5;
Brown     = 6;
LightGray = 7;
```

The following color constants can be used as foreground colors only:

```
DarkGray   = 8;
LightBlue  = 9;
LightGreen = 10;
LightCyan  = 11;
LightRed   = 12;
LightMagenta = 13;
Yellow     = 14;
White      = 15;
```

The foreground and background color can be combined to a color attribute with the following code:

```
Attr:=ForeGroundColor + (BackGroundColor shl 4);
```

The color attribute can be logically or-ed with the blink attribute to produce a blinking character:

```
Blink      = 128;
```

But not all drivers may support this.

The following constants describe the capabilities of a certain video mode:

```
cpUnderLine = $0001;
cpBlink     = $0002;
cpColor     = $0004;
cpChangeFont = $0008;
cpChangeMode = $0010;
cpChangeCursor = $0020;
```

The following constants describe the various supported cursor modes:

```
crHidden     = 0;
crUnderLine  = 1;
crBlock     = 2;
crHalfBlock  = 3;
```

When a video function needs to report an error condition, the following constants are used:

```

vioOK           = 0;
errVioBase     = 1000;
errVioInit     = errVioBase + 1; { Initialization error}
errVioNotSupported = errVioBase + 2; { Unsupported function }
errVioNoSuchMode = errVioBase + 3; { No such video mode }

```

The following constants can be read to get some information about the current screen:

```

ScreenWidth    : Word = 0; { Width of the screen, in characters }
ScreenHeight   : Word = 0; { Height of the screen, in characters }
LowAscii       : Boolean = true;
NoExtendedFrame : Boolean = false;
FVMaxWidth     = 132;

```

The error-handling code uses the following constants:

```

errOk          = 0;
ErrorCode: Longint = ErrOK;
ErrorInfo: Pointer = nil;
ErrorHandler: TErrorHandler = DefaultErrorHandler;

```

The `ErrorHandler` variable can be set to a custom-error handling function. It is set by default to the `DefaultErrorHandler` (510) function.

Types

The `TVideoMode` record describes a videomode. Its fields are self-explaining: `Col`, `Row` describe the number of columns and rows on the screen for this mode. `Color` is `True` if this mode supports colors, or `False` if not.

```

PVideoMode = ^TVideoMode;
TVideoMode = record
  Col, Row : Word;
  Color    : Boolean;
end;

```

`TVideoCell` describes one character on the screen. One of the bytes contains the color attribute with which the character is drawn on the screen, and the other byte contains the ASCII code of the character to be drawn. The exact position of the different bytes in the record is operating system specific. On most little-endian systems, the high byte represents the color attribute, while the low-byte represents the ASCII code of the character to be drawn.

```

TVideoCell = Word;
PVideoCell = ^TVideoCell;

```

The `TVideoBuf` and `PVideoBuf` are two types used to represent the screen.

```

TVideoBuf = array[0..32759] of TVideoCell;
PVideoBuf = ^TVideoBuf;

```

The following type is used when reporting error conditions:

```

TErrorHandlerReturnValue = (errRetry, errAbort, errContinue);

```

Here, `errRetry` means retry the operation, `errAbort` abort and return error code and `errContinue` means abort without returning an errorcode.

The `TErrorHandler` function is used to register an own error handling function. It should be used when installing a custom error handling function, and must return one of the above values.

```
TErrorHandler =
  function (Code: Longint; Info: Pointer): TErrorHandlerReturnValue;
```

Code should contain the error code for the error condition, and the `Info` parameter may contain any data type specific to the error code passed to the function.

The `TVideoDriver` record can be used to install a custom video driver, with the `SetVideoDriver` (517) call:

```
TVideoDriver = Record
  InitDriver      : Procedure;
  DoneDriver      : Procedure;
  UpdateScreen    : Procedure(Force : Boolean);
  ClearScreen     : Procedure;
  SetVideoMode    : Function (Const Mode : TVideoMode) : Boolean;
  GetVideoModeCount : Function : Word;
  GetVideoModeData : Function(Index : Word; Var Data : TVideoMode) : Boolean;
  SetCursorPos    : procedure (NewCursorX, NewCursorY: Word);
  GetCursorType   : function : Word;
  SetCursorType   : procedure (NewType: Word);
  GetCapabilities : Function : Word;
end;
```

Variables

The following variables contain information about the current screen status:

```
ScreenColor      : Boolean;
CursorX, CursorY : Word;
```

`ScreenColor` indicates whether the current screen supports colors. `CursorX`, `CursorY` contain the current cursor position.

The following variable forms the heart of the `Video` unit: The `VideoBuf` array represents the physical screen. Writing to this array and calling `UpdateScreen` (519) will write the actual characters to the screen.

```
VideoBuf        : PVideoBuf;
OldVideoBuf     : PVideoBuf;
VideoBufSize    : Longint;
```

The `OldVideoBuf` contains the state of the video screen after the last screen update. The `UpdateScreen` (519) function uses this array to decide which characters on screen should be updated, and which not.

Note that the `OldVideoBuf` array may be ignored by some drivers, so it should not be used. The Array is in the interface section of the video unit mainly so drivers that need it can make use of it.

24.2 Functions and Procedures

The examples in this section make use of the unit `vidutil`, which contains the `TextOut` function. This function writes a text to the screen at a given location. It looks as follows:

Listing: `videoex/vidutil.pp`

```

unit vidutil;

Interface

uses
  video;

  { $ifndef cpu86 }
  { $error This example only works on intel 80x86 machines }
  { $endif }

Procedure TextOut(X,Y : Word;Const S : String );

Implementation

Procedure TextOut(X,Y : Word;Const S : String );

Var
  W,P,I,M : Word;

begin
  P:=((X-1)+(Y-1)*ScreenWidth);
  M:=Length(S);
  If P+M>ScreenWidth*ScreenHeight then
    M:=ScreenWidth*ScreenHeight-P;
  For I:=1 to M do
    VideoBuf^[P+I-1]:=Ord(S[i])+($07 shl 8);
end;

end.

```

ClearScreen

Declaration: `procedure ClearScreen;`

Description: `ClearScreen` clears the entire screen, and calls `UpdateScreen` (519) after that. This is done by writing spaces to all character cells of the video buffer in the default color (lightgray on black, color attribute \$07).

Errors: None.

See also: `InitVideo` (515), `UpdateScreen` (519)

Listing: `videoex/ex3.pp`

```

program testvideo;

uses video , keyboard , vidutil ;

  { $ifndef cpu86 }

```

```
{ $error This example only works on intel 80x86 machines }
{ $endif }
```

Var

```
  i : longint;
  k : TKeyEvent;
```

begin

```
  InitVideo;
  InitKeyboard;
  For l:=1 to 10 do
    TextOut(i,i, 'Press any key to clear screen');
  UpdateScreen(false);
  K:=GetKeyEvent;
  ClearScreen;
  TextOut(1,1, 'Cleared screen. Press any key to end');
  UpdateScreen(true);
  K:=GetKeyEvent;
  DoneKeyBoard;
  DoneVideo;
```

```
end.
```

DefaultErrorHandler

Declaration: `function DefaultErrorHandler(AErrorCode: Longint; AErrorInfo: Pointer): TErrorHandlerReturnValue;`

Description: `DefaultErrorHandler` is the default error handler used by the video driver. It simply sets the error code `AErrorCode` and `AErrorInfo` in the global variables `ErrorCode` and `ErrorInfo` and returns `errContinue`.

Errors: None.

See also:

DoneVideo

Declaration: `procedure DoneVideo;`

Description: `DoneVideo` disables the Video driver if the video driver is active. If the videodriver was already disabled or not yet initialized, it does nothing. Disabling the driver means it will clean up any allocated resources, possibly restore the screen in the state it was before `InitVideo` was called. Particularly, the `VideoBuf` and `OldVideoBuf` arrays are no longer valid after a call to `DoneVideo`.

The `DoneVideo` should always be called if `InitVideo` was called. Failing to do so may leave the screen in an unusable state after the program exits.

Errors: Normally none. If the driver reports an error, this is done through the `ErrorCode` variable.

See also: `InitVideo` (515)

For an example, see most other functions.

GetCapabilities

Declaration: `function GetCapabilities: Word;`

Description: `GetCapabilities` returns the capabilities of the current driver. It is an or-ed combination of the following constants:

cpUnderLineThe driver supports underlined characters.

cpBlinkThe driver supports blinking characters.

cpColorThe driver supports colors.

cpChangeFontThe driver supports the setting of a screen font. Note, however, that a font setting API is not supported by the video unit.

cpChangeModeThe driver supports the setting of screen modes.

cpChangeCursorThe driver supports changing the cursor shape.

Note that the video driver should not yet be initialized to use this function. It is a property of the driver.

Errors: None.

See also: `GetCursorType` (512), `GetVideoDriver` (513)

Listing: `videoex/ex4.pp`

Program `Example4;`

{ Program to demonstrate the GetCapabilities function. }

Uses `video;`

Var

`W: Word;`

Procedure `TestCap(Cap: Word; Msg : String);`

begin

`Write(Msg, ' : ');`

`If (W and Cap=Cap) then`

`Writeln('Yes')`

`else`

`Writeln('No');`

`end;`

begin

`W:=GetCapabilities;`

`Writeln('Video driver supports following functionality');`

`TestCap(cpUnderLine,'Underlined characters');`

`TestCap(cpBlink,'Blinking characters');`

`TestCap(cpColor,'Color characters');`

`TestCap(cpChangeFont,'Changing font');`

`TestCap(cpChangeMode,'Changing video mode');`

`TestCap(cpChangeCursor,'Changing cursor shape');`

`end.`

GetCursorType

Declaration: `function GetCursorType: Word;`

Description: `GetCursorType` returns the current cursor type. It is one of the following values:

crHiddenThe cursor is currently hidden.

crUnderLineThe cursor is currently the underline character.

crBlockThe cursor is currently the block character.

crHalfBlockThe cursor is currently a block with height of half the character cell height.

Note that not all drivers support all types of cursors.

Errors: None.

See also: `SetCursorType` (517), `GetCapabilities` (511)

Listing: `videoex/ex5.pp`

Program `Example5;`

{ Program to demonstrate the GetCursorType function. }

Uses `video, keyboard, vidutil;`

Const

`CursorTypes : Array[crHidden..crHalfBlock] of string =`
`('Hidden', 'UnderLine', 'Block', 'HalfBlock');`

begin

`InitVideo;`
`InitKeyboard;`
`TextOut(1,1, 'Cursor type: '+CursorTypes[GetCursorType]);`
`TextOut(1,2, 'Press any key to exit.');`
`UpdateScreen(False);`
`GetKeyEvent;`
`DoneKeyboard;`
`DoneVideo;`

end.

GetLockScreenCount

Declaration: `Function GetLockScreenCount : integer;`

Description: `GetLockScreenCount` returns the current lock level. When the lock level is zero, a call to `UpdateScreen` (519) will actually update the screen.

Errors: None.

See also: `LockScreenUpdate` (516), `UnlockScreenUpdate` (518), `UpdateScreen` (519)

Listing: `videoex/ex6.pp`

Program `Example6;`

{ Program to demonstrate the GetLockScreenCount function. }

Uses `video, keyboard, vidutil;`

```
Var
  I : Longint;
  S : String;

begin
  InitVideo;
  InitKeyboard;
  TextOut(1,1,'Press key till new text appears. ');
  UpdateScreen(False);
  Randomize;
  For I:=0 to Random(10)+1 do
    LockScreenUpdate;
  I:=0;
  While GetLockScreenCount<>0 do
    begin
      Inc(I);
      Str(I,S);
      UnlockScreenUpdate;
      GetKeyEvent;
      TextOut(1,1,'UnLockScreenUpdate had to be called '+S+' times');
      UpdateScreen(False);
    end;
  TextOut(1,2,'Press any key to end. ');
  UpdateScreen(False);
  GetKeyEvent;
  DoneKeyboard;
  DoneVideo;
end.
```

GetVideoDriver

Declaration: `Procedure GetVideoDriver (Var Driver : TVideoDriver);`

Declaration: `GetVideoDriver` retrieves the current videodriver and returns it in `Driver`. This can be used to chain video drivers.

Errors: None.

See also: [SetVideoDriver \(517\)](#)

For an example, see the section on writing a custom video driver.

GetVideoMode

Declaration: `procedure GetVideoMode(var Mode: TVideoMode);`

Description: `GetVideoMode` returns the settings of the currently active video mode. The `row`, `col` fields indicate the dimensions of the current video mode, and `Color` is true if the current video supports colors.

Errors: None.

See also: [SetVideoMode \(518\)](#), [GetVideoModeData \(515\)](#)

Listing: `videoex/ex7.pp`

```

Program Example7;

{ Program to demonstrate the GetVideoMode function. }

Uses video , keyboard , vidutil ;

Var
  M : TVideoMode;
  S : String;

begin
  InitVideo;
  InitKeyboard;
  GetVideoMode(M);
  if M.Color then
    TextOut(1,1, 'Current mode has color')
  else
    TextOut(1,1, 'Current mode does not have color');
  Str(M.Row,S);
  TextOut(1,2, 'Number of rows      : '+S);
  Str(M.Col,S);
  TextOut(1,3, 'Number of columns : '+S);
  Textout(1,4, 'Press any key to exit. ');
  UpdateScreen(False);
  GetKeyEvent;
  DoneKeyboard;
  DoneVideo;
end.

```

GetVideoModeCount

Declaration: `Function GetVideoModeCount : Word;`

Description: `GetVideoModeCount` returns the number of video modes that the current driver supports. If the driver does not support switching of modes, then 1 is returned.

This function can be used in conjunction with the `GetVideoModeData` (515) function to retrieve data for the supported video modes.

Errors: None.

See also: `GetVideoModeData` (515), `GetVideoMode` (513)

Listing: videoex/ex8.pp

```

Program Example8;

{ Program to demonstrate the GetVideoModeCount function. }

Uses video , keyboard , vidutil ;

Procedure DumpMode (M : TVideoMode; Index : Integer);

Var
  S : String;

begin

```

```

Str(Index:2,S);
inc(Index);
TextOut(1,Index,'Data for mode '+S+' : ');
if M.Color then
  TextOut(19,Index,'  color ,')
else
  TextOut(19,Index,'No color ,');
Str(M.Row:3,S);
TextOut(28,Index,S+' rows ');
Str(M.Col:3,S);
TextOut(36,Index,S+' columns ');
end;

Var
  i,Count : Integer;
  m : TVideoMode;

begin
  InitVideo;
  InitKeyboard;
  Count:=GetVideoModeCount;
  For I:=1 to Count do
    begin
      GetVideoModeData(I-1,M);
      DumpMode(M,I-1);
    end;
    TextOut(1,Count+1,'Press any key to exit');
    UpdateScreen(False);
    GetKeyEvent;
    DoneKeyboard;
    DoneVideo;
  end.

```

GetVideoModeData

Declaration: `Function GetVideoModeData(Index : Word; Var Data: TVideoMode) : Boolean;`

Description: `GetVideoModeData` returns the characteristics of the `Index`-th video mode in `Data`. `Index` is zero based, and has a maximum value of `GetVideoModeCount-1`. If the current driver does not support setting of modes (`GetVideoModeCount=1`) and `Index` is zero, the current mode is returned.

The function returns `True` if the mode data was retrieved successfully, `False` otherwise.

Errors: In case `Index` has a wrong value, `False` is returned.

See also: `GetVideoModeCount` (514), `SetVideoMode` (518), `GetVideoMode` (513)

For an example, see `GetVideoModeCount` (514).

InitVideo

Declaration: `procedure InitVideo;`

Description: `InitVideo` initializes the video subsystem. If the video system was already initialized, it does nothing. After the driver has been initialized, the `VideoBuf` and `OldVideoBuf` pointers are

initialized, based on the `ScreenWidth` and `ScreenHeight` variables. When this is done, the screen is cleared.

Errors: if the driver fails to initialize, the `ErrorCode` variable is set.

See also: [DoneVideo \(510\)](#)

For an example, see most other functions.

LockScreenUpdate

Declaration: `Procedure LockScreenUpdate;`

Description: `LockScreenUpdate` increments the screen update lock count with one. As long as the screen update lock count is not zero, `UpdateScreen (519)` will not actually update the screen.

This function can be used to optimize screen updating: If a lot of writing on the screen needs to be done (by possibly unknown functions), calling `LockScreenUpdate` before the drawing, and `UnlockScreenUpdate (518)` after the drawing, followed by a `UpdateScreen (519)` call, all writing will be shown on screen at once.

Errors: None.

See also: [UpdateScreen \(519\)](#), [UnlockScreenUpdate \(518\)](#), [GetLockScreenCount \(512\)](#)

For an example, see [GetLockScreenCount \(512\)](#).

SetCursorPos

Declaration: `procedure SetCursorPos(NewCursorX, NewCursorY: Word);`

Description: `SetCursorPos` positions the cursor on the given position: Column `NewCursorX` and row `NewCursorY`. The origin of the screen is the upper left corner, and has coordinates (0 , 0).

The current position is stored in the `CursorX` and `CursorY` variables.

Errors: None.

See also: [SetCursorType \(517\)](#)

Listing: `videoex/ex2.pp`

```

program example2;

uses video , keyboard;

{ $ifdef cpu86 }
{ $error This example only works on intel 80x86 machines }
{ $endif }

Var
  P,PP,D : Integer;
  K: TKeyEvent;

Procedure PutSquare ( P : Integer; C : Char);

begin
  VideoBuf^[P]:=Ord(C)+($07 shl 8);

```

```

    VideoBuf^[P+ScreenWidth]:=Ord(c)+($07 shl 8);
    VideoBuf^[P+1]:=Ord(c)+($07 shl 8);
    VideoBuf^[P+ScreenWidth+1]:=Ord(c)+($07 shl 8);
end;

begin
  InitVideo;
  InitKeyBoard;
  P:=0;
  PP:=-1;
  Repeat
    If PP<>-1 then
      PutSquare(PP, ' ');
      PutSquare(P, '# ');
      SetCursorPos(P Mod ScreenWidth,P div ScreenWidth);
      UpdateScreen(False);
      PP:=P;
    Repeat
      D:=0;
      K:=TranslateKeyEvent(GetKeyEvent);
      Case GetKeyEventCode(K) of
        kbdLeft : If (P Mod ScreenWidth)<>0 then
          D:=-1;
        kbdUp : If P>=ScreenWidth then
          D:=-ScreenWidth;
        kbdRight : If ((P+2) Mod ScreenWidth)<>0 then
          D:=1;
        kbdDown : if (P<(VideoBufSize div 2)-(ScreenWidth*2)) then
          D:=ScreenWidth;
      end;
      Until (D<>0) or (GetKeyEventChar(K)='q');
      P:=P+D;
    until GetKeyEventChar(K)='q';
  DoneKeyBoard;
  DoneVideo;
end.

```

SetCursorType

Declaration: `procedure SetCursorType(NewType: Word);`

Description: `SetCursorType` sets the cursor to the type specified in `NewType`.

crHiddenthe cursor is not visible.

crUnderLinethe cursor is a small underline character (usually denoting insert mode).

crBlockthe cursor is a block the size of a screen cell (usually denoting overwrite mode).

crHalfBlockthe cursor is a block half the size of a screen cell.

Errors: None.

See also: `SetCursorPos` ([516](#))

SetVideoDriver

Declaration: `Function SetVideoDriver (Const Driver : TVideoDriver) : Boolean;`

Description: `SetVideoDriver` sets the videodriver to be used to `Driver`. If the current videodriver is initialized (after a call to `InitVideo`) then it does nothing and returns `False`.

A new driver can only be installed if the previous driver was not yet activated (i.e. before a call to `InitVideo` (515)) or after it was deactivated (i.e after a call to `DoneVideo`).

For more information about installing a videodriver, see section 24.3, page 519.

Errors: If the current driver is initialized, then `False` is returned.

See also: The example video driver in section 24.3, page 519

For an example, see the section on writing a custom video driver.

SetVideoMode

Declaration: `Function SetVideoMode(Mode: TVideoMode) : Boolean;`

Description: `SetVideoMode` sets the video mode to the mode specified in `Mode`:

```
TVideoMode = record
  Col,Row : Word;
  Color   : Boolean;
end;
```

If the call was succesful, then the screen will have `Col` columns and `Row` rows, and will be displaying in color if `Color` is `True`.

The function returns `True` if the mode was set succesfully, `False` otherwise.

Note that the video mode may not always be set. E.g. a console on Linux or a telnet session cannot always set the mode. It is important to check the error value returned by this function if it was not succesful.

The mode can be set when the video driver has not yet been initialized (i.e. before `InitVideo` (515) was called) In that case, the video mode will be stored, and after the driver was initialized, an attempt will be made to set the requested mode. Changing the video driver before the call to `InitVideo` will clear the stored video mode.

To know which modes are valid, use the `GetVideoModeCount` (514) and `GetVideoModeData` (515) functions. To retrieve the current video mode, use the `GetVideoMode` (513) procedure.

Errors: If the specified mode cannot be set, then `errVioNoSuchMode` may be set in `ErrorCode`

See also: `GetVideoModeCount` (514) `GetVideoModeData` (515) `GetVideoMode` (513)

UnlockScreenUpdate

Declaration: `Procedure UnlockScreenUpdate;`

Description: `UnlockScreenUpdate` decrements the screen update lock count with one if it is larger than zero. When the lock count reaches zero, the `UpdateScreen` (519) will actually update the screen. No screen update will be performed as long as the screen update lock count is nonzero. This mechanism can be used to increase screen performance in case a lot of writing is done.

It is important to make sure that each call to `LockScreenUpdate` (516) is matched by exactly one call to `UnlockScreenUpdate`

Errors: None.

See also: `LockScreenUpdate` (516), `GetLockScreenCount` (512), `UpdateScreen` (519)

For an example, see `GetLockScreenCount` (512).

UpdateScreen

Declaration: `procedure UpdateScreen(Force: Boolean);`

Description: `UpdateScreen` synchronizes the actual screen with the contents of the `VideoBuf` internal buffer. The parameter `Force` specifies whether the whole screen has to be redrawn (`Force=True`) or only parts that have changed since the last update of the screen.

The `Video` unit keeps an internal copy of the screen as it last wrote it to the screen (in the `OldVideoBuf` array). The current contents of `VideoBuf` are examined to see what locations on the screen need to be updated. On slow terminals (e.g. a LINUX telnet session) this mechanism can speed up the screen redraw considerably.

Errors: None.

See also: `ClearScreen` (509)

For an example, see most other functions.

24.3 Writing a custom video driver

Writing a custom video driver is not difficult, and generally means implementing a couple of functions, which would be registered with the `SetVideoDriver` (517) function. The various functions that can be implemented are located in the `TVideoDriver` record:

```
TVideoDriver = Record
  InitDriver      : Procedure;
  DoneDriver      : Procedure;
  UpdateScreen    : Procedure(Force : Boolean);
  ClearScreen     : Procedure;
  SetVideoMode    : Function (Const Mode : TVideoMode) : Boolean;
  GetVideoModeCount : Function : Word;
  GetVideoModeData : Function(Index : Word; Var Data : TVideoMode) : Boolean;
  SetCursorPos    : procedure (NewCursorX, NewCursorY: Word);
  GetCursorType   : function : Word;
  SetCursorType   : procedure (NewType: Word);
  GetCapabilities : Function : Word;
end;
```

Not all of these functions must be implemented. In fact, the only absolutely necessary function to write a functioning driver is the `UpdateScreen` function. The general calls in the `Video` unit will check which functionality is implemented by the driver.

The functionality of these calls is the same as the functionality of the calls in the video unit, so the expected behaviour can be found in the previous section. Some of the calls, however, need some additional remarks.

InitDriver Called by `InitVideo`, this function should initialize any data structures needed for the functionality of the driver, maybe do some screen initializations. The function is guaranteed to be called only once; It can only be called again after a call to `DoneVideo`. The variables `ScreenWidth` and `ScreenHeight` should be initialized correctly after a call to this function, as the `InitVideo` call will initialize the `VideoBuf` and `OldVideoBuf` arrays based on their values.

DoneDriver This should clean up any structures that have been initialized in the `InitDriver` function. It should possibly also restore the screen as it was before the driver was initialized.

The `VideoBuf` and `OldVideoBuf` arrays will be disposed of by the general `DoneVideo` call.

UpdateScreen This is the only required function of the driver. It should update the screen based on the `VideoBuf` array's contents. It can optimize this process by comparing the values with values in the `OldVideoBuf` array. After updating the screen, the `UpdateScreen` procedure should update the `OldVideoBuf` by itself. If the `Force` parameter is `True`, the whole screen should be updated, not just the changed values.

ClearScreen If there is a faster way to clear the screen than to write spaces in all character cells, then it can be implemented here. If the driver does not implement this function, then the general routines will write spaces in all video cells, and will call `UpdateScreen(True)`.

SetVideoMode Should set the desired video mode, if available. It should return `True` if the mode was set, `False` if not.

GetVideoModeCount Should return the number of supported video modes. If no modes are supported, this function should not be implemented; the general routines will return 1. (for the current mode)

GetVideoModeData Should return the data for the `Index`-th mode; `Index` is zero based. The function should return true if the data was returned correctly, false if `Index` contains an invalid index. If this is not implemented, then the general routine will return the current video mode when `Index` equals 0.

GetCapabilities If this function is not implemented, zero (i.e. no capabilities) will be returned by the general function.

The following unit shows how to override a video driver, with a driver that writes debug information to a file.

Listing: `videoex/viddbg.pp`

```

unit viddbg;

Interface

uses video;

Procedure StartVideoLogging;
Procedure StopVideoLogging;
Function IsVideoLogging : Boolean;
Procedure SetVideoLogFileName (FileName : String);

Const
  DetailedVideoLogging : Boolean = False;

Implementation

uses sysutils , keyboard;

var
  NewVideoDriver ,
  OldVideoDriver : TVideoDriver;
  Active , Logging : Boolean;
  LogFileName : String;
  VideoLog : Text;

```

```

Function TimeStamp : String;

begin
  TimeStamp:=FormatDateTime( 'hh:nn:ss ',Time());
end;

Procedure StartVideoLogging;

begin
  Logging:=True;
  WriteLn(VideoLog, 'Start logging video operations at: ',TimeStamp);
end;

Procedure StopVideoLogging;

begin
  WriteLn(VideoLog, 'Stop logging video operations at: ',TimeStamp);
  Logging:=False;
end;

Function IsVideoLogging : Boolean;

begin
  IsVideoLogging:=Logging;
end;

Var
  ColUpd,RowUpd : Array[0..1024] of Integer;

Procedure DumpScreenStatistics(Force : Boolean);

Var
  I,Count : Integer;

begin
  If Force then
    Write(VideoLog, 'forced ');
    WriteLn(VideoLog, 'video update at ',TimeStamp, ' : ');
    FillChar( Colupd, SizeOf(ColUpd),#0);
    FillChar( Rowupd, SizeOf(RowUpd),#0);
    Count:=0;
    For I:=0 to VideoBufSize div SizeOf(TVideoCell) do
      begin
        If VideoBuf^[i]<>OldVideoBuf^[i] then
          begin
            Inc(Count);
            Inc(ColUpd[I mod ScreenWidth]);
            Inc(RowUpd[I div ScreenHeight]);
          end;
        end;
      Write(VideoLog,Count, ' videocells differed divided over ');
      Count:=0;
      For I:=0 to ScreenWidth-1 do
        If ColUpd[I]<>0 then
          Inc(Count);
      Write(VideoLog,Count, ' columns and ');
      Count:=0;
      For I:=0 to ScreenHeight-1 do

```

```

    If RowUpd[ I ] <> 0 then
        Inc (Count);
    WriteLn (VideoLog, Count, ' rows. ');
    If DetailedVideoLogging Then
        begin
            For I := 0 to ScreenWidth - 1 do
                If (ColUpd[ I ] <> 0) then
                    WriteLn (VideoLog, 'Col ', i, ' : ', ColUpd[ I ] : 3, ' rows changed ');
            For I := 0 to ScreenHeight - 1 do
                If (RowUpd[ I ] <> 0) then
                    WriteLn (VideoLog, 'Row ', i, ' : ', RowUpd[ I ] : 3, ' columns changed ');
            end;
        end;
end;

Procedure LogUpdateScreen (Force : Boolean);

begin
    If Logging then
        DumpScreenStatistics (Force);
        OldVideoDriver.UpdateScreen (Force);
end;

Procedure LogInitVideo;

begin
    OldVideoDriver.InitDriver ();
    Assign (VideoLog, logFileName);
    Rewrite (VideoLog);
    Active := True;
    StartVideoLogging;
end;

Procedure LogDoneVideo;

begin
    StopVideoLogging;
    Close (VideoLog);
    Active := False;
    OldVideoDriver.DoneDriver ();
end;

Procedure SetVideoLogFileName (FileName : String);

begin
    If Not Active then
        LogFileName := FileName;
end;

Initialization
    GetVideoDriver (OldVideoDriver);
    NewVideoDriver := OldVideoDriver;
    NewVideoDriver.UpdateScreen := @LogUpdateScreen;
    NewVideoDriver.InitDriver := @LogInitVideo;
    NewVideoDriver.DoneDriver := @LogDoneVideo;
    LogFileName := 'Video.log';
    Logging := False;
    SetVideoDriver (NewVideoDriver);
end.

```

The unit can be used in any of the demonstration programs, by simply including it in the `uses` clause. Setting `DetailedVideoLogging` to `True` will create a more detailed log (but will also slow down functioning)

Index

Abstract, 317
Accept, 379, 381
Access, 190
AddDisk, 45
AddDisk (Linux only), 422
AdjustLineBreaks, 442
Alarm, 191
allocate_ldt_descriptors, 86
allocate_memory_block, 88
AnsiCompareStr, 443
AnsiCompareText, 444
AnsiExtractQuotedStr, 445
AnsiLastChar, 445
AnsiLowerCase, 446
AnsiQuotedStr, 446
AnsiStrComp, 446
AnsiStrIComp, 447
AnsiStrLastChar, 448
AnsiStrLComp, 449
AnsiStrLIComp, 449
AnsiStrLower, 450
AnsiStrUpper, 451
AnsiUpperCase, 452
AppendStr, 452
Arc, 119
arccos, 261
arcosh, 261
arcsin, 262
arctan2, 263
arsinh, 263
artanh, 264
AssignCrt, 30
AssignLst, 376
AssignPipe, 192
AssignStr, 453
AssignStream, 192

Bar, 119
Bar3D, 119
BaseName, 194
BCDToInt, 453
Bind, 381, 382

ceil, 264
CFMakeRaw, 194
CFSetISpeed, 195
CFSetOSpeed, 195
ChangeFileExt, 425
Chmod, 196
Chown, 195
Circle, 120
ClearDevice, 120
ClearScreen, 509
ClearViewPort, 120
Clone, 197
CloseDir, 199
CloseGraph, 120
ClrEol, 30
ClrScr, 31
CompareMem, 454
CompareStr, 454
CompareText, 455
Connect, 382, 383
copyfromdos, 88
copytodos, 88
cosh, 265
cotan, 265
create_code_segment_alias_descriptor, 89
CreateDir, 423
CreateShellArgV, 199
CursorBig, 30
CursorOff, 31
CursorOn, 32
cycletorad, 265

Date, 408
DateTimeToFileDate, 409
DateTimeToStr, 409
DateTimeToString, 410
DateTimeToSystemTime, 411
DateTimeToTimeStamp, 411
DateToStr, 412
DayOfWeek, 412
DecodeDate, 413
DecodeTime, 413
DefaultErrorHandler, 510
degtograd, 266
degtorad, 266
Delay, 32
DeleteFile, 426

- DelLine, 32
- DetectGraph, 120
- DetectMouse, 293
- DirName, 200
- disable, 89
- DiskFree, 45, 423
- DiskSize, 46, 424
- DisposeStr, 317, 456
- DoDirSeparators, 426
- DoneKeyboard, 163
- DoneMouse, 294
- DoneVideo, 510
- DosExitCode, 47
- dosmemfillchar, 89
- dosmemfillword, 90
- dosmemget, 91
- dosmemmove, 91
- dosmemput, 91
- DosVersion, 47
- DrawPoly, 121
- DumpHeap, 139
- Dup, 200
- Dup2, 201
- dxe_load, 61

- Ellipse, 121
- Emms, 291
- enable, 92
- EncodeDate, 414
- EncodeTime, 414
- EnvCount, 48
- EnvStr, 48
- EpochToLocal, 202
- Exec, 49
- Execl, 202
- Execl, 203
- Execlp, 204
- Execv, 205
- Execve, 205
- Execvp, 206
- ExpandFileName, 427
- ExpandUNCFileName, 427
- ExtractFileDir, 428
- ExtractFileDrive, 428
- ExtractFileExt, 429
- ExtractFileName, 429
- ExtractFilePath, 429
- ExtractRelativePath, 429

- Fcntl, 216
- FD_Clr, 207
- FD_IsSet, 208
- FD_Set, 208
- FD_ZERO, 207

- fdClose, 208
- fdFlush, 208
- fdOpen, 209
- fdRead, 210
- fdSeek, 211
- fdTruncate, 211
- fdWrite, 211
- FExpand, 49, 212
- FileAge, 430
- FileClose, 431
- FileCreate, 431
- FileDateToDateTime, 415
- FileExists, 432
- FileGetAttr, 432
- FileGetDate, 433
- FileOpen, 434
- FileRead, 434
- FileSearch, 435
- FileSeek, 435
- FileSetAttr (Not on Linux), 436
- FileSetDate (Not on Linux), 436
- FileTruncate, 436
- FileWrite, 437
- FillEllipse, 121
- FillPoly, 121
- FindClose, 49, 437
- FindFirst, 50, 437
- FindNext, 50, 438
- FindPropInfo, 483
- FloatToStr, 456
- FloatToStrF, 457
- FloatToText, 458
- FLock, 212
- FloodFill, 121
- floor, 267
- FmtStr, 459
- FNMatch, 212
- Fork, 217
- Format, 459
- FormatBuf, 465
- FormatDateTime, 415
- FormatFloat, 465
- free_ldt_descriptor, 92
- free_memory_block, 92
- free_rm_callback, 92
- FRename, 217
- frexp, 267
- FSearch, 51, 213
- FSplit, 51, 213
- FSSStat, 214
- FStat, 215
- ftok, 147
- FunctionKeyName, 163

get_cs, 93
get_descriptor_access_rights, 93
get_ds, 93
get_linear_addr, 93
get_meminfo, 94
get_next_selector_increment_value, 95
get_page_size, 95
get_pm_interrupt, 95
get_rm_callback, 96
get_rm_interrupt, 98
get_run_mode, 99
get_segment_base_address, 99
get_segment_limit, 100
get_ss, 100
GetArcCoords, 122
GetAspectRatio, 122
GetBkColor, 122
GetCapabilities, 511
GetCBreak, 52
GetColor, 122
GetCurrentDir, 424
GetCursorType, 512
GetDate, 52, 218
GetDateTime, 218
GetDefaultPalette, 122
GetDirs, 438
GetDomainName, 219
GetDriverName, 122
GetEGid, 219
GetEnumName, 484
GetEnumProp, 484
GetEnumValue, 485
GetEnv, 53, 220
GetEpochTime, 220
GetEUid, 220
GetFAttr, 53
GetFillPattern, 123
GetFillSettings, 123
GetFloatProp, 485
GetFS, 221
GetFTime, 54
GetGid, 221
GetGraphMode, 123
GetHostName, 222
GetImage, 123
GetInt64Prop, 486
GetIntVec, 55
GetKeyboardDriver, 164
GetKeyEvent, 164
GetKeyEventChar, 165
GetKeyEventCode, 165
GetKeyEventFlags, 166
GetKeyEventShiftState, 166
GetKeyEventUnicode, 167
GetLastButtonPress, 303
GetLastButtonRelease, 304
GetLineSettings, 123
GetLocalTimezone, 222
GetLockScreenCount, 512
GetLongName, 55
GetLongOpts, 65
GetMaxColor, 123
GetMaxMode, 124
GetMaxX, 124
GetMaxY, 124
GetMethodProp, 487
GetModeName, 124
GetModeRange, 124
GetMouseButtons, 294
GetMouseDriver, 295
GetMouseEvent, 295
GetMouseState, 305
GetMouseX, 295
GetMouseY, 296
GetObjectProp, 489
GetObjectPropClass, 490
Getopt, 65
GetOrdProp, 490
GetPalette, 125
GetPaletteSize, 125
GetPeerName, 384
GetPid, 222
GetPixel, 125
GetPPid, 223
GetPriority, 223
GetPropInfo, 491
GetPropInfos, 492
GetPropList, 493
GetPropValue, 494
GetSetProp, 494
GetShortName, 55
GetSocketName, 385
GetSocketOptions, 385
GetStrProp, 495
GetTextSettings, 125
GetTime, 55, 224
GetTimeOfDay, 224
GetTimezoneFile, 225
GetTypeData, 496
GetUid, 225
GetVariantProp, 496
GetVerify, 56
GetVideoDriver, 513
GetVideoMode, 513
GetVideoModeCount, 514
GetVideoModeData, 515
GetViewSettings, 125
GetX, 125

- GetY, 126
Glob, 225
global_dos_alloc, 100
global_dos_free, 102
GlobFree, 226
GotoXY, 33
Gpm_AnyDouble, 70
Gpm_AnySingle, 71
Gpm_AnyTriple, 71
Gpm_Close, 71
Gpm_FitValues, 71
Gpm_FitValuesM, 71
Gpm_GetEvent, 72
Gpm_GetLibVersion, 73
Gpm_GetServerVersion, 73
Gpm_GetSnapshot, 73
Gpm_LowerRoi, 74
Gpm_Open, 74
Gpm_PopRoi, 74
Gpm_PushRoi, 74
Gpm_RaiseRoi, 75
Gpm_Repeat, 75
Gpm_StrictDouble, 75
Gpm_StrictSingle, 75
Gpm_StrictTriple, 76
gradtodeg, 268
gradtorad, 268
GraphDefaults, 126
GraphErrorMsg, 126
GraphResult, 126

HideMouse, 296, 306
HighVideo, 33
hypot, 269

ImageSize, 127
IncMonth, 416
InitGraph, 127
InitKeyBoard, 167
InitMouse, 297, 306
InitVideo, 515
inportb, 102
inportl, 102
inportw, 102
InsLine, 34
InstallUserDriver, 127
InstallUserFont, 128
intpower, 269
Intr, 56
IntToHex, 466
IntToStr, 467
IOctl, 226
IOperm, 227
IsATTY, 227
IsFunctionKey, 167
IsLeapYear, 416
IsPublishedProp, 496
IsStoredProp, 497
IsValidIdent, 468

Keep, 57
KeyEventToString, 168
KeyPressed, 34
Kill, 229

LastDelimiter, 468
ldexp, 270
LeftStr, 469
Line, 128
LineRel, 128
LineTo, 128
Link, 231
Listen, 385
lnxp1, 270
LoadStr, 469
LocalToEpoch, 232
lock_code, 103
lock_data, 103
lock_linear_region, 103
LockScreenUpdate, 516
log10, 271
log2, 271
logn, 272
LongDiv, 319
LongMul, 319
LowerCase, 469
LowVideo, 35
LPressed, 307
LStat, 230

MarkHeap, 139
max, 272
maxIntValue, 273
maxvalue, 273
mean, 274
meanandstddev, 275
min, 276
minIntValue, 276
minvalue, 277
MkFifo, 232
MMap, 232
momentskewkurtosis, 278
MoveRel, 128
MoveTo, 129
MPressed, 307
MSDos, 57
MSecsToTimeStamp, 417
msgctl, 148

- msgget, 147
- msgrcv, 148
- msgsnd, 147
- MUnMap, 234

- NanoSleep, 234
- NewStr, 316, 470
- Nice, 235
- norm, 278
- NormVideo, 35
- NoSound, 35
- Now, 418
- npxsetup, 63

- Octal, 235
- OpenDir, 236
- outportb, 104
- outportl, 104
- outportw, 104
- OutText, 129
- OutTextXY, 129

- PackTime, 57
- pause, 237
- PClose, 237
- PieSlice, 129
- PollKeyEvent, 168
- PollMouseEvent, 297
- PollShiftStateEvent, 169
- POpen, 237
- popnstddev, 279
- popnvariance, 280
- power, 280
- PropIsType, 498
- PropType, 499
- PutImage, 129
- PutKeyEvent, 169
- PutMouseEvent, 297
- PutPixel, 130

- QuotedStr, 470

- radtcycle, 281
- radtodeg, 281
- radtograd, 282
- randg, 282
- ReadDir, 238
- ReadKey, 36
- ReadLink, 239
- ReadPort, 240
- ReadPortB, 240
- ReadPortL, 240
- ReadPortW, 241
- ReadTimezoneFile, 241
- realintr, 105

- Rectangle, 130
- Recv, 386
- RegisterBGIDriver, 130
- RegisterBGIFont, 130
- RegisterObjects, 317
- RegisterType, 317
- RemoveDir, 425
- RenameFile, 439
- RestoreCRTMode, 130
- RightStr, 470
- RPressed, 307

- S_ISBLK, 227
- S_ISCHR, 228
- S_ISDIR, 228
- S_ISFIFO, 228
- S_ISLNK, 228
- S_ISREG, 229
- S_ISSOCK, 229
- Sector, 131
- SeekDir, 241
- seg_fillchar, 105
- seg_fillword, 106
- seg_move, 107
- segment_to_descriptor, 106
- Select, 241
- SelectText, 242
- semctl, 152
- semget, 151
- semop, 151
- Send, 386
- set_descriptor_access_rights, 107
- set_pm_interrupt, 107
- set_rm_interrupt, 108
- set_segment_base_address, 109
- set_segment_limit, 109
- SetActivePage, 131
- SetAllPalette, 131
- SetAspectRatio, 131
- SetBkColor, 131
- SetCBreak, 58
- SetColor, 132
- SetCurrentDir, 425
- SetCursorPos, 516
- SetCursorType, 517
- SetDate, 58
- SetDirSeparators, 439
- SetEnumProp, 500
- SetExtraInfo, 140
- SetFAttr, 58
- SetFillPattern, 132
- SetFillStyle, 132
- SetFloatProp, 500
- SetFTime, 59

SetGraphBufSize, 132
SetGraphMode, 133
SetHeapTraceOutput, 141
SetInt64Prop, 500
SetIntVec, 59
SetKeyboardDriver, 170
SetLineStyle, 133
SetMethodProp, 501
SetMouseAscii, 307
SetMouseDriver, 298
SetMouseHideWindow, 308
SetMousePos, 309
SetMouseShape, 310
SetMouseSpeed, 311
SetMouseWindow, 312
SetMouseXRange, 312
SetMouseXY, 298
SetMouseYRange, 313
SetObjectProp, 501
SetOrdProp, 502
SetPalette, 133
SetPriority, 243
SetPropValue, 502
SetRGBPalette, 133
SetSetProp, 502
SetSocketOptions, 387
SetStrProp, 503
SetTextJustify, 134
SetTextStyle, 134
SetTime, 59
SetToString, 503
SetUserCharSize, 135
SetVariantProp, 504
SetVerify, 59
SetVideoDriver, 517
SetVideoMode, 518
SetViewPort, 135
SetVisualPage, 135
SetWriteMode, 135
Shell, 243
ShiftStateToString, 171
shmat, 157
shmctl, 157
shmdt, 157
shmget, 156
ShowMouse, 299, 313
Shutdown, 387
SigAction, 244
Signal, 246
SigPending, 245
SigProcMask, 245
SigRaise, 245
SigSuspend, 246
sincos, 283
sinh, 283
Sock2File, 387
Sock2Text, 388
Socket, 388
SocketPair, 388
Sound, 37
stddev, 284
Str2UnixSockAddr, 388
StrAlloc, 389, 441
StrBufSize, 441
StrCat, 389
StrComp, 390
StrCopy, 390
StrDispose, 391, 441
StrECopy, 391
StrEnd, 392
StrFmt, 471
StrIComp, 392
StringToPPchar, 247
StringToSet, 504
StrLCat, 393
StrLComp, 393
StrLCopy, 394
StrLen, 394
StrLFmt, 471
StrLIComp, 395
StrLower, 395
StrMove, 396
StrNew, 396
StrPas, 397, 442
StrPCopy, 397, 442
StrPLCopy, 442
StrPos, 398
StrRScan, 398
StrScan, 398
StrToDate, 418
StrToDateTime, 419
StrToFloat, 472
StrToInt, 473
StrToIntDef, 473
StrToTime, 419
StrUpper, 399
sum, 285
sumofsquares, 285
sumsandsquares, 286
SwapVectors, 60
SymLink, 248
SysInfo, 249
SystemTimeToDateTime, 420
tan, 287
tanh, 287
tb_size, 109
TBufStream.Close, 339

- TBufStream.Done, 339
- TBufStream.Flush, 339
- TBufStream.Init, 338
- TBufStream.Open, 340
- TBufStream.Read, 341
- TBufStream.Seek, 340
- TBufStream.Truncate, 340
- TBufStream.Write, 341
- TCDrain, 250
- TCFlow, 250
- TCFlush, 251
- TCGetAttr, 251
- TCGetPGrp, 252
- TCollection.At, 346
- TCollection.AtDelete, 354
- TCollection.AtFree, 353
- TCollection.AtInsert, 356
- TCollection.AtPut, 356
- TCollection.Delete, 352
- TCollection.DeleteAll, 351
- TCollection.Done, 345
- TCollection.Error, 356
- TCollection.FirstThat, 348
- TCollection.ForEach, 355
- TCollection.Free, 351
- TCollection.FreeAll, 350
- TCollection.FreeItem, 354
- TCollection.GetItem, 347
- TCollection.IndexOf, 346
- TCollection.Init, 344
- TCollection.Insert, 352
- TCollection.LastThat, 347
- TCollection.Load, 345
- TCollection.Pack, 349
- TCollection.PutItem, 358
- TCollection.SetLimit, 356
- TCollection.Store, 357
- TCSendBreak, 252
- TCSetAttr, 252
- TCSetPGrp, 253
- TDateTime, 408
- TDosStream.Close, 335
- TDosStream.Done, 335
- TDosStream.Init, 334
- TDosStream.Open, 337
- TDosStream.Read, 337
- TDosStream.Seek, 336
- TDosStream.Truncate, 335
- TDosStream.Write, 338
- TellDir, 253
- TextBackground, 37
- TextColor, 37
- TextHeight, 135
- TextMode, 38
- TextToFloat, 474
- TextWidth, 136
- Time, 420
- TimeStampToDateTime, 421
- TimeStampToMsecs, 421
- TimeToStr, 422
- TMemoryStream.Done, 342
- TMemoryStream.Init, 342
- TMemoryStream.Read, 343
- TMemoryStream.Truncate, 342
- TMemoryStream.Write, 343
- TObject.Done, 325
- TObject.Free, 325
- TObject.Init, 325
- totalvariance, 288
- transfer_buffer, 110
- TranslateKeyEvent, 171
- TranslateKeyEventUnicode, 171
- TRect.Assign, 324
- TRect.Contains, 321
- TRect.Copy, 321
- TRect.Empty, 320
- TRect.Equals, 321
- TRect.Grow, 323
- TRect.Intersect, 322
- TRect.Move, 323
- TRect.Union, 322
- TResourceCollection.FreeItem, 369
- TResourceCollection.GetItem, 368
- TResourceCollection.KeyOf, 368
- TResourceCollection.PutItem, 369
- TResourceFile.Count, 370
- TResourceFile.Delete, 371
- TResourceFile.Done, 370
- TResourceFile.Flush, 371
- TResourceFile.Get, 370
- TResourceFile.Init, 370
- TResourceFile.KeyAt, 370
- TResourceFile.Put, 371
- TResourceFile.SwitchTo, 371
- Trim, 475
- TrimLeft, 476
- TrimRight, 476
- TSortedCollection.Compare, 360
- TSortedCollection.IndexOf, 360
- TSortedCollection.Init, 359
- TSortedCollection.Insert, 362
- TSortedCollection.KeyOf, 359
- TSortedCollection.Load, 359
- TSortedCollection.Search, 361
- TSortedCollection.Store, 363
- TStrCollection.Compare, 365
- TStrCollection.FreeItem, 366
- TStrCollection.GetItem, 365

TStrCollection.PutItem, 366
TStream.Close, 330
TStream.CopyFrom, 333
TStream.Error, 332
TStream.Flush, 330
TStream.Get, 327
TStream.GetPos, 328
TStream.GetSize, 328
TStream.Open, 330
TStream.Put, 331
TStream.Read, 332
TStream.ReadStr, 329
TStream.Reset, 330
TStream.Seek, 332
TStream.StrRead, 327
TStream.StrWrite, 331
TStream.Truncate, 331
TStream.Write, 333
TStream.WriteStr, 331
TStringCollection.Compare, 364
TStringCollection.FreeItem, 364
TStringCollection.GetItem, 363
TStringCollection.PutItem, 365
TStringList.Done, 372
TStringList.Get, 372
TStringList.Load, 372
TStrListMaker.Done, 373
TStrListMaker.Init, 373
TStrListMaker.Put, 373
TStrListMaker.Store, 373
TTYName, 253
TUnSortedStrCollection.Insert, 367

Umask, 253
Uname, 254
UnLink, 254
unlock_code, 110
unlock_data, 110
unlock_linear_region, 110
UnlockScreenUpdate, 518
UnPackTime, 60
UpdateScreen, 519
UpperCase, 477
Utime, 254

variance, 288

WaitPid, 255
WhereX, 38
WhereY, 38
Window, 39
WritePort, 256
WritePortB, 256
WritePortL, 256
WritePortW, 257