

Free Pascal supplied units :
Reference guide.

Reference guide for standard Free Pascal units.

1.6

January 2000

Michaël Van Canneyt
Florian Klämpfl

Contents

1	The CRT unit.	21
1.1	Types, Variables, Constants	21
1.2	Procedures and Functions	22
	AssignCrt	22
	BigCursor	23
	ClrEol	23
	ClrScr	23
	CursorOff	24
	CursorOn	24
	Delay	24
	DelLine	25
	GotoXY	25
	HighVideo	26
	InsLine	26
	KeyPressed	27
	LowVideo	27
	NormVideo	28
	NoSound	28
	ReadKey	28
	Sound	29
	TextBackground	29
	TextColor	30
	WhereX	30
	WhereY	30
	Window	31
2	The DOS unit.	32
2.1	Types, Variables, Constants	32
	Constants	32
	Types	33
	Variables	34

2.2	Functions and Procedures	35
	AddDisk	35
	DiskFree	35
	DiskSize	36
	DosExitCode	36
	DosVersion	37
	EnvCount	37
	EnvStr	38
	Exec	38
	FExpand	38
	FindClose	39
	FindFirst	39
	FindNext	40
	FSearch	40
	FSplit	40
	GetCBreak	41
	GetDate	41
	GetEnv	42
	GetFAttr	42
	GetFTime	43
	GetIntVec	44
	GetTime	44
	GetVerify	45
	Intr	45
	Keep	45
	MSDos	45
	PackTime	45
	SetCBreak	46
	SetDate	46
	SetFAttr	47
	SetFTime	47
	SetIntVec	47
	SetTime	47
	SetVerify	48
	SwapVectors	48
	UnPackTime	48
3	The GETOPTS unit.	49
3.1	Types, Constants and variables :	49
	Constants	49

Types	49
Variables	50
3.2 Procedures and functions	50
GetLongOpts	50
Getopt	50
4 The GO32 unit	53
4.1 Introduction	53
4.2 Protected mode memory organization	53
What is DPMI	53
Selectors and descriptors	53
FPC specialities	54
DOS memory access	54
I/O port access	54
Processor access	54
Interrupt redirection	54
Handling interrupts with DPMI	55
Protected mode interrupts vs. Real mode interrupts	55
Creating own interrupt handlers	55
Disabling interrupts	55
Hardware interrupts	55
Software interrupts	57
Real mode callbacks	59
4.3 Types, Variables and Constants	60
Constants	60
Predefined types	61
Variables.	62
4.4 Functions and Procedures	62
allocate_ldt_descriptors	62
allocate_memory_block	65
copyfromdos	65
copytodos	65
create_code_segment_alias_descriptor	66
disable	66
dosmemfillchar	66
dosmemfillword	67
dosmemget	67
dosmemmove	68
dosmemput	68
enable	69

free_ldt_descriptor	69
free_memory_block	69
free_rm_callback	69
get_cs	70
get_descriptor_access_rights	70
get_ds	70
get_linear_addr	70
get_meminfo	71
get_next_selector_increment_value	72
get_page_size	72
get_pm_interrupt	72
get_rm_callback	73
get_rm_interrupt	76
get_run_mode	76
get_segment_base_address	77
get_segment_limit	77
get_ss	77
global_dos_alloc	78
global_dos_free	79
inportb	79
inportl	80
inportw	80
lock_code	80
lock_data	80
lock_linear_region	81
outportb	81
outportl	81
outportw	82
realintr	82
seg_fillchar	83
seg_fillword	83
segment_to_descriptor	84
seg_move	84
set_descriptor_access_rights	84
set_pm_interrupt	85
set_rm_interrupt	86
set_segment_base_address	86
set_segment_limit	86
tb_size	87
transfer_buffer	87

unlock_code	87
unlock_data	87
unlock_linear_region	88
5 The GRAPH unit.	89
5.1 Introduction	89
Requirements	89
5.2 Constants, Types and Variables	89
Types	89
5.3 Functions and procedures	90
Arc	90
Bar	90
Bar3D	90
Circle	90
ClearDevice	91
ClearViewPort	91
CloseGraph	91
DetectGraph	91
DrawPoly	91
Ellipse	92
FillEllipse	92
FillPoly	92
FloodFill	92
GetArcCoords	92
GetAspectRatio	93
GetBkColor	93
GetColor	93
GetDefaultPalette	93
GetDriverName	93
GetFillPattern	93
GetFillSettings	94
GetGraphMode	94
GetImage	94
GetLineSettings	94
GetMaxColor	94
GetMaxMode	94
GetMaxX	95
GetMaxY	95
GetModeName	95
GetModeRange	95

GetPalette	95
GetPaletteSize	95
GetPixel	96
GetTextSettings	96
GetViewSettings	96
GetX	96
GetY	96
GraphDefaults	96
GraphErrorMsg	97
GraphResult	97
ImageSize	97
InitGraph	97
InstallUserDriver	98
InstallUserFont	98
Line	98
LineRel	99
LineTo	99
MoveRel	99
MoveTo	99
OutText	99
OutTextXY	100
PieSlice	100
PutImage	100
PutPixel	100
Rectangle	100
RegisterBGIDriver	101
RegisterBGIFont	101
RestoreCRTMode	101
Sector	101
SetActivePage	101
SetAllPalette	102
SetAspectRatio	102
SetBkColor	102
SetColor	102
SetFillPattern	102
SetFillStyle	103
SetGraphBufSize	103
SetGraphMode	103
SetLineStyle	103
SetPalette	104

SetRGBPalette	104
SetTextJustify	104
SetTextStyle	105
SetUserCharSize	105
SetViewPort	105
SetVisualPage	105
SetWriteMode	106
TextHeight	106
TextWidth	106
6 The HEAPTRC unit.	107
6.1 Purpose	107
6.2 Usage	107
6.3 Constants, Types and variables	108
6.4 Functions and procedures	109
DumpHeap	109
MarkHeap	109
SetExtraInfo	110
7 The IPC unit.	112
7.1 Types, Constants and variables :	112
Variables	112
Constants	112
Types	113
7.2 Functions and procedures	116
ftok	116
msgget	117
msgsnd	117
msgrcv	118
msgctl	118
semget	121
semop	121
semctl	122
shmget	127
shmat	127
shmdt	127
shmctl	128
8 The LINUX unit.	131
8.1 Type, Variable and Constant declarations	131
Types	131

Variables	134
Constants	134
8.2 Functions and procedures	137
Access	137
Alarm	138
AssignPipe	139
AssignStream	139
BaseName	141
CFMakeRaw	141
CFSetISpeed	142
CFSetOSpeed	142
Chown	142
Chmod	143
CloseDir	144
DirName	144
Dup	145
Dup2	145
EpochToLocal	146
Execl	147
Execle	147
Execlp	148
Execv	149
Execve	150
Execvp	150
FD_ZERO	151
FD_Clr	152
FD_IsSet	152
FD_Set	152
fdClose	152
fdFlush	153
fdOpen	153
fdRead	153
fdSeek	155
fdTruncate	155
fdWrite	155
FExpand	155
FLock	156
FSSStat	156
FSearch	157
FStat	157

Fcntl	158
Fcntl	159
Fork	159
GetDate	160
GetDomainName	160
GetEGid	161
GetEUid	161
GetEnv	161
GetEpochTime	162
GetFS	162
GetGid	163
GetHostName	163
GetPid	164
GetPPid	164
GetPriority	164
GetTime	165
GetUid	165
Glob	165
GlobFree	166
IOCtl	166
IOPerm	167
IsATTY	167
S_ISBLK	167
S_ISCHR	168
S_ISDIR	168
S_ISFIFO	168
S_ISLNK	168
S_ISREG	169
S_ISSOCK	169
Kill	169
LStat	170
Link	171
LocalToEpoch	172
MkFifo	173
Nice	173
OpenDir	174
pause	175
PClose	175
POpen	175
ReadDir	176

SeekDir	176
Select	177
SelectText	178
SetPriority	178
Shell	178
SigAction	179
SigPending	180
SigProcMask	180
SigSuspend	181
Signal	181
SymLink	182
TCDrain	183
TCFlow	183
TCFlush	183
TCGetAttr	184
TCGetPGrp	184
TCSendBreak	185
TCSetAttr	185
TCSetPGrp	185
TTYName	185
TellDir	186
Umask	186
Uname	186
UnLink	186
Utime	187
WaitPid	188
9 The MMX unit	189
9.1 Variables, Types and constants	189
9.2 Functions and Procedures	190
Emms	190
10 The Mouse unit	191
10.1 Constants, types and variables	191
10.2 Functions and procedures	192
GetLastButtonPress	192
GetLastButtonRelease	193
GetMouseState	193
HideMouse	195
InitMouse	195
LPressed	196

MPressed	196
RPressed	196
SetMouseAscii	196
SetMouseHideWindow	197
SetMousePos	197
SetMouseShape	198
SetMouseSpeed	199
SetMouseWindow	200
SetMouseXRange	200
SetMouseYRange	201
ShowMouse	201
11 The Objects unit.	202
11.1 Constants	202
11.2 Types	203
11.3 Procedures and Functions	204
NewStr	204
DisposeStr	205
Abstract	205
RegisterObjects	205
RegisterType	205
LongMul	207
LongDiv	207
11.4 TRect	207
TRect.Empty	208
TRect.Equals	209
TRect.Contains	209
TRect.Copy	209
TRect.Union	210
TRect.Intersect	210
TRect.Move	211
TRect.Grow	212
TRect.Assign	212
11.5 TObject	212
TObject.Init	213
TObject.Free	213
TObject.Done	213
11.6 TStream	214
TStream.Get	215
TStream.StrRead	215

TStream.GetPos	216
TStream.GetSize	217
TStream.ReadStr	217
TStream.Open	218
TStream.Close	218
TStream.Reset	218
TStream.Flush	218
TStream.Truncate	219
TStream.Put	219
TStream.StrWrite	219
TStream.WriteStr	219
TStream.Seek	220
TStream.Error	220
TStream.Read	220
TStream.Write	221
TStream.CopyFrom	221
11.7 TDosStream	222
TDosStream.Init	222
TDosStream.Done	223
TDosStream.Close	223
TDosStream.Truncate	223
TDosStream.Seek	224
TDosStream.Open	225
TDosStream.Read	225
TDosStream.Write	226
11.8 TBufStream	226
TBufStream.Init	226
TBufStream.Done	227
TBufStream.Close	227
TBufStream.Flush	227
TBufStream.Truncate	228
TBufStream.Seek	228
TBufStream.Open	229
TBufStream.Read	229
TBufStream.Write	229
11.9 TMemoryStream	229
TMemoryStream.Init	230
TMemoryStream.Done	230
TMemoryStream.Truncate	230
TMemoryStream.Read	231

TMemoryStream.Write	231
11.10 TCollection	232
TCollection.Init	232
TCollection.Load	233
TCollection.Done	233
TCollection.At	234
TCollection.IndexOf	234
TCollection.GetItem	235
TCollection.LastThat	235
TCollection.FirstThat	236
TCollection.Pack	237
TCollection.FreeAll	238
TCollection.DeleteAll	239
TCollection.Free	239
TCollection.Insert	240
TCollection.Delete	240
TCollection.AtFree	241
TCollection.FreeItem	242
TCollection.AtDelete	242
TCollection.ForEach	243
TCollection.SetLimit	244
TCollection.Error	244
TCollection.AtPut	244
TCollection.AtInsert	245
TCollection.Store	245
TCollection.PutItem	246
11.11 TSortedCollection	246
TSortedCollection.Init	247
TSortedCollection.Load	247
TSortedCollection.KeyOf	247
TSortedCollection.IndexOf	248
TSortedCollection.Compare	248
TSortedCollection.Search	249
TSortedCollection.Insert	250
TSortedCollection.Store	251
11.12 TStringCollection	251
TStringCollection.GetItem	251
TStringCollection.Compare	252
TStringCollection.FreeItem	253
TStringCollection.PutItem	253

11.13TStrCollection	253
TStrCollection.GetItem	253
TStrCollection.Compare	254
TStrCollection.FreeItem	254
TStrCollection.PutItem	255
11.14TUnSortedStrCollection	255
TUnSortedStrCollection.Insert	255
11.15TResourceCollection	256
TResourceCollection.KeyOf	256
TResourceCollection.GetItem	257
TResourceCollection.FreeItem	257
TResourceCollection.PutItem	257
11.16TResourceFile	257
TResourceFile.Fields	258
TResourceFile.Init	258
TResourceFile.Done	258
TResourceFile.Count	258
TResourceFile.KeyAt	258
TResourceFile.Get	259
TResourceFile.SwitchTo	259
TResourceFile.Flush	259
TResourceFile.Delete	259
TResourceFile.Put	259
11.17TStringList	260
TStringList.Load	260
TStringList.Done	260
TStringList.Get	260
11.18TStrListMaker	261
TStrListMaker.Init	261
TStrListMaker.Done	261
TStrListMaker.Put	261
TStrListMaker.Store	262
12 The PRINTER unit.	263
12.1 Types, Constants and variables :	263
12.2 Procedures and functions	263
AssignLst	263
13 The SOCKETS unit.	265
13.1 Types, Constants and variables :	265
13.2 Functions and Procedures	266

Accept	266
Accept	268
Accept	268
Accept	268
Bind	268
Bind	269
Connect	269
Connect	270
Connect	270
Connect	270
GetPeerName	271
GetSocketName	272
GetSocketOptions	272
Listen	272
Recv	273
Send	273
SetSocketOptions	274
Shutdown	274
Sock2File	274
Sock2Text	275
Socket	275
SocketPair	275
Str2UnixSockAddr	275
14 The STRINGS unit.	276
14.1 Functions and procedures.	276
StrAlloc	276
StrCat	276
StrComp	277
StrCopy	277
StrDispose	278
StrECopy	278
StrEnd	279
StrIComp	279
StrLCat	280
StrLComp	280
StrLCopy	281
StrLen	281
StrLIComp	282
StrLower	282

StrMove	283
StrNew	283
StrPas	284
StrPCopy	284
StrPos	285
StrRScan	285
StrScan	285
StrUpper	286
15 The SYSUTILS unit.	287
15.1 Constants and types	287
15.2 Date and time functions	290
Date and time formatting characters	290
TDateTime	291
Date	291
DateTimeToFileDate	292
DateTimeToStr	292
DateTimeToString	292
DateTimeToSystemTime	293
DateTimeToTimeStamp	294
DateToStr	294
DayOfWeek	295
DecodeDate	295
DecodeTime	296
EncodeDate	296
EncodeTime	297
FileDateToDateTime	297
FormatDateTime	298
IncMonth	298
IsLeapYear	299
MSecsToTimeStamp	299
Now	300
StrToDate	300
StrToDateTime	301
StrToTime	302
SystemTimeToDateTime	302
Time	303
TimeStampToDateTime	303
TimeStampToMSecs	304
TimeToStr	304

15.3	Disk functions	304
	AddDisk (Linux only)	304
	CreateDir	305
	DiskFree	305
	DiskSize	306
	GetCurrentDir	306
	RemoveDir	307
	SetCurrentDir	307
15.4	File handling functions	307
	ChangeFileExt	307
	DeleteFile	308
	DoDirSeparators	308
	ExpandFileName	309
	ExpandUNCFileName	309
	ExtractFileDir	310
	ExtractFileDrive	310
	ExtractFileExt	311
	ExtractFileName	311
	ExtractFilePath	311
	ExtractRelativePath	311
	FileAge	312
	FileClose	312
	FileCreate	313
	FileExists	314
	FileGetAttr	314
	FileGetDate	315
	FileOpen	316
	FileRead	316
	FileSearch	316
	FileSeek	317
	FileSetAttr (Not on Linux)	318
	FileSetDate (Not on Linux)	318
	FileTruncate	318
	FileWrite	318
	FindClose	319
	FindFirst	319
	FindNext	320
	GetDirs	320
	RenameFile	320
	SetDirSeparators	321

15.5 PChar functions	321
Introduction	321
StrAlloc	322
StrBufSize	323
StrDispose	323
StrPCopy	323
StrPLCopy	324
StrPas	324
15.6 String handling functions	324
AdjustLineBreaks	324
AnsiCompareStr	325
AnsiCompareText	325
AnsiExtractQuotedStr	326
AnsiLastChar	327
AnsiLowerCase	327
AnsiQuotedStr	328
AnsiStrComp	328
AnsiStrIComp	329
AnsiStrLastChar	330
AnsiStrLComp	330
AnsiStrLIComp	331
AnsiStrLower	332
AnsiStrUpper	333
AnsiUpperCase	333
AppendStr	334
AssignStr	334
BCDToInt	335
CompareMem	335
CompareStr	336
CompareText	337
DisposeStr	337
FloatToStr	338
FloatToStrF	338
FloatToText	340
FmtStr	341
Format	341
FormatBuf	347
IntToHex	347
IntToStr	348
IsValidIdent	348

LeftStr	349
LoadStr	349
LowerCase	349
NewStr	350
QuotedStr	350
RightStr	351
StrFmt	351
StrLFmt	351
StrToInt	352
StrToIntDef	353
Trim	353
TrimLeft	354
TrimRight	354
UpperCase	355

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 and LINUX. 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. 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;
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;
```

¹Current e-mail address mmay@dnaco.net

```
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: 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 (31)

```
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.
```

BigCursor

Declaration: Procedure BigCursor ;

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

Errors: None.

See also: CursorOn (24), CursorOff (24)

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 (25), InsLine (26), ClrScr (23)

```
Program Example9;  
uses Crt;  
  
{ Program to demonstrate the ClrEol function . }  
  
begin  
  Write('This line will be cleared from the ',  
        ' cursor position until the right of the screen');  
  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 (31)

```
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 (24), BigCursor (23)

CursorOn

Declaration: `Procedure CursorOn ;`

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

Errors: None.

See also: BigCursor (23), CursorOff (24)

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 (29), NoSound (28)

```
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 (23), InsLine (26), ClrScr (23)

```
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 postion');
  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 (30), WhereY (30), Window (31)

```
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 (30), TextBackground (29), LowVideo (27), NormVideo (28)

```
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 (23), DelLine (25), ClrScr (23)

```
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` (28)

```
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` (30), `TextBackground` (29), `HighVideo` (26), `NormVideo` (28)

For an example, see `HighVideo` (26)

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 (30), TextBackground (29), LowVideo (27), HighVideo (26)

For an example, see HighVideo (26)

NoSound

Declaration: `Procedure NoSound ;`

Description: Stops the speaker sound. This is not supported in LINUX

Errors: None.

See also: Sound (29)

```
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 (27)

```
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. This is not supported in LINUX

Errors: None.

See also: NoSound (28)

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 (30), HighVideo (26), LowVideo (27), NormVideo (28)

```
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);  
end.
```

```
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 (29), HighVideo (26), LowVideo (27), NormVideo (28)

```
Program Example12;
uses Crt;

{ Program to demonstrate the TextColor function . }

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

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 (25), WhereY (30), Window (31)

```
Program Example7;
uses Crt;

{ Program to demonstrate the WhereX and WhereY functions . }

begin
  WriteLn('Cursor position : 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 (25), WhereX (30), Window (31)

```
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 (25), WhereX (30), WhereY (30), ClrScr (23)

```
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, both under DOS and LINUX. 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. Under LINUX, some of the functionality is lost, as it is either impossible or meaningless to implement it. Other than that, the functionality for both operating systems is the same. 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 DOS unit.

2.1 Types, Variables, Constants

Constants

The DOS unit implements the following constants:

```
{Bitmasks for CPU Flags}
fcarry =      $0001;
fparity =     $0004;
fauxiliary =  $0010;
fzero =       $0040;
fsign =       $0080;
foverflow =   $0800;
{Bitmasks for file attribute}
readonly =    $01;
hidden =      $02;
sysfile =     $04;
volumeid =    $08;
directory =   $10;
archive =     $20;
anyfile =     $3F;
fmclosed =    $D7B0;
fminput =     $D7B1;
fmoutput =    $D7B2;
fminout =     $D7B3;
```

¹Current e-mail address mmay@dnaco.net

Types

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

```
ComStr  = String[127]; { For command-lines }
PathStr = String[79];  { For full path for file names }
DirStr  = String[67];  { For Directory and (DOS) drive string }
NameStr = String[8];   { For Name of file }
ExtStr  = String[4];   { For Extension of file }
```

Under LINUX, these strings all have length 255.

```
{ $PACKRECORDS 1 }
SearchRec = 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 (45) and UnPackTime (48) for setting/reading file times with GetFTime (43) and SetFTime (47).

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 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 `LINUX` only. This list is used to determine which disks to use in the `DiskFree` (35) and `DiskSize` (36) calls. The `DiskFree` (35) and `DiskSize` (36) 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.
- `'/fd1/.'` for the second floppy-drive.
- `'/'` 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` (35), `DiskSize` (36)

DiskFree

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

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. Typically, the free space is the size of a disk block, multiplied by the number of free blocks on the disk. **For LINUX 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.
- `'/fd1/.'` for the second floppy-drive.
- `'/'` for the first hard disk.

There is room for 1-26 drives. You can add a drive with the `AddDisk` (35) procedure. These settings can be coded in `dos.pp`, in the initialization part.

Errors: -1 when a failure occurs, or an invalid `drivenr` is given.

See also: `DiskSize` (36), `AddDisk` (35)

```
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) : longint;`

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 LINUX 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.
- '/fd1/ .' for the second floppy-drive.
- '/' for the first hard disk.

There is room for 1-26 drives. You can add a drive with the `AddDisk` (35) 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` (35), `AddDisk` (35)

For an example, see `DiskFree` (35).

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` (38)

```
Program Example5;  
uses Dos;  
  
{ Program to demonstrate the Exec and DosExitCode function . }
```

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

DosVersion

Declaration: `Function DosVersion : Word;`

Description: `DosVersion` returns the DOS version number. On LINUX systems, it returns the Linux version (The first 2 numbers, e.g Linux version 2.1.76 will give you `DosVersion` 2.1)

Errors: None.

See also:

```
Program Example1;
uses Dos;

{ Program to demonstrate the DosVersion function . }

var
  OS      : string [32];
  Version : word;
begin
{$IFDEF LINUX}
  OS:= ' Linux ' ;
{$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` (38), `Dos:GetEnv` (42)

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. This may cause problems under LINUX. The LINUX unit solves this problem.

See also: `EnvCount` (37), `Dos:GetEnv` (42)

```
Program Example13;  
uses Dos;  
  
{ Program to demonstrate the EnvCount and EnvStr function . }  
  
var  
  i : Longint;  
begin  
  WriteLn(' Current Environment is :' );  
  for i:=1 to 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` (36)

For an example, see `DosExitCode` (36)

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 (under DOS). The resulting name is converted to uppercase on DOS systems. Under LINUX, the name is left as it is. (filenames are case sensitive under Unix)

Errors: `FSplit` (40)

```
Program Example5;  
uses Dos;  
  
{ Program to demonstrate the Exec and DosExitCode function . }  
  
begin
```

```

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

```

See also:

FindClose

Declaration: `Procedure FindClose (Var F: SearchRec);`

Description: **LINUX only** Under LINUX, the `findFirst/findnext` calls have to be mimicked. An internal table of file descriptors is kept. When using different `searchrecs` at the same time, the system may run out of file descriptors for directories. 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. It is recommended to use the LINUX call `Glob` when looking for files.

Errors: None.

See also: `Glob` (165).

FindFirst

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

Description: `FindFirst` searches the file specified in `Path`, checks the attributes specified in `Attr`. 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.

Errors: Errors are reported in `DosError`.

See also: `FindNext` (40), `FindClose` (39)

```

Program Example7;
uses Dos;

{ Program to demonstrate the FindFirst and FindNext function . }

var
  Dir : SearchRec;
begin
  FindFirst( '*.*', $20, 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 (39), FindClose (39)

For an example, see FindFirst (39).

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 (or colons under LINUX). When no file is found, an empty string is returned.

Errors: None.

See also: FExpand (38)

```
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.) Under LINUX, the extension is taken to be all letters after the last dot (.).

Errors: None.

See also: `FSearch` (40)

```
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. 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.

Errors: Under Linux, this exists but is not implemented, i.e. the call does nothing.

See also: `SetCBreak` (46)

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` (44),`SetDate` (46)

```
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`. Under LINUX, case is important when looking for `EnvVar`. When there is no environment variable `EnvVar` defined, an empty string is returned.

Errors: None.

See also: `EnvCount` (37), `EnvStr` (38)

```
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` = 01h
- `Hidden` = 02h
- `SysFile` = 04h
- `VolumeId` = 08h
- `Directory` = 10h
- `Archive` = 20h

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` (47)

```
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 $20) <> 0 then WriteLn(' - Archive ');
  if (Attr and $10) <> 0 then WriteLn(' - Directory ');
  if (Attr and $4) <> 0 then WriteLn(' - Read-Only ');
  if (Attr and $2) <> 0 then WriteLn(' - System ');
  if (Attr and $1) <> 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 (47), PackTime (45), UnPackTime (48)

```
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`.

Errors: None. Under LINUX, this call exists but isn't implemented, i.e. it does nothing.

See also: `SetIntVec` (47)

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.

Errors: None.

See also: `GetDate` (41), `SetTime` (47)

```
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.

Errors: Under `LINUX`, `Verify` is always `True`.

See also: `SetVerify` (48)

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`.

Errors: Under `LINUX` this call does nothing, because interrupts are managed by the kernel. The only allowed interrupt is 80h, the Linux kernel entry interrupt.

See also: `MSDos` (45), 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.

Errors: Under `LINUX`, this call does nothing.

See also: `Halt` ()

MSDos

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

Description: `MSdos` executes an MS-DOS call (int 21h). This is the same as doing a `Intr` call with an interrupt number of 21h.

Errors: None.

See also: `Intr` (45)

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` (47), `FindFirst` (39), `FindNext` (40), `UnPackTime` (48)

```
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 under DOS. 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.

Errors: Under Linux, this call exists but is not implemented, i.e. it does nothing.

See also: `GetCBreak` (41)

SetDate

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

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

Errors: On a LINUX machine, this is not implemented (although a procedure exists, it just doesn't do anything. The setting of the date is a root-only privilege, and is hence not implemented.

See also: `Dos.GetDate` (41), `SetTime` (47)

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` = 01h
- `Hidden` = 02h
- `SysFile` = 04h
- `VolumeId` = 08h
- `Directory` = 10h
- `Archive` = 20h
- `AnyFile` = 3fh

Errors: Errors are reported in `DosError`. Under LINUX the call exists, but is not implemented, i.e. it does nothing.

See also: `GetFAttr` (42)

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.

Errors: Errors are reported in `DosError`

See also: `GetFTime` (43), `PackTime` (45), `UnPackTime` (48)

SetIntVec

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

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

Errors: Under LINUX, this call exists but is not implemented, the kernel manages all interrupts.

See also: `GetIntVec` (44)

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.

Errors: this call exists, but is not implemented on LINUX, as setting the time is a root-only privilege.

See also: `Dos:GetTime` (44), `SetDate` (46)

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.

Errors: Under LINUX, `Verify` is always `True`.

See also: `SetVerify` (48)

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.

Errors: Under LINUX this call does nothing, as the interrupt vectors are managed by the kernel.

See also: `Exec` (38), `SetIntVec` (47)

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` (43), `FindFirst` (39), `FindNext` (40), `PackTime` (45)

For an example, see `PackTime` (45).

Chapter 3

The GETOPTS unit.

This document describes the GETOPTS unit for Free Pascal. It was written for LINUX by Michaël Van Canneyt. It also works under DOS and Tp7.

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.

3.1 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.

3.2 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` (50) 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` (50), `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` (50), `getopt` (3)

```
program testopt;  
  
  { Program to demonstrate 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' , @theo[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 4

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 Klaempfl. 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.

4.1 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

4.2 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` (70), `get_ds` (70), `gett_ss` (77), `allocate_ldt_descriptors` (62), `free_ldt_descriptor` (69), `segment_to_descriptor` (84), `get_next_selector_increment_value` (72), `get_segment_base_address` (77), `set_segment_base_address` (86), `set_segment_limit` (86), `create_code_segment_alias_descriptor` (66)

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` (67), `dosmemput` (68), `dosmemmove` (68), `dosmemfillchar` (66), `dosmemfillword` (67), `mem[]`-arrays, `seg_move` (84), `seg_fillchar` (83), `seg_fillword` (83).

I/O port access

The I/O port access is done via the various `inportb` (79), `outportb` (81) 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` (81), `inportb` (79), `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` (70), `get_ds` (70), `get_ss` (77)

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 an 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.

Program Keyclick ;

```
uses crt ,  
      go32;
```

```
const kbdint = $9;
```



```
var oldint9_handler : tseginfo;
    newint9_handler : tseginfo;

    clickproc : pointer;

{$ASMMODE DIRECT}
procedure int9_handler; assembler;
asm
    cli
    pushal
    movw %cs:INT9_DS, %ax
    movw %ax, %ds
    movw %ax, %es
    movw U_GO32_DOSMEMSELECTOR, %ax
    movw %ax, %fs
    call *_CLICKPROC
    popal

    ljmp %cs:OLDHANDLER

INT9_DS: . word 0
OLDHANDLER:
    . long 0
    . word 0

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 );
asm
    movw %ds, %ax
    movw %ax, INT9_DS
    movl _OLDINT9_HANDLER, %eax
```

```
        movl %eax, OLDHANDLER
        movw 4+_OLDINT9_HANDLER, %ax
        movw %ax, 4+OLDHANDLER
    end;
    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` (85) only services software interrupts that are executed in protected mode; real mode software interrupts can be redirected by `set_rm_interrupt` (86). See also `set_rm_interrupt` (86), `get_rm_interrupt` (76), `set_pm_interrupt` (85), `get_pm_interrupt` (72), `lock_data` (80), `lock_code` (80), `enable` (69), `disable` (66), `outportb` (81) 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 it's contents may change when calling other procedures. It's size can be obtained with `tb_size` (87) and it's linear address via `transfer_buffer` (87). Another way is to allocate a completely new DOS memory area via the `global_dos_alloc` (78) function for your use and supply its real mode address. See also: `tb_size` (87), `transfer_buffer` (87). `global_dos_alloc` (78), `global_dos_free` (79), `realintr` (82) The following examples illustrate the use of software interrupts.

Program softint;

uses go32;

```
var r : trealregs;

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

Program rmpm_int;

uses crt, go32;

{$ASMMODE DIRECT}

var r : trealregs;
    axreg : Word;

    oldint21h : tseginfo;
    newint21h : tseginfo;

procedure int21h_handler; assembler;
asm
    cmpw $0x3001, %ax
    jne CallOld
    movw $0x3112, %ax
    iret

CallOld:
    ljmp %cs:OLDHANDLER

OLDHANDLER: . long 0
             . word 0

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 DPMI 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);
    asm
        movl _OLDINT21H, %eax
        movl %eax, OLDHANDLER
        movw 4+_OLDINT21H, %ax
        movw %ax, 4+OLDHANDLER
    end;
    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 ');
    Writeln('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` (73)
- %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` (73), `free_rm_callback` (69), `lock_code` (80), `lock_data` (80)

4.3 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.

Table 4.1: 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.

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 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.

4.4 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` (72) function.

Errors: Check the `int31error` variable.

See also: `free_ldt_descriptor` (69), `get_next_selector_increment_value` (72), `segment_to_descriptor` (84), `create_code_segment_alias_descriptor` (66), `set_segment_limit` (86), `set_segment_base_address` (86)

```
Program sel_des ;

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` (69)

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` (87), `transfer_buffer` (87), `copytodos` (65)

copytodos

Declaration: `Procedure copytodos (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` (87), `transfer_buffer` (87), `copyfromdos` (65)

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` (62), `set_segment_limit` (86), `set_segment_base_address` (86)

disable

Declaration: `Procedure disable ;`

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

Errors: None.

See also: `enable` (69)

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: `dosmemput` (68), `dosmemget` (67), `dosmemmove` (68), `dosmemmove`, `dosmemfillword` (67), `seg_move` (84), `seg_fillchar` (83), `seg_fillword` (83)

Program `textmess;`

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, $B800,  
                      random(columns)*2+random(rows)*columns*2,  
                      length(text)*2);  
            delay(1);  
        end;  
        readkey;  
        readkey;  
        dosmemput($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: dosmemput (68), dosmemget (67), dosmemmove (68), dosmemfillchar (66), seg_move (84),
seg_fillchar (83), seg_fillword (83)

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: dosmemput (68), dosmemmove (68), dosmemfillchar (66), dosmemfillword (67), seg_move (84), seg_fillchar (83), seg_fillword (83)

For an example, see global_dos_alloc (78).

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: dosmemput (68), dosmemget (67), dosmemfillchar (66), dosmemfillword (67) seg_move (84), seg_fillchar (83), seg_fillword (83)

For an example, see seg_fillchar (83).

dosmemput

Declaration: Procedure dosmemput (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 (67), dosmemmove (68), dosmemfillchar (66), dosmemfillword (67), seg_move (84), seg_fillchar (83), seg_fillword (83)

For an example, see global_dos_alloc (78).

enable

Declaration: Procedure `enable` ;

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

Errors: None.

See also: `disable` (66)

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` (62) 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` (62), `get_next_selector_increment_value` (72)

For an example, see `allocate_ldt_descriptors` (62).

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` (65) . 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` (65)

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` (73) function. Parameters:

intaddr: real mode address buffer returned by `get_rm_callback` (73) .

Return values: True if successful, False if not

Errors: Check the `int31error` variable.

See also: `set_rm_interrupt` (86), `get_rm_callback` (73)

For an example, see `get_rm_callback` (73).

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 (70)`, `get_ss (77)`

For an example, see `set_pm_interrupt (85)`.

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 (84)`

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 (70)`, `get_ss (77)`

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 (62)`, `set_segment_limit (86)`, `set_segment_base_address (86)`

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 DPMI host will be set by the host to `-1` (`0FFFFFFFFH`) to indicate that the information is not available. The size of the pages used by the DPMI host can be obtained with the `get_page_size (72)` function.

Errors: Check the `int31error` variable.

See also: `get_page_size (72)`

Program `meminf;`

uses `go32;`

var `meminfo : tmeminfo;`

begin

`get_meminfo(meminfo);`

if (`int31error <> 0`) **then**

begin

Writeln('Error getting DPMI memory information ... Halting');

Writeln('DPMI error number : ', `int31error`);

end

else

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.
```

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` (62). Parameters: None. Return value: Selector increment value. Notes: Because `allocate_ldt_descriptors` (62) 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` (62), `free_ldt_descriptor` (69)

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` (71)

For an example, see `get_meminfo` (71).

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` (85), `set_rm_interrupt` (86), `get_rm_interrupt` (76)

For an example, see `set_pm_interrupt` (85).

get_rm_callback

Declaration: Function `get_rm_callback` (`pm_func` : pointer; `const reg` : `trealregs`; `var rmcb`: `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.

rmcb: 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` (69)

Program `callback`;

```
uses crt ,  
      go32;
```

```
const mouseint = $33;
```

```
var mouse_regs      : trealregs;  
    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;
```

```
{$ASMMODE DIRECT}
```

```
procedure callback_handler; assembler;  
asm
```

```
    pushw %es  
    pushw %ds  
    pushl %edi  
    pushl %esi  
    cmpl $1, _USERPROC_INSTALLED  
    je .LNoCallback  
    pushal  
    movw %es, %ax  
    movw %ax, %ds  
    movw U_GO32_DOSMEMSELECTOR, %ax
```

```
    movw %ax, %fs
    call *_USERPROC_PROC
    popal
.LNoCallback:

    popl %esi
    popl %edi
    popw %ds
    popw %es

    movl (%esi), %eax
    movl %eax, %es: 42(%edi)
    addw $4, %es: 46(%edi)
    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;
                        userproc_len : longint);
var r : trealregs;
begin
    r.eax := $0; realintr(mouseint, r);
    if (r.eax <> $FFFF) then begin
        Writeln('No Microsoft compatible mouse found');
        Write('A Microsoft compatible mouse driver is');
        writeln(' 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 := userproc_len;
        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
        { write mouse state info }
        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` (86), `set_pm_interrupt` (85), `get_pm_interrupt` (72)

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` (76)

Program `getrunmd`;

uses `go32`;

begin

```
{  
    depending on the detected environment,  
    we simply write another message  
}
```

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 ( 'DPMI detected.',  
        ' You''re using a DPMI host like ',  
        ' a windows DOS box or CWSDPMI' );  
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` (62), `set_segment_base_address` (86), `allocate_ldt_descriptors` (62), `set_segment_limit` (86), `get_segment_limit` (77)

For an example, see `allocate_ldt_descriptors` (62).

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` (62), `set_segment_limit` (86), `set_segment_base_address` (86), `get_segment_base_address` (77),

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` (70), `get_cs` (70)

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` (79) call.

Errors: Check the `int31error` variable.

See also: `global_dos_free` (79)

Program `buffer;`

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 = record`

`Signature : array[0..3] of char;`
 `Version : Word;`
 `reserved : array[0..505] of byte;`

end;

var `selector,`
 `segment : Word;`

`r : trealregs;`
 `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` (78).

Errors: Check the `int31error` variable.

See also: `global_dos_alloc` (78)

For an example, see `global_dos_alloc` (78).

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` (81), `inportw` (80), `inportl` (80)

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` (81), `inportb` (79), `inportw` (80)

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` (82), `inportb` (79), `inportl` (80)

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` (81), `lock_data` (80), `unlock_linear_region` (88), `unlock_data` (87), `unlock_code` (87)

For an example, see `get_rm_callback` (73).

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` (81), `lock_code` (80), `unlock_linear_region` (88), `unlock_data` (87), `unlock_code` (87)

For an example, see `get_rm_callback` (73).

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` (80), `lock_code` (80), `unlock_linear_region` (88), `unlock_data` (87), `unlock_code` (87)

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` (79), `outportl` (81), `outportw` (82)

```
program outport;  
  
uses crt , go32;  
  
begin  
  { turn on speaker }  
  outportb($61, $ff);  
  { wait a little bit }  
  delay(50);  
  { turn it off again }  
  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` (80), `outportw` (82), `outportb` (81)

For an example, see `outportb` (81).

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 (80), outportl (81), outportb (81)

For an example, see outportb (81).

realintr

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

Description: Simulates an interrupt in real mode. Parameters:

intnr: 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 intnr. The real mode handler must return by executing an IRET.

Errors: Check the int31error variable.

See also:

Program flags ;

uses go32;

var r : trealregs ;

begin

 r.ax := \$5300;

 r.bx := 0;

 realintr (\$15, r);

{ check if carry clear and write a suited message }

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 (84), seg_fillword (83), dosmemfillchar (66), dosmemfillword (67), dosmemget (67), dosmemput (68), dosmemmove (68)

Program svgasel;

uses go32;

var vgasel : Word;
r : trealregs;

begin

r.eax := \$13; realintr(\$10, r);
vgasel := segment_to_descriptor(\$A000);
{ simply fill the screen memory with color 15 }
seg_fillchar(vgasel, 0, 64000, #15);
readln;
{ back to text mode }
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 (84), seg_fillchar (83), dosmemfillchar (66), dosmemfillword (67), dosmemget (67), dosmemput (68), dosmemmove (68)

For an example, see allocate_ldt_descriptors (62).

segment_to_descriptor

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

Description: Maps a real mode segment (paragraph) address onto an 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` (62) and change the base address as necessary.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (62), `free_ldt_descriptor` (69), `set_segment_base_address` (86)

For an example, see `seg_fillchar` (83).

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` (83), `seg_fillword` (83), `dosmemfillchar` (66), `dosmemfillword` (67), `dosmemget` (67), `dosmempu` (68), `dosmemmove` (68)

For an example, see `allocate_ldt_descriptors` (62).

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` (70)

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` (72), `set_rm_interrupt` (86), `get_rm_interrupt` (76)

```
Program int_pm;  
  
uses crt, go32;  
  
const int1c = $1c;  
  
var oldint1c : tseginfo;  
    newint1c : tseginfo;  
    int1c_counter : Longint;  
  
{ $ASMMODE DIRECT }  
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  
INT1C_DS: . word 0  
end;  
  
var i : Longint;  
  
begin  
    newint1c.offset := @int1c_handler;  
    newint1c.segment := get_cs;  
    get_pm_interrupt(int1c, oldint1c);  
    asm  
        movw %ds, %ax  
        movw %ax, INT1C_DS  
    end;  
    WriteLn('— Press any key to exit —');  
    set_pm_interrupt(int1c, newint1c);  
    while ( not keypressed ) do begin
```

```
        gotoxy(1, wherey);
        write('Number of interrupts occurred : ',
              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` (73).

Errors: Check the `int31error` variable.

See also: `get_rm_interrupt` (76), `set_pm_interrupt` (85), `get_pm_interrupt` (72), `get_rm_callback` (73)

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` (62), `get_segment_base_address` (77), `allocate_ldt_descriptors` (62), `set_segment_limit` (86), `get_segment_base_address` (77), `get_segment_limit` (77)

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` (62), `set_segment_base_address` (86), `get_segment_limit` (77), `set_segment_limit` (86)

For an example, see `allocate_ldt_descriptors` (62).

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` (87), `copyfromdos` (65) `copytodos` (65)

transfer_buffer

Declaration: `Function transfer_buffer : Longint;`

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

Errors: None.

See also: `tb_size` (87)

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` (88), `unlock_data` (87), `lock_linear_region` (81), `lock_data` (80), `lock_code` (80)

For an example, see `get_rm_callback` (73).

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` (88), `unlock_code` (87), `lock_linear_region` (81), `lock_data` (80), `lock_code` (80)

For an example, see `get_rm_callback` (73).

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` (87), `unlock_code` (87), `lock_linear_region` (81), `lock_data` (80), `lock_code` (80)

Chapter 5

The GRAPH unit.

This document describes the GRAPH unit for Free Pascal, under DOS. The unit was first written for DOS by Florian klämpfl. This chapter is divided in three 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.

5.1 Introduction

Requirements

The unit Graph exports functions and procedures for graphical output. It requires at least a VESA compatible VGA-Card or a VGA-Card with software-driver (min. **512Kb** video memory). Before the graph unit can be used, be sure your graphics adapter supports the VESA-Standard. Otherwise in the most cases you can try to use a VESA-TSR to make your adapter VESA compatible (e.g. UNIVBE).

5.2 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;
LineSettingsType = 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;
```

5.3 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 (90),Ellipse (92) GetArcCoords (92),PieSlice (100), Sector (101)

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 (90), Rectangle (100)

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 (90), Rectangle (100)

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 (92),Arc (90) GetArcCoords (92),PieSlice (100), Sector (101)

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` (91), `SetBkColor` (102)

ClearViewPort

Declaration: `Procedure ClearViewPort ;`

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

Errors: None.

See also: `ClearDevice` (91), `SetViewPort` (105), `SetBkColor` (102)

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` (97)

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` (97)

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` (90), `seepBar3D`, `Rectangle` (100)

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.

Errors: None.

See also: `Arc` (90) `Circle` (90), `FillEllipse` (92)

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` (90) `Circle` (90), `GetArcCoords` (92), `PieSlice` (100), `Sector` (101)

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` (90), `seepBar3D`, `Rectangle` (100)

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` (102), `SetBkColor` (102)

GetArcCoords

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

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

Errors: None.

See also: `Arc` (90), `Ellipse` (92)

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` (97), `SetAspectRatio` (102)

GetBkColor

Declaration: `Function GetBkColor : Word;`

Description: `GetBkColor` returns the current background color (the palette entry).

Errors: None.

See also: `GetColor` (93), `SetBkColor` (102)

GetColor

Declaration: `Function GetColor : Word;`

Description: `GetColor` returns the current drawing color (the palette entry).

Errors: None.

See also: `GetColor` (93), `SetBkColor` (102)

GetDefaultPalette

Declaration: `Procedure GetDefaultPalette (Var Palette : PaletteType);`

Description: Returns the current palette in `Palette`.

Errors: None.

See also: `GetColor` (93), `GetBkColor` (93)

GetDriverName

Declaration: `Function GetDriverName : String;`

Description: `GetDriverName` returns a string containing the name of the current driver.

Errors: None.

See also: `GetModeName` (95), `InitGraph` (97)

GetFillPattern

Declaration: `Procedure GetFillPattern (Var FillPattern : FillPatternType);`

Description: `GetFillPattern` returns an array with the current fill-pattern in `FillPattern`

Errors: None

See also: `SetFillPattern` (102)

GetFillSettings

Declaration: `Procedure GetFillSettings (Var FillInfo : FillSettingsType);`

Description: `GetFillSettings` returns the current fill-settings in `FillInfo`

Errors: None.

See also: `SetFillPattern` (102)

GetGraphMode

Declaration: `Function GetGraphMode : Integer;`

Description: `GetGraphMode` returns the current graphical modulus

Errors: None.

See also: `InitGraph` (97)

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` (97), `PutImage` (100)

GetLineSettings

Declaration: `Procedure GetLineSettings (Var LineInfo : LineSettingsType);`

Description: `GetLineSettings` returns the current Line settings in `LineInfo`

Errors: None.

See also: `SetLineStyle` (103)

GetMaxColor

Declaration: `Function GetMaxColor : Word;`

Description: `GetMaxColor` returns the maximum color-number which can be set with `SetColor`

Errors: None.

See also: `SetColor` (102), `GetPaletteSize` (95)

GetMaxMode

Declaration: `Function GetMaxMode : Word;`

Description: `GetMaxMode` returns the highest modulus for the current driver.

Errors: None.

See also: `InitGraph` (97)

GetMaxX

Declaration: `Function GetMaxX : Word;`

Description: `GetMaxX` returns the maximum horizontal screen length

Errors: None.

See also: `GetMaxY` (95)

GetMaxY

Declaration: `Function GetMaxY : Word;`

Description: `GetMaxY` returns the maximum number of screen lines

Errors: None.

See also: `GetMaxX` (95)

GetModeName

Declaration: `Function GetModeName (Var modus : Integer) : String;`

Description: Returns a string with the name of modus `Modus`

Errors: None.

See also: `GetDriverName` (93), `InitGraph` (97)

GetModeRange

Declaration: `Procedure GetModeRange (Driver : Integer;
LoModus, HiModus: Integer);`

Description: `GetModeRange` returns the Lowest and Highest modus of the currently installed driver.

Errors: None.

See also: `InitGraph` (97)

GetPalette

Declaration: `Procedure GetPalette (Var Palette : PaletteType);`

Description: `GetPalette` returns in `Palette` the current palette.

Errors: None.

See also: `GetPaletteSize` (95), `SetPalette` (104)

GetPaletteSize

Declaration: `Function GetPaletteSize : Word;`

Description: `GetPaletteSize` returns the maximum number of entries in the current palette.

Errors: None.

See also: `GetPalette` (95), `SetPalette` (104)

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` (105), `SetTextJustify` (104)

GetViewSettings

Declaration: `Procedure GetViewSettings (Var ViewPort : ViewPortType);`

Description: `GetViewSettings` returns the current view-port and clipping settings in `ViewPort`.

Errors: None.

See also: `SetViewPort` (105)

GetX

Declaration: `Function GetX : Integer;`

Description: `GetX` returns the X-coordinate of the current position of the graphical pointer

Errors: None.

See also: `GetY` (96)

GetY

Declaration: `Function GetY : Integer;`

Description: `GetY` returns the Y-coordinate of the current position of the graphical pointer

Errors: None.

See also: `GetX` (96)

GraphDefaults

Declaration: `Procedure GraphDefaults ;`

Description: `GraphDefaults` resets all settings for view-port, 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` (105), `SetFillStyle` (103), `SetColor` (102), `SetBkColor` (102), `SetLineStyle` (103)

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` (97)

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. Except for all operations which draw something on the screen, the following procedures also can produce a `GraphResult` different from zero:

- `InstallUserFont` (98)
- `SetLineStyle` (103)
- `SetWriteMode` (106)
- `SetFillStyle` (103)
- `SetTextJustify` (104)
- `SetGraphMode` (103)
- `SetTextStyle` (105)

Errors: None.

See also: `GraphErrorMsg` (97)

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` (94)

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 89), DetectGraph (91), CloseGraph (91), GraphResult (97)

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 (97), InstallUserFont (98)

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 (97), InstallUserDriver (98)

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 (99),LineTo (99)

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 (98), LineTo (99)

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 (99),Line (98)

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 (99)

MoveTo

Declaration: Procedure MoveTo (X,Y : Integer;

Description: MoveTo moves the pointer to the point (X,Y).

Errors: None.

See also: MoveRel (99)

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 (100)

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` (99)

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` (90), `Circle` (90), `Sector` (101)

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` (97), `GetImage` (94)

PutPixel

Declaration: `Procedure PutPixel (X,Y : Integer; Color : Word);`

Description: Puts a point at `(X,Y)` using color `Color`

Errors: None.

See also: `GetPixel` (96)

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` (90), `Bar3D` (90)

RegisterBGIDriver

Declaration: `Function RegisterBGIDriver (Driver : Pointer) : Integer;`

Description: Registers a user-defined BGI driver

Errors: None.

See also: `InstallUserDriver` (98), `RegisterBGIFont` (101)

RegisterBGIFont

Declaration: `Function RegisterBGIFont (Font : Pointer) : Integer;`

Description: Registers a user-defined BGI driver

Errors: None.

See also: `InstallUserFont` (98), `RegisterBGIDriver` (101)

RestoreCRTMode

Declaration: `Procedure RestoreCRTMode ;`

Description: Restores the screen modus which was active before the graphical modus was started.

Errors: None.

See also: `InitGraph` (97)

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` (90), `Circle` (90), `PieSlice` (100)

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` (95)

SetAspectRatio

Declaration: `Procedure SetAspectRatio (Xasp, Yasp : Word);`

Description: Sets the aspect ratio of the current screen to `Xasp/Yasp`.

Errors: None

See also: `InitGraph` (97), `GetAspectRatio` (93)

SetBkColor

Declaration: `Procedure SetBkColor (Color : Word);`

Description: Sets the background color to `Color`.

Errors: None.

See also: `GetBkColor` (93), `SetColor` (102)

SetColor

Declaration: `Procedure SetColor (Color : Word);`

Description: Sets the foreground color to `Color`.

Errors: None.

See also: `GetColor` (93), `SetBkColor` (102)

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` (93), `SetFillStyle` (103)

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` (102)

SetGraphBufSize

Declaration: `Procedure SetGraphBufSize (BufSize : Word);`

Description: `SetGraphBufSize` sets the graphical buffer size. The default size is 4Kb

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` (97)

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 (94)

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 (102), SetRGBPalette (104)

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 (102), SetPalette (104)

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 (99), OutTextXY (100)

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=2;
- SmallFont=2;
- SansSerifFont=3;
- GothicFont=4;

Pre-defined constants for Direction are :

- HorizDir=0;
- VertDir=1;

Errors: None.

See also: GetTextSettings (96)

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 (105)

SetViewPort

Declaration: Procedure SetViewPort (X1,Y1,X2,Y2 : Integer; Clip : Boolean);

Description: Sets the current graphical view-port (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 view-port (window) will be clipped (i.e. not drawn). Coordinates specified after this call are relative to the top-left corner of the view-port.

Errors: None.

See also: GetViewSettings (96)

SetVisualPage

Declaration: Procedure SetVisualPage (Page : Word);

Description: SetVisualPage sets the video page to page number Page.

Errors: None

See also: SetActivePage (101)

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` (106)

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` (106)

Chapter 6

The HEAPTRC unit.

This chapter describes the HEAPTRC unit for Free Pascal. It was written by Pierre Muller.

6.1 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.

6.2 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.

The following example shows how to use the `heaptrc` unit.

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 I:=1 to 10 do
  begin
    GetMem (P2,128);
    // When I is even, deallocate block. We loose 5 times 128
    // bytes this way.
    If (I 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 08052C48 invalid
Wrong size : 128 allocated 64 freed
  0x0804C29C
  0x080509E2
  0x080480A4
  0x00000000
Heap dump by heaptrc unit
13 memory blocks allocated : 1416/1424
6 memory blocks freed      : 708/712
7 unfreed memory blocks : 708
True heap size : 2097152
True free heap : 2096040
Should be : 2096104
Call trace for block 0x08052C48 size 128
  0x080509D6
  0x080480A4
Call trace for block 0x08052B98 size 128
  0x08050992
  0x080480A4
Call trace for block 0x08052AE8 size 128
  0x08050992
  0x080480A4
Call trace for block 0x08052A38 size 128
  0x08050992
  0x080480A4
Call trace for block 0x08052988 size 128
  0x08050992
  0x080480A4
Call trace for block 0x080528D8 size 128
  0x08050992
  0x080480A4
Call trace for block 0x080528A0 size 4
  0x08050961
  0x080480A4
```

6.3 Constants, Types and variables

The `FillExtraInfoType` is a procedural type used in the `SetExtraInfo` (110) call.

type

```
FillExtraInfoType = procedure(p : pointer);
```

The following typed constants allow to fine-tune the standard dump of the memory usage by `DumpHeap` (109):

const

```
tracesize = 8;  
quicktrace : boolean = true;  
HaltOnError : boolean = true;  
keepreleased : boolean = false;
```

`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.

6.4 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 instaling an exit procedure), but it can be called at any time

Errors: None.

See also: `MarkHeap` (109)

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` (109)

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 memory 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` (109) is executed.

See also: `DumpHeap` (109)

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.
```


Chapter 7

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.

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.

7.1 Types, Constants and variables :

Variables

```
Var
    IPCError : longint;
```

The `IPCError` variable is used to report errors, by all calls.

Constants

```
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` (121) 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` (128) call.

Types

```
Type
TKey   = Longint;
```

TKey is the type returned by the `ftok` (116) 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 strucure is used in the shmctl (128) 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 programer 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_lrpids  : word;
end;
```

The TMSQid_ds record is returned by the `msgctl` (118) 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 TSEMid_ds structure is returned by the `semctl` (122) 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` (121) 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 : PSEMid_ds );  
    2 : ( arr : PWord );  
    3 : ( padbuf : PSEminfo );  
    4 : ( padpad : pointer );  
  end;
```

The TSEMun variant record (actually a C union) is used in the `semctl` (122) call.

7.2 Functions and procedures

ftok

Declaration: Function `ftok` (Path : String; ID : char) : TKey;

Description: `ftok` returns a key that can be used in a `semget` (121), `shmget` (127) or `msgget` (117) 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` (121), `shmget` (127), `msgget` (117)

For an example, see `msgctl` (118), `semctl` (122), `shmctl` (128).

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_CREAT The queue is created if it doesn't already exist.

IPC_EXCL If 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` (116), `msgsnd` (117), `msgrcv` (118), `msgctl` (118), `semget` (2)

For an example, see `msgctl` (118).

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):

0 No special meaning. The message will be written to the queue. If the queue is full, then the process is blocked.

IPC_NOWAIT If the queue is full, then no message is written, and the call returns immediately.

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` (117), `msgrcv` (118), `seefmsgctl`

For an example, see `msgctl` (118).

msgrcv

Declaration: `Function msgrcv(msqid:longint; msgp: PMSGBuf; msgsz: longint; msgtyp:longint; msgflg:longint): Boolean;`

Description: `msgrcv` retrieves a message of type `msgtyp` from the message queue with ID `msqid`. `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` (117), `msgsnd` (117), `msgctl` (118)

For an example, see `msgctl` (118).

msgctl

Declaration: `Function msgctl(msqid: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` (117), `msgsnd` (117), `msgrcv` (118)

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 : ' , ipcerror );
  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' );
  Writeln ( ' Old permissions : ' , QueueDS.msg_perm.mode);
  QueueDS.msg_perm.mode:=Mode;
  if msgctl ( ID ,IPC_SET, @QueueDS) then
    Writeln ( ' New permissions : ' , QueueDS.msg_perm.mode)
  else
    DoError ( ' msgctl : IPC_SET' );
```



```
end;

procedure usage;

begin
  Writeln ( ' Usage : msgtool s(end)    < type> < text> ( max 255 characters )' );
  Writeln ( '                               r ( eceive ) < type>' );
  Writeln ( '                               d ( elete )' );
  Writeln ( '                               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` (116), `semop` (121), `semctl` (122)

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` (121), `semctl` (122)

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 : PSEMid_ds );
      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 `TSEMid_ds` record. The `semctl` call fills this `TSEMid_ds` 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 `TSEMid_ds` 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.

GETNCNTThis 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` (121) 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` (121), `semop` (121)

```
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' );
  Writeln ( ' 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;
    Writeln ( ' Attempting to lock member ',member, ' of semaphore ',ID);
    if not semop(ld,@lock,1) then
      DoError ( ' Lock failed ' )
    else
      Writeln ( ' 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;
    Writeln ( ' Attempting to unlock member ',member, ' of semaphore ',ID);
```

```
    if not semop(Id, @unlock, 1) then
        DoError ( 'Unlock failed' )
    else
        Writeln ( '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 : TSEMid_ds;

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( elete )' );
    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` (127), `shmdt` (127), `shmctl` (128)

For an example, see `shmctl` (128).

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` (127).

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` (127), `shmat` (127), `shmctl` (128)

shmctl

Declaration: Function shmctl(shmid:longint; cmd:longint; buf: pshmids): Boolean;

Description: shmctl performs various operations on the shared memory block identified by identifier shmid.

The buf parameter points to a TSHMids record. The cmd parameter is used to pass which operation is to be performed. It can have one of the following values :

IPC_STATshmctl fills the TSHMids 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_RMIDthe 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 (127), shmat (127), shmdt (127)

```
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  
  strpcopy ( 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 ( shmid,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 ( shmid,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' );
  shmid := shmget(key, segsize, IPC_CREAT or IPC_EXCL or 438);
  If shmid=-1 then
    begin
      Writeln ( 'Shared memory exists. Opening as client' );
      shmid := shmget(key, segsize, 0);
      If shmid = -1 then
        begin
          Writeln ( 'shmget : Error !', ipcerror );
          halt (1);
        end
      end
    else
      Writeln ( 'Creating new shared memory segment.' );
      segptr:=shmat(shmid, nil, 0);
      if longint(segptr)=-1 then
        begin
          Writeln ( 'Shmat : error !', ipcerror );
          halt (1);
        end;
      case upcase(paramstr(1)[1]) of
        'W' : writeshm ( shmid, segptr, paramstr(2));
```

```
'R' : readshm ( shmidx , segptr );  
'D' : removeshm( shmidx );  
'M' : changemode ( shmidx , paramstr (2));  
else  
  begin  
    writeln ( paramstr (1));  
    usage;  
  end;  
end;  
end.
```

Chapter 8

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 2 sections:

- The first section lists all constants, types and variables, as listed in the interface section of the LINUX unit.
- The second section describes all procedures and functions in the LINUX unit.

8.1 Type, Variable and Constant declarations

Types

PGlob and TGlob are 2 types used in the Glob (165) function:

```
PGlob = ^TGlob;
TGlob = record
  Name : PChar;
  Next : PGlob;
end;
```

The following types are used in the signal-processing procedures.

```
{ $Packrecords 1 }
SignalHandler = Procedure ( Sig : Integer ); cdecl;
PSignalHandler = SignalHandler;
SignalRestorer = Procedure; cdecl;
PSignalrestorer = SignalRestorer;
SigActionRec = Record
  Sa_Handler : Signalhandler;
  Sa_Mask : Longint;
  Sa_flags : Integer;
  Sa_Restorer : SignalRestorer;
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` (174) and `ReadDir` (176) 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` (176) 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** (187) call to set access and modification time of a file.

```
utimbuf = record
  actime, modtime : Longint;
end;
```

For the **Select** (177) call, the following 4 types are needed:

```
FDSets = Array [0..31] of longint;
PFDSets = ^FDSets;
TimeVal = Record
  sec, usec : Longint;
end;
PTimeVal = ^TimeVal;
```

The **Uname** (186) 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 ;
TIOCGLOCKTSMIOS = $5456 ;
TIOCSLOCKTSMIOS = $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** (156) 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** (156) call uses the following mode constants :

```
LOCK_SH = 1;
LOCK_EX = 2;
LOCK_UN = 8;
LOCK_NB = 4;
```

8.2 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_eloop`Path` has a circular symbolic link.

See also: `Chown` (142), `Chmod` (143), `Access` (2)

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

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: Procedure AssignPipe (Pipe_in, Pipe_out : Text);

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. Reading and writing happens through the usual Readln(Pipe_in,...) and Writeln (Pipe_out,...) procedures.

Errors: LinuxError is used to report errors:

sys_enfile Too many file descriptors for this process.

sys_enfile The system file table is full.

See also: POpen (175), MkFifo (173), pipe (2)

Program Example36;

{ Program to demonstrate the AssignPipe function. }

Uses linux;

Var pipi, pipo : Text;
s : **String**;

```
begin
  Writeln(' Assigning Pipes. ');
  assignpipe(pipi, pipo);
  if linuxerror <> 0 then
    Writeln(' Error assigning pipes ! ');
  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: Procedure AssignStream (StreamIn, StreamOut : Text; Const prog : String);

Description: AssignStream creates a 2 pipes, i.e. two file objects, one for input, one for output, the other ends of these pipes are connected to standard input and and output 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 it's standard output be read from StreamIn. 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.

Errors: LinuxError is used to report errors:

sys_emfileToo many file descriptors for this process.

sys_enfileThe system file table is full.

Other errors include the ones by the fork and exec programs

See also: AssignPipe (139), POpen (175),pipe (2)

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;

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;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 (144), FExpand (155), Basename (1)

```
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 (142), CFSetISpeed (142), termios (2)

For an example, see TCGetAttr (184).

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 (142), CFMakeRaw (141), 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 (142), CFMakeRaw (141), 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 succesfull, 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 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: Chmod (143), Access (137), Chown (1 2)

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_ISUIDSet user ID on execution.
S_ISGIDSet Group ID on execution.
S_ISVTXSet sticky bit.
S_IRUSRRead by owner.
S_IWUSRWrite by owner.
S_IXUSRExecute by owner.
S_IRGRPRead by group.
S_IWGRPWrite by group.
S_IXGRPExecute by group.
S_IROTHRead by others.
S_IWOTHWrite by others.
S_IXOTHExecute by others.
S_IRWXORead, write, execute by others.
S_IRWXGRead, write, execute by groups.
S_IRWXURead, 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_eroofsThe 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 (142), Access (137), Chmod (1) 2)

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.
```

CloseDir

Declaration: Function CloseDir (p:pdirent) : 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 (174), ReadDir (176), SeekDir (176), Telldir (186), closedir (3)

For an example, see OpenDir (174).

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 (141), FExpand (155), Dirname (1)

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: Procedure Dup (Var OldFile, NewFile : Text);

Description: Makes NewFile an exact copy of OldFile, after having flushed the buffer of OldFile. 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.

Errors: Linuxerror is used to report errors.

sys_ebadfOldFile hasn't been assigned.

sys_emfileMaximum number of open files for the process is reached.

See also: Dup2 (145), Dup (2)

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: Procedure Dup2 (Var OldFile, NewFile : Text);

Description: Makes NewFile an exact copy of OldFile, after having flushed the buffer of OldFile. New-File 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.

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: `Dup` (145), `Dup2` (2)

```
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.

Errors: None

See also: `GetEpochTime` (162), `LocalToEpoch` (172), `GetTime` (165), `GetDate` (160)

```
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.
```

Exec1

Declaration: Procedure Exec1 (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 NOT searched in the path. The current environment is passed to the program. On success, exec1 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 (150), Execv (149), Execvp (150), Execle (147), Execlp (148), Fork (159), execvp (3)

Program Example10;

```
{ Program to demonstrate the Exec1 function . }
```

Uses linux , strings ;

begin

```
    { Execute 'ls -l' , with current environment . }
```

```
    { 'ls' is NOT looked for in PATH environment variable . }
```

```
    Exec1 ( '/ 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 it's 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 (150), Execv (149), Execvp (150), Execl (147), Execlp (148), Fork (159), execvp (3)

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 (150), Execv (149), Execvp (150), Execl (147), Execl (147), Fork (159), execvp (3)

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 (150), Execvp (150), Execl (147), Execl (147), Execlp (148), Fork (159), execv (3)

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 : 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 (150), Execv (149), Execvp (150) Execle (147), Execl (147), Execlp (148), Fork (159), execve (2)

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` (150), `Execv` (149), `Execle` (147), `Execl` (147), `Execlp` (148), `Fork` (159), `execvp` (3)

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` (177), `SelectText` (178), `GetFS` (162), `FD_Clr` (152), `FD_Set` (152), `FD_IsSet` (152)

For an example, see `Select` (177).

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` (177), `SelectText` (178), `GetFS` (162), `FD_ZERO` (151), `FD_Set` (152), `FD_IsSet` (152)

For an example, see `Select` (177).

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` (177), `SelectText` (178), `GetFS` (162), `FD_ZERO` (151), `FD_Clr` (152), `FD_Set` (152)

For an example, see `Select` (177).

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` (177), `SelectText` (178), `GetFS` (162), `FD_ZERO` (151), `FD_Clr` (152), `FD_IsSet` (152)

For an example, see `Select` (177).

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` (153), `fdRead` (153), `fdWrite` (155), `fdTruncate` (155), `fdFlush` (153), `seefdSeek`

For an example, see `fdOpen` (153).

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` (153), `fdClose` (152), `fdRead` (153), `fdWrite` (155), `fdTruncate` (155), `fdSeek` (155)

For an example, see `fdRead` (153).

fdOpen

Declaration: `Function fdOpen (Var PathName; flags: longint[; Mode: longint]) : longint;`

Description: `fdOpen` opens a file in `pathname` with flags `flags` a Ored combination of `Open_Accmode`, `Open_RdOnly`, `Open_WrOnly`, `Open_RdWr`, `Open_Creat`, `Open_Excl`, `Open_NoCtty`, `Open_Trunc`, `Open_Append`, `Open_NonBlock`, `Open_NDelay`, `Open_Sync` `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` (152), `fdRead` (153), `fdWrite` (155), `fdTruncate` (155), `fdFlush` (153), `fdSeek` (155)

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` (153), `fdClose` (152), `fdWrite` (155), `fdTruncate` (155), `fdFlush` (153), `fdSeek` (155)

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.

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` (153), `fdWrite` (155), `fdClose` (152), `fdRead` (153), `fdTruncate` (155), `fdFlush` (153)

For an example, see `fdOpen` (153).

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` (153), `fdClose` (152), `fdRead` (153), `fdWrite` (155), `fdFlush` (153), `fdSeek` (155)

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` (153), `fdClose` (152), `fdRead` (153), `fdTruncate` (155), `fdSeek` (155), `fdFlush` (153)

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` (141), `DirName` (144)

Program Example45;

{ Program to demonstrate the FExpand function . }

Uses linux ;

begin

WriteLn (' This program is in : ' , FExpand(**Paramstr** (0)));

end.

FLock

Declaration: Procedure FLock (Var F; Mode : longint);

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.

Errors: Errors are reported in **LinuxError**.

See also: **Fcntl** (158), **flock** (2)

FSStat

Declaration: Function FSStat (Path : Pathstr; Var Info : statfs) : Boolean;

Description: Return in Info information about the filesystem on which the file Path 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_enotdir A component of Path is not a directory.

sys_einval Invalid character in Path.

sys_enoent Path does not exist.

sys_eaccess Search permission is denied for component in Path.

sys_eloop A circular symbolic link was encountered in Path.

sys_eio An error occurred while reading from the filesystem.

See also: **FStat** (157), **LStat** (170), **statfs** (2)

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.
```

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 (141), DirName (144), FExpand (155)

Program Example46;

{ Program to demonstrate the FSearch function . }

Uses linux , strings ;

```
begin
  Writeln ( 'ls is in : ' ,FSearch ( 'ls' ,strpas ( Getenv ( 'PATH' ) ) ) );
end.
```

FStat

Declaration: Function FStat (Path : Pathstr; Var Info : stat) : Boolean;

Description: FStat gets information about the file specified in Path, 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_enoent`Path does not exist.

See also: `FStat` (156), `LStat` (170), `stat` (2)

```
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 : text, Cmd : Integer) : Integer;`

Description: Read a file's attributes. `Fd` is an assigned file. `Cmd` specifies what to do, and is one of the following:

F_GetFdRead the `close_on_exec` flag. If the low-order bit is 0, then the file will remain open across `execve` calls.

F_GetFIRead the descriptor's flags.

F_GetOwnGet 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` (159), `Fcntl` (2)

Fcntl

Declaration: `Procedure Fcntl (Fd : text, Cmd : Integer; Arg : longint);`

Description: Read or Set a file's attributes. `Fd` is an assigned file. `Cmd` specifies what to do, and is one of the following:

F_SetFdSet the `close_on_exec` flag of `Fd`. (only the least significant bit is used).

F_GetLkReturn 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_SetLkSet 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_GetLkwSame as for **F_Setlk**, but wait until the lock is released.

F_SetOwnSet 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` (158), `Fcntl` (2)

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` (164)).

Errors: On error, -1 is returned to the parent, and no child is created.

sys_eagainNot enough memory to create child process.

See also: `Execve` (150), `fork` (2)

Program Example14;

{ Program to demonstrate the Fork and WaitPidfunction . }

Uses linux ;

Var PID, ExitStatus : Longint;

begin

Writeln ('Spawning a child');
 PID := `Fork`;


```

If PID=0 then
  begin
    Writeln ( 'Hello From the Child !!' );
    Writeln ( 'Exiting with exit status 1 !' );
    Halt (1);
  end
Else
  begin
    Writeln ( 'Spawned child with PID : ',PID);
    WaitPid ( PID, @ExitStatus,0);
    Writeln ( 'Child exited with status : ',ExitStatus shr 8);
  end;
end.
```

GetDate

Declaration: `Procedure GetDate (Var Year, Month, Day : Word) ;`

Description: Returns the current day.

Errors: None

See also: `GetEpochTime` (162), `GetTime` (165), `EpochToLocal` (146)

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.
```

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` (163), `seemGetdomainname2`

Program Example39;

{ Program to demonstrate the GetDomainName function . }

Uses linux ;

```
begin
  WriteLn ( '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 (163)`, `getegid (2)`

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 (161)`, `geteuid (2)`

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 accomodate for strings longer than 255 bytes, TERMCAP and LS_COLORS, for instance.

Errors: None.

See also: `sh (1)` , `csch (1)`

Program Example41;

{ Program to demonstrate the GetEnv function . }

Uses linux ;

begin

WriteIn (' 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 (146), GetTime (165), time (2)

Program Example1;

{ Program to demonstrate the GetEpochTime function . }

Uses linux ;

begin

Write (' Secs past the start of the Epoch (00:00 1/1/1980) : ');
 WriteIn (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' need this file selector. Only for some calls it is needed, such as the **Select** (177) call or so.

Errors: In case the file was not opened, then -1 is returned.

See also: Select (177)

Program Example33;

{ Program to demonstrate the SelectText function . }

Uses linux ;

Var tv : TimeVal;

begin

WriteIn (' 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 (161), getgid (2)

```
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 (160), seemGethostname2

```
Program Example40;  
  
{ Program to demonstrate the GetHostName function . }  
  
Uses linux ;  
  
begin  
  Writeln ( ' Name of this machine is : ', GetHostName );  
end.
```

GetPid

Declaration: `Function GetPid : Longint;`

Description: Get the Process ID of the currently running process.

Errors: None.

See also: `GetPPid` (164), `getpid` (2)

Program Example16;

{ Program to demonstrate the GetPid, GetPPid function . }

Uses linux;

begin

WriteLn ('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` (164), `getppid` (2)

Program Example16;

{ Program to demonstrate the GetPid, GetPPid function . }

Uses linux;

begin

WriteLn ('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` (178), `Nice` (173), `Getpriority` (2)

For an example, see `Nice` (173).

GetTime

Declaration: `Procedure GetTime (Var Hour,Minute, Second : Word) ;`

Description: Returns the current time of the day.

Errors: None

See also: `GetEpochTime` (162), `GetDate` (160), `EpochToLocal` (146)

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.

GetUid

Declaration: `Function GetUid : Longint;`

Description: Get the real user ID of the currently running process.

Errors: None.

See also: `GetEUid` (161), `getuid` (2)

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` (166), `Glob` (3)

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 (165)

For an example, see Glob (165).

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)

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 : Cadinal; Value : Longint) : boolean;

Description: IOperm sets permissions on Num ports starting with port From to Value. The function returns True if the call was successfull, False otherwise. *Remark:*

- This works ONLY as root.
- Only the first 0x03ff ports can be set.
- When doing a Fork (159), the permissions are reset. When doing a Execve (150) 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 (166), TTYName (185)

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 (157), S_ISLNK (168), S_ISREG (169), S_ISDIR (168), S_ISCHR (168), S_ISFIFO (168), S_ISSOCK (169)

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 (157), S_ISLNK (168), S_ISREG (169), S_ISDIR (168), S_ISBLK (167), S_ISFIFO (168), S_ISSOCK (169)

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 (157), S_ISLNK (168), S_ISREG (169), S_ISCHR (168), S_ISBLK (167), S_ISFIFO (168), S_ISSOCK (169)

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 (157), S_ISLNK (168), S_ISREG (169), S_ISDIR (168), S_ISCHR (168), S_ISBLK (167), S_ISSOCK (169)

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 (157), S_ISREG (169), S_ISDIR (168), S_ISCHR (168), S_ISBLK (167), S_ISFIFO (168), S_ISSOCK (169)

See also:

Program Example53;

{ Program to demonstrate the S_ISLNK function . }

Uses linux ;

Var Info : Stat;

begin

if FStat (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 (157), S_ISLNK (168), S_ISDIR (168), S_ISCHR (168), S_ISBLK (167), S_ISFIFO (168), S_ISSOCK (169)

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 (157), S_ISLNK (168), S_ISREG (169), S_ISDIR (168), S_ISCHR (168), S_ISBLK (167), S_ISFIFO (168)

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 (179), Signal (181), 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 succesfull, `False` if the call failed.

Errors: `LinuxError` is used to report errors.

`sys_enoent` `Path` does not exist.

See also: `FStat` (157), `FSSStat` (156), `stat` (2)

```
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;
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_mlinkOldPath 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 (182), UnLink (186), Link (2)

Program Example21;

{ Program to demonstrate the Link 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 Link (' test . txt ', ' new . txt ') **then**

writeln (' Error when linking ! ');

{ Removing test . txt still leaves new . txt }

If not Unlink (' test . txt ') **then**

Writeln (' Error when unlinking ! ');

 Assign (f, ' new . txt ');

Reset (F);

While not EOF (f) **do**

begin

Readln (F, S);

Writeln (' > ', s);

end;

 Close (f);

{ Remove new . txt also }

If not Unlink (' new . txt ') **then**

Writeln (' Error when unlinking ! ');

end.

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 (162), EpochToLocal (146), GetTime (165),GetDate (160)

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 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` (175), `MkFifo` (173), `mkfifo` (4)

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_eperm` A non-superuser tried to specify a negative `N`, i.e. do a priority increase.

See also: `GetPriority` (164), `SetPriority` (178), `Nice` (2)

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.
```

OpenDir

Declaration: Function OpenDir (f:pchar) : 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 (144), ReadDir (176), SeekDir (176), TellDir (186), opendir (3)

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 (138).

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 (175)

For an example, see POpen (175)

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 (175). 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 (139), popen (3), PClose (175)

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 (144), OpenDir (174), SeekDir (176), TellDir (186), readdir (3)

For an example, see OpenDir (174).

SeekDir

Declaration: Procedure SeekDir (p:pdirent; 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 (144), ReadDir (176), OpenDir (174), TellDir (186), seekdir (3)

For an example, see OpenDir (174).

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 (151), FD_Clr (152), FD_Set (152), FD_IsSet (152) 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 (178), GetFS (162), FD_ZERO (151), FD_Clr (152), FD_Set (152), FD_IsSet (152)

Program Example33;

{ Program to demonstrate the Select function . }

Uses linux ;

Var FDS : FDSet;

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** (177) 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** (177). **SYS_EBADF** can also mean that the file wasn't opened.

See also: **Select** (177), **GetFS** (162)

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_esrchNo process found using which and who.

sys_einvalWhich 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_eaccessA non-superuser tried to a priority increase.

See also: **GetPriority** (164), **Nice** (173), **Setpriority** (2)

For an example, see **Nice** (173).

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** (159) or **Execve** (150) calls.

Errors: Errors are reported in **LinuxError**.

See also: **POpen** (175), **Fork** (159), **Execve** (150), **system** (3)

```

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 (Signal : Integer; Var Act,OldAct : PSigAction-Rec);

Description: Changes the action to take upon receipt of a signal. Act and Oldact are pointers to a SigActionRec record. Signal specifies the signal, and can be any signal except **SIGKILL** or **SIGSTOP**. If Act is non-nil, then the new action for signal Signal 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_NOCLDSTOP If signal 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_RESTART For 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_einval an invalid signal was specified, or it was **SIGKILL** or **SIGSTOP**.

sys_efault Act , OldAct point outside this process address space

sys_eintr System call was interrupted.

See also: SigProcMask (180), SigPending (180), SigSuspend (181), Kill (169), Sigaction (2)

```

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^. Sa_Handler := @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 ( ' 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 (179), SigProcMask (180), SigSuspend (181), Signal (181), Kill (169), 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 adress outside the range of the process.

sys_eintrSystem call was interrupted.

See also: SigAction (179), SigPending (180), SigSuspend (181), Kill (169), Sigprocmask (2)

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 (179), SigProcMask (180), SigPending (180), Signal (181), Kill (169), 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 (179), Kill (169), Signal (2)

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.

```

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_eperm The filesystem containing oldpath and newpath doesn't support linking files.

sys_eaccess Write access for the directory containing Newpath is disallowed, or one of the directories in OldPath or NewPath has no search (=execute) permission.

sys_enoent A directory entry in OldPath or NewPath does not exist or is a symbolic link pointing to a non-existent directory.

sys_enotdir A directory entry in OldPath or NewPath is not a directory.

sys_enomem Insufficient kernel memory.

sys_erofs The 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_enospc The device containing NewPath has no room for another entry.

See also: Link (171), UnLink (186), SymLink (2)

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.
```

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 successful, `False` otherwise.

Errors: Errors are reported in `LinuxError`

See also: `TCSetAttr` (185), `termios` (2)

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 asynchrone serial connection decsribed 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 succesfull, `False` otherwise.

Errors: Errors are reported in `LinuxError`.

See also: `TCGetAttr` (184), `termios` (2)

For an example, see `TCGetAttr` (184).

TCSetPGrp

Declaration: `Function TCSetPGrp (Fd,Id:longint) : boolean;`

Description: `TCSetPGrp` 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` (184), `termios` (2)

For an example, see `TCGetPGrp` (184).

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` (167), `IOctl` (166)

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` (144), `ReadDir` (176), `SeekDir` (176), `OpenDir` (174), `tellmdir` (3)

For an example, see `OpenDir` (174).

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` (143), `Umask` (2)

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` (163), `GetDomainName` (160), `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_eisdir`Path` refers to a directory.

sys_enomemInsufficient kernel memory.

sys_erofs`Path` is on a read-only filesystem.

See also: `Link` (171), `SymLink` (182), `Unlink` (2)

For an example, see `Link` (171).

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_enoentA 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` (162), `Chown` (142), `Access` (137), `utime` (0 2)

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**
 writeln (' Call to UTime failed !')
 else

```
begin
Write ( 'Set access and modification times to : ' );
Write ( Hour:2, ':' , minute:2, ':' , second, ' , ' );
Writeln ( Day:2, '/' , month:2, '/' , year:4);
end;
end.
```

WaitPid

Declaration: Function WaitPid (Pid : longint; Status : pointer; Options : Integer) : 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.

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 (159), Execve (150), waitpid (2)

for an example, see Fork (159).

Chapter 9

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.

9.1 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;
```

9.2 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 10

The Mouse unit

The mouse unit provides basic Mouse handling under Dos (Go32v1 and Go32v2) Some general remarks about the mouse unit:

- 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 mouse 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.

10.1 Constants, types and variables

The following constants are defined (to be used in e.g. the GetLastButtonPress (192) 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.

10.2 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. For two-button mice, checking the status of the middle button seems to give and clear the stats of the right button.

Errors: None.

See also: `GetLastButtonRelease` (193)

{example for GetLastButtonPress and GetLastButtonRelease}

Uses Mouse, 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, t

GotoXY(1,22);

Write('Since the last call to `GetLastButtonRelease` with this button as parameter,

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);
      Writeln(' 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);
    Writeln(' 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. For two-button mice, checking the stats of the middle button seems to give and clear the stats of the right button.

Errors: None.

See also: GetLastButtonPress (192)

For an example, see GetLastButtonPress (192).

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` (196), `MPressed` (196), `RPressed` (196), `SetMousePos` (197)

{example for `GetMouseState`, `IsLPressed`, `IsRPressed` and `IsMPressed`}

Uses Mouse, 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 again visible.

Errors: None.

See also: `ShowMouse` (201), `SetMouseHideWindow` (197)

For an example, see `ShowMouse` (201).

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.

Program `Mouse1;`

{example for InitMouse and MouseFound}

Uses `Mouse;`

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}*

WriteLn (`'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` (193), `MPressed` (196), `RPressed` (196)

For an example, see `GetMouseState` (193).

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` (193), `LPressed` (196), `RPressed` (196)

For an example, see `GetMouseState` (193).

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` (193), `LPressed` (196), `MPressed` (196)

For an example, see `GetMouseState` (193).

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` (198), 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` (198)

{example for SetMouseAscii}

{warning: no error checking is performed on the input}

Uses Mouse, 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 (201), 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.

Errors: None.

See also: ShowMouse (201), HideMouse (195)

nputlistingmouseex/mouse9.pp

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 (193)

{example for SetMousePos}

Uses Mouse, 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 (196)

{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 Mouse, 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:');
    End
  End
```

```
    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:

Uses Mouse, 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 (200) and SetMouseYRange (201) procedures. While xmin, ymin, xmax and ymax are Longint parameters, only the lower 16 bits are used.

Errors: None.

See also: SetMouseXRange (200), SetMouseYRange (201)

For an example, see SetMouseXRange (200).

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 (201), SetMouseWindow (200)

{example for SetMouseXRange, SetMouseYRange and SetMouseWindow}

Uses Mouse, Crt;

Begin

If MouseFound **Then**

Begin

 SetMouseXRange(20*8,50*8); *{charracter 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)}*

WriteIn('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` (200), `SetMouseWindow` (200)

For an example, see `SetMouseXRange` (200).

ShowMouse

Declaration: `Procedure ShowMouse ;`

Description: `ShowMouse` makes the mouse cursor visible. At the start of your program, the mouse is invisible.

Errors: None.

See also: `HideMouse` (195), `SetMouseHideWindow` (197)

{example for ShowMouse and HideMouse}

Uses Mouse;

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 11

The Objects unit.

This chapter documents the `objects` unit. The unit was implemented by many people, and was mainly taken from the FreeVision sources.

The methods and fields that are in a `Private` part of an object declaration have been left out of this documentation.

11.1 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 collec-
tion size }
```

11.2 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 11.4, page 207):

```
TYPE
  PPoint = ^TPoint;
  TPoint = OBJECT
    X, Y: Sw_Integer;
  END;
```

11.3 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` (205)

Program ex40;

{ Program to demonstrate the NewStr function }

Uses Objects;

```
Var S : String;
     P : PString;
```

```
begin
  S:= 'Some really cute string';
  WriteLn ( 'Memavail : ', Memavail);
  P:= NewStr(S);
  If P^<>S then
    WriteLn ( 'Oh-oh... Something is wrong !!' );
    WriteLn ( 'Allocated string . Memavail : ', Memavail);
    DisposeStr(P);
    WriteLn ( '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` (204)

For an example, see `NewStr` (204).

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 11.10, page 232.
2. `TStringCollection`, see section 11.12, page 251.
3. `TStrCollection`, see section 11.13, page 253.

Errors: None.

See also: `RegisterType` (205)

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_Word` This should be a unique identifier. Each possible type should have it's own identifier.

VmtLink: **pointer** This 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(TypeOf(MyType)^);`

Load : Pointer is 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 it's 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.

```
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;
```

```
Function 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 (207)

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 (207)

11.4 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 (209), TRect.Contains (209)

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 (208), Contains (209)

For an example, see TRect.Empty (208)

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 (210), Equals (209)

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 (212)

```
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` (210)

```
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  
    Writeln ( 'ARect equals CRect' )  
  Else  
    Writeln ( '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` (210)

```
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 (212)

```
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` (211).

```
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` (209)

For an example, see `TRect.Copy` (209).

11.5 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 (213), Done (213)

For an example, see Free (213)

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 (213), Done (213)

```
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 (213) method.

The destructore Done does not free the memory occupied by the object.

Errors: None.

See also: Free (213), Init (213)

```
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.
```

11.6 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 (219)

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 (219), ReadStr (217)

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 (220), GetSize (217)

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` (220), `GetPos` (216)

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` (215)

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 (218), Reset (218)

For an example, see TDosStream.Open (225).

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 (218), Reset (218)

for an example, see TDosStream.Open (225).

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 (218), Close (218)

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 (219)

for an example, see TBufStream.Flush (227).

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` (220)

For an example, see `TDosStream.Truncate` (223).

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` (205).

After the object has been written, it can be read again with `Get` (215).

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` (215)

For an example, see `TStream.Get` (215);

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` (219), `StrRead` (215), `ReadStr` (217)

For an example, see `TStream.StrRead` (215).

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` (219), `StrRead` (215), `ReadStr` (217)

For an example, see `TStream.ReadStr` (217).

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` (216), `GetSize` (217)

For an example, see `TDosStream.Seek` (224).

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 it's 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` (221), `ReadStr` (217), `StrRead` (215)

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 (220), WriteStr (219), StrWrite (219)

For an example, see TStream.Read (220).

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 (220) method to read the data, and the Write (221) method to write in the current stream.

Errors: None.

See also: Read (220), Write (221)

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.
```

11.7 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 11.6, page 214), 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 11.8, page 226.

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:

stCreateCreates a new file.

stOpenReadRead access only.

stOpenWriteWrite access only.

stOpenRead and write access.

Errors: On error, Status is set to stInitError, and ErrorInfo is set to the DOS error code.

See also: Done (223)

For an example, see TDosStream.Truncate (223).

TDosStream.Done

Declaration: Destructeur `TDosStream.Done; Virtual;`

Description: `Done` closes the file if it was open and cleans up the instance of `TDosStream`.

Errors: None.

See also: `Init` (222), `Close` (223)

for an example, see e.g. `TDosStream.Truncate` (223).

TDosStream.Close

Declaration: Procedure `TDosStream.Close; Virtual;`

Description: `Close` closes the file if it was open, and sets `Handle` to -1. Contrary to `Done` (223) it does not clean up the instance of `TDosStream`

Errors: None.

See also: `TStream.Close` (218), `Init` (222), `Done` (223)

For an example, see `TDosStream.Open` (225).

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` (219), `GetSize` (217)

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 (220), GetPos (216)

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 (223) 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 (218), Close (223)

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 ));  
    WriteLn ( ' Writing "' ,L, '"' to stream with handle ', S^. Handle);  
    S^. WriteStr (@L);  
    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.
```

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 (220), Write (226)

For an example, see TStream.Read (220).

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 (221), Read (225)

For an example, see TStream.Read (220).

11.8 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:

stCreateCreates a new file.

stOpenReadRead access only.

stOpenWriteWrite 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** (222), **Done** (227)

For an example see **TBufStream.Flush** (227).

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** (223), **Init** (226), **Close** (227)

For an example see **TBufStream.Flush** (227).

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** (227) it does not clean up the instance of **TBufStream**

Errors: None.

See also: **TStream.Close** (218), **Init** (226), **Done** (227)

For an example see **TBufStream.Flush** (227).

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** (229) for more info on the errors.

See also: **TStream.Close** (218), **Init** (226), **Done** (227)

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 (227) or TDosStream.Truncate (223).

See also: TStream.Truncate (219), TDosStream.Truncate (223), GetSize (217)

For an example, see TDosStream.Truncate (223).

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 (220), GetPos (216)

For an example, see TStream.Seek (220);

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` (227) 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` (218), `Close` (227)

For an example, see `TDosStream.Open` (225).

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` (220), `Write` (229)

For an example, see `TStream.Read` (220).

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` (221), `Read` (229)

For an example, see `TStream.Read` (220).

11.9 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 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;                                              Virtual;
    PROCEDURE Truncate;                                          Virtual;
    PROCEDURE Read (Var Buf; Count: Sw_Word);                   Virtual;
    PROCEDURE Write (Var Buf; Count: Sw_Word);                  Virtual;
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 (230)

For an example, see e.g TStream.CopyFrom (221).

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 (230)

For an example, see e.g TStream.CopyFrom (221).

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 (219)

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 (231)

For an example, see TStream.Read (220).

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 (230)) as needed.

Errors: If the stream cannot allocate more memory, then the status is set to stWriteError

See also: TStream.Write (221), Read (231)

For an example, see TStream.Read (220).

11.10 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. ALI 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 (233), Done (233)

For an example, see TCollection.ForEach (243).

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 (235).

See also: Init (232), GetItem (235), Done (233).

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 (232), FreeAll (238)

For an example, see `TCollection.ForEach` (243).

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` (240)

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:

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 (215).

See also: TStream.Get (215), 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 (236)

```
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 (235)

```
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 (244)

```
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 (239), FreeItem (242)

```
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 (238), DeleteAll doesn't call the destructor of the objects.

Errors: None.

See also: FreeAll (238), Delete (240)

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` (242),

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` (245), `AtPut` (244),

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` (239) call is provided.

Errors: If the `Item` is not in the collection, `Error` will be called with `coIndexError`.

See also: `AtDelete` (242), `Free` (239)

```
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;  
  WriteIn ( ' Initial memory : ' , InitMem );  
  For I:=1 to 100 do  
    begin  
      M:=New( PMyObject, Init );  
      M^. SetField (I-1);  
      C^. Insert (M);  
    end;  
  WriteIn ( ' Added 100 Items . Memory available : ' , Memavail );  
  Write ( ' Lost : ' , Initmem-Memavail , ' bytes . ' );  
  Write ( ' ( Should be 100* ' , SizeOf (TMyObject));  
  WriteIn ( ' = ' , 100* SizeOf (TMyObject) , ' ) ' );  
  With C^ do  
    While Count>0 do Delete (At(Count-1));  
  WriteIn ( ' Freed all objects . Memory available : ' , Memavail );  
  WriteIn ( ' 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` (244) is called with `CoIndexError`.

See also: `Free` (239), `AtDelete` (242)

```
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 (241), seeplAtFreeTCollection.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 (244) is called with CoIndexError.

See also: Delete (240)

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 (236), LastThat (235)

```
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;
  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 (232)

For an example, see Pack (237).

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 (205)

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 (244) is called with CoIndexError.

See also:

For an example, see Pack (237).

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 (244) is called with CoIndexError. If the collection fails to expand, then coOverflow is passed to Error.

See also: Insert (240)

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
 WriteIn (' Field : ' , P^.GetField);
end;

begin
 Randomize;
 C:=**New**(PCollection, Init (120,10));
 WriteIn (' 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;
 WriteIn (' Values : ');
 C^.Foreach (@PrintField);
 Dispose(C, Done);
 end.
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 (233).

Errors: Errors returned are those by TStream.Put (219).

See also: Load (233), PutItem (246)

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 (219).

See also: Store (245), GetItem (235).

11.11 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 (248) method.

Because the collection is ordered, TSortedCollection overrides some TCollection methods, to provide faster routines for lookup.

The Compare (248) 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:

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 (232)) 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 (247), Done (233)

For an example, see

TSortedCollection.Load

Declaration: Constructor Load (Var S : TStream) ;

Description: Load calls the inherited constructor (see TCollection . Load (233)) 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 (247), Done (233)

For an example, see TCollection . Load (233).

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` (248), `Compare` (248).

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` (249), `Compare` (248).

For an example, see `TCollection.IndexOf` (234)

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` (249) method and in the `Insert` (250) 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` (248), `Search` (249)

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** (248) function to implement this search.

If the item is found, Search returns True, otherwise False is returned.

Errors: None.

See also: IndexOf (234).

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;
  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 (245), 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 (245)

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 (245), and then writing the Duplicates flag to the stream.

After a Store, the collection can be loaded from the stream with the constructor Load (247)

Errors: Errors can be those of TStream.Put (219).

See also: Load (247)

For an example, see TCollection.Load (233).

11.12 TStringCollection

The TStringCollection object manages a sorted collection of pascal strings. To this end, it overrides the Compare (248) 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` (217).

See also: `PutItem` (253)

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:

-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` (248)

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 (242)

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 (219).

See also: GetItem (251)

11.13 TStrCollection

The TStrCollection object manages a sorted collection of null-terminated strings (pchar strings). To this end, it overrides the Compare (248) 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 (215).

See also: PutItem (255)

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` (248)

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` (242)

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 (219).

See also: GetItem (253)

11.14 TUnSortedStrCollection

The TUnSortedStrCollection object manages an unsorted list of objects. To this end, it overrides the TSortedCollection.Insert (250) method to add strings at the end of the collection, rather than in the alphabetically correct position.

Take care, the Search (249) and IndexOf (234) 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 it's alphabetical place, resulting in an unsorted collection of strings.

Errors:

See also:

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;
  P:=StrAlloc (Length(S)+1);
  C^.Insert (StrPCopy(P,S));
end;
For I:=0 to 99 do
  Writeln (I:2, ': ', PChar(C^.At(i)));
Dispose(C,Done);
end.
```

11.15 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 (252)

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 (233)` method.

Errors: Errors returned are those by `TStream.Read (220)`

See also: `TCollection.Load (233)`, `TStream.Read (220)`

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 resource item record.

It does NOT remove the item from the collection.

Errors: None.

See also: `TCollection.FreeItem (242)`

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 (245)` method.

Errors: Errors returned are those by `TStream.Write (221)`.

See also: `Store (245)`

11.16 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** (258) constructor call.

Modified is set to **True** if one of the resources has been changed. It is set by the **SwitchTo** (258), **Delete** (259) and **Put** (259) methods. Calling **Flush** (259) 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** (258)

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** (258)

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** (258)

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** (259)

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` (220) and `TStream.Write` (221).

See also: `Flush` (259)

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` (220) and `TStream.Write` (221).

See also: `SwitchTo` (259)

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` (259)

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` (219) and `TStream.Seek`

See also: `Get` (259)

11.17 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** (205) 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 (260)

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 (260), TObject.Done (213)

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 (261)

11.18 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 (205) 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 (213), Done (261)

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 (213), Init (261)

TStrListMaker.Put

Declaration: Procedure TStrListMaker.Put (Key: Sw_Word; S: String);

Description: Put adds the 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 (262) method.

Errors: None.

See also: Store (262).

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` (260), `Put` (261).

Chapter 12

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. Its basic functionality is the same for both systems. 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.

12.1 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.

12.2 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)


```
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.' );
  {$ifdef linux}
  writeln ( 'Writing to pipe ...' );
  assignlst ( f, '/usr/bin/lpr -m' );
  rewrite ( f );
  for i:=1 to 80 do writeln ( f, 'This is line ', i, '.' #13);
  close ( f );
  writeln ( 'Done.' )
  {$endif}
end.
```

Chapter 13

The SOCKETS unit.

This chapter describes the SOCKETS unit for Free Pascal. it was written for LINUX by Michaël Van Canneyt. 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.

13.1 Types, Constants and variables :

The following constants identify the different socket types, as needed in the `Socket` (275) 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` (275) 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` (275) 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` (268), `Recv` (273) and `Send` (273) 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` (275) call.

```
TSockArray = Array[1..2] of Longint;
```

13.2 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 (272), Connect (269)

```
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 : ' );
  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` (266) command. It is equivalent to subsequently calling the regular `Accept` (266) function and the `Sock2Text` (275) function. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Accept` (266).

See also: `Accept` (266)

Accept

Declaration: `Function Accept (Sock:longint;var addr:string;var SockIn,SockOut:File)
: Boolean;`

Description: This is an alternate form of the `Accept` (266) command. It is equivalent to subsequently calling the regular `Accept` (266) function and the `Sock2File` (274) 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` (266).

See also: `Accept` (266)

Accept

Declaration: `Function Accept (Sock:longint;var addr:TInetSockAddr;var SockIn,SockOut:File)
: Boolean;`

Description: This is an alternate form of the `Accept` (266) command. It is equivalent to subsequently calling the regular `Accept` (266) function and the `Sock2File` (274) 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` (266).

See also: `Accept` (266)

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` (275)

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 (275) and the regular Bind (268) function. The function returns True if successful, False otherwise.

Errors: Errors are those of the regular Bind (268) command.

See also: Bind (268)

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 TSocketAddr or TUnixSocketAddr.

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 (272), Bind (268), Accept (266)

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** (269) command. It is equivalent to subsequently calling the regular **Connect** (269) function and the **Sock2Text** (275) function. The function returns True if successfull, False otherwise.

Errors: The errors are those of **Connect** (269).

See also: **Connect** (269)

Connect

Declaration: Function Connect (Sock:longint;const addr:string;var SockIn,SockOut:file)
: Boolean;

Description: This is an alternate form of the **Connect** (269) command. The parameter **addr** contains the name of the unix socket file to be opened. It is equivalent to subsequently calling the regular **Connect** (269) function and the **Sock2File** (274) function. The function returns True if successfull, False otherwise.

Errors: The errors are those of **Connect** (269).

See also: **Connect** (269)

Connect

Declaration: Function Connect (Sock:longint;const addr: TInetSockAddr;var SockIn,SockOut:file)
: Boolean;

Description: This is another alternate form of the **Connect** (269) command. It is equivalent to subsequently calling the regular **Connect** (269) function and the **Sock2File** (274) function. The **Addr** parameter contains the parameters of the internet socket to connect to. The function returns True if successfull, False otherwise.

Errors: The errors are those of **Connect** (269).

See also: **Connect** (269)

```
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 (269), Socket (275), connect (2)

GetSocketName

Declaration: `Function GetSocketName (Sock:Longint;Var Addr;Var Addrlen:Longint) : Longint;`

Description: `GetSockName` 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` (268)

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` (272)

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` (275), `Bind` (268), `Connect` (269)

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 functions 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` (273)

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` (273), `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 (272)`

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 (275)`, `Connect (269)`

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 (275)`, `Sock2Text (275)`

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` (275), `Sock2File` (274)

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` (268) call. If unsuccesfull, 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` (275), `socket` (2)

for an example, see `Accept` (266).

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` (275)

See also: `Str2UnixSockAddr` (275)

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` (268) call.

Errors: None.

See also: `Socket` (275), `Bind` (268)

Chapter 14

The STRINGS unit.

This chapter describes the STRINGS unit for Free Pascal. 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.

14.1 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` (283), `StrPCopy` (284).

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` ()

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` (280), `StrlComp` (279), `StrLIComp` (282)

For an example, see `StrLComp` (280).

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` (284), `StrLCopy` (281), `StrECopy` (278)

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` (283)

Program Example17;

Uses strings;

{ Program to demonstrate the StrDispose function. }

Const P1 : PChar = 'This is a PChar string';

var P2 : PChar;

begin

WriteIn (' Before StrNew : Memory available : ', **MemAvail**);

 P2:=**StrNew** (P1);

WriteIn (' After StrNew : Memory available : ', **MemAvail**);

WriteIn (' P2 : ', P2);

StrDispose(P2);

WriteIn (' 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` (281), `StrCopy` (277)

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**

WriteIn('Something is wrong here !')

else

WriteIn (' 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 (281)

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 (280), StrComp (277), StrLIComp (282)

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 (276)

```

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 (277), StrlComp (279), StrLIComp (282)

```

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 (277), StrECopy (278)

```

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 ()

```

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 (280), StrComp (277), StrlComp (279)

For an example, see StrlComp (279)

StrLower

Declaration: Function StrLower (P : PChar) : PChar;

Description: Converts P to an all-lowercase string. Returns P.

Errors: None.

See also: Upcase (), StrUpper (286)

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 (281), StrCopy (277)

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 (277), StrDispose (278)

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 (284)

```
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 (284)

```
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 (285)`, `StrRScan (285)`

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 (285)`, `StrPos (285)`

For an example, see `StrScan (285)`.

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 (285)`, `StrPos (285)`

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: Upcase () , StrLower (282)

For an example, see StrLower (282)

Chapter 15

The SYSUTILS unit.

This chapter describes the `sysutils` unit. The `sysutils` unit was largely written by Gertjan Schouten, and completed by michael 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.

This chapter starts out with a definition of all types and constants that are defined, followed by a complete explanation of each function.

15.1 Constants and types

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` (319), `FindNext` (320) and `FindClose` (319) 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` (316) call.

```
Const
    fmOpenRead      = $0000;
    fmOpenWrite     = $0001;
    fmOpenReadWrite = $0002;
```

The following constants can be used in the `FileSeek` (317) 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" "mmmm" "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 = ['/', '\'];
{$ifdef Linux}
  OsDirSeparator = '/';
{$else}
  OsDirSeparator = '\';
{$endif}
```

15.2 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:

Date

Declaration: `Function Date: TDateTime;`

Description: `Date` returns the current date in `TDateTime` format. For more information about the `TDateTime` type, see `TDateTime` (291).

Errors: None.

See also: `Time` (303), `Now` (300), `TDateTime` (291).

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` (312) function.

Errors: None.

See also: `Time` (303), `Date` (291), `FileDateToDateTime` (297), `DateTimeToSystemTime` (293), `DateTimeToTimeStamp` (294)

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 15.2, page 290).

Errors: None.

See also: `FormatDateTime` (298), `TDateTime` (291).

Program Example3;

{ This program demonstrates the DateTimeToStr function }

Uses sysutils;

Begin

WriteLn (' Today is : ', **DateTimeToStr**(**Now**));
WriteLn (' 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 15.2, page 290.

Errors: In case a wrong formatting character is found, an `EConvertError` is raised.

See also: `FormatDateTime` (298), section 15.2, page 290.

```
Program Example4;  
  
{ This program demonstrates the DateTimeToString function }  
  
Uses sysutils;  
  
Procedure today (Fmt : string);  
  
Var S : AnsiString;  
  
begin  
    DateTimeToString ( S, Fmt, Date );  
    WriteLn ( S );  
end;  
  
Procedure Now ( Fmt : string );  
  
Var S : AnsiString;  
  
begin  
    DateTimeToString ( S, Fmt, Time );  
    WriteLn ( 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` (292), `SystemTimeToDateTime` (302), `DateTimeToTimeStamp` (294)

```
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 (292), SystemTimeToDateTime (302), DateTimeToSystemTime (293)

Program Example6;

{ This program demonstrates the DateTimeToTimeStamp function }

Uses sysutils ;

Var TS : TTimeStamp;

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;

End.

DateToStr

Declaration: Function DateToStr(Date: TDateTime): string;

Description: DateToStr converts Date to a string representation. It uses ShortDateFormat as it's formatting string. It is hence completely equivalent to a FormatDateTime('dddd' , Date).

Errors: None.

See also: TimeToStr (304), DateTimeToStr (292), FormatDateTime (298), StrToDate (300)

Program Example7;

{ This program demonstrates the DateToStr function }

Uses sysutils ;

Begin

WriteLn (**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 (291), DateToStr (294)

Program Example8;

{ This program demonstrates the DayOfWeek function }

Uses sysutils ;

Begin

WriteLn (' 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 (296), DecodeTime (296).

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 (297), DecodeDate (295).

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 (295) procedure.

The parameters must lie withing valid ranges (boundaries included):

Year must be between 1 and 9999.

Month must be within the range 1-12.

Days must be between 1 and 31.

Errors: In case one of the parameters is out of it's valid range, 0 is returned.

See also: EncodeTime (297), DecodeDate (295).

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 mmmm 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` (296) 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` (296), `DecodeTime` (296).

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` (312) or `FindFirst` (319)/`FindNext` (320) functions to `TDateTime` form.

Errors: None.

See also: `DateTimeToFileDate` (292)

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 15.2, page 290.

Errors: On error (such as an invalid character in the formatting string), and EConvertError exception is raised.

See also: DateTimeToStr (292), DateToStr (294), TimeToStr (304), StrToDateTime (301)

Program Example14;

{ This program demonstrates the FormatDateTime function }

Uses sysutils;

Var ThisMoment : TDateTime;

Begin

ThisMoment:=**Now**;

Writeln (' Now : ' , **FormatDateTime**(' hh:mm' , 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 (291), Time (303), Now (300)

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 (298), Date (291)

```
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 (304), DateTimeToTimeStamp (294),

```
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 (291), Time (303)

```
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 (302), DateToStr (294)n TimeToStr (304).

```
Program Example19;

{ This program demonstrates the StrToDate function }
```

```
Uses sysutils ;

Procedure TestStr ( S : String );

begin
  Writeln ( S, ' : ', DateTimeToStr ( 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 (300), StrToTime (302), DateTimeToStr (292)

```
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 1:30 PM' );
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` (300), `StrToDateTime` (301), `TimeToStr` (304)

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` (293)

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 (300), Date (291)

```
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 (294).

Errors: None.

See also: DateTimeToTimeStamp (294), TimeStampToMSecs (304)

```
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 (299), TimeStampToDateTime (303)

For an example, see MSecsToTimeStamp (299).

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 therefor entirely equivalent to a FormatDateTime('t',Time) call.

Errors: None.

See also:

```
Program Example25;  
  
{ This program demonstrates the TimeToStr function }  
  
Uses sysutils;  
  
Begin  
  WriteLn('The current time is : ',TimeToStr(Time));  
End.
```

15.3 Disk functions

AddDisk (Linux only)

Declaration: Function AddDisk (Const Path : String) : Longint;

Description: On Linux both the DiskFree (35) and DiskSize (36) functions need a file on the specified drive, since 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 (305), DiskSize (306)

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 (307)

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) : Longint;

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` (36) functions must be mimicked using filenames that reside on the partitions. For more information, see `AddDisk` (304)

Errors: On error, -1 is returned.

See also: `DiskSize` (306), `AddDisk` (304)

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) : Longint;`

Description: `DiskSize` returns the size (in bytes) of 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` (35) and `DiskSize` functions must be mimicked using filenames that reside on the partitions. For more information, see `AddDisk` (304)

Errors: On error, -1 is returned.

See also: `DiskFree` (305), `AddDisk` (304)

For an example, see `DiskFree` (305).

GetCurrentDir

Declaration: `Function GetCurrentDir : String;`

Description: `GetCurrentDir` returns the current working directory.

Errors: None.

See also: `SetCurrentDir` (307), `DiskFree` (35), `DiskSize` (36)

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 (305).

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 (306)

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.

15.4 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` (311), `ExtractFilePath` (311), `ExpandFileName` (309)

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` (313), `FileExists` (314)

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 [1], **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` (311), `ExtractFilePath` (311)

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\fpcc');

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 (311), ExtractFilePath (311), ExtractFileDir (310), ExtractFileDrive (310), ExtractFileExt (311), ExtractRelativePath (311)

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` (309) on `FileName` and then attempts to replace the driveletter by the name of a shared disk.

Errors:

See also: `ExtractFileName` (311), `ExtractFilePath` (311), `ExtractFileDir` (310), `ExtractFileDrive` (310), `ExtractFileExt` (311), `ExtractRelativePath` (311)

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` (311).

Errors: None.

See also: `ExtractFileName` (311), `ExtractFilePath` (311), `ExtractFileDir` (310), `ExtractFileDrive` (310), `ExtractFileExt` (311), `ExtractRelativePath` (311)

Program Example34;

```
{ This program demonstrates the ExtractFileName function }
{$H+}
```

Uses sysutils;

Procedure Testit (F : **String**);

begin

```
  Writeln ( ' FileName      : ' , F);
  Writeln ( ' Has Name     : ' , ExtractFileName (F));
  Writeln ( ' Has Path     : ' , ExtractFilePath (F));
  Writeln ( ' Has Extension : ' , ExtractFileExt (F));
  Writeln ( ' Has Directory : ' , ExtractFileDir (F));
  Writeln ( ' 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` (311), `ExtractFilePath` (311), `ExtractFileDir` (310), `ExtractFileDrive` (310), `ExtractFileExt` (311), `ExtractRelativePath` (311)

For an example, see `ExtractFileDir` (310).

ExtractFileExt

Declaration: `Function ExtractFileExt(const FileName: string): string;`

Description: `ExtractFileExt` returns the extension (including the `.`(dot) character) of `FileName`.

Errors: None.

See also: `ExtractFileName` (311), `ExtractFilePath` (311), `ExtractFileDir` (310), `ExtractFileDrive` (310), `ExtractFileExt` (311), `ExtractRelativePath` (311)

For an example, see `ExtractFileDir` (310).

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` (311) and `ExtractFileName`.

Errors: None.

See also: `ExtractFileName` (311), `ExtractFilePath` (311), `ExtractFileDir` (310), `ExtractFileDrive` (310), `ExtractFileExt` (311), `ExtractRelativePath` (311)

For an example, see `ExtractFileDir` (310).

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` (311).

Errors: None.

See also: `ExtractFileName` (311), `ExtractFilePath` (311), `ExtractFileDir` (310), `ExtractFileDrive` (310), `ExtractFileExt` (311), `ExtractRelativePath` (311)

For an example, see `ExtractFileDir` (310).

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 (311), ExtractFilePath (311), ExtractFileDir (310), ExtractFileDrive (310), ExtractFileExt (311),

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 (297) function.

Errors: In case of errors, -1 is returned.

See also: FileDateToDateTime (297), FileExists (314), FileGetAttr (314)

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 (' I ' ' 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` (313), `FileWrite` (318), `FileOpen` (316), `FileRead` (316), `FileTruncate` (318), `FileSeek` (317)

For an example, see `FileCreate` (313)

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` (316) and `FileWrite` (318) 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` (312), `FileWrite` (318), `FileOpen` (316), `FileRead` (316), `FileTruncate` (318), `FileSeek` (317)

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 (312), FileGetAttr (314), FileSetAttr (318)

```
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 (318), FileAge (312), FileGetDate (315).

```
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 (312), 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 (312)

```
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` (316) 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` (313) function.

Errors: On Error, -1 is returned.

See also: `FileClose` (312), `FileWrite` (318), `FileCreate` (313), `FileRead` (316), `FileTruncate` (318), `FileSeek` (317)

For an example, see `FileRead` (316)

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` (316) call.

Errors: On error, -1 is returned.

See also: `FileClose` (312), `FileWrite` (318), `FileCreate` (313), `FileOpen` (316), `FileTruncate` (318), `FileSeek` (317)

For an example, see `FileOpen` (316)

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` (309), `FindFirst` (319)

Program Example41;

{ Program to demonstrate the FileSearch function . }

Uses Sysutils ;

Const

```
{ $ifdef linux }
  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 (312), FileWrite (318), FileCreate (313), FileOpen (316) FileRead (316), FileTruncate (318)

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 (313)

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` (314), `FileGetDate` (315), `FileSetDate` (318).

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` (312), `FileWrite` (318), `FileCreate` (313), `FileOpen` (316) `FileRead` (316), `FileSeek` (317)

For an example, see `FileCreate` (313).

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` (312), `FileCreate` (313), `FileOpen` (316) `FileRead` (316), `FileTruncate` (318), `FileSeek` (317)

For an example, see `FileCreate` (313).

FindClose

Declaration: `Procedure FindClose(Var F : TSearchrec);`

Description: `FindClose` ends a series of `FindFirst` (319)/`FindNext` (320) 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` (319), `FindNext` (320).

For an example, see `FindFirst` (319).

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` (319) 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` (39)`FindCloseSys`, `FindNext` (320).

Program Example43;

{ This program demonstrates the FindFirst function }

Uses sysutils;

Var Info : TSearchRec;
Count : Longint;

Begin

Count:=0;

If `FindFirst` ('*.pp', faAnyFile , Info)=0 **then**

begin

Repeat

Inc (Count);

With Info **do**

WriteLn (Name:40, Size:15);

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` (319), `FindClose` (39)

For an example, see `FindFirst` (319)

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` (311)

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 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` (308)

```
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` (309), `ExtractFilePath` (311), `ExtractFileDir` (310)

```
Program Example47;  
  
  { This program demonstrates the SetDirSeparators function }  
  
Uses sysutils;  
  
Begin  
  WriteLn ( SetDirSeparators ( '/ pp\bin / win32\ppc386' ));  
End.
```

15.5 PChar functions

Introduction

Most PChar functions are the same as their counterparts in the `STRINGS` unit. The following functions are the same :

1. **StrCat** (276) : Concatenates two PChar strings.
2. **StrComp** (277) : Compares two PChar strings.
3. **StrCopy** (277) : Copies a PChar string.
4. **StrECopy** (278) : Copies a PChar string and returns a pointer to the terminating null byte.
5. **StrEnd** (279) : Returns a pointer to the terminating null byte.
6. **StrlComp** (279) : Case insensitive compare of 2 PChar strings.
7. **StrLCat** (280) : Appends at most L characters from one PChar to another PChar.
8. **StrLComp** (280) : Case sensitive compare of at most L characters of 2 PChar strings.
9. **StrLCopy** (281) : Copies at most L characters from one PChar to another.
10. **StrLen** (281) : Returns the length (exclusive terminating null byte) of a PChar string.
11. **StrLIComp** (282) : Case insensitive compare of at most L characters of 2 PChar strings.
12. **StrLower** (282) : Converts a PChar to all lowercase letters.
13. **StrMove** (283) : Moves one PChar to another.
14. **StrNew** (283) : Makes a copy of a PChar on the heap, and returns a pointer to this copy.
15. **StrPos** (285) : Returns the position of one PChar string in another?
16. **StrRScan** (285) : returns a pointer to the last occurrence of on PChar string in another one.
17. **StrScan** (285) : returns a pointer to the first occurrence of on PChar string in another one.
18. **StrUpper** (286) : 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` (276) function of the `Strings` unit.

Errors: None.

See also: `StrBufSize` (323), `StrDispose` (323), `StrAlloc` (276)

For an example, see `StrBufSize` (323).

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` (322).

Errors: If no more memory is available, a runtime error occurs.

See also: `StrAlloc` (322), `StrDispose` (323).

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` (322) 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` (323), `StrAlloc` (322), `StrDispose` (278)

For an example, see `StrBufSize` (323).

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` (324), `StrPCopy` (284)

For an example, see `StrPCopy` (284).

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` (323).

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` (284).

For an example, see `StrPas` (284).

15.6 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` (325), `AnsiCompareText` (325)

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:

`<0` if `S1<S2`.

`0` if `S1=S2`.

`>0` if `S1>S2`.

the comparison takes into account Ansi characters, i.e. it takes care of strange accented characters.
Contrary to `AnsiCompareText` (325), the comparison is case sensitive.

Errors: None.

See also: `AdjustLineBreaks` (324), `AnsiCompareText` (325)

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:

`<0` if `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` (325), the comparison is case insensitive.

Errors: None.

See also: `AdjustLineBreaks` (324), `AnsiCompareText` (325)

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` (328).

Errors: None.

See also: `AnsiQuotedStr` (328)

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 (330)

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 (333), AnsiStrLower (332), AnsiStrUpper (333)

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 \(326\)](#).

Errors: None.

See also: [AnsiExtractQuotedStr \(326\)](#)

For an example, see [AnsiExtractQuotedStr \(326\)](#)

AnsiStrComp

Declaration: Function AnsiStrComp(S1, S2: PChar): integer;

Description: AnsiStrComp 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-sensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: [AnsiCompareText \(325\)](#), [AnsiCompareStr \(325\)](#)

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 ' );
  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.
```

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 (325), AnsiCompareStr (325)

```
Program Example55;

{ This program demonstrates the AnsiStrIComp function }

Uses sysutils ;

Procedure TestIt ( S1,S2 : Pchar);

Var R : Longint;

begin
  R:= AnsiStrIComp ( 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 (327)

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:

<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 (325), AnsiCompareStr (325)

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.

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-insensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: AnsiCompareText (325), AnsiCompareStr (325)

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** (327). 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** (333), **AnsiLowerCase** (327)

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` (333). 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` (333), `AnsiStrLower` (332), `AnsiLowerCase` (327)

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` (333), `AnsiStrLower` (332), `AnsiLowerCase` (327)

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 STring');
 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 (334), NewStr (204), DisposeStr (205)

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 (204), AppendStr (334), DisposeStr (205)

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 (352), IntToStr (348)

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.

0if 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:

<0if `S1`<`S2`.

0if `S1`=`S2`.

>0if `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` (325), `AnsiCompareStr` (325), `CompareText` (337)

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:

`<0` if `S1<S2`.

`0` if `S1=S2`.

`>0` if `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` (325), `AnsiCompareStr` (325), `CompareStr` (336)

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 (204), AppendStr (334), AssignStr (334)

For an example, see DisposeStr (205).

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` (338)) `FloatToStr` is completely equivalent to a `FloatToStrF(Value, ffGeneral, 15, 0)` call.

Errors: None.

See also: `FloatToStrF` (338)

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 (1.1 e-3);

 Testit (1.1 e-20);

 Testit (1.1 e-200);

 Testit (1.1 e+3);

 Testit (1.1 e+20);

 Testit (1.1 e+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 result string.

Errors: None.

See also: FloatToStr (338), FloatToText (340)

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 (1.1 E1);

 Testit (1.1 E-1);

```

Testit (1.1 E5);
Testit (1.1 E-5);
Testit (1.1 E10);
Testit (1.1 E-10);
Testit (1.1 E15);
Testit (1.1 E-15);
Testit (1.1 E100);
Testit (1.1 E-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 (338). 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 (338), FloatToStrF (338)

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;

end;

Begin

```
Testit (1.1);  
Testit (1.1 E1);  
Testit (1.1 E-1);  
Testit (1.1 E5);  
Testit (1.1 E-5);  
Testit (1.1 E10);  
Testit (1.1 E-10);  
Testit (1.1 E15);  
Testit (1.1 E-15);  
Testit (1.1 E100);  
Testit (1.1 E-100);
```

End.**FmtStr**

Declaration: Procedure (Var Res: String; Const Fmt : String; Const args: Array of const);

Description: FmtStr calls Format (341) with Fmt and Args as arguments, and stores the result in Res. For more information on how the resulting string is composed, see Format (341).

Errors: In case of error, a EConvertError exception is raised.

See also: Format (341), FormatBuf (347).

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 `'i'` takes the `Index`-th element in the argument array as the element to insert.

`'l'` 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 `'r'` character.

`'p'` **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` (338), 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 its 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` (338)). `Precision` indicates the number of digits following the decimal point.

In short, the `F` specifier formats its argument as follows:

```
FloatToStrF(Argument, ffFixed, fixed, 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 its 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` (338)

In short, the `M` specifier formats its argument as follows:

```
FloatToStrF(Argument, ffCurrency, 9999, Precision)
```

N Number format. This is the same as fixed point format, except that thousand separators are inserted in the resulting string.

P Pointer 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.

S String 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` (347)

Program example71;

{ 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:='[0 x%p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%10p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%10.4p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%0:p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%0:10p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%0:10.4p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%0:-10p]'; S:=Format ( Fmt,[ P]); writeln (Fmt:12, ' => ', s);
    Fmt:='[0 x%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;
  end;

```

```
        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;
end.
```

FormatBuf

Declaration: Function FormatBuf(Var Buffer; BufLen : Cardinal; Const Fmt; fmtLen : Cardinal; Const Args : Array of const) : Cardinal;

Description: Format

Errors:

See also:

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.

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 (348), StrToInt

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` converts `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` (347), `StrToInt` (352)

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:

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 ( '1 MyObject' );
Testit ( ' My@Object' );
Testit ( ' M123' );
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` (351), `TrimLeft` (354), `TrimRight` (354), `Trim` (353)

Program Example76;

{ This program demonstrates the LeftStr function }

Uses sysutils ;

Begin

```
  Writeln ( LeftStr ( ' abcdefghijklmnopqrstuvwxyz ' ,20));
  Writeln ( LeftStr ( ' abcdefghijklmnopqrstuvwxyz ' ,15));
  Writeln ( LeftStr ( ' abcdefghijklmnopqrstuvwxyz ' ,1));
  Writeln ( LeftStr ( ' abcdefghijklmnopqrstuvwxyz ' ,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` (327), `UpperCase` (355), `AnsiUpperCase` (333)

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 ansistrings 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 (334), DisposeStr (337)

For an example, see AssignStr (334).

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 (328), AnsiExtractQuotedStr (326).

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 (349), Trim (353), TrimLeft (354), TrimRight (354)

Program Example79;

{ This program demonstrates the RightStr function }

Uses sysutils ;

Begin

```
WriteLn ( RightStr ( ' abcdefghijklmnopqrstuvwxyz ',20));  
WriteLn ( RightStr ( ' abcdefghijklmnopqrstuvwxyz ',15));  
WriteLn ( RightStr ( ' abcdefghijklmnopqrstuvwxyz ',1));  
WriteLn ( RightStr ( ' abcdefghijklmnopqrstuvwxyz ',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 (341) 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 (341).

See also: StrLFmt (351), FmtStr (341), Format (341), FormatBuf (347)

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 fomattting 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` (341) 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` (341).

See also: `StrFmt` (351), `FmtStr` (341), `Format` (341), `FormatBuf` (347)

Program Example80;

{ This program demonstrates the StrFmt function }

Uses sysutils ;

Var S : AnsiString ;

Begin

SetLength (S,80);

WriteLn (**StrLFmt** (@S[1],80, 'For some nice examples of fomatting see %s.',['Format']))
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` (348), `StrToIntDef` (353)

Program Example82;

{ 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` (348), `StrToInt` (352)

Program Example82;

{ 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.

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` (354), `TrimRight` (354)

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` (353), `TrimRight` (354)

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` (353), `TrimLeft` (354)

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 (327), LowerCase (349), AnsiUpperCase (333)

Errors:

See also:

```
Program Example87;  
  
{ This program demonstrates the UpperCase function }  
  
Uses sysutils ;  
  
Begin  
  WriteLn ( UpperCase('this will come OUT ALL uPpErCaSe !' ));  
End.
```

Index

Abstract, 205
Accept, 266, 268
Access, 137
AddDisk, 35
AddDisk (Linux only), 304
AdjustLineBreaks, 324
Alarm, 138
allocate_ldt_descriptors, 62
allocate_memory_block, 65
AnsiCompareStr, 325
AnsiCompareText, 325
AnsiExtractQuotedStr, 326
AnsiLastChar, 327
AnsiLowerCase, 327
AnsiQuotedStr, 328
AnsiStrComp, 328
AnsiStrlComp, 329
AnsiStrLastChar, 330
AnsiStrLComp, 330
AnsiStrLIComp, 331
AnsiStrLower, 332
AnsiStrUpper, 333
AnsiUpperCase, 333
AppendStr, 334
Arc, 90
AssignCrt, 22
AssignLst, 263
AssignPipe, 139
AssignStr, 334
AssignStream, 139

Bar, 90
Bar3D, 90
BaseName, 141
BCDToInt, 335
BigCursor, 23
Bind, 268, 269

CFMakeRaw, 141
CFSetISpeed, 142
CFSetOSpeed, 142
ChangeFileExt, 307
Chmod, 143
Chown, 142
Circle, 90

ClearDevice, 91
ClearViewPort, 91
CloseDir, 144
CloseGraph, 91
ClrEol, 23
ClrScr, 23
CompareMem, 335
CompareStr, 336
CompareText, 337
Connect, 269, 270
copyfromdos, 65
copytodos, 65
create_code_segment_alias_descriptor, 66
CreateDir, 305
CursorOff, 24
CursorOn, 24

Date, 291
DateTimeToFileDate, 292
DateTimeToStr, 292
DateTimeToString, 292
DateTimeToSystemTime, 293
DateTimeToTimeStamp, 294
DateToStr, 294
DayOfWeek, 295
DecodeDate, 295
DecodeTime, 296
Delay, 24
DeleteFile, 308
DelLine, 25
DetectGraph, 91
DirName, 144
disable, 66
DiskFree, 35, 305
DiskSize, 36, 306
DisposeStr, 205, 337
DoDirSeparators, 308
DosExitCode, 36
dosmemfillchar, 66
dosmemfillword, 67
dosmemget, 67
dosmemmove, 68
dosmemput, 68
DosVersion, 37
DrawPoly, 91

DumpHeap, 109
Dup, 145
Dup2, 145

Ellipse, 92
Emms, 190
enable, 69
EncodeDate, 296
EncodeTime, 297
EnvCount, 37
EnvStr, 38
EpochToLocal, 146
Exec, 38
Execl, 147
Execl, 147
Execlp, 148
Execv, 149
Execve, 150
Execvp, 150
ExpandFileName, 309
ExpandUNCFileName, 309
ExtractFileDir, 310
ExtractFileDrive, 310
ExtractFileExt, 311
ExtractFileName, 311
ExtractFilePath, 311
ExtractRelativePath, 311

Fcntl, 158, 159
FD_Clr, 152
FD_IsSet, 152
FD_Set, 152
FD_ZERO, 151
fdClose, 152
fdFlush, 153
fdOpen, 153
fdRead, 153
fdSeek, 155
fdTruncate, 155
fdWrite, 155
FExpand, 38, 155
FileAge, 312
FileClose, 312
FileCreate, 313
FileDateToDateTime, 297
FileExists, 314
FileGetAttr, 314
FileGetDate, 315
FileOpen, 316
FileRead, 316
FileSearch, 316
FileSeek, 317
FileSetAttr (Not on Linux), 318
FileSetDate (Not on Linux), 318

FileTruncate, 318
FileWrite, 318
FillEllipse, 92
FillPoly, 92
FindClose, 39, 319
FindFirst, 39, 319
FindNext, 40, 320
FloatToStr, 338
FloatToStrF, 338
FloatToText, 340
FLock, 156
FloodFill, 92
FmtStr, 341
Fork, 159
Format, 341
FormatBuf, 347
FormatDateTime, 298
free_ldt_descriptor, 69
free_memory_block, 69
free_rm_callback, 69
FSearch, 40, 157
FSplit, 40
FSSStat, 156
FStat, 157
ftok, 116

get_cs, 70
get_descriptor_access_rights, 70
get_ds, 70
get_linear_addr, 70
get_meminfo, 71
get_next_selector_increment_value, 72
get_page_size, 72
get_pm_interrupt, 72
get_rm_callback, 73
get_rm_interrupt, 76
get_run_mode, 76
get_segment_base_address, 77
get_segment_limit, 77
get_ss, 77
GetArcCoords, 92
GetAspectRatio, 93
GetBkColor, 93
GetCBreak, 41
GetColor, 93
GetCurrentDir, 306
GetDate, 41, 160
GetDefaultPalette, 93
GetDirs, 320
GetDomainName, 160
GetDriverName, 93
GetEGid, 161
GetEnv, 42, 161
GetEpochTime, 162

GetEUid, 161
GetFAttr, 42
GetFillPattern, 93
GetFillSettings, 94
GetFS, 162
GetFTime, 43
GetGid, 163
GetGraphMode, 94
GetHostName, 163
GetImage, 94
GetIntVec, 44
GetLastButtonPress, 192
GetLastButtonRelease, 193
GetLineSettings, 94
GetLongOpts, 50
GetMaxColor, 94
GetMaxMode, 94
GetMaxX, 95
GetMaxY, 95
GetModeName, 95
GetModeRange, 95
GetMouseState, 193
Getopt, 50
GetPalette, 95
GetPaletteSize, 95
GetPeerName, 271
GetPid, 164
GetPixel, 96
GetPPid, 164
GetPriority, 164
GetSocketName, 272
GetSocketOptions, 272
GetTextSettings, 96
GetTime, 44, 165
GetUid, 165
GetVerify, 45
GetViewSettings, 96
GetX, 96
GetY, 96
Glob, 165
global_dos_alloc, 78
global_dos_free, 79
GlobFree, 166
GotoXY, 25
GraphDefaults, 96
GraphErrorMsg, 97
GraphResult, 97

HideMouse, 195
HighVideo, 26

ImageSize, 97
IncMonth, 298
InitGraph, 97
InitMouse, 195
inportb, 79
inportl, 80
inportw, 80
InsLine, 26
InstallUserDriver, 98
InstallUserFont, 98
Intr, 45
IntToHex, 347
IntToStr, 348
IOctl, 166
IOperm, 167
IsATTY, 167
IsLeapYear, 299
IsValidIdent, 348

Keep, 45
KeyPressed, 27
Kill, 169

LeftStr, 349
Line, 98
LineRel, 99
LineTo, 99
Link, 171
Listen, 272
LoadStr, 349
LocalToEpoch, 172
lock_code, 80
lock_data, 80
lock_linear_region, 81
LongDiv, 207
LongMul, 207
LowerCase, 349
LowVideo, 27
LPressed, 196
LStat, 170

MarkHeap, 109
MkFifo, 173
MoveRel, 99
MoveTo, 99
MPressed, 196
MSDos, 45
MSEcsToTimeStamp, 299
msgctl, 118
msgget, 117
msgrcv, 118
msgsnd, 117

NewStr, 204, 350
Nice, 173
NormVideo, 28
NoSound, 28

Now, 300

OpenDir, 174

outportb, 81

outportl, 81

outportw, 82

OutText, 99

OutTextXY, 100

PackTime, 45

pause, 175

PClose, 175

PieSlice, 100

POpen, 175

PutImage, 100

PutPixel, 100

QuotedStr, 350

ReadDir, 176

ReadKey, 28

realintr, 82

Rectangle, 100

Recv, 273

RegisterBGIDriver, 101

RegisterBGIFont, 101

RegisterObjects, 205

RegisterType, 205

RemoveDir, 307

RenameFile, 320

RestoreCRTMode, 101

RightStr, 351

RPressed, 196

S_ISBLK, 167

S_ISCHR, 168

S_ISDIR, 168

S_ISFIFO, 168

S_ISLNK, 168

S_ISREG, 169

S_ISSOCK, 169

Sector, 101

SeekDir, 176

seg_fillchar, 83

seg_fillword, 83

seg_move, 84

segment_to_descriptor, 84

Select, 177

SelectText, 178

semctl, 122

semget, 121

semop, 121

Send, 273

set_descriptor_access_rights, 84

set_pm_interrupt, 85

set_rm_interrupt, 86

set_segment_base_address, 86

set_segment_limit, 86

SetActivePage, 101

SetAllPalette, 102

SetAspectRatio, 102

SetBkColor, 102

SetCBreak, 46

SetColor, 102

SetCurrentDir, 307

SetDate, 46

SetDirSeparators, 321

SetExtraInfo, 110

SetFAttr, 47

SetFillPattern, 102

SetFillStyle, 103

SetFTime, 47

SetGraphBufSize, 103

SetGraphMode, 103

SetIntVec, 47

SetLineStyle, 103

SetMouseAscii, 196

SetMouseHideWindow, 197

SetMousePos, 197

SetMouseShape, 198

SetMouseSpeed, 199

SetMouseWindow, 200

SetMouseXRange, 200

SetMouseYRange, 201

SetPalette, 104

SetPriority, 178

SetRGBPalette, 104

SetSocketOptions, 274

SetTextJustify, 104

SetTextStyle, 105

SetTime, 47

SetUserCharSize, 105

SetVerify, 48

SetViewPort, 105

SetVisualPage, 105

SetWriteMode, 106

Shell, 178

shmat, 127

shmctl, 128

shmdt, 127

shmget, 127

ShowMouse, 201

Shutdown, 274

SigAction, 179

Signal, 181

SigPending, 180

SigProcMask, 180

SigSuspend, 181

Sock2File, 274

Sock2Text, 275
Socket, 275
SocketPair, 275
Sound, 29
Str2UnixSockAddr, 275
StrAlloc, 276, 322
StrBufSize, 323
StrCat, 276
StrComp, 277
StrCopy, 277
StrDispose, 278, 323
StrECopy, 278
StrEnd, 279
StrFmt, 351
StrIComp, 279
StrLCat, 280
StrLComp, 280
StrLCopy, 281
StrLen, 281
StrLFmt, 351
StrLIComp, 282
StrLower, 282
StrMove, 283
StrNew, 283
StrPas, 284, 324
StrPCopy, 284, 323
StrPLCopy, 324
StrPos, 285
StrRScan, 285
StrScan, 285
StrToDate, 300
StrToDateTime, 301
StrToInt, 352
StrToIntDef, 353
StrToTime, 302
StrUpper, 286
SwapVectors, 48
SymLink, 182
SystemTimeToDateTime, 302

tb_size, 87
TBufStream.Close, 227
TBufStream.Done, 227
TBufStream.Flush, 227
TBufStream.Init, 226
TBufStream.Open, 229
TBufStream.Read, 229
TBufStream.Seek, 228
TBufStream.Truncate, 228
TBufStream.Write, 229
TCDrain, 183
TCFlow, 183
TCFlush, 183
TCGetAttr, 184
TCGetPGrp, 184
TCollection.At, 234
TCollection.AtDelete, 242
TCollection.AtFree, 241
TCollection.AtInsert, 245
TCollection.AtPut, 244
TCollection.Delete, 240
TCollection.DeleteAll, 239
TCollection.Done, 233
TCollection.Error, 244
TCollection.FirstThat, 236
TCollection.ForEach, 243
TCollection.Free, 239
TCollection.FreeAll, 238
TCollection.FreeItem, 242
TCollection.GetItem, 235
TCollection.IndexOf, 234
TCollection.Init, 232
TCollection.Insert, 240
TCollection.LastThat, 235
TCollection.Load, 233
TCollection.Pack, 237
TCollection.PutItem, 246
TCollection.SetLimit, 244
TCollection.Store, 245
TCSendBreak, 185
TCSetAttr, 185
TCSetPGrp, 185
TDateTime, 291
TDosStream.Close, 223
TDosStream.Done, 223
TDosStream.Init, 222
TDosStream.Open, 225
TDosStream.Read, 225
TDosStream.Seek, 224
TDosStream.Truncate, 223
TDosStream.Write, 226
TellDir, 186
TextBackground, 29
TextColor, 30
TextHeight, 106
TextWidth, 106
Time, 303
TimeStampToDateTime, 303
TimeStampToMSecs, 304
TimeToStr, 304
TMemoryStream.Done, 230
TMemoryStream.Init, 230
TMemoryStream.Read, 231
TMemoryStream.Truncate, 230
TMemoryStream.Write, 231
TObject.Done, 213
TObject.Free, 213
TObject.Init, 213

transfer_buffer, 87
TRect.Assign, 212
TRect.Contains, 209
TRect.Copy, 209
TRect.Empty, 208
TRect.Equals, 209
TRect.Grow, 212
TRect.Intersect, 210
TRect.Move, 211
TRect.Union, 210
TResourceCollection.FreeItem, 257
TResourceCollection.GetItem, 257
TResourceCollection.KeyOf, 256
TResourceCollection.PutItem, 257
TResourceFile.Count, 258
TResourceFile.Delete, 259
TResourceFile.Done, 258
TResourceFile.Flush, 259
TResourceFile.Get, 259
TResourceFile.Init, 258
TResourceFile.KeyAt, 258
TResourceFile.Put, 259
TResourceFile.SwitchTo, 259
Trim, 353
TrimLeft, 354
TrimRight, 354
TSortedCollection.Compare, 248
TSortedCollection.IndexOf, 248
TSortedCollection.Init, 247
TSortedCollection.Insert, 250
TSortedCollection.KeyOf, 247
TSortedCollection.Load, 247
TSortedCollection.Search, 249
TSortedCollection.Store, 251
TStrCollection.Compare, 254
TStrCollection.FreeItem, 254
TStrCollection.GetItem, 253
TStrCollection.PutItem, 255
TStream.Close, 218
TStream.CopyFrom, 221
TStream.Error, 220
TStream.Flush, 218
TStream.Get, 215
TStream.GetPos, 216
TStream.GetSize, 217
TStream.Open, 218
TStream.Put, 219
TStream.Read, 220
TStream.ReadStr, 217
TStream.Reset, 218
TStream.Seek, 220
TStream.StrRead, 215
TStream.StrWrite, 219
TStream.Truncate, 219
TStream.Write, 221
TStream.WriteStr, 219
TStringCollection.Compare, 252
TStringCollection.FreeItem, 253
TStringCollection.GetItem, 251
TStringCollection.PutItem, 253
TStringList.Done, 260
TStringList.Get, 260
TStringList.Load, 260
TStrListMaker.Done, 261
TStrListMaker.Init, 261
TStrListMaker.Put, 261
TStrListMaker.Store, 262
TTYName, 185
TUnSortedStrCollection.Insert, 255

Umask, 186
Uname, 186
UnLink, 186
unlock_code, 87
unlock_data, 87
unlock_linear_region, 88
UnPackTime, 48
UpperCase, 355
Utime, 187

WaitPid, 188
WhereX, 30
WhereY, 30
Window, 31