

Free Pascal supplied units :  
Reference guide.

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Reference guide for standard Free Pascal units.

1.6

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## 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 May<sup>1</sup>, 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 an 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

---

<sup>1</sup>Current e-mail address [mmay@dnaco.net](mailto:mmay@dnaco.net)

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

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

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

The following constants define screen modes on a DOS system:

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

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

```
var TextAttr : byte;
```

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

```
var DirectVideo : Boolean;
```

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

```
var lastmode : Word;
```

## 1.2 Procedures and Functions

### **AssignCrt**

Declaration: Procedure AssignCrt (Var F: Text);

Description: 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 (24)

```
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 (24)

```
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 (31), 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 (24)

```
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 position');  
  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 );  
  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 (31), 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 (31), ClrScr (24)

```
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' );  
end.
```

```
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 ;  
WriteIn ( ' 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 May<sup>1</sup>, 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;
```

---

<sup>1</sup>Current e-mail address [mmay@dnaco.net](mailto: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,
         f51,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` (47) and `UnPackTime` (49) for setting/reading file times with `GetFTime` (44) and `SetFTime` (48).

## 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 (36) and DiskSize (37) calls. The DiskFree (36) and DiskSize (37) 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 (36), DiskSize (37)

### 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` (36) 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` (37), `AddDisk` (36)

```
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` (36) 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` (36), `AddDisk` (36)

For an example, see `DiskFree` (36).

## 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` (39)

```

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` (39), `Dos:GetEnv` (43)

## 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 (38), Dos:GetEnv (43)

```
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 (37)

For an example, see DosExitCode (37)

## 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 (42)

```
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` (167).

### 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` (41), `FindClose` (40)

```

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 (40), FindClose (40)

For an example, see FindFirst (40).

### 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 (39)

```
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 (41)

```
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 (47)

## 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 (45), SetDate (48)

```
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` (38), `EnvStr` (39)

```

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
- `AnyFile` = 3fh

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` (48)

```

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` (48), `PackTime` (47), `UnPackTime` (49)

```

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 (48)

### 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 hundredth of a second.

Errors: None.

See also: GetDate (42), SetTime (49)

```

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` (49)

### **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 kernel entry interrupt.

See also: `MSDos` (46), 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` (46)

## 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 (48), FindFirst (40), FindNext (41), UnPackTime (49)

```

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 (42)

### 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 (42), SetTime (49)

### 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 (43)

### 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 (44), PackTime (47),UnPackTime (49)

### 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 (45)

### **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 (45), SetDate (48)

### **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 (49)

### **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 (39), SetIntVec (48)

### **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 (44), FindFirst (40), FindNext (41), PackTime (47)

For an example, see PackTime (47).

# 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 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` (51) 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` (51), `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 (51), getopt (3)

```
program testopt ;

{ Program to depmonstrate the getopt function. }

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

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

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

```

    name:=' create ' ;
    has_arg:=1;
    flag:=nil ;
    value:='c'
end;
with theopts [6] do
begin
    name:=' file ' ;
    has_arg:=1;
    flag:=nil ;
    value:=#0;
end;
with theopts [7] do
begin
    name:=' ' ;
    has_arg:=0;
    flag:=nil ;
end;
c:=#0;
repeat
    c:=getlongopts (' abc:d:012' , @thetxt [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 three sections. The first section is an introduction to the GO32 unit. The second section lists the pre-defined constants, types and variables. The third 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 former 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 `DOSMEM_SELECTOR` 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` (71), `get_ds` (72), `gett_ss` (79), `allocate_ldt_descriptors` (64), `free_ldt_descriptor` (70), `segment_to_descriptor` (85), `get_next_selector_increment_value` (73), `get_segment_base_address` (78), `set_segment_base_address` (88), `set_segment_limit` (88), `create_code_segment_alias_descriptor` (67)

### 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 `DOSMEM_SELECTOR` variable. See also: `dosmemget` (69), `dosmemput` (70), `dosmemmove` (69), `dosmemfillchar` (68), `dosmemfillword` (69), `mem[]`-arrays, `seg_move` (86), `seg_fillchar` (84), `seg_fillword` (85).

### I/O port access

The I/O port access is done via the various `inportb` (81), `outportb` (83) 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` (83), `inportb` (81), `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` (71), `get_ds` (72), `get_ss` (79)

## 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. These functions are called handlers.

## Handling interrupts with DPMI

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

## Protected mode interrupts vs. Real mode interrupts

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

## Creating own interrupt handlers

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

## Disabling interrupts

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

## Hardware interrupts

Hardware interrupts are generated by hardware devices when something unusual happens; this could be a keypress or a mouse move or any other action. This is done to minimize CPU time, else the CPU would have to check all installed hardware for data in a big loop (this method is called 'polling') and this would take much time. A standard IBM-PC has two interrupt controllers, that are responsible for these hardware interrupts: both allow up to 8 different interrupt sources (IRQs, interrupt requests). The second controller is connected to the first through IRQ 2 for compatibility reasons, e.g. if controller 1 gets an IRQ 2, he hands the IRQ over to controller 2. Because of this up to 15 different hardware interrupt sources

can be handled. IRQ 0 through IRQ 7 are mapped to interrupts 8h to Fh and the second controller (IRQ 8 to 15) is mapped to interrupt 70h to 77h. All of the code and data touched by these handlers MUST be locked (via the various locking functions) to avoid page faults at interrupt time. Because hardware interrupts are called (as in real mode) with interrupts disabled, the handler has to enable them before it returns to normal program execution. Additionally a hardware interrupt must send an EOI (end of interrupt) command to the responsible controller; this is accomplished by sending the value 20h to port 20h (for the first controller) or A0h (for the second controller). The following example shows how to redirect the keyboard interrupt.

**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 (86)` only services software interrupts that are executed in protected mode; real mode software interrupts can be

redirected by `set_rm_interrupt` (88). See also `set_rm_interrupt` (88), `get_rm_interrupt` (77), `set_pm_interrupt` (86), `get_pm_interrupt` (74), `lock_data` (82), `lock_code` (82), `enable` (70), `disable` (67), `outportb` (83) 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` (89) and it's linear address via `transfer_buffer` (89). Another way is to allocate a completely new DOS memory area via the `global_dos_alloc` (79) function for your use and supply its real mode address. See also: `tb_size` (89), `transfer_buffer` (89), `global_dos_alloc` (79), `global_dos_free` (81), `realintr` (84) 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 DPMS host saves the registers contents in the supplied register data structure, switches into protected mode, and enters the callback routine with the following conditions:

- interrupts disabled
- %CS:%EIP = 48 bit pointer specified in the original call to `get_rm_callback` (74)
- %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 DPMS 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` (74), `free_rm_callback` (71), `lock_code` (82), `lock_data` (82)

## 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_dpmsi   = 4; { DPMSI (for example \dos box or 386Max) }
```

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

#### Processor flags constants

They are provided for a simple check with the flags identifier in the `trearegs` 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;
```

Table 4.1: Record description

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

Holds information about the memory allocation, etc. NOTE: The value of a field is -1 (0fffffffh) 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` (73) function.

Errors: Check the `int31error` variable.

See also: `free_ldt_descriptor` (70), `get_next_selector_increment_value` (73), `segment_to_descriptor` (85), `create_code_segment_alias_descriptor` (67), `set_segment_limit` (88), `set_segment_base_address` (88)

```
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 is used to free the memory block afterwards or use this handle for other purposes. So this block can't be deallocated and is henceforth 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 (71)

### 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` (89), `transfer_buffer` (89), `copytodos` (67)

### **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` (89), `transfer_buffer` (89), `copyfromdos` (66)

### **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:** selector.

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` (64), `set_segment_limit` (88), `set_segment_base_address` (88)

### **disable**

Declaration: Procedure `disable ;`

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

Errors: None.

See also: `enable` (70)

**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 (70), dosmemget (69), dosmemmove (69), dosmemfillword (69), seg\_move (86), seg\_fillchar (84), seg\_fillword (85)

**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: dosmempu (70), dosmemget (69), dosmemmove (69), dosmemfillchar (68), seg\_move (86), seg\_fillchar (84), seg\_fillword (85)

### **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: dosmempu (70), dosmemmove (69), dosmemfillchar (68), dosmemfillword (69), seg\_move (86), seg\_fillchar (84), seg\_fillword (85)

For an example, see global\_dos\_alloc (79).

### **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: dosmempu (70), dosmemget (69), dosmemfillchar (68), dosmemfillword (69) seg\_move (86), seg\_fillchar (84), seg\_fillword (85)

For an example, see seg\_fillchar (84).

### **dosmempu**

Declaration: Procedure dosmempu (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 (69), dosmemmove (69), dosmemfillchar (68), dosmemfillword (69), seg\_move (86), seg\_fillchar (84), seg\_fillword (85)

For an example, see global\_dos\_alloc (79).

### **enable**

Declaration: Procedure enable ;

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

Errors: None.

See also: disable (67)

### **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` (64) 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` (64), `get_next_selector_increment_value` (73)

For an example, see `allocate_ldt_descriptors` (64).

### **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 (66)` . 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 (66)`

### **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 (74)` function. Parameters:

**intaddr**: real mode address buffer returned by `get_rm_callback (74)` .

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

Errors: Check the `int31error` variable.

See also: `set_rm_interrupt (88)`, `get_rm_callback (74)`

For an example, see `get_rm_callback (74)`.

### **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 (72)`, `get_ss (79)`

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

### **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 (86)`

**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` (71), `get_ss` (79)

**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` (64), `set_segment_limit` (88), `set_segment_base_address` (88)

**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` (`0FFFFFFFH`) 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` (74) function.

Errors: Check the `int31error` variable.

See also: `get_page_size` (74)

```
Program meminf;
```

```
uses go32;
```

```
var meminfo : tmeminfo;
```

```
begin
```

```
  get_meminfo(meminfo);
```

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

```

begin
  Writeln(' Error getting DPML memory information ... Halting ');
  Writeln(' DPML error number :', int31error );
end
else
  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` (64). Parameters: None. Return value: Selector increment value. Notes: Because `allocate_ldt_descriptors` (64) 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` (64), `free_ldt_descriptor` (70)

**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` (72)

For an example, see `get_meminfo` (72).

**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` (86), `set_rm_interrupt` (88), `get_rm_interrupt` (77)

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

**get\_rm\_callback**

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

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

**pm\_func:** pointer to the protected mode callback function.

**reg:** supplied registers structure.

**rmc\_b:** buffer to real mode address of callback function.

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

Errors: Check the `int31error` variable.

See also: `free_rm_callback` (71)

```
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 ;
                          userproclen : 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 := userproclen ;
        lock_code ( userproc_proc, userproc_length );
    end else begin
        userproc_proc := nil ;
        userproc_length := 0 ;
        userproc_installed := false ;
    end;
    lock_data ( mouse_x, sizeof ( mouse_x ) );
    lock_data ( mouse_y, sizeof ( mouse_y ) );
    lock_data ( mouse_b, sizeof ( mouse_b ) );
    lock_data ( mouse_action, sizeof ( mouse_action ) );

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

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

procedure remove_mouse;
var r : trealregs ;
begin
    r.eax := $02; realintr ( mouseint, r );

```

```

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

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

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

begin
    install_mouse (@textuserproc, 400);
    Writeln (' Press _any_key_to_exit ... ');
    while (not keypressed) do begin
        { 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` (88), `set_pm_interrupt` (86), `get_pm_interrupt` (74)

### **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` (78)

```

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 ( 'DPML_detected.',
              'You''re_using_a_DPML_host_like',
              'a_windows_DOS_box_or_CWSDPML' );
end;
end.

```

### **get\_segment\_base\_address**

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

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

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

Return values: Linear base address of specified descriptor.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (64), `set_segment_base_address` (88), `allocate_ldt_descriptors` (64), `set_segment_limit` (88), `get_segment_limit` (79)

For an example, see `allocate_ldt_descriptors` (64).

### **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` (64), `set_segment_limit` (88), `set_segment_base_address` (88), `get_segment_base_address` (78),

### **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` (72), `get_cs` (71)

### **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` (81) call.

Errors: Check the `int31error` variable.

See also: `global_dos_free` (81)

```

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 (79)`.

Errors: Check the `int31error` variable.

See also: `global_dos_alloc (79)`

For an example, see `global_dos_alloc (79)`.

### **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 (83)`, `inportw (81)`, `inportl (81)`

### **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 (83)`, `inportb (81)`, `inportw (81)`

### **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 (83)` `inportb (81)`, `inportl (81)`

### **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` (82), `lock_data` (82), `unlock_linear_region` (90), `unlock_data` (89), `unlock_code` (89)

For an example, see `get_rm_callback` (74).

### **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` (82), `lock_code` (82), `unlock_linear_region` (90), `unlock_data` (89), `unlock_code` (89)

For an example, see `get_rm_callback` (74).

### **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` (82), `lock_code` (82), `unlock_linear_region` (90), `unlock_data` (89), `unlock_code` (89)

**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 (81), outportl (83), outportw (83)

```
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 (81), outportw (83), outportb (83)

For an example, see outportb (83).

**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 (81), outportl (83), outportb (83)

For an example, see outportb (83).

**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` (86), `seg_fillword` (85), `dosmemfillchar` (68), `dosmemfillword` (69), `dosmemget` (69), `dosmempu` (70), `dosmemmove` (69)

```
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` (86), `seg_fillchar` (84), `dosmemfillchar` (68), `dosmemfillword` (69), `dosmemget` (69), `dosmemput` (70), `dosmemmove` (69)

For an example, see `allocate_ldt_descriptors` (64).

### **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` (64) and change the base address as necessary.

Errors: Check the `int31error` variable.

See also: `allocate_ldt_descriptors` (64), `free_ldt_descriptor` (70), `set_segment_base_address` (88)

For an example, see `seg_fillchar` (84).

### **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` (84), `seg_fillword` (85), `dosmemfillchar` (68), `dosmemfillword` (69), `dosmemget` (69), `dosmempu` (70), `dosmemmove` (69)

For an example, see `allocate_ldt_descriptors` (64).

### **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` (71)

### **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` (74), `set_rm_interrupt` (88), `get_rm_interrupt` (77)

```

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_occured :',
            int1c_counter);
    end;
    set_pm_interrupt(int1c, oldint1c);
end.
```

### **set\_rm\_interrupt**

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

Description: Sets a real mode interrupt handler. Parameters:

**vector:** the interrupt vector number to set.

**intaddr:** address of new interrupt vector.

Return values: **True** if successful, otherwise **False**. Notes: The address supplied **MUST** be a real mode segment address, not a `selector:offset` address. So the interrupt handler must either reside in DOS memory (below 1 Mb boundary) or the application must allocate a real mode callback address with `get_rm_callback` (74).

Errors: Check the `int31error` variable.

See also: `get_rm_interrupt` (77), `set_pm_interrupt` (86), `get_pm_interrupt` (74), `get_rm_callback` (74)

### **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` (64), `get_segment_base_address` (78), `allocate_ldt_descriptors` (64), `set_segment_limit` (88), `get_segment_base_address` (78), `get_segment_limit` (79)

### **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` (64), `set_segment_base_address` (88), `get_segment_limit` (79), `set_segment_limit` (88)

For an example, see `allocate_ldt_descriptors` (64).

### **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` (89), `copyfromdos` (66) `copytodos` (67)

### **transfer\_buffer**

Declaration: Function `transfer_buffer` : `Longint`;

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

Errors: None.

See also: `tb_size` (89)

### **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` (90), `unlock_data` (89), `lock_linear_region` (82), `lock_data` (82), `lock_code` (82)

For an example, see `get_rm_callback` (74).

### **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` (90), `unlock_code` (89), `lock_linear_region` (82), `lock_data` (82), `lock_code` (82)

For an example, see `get_rm_callback` (74).

### **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` (89), `unlock_code` (89), `lock_linear_region` (82), `lock_data` (82), `lock_code` (82)

# 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;
LineStyleType = Record
  LineStyle,Pattern, Width : Word;
end;
PaletteType = Record
  Size : Byte;
  Colors : array[0..MAxColor] of shortint;
```

```
end;  
PointType = Record  
  X,Y : Integer;  
end;  
TextSettingsType = Record  
  Font,Direction, CharSize, Horiz, Vert : Word  
end;  
ViewPortType = Record  
  X1,Y1,X2,Y2 : Integer;  
  Clip : Boolean  
end;
```

## 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 (92),Ellipse (94) GetArcCoords (94),PieSlice (102), Sector (103)

### 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 (92), Rectangle (103)

### 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 (92), Rectangle (103)

### 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 (94),Arc (92) GetArcCoords (94),PieSlice (102), Sector (103)

### **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` (93), `SetBkColor` (104)

### **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` (93), `SetViewPort` (107), `SetBkColor` (104)

### **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` (100)

### **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` (100)

### **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` (92), `seepBar3D`, `Rectangle` (103)

### **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` (92) `Circle` (92), `FillEllipse` (94)

### **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` (92) `Circle` (92), `GetArcCoords` (94), `PieSlice` (102), `Sector` (103)

### **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` (92), `seepBar3D`, `Rectangle` (103)

### **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` (104), `SetBkColor` (104)

### **GetArcCoords**

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

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

Errors: None.

See also: `Arc` (92), `Ellipse` (94)

### **GetAspectRatio**

Declaration: Procedure `GetAspectRatio (Var Xasp,Yasp : Word);`

Description: `GetAspectRatio` determines the effective resolution of the screen. The aspect ratio can be calculated as `Xasp/Yasp`.

Errors: None.

See also: `InitGraph (100)`,`SetAspectRatio (104)`

### **GetBkColor**

Declaration: Function `GetBkColor : Word;`

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

Errors: None.

See also: `GetColor (95)`,`SetBkColor (104)`

### **GetColor**

Declaration: Function `GetColor : Word;`

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

Errors: None.

See also: `GetColor (95)`,`SetBkColor (104)`

### **GetDefaultPalette**

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

Description: Returns the current palette in `Palette`.

Errors: None.

See also: `GetColor (95)`, `GetBkColor (95)`

### **GetDriverName**

Declaration: Function `GetDriverName : String;`

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

Errors: None.

See also: `GetModeName (97)`, `InitGraph (100)`

### **GetFillPattern**

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

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

Errors: None

See also: `SetFillPattern (105)`

### **GetFillSettings**

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

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

Errors: None.

See also: `SetFillPattern` (105)

### **GetGraphMode**

Declaration: Function `GetGraphMode` : `Integer`;

Description: `GetGraphMode` returns the current graphical modulus

Errors: None.

See also: `InitGraph` (100)

### **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` (99), `PutImage` (102)

### **GetLineSettings**

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

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

Errors: None.

See also: `SetLineStyle` (106)

### **GetMaxColor**

Declaration: Function `GetMaxColor` : `Word`;

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

Errors: None.

See also: `SetColor` (104), `GetPaletteSize` (97)

### **GetMaxMode**

Declaration: Function `GetMaxMode` : `Word`;

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

Errors: None.

See also: `InitGraph` (100)

### **GetMaxX**

Declaration: `Function GetMaxX : Word;`

Description: `GetMaxX` returns the maximum horizontal screen length

Errors: None.

See also: `GetMaxY` (97)

### **GetMaxY**

Declaration: `Function GetMaxY : Word;`

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

Errors: None.

See also: `GetMaxX` (97)

### **GetModeName**

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

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

Errors: None.

See also: `GetDriverName` (95), `InitGraph` (100)

### **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` (100)

### **GetPalette**

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

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

Errors: None.

See also: `GetPaletteSize` (97), `SetPalette` (106)

### **GetPaletteSize**

Declaration: `Function GetPaletteSize : Word;`

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

Errors: None.

See also: `GetPalette` (97), `SetPalette` (106)

### **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` (107), `SetTextJustify` (106)

### **GetViewSettings**

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

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

Errors: None.

See also: `SetViewPort` (107)

### **GetX**

Declaration: `Function GetX : Integer;`

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

Errors: None.

See also: `GetY` (98)

### **GetY**

Declaration: `Function GetY : Integer;`

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

Errors: None.

See also: `GetX` (98)

### 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` (107), `SetFillStyle` (105), `SetColor` (104), `SetBkColor` (104), `SetLineStyle` (106)

### 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` (99)

### 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` (100)
- `SetLineStyle` (106)
- `SetWriteMode` (108)
- `SetFillStyle` (105)
- `SetTextJustify` (106)
- `SetGraphMode` (105)
- `SetTextStyle` (107)

Errors: None.

See also: `GraphErrorMsg` (99)

### 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` (96)

## 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 91), DetectGraph (93), CloseGraph (93), GraphResult (99)

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 (100), InstallUserFont (100)

## 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 (100), InstallUserDriver (100)

### 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 (101)`, `LineTo (101)`

### 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 (101)`, `LineTo (101)`

### 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 (101)`, `Line (101)`

### 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 (101)`

### MoveTo

Declaration: Procedure `MoveTo (X,Y : Integer);`

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

Errors: None.

See also: `MoveRel (101)`

### **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 (102)

### **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 (102)

### **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 (92), Circle (92), Sector (103)

### **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 (99),GetImage (96)

### **PutPixel**

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

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

Errors: None.

See also: GetPixel (98)

### **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 (92)`, `Bar3D (92)`

### **RegisterBGIDriver**

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

Description: Registers a user-defined BGI driver

Errors: None.

See also: `InstallUserDriver (100)`, `RegisterBGIFont (103)`

### **RegisterBGIFont**

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

Description: Registers a user-defined BGI driver

Errors: None.

See also: `InstallUserFont (100)`, `RegisterBGIDriver (103)`

### **RestoreCRTMode**

Declaration: Procedure `RestoreCRTMode ;`

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

Errors: None.

See also: `InitGraph (100)`

### **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 (92)`, `Circle (92)`, `PieSlice (102)`

### **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` (97)

### **SetAspectRatio**

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

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

Errors: None

See also: `InitGraph` (100), `GetAspectRatio` (95)

### **SetBkColor**

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

Description: Sets the background color to `Color`.

Errors: None.

See also: `GetBkColor` (95), `SetColor` (104)

### **SetColor**

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

Description: Sets the foreground color to `Color`.

Errors: None.

See also: `GetColor` (95), `SetBkColor` (104)

### **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 (95), SetFillStyle (105)

### **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 (105)

### **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 (100)

## 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 (96)

## 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 (104),SetRGBPalette (106)

## 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 (104), SetPalette (106)

## 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` (102), `OutTextXY` (102)

### **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` (98)

### **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` (107)

### **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` (98)

### **SetVisualPage**

Declaration: Procedure SetVisualPage (Page : Word);

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

Errors: None

See also: SetActivePage (104)

### **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 (108)

### **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 (108)

# 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` (112) call.

**type**

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

The following typed constants allow to fine-tune the standard dump of the memory usage by `DumpHeap` (111):

**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 installing an exit procedure), but it can be called at any time

Errors: None.

See also: `MarkHeap` (111)

### 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 (111)

### SetExtraInfo

Declaration: `procedure SetExtraInfo( size : longint;func : FillExtraInfoType);`

Description: You can use `SetExtraInfo` to store extra info in the blocks that the heaptrc unit reserves when tracing `getmem` calls. `Size` indicates the size (in bytes) that the trace mechanism should reserve for your extra information. For each call to `getmem`, `func` will be called, and passed a pointer to the memory reserved.

When dumping the memory summary, the extra info is shown as Longint values.

Errors: You can only call `SetExtraInfo` if no memroy has been allocated yet. If memory was already allocated prior to the call to `SetExtraInfo`, then an error will be displayed on standard error output, and a `DumpHeap` (111) is executed.

See also: DumpHeap (111)

**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` (123) 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` (130) call.

## Types

```
Type
TKey   = Longint;
```

TKey is the type returned by the `ftok` (119) key generating function.

```
type
TIPC_Perm = ^TIPC_Perm;
TIPC_Perm = record
  key : TKey;
  uid,
  gid,
```

```

    cuid,
    cgid,
    mode,
    seq : Word;
end;
```

The TIPC\_Perm structure is used in all IPC systems to specify the permissions.

```

Type
PSHMid_DS = ^TSHMid_ds;
TSHMid_ds = record
    shm_perm   : TIPC_Perm;
    shm_segsz  : longint;
    shm_atime  : longint;
    shm_dtime  : longint;
    shm_ctime  : longint;
    shm_cpid   : word;
    shm_lpid   : word;
    shm_nattch : integer;
    shm_npages : word;
    shm_pages  : Pointer;
    attaches   : pointer;
end;
```

The TSHMid\_ds structure is used in the shmctl (130) call to set or retrieve settings concerning shared memory.

```

type
PSHMinfo = ^TSHMinfo;
TSHMinfo = record
    shmmax : longint;
    shmmni : longint;
    shmseg : longint;
    shmall : longint;
end;
```

The TSHMinfo record is used by the shared memory system, and should not be accessed by the programmer directly.

```

type
PMSG = ^TMSG;
TMSG = record
    msg_next : PMSG;
    msg_type : Longint;
    msg_spot : PChar;
    msg_stime : Longint;
    msg_ts    : Integer;
end;
```

The TMSG record is used in the handling of message queues. There should be few cases where the programmer needs to access this data.

```

type
```

```

PMSQid_ds = ^TMSQid_ds;
TMSQid_ds = record
    msg_perm    : TIPC_perm;
    msg_first   : PMsg;
    msg_last    : PMsg;
    msg_stime   : Longint;
    msg_rtime   : Longint;
    msg_ctime   : Longint;
    wwait       : Pointer;
    rwait       : pointer;
    msg_cbytes  : word;
    msg_qnum    : word;
    msg_qbytes  : word;
    msg_lspid   : word;
    msg_lrpid   : word;
end;

```

The TMSQid\_ds record is returned by the msgctl (120) 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` (124) 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` (123) 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;
end;

```

The `TSEMun` variant record (actually a C union) is used in the `semctl` (124) 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` (123), `shmget` (129) or `msgget` (119) 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` (123), `shmget` (129), `msgget` (119)

For an example, see `msgctl` (120), `semctl` (124), `shmctl` (130).

### 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` (119), `msgsnd` (119), `msgrcv` (120), `msgctl` (120), `semget` (2)

For an example, see `msgctl` (120).

### msgsnd

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

Description: `msgsend` 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 immediatly.

The function returns `True` if the message was sent successfully, `False` otherwise.

Errors: In case of error, the call returns `False`, and `IPCError` is set.

See also: `msgget` (119), `msgrcv` (120), `seefmsgctl`

For an example, see `msgctl` (120).

### **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:

**0**No special meaning.

**IPC\_NOWAIT**If no messages are available, then the call returns immediately, with the `ENOMSG` error.

**MSG\_NOERROR**If 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` (119), `msgsnd` (119), `msgctl` (120)

For an example, see `msgctl` (120).

### **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\_STAT**In this case, the `msgctl` call fills the `TMSqid_ds` structure with information about the message queue.

**IPC\_SET**In this case, the `msgctl` call sets the permissions of the queue as specified in the `ipc_perm` record inside `buf`.

**IPC\_RMID**If 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` (119), `msgsnd` (119), `msgrcv` (120)

```

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 <end> <type><text> <max 255 characters > ');
  Writeln ( ' r(eceive) <type> ');
  Writeln ( ' d(DELETE) ');
  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\_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 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` (119), `semop` (123), `semctl` (124)

**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\_num**The number of the semaphore in the set on which the operation must be performed.

**sem\_op**The 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\_flg**Optional 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` (123), `semctl` (124)

## **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\_STAT**In 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\_SET**In 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\_RMID**If this is specified, the semaphore set is removed from the system.

**GETALL**In 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.

**GETNCNT**This 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` (123) 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.

**SETALL**In 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.

**SETVAL**This 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 (123)`, `semop (123)`

**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 : TSEMid\_ds;

**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 (Id, @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 : TSEMids;

begin
  opts.buf := @semds;
  If not semctl ( Id, 0, IPC_STAT, opts) <> -1 then
    DoError ( ' Couldn't stat semaphore ');
  Writeln ( ' Old permissions were ', semds.sem_perm.mode);
  semds.sem_perm.mode := mode;
  If semctl (id, 0, IPC_SET, opts) <> -1 then
    Writeln ( ' Set permissions to ', mode)
  else
    DoError ( ' Couldn't set permissions ');
  end;

Procedure PrintSem ( ID : longint );

```

```

Var l,cnt : longint ;

begin
  cnt:=getmembercount (ID);
  Writeln ( ' Semaphore ' , ID , ' has ' , cnt , ' Members ' );
  For l:=0 to cnt-1 Do
    DispVal ( id , i );
end;

Procedure USage;

begin
  Writeln ( ' Usage : semtool ( create ) < 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\_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.

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\_RND**The suggested address in shmaddr is rounded down to SHMLBA.

**SHM\_RDONLY** the 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` (129), `shmdt` (130), `shmctl` (130)

For an example, see `shmctl` (130).

### **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` (129).

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` (129), `shmat` (129), `shmctl` (130)

### **shmctl**

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

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

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

**IPC\_STAT** `shmctl` fills the `TSHMid_ds` record that `buf` points to with the available information about the shared memory block.

**IPC\_SET** applies the values in the `ipc_perm` record that `buf` points to, to the shared memory block.

**IPC\_RMID** the shared memory block is destroyed (after all processes to which the block is attached, have detached from it).

If successful, the function returns `True`, `False` otherwise.

Errors: If an error occurs, the function returns `False`, and `IPCError` is set.

See also: `shmget` (129), `shmat` (129), `shmdt` (130)

**Program** `shmtool` ;

**uses** `ipc` , `strings` ;

**Const** `SegSize` = 100;

**var** `key` : `Tkey` ;  
      `shmid, cntr` : `longint` ;  
      `segptr` : `pchar` ;

```

Procedure USage;

begin
  Writeln ( ' Usage : _shmtree_( rite )_text ' );
  writeln ( ' _r(ead)' );
  writeln ( ' _d(elete)' );
  writeln ( ' _m(ode_change)_mode' );
  halt (1);
end;

Procedure Writeshm ( ID : Longint ; ptr : pchar ; S : string );

begin
  strcpy ( ptr, s );
end;

Procedure Readshm ( ID : longint ; ptr : pchar );

begin
  Writeln ( ' Read : _', ptr );
end;

Procedure removeshm ( ID : Longint );

begin
  shmctl ( ID, IPC_RMID, Nil );
  writeln ( ' Shared _memory _marked _for _deletion ' );
end;

Procedure CHangeMode ( ID : longint ; mode : String );

Var m : word;
    code : integer;
    data : TSHMid_ds;

begin
  val ( mode, m, code );
  if code <> 0 then
    usage;
  If Not shmctl ( 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' );
  shmids := shmget ( key , segsize , IPC_CREAT or IPC_EXCL or 438 );
  if shmids = -1 then
    begin
      Writeln ( ' Shared memory exists . Opening as client ' );
      shmids := shmget ( key , segsize , 0 );
      if shmids = -1 then
        begin
          Writeln ( ' shmget : Error ! ' , ipcerror );
          halt ( 1 );
        end
      end
    else
      Writeln ( ' Creating new shared memory segment . ' );
      segptr := shmat ( shmids , nil , 0 );
      if longint ( segptr ) = -1 then
        begin
          Writeln ( ' Shmat : error ! ' , ipcerror );
          halt ( 1 );
        end ;
      case upcase ( paramstr ( 1 ) [ 1 ] ) of
        'W' : writeshm ( shmids , segptr , paramstr ( 2 ) );
        'R' : readshm ( shmids , segptr );
        'D' : removeshm ( shmids );
        'M' : changemode ( shmids , 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 (167) 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 (176) and ReadDir (178) 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 (178) 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;

```

Utimebuf is used in the `Utime` (189) call to set access and modification time of a file.

```

utimbuf = record
  actime,modtime : Longint;
end;

```

For the `Select` (178) call, the following 4 types are needed:

```

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

```

The `Uname` (188) 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 ;
TIOCGLKTRMIO = $5456 ;
TIOCSLKTRMIO = $5457 ;
TIOCSERGSTRUCT = $5458 ;
TIOCSERGETLSR = $5459 ;
TIOCSERGETMULTI = $545A ;
TIOCSERSETMULTI = $545B ;
TIOCMIWAIT = $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` (158) 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` (157) 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\_OK**User has read rights.

**W\_OK**User has write rights.

**X\_OK**User has execute rights.

**F\_OK**User 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\_eaccess**The requested access is denied, either to the file or one of the directories in its path.

**sys\_einval**Mode was incorrect.

**sys\_enoent**A directory component in `Path` doesn't exist or is a dangling symbolic link.

**sys\_enotdir**A directory component in `Path` is not a directory.

**sys\_enomem**Insufficient kernel memory.

**sys\_eloop**`Path` has a circular symbolic link.

See also: `Chown` (143), `Chmod` (144), `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.
```

## 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\_emfile**Too many file descriptors for this process.

**sys\_enfile**The system file table is full.

See also: `POpen` (177), `MkFifo` (175), `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 (140), POpen (177),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` (146), `FExpand` (157), `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` (143), `CFSetISpeed` (143), `termios` (2)

For an example, see `TCGetAttr` (186).

### **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` (143), `CFMakeRaw` (143), `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` (143), `CFMakeRaw` (143), `termios` (2)

### **Chown**

Declaration: Function `Chown` (`Path` : `Pathstr`; `NewUid`, `NewGid` : `Longint`) : `Boolean`;

Description: `Chown` sets the User ID and Group ID of the file in `Path` to `NewUid`, `NewGid`. The function returns `True` if the call was successful, `False` if the call failed.

Errors: Errors are returned in `LinuxError`.

**sys\_eperm**The effective UID doesn't match the ownership of the file, and is not zero. Owner or group were not specified correctly.

**sys\_eaccess**One of the directories in `Path` has no search (=execute) permission.

**sys\_enoent**A directory entry in `Path` does not exist or is a symbolic link pointing to a non-existent directory.

**sys\_enotdir**A directory entry in `OldPath` or `NewPath` is nor a directory.

**sys\_enomem**Insufficient kernel memory.

**sys\_erofs**The file is on a read-only filesystem.

**sys\_eloop**`Path` has a reference to a circular symbolic link, i.e. a symbolic link, whose expansion points to itself.

See also: `Chmod` (144), `Access` (139), `Chown` (( ) 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\_ISUID**Set user ID on execution.

**S\_ISGID**Set Group ID on execution.  
**S\_ISVTX**Set sticky bit.  
**S\_IRUSR**Read by owner.  
**S\_IWUSR**Write by owner.  
**S\_IXUSR**Execute by owner.  
**S\_IRGRP**Read by group.  
**S\_IWGRP**Write by group.  
**S\_IXGRP**Execute by group.  
**S\_IROTH**Read by others.  
**S\_IWOTH**Write by others.  
**S\_IXOTH**Execute by others.  
**S\_IRWXO**Read, write, execute by others.  
**S\_IRWXG**Read, write, execute by groups.  
**S\_IRWXU**Read, write, execute by user.

Errors: Errors are returned in `LinuxError`.

**sys\_eperm**The effective UID doesn't match the ownership of the file, and is not zero. Owner or group were not specified correctly.  
**sys\_eaccess**One of the directories in `Path` has no search (=execute) permission.  
**sys\_enoent**A directory entry in `Path` does not exist or is a symbolic link pointing to a non-existent directory.  
**sys\_enotdir**A directory entry in `OldPath` or `NewPath` is nor a directory.  
**sys\_enomem**Insufficient kernel memory.  
**sys\_erofs**The file is on a read-only filesystem.  
**sys\_eloop**`Path` has a reference to a circular symbolic link, i.e. a symbolic link, whose expansion points to itself.

See also: `Chown` (143), `Access` (139), `Chmod` (( ) 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:mdir) : 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` (176), `ReadDir` (178), `SeekDir` (178), `TellDir` (188), `closedir` (3)

For an example, see `OpenDir` (176).

## 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` (142), `FExpand` (157), `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_emfile`Maximum number of open files for the process is reached.

See also: `Dup2` (147), `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. NewFile can be an assigned file. If newfile was open, it is closed first. Due to the buffering mechanism of Pascal, this has not the same functionality as the dup2 (2) call in C. The internal Pascal buffers are not the same after this call, but when the buffers are flushed (e.g. after output), the output is sent to the same file. Doing an lseek will, however, work as in C, i.e. doing a lseek will change the fileposition in both files.

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: Dup (146), 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 (163), LocalToEpoch (174), GetTime (166),GetDate (161)

**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\_eaccess**File is not a regular file, or has no execute permission. A component of the path has no search permission.

**sys\_eperm**The file system is mounted *noexec*.

**sys\_e2big**Argument list too big.

**sys\_enoexec**The magic number in the file is incorrect.

**sys\_enoent**The file does not exist.

**sys\_enomem**Not enough memory for kernel, or to split command line.

**sys\_enotdir**A component of the path is not a directory.

**sys\_eloop**The path contains a circular reference (via symlinks).

See also: Execve (151), Execv (150), Execvp (152), Execl (149), Execlp (150), Fork (161), execvp (3)

**Program** Example10;

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

**Uses** linux, strings;

**begin**

```
{ Execute 'ls -l', with current environment. }
{ 'ls' is NOT looked for in PATH environment variable. }
Execl ( '/bin/ls -l' );
```

**end.**

## Execl

Declaration: Procedure Execl (Path : pathstr, Ep : ppchar);

Description: Replaces the currently running program with the program, specified in **path**. Path is split into a command and its options. The executable in **path** is searched in the path, if it isn't an absolute filename. The environment in **ep** is passed to the program. On success, **execl** does not return.

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

**sys\_eaccess**File is not a regular file, or has no execute permission. A component of the path has no search permission.

**sys\_eperm**The file system is mounted *noexec*.

**sys\_e2big**Argument list too big.

**sys\_enoexec**The magic number in the file is incorrect.

**sys\_enoent**The file does not exist.

**sys\_enomem**Not enough memory for kernel, or to split command line.

**sys\_enotdir**A component of the path is not a directory.

**sys\_eloop**The path contains a circular reference (via symlinks).

See also: Execve (151), Execv (150), Execvp (152), Execl (148), Execlp (150), Fork (161), 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\_\_eaccess**File is not a regular file, or has no execute permission. A component of the path has no search permission.

**sys\_\_eperm**The file system is mounted *noexec*.

**sys\_\_e2big**Argument list too big.

**sys\_\_enoexec**The magic number in the file is incorrect.

**sys\_\_enoent**The file does not exist.

**sys\_\_enomem**Not enough memory for kernel, or to split command line.

**sys\_\_enotdir**A component of the path is not a directory.

**sys\_\_eloop**The path contains a circular reference (via symlinks).

See also: Execve (151), Execv (150), Execvp (152), Execl (149), Execl (148), Fork (161), 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\_\_eaccess**File is not a regular file, or has no execute permission. A component of the path has no search permission.

**sys\_\_eperm**The file system is mounted *noexec*.

**sys\_\_e2big**Argument list too big.

**sys\_\_enoexec**The magic number in the file is incorrect.

**sys\_enoent**The file does not exist.

**sys\_enomem**Not enough memory for kernel.

**sys\_enotdir**A component of the path is not a directory.

**sys\_eloop**The path contains a circular reference (via symlinks).

See also: Execve (151), Execvp (152), Execl (149), Execl (148), Execlp (150), Fork (161), 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**:

**eaccess**File is not a regular file, or has no execute permission. A component of the path has no search permission.

**sys\_eperm**The file system is mounted *noexec*.

**sys\_e2big**Argument list too big.

**sys\_enoexec**The magic number in the file is incorrect.

**sys\_enoent**The file does not exist.

**sys\_enomem**Not enough memory for kernel.

**sys\_enotdir**A component of the path is not a directory.

**sys\_eloop**The path contains a circular reference (via symlinks).

See also: Execve (151), Execv (150), Execvp (152) Execl (149), Execl (148), Execlp (150), Fork (161), **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\_eaccess**File is not a regular file, or has no execute permission. A component of the path has no search permission.

**sys\_eperm**The file system is mounted *noexec*.

**sys\_e2big**Argument list too big.

**sys\_enoexec**The magic number in the file is incorrect.

**sys\_enoent**The file does not exist.

**sys\_enomem**Not enough memory for kernel.

**sys\_enotdir**A component of the path is not a directory.

**sys\_eloop**The path contains a circular reference (via symlinks).

See also: Execve (151), Execv (150), Execle (149), Execl (148), Execlp (150), Fork (161), 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. }
  { Envp 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** (178), **SelectText** (180), **GetFS** (164), **FD\_Clr** (153), **FD\_Set** (154), **FD\_IsSet** (153)

For an example, see **Select** (178).

**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** (178), **SelectText** (180), **GetFS** (164), **FD\_ZERO** (153), **FD\_Set** (154), **FD\_IsSet** (153)

For an example, see **Select** (178).

**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** (178), **SelectText** (180), **GetFS** (164), **FD\_ZERO** (153), **FD\_Clr** (153), **FD\_Set** (154)

For an example, see **Select** (178).

### **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` (178), `SelectText` (180), `GetFS` (164), `FD_ZERO` (153), `FD_Clr` (153), `FD_IsSet` (153)

For an example, see `Select` (178).

### **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` (154), `fdRead` (155), `fdWrite` (157), `fdTruncate` (156), `fdFlush` (154), `seefd-Seek`

For an example, see `fdOpen` (154).

### **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` (154), `fdClose` (154), `fdRead` (155), `fdWrite` (157), `fdTruncate` (156), `fdSeek` (156)

For an example, see `fdRead` (155).

### **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 (154), fdRead (155), fdWrite (157),fdTruncate (156), fdFlush (154), fdSeek (156)

**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 (154), fdClose (154), fdWrite (157),fdTruncate (156), fdFlush (154), fdSeek (156)

**Program** Example20;

*{ Program to demonstrate the fdRead and fdTruncate functions. }*

**Uses** linux;

**Const** Data : **string** [10] = '12345687890';

**Var** FD : Longint;

    l : longint;

**begin**

    FD:=fdOpen(' test.dat',open\_wronly **or** open\_creat,octal (666));

**if** fd>0 **then**

**begin**

*{ Fill file with data }*

**for** l:=1 **to** 10 **do**

**if** fdWrite (FD,Data[l],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 l:=1 to 5 do
if fdRead ( FD, Data [1],10)<>10 then
begin
Writeln ( ' Error _when_Reading _!' );
Halt (2);
end;
fdClose (FD);
{ Truncating file at 60 bytes }
{ For truncating , file must be open or write }
FD:=fdOpen( ' test . dat ' , open_wronly , octal (666));
if FD>0 then
begin
if not fdTruncate (FD,60) then
Writeln( ' Error _when_truncating _!' );
fdClose (FD);
end;
end;
end;
end.

```

### fdSeek

Declaration: Function fdSeek (fd,Pos,SeekType:longint : longint;

Description: fdSeek sets the current fileposition of file fd to Pos, starting from SeekType, which can be one of the following:

**Seek\_Set** Pos is the absolute position in the file.

**Seek\_Cur** Pos is relative to the current position.

**Seek\_end** Pos is relative to the end of the file.

The function returns the new fileposition, or -1 of an error occurred.

Errors: Errors are returned in LinuxError.

See also: fdOpen (154), fdWrite (157), fdClose (154), fdRead (155),fdTruncate (156), fdFlush (154)

For an example, see fdOpen (154).

### 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` (154), `fdClose` (154), `fdRead` (155), `fdWrite` (157), `fdFlush` (154), `fdSeek` (156)

### **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` (154), `fdClose` (154), `fdRead` (155), `fdTruncate` (156), `fdSeek` (156), `fdFlush` (154)

### **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` (142), `DirName` (146)

**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` (160), `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 (159), LStat (172), 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 (142), DirName (146), FExpand (157)

**Program** Example46;

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

**Uses** linux , strings ;

**begin**

```
  WriteLn ( 'Is _is_in _:_', FSearch ( 'Is ', 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\_enoentPath does not exist.

See also: FSStat (158), LStat (172), 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\_GetFd**Read the close\_on\_exec flag. If the low-order bit is 0, then the file will remain open across execve calls.

**F\_GetFl**Read the descriptor's flags.

**F\_GetOwn**Get the Process ID of the owner of a socket.

Errors: LinuxError is used to report errors.

sys\_ebadfd has a bad file descriptor.

See also: Fcntl (160), 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\_SetFd**Set the close\_on\_exec flag of Fd. (only the least significant bit is used).

**F\_GetLk**Return the flock record that prevents this process from obtaining the lock, or set the l\_type field of the lock of there is no obstruction. Arg is a pointer to a flock record.

**F\_SetLk**Set the lock or clear it (depending on l\_type in the flock structure). if the lock is held by another process, an error occurs.

**F\_GetLkw**Same as for F\_Setlk, but wait until the lock is released.

**F\_SetOwn**Set the Process or process group that owns a socket.

Errors: LinuxError is used to report errors.

`sys_ebadfd` has a bad file descriptor.

`sys_eagain` or `sys_eaccess` for `F_SetLk`, if the lock is held by another process.

See also: `Fcntl` (160), `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` (166)).

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

`sys_eagain` Not enough memory to create child process.

See also: `Execve` (151), `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` (163), `GetTime` (166), `EpochToLocal` (148)

**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 (165), 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 (164), 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 (163), 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) , csh (1)

**Program** Example41;

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

**Uses** linux;

**begin**

```
  Writeln ( ' Path is : ', Getenv ( ' PATH ' ) );  
end.
```

### GetEpochTime

Declaration: Function GetEpochTime : longint;

Description: returns the number of seconds since 00:00:00 gmt, january 1, 1970. it is adjusted to the local time zone, but not to DST.

Errors: no errors

See also: EpochToLocal (148), GetTime (166), 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)\_:\_');

**Writeln** ( GetEpochTime);

**end.**

## GetFS

Declaration: Function GetFS (Var F : Any File Type) : Longint;

Description: GetFS returns the file selector that the kernel provided for your file. In principle you don't need this file selector. Only for some calls it is needed, such as the Select (178) call or so.

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

See also: Select (178)

**Program** Example33;

{ *Program to demonstrate the SelectText function.* }

**Uses** linux;

**Var** tv : TimeVal;

**begin**

**Writeln** ( 'Press the <ENTER> to continue the program.' );

    { *Wait until File descriptor 0 (=Input) changes* }

    SelectText ( Input, nil );

    { *Get rid of <ENTER> in buffer* }

**readln**;

**Writeln** ( 'Press <ENTER> key in less than 2 seconds ...' );

    tv.sec:=2;

    tv.usec:=0;

**if** SelectText ( Input, @tv) > 0 **then**

**Writeln** ( 'Thank you!'

**else**

**Writeln** ( 'Too late!'

**end.**

## GetGid

Declaration: Function GetGid : Longint;

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

Errors: None.

See also: GetEGid (162), 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 (162), 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 (166), 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` (165), `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_esrch`No process found using `which` and `who`.

`sys_einval``Which` was not one of `Prio_Process`, `Prio_Grp` or `Prio_User`.

See also: `SetPriority` (180), `Nice` (175), `Getpriority` (2)

For an example, see `Nice` (175).

### GetTime

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

Description: Returns the current time of the day.

Errors: None

See also: `GetEpochTime` (163), `GetDate` (161), `EpochToLocal` (148)

**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 (163), 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\_enomem**No memory on heap for glob structure.  
**others**As returned by the opendir call, and sys\_readdir.

See also: GlobFree (168), 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 : : ' );
    end ;
end .
```

```

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 (167)

For an example, see Glob (167).

### 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 (161), the permissions are reset. When doing a Execve (151) 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 (168),TTYName (187)

## 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 (159), S\_ISLNK (170), S\_ISREG (171), S\_ISDIR (170), S\_ISCHR (169), S\_ISFIFO (170), S\_ISSOCK (171)

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 (159), S\_ISLNK (170), S\_ISREG (171), S\_ISDIR (170), S\_ISBLK (169), S\_ISFIFO (170), S\_ISSOCK (171)

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 (159), S\_ISLNK (170), S\_ISREG (171), S\_ISCHR (169), S\_ISBLK (169), S\_ISFIFO (170), S\_ISSOCK (171)

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 (159), S\_ISLNK (170), S\_ISREG (171), S\_ISDIR (170), S\_ISCHR (169), S\_ISBLK (169), S\_ISSOCK (171)

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 (159), S\_ISREG (171), S\_ISDIR (170), S\_ISCHR (169), S\_ISBLK (169), S\_ISFIFO (170), S\_ISSOCK (171)

**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) ' );
    end
  end

```

```

    if S_ISSOCK(info.mode) then
        Writeln ( ' File is a socket ' );
    end;
end.

```

See also:

## 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 (159), S\_ISLNK (170), S\_ISDIR (170), S\_ISCHR (169), S\_ISBLK (169), S\_ISFIFO (170), S\_ISSOCK (171)

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 (159), S\_ISLNK (170), S\_ISREG (171), S\_ISDIR (170), S\_ISCHR (169), S\_ISBLK (169), S\_ISFIFO (170)

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 $\neq$ 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 $\neq$ -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\_einval**An invalid signal is sent.

**sys\_esrch**The Pid or process group don't exist.

**sys\_eperm**The effective userid of the current process doesn't math the one of process Pid.

See also: SigAction (181), Signal (183), Kill (2)

**LStat**

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

Description: LStat gets information about the link specified in Path, and stores it in Info, which is of type stat. Contrary to FStat, it stores information about the link, not about the file the link points to. The function returns True if the call was successful, False if the call failed.

Errors: LinuxError is used to report errors.

sys\_enoentPath does not exist.

See also: FStat (159), FSStat (158), 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 lstat 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\_exdev** OldPath and NewPath are not on the same filesystem.

**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 nor a directory.

**sys\_enomem** Insufficient kernel memory.

**sys\_erofs** The files are on a read-only filesystem.

**sys\_eexist** NewPath already exists.

**sys\_mlink** OldPath has reached maximal link count.

**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 anothe entry.

**sys\_eperm** OldPath points to . or .. of a directory.

See also: SymLink (184), UnLink (188), 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 (163), EpochToLocal (148), GetTime (166),GetDate (161)

```

Program Example4;

{ Program to demonstrate the LocalToEpoch function. }

Uses linux;

Var year , month , day , hour , minute , second : Word;

begin
  Write (' Year : '); readln (Year);
  Write (' Month : '); readln (Month);

```

```

Write ( ' Day_#####:_' ); readln ( Day );
Write ( ' Hour_####:_' ); readln ( Hour );
Write ( ' Minute_:::_' ); readln ( Minute );
Write ( ' Seonds_:::_' ); readln ( Second );
Write ( ' This_is_::_' );
Write ( LocalToEpoch ( year , month , day , hour , minute , second ) );
Writeln ( ' _seconds_past_00:00_1/1/1980' );
end .

```

## MkFifo

Declaration: `Function MkFifo (PathName: String; Mode : Longint) : Boolean;`

Description: `MkFifo` creates named a named pipe in the filesystem, with name `PathName` and mode `Mode`.

Errors: `LinuxError` is used to report errors:

`sys_emfile` Too many file descriptors for this process.

`sys_enfile` The system file table is full.

See also: `POpen` (177), `MkFifo` (175), `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` (166), `SetPriority` (180), `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` (146), `ReadDir` (178), `SeekDir` (178), `TellDir` (188), `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.
```

### 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 (177)

For an example, see POpen (177)

### 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 (177). 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 (140), popen (3) , PClose (177)

**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 (146), OpenDir (176), SeekDir (178), TellDir (188), readdir (3)

For an example, see OpenDir (176).

## 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 (146), ReadDir (178), OpenDir (176), TellDir (188), seekdir (3)

For an example, see OpenDir (176).

## 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 `writfds` 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` (153), `FD_Clr` (153), `FD_Set` (154), `FD_IsSet` (153) 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` (180), `GetFS` (164), `FD_ZERO` (153), `FD_Clr` (153), `FD_Set` (154), `FD_IsSet` (153)

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

See also: `Select` (178), `GetFS` (164)

## SetPriority

Declaration: `Function SetPriority (Which,Who,Prio : Integer) : Integer;`

Description: `SetPriority` sets the priority with which a process is running. Which process(es) is determined by the `Which` and `Who` variables. `Which` can be one of the pre-defined `Prio_Process`, `Prio_PGrp`, `Prio_User`, in which case `Who` is the process ID, Process group ID or User ID, respectively. `Prio` is a value in the range -20 to 20.

Errors: Error checking must be done on `LinuxError`, since a priority can be negative.

`sys_esrch`No process found using `which` and `who`.

`sys_einval``Which` was not one of `Prio_Process`, `Prio_Grp` or `Prio_User`.

`sys_eperm`A process was found, but neither its effective or real user ID match the effective user ID of the caller.

`sys_eaccess`A non-superuser tried to a priority increase.

See also: `GetPriority` (166), `Nice` (175), `Setpriority` (2)

For an example, see `Nice` (175).

## 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` (161) or `Execve` (151) calls.

Errors: Errors are reported in `LinuxError`.

See also: `POpen` (177), `Fork` (161), `Execve` (151), `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 (Signum : Integer; Var Act,OldAct : PSigActionRec);

Description: Changes the action to take upon receipt of a signal. Act and Oldact are pointers to a SigActionRec record. SigNum specifies the signal, and can be any signal except **SIGKILL** or **SIGSTOP**. If Act is non-nil, then the new action for signal SigNum is taken from it. If OldAct is non-nil, the old action is stored there. Sa\_Handler may be **SIG\_DFL** for the default action or **SIG\_IGN** to ignore the signal. Sa\_Mask Specifies which signals should be ignored during the execution of the signal handler. Sa\_Flags Specifies a series of flags which modify the behaviour of the signal handler. You can 'or' none or more of the following :

**SA\_NOCLDSTOP** If signum is **SIGCHLD** do not receive notification when child processes stop.

**SA\_ONESHOT** or **SA\_RESETHAND** Restore the signal action to the default state once the signal handler has been called.

**SA\_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 (182), SigPending (182), SigSuspend (183), Kill (171), 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 (181), SigProcMask (182), SigSuspend (183), Signal (183), Kill (171), 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\_BLOCK**The set of blocked signals is the union of the current set and the SSet argument.

**SIG\_UNBLOCK**The signals in SSet are removed from the set of currently blocked signals.

**SIG\_SETMASK**The 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\_eintr**System call was interrupted.

See also: SigAction (181), SigPending (182), SigSuspend (183), Kill (171), 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 (181), SigProcMask (182), SigPending (182), Signal (183), Kill (171), 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\_ERR**An error occurred.

See also: SigAction (181), Kill (171), 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` (173), `UnLink` (188), `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  
  WriteIn ( ' This _shouldn ' ' t _happen ' );  
{ Now remove new.txt also }  
If not Unlink ( ' new.txt ' ) then  
  WriteIn ( ' 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: `TCSsetattr` (187), `termios` (2)

**Program** Example55;

**uses** Linux;

{ Program to demonstrate the TCGetAttr/TCSsetattr/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);
  TCSsetattr(1, TCSANOW, tios);
  WriteLn(' Current attributes :');
  TCGetAttr(1, tios);
  ShowTermios(tios);
  TCSsetattr(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 described by file-descriptor `Fd`, for duration `Duration`. The function returns `True` if the action was performed successfully, `False` otherwise.

Errors: Errors are reported in `LinuxError`.

See also: `termios` (2)

### TCSetAttr

Declaration: `Function TCSetAttr (Fd:longint;OptAct:longint;var Tios:TermIOS) : Boolean;`

Description: `TCSetAttr` Sets the terminal parameters you specify in a `TermIOS` structure `Tios` for the terminal referred to by the file descriptor `Fd`. `OptAct` specifies an optional action when the set need to be done, this could be one of the following pre-defined values:

`TCSANOW` set immediately.

`TCSADRAIN` wait for output.

`TCSAFLUSH` wait for output and discard all input not yet read.

The function Returns `True` if the call was succesfull, `False` otherwise.

Errors: Errors are reported in `LinuxError`.

See also: `TCGetAttr` (186), `termios` (2)

For an example, see `TCGetAttr` (186).

### 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` (186), `termios` (2)

For an example, see `TCGetPGrp` (186).

### 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` (169),`IOctl` (168)

## TellDir

Declaration: Function TellDir (p:mdir) : 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 (146), ReadDir (178), SeekDir (178), OpenDir (176), telldir (3)

For an example, see OpenDir (176).

## 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 (144), 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 (165), GetDomainName (162), 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 successful, False if the call failed.

Errors: Errors are returned in LinuxError.

**sys\_eaccess**You 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\_eperm**The 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\_enoent**A component of the path doesn't exist.

**sys\_enotdir**A directory component of the path is not a directory.

**sys\_eisdir**`Path` refers to a directory.

**sys\_enomem**Insufficient kernel memory.

**sys\_erofs**`Path` is on a read-only filesystem.

See also: `Link` (173), `SymLink` (184), `UnLink` (2)

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

## 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\_eaccess**One of the directories in `Path` has no search (=execute) permission.

**sys\_enoent**A directory entry in `Path` does not exist or is a symbolic link pointing to a non-existent directory.

Other errors may occur, but aren't documented.

See also: `GetEpochTime` (163), `Chown` (143), `Access` (139), `utime` (()) 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 (161), Execve (151), waitpid (2)

for an example, see Fork (161).

# 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 (194) 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` (195)

*{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
```

```
      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 (194)

For an example, see `GetLastButtonPress` (194).

## 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` (198), `MPressed` (198), `RPressed` (198), `SetMousePos` (200)

*{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):

**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 (203), SetMouseHideWindow (199)

For an example, see ShowMouse (203).

### 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` (196), `MPressed` (198), `RPressed` (198)

For an example, see `GetMouseState` (196).

### **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` (196), `LPressed` (198), `RPressed` (198)

For an example, see `GetMouseState` (196).

### **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` (196), `LPressed` (198), `MPressed` (198)

For an example, see `GetMouseState` (196).

### **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` (200), 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` (200)

```
{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` (203), 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` (203), `HideMouse` (197)

nputlistingmouseex/mouse9.pp

## SetMousePos

Declaration: Procedure SetMousePos (x,y:Longint);

Description: SetMousePos 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 (196)

*{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 (198)

*{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 : ' );
      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 . ' );
    End ;

```

```

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 botto-right corner at (xmax,ymax), out of which the mouse cursor can't move. This procedure is simply a wrapper for the SetMouseXRange (202) and SetMouseYRange (203) procedures. While xmin, ymin, xmax and ymax are Longint parameters, only the lower 16 bits are used.

Errors: None.

See also: SetMouseXRange (202), SetMouseYRange (203)

For an example, see SetMouseXRange (202).

### 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 (203), SetMouseWindow (202)

*{ 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)}*

```
    WriteLn(' Press ↵any ↵key ↵to ↵quit .' );  
    ShowMouse;  
    While KeyPressed Do ReadKey;  
    Readkey;  
    While KeyPressed Do ReadKey;  
    HideMouse  
End  
End.
```

### SetMouseYRange

Declaration: Procedure SetMouseYRange (Min, Max: Longint);

Description: SetMouseYRange sets the minimum (Min) and maximum (Max) vertical coordinates in between which the mouse cursor can move. While Min and Max are Longint parameters, only the lower 16 bits are used.

Errors: None.

See also: SetMouseXRange (202), SetMouseWindow (202)

For an example, see SetMouseXRange (202).

### 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 (197),SetMouseHideWindow (199)

*{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  
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 collection 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 209):

```
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 (207)

**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 (206)

For an example, see NewStr (206).

## 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 234.
2. TStringCollection, see section 11.12, page 254.
3. TStrCollection, see section 11.13, page 255.

Errors: None.

See also: RegisterType (207)

## 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 its 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 its sole argument a **PStream** type variable.

**Store: Pointer** is a pointer to a method that stores an instance of the object to a stream. This method should accept as its sole argument a **PStream** type variable.

**Errors:** In case of error (if a object with the same **ObjType**) is already registered), run-time error 212 occurs.

```
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 (209)

### 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 (209)

## 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 (211), TRect.Contains (211)

**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 (210), Contains (211)

For an example, see TRect.Empty (210)

### 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 (212), Equals (211)

### 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 (214)

```
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 (212)

```
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 (212)

```

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 (214)

```

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 (213).

```
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 (211)

For an example, see TRect.Copy (211).

## **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 (215), Done (215)

For an example, see Free (215)

### **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 (215), Done (215)

```
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 (215) method.

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

Errors: None.

See also: Free (215), Init (215)

```
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 (221)

**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 (221), ReadStr (219)

```
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 (222), GetSize (219)

```
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 (222), GetPos (218)

```

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 (217)

```

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: ', 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 (220), Reset (220)

For an example, see TDosStream.Open (227).

### **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 (220), Reset (220)

for an example, see TDosStream.Open (227).

### **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 (220), Close (220)

### **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 \(221\)](#)

for an example, see [TBufStream.Flush \(230\)](#).

### **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 \(222\)](#)

For an example, see [TDosStream.Truncate \(225\)](#).

### **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 \(207\)](#).

After the object has been written, it can be read again with [Get \(217\)](#).

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 \(217\)](#)

For an example, see [TStream.Get \(217\)](#);

### **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 \(221\)](#), [StrRead \(217\)](#), [ReadStr \(219\)](#)

For an example, see [TStream.StrRead \(217\)](#).

### **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 \(221\)](#), [StrRead \(217\)](#), [ReadStr \(219\)](#)

For an example, see [TStream.ReadStr \(219\)](#).

### 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 (218), GetSize (219)

For an example, see TDosStream.Seek (226).

### 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 (223), ReadStr (219), StrRead (217)

```
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 (222), WriteStr (221), StrWrite (221)

For an example, see TStream.Read (222).

### 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 (222) method to read the data, and the Write (223) method to write in the current stream.

Errors: None.

See also: Read (222), Write (223)

**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 216), 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 228.

Here is the full declaration of the **TDosStream** object:

```

TYPE
  TDosStream = OBJECT (TStream)
    Handle: THandle; { DOS file handle }
    FName : AsciiZ; { AsciiZ filename }
    CONSTRUCTOR Init (FileName: FNameStr; Mode: Word);
    DESTRUCTOR Done; Virtual;
    PROCEDURE Close; Virtual;
    PROCEDURE Truncate; Virtual;
    PROCEDURE Seek (Pos: LongInt); Virtual;
    PROCEDURE Open (OpenMode: Word); Virtual;
    PROCEDURE Read (Var Buf; Count: Sw_Word); Virtual;
    PROCEDURE Write (Var Buf; Count: Sw_Word); Virtual;
  END;
  PDosStream = ^TDosStream;

```

### TDosStream.Init

Declaration: Constructor **Init** (FileName: FNameStr; Mode: Word);

Description: **Init** instantiates an instance of **TDosStream**. The name of the file that contains (or will contain) the data of the stream is given in **FileName**. The **Mode** parameter determines whether a new file should be created and what access rights you have on the file. It can be one of the following constants:

**stCreate** Creates a new file.  
**stOpenRead** Read access only.  
**stOpenWrite** Write access only.  
**stOpenRead** and write access.

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

See also: Done (225)

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

### **TDosStream.Done**

Declaration: Destructor TDosStream.Done; Virtual;

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

Errors: None.

See also: Init (224), Close (225)

for an example, see e.g. TDosStream.Truncate (225).

### **TDosStream.Close**

Declaration: Procedure TDosStream.Close; Virtual;

Description: Close closes the file if it was open, and sets Handle to -1. Contrary to Done (225) it does not clean up the instance of TDosStream

Errors: None.

See also: TStream.Close (220), Init (224), Done (225)

For an example, see TDosStream.Open (227).

### **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 (221), GetSize (219)

**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 (222), GetPos (218)

**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** (225) 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 (220), Close (225)

**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` (222), `Write` (228)

For an example, see `TStream.Read` (222).

### **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` (223), `Read` (227)

For an example, see `TStream.Read` (222).

## **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:

**stCreate**Creates a new file.

**stOpenRead**Read access only.

**stOpenWrite**Write access only.

**stOpen**Read 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` (224), `Done` (229)

For an example see `TBufStream.Flush` (230).

### **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` (225), `Init` (229), `Close` (229)

For an example see `TBufStream.Flush` (230).

### **TBufStream.Close**

Declaration: Procedure `TBufStream.Close; Virtual;`

Description: `Close` flushes and closes the file if it was open, and sets `Handle` to -1. Contrary to `Done` (229) it does not clean up the instance of `TBufStream`

Errors: None.

See also: `TStream.Close` (220), `Init` (229), `Done` (229)

For an example see `TBufStream.Flush` (230).

**TBufStream.Flush**

Declaration: Procedure 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 (231) for more info on the errors.

See also: TStream.Close (220), Init (229), Done (229)

**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 (230) or TDosStream.Truncate (225).

See also: TStream.Truncate (221), TDosStream.Truncate (225), GetSize (219)

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

### **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 (222), GetPos (218)

For an example, see TStream.Seek (222);

### **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` (229) 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 (220), Close (229)

For an example, see TDosStream.Open (227).

### **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 (222), Write (231)

For an example, see TStream.Read (222).

### **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` (223), `Read` (231)

For an example, see `TStream.Read` (222).

## 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;
    PROCEDURE Truncate;
    PROCEDURE Read (Var Buf; Count: Sw_Word);
    PROCEDURE Write (Var Buf; Count: Sw_Word);
END;
PMemoryStream = ^TMemoryStream;

```

### TMemoryStream.Init

Declaration: `Constructor TMemoryStream.Init (ALimit: Longint; ABlockSize: Word);`

Description: `Init` instantiates a new `TMemoryStream` object. The `memorystreamobject` will initially allocate at least `ALimit` bytes memory, divided into memory blocks of size `ABlockSize`. The number of blocks needed to get to `ALimit` bytes is rounded up.

By default, the number of blocks is 1, and the size of a block is 8192. This is selected if you specify 0 as the blocksize.

Errors: If the stream cannot allocate the initial memory needed for the memory blocks, then the stream's status is set to `stInitError`.

See also: `Done` (232)

For an example, see e.g `TStream.CopyFrom` (223).

### 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` (232)

For an example, see e.g `TStream.CopyFrom` (223).

## 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 (221)

**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 (234)

For an example, see TStream.Read (222).

## 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 (232)) as needed.

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

See also: TStream.Write (223), Read (233)

For an example, see TStream.Read (222).

## 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. All kinds come in 2 flavors, one for objects, one for pointers.

This is the full declaration of the TCollection object:

TYPE

```
TItemList = Array [0..MaxCollectionSize - 1] Of Pointer;
PItemList = ^TItemList;
```

```
TCollection = OBJECT (TObject)
  Items: PItemList; { Item list pointer }
  Count: Sw_Integer; { Item count }
  Limit: Sw_Integer; { Item limit count }
  Delta: Sw_Integer; { Inc delta size }
  Constructor Init (ALimit, ADelta: Sw_Integer);
  Constructor Load (Var S: TStream);
  Destructor Done; Virtual;
  Function At (Index: Sw_Integer): Pointer;
  Function IndexOf (Item: Pointer): Sw_Integer; Virtual;
  Function GetItem (Var S: TStream): Pointer; Virtual;
  Function LastThat (Test: Pointer): Pointer;
  Function FirstThat (Test: Pointer): Pointer;
  Procedure Pack;
  Procedure FreeAll;
  Procedure DeleteAll;
  Procedure Free (Item: Pointer);
  Procedure Insert (Item: Pointer); Virtual;
  Procedure Delete (Item: Pointer);
  Procedure AtFree (Index: Sw_Integer);
  Procedure FreeItem (Item: Pointer); Virtual;
  Procedure AtDelete (Index: Sw_Integer);
  Procedure ForEach (Action: Pointer);
  Procedure SetLimit (ALimit: Sw_Integer); Virtual;
  Procedure Error (Code, Info: Integer); Virtual;
```

```
Procedure AtPut (Index: Sw_Integer; Item: Pointer);
Procedure AtInsert (Index: Sw_Integer; Item: Pointer);
Procedure Store (Var S: TStream);
Procedure PutItem (Var S: TStream; Item: Pointer); Virtual;
END;
PCollection = ^TCollection;
```

### **TCollection.Init**

Declaration: Constructor `TCollection.Init (ALimit, ADelta: Sw_Integer);`

Description: `Init` initializes a new instance of a collection. It sets the (initial) maximum number of items in the collection to `ALimit`. `ADelta` is the increase size : The number of memory places that will be allocated in case `ALimit` is reached, and another element is added to the collection.

Errors: None.

See also: `Load` (235), `Done` (236)

For an example, see `TCollection.ForEach` (245).

### **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` (238).

See also: `Init` (235), `GetItem` (238), `Done` (236).

**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 (235), FreeAll (240)

For an example, see TCollection.ForEach (245).

### 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, seplErrorTCollection.Error is called with coIndexError and Index as arguments, resulting in a run-time error.

See also: Insert (243)

**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` (217).

See also: `TStream.Get` (217), `seoplStoreTCollection.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` (239)

**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` (238)

```

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 (246)

```

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 (241), Freetem (244)

```

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

Errors: None.

See also: FreeAll (240), Delete (243)

**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 (244),

**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 (247), AtPut (247),

### 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 (242) call is provided.

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

See also: AtDelete (245), Free (242)

**Program** ex31;

*{ Program to demonstrate the TCollection.Delete method }*

**Uses** Objects, MyObject; *{ For TMyObject definition and registration }*

```
Var C : PCollection;  
    M : PMyObject;  
    I, InitMem : Longint;
```

**begin**

```
    Randomize;  
    C:=New( PCollection, Init (120,10));  
    InitMem:=Memavail;  
    Writeln ( ' Initial _memory_:_', InitMem);  
    For I:=1 to 100 do  
        begin  
            M:=New(PMyObject, Init );  
            M^. SetField (I-1);  
            C^. Insert (M);  
        end;  
    Writeln ( ' Added _100_ Items _ Memory _available _:_', Memavail);  
    Write ( ' Lost _:_', Initmem-Memavail, '_ bytes .' );  
    Write ( '( Should _be_100*', SizeOf( TMyObject));  
    Writeln ( '=', 100* SizeOf( TMyObject), ' )' );  
    With C^ do  
        While Count>0 do Delete (At(Count-1));  
    Writeln ( ' Freed _all_ objects _ Memory _available _:_', Memavail);  
    Writeln ( ' Lost _:_', Initmem-Memavail, '_ bytes .' );
```

```

    Dispose (C, Done);
end.

```

### TCollection.AtFree

Declaration: Procedure TCollection.AtFree (Index: Sw\_Integer);

Description: AtFree deletes the item at position Index in the collection, and calls the item's destructor if it is not Nil.

Errors: If Index isn't valid then Error (246) is called with CoIndexError.

See also: Free (242), AtDelete (245)

```

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 (244), 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 (246) is called with CoIndexError.

See also: Delete (243)

**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 (239), LastThat (238)

```
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 (235)

For an example, see Pack (239).

### **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 (207)

### **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 (246) is called with CoIndexError.

See also:

For an example, see Pack (239).

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

See also: Insert (243)

**Program** ex34;

*{ Program to demonstrate the TCollection.AtInsert method }*

**Uses** Objects, MyObject; *{ For TMyObject definition and registration }*

**Var** C : PCollection;  
M : PMyObject;  
I : Longint;

**Procedure** PrintField (Dummy: Pointer; P : PMyObject);

**begin**  
  **Writeln** ( ' Field \_:\_\_', P^.GetField );  
**end**;

**begin**  
  **Randomize**;  
  C:=**New**( PCollection, Init (120,10));  
  **Writeln** ( ' Inserting \_100\_ records \_at\_ random \_places .' );  
  **For** I:=1 **to** 100 **do**  
    **begin**  
      M:=**New**( PMyObject, Init );  
      M^.SetField ( I-1 );  
    **end**

```

If I=1 then
  C^. Insert (M)
else
  With C^ do
    AtInsert ( Random( Count ),M);
  end;
  WriteLn ( ' Values : ' );
  C^. Foreach ( @PrintField );
  Dispose (C, Done);
end .

```

### **TCollection.Store**

Declaration: Procedure TCollection.Store (Var S: TStream);

Description: Store writes the collection to the stream S. It does this by writing the current Count, Limit and Delta to the stream, and then writing each item to the stream. The contents of the stream are then suitable for instantiating another collection with Load (235).

Errors: Errors returned are those by TStream.Put (221).

See also: Load (235), PutItem (248)

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 (221).

See also: Store (248), GetItem (238).

## **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 (250) method.

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

The Compare (250) 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 (235)) 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 (250), Done (236)

For an example, see

### **TSortedCollection.Load**

Declaration: Constructor Load (Var S: TStream);

Description: Load calls the inherited constructor (see TCollection.Load (235)) 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 (249), Done (236)

For an example, see TCollection.Load (235).

### **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 (250), Compare (250).

### **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 it's 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 (251), Compare (250).

For an example, see TCollection.IndexOf (237)

### **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 (251) method and in the Insert (252) method to determine the ordering of the objects.

The function should compare the two keys of items and return the following function results:

**Result** ; 0If Key1 is logically before Key2 (Key1<Key2)

**Result** = 0If Key1 and Key2 are equal. (Key1=Key2)

**Result** ; 0If 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` (250), `Search` (251)

**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` (250) function to implement this search.

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

Errors: None.

See also: `IndexOf` (237).

**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 (247), 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 \(247\)](#)

```

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

After a `Store`, the collection can be loaded from the stream with the constructor `Load (250)`

Errors: Errors can be those of `TStream.Put (221)`.

See also: [Load \(250\)](#)

For an example, see [TCollection.Load \(235\)](#).

## 11.12 TStringCollection

The TStringCollection object manages a sorted collection of pascal strings. To this end, it overrides the Compare (250) 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 (219).

See also: PutItem (255)

### TStringCollection.Compare

Declaration: Function TStringCollection.Compare (Key1, Key2: Pointer): Sw\_Integer; Virtual;

Description: TStringCollection overrides the Compare function so it compares the two keys as if they were pointers to strings. The compare is done case sensitive. It returns the following results:

-1if the first string is alphabetically earlier than the second string.

0if the two strings are equal.

1if the first string is alphabetically later than the second string.

Errors: None.

See also: TSortedCollection.Compare (250)

**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 (244)

### 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.WriteStr (221).

See also: GetItem (254)

## 11.13 TStrCollection

The TStrCollection object manages a sorted collection of null-terminated strings (pchar strings). To this end, it overrides the Compare (250) 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 (217).

See also: PutItem (257)

### 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

-1if the first string is alphabetically earlier than the second string.

0if the two strings are equal.

1if the first string is alphabetically later than the second string.

Errors: None.

See also: TSortedCollection.Compare (250)

**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.
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 (244)

### 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 (221).

See also: GetItem (256)

## 11.14 TUnSortedStrCollection

The TUnSortedStrCollection object manages an unsorted list of objects. To this end, it overrides the TSortedCollection.Insert (252) method to add strings at the end of the collection, rather than in the alphabetically correct position.

Take care, the Search (251) and IndexOf (237) 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` (254)

### **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` (235) method.

Errors: Errors returned are those by `TStream.Read` (222)

See also: `TCollection.Load` (235), `TStream.Read` (222)

### **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` (244)

## 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 (248) method.

Errors: Errors returned are those by TStream.Write (223).

See also: Store (248)

## 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 (260) constructor call.

**Modified** is set to True if one of the resources has been changed. It is set by the SwitchTo (260), Delete (262) and Put (262) methods. Calling Flush (262) 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 (261)

### **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` (260)

### **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` (260)

### **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` (261)

### **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` (222) and `TStream.Write` (223).

See also: `Flush` (262)

### **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 (222) and TStream.Write (223).

See also: SwitchTo (261)

### **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 (262)

### **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 (221) and TStream.Seek

See also: Get (261)

## **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 (207) 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` (263)

### **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` (263), `TObject.Done` (215)

### **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` (264)

## **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` (207) 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` (215), `Done` (264)

### **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` (215), `Init` (264)

### **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` (264) method.

Errors: None.

See also: `Store` (264).

### **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` (263), `Put` (264).

# 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 (277) 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 (277) 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 (277) 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` (270), `Recv` (275) and `Send` (275) 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` (277) 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\_EBADF**The socket descriptor is invalid.

**SYS\_ENOTSOCK**The descriptor is not a socket.

**SYS\_EOPNOTSUPP**The socket type doesn't support the Listen operation.

**SYS\_EFAULT**Addr points outside your address space.

**SYS\_EWOULDBLOCK**The requested operation would block the process.

See also: Listen (274), Connect (271)

**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 another 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 (268)` command. It is equivalent to subsequently calling the regular `Accept (268)` function and the `Sock2Text (277)` function. The function returns `True` if successful, `False` otherwise.

Errors: The errors are those of `Accept (268)`.

See also: `Accept (268)`

### **Accept**

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

Description: This is an alternate form of the `Accept (268)` command. It is equivalent to subsequently calling the regular `Accept (268)` function and the `Sock2File (276)` 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 (268)`.

See also: `Accept (268)`

### **Accept**

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

Description: This is an alternate form of the `Accept (268)` command. It is equivalent to subsequently calling the regular `Accept (268)` function and the `Sock2File (276)` 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 (268)`.

See also: `Accept (268)`

### **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\_EBADF**The socket descriptor is invalid.

**SYS\_EINVAL**The socket is already bound to an address,

**SYS\_EACCESS**Address is protected and you don't have permission to open it.

More errors can be found in the Unix man pages.

See also: Socket (277)

## 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` (277) and the regular `Bind` (270) function. The function returns `True` if successful, `False` otherwise.

Errors: Errors are those of the regular `Bind` (270) command.

See also: Bind (270)

## Connect

Declaration: `Function Connect (Sock:Longint;Var Addr;AddrLen:Longint) : Longint;`

Description: `Connect` opens a connection to a peer, whose address is described by `Addr`. `AddrLen` contains the length of the address. The type of `Addr` depends on the kind of connection you're trying to make, but is generally one of `TSockAddr` or `TUnixSockAddr`.

The `Connect` function returns a file descriptor if the call was successful, `-1` in case of error.

Errors: On error, `-1` is returned and errors are reported in `SocketError`.

See also: Listen (274), Bind (270), Accept (268)

**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 (271) command. It is equivalent to subsequently calling the regular Connect (271) function and the Sock2Text (277) function. The function returns **True** if successful, **False** otherwise.

Errors: The errors are those of Connect (271).

See also: Connect (271)

### Connect

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

Description: This is an alternate form of the Connect (271) command. The parameter **addr** contains the name of the unix socket file to be opened. It is equivalent to subsequently calling the regular Connect (271) function and the Sock2File (276) function. The function returns **True** if successful, **False** otherwise.

Errors: The errors are those of Connect (271).

See also: Connect (271)

### Connect

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

Description: This is another alternate form of the Connect (271) command. It is equivalent to subsequently calling the regular Connect (271) function and the Sock2File (276) function. The **Addr** parameter contains the parameters of the internet socket to connect to. The function returns **True** if successful, **False** otherwise.

Errors: The errors are those of Connect (271).

See also: Connect (271)

```

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 ;
    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` (271), `Socket` (277), `connect` (2)

### GetSocketName

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

Description: `GetSocketName` returns the current name of the specified socket `Sock`. `Addr` should point to enough space to store the name, the amount of space pointed to should be set in `AddrLen`. When the function returns successfully, `Addr` will be filled with the name, and `AddrLen` will be set to the length of `Addr`.

Errors: Errors are reported in `SocketError`, and include the following:

**SYS\_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.

See also: `Bind` (270)

### 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\_SOCKET**From the socket itself.

**XXX**set `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\_EBADF**The socket descriptor is invalid.

**SYS\_ENOTSOCK**The descriptor is not a socket.

**SYS\_EFAULT**`OptVal` points outside your address space.

See also: `GetSocketOptions` (274)

### 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\_EBADF**The socket descriptor is invalid.
- SYS\_ENOTSOCK**The descriptor is not a socket.
- SYS\_EOPNOTSUPP**The socket type doesn't support the `Listen` operation.

See also: `Socket` (277), `Bind` (270), `Connect` (271)

## 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\_EMMSGSIZE**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` (275)

## 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\_EMMSGSIZE**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` (275), `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\_SOCKET**To manipulate the socket itself.

**XXX**set 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\_EBADF**The socket descriptor is invalid.

**SYS\_ENOTSOCK**The descriptor is not a socket.

**SYS\_EFAULT**OptVal points outside your address space.

See also: GetSocketOptions (274)

## 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\_EBADF**The socket descriptor is invalid.

**SYS\_ENOTCONN**The socket isn't connected.

**SYS\_ENOTSOCK**The descriptor is not a socket.

See also: Socket (277), Connect (271)

## 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 (277), Sock2Text (277)

## 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 (277), Sock2File (276)

## 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 successful, the function returns a socket descriptor, which can be passed to a subsequent Bind (270) call. If unsuccessful, the function returns -1.

Errors: Errors are returned in SocketError, and include the following:

**SYS\_EPROTONOSUPPORT**The protocol type or the specified protocol is not supported within this domain.

**SYS\_EMFILE**The per-process descriptor table is full.

**SYS\_ENFILE**The system file table is full.

**SYS\_EACCESS**Permission to create a socket of the specified type and/or protocol is denied.

**SYS\_ENOBUFS**Insufficient buffer space is available. The socket cannot be created until sufficient resources are freed.

See also: SocketPair (277), socket (2)

for an example, see Accept (268).

## 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 (277)

See also: Str2UnixSockAddr (277)

## 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 (270) call.

Errors: None.

See also: Socket (277), Bind (270)

## 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` (286), `StrPCopy` (287).

#### **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** (283), **StrIComp** (282), **StrLIComp** (285)

For an example, see **StrLComp** (283).

## 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** (287), **StrLCopy** (284), **StrECopy** (281)

```

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 (286)

```

Program Example17;

Uses strings;

{ Program to demonstrate the StrDispose function. }

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

var P2 : PChar;

begin
  Writeln ( ' Before StrNew Memory available ', MemAvail );
  P2:=StrNew ( P1);
  Writeln ( ' After StrNew Memory available ', MemAvail );
  Writeln ( ' P2 ', P2);
  StrDispose(P2);
  Writeln ( ' After StrDispose Memory available ', MemAvail );
end.

```

**StrECopy**

Declaration: Function StrECopy (Dest,Source : PChar) : PChar;

Description: Copies the Null-terminated string in Source to Dest, and returns a pointer to the end (i.e. the terminating Null-character) of the copied string.

Errors: No length checking is performed.

See also: StrLCopy (284), StrCopy (280)

```

Program Example6;

Uses strings;

{ Program to demonstrate the StrECopy function. }

Const P : PChar = 'This is a PCHAR string.';

Var PP : PChar;

begin
  PP:=StrAlloc ( StrLen(P)+1);
  If Longint (StrECopy(PP,P)) - Longint (PP) <> StrLen(P) then
    Writeln ( ' Something is wrong here !' )
  else
    Writeln ( ' PP=', PP);
end.

```

**StrEnd**

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

Description: Returns a pointer to the end of P. (i.e. to the terminating null-character.

Errors: None.

See also: StrLen (284)

**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 (283), StrComp (280), StrLIComp (285)

**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, '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 (279)

```
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 (280), StrComp (282), StrLComp (285)

```
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** (280), **StrECopy** (281)

```

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 (283), StrComp (280), StrIComp (282)

For an example, see StrIComp (282)

### StrLower

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

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

Errors: None.

See also: Uppcase (), StrUpper (289)

```

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 (284), StrCopy (280)

**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 (280), StrDispose (281)

**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 (287)

```
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 (287)

```
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 (288), StrRScan (288)

**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 (288), StrPos (288)

For an example, see StrScan (288).

**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 (288), StrPos (288)

**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: **Ucase** () , **StrLower** (285)

For an example, see **StrLower** (285)

# 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` (322), `FindNext` (323) and `FindClose` (322) 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 (319) call.

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

The following constants can be used in the FileSeek (320) 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" "mmm" "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` (294).

Errors: None.

See also: `Time` (306), `Now` (303), `TDateTime` (294).

**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` (315) function.

Errors: None.

See also: `Time` (306), `Date` (294), `FileDateToDateTime` (300), `DateTimeToSystemTime` (296), `DateTimeToTimeStamp` (297)

**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 293).

Errors: None.

See also: `FormatDateTime` (301), `TDateTime` (294).

**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 293.

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

See also: `FormatDateTime` (301), section 15.2, page 293.

```
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_mmm_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` (295), `SystemTimeToDateTime` (305), `DateTimeToTimeStamp` (297)

```
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 (295), SystemTimeToDateTime (305), DateTimeToSystemTime (296)

**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**, ' milliseconds 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 (307), DateTimeToStr (295), FormatDateTime (301), StrToDate (303)

**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 (294), DateToStr (297)

**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 (299), DecodeTime (299).

**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 (300), DecodeDate (298).

**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 (298) procedure.

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

**Year** must be between 1 and 9999.

**Month** must be within the range 1-12.

**Days** must be between 1 and 31.

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

See also: EncodeTime (300), DecodeDate (298).

**Program** Example11;

*{ This program demonstrates the EncodeDate function }*

**Uses** sysutils;

**Var** YY,MM,DD : Word;

**Begin**

**DecodeDate** ( **Date** , YY,MM,DD);

**WriteLn** ( ' Today\_is\_:' , **FormatDateTime** ( ' dd\_mmm\_yyyy' , **EncodeDate**(YY,Mm,Dd)));

**End.**

**EncodeTime**

Declaration: `Function EncodeTime(Hour, Minute, Second, MilliSecond:word): TDateTime;`

Description: `EncodeTime` encodes the `Hour`, `Minute`, `Second`, `MilliSecond` variables to a `TDateTime` format result. It does the opposite of the `DecodeTime` (299) 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 it's valid range, 0 is returned.

See also: `EncodeDate` (299), `DecodeTime` (299).

**Program** Example12;

*{ This program demonstrates the EncodeTime function }*

**Uses** sysutils;

**Var** Hh,MM,SS,MS : Word;

**Begin**

**DeCodeTime** ( **Time**, Hh,MM,SS,MS);

**WriteIn** ( ' 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` (315) or `FindFirst` (322)/`FindNext` (323) functions to `TDateTime` form.

Errors: None.

See also: `DateTimeToFileDate` (295)

**Program** Example13;

*{ This program demonstrates the FileDateToDateTime function }*

**Uses** sysutils;

**Var**

  ThisAge : Longint;

**Begin**

**Write** ( ' ex13.pp\_ created \_on\_:' );

  ThisAge:=**FileAge**( ' ex13.pp ');

**WriteIn** ( **DateToStr**( **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 293.

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

See also: DateTimeToStr (295), DateToStr (297), TimeToStr (307), StrToDateTime (304)

**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\_MMLYYYY' , 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 (294), Time (306), Now (303)

**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 (301), Date (294)

```
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 (307), DateTimeToTimeStamp (297),

```
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 (294), Time (306)

```

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 (305), DateToStr (297) and TimeToStr (307).

```

Program Example19;

{ This program demonstrates the StrToDate function }

Uses sysutils;

Procedure TestStr (S : String);

begin
  WriteLn (S, '␣:␣', DateToStr(StrToDate(S)));
end;

Begin

  WriteLn (' ShortDateFormat ␣', ShortDateFormat);
  TestStr (DateTimeToStr(Date));
  TestStr ('05/05/1999');
  TestStr ('5/5');
  TestStr ('5');
End.

```

### StrToDateTime

Declaration: `Function StrToDateTime(const S: string): TDateTime;`

Description: `StrToDateTime` converts the string `S` to a `TDateTime` date and time value. The Date must consist of 1 to three digits, separated by the `DateSeparator` character. If two numbers are given, they are supposed to form the day and month of the current year. If only one number is given, it is supposed to represent the day of the current month. (This is *not supported in Delphi*)

*The order of the digits (y/m/d, m/d/y, d/m/y) is determined from the ShortDateFormat variable.*

*Errors: On error (e.g. an invalid date or invalid character), an `EConvertError` exception is raised.*

See also: `StrToDate` (303), `StrToTime` (305), `DateTimeToStr` (295)

```

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 (303), StrToDateTime (304), TimeToStr (307)

**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 ( '3:30 PM' );
```

**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 (296)

**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 to: ', 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 (303), Date (294)

```
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 (297).

Errors: None.

See also: DateTimeToTimeStamp (297), TimeStampToMSecs (307)

```
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 (302), TimeStampToDateTime (306)

For an example, see MSecsToTimeStamp (302).

### TimeToStr

Declaration: Function TimeToStr(Time: TDateTime): string;

Description: TimeToStr converts the time in Time to a string. It uses the ShortTimeFormat variable to see what formatting needs to be applied. It is therefore entirely equivalent to a FormatDateTime('t',Time) call.

Errors: None.

See also:

```

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 (36) and DiskSize (37) 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` (308), `DiskSize` (309)

## 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` (310)

**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:

**0**for the current drive.  
**1**for the first floppy drive.  
**2**for the second floppy drive.  
**3**for the first hard-disk parttion.  
**4-26**for all other drives and partitions.

*Remark* Under LINUX, and Unix in general, the concept of disk is different than the DOS one, since the filesystem is seen as one big directory tree. For this reason, the `DiskFree` and `DiskSize` (37) functions must be mimicked using filenames that reside on the partitions. For more information, see `AddDisk` (307)

Errors: On error, -1 is returned.

See also: `DiskSize` (309), `AddDisk` (307)

**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:

**0**for the current drive.  
**1**for the first floppy drive.  
**2**for the second floppy drive.  
**3**for the first hard-disk parttion.  
**4-26**for all other drives and partitions.

*Remark* Under LINUX, and Unix in general, the concept of disk is different than the DOS one, since the filesystem is seen as one big directory tree. For this reason, the `DiskFree` (36) and `DiskSize` functions must be mimicked using filenames that reside on the partitions. For more information, see `AddDisk` (307)

Errors: On error, -1 is returned.

See also: `DiskFree` (308), `AddDisk` (307)

For an example, see `DiskFree` (308).

### GetCurrentDir

Declaration: `Function GetCurrentDir : String;`

Description: `GetCurrentDir` returns the current working directory.

Errors: None.

See also: `SetCurrentDir` (310), `DiskFree` (36), `DiskSize` (37)

**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` (308).

### 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` (310)

**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` (314), `ExtractFilePath` (314), `ExpandFileName` (312)

### 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` (316), `FileExists` (317)

**Program** Example31;

```
{ This program demonstrates the DeleteFile function }
```

**Uses** sysutils;

**Var**

```
Line : String;  
F, l : Longint;
```

**Begin**

```
F:=FileCreate('test.txt');  
Line:='Some_string_line.' #10;  
For l:=1 to 10 do  
    FileWrite (F, Line[l], 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` (314), `ExtractFilePath` (314)

**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\fp' );

**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 (314), ExtractFilePath (314), ExtractFileDir (313), ExtractFileDrive (313), ExtractFileExt (314), ExtractRelativePath (315)

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

Errors:

See also: `ExtractFileName` (314), `ExtractFilePath` (314), `ExtractFileDir` (313), `ExtractFileDrive` (313), `ExtractFileExt` (314), `ExtractRelativePath` (315)

## 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` (314).

Errors: None.

See also: `ExtractFileName` (314), `ExtractFilePath` (314), `ExtractFileDir` (313), `ExtractFileDrive` (313), `ExtractFileExt` (314), `ExtractRelativePath` (315)

### 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/mysqld');
  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 \(314\)](#), [ExtractFilePath \(314\)](#), [ExtractFileDir \(313\)](#), [ExtractFileDrive \(313\)](#), [ExtractFileExt \(314\)](#), [ExtractRelativePath \(315\)](#)

For an example, see [ExtractFileDir \(313\)](#).

### **ExtractFileExt**

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

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

Errors: None.

See also: [ExtractFileName \(314\)](#), [ExtractFilePath \(314\)](#), [ExtractFileDir \(313\)](#), [ExtractFileDrive \(313\)](#), [ExtractFileExt \(314\)](#), [ExtractRelativePath \(315\)](#)

For an example, see [ExtractFileDir \(313\)](#).

### **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 (314)` and `ExtractFileName`.

Errors: None.

See also: [ExtractFileName \(314\)](#), [ExtractFilePath \(314\)](#), [ExtractFileDir \(313\)](#), [ExtractFileDrive \(313\)](#), [ExtractFileExt \(314\)](#), [ExtractRelativePath \(315\)](#)

For an example, see [ExtractFileDir \(313\)](#).

### **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 (314)`.

Errors: None.

See also: [ExtractFileName \(314\)](#), [ExtractFilePath \(314\)](#), [ExtractFileDir \(313\)](#), [ExtractFileDrive \(313\)](#), [ExtractFileExt \(314\)](#), [ExtractRelativePath \(315\)](#)

For an example, see [ExtractFileDir \(313\)](#).

**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` (314), `ExtractFilePath` (314), `ExtractFileDir` (313), `ExtractFileDrive` (313), `ExtractFileExt` (314),

**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` (300) function.

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

See also: `FileDateToDateTime` (300), `FileExists` (317), `FileGetAttr` (317)

**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 ( ' l ' 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 (316), FileWrite (322), FileOpen (319), FileRead (319), FileTruncate (321), FileSeek (320)

For an example, see FileCreate (316)

### 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 (319) and FileWrite (322) 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 (316), FileWrite (322), FileOpen (319), FileRead (319), FileTruncate (321), FileSeek (320)

**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 );
I:=50*SizeOf( Longint );
If FileTruncate ( F, I ) then
    Writeln ( ' Successfully truncated file to ', I, ' 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 (315), FileGetAttr (317), FileSetAttr (321)

```

Program Example38;

{ This program demonstrates the FileExists function }

Uses sysutils;

Begin
    If FileExists ( ParamStr(0) ) Then
        Writeln ( ' All is well, it 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:

**faReadOnly**The file is read-only.

**faHidden**The file is hidden. (On LINUX, this means that the filename starts with a dot)

**faSysFile**The file is a system file (On LINUX, this means that the file is a character, block or FIFO file).

**faVolumeId**Volume Label. Not possible under LINUX.

**faDirectory**File is a directory.

**faArchive**file is an archive. Not possible on LINUX.

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

See also: FileSetAttr (321), FileAge (315), FileGetDate (318).

```

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 faVolumID)<>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 (315), 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 (315)

```

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:

**fmOpenRead**The file is opened for reading.

**fmOpenWrite**The file is opened for writing.

**fmOpenReadWrite**The 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 (319) 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 (316) function.

Errors: On Error, -1 is returned.

See also: FileClose (316), FileWrite (322), FileCreate (316), FileRead (319), FileTruncate (321), FileSeek (320)

For an example, see FileRead (319)

## 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 (319) call.

Errors: On error, -1 is returned.

See also: FileClose (316), FileWrite (322), FileCreate (316), FileOpen (319), FileTruncate (321), FileSeek (320)

For an example, see FileOpen (319)

## 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 (312), FindFirst (322)

**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:

**fsFromBeginningOffset** is relative to the first byte of the file. This position is zero-based. i.e. the first byte is at offset 0.

**fsFromCurrentOffset** is relative to the current position.

**fsFromEndOffset** 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 (316), FileWrite (322), FileCreate (316), FileOpen (319) FileRead (319), FileTruncate (321)

**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 (316)

### 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 (317), FileGetDate (318), FileSetDate (321).

### 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 successfull.

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 (316), FileWrite (322), FileCreate (316), FileOpen (319) FileRead (319), FileSeek (320)

For an example, see FileCreate (316).

## 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` (316), `FileCreate` (316), `FileOpen` (319) `FileRead` (319), `FileTruncate` (321), `FileSeek` (320)

For an example, see `FileCreate` (316).

## FindClose

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

Description: `FindClose` ends a series of `FindFirst` (322)/`FindNext` (323) 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` (322), `FindNext` (323).

For an example, see `FindFirst` (322).

## 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` (322) 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` (40)`FindCloseSys`, `FindNext` (323).

**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 (322), FindClose (40)

For an example, see FindFirst (322)

### 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 (315)

**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 (311)

**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 (312), ExtractFilePath (314), ExtractFileDir (313)

**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 (279) : Concatenates two PChar strings.
2. StrComp (280) : Compares two PChar strings.
3. StrCopy (280) : Copies a PChar string.
4. StrECopy (281) : Copies a PChar string and returns a pointer to the terminating null byte.
5. StrEnd (282) : Returns a pointer to the terminating null byte.
6. StrlComp (282) : Case insensitive compare of 2 PChar strings.
7. StrLCat (283) : Appends at most L characters from one PChar to another PChar.
8. StrLComp (283) : Case sensitive compare of at most L characters of 2 PChar strings.
9. StrLCopy (284) : Copies at most L characters from one PChar to another.
10. StrLen (284) : Returns the length (exclusive terminating null byte) of a PChar string.
11. StrLIComp (285) : Case insensitive compare of at most L characters of 2 PChar strings.
12. StrLower (285) : Converts a PChar to all lowercase letters.
13. StrMove (286) : Moves one PChar to another.
14. StrNew (286) : Makes a copy of a PChar on the heap, and returns a pointer to this copy.
15. StrPos (288) : Returns the position of one PChar string in another?
16. StrRScan (288) : returns a pointer to the last occurrence of on PChar string in another one.

17. `StrScan` (288) : returns a pointer to the first occurrence of on `PChar` string in another one.
18. `StrUpper` (289) : 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` (279) function of the `Strings` unit.

Errors: None.

See also: `StrBufSize` (326), `StrDispose` (327), `StrAlloc` (279)

For an example, see `StrBufSize` (326).

### **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` (326).

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

See also: `StrAlloc` (326).`StrDispose` (327).

**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 (326) 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 (326), StrAlloc (326), StrDispose (281)

For an example, see StrBufSize (326).

## 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 (327), StrPCopy (287)

For an example, see StrPCopy (287).

## 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 (327).

## 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 (287).

For an example, see StrPas (287).

## 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 (328), AnsiCompareText (329)

**Program** Example48;

*{ This program demonstrates the AdjustLineBreaks function }*

**Uses** sysutils;

**Const**

S = 'This is a string ' #13' with embedded ' #10' linefeed and '+  
#13' CR characters ';

**Begin**

Writeln ( AdjustLineBreaks (S));

**End.**

### AnsiCompareStr

Declaration: Function AnsiCompareStr(const S1, S2: string): integer;

Description: AnsiCompareStr compares two strings and returns the following result:

0if S1<S2.

0if S1=S2.

0if S1>S2.

the comparison takes into account Ansi characters, i.e. it takes care of strange accented characters. Contrary to AnsiCompareText (329), the comparison is case sensitive.

Errors: None.

See also: AdjustLineBreaks (328), AnsiCompareText (329)

**Program** Example49;

*{ This program demonstrates the AnsiCompareStr function }*  
*{ \$H+ }*

**Uses** sysutils;

**Procedure** TestIt ( S1, S2 : **String** );

```

Var R : Longint;

begin
  R:=AnsiCompareStr(S1,S2);
  Write ( '',S1, ' is ');
  If R<0 then
    write ( 'less than ');
  else If R=0 then
    Write ( 'equal to ');
  else
    Write ( 'larger than ');
  Writeln ( '',S2, '' );
end;

Begin
  Testit ( 'One_string', 'One_smaller_string' );
  Testit ( 'One_string', 'one_string' );
  Testit ( 'One_string', 'One_string' );
  Testit ( 'One_string', 'One_tall_string' );
End.

```

### AnsiCompareText

Declaration: Function AnsiCompareText(const S1, S2: string): integer;

Description:

Description: AnsiCompareText compares two strings and returns the following result:

```

;0if S1<S2.
0if S1=S2.
;0if S1>S2.

```

the comparison takes into account Ansi characters, i.e. it takes care of strange accented characters. Contrary to AnsiCompareStr (328), the comparison is case insensitive.

Errors: None.

See also: AdjustLineBreaks (328), AnsiCompareText (329)

**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 (331).

Errors: None.

See also: AnsiQuotedStr (331)

```

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 (333)

**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` (337), `AnsiStrLower` (336), `AnsiStrUpper` (336)

**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` (330).

Errors: None.

See also: [AnsiExtractQuotedStr \(330\)](#)

For an example, see [AnsiExtractQuotedStr \(330\)](#)

## 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 \(329\)](#), [AnsiCompareStr \(328\)](#)

**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.**

**AnsiStrlComp**

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

Description: AnsiStrlComp 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 (329), AnsiCompareStr (328)

**Program** Example55;

```
{ This program demonstrates the AnsiStrlComp function }
```

**Uses** sysutils;

**Procedure** TestIt (S1, S2 : Pchar);

**Var** R : Longint;

**begin**

```

R:=AnsiStrlComp(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;

Description: 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 (330)

**Program** Example58;

{ *This program demonstrates the AnsiStrLastChar function* }

**Uses** sysutils;

**Var** P : Pchar;  
L : Longint;

**Begin**

```
P:= ' This is an PChar string . ' ;  
WriteLn ( ' Last character of P is : ', AnsiStrLastChar (P));  
L:= Longint ( AnsiStrLastChar (P)) - Longint (P) + 1;  
WriteLn ( ' Length of P (', P, ') is : ', L);
```

**End.**

### AnsiStrLComp

Declaration: Function AnsiStrLComp(S1, S2: PChar; MaxLen: cardinal): integer;

Description: AnsiStrLComp compares the first MaxLen characters of 2 PChar strings, S1 and S2, and returns the following result:

```
!0if S1<S2.  
0if S1=S2.  
!0if S1>S2.
```

The comparison of the two strings is case-sensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: AnsiCompareText (329), AnsiCompareStr (328)

**Program** Example56;

{ *This program demonstrates the AnsiStrLComp function* }

**Uses** sysutils;

**Procedure** TestIt (S1, S2 : Pchar; L : longint);

**Var** R : Longint;

**begin**

```
R:=AnsiStrLComp (S1, S2, L);  
Write ( ' First ', L, ' characters of "', S1, '" are ');  
If R<0 then  
  write ( ' less than ')  
else If R=0 then  
  Write ( ' equal to ')  
else  
  Write ( ' larger than ');  
WriteLn ( ' those of "', S2, '"');
```

```
end;
```

```
Begin
```

```
  Testit ('One_string', 'One_smaller_string', 255);  
  Testit ('One_string', 'One_String', 4);  
  Testit ('One_string', '1_string', 0);  
  Testit ('One_string', 'One_string.', 9);
```

```
End.
```

### **AnsiStrLIComp**

Declaration: Function AnsiStrLIComp(S1, S2: PChar; MaxLen: cardinal): integer;

Description: AnsiStrLIComp compares the first Maxlen characters of 2 PChar strings, S1 and S2, and returns the following result:

```
;  
;0if S1<S2.  
0if S1=S2.  
;  
;0if S1>S2.
```

The comparison of the two strings is case-insensitive. The function does not yet take internationalization settings into account.

Errors: None.

See also: AnsiCompareText (329), AnsiCompareStr (328)

```
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` (331). 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` (336), `AnsiLowerCase` (331)

**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` (337). 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` (337), `AnsiStrLower` (336), `AnsiLowerCase` (331)

**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` (336), `AnsiStrLower` (336), `AnsiLowerCase` (331)

**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` (338), `NewStr` (206), `DisposeStr` (207)

**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 (206), AppendStr (337), DisposeStr (207)

**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 (356), IntToStr (352)

**Program** Example64 ;

```
{ This program demonstrates the BCDToInt function }
```

**Uses** sysutils ;

```
Procedure Testit ( L : longint );  
begin  
  WriteLn ( L, 'L->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:

**;**0if at some position the byte at P1 is less than the byte at the same position at P2.

**0**if all L bytes are the same.

**3**

Errors:

See also:

## CompareStr

Declaration: Function CompareStr(const S1, S2: string): Integer;

Description: CompareStr compares two strings, S1 and S2, and returns the following result:

**;**0if S1<S2.

**0**if 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 (329), AnsiCompareStr (328), CompareText (340)

**Program** Example65 ;

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

```
Uses sysutils ;

Procedure TestIt ( S1,S2 : String );

Var R : Longint ;

begin
  R:=CompareStr(S1,S2);
  Write ( '' ,S1, '' is ');
  If R<0 then
    write ( 'less than ')
  else If R=0 then
    Write ( 'equal to ')
  else
    Write ( 'larger than ');
  Writeln ( '' ,S2, '' );
end;

Begin
  Testit ( 'One_string ', 'One_smaller_string ');
  Testit ( 'One_string ', 'one_string ');
  Testit ( 'One_string ', 'One_string ');
  Testit ( 'One_string ', 'One_tall_string ');
End.
```

### CompareText

Declaration: Function CompareText(const S1, S2: string): integer;

Description: CompareText compares two strings, S1 and S2, and returns the following result:

```
¡0if S1<S2.
0if S1=S2.
¡0if S1>S2.
```

The comparison of the two strings is case-insensitive. The function does not take internationalization settings into account, it simply compares ASCII values.

Errors: None.

See also: AnsiCompareText (329), AnsiCompareStr (328), CompareStr (339)

**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 \(206\)](#), [AppendStr \(337\)](#), [AssignStr \(338\)](#)

For an example, see [DisposeStr \(207\)](#).

## 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 \(342\)](#)) **FloatToStr** is completely equivalent to a **FloatToStrF(Value, ffGeneral, 15, 0)**; call.

Errors: None.

See also: [FloatToStrF \(342\)](#)

**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 resulting string.

Errors: None.

See also: `FloatToStr` (341), `FloatToText` (344)

**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 (342). 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 (341), FloatToStrF (342)

**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` (345) with `Fmt` and `Args` as arguments, and stores the result in `Res`. For more information on how the resulting string is composed, see `Format` (345).

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

See also: `Format` (345), `FormatBuf` (351).

```

Program Example70;

{ This program demonstrates the FmtStr function }

Uses sysutils;

Var S : AnsiString;

Begin
    S:= '';
    FmtStr ( S, 'For some nice examples of formatting see %s.', [ 'Format' ] );
    Writeln ( S );
End.

```

## Format

Declaration: Function `Format`(Const `Fmt` : String; const `Args` : Array of const) : String;

Description: `Format` replaces all placeholders in `Fmt` with the arguments passed in `Args` and returns the resulting string. A placeholder looks as follows:

```
'%' [Index':'] ['-'] [Width] ['.' Precision] ArgType
```

elements between single quotes must be typed as shown without the quotes, and elements between square brackets [ ] are optional. The meaning of the different elements is shown below:

'%' starts the placeholder. If you want to insert a literal % character, then you must insert two of them : %%.

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

'-' tells `Format` to left-align the inserted text. The default behaviour is to right-align inserted text. This can only take effect if the `Width` element is also specified.

**Width** the inserted string must have at least have `Width` characters. If not, the inserted string will be padded with spaces. By default, the string is left-padded, resulting in a right-aligned string. This behaviour can be changed by the '-' character.

**'.** **Precision** Indicates the precision to be used when converting the argument. The exact meaning of this parameter depends on **ArgType**.

The **Index**, **Width** and **Precision** parameters can be replaced by **\***, in which case their value will be read from the next element in the **Args** array. This value must be an integer, or an **EConvertError** exception will be raised.

The argument type is determined from **ArgType**. It can have one of the following values (case insensitive):

**D** Decimal format. The next argument in the **Args** array should be an integer. The argument is converted to a decimal string,. If precision is specified, then the string will have at least **Precision** digits in it. If needed, the string is (left) padded with zeroes.

**E** Scientific format. The next argument in the **Args** array should be a Floating point value. The argument is converted to a decimal string using scientific notation, using **FloatToStrF** (342), where the optional precision is used to specify the total number of decimals. (default a value of 15 is used). The exponent is formatted using maximally 3 digits.

In short, the **E** specifier formats it's argument as follows:

```
FloatToStrF(Argument,ffexponent,Precision,3)
```

**F** Fixed point format. The next argument in the **Args** array should be a floating point value. The argument is converted to a decimal string, using fixed notation (see **FloatToStrF** (342)). **Precision** indicates the number of digits following the decimal point.

In short, the **F** specifier formats it's argument as follows:

```
FloatToStrF(Argument,ffFixed,ffixed,9999,Precision)
```

**G** General number format. The next argument in the **Args** array should be a floating point value. The argument is converted to a decimal string using fixed point notation or scientific notation, depending on which gives the shortest result. **Precision** is used to determine the number of digits after the decimal point.

In short, the **G** specifier formats it's argument as follows:

```
FloatToStrF(Argument,ffGeneral,Precision,3)
```

**M** Currency format. the next argument in the **varArgs** array must be a floating point value. The argument is converted to a decimal string using currency notation. This means that fixed-point notation is used, but that the currency symbol is appended. If precision is specified, then then it overrides the **CurrencyDecimals** global variable used in the **FloatToStrF** (342)

In short, the **M** specifier formats it's 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.

**X**hexadecimal 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` (351)

**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 ( ffmt:12, '=>', s);
    ffmt:= '[%0:s]'; s:=Format(fmt,[ ' This is a string ' ]); Writeln ( ffmt:12, '=>', s);
    ffmt:= '[%0:18s]'; s:=Format(fmt,[ ' This is a string ' ]); Writeln ( ffmt:12, '=>', s);
    ffmt:= '[%0:-18s]'; s:=Format(fmt,[ ' This is a string ' ]); Writeln ( ffmt:12, '=>', s);
    ffmt:= '[%0:18.12s]'; s:=Format(fmt,[ ' This is a string ' ]); Writeln ( ffmt:12, '=>', s);
    ffmt:= '[%-*.s]'; s:=Format(fmt,[18,12, ' This is a string ' ]); Writeln ( ffmt:12, '=>', s);
  except
    On E : Exception do
      begin

```

```

        Writeln ( ' Exception _caught _:_', E. Message );
    end;
end;
writeln ( ' Press _enter ' );
readln ;
end;

Procedure TestExponential ;

begin
    Try
        Fmt:= '[% e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%10 e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%10.4 e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0: e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:10 e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:10.4 e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:-10 e]'; S:=Format ( Fmt, [1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:-10.4 e]'; 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:= '[%10 e]'; S:=Format ( Fmt, [-1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%10.4 e]'; S:=Format ( Fmt, [-1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0: e]'; S:=Format ( Fmt, [-1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:10 e]'; S:=Format ( Fmt, [-1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:10.4 e]'; S:=Format ( Fmt, [-1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:-10 e]'; S:=Format ( Fmt, [-1.234]); writeln ( Fmt:12, '_=>_', s );
        Fmt:= '[%0:-10.4 e]'; 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 formatting 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 (352), 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` (351), `StrToInt` (356)

```
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 (355), TrimLeft (358), TrimRight (358), Trim (357)

**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 (331), UpperCase (359), AnsiUpperCase (337)

**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** (338), **DisposeStr** (341)

For an example, see **AssignStr** (338).

### 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** (331), **AnsiExtractQuotedStr** (330).

**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 (353), Trim (357), TrimLeft (358), TrimRight (358)

**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 (345) 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 (345).

See also: StrLFmt (355), FmtStr (345), Format (345), FormatBuf (351)

**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 formatting 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` (345) 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` (345).

See also: `StrFmt` (355), `FmtStr` (345), `Format` (345), `FormatBuf` (351)

**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 formatting see %s.', [ 'Format' ] ));
```

**End.**

## StrToInt

Declaration: Function `StrToInt(const s: string): integer;`

Description: `StrToInt` will convert the string `S` to 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` (352), `StrToIntDef` (357)

**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` (352), `StrToInt` (356)

**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` (358), `TrimRight` (358)

**Program** Example84;

```
{ This program demonstrates the Trim function }
```

**Uses** sysutils;

```
{ $H+ }
```

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

**begin**

```
  Writeln ( '', Trim(S), '' );
```

**end;**



```
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` (331), `LowerCase` (353), `AnsiUpperCase` (337)

Errors:

See also:

```
Program Example87 ;

{ This program demonstrates the UpperCase function }

Uses sysutils ;

Begin
  WriteLn ( UpperCase( ' this _ will _ come _ OUT _ ALL _ uPpErCaSe _ ! ' ) );
End.
```

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