Free Pascal
User's Guide

User's Guide for Free Pascal, Version 3.2.2
Document version 3.2.2
May 2024

Michaël Van Canneyt
Florian Klämpfl

Contents

1 Introduction **7**

1.1 About this document . . . 7

1.2 About the compiler . . . 7

1.3 Getting more information. . . . 9

2 Installing the compiler **10**

2.1 Before Installation : Requirements . . . 10

2.1.1 Hardware requirements . . . 10

2.1.2 Software requirements . . . 10

Under DOS . . . 10

Under UNIX . . . 10

Under Windows . . . 11

Under OS/2 . . . 11

Under Mac OS X . . . 11

2.2 Installing the compiler. . . . 11

2.2.1 Installing under Windows . . . 11

2.2.2 Installing under DOS or OS/2 . . . 11

Mandatory installation steps. . . . 11

Optional Installation: The coprocessor emulation . . . 12

2.2.3 Installing under Linux . . . 13

Mandatory installation steps. . . . 13

2.3 Optional configuration steps . . . 14

2.4 Before compiling . . . 14

2.5 Testing the compiler . . . 15

3 Compiler usage **16**

3.1 File searching . . . 16

3.1.1 Command line files . . . 16

3.1.2 Unit files . . . 16

3.1.3 Include files . . . 19

3.1.4 Object files . . . 20

3.1.5 Configuration file . . . 20
3.1.6 About long filenames . . . 21
3.2 Compiling a program . . . 21
3.3 Compiling a unit . . . 22
3.4 Units, libraries and smartlinking . . . 22
3.5 Reducing the size of your program . . . 22

4 Compiling problems **23**
4.1 General problems . . . 23
4.2 Problems you may encounter under DOS . . . 23

5 Compiler configuration **24**
5.1 Using the command line options . . . 24
5.1.1 General options . . . 24
5.1.2 Options for getting feedback . . . 25
5.1.3 Options concerning files and directories . . . 26
5.1.4 Options controlling the kind of output. . . . 27
5.1.5 Options concerning the sources (language options) . . . 33
5.2 Using the configuration file . . . 35
5.2.1 Conditional processing of the config file . . . 36
5.2.2 #CFGDIR . . . 36
5.2.3 #IFDEF . . . 36
5.2.4 #IFNDEF . . . 37
5.2.5 #ELSE . . . 37
5.2.6 #ENDIF . . . 38
5.2.7 #DEFINE . . . 38
5.2.8 #UNDEF . . . 38
5.2.9 #WRITE . . . 38
5.2.10 #INCLUDE . . . 38
5.2.11 #SECTION . . . 39
5.3 Variable substitution in paths . . . 39

6 The IDE **41**
6.1 First steps with the IDE . . . 41
6.1.1 Starting the IDE . . . 41
6.1.2 IDE command line options . . . 41
6.1.3 The IDE screen . . . 42
6.2 Navigating in the IDE . . . 43
6.2.1 Using the keyboard . . . 43
6.2.2 Using the mouse . . . 43
6.2.3 Navigating in dialogs . . . 44

6.3 Windows . . . 44
6.3.1 Window basics . . . 44
6.3.2 Sizing and moving windows . . . 45
6.3.3 Working with multiple windows . . . 46
6.3.4 Dialog windows . . . 46
6.4 The Menu . . . 46
6.4.1 Accessing the menu . . . 46
6.4.2 The File menu . . . 47
6.4.3 The Edit menu . . . 48
6.4.4 The Search menu . . . 49
6.4.5 The Run menu . . . 49
6.4.6 The Compile menu . . . 50
6.4.7 The Debug menu . . . 50
6.4.8 The Tools menu . . . 51
6.4.9 The Options menu . . . 51
6.4.10 The Window menu . . . 52
6.4.11 The Help menu . . . 53
6.5 Editing text . . . 53
6.5.1 Insert modes . . . 53
6.5.2 Blocks . . . 53
6.5.3 Setting bookmarks . . . 54
6.5.4 Jumping to a source line . . . 54
6.5.5 Syntax highlighting . . . 55
6.5.6 Code Completion . . . 55
6.5.7 Code Templates . . . 56
6.6 Searching and replacing . . . 57
6.7 The symbol browser . . . 59
6.8 Running programs . . . 60
6.9 Debugging programs . . . 61
6.9.1 Using breakpoints . . . 61
6.9.2 Using watches . . . 63
6.9.3 The call stack . . . 64
6.9.4 The GDB window . . . 64
6.10 Using Tools . . . 65
6.10.1 The messages window . . . 65
6.10.2 Grep . . . 66
6.10.3 The ASCII table . . . 66
6.10.4 The calculator . . . 67
6.10.5 Adding new tools . . . 69
6.10.6 Meta parameters . . . 69

6.10.7 Building a command line dialog box . . . 71
6.11 Project management and compiler options . . . 73
6.11.1 The primary file . . . 73
6.11.2 The directory dialog . . . 74
6.11.3 The target operating system . . . 74
6.11.4 Compiler options . . . 75
6.11.5 Linker options . . . 80
6.11.6 Memory sizes . . . 81
6.11.7 Debug options . . . 82
6.11.8 The switches mode . . . 83
6.12 Customizing the IDE . . . 83
6.12.1 Preferences . . . 84
6.12.2 The desktop . . . 85
6.12.3 The Editor . . . 86
6.12.4 Keyboard & Mouse . . . 88
6.13 The help system . . . 89
6.13.1 Navigating in the help system . . . 89
6.13.2 Working with help files . . . 89
6.13.3 The about dialog . . . 90
6.14 Keyboard shortcuts . . . 91

7 Porting and portable code **95**
7.1 Free Pascal compiler modes . . . 95
7.2 Turbo Pascal . . . 96
7.2.1 Things that will not work . . . 96
7.2.2 Things which are extra . . . 98
7.2.3 Turbo Pascal compatibility mode . . . 99
7.2.4 A note on long file names under DOS . . . 101
7.3 Porting Delphi code . . . 101
7.3.1 Missing language constructs . . . 101
7.3.2 Missing calls / API incompatibilities . . . 102
7.3.3 Delphi compatibility mode . . . 103
7.3.4 Best practices for porting . . . 103
7.4 Writing portable code . . . 104

8 Utilities that come with Free Pascal **106**
8.1 Demo programs and examples . . . 106
8.2 fpcmake . . . 106
8.3 fpdoc - Pascal Unit documenter . . . 106
8.4 h2pas - C header to Pascal Unit converter . . . 107
8.4.1 Options . . . 107

8.4.2 Constructs . . . 107
8.5 h2paspp - preprocessor for h2pas . . . 109
8.5.1 Usage . . . 109
8.5.2 Options . . . 109
8.6 ppudump program . . . 109
8.7 ppumove program . . . 110
8.8 ptop - Pascal source beautifier . . . 111
8.8.1 ptop program . . . 111
8.8.2 The ptop configuration file . . . 112
8.8.3 ptopu unit . . . 114
8.9 rstconv program . . . 115
8.10 unitdiff program . . . 115
8.10.1 Synopsis . . . 115
8.10.2 Description and usage . . . 115
8.10.3 Options . . . 115

9 Units that come with Free Pascal 117
9.1 Standard units . . . 117
9.2 Under DOS . . . 118
9.3 Under Windows . . . 119
9.4 Under Linux and BSD-like platforms . . . 119
9.5 Under OS/2 . . . 120
9.6 Unit availability . . . 120

10 Debugging your programs 121
10.1 Compiling your program with debugger support . . . 121
10.2 Using gdb to debug your program . . . 122
10.3 Caveats when debugging with gdb . . . 123
10.4 Support for gprof, the GNU profiler . . . 124
10.5 Detecting heap memory leaks . . . 124
10.6 Line numbers in run-time error backtraces . . . 125
10.7 Combining heaptrc and lineinfo . . . 126

A Alphabetical listing of command line options 127

B Alphabetical list of reserved words 133

C Compiler messages 134
C.1 General compiler messages . . . 134
C.2 Scanner messages. . . . 136
C.3 Parser messages . . . 142
C.4 Type checking errors . . . 167

C.5 Symbol handling . . . 177
C.6 Code generator messages . . . 183
C.7 Errors of assembling/linking stage . . . 187
C.8 Executable information messages. . . . 189
C.9 Linker messages . . . 189
C.10 Unit loading messages. . . . 191
C.11 Command line handling errors . . . 195
C.12 Whole program optimization messages . . . 198
C.13 Package loading messages. . . . 200
C.14 Assembler reader errors. . . . 202
C.14.1 General assembler errors . . . 202
C.14.2 I386 specific errors . . . 205
C.14.3 m68k specific errors. . . . 207

D Run-time errors **208**

E A sample gdb.ini file **212**

F Options and settings **213**

G Getting the latest sources or installers **215**
G.1 Download via Subversion . . . 215
G.2 Downloading a source zip . . . 216
G.3 Downloading a snapshot . . . 216

Chapter 1

Introduction

1.1 About this document

This is the user's guide for Free Pascal. It describes the installation and use of the Free Pascal compiler on the different supported platforms. It does not attempt to give an exhaustive list of all supported commands, nor a definition of the Pascal language. Look at the Reference Guide for these things. For a description of the possibilities and the inner workings of the compiler, see the Programmer's Guide. In the appendices of this document you will find lists of reserved words and compiler error messages (with descriptions).

This document describes the compiler as it is/functions at the time of writing. First consult the README and FAQ files, distributed with the compiler. The README and FAQ files are, in case of conflict with this manual, authoritative.

1.2 About the compiler

Free Pascal is a 32- and 64-bit Pascal compiler. The current version (3.2.2) can compile code for the following processors (the list is not exhaustive):

- Intel i386 and higher (i486, Pentium family and higher)
- AMD64/x86_64
- PowerPC
- PowerPC64
- SPARC
- ARM
- The m68K processor is supported by an older version.
- JVM
- Javascript
- aarch64
- Intel 8086.

The compiler and Run-Time Library are available for the following operating systems:

- DOS
- LINUX
- AMIGA (version 0.99.5 only)
- WINDOWS
- Mac OS X and iOS.
- OS/2 (optionally using the EMX package, so it also works on DOS/Windows)
- FREEBSD
- BEOS
- SOLARIS
- NETBSD
- NETWARE
- OPENBSD
- MorphOS
- Symbian

The complete list is at all times available on the Free Pascal website.

Free Pascal is designed to be, as much as possible, language and source-level compatible with ISO pascal, Mac Pascal, Turbo Pascal 7.0 and most (if not all) versions of Delphi. It achieves this through a system of compiler directives which tell the compiler what language is targeted (they can be mixed to a certain degree).

It also differs from them in the sense that you cannot use compiled units from one system for the other, i.e. you cannot use TP compiled units.

Also, there is a text version of an Integrated Development Environment (IDE) available for Free Pascal. Users that prefer a graphical IDE can have a look at the Lazarus[1] or MSEIDE[2] projects.

Free Pascal consists of several parts :

1. The compiler program itself.
2. The Run-Time Library (RTL).
3. The packages. This is a collection of many utility units, ranging from the whole Windows 32 API, through native ZIP/BZIP file handling to the whole GTK-2 interface.
4. The Free Component Library. This is a set of class-based utility units which give a database framework, image support, web support, XML support and many many more.
5. Utility programs and units.

Of these you only need the first two, in order to be able to use the compiler. In this document, we describe the use of the compiler and utilities. The supported (Object) Pascal Language constructs are described in the Reference Guide, and the available routines (units) are described in the RTL and FCL Unit reference guides.

[1] Lazarus homepage at http://http://www.lazarus-ide.org/
[2] MSEIDE+MSEGUI homepage at http://www.msegui.org/

1.3 Getting more information.

If the documentation doesn't give an answer to your questions, you can obtain more information on the Internet, at the following addresses:

- http://www.freepascal.org/ is the main site. It contains also useful mail addresses and links to other places. It also contains the instructions for subscribing to the *mailing list*.
- http://forum.lazarus.freepascal.org/ is a forum site where questions can be posted.

Other than that, some mirrors exist.

Finally, if you think something should be added to this manual (entirely possible), please do not hesitate and contact me at michael@freepascal.org. .

Let's get on with something useful.

Chapter 2

Installing the compiler

2.1 Before Installation : Requirements

2.1.1 Hardware requirements

The compiler needs at least one of the following processors:

1. An Intel 80386 or higher processor. A coprocessor is not required, although it will slow down your program's performance if you do floating point calculations without a coprocessor, since emulation will be used.
2. An AMD64 or EMT64 processor.
3. A PowerPC processor. (32 or 64 bit)
4. A SPARC processor
5. An ARM processor (32 or 64 bit).
6. Older FPC versions exist for the motorola 68000 processor, but these are no longer maintained.

Memory and disk requirements:

The memory and disk requirements vary from platform to platform. One should count in the order of 100 megabytes for a basic installation; 2 Gigabytes should be counted if you want to recompile the compiler and all basic packages.

2.1.2 Software requirements

Under DOS

The DOS distribution contains all the files you need to run the compiler and compile Pascal programs.

Under UNIX

Under UNIX systems (such as LINUX) you need to have the following programs installed :

1. GNU as, the GNU assembler.
2. GNU ld, the GNU linker.
3. Optionally (but highly recommended) : GNU make. For easy recompiling of the compiler and Run-Time Library, this is needed.

Under Windows

The WINDOWS distributions (both 32 and 64 bit) contain all the files you need to run the compiler and compile Pascal programs. However, it may be a good idea to install the mingw32 tools or the `cygwin` development tools. Links to both of these tools can be found on `http://www.freePascal.org`

Under OS/2

While the Free Pascal distribution comes with all necessary tools, it is a good idea to install the EMX extender in order to compile and run programs with the Free Pascal compiler. The EMX extender can be found on:
`ftp://hobbes.nmsu.edu/pub/os2/dev/emx/v0.9d`

Under Mac OS X

Mac OS X 10.1 or higher is required, and the developer tools or XCode must be installed. The installer contains the necessary instructions.

2.2 Installing the compiler.

The installation of Free Pascal is easy, but is platform-dependent. We discuss the process for each platform separately.

2.2.1 Installing under Windows

For WINDOWS, there is a WINDOWS installer, setup.exe. This is a normal installation program, which offers the usual options of selecting a directory, and which parts of the distribution you want to install. It will, optionally, associate the .pp or `.pas` extensions with the text mode IDE.

It is not recommended to install the compiler in a directory which has spaces in its path name. Some of the external tools do not support filenames with spaces in them, and you will have problems creating programs.

2.2.2 Installing under DOS or OS/2

Mandatory installation steps.

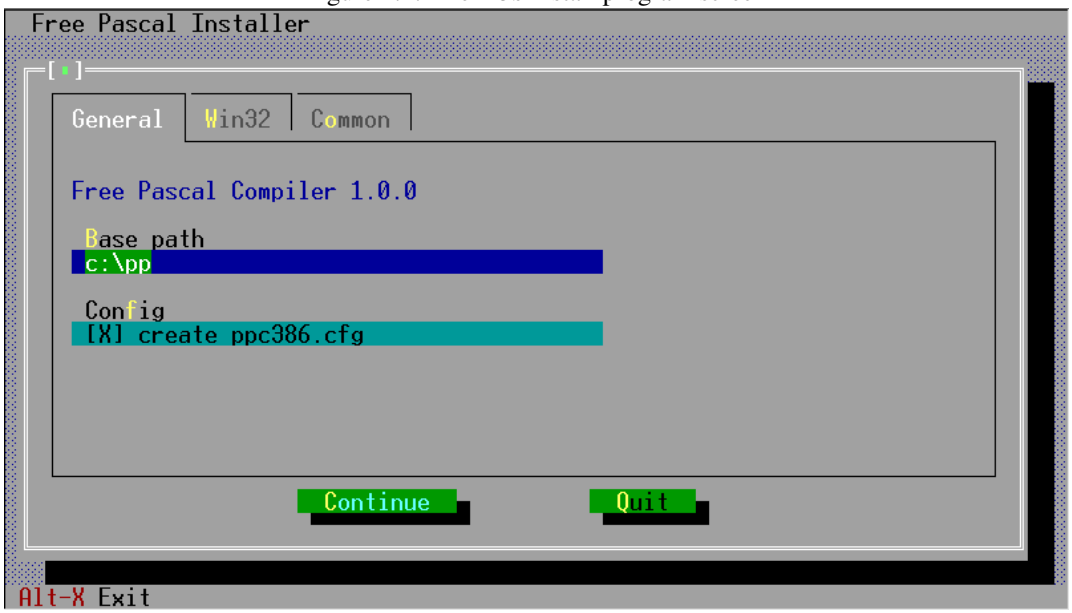
First, you must get the latest distribution files of Free Pascal. They come as zip files, which you must unzip first, or you can download the compiler as a series of separate files. This is especially useful if you have a slow connection, but it is also nice if you want to install only some parts of the compiler distribution. The distribution zip files for DOS or OS/2 contain an installation program INSTALL.EXE. You must run this program to install the compiler.

The screen of the DOS or OS/2 installation program looks like figure 2.1.

The program allows you to select:

- What components you wish to install. e.g do you want the sources or not, do you want docs or not. Items that you didn't download when downloading as separate files, will not be enabled, i.e. you can't select them.
- Where you want to install (the default location is `C:\PP`).

Figure 2.1: The DOS install program screen



In order to run Free Pascal from any directory on your system, you must extend your path variable to contain the `C:\PP\BIN` directory. Usually this is done in the AUTOEXEC.BAT file. It should look something like this :

```
SET PATH=%PATH%;C:\PP\2.6\BIN\i386-DOS
```

for DOS or

```
SET PATH=%PATH%;C:\PP\2.6\BIN\i386-OS2
```

for OS/2. (Again, assuming that you installed in the default location).

On OS/2, Free Pascal installs some libraries from the EMX package if they were not yet installed. (The installer will notify you if they should be installed). They are located in the

```
C:\PP\DLL
```

directory. The name of this directory should be added to the `LIBPATH` directive in the config.sys file:

```
LIBPATH=XXX;C:\PP\DLL
```

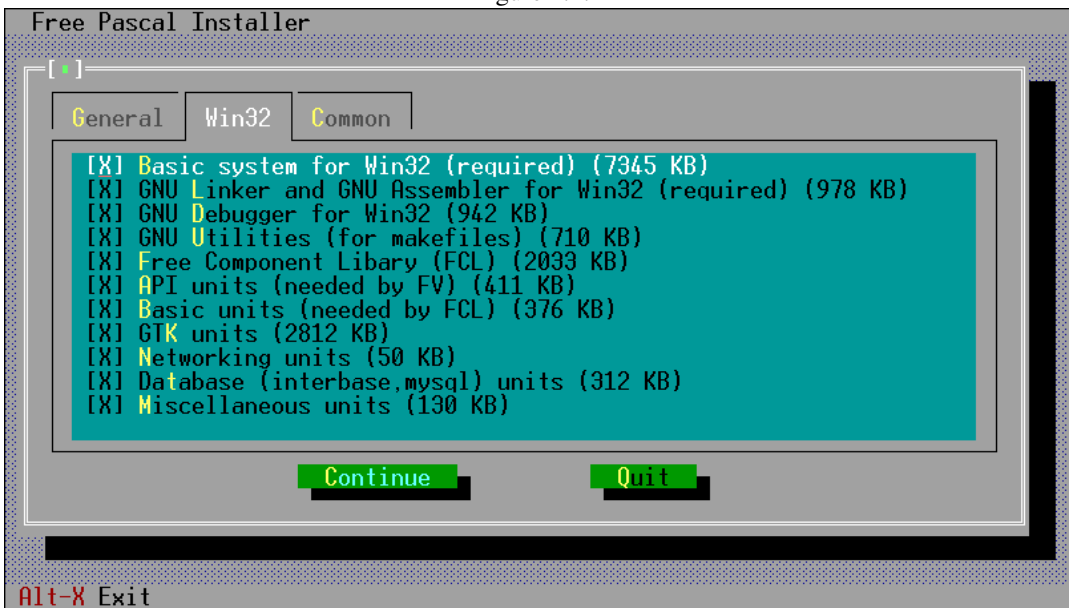
Obviously, any existing directories in the `LIBPATH` directive (indicated by `XXX` in the above example) should be preserved.

Optional Installation: The coprocessor emulation

For people who have an older CPU type, without math coprocessor (i387) it is necessary to install a coprocessor emulation, since Free Pascal uses the coprocessor to do all floating point operations.

The installation of the coprocessor emulation is handled by the installation program (INSTALL.EXE) under DOS and WINDOWS.

Figure 2.2:



2.2.3 Installing under Linux

Mandatory installation steps.

The LINUX distribution of Free Pascal comes in three forms:

- a tar.gz version, also available as separate files.
- a .rpm (Red Hat Package Manager) version, and
- a .deb (Debian) version.

If you use the .rpm format, installation is limited to

```
rpm -i fpc-X.Y.Z-N.ARCH.rpm
```

Where `X.Y.Z` is the version number of the .rpm file, and `ARCH` is one of the supported architectures (i386, x86_64 etc.).

If you use Debian, installation is limited to

```
dpkg -i fpc-XXX.deb
```

Here again, `XXX` is the version number of the .deb file.

You need root access to install these packages. The .tar file allows you to do an installation below your home directory if you don't have root permissions.

When downloading the `.tar` file, or the separate files, installation is more interactive.

In case you downloaded the .tar file, you should first untar the file, in some directory where you have write permission, using the following command:

```
tar -xvf fpc.tar
```

We supposed here that you downloaded the file fpc.tar somewhere from the Internet. (The real filename will have some version number in it, which we omit here for clarity.)

When the file is untarred, you will be left with more archive files, and an install program: an installation shell script.

If you downloaded the files as separate files, you should at least download the install.sh script, and the libraries (in libs.tar.gz).

To install Free Pascal, all that you need to do now is give the following command:

```
./install.sh
```

And then you must answer some questions. They're very simple, they're mainly concerned with 2 things :

1. Places where you can install different things.
2. Deciding if you want to install certain components (such as sources and demo programs).

The script will automatically detect which components are present and can be installed. It will only offer to install what has been found. Because of this feature, you must keep the original names when downloading, since the script expects this.

If you run the installation script as the `root` user, you can just accept all installation defaults. If you don't run as `root`, you must take care to supply the installation program with directory names where you have write permission, as it will attempt to create the directories you specify. In principle, you can install it wherever you want, though.

At the end of installation, the installation program will generate a configuration file (fpc.cfg) for the Free Pascal compiler which reflects the settings that you chose. It will install this file in the /etc directory or in your home directory (with name .fpc.cfg) if you do not have write permission in the /etc directory. It will make a copy in the directory where you installed the libraries.

The compiler will first look for a file .fpc.cfg in your home directory before looking in the /etc directory.

2.3 Optional configuration steps

On any platform, after installing the compiler you may wish to set some environment variables. The Free Pascal compiler recognizes the following variables :

- `PPC_EXEC_PATH` contains the directory where support files for the compiler can be found.
- `PPC_CONFIG_PATH` specifies an alternate path to find the fpc.cfg.
- `PPC_ERROR_FILE` specifies the path and name of the error-definition file.
- `FPCDIR` specifies the root directory of the Free Pascal installation. (e.g : `C:\PP\BIN`)

These locations are, however, set in the sample configuration file which is built at the end of the installation process, except for the `PPC_CONFIG_PATH` variable, which you must set if you didn't install things in the default places.

2.4 Before compiling

Also distributed in Free Pascal is a README file. It contains the latest instructions for installing Free Pascal, and should always be read first.

Furthermore, platform-specific information and common questions are addressed in the FAQ. It should be read before reporting any bug.

2.5 Testing the compiler

After the installation is completed and the optional environment variables are set as described above, your first program can be compiled.

Included in the Free Pascal distribution are some demonstration programs, showing what the compiler can do. You can test if the compiler functions correctly by trying to compile these programs.

The compiler is called

- fpc.exe under WINDOWS, OS/2 and DOS.
- fpc under most other operating systems.

To compile a program (e.g `demo\text\hello.pp`), copy the program to your current working directory, and simply type :

```
fpc hello
```

at the command prompt. If you don't have a configuration file, then you may need to tell the compiler where it can find the units, for instance as follows:

```
fpc -Fuc:\pp\NNN\units\i386-go32v2\rtl hello
```

under DOS, and under LINUX you could type

```
fpc -Fu/usr/lib/fpc/NNN/units/i386-linux/rtl hello
```

(replace NNN with the version number of Free Pascal that you are using). This is, of course, assuming that you installed under `C:\PP` or /usr/lib/fpc/NNN, respectively.

If you got no error messages, the compiler has generated an executable called hello.exe under DOS, OS/2 or WINDOWS, or hello (no extension) under UNIX and most other operating systems.

To execute the program, simply type :

```
hello
```

or

```
./hello
```

on Unices (where the current directory usually is not in the PATH).

If all went well, you should see the following friendly greeting:

```
Hello world
```

Chapter 3

Compiler usage

Here we describe the essentials to compile a program and a unit. For more advanced uses of the compiler, see the section on configuring the compiler, and the Programmer's Guide.

The examples in this section suppose that you have an fpc.cfg which is set up correctly, and which contains at least the path setting for the RTL units. In principle this file is generated by the installation program. You may have to check that it is in the correct place. (see section 5.2 for more information on this.)

3.1 File searching

Before you start compiling a program or a series of units, it is important to know where the compiler looks for its source files and other files. In this section we discuss this, and we indicate how to influence this.

Remark The use of slashes (/) and backslashes (\) as directory separators is irrelevant, the compiler will convert to whatever character is used on the current operating system. Examples will be given using slashes, since this avoids problems on UNIX systems (such as LINUX).

3.1.1 Command line files

The file that you specify on the command line, such as in

```
fpc foo.pp
```

will be looked for ONLY in the current directory. If you specify a directory in the filename, then the compiler will look in that directory:

```
fpc subdir/foo.pp
```

will look for foo.pp in the subdirectory subdir of the current directory.

Under case sensitive file systems (such as LINUX and UNIX), the name of this file is case sensitive; under other operating systems (such as DOS, WINDOWS NT, OS/2) this is not the case.

3.1.2 Unit files

When you compile a unit or program that needs other units, the compiler will look for compiled versions of these units in the following way:

1. It will look in the current directory.
2. It will look in the directory where the source file resides.
3. It will look in the directory where the compiler binary is.
4. It will look in all the directories specified in the unit search path.

You can add a directory to the unit search path with the (`-Fu` (see page 27)) option. Every occurrence of one of these options will *insert* a directory to the unit search path. i.e. the last path on the command line will be searched first.

The compiler adds several paths to the unit search path:

1. The contents of the environment variable `XXUNITS`, where `XX` must be replaced with one of the supported targets: `GO32V2`, `LINUX`,`WIN32`, `OS2`, `BEOS`, `FREEBSD`, `SUNOS`, `DARWIN` (the actual list depends on the available targets).
2. The standard unit directory. This directory is determined from the `FPCDIR` environment variable. If this variable is not set, then it is defaulted to the following:
   - On LINUX:

     ```
     /usr/local/lib/fpc/FPCVERSION
     or
     /usr/lib/fpc/FPCVERSION
     ```

     whichever is found first.
   - On other OSes: the compiler binary directory, with '../' appended to it, if it exists. For instance, on Windows, this would mean

     ```
     C:\FPC\2.6\units\i386-win32
     ```

     This is assuming the compiler was installed in the directory

     ```
     C:\FPC\2.6
     ```

   After this directory is determined, the following paths are added to the search path:

   (a) FPCDIR/units/FPCTARGET
   (b) FPCDIR/units/FPCTARGET/rtl

   Here target must be replaced by the name of the target you are compiling for: this is a combination of CPU and OS, so for instance

   ```
   /usr/local/lib/fpc/2.6/units/i386-linux/
   ```

   or, when cross-compiling

   ```
   /usr/local/lib/fpc/2.6/units/i386-win32/
   ```

The `-Fu` option accepts a single `*` wildcard, which will be replaced by all directories found on that location, but *not* the location itself. For example, given the directories

```
rtl/units/i386-linux
fcl/units/i386-linux
packages/base
packages/extra
```

the command

```
fpc -Fu"*/units/i386-linux"
```

will have the same effect as

```
fpc -Furtl/units/i386-linux -Fufcl/units/i386-linux
```

since both the rtl and fcl directories contain further units/i386-linux subdirectories. The packages directory will not be added, since it doesn't contain a units/i386-linux subdirectory.

The following command

```
fpc -Fu"units/i386-linux/*"
```

will match any directory below the units/i386-linux directory, but will not match the units/i386-linux directory itself, so you should add it manually if you want the compiler to look for files in this directory as well:

```
fpc -Fu"units/i386-linux" -Fu"units/i386-linux/*"
```

Note that (for optimization) the compiler will drop any non-existing paths from the search path, i.e. the existence of the path (after wildcard and environment variable expansion) will be tested.

You can see what paths the compiler will search by giving the compiler the `-vu` option.

Note that unit file paths specified in a config file will be added at the end, while paths specified on the command-line are added at the beginning.

Imagine the following command-line:

```
fpc -n -Fu/home @cfg  -Fu/usr foo.pp
```

Where the file cfg has the following contents:

```
-Fu/etc
```

This will result in the following search path

```
Using unit path: /home/
Using unit path: /usr/
Using unit path: /etc/
Using unit path: /data/FPC/installed/3.1.1/
```

Reverting the order of the files on the command-line :

```
fpc -n -Fu/usr @cfg  -Fu/home foo.pp
```

Results in

```
Using unit path: /usr/
Using unit path: /home/
Using unit path: /etc/
Using unit path: /data/FPC/installed/3.1.1/
```

Moving the position of `@cfg` will not change the path:

```
fpc -n @cfg -Fu/home  -Fu/usr foo.pp
```

Results in

```
Using unit path: /home/
Using unit path: /usr/
Using unit path: /etc/
Using unit path: /data/FPC/installed/3.1.1/
```

On systems where filenames are case sensitive (such as UNIX and LINUX), the compiler will :

1. Search for the original file name, i.e. preserves case.
2. Search for the filename all lowercased.
3. Search for the filename all uppercased.

This is necessary, since Pascal is case-independent, and the statements `Uses Unit1;` or `uses unit1;` should have the same effect.

It will do this first with the extension .ppu (the compiled unit), .pp and then with the extension .pas.

For instance, suppose that the file foo.pp needs the unit bar. Then the command

```
fpc -Fu.. -Fuunits foo.pp
```

will tell the compiler to look for the unit bar in the following places:

1. In the current directory.
2. In the directory where the compiler binary is (not under LINUX).
3. In the parent directory of the current directory.
4. In the subdirectory units of the current directory
5. In the standard unit directory.

Also, unit names that are longer than 8 characters will first be looked for with their full length. If the unit is not found with this name, the name will be truncated to 8 characters, and the compiler will look again in the same directories, but with the truncated name.

If the compiler finds the unit it needs, it will look for the source file of this unit in the same directory where it found the unit. If it finds the source of the unit, then it will compare the file times. If the source file was modified more recent than the unit file, the compiler will attempt to recompile the unit with this source file.

If the compiler doesn't find a compiled version of the unit, or when the `-B` option is specified, then the compiler will look in the same manner for the unit source file, and attempt to recompile it.

It is recommended to set the unit search path in the configuration file fpc.cfg. If you do this, you don't need to specify the unit search path on the command line every time you want to compile something.

3.1.3 Include files

If you include a file in your source with the `{$I filename}` directive, the compiler will look for it in the following places:

1. It will look in the path specified in the include file name.

2. It will look in the directory where the current source file is.
3. it will look in all directories specified in the include file search path.

You can add files to the include file search path with the `-I` (see page 27) or `-Fi` (see page 26) options.

As an example, consider the following include statement in a file units/foo.pp:

```
{$i ../bar.inc}
```

Then the following command :

```
fpc -Iincfiles units/foo.pp
```

will cause the compiler to look in the following directories for bar.inc:

1. The parent directory of the current directory.
2. The units subdirectory of the current directory.
3. The incfiles subdirectory of the current directory.

3.1.4 Object files

When you link to object files (using the `{$L file.o}` directive, the compiler will look for this file in the same way as it looks for include files:

1. It will look in the path specified in the object file name.
2. It will look in the directory where the current source file is.
3. It will look in all directories specified in the object file search path.

You can add files to the object file search path with the `-Fo` (see page 27) option.

3.1.5 Configuration file

Not all options must be given on the compiler command line. The compiler can use a configuration file which can contain the same options as on the command line. There can be only one command-line option on each line in the configuration file.

Unless you specify the `-n` (see page 25) option, the compiler will look for a configuration file fpc.cfg in the following places:

- Under UNIX (such as LINUX)
  1. The current directory.
  2. Your home directory, it looks for .fpc.cfg.
  3. The directory specified in the environment variable `PPC_CONFIG_PATH`.
  4. in the etc directory above the compiler directory.
     For instance, if the compiler is in /usr/local/bin, it will look in /usr/local/etc.
     See below for some additional information about this point.

5. The directory /etc.

- Under all other OSes:

1. The current directory.
2. If it is set, the directory specified in the environment variable `PPC_CONFIG_PATH`.
3. The directory where the compiler is.

Remark Note that the compiler directory is determined by the location of the actual compiler binary. This has 2 consequences:

1. The default installation on unix places this under /usr/local/lib/fpc, or /usr/lib/fpc. It places several symlinks in /usr/local/bin or /usr/bin. These symlinks are not considered when looking for the configuration file(s), so the places to look for the configuration file are /usr/local/lib/fpc/etc, or /usr/lib/fpc/etc.
2. The fpc command is not the actual compiler binary. The fpc command selects the actual compiler binary based on e.g. the CPU target. The actual compiler binary is called ppcXYZ.
3. The actual installation directory may vary: /usr/local/bin may be /usr/bin, depending on the packager.

3.1.6 About long filenames

Free Pascal can handle long filenames on all platforms, except DOS. On Windows, it will use support for long filenames if it is available (which is not always the case on older versions of Windows).

If no support for long filenames is present, it will truncate unit names to 8 characters.

It is not recommended to put units in directories that contain spaces in their names, since the external GNU linker doesn't understand such filenames.

3.2 Compiling a program

Compiling a program is very simple. Assuming that you have a program source in the file prog.pp, you can compile this with the following command:

```
fpc [options] prog.pp
```

The square brackets `[ ]` indicate that what is between them is optional.

If your program file has the .pp or .pas extension, you can omit this on the command line, e.g. in the previous example you could have typed:

```
fpc [options] prog
```

If all went well, the compiler will produce an executable file. You can execute it straight away; you don't need to do anything else.

You will notice that there is also another file in your directory, with extension .o. This contains the object file for your program. If you compiled a program, you can delete the object file (.o), but don't delete it if you compiled a unit. This is because the unit object file contains the code of the unit, and will be linked in any program that uses it.

3.3 Compiling a unit

Compiling a unit is not essentially different from compiling a program. The difference is mainly that the linker isn't called in this case.

To compile a unit in the file foo.pp, just type :

```
fpc  foo
```

Recall the remark about file extensions in the previous section.

When all went well, you will be left with 2 (two) unit files:

1. foo.ppu - this is the file describing the unit you just compiled.
2. foo.o - this file contains the actual code of the unit. This file will eventually end up in the executables.

Both files are needed if you plan to use the unit for some programs. So don't delete them. If you want to distribute the unit, you must provide both the .ppu and .o file. One is useless without the other.

3.4 Units, libraries and smartlinking

The Free Pascal compiler supports smartlinking and the creation of libraries. However, the default behavior is to compile each unit into one big object file, which will be linked as a whole into your program. Shared libraries can be created on most platforms, although current level of FPC support may vary (they are e.g. not supported for GO32v2 and OS2 targets).

It is also possible to take existing units and put them together in 1 static or shared library (using the ppumove tool, section 8.7, page 110).

3.5 Reducing the size of your program

When you created your program, it is possible to reduce the size of the resulting executable. This is possible, because the compiler leaves a lot of information in the program which, strictly speaking, isn't required for the execution of the program.

The surplus of information can be removed with a small program called strip.The usage is simple. Just type

```
strip prog
```

On the command line, and the strip program will remove all unnecessary information from your program. This can lead to size reductions of up to 30 %.

You can use the `-Xs` switch to let the compiler do this stripping automatically at program compile time. (The switch has no effect when compiling units.)

Another technique to reduce the size of a program is to use smartlinking. Normally, units (including the system unit) are linked in as a whole. It is however possible to compile units such that they can be smartlinked. This means that only the functions and procedures that are actually used are linked in your program, leaving out any unnecessary code. The compiler will turn on smartlinking with the `-XX` (see page 32) switch. This technique is described in full in the programmers guide.

Chapter 4

Compiling problems

4.1 General problems

- **IO-error -2 at ...** : Under LINUX you can get this message at compiler startup. It means typically that the compiler doesn't find the error definitions file. You can correct this mistake with the `-Fr` (see page 27) option under LINUX.
- **Error : File not found : xxx** or **Error: couldn't compile unit xxx**: This typically happens when your unit path isn't set correctly. Remember that the compiler looks for units only in the current directory, and in the directory where the compiler itself is. If you want it to look somewhere else too, you must explicitly tell it to do so using the `-Fu` (see page 27) option. Or you must set up a configuration file.

4.2 Problems you may encounter under DOS

- **No space in environment**.
  An error message like this can occur if you call `SET_PP.BAT` in AUTOEXEC.BAT.
  To solve this problem, you must extend your environment memory. To do this, search a line in CONFIG.SYS like

  ```
  SHELL=C:\DOS\COMMAND.COM
  ```

  and change it to the following:

  ```
  SHELL=C:\DOS\COMMAND.COM /E:1024
  ```

  You may just need to specify a higher value, if this parameter is already set.
- **Coprocessor missing**
  If the compiler writes a message that there is no coprocessor, install the coprocessor emulation.
- **Not enough DPMI memory**
  If you want to use the compiler with `DPMI` you must have at least 7-8 MB free `DPMI` memory, but 16 Mb is a more realistic amount.

Chapter 5

Compiler configuration

The output of the compiler can be controlled in many ways. This can be done essentially in two distinct ways:

- Using command line options.
- Using the configuration file: fpc.cfg.

The compiler first reads the configuration file. Only then are the command line options checked. This creates the possibility to set some basic options in the configuration file, and at the same time you can still set some specific options when compiling some unit or program. First we list the command line options, and then we explain how to specify the command line options in the configuration file. When reading this, keep in mind that the options are case sensitive.

5.1 Using the command line options

The available options for the current version of the compiler are listed by category. Also, see chapter A, page 127 for a listing as generated by the current compiler.

5.1.1 General options

-h Print a list of all options and exit.

-? Same as `-h`, waiting after each screenfull for the enter key.

-i Print copyright and other information. You can supply a qualifier, as `-ixxx` where xxx can be one of the following:

D : Returns the compiler date.

V : Returns the short compiler version.

W : Return full compiler version.

SO : Returns the compiler OS.

SP : Returns the compiler processor.

TO : Returns the target OS.

TP : Returns the target processor.

a : Returns a list of supported ABI targets

c : Returns a list of supported CPU instruction sets

f : Returns a list of supported FPU instruction sets

i : Returns a list of supported inline assembler modes

o : Returns a list of supported optimizations

r : Returns a list of recognized compiler and RTL features

t : Returns a list of supported targets

u : Returns a list of supported microcontroller types

w : Returns a list of supported whole program optimizations

-l Print a line stating which program this is and its version.

-n Ignore the default configuration file. You can still pass a configuration file with the `@` option.

-VNNN set the version number to NNN (appends -NNN to the binary name)

5.1.2 Options for getting feedback

-vxxx Be verbose. `xxx` is a combination of the following :

- `e` : Show errors. This option is on by default.
- `w` : Issue warnings.
- `n` : Issue notes.
- `h` : Issue hints.
- `i` : Issue informational messages.
- `l` : Report number of lines processed (every 100 lines).
- `u` : Show information on units being loaded.
- `t` : Show names of files being opened.
- `p` : Write parse tree (tree.log)
- `q` : Show message numbers.
- `c` : Notify on each conditional being processed.
- `mxxx` : `xxx` is a comma-separated list of messages numbers which should not be shown. This option can be specified multiple times.
- `d` : Show additional debugging information.
- `0` : No messages. This is useful for overriding the default setting in the configuration file.
- `b` : Show all procedure declarations if an overloaded function error occurs.
- `x` : Show information about the executable (Win32 platform only).
- `r` : Format errors in RHIDE/GCC compatibility mode.
- `a` : Show all possible information. (this is the same as specifying all options)
- `b` : Tells the compiler to write filenames using the full path.
- `v` : Write copious debugging information to file. fpcdebug.txt..
- `s` : Write timestamps. Mainly for the compiler developers.
- `p` Write parse tree to file tree.log. (Intended for compiler developers.)
- `z` Write compiler messages to standard error instead of standard output.

The difference between an error/fatal error/hint/warning/note is the severity:

Fatal The compiler encountered an error, and can no longer continue compiling. It will stop at once.

Error The compiler encountered an error, but can continue to compile (at most till the end of the current unit).

Warning if there is a warning, it means there is probably an error, i.e. something may be wrong in your code.

Hint Is issued if the compiler thinks the code could be better, but there is no suspicion of error.

Note Is some noteworthy information, but again there is no error.

The difference between hints and notes is not really very clear. Both can be ignored without too much risk, but warnings should always be checked.

5.1.3 Options concerning files and directories

-exxx Specify xxx as the directory containing the executables for the programs as (the assembler) and `ld` (the linker).

-FaXYZ load units `XYZ` after the system unit, but before any other unit is loaded. `XYZ` is a comma-separated list of unit names. This can only be used for programs, and has the same effect as if `XYZ` were inserted as the first item in the program's `uses` clause.

-FcXXX Set the input codepage to `XXX`. Experimental.

-FCxxx Set the RC compiler (resource compiler) binary name to xxx.

-Fd Disable the compiler's internal directory cache. By default, the compiler caches the names of all files in a directory as soon as it looks for a single file in said directory. This ensures that the correct case of all file names is used in the debug information. It also allows to create compiled files with the correct casing when compiling on a case-preserving file systems under an OS that also support case-sensitive file systems. Lastly, it can also increase performance. This feature can however cause severe slowdowns on networked file systems, especially when compiling trivial programs in directories containing many files, and such slowdowns can be addressed by disabling the cache using this switch.

-FD Same as `-e`.

-Fexxx Write errors, etc. to the file named xxx.

-FExxx Write the executable and units to directory xxx instead of the current directory. If this option contains a path component and is followed by an option `-o` (see page 30)), then the `-o` path will override the `-FE` path setting.

-Ffxxx Add xxx to the framework path (only for Darwin).

-Fg ?

-Fixxx Add xxx to the include file search path.

-Flxxx Add xxx to the library search path. (This is also passed to the linker.)

-FLxxx (LINUX only) Use xxx as the dynamic linker. The default is /lib/ld-linux.so.2, or /lib/ld-linux.so.1, depending on which one is found first.

-Fmxxx Load the unicode conversion table from file x.txt in the directory where the compiler is located. Only used when `-Fc` is also in effect.

-FMxxx Set the directory where to search for unicode binary files to `xxx`.

-Foxxx Add xxx to the object file search path. This path is used when looking for files that need to be linked in.

-Frxxx Specify xxx as the file which contain the compiler messages. This will override the compiler's built-in default messages, which are in english.

-FRxxx set the resource (.res) linker to xxx.

-Fuxxx Add xxx to the unit search path. Units are first searched in the current directory. If they are not found there then the compiler searches them in the unit path. You must *always* supply the path to the system unit. The xxx path can contain a single wildcard (*) which will be expanded to all possible directory names found at that location. Note that the location itself is not included in the list. See section 3.1.2, page 16 for more information about this option.

-FUxxx Write units to directory `xxx` instead of the current directory. It overrides the `-FE` option.

-Ixxx Add xxx to the include file search path. This option has the same effect as `-Fi`.

-FWxxx store generated Whole Program Optimization information in file xxx.

-Fwxxx Read Whole Program Optimization information (as saved using -FWxxx) from file xxx.

5.1.4 Options controlling the kind of output.

For more information on these options, see Programmer's Guide.

-a Do not delete the assembler files (not applicable when using the internal assembler). This also applies to the (possibly) generated batch script.

-al Include the source code lines in the assembler file as comments.

-an Write node information in the assembler file (nodes are the way the compiler represents statements or parts thereof internally). This is primarily intended for debugging the code generated by the compiler.

-ap Use pipes instead of creating temporary assembler files. This may speed up the compiler on OS/2 and LINUX. Only with assemblers (such as GNU if the internal assembler is used.

-ar List register allocation and release info in the assembler file. This is primarily intended for debugging the code generated by the compiler.

-at List information about temporary allocations and deallocations in the assembler file.

-Axxx specify what kind of assembler should be generated. Here `xxx` is one of the following :

default Use the built-in default.

as Assemble using GNU as.

gas Assemble using GNU gas.

gas-darwin Assemble using GNU gas for darwin Mach-O64.

nasmcoff Coff (Go32v2) file using Nasm.

nasmelf Elf32 (LINUX) file using Nasm.

nasmwin32 WINDOWS 32-bit file using Nasm.

nasmwin64 WINDOWS 64-bit file using Nasm.

nasmwdosx WINDOWS 32-bit/DOSX file using Nasm.

nasmdarwin Object file using Nasm.darwin Mach-O64 using GNU GAS

macho Mach-O (Darwin, Intel 32 bit) using internal writer.

masm Object file using Masm (Microsoft).

tasm Object file using Tasm (Borland).

elf Elf32 (LINUX) using internal writer.

coff Coff object file (Go32v2) using the internal binary object writer.

pecoff PECoff object file (Win32) using the internal binary object writer.

wasm Object file using wasm (Watcom).

yasm Object file using yasm (experimental).

-B Re-compile all used units, even if the unit sources didn't change since the last compilation.

-b Generate browser info. This information can be used by an Integrated Development Environment (IDE) to provide information on classes, objects, procedures, types and variables in a unit.

-bl The same as `-b` but also generates information about local variables, types and procedures.

-C3 Turn on (or off) IEEE error checking for constants.

-Caxxx Set the ABI (Application Binary Interface) to xxx. The `-i` option gives the possible values for xxx.

-Cb Generate big-endian code.

-Cc Set the default calling convention used by the compiler.

-CD Create a dynamic library. This is used to transform units into dynamically linkable libraries on LINUX.

-Ce Emulate floating point operations.

-Cfxxx Set the used floating point processor to xxx. `fpc -i` lists all possible values.

-CFNN Set the minimal floating point precision to `NN`. Possible values are 32 and 64.

-Cg Enable generation of PIC code. This should only be necessary when generating libraries on LINUX or other Unices.

-Chxxx Reserves `xxx` bytes heap. `xxx` should be between 1024 and 67107840.

-Ci Generate Input/Output checking code. In case some input/output code of your program returns an error status, the program will exit with a run-time error. Which error is generated depends on the I/O error.

-Cn Omit the linking stage.

-CN Generate nil-pointer checks (AIX-only).

-Co Generate Integer overflow checking code. In case of integer errors, a run-time error will be generated by your program.

-CO Check for possible overflow of integer operations.

-CpXXX Set the processor type to `XXX`.

-CPX=N Set the packing for X to N. X can be `PACKSET`, `PACKENUM` or `PACKRECORDS`, and N can be a value of 1,2,4,8 or one of the keywords `DEFAULT` (0) or `NORMAL`. PACKRECORDS supports also values 16 and 32. (see the Programmer's Guide for more info).

-Cr Generate Range checking code. If your program accesses an array element with an invalid index, or if it increases an enumerated type beyond its scope, a run-time error will be generated.

-CR Generate checks when calling methods to verify if the virtual method table for that object is valid.

-Csxxx Set stack size to `xxx`.

-Ct Generate stack checking code. If your program performs a faulty stack operation, a run-rime error will be generated.

-CTNNN Target specific code generation options:

cld Emit a CLD instruction before using the x86 string instructions

-CX Create a smartlinked unit when writing a unit. Smartlinking will only link in the code parts that are actually needed by the program. All unused code is left out. This can lead to substantially smaller binaries.

-dxxx Define the symbol name `xxx`. This can be used to conditionally compile parts of your code.

-D Generate a DEF file (for OS/2).

-Dd Set the description of the executable/library (WINDOWS).

-Dv Set the version of the executable/library (WINDOWS).

-Dw PM application (for OS/2)

-E Same as `-Cn`.

-fPIC same as `-Cg`.

-g Generate debugging information for debugging with gdb.

-gc Generate checks for pointers. This must be used with the `-gh` command line option. When this options is enabled, it will verify that all pointer accesses are within the heap.

-gg Same as `-g`.

-gh Use the heaptrc unit (see Unit Reference). (Produces a report about heap usage after the program exits)

-gl Use the lineinfo unit (see Unit Reference). (Produces file name/line number information if the program exits due to an error.)

-goXXX set debug information options. One of the options is `dwarfsets`: It enables dwarf set debug information (this does not work with `gdb` versions prior to 6.5. `stabsabsincludes` tells the compiler to store absolute/full include file paths in stabs. `dwarfmethodclassprefix` tells the compiler to prefix method names in DWARF with class name. item [-gp] Preserve case in stabs symbol names. Default is to uppercase all names.

-gs Write stabs debug information.

-gt Trash local variables. This writes a random value to local variables at procedure start. This can be used to detect uninitialized variables. The t can be specified multiple times

-gv Emit info for valgrind. *Note:* this will include the `cmem` unit in your executable, replacing the default memory manager with the C memory manager.

-gw Emit dwarf debugging info (version 2).

-gw2 Emit dwarf debugging info (version 2).

-gw3 Emit dwarf debugging info (version 3).

-gw4 Emit dwarf debugging info (version 4, experimental).

-kxxx Pass `xxx` to the linker.

-Nxxx Do node tree optimizations. Here xxx is one of

u Unroll loops

-Oxxx Optimize the compiler's output; `xxx` can have one of the following values :

aPARAM=VALUE Specify alignment of structures and code. `PARAM` determines what should be aligned; `VALUE` specifies the alignment boundary. See the Programmer's Guide for a description of the possible values.

1 Level 1 optimizations (quick and debugger-friendly optimizations).

2 Level 2 optimizations (`-O1` plus quick optimizations).

3 Level 3 optimizations (`-O2` plus slower optimizations).

4 Level 4 optimizations (`-O3` plus optimizations that might have side effects).

oNNN Specify individual optimizations: `NNN` can be one of

REGVAR Use register variables

UNCERTAIN Uncertain optimizations (use with care)

STACKFRAME Skip stack frames

PEEPHOLE Peephole optimizations

ASMCSE Common subexpression elimination at the assembler level (i386-only, deprecated)

LOOPUNROLL Unroll (small) loops

TAILREC Change tail recursion to non-recursive loop

CSE Common subexpression elimination

DFA Enable Data Flow Analysis

USEEBP Use the EBP/RBP register to hold variables (x86-only)

ORDERFIELDS Reorder class instance fields if this results in better alignment

FASTMATH Fast math operations (may reduce floating point precision)

REMOVEEMPTYPROCS Remove calls to empty procedures.

CONSTPROP Constant propagation (experimental, requires `-Oodfa`)

pxxx select processor `xxx` to optimize for. `fpc -i` lists all available processor instruction sets.

Wxxx Generate Whole-Program-Optimization information for feature `xxx`. `fpc -i` will generate a list of possible values.

wxxx Perform Whole-Program-Optimization information for feature `xxx`. `fpc -i` will generate a list of possible values.

s Optimize for size rather than speed.

The exact effect of some of these optimizations can be found in the Programmer's Guide.

-oxxx Use `xxx` as the name of the output file (executable). For use only with programs. The output filename can contain a path, and if it does, it will override any previous `-FE` setting. If the output filename does not contain a path, the `-FE` setting is observed.

-pg Generate profiler code for gprof. This will define the symbol `FPC_PROFILE`, which can be used in conditional defines.

-PB Show default Target CPU compiler binary

-PP Show default target cpu

-Pxxx Set target CPU (arm,avr,i386,jvm,m68k,mips,mipsel,powerpc,powerpc64,sparc,x86_64)]

-s Do not call the assembler and linker. Instead, the compiler writes a script, PPAS.BAT under DOS, or ppas.sh under LINUX, which can then be executed to produce an executable. This can be used to speed up the compiling process or to debug the compiler's output. This option can take an extra parameter, mainly used for cross-compilation. It can have one of the following values:

h Generate script to link on host. The generated script can be run on the compilation platform (host platform).

t Generate script to link on target platform. The generated script can be run on the target platform. (where the binary is intended to be run)

r Skip register allocation phase (optimizations will be disabled).

-Txxx Specify the target operating system. `xxx` can be one of the following:

- **darwin** : Darwin Mac OS/X.
- **emx** : OS/2 via EMX (and DOS via EMX extender).
- **freebsd** : FreeBSD.
- **go32v2** : DOS and version 2 of the DJ DELORIE extender.
- **iphonesim** : iPhone simulator.
- **linux** : LINUX.
- **netbsd** : NetBSD.
- **netware** : Novell Netware Module (clib).
- **netwlibc** : Novell Netware Module (libc).
- **openbsd** : OpenBSD.
- **os2** : OS/2 (2.x) using the EMX extender.
- **sunos** : SunOS/Solaris.
- **watcom** : Watcom compatible DOS extender
- **wdosx** : WDOSX extender.
- **win32** : WINDOWS 32 bit.
- **win64** : WINDOWS 64 bit.
- **wince** : WINDOWS for handhelds (ARM processor).

The available list of targets depends on the actual compiler binary. Use `fpc -i` to get a list of targets supported by the compiler binary.

-uxxx Undefine the symbol `xxx`. This is the opposite of the `-d` option.

-Ur Generate release unit files. These files will not be recompiled, even when the sources are available. This is useful when making release distributions. This also overrides the `-B` option for release mode units.

-W Set some WINDOWS or OS/2 attributes of the generated binary. It can be one or more of the following

A Specify native type application (Windows)

b Create a bundle instead of a library (Darwin)

B Create arelocatable image (Windows)

Bhhh Set preferred base address to hhh (a hexadecimal address)

C Generate a console application (+) or a gui application (-).

D Force use of Def file for exports.

e Use external resources (Darwin)

F Generate a FS application (+) or a console application (-).

G Generate a GUI application (+) or a console application (-).

i Use internal (FPC) resources (Darwin)

I Turn on/off the usage of import sections (Windows)

Mnnn Minimum Mac OS X deployment version: nnn equals 10.4, 10.5.1, ... (Darwin)

N Do not generate a relocation section.

PXXX Minimum iOS deployment version needed (iphonesim) XXX is one of 8.0, 8.0.2, etc.

R Generate a relocation section.

T Generate a TOOL application (+) or a console application (-).

X Enable use of an executable stack (Linux)

-Xx Specify executable options. This tells the compiler what kind of executable should be generated. The parameter `x` can be one of the following:

- **c** : (LINUX only) Link with the C library. You should only use this when you start to port Free Pascal to another operating system.
- **d** Do not use the standard library path. This is needed for cross-compilation, to avoid linking with the host platform's libraries.
- **D** : Link with dynamic libraries (defines the `FPC_LINK_DYNAMIC` symbol)
- **e** use external (GNU) linker.
- **f** Substitute pthread library name for linking (BSD).
- **g** Create debug information in a separate file and add a debuglink section to executable.
- **i** use internal linker.
- **LA** Define library name substitutions for the linking stage.
- **LO** Define the order of library linking.
- **LD** Exclude default order of standard libraries.
- **MXXX** : Set the name of the program entry routine. The default is 'main'.
- **m** : Generate linker map file.
- **n** : Use target system native linker instead of GNU ld (Solaris, AIX)
- **pXXX** : First search for the compiler binary in the directory `XXX`. (fpc command only).
- **PXXX** : Prepend binutils names with `XXX` for cross-compiling.
- **rXXX** : Set library path to `XXX`.
- **Rxxx** Prepend xxx to all linker search paths. (used for cross compiling).
- **s** : Strip the symbols from the executable.
- **S** : Link with static units (defines the `FPC_LINK_STATIC` symbol).
- **t** : Link static (passes the `-static` option to the linker).
- **v** : Generate table for Virtual Entry calls.
- **X** : Link with smartlinked units (defines the `FPC_LINK_SMART` symbol).

5.1.5 Options concerning the sources (language options)

For more information on these options, see Programmer's Guide

-Mmode Set language mode to `mode`, which can be one of the following:

delphi Try to be Delphi compatible. This is more strict than the `objfpc` mode, since some Free Pascal extensions are switched off.

fpc Free Pascal dialect (default).

macpas Try to be compatible with Macintosh Pascal dialects.

objfpc Switch on some Delphi extensions. This is different from Delphi mode, because some Free Pascal constructs are still available.

tp Try to be TP/BP 7.0 compatible. This means no function overloading etc.

ISO In this mode, the compiler complies with the requirements of level 0 and level 1 of ISO/IEC 7185.

-Mfeature Select language feature `feature`. As of FPC version 2.3.1, the `-M` command line switch can be used to select individual language features. In that case, `feature` is one of the following keywords:

CLASS Use object pascal classes.

OBJPAS Automatically include the ObjPas unit.

RESULT Enable the `Result` identifier for function results.

PCHARTOSTRING Allow automatic conversion of null-terminated strings to strings,

CVAR Allow the use of the `CVAR` keyword.

NESTEDCOMMENTS Allow use of nested comments.

CLASSICPROCVARS Use classical procedural variables.

MACPROCVARS Use mac-style procedural variables.

REPEATFORWARD Implementation and Forward declaration must match completely.

POINTERTOPROCVAR Allow silent conversion of pointers to procedural variables.

AUTODEREF Automatic (silent) dereferencing of typed pointers.

INITFINAL Allow use of `Initialization` and `Finalization`

ANSISTRINGS Allow use of ansistrings.

OUT Allow use of the `out` parameter type.

DEFAULTPARAMETERS Allow use of default parameter values.

HINTDIRECTIVE Support the hint directives (`deprecated`, `platform` etc.)

DUPLICATELOCALS Allow method arguments with the same name as properties in classes.

PROPERTIES Allow use of global properties.

ALLOWINLINE Allow inline procedures.

EXCEPTIONS Allow the use of exceptions.

OBJECTIVEC1 Allow the use of objective C version 1.

OBJECTIVEC2 Allow the use of objective C version 2.

NESTEDPROCVARS Allow assigning local procedures to nested procedural variables and defining inline procedural variable types, which can always accept local procedures, in parameter declarations.

NONLOCALGOTO Allow a GOTO statement to jump outside the local scope (as ISO Pascal).

ADVANCEDRECORDS Allow the use of advanced records (records with methods/properties)

ISOUNARYMINUS Treat unary minus like in ISO Pascal: same precedence level as binary minus/plus.

The keyword can be followed by a plus or minus sign to enable or disable the feature. Note that the order of mode and feature switches is important, a mode switch resets the feature list to the default features for that mode.

-Rxxx Specify what kind of assembler you use in your `asm` assembler code blocks. Here `xxx` is one of the following:

att `asm` blocks contain AT&T-style assembler. This is the default style.

intel `asm` blocks contain Intel-style assembler.

default Use the default assembler for the specified target.

-S2 Switch on Delphi 2 extensions (`objfpc` mode). Deprecated, use `-Mobjfpc` instead.

-Sa Include assert statements in compiled code. Omitting this option will cause assert statements to be ignored.

-Sc Support C-style operators, i.e. `*=, +=, /= and -=`.

-Sd Try to be Delphi compatible. Deprecated, use `-Mdelphi` instead.

-SeN The compiler stops after the N-th error. Normally, the compiler tries to continue compiling after an error, until 50 errors are reached, or a fatal error is reached, and then it stops. With this switch, the compiler will stop after the N-th error (if N is omitted, a default of 1 is assumed). Instead of a number, one of `n`, `h` or `w` can also be specified. In that case the compiler will consider notes, hints or warnings as errors and stop when one is encountered.

-Sf Enable certain features in compiler and RTL. This allows for finer control over available language features than the mode switch. Possible values are:

HEAP Allow heap memory.

INITFINAL Initialization/finalization.

RTTI Allow use of RTTI.

CLASSES Allow use of classes.

EXCEPTIONS Allow use of exceptions.

EXITCODE Allow use of exit code for applications.

ANSISTRINGS Allow use of ansistrings.

WIDESTRINGS Allow use of widestrings.

TEXTIO Allow use of standard Pascal text file I/O.

CONSOLEIO Allow use of standard Pascal console I/O (text file).

FILEIO Allow use of standard Pascal binary file I/O.

RANDOM Allow use of Random() function.

VARIANTS Allow use of variants.

OBJECTS Allow use of TP-style objects.

DYNARRAYS Allow use of dynamic arrays.

THREADING Allow use of threading.

COMMANDARGS Allow use of command-line arguments.

PROCESSES Allow use of processes.

STACKCHECK Enable stack checking.

DYNLIBS Allow use of dynamically loadable libraries in the system unit.

SOFTFPU Allow (enable) the use of software floating point operations.

OBJECTIVEC1 Allow use of Objective C support routines.

RESOURCES Allow use of resources.

UNICODESTRING Allow use of unicode strings.

-Sg Support the `label` and `goto` commands. By default these are not supported. You must also specify this option if you use labels in assembler statements. (if you use the `AT&T` style assembler)

-Sh Use ansistrings by default for strings. If this option is specified, the compiler will interpret the `string` keyword as an ansistring. Otherwise it is supposed to be a shortstring (TP style).

-Si Support `C++` style INLINE.

-SIXXX Set interfaces style to `XXX`. Here `XXX` is one of

COM COM compatible interfaces (reference counted, descend from IUnknown).

CORBA Not reference counted interfaces.

-Sk Load the Kylix compatibility unit (fpcylix).

-Sm Support C-style macros.

-So Try to be Borland TP 7.0 compatible. Deprecated, use `-Mtp` instead.

-Ss The name of constructors must be `init`, and the name of destructors should be `done`.

-St Allow the `static` keyword in objects. This flag is obsolete since Free Pascal 2.6.0.

-Sv Support vector processing (uses CPU vector extensions if available)

-Sx Enable exception keywords (default in Delphi/Objfpc mode). This will mark all exception related keywords as keywords, also in Turbo Pascal or FPC mode. This can be used to check for code which should be mode-neutral as much as possible.

-Sy @pointer returns a typed pointer, this is the same as the $T+ option.

-Un Do not check the unit name. Normally, the unit name is the same as the filename. This option allows them to be different.

-Us Compile a system unit. This option causes the compiler to define only some very basic types.

5.2 Using the configuration file

Using the configuration file fpc.cfg is an alternative to command line options. When a configuration file is found, it is read, and the lines in it are treated as if you had typed them as options on the command line: Specify one option on each line of the configuration file. They are treated before the options that you type on the command line.

You can specify comments in the configuration file with the # sign. Everything from the # on will be ignored.

The algorithm to determine which file is used as a configuration file is described in 3.1.5 on page 20.

When the compiler has finished reading the configuration file, it continues to treat the command line options.

One of the command line options allows you to specify a second configuration file: Specifying @foo on the command line will open file foo, and read further options from there. When the compiler has finished reading this file, it continues to process the command line.

5.2.1 Conditional processing of the config file

In addition to placeholder substitution, the configuration file allows a type of preprocessing. It understands the following directives, which you should place starting on the first column of a line:

#CFGDIR

#IFDEF

#IFNDEF

#ELSE

#ENDIF

#DEFINE

#UNDEF

#WRITE

#INCLUDE

#SECTION

They work the same way as their {$...} counterparts in Pascal source code. All the default defines used to compile source code are also defined while processing the configuration file. For example, if the target compiler is an intel 80x86 compatible linux platform, both `cpu86` and `linux` will be defined while interpreting the configuration file. For the possible default defines when compiling, consult Appendix G of the Programmer's Guide.

What follows is a description of the different directives.

5.2.2 #CFGDIR

Syntax:

```
#CFGDIR /path/to/config/dir
```

Sets the directory where the compiler looks for configuration files that it includes through the `#INCLUDE` directive. The path can contain the usual placeholders which will be replaced with appropriate values. The substituted values are the values at the moment the `CFGDIR` directive is encountered.

5.2.3 #IFDEF

Syntax:

```
#IFDEF name
```

Lines following #IFDEF are read only if the keyword name following it is defined.

They are read until the keywords #ELSE or #ENDIF are encountered, after which normal processing is resumed.

Example :

```
#IFDEF VER2_6_0
-Fu/usr/lib/fpc/2.6.0/linuxunits
#ENDIF
```

In the above example, /usr/lib/fpc/2.6.0/linuxunits will be added to the path if you're compiling with version 2.6.0 of the compiler.

5.2.4 #IFNDEF

Syntax:

```
#IFNDEF name
```

Lines following #IFNDEF are read only if the keyword name following it is not defined.

They are read until the keywords #ELSE or #ENDIF are encountered, after which normal processing is resumed.

Example :

```
#IFNDEF VER2_6_0
-Fu/usr/lib/fpc/2.6.0/linuxunits
#ENDIF
```

In the above example, /usr/lib/fpc/2.6.0/linuxunits will be added to the path if you're NOT compiling with version 2.6.0 of the compiler.

5.2.5 #ELSE

Syntax:

```
#ELSE
```

#ELSE can be specified after a #IFDEF or #IFNDEF directive as an alternative. Lines following #ELSE are read only if the preceding #IFDEF or #IFNDEF was not accepted.

They are skipped until the keyword #ENDIF is encountered, after which normal processing is resumed.

Example :

```
#IFDEF VER2_6_2
-Fu/usr/lib/fpc/2.6.2/linuxunits
#ELSE
-Fu/usr/lib/fpc/2.6.0/linuxunits
#ENDIF
```

In the above example, /usr/lib/fpc/2.6.2/linuxunits will be added to the path if you're compiling with version 2.6.2 of the compiler, otherwise /usr/lib/fpc/2.6.0/linuxunits will be added to the path.

5.2.6 #ENDIF

Syntax:

```
#ENDIF
```

`#ENDIF` marks the end of a block that started with `#IF(N)DEF`, possibly with an `#ELSE` between them.

5.2.7 #DEFINE

Syntax:

```
#DEFINE name
```

`#DEFINE` defines a new keyword. This has the same effect as a `-dname` command line option.

5.2.8 #UNDEF

Syntax:

```
#UNDEF name
```

`#UNDEF` un-defines a keyword if it existed. This has the same effect as a `-uname` command line option.

5.2.9 #WRITE

Syntax:

```
#WRITE Message Text
```

`#WRITE` writes `Message Text` to the screen. This can be useful to display warnings if certain options are set.

Example:

```
#IFDEF DEBUG
#WRITE Setting debugging ON...
-g
#ENDIF
```

If `DEBUG` is defined, this will produce a line

```
Setting debugging ON...
```

and will then switch on debugging information in the compiler.

5.2.10 #INCLUDE

Syntax:

```
#INCLUDE filename
```

#INCLUDE instructs the compiler to read the contents of filename before continuing to process options in the current file.

This can be useful if you want to have a particular configuration file for a project (or, under LINUX, in your home directory), but still want to have the global options that are set in a global configuration file.

Example:

```
#IFDEF LINUX
#INCLUDE /etc/fpc.cfg
#ELSE
#IFDEF GO32V2
#INCLUDE c:\pp\bin\fpc.cfg
#ENDIF
#ENDIF
```

This will include /etc/fpc.cfg if you're on a LINUX machine, and will include `c:\pp\bin\fpc.cfg` on a DOS machine.

5.2.11 #SECTION

Syntax:

```
#SECTION name
```

The #SECTION directive acts as a #IFDEF directive, only it doesn't require an #ENDIF directive. The special name COMMON always exists, i.e. lines following #SECTION COMMON are always read.

5.3 Variable substitution in paths

To avoid having to edit your configuration files too often, the compiler allows you to insert some variables in the paths that you specify for the compiler. They are specified as follows:

```
$VARNAME
```

The above will be replaced with the value of the variable VARNAME.

Normally, only a set of compiler-defined variable names are recognized. In addition to these compiler-defined variable names, the following notation can be used

```
$ENVVAR$
```

to substitute the value of an environment variable. The compiler will fetch the value of ENVVAR from the environment, and replace the $ENVVAR$ with this value.

The compiler defines the following variable names:

FPCFULLVERSION is replaced by the compiler's version string.

FPCVERSION is replaced by the compiler's version string.

FPCDATE is replaced by the compiler's date.

FPCTARGET is replaced by the compiler's target (combination of CPU-OS)

FPCCPU is replaced by the compiler's target CPU.

FPCOS is replaced by the compiler's target OS.

Additionally, under windows the following special variables are recognized:

LOCAL_APPDATA Usually the directory "Local settings/Application Data" under the user's home directory.

APPDATA Usually the directory "Application Data" under the user's home directory.

COMMON_APPDATA Usually the directory "Application Data" under the 'All users' directory.

PERSONAL Usually the "My documents" directory of the user.

PROGRAM_FILES Usually "program files" directory on the system drive

PROGRAM_FILES_COMMON Usually the "Common files" directory under the program files directory.

PROFILE The user's home directory.

The values of these can vary based on the installation, they are fetched from the operating system.

If none of the pre-defines variable names were matched, and the template name ends on $, then the environment variable with the same name is used:

```
-Fu$HOME$/FPC/currentversion/
```

This will refer to the directory FPC/currentversion under the user's home directory on Unix (HOME is the environment variable that contains the location of the user's directory).

So, have one of the above variables substituted, just insert them with a `$` prepended, as follows:

```
-Fu/usr/lib/fpc/$FPCVERSION/rtl/$FPCOS
```

This is equivalent to

```
-Fu/usr/lib/fpc/2.6.2/rtl/linux
```

if the compiler version is `2.6.2` and the target OS is LINUX.

These replacements are valid on the command line and also in the configuration file.

On the LINUX command line, you must be careful to escape the `$` since otherwise the shell will attempt to expand the variable for you, which may have undesired effects.

Chapter 6

The IDE

The IDE (**I**ntegrated **D**evelopment **E**nvironment) provides a comfortable user interface to the compiler. It contains an editor with syntax highlighting, a debugger, symbol browser etc. The IDE is a text-mode application which has the same look and feel on all supported operating systems. It is modelled after the IDE of Turbo Pascal, so many people should feel comfortable using it.

Currently, the IDE is available for DOS, WINDOWS and LINUX.

6.1 First steps with the IDE

6.1.1 Starting the IDE

The IDE is started by entering the command:

```
fp
```

at the command line. It can also be started from a graphical user interface such as WINDOWS.

Remark Under WINDOWS, it is possible to switch between windowed mode and full screen mode by pressing ALT-ENTER.

6.1.2 IDE command line options

When starting the IDE, command line options can be passed:

```
fp [-option] [-option] ... <file name> ...
```

`Option` is one of the following switches (the option letters are case insensitive):

-N (DOS only) Do not use long file names. WINDOWS 95 and later versions of WINDOWS provide an interface to DOS applications to access long file names. The IDE uses this interface by default to access files. Under certain circumstances, this can lead to problems. This switch tells the IDE not to use the long filenames.

-Cfilename Read IDE options from filename. There should be no whitespace between the file name and the `-C`.

-F Use alternative graphic characters. This can be used to run the IDE on LINUX in an X-term or through a telnet session.

-R After starting the IDE, change automatically to the directory which was active when the IDE exited the last time.

-S Disable the mouse. When this option is used, the use of a mouse is disabled, even if a mouse is present.

-Tttyname (LINUX/Unix only) Send program output to tty `ttyname`. This avoids having to continually switch between program output and the IDE.

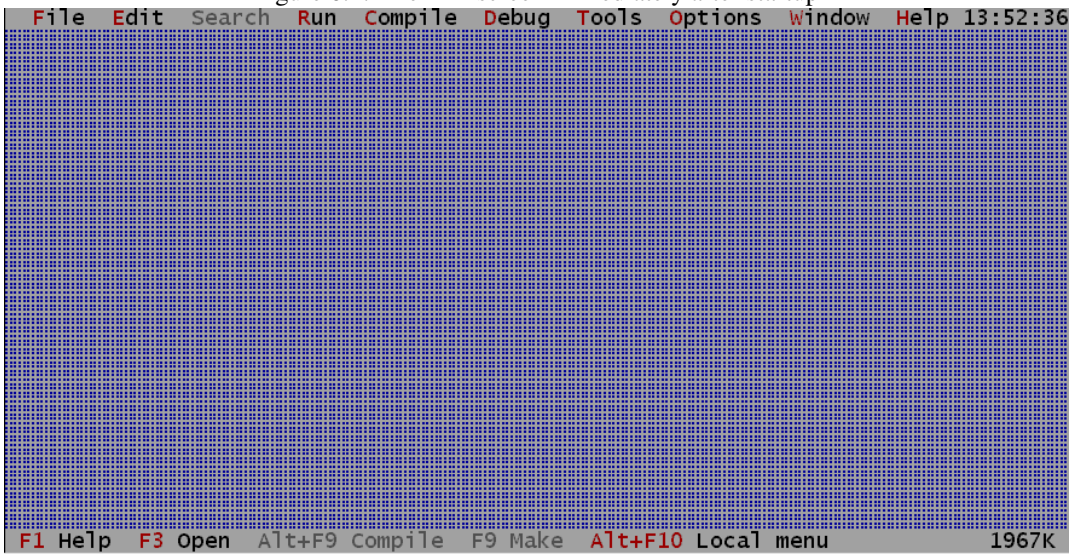
The files given at the command line are loaded into edit windows automatically.

Remark Under DOS/Win32, the first character of a command line option can be a `/` character instead of a `-` character. So `/S` is equivalent to `-S`.

6.1.3 The IDE screen

After start up, the screen of the IDE can look like figure (6.1).

Figure 6.1: The IDE screen immediately after startup



At the top of the screen the *menu bar* is visible, at the bottom the *status bar*. The empty space between them is called the *desktop*.

The status bar shows the keyboard shortcuts for frequently used commands, and allows quick access to these commands by clicking them with the mouse. At the right edge of the status bar, the current amount of unused memory is displayed. This is only an indication, since the IDE tries to allocate more memory from the operating system if it runs out of memory.

The menu provides access to all of the IDE's functionality, and at the right edge of the menu, a clock is displayed.

The IDE can be exited by selecting **"File|Exit"** in the menu [1] or by pressing ALT-X.

Remark If a file fp.ans is found in the current directory, then it is loaded and used to paint the background. This file should contain ANSI drawing commands to draw on a screen.

[1] **"File|Exit"** means select the item 'Exit' in the menu 'File'.

6.2 Navigating in the IDE

The IDE can be navigated both with the keyboard and with a mouse, if the system is equipped with a mouse.

6.2.1 Using the keyboard

All functionality of the IDE is available through use of the keyboard.

- It is used for typing and navigating through the sources.
- Editing commands such as copying and pasting text.
- Moving and resizing windows.
- It can be used to access the menu, by pressing ALT and the appropriate highlighted menu letter, or by pressing F10 and navigating through the menu with the arrow keys. More information on the menu can be found in section 6.4, page 46.
- Many commands in the IDE are bound to shortcuts, i.e. typing a special combination of keys will execute a command immediately.

Remark

- When working in a LINUX X-Term or through a telnet session, the key combination with ALT may not be available. To remedy this, the CTRL-Z combination can be typed first. This means that e.g. ALT-X can be replaced by CTRL-Z X.
- Alternatively, you can try the key combination ESC-X for ALT-X when working on LINUX.
- A complete reference of all keyboard shortcuts can be found in section 6.14, page 91.

6.2.2 Using the mouse

If the system is equipped with a mouse, it can be used to work with the IDE. The left button is used to select menu items, press buttons, select text blocks etc.

The right mouse button is used to access the local menu, if available. Holding down the CTRL or ALT key and clicking the right button will execute user defined functions. See section 6.12.4, page 88.

Remark

1. Occasionally, the manual uses the term "drag the mouse". This means that the mouse is moved while the left mouse button is being pressed.
2. The action of mouse buttons may be reversed, i.e. the actions of the left mouse button can be assigned to the right mouse button and vice versa [2]. Throughout the manual, it is assumed that the actions of the mouse buttons are not reversed.
3. The mouse is not always available, even if a mouse is installed:
   - The IDE is running under LINUX through a telnet connection from a WINDOWS machine.
   - The IDE is running under LINUX in an X-term under X-windows. In this case it depends on the terminal program: under Konsole (the KDE terminal) it works.

[2] See section 6.12.4, page 88 for more information on how to reverse the actions of the mouse buttons.

4. On Windows, the console has an option 'Quick edit', allowing text to be copied to the clipboard by selecting text in the console window. If this mode is enabled, the mouse will not work. The 'Quick edit' option should be disabled in the console window's properties in order for the IDE to receive mouse events.

6.2.3 Navigating in dialogs

Dialogs usually have a lot of elements in them such as buttons, edit fields, memo fields, list boxes and so on. To activate one of these fields, choose one of the following methods:

1. Click on the element with the mouse.
2. Press the TAB key till the focus reaches the element.
3. Press the highlighted letter in the element's label. If the focus is currently on an element that allows editing, then ALT should be pressed simultaneously with the highlighted letter. For a button, the action associated with the button will then be executed.

Inside edit fields, list boxes and memos, navigation is carried out with the usual arrow key commands.

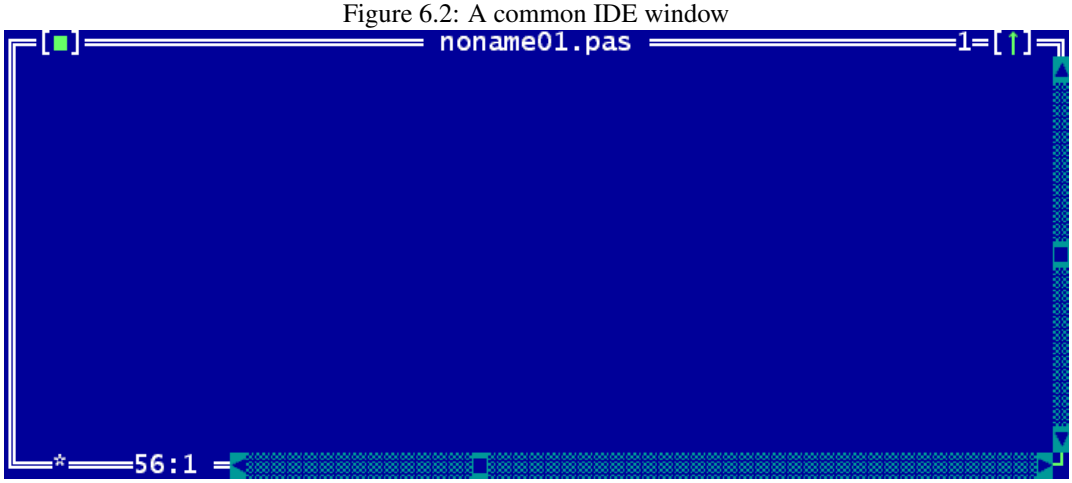
6.3 Windows

Nowadays, working with windowed applications should be no problem for most WINDOWS and LINUX users. Nevertheless, the following section describes how the windows work in order to derive the most benefit from the Free Pascal IDE.

6.3.1 Window basics

A common IDE window is displayed in figure (6.2).

Figure 6.2: A common IDE window



The window is surrounded by a so-called *frame*, the white double line around the window.

At the top of the window 4 things are displayed:

- At the upper left corner of the window, a *close icon* is shown. When clicked, the window will be closed. It can also be closed by pressing ALT-F3 or by selecting the menu item **"Window|Close"**. All open windows can be closed by selecting the menu item **"Window|Close all"**.
- In the middle, the title of the window is displayed.
- Almost at the upper right corner, a number is visible. This number identifies the editor window, and pressing ALT-NUMBER will jump to this window. Only the first 9 windows will get such a number.
- At the upper right corner, a small green arrow is visible. Clicking this arrow zooms the window so it covers the whole desktop. Clicking this arrow on a zoomed window will restore the old size of the window. Pressing the F5 key has the same effect as clicking that arrow. The same effect can be achieved with the menu item **"Window|Zoom"**. Windows and dialogs which aren't resizeable can't be zoomed, either.

The right edge and bottom edges of a window contain scrollbars. They can be used to scroll the window contents with the mouse. The arrows at the ends of the scrollbars can be clicked to scroll the contents line by line. Clicking on the dotted area between the arrows and the cyan-colored rectangle will scroll the window's content page by page. By dragging the rectangle the content can be scrolled continuously.

The star and the numbers in the lower left corner of the window display information about the contents of the window. They are explained in the section about the editor, see section 6.5, page 53.

6.3.2 Sizing and moving windows

A window can be moved and sized using the mouse and the keyboard.

To move a window:

- Using the mouse, click on the title bar and drag the window with the mouse.
- Using the keyboard, go into the size/move mode by pressing CTRL-F5 or selecting the menu item **"Window|Size/Move"**. The window frame will change to green to indicate that the IDE is in size/move mode. Now the cursor keys can be used to move the window. Press ENTER to leave the size/move mode. In this case, the window will keep its size and position. Alternatively, pressing ESC will restore the old position.

To resize a window:

- Using the mouse, click on the lower right corner of the window and drag it.
- Using the keyboard, go into the size/move mode by pressing CTRL-F5 or selecting the menu item **"Window|Size/Move"**. The window frame will change to green to indicate that the IDE is in size/move mode. Now hold down the SHIFT key and press one of the cursor keys in order to resize the window. Press ENTER to leave the size/move mode. Pressing ESC will restore the old size.

Not all windows can be resized. This applies, for example, to *dialog windows* (section 6.3.4, page 46).

A window can also be hidden. To hide a window, the CTRL-F6 key combination can be used, or the **"Window|Hide"** menu may be selected. To restore a Hidden window, it is necessary to select it from the window list. More information about the window list can be found in the next section.

6.3.3 Working with multiple windows

When working with larger projects, it is likely that multiple windows will appear on the desktop. However, only one of these windows will be the active window; all other windows will be inactive.

An inactive window is identified by a grey frame. An inactive window can be made active in one of several ways:

- Using the mouse, activate a window by clicking on it.
- Using the keyboard, pressing F6 will step through all open windows. To activate the previously activated window, SHIFT-F6 can be used.
- The menu item **"Window|Next"** can be used to activate the next window in the list of windows, while `Window|Previous` will select the previous window.
- If the window has a number in the upper right corner, it can be activated by pressing ALT-<NUMBER>.
- Pressing ALT-0 will pop up a dialog with all available windows which allows a quick activation of windows which don't have a number.

The windows can be ordered and placed on the IDE desktop by zooming and resizing them with the mouse or keyboard. This is a time-consuming task, and particularly difficult with the keyboard. Instead, the menu items **"Window|Tile"** and **"Window|Cascade"** can be used:

Tile will divide the whole desktop space evenly between all resizable windows.

Cascade puts all the windows in a cascaded arrangement.

In very rare cases the screen of the IDE may become mixed up. In this case the whole IDE screen can be refreshed by selecting the menu item **"Window|Refresh display"**.

6.3.4 Dialog windows

In many cases the IDE displays a dialog window to get user input. The main difference to normal windows is that other windows cannot be activated while a dialog is active. Also the menu is not accessible while in a dialog. This behavior is called *modal*. To activate another window, the modal window or dialog must be closed first.

A typical dialog window is shown in figure (6.3).

6.4 The Menu

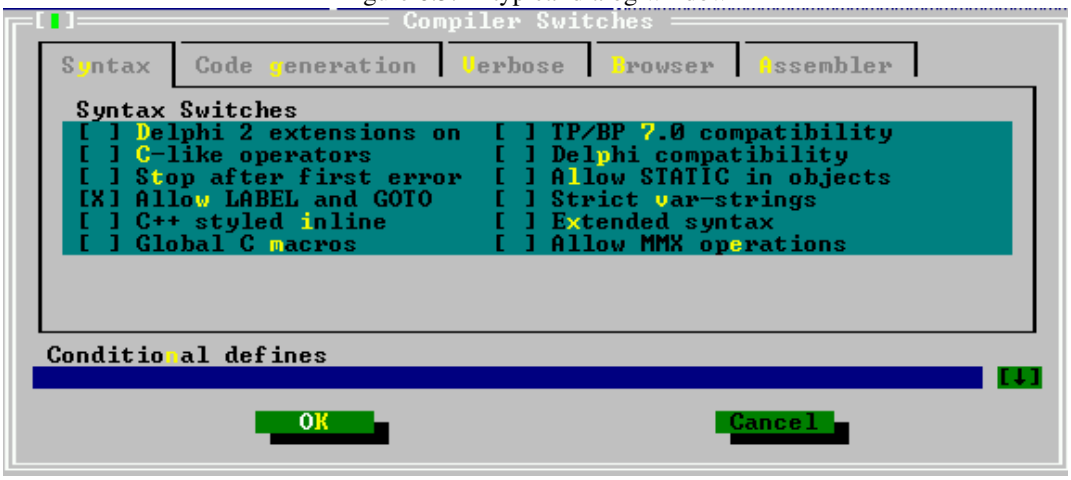
The main menu (the gray bar at the top of the IDE) provides access to all the functionality of the IDE. It also contains a clock, displaying the current time. The menu is always available, except when a dialog is opened. If a dialog is opened, it must be closed first in order to access the menu.

In certain windows, a local menu is also available. The local menu will appear where the cursor is, and provides additional commands that are context-sensitive.

6.4.1 Accessing the menu

The menu can be accessed in a number of ways:

Figure 6.3: A typical dialog window



1. By using the mouse to select items. The mouse cursor should be located over the desired menu item, and a left mouse click will then select it.
2. By pressing F10. This will switch the IDE focus to the menu. The arrow keys can then be used to navigate in the menu. The ENTER key should be used to select items.
3. To access menu items directly, ALT-<HIGHLIGHTED MENU LETTER> can be used to select a menu item. Afterwards submenu entries can be selected by pressing the highlighted letter, but without ALT. E.g. ALT-S G is a fast way to display the *goto line* dialog.

Every menu item is explained by a short text in the status bar.

When a local menu is available, it can be accessed by pressing the right mouse button or ALT-F10.

To exit any menu without taking any action, press the ESC key twice.

In the following, all menu entries and their actions are described.

6.4.2 The File menu

The **"File"** menu contains all menu items that allow the user to load and save files, as well as to exit the IDE.

New Opens a new, empty editor window.

New from template Prompts for a template to be used, asks to fill in any parameters, and then starts a new editor window with the template.

Open (F3) Presents a file selection dialog, and opens the selected file in a new editor window.

Print print the contents of the current edit window.

Print setup set up the printer properties.

Reload Reload a file from disk.

Save (F2) Saves the contents of the current edit window with the current filename. If the current edit window does not yet have a filename, a dialog is presented to enter a new filename.

Save as Presents a dialog in which a filename can be entered. The current window's contents are then saved to this new filename, and the filename is stored for further save actions.

Save all Saves the contents of all edit windows.

Change dir Presents a dialog in which a directory can be selected. The current working directory is then changed to the selected directory.

Command shell Executes a command shell. After the shell is exited, the IDE resumes. Which command shell is executed depends on the system.

Exit (ALT-X) Exits the IDE. If any unsaved files are in the editor, the IDE will ask if these files should be saved.

Under the **"Exit"** menu appear some filenames of recently used files. These entries can be used to quickly reload these files in the editor.

6.4.3 The Edit menu

The **"Edit"** menu contains entries for accessing the clipboard, and undoing or redoing editing actions. Most of these functions have shortcut keys associated with them.

Undo (ALT-BKSP) Reverses the effect of the last editing action. The editing actions are stored in a buffer. Selecting this mechanism will move backwards through this buffer, i.e. multiple undo levels are possible. However, any selections that may have been made are not reproduced.

Redo Repeats the last action that was just undone with Undo. Redo can redo multiple undone actions.

Cut (SHIFT-DEL) Deletes the selected text from the window and copies it to the clipboard. Any previous clipboard contents are lost. The new clipboard contents are available for pasting elsewhere.

Copy (CTRL-INS) Copies the current selection to the clipboard. Any previous clipboard contents are lost. The new clipboard contents are available for pasting elsewhere.

Paste (SHIFT-INS) Inserts the current clipboard contents in the text at the cursor position. The clipboard contents remain as they were.

Clear (CTRL-DEL) Clears (i.e. deletes) the current selection.

Select All Selects all text in the current window. The selected text can then be cut or copied to the clipboard.

Unselect undo the selection.

Show clipboard Opens a window in which the current clipboard contents are shown.

When running an IDE under WINDOWS, the **"Edit"** menu has two additional entries. The IDE maintains a separate clipboard which does not share its contents with the WINDOWS clipboard. To access the WINDOWS clipboard, the following two entries are also present:

Copy to Windows Copy the selection to the WINDOWS clipboard.

Paste from Windows Insert the contents of the WINDOWS clipboard (if it contains text) in the edit window at the current cursor position.

6.4.4 The Search menu

The **"Search"** menu provides access to the search and replace dialogs, as well as access to the symbol browser of the IDE.

Find (CTRL-Q F) Presents the search dialog. A search text can be entered, and when the dialog is closed, the entered text is searched for in the active window. If the text is found, it will be selected.

Replace (CTRL-Q A) Presents the search and replace dialog. After the dialog is closed, the search text will be replaced by the replace text in the active window.

Search again (CTRL-L) Repeats the last search or search and replace action, using the same parameters.

Go to line number (ALT-G) Prompts for a line number, and then jumps to this line number.

When the program and units are compiled with browse information, then the following menu entries are also enabled:

Find procedure Not yet implemented.

Objects Asks for the name of an object and opens a browse window for this object.

Modules Asks for the name of a module and opens a browse window for this module.

Globals Asks for the name of a global symbol and opens a browse window for this global symbol.

Symbol Opens a window with all known symbols, so a symbol can be selected. After the symbol is selected, a browse window for that symbol is opened.

6.4.5 The Run menu

The **"Run"** menu contains all entries related to running a program,

Run (CTRL-F9) If the sources were modified, compiles the program. If the compile is successful, the program is executed. If the primary file was set, then that is used to determine which program to execute. See section 6.4.6, page 50 for more information on how to set the primary file.

Step over (F8) Run the program until the next source line is reached. If any calls to procedures are made, these will be executed completely as well.

Trace into (F7) Execute the current line. If the current line contains a call to another procedure, the process will stop at the entry point of the called procedure.

Goto cursor (F4) Run the program until the execution point matches the line where the cursor is.

Until return Runs the current procedure until it exits.

Run directory Set the working directory to change to when executing the program.

Parameters Permits the entry of parameters that will be passed to the program when it is being executed.

Program reset (CTRL-F2) if the program is being run or debugged, the debug session is aborted, and the running program is killed.

6.4.6 The Compile menu

The **"Compile"** menu contains all entries related to compiling a program or unit.

Compile (ALT-F9) Compiles the contents of the active window, irrespective of the primary file setting.

Make (F9) Compiles the contents of the active window, and any files that the unit or program depends on and that were modified since the last compile. If the primary file was set, the primary file is compiled instead.

Build Compiles the contents of the active window, and any files that the unit or program depends on, whether they were modified or not. If the primary file was set, the primary file is compiled instead.

Target Sets the target operating system for which the program should be compiled.

Primary file Sets the primary file. If set, any run or compile command will act on the primary file instead of on the active window. The primary file need not be loaded in the IDE for this to have effect.

Clear primary file Clears the primary file. After this command, any run or compile action will act on the active window.

Compiler messages (F12) Displays the compiler messages window. This window will display the messages generated by the compiler during the most recent compile.

6.4.7 The Debug menu

The **"Debug"** menu contains menu entries to aid in debugging a program, such as setting breakpoints and watches.

Output Show user program output in a window.

User screen (ALT-F5) Switches to the screen as it was last left by the running program.

Add watch (CTRL-F7) Adds a watch. A watch is an expression that can be evaluated by the IDE and will be shown in a special window. Usually this is the content of some variable.

Watches Shows the current list of watches in a separate window.

Breakpoint (CTRL-F8) Sets a breakpoint at the current line. When debugging, program execution will stop at this breakpoint.

Breakpoint list Shows the current list of breakpoints in a separate window.

Evaluate

Call stack (CTRL-F3) Shows the call stack. The call stack is the list of addresses (and filenames and line numbers, if this information was compiled in) of procedures that are currently being called by the running program.

Disassemble Shows the call stack.

Registers Shows the current content of the CPU registers.

Floating point unit Shows the current content of the FPU registers.

Vector unit Shows the current content of the MMX (or equivalent) registers.

GDB window Shows the GDB debugger console. This can be used to interact with the debugger directly; here arbitrary GDB commands can be typed and the result will be shown in the window.

6.4.8 The Tools menu

The **"Tools"** menu defines some standard tools. If new tools are defined by the user, they are appended to this menu as well.

Messages (F11) Shows the messages window. This window contains the output from one of the tools. For more information, see section 6.10.1, page 65.

Goto next (ALT-F8) Goes to the next message.

Goto previous (ALT-F7) Goes to the previous message

Grep (SHIFT-F2) Prompts for a regular expression and options to be given to grep, and then executes grep with the given expression and options. For this to work, the grep program must be installed on the system, and be in a directory that is in the `PATH`. For more information, see section 6.10.2, page 66.

Calculator Displays the calculator. For more information, see section 6.10.4, page 67.

Ascii table Displays the `ASCII` table. For more information, see section 6.10.3, page 66.

6.4.9 The Options menu

The **"Options"** menu is the entry point for all dialogs that are used to set options for the compiler and the IDE, as well as the user preferences.

Mode Presents a dialog to set the current mode of the compiler. The current mode is shown at the right of the menu entry. For more information, see section 6.11.8, page 83.

Compiler Presents a dialog that can be used to set common compiler options. These options will be used when compiling a program or unit.

Memory sizes Presents a dialog where the stack size and the heap size for the program can be set. These options will be used when compiling a program.

Linker Presents a dialog where some linker options can be set. These options will be used when a program or library is compiled.

Debugger Presents a dialog where the debugging options can be set. These options are used when compiling units or programs. Note that the debugger will not work unless debugging information is generated for the program.

Directories Presents a dialog where the various directories needed by the compiler can be set. These directories will be used when a program or unit is compiled.

Browser Presents a dialog where the browser options can be set. The browser options affect the behavior of the symbol browser of the IDE.

Tools Presents a dialog to configure the tools menu. For more information, see section 6.10.5, page 69.

Environment Presents a dialog to configure the behavior of the IDE. A sub menu is presented with the various aspects of the IDE:

Preferences General preferences, such as whether to save files automatically or not, and which files should be saved. The video mode can also be set here.

Editor Controls various aspects of the edit windows.

CodeComplete Used to set the words which can be automatically completed when typing in the editor windows.

Codetemplates Used to define code templates, which can be inserted in an edit window.

Desktop Used to control the behavior of the desktop, i.e. several features can be switched on or off.

Keyboard & Mouse Can be used to select the cut/copy/paste convention, control the actions of the mouse, and to assign commands to various mouse actions.

Learn keys Let the IDE learn keystrokes to be assigned to various commands. This is useful mostly on LINUX and Unix-like platforms, where the actual keys sent to the IDE depend on the terminal emulation.

Open Presents a dialog in which a file containing editor preferences can be selected. After the dialog is closed, the preferences file will be read and the preferences will be applied.

Save Saves the current options in the default file.

Save as Saves the current options in an alternate file. A file selection dialog box will be presented in which the alternate settings file can be specified.

Please note that options are not saved automatically. They should be saved explicitly with the **"Options|Save"** command.

6.4.10 The Window menu

The **"Window"** menu provides access to some window functions. More information on all these functions can be found in section 6.3, page 44

Tile Tiles all opened windows on the desktop.

Cascade Cascades all opened windows on the desktop.

Close all Closes all opened windows.

Size/move (CTRL-F5) Puts the IDE in Size/move mode; after this command the active window can be moved and resized using the arrow keys.

Zoom (F5) Zooms or unzooms the current window.

Next (F6) Activates the next window in the window list.

Previous (SHIFT-F6) Activates the previous window in the window list.

Hide (CTRL-F6) Hides the active window.

Close (ALT-F3) Closes the active window.

List (ALT-0) Shows the list of opened windows. From there a window can be activated, closed, shown and hidden.

Refresh display Redraws the screen.

6.4.11 The Help menu

The **"Help"** menu provides entry points to all the help functionality of the IDE, as well as the means to customize the help system.

Contents Shows the help table of contents

Index (SHIFT-F1) Jumps to the help Index.

Topic search (CTRL-F1) Jumps to the topic associated with the currently highlighted text.

Previous topic (ALT-F1) Jumps to the previously visited topic.

Using help Displays help on using the help system.

Files Allows the configuration of the help menu. With this menu item, help files can be added to the help system.

About Displays information about the IDE. See section 6.13.3, page 90 for more information.

6.5 Editing text

In this section, the basics of editing (source) text are explained. The IDE works like many other text editors in this respect, so mainly the distinguishing points of the IDE will be explained.

6.5.1 Insert modes

Normally, the IDE is in insert mode. This means that any text that is typed will be inserted before text that is present after the cursor.

In overwrite mode, any text that is typed will replace existing text.

When in insert mode, the cursor is a flat blinking line. If the IDE is in overwrite mode, the cursor is a cube with the height of one line. Switching between insert mode and overwrite mode happens with the INSERT key or with the CTRL-V key.

6.5.2 Blocks

The IDE handles selected text just as the Turbo Pascal IDE handles it. This is slightly different from the way e.g. WINDOWS applications handle selected text.

Text can be selected in 3 ways:

1. Using the mouse, dragging the mouse over existing text selects it.
2. Using the keyboard, press CTRL-K B to mark the beginning of the selected text, and CTRL-K K to mark the end of the selected text.
3. Using the keyboard, hold the SHIFT key depressed while navigating with the cursor keys.

There are also some special select commands:

1. The current line can be selected using CTRL-K L.
2. The current word can be selected using CTRL-K T.

In the Free Pascal IDE, selected text is persistent. After selecting a range of text, the cursor can be moved, and the selection will not be destroyed; hence the term 'block' is more appropriate for the selection, and will be used henceforth...

Several commands can be executed on a block:

- Move the block to the cursor location (CTRL-K V).
- Copy the block to the cursor location (CTRL-K C).
- Delete the block (CTRL-K Y).
- Write the block to a file (CTRL-K W).
- Read the contents of a file into a block (CTRL-K R). If there is already a block, this block is not replaced by this command. The file is inserted at the current cursor position, and then the inserted text is selected.
- Indent a block (CTRL-K I).
- Undent a block (CTRL-K U).
- Print the block contents (CTRL-K P).

When searching and replacing, the search can be restricted to the block contents.

6.5.3 Setting bookmarks

The IDE provides a feature which allows the setting of a bookmark at the current cursor position. Later, the cursor can be returned to this position by pressing a keyboard shortcut.

Up to 9 bookmarks per source file can be set up; they are set by CTRL-K <NUMBER> (where number is the number of the bookmark). To go to a previously set bookmark, press CTRL-Q <NUMBER>.

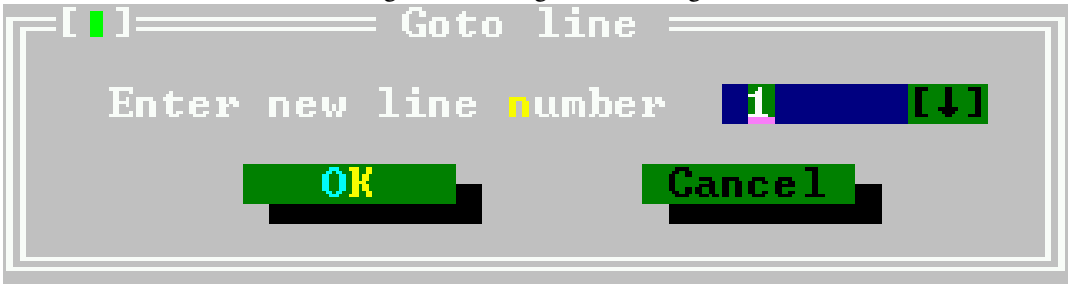
Remark Currently, the bookmarks are not saved when the IDE is exited. This may change in future implementations of the IDE.

6.5.4 Jumping to a source line

It is possible to go directly to a specific source line. To do this, open the *goto line* dialog via the **"Search|Goto line number"** menu.

In the dialog that appears, the line number the IDE should jump to can be entered. The goto line dialog is shown in figure (6.4).

Figure 6.4: The goto line dialog.



6.5.5 Syntax highlighting

The IDE is capable of syntax highlighting, i.e. the color of certain Pascal elements can be set. As text is entered in an editor window, the IDE will try to recognize the elements, and set the color of the text accordingly.

The syntax highlighting can be customized in the colors preferences dialog, using the menu option **"Options|Environment|Colors"**. In the colors dialog, the group "Syntax" must be selected. The item list will then display the various syntactical elements that can be colored:

Whitespace The empty text between words. Note that for whitespace, only the background color will be used.

Comments All styles of comments in Free Pascal.

Reserved words All reserved words of Free Pascal. (See also Reference Guide).

Strings Constant string expressions.

Numbers Numbers in decimal notation.

Hex numbers Numbers in hexadecimal notation.

Assembler Any assembler blocks.

Symbols Recognised symbols (variables, types).

Directives Compiler directives.

Tabs Tab characters in the source can be given a different color than other whitespace.

The editor uses some default settings, but experimentation is the best way to find a suitable color scheme. A good color scheme helps in detecting errors in sources, since errors will result in wrong syntax highlighting.

6.5.6 Code Completion

Code completion means the editor will try to guess the text as it is being typed. It does this by checking what text is typed, and as soon as the typed text can be used to identify a keyword in a list of keywords, the keyword will be presented in a small colored box under the typed text. Pressing the ENTER key will complete the word in the text.

There is no code completion yet for filling in function arguments, or choosing object methods as in e.g. the Lazarus or Delphi IDEs.

Code completion can be customized in the Code completion dialog, reachable through the menu option **"Options|Preferences|Codecomple"**. The list of keywords that can be completed can be maintained here. The code completion dialog is shown in figure (6.5).

The dialog shows in alphabetical order the currently defined keywords that are available for completion. The following buttons are available:

Ok Saves all changes and closes the dialog.

Edit Pops up a dialog that allows the editing of the currently highlighted keyword.

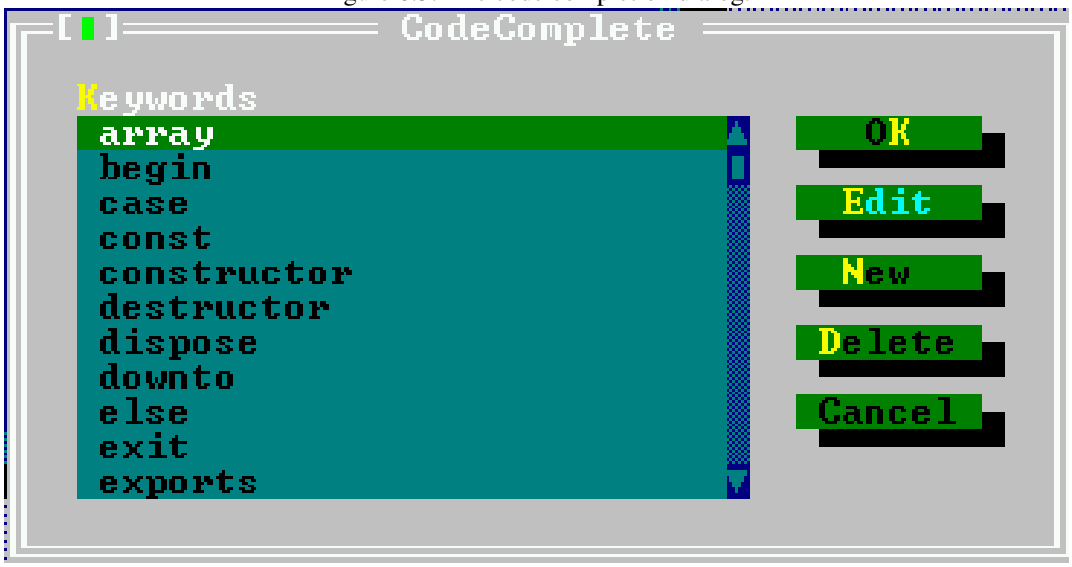
New Pops up a dialog that allows the entry of a new keyword which will be added to the list.

Delete Deletes the currently highlighted keyword from the list.

Cancel Discards all changes and closes the dialog.

All keywords are saved and are available the next time the IDE is started. Duplicate names are not allowed. If an attempt is made to add a duplicate name to the list, an error will follow.

Figure 6.5: The code completion dialog.



6.5.7 Code Templates

Code templates are a way to insert large pieces of code at once. Each code templates is identified by a unique name. This name can be used to insert the associated piece of code in the text.

For example, the name `ifthen` could be associated to the following piece of code:

```
If | Then
  begin
  end
```

A code template can be inserted by typing its name, and pressing CTRL-J when the cursor is positioned right after the template name.

If there is no template name before the cursor, a dialog will pop up to allow selection of a template.

If a vertical bar (|) is present in the code template, the cursor is positioned on it, and the vertical bar is deleted. In the above example, the cursor would be positioned between the `if` and `then`, ready to type an expression.

Code templates can be added and edited in the code templates dialog, reachable via the menu option **"Options|Environment|CodeTemplates"**. The code templates dialog is shown in figure (6.6).

The top listbox in the code templates dialog shows the names of all known templates. The bottom half of the dialog shows the text associated with the currently highlighted code template. The following buttons are available:

Ok Saves all changes and closes the dialog.

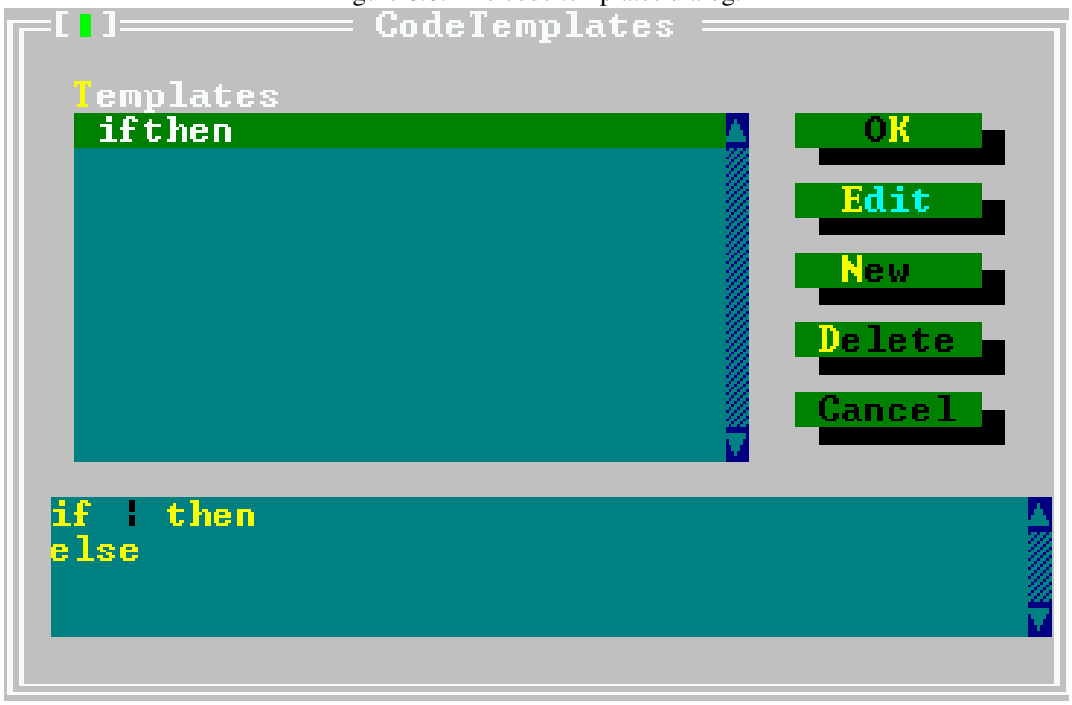
Edit Pops up a dialog that allows the editing of the currently highlighted code template. Both the name and text can be edited.

New Pops up a dialog that allows the entry of a new code template which will be added to the list. A name must be entered for the new template.

Delete Deletes the currently highlighted code template from the list.

Cancel Discards all changes and closes the dialog.

Figure 6.6: The code templates dialog.



All templates are saved and are available the next time the IDE is started.

Remark Duplicates are not allowed. If an attempt is made to add a duplicate name to the list, an error will occur.

6.6 Searching and replacing

The IDE allows you to search for text in the active editor window. To search for text, one of the following can be done:

1. Select **"Search|Find"** in the menu.
2. Press CTRL-Q F.

After that, the dialog shown in figure (6.7) will pop up, and the following options can be entered:

Text to find The text to be searched for. If a block was active when the dialog was started, the first line of this block is proposed.

Case sensitive When checked, the search is case sensitive.

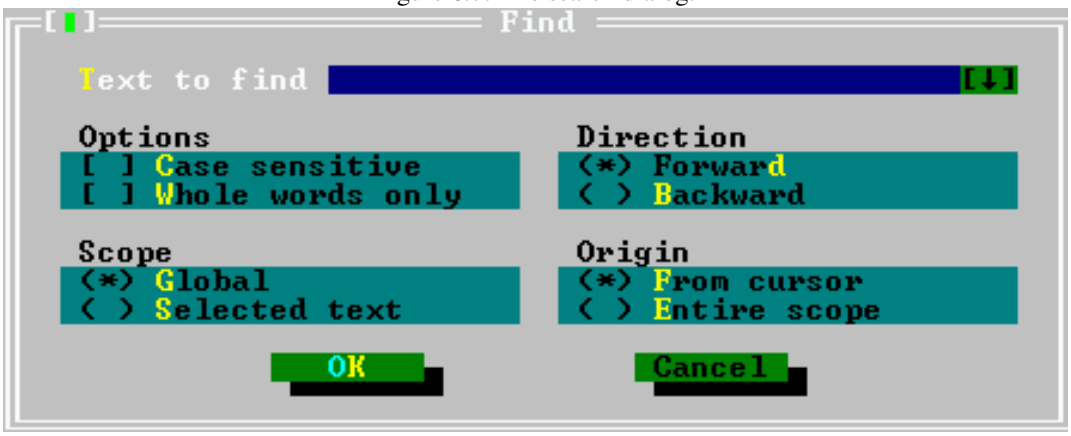
Whole words only When checked, the search text must appear in the text as a complete word.

Direction The direction in which the search must be conducted, starting from the specified origin.

Scope Specifies if the search should be on the whole file, or just the selected text.

Origin Specifies if the search should start from the cursor position or the start of the scope.

Figure 6.7: The search dialog.



After the dialog has closed, the search is performed using the given options.

A search can be repeated (using the same options) in one of 2 ways:

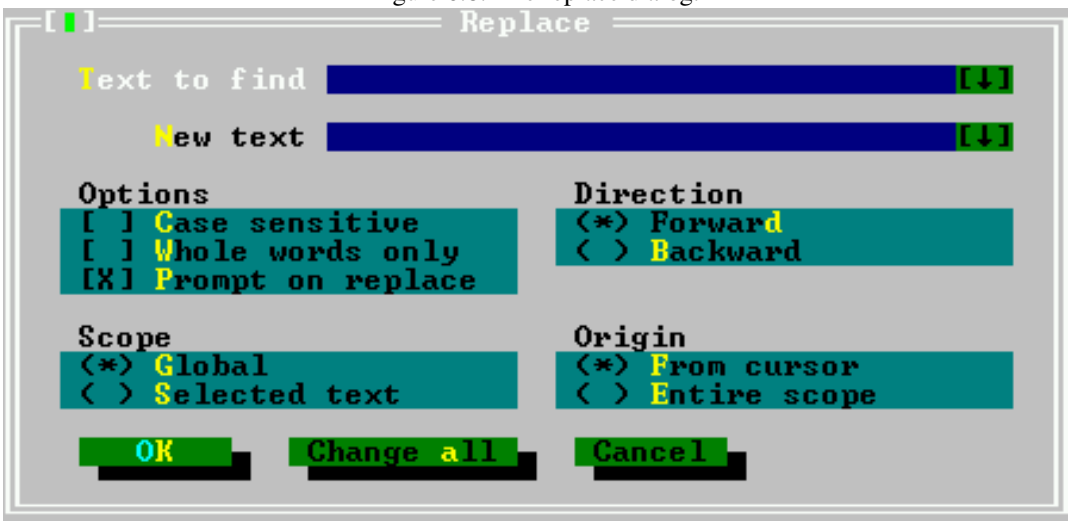
1. Select **"Search|Search again"** from the menu.
2. Press CTRL-L.

It is also possible to replace occurrences of a text with another text. This can be done in a similar manner to searching for a text:

1. Select **"Search|Replace"** from the menu.
2. Press CTRL-Q A.

A dialog, similar to the search dialog will pop up, as shown in figure (6.8).

Figure 6.8: The replace dialog.



In this dialog, in addition to the things that can be entered in the search dialog, the following things can be entered:

New text Text that will replace the found text.

Prompt on replace Before a replacement is made, the IDE will ask for confirmation.

If the dialog is closed with the 'OK' button, only the next occurrence of the search text will be replaced. If the dialog is closed with the 'Change All' button, all occurrences of the search text will be replaced.

6.7 The symbol browser

The symbol browser allows searching all occurrences of a symbol. A symbol can be a variable, type, procedure or constant that occurs in the program or unit sources.

To enable the symbol browser, the program or unit must be compiled with browser information. This can be done by setting the browser information options in the compiler options dialog.

The IDE allows to browse several types of symbols:

Procedures Allows quick jumping to a procedure definition or implementation.

Objects Quickly browse for an object.

Modules Browse a module.

Globals Browse any global symbol.

Arbitrary symbol Browse an arbitrary symbol.

In all cases, first a symbol to be browsed must be selected. After that, a browse window appears. In the browse window, all locations where the symbol was encountered are shown. Selecting a location and pressing the space bar will cause the editor to jump to that location; the line containing the symbol will be highlighted.

If the location is in a source file that is not yet displayed, a new window will be opened with the source file loaded.

After the desired location has been reached, the browser window can be closed with the usual commands.

The behavior of the browser can be customized with the browser options dialog, using the **"Options|Browser"** menu. The browser options dialog looks like figure (6.9).

The following options can be set in the browser options dialog:

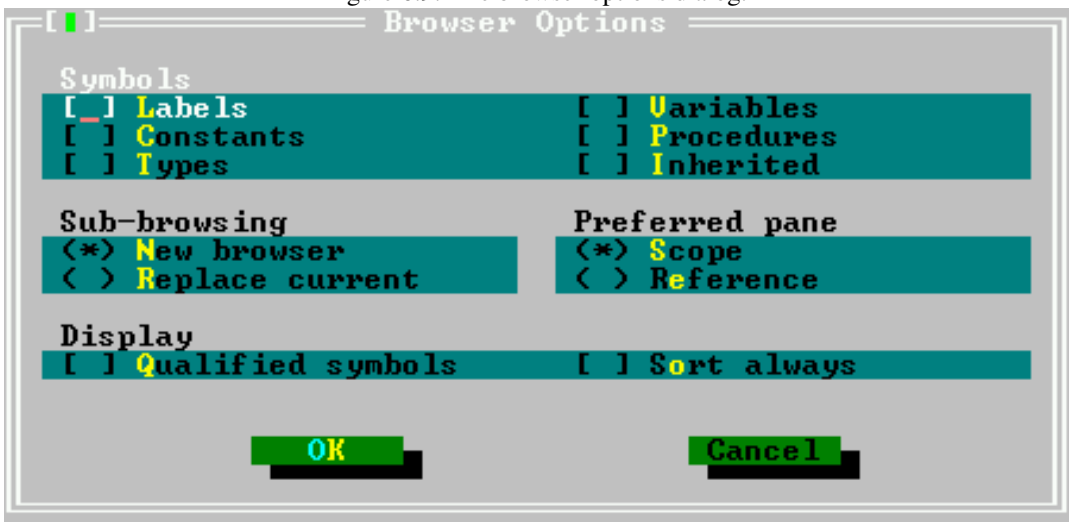
Symbols Here the types of symbols displayed in the browser can be selected:

- **Labels** Labels are shown.
- **Constants** Constants are shown.
- **Types** Types are shown.
- **Variables** Variables are shown.
- **Procedures** Procedures are shown.
- **Inherited**

Sub-browsing Specifies what the browser should do when displaying the members of a complex symbol such as a record or class:

- **New browser** The members are shown in a new browser window.

Figure 6.9: The browser options dialog.



Replace current The contents of the current window are replaced with the members of the selected complex symbol.

Preferred pane Specifies what pane is shown in the browser when it is initially opened:

Scope

Reference

Display Determines how the browser should display the symbols:

Qualified symbols

Sort always Sorts the symbols in the browser window.

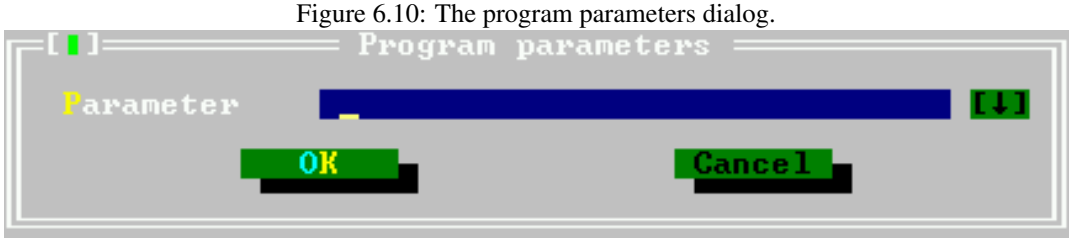
6.8 Running programs

A compiled program can be run straight from the IDE. This can be done in one of several ways:

1. select the **"Run|Run"** menu, or
2. press CTRL-F9.

If command line parameters should be passed to the program, then these can be set through the **"Run|Parameters"** menu. The program parameters dialog looks like figure (6.10).

Figure 6.10: The program parameters dialog.



Once the program has started, it will continue to run, until

1. the program quits normally,
2. an error happens,
3. a breakpoint is encountered, or
4. the program is reset by the user.

The last alternative is only possible if the program is compiled with debug information.

Alternatively, it is possible to position the cursor somewhere in a source file, and run the program till the execution reaches the source line where the cursor is located. This can be done by

1. selecting **"Run|Goto Cursor"** in the menu,
2. pressing F4.

Again, this is only possible if the program was compiled with debug information.

The program can also executed line by line. Pressing F8 will execute the next line of the program. If the program wasn't started yet, it is started. Repeatedly pressing F8 will execute the program line by line, and the IDE will show the line to be executed in an editor window. If somewhere in the code a call occurs to a subroutine, then pressing F8 will cause the whole routine to be executed before control returns to the IDE. If the code of the subroutine should be stepped through as well, then F7 should be used instead. Using F7 will cause the IDE to execute line by line any subroutine that is encountered.

If a subroutine is being stepped through, then the **"Run|Until return"** menu will execute the program till the current subroutine ends.

If the program should be stopped before it quits by itself, then this can be done by

1. selecting **"Run|Program reset"** from the menu, or
2. pressing CTRL-F2.

The running program will then be aborted.

6.9 Debugging programs

To debug a program, it must be compiled with debug information. Compiling a program with debug information allows you to:

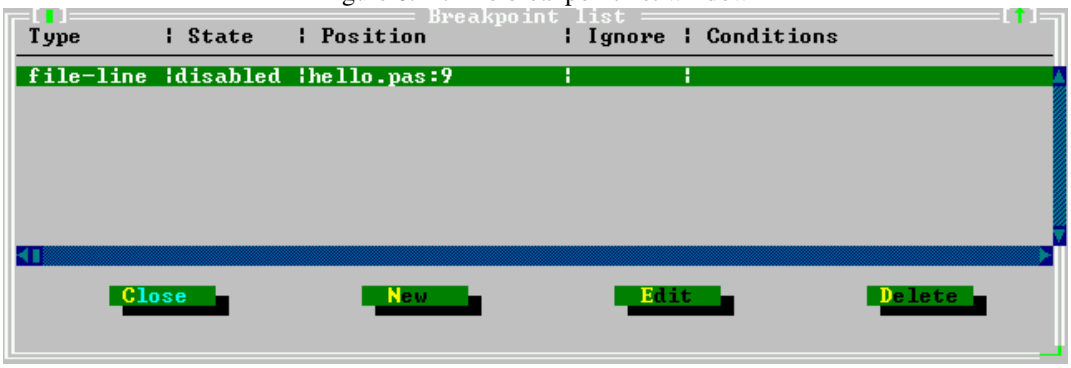
1. Execute the program line by line.
2. Run the program up to a certain point (a breakpoint).
3. Inspect the contents of variables or memory locations while the program is running.

6.9.1 Using breakpoints

Breakpoints will cause a running program to stop when the execution reaches the line where the breakpoint was set. At that moment, control is returned to the IDE, and it is possible to continue execution.

To set a breakpoint on the current source line, use the **"Debug|Breakpoint"** menu entry, or press CTRL-F8.

Figure 6.11: The breakpoint list window



A list of current breakpoints can be obtained through the **"Debug|Breakpoint list"** menu. The breakpoint list window is shown in figure (6.11).

In the breakpoint list window, the following things can be done:

New Shows the breakpoint property dialog where the properties for a new breakpoint can be entered.

Edit Shows the breakpoint property dialog where the properties of the highlighted breakpoint can be changed.

Delete Deletes the highlighted breakpoint.

The dialog can be closed with the 'Close' button. The breakpoint properties dialog is shown in figure (6.12)

Figure 6.12: The breakpoint properties dialog



The following properties can be set:

Type Set the type of the breakpoint. The following types of breakpoints exist:

function Function breakpoint. The program will stop when the function with the given name is reached.

file-line Source line breakpoint. The program will stop when the source file with given name and line is reached.

watch Expression breakpoint. An expression may be entered, and the program will stop as soon as the expression changes.

awatch (access watch) Expression breakpoint. An expression that references a memory location may be entered, and the program will stop as soon as the memory indicated by the expression is accessed.

Address stop as soon as an address is reached.

rwatch (read watch) Expression breakpoint. An expression that references a memory location may be entered, and the program will stop as soon as the memory indicated by the expression is read.

Name Name of the function or file where to stop.

Conditions Here an expression can be entered which must evaluate to `True` for the program to stop at the breakpoint. The expressions that can be entered must be valid GDB expressions.

Line Line number in the file where to stop. Only for breakpoints of type file-line.

Ignore count The number of times the breakpoint will be ignored before the program stops.

Remark

1. Because the IDE uses GDB to do its debugging, it is necessary to enter all expressions in *uppercase*.
2. Expressions that reference memory locations should be no longer than 16 bytes on LINUX or go32v2 on an Intel processor, since the Intel processor's debug registers are used to monitor these locations.
3. Memory location watches will not function on Win32 unless a special patch is applied.

6.9.2 Using watches

When debugging information is compiled in the program, watches can be used. Watches are expressions which can be evaluated by the IDE and shown in a separate window. When program execution stops (e.g. at a breakpoint) all watches will be evaluated and their current values will be shown.

Setting a new watch can be done with the **"Debug|Add watch"** menu command or by pressing CTRL-F7. When this is done, the watch property dialog appears, and a new expression can be entered. The watch property dialog is shown in figure (6.13).

In the dialog, the expression can be entered. Any possible previous value and current value are shown.

Remark Because the IDE uses GDB to do its debugging, it is necessary to enter all expressions in *uppercase* in FREEBSD.

A list of watches and their present value is available in the watches window, which can be opened with the **"Debug|Watches"** menu. The watch list window is shown in figure (6.14).

Pressing ENTER or the space bar will show the watch property dialog for the currently highlighted watch in the watches window.

The list of watches is updated whenever the IDE resumes control when debugging a program.

Figure 6.13: The watch property dialog

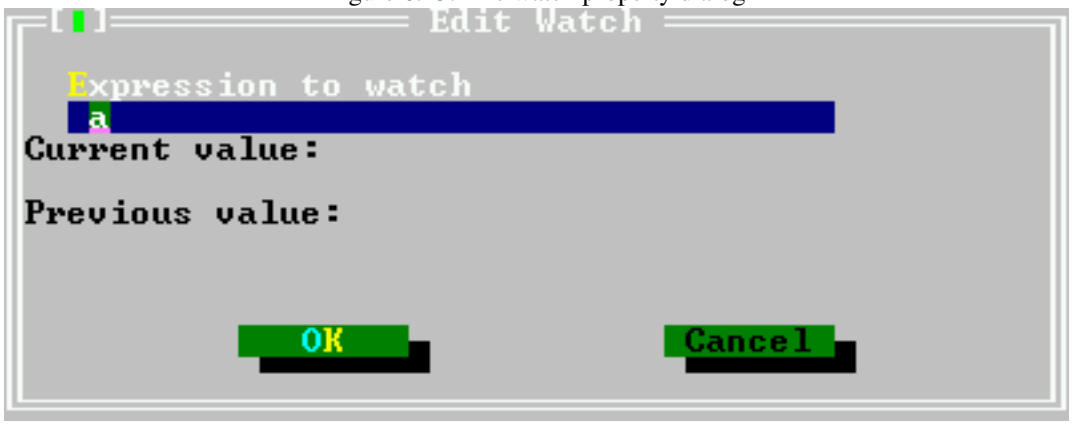
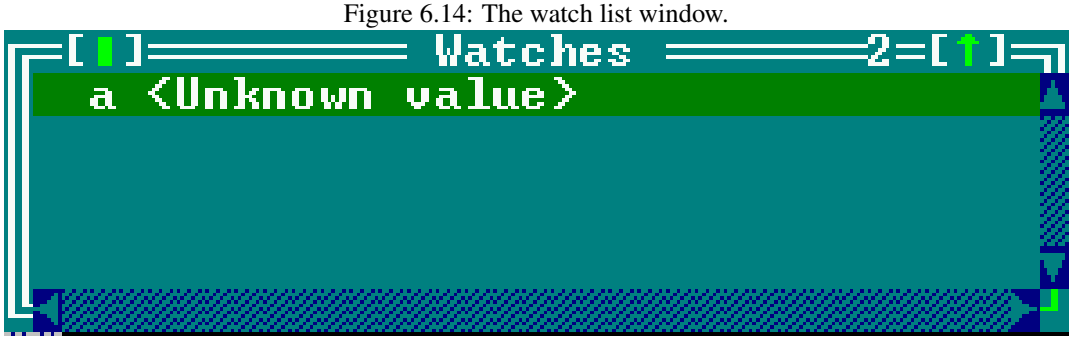


Figure 6.14: The watch list window.



6.9.3 The call stack

The call stack helps in showing the program flow. It shows the list of procedures that are being called at this moment, in reverse order. The call stack window can be shown using the **"Debug|Call Stack"** menu. It will show the address or procedure name of all currently active procedures with their filename and addresses. If parameters were passed they will be shown as well. The call stack is shown in figure (6.15).

By pressing the space bar in the call stack window, the line corresponding to the call will be highlighted in the edit window.

6.9.4 The GDB window

The GDB window provides direct interaction with the GDB debugger. In it, GDB commands can be typed as they would be typed in GDB. The response of GDB will be shown in the window.

Some more information on using GDB can be found in section 10.2, page 122, but the final reference is of course the GDB manual itself [3]. The GDB window is shown in figure (6.16).

[3] Available from the Free Software Foundation website.

Figure 6.15: The call stack window.

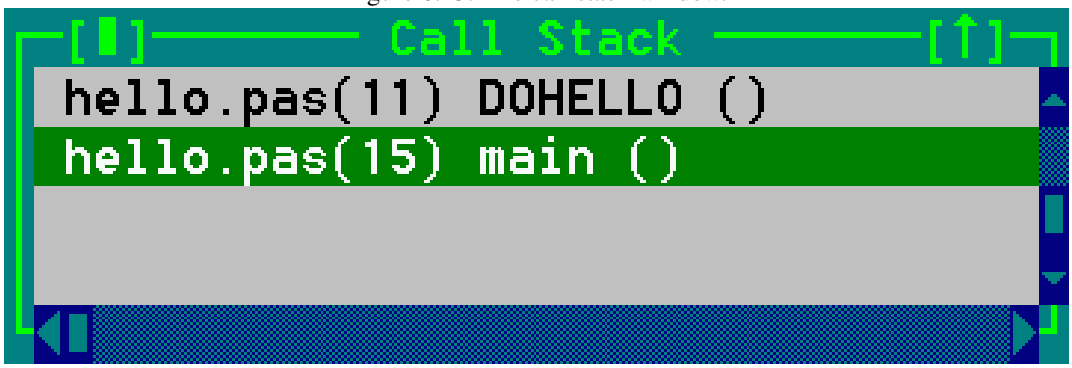
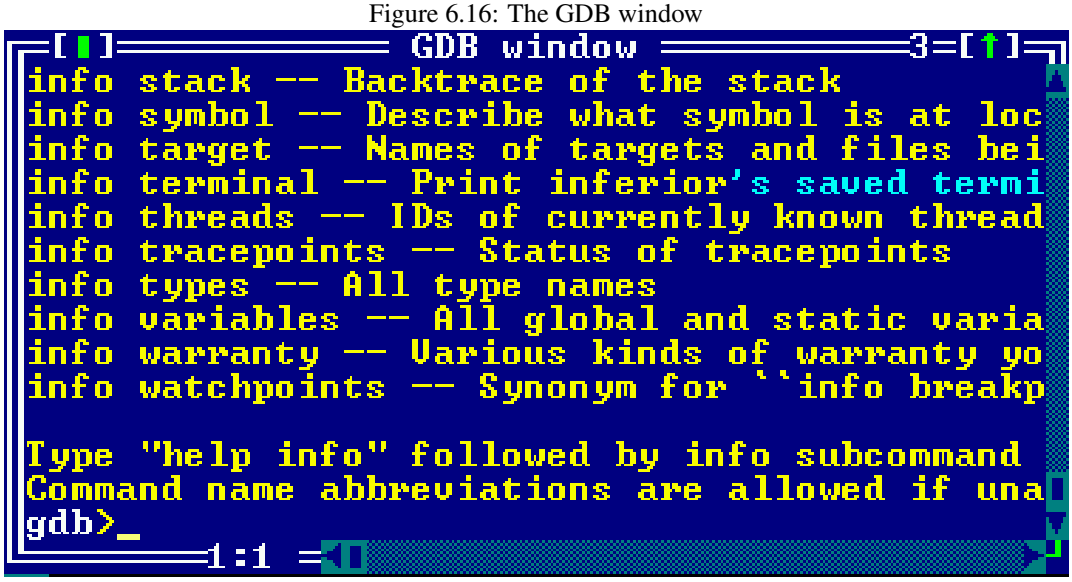


Figure 6.16: The GDB window



6.10 Using Tools

The tools menu provides easy access to external tools. It also has three predefined tools for programmers: an ASCII table, a grep tool and a calculator. The output of the external tools can be accessed through this menu as well.

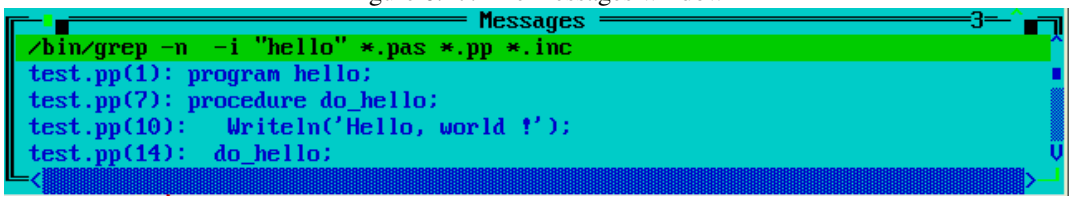
6.10.1 The messages window

The output of the external utilities is redirected by the IDE and it will be displayed in the messages window. The messages window is displayed automatically, if an external tool was run. The messages window can also be displayed manually by selecting the menu item **"Tools|Messages"** or by pressing the F11 key. The messages window is shown in figure (6.17).

If the output of the tool contains filenames and line numbers, the messages window can be used to navigate the source as in a browse window:

1. Pressing ENTER or double clicking the output line will jump to the specified source line and close the messages window.

Figure 6.17: The messages window



2. Pressing the space bar will jump to the specified source line, but will leave the messages window open, with the focus on it. This allows the quick selection of another message line with the arrow keys and jump to another location in the sources.

The algorithm which extracts the file names and line numbers from the tool output is quite sophisticated, but in some cases it may fail[4].

6.10.2 Grep

One external tool in the Tools menu is already predefined: a menu item to call the grep utility (**"Tools|Grep"** or SHIFT-F2). Grep searches for a given string in files and returns the lines which contain the string. The search string can even be a regular expression. For this menu item to work, the grep program must be installed, since it is not distributed with Free Pascal.

The messages window displayed in figure (6.17) in the previous section shows the output of a typical grep session. The messages window can be used in combination with grep to find special occurrences in the text.

Grep supports regular expressions. A regular expression is a string with special characters which describe a whole class of expressions. The command line in DOS or LINUX has limited support for regular expressions: entering `ls *.pas` (or `dir *.pas`) to get a list of all Pascal files in a directory. *.pas is something similar to a regular expression. It uses a wildcard to describe a whole class of strings: those which end on ".pas". Regular expressions offer much more: for example `[A-Z][0-9]+` describes all strings which begin with an upper case letter followed by one or more digits.

It is outside the scope of this manual to describe regular expressions in great detail. Users of a LINUX system can get more information on grep using `man grep` on the command line.

6.10.3 The ASCII table

The tools menu also provides an ASCII table (**"Tools|Ascii table"**). The ASCII table can be used to look up ASCII codes as well as to insert characters into the window which was active when invoking the table.

To reveal the ASCII code of a character in the table, move the cursor onto this character or click it with the mouse. The decimal and hex values of the character are shown at the bottom on the ASCII table window.

To insert a character into an editor window either:

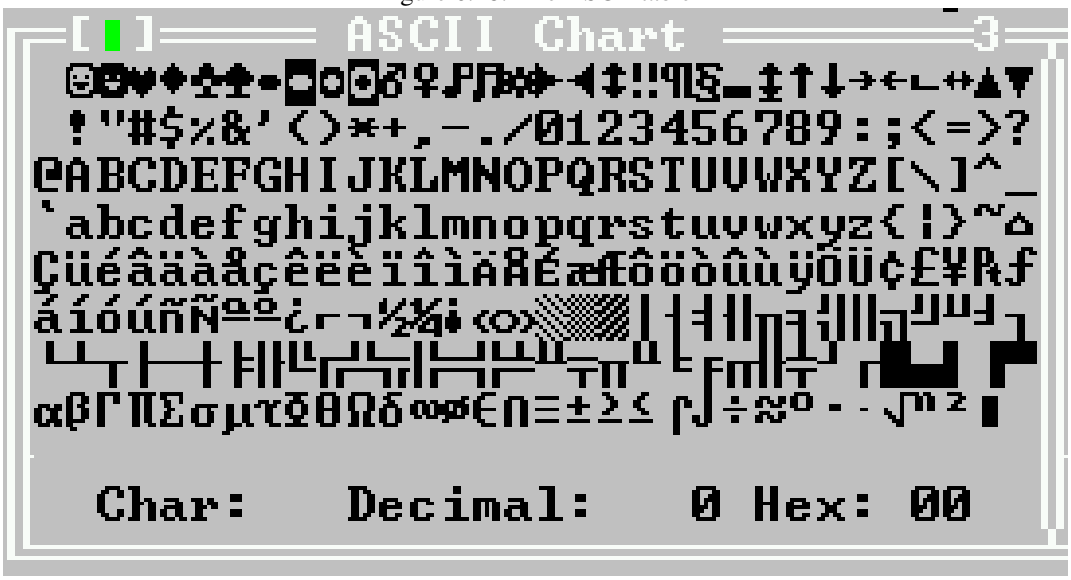
1. using the mouse, double click it, or,
2. using the keyboard, press ENTER while the cursor is on it.

[4] Suggestions for improvement, or better yet, patches that improve the algorithm, are always welcome.

This is especially useful for pasting graphical characters in a constant string.

The ASCII table remains active till another window is explicitly activated; thus multiple characters can be inserted at once. The ASCII table is shown in figure (6.18).

Figure 6.18: The ASCII table



6.10.4 The calculator

The calculator allows quick calculations without leaving the IDE. It is a simple calculator, since it does not take care of operator precedence, and bracketing of operations is not (yet) supported.

The result of the calculations can be pasted into the text using the CTRL-ENTER keystroke. The calculator dialog is shown in figure (6.19).

The calculator supports all basic mathematical operations such as addition, subtraction, division and multiplication. They are summarised in table (6.1).

Table 6.1: Basic mathematical operations

Operation	Button	Key
Add two numbers	+	+
Subtract two numbers		
Multiply two numbers	*	*
Divide two numbers	/	/
Delete the last typed digit	<–	BACKSPACE
Clear display	C	C
Change the sign	+	
Do per cent calculation	%	%
Get result of operation	=	ENTER

But also more sophisticated mathematical operations such as exponentiation and logarithms are supported. The advanced mathematical operations are shown in table (6.2).

Figure 6.19: The calculator dialog

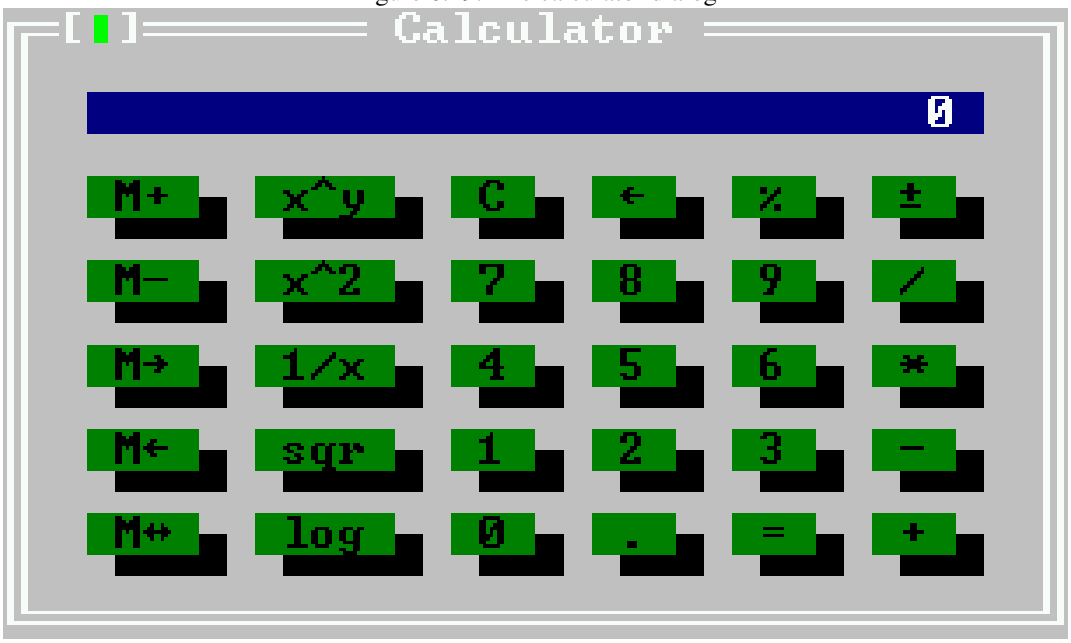


Table 6.2: Advanced mathematical operations

Operation	Button	Key
Calculate power	`x^y`	
Calculate the inverse value	`1/x`	
Calculate the square root	`sqr`	
Calculate the natural logarithm	`log`	
Square the display contents	`x^2`	

.

Like many calculators, the calculator in the IDE also supports storing a single value in memory, and several operations can be done on this memory value. The available operations are listed in table (6.3)

Table 6.3: Advanced calculator commands

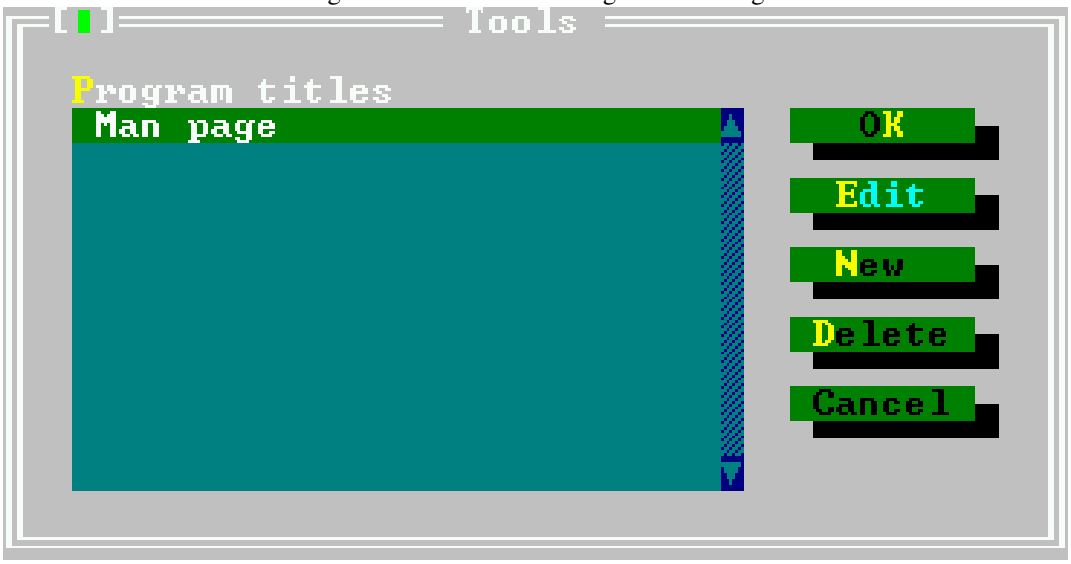
Operation	Button	Key
Add the displayed number to the memory	`M+`	
Subtract the displayed number from the memory	`M-`	
Move the memory contents to the display	`M->`	
Move the display contents to the memory	`M<-`	
Exchange display and memory contents	`M<->`	

6.10.5 Adding new tools

The tools menu can be extended with any external program which is command line oriented. The output of such a program will be caught and displayed in the messages window.

Adding a tool to the tools menu can be done using the **"Options|Tools"** menu. This will display the tools dialog. The tools dialog is shown in figure (6.20).

Figure 6.20: The tools configuration dialog



In the tools dialog, the following actions are available:

New Shows the tool properties dialog where the properties of a new tool can be entered.

Edit Shows the tool properties dialog where the properties of the highlighted tool can be edited.

Delete Removes the currently highlighted tool.

Cancel Discards all changes and closes the dialog.

OK Saves all changes and closes the dialog.

The definitions of the tools are written in the desktop configuration file. So unless auto-saving of the desktop file is enabled, the desktop file should be saved explicitly after the dialog is closed.

6.10.6 Meta parameters

When specifying the command line for the called tool, meta parameters can be used. Meta parameters are variables and they are replaced by their contents before passing the command line to the tool.

$CAP Captures the output of the tool.

$CAP_MSG() Captures the output of the tool and puts it in the messages window.

$CAP_EDIT() Captures the output of the tool and puts it in a separate editor window.

$COL Replaced by the column of the cursor in the active editor window. If there is no active window or the active window is a dialog, then it is replaced by 0.

$CONFIG Replaced by the complete filename of the current configuration file.

$DIR() Replaced by the full directory of the filename argument, including the trailing directory separator, e.g.

```
$DIR('d:\data\myfile.pas')
```

would return `d:\data\`.

$DRIVE() Replaced by the drive letter of the filename argument. e.g.

```
$DRIVE('d:\data\myfile.pas')
```

would return d:.

$EDNAME Replaced by the complete file name of the file in the active edit window. If there is no active edit window, this is an empty string.

$EXENAME Replaced by the executable name that would be created if the make command was used. (i.e. from the 'Primary File' setting or the active edit window).

$EXT() Replaced by the extension of the filename argument. The extension includes the dot. e.g.

```
$EXT('d:\data\myfile.pas')
```

would return .pas.

$LINE Replaced by the line number of the cursor in the active edit window. If no edit window is present or active, this is 0.

$NAME() Replaced by the name part (excluding extension and dot) of the filename argument. e.g.

```
$NAME('d:\data\myfile.pas')
```

would return myfile.

$NAMEEXT() Replaced by the name and extension part of the filename argument. e.g.

```
$NAMEEXT('d:\data\myfile.pas')
```

would return myfile.pas.

$NOSWAP Does nothing in the IDE; it is provided only for compatibility with Turbo Pascal.

$PROMPT() Prompt displays a dialog box that allows editing of all arguments that come after it. Arguments that appear before the `$PROMPT` keyword are not presented for editing.

`$PROMPT()` can also take an optional filename argument. If present, `$PROMPT()` will load a dialog description from the filename argument. E.g.

```
$PROMPT(cvsco.tdf)
```

would parse the file cvsco.tdf, construct a dialog with it and display it. After the dialog closed, the information entered by the user is used to construct the tool command line.

See section 6.10.7, page 71 for more information on how to create a dialog description.

$SAVE Before executing the command, the active editor window is saved, even if it is not modified.

$SAVE_ALL Before executing the command, all unsaved editor files are saved without prompting.

$SAVE_CUR Before executing the command the contents of the active editor window are saved without prompting if they are modified.

$SAVE_PROMPT Before executing the command, a dialog is displayed asking whether any unsaved files should be saved before executing the command.

$WRITEMSG() Writes the parsed tool output information to a file with name as in the argument.

6.10.7 Building a command line dialog box

When defining a tool, it is possible to show a dialog to the user, asking for additional arguments, using the `$PROMPT(filename)` command-macro. The Free Pascal distribution contains some ready-made dialogs, such as a 'grep' dialog, a 'cvs checkout' dialog and a 'cvs check in' dialog. The files for these dialogs are in the binary directory and have an extension .tdf.

In this section, the file format for the dialog description file is explained. The format of this file resembles a windows .INI file, where each section in the file describes an element (or control) in the dialog. An `OK` and a `Cancel` button will be added to the bottom of the dialog, so these should not be specified in the dialog definition.

A special section is the `Main` section. It describes how the result of the dialog will be passed to the command line, and the total size of the dialog.

Remark Keywords that contain a string value should have the string value enclosed in double quotes as in

```
Title="Dialog title"
```

The `Main` section should contain the following keywords:

Title The title of the dialog. This will appear in the frame title of the dialog. The string should be enclosed in quotes.

Size The size of the dialog, this is formatted as `(Cols,Rows)`, so

```
Size=(59,9)
```

means the dialog is 59 characters wide, and 9 lines high. This size does not include the border of the dialog.

CommandLine specifies how the command line will be passed to the program, based on the entries made in the dialog. The text typed here will be passed on after replacing some control placeholders with their values.

A control placeholder is the name of some control in the dialog, enclosed in percent (`%`) characters. The name of the control will be replaced with the text associated with the control. Consider the following example:

```
CommandLine="-n %l% %v% %i% %w% %searchstr% %filemask%"
```

Here the values associated with the controls named `l, v, i, w` and `searchstr` and `filemask` will be inserted in the command line string.

Default The name of the control that is the default control, i.e. the control that is to have the focus when the dialog is opened.

The following is an example of a valid main section:

```
[Main]
Title="GNU Grep"
Size=(56,9)
CommandLine="-n %l% %v% %i% %w% %searchstr% %filemask%"
Default="searchstr"
```

After the `Main` section, a section must be specified for each control that should appear on the dialog. Each section has the name of the control it describes, as in the following example:

```
[CaseSensitive]
Type=CheckBox
Name="~C~ase sensitive"
Origin=(2,6)
Size=(25,1)
Default=On
On="-i"
```

Each control section must have at least the following keywords associated with it:

Type The type of control. Possible values are:

Label A plain text label which will be shown on the dialog. A control can be linked to this label, so it will be focused when the user presses the highlighted letter in the label caption (if any).

InputLine An edit field where a text can be entered.

CheckBox A checkbox which can be in an on or off state.

Origin Specifies where the control should be located in the dialog. The origin is specified as `(left,top)` and the top-left corner of the dialog has coordinate `(1,1)` (not counting the frame).

Size Specifies the size of the control, which should be specified as `(Cols,Rows)`.

Each control has some specific keywords associated with it; they will be described below.

A label (`Type=Label`) has the following extra keywords associated with it:

Text the text displayed in the label. If one of the letters should be highlighted so it can be used as a shortcut, then it should be enclosed in tilde characters (~). E.g. in

```
Text="~T~ext to find"
```

the `T` will be highlighted.

Link The name of a control in the dialog may be specified. If specified, pressing the label's highlighted letter in combination with the ALT key will put the focus on the control specified here.

A label does not contribute to the text of the command line; it is for informational and navigational purposes only. The following is an example of a label description section:

```
[label2]
Type=Label
Origin=(2,3)
Size=(22,1)
Text="File ~m~ask"
Link="filemask"
```

An edit control (`Type=InputLine`) allows entry of arbitrary text. The text of the edit control will be pasted in the command line if it is referenced there. The following keyword can be specified in a inputline control section:

Value A standard value (text) for the edit control can be specified. This value will be filled in when the dialog appears.

The following is an example of an input line section:

```
[filemask]
Type=InputLine
Origin=(2,4)
Size=(22,1)
Value="*.pas *.pp *.inc"
```

A checkbox control (`Type=CheckBox`) presents a checkbox which can be in one of two states, `on` or `off`. With each of these states, a value can be associated which will be passed on to the command line. The following keywords can appear in a checkbox type section:

Name The text that appears after the checkbox. If there is a highlighted letter in it, this letter can be used to set or unset the checkbox using the ALT-letter combination.

Default Specifies whether the checkbox is checked or not when the dialog appears (value `on` or `off`).

On The text associated with this checkbox if it is in the checked state.

Off The text associated with this checkbox if it is in the unchecked state.

The following is an example of a valid checkbox description:

```
[i]
Type=CheckBox
Name="~C~ase sensitive"
Origin=(2,6)
Size=(25,1)
Default=On
On="-i"
```

If the checkbox is checked, then the value `-i` will be added on the command line of the tool. If it is unchecked, no value will be added.

6.11 Project management and compiler options

Project management in Pascal is much easier than with C. The compiler knows from the source which units, sources etc. it needs. So the Free Pascal IDE does not need a full featured project manager like some C development environments offer. Nevertheless there are some settings in the IDE which apply to projects.

6.11.1 The primary file

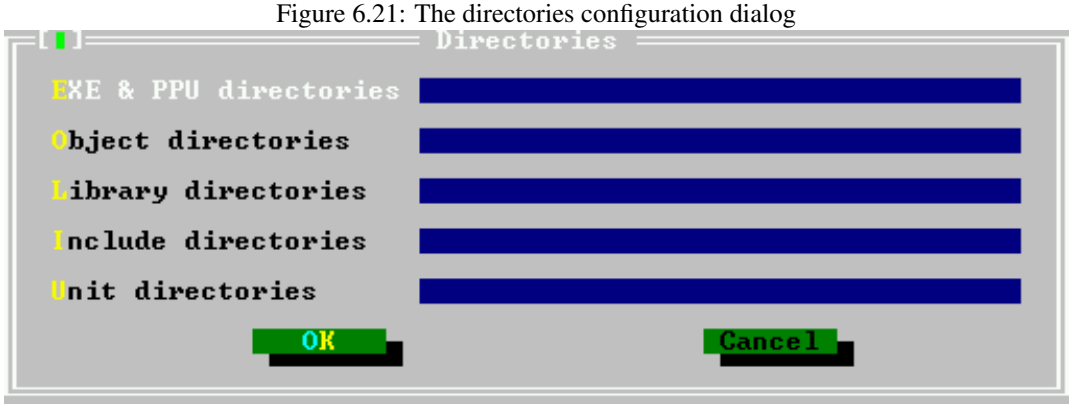
Without a primary file the IDE compiles/runs the source of the active window when a program is started. If a primary file is specified, the IDE always compiles/runs this source, even if another source window is active. With the menu item **"Compile|Primary file..."** a file dialog can be opened where the primary file can be selected. Only the menu item **"Compile|Compile"** compiles the active window regardless. This is useful if a large project is being edited, and only the syntax of the current source should be checked.

The menu item **"Compiler|Clear primary file"** restores the default behavior of the IDE, i.e. the 'compile' and 'run' commands apply to the active window.

6.11.2 The directory dialog

In the directory dialog, the directories can be specified where the compiler should look for units, libraries, object files. It also says where the output files should be stored. Multiple directories (except for the output directory) can be entered, separated by semicolons. The directories dialog is shown in figure (6.21).

Figure 6.21: The directories configuration dialog



The following directories can be specified:

EXE & PPU directories Specifies where the compiled units and executables will go. (`-FE` (see page 26) on the command line.)

Object directories Specifies where the compiler looks for external object files. (`-Fo` (see page 27) on the command line.)

Library directories Specifies where the compiler (more exactly, the linker) looks for external libraries. (`-Fl` (see page 26) on the command line.)

Include directories Specifies where the compiler will look for include files, included with the `{$i }` directive. (`-Fi` (see page 26) or `-I` (see page 27) on the command line.)

Unit directories Specifies where the compiler will look for compiled units. The compiler always looks first in the current directory, and also in some standard directories. (`-Fu` (see page 27) on the command line.)

6.11.3 The target operating system

The menu item **"Compile|Target"** allows specification of the target operating system for which the sources will be compiled. Changing the target doesn't affect any compiler switches or directories. It does affect some defines defined by the compiler. The settings here correspond to the option on the command line `-T` (see page 31). A sample compilation target dialog is shown in figure (6.22): the actual dialog will show only those targets that the IDE actually supports.

The following targets can be set (the list depends on the platform for which the IDE was compiled):

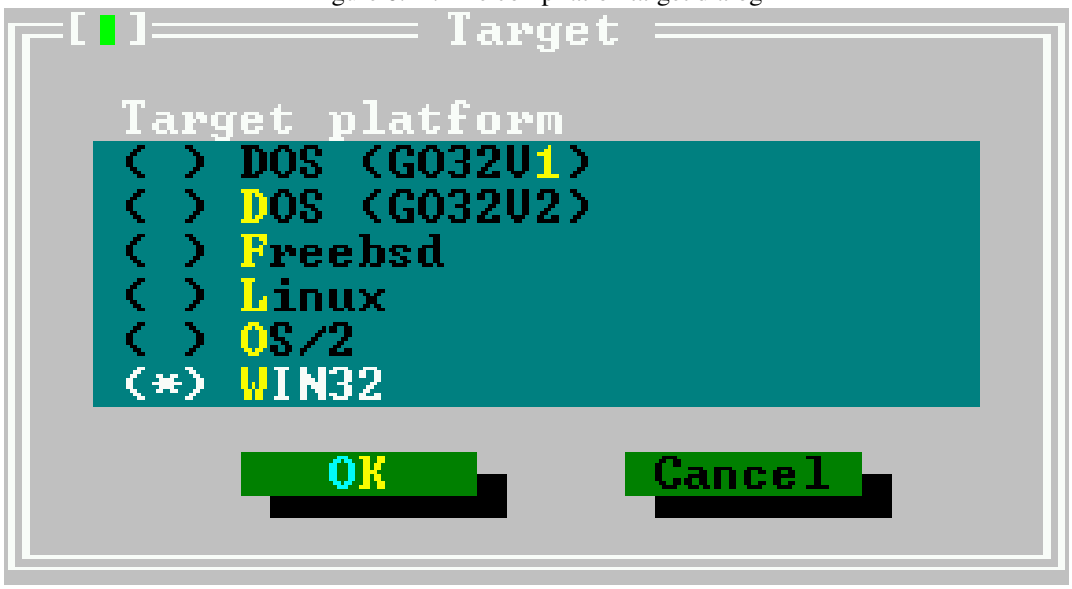
Dos (go32v1) This switch will disappear in time as this target is no longer being maintained.

Dos (go32v2) Compile for DOS, using version 2 of the Go32 extender.

FreeBSD Compile for FREEBSD.

Linux Compile for LINUX.

Figure 6.22: The compilation target dialog



OS/2 Compile for OS/2 (using the EMX extender).

Windows Compile for WINDOWS.

The currently selected target operating system is shown in the **"Target"** menu item in the **"Compile"** menu. Initially, this will be set to the operating system for which the IDE was compiled.

6.11.4 Compiler options

The menu **"Options|Compiler"** allow the setting of options that affect the compilers behavior. When this menu item is chosen, a dialog pops up that displays several tabs.

There are six tabs:

Syntax Here options can be set that affect the various syntax aspects of the code. They correspond mostly to the `-S` option on the command line (section 5.1.5, page 33).

Code generation These options control the generated code; they are mostly concerned with the `-C` and `-X` command line options.

Verbose These set the verbosity of the compiler when compiling. The messages of the compiler are shown in the compiler messages window (can be called with F12).

Browser Options concerning the generated browser information. Browser information needs to be generated for the symbol browser to work.

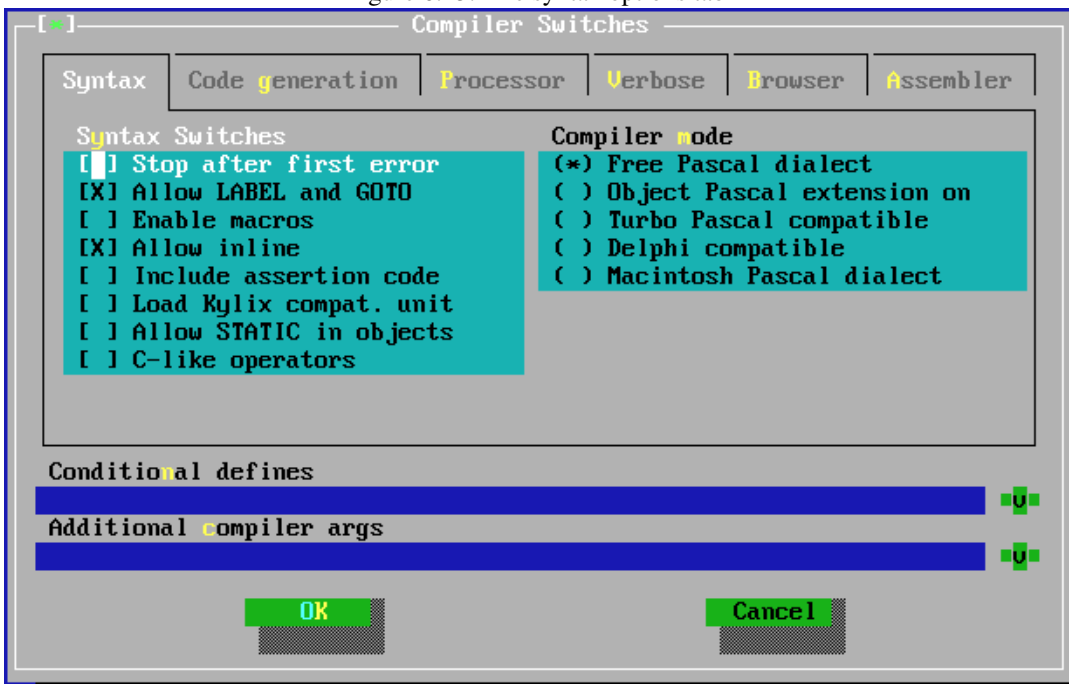
Assembler Options concerning the reading of assembler blocks (-R on the command line) and the generated assembler (`-A` on the command line)

Processor Here the target processor can be selected.

On each tab page, there are two entry boxes: the first for Conditional defines and the second for additional compiler arguments. The symbols, and arguments, should be separated with semi-colons.

The syntax tab of the compiler options dialog is shown in figure (6.23).

Figure 6.23: The syntax options tab



In the syntax options dialog, the following options can be set:

Stop after first error when checked, the compiler stops after the first error. Normally the compiler continues compiling till a fatal error is reached. (`-Se` (see page 34) on the command line)

Allow label and goto Allow the use of label declarations and goto statements (`-Sg` (see page 35) on the command line).

Enable macros Allow the use of macros (`-Sm` (see page 35)).

Allow inline Allow the use of inlined functions (`-Sc` (see page 34) on the command line).

Include assertion code Include `Assert` statements in the code.

Load kylix compat. unit Load the Kylix compatibility unit.

Allow STATIC in objects Allow the `Static` modifier for object methods (`-St` (see page 35) on the command line)

C-like operators Allows the use of some extended operators such as `+=, -=` etc. (`-Sc` (see page 34) on the command line).

Compiler mode select the appropriate compiler mode:

Free Pascal Dialect The default Free Pascal compiler mode (`FPC`).

Object pascal extensions on Enables the use of classes and exceptions (`-Sd` (see page 34) on the command line).

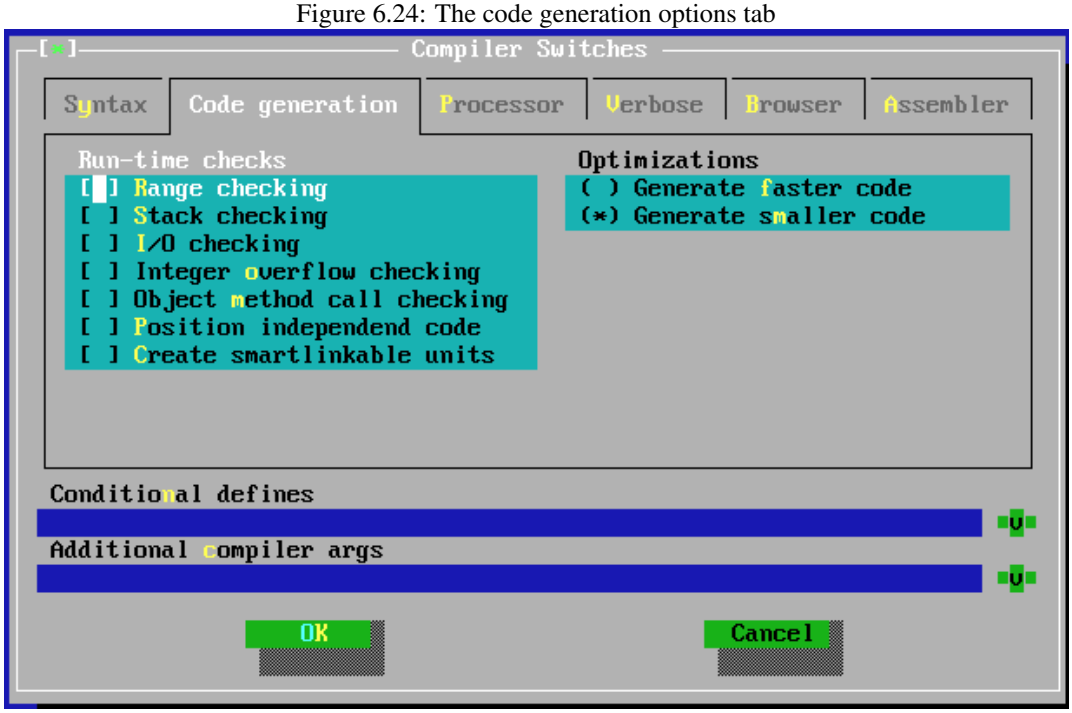
Turbo pascal compatible Try to be more Turbo Pascal compatible (`-So` (see page 35) on the command line).

Delphi compatible Try to be more Delphi compatible (`-Sd` (see page 34) on the command line).

Macintosh Pascal dialect Try to be Macintosh pascal compatible.

The code generation tab of the compiler options dialog is shown in figure (6.24).

Figure 6.24: The code generation options tab



In the code generation dialog, the following options can be set:

Run-time checks Controls what run-time checking code is generated. If such a check fails, a run-time error is generated. The following checking code can be generated:

Range checking Checks the results of enumeration and subset type operations (`-Cr` (see page 29) command line option).

Stack checking Checks whether the stack limit is not reached (`-Cs` (see page 29) command line option).

I/O checking Checks the result of IO operations (`-Ci` (see page 28) command line option).

Integer overflow checking Checks the result of integer operations (`-Co` (see page 28) command line option).

Object method call checking Check the validity of the method pointer prior to calling it.

Position independent code Generate PIC code.

Create smartlinkable units Create smartlinkable units.

Optimizations What optimizations should be used when compiling:

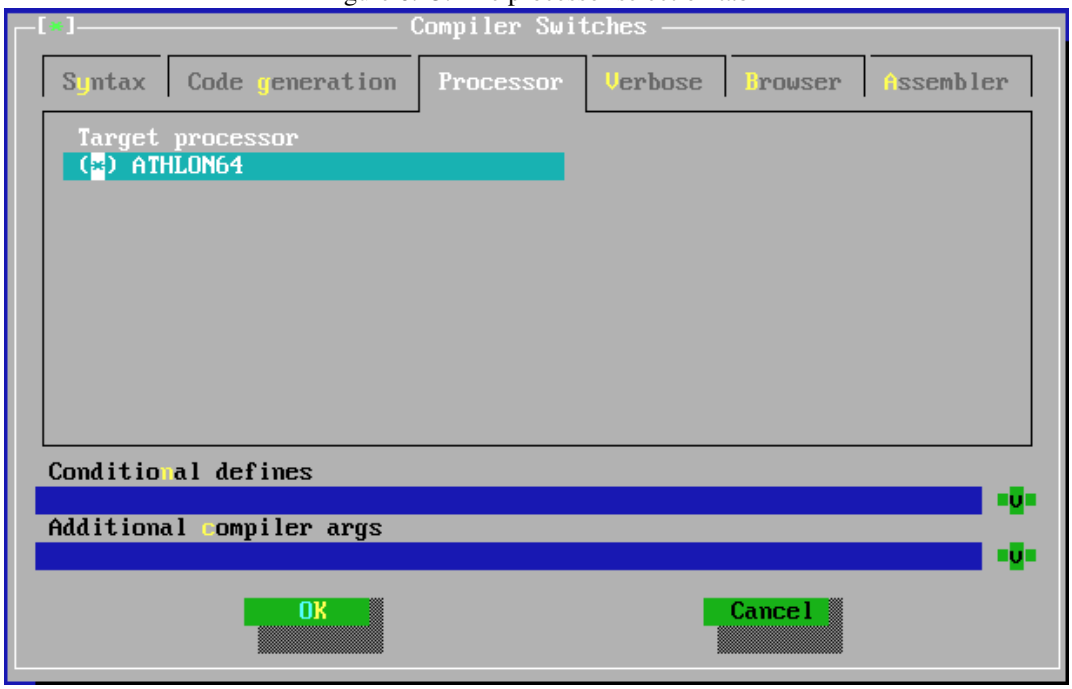
Generate faster code Corresponds to the `-OG` command line option.

Generate smaller code Corresponds to the `-Og` command line option.

More information on these switches can be found in section 5.1.4, page 27.

The processor tab of the compiler options dialog is shown in figure (6.25).

Figure 6.25: The processor selection tab



In the processor dialog, the target processor can be set. The compiler can use different optimizations for different processors.

The verbose tab of the compiler options dialog is shown in figure (6.26).

In this dialog, the following verbosity options can be set (on the command line: `-v` (see page 25)):

Warnings Generate warnings. Corresponds to `-vw` on the command line.

Notes Generate notes. Corresponds to `-vn` on the command line.

Hints Generate hints. Corresponds to `-vh` on the command line.

General info Generate general information. Corresponds to `-vi` on the command line.

User,tried info Generate information on used and tried files. Corresponds to `-vut` on the command line.

All Switch on full verbosity. Corresponds to `-va` on the command line.

Show all procedures if error If an error using overloaded procedure occurs, show all procedures. Corresponds to `-vb` on the command line.

The browser tab of the compiler options dialog is shown in figure (6.27).

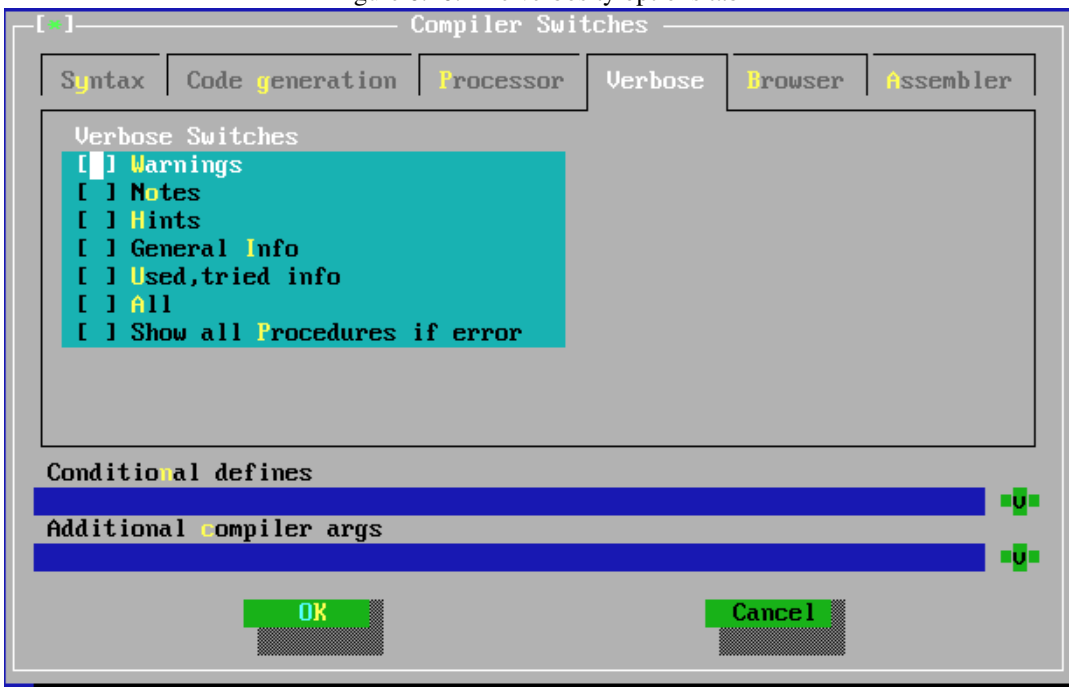
In this dialog, the browser options can be set:

No browser (default) No browser information is generated by the compiler.

Only global browser Browser information is generated for global symbols only, i.e. symbols defined not in a procedure or function (`-b` on the command line)

Local and global browser Browser information is generated for all symbols, i.e. also for symbols that are defined in procedures or functions (`-bl` on the command line)

Figure 6.26: The verbosity options tab



Remark If no browser information is generated, the symbol browser of the IDE will not work.

The assembler tab of the compiler options dialog is shown in figure (6.28). The actual dialog may vary, as it depends on the target CPU the IDE was compiled for.

In this dialog, the assembler reader and writer options can be set:

Assembler reader This permits setting the style of the assembler blocks in the sources:

AT&T assembler The assembler is written in `AT&T` style assembler (`-Ratt` on the command line).

Intel style assembler The assembler is written in `Intel` style assembler blocks (`-Rintel` on the command line).

remark that this option is global, but locally the assembler style can be changed with compiler directives.

Assembler info When writing assembler files, this option decides which extra information is written to the assembler file in comments:

List source The source lines are written to the assembler files together with the generated assembler (`-al` on the command line).

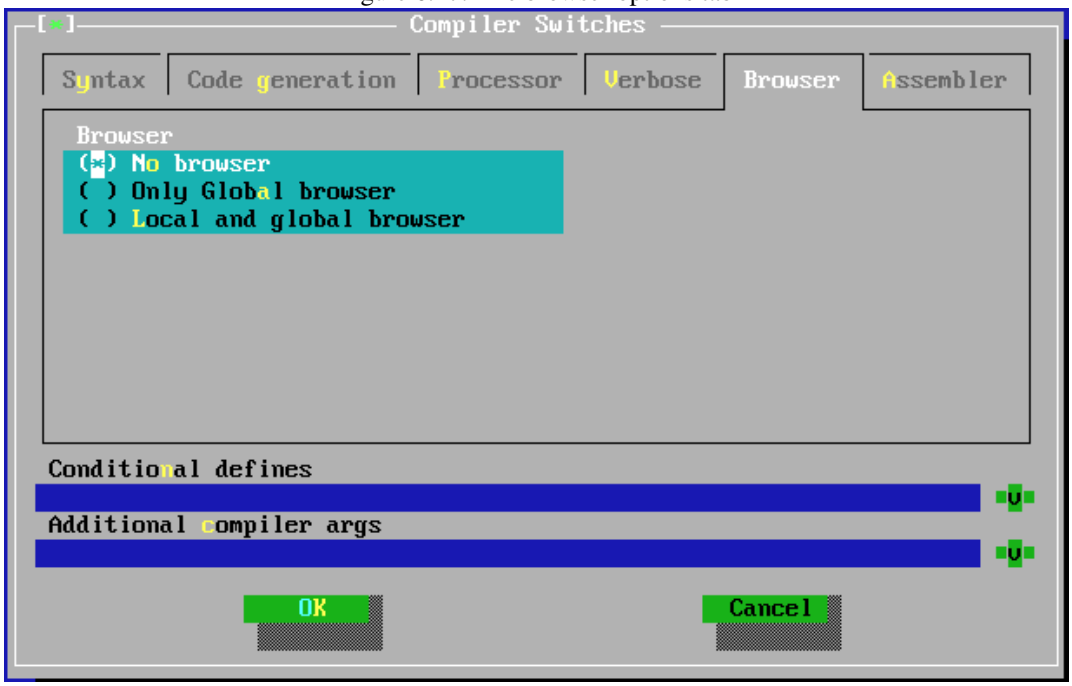
List register allocation The compiler's internal register allocation/deallocation information is written to the assembler file (`-ar` on the command line).

List temp allocation The temporary register allocation/deallocation is written to the assembler file. (`-at` on the command line).

List node allocation The node allocation/deallocation is written to the assembler file. (`-an` on the command line).

use pipe with assembler use a pipe on unix systems when feeding the assembler code to an external assembler.

Figure 6.27: The browser options tab



The latter three of these options are mainly useful for debugging the compiler itself, it should rarely be necessary to use these.

Assembler output This option tells the compiler what assembler output should be generated.

Use default output This depends on the target.

Use GNU as Assemble using GNU as (`-Aas` on the command line).

Use NASM coff Produce NASM coff assembler (go32v2, `-Anasmcoff` on the command line)

Use NASM elf Produce NASM elf assembler (LINUX, `-Anasmelf` on the command line).

Use NASM obj Produce NASM obj assembler (`-Anasmobj` on the command line).

Use MASM Produce MASM (Microsoft assembler) assembler (`-Amasm` on the command line).

Use TASM Produce TASM (Turbo Assembler) assembler (`-Atasm` on the command line).

Use coff Write binary coff files directly using the internal assembler (go32v2, `-Acoff` on the command line).

Use pecoff Write binary pecoff files files directly using the internal writer. (Win32)

6.11.5 Linker options

The linker options can be set in the menu **"Options|Linker"**. It permits the specification of how libraries and units are linked, and how the linker should be called. The linker options dialog is shown in figure (6.29).

The following options can be set:

Call linker after If this option is set then a script is written which calls the linker. This corresponds to the `s` option on the command line (`-s` (see page 31)).

Figure 6.28: The assembler options tab

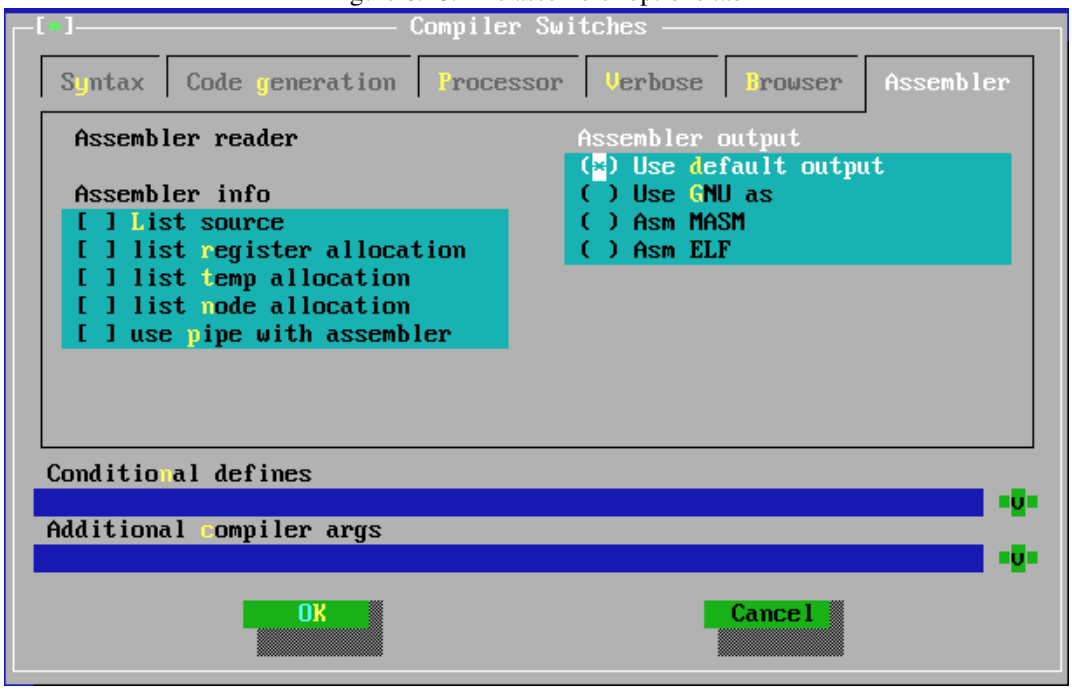
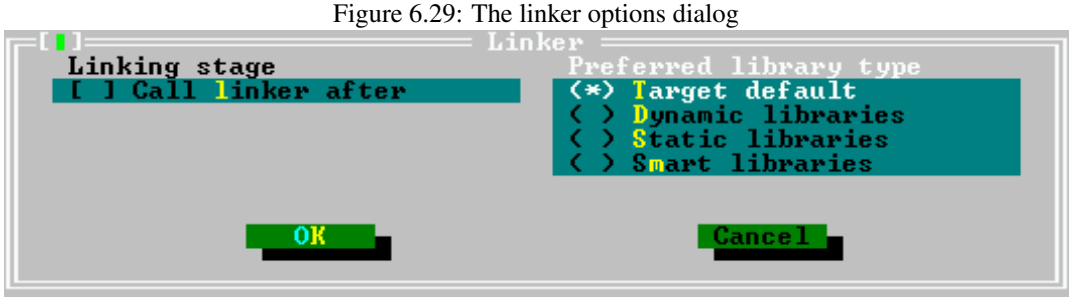


Figure 6.29: The linker options dialog



Only link to static library Only use static libraries.

Preferred library type With this option, the type of library to be linked in can be set:

Target default This depends on the platform.

Dynamic libraries Tries to link in units in dynamic libraries. (option `-XD` on the command line.)

Static libraries Tries to link in units in static libraries. (option `-XS` on the command line.)

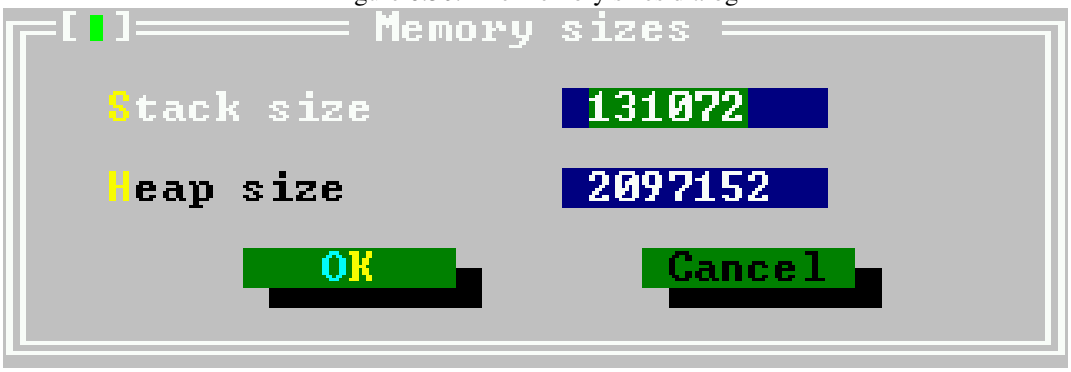
Smart libraries Tries to link in units in smart-linked libraries. (option `-XX` on the command line.)

6.11.6 Memory sizes

The memory sizes dialog (reachable via **"options|Memory sizes"**) permits the entry of the memory sizes for the project. The memory sizes dialog is shown in figure (6.30).

The following sizes can be entered:

Figure 6.30: The memory sizes dialog



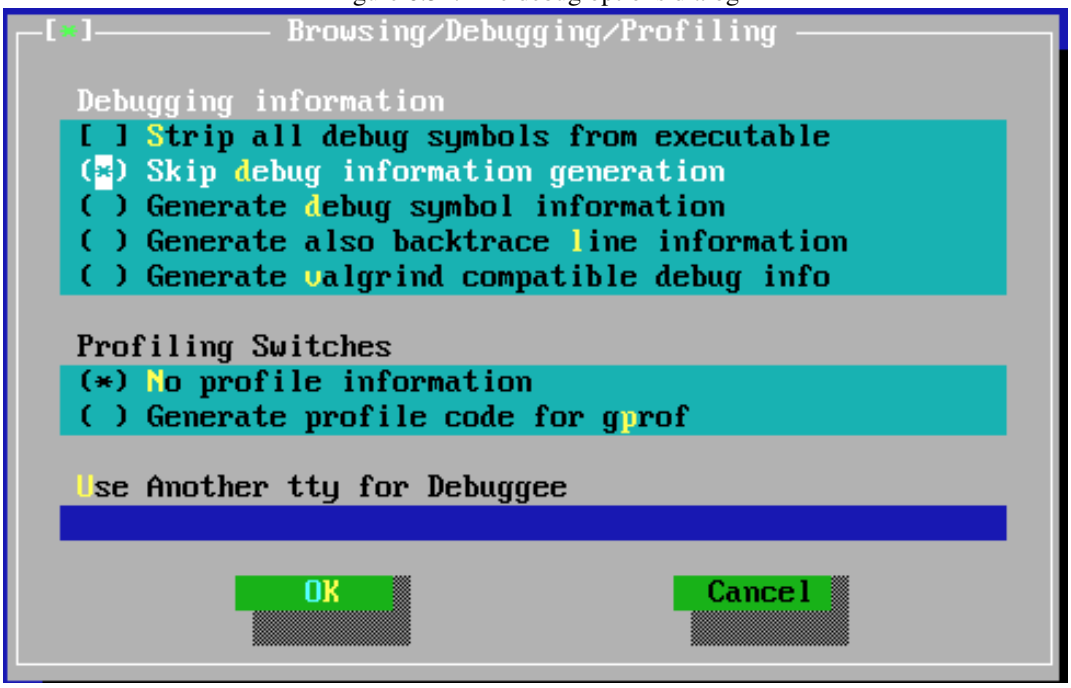
Stack size Sets the size of the stack in bytes (option `-Cs` on the command line). This size may be ignored on some systems.

Heap size Sets the size of the heap in bytes; (option `-Ch` on the command line). Note that the heap grows dynamically as much as the OS allows.

6.11.7 Debug options

In the debug options dialog (reachable via **"Options|Debugger"**), some options for inclusion of debug information in the binary can be set; it is also possible to add additional compiler options in this dialog. The debug options dialog is shown in figure (6.31).

Figure 6.31: The debug options dialog



The following options can be set:

Debugging information tells the compiler which debug information should be compiled in. One of the following options can be chosen:

Strip all debug symbols from executable Will strip all debug and symbol information from the binary. (option `-Xs` on the command line).

Skip debug information generation Do not generate debug information at all.

Generate debug symbol information Include debug information in the binary (option `-g` on the command line). Please note that no debug information for units in the Run-Time Library will be included, unless a version of the RTL compiled with debug information is available. Only units specific to the current project will have debug information included.

Generate also backtrace line information Will compile with debug information, and will additionally include the lineinfo unit in the binary, so that in case of an error the backtrace will contain the file names and line numbers of procedures in the call-stack. (Option `-gl` on the command line.)

Generate valgrind compatible debug info Generate debug information that can be read with valgrind (a memory checking tool).

Profiling switches Tells the compiler whether or not profile code should be included in the binary.

No profile information Has no effect, as it is the default.

Generate Profile code for gprof If checked, profiling code is included in the binary (option `-p` on the command line).

Use another TTY for Debuggee An attempt will be made to redirect the output of the program being debugged to another window (terminal), whose file name should be entered here.

6.11.8 The switches mode

The IDE allows saving a set of compiler settings under a common name. It provides 3 names under which the switches can be saved:

Normal For normal (fast) compilation.

Debug For debugging; intended to set most debug switches on. Also useful for setting conditional defines that e.g. allow including some debug code.

Release For a compile of the program as it should be released, debug information should be off, the binary should be stripped, and optimizations should be used.

Selecting one of these modes will load the compiler options as they were saved the last time the selected mode was active, i.e. it doesn't specifically set or unset options.

When setting and saving compiler options, be sure to select the correct switch mode first; it makes little sense to set debug options while the release switch is active. The switches mode dialog is shown in figure (6.32).

6.12 Customizing the IDE

The IDE is configurable over a wide range of parameters: colors can be changed, screen resolution. The configuration settings can be reached via the sub-menu `Environment` in the `Options` menu.

Figure 6.32: The switches mode dialog

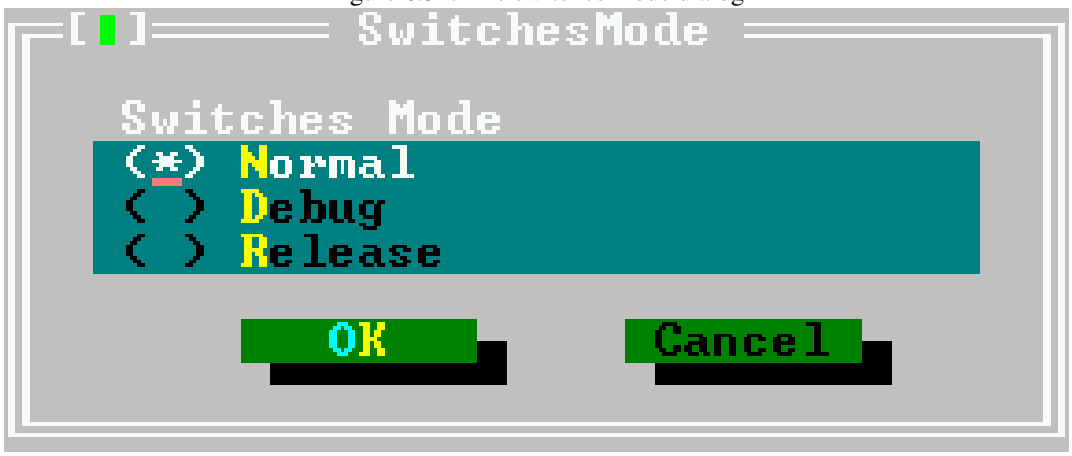
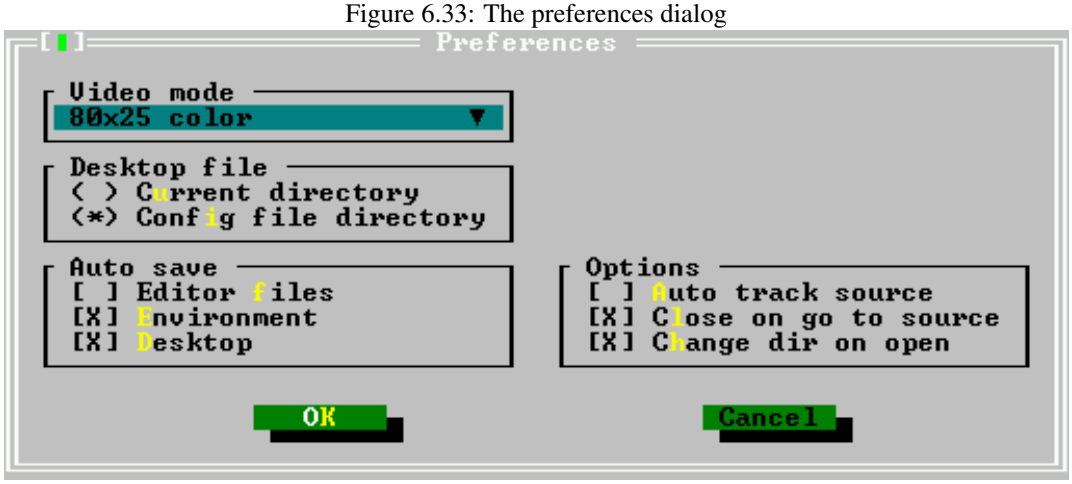


Figure 6.33: The preferences dialog



6.12.1 Preferences

The *preferences dialog* is called by the menu item **"Options|Environment|Preferences"**. The preferences dialog is shown in figure (6.33).

Video mode The drop down list at the top of the dialog allows selecting a video mode. The available video modes depend on the system on which the IDE is running.

Remark

1. The video mode must be selected by pressing space or clicking on it. If the drop down list is opened while leaving the dialog, the new video mode will not be applied.
2. For the DOS version of the IDE, the following should be noted: When using VESA modes, the display refresh rate may be very low. On older graphics card (1998 and before), it is possible to use the *UniVBE* driver from *SciTech*[5]

Desktop File Specifies where the desktop file is saved: the current directory, or the directory where the config file was found.

[5] It can be downloaded from http://www.informatik.fh-muenchen.de/ ifw98223/vbehz.htm

Auto save Here it is possible to set which files are saved when a program is run or when the IDE is exited:

Editor files The contents of all open edit windows will be saved.

Environment The current environment settings will be saved.

Desktop The desktop file with all desktop settings (open windows, history lists, breakpoints etc.) will be saved.

Options Some special behaviors of the IDE can be specified here:

Auto track source

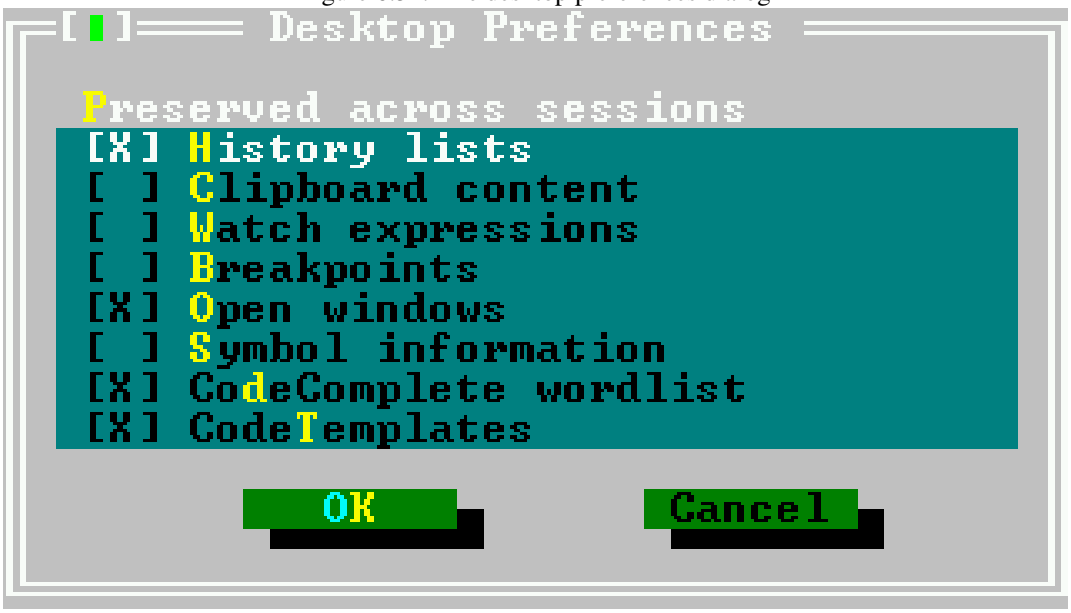
Close on go to source When checked, the messages window is closed when the 'go to source line' action is executed.

Change dir on open When a file is opened, the directory of that file is made the current working directory.

6.12.2 The desktop

The desktop preferences dialog allows to specify what elements of the desktop are saved across sessions, i.e. they are saved when the IDE is left, and they are again restored when the IDE is started the next time. They are saved in the file fp.dsk. The desktop preferences dialog is shown in figure (6.34).

Figure 6.34: The desktop preferences dialog



The following elements can be saved and restored across IDE sessions:

History lists Most entry boxes have a history list where previous entries are saved and can be selected. When this option is checked, these entries are saved in the desktop file. On by default.

Clipboard content When checked, the contents of the clipboard are also saved to disk. Off by default.

Watch expressions When checked, all watch expressions are saved in the desktop file. Off by default.

Breakpoints When checked, all breakpoints with their properties are saved in the desktop file. Off by default.

Open windows When checked, the list of files in open editor windows is saved in the desktop file, and the windows will be restored the next time the IDE is run. On by default.

Symbol information When checked, the information for the symbol browser is saved in the desktop file. Off by default.

CodeComplete wordlist When checked, the list of codecompletion words is saved. On by default.

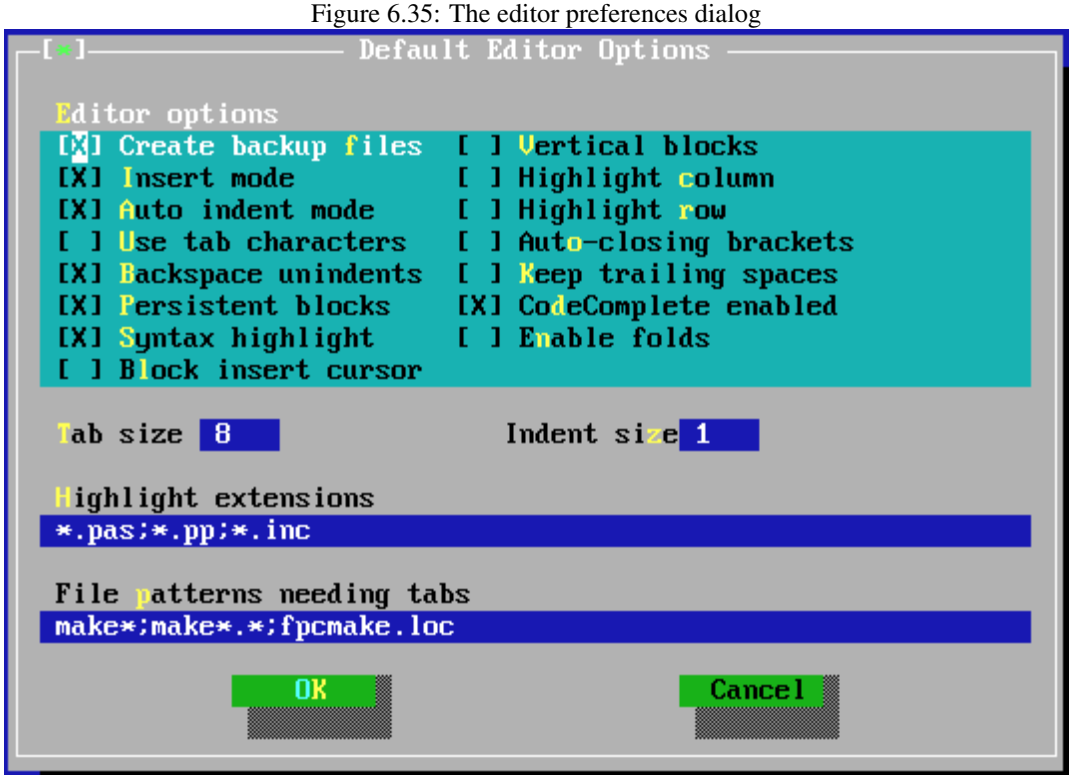
CodeTemplates When checked, the defined code templates are saved. On by default.

Remark The format of the desktop file changes between editor versions. So when installing a new version, it may be necessary to delete the fp.dsk files wherever the IDE searches for them.

6.12.3 The Editor

Several aspects of the editor window behavior can be set in this dialog. The editor preferences dialog is shown in figure (6.35). Note that some of these options affect only newly opened windows, not already opened windows (e.g. Vertical Blocks, Highlight Column/Row).

Figure 6.35: The editor preferences dialog



The following elements can be set in the editor preferences dialog:

Create backup files Whenever an editor file is saved, a backup is made of the old file. On by default.

Insert mode Start with insert mode.

Auto indent mode Smart indenting is on. This means that pressing ENTER will position the cursor on the next line in the same column where text starts on the current line. On by default.

Use tab characters When the tab key is pressed, use a tab character. Normally, when the tab key is pressed, spaces are inserted. When this option is checked, tab characters will be inserted instead. Off by default.

Backspace unindents Pressing the BKSP key will unindent if the beginning of the text on the current line is reached, instead of deleting just the previous character. On by default.

Persistent blocks When a selection is made, and the cursor is moved, the selection is not destroyed, i.e. the selected block stays selected. On by default.

Syntax highlight Use syntax highlighting on the files that have an extension which appears in the list of highlight extensions. On by default.

Block insert cursor The insert cursor is a block instead of an underscore character. By default the overwrite cursor is a block. This option reverses that behavior. Off by default.

Vertical blocks When selecting blocks spanning several lines, the selection doesn't contain the entirety of the lines within the block; instead, it contains the lines as far as the column on which the cursor is located. Off by default.

Highlight column When checked, the current column (i.e. the column where the cursor is) is highlighted. Off by default.

Highlight row When checked, the current row (i.e. the row where the cursor is) is highlighted. Off by default.

Auto closing brackets When an opening bracket character is typed, the closing bracket is also inserted at once. Off by default.

Keep trailing spaces When saving a file, the spaces at the end of lines are stripped off. This option disables that behavior; i.e. any trailing spaces are also saved to file. Off by default.

Codecomplete enabled Enable code completion. On by default.

Enable folds Enable code folding. Off by default.

Tab size The number of spaces that are inserted when the TAB key is pressed. The default value is 8.

Indent size The number of spaces a block is indented when calling the block indent function. The default value is 2.

Highlight extensions When syntax highlighting is on, the list of file masks entered here will be used to determine which files are highlighted. File masks should be separated with semicolon (;) characters. The default is *.pas;*.pp;*.inc.

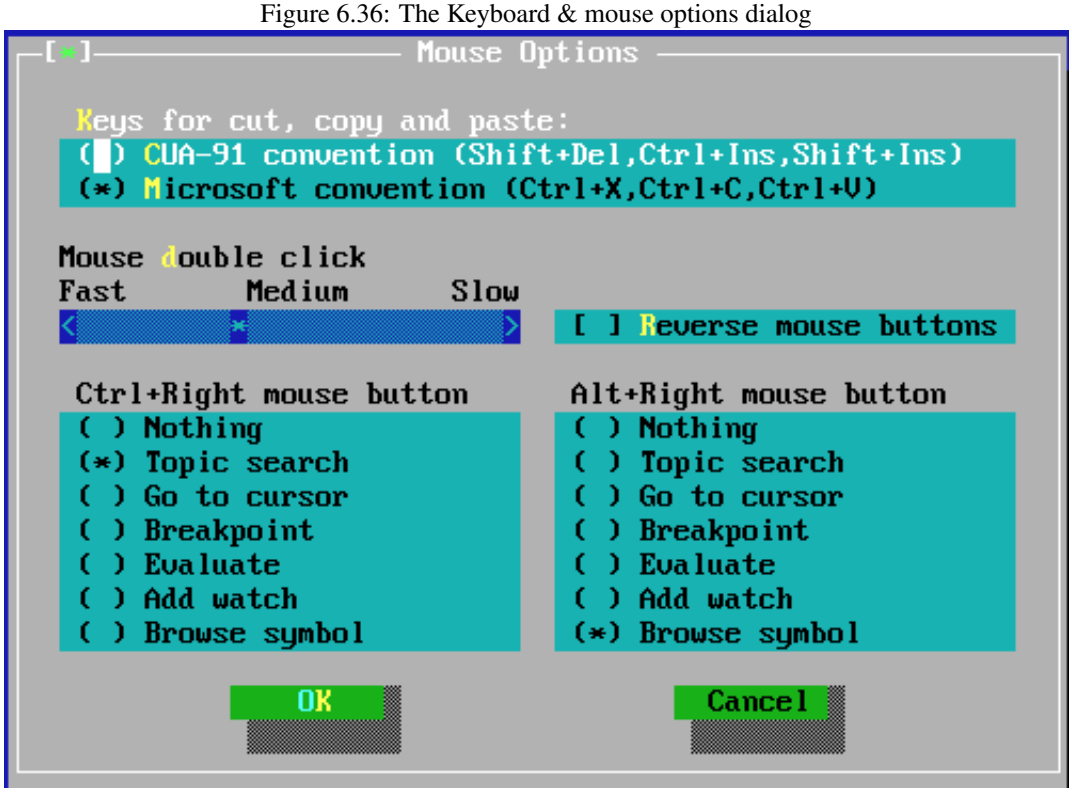
File patterns needing tabs Some files (such as makefiles) need actual tab characters instead of spaces. Here a series of file masks can be entered to indicate files for which tab characters will always be used. Default is make*;make*.*.

Remark These options will not be applied to already opened windows; only newly opened windows will have these options.

6.12.4 Keyboard & Mouse

The Keyboard & mouse options dialog is called by the menu item **"Options|Environment|Keyboard & Mouse"**. It allows adjusting the behavior of the keyboard and mouse as well as the sensitivity of the mouse. The keyboard and mouse options dialog is shown in figure (6.36).

Figure 6.36: The Keyboard & mouse options dialog



Keys for copy, cut and paste Set the keys to use for clipboard operations:

- CUA-91 convention (Shift+Del,Ctrl+Ins,Shift+Ins)
- Microsoft convention (Ctrl+X,Ctrl+C,Ctrl+V)

Mouse double click The slider can be used to adjust the double click speed. Fast means that the time between two clicks is very short; slow means that the time between two mouse clicks can be quite long.

Reverse mouse buttons the behavior of the left and right mouse buttons can be swapped by by checking the checkbox; this is especially useful for left-handed people.

Ctrl+Right mouse button Assigns an action to a right mouse button click while holding the CTRL key pressed.

Alt+right mouse button Assigns an action to right mouse button click while holding the ALT key pressed.

The following actions can be assigned to CTRL-Right mouse button or ALT-right mouse button:

Nothing No action is associated to the event.

Topic search The keyword at the mouse cursor is searched in the help index.

Go to cursor The program is executed until the line where the mouse cursor is located.

Breakpoint Set a breakpoint at the mouse cursor position.

Evaluate Evaluate the value of the variable at the mouse cursor.

Add watch Add the variable at the mouse cursor to the watch list.

Browse symbol The symbol at the mouse cursor is displayed in the browser.

6.13 The help system

More information on how to handle the IDE, or about the use of various calls in the RTL, explanations regarding the syntax of a Pascal statement, can be found in the *help system*. The help system is activated by pressing F1.

6.13.1 Navigating in the help system

The help system contains hyperlinks; these are sensitive locations that lead to another topic in the help system. They are marked by a different color. The hyperlinks can be activated in one of two ways:

1. by directly clicking the one you want with the mouse, or
2. by using the TAB and SHIFT-TAB keys to move between the different hyperlinks of a page and then pressing the ENTER key to activate the one you want.

When SHIFT-F1 is pressed, the contents of the help system are displayed. To go back to the previous help topic, press ALT-F1. This also works if the help window isn't displayed on the desktop; the help window will then be activated.

6.13.2 Working with help files

The IDE contains a help system which can display the following file formats:

TPH The help format for the Turbo Pascal help viewer.

INF The OS/2 help format.

NG The Norton Guide Help format.

HTML HTML files.

In future some more formats may be added. However, the above formats should cover already a wide spectrum of available help files.

Remark Concerning the support for HTML files the following should be noted:

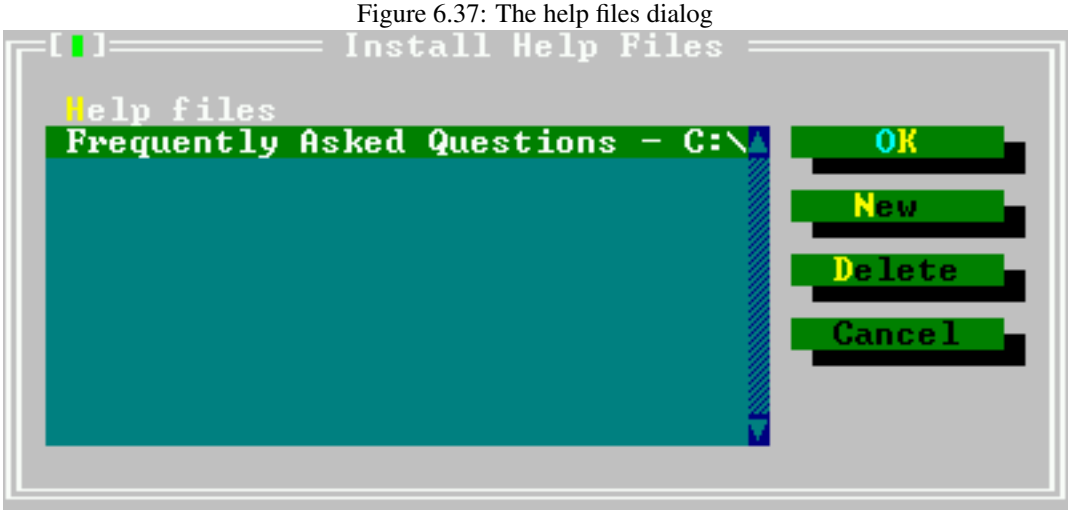
1. The HTML viewer of the help system is limited, it can only handle the most basic HTML files (graphics excluded), since it is only designed to display the Free Pascal help files. [6].

[6] ...but feel free to improve it and send patches to the Free Pascal development team...

2. When the HTML help viewer encounters a graphics file, it will try and find a file with the same name but an extension of .ans; If this file is found, this will be interpreted as a file with ANSI escape sequences, and these will be used to display a text image. The displays of the IDE dialogs in the IDE help files are made in this way.

The menu item **"Help|Files"** permits help files to be added to, and deleted from, the list of files in the help table of contents. The help files dialog is displayed in figure (6.37).

Figure 6.37: The help files dialog



The dialog lists the files that will be presented in the table of contents window of the help system. Each entry has a small descriptive title and a filename next to it. The following actions are available when adding help files:

New Adds a new file. IDE will display a prompt, in which the location of the help file should be entered.

If the added file is an HTML file, a dialog box will be displayed which asks for a title. This title will then be included in the contents of help.

Delete Deletes the currently highlighted file from the help system. It is *not* deleted from the hard disk; only the help system entry is removed.

Cancel Discards all changes and closes the dialog.

OK Saves the changes and closes the dialog.

The Free Pascal documentation in HTML format can be added to the IDE's help system. This way the documentation can be viewed from within the IDE. If Free Pascal has been installed using the installer, the installer should have added the FPC documentation to the list of help files, if the documentation was installed as well.

6.13.3 The about dialog

The *about dialog*, reachable through (**"Help|About..."**) shows some information about the IDE, such as the version number, the date it was built, what compiler and debugger it uses. When reporting bugs about the IDE, please use the information given by this dialog to identify the version of the IDE that was used.

It also displays some copyright information.

6.14 Keyboard shortcuts

A lot of keyboard shortcuts used by the IDE are compatible with WordStar and should be well known to Turbo Pascal users.

Below are the following tables:

1. In table (6.4) some shortcuts for handling the IDE windows and Help are listed.
2. In table (6.5) the shortcuts for compiling, running and debugging a program are presented.
3. In table (6.6) the navigation keys are described.
4. In table (6.7) the editing keys are listed.
5. In table (6.8) all block command shortcuts are listed.
6. In table (6.9) all selection-changing shortcuts are presented.
7. In table (6.10) some general shortcuts, which do not fit in the previous categories, are presented.

Table 6.4: General

Command	Shortcut key	Alternative
Help	F1	
Goto last help topic	ALT-F1	
Search word at cursor position in help	CTRL-F1	
Help index	SHIFT-F1	
Close active window	ALT-F3	
Zoom/Unzoom window	F5	
Move/Zoom active window	CTRL-F5	
Switch to next window	F6	
Switch to last window	SHIFT-F6	
Menu	F10	
Local menu	ALT-F10	
List of windows	ALT-0	
Active another window	ALT-<DIGIT>	
Call grep utility	SHIFT-F2	
Exit IDE	ALT-X	

Table 6.5: Compiler

Command	Shortcut key	Alternative
Reset debugger/program	CTRL-F2	
Display call stack	CTRL-F3	
Run as far as the cursor	F4	
Switch to user screen	ALT-F5	
Trace into	F7	
Add watch	CTRL-F7	
Step over	F8	
Set breakpoint at current line	CTRL-F8	
Make	F9	
Run	CTRL-F9	
Compile the active source file	ALT-F9	
Message	F11	
Compiler messages	F12	

Table 6.6: Text navigation

Command	Shortcut key	Alternative
Char left	ARROW LEFT	CTRL-S
Char right	ARROW RIGHT	CTRL-D
Line up	ARROW UP	CTRL-E
Line down	ARROW DOWN	CTRL-X
Word left	CTRL-ARROW LEFT	CTRL-A
Word right	CTRL-ARROW RIGHT	CTRL-F
Scroll one line up	CTRL-W	
Scroll one line down	CTRL-Z	
Page up	PAGEUP	CTRL-R
Page down	PAGEDOWN	
Beginning of Line	POS1	CTRL-Q-S
End of Line	END	CTRL-Q-D
First line of window	CTRL-HOME	CTRL-Q-E
Last line of window	CTRL-END	CTRL-Q-X
First line of file	CTRL-PAGEUP	CTRL-Q-R
Last line of file	CTRL-PAGEDOWN	CTRL-Q-C
Last cursor position	CTRL-Q-P	
Find matching block delimiter	CTRL-Q-[	
Find last matching block delimiter	CTRL-Q-]	

Table 6.7: Edit

Command	Shortcut key	Alternative
Delete char	DEL	CTRL-G
Delete left char	BACKSPACE	CTRL-H
Delete line	CTRL-Y	
Delete til end of line	CTRL-Q-Y	
Delete word	CTRL-T	
Insert line	CTRL-N	
Toggle insert mode	INSERT	CTRL-V

Table 6.8: Block commands

Command	Shortcut key	Alternative
Goto Beginning of selected text	CTRL-Q-B	
Goto end of selected text	CTRL-Q-K	
Select current line	CTRL-K-L	
Print selected text	CTRL-K-P	
Select current word	CTRL-K-T	
Delete selected text	CTRL-DEL	CTRL-K-Y
Copy selected text to cursor position	CTRL-K-C	
Move selected text to cursor position	CTRL-K-V	
Copy selected text to clipboard	CTRL-INS	
Move selected text to the clipboard	SHIFT-DEL	
Indent block one column	CTRL-K-I	
Unindent block one column	CTRL-K-U	
Insert text from clipboard	SHIFT-INSERT	
Insert file	CTRL-K-R	
Write selected text to file	CTRL-K-W	
Uppercase current block	CTRL-K-N	
Lowercase current block	CTRL-K-O	
Uppercase word	CTRL-K-F	
Lowercase word	CTRL-K-E	

Table 6.9: Change selection

Command	Shortcut key	Alternative
Mark beginning of selected text	CTRL-K-B	
Mark end of selected text	CTRL-K-K	
Remove selection	CTRL-K-Y	
Extend selection one char to the left	SHIFT-ARROW LEFT	
Extend selection one char to the right	SHIFT-ARROW RIGHT	
Extend selection to the beginning of the line	SHIFT-POS1	
Extend selection to the end of the line	SHIFT-END	
Extend selection to the same column in the last row	SHIFT-ARROW UP	
Extend selection to the same column in the next row	SHIFT-ARROW DOWN	
Extend selection to the end of the line	SHIFT-END	
Extend selection one word to the left	CTRL-SHIFT-ARROW LEFT	
Extend selection one word to the right	CTRL-SHIFT-ARROW RIGHT	
Extend selection one page up	SHIFT-PAGEUP	
Extend selection one page down	SHIFT-PAGEDOWN	
Extend selection to the beginning of the file	CTRL-SHIFT-POS1	CTRL-SHIFT-PAGEUP
Extend selection to the end of the file	CTRL-SHIFT-END	CTRL-SHIFT-PAGEUP

Table 6.10: Misc. commands

Command	Shortcut key	Alternative
Save file	F2	CTRL-K-S
Open file	F3	
Search	CTRL-Q-F	
Search again	CTRL-L	
Search and replace	CTRL-Q-A	
Set mark	CTRL-K-N (where n can be 0..9)	
Goto mark	CTRL-Q-N (where n can be 0..9)	
Undo	ALT-BACKSPACE	
Open File at cursor	CTRL-ENTER	

Chapter 7

Porting and portable code

7.1 Free Pascal compiler modes

The Free Pascal team tries to create a compiler that can compile as much as possible code produced for Turbo Pascal, Delphi or the Mac pascal compilers: this should make sure that porting code that was written for one of these compilers is as easy as possible.

At the same time, the Free Pascal developers have introduced a lot of extensions in the Object Pascal language. To reconcile these different goals, and to make sure that people can produce code which can still be compiled by the Turbo Pascal and Delphi compilers, the compiler has a concepts of 'compiler modes'. In a certain compiler mode, the compiler has certain functionalities switched on or off. This allows to introduce a compatibility mode in which only features supported by the original compiler are supported. Currently, 5 modes are supported:

FPC This is the original Free Pascal compiler mode: here all language constructs except classes, interfaces and exceptions are supported. Objects are supported in this mode. This is the default mode of the compiler.

OBJFPC This is the same mode as `FPC` mode, but it also includes classes, interfaces and exceptions.

TP Turbo Pascal compatibility mode. In this mode, the compiler tries to mimic the Turbo Pascal compiler as closely as possible. Obviously, only 32-bit or 64-bit code can be compiled.

DELPHI Delphi compatibility mode. In this mode, the compiler tries to resemble the Delphi compiler as best as it can: Most Delphi 7 and above features are implemented.

DELPHIUNICODE Delphi compatibility mode. In this mode, the compiler tries to resemble the Delphi compiler as best as it can: All Delphi 2009 and above features are implemented. In this mode, string equals a unicode string.

MACPAS the Mac Pascal compatibility mode. In this mode, the compiler attempts to allow all constructs that are implemented in Mac pascal. In particular, it attempts to compile the universal interfaces.

ISO Standard Pascal, ISO 7185 mode. In this mode, the compiler complies with the requirements of level 0 and level 1 of ISO/IEC 7185.

ExtendedPascal Standard Extended Pascal, ISO 10206 mode. In this mode, the compiler complies with the requirements of level 0 and level 1 of ISO/IEC 10206.

The compiler mode can be set on a per-unit basis: each unit can have its own compiler mode, and it is possible to use units which have been compiled in different modes intertwined. The mode can be set in one of 2 ways:

1. On the command line, with the -M switch.
2. In the source file, with the `{$MODE }` directive.

Both ways take the name of the mode as an argument. If the unit or program source file does not specify a mode, the mode specified on the command-line is used. If the source file specifies a mode, then it overrides the mode given on the command-line.

Thus compiling a unit with the `-M` switch as follows:

```
fpc -MOBJFPC myunit
```

is the same as having the following mode directive in the unit:

```
{$MODE OBJFPC}
Unit myunit;
```

The `MODE` directive should always be located before the uses clause of the unit interface or program uses clause, because setting the mode may result in the loading of an additional unit as the first unit to be loaded.

Note that the `{$MODE }` directive is a global directive, i.e. it is valid for the whole unit; Only one directive can be specified.

The mode has no influence on the availability of units: all available units can be used, independent of the mode that is used to compile the current unit or program.

7.2 Turbo Pascal

Free Pascal was originally designed to resemble Turbo Pascal as closely as possible. There are, of course, restrictions. Some of these are due to the fact that Turbo Pascal was developed for 16-bit architectures whereas Free Pascal is a 32-bit/64-bit compiler. Other restrictions result from the fact that Free Pascal works on more than one operating system.

In general we can say that if you keep your program code close to ANSI Pascal, you will have no problems porting from Turbo Pascal, or even Delphi, to Free Pascal. To a large extent, the constructs defined by Turbo Pascal are supported. This is even more so if you use the `-Mtp` or `-MObjfpc` switches.

In the following sections we will list the Turbo Pascal and Delphi constructs which are not supported in Free Pascal, and we will list in what ways Free Pascal extends Turbo Pascal.

7.2.1 Things that will not work

Here we give a list of things which are defined/allowed in Turbo Pascal, but which are not supported by Free Pascal. Where possible, we indicate the reason.

1. Duplicate case labels are permitted in Turbo Pascal, but not in Free Pascal. This is actually a bug in Turbo Pascal, and so support for it will not be implemented in Free Pascal.
2. In Turbo Pascal, parameter lists of previously defined functions and procedures did not have to match exactly. In Free Pascal, they must. The reason for this is the function overloading mechanism of Free Pascal. However, the `-M` (see page 33) option overcomes this restriction.
3. The Turbo Pascal variables `MEM, MEMW, MEML` and `PORT` for memory and port access are not available in the system unit. This is due to the operating system. Under DOS, both the system and the extender unit (GO32) implement the mem constuct. Under LINUX, the ports unit implements such a construct for the `Ports` variable.

4. Turbo Pascal allows you to create procedure and variable names using words that are not permitted in that role in Free Pascal. This is because there are certain words that are reserved in Free Pascal (and Delphi) that are not reserved in Turbo Pascal, such as: `PROTECTED`, `PUBLIC`, `PUBLISHED`, `TRY`, `FINALLY`, `EXCEPT`, `RAISE`. Using the `-Mtp` switch will solve this problem if you want to compile Turbo Pascal code that uses these words (chapter B, page 133 for a list of all reserved words).

5. The Turbo Pascal reserved words `FAR`, `NEAR` are ignored. This is because their purpose was limited to a 16-bit environment and Free Pascal is a 32-bit/64-bit compiler.

6. The Turbo Pascal `INTERRUPT` directive will work only on the Free Pascal `DOS` target. Other operating systems do not allow handling of interrupts by user programs.

7. By default the Free Pascal compiler uses `AT&T` assembler syntax. This is mainly because Free Pascal uses `GNU as`. However, other assembler forms are available. For more information, see the Programmer's Guide.

8. Turbo Pascal's Turbo Vision is available in Free Pascal under the name of FreeVision, which should be almost 100% compatible with Turbo Vision.

9. Turbo Pascal's 'overlay' unit is not available. It also isn't necessary, since Free Pascal is a 32/64-bit compiler, so program size shouldn't be an issue.

10. The command line parameters of the compiler are different.

11. Compiler switches and directives are mostly the same, but some extra exist.

12. Units are not binary compatible. That means that you cannot use a .tpu unit file, produced by Turbo Pascal, in a Free Pascal project.

13. The Free Pascal `TextRec` structure (for internal description of files) is not binary compatible with TP or Delphi.

14. Sets are by default 4 bytes in Free Pascal; this means that some typecasts which were possible in Turbo Pascal are no longer possible in Free Pascal. However, there is a switch to set the set size, see Programmer's Guide for more information.

15. A file is opened for output only (using `fmOutput`) when it is opened with `Rewrite`. In order to be able to read from it, it should be reset with `Reset`.

16. Turbo Pascal destructors allowed parameters. This is not permitted in Free Pascal: by default, in Free Pascal, Destructors cannot have parameters. This restriction can be removed by using the `-So` switch.

17. Turbo Pascal permits more than one destructor for an object. In Free Pascal, there can be only one destructor. This restriction can also be removed by using the `-So` switch.

18. The order in which expressions are evaluated is not necessarily the same. In the following expression:

    ```
    a := g(2) + f(3);
    ```

    it is not guaranteed that `g(2)` will be evaluated before `f(3)`.

19. In Free Pascal, you need to use the address @ operator when assigning procedural variables.

7.2.2 Things which are extra

Here we give a list of things which are possible in Free Pascal, but which didn't exist in Turbo Pascal or Delphi.

1. Free Pascal functions can also return complex types, such as records and arrays.
2. In Free Pascal, you can use the function return value in the function itself, as a variable. For example:

```
function a : longint;

begin
   a:=12;
   while a>4 do
     begin
        {...}
     end;
end;
```

   The example above would work with TP, but the compiler would assume that the `a>4` is a recursive call. If a recursive call is actually what is desired, you must append `()` after the function name:

```
function a : longint;

begin
   a:=12;
   { this is the recursive call }
   if a()>4 then
     begin
        {...}
     end;
end;
```

3. In Free Pascal, there is partial support of Delphi constructs. (See the Programmer's Guide for more information on this).
4. The Free Pascal `exit` call accepts a return value for functions.

```
function a : longint;

begin
   a:=12;
   if a>4 then
     begin
        exit(a*67); {function result upon exit is a*67 }
     end;
end;
```

5. Free Pascal supports function overloading. That is, you can define many functions with the same name, but with different arguments. For example:

```
procedure DoSomething (a : longint);
begin
```

```
{...}
end;

procedure DoSomething (a : real);
begin
{...}
end;
```

You can then call procedure `DoSomething` with an argument of type `Longint` or `Real`. This feature has the consequence that a previously declared function must always be defined with the header completely the same:

```
procedure x (v : longint); forward;

{...}

procedure x;{ This will overload the previously declared x}
begin
{...}
end;
```

This construction will generate a compiler error, because the compiler didn't find a definition of `procedure x (v : longint);`. Instead you should define your procedure x as:

```
procedure x (v : longint);
{ This correctly defines the previously declared x}
begin
{...}
end;
```

The command line option `-So` (see page 35) disables overloading. When you use it, the above will compile, as in Turbo Pascal.

6. Operator overloading. Free Pascal allows operator overloading, e.g. you can define the '+' operator for matrices.
7. On FAT16 and FAT32 systems, long file names are supported.

7.2.3 Turbo Pascal compatibility mode

When you compile a program with the `-Mtp` switch, the compiler will attempt to mimic the Turbo Pascal compiler in the following ways:

- Assigning a procedural variable doesn't require an @ operator. One of the differences between Turbo Pascal and Free Pascal is that the latter requires you to specify an address operator when assigning a value to a procedural variable. In Turbo Pascal compatibility mode, this is not required.
- Procedure overloading is disabled. If procedure overloading is disabled, the function header doesn't need to repeat the function header.
- Forward defined procedures don't need the full parameter list when they are defined. Due to the procedure overloading feature of Free Pascal, you must always specify the parameter list of a function when you define it, even when it was declared earlier with `Forward`. In Turbo Pascal compatibility mode, there is no function overloading; hence you can omit the parameter list:

```
Procedure a (L : Longint); Forward;

...

Procedure a ; { No need to repeat the (L : Longint) }

begin
 ...
end;
```

- Recursive function calls are handled differently. Consider the following example:

```
Function expr : Longint;

begin
  ...
  Expr:=L:
  Writeln (Expr);
  ...
end;
```

In Turbo Pascal compatibility mode, the function will be called recursively when the `writeln` statement is processed. In Free Pascal, the function result will be printed. In order to call the function recursively under Free Pascal, you need to implement it as follows :

```
Function expr : Longint;

begin
  ...
  Expr:=L:
  Writeln (Expr());
  ...
end;
```

- You cannot assign procedural variables to untyped pointers; so the following is invalid:

```
 a: Procedure;
 b: Pointer;
begin
 b := a; // Error will be generated.
```

- The @ operator is typed when applied on procedures.
- You cannot nest comments.

Remark The `MemAvail` and `MaxAvail` functions are no longer available in Free Pascal as of version 2.0. The reason for this incompatibility follows:

On modern operating systems, [1] the idea of "Available Free Memory" is not valid for an application. The reasons are:

1. One processor cycle after an application asked the OS how much memory is free, another application may have allocated everything.

[1] The DOS extender GO32V2 falls under this definition of "modern" because it can use paged memory and run in multi-tasked environments.

2. It is not clear what "free memory" means: does it include swap memory, does it include disk cache memory (the disk cache can grow and shrink on modern OS'es), does it include memory allocated to other applications but which can be swapped out, etc.

Therefore, programs using `MemAvail` and `MaxAvail` functions should be rewritten so they no longer use these functions, because it does not make sense any more on modern OS'es. There are 3 possibilities:

1. Use exceptions to catch out-of-memory errors.
2. Set the global variable "ReturnNilIfGrowHeapFails" to `True` and check after each allocation whether the pointer is different from `Nil`.
3. Don't care and declare a dummy function called `MaxAvail` which always returns `High(LongInt)` (or some other constant).

7.2.4 A note on long file names under DOS

Under WINDOWS 95 and higher, long filenames are supported. Compiling for the WINDOWS target ensures that long filenames are supported in all functions that do file or disk access in any way.

Moreover, Free Pascal supports the use of long filenames in the system unit and the Dos unit also for go32v2 executables. The system unit contains the boolean variable `LFNsupport`. If it is set to `True` then all system unit functions and Dos unit functions will use long file names if they are available. This should be so on WINDOWS 95 and 98, but not on WINDOWS NT or WINDOWS 2000. The system unit will check this by calling DOS function `71A0h` and checking whether long filenames are supported on the C: drive.

It is possible to disable the long filename support by setting the `LFNSupport` variable to `False`; but in general it is recommended to compile programs that need long filenames as native WINDOWS applications.

7.3 Porting Delphi code

Porting Delphi code should be quite painless. The `Delphi` mode of the compiler tries to mimic Delphi as closely as possible. This mode can be enabled using the `-Mdelphi` command line switch, or by inserting the following code in the sources before the `unit` or `program` clause:

```
{$IFDEF FPC}
{$MODE DELPHI}
{$ENDIF FPC}
```

This ensures that the code will still compile with both Delphi and FPC.

Nevertheless, there are some things that will not work. Delphi compatibility is relatively complete up to Delphi 7. New constructs in higher versions of Delphi (notably, the versions that work with .NET) are not supported.

7.3.1 Missing language constructs

At the level of language compatibility, FPC is very compatible with Delphi: it can compile most of FreeCLX, the free Widget library that was shipped with Delphi 6, Delphi 7 and Kylix.

Currently, the only missing language constructs are:

1. `Dynamic` methods are actually the same as `virtual`.
2. `Const` for a parameter to a procedure does not necessarily mean that the variable or value is passed by reference.
3. Packages are not supported.

There are some inline assembler constructs which are not supported, and since Free Pascal is designed to be platform independent, it is quite unlikely that these constructs will be supported in the future.

Note that the `-Mobjfpc` mode switch is to a large degree Delphi compatible, but is more strict than Delphi. The most notable differences are:

1. Parameters or local variables of methods cannot have the same names as properties of the class in which they are implemented.
2. The address operator is needed when assigning procedural variables (or event handlers).
3. AnsiStrings are not switched on by default.
4. Hi/Lo functions in Delphi are always evaluated using a word argument, in FPC there are several overloaded versions of these functions, and therefor the actual type of the passed variable is used to determine which overload is called. This may result in different results.

7.3.2 Missing calls / API incompatibilities

Delphi is heavily bound to Windows. Because of this, it introduced a lot of Windows-isms in the API (e.g. file searching and opening, loading libraries).

Free Pascal was designed to be portable, so things that are very Windows specific are missing, although the Free Pascal team tries to minimize this. The following are the main points that should be considered:

- By default, Free Pascal generates console applications. This means that you must explicitly enable the GUI application type for Windows:

  ```
  {$APPTYPE GUI}
  ```

- The Windows unit provides access to most of the core Win32 API. Some calls may have different parameter lists: instead of declaring a parameter as passed by reference (var), a pointer is used (as in C). For most cases, Free Pascal provides overloaded versions of such calls.
- Widestrings. Widestring management is not automatic in Free Pascal, since various platforms have different ways of dealing with widestring encodings and Multi-Byte Character Sets. FPC supports Widestrings, but may not use the same encoding as on Windows.

  Note that in order to have correct widestring management, you need to include the cwstring unit on Unix/LINUX platforms: This unit initializes the widestring manager with the necessary callbacks which use the C library to implement all needed widestring functionality.
- Threads: At this moment, Free Pascal does not offer native thread management on all platforms; on Unix, linking to the C library is needed to provide thread management in an FPC application. This means that a cthreads unit must be included to enable threads.
- A much-quoted example is the `SetLastOSError` call. This is not supported, and will never be supported.

- Filename Case sensitivity: Pascal is a case-insensitive language, so the uses clause should also be case insensitive. Free Pascal ensures case insensitive filenames by also searching for a lowercase version of the file. Kylix does not do this, so this could create problems if two differently cased versions of the same filename are in the path.
- RTTI is NOT stored in the same way as for Delphi. The format is mostly compatible, but may differ. This should not be a problem if the API of the TypeInfo unit is used and no direct access to the RTTI information is attempted.
- By default, sets are of different size than in Delphi, but set size can be specified using directives or command line switches.
- Likewise, by default enumeration types are of different size than in Delphi. Here again, the size can be specified using directives or command line switches.
- In general, one should not make assumptions about the internal structure of complex types such as records, objects, classes and their associated structure. For example, the VMT table layout is different, the alignment of fields in a record may be different, etc.
- The same is true for basic types: on other processors the high and low bytes of a word or integer may not be at the same location as on an Intel processor (the endianness is different).
- Names of local variables and method arguments are not allowed to match the name of a property or field of the class: this is bad practise, as there can be confusion as to which of the two is meant.

7.3.3 Delphi compatibility mode

Switching on Dephi compatibility mode has the following effect:

1. Support for Classes, exceptions and threadvars is enabled.
2. The objpas is loaded as the first unit. This unit redefines some basic types: `Integer` is 32-bit for instance.
3. The address operator (@) is no longer needed to set event handlers (i.e. assign to procedural variables or properties).
4. Names of local variables and method parameters in classes can match the name of properties or field of the class.
5. The `String` keyword implies `AnsiString` by default.
6. Operator overloading is switched off.

7.3.4 Best practices for porting

When encountering differences in Delphi/FPC calls, the best thing to do is not to insert IFDEF statements whenever a difference is encountered, but to create a separate unit which is only used when compiling with FPC. The missing/incompatible calls can then be implemented in that unit. This will keep the code more readable and easier to maintain.

If a language construct difference is found, then the Free Pascal team should be contacted and a bug should be reported.

7.4 Writing portable code

Free Pascal is designed to be cross-platform. This means that the basic RTL units are usable on all platforms, and the compiler behaves the same on all platforms (as far as possible). The Object Pascal language is the same on all platforms. Nevertheless, FPC comes with a lot of units that are not portable, but provide access to all possibilities that a platform provides.

The following are some guidelines to consider when writing portable code:

- Avoid system-specific units. The system unit, the objects and classes units and the SysUtils unit are guaranteed to work on all systems. So is the DOS unit, but that is deprecated.
- Avoid direct hardware access. Limited, console-like hardware access is available for most platforms in the Video, Mouse and Keyboard units.
- Do not use hard-coded filename conventions. See below for more information on this.
- Make no assumptions on the internal representation of types. Various processors store information in different ways ('endianness').
- If system-specific functionality is needed, it is best to separate this out in a single unit. Porting efforts will then be limited to re-implementing this unit for the new platform.
- Don't use assembler, unless you have to. Assembler is processor specific. Some instructions will not work even on the same processor family.
- Do not assume that pointers and integers have the same size. They do on an Intel 32-bit processor, but not necessarily on other processors. The `PtrInt` type is an alias for the integer type that has the same size as a pointer. `SizeInt` is used for all size-related issues.

The system unit contains some constants which describe file access on a system:

AllFilesMask a file mask that will return all files in a directory. This is $*$ on Unix-like platforms, and $*.*$ on dos and windows like platforms.

LineEnding A character or string which describes the end-of-line marker used on the current platform. Commonly, this is one of #10, #13#10 or #13.

LFNSupport A boolean that indicates whether the system supports long filenames (i.e. is not limited to MS-DOS 8.3 filenames).

DirectorySeparator The character which acts as a separator between directory parts of a path.

DriveSeparator For systems that support drive letters, this is the character that is used to separate the drive indication from the path.

PathSeparator The character used to separate items in a list (notably, a PATH).

maxExitCode The maximum value for a process exitcode.

MaxPathLen The maximum length of a filename, including a path.

FileNameCaseSensitive A boolean that indicates whether filenames are handled case sensitively.

FileNameCasePreserving A boolean that indicates whether case in filenames is preserved on creation or rename.

UnusedHandle A value used to indicate an unused/invalid file handle.

StdInputHandle The value of the standard input file handle. This is not always 0 (zero), as is commonly the case on Unices.

StdOutputHandle The value of the standard output file handle. This is not always 1, as is commonly the case on Unices.

StdErrorHandle The value of the standard diagnostics output file handle. This is not always 2, as is commonly the case on Unices.

CtrlZMarksEOF A boolean that indicates whether the #26 character marks the end of a file (an old MS-DOS convention).

To ease writing portable file system code, the Free Pascal file routines in the system unit and sysutils unit treat the common directory separator characters (/ and \) as equivalent. That means that if you use / on a WINDOWS system, it will be transformed to a backslash, and vice versa.

This feature is controlled by 2 (pre-initialized) variables in the system unit:

AllowDirectorySeparators A set of characters which, when used in filenames, are treated as directory separators. They are transformed to the `DirectorySeparator` character.

AllowDriveSeparators A set of characters which, when used in filenames, are treated as drive separator characters. They are transformed to the `DriveSeparator` character.

Chapter 8

Utilities that come with Free Pascal

Besides the compiler and the runtime Library, Free Pascal comes with some utility programs and units. Here we list these programs and units.

8.1 Demo programs and examples

A suite of demonstration programs comes included with the Free Pascal distribution. These programs have no other purpose than to demonstrate the capabilities of Free Pascal. They are located in the demo directory of the sources.

All example programs mentioned in the documentation are available. Check out the directories that are beneath the same directory as the demo directory. The names of these directories end on ex. There you will find all example sources.

8.2 fpcmake

fpcmake is the Free Pascal makefile constructor program.

It reads a Makefile.fpc configuration file and converts it to a Makefile suitable for reading by GNU make to compile your projects. It is similar in functionality to GNU autoconf or Imake for making X projects.

fpcmake accepts filenames of makefile description files as its command line arguments. For each of these files it will create a Makefile in the same directory where the file is located, overwriting any other existing file.

If no options are given, it just attempts to read the file Makefile.fpc in the current directory and tries to construct a makefile from it. Any previously existing Makefile will be erased.

The format of the fpcmake configuration file is described in great detail in the appendices of the Programmer's Guide.

8.3 fpdoc - Pascal Unit documenter

fpdoc is a program which generates fully cross-referenced documentation for a unit. It generates documentation for each identifier found in the unit's interface section. The generated documentation can be in many formats, for instance HTML, RTF, Text, man page and LaTeX. Unlike other documentation tools, the documentation can be in a separate file (in XML format), so the sources aren't

cluttered with documentation. Its companion program makeskel creates an empty XML file with entries for all identifiers, or it can update an existing XML file, adding entries for new identifiers.

fpdoc and makeskel are described in the FPDoc Reference Guide.

8.4 h2pas - C header to Pascal Unit converter

h2pas attempts to convert a C header file to a Pascal unit. It can handle most C constructs that one finds in a C header file, and attempts to translate them to their Pascal counterparts.

See below (constructs) for a full description of what the translator can handle. The unit with Pascal declarations can then be used to access code written in C.

The output of the h2pas program is written to a file with the same name as the C header file that was used as input, but with the extension .pp The output file that h2pas creates can be customized in a number of ways by means of many options.

8.4.1 Options

The output of h2pas can be controlled with the following options:

-d Use `external;` for all procedure and function declarations.

-D Use `external libname name 'func_name'` for function and procedure declarations.

-e Emit a series of constants instead of an enumeration type for the C `enum` construct.

-i Create an include file instead of a unit (omits the unit header).

-l libname specify the library name for external function declarations.

-o outfile Specify the output file name. Default is the input file name with the extension replaced by .pp

-p Use the letter `P` in front of pointer type parameters instead of `^`.

-s Strip comments from the input file. By default comments are converted to comments, but they may be displaced, since a comment is handled by the scanner.

-t Prepend typedef type names with the letter `T` (used to follow Borland's convention that all types should be defined with T).

-v Replace pointer parameters with call by reference parameters. Use with care because some calls can expect a `Nil` pointer.

-w Header file is a win32 header file (adds support for some special macros).

-x Handle SYS_TRAP of the PalmOS header files.

8.4.2 Constructs

The following C declarations and statements are recognized:

defines Defines are changed into Pascal constants if they are simple defines. Macros are changed - wherever possible - to functions; however the arguments are all integers, so these must be changed manually. Simple expressions in define statements are recognized, as are most arithmetic operators: addition, subtraction, multiplication, division, logical operators, comparison operators, shift operators. The C construct (A ? B : C) is also recognized and translated to a Pascal construct with an IF statement. (This is buggy, however).

preprocessor statements The conditional preprocessing commands are recognized and translated into equivalent Pascal compiler directives. The special

```
#ifdef __cplusplus
```

is also recognized and removed.

typedef A typedef statement is changed into a Pascal type statement. The following basic types are recognized:

- `char` changed to `char`.
- `float` changed to `real` (=double in Free Pascal).
- `int` changed to `longint`.
- `long` changed to `longint`.
- `long int` changed to `longint`.
- `short` changed to `integer`.
- `unsigned` changed to `cardinal`.
- `unsigned char` changed to `byte`.
- `unsigned int` changed to `cardinal`.
- `unsigned long int` changed to `cardinal`.
- `unsigned short` changed to `word`.
- `void` ignored.

These types are also changed if they appear in the arguments of a function or procedure.

functions and procedures Functions and procedures are translated as well. Pointer types may be changed to call by reference arguments (using the `var` argument) by using the `-p` command line argument. Functions that have a variable number of arguments are changed to a function with a `cvar` modifier. (This used to be the `array of const` argument.)

specifiers The `extern` specifier is recognized; however it is ignored. The `packed` specifier is also recognised and changed with the `PACKRECORDS` directive. The `const` specifier is also recognized, but is ignored.

modifiers If the `-w` option is specified, then the following modifiers are recognized:

```
STDCALL
CDECL
CALLBACK
PASCAL
WINAPI
APIENTRY
WINGDIAPI
```

as defined in the win32 headers. If additionally the `-x` option is specified then the

```
SYS_TRAP
```

specifier is also recognized.

enums Enum constructs are changed into enumeration types. Bear in mind that, in C, enumeration types can have values assigned to them. Free Pascal also allows this to a certain degree. If you know that values are assigned to enums, it is best to use the `-e` option to change the enumerations to a series of integer constants.

unions Unions are changed to variant records.

structs Structs are changed to Pascal records, with C packing.

8.5 h2paspp - preprocessor for h2pas

`h2paspp` can be used as a simple preprocessor for h2pas. It removes some of the constructs that h2pas has difficulties with. h2paspp reads one or more C header files and preprocesses them, writing the result to files with the same name as the originals as it goes along. It does not accept all preprocessed tokens of C, but takes care of the following preprocessor directives:

#define symbol Defines the new symbol `symbol`. Note that macros are not supported.

#if symbol The text following this directive is included if `symbol` is defined.

#ifdef symbol The text following this directive is included if `symbol` is defined.

#ifndef symbol The text following this directive is included if `symbol` is not defined.

#include filename Include directives are removed, unless the `-I` option was given, in which case the include file is included and written to the output file.

#undef symbol The symbol `symbol` is undefined.

8.5.1 Usage

h2paspp accepts one or more filenames and preprocessed them. It will read the input, and write the output to a file with the same name unless the `-o` option is given, in which case the file is written to the specified file. Note that only one output filename can be given.

8.5.2 Options

h2paspp has a small number of options to control its behavior:

-dsymbol Define the symbol `symbol` before processing is started.

-h Emit a small helptext.

-I Include include files instead of dropping the include statement.

-ooutfile If this option is given, the output will be written to a file named outfile. Note that only one output file can be given.

8.6 ppudump program

ppudump is a program which shows the contents of a Free Pascal unit. It is distributed with the compiler. You can just issue the following command

```
ppudump [options] foo.ppu
```

to display the contents of the foo.ppu unit. You can specify multiple files on the command line.

The options can be used to change the verbosity of the display. By default, all available information is displayed. You can set the verbosity level using the `-Vxxx` option. Here, `xxx` is a combination of the following letters:

h: Show header info.

i: Show interface information.

m: Show implementation information.

d: Show only (interface) definitions.

s: Show only (interface) symbols.

b: Show browser info.

a: Show everything (default if no -V option is present).

8.7 ppumove program

ppumove is a program to make shared or static libraries from multiple units. It can be compared with the tpumove program that comes with Turbo Pascal.

It is distributed in binary form along with the compiler.

Its usage is very simple:

```
ppumove [options] unit1.ppu unit2.ppu ... unitn.ppu
```

where `options` is a combination of:

-b: Generate a batch file that will contain the external linking and archiving commands that must be executed. The name of this batch file is pmove.sh on LINUX (and Unix like OSes), and pmove.bat on WINDOWS and DOS.

-d xxx: Set the directory in which to place the output files to xxx.

-e xxx: Set the extension of the moved unit files to xxx. By default, this is .ppl. You don't have to specify the dot.

-o xxx: Set the name of the output file, i.e. the name of the file containing all the units. This parameter is mandatory when you use multiple files. On LINUX, ppumove will prepend this name with lib if it isn't already there, and will add an extension appropriate to the type of library.

-q: Operate silently.

-s: Make a static library instead of a dynamic one; By default a dynamic library is made on LINUX.

-w: Tell ppumove that it is working under WINDOWS NT. This will change the names of the linker and archiving program to ldw and arw, respectively.

-h or -?: Display a short help.

The action of the ppumove program is as follows: It takes each of the unit files, and modifies it so that the compiler will know that it should look for the unit code in the library. The new unit files will have an extension .ppl; this can be changed with the `-e` option. It will then put together all the object files of the units into one library, static or dynamic, depending on the presence of the `-s` option.

The name of this library must be set with the `-o` option. If needed, the prefix lib will be prepended under LINUX. The extension will be set to .a for static libraries, for shared libraries, the extensions are `.so` on linux, and `.dll` under WINDOWS NT and OS/2.

As an example, the following command

```
./ppumove -o both -e ppl ppu.ppu timer.ppu
```

will generate the following output under LINUX:

```
PPU-Mover Version 2.1.1
Copyright (c) 1998-2007 by the Free Pascal Development Team

Processing ppu.ppu... Done.
Processing timer.ppu... Done.
Linking timer.o ppu.o
Done.
```

And it will produce the following files:

1. libboth.so : The shared library containing the code from ppu.o and timer.o. Under WINDOWS NT, this file would be called both.dll.
2. timer.ppl : The unit file that tells the Free Pascal compiler to look for the timer code in the library.
3. ppu.ppl : The unit file that tells the Free Pascal compiler to look for the ppu code in the library.

You could then use or distribute the files libboth.so, timer.ppl and ppu.ppl.

8.8 ptop - Pascal source beautifier

8.8.1 ptop program

ptop is a source beautifier written by Peter Grogono based on the ancient pretty-printer by Ledgard, Hueras, and Singer, modernized by the Free Pascal team (objects, streams, configurability etc).

This configurability, and the thorough bottom-up design are the advantages of this program over the diverse Turbo Pascal source beautifiers on e.g. SIMTEL.

The program is quite simple to operate:

ptop "[-v] [-i indent] [-b bufsize][-c optsfile] infile outfile"

The infile parameter is the Pascal file to be processed, and will be written to outfile, overwriting an existing outfile if it exists.

Some options modify the behavior of ptop:

-h Write an overview of the possible parameters and command line syntax.

-c ptop.cfg Read some configuration data from configuration file instead of using the internal defaults then. A config file is not required, the program can operate without one. See also -g.

-i ident Set the number of indent spaces used for BEGIN END; and other blocks.

-b bufsize Set the streaming buffersize to bufsize. The default is 255; 0 is considered non-valid and ignored.

-v Be verbose. Currently only outputs the number of lines read/written and some error messages.

-g ptop.cfg Write ptop configuration defaults to the file "ptop.cfg". The contents of this file can be changed to your liking, and it can be used with the -c option.

8.8.2 The ptop configuration file

Creating and distributing a configuration file for ptop is not necessary, unless you want to modify the standard behavior of ptop. The configuration file is never preloaded, so if you want to use it you should always specify it with a `-c ptop.cfg` parameter.

The structure of a ptop configuration file is a simple building block repeated several (20-30) times, for each Pascal keyword known to the ptop program. (See the default configuration file or ptopu.pp source to find out which keywords are known).

The basic building block of the configuration file consists of one or two lines, describing how ptop should react on a certain keyword. First comes a line without square brackets with the following format:

keyword=option1,option2,option3,...

If one of the options is "dindonkey" (see further below), a second line - with square brackets - is needed:

[keyword]=otherkeyword1,otherkeyword2,otherkeyword3,...

As you can see the block contains two types of identifiers: keywords (keyword and otherkeyword1..3 in above example) and options, (option1..3 above).

`Keywords` are the built-in valid Pascal structure-identifiers like BEGIN, END, CASE, IF, THEN, ELSE, IMPLEMENTATION. The default configuration file lists most of these.

Besides the real Pascal keywords, some other codewords are used for operators and comment expressions as in table (8.1).

Table 8.1: Keywords for operators

Name of codeword	Operator
casevar	: in a case label (unequal 'colon')
becomes	:=
delphicomment	//
opencomment	{ or (*
closecomment	} or *)
semicolon	;
colon	:
equals	=
openparen	[
closeparen	]
period	.

The **options** codewords define actions to be taken when the keyword before the equal sign is found, as listed in table (8.2).

Table 8.2: Possible options

Option	does what
crsupp	Suppress CR before the keyword.
crbefore	Force CR before keyword. (do not use with crsupp.)
blinbefore	Blank line before keyword.
dindonkey	De-indent on associated keywords. (see below)
dindent	Deindent (always)
spbef	Space before
spaft	Space after
gobsym	Print symbols which follow a keyword but which do not affect layout. prints until terminators occur. (terminators are hard-coded in pptop, still needs changing)
inbytab	Indent by tab.
crafter	Force CR after keyword.
upper	Prints keyword all uppercase
lower	Prints keyword all lowercase
capital	Capitalizes keyword: 1st letter uppercase, rest lowercase.

The option "dindonkey" given in table table (8.2) requires some further explanation. "dindonkey" is a contraction of "DeINDent ON associated KEYword". When it is present as an option in the first line, then a second, square-bracketed, line is required. A de-indent will be performed when any of the other keywords listed in the second line are encountered in the source.

Example: The lines

```
else=crbefore,dindonkey,inbytab,upper
[else]=if,then,else
```

mean the following:

- The keyword this block is about is **else** because it's on the LEFT side of both equal signs.
- The option `crbefore` signals not to allow other code (so just spaces) before the ELSE keyword on the same line.
- The option `dindonkey` de-indents if the parser finds any of the keywords in the square brackets line (if,then,else).
- The option `inbytab` means indent by a tab.
- The option `upper` uppercase the keyword (else or Else becomes ELSE)

Try to play with the configfile step by step until you find the effect you desire. The configurability and possibilities of ptop are quite large. E.g. I like all keywords uppercased instead of capitalized, so I replaced all capital keywords in the default file by upper.

ptop is still development software. So it is wise to visually check the generated source and try to compile it, to see if ptop hasn't introduced any errors.

8.8.3 ptopu unit

The source of the PtoP program is conveniently split in two files: one is a unit containing an object that does the actual beautifying of the source, the other is a shell built around this object so it can be used from the command line. This design makes it possible to include the object in a program (e.g. an IDE) and use its features to format code.

The object resides in the PtoPU unit, and is declared as follows

```
  TPrettyPrinter=Object(TObject)
      Indent : Integer;    { How many characters to indent ? }
      InS    : PStream;
      OutS   : PStream;
      DiagS  : PStream;
      CfgS : PStream;
      Constructor Create;
      Function PrettyPrint : Boolean;
    end;
```

Using this object is very simple. The procedure is as follows:

1. Create the object, using its constructor.
2. Set the `InS` stream. This is an open stream, from which Pascal source will be read. This is a mandatory step.
3. Set the `OutS` stream. This is an open stream, to which the beautified Pascal source will be written. This is a mandatory step.
4. Set the `DiagS` stream. Any diagnostics will be written to this stream. This step is optional. If you don't set this, no diagnostics are written.
5. Set the `CfgS` stream. A configuration is read from this stream. (see the previous section for more information about configuration). This step is optional. If you don't set this, a default configuration is used.
6. Set the `Indent` variable. This is the number of spaces to use when indenting. Tab characters are not used in the program. This step is optional. The indent variable is initialized to 2.
7. Call `PrettyPrint`. This will pretty-print the source in `InS` and write the result to `OutS`. The function returns `True` if no errors occurred, `False` otherwise.

So, a minimal procedure would be:

```
Procedure CleanUpCode;

var
  Ins,OutS : PBufStream;
  PPRinter : TPrettyPrinter;

begin
  Ins:=New(PBufStream,Init('ugly.pp',StopenRead,TheBufSize));
  OutS:=New(PBufStream,Init('beauty.pp',StCreate,TheBufSize));
  PPrinter.Create;
  PPrinter.Ins:=Ins;
  PPrinter.outS:=OutS;
  PPrinter.PrettyPrint;
end;
```

Using memory streams allows very fast formatting of code, and is particularly suitable for editors.

8.9 rstconv program

The rstconv program converts the resource string files generated by the compiler (when you use resource string sections) to .po files that can be understood by the GNU msgfmt program.

Its usage is very easy; it accepts the following options:

-i file Use the specified file instead of stdin as input file. This option is optional.

-o file Write output to the specified file. This option is required.

-f format Specify the output format. At the moment, only one output format is supported: *po* for GNU gettext .po format. It is the default format.

As an example:

```
rstconv -i resdemo.rst -o resdemo.po
```

will convert the resdemo.rst file to resdemo.po.

More information on the rstconv utility can be found in the Programmer's Guide, under the chapter about resource strings.

8.10 unitdiff program

8.10.1 Synopsis

unitdiff shows the differences between two unit interface sections.

```
unitdiff [--disable-arguments] [--disable-private] [--disable-protected]
[--help] [--lang=language] [--list] [--output=filename] [--sparse]
file1 file2
```

8.10.2 Description and usage

Unitdiff scans one or two Free Pascal unit source files and either lists all available identifiers, or describes the differences in identifiers between the two units.

You can invoke unitdiff with an input filename as the only required argument. It will then simply list all available identifiers.

The regular usage is to invoke unitdiff with two arguments:

```
unitdiff input1 input2
```

Invoked like this, it will show the difference in interface between the two units, or list the available identifiers in both units. The output of unitdiff will go to standard output by default.

8.10.3 Options

Most of the unitdiff options are not required. Defaults will be used in most cases.

–disable-arguments Do not check the arguments of functions and procedures. The default action is to check them.

–disable-private Do not check private fields or methods of classes. The default action is to check them.

–disable-protected Do not check protected fields or methods of classes. The default action is to check them.

–help Emit a short help text and exit.

–lang=language Set the language for the output file. This will mainly set the strings used for the headers in various parts of the documentation files (by default they're in English). Currently, valid options are:

- `de`: German.
- `fr`: French.
- `nl`: Dutch.

–list Display just the list of available identifiers for the unit or units. If only one unit is specified on the command line, this option is automatically assumed.

–output=filename Specify where the output should go. The default action is to send the output is sent to standard output (the screen).

–sparse Turn on sparse mode. Output only the identifier names. Do not output types or type descriptions. By default, type descriptions are also written.

Chapter 9

Units that come with Free Pascal

Here we list the units that come with the Free Pascal distribution. Since there is a difference in the supplied units per operating system, we first describe the generic ones, then describe those which are operating system specific.

9.1 Standard units

The following units are standard and are meant to be ported to all platforms supported by Free Pascal. A brief description of each unit is also given.

charset A unit to provide mapping of character sets.

cmem Using this unit replaces the Free Pascal memory manager with the memory manager of the C library.

crt This unit is similar to the unit of the same name of Turbo Pascal. It implements writing to the console in color, moving the text cursor around and reading from the keyboard.

dos This unit provides basic routines for accessing the operating system. This includes file searching, environment variables access, getting the operating system version, getting and setting the system time. It is to note that some of these routines are duplicated in functionality in the `sysutils` unit.

dynlibs Provides cross-platform access to loading dynamical libraries.

getopts This unit gives you the GNU `getopts` command line arguments handling mechanism. It also supports long options.

graph *This unit is deprecated.* This unit provides basic graphics handling, with routines to draw lines on the screen, display text etc. It provides the same functions as the Turbo Pascal unit.

heaptrc a unit which debugs the heap usage. When the program exits, it outputs a summary of the used memory, and dumps a summary of unreleased memory blocks (if any). You should not include this unit directly, instead use the `-gh` command-line switch.

keyboard provides basic keyboard handling routines in a platform independent way, and supports writing custom drivers.

macpas This unit implements several functions available only in MACPAS mode. This unit should not be included; it's automatically included when the MACPAS mode is used.

math This unit contains common mathematical routines (trigonometric functions, logarithms, etc.) as well as more complex ones (summations of arrays, normalization functions, etc.).

matrix A unit providing matrix manipulation routines.

mmx This unit provides support for `mmx` extensions in your code.

mouse Provides basic mouse handling routines in a platform independent way, and supports writing custom drivers.

objects This unit provides the base object for standard Turbo Pascal objects. It also implements File and Memory stream objects, as well as sorted and non-sorted collections, and string streams.

objpas Is used for Delphi compatibility. You should never load this unit explicitly; it is automatically loaded if you request Delphi mode.

printer This unit provides all you need for rudimentary access to the printer using standard I/O routines.

sockets This gives the programmer access to sockets and TCP/IP programming.

strings This unit provides basic string handling routines for the `pchar` type, comparable to similar routines in standard `C` libraries.

system This unit is available for all supported platforms. It includes among others, basic file I/O routines, memory management routines, all compiler helper routines, and directory services routines.

strutils Offers a lot of extended string handling routines.

dateutils Offers a lot of extended date/time handling routines for almost any date and time math.

sysutils Is an alternative implementation of the sysutils unit of Delphi. It includes file I/O access routines which takes care of file locking, date and string handling routines, file search, date and string conversion routines.

typinfo Provides functions to access runtime Type Information, just like Delphi.

variants Provides basic variant handling.

video Provides basic screen handling in a platform independent way, and supports writing custom drivers.

9.2 Under DOS

emu387 This unit provides support for the coprocessor emulator.

go32 This unit provides access to capabilities of the `GO32` `DOS` extender.

ports This implements the various `port[]` constructs for low-level I/O.

9.3 Under Windows

wincrt This implements a console in a standard GUI window, contrary to the `crt` unit which is for the Windows console only.

Windows This unit provides access to all Win32 API calls. Effort has been taken to make sure that it is compatible to the Delphi version of this unit, so code for Delphi is easily ported to Free Pascal.

opengl Provides access to the low-level opengl functions in WINDOWS.

winmouse Provides access to the mouse in WINDOWS.

ole2 Provides access to the OLE capabilities of WINDOWS.

winsock Provides access to the WINDOWS sockets API Winsock.

Jedi windows header translations The units containing the Jedi translations of the Windows API headers is also distributed with Free Pascal. The names of these units start with jw, followed by the name of the particular API.

9.4 Under Linux and BSD-like platforms

baseunix Basic Unix operations, basically a subset of the POSIX specification. Using this unit should ensure portability across most unix systems.

clocale This unit initializes the internationalization settings in the sysutils unit with settings obtained through the C library.

cthreads This unit should be specified as the first or second unit in the uses clause of your program: it will use the Posix threads implementation to enable threads in your FPC program.

cwstring If widestring routines are used, then this unit should be inserted as one of the first units in the uses clause of your program: it will initialize the widestring manager in the system unit with routines that use C library functions to handle Widestring conversions and other widestring operations.

errors Returns a string describing an operating system error code.

Libc This is the interface to GLibc on a linux I386 system. It will *not* work for other platforms, and is in general provided for Kylix compatibility.

ports This implements the various `port[]` constructs. These are provided for compatibility only, and it is not recommended to use them extensively. Programs using this construct must be run as root or setuid root, and are a serious security risk on your system.

termio Terminal control routines, which are compatible to the C library routines.

unix Extended Unix operations.

unixtype All types used commonly on Unix platforms.

9.5 Under OS/2

doscalls Interface to doscalls.dll.

dive Interface to dive.dll

emx Provides access to the EMX extender.

pm* Interface units for the Presentation Manager (PM) functions (GUI).

viocalls Interface to viocalls.dll screen handling library.

moucalls Interface to moucalls.dll mouse handling library.

kbdcalls Interface to kbdcalls.dll keyboard handling library.

moncalls Interface to moncalls.dll monitoring handling library.

winsock Provides access to the (emulated) WINDOWS sockets API Winsock.

ports This implements the various `port[]` constructs for low-level I/O.

9.6 Unit availability

Standard unit availability for each of the supported platforms is given in the FAQ / Knowledge base.

Chapter 10

Debugging your programs

Free Pascal supports debug information for the GNU debugger gdb, or its derivatives Insight on win32 or ddd on LINUX. It can write 2 kinds of debug information:

stabs The old debug information format.

dwarf The new debug information format.

Both are understood by GDB.

This chapter briefly describes how to use this feature. It doesn't attempt to describe completely the GNU debugger, however. For more information on the workings of the GNU debugger, see the GDB User Manual.

Free Pascal also supports gprof, the GNU profiler. See section 10.4 for more information on profiling.

10.1 Compiling your program with debugger support

First of all, you must be sure that the compiler is compiled with debugging support. Unfortunately, there is no way to check this at run time, except by trying to compile a program with debugging support.

To compile a program with debugging support, just specify the -g option on the command line, as follows:

```
fpc -g hello.pp
```

This will incorporate debugging information in the executable generated from your program source. You will notice that the size of the executable increases substantially because of this[1].

Note that the above will only incorporate debug information *for the code that has been generated* when compiling hello.pp. This means that if you used some units (the system unit, for instance) which were not compiled with debugging support, no debugging support will be available for the code in these units.

There are 2 solutions for this problem.

1. Recompile all units manually with the -g option.

[1] A good reason not to include debug information in an executable you plan to distribute.

2. Specify the 'build' option (`-B`) when compiling with debugging support. This will recompile all units, and insert debugging information in each of the units.

The second option may have undesirable side effects. It may be that some units aren't found, or compile incorrectly due to missing conditionals, etc.

If all went well, the executable now contains the necessary information with which you can debug it using GNU `gdb`.

10.2 Using `gdb` to debug your program

To use gdb to debug your program, you can start the debugger, and give it as an option the *full* name of your program:

```
gdb hello
```

Or, under DOS:

```
gdb hello.exe
```

This starts the debugger, and the debugger immediately loads your program into memory, but it does not run the program yet. Instead, you are presented with the following (more or less) message, followed by the `gdb` prompt `'(gdb)'`:

```
GNU gdb 6.6.50.20070726-cvs
Copyright (C) 2007 Free Software Foundation, Inc.
GDB is free software, covered by the GNU General Public License, and you are
welcome to change it and/or distribute copies of it under certain conditions.
Type "show copying" to see the conditions.
There is absolutely no warranty for GDB.  Type "show warranty" for details.
This GDB was configured as "x86_64-suse-linux".
(gdb)
```

The actual prompt will vary depending on your operating system and installed version of gdb, of course.

To start the program you can use the `run` command. You can optionally specify command line parameters, which will then be fed to your program, for example:

```
(gdb) run -option -anotheroption needed_argument
```

If your program runs without problems, `gdb` will inform you of this, and return the exit code of your program. If the exit code was zero, then the message `'Program exited normally'` is displayed.

If something went wrong (a segmentation fault or such), `gdb` will stop the execution of your program, and inform you of this with an appropriate message. You can then use the other `gdb` commands to see what happened. Alternatively, you can instruct `gdb` to stop at a certain point in your program, with the `break` command.

Here is a short list of `gdb` commands, which you are likely to need when debugging your program:

quit Exit the debugger.

kill Stop a running program.

help Give help on all gdb commands.

file Load a new program into the debugger.

directory Add a new directory to the search path for source files.

Remark My copy of gdb needs '.' to be added explicitly to the search path, otherwise it doesn't find the sources.

list List the program sources in chunks of 10 lines. As an option you can specify a line number or function name.

break Set a breakpoint at a specified line or function.

awatch Set a watch-point for an expression. A watch-point stops execution of your program whenever the value of an expression is either read or written.

In appendix E a sample init file for gdb is presented. It produces good results when debugging Free Pascal programs.

For more information, refer to the gdb User Manual, or use the 'help' function in gdb.

The text mode IDE and Lazarus both use GDB as a debugging backend. It may be preferable to use that, as they hide much of the details of the debugger in an easy-to-use user interface.

10.3 Caveats when debugging with gdb

There are some peculiarities of Free Pascal which you should be aware of when using gdb. We list the main ones here:

1. Free Pascal generates information for GDB in uppercase letters. This is a consequence of the fact that Pascal is a case insensitive language. So, when referring to a variable or function, you need to make its name all uppercase.

   As an example, if you want to watch the value of a loop variable count, you should type

   ```
   watch COUNT
   ```

   Or if you want to stop when a certain function (e.g MyFunction) is called, type

   ```
   break MYFUNCTION
   ```

2. gdb does not know sets.

3. gdb doesn't know strings. Strings are represented in gdb as records with a length field and an array of char containing the string.

   You can also use the following user function to print strings:

   ```
   define pst
   set $pos=&$arg0
   set $strlen = {byte}$pos
   print {char}&$arg0.st@($strlen+1)
   end

   document pst
     Print out a Pascal string
   end
   ```

If you insert it in your gdb.ini file, you can look at a string with this function. There is a sample gdb.ini in appendix E.

4. Objects are difficult to handle, mainly because `gdb` is oriented towards C and C++. The workaround implemented in Free Pascal is that object methods are represented as functions, with an extra parameter `this` (all lowercase!). The name of this function is a concatenation of the object type and the function name, separated by two underscore characters.

   For example, the method `TPoint.Draw` would be converted to `TPOINT__DRAW`, and you could stop at it by using:

   ```
   break TPOINT__DRAW
   ```

5. Global overloaded functions confuse `gdb` because they have the same name. Thus you cannot set a breakpoint at an overloaded function, unless you know its line number, in which case you can set a breakpoint at the starting line number of the function.

10.4 Support for `gprof`, the GNU profiler

You can compile your programs with profiling support. For this, you just have to use the compiler switch `-pg`. The compiler will insert the necessary stuff for profiling.

When you have done this, you can run your program as you would normally run it:

```
yourexe
```

Where yourexe is the name of your executable.

When your program finishes, a file called gmon.out is generated. Then you can start the profiler to see the output. You can benefit from redirecting the output to a file, because it could be quite a lot:

```
gprof yourexe > profile.log
```

Hint: you can use the `-flat` option to reduce the amount of output of gprof. It will then only output the information about the timings.

For more information on the GNU profiler `gprof`, see its manual.

10.5 Detecting heap memory leaks

Free Pascal has a built in mechanism to detect memory leaks. There is a plug-in unit for the memory manager that analyses the memory allocation/deallocation and prints a memory usage report after the program exits.

The unit that does this is called heaptrc. Do not include this unit in your uses clause directly. Instead, supply the `-gh` switch to the compiler, and it will include the unit automatically for you, in the correct place.

After the program exits, you will get a report looking like this:

```
Marked memory at 0040FA50 invalid
Wrong size : 128 allocated 64 freed
  0x00408708
  0x0040CB49
  0x0040C481
```

```
Call trace for block 0x0040FA50 size 128
  0x0040CB3D
  0x0040C481
```

The output of the heaptrc unit is customizable by setting some variables. Output can also be customized using environment variables.

You can find more information about the usage of the heaptrc unit in the Unit Reference.

10.6 Line numbers in run-time error backtraces

Normally, when a run-time error occurs, you are presented with a list of addresses that represent the call stack backtrace, i.e. the addresses of all procedures that were invoked when the run-time error occurred.

This list is not very informative, so there exists a unit that generates the file names and line numbers of the called procedures using the addresses of the stack backtrace. This unit is called lineinfo.

You can use this unit by giving the `-gl` option to the compiler. The unit will be automatically included. It is also possible to use the unit explicitly in your `uses` clause, but you must make sure that you compile your program with debug info.

Here is an example program:

```
program testline;

procedure generateerror255;

begin
  runerror(255);
end;

procedure generateanerror;

begin
  generateerror255;
end;

begin
  generateanerror;
end.
```

When compiled with `-gl`, the following output is generated:

```
Runtime error 255 at 0x0040BDE5
  0x0040BDE5  GENERATEERROR255,  line 6 of testline.pp
  0x0040BDF0  GENERATEANERROR,  line 13 of testline.pp
  0x0040BE0C  main,  line 17 of testline.pp
  0x0040B7B1
```

This is more understandable than the normal message. Make sure that all units you use are compiled with debug info, because if they are not, no line number and filename can be found.

10.7 Combining heaptrc and lineinfo

If you combine the lineinfo and the heaptrc information, then the output of the heaptrc unit will contain the names of the files and line numbers of the procedures that occur in the stack backtrace.

In such a case, the output will look something like this:

```
Marked memory at 00410DA0 invalid
Wrong size : 128 allocated 64 freed
  0x004094B8
  0x0040D8F9  main,  line 25 of heapex.pp
  0x0040D231
Call trace for block 0x00410DA0 size 128
  0x0040D8ED  main,  line 23 of heapex.pp
  0x0040D231
```

If lines without filename / line number occur, this means there is a unit which has no debug info included (in the above case, the getmem call itself).

Appendix A

Alphabetical listing of command line options

The following is an alphabetical listing of all command line options, as generated by the compiler:

```
Free Pascal Compiler version 3.2.2 [2026/11/12] for x86_64
Copyright (c) 1993-2021 by Florian Klaempfl and others
/usr/bin/fpc [options] <inputfile> [options]
 Only options valid for the default or selected platform are listed.
 Put + after a boolean switch option to enable it, - to disable it.
  @<x>   Read compiler options from <x> in addition to the default fpc.cfg
  -a     The compiler does not delete the generated assembler file
      -a5        Don't generate Big Obj COFF files for GNU Binutils older than 2.25
      -al        List sourcecode lines in assembler file
      -an        List node info in assembler file (-dEXTDEBUG compiler)
      -ao        Add an extra option to external assembler call (ignored for interna
      -ap        Use pipes instead of creating temporary assembler files
      -ar        List register allocation/release info in assembler file
      -at        List temp allocation/release info in assembler file
  -A<x>  Output format:
      -Adefault  Use default assembler
      -Aas       Assemble using GNU AS
      -Agas      Assemble using GNU GAS
      -Agas-darwin Assemble darwin Mach-O64 using GNU GAS
      -Amasm     Win64 object file using ml64 (Microsoft)
      -Apecoff   PE-COFF (Win64) using internal writer
      -Aelf      ELF (Linux-64bit) using internal writer
      -Ayasm     Assemble using Yasm (experimental)
      -Anasm     Assemble using Nasm (experimental)
      -Anasmwin64 Assemble Win64 object file using Nasm (experimental)
      -Anasmelf  Assemble Linux-64bit object file using Nasm (experimental)
      -Anasmdarwin Assemble darwin macho64 object file using Nasm (experimental)
  -b     Generate browser info
      -bl        Generate local symbol info
  -B     Build all modules
  -C<x>  Code generation options:
      -C3        Turn on ieee error checking for constants
      -Ca<x>     Select ABI; see fpc -i or fpc -ia for possible values
      -Cb        Generate code for a big-endian variant of the target architecture
```

```
    -Cc<x>     Set default calling convention to <x>
    -CD        Create also dynamic library (not supported)
    -Ce        Compilation with emulated floating point opcodes
    -Cf<x>     Select fpu instruction set to use; see fpc -i or fpc -if for possib
    -CF<x>     Minimal floating point constant precision (default, 32, 64)
    -Cg        Generate PIC code
    -Ch<n>[,m] <n> bytes min heap size (between 1023 and 67107840) and optionally
    -Ci        IO-checking
    -Cn        Omit linking stage
    -Co        Check overflow of integer operations
    -CO        Check for possible overflow of integer operations
    -Cp<x>     Select instruction set; see fpc -i or fpc -ic for possible values
    -CP<x>=<y>  packing settings
       -CPPACKSET=<y>  <y> set allocation: 0, 1 or DEFAULT or NORMAL, 2, 4 and 8
       -CPPACKENUM=<y>  <y> enum packing: 0, 1, 2 and 4 or DEFAULT or NORMAL
       -CPPACKRECORD=<y>  <y> record packing: 0 or DEFAULT or NORMAL, 1, 2, 4, 8,
    -Cr        Range checking
    -CR        Verify object method call validity
    -Cs<n>     Set stack checking size to <n>
    -Ct        Stack checking (for testing only, see manual)
    -CT<x>     Target-specific code generation options
       -CTcld                       Emit a CLD instruction before using the x86 str
    -CX        Create also smartlinked library
-d<x>  Defines the symbol <x>
-D     Generate a DEF file
    -Dd<x>     Set description to <x>
    -Dv<x>     Set DLL version to <x>
-e<x>  Set path to executable
-E     Same as -Cn
-fPIC  Same as -Cg
-F<x>  Set file names and paths:
    -Fa<x>[,y] (for a program) load units <x> and [y] before uses is parsed
    -Fc<x>     Set input codepage to <x>
    -FC<x>     Set RC compiler binary name to <x>
    -Fd        Disable the compiler's internal directory cache
    -FD<x>     Set the directory where to search for compiler utilities
    -Fe<x>     Redirect error output to <x>
    -Ff<x>     Add <x> to framework path (Darwin only)
    -FE<x>     Set exe/unit output path to <x>
    -Fi<x>     Add <x> to include path
    -Fl<x>     Add <x> to library path
    -FL<x>     Use <x> as dynamic linker
    -Fm<x>     Load unicode conversion table from <x>.txt in the compiler dir
    -FM<x>     Set the directory where to search for unicode binary files
    -FN<x>     Add <x> to list of default unit scopes (namespaces)
    -Fo<x>     Add <x> to object path
    -Fr<x>     Load error message file <x>
    -FR<x>     Set resource (.res) linker to <x>
    -Fu<x>     Add <x> to unit path
    -FU<x>     Set unit output path to <x>, overrides -FE
    -FW<x>     Store generated whole-program optimization feedback in <x>
    -Fw<x>     Load previously stored whole-program optimization feedback from <x>
-g     Generate debug information (default format for target)
    -gc        Generate checks for pointers (experimental, only available on some
```

```
    -gh        Use heaptrace unit (for memory leak/corruption debugging)
    -gl        Use line info unit (show more info with backtraces)
    -gm        Generate Microsoft CodeView debug information (experimental)
    -go<x>     Set debug information options
       -godwarfsets  Enable DWARF 'set' type debug information (breaks gdb < 6.5)
       -gostabsabsincludes  Store absolute/full include file paths in Stabs
       -godwarfmethodclassprefix  Prefix method names in DWARF with class name
       -godwarfcpp  Simulate C++ debug information in DWARF
       -godwarfomflinnum  Generate line number information in OMF LINNUM records i
    -gp        Preserve case in stabs symbol names
    -gs        Generate Stabs debug information
    -gt        Trash local variables (to detect uninitialized uses; multiple 't' cl
    -gv        Generates programs traceable with Valgrind
    -gw        Generate DWARFv2 debug information (same as -gw2)
    -gw2       Generate DWARFv2 debug information
    -gw3       Generate DWARFv3 debug information
    -gw4       Generate DWARFv4 debug information (experimental)
-i     Information
    -iD        Return compiler date
    -iSO       Return compiler OS
    -iSP       Return compiler host processor
    -iTO       Return target OS
    -iTP       Return target processor
    -iV        Return short compiler version
    -iW        Return full compiler version
    -ia        Return list of supported ABI targets
    -ic        Return list of supported CPU instruction sets
    -if        Return list of supported FPU instruction sets
    -ii        Return list of supported inline assembler modes
    -io        Return list of supported optimizations
    -ir        Return list of recognized compiler and RTL features
    -it        Return list of supported targets
    -iu        Return list of supported microcontroller types
    -iw        Return list of supported whole program optimizations
-I<x>  Add <x> to include path
-k<x>  Pass <x> to the linker
-l     Write logo
-M<x>  Set language mode to <x>
    -Mfpc      Free Pascal dialect (default)
    -Mobjfpc   FPC mode with Object Pascal support
    -Mdelphi   Delphi 7 compatibility mode
    -Mtp       TP/BP 7.0 compatibility mode
    -Mmacpas   Macintosh Pascal dialects compatibility mode
    -Miso      ISO 7185 mode
    -Mextendedpascal ISO 10206 mode
    -Mdelphiunicode Delphi 2009 and later compatibility mode
-n     Do not read the default config files
-o<x>  Change the name of the executable produced to <x>
-O<x>  Optimizations:
    -O-        Disable optimizations
    -O1        Level 1 optimizations (quick and debugger friendly)
    -O2        Level 2 optimizations (-O1 + quick optimizations)
    -O3        Level 3 optimizations (-O2 + slow optimizations)
    -O4        Level 4 optimizations (-O3 + optimizations which might have unexpec
```

```
    -Oa<x>=<y> Set alignment
    -Oo[NO]<x> Enable or disable optimizations; see fpc -i or fpc -io for possible
    -Op<x>     Set target cpu for optimizing; see fpc -i or fpc -ic for possible va
    -OW<x>     Generate whole-program optimization feedback for optimization <x>; s
    -Ow<x>     Perform whole-program optimization <x>; see fpc -i or fpc -iw for po
    -Os        Optimize for size rather than speed
-pg    Generate profile code for gprof (defines FPC_PROFILE)
-P<x>  Target CPU / compiler related options:
    -PB        Show default compiler binary
    -PP        Show default target cpu
    -P<x>      Set target CPU (aarch64,arm,avr,i386,i8086,jvm,m68k,mips,mipsel,powe
-R<x>  Assembler reading style:
    -Rdefault  Use default assembler for target
    -Ratt      Read AT&T style assembler
    -Rintel    Read Intel style assembler
-S<x>  Syntax options:
    -S2        Same as -Mobjfpc
    -Sc        Support operators like C (*=,+=,/= and -=)
    -Sa        Turn on assertions
    -Sd        Same as -Mdelphi
    -Se<x>     Error options. <x> is a combination of the following:
       <n> : Compiler halts after the <n> errors (default is 1)
       w : Compiler also halts after warnings
       n : Compiler also halts after notes
       h : Compiler also halts after hints
    -Sf        Enable certain features in compiler and RTL; see fpc -i or fpc -ir s
    -Sg        Enable LABEL and GOTO (default in -Mtp and -Mdelphi)
    -Sh        Use reference counted strings (ansistring by default) instead of sho
    -Si        Turn on inlining of procedures/functions declared as "inline"
    -Sj        Allows typed constants to be writeable (default in all modes)
    -Sk        Load fpcylix unit
    -SI<x>     Set interface style to <x>
       -SIcom     COM compatible interface (default)
       -SIcorba   CORBA compatible interface
    -Sm        Support macros like C (global)
    -So        Same as -Mtp
    -Sr        Transparent file names in ISO mode
    -Ss        Constructor name must be init (destructor must be done)
    -Sv        Support vector processing (use CPU vector extensions if available)
    -Sx        Enable exception keywords (default in Delphi/ObjFPC modes)
    -Sy        @<pointer> returns a typed pointer, same as $T+
-s     Do not call assembler and linker
    -sh        Generate script to link on host
    -st        Generate script to link on target
    -sr        Skip register allocation phase (use with -alr)
-T<x>  Target operating system:
    -Taros     AROS
    -Tdarwin   Darwin/Mac OS X
    -Tdragonfly DragonFly BSD
    -Tembedded Embedded
    -Tfreebsd  FreeBSD
    -Tiphonesim iPhoneSimulator
    -Tlinux    Linux
    -Tnetbsd   NetBSD
```

```
    -Topenbsd  OpenBSD
    -Tsolaris  Solaris
    -Twin64    Win64 (64 bit Windows systems)
-u<x>  Undefines the symbol <x>
-U     Unit options:
    -Un        Do not check where the unit name matches the file name
    -Ur        Generate release unit files (never automatically recompiled)
    -Us        Compile a system unit
-v<x>  Be verbose. <x> is a combination of the following letters:
    e : Show errors (default)       0 : Show nothing (except errors)
    w : Show warnings               u : Show unit info
    n : Show notes                  t : Show tried/used files
    h : Show hints                  c : Show conditionals
    i : Show general info           d : Show debug info
    l : Show linenumbers            r : Rhide/GCC compatibility mode
    s : Show time stamps            q : Show message numbers
    a : Show everything             x : Show info about invoked tools
    b : Write file names messages   p : Write tree.log with parse tree
        with full path              v : Write fpcdebug.txt with
    z : Write output to stderr          lots of debugging info
    m<x>,<y> : Do not show messages numbered <x> and <y>
-V<x>  Append '-<x>' to the used compiler binary name (e.g. for version)
-W<x>  Target-specific options (targets)
    -WA        Specify native type application (Windows)
    -Wb        Create a bundle instead of a library (Darwin)
    -WB        Create a relocatable image (Windows)
    -WB<x>     Set image base to <x> (Windows)
    -WC        Specify console type application (Windows)
    -WD        Use DEFFILE to export functions of DLL or EXE (Windows)
    -We        Use external resources (Darwin)
    -WG        Specify graphic type application (Windows)
    -Wi        Use internal resources (Darwin)
    -WI        Turn on/off the usage of import sections (Windows)
    -WM<x>     Minimum Mac OS X deployment version: 10.4, 10.5.1, ... (Darwin)
    -WN        Do not generate relocation code, needed for debugging (Windows)
    -WP<x>     Minimum iOS deployment version: 8.0, 8.0.2, ... (iphonesim)
    -WR        Generate relocation code (Windows)
    -WX        Enable executable stack (Linux)
-X     Executable options:
    -X9        Generate linkerscript for GNU Binutils ld older than version 2.19.1
    -Xc        Pass --shared/-dynamic to the linker (BeOS, Darwin, FreeBSD, Linux)
    -Xd        Do not search default library path (sometimes required for cross-co
    -Xe        Use external linker
    -Xf        Substitute pthread library name for linking (BSD)
    -Xg        Create debuginfo in a separate file and add a debuglink section to
    -XD        Try to link units dynamically      (defines FPC_LINK_DYNAMIC)
    -Xi        Use internal linker
    -XLA       Define library substitutions for linking
    -XLO       Define order of library linking
    -XLD       Exclude default order of standard libraries
    -Xm        Generate link map
    -XM<x>     Set the name of the 'main' program routine (default is 'main')
    -Xn        Use target system native linker instead of GNU ld (Solaris, AIX)
    -Xp<x>     First search for the compiler binary in the directory <x>
```

```
     -XP<x>     Prepend the binutils names with the prefix <x>
     -Xr<x>     Set the linker's rlink-path to <x> (needed for cross compile, see t
     -XR<x>     Prepend <x> to all linker search paths (BeOS, Darwin, FreeBSD, Linu
     -Xs        Strip all symbols from executable
     -XS        Try to link units statically (default, defines FPC_LINK_STATIC)
     -Xt        Link with static libraries (-static is passed to linker)
     -Xv        Generate table for Virtual Entry calls
     -XV        Use VLink as external linker       (default on Amiga, MorphOS)
     -XX        Try to smartlink units             (defines FPC_LINK_SMART)

-?     Show this help
-h     Shows this help without waiting
```

Appendix B

Alphabetical list of reserved words

absolute
abstract
and
array
as
asm
assembler
begin
break
case
cdecl
class
const
constructor
continue
cppclass
deprecated
destructor
div
do
downto
else
end
except
exit
export
exports
external
experimental
fail
false
far
file
finally
for
forward
function
goto
if
implementation
in
index
inherited
initialization
inline
interface
interrupt
is
label
library
mod
name
near
nil
not
object
of
on
operator
or
otherwise
packed
popstack
private
procedure
program
property
protected
public
raise
record
reintroduce
repeat
self
set
shl
shr
stdcall
string
then
to
true
try
type
unimplemented
unit
until
uses
var
virtual
while
with
xor

Appendix C

Compiler messages

This appendix is meant to list all the compiler messages. The list of messages is generated from he compiler source itself, and should be fairly complete. At this point, only assembler errors are not in the list.

For an explanation of how to control the messages, section 5.1.2, page 25.

C.1 General compiler messages

This section gives the compiler messages which are not fatal, but which display useful information. The number of such messages can be controlled with the various verbosity level `-v` switches.

Compiler: arg1
When the `-vt` switch is used, this line tells you what compiler is used.

Compiler OS: arg1
When the `-vd` switch is used, this line tells you what the source operating system is.

Info: Target OS: arg1
When the `-vd` switch is used, this line tells you what the target operating system is.

Using executable path: arg1
When the `-vt` switch is used, this line tells you where the compiler looks for its binaries.

Using unit path: arg1
When the `-vt` switch is used, this line tells you where the compiler looks for compiled units. You can set this path with the `-Fu` option.

Using include path: arg1
When the `-vt` switch is used, this line tells you where the compiler looks for its include files (files used in `{$I xxx}` statements). You can set this path with the `-Fi` option.

Using library path: arg1
When the `-vt` switch is used, this line tells you where the compiler looks for the libraries. You can set this path with the `-Fl` option.

Using object path: arg1
When the `-vt` switch is used, this line tells you where the compiler looks for object files you link in (files used in `{$L xxx}` statements). You can set this path with the `-Fo` option.

Info: arg1 lines compiled, arg2 secarg3
When the `-vi` switch is used, the compiler reports the number of lines compiled, and the time it took to compile them (real time, not program time).

Fatal: No memory left
The compiler doesn't have enough memory to compile your program. There are several remedies for this:

- If you're using the build option of the compiler, try compiling the different units manually.
- If you're compiling a huge program, split it up into units, and compile these separately.
- If the previous two don't work, recompile the compiler with a bigger heap. (You can use the `-Ch` option for this, `-Ch` (see page 28).)

Info: Writing Resource String Table file: arg1
This message is shown when the compiler writes the Resource String Table file containing all the resource strings for a program.

Error: Writing Resource String Table file: arg1
This message is shown when the compiler encounters an error when writing the Resource String Table file.

Info: Fatal:
Prefix for Fatal Errors.

Info: Error:
Prefix for Errors.

Info: Warning:
Prefix for Warnings.

Info: Note:
Prefix for Notes.

Info: Hint:
Prefix for Hints.

Error: Path "arg1" does not exist
The specified path does not exist.

Fatal: Compilation aborted
Compilation was aborted.

bytes code
The size of the generated executable code, in bytes.

bytes data
The size of the generated program data, in bytes.

Info: arg1 warning(s) issued
Total number of warnings issued during compilation.

Info: arg1 hint(s) issued
Total number of hints issued during compilation.

Info: arg1 note(s) issued
Total number of notes issued during compilation.

Fatal: I/O error: arg1
During compilation an I/O error happened which allows no further compilation.

Fatal: Operating system error: arg1
During compilation an operating system error happened which allows no further compilation.

Error: Compilation raised exception internally
Compilation was aborted, due to an exception generation.

Using unit scope: arg1
When the `-vt` switch is used, this line tells you what unit scopes (namespaces) the compiler is using when looking up units. You can add a unit scope with the `-FN` option.

C.2 Scanner messages.

This section lists the messages that the scanner emits. The scanner takes care of the lexical structure of the pascal file, i.e. it tries to find reserved words, strings, etc. It also takes care of directives and conditional compilation handling.

Fatal: Unexpected end of file
This typically happens in one of the following cases:

- The source file ends before the final `end.` statement. This happens mostly when the `begin` and `end` statements are not balanced;
- An include file ends in the middle of a statement.
- A comment was not closed.

Fatal: String exceeds line
There is a missing closing ' in a string, so it occupies multiple lines.

Fatal: illegal character "arg1" (arg2)
An illegal character was encountered in the input file.

Fatal: Syntax error, "arg1" expected but "arg2" found
This indicates that the compiler expected a different token than the one you typed. It can occur almost anywhere it is possible to make an error against the Pascal language.

Start reading includefile arg1
When you provide the `-vt` switch, the compiler tells you when it starts reading an included file.

Warning: Comment level arg1 found
When the `-vw` switch is used, then the compiler warns you if it finds nested comments. Nested comments are not allowed in Turbo Pascal and Delphi, and can be a possible source of errors.

Note: Ignored compiler switch "arg1"
With `-vn` on, the compiler warns if it ignores a switch.

Warning: Illegal compiler switch "arg1"
You included a compiler switch (i.e. `{$...}`) which the compiler does not recognise.

Warning: Misplaced global compiler switch, ignored
The compiler switch is misplaced. It must be located at the start of the compilation unit, before the uses clause or any declaration.

Error: Illegal char constant
This happens when you specify a character with its ASCII code, as in `#96`, but the number is either illegal, or out of range.

Fatal: Cannot open file "arg1"
Free Pascal cannot find the program or unit source file you specified on the command line.

Fatal: Cannot open include file "arg1"
Free Pascal cannot find the source file you specified in a `{$include ..}` statement.

Error: Illegal record alignment specifier "arg1"
You are specifying `{$PACKRECORDS n}` or `{$ALIGN n}` with an illegal value for `n`. For $PACKRECORDS valid alignments are 1, 2, 4, 8, 16, 32, C, NORMAL, DEFAULT, and for $ALIGN valid alignments are 1, 2, 4, 8, 16, 32, ON, OFF. Under mode MacPas $ALIGN also supports MAC68K, POWER and RESET.

Error: Illegal enum minimum-size specifier "arg1"
You are specifying the `{$PACKENUM n}` with an illegal value for `n`. Only 1,2,4, NORMAL or DEFAULT is valid here.

Error: $ENDIF expected for arg1 arg2 defined in arg3 line arg4
Your conditional compilation statements are unbalanced.

Error: Syntax error while parsing a conditional compiling expression
There is an error in the expression following the `{$if ..}`, `{$ifc }` or `{$setc }` compiler directives.

Error: Evaluating a conditional compiling expression
There is an error in the expression following the `{$if ..}`, *if cor*setc compiler directives.

Warning: Macro contents are limited to 255 characters in length
The contents of macros cannot be longer than 255 characters.

Error: ENDIF without IF(N)DEF
Your `{$IFDEF ..}` and {$ENDIF} statements are not balanced.

Fatal: User defined: arg1
A user defined fatal error occurred. See also the Programmer's Guide.

Error: User defined: arg1
A user defined error occurred. See also the Programmer's Guide.

Warning: User defined: arg1
A user defined warning occurred. See also the Programmer's Guide.

Note: User defined: arg1
A user defined note was encountered. See also the Programmer's Guide.

Hint: User defined: arg1
A user defined hint was encountered. See also the Programmer's Guide.

Info: User defined: arg1
User defined information was encountered. See also the Programmer's Guide.

Error: Keyword redefined as macro has no effect
You cannot redefine keywords with macros.

Fatal: Macro buffer overflow while reading or expanding a macro
Your macro or its result was too long for the compiler.

Warning: Expanding of macros exceeds a depth of 16.
When expanding a macro, macros have been nested to a level of 16. The compiler will expand no further, since this may be a sign that recursion is used.

Warning: compiler switches are not supported in // styled comments
Compiler switches should be in normal Pascal style comments.

Handling switch "arg1"
When you set debugging info on (`-vd`) the compiler tells you when it is evaluating conditional compile statements.

ENDIF arg1 found
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements.

IFDEF arg1 found, arg2
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements.

IFOPT arg1 found, arg2
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements.

IF arg1 found, arg2
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements.

IFNDEF arg1 found, arg2
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements.

ELSE arg1 found, arg2
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements.

Skipping until...
When you turn on conditional messages (`-vc`), the compiler tells you where it encounters conditional statements, and whether it is skipping or compiling parts.

Info: Press <return> to continue
When the `-vi` switch is used, the compiler stops compilation and waits for the `Enter` key to be pressed when it encounters a `{$STOP}` directive.

Warning: Unsupported switch "arg1"
When warnings are turned on (`-vw`), the compiler warns you about unsupported switches. This means that the switch is used in Delphi or Turbo Pascal, but not in Free Pascal.

Warning: Illegal compiler directive "arg1"
When warnings are turned on (`-vw`), the compiler warns you about unrecognised switches. For a list of recognised switches, see the Programmer's Guide.

Back in arg1
When you use the `-vt` switch, the compiler tells you when it has finished reading an include file.

Warning: Unsupported application type: "arg1"
You get this warning if you specify an unknown application type with the directive `{$APPTYPE}`.

Warning: APPTYPE is not supported by the target OS
The `{$APPTYPE}` directive is supported by certain operating systems only.

Warning: DESCRIPTION is not supported by the target OS
The `{$DESCRIPTION}` directive is not supported on this target OS.

Note: VERSION is not supported by target OS
The {$VERSION} directive is not supported on this target OS.

Note: VERSION only for exes or DLLs
The {$VERSION} directive is only used for executable or DLL sources.

Warning: Wrong format for VERSION directive "arg1"
The {$VERSION} directive format is majorversion.minorversion where majorversion and minorversion are words.

Error: Illegal assembler style specified "arg1"
When you specify an assembler mode with the {$ASMMODE xxx} directive, the compiler didn't recognize the mode you specified.

Warning: ASM reader switch is not possible inside asm statement, "arg1" will be effective only for next
It is not possible to switch from one assembler reader to another inside an assembler block. The new reader will be used for next assembler statements only.

Error: Wrong switch toggle, use ON/OFF or +/-
You need to use ON or OFF or a + or - to toggle the switch.

Error: Resource files are not supported for this target
The target you are compiling for doesn't support resource files.

Warning: Include environment "arg1" not found in environment
The included environment variable cannot be found in the environment; it will be replaced by an empty string instead.

Error: Illegal value for FPU register limit
Valid values for this directive are 0..8 and NORMAL/DEFAULT.

Warning: Only one resource file is supported for this target
The target you are compiling for supports only one resource file. The first resource file found is used, the others are discarded.

Warning: Macro support has been turned off
A macro declaration has been found, but macro support is currently off, so the declaration will be ignored. To turn macro support on compile with -Sm on the command line or add {$MACRO ON} in the source.

Error: Illegal interface type specified. Valids are COM, CORBA or DEFAULT.
The interface type that was specified is not supported.

Warning: APPID is only supported for PalmOS
The {$APPID} directive is only supported for the PalmOS target.

Warning: APPNAME is only supported for PalmOS
The {$APPNAME} directive is only supported for the PalmOS target.

Error: Constant strings cannot be longer than 255 chars
A single string constant can contain at most 255 chars. Try splitting up the string into multiple smaller parts and concatenate them with a + operator.

Fatal: Including include files exceeds a depth of 16.
When including include files the files have been nested to a level of 16. The compiler will expand no further, since this may be a sign that recursion is used.

Fatal: Too many levels of PUSH
A maximum of 20 levels is allowed. This error occurs only in mode MacPas.

Error: A POP without a preceding PUSH
This error occurs only in mode MacPas.

Error: Macro or compile time variable "arg1" does not have any value
Thus the conditional compile time expression cannot be evaluated.

Error: Wrong switch toggle, use ON/OFF/DEFAULT or +/-/*
You need to use ON or OFF or DEFAULT or a + or - or * to toggle the switch.

Error: Mode switch "arg1" not allowed here
A mode switch has already been encountered, or, in the case of option -Mmacpas, a mode switch occurs after UNIT.

Error: Compile time variable or macro "arg1" is not defined.
Thus the conditional compile time expression cannot be evaluated. Only in mode MacPas.

Error: UTF-8 code greater than 65535 found
Free Pascal handles UTF-8 strings internally as widestrings, i.e. the char codes are limited to 65535.

Error: Malformed UTF-8 string
The given string isn't a valid UTF-8 string.

UTF-8 signature found, using UTF-8 encoding
The compiler found a UTF-8 encoding signature ($ef, $bb, $bf) at the beginning of a file, so it interprets it as a UTF-8 file.

Error: Compile time expression: Wanted arg1 but got arg2 at arg3
The type-check of a compile time expression failed.

Note: APPTYPE is not supported by the target OS
The `{$APPTYPE}` directive is supported by certain operating systems only.

Error: Illegal optimization specified "arg1"
You specified an optimization with the `{$OPTIMIZATION xxx}` directive, and the compiler didn't recognize the optimization you specified.

Warning: SETPEFLAGS is not supported by the target OS
The `{$SETPEFLAGS}` directive is not supported by the target OS.

Warning: IMAGEBASE is not supported by the target OS
The `{$IMAGEBASE}` directive is not supported by the target OS.

Warning: MINSTACKSIZE is not supported by the target OS
The `{$MINSTACKSIZE}` directive is not supported by the target OS.

Warning: MAXSTACKSIZE is not supported by the target OS
The `{$MAXSTACKSIZE}` directive is not supported by the target OS.

Error: Illegal state "arg1" for $WARN directive
Only ON and OFF can be used as state with a `{$WARN}` compiler directive.

Error: Illegal set packing value
Only 0, 1, 2, 4, 8, DEFAULT and NORMAL are allowed as packset parameters.

Warning: PIC directive or switch ignored
Several targets, such as WINDOWS, do not support nor need PIC, so the PIC directive and switch are ignored.

Warning: The switch "arg1" is not supported by the currently selected target
Some compiler switches like $E are not supported by all targets.

Warning: Framework-related options are only supported for Darwin/Mac OS X
Frameworks are not a known concept, or at least not supported by FPC, on operating systems other than Darwin/Mac OS X.

Error: Illegal minimal floating point constant precision "arg1"
Valid minimal precisions for floating point constants are default, 32 and 64, which mean respectively minimal (usually 32 bit), 32 bit and 64 bit precision.

Warning: Overriding name of "main" procedure multiple times, was previously set to "arg1"
The name for the main entry procedure is specified more than once. Only the last name will be used.

Warning: Illegal identifier "arg1" for $WARN directive
Identifier is not known by a `{$WARN}` compiler directive.

Error: Illegal alignment directive
The alignment directive is not valid. Either the alignment type is not known or the alignment value is not a power of two.

Fatal: It is not possible to include a file that starts with an UTF-8 BOM in a module that uses a different code page
All source code that is part of a single compilation entity (program, library, unit) must be encoded in the same code page

Warning: Directive "arg1" is ignored for the current target platform
Some directives are ignored for certain targets, such as changing the packrecords and packenum settings on managed platforms.

Warning: Current system codepage "arg1" is not available for the compiler. Switching default codepage back to "arg2".
The current system codepage is not known by the compiler. The compiler is compiled with support for several codepages built-in. The codepage of the operation system is not in that list. You will need to recompile the compiler with support for this codepage.

Warning: SETPEOPTFLAGS is not supported by the target OS
The `{$SETPEOPTFLAGS}` directive is not supported by the target OS.

Error: Illegal argument for SETPEFLAGS
The given argument for SETPEFLAGS is neither a correct named value nor an ordinal value

Error: Illegal argument for SETPEOPTFLAGS
The given argument for SETPEOPTFLAGS is neither a correct named value nor an ordinal value

Error: Directive arg1 is not supported on this target
Not all compiler directives are supported on all targets.

Warning: The specified stack size is not within the valid range for the platform. Setting the stack size ignored.
The valid range for the stack size is 1024 - 67107839 on 32-bit and 64-bit platforms and 1024 - 65520 on 16-bit platforms. Additionally, for Turbo Pascal 7 compatibility reasons, specifying a stack size of 65521 on 16-bit platforms actually sets the stack size to 65520.

Warning: The specified HeapMax value is smaller than the HeapMin value. Setting HeapMax ignored.
The HeapMax value (if specified) must be greater than or equal to the HeapMin value. Otherwise, the HeapMax value is ignored.

Error: Illegal argument for HUGEPOINTERNORMALIZATION
The only allowed values for HUGEPOINTERNORMALIZATION are BORLANDC, MICROSOFTC and WATCOMC.

Error: Illegal assembler CPU instruction set specified "arg1"
When you specify an assembler CPU with the `{$ASMCPU xxx}` directive, the compiler didn't recognize the CPU you specified.

Warning: Specified syscall convention is not useable on this target
The specified syscall convention using the `{$SYSCALL xxx}` directive, is not useable on the current target system.

Warning: Invalid syscall convention specified
The compiler did not recognize the syscall convention specified by the `{$SYSCALL xxx}` directive.

Warning: SETPEUSERVERSION is not supported by the target OS
The `{$SETPEUSERVERSION}` directive is not supported by the target OS.

Warning: SETPEOSVERSION is not supported by the target OS
The `{$SETPEOSVERSION}` directive is not supported by the target OS.

Warning: SETPESUBSYSVERSION is not supported by the target OS
The `{$SETPESUBSYSVERSION}` directive is not supported by the target OS.

Note: Changed CPU type to be consistent with specified controller

C.3 Parser messages

This section lists all parser messages. The parser takes care of the semantics of you language, i.e. it determines if your Pascal constructs are correct.

Error: Parser - Syntax Error
An error against the Turbo Pascal language was encountered. This typically happens when an illegal character is found in the source file.

Error: INTERRUPT procedure cannot be nested
An `INTERRUPT` procedure must be global.

Warning: Procedure type "arg1" ignored
The specified procedure directive is ignored by FPC programs.

Error: Not all declarations of "arg1" are declared with OVERLOAD
When you want to use overloading using the `OVERLOAD` directive, then all declarations need to have `OVERLOAD` specified.

Error: Duplicate exported function name "arg1"
Exported function names inside a specific DLL must all be different.

Error: Duplicate exported function index arg1
Exported function indexes inside a specific DLL must all be different.

Error: Invalid index for exported function
DLL function index must be in the range `1..$FFFF`.

Warning: Relocatable DLL or executable arg1 debug info does not work, disabled.
It is currently not possible to include debug information in a relocatable DLL.

Warning: To allow debugging for win32 code you need to disable relocation with -WN option
Stabs debug info is wrong for relocatable DLL or EXES. Use -WN if you want to debug win32 executables.

Error: Constructor name must be INIT
You are declaring an object constructor with a name which is not `init`, and the `-Ss` switch is in effect. See the switch `-Ss` (see page 35).

Error: Destructor name must be DONE
You are declaring an object destructor with a name which is not `done`, and the `-Ss` switch is in effect. See the switch `-Ss` (see page 35).

Error: Procedure type INLINE not supported
You tried to compile a program with C++ style inlining, and forgot to specify the `-Si` option (`-Si` (see page 35)). The compiler doesn't support C++ styled inlining by default.

Warning: Constructor should be public
Constructors must be in the 'public' part of an object (class) declaration.

Warning: Destructor should be public
Destructors must be in the 'public' part of an object (class) declaration.

Note: Class should have one destructor only
You can declare only one destructor for a class.

Error: Local class definitions are not allowed
Classes must be defined globally. They cannot be defined inside a procedure or function.

Fatal: Anonymous class definitions are not allowed
An invalid object (class) declaration was encountered, i.e. an object or class without methods that isn't derived from another object or class. For example:

```
Type o = object
         a : longint;
         end;
```

will trigger this error.

Note: The object "arg1" has no VMT
This is a note indicating that the declared object has no virtual method table.

Error: Illegal parameter list
You are calling a function with parameters that are of a different type than the declared parameters of the function.

Error: Wrong number of parameters specified for call to "arg1"
There is an error in the parameter list of the function or procedure – the number of parameters is not correct.

Error: overloaded identifier "arg1" isn't a function
The compiler encountered a symbol with the same name as an overloaded function, but it is not a function it can overload.

Error: overloaded functions have the same parameter list
You're declaring overloaded functions, but with the same parameter list. Overloaded function must have at least 1 different parameter in their declaration.

Error: function header doesn't match the previous declaration "arg1"
You declared a function with the same parameters but different result type or function modifiers.

Error: function header "arg1" doesn't match forward : var name changes arg2 => arg3
You declared the function in the `interface` part, or with the `forward` directive, but defined it with a different parameter list.

Note: Values in enumeration types have to be ascending
Free Pascal allows enumeration constructions as in C. Examine the following two declarations:

```
type a = (A_A,A_B,A_E:=6,A_UAS:=200);
type a = (A_A,A_B,A_E:=6,A_UAS:=4);
```

The second declaration would produce an error. `A_UAS` needs to have a value higher than `A_E`, i.e. at least 7.

Error: With cannot be used for variables in a different segment
With stores a variable locally on the stack, but this is not possible if the variable belongs to another segment.

Error: function nesting > 31
You can nest function definitions only 31 levels deep.

Error: range check error while evaluating constants
The constants are out of their allowed range.

Warning: range check error while evaluating constants
The constants are out of their allowed range.

Error: duplicate case label
You are specifying the same label 2 times in a `case` statement.

Error: Upper bound of case range is less than lower bound
The upper bound of a `case` label is less than the lower bound and this is useless.

Error: typed constants of classes or interfaces are not allowed
You cannot declare a constant of type class or object.

Error: functions variables of overloaded functions are not allowed
You are trying to assign an overloaded function to a procedural variable. This is not allowed.

Error: string length must be a value from 1 to 255
The length of a shortstring in Pascal is limited to 255 characters. You are trying to declare a string with length less than 1 or greater than 255.

Warning: use extended syntax of NEW and DISPOSE for instances of objects
If you have a pointer `a` to an object type, then the statement `new(a)` will not initialize the object (i.e. the constructor isn't called), although space will be allocated. You should issue the `new(a,init)` statement. This will allocate space, and call the constructor of the object.

Warning: use of NEW or DISPOSE for untyped pointers is meaningless

Error: use of NEW or DISPOSE is not possible for untyped pointers
You cannot use `new(p)` or `dispose(p)` if `p` is an untyped pointer because no size is associated to an untyped pointer. It is accepted for compatibility in `TP` and `DELPHI` modes, but the compiler will still warn you if it finds such a construct.

Error: class identifier expected
This happens when the compiler scans a procedure declaration that contains a dot, i.e., an object or class method, but the type in front of the dot is not a known type.

Error: type identifier not allowed here
You cannot use a type inside an expression.

Error: method identifier expected
This identifier is not a method. This happens when the compiler scans a procedure declaration that contains a dot, i.e., an object or class method, but the procedure name is not a procedure of this type.

Error: function header doesn't match any method of this class "arg1"
This identifier is not a method. This happens when the compiler scans a procedure declaration that contains a dot, i.e., an object or class method, but the procedure name is not a procedure of this type.

procedure/function arg1
When using the `-vd` switch, the compiler tells you when it starts processing a procedure or function implementation.

Error: Illegal floating point constant
The compiler expects a floating point expression, and gets something else.

Error: FAIL can be used in constructors only
You are using the `fail` keyword outside a constructor method.

Error: Destructors cannot have parameters
You are declaring a destructor with a parameter list. Destructor methods cannot have parameters.

Error: Only class methods, class properties and class variables can be referred with class references
This error occurs in a situation like the following:

```
Type :
   Tclass = Class of Tobject;

Var C : TClass;

begin
...
C.free
```

`Free` is not a class method and hence cannot be called with a class reference.

Error: Only class methods, class properties and class variables can be accessed in class methods
This is related to the previous error. You cannot call a method of an object from inside a class method. The following code would produce this error:

```
class procedure tobject.x;

begin
  free
```

Because free is a normal method of a class it cannot be called from a class method.

Error: Constant and CASE types do not match
One of the labels is not of the same type as the case variable.

Error: The symbol cannot be exported from a library
You can only export procedures and functions when you write a library. You cannot export variables or constants.

Warning: An inherited method is hidden by "arg1"
A method that is declared `virtual` in a parent class, should be overridden in the descendant class with the `override` directive. If you don't specify the `override` directive, you will hide the parent method; you will not override it.

Error: There is no method in an ancestor class to be overridden: "arg1"
You are trying to `override` a virtual method of a parent class that does not exist.

Error: No member is provided to access property
You specified no `read` directive for a property.

Warning: Stored property directive is not yet implemented
This message is no longer used, as the `stored` directive has been implemented.

Error: Illegal symbol for property access
There is an error in the `read` or `write` directives for an array property. When you declare an array property, you can only access it with procedures and functions. The following code would cause such an error.

```
tmyobject = class
  i : integer;
  property x [i : integer]: integer read I write i;
```

Error: Cannot access a protected field of an object here
Fields that are declared in a `protected` section of an object or class declaration cannot be accessed outside the module where the object is defined, or outside descendent object methods.

Error: Cannot access a private field of an object here
Fields that are declared in a `private` section of an object or class declaration cannot be accessed outside the module where the class is defined.

Error: Overridden methods must have the same return type: "arg2" is overridden by "arg1" which has another return type
If you declare overridden methods in a class definition, they must have the same return type.

Error: EXPORT declared functions cannot be nested
You cannot declare a function or procedure within a function or procedure that was declared as an export procedure.

Error: Methods cannot be EXPORTed
You cannot declare a procedure that is a method for an object as `export`ed.

Error: Call by var for arg no. arg1 has to match exactly: Got "arg2" expected "arg3"
When calling a function declared with `var` parameters, the variables in the function call must be of exactly the same type. There is no automatic type conversion.

Error: Class isn't a parent class of the current class
When calling inherited methods, you are trying to call a method of a non-related class. You can only call an inherited method of a parent class.

Error: SELF is only allowed in methods
You are trying to use the `self` parameter outside an object's method. Only methods get passed the `self` parameters.

Error: Methods can be only in other methods called direct with type identifier of the class
A construction like `sometype.somemethod` is only allowed in a method.

Error: Illegal use of ':'
You are using the format `:` (colon) 2 times on an expression that is not a real expression.

Error: range check error in set constructor or duplicate set element
The declaration of a set contains an error. Either one of the elements is outside the range of the set type, or two of the elements are in fact the same.

Error: Pointer to object expected
You specified an illegal type in a `new` statement. The extended syntax of `new` needs an object as a parameter.

Error: Expression must be constructor call
When using the extended syntax of `new`, you must specify the constructor method of the object you are trying to create. The procedure you specified is not a constructor.

Error: Expression must be destructor call
When using the extended syntax of `dispose`, you must specify the destructor method of the object you are trying to dispose of. The procedure you specified is not a destructor.

Error: Illegal order of record elements
When declaring a constant record, you specified the fields in the wrong order.

Error: Expression type must be class or record type, got arg1
A `with` statement needs an argument that is of the type `record` or `class`. You are using `with` on an expression that is not of this type.

Error: Procedures cannot return a value
In Free Pascal, you can specify a return value for a function when using the `exit` statement. This error occurs when you try to do this with a procedure. Procedures cannot return a value.

Error: constructors, destructors and class operators must be methods
You're declaring a procedure as destructor, constructor or class operator, when the procedure isn't a class method.

Error: Operator is not overloaded
You're trying to use an overloaded operator when it is not overloaded for this type.

Error: Impossible to overload assignment for equal types
You cannot overload assignment for types that the compiler considers as equal.

Error: Impossible operator overload
The combination of operator, arguments and return type are incompatible.

Error: Re-raise isn't possible there
You are trying to re-raise an exception where it is not allowed. You can only re-raise exceptions in an `except` block.

Error: The extended syntax of new or dispose isn't allowed for a class
You cannot generate an instance of a class with the extended syntax of `new`. The constructor must be used for that. For the same reason, you cannot call `dispose` to de-allocate an instance of a class, the destructor must be used for that.

Error: Procedure overloading is switched off
When using the `-So` switch, procedure overloading is switched off. Turbo Pascal does not support function overloading.

Error: It is not possible to overload this operator. Related overloadable operators (if any) are: arg1
You are trying to overload an operator which cannot be overloaded. The following operators can be overloaded :

```
+, -, *, /, =, >, <, <=, >=, is, as, in, **, :=
```

Error: Comparative operator must return a boolean value
When overloading the = operator, the function must return a boolean value.

Error: Only virtual methods can be abstract
You are declaring a method as abstract, when it is not declared to be virtual.

Fatal: Use of unsupported feature: "arg1".
You're trying to force the compiler into doing something it cannot do yet.

Error: The mix of different kind of objects (class, object, interface, etc) isn't allowed
You cannot derive `objects`, `classes`, `cppclasses` and `interfaces` intertwined. E.g. a class cannot have an object as parent and vice versa.

Warning: Unknown procedure directive had to be ignored: "arg1"
The procedure directive you specified is unknown.

Error: arg1 can be associated with only one variable
You cannot specify more than one variable before the `absolute`, `export`, `external`, `weakexternal`, `public` and `cvar` directives. As a result, for example the following construct will provide this error:

```
Var Z : Longint;
    X,Y : Longint absolute Z;
```

Error: absolute can only be associated with a var or const
The address of an `absolute` directive can only point to a variable or constant. Therefore, the following code will produce this error:

```
Procedure X;

var p : longint absolute x;
```

Error: Only one variable can be initialized
You cannot specify more than one variable with a initial value in Delphi mode.

Error: Abstract methods shouldn't have any definition (with function body)
Abstract methods can only be declared, you cannot implement them. They should be overridden by a descendant class.

Error: This overloaded function cannot be local (must be exported)
You are defining an overloaded function in the implementation part of a unit, but there is no corresponding declaration in the interface part of the unit.

Warning: Virtual methods are used without a constructor in "arg1"
If you declare objects or classes that contain virtual methods, you need to have a constructor and destructor to initialize them. The compiler encountered an object or class with virtual methods that doesn't have a constructor/destructor pair.

Macro defined: arg1
When `-vc` is used, the compiler tells you when it defines macros.

Macro undefined: arg1
When `-vc` is used, the compiler tells you when it undefines macros.

Macro arg1 set to arg2
When `-vc` is used, the compiler tells you what values macros get.

Info: Compiling arg1
When you turn on information messages (`-vi`), the compiler tells you what units it is recompiling.

Parsing interface of unit arg1
This tells you that the reading of the interface of the current unit has started

Parsing implementation of arg1
This tells you that the code reading of the implementation of the current unit, library or program starts

Compiling arg1 for the second time
When you request debug messages (`-vd`) the compiler tells you what units it recompiles for the second time.

Error: No property found to override
You want to override a property of a parent class, when there is, in fact, no such property in the parent class.

Error: Only one default property is allowed
You specified a property as `Default`, but the class already has a default property, and a class can have only one default property.

Error: The default property must be an array property
Only array properties of classes can be made `default` properties.

Error: Virtual constructors are only supported in class object model
You cannot have virtual constructors in objects. You can only have them in classes.

Error: No default property available
You are trying to access a default property of a class, but this class (or one of its ancestors) doesn't have a default property.

Error: The class cannot have a published section, use the {$M+} switch
If you want a `published` section in a class definition, you must use the `{$M+}` switch, which turns on generation of type information.

Error: Forward declaration of class "arg1" must be resolved here to use the class as ancestor
To be able to use an object as an ancestor object, it must be defined first. This error occurs in the following situation:

```
Type ParentClas = Class;
     ChildClass = Class(ParentClass)
       ...
     end;
```

where `ParentClass` is declared but not defined.

Error: Local operators not supported
You cannot overload locally, i.e. inside procedures or function definitions.

Error: Procedure directive "arg1" not allowed in interface section
This procedure directive is not allowed in the `interface` section of a unit. You can only use it in the `implementation` section.

Error: Procedure directive "arg1" not allowed in implementation section
This procedure directive is not allowed in the `implementation` section of a unit. You can only use it in the `interface` section.

Error: Procedure directive "arg1" not allowed in procvar declaration
This procedure directive cannot be part of a procedural or function type declaration.

Error: Function is already declared Public/Forward "arg1"
You will get this error if a function is defined as `forward` twice. Or if it occurs in the `interface` section, and again as a `forward` declaration in the `implementation` section.

Error: Cannot use both EXPORT and EXTERNAL
These two procedure directives are mutually exclusive.

Hint: "arg1" not yet supported inside inline procedure/function
Inline procedures don't support this declaration.

Hint: Inlining disabled
Inlining of procedures is disabled.

Info: Writing Browser log arg1
When information messages are on, the compiler warns you when it writes the browser log (generated with the `{$Y+ }` switch).

Hint: may be pointer dereference is missing
The compiler thinks that a pointer may need a dereference.

Fatal: Selected assembler reader not supported
The selected assembler reader (with `{$ASMMODE xxx}` is not supported. The compiler can be compiled with or without support for a particular assembler reader.

Error: Procedure directive "arg1" cannot be used with arg2
You specified a procedure directive that conflicts with other directives. For instance `cdecl` and `pascal` are mutually exclusive.

Error: Calling convention doesn't match forward
This error happens when you declare a function or procedure with e.g. `cdecl;` but omit this directive in the implementation, or vice versa. The calling convention is part of the function declaration, and must be repeated in the function definition.

Error: Property cannot have a default value
Set properties or indexed properties cannot have a default value.

Error: The default value of a property must be constant
The value of a `default` declared property must be known at compile time. The value you specified is only known at run time. This happens e.g. if you specify a variable name as a default value.

Error: Symbol cannot be published, can be only a class
Only class type variables can be in a `published` section of a class if they are not declared as a property.

Error: This kind of property cannot be published
Properties in a `published` section cannot be array properties. They must be moved to public sections. Properties in a `published` section must be an ordinal type, a real type, strings or sets.

Error: An import name is required
Some targets need a name for the imported procedure or a `cdecl` specifier.

Error: Division by zero
A division by zero was encountered.

Error: Invalid floating point operation
An operation on two real type values produced an overflow or a division by zero.

Error: Upper bound of range is less than lower bound
The upper bound of an array declaration is less than the lower bound and this is not possible.

Warning: string "arg1" is longer than "arg2"
The size of the constant string is larger than the size you specified in string type definition.

Error: string length is larger than array of char length
The size of the constant string is larger than the size you specified in the `Array[x..y] of char` definition.

Error: Illegal expression after message directive
Free Pascal supports only integer or string values as message constants.

Error: Message handlers can take only one call by ref. parameter
A method declared with the `message` directive as message handler can take only one parameter which must be declared as call by reference. Parameters are declared as call by reference using the `var`-directive.

Error: Duplicate message label: "arg1"
A label for a message is used twice in one object/class.

Error: Self can only be an explicit parameter in methods which are message handlers
The `Self` parameter can only be passed explicitly to a method which is declared as message handler.

Error: Threadvars can be only static or global
Threadvars must be static or global; you cannot declare a thread local to a procedure. Local variables are always local to a thread, because every thread has its own stack and local variables are stored on the stack.

Fatal: Direct assembler not supported for binary output format
You cannot use direct assembler when using a binary writer. Choose an other output format or use another assembler reader.

Warning: Don't load OBJPAS unit manually, use {$mode objfpc} or {$mode delphi} instead
You are trying to load the ObjPas unit manually from a `uses` clause. This is not a good idea. Use the `{$MODE OBJFPC}` or `{$mode delphi}` directives which load the unit automatically.

Error: OVERRIDE cannot be used in objects
`Override` is not supported for objects, use `virtual` instead to override a method of a parent object.

Error: Data types which require initialization/finalization cannot be used in variant records
Some data types (e.g. `ansistring`) need initialization/finalization code which is implicitly generated by the compiler. Such data types cannot be used in the variant part of a record.

Error: Resourcestrings can be only static or global
Resourcestring cannot be declared local, only global or using the static directive.

Error: Exit with argument cannot be used here
An exit statement with an argument for the return value cannot be used here. This can happen for example in `try..except` or `try..finally` blocks.

Error: The type of the storage symbol must be boolean
If you specify a storage symbol in a property declaration, it must be a boolean type.

Error: This symbol isn't allowed as storage symbol
You cannot use this type of symbol as storage specifier in property declaration. You can use only methods with the result type boolean, boolean class fields or boolean constants.

Error: Only classes which are compiled in $M+ mode can be published
A class-typed field in the published section of a class can only be a class which was compiled in `{$M+}` or which is derived from such a class. Normally such a class should be derived from `TPersistent`.

Error: Procedure directive expected
This error is triggered when you have a `{$Calling}` directive without a calling convention specified. It also happens when declaring a procedure in a const block and you used a ; after a procedure declaration which must be followed by a procedure directive. Correct declarations are:

```
const
  p : procedure;stdcall=nil;
  p : procedure stdcall=nil;
```

Error: The value for a property index must be of an ordinal type
The value you use to index a property must be of an ordinal type, for example an integer or enumerated type.

Error: Procedure name too short to be exported
The length of the procedure/function name must be at least 2 characters long. This is because of a bug in dlltool which doesn't parse the .def file correctly with a name of length 1.

Error: No DEFFILE entry can be generated for unit global vars

Error: Compile without -WD option
You need to compile this file without the -WD switch on the command line.

Fatal: You need ObjFpc (-S2) or Delphi (-Sd) mode to compile this module
You need to use `{$MODE OBJFPC}` or `{$MODE DELPHI}` to compile this file. Or use the corresponding command line switch, either `-Mobjfpc` or `-MDelphi`.

Error: Cannot export with index under arg1
Exporting of functions or procedures with a specified index is not supported on this target.

Error: Exporting of variables is not supported under arg1
Exporting of variables is not supported on this target.

Error: Improper GUID syntax
The GUID indication does not have the proper syntax. It should be of the form

```
{XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX}
```

Where each `X` represents a hexadecimal digit.

Warning: Procedure named "arg1" not found that is suitable for implementing the arg2.arg3
The compiler cannot find a suitable procedure which implements the given method of an interface. A procedure with the same name is found, but the arguments do not match.

Error: interface identifier expected
This happens when the compiler scans a `class` declaration that contains `interface` function name mapping code like this:

```
type
  TMyObject = class(TObject, IDispatch)
    function IUnknown.QueryInterface=MyQueryInterface;
    ....
```

and the `interface` before the dot is not listed in the inheritance list.

Error: Type "arg1" cannot be used as array index type
Types like `qword` or `int64` are not allowed as array index type.

Error: Con- and destructors are not allowed in interfaces
Constructor and destructor declarations are not allowed in interfaces. In the most cases method `QueryInterface` of `IUnknown` can be used to create a new interface.

Error: Access specifiers cannot be used in INTERFACEs and OBJCPROTOCOLs
The access specifiers `public`, `private`, `protected` and `published` cannot be used in interfaces, Objective-C protocols and categories because all methods of an interface/protocol/-category must be public.

Error: An interface, helper or Objective-C protocol or category cannot contain fields
Declarations of fields are not allowed in interfaces, helpers and Objective-C protocols and categories. An interface/helper/protocol/category can contain only methods and properties with method read/write specifiers.

Error: Cannot declare local procedure as EXTERNAL
Declaring local procedures as external is not possible. Local procedures get hidden parameters that will make the chance of errors very high.

Warning: Some fields coming before "arg1" were not initialized
In Delphi mode, not all fields of a typed constant record have to be initialized, but the compiler warns you when it detects such situations.

Error: Some fields coming before "arg1" were not initialized
In all syntax modes but Delphi mode, you cannot leave some fields uninitialized in the middle of a typed constant record.

Warning: Some fields coming after "arg1" were not initialized
You can leave some fields at the end of a type constant record uninitialized (The compiler will initialize them to zero automatically). This may be the cause of subtle problems.

Error: VarArgs directive (or '...' in MacPas) without CDecl/CPPDecl/MWPascal/StdCall and External
The varargs directive (or the "..." varargs parameter in MacPas mode) can only be used with procedures or functions that are declared with `external` and one of `cdecl`, `cppdecl`, `stdcall` and `mwpascal`. This functionality is only supported to provide a compatible interface to C functions like printf.

Error: Self must be a normal (call-by-value) parameter
You cannot declare `Self` as a const or var parameter, it must always be a call-by-value parameter.

Error: Interface "arg1" has no interface identification
When you want to assign an interface to a constant, then the interface must have a GUID value set.

Error: Unknown class field or method identifier "arg1"
Properties must refer to a field or method in the same class.

Warning: Overriding calling convention "arg1" with "arg2"
There are two directives in the procedure declaration that specify a calling convention. Only the last directive will be used.

Error: Typed constants of the type "procedure of object" can only be initialized with NIL
You cannot assign the address of a method to a typed constant which has a 'procedure of object' type, because such a constant requires two addresses: that of the method (which is known at compile time) and that of the object or class instance it operates on (which cannot be known at compile time).

Error: Default value can only be assigned to one parameter
It is not possible to specify a default value for several parameters at once. The following is invalid:

```
Procedure MyProcedure (A,B : Integer = 0);
```

Instead, this should be declared as

```
Procedure MyProcedure (A : Integer = 0; B : Integer = 0);
```

Error: Default parameter required for "arg1"
The specified parameter requires a default value.

Warning: Use of unsupported feature!
You're trying to force the compiler into doing something it cannot do yet.

Hint: C arrays are passed by reference
Any array passed to a C function is passed by a pointer (i.e. by reference).

Error: C array of const must be the last argument
You cannot add any other argument after an `array of const` for `cdecl` functions, as the size pushed on stack for this argument is not known.

Hint: Type "arg1" redefinition
This is an indicator that a previously declared type is being redefined as something else. This may, or may not be, a potential source of errors.

Warning: cdecl'ared functions have no high parameter
Functions declared with the `cdecl` modifier do not pass an extra implicit parameter.

Warning: cdecl'ared functions do not support open strings
Openstring is not supported for functions that have the `cdecl` modifier.

Error: Cannot initialize variables declared as threadvar
Variables declared as threadvar cannot be initialized with a default value. The variables will always be filled with zero at the start of a new thread.

Error: Message directive is only allowed in Classes
The message directive is only supported for Class types.

Error: Procedure or Function expected
A class method can only be specified for procedures and functions.

Warning: Calling convention directive ignored: "arg1"
Some calling conventions are supported only by certain CPUs. I.e. most non-i386 ports support only the standard ABI calling convention of the CPU.

Error: REINTRODUCE cannot be used in objects
`reintroduce` is not supported for objects, Objective-C classes and Objective-C protocols.

Error: Each argument must have its own location
If locations for arguments are specified explicitly as it is required by some syscall conventions, each argument must have its own location. Things like

```
procedure p(i,j : longint 'r1');
```

are not allowed.

Error: Each argument must have an explicit location
If one argument has an explicit argument location, all arguments of a procedure must have one.

Error: Unknown argument location
The location specified for an argument isn't recognized by the compiler.

Error: 32 Bit-Integer or pointer variable expected
The libbase for MorphOS/AmigaOS can be given only as `longint`, `dword` or any pointer variable.

Error: Goto statements are not allowed between different procedures
It isn't allowed to use `goto` statements referencing labels outside the current procedure. The following example shows the problem:

```
...
  procedure p1;
  label
    l1;

    procedure p2;
    begin
      goto l1; // This goto ISN'T allowed
    end;

  begin
    p2
```

```
  l1:
  end;
...
```

Fatal: Procedure too complex, it requires too many registers
Your procedure body is too long for the compiler. You should split the procedure into multiple smaller procedures.

Error: Illegal expression
This can occur under many circumstances. Usually when trying to evaluate constant expressions.

Error: Invalid integer expression
You made an expression which isn't an integer, and the compiler expects the result to be an integer.

Error: Illegal qualifier
One of the following is happening :

- You're trying to access a field of a variable that is not a record.
- You're indexing a variable that is not an array.
- You're dereferencing a variable that is not a pointer.

Error: High range limit < low range limit
You are declaring a subrange, and the high limit is less than the low limit of the range.

Error: Exit's parameter must be the name of the procedure it is used in or of a surrounding procedure
The parameter of a exit call in macpas mode must be either the name of the current subroutine or of a surrounding one

Error: Illegal assignment to for-loop variable "arg1"
The type of a `for` loop variable must be an ordinal type. Loop variables cannot be reals or strings. You also cannot assign values to loop variables inside the loop (Except in Delphi and TP modes). Use a while or repeat loop instead if you need to do something like that, since those constructs were built for that.

Error: Cannot declare local variable as EXTERNAL
Declaring local variables as external is not allowed. Only global variables can reference external variables.

Error: Procedure is already declared EXTERNAL
The procedure is already declared with the EXTERNAL directive in an interface or forward declaration.

Warning: Implicit uses of Variants unit
The Variant type is used in the unit without any used unit using the Variants unit. The compiler has implicitly added the Variants unit to the uses list. To remove this warning the Variants unit needs to be added to the uses statement.

Error: Class and static methods cannot be used in INTERFACES
The specifier `class` and directive `static` cannot be used in interfaces because all methods of an interface must be public.

Error: Overflow in arithmetic operation
An operation on two integer values produced an overflow.

Error: Protected or private expected
`strict` can be only used together with `protected` or `private`.

Error: SLICE cannot be used outside of parameter list
`slice` can be used only for arguments accepting an open array parameter.

Error: A DISPINTERFACE cannot have a parent class
A DISPINTERFACE is a special type of interface which cannot have a parent class. Dispinterface always derive from IDispatch type.

Error: A DISPINTERFACE needs a guid
A DISPINTERFACE always needs an interface identification (a GUID).

Warning: Overridden methods must have a related return type. This code may crash, it depends on a Delphi parser bug ("arg2" is overridden by "arg1" which has another return type)
If you declare overridden methods in a class definition, they must have the same return type. Some versions of Delphi allow you to change the return type of interface methods, and even to change procedures into functions, but the resulting code may crash depending on the types used and the way the methods are called.

Error: Dispatch IDs must be ordinal constants
The `dispid` keyword must be followed by an ordinal constant (the dispid index).

Error: The range of the array is too large
Regardless of the size taken up by its elements, an array cannot have more than high(ptrint) elements. Additionally, the range type must be a subrange of ptrint.

Error: The address cannot be taken of bit packed array elements and record fields
If you declare an array or record as `packed` in Mac Pascal mode (or as `packed` in any mode with `{$bitpacking on}`), it will be packed at the bit level. This means it becomes impossible to take addresses of individual array elements or record fields. The only exception to this rule is in the case of packed arrays elements whose packed size is a multiple of 8 bits.

Error: Dynamic arrays cannot be packed
Only regular (and possibly in the future also open) arrays can be packed.

Error: Bit packed array elements and record fields cannot be used as loop variables
If you declare an array or record as `packed` in Mac Pascal mode (or as `packed` in any mode with `{$bitpacking on}`), it will be packed at the bit level. For performance reasons, they cannot be used as loop variables.

Error: VAR, TYPE and CONST are allowed only in records, objects and classes
The usage of VAR, TYPE and CONST to declare new types inside an object is allowed only inside records, objects and classes.

Error: This type cannot be a generic
Only Classes, Objects, Interfaces and Records are allowed to be used as generic.

Warning: Don't load LINEINFO unit manually, Use the -gl compiler switch instead
Do not use the lineinfo unit directly, Use the `-gl` switch which automatically adds the correct unit for reading the selected type of debugging information. The unit that needs to be used depends on the type of debug information used when compiling the binary.

Error: No function result type specified for function "arg1"
The first time you declare a function you have to declare it completely, including all parameters and the result type.

Error: Specialization is only supported for generic types
Types which are not generics cannot be specialized.

Error: Generics cannot be used as parameters when specializing generics
When specializing a generic, only non-generic types can be used as parameters.

Error: Constants of objects containing a VMT are not allowed
If an object requires a VMT either because it contains a constructor or virtual methods, it's not allowed to create constants of it. In TP and Delphi mode this is allowed for compatibility reasons.

Error: Taking the address of labels defined outside the current scope isn't allowed
It isn't allowed to take the address of labels outside the current procedure.

Error: Cannot initialize variables declared as external
Variables declared as external cannot be initialized with a default value.

Error: Illegal function result type
Some types like file types cannot be used as function result.

Error: No common type possible between "arg1" and "arg2"
To perform an operation on integers, the compiler converts both operands to their common type, which appears to be an invalid type. To determine the common type of the operands, the compiler takes the minimum of the minimal values of both types, and the maximum of the maximal values of both types. The common type is then minimum..maximum.

Error: Generics without specialization cannot be used as a type for a variable
Generics must be always specialized before being used as variable type.

Warning: Register list is ignored for pure assembler routines
When using pure assembler routines, the list with modified registers is ignored.

Error: Implements property must have class or interface type
A property which implements an interface must be of type class or interface.

Error: Implements-property must implement interface of correct type, found "arg1" expected "arg2"
A property which implements an interface actually implements a different interface.

Error: Implements-property must have read specifier
A property which implements an interface must have at least a read specifier.

Error: Implements-property must not have write-specifier
A property which implements an interface may not have a write specifier.

Error: Implements-property must not have stored-specifier
A property which implements an interface may not have a stored specifier.

Error: Implements-property used on unimplemented interface: "arg1"
The interface which is implemented by a property is not an interface implemented by the class.

Error: Floating point not supported for this target
The compiler parsed a floating point expression, but it is not supported.

Error: Class "arg1" does not implement interface "arg2"
The delegated interface is not implemented by the class given in the implements clause.

Error: Type used by implements must be an interface
The `implements` keyword must be followed by an interface type.

Error: Variables cannot be exported with a different name on this target, add the name to the declaration using the "export" directive (variable name: arg1, declared export name: arg2)
On most targets it is not possible to change the name under which a variable is exported inside the `exports` statement of a library. In that case, you have to specify the export name at the point where the variable is declared, using the `export` and `alias` directives.

Error: Weak external symbols are not supported for the current target
A "weak external" symbol is a symbol which may or may not exist at (either static or dynamic) link time. This concept may not be available (or implemented yet) on the current cpu/OS target.

Error: Forward type definition does not match
Classes and interfaces being defined forward must have the same type when being implemented. A forward interface cannot be changed into a class.

Note: Virtual method "arg1" has a lower visibility (arg2) than parent class arg3 (arg4)
The virtual method overrides an method that is declared with a higher visibility. This might give unexpected results. E.g., in case the new visibility is private then a call to “inherited” in a new child class will call the higher-visible method in a parent class and ignores the private method.

Error: Fields cannot appear after a method or property definition, start a new visibility section first
Once a method or property has been defined in a class or object, you cannot define any fields afterwards without starting a new visibility section (such as `public`, `private`, etc.). The reason is that otherwise the source code can appear ambiguous to the compiler, since it is possible to use modifiers such as `default` and `register` also as field names.

Error: Parameters or result types cannot contain local type definitions. Use a separate type definition in a type block.
In Pascal, types are not considered to be identical simply because they are semantically equivalent. Two variables or parameters are only considered to be of the same type if they refer to the same type definition. As a result, it is not allowed to define new types inside parameter lists, because then it is impossible to refer to the same type definition in the procedure headers of the interface and implementation of a unit (both procedure headers would define a separate type). Keep in mind that expressions such as “file of byte” or “string[50]” also define a new type.

Error: ABSTRACT and SEALED conflict
ABSTRACT and SEALED cannot be used together in one declaration

Error: Cannot create a descendant of the sealed class "arg1"
Sealed means that class cannot be derived by another class.

Error: SEALED class cannot have an ABSTRACT method
Sealed means that class cannot be derived. Therefore no one class is able to override an abstract method in a sealed class.

Error: Only virtual methods can be final
You are declaring a method as final, when it is not declared to be virtual.

Error: Final method cannot be overridden: "arg1"
You are trying to `override` a virtual method of a parent class that does not exist.

Error: Only one message can be used per method.
It is not possible to associate multiple messages with a single method.

Error: Invalid enumerator identifier: "arg1"
Only "MoveNext" and "Current" enumerator identifiers are supported.

Error: Enumerator identifier required
"MoveNext" or "Current" identifier must follow the `enumerator` modifier.

Error: Enumerator MoveNext pattern method is not valid. Method must be a function with the Boolean return type and no required arguments.
"MoveNext" enumerator pattern method must be a function with Boolean return type and no required arguments

Error: Enumerator Current pattern property is not valid. Property must have a getter.
"Current" enumerator pattern property must have a getter

Error: Only one enumerator MoveNext method is allowed per class/object
Class or Object can have only one enumerator MoveNext declaration.

Error: Only one enumerator Current property is allowed per class/object
Class or Object can have only one enumerator Current declaration.

Error: For in loop cannot be used for the type "arg1"
For in loop can be used not for all types. For example it cannot be used for the enumerations with jumps.

Error: Objective-C messages require their Objective-C selector name to be specified using the "message" directive.
Objective-C messages require their Objective-C name (selector name) to be specified using the `message 'someName:'` procedure directive. While bindings to other languages automatically generate such names based on the identifier you use (by replacing all underscores with colons), this is unsafe since nothing prevents an Objective-C method name to contain actual colons.

Error: Objective-C does not have formal constructors nor destructors. Use the alloc, initXXX and dealloc messages.
The Objective-C language does not have any constructors or destructors. While there are some messages with a similar purpose (such as `init` and `dealloc`), these cannot be identified using automatic parsers and do not guarantee anything like Pascal constructors/destructors (e.g., you have to take care of only calling “designated” inherited “constructors”). For these reasons, we have opted to follow the standard Objective-C patterns for instance creation/destruction.

Error: Message name is too long (max. 255 characters)
Due to compiler implementation reasons, message names are currently limited to 255 characters.

Error: Objective-C message symbol name for "arg1" is too long
Due to compiler implementation reasons, mangled message names (i.e., the symbol names used in the assembler code) are currently limited to 255 characters.

Hint: Defining a new Objective-C root class. To derive from another root class (e.g., NSObject), specify it as the parent class.
If no parent class is specified for an Object Pascal class, then it automatically derives from TObject. Objective-C classes however do not automatically derive from NSObject, because one can have multiple root classes in Objective-C. For example, in the Cocoa framework both NSObject and NSProxy are root classes. Therefore, you have to explicitly define a parent class (such as NSObject) if you want to derive your Objective-C class from it.

Error: Objective-C classes cannot have published sections.
In Object Pascal, "published" determines whether or not RTTI is generated. Since the Objective-C runtime always needs RTTI for everything, this specified does not make sense for Objective-C classes.

Fatal: This module requires an Objective-C mode switch to be compiled
This error indicates the use of Objective-C language features without an Objective-C mode switch active. Enable one via the -M command line switch, or the $modeswitch x directive.

Error: Inherited methods can only be overridden in Objective-C and Java, add "override" (inherited method defined in arg1)

Hint: Inherited methods can only be overridden in Objective-C and Java, add "override" (inherited method defined in arg1).
It is not possible to `reintroduce` methods in Objective-C or Java like in Object Pascal. Methods with the same name always map to the same virtual method entry. In order to make this clear in the source code, the compiler always requires the `override` directive to be specified when implementing overriding Objective-C or Java methods in Pascal. If the implementation is external, this rule is relaxed because Objective-C and Java do not have any `override`-style keyword (since it's the default and only behaviour in these languages), which makes it hard for automated header conversion tools to include it everywhere. The type in which the inherited method is defined is explicitly mentioned, because this may either be an objcclass or an objccategory in case of Objective-C.

Error: Message name "arg1" in inherited class is different from message name "arg2" in current class.
An overriding Objective-C method cannot have a different message name than an inherited method. The reason is that these message names uniquely define the message to the Objective-C runtime, which means that giving them a different message name breaks the "override" semantics.

Error: It is not yet possible to make unique copies of Objective-C or Java types
Duplicating an Objective-C or Java type using `type x = type y;` is not yet supported. You may be able to obtain the desired effect using `type x = objcclass(y) end;` resp. `type x = class(y) end;` instead.

Error: Objective-C categories and Object Pascal class helpers cannot be used as types
It is not possible to declare a variable as an instance of an Objective-C category or an Object Pascal class helper. A category/class helper adds methods to the scope of an existing class, but does not define a type by itself. An exception of this rule is when inheriting an Object Pascal class helper from another class helper.

Error: Categories do not override, but replace methods. Use "reintroduce" instead.

Error: Replaced methods can only be reintroduced in Objective-C, add "reintroduce" (replaced method defined in arg1).

Hint: Replaced methods can only be reintroduced in Objective-C, add "reintroduce" (replaced method defined in arg1).
A category replaces an existing method in an Objective-C class, rather than that it overrides it. Calling an inherited method from an category method will call that method in the extended class' parent, not in the extended class itself. The replaced method in the original class is basically lost, and can no longer be called or referred to. This behaviour corresponds somewhat more closely to `reintroduce` than to `override` (although in case of `reintroduce`

in Object Pascal, hidden methods are still reachable via inherited). The type in which the inherited method is defined is explicitly mentioned, because this may either be an objcclass or an objccategory.

Error: Getter for implements interface must use the target's default calling convention.
Interface getters are called via a helper in the run time library, and hence have to use the default calling convention for the target (`register` on i386 and x86_64, `stdcall` on other architectures).

Error: Typed files cannot contain reference-counted types.
The data in a typed file cannot be of a reference counted type (such as `ansistring` or a record containing a field that is reference counted).

Error: Operator is not overloaded: arg2 "arg1"
You are trying to use an overloaded operator when it is not overloaded for this type.

Error: Operator is not overloaded: "arg1" arg2 "arg3"
You are trying to use an overloaded operator when it is not overloaded for this type.

Error: Expected another arg1 array elements
When declaring a typed constant array, you provided to few elements to initialize the array

Error: String constant too long while ansistrings are disabled
Only when a piece of code is compiled with ansistrings enabled (`{$H+}`), string constants longer than 255 characters are allowed.

Error: Type cannot be used as univ parameter because its size is unknown at compile time: "arg1"
`univ` parameters are compatible with all values of the same size, but this cannot be checked in case a parameter's size is unknown at compile time.

Error: Only one class constructor can be declared in class: "arg1"
You are trying to declare more than one class constructor but only one class constructor can be declared.

Error: Only one class destructor can be declared in class: "arg1"
You are trying to declare more than one class destructor but only one class destructor can be declared.

Error: Class constructors cannot have parameters
You are declaring a class constructor with a parameter list. Class constructor methods cannot have parameters.

Error: Class destructors cannot have parameters
You are declaring a class destructor with a parameter list. Class destructor methods cannot have parameters.

Fatal: This construct requires the \{\$modeswitch objectivec1\} mode switch to be active
Objective-Pascal constructs are not supported when {$modeswitch ObjectiveC1} is not active.

Error: Unicodechar/string constants cannot be converted to ansi/shortstring at compile-time
It is not possible to use unicodechar and unicodestring constants in constant expressions that have to be converted into an ansistring or shortstring at compile time, for example inside typed constants. The reason is that the compiler cannot know what the actual ansi encoding will be at run time.

Error: For-in Objective-Pascal loops require \{\$modeswitch ObjectiveC2\} to be active
Objective-C "fast enumeration" support was added in Objective-C 2.0, and hence the appropriate modeswitch has to be activated to expose this feature. Note that Objective-C 2.0 programs require Mac OS X 10.5 or later.

Error: The compiler cannot find the NSFastEnumerationProtocol or NSFastEnumerationState type in the CocoaAll unit
Objective-C for-in loops (fast enumeration) require that the compiler can find a unit called CocoaAll that contains definitions for the NSFastEnumerationProtocol and NSFastEnumerationState types. If you get this error, most likely the compiler is finding and loading an alternate CocoaAll unit.

Error: Typed constants of the type 'procedure is nested' can only be initialized with NIL and global procedures/functions
A nested procedural variable consists of two components: the address of the procedure/function to call (which is always known at compile time), and also a parent frame pointer (which is never known at compile time) in case the procedural variable contains a reference to a nested procedure/function. Therefore such typed constants can only be initialized with global functions/procedures since these do not require a parent frame pointer.

Fatal: Declaration of generic inside another generic is not allowed
At the moment, scanner supports recording of only one token buffer at the time (guarded by internal error 200511173 in tscannerfile.startrecordtokens). Since generics are implemented by recording tokens, it is not possible to have declaration of a generic (type or method) inside another generic.

Error: Forward declaration "arg1" must be resolved before a class can conform to or implement it
An Objective-C protocol or Java Interface must be fully defined before classes can conform to it. This error occurs in the following situation (example for Objective-C, but the same goes for Java interfaces):

```
Type MyProtocol = objcprotoocl;
     ChildClass = Class(NSObject,MyProtocol)
       ...
     end;
```

where `MyProtocol` is declared but not defined.

Error: Record types cannot have published sections
Published sections can be used only inside classes.

Error: Destructors are not allowed in records or helpers
Destructor declarations are not allowed in records or helpers.

Error: Class methods must be static in records
Class methods declarations are not allowed in records without static modifier. Records have no inheritance and therefore non static class methods have no sense for them.

Error: Parameterless constructors are not allowed in records or record/type helpers
Constructor declarations with no arguments are not allowed in records or record/type helpers.

Error: Either the result or at least one parameter must be of type "arg1"
It is required that either the result of the routine or at least one of its parameters be of the specified type. For example class operators either take an instance of the structured type in which they are defined, or they return one.

Error: Type parameters may require initialization/finalization - cannot be used in variant records
Type parameters may be specialized with types which (e.g. `ansistring`) need initialization/finalization code which is implicitly generated by the compiler.

Error: Variables being declared as external cannot be in a custom section
A section directive is not valid for variables being declared as external.

Error: Non-static and non-global variables cannot have a section directive
A variable placed in a custom section is always statically allocated so it must be either a static or global variable.

Error: "arg1" is not allowed in helper types
Some directives and specifiers like "virtual", "dynamic", "override" are not allowed inside helper types in mode ObjFPC (they are ignored in mode Delphi), because they have no meaning within helpers. Also "abstract" isn't allowed in either mode.

Error: Class constructors are not allowed in helpers
Class constructor declarations are not allowed in helpers.

Error: The use of "inherited" is not allowed in a record
As records don't support inheritance the use of "inherited" is prohibited for these as well as for record helpers (in mode "Delphi" only).

Error: Type declarations are not allowed in local or anonymous records
Records with types must be defined globally. Types cannot be defined inside records which are defined in a procedure or function or in anonymous records.

Error: Duplicate implements clause for interface "arg1"
A class may delegate an interface using the "implements" clause only to a single property. Delegating it multiple times is a error.

Error: Interface "arg1" cannot be delegated by "arg2", it already has method resolutions
Method resolution clause maps a method of an interface to a method of the current class. Therefore the current class has to implement the interface directly. Delegation is not possible.

Error: Interface "arg1" cannot have method resolutions, "arg2" already delegates it
Method resolution is only possible for interfaces that are implemented directly, not by delegation.

Error: Invalid codepage
When declaring a string with a given codepage, the range of valid codepages values is limited to 0 to 65535.

Error: Only fields (var-sections) and constants can be final in object types
A final (class) field must be assigned a single value in the (class) constructor, and cannot be overwritten afterwards. A final (typed) constant is read-only.

Error: Final fields are currently only supported for external classes
Support for final fields in non-external classes requires a full data flow analysis implementation in FPC, which it currently still lacks.

Error: Typed constants are not allowed here, only formal constants are
Java interfaces define a namespace in which formal constant can be defined, but since they define no storage it is not possible to define typed constants in them (those are more or less the same as initialised class fields).

Error: Constructors are not automatically inherited in the JVM; explicitly add a constructor that calls the inherited one if you need it
Java does not automatically add inherited constructors to child classes, so that they can be hidden. For compatibility with external Java code, FPC does the same. If you require access to the same constructors in a child class, define them in the child class and call the inherited one from there.

Parsing internally generated code: arg1
The compiler sometimes internally constructs Pascal code that is subsequently injected into the program. These messages display such code, in order to help with debugging errors in them.

Error: This language feature is not supported on managed VM targets
Certain language features are not supported on targets that are managed virtual machines.

Error: Calling a virtual constructor for the current instance inside another constructor is not possible on the JVM target
The JVM does not natively support virtual constructor. Unforunately, we are not aware of a way to emulate them in a way that makes it possible to support calling virtual constructors for the current instance inside another constructor.

Error: Overriding method "arg1" cannot have a lower visibility (arg2) than in parent class arg3 (arg4)
The JVM does not allow lowering the visibility of an overriding method.

Error: Procedure/Function declared with call option NOSTACKFRAME but without ASSEMBLER
nostackframe call modifier is supposed to be used in conjunction with assembler.

Error: Procedure/Function declared with call option NOSTACKFRAME but local stack size is arg1
nostackframe call modifier used without assembler modifier might still generate local stack needs.

Error: Cannot generate property getter/setter arg1 because its name clashes with existing identifier arg2
Automatically generated getters/setters cannot have the same name as existing identifiers, because this may change the behaviour of existing code.

Warning: Automatically generated property getter/setter arg1 overrides the same-named getter/setter in class arg2
Automatically generated property getters/setters on the JVM platform are virtual methods, because the JVM does not support non-virtual methods that can be changed in child classes. This means that if a child class changes an inherited property definition, the behaviour of that property can change compared to native targets since even if a variable is declared as the parent type, by calling the virtual method the getter from the child will be used. This is different from the behaviour on native targets or when not activating automatically generated setters/getters, because in that case only the declared type of a variable influences the property behaviour.

Warning: Case mismatch between declared property getter/setter arg1 and automatically constructed name arg2, not changing declared name
If a property's specified getter/setter already corresponded to the naming convention specified by the automatic getter/setter generation setting except in terms of upper/lowercase, the compiler will print a warning because it cannot necessarily change that other declaration itself not can it add one using the correct case (it could conflict with the original declaration). Manually correct the case of the getter/setter to conform to the desired coding rules. `TChild` overrides

Error: Constants declarations are not allowed in local or anonymous records
Records with constants must be defined globally. Constants cannot be defined inside records which are defined in a procedure or function or in anonymous records.

Error: Method declarations are not allowed in local or anonymous records
Records with methods must be defined globally. Methods cannot be defined inside records which are defined in a procedure or function or in anonymous records.

Error: Property declarations are not allowed in local or anonymous records
Records with properties must be defined globally. Properties cannot be defined inside records which are defined in a procedure or function or in anonymous records.

Error: Class member declarations are not allowed in local or anonymous records
Records with class members must be defined globally. Class members cannot be defined inside records which are defined in a procedure or function or in anonymous records.

Error: Visibility section "arg1" not allowed in records
The visibility sections (protected) and (strict protected) are only useful together with inheritance. Since records do not support that they are forbidden.

Error: Directive "arg1" not allowed here
This directive is not allowed in the given context. E.g. "static" is not allowed for instance methods or class operators.

Error: Assembler blocks not allowed inside generics
The use of assembler blocks/routines is not allowed inside generics.

Error: Properties can be only static, global or inside structured types
Properties cannot be declared local, only global, using the static directive or inside structured types.

Error: Overloaded routines have the same mangled name
Some platforms, such as the JVM platform, encode the parameters in the routine name in a prescribed way, and this encoding may map different Pascal types to the same encoded (a.k.a. "mangled") name. This error can only be solved by removing or changing the conflicting definitions' parameter declarations or routine names.

Error: Default values can only be specified for value, const and constref parameters
A default parameter value allows you to not specify a value for this parameter when calling the routine, and the compiler will instead pass the specified default (constant) value. As a result, default values can only be specified for parameters that can accept constant values.

Warning: Pointer type "arg1" ignored
The specified pointer type modifier is ignored, because it is not supported on the current platform. This happens, for example, when a far pointer is declared on a non-x86 platform.

Error: Global Generic template references static symtable
A generic declared in the interface section of a unit must not reference symbols that belong solely to the implementation section of that unit.

Unit arg1 has been already compiled meanwhile.
This tells you that the recursive reading of the uses clauses triggered already a compilation of the current unit, so the current compilation can be aborted.

Error: Explicit implementation of methods for specializations of generics is not allowed
Methods introduced in a generic must be implemented for the generic. It is not possible to implement them only for specializations.

Error: Generic methods are not allowed in interfaces
Generic methods are not allowed in interfaces, because there is no way to specialize a suitable implementation.

Error: Generic methods can not be virtual
Generic methods can not be declared as virtual as there'd need to be a VMT entry for each specialization. This is however not possible with a static VMT.

Error: Dynamic packages not supported for target OS
Support for dynamic packages is not implemented for the specified target OS or it is at least not tested and thus disabled.

Error: The HardFloat directive cannot be used if soft float code is generated or fpu emulation is turned on
The `HardFloat` directive can only be used if an instruction set is used which supports floating point operations.

Error: Index arg1 is not a valid internal function index
The index specified for the `compilerproc` directive is not an index that's recognized by the compiler.

Warning: Operator overload hidden by internal operator: "arg1" arg2 "arg3"
An operator overload is defined for the specified overload, but the internal overload by the compiler takes precedence. This only happens for operators that had been overloadable before (e.g. dynamic array + dynamic array), but aren't anymore due to an internal operator being defined while this behavior is controllable by a modeswitch (in case of dynamic arrays that is the modeswitch `ArrayOperators`).

Error: Thread variables inside classes or records must be class variables
A `threadvar` section inside a class or record was started without it being prefixed by `class`.

Error: Only static methods and static variables can be referenced through an object type
This error occurs in a situation like the following:

```
Type
   TObj = object
     procedure test;
   end;

begin
  TObj.test;
```

`test` is not a static method and hence cannot be called through a type, but only using an instance.

C.4 Type checking errors

This section lists all errors that can occur when type checking is performed.

Error: Type mismatch
This can happen in many cases:

- The variable you're assigning to is of a different type than the expression in the assignment.
- You are calling a function or procedure with parameters that are incompatible with the parameters in the function or procedure definition.

Error: Incompatible types: got "arg1" expected "arg2"
There is no conversion possible between the two types. Another possibility is that they are declared in different declarations:

```
Var
   A1 : Array[1..10] Of Integer;
   A2 : Array[1..10] Of Integer;

Begin
   A1:=A2; { This statement also gives this error. It
             is due to the strict type checking of Pascal }
End.
```

Error: Type mismatch between "arg1" and "arg2"
The types are not equal.

Error: Type identifier expected
The identifier is not a type, or you forgot to supply a type identifier.

Error: Variable identifier expected
This happens when you pass a constant to a routine (such as `Inc` var or `Dec`) when it expects a variable. You can only pass variables as arguments to these functions.

Error: Integer expression expected, but got "arg1"
The compiler expects an expression of type integer, but gets a different type.

Error: Boolean expression expected, but got "arg1"
The expression must be a boolean type. It should be return `True` or `False`.

Error: Ordinal expression expected
The expression must be of ordinal type, i.e., maximum a `Longint`. This happens, for instance, when you specify a second argument to `Inc` or `Dec` that doesn't evaluate to an ordinal value.

Error: pointer type expected, but got "arg1"
The variable or expression isn't of the type `pointer`. This happens when you pass a variable that isn't a pointer to `New` or `Dispose`.

Error: class type expected, but got "arg1"
The variable or expression isn't of the type `class`. This happens typically when

1. The parent class in a class declaration isn't a class.
2. An exception handler (`On`) contains a type identifier that isn't a class.

Error: Can't evaluate constant expression
This error can occur when the bounds of an array you declared do not evaluate to ordinal constants.

Error: Set elements are not compatible
You are trying to perform an operation on two sets, when the set element types are not the same. The base type of a set must be the same when taking the union.

Error: Operation not implemented for sets
several binary operations are not defined for sets. These include: `div`, `mod`, `**`, >= and <=. The last two may be defined for sets in the future.

Warning: Automatic type conversion from floating type to COMP which is an integer type
An implicit type conversion from a real type to a `comp` is encountered. Since `comp` is a 64 bit integer type, this may indicate an error.

Hint: use DIV instead to get an integer result
When hints are on, then an integer division with the '/' operator will produce this message, because the result will then be of type real.

Error: String types have to match exactly in $V+ mode
When compiling in `{$V+}` mode, the string you pass as a parameter should be of the exact same type as the declared parameter of the procedure.

Error: succ or pred on enums with assignments not possible
If you declare an enumeration type which has C-like assignments in it, such as in the following:

```
Tenum = (a,b,e:=5);
```

then you cannot use the `Succ` or `Pred` functions with this enumeration.

Error: Can't read or write variables of this type
You are trying to `read` or `write` a variable from or to a file of type text, which doesn't support that variable's type. Only integer types, reals, pchars and strings can be read from or written to a text file. Booleans can only be written to text files.

Error: Can't use readln or writeln on typed file
`readln` and `writeln` are only allowed for text files.

Error: Can't use read or write on untyped file.
`read` and `write` are only allowed for text or typed files.

Error: Type conflict between set elements
There is at least one set element which is of the wrong type, i.e. not of the set type.

Warning: lo/hi(dword/qword) returns the upper/lower word/dword
Free Pascal supports an overloaded version of `lo/hi` for `longint/dword/int64/qword` which returns the lower/upper word/dword of the argument. Turbo Pascal always uses a 16 bit `lo/hi` which always returns bits 0..7 for `lo` and the bits 8..15 for `hi`. If you want the Turbo Pascal behavior you have to type cast the argument to a `word` or `integer`.

Error: Integer or real expression expected
The first argument to `str` must be a real or integer type.

Error: Wrong type "arg1" in array constructor
You are trying to use a type in an array constructor which is not allowed.

Error: Incompatible type for arg no. arg1: Got "arg2", expected "arg3"
You are trying to pass an invalid type for the specified parameter.

Error: Method (variable) and Procedure (variable) are not compatible
You cannot assign a method to a procedure variable or a procedure to a method pointer.

Error: Illegal constant passed to internal math function
The constant argument passed to a `ln` or `sqrt` function is out of the definition range of these functions.

Error: Can't take the address of constant expressions
It is not possible to get the address of a constant expression, because they are not stored in memory. You can try making it a typed constant. This error can also be displayed if you try to pass a property to a var parameter.

Error: Argument cannot be assigned to

Only expressions which can be on the left side of an assignment can be passed as call by reference arguments.

Remark: Properties can be used on the left side of an assignment, nevertheless they cannot be used as arguments.

Error: Can't assign local procedure/function to procedure variable

It's not allowed to assign a local procedure/function to a procedure variable, because the calling convention of a local procedure/function is different. You can only assign local procedure/-function to a void pointer.

Error: Can't assign values to an address

It is not allowed to assign a value to an address of a variable, constant, procedure or function. You can try compiling with -So if the identifier is a procedure variable.

Error: Can't assign values to const variable

It's not allowed to assign a value to a variable which is declared as a const. This is normally a parameter declared as const. To allow changing the value, pass the parameter by value, or a parameter by reference (using var).

Error: Array type required

If you are accessing a variable using an index '[<x>]' then the type must be an array. In FPC mode a pointer is also allowed.

Error: interface type expected, but got "arg1"

The compiler expected to encounter an interface type name, but got something else. The following code would produce this error:

```
Type
  TMyStream = Class(TStream,Integer)
```

Hint: Mixing signed expressions and longwords gives a 64bit result

If you divide (or calculate the modulus of) a signed expression by a longword (or vice versa), or if you have overflow and/or range checking turned on and use an arithmetic expression (+, -, *, div, mod) in which both signed numbers and longwords appear, then everything has to be evaluated in 64-bit arithmetic which is slower than normal 32-bit arithmetic. You can avoid this by typecasting one operand so it matches the result type of the other one.

Warning: Mixing signed expressions and cardinals here may cause a range check error

If you use a binary operator (and, or, xor) and one of the operands is a longword while the other one is a signed expression, then, if range checking is turned on, you may get a range check error because in such a case both operands are converted to longword before the operation is carried out. You can avoid this by typecasting one operand so it matches the result type of the other one.

Error: Typecast has different size (arg1 -> arg2) in assignment

Type casting to a type with a different size is not allowed when the variable is used in an assignment.

Error: enums with assignments cannot be used as array index

When you declared an enumeration type which has C-like assignments, such as in the following:

```
Tenum = (a,b,e:=5);
```

you cannot use it as the index of an array.

Error: Class or Object types "arg1" and "arg2" are not related
There is a typecast from one class or object to another while the class/object are not related. This will probably lead to errors.

Warning: Class types "arg1" and "arg2" are not related
There is a typecast from one class to another while the classes are not related. This will probably lead to errors.

Error: Class or interface type expected, but got "arg1"
The compiler expected a class or interface name, but got another type or identifier.

Error: Type "arg1" is not completely defined
This error occurs when a type is not complete: i.e. a pointer type which points to an undefined type.

Warning: String literal has more characters than short string length
The size of the constant string, which is assigned to a shortstring, is longer than the maximum size of the shortstring (255 characters).

Warning: Comparison might be always false due to range of constant and expression
There is a comparison between a constant and an expression where the constant is out of the valid range of values of the expression. Because of type promotion, the statement will always evaluate to false. Explicitly typecast the constant or the expression to the correct range to avoid this warning if you think the code is correct.

Warning: Comparison might be always true due to range of constant and expression
There is a comparison between a constant and an expression where the constant is out of the valid range of values of the expression. Because of type promotion, the statement will always evaluate to true. Explicitly typecast the constant or the expression to the correct range to avoid this warning if you think the code is correct.

Warning: Constructing a class "arg1" with abstract method "arg2"
An instance of a class is created which contains non-implemented abstract methods. This will probably lead to a runtime error 211 in the code if that routine is ever called. All abstract methods should be overridden.

Hint: The left operand of the IN operator should be byte sized
The left operand of the `in` operator is not an ordinal or enumeration which fits within 8 bits. This may lead to range check errors. The `in` operator currently only supports a left operand which fits within a byte. In the case of enumerations, the size of an element of an enumeration can be controlled with the `{$PACKENUM}` or `{$Zn}` switches.

Warning: Type size mismatch, possible loss of data / range check error
There is an assignment to a smaller type than the source type. This means that this may cause a range-check error, or may lead to possible loss of data.

Hint: Type size mismatch, possible loss of data / range check error
There is an assignment to a smaller type than the source type. This means that this may cause a range-check error, or may lead to possible loss of data.

Error: The address of an abstract method cannot be taken
An abstract method has no body, so the address of an abstract method cannot be taken.

Error: Assignments to formal parameters and open arrays are not possible
You are trying to assign a value to a formal (untyped var, const or out) parameter, or to an open array.

Error: Constant Expression expected
The compiler expects an constant expression, but gets a variable expression.

Error: Operation "arg1" not supported for types "arg2" and "arg3"
The operation is not allowed for the supplied types.

Error: Illegal type conversion: "arg1" to "arg2"
When doing a type-cast, you must take care that the sizes of the variable and the destination type are the same.

Hint: Conversion between ordinals and pointers is not portable
If you typecast a pointer to a longint (or vice-versa), this code will not compile on a machine using 64 bits addressing.

Warning: Conversion between ordinals and pointers is not portable
If you typecast a pointer to an ordinal type of a different size (or vice-versa), this can cause problems. This is a warning to help in finding the 32-bit specific code where cardinal/longint is used to typecast pointers to ordinals. A solution is to use the ptrint/ptruint types instead.

Error: Can't determine which overloaded function to call
You're calling overloaded functions with a parameter that doesn't correspond to any of the declared function parameter lists. e.g. when you have declared a function with parameters `word` and `longint`, and then you call it with a parameter which is of type `integer`.

Error: Illegal counter variable
The type of a `for` loop variable must be an ordinal type. Loop variables cannot be reals or strings.

Warning: Converting constant real value to double for C variable argument, add explicit typecast to prevent this.
In C, constant real values are double by default. For this reason, if you pass a constant real value to a variable argument part of a C function, FPC by default converts this constant to double as well. If you want to prevent this from happening, add an explicit typecast around the constant.

Error: Class or COM interface type expected, but got "arg1"
Some operators, such as the AS operator, are only applicable to classes or COM interfaces.

Error: Constant packed arrays are not yet supported
You cannot declare a (bit)packed array as a typed constant.

Error: Incompatible type for arg no. arg1: Got "arg2" expected "(Bit)Packed Array"
The compiler expects a (bit)packed array as the specified parameter.

Error: Incompatible type for arg no. arg1: Got "arg2" expected "(not packed) Array"
The compiler expects a regular (i.e., not packed) array as the specified parameter.

Error: Elements of packed arrays cannot be of a type which need to be initialised
Support for packed arrays of types that need initialization (such as ansistrings, or records which contain ansistrings) is not yet implemented.

Error: Constant packed records and objects are not yet supported
You cannot declare a (bit)packed array as a typed constant at this time.

Warning: Arithmetic "arg1" on untyped pointer is unportable to {$T+}, suggest typecast
Addition/subtraction from an untyped pointer may work differently in `{$T+}`. Use a typecast to a typed pointer.

Error: Can't take address of a subroutine marked as local
The address of a subroutine marked as local cannot be taken.

Error: Can't export subroutine marked as local from a unit
A subroutine marked as local cannot be exported from a unit.

Error: Type is not automatable: "arg1"
Only byte, integer, longint, smallint, currency, single, double, ansistring, widestring, tdatetime, variant, olevariant, wordbool and all interfaces are automatable.

Hint: Converting the operands to "arg1" before doing the add could prevent overflow errors.
Adding two types can cause overflow errors. Since you are converting the result to a larger type, you could prevent such errors by converting the operands to this type before doing the addition.

Hint: Converting the operands to "arg1" before doing the subtract could prevent overflow errors.
Subtracting two types can cause overflow errors. Since you are converting the result to a larger type, you could prevent such errors by converting the operands to this type before doing the subtraction.

Hint: Converting the operands to "arg1" before doing the multiply could prevent overflow errors.
Multiplying two types can cause overflow errors. Since you are converting the result to a larger type, you could prevent such errors by converting the operands to this type before doing the multiplication.

Warning: Converting pointers to signed integers may result in wrong comparison results and range errors, use an unsigned type instead.
The virtual address space on 32-bit machines runs from $00000000 to $ffffffff. Many operating systems allow you to allocate memory above $80000000. For example both WINDOWS and LINUX allow pointers in the range $0000000 to $bfffffff. If you convert pointers to signed types, this can cause overflow and range check errors, but also $80000000 < $7fffffff. This can cause random errors in code like "if p>q".

Error: Interface type arg1 has no valid GUID
When applying the as-operator to an interface or class, the desired interface (i.e. the right operand of the as-operator) must have a valid GUID.

Error: Invalid selector name "arg1"
An Objective-C selector cannot be empty, must be a valid identifier or a single colon, and if it contains at least one colon it must also end in one.

Error: Expected Objective-C method, but got arg1
A selector can only be created for Objective-C methods, not for any other kind of procedure/-function/method.

Error: Expected Objective-C method or constant method name
A selector can only be created for Objective-C methods, either by specifying the name using a string constant, or by using an Objective-C method identifier that is visible in the current scope.

Error: No type info available for this type
Type information is not generated for some types, such as enumerations with gaps in their value range (this includes enumerations whose lower bound is different from zero).

Error: Ordinal or string expression expected
The expression must be an ordinal or string type.

Error: String expression expected
The expression must be a string type.

Warning: Converting 0 to NIL
Use NIL rather than 0 when initialising a pointer.

Error: Objective-C protocol type expected, but got "arg1"
The compiler expected a protocol type name, but found something else.

Error: The type "arg1" is not supported for interaction with the Objective-C and the blocks runtime.
Objective-C and Blocks make extensive use of run time type information (RTTI). This format is defined by the maintainers of the run time and can therefore not be adapted to all possible Object Pascal types. In particular, types that depend on reference counting by the compiler (such as ansistrings and certain kinds of interfaces) cannot be used as fields of Objective-C classes, cannot be directly passed to Objective-C methods or Blocks, and cannot be encoded using `objc_encode`.

Error: Class or objcclass type expected, but got "arg1"
It is only possible to create class reference types of `class` and `objcclass`

Error: Objcclass type expected
The compiler expected an `objcclass` type

Warning: Coerced univ parameter type in procedural variable may cause crash or memory corruption: arg1 to arg2
`univ` parameters are implicitly compatible with all types of the same size, also in procedural variable definitions. That means that the following code is legal, because `single` and `longint` have the same size:

```
{$mode macpas}
Type
  TIntProc = procedure (l: univ longint);

  procedure test(s: single);
    begin
      writeln(s);
    end;

  var
    p: TIntProc;
  begin
    p:=test;
    p(4);
  end.
```

This code may however crash on platforms that pass integers in registers and floating point values on the stack, because then the stack will be unbalanced. Note that this warning will not flag all potentially dangerous situations. when `test` returns.

Error: Type parameters of specializations of generics cannot reference the currently specialized type
Recursive specializations of generics like `Type MyType = specialize MyGeneric<MyType>;` are not possible.

Error: Type parameters are not allowed on non-generic class/record/object procedure or function
Type parameters are only allowed for methods of generic classes, records or objects

Error: Generic declaration of "arg1" differs from previous declaration
Generic declaration does not match the previous declaration

Error: Helper type expected
The compiler expected a `class helper` type.

Error: Record type expected
The compiler expected a `record` type.

Error: Derived class helper must extend a subclass of "arg1" or the class itself
If a class helper inherits from another class helper the extended class must extend either the same class as the parent class helper or a subclass of it

Error: Derived record or type helper must extend "arg1"
If a record helper inherits from another record helper it must extend the same record that the parent record helper extended.

Error: Invalid assignment, procedures return no value
This error occurs when one tries to assign the result of a procedure or destructor call. A procedure or destructor returns no value so this is not possible.

Warning: Implicit string type conversion from "arg1" to "arg2"
An implicit type conversion from an ansi string type to an unicode string type is encountered. To avoid this warning perform an explicit type conversion.

Warning: Implicit string type conversion with potential data loss from "arg1" to "arg2"
An implicit type conversion from an unicode string type to an ansi string type is encountered. This conversion can lose data since not all unicode characters may be represented in the codepage of destination string type.

Warning: Explicit string typecast from "arg1" to "arg2"
An explicit typecast from an ansi string type to an unicode string type is encountered. This warning is off by default. You can turn it on to see all suspicious string conversions.

Warning: Explicit string typecast with potential data loss from "arg1" to "arg2"
An explicit typecast from an unicode string type to an ansi string type is encountered. This conversion can lose data since not all unicode characters may be represented in the codepage of destination string type. This warning is off by default. You can turn it on to see all the places with lossy string conversions.

Warning: Unicode constant cast with potential data loss
Conversion from a WideChar to AnsiChar can lose data since now all unicode characters may be represented in the current system codepage You can nest function definitions only 31 levels deep.

Error: range check error while evaluating constants (arg1 must be between arg2 and arg3)

Warning: range check error while evaluating constants (arg1 must be between arg2 and arg3)
The constants are outside their allowed range.

Error: This type is not supported for the Default() intrinsic
Some types like for example Text and File Of X are not supported by the Default intrinsic.

Error: JVM virtual class methods cannot be static
Virtual class methods cannot be static when targeting the JVM platform, because the self pointer is required for correct dispatching.

Error: Final (class) fields can only be assigned in their class' (class) constructor
It is only possible to assign a value to a final (class) field inside a (class) constructor of its owning class.

Error: It is not possible to typecast untyped parameters on managed platforms, simply assign a value to them instead.
On managed platforms, untyped parameters are translated by the compiler into the equivalent of `var x: BaseClassType`. Non-class-based types passed to such parameters are automatically wrapped (or boxed) in a class, and after the call the potentially modified value is assigned back to the original variable. On the caller side, changing untyped var/out parameters happens by simply assigning values to them (either class-based or primitive ones). On the caller side, they will be extracted and if their type does not match the original variable's, an exception will be raised.

Error: The assignment side of an expression cannot be typecasted to a supertype on managed platforms
Managed platforms guarantee type safety at the bytecode level. This means that the virtual machine must be able to statically determine that no type-unsafe assignments or operations occur. By assigning a parent class type to a variable of a child type by typecasting the assignment side to the parent class type, the type safety would no longer be guaranteed and the generated code would fail verification at run time time.

Warning: The interface method "arg1" raises the visibility of "arg2" to public when accessed via an interface instance

Error: The interface method "arg1" has a higher visibility (public) than "arg2"
All methods in an interface have always public visibility. That means that if an interface method is implemented using a (strict) protected or private method, this method is actually publicly accessible via the interface. On the JVM target this situation results in an error because the JVM rejects such attempts to circumvent the visibility rules. On other targets this is a warning that is disabled by default because such situations are common practice, but it can be enabled in case you are concerned with keeping your code compilable for the JVM target.

Error: TYPEOF can only be used on object types with VMT
Typeof() intrinsic returns pointer to VMT of its argument. It cannot be used on object types that do not have VMT.

Error: It is not possible to define a default value for a parameter of type "arg1"
Parameters declared as structured types, such as files, variants, non-dynamic arrays and TP-style objects, cannot have a default value.

Error: Type "arg1" cannot be extended by a type helper
Types like procedural variables cannot be extended by type helpers

Error: Procedure or function must be far in order to allow taking its address: "arg1"
In certain i8086 memory models (medium, large and huge), procedures and functions have to be declared 'far' in order to allow their address to be taken.

Warning: Creating an instance of abstract class "arg1"
The specified class is declared as `abstract` and thus no instance of this class should be created. This is merely a warning for Delphi compatibility.

Error: Subroutine references cannot be declared as "of object" or "is nested", they can always refer to any kind of subroutine
Subroutine references can refer to any kind of subroutine and hence do not require specialisation for methods or nested subroutines.

Error: Procedure variables in that memory model do not store segment information

Warning: The first value of a set constructur range is greater then the second value, so the range describes an empty set.
If a set is constructed like this: `s:=[9..7];`, then an empty set is generated. As this is something normally not desired, the compiler warns about it.

Error: C block reference must use CDECL or MWPASCAL calling convention.
When declaring a C block reference ensure that it uses either the `cdecl` or `mwpascal` calling convention either by adding the corresponding function directive or by using the `{$Calling}` compiler directive.

C.5 Symbol handling

This section lists all the messages that concern the handling of symbols. This means all things that have to do with procedure and variable names.

Error: Identifier not found "arg1"
The compiler doesn't know this symbol. Usually happens when you misspell the name of a variable or procedure, or when you forget to declare a variable.

Fatal: Internal Error in SymTableStack()
An internal error occurred in the compiler; If you encounter such an error, please contact the developers and try to provide an exact description of the circumstances in which the error occurs.

Error: Duplicate identifier "arg1"
The identifier was already declared in the current scope.

Hint: Identifier already defined in arg1 at line arg2
The identifier was already declared in a previous scope.

Error: Unknown identifier "arg1"
The identifier encountered has not been declared, or is used outside the scope where it is defined.

Error: Forward declaration not solved "arg1"
This can happen in two cases:

- You declare a function in the `interface` part, or with a `forward` directive, but do not implement it.
- You reference a type which isn't declared in the current `type` block.

Error: Error in type definition
There is an error in your definition of a new array type. One of the range delimiters in an array declaration is erroneous. For example, `Array [1..1.25]` will trigger this error.

Error: Forward type not resolved "arg1"
A symbol was forward defined, but no declaration was encountered.

Error: Only static variables can be used in static methods or outside methods
A static method of an object can only access static variables.

Error: Record or object or class type expected
The variable or expression isn't of the type `record` or `object` or `class`.

Error: Instances of classes or objects with an abstract method are not allowed
You are trying to generate an instance of a class which has an abstract method that wasn't overridden.

Warning: Label not defined "arg1"
A label was declared, but not defined.

Error: Label used but not defined "arg1"
A label was declared and used, but not defined.

Error: Illegal label declaration
This error should never happen; it occurs if a label is defined outside a procedure or function.

Error: GOTO and LABEL are not supported (use switch -Sg)
You must use the -Sg switch to compile a program which has `label`s and `goto` statements. By default, `label` and `goto` are not supported.

Error: Label not found
A `goto label` was encountered, but the label wasn't declared.

Error: identifier isn't a label
The identifier specified after the `goto` isn't of type label.

Error: label already defined
You are defining a label twice. You can define a label only once.

Error: illegal type declaration of set elements
The declaration of a set contains an invalid type definition.

Error: Forward class definition not resolved "arg1"
You declared a class, but you did not implement it.

Hint: Unit "arg1" not used in arg2
The unit referenced in the `uses` clause is not used.

Hint: Parameter "arg1" not used
The identifier was declared (locally or globally) but was not used (locally or globally).

Note: Local variable "arg1" not used
You have declared, but not used, a variable in a procedure or function implementation.

Hint: Value parameter "arg1" is assigned but never used
The identifier was declared (locally or globally) and assigned to, but is not used (locally or globally) after the assignment.

Note: Local variable "arg1" is assigned but never used
The variable in a procedure or function implementation is declared and assigned to, but is not used after the assignment.

Hint: Local arg1 "arg2" is not used
A local symbol is never used.

Note: Private field "arg1.arg2" is never used
The indicated private field is defined, but is never used in the code.

Note: Private field "arg1.arg2" is assigned but never used
The indicated private field is declared and assigned to, but never read.

Note: Private method "arg1.arg2" never used
The indicated private method is declared but is never used in the code.

Error: Set type expected
The variable or expression is not of type `set`. This happens in an `in` statement.

Warning: Function result does not seem to be set
You can get this warning if the compiler thinks that a function return value is not set. This will not be displayed for assembler procedures, or procedures that contain assembler blocks.

Warning: Type "arg1" is not aligned correctly in current record for C
Arrays with sizes not multiples of 4 will be wrongly aligned for C structures.

Error: Unknown record field identifier "arg1"
The field doesn't exist in the record/object definition.

Warning: Local variable "arg1" does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. appeared in the left-hand side of an assignment).

Warning: Variable "arg1" does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. appeared in the left-hand side of an assignment).

Error: identifier idents no member "arg1"
This error is generated when an identifier of a record, field or method is accessed while it is not defined.

Hint: Found declaration: arg1
You get this when you use the `-vh` switch.In the case of an overloaded procedure not being found. Then all candidate overloaded procedures are listed, with their parameter lists.

Error: Data element too large
You get this when you declare a data element whose size exceeds the prescribed limit (2 Gb on 80386+/68020+ processors).

Error: No matching implementation for interface method "arg1" found
There was no matching method found which could implement the interface method. Check argument types and result type of the methods.

Warning: Symbol "arg1" is deprecated
This means that a symbol (a variable, routine, etc...) which is declared as `deprecated` is used. Deprecated symbols may no longer be available in newer versions of the unit / library. Use of this symbol should be avoided as much as possible.

Warning: Symbol "arg1" is not portable
This means that a symbol (a variable, routine, etc...) which is declared as `platform` is used. This symbol's value, use and availability is platform specific and should not be used if the source code must be portable.

Warning: Symbol "arg1" is not implemented
This means that a symbol (a variable, routine, etc...) which is declared as `unimplemented` is used. This symbol is defined, but is not yet implemented on this specific platform.

Error: Can't create unique type from this type
Only simple types like ordinal, float and string types are supported when redefining a type with `type newtype = type oldtype;`.

Hint: Local variable "arg1" does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. it did not appear in the left-hand side of an assignment).

Hint: Variable "arg1" does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. t did not appear in the left-hand side of an assignment).

Warning: Function result variable does not seem to be initialized
This message is displayed if the compiler thinks that the function result variable will be used (i.e. it appears in the right-hand side of an expression) before it is initialized (i.e. before it appeared in the left-hand side of an assignment).

Hint: Function result variable does not seem to be initialized
This message is displayed if the compiler thinks that the function result variable will be used (i.e. it appears in the right-hand side of an expression) before it is initialized (i.e. it appears in the left-hand side of an assignment)

Warning: Variable "arg1" read but nowhere assigned
You have read the value of a variable, but nowhere assigned a value to it.

Hint: Found abstract method: arg1
When getting a warning about constructing a class/object with abstract methods you get this hint to assist you in finding the affected method.

Warning: Symbol "arg1" is experimental
This means that a symbol (a variable, routine, etc...) which is declared as `experimental` is used. Experimental symbols might disappear or change semantics in future versions. Usage of this symbol should be avoided as much as possible.

Warning: Forward declaration "arg1" not resolved, assumed external
This happens if you declare a function in the `interface` of a unit in macpas mode, but do not implement it.

Warning: Symbol "arg1" is belongs to a library
This means that a symbol (a variable, routine, etc...) which is declared as `library` is used. Library symbols may not be available in other libraries.

Warning: Symbol "arg1" is deprecated: "arg2"
This means that a symbol (a variable, routine, etc...) which is declared as `deprecated` is used. Deprecated symbols may no longer be available in newer versions of the unit / library. Use of this symbol should be avoided as much as possible.

Error: Cannot find an enumerator for the type "arg1"
This means that compiler cannot find an appropriate enumerator to use in the for-in loop. To create an enumerator you need to define an operator enumerator or add a public or published GetEnumerator method to the class or object definition.

Error: Cannot find a "MoveNext" method in enumerator "arg1"
This means that compiler cannot find a public MoveNext method with the Boolean return type in the enumerator class or object definition.

Error: Cannot find a "Current" property in enumerator "arg1"
This means that compiler cannot find a public Current property in the enumerator class or object definition.

Error: Mismatch between number of declared parameters and number of colons in message string.
In Objective-C, a message name automatically contains as many colons as parameters. In order to prevent mistakes when specifying the message name in FPC, the compiler checks whether this is also the case here. Note that in case of messages taking a variable number of arguments translated to FPC via an `array of const` parameter, this final `array of const` parameter is not counted. Neither are the hidden `self` and `_cmd` parameters.

Note: Private type "arg1.arg2" never used
The indicated private type is declared but is never used in the code.

Note: Private const "arg1.arg2" never used
The indicated private const is declared but is never used in the code.

Note: Private property "arg1.arg2" never used
The indicated private property is declared but is never used in the code.

Warning: Unit "arg1" is deprecated
This means that a unit which is declared as `deprecated` is used. Deprecated units may no longer be available in newer versions of the library. Use of this unit should be avoided as much as possible.

Warning: Unit "arg1" is deprecated: "arg2"
This means that a unit which is declared as `deprecated` is used. Deprecated units may no longer be available in newer versions of the library. Use of this unit should be avoided as much as possible.

Warning: Unit "arg1" is not portable
This means that a unit which is declared as `platform` is used. This unit use and availability is platform specific and should not be used if the source code must be portable.

Warning: Unit "arg1" is belongs to a library
This means that a unit which is declared as `library` is used. Library units may not be available in other libraries.

Warning: Unit "arg1" is not implemented
This means that a unit which is declared as `unimplemented` is used. This unit is defined, but is not yet implemented on this specific platform.

Warning: Unit "arg1" is experimental
This means that a unit which is declared as `experimental` is used. Experimental units might disappear or change semantics in future versions. Usage of this unit should be avoided as much as possible.

Error: No full definition of the formally declared class "arg1" is in scope. Add the unit containing its full definition to the uses clause.
Objecive-C and Java classes can be imported formally, without using the unit in which it is fully declared. This enables making forward references to such classes and breaking circular dependencies amongst units. However, as soon as you wish to actually do something with an entity of this class type (such as access one of its fields, send a message to it, or use it to inherit from), the compiler requires the full definition of the class to be in scope.

Error: Gotos into initialization or finalization blocks of units are not allowed
Gotos into initialization or finalization blockse of units are not allowed.

Error: Invalid external name "arg1" for formal class "arg2"

Error: Complete class definition with external name "arg1" here
When a class is declared using a formal external definition, the actual external definition (if any) must specify the same external name as the formal definition (since both definitions refer to the same actual class type).

Warning: Possible library conflict: symbol "arg1" from library "arg2" also found in library "arg3"
Some OS do not have library specific namespaces, for those OS, the function declared as "external 'libname' name 'funcname'", the 'libname' part is only a hint, funcname might also be loaded by another library. This warning appears if 'funcname' is used twice with two different library names.

Error: Cannot add implicit constructor 'Create' because identifier already used by "arg1"
Java does not automatically add inherited constructors to child classes, so that they can be hidden. However, if a class does not explicitly declare at least one constructor, the compiler is required to add a public, parameterless constructor. In Java, constructors are nameless, but in FPC they are all called "Create". Therefore, if you do not add a constructor to a Java class and furthermore use the "Create" identifier for another entity (e.g., a field, or a parameterless method), the compiler cannot satisfy this requirement.

Error: Cannot generate default constructor for class, because parent has no parameterless constructor
Java does not automatically add inherited constructors to child classes, so that they can be hidden. However, if a class does not explicitly declare at least one constructor, the compiler is required to add a public, parameterless constructor. This compiler must then call the parameterless constructor from the parent class inside this added constructor. This is however impossible if the parent class does not declare such a constructor. In this case you must add a valid constructor yourself.

Adding helper for arg1
A helper for the mentioned type is added to the current scope

Error: Found declaration: arg1
This message shows all overloaded declarations in case of an error.

Warning: Local variable "arg1" of a managed type does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. appeared in the left-hand side of an assignment). Since the variable is managed, i. e. implicitly initialized by the compiler, this might be intended behaviour and does not necessarily mean that the code is wrong.

Warning: Variable "arg1" of a managed type does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. appeared in the left-hand side of an assignment). Since the variable is managed, i. e. implicitly initialized by the compiler, this might be intended behaviour and does not necessarily mean that the code is wrong.

Hint: Local variable "arg1" of a managed type does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. it did not appear in the left-hand side of an assignment). Since the variable is managed, i. e. implicitly initialized by the compiler, this might be intended behaviour and does not necessarily mean that the code is wrong.

Hint: Variable "arg1" of a managed type does not seem to be initialized
This message is displayed if the compiler thinks that a variable will be used (i.e. it appears in the right-hand side of an expression) when it was not initialized first (i.e. t did not appear in the left-hand side of an assignment). Since the variable is managed, i. e. implicitly initialized by the compiler, this might be intended behaviour and does not necessarily mean that the code is wrong.

Warning: function result variable of a managed type does not seem to be initialized
This message is displayed if the compiler thinks that the function result variable will be used (i.e. it appears in the right-hand side of an expression) before it is initialized (i.e. before it appeared in the left-hand side of an assignment). Since the variable is managed, i. e. implicitly initialized by the compiler, this might be intended behaviour and does not necessarily mean that the code is wrong.

Hint: Function result variable of a managed type does not seem to be initialized
This message is displayed if the compiler thinks that the function result variable will be used (i.e. it appears in the right-hand side of an expression) before it is initialized (i.e. it appears in the left-hand side of an assignment). Since the variable is managed, i. e. implicitly initialized by the compiler, this might be intended behaviour and does not necessarily mean that the code is wrong.

Warning: Duplicate identifier "arg1"
The identifier was already declared in an Objective-C category that's in the same scope as the current identifier. This is a warning instead of an error, because while this hides the identifier from the category, there are often many unused categories in scope.

Error: Generic type parameter "arg1" does not match with the one in the declaration
The specified generic type parameter for the generic class, record or routine does not match with the one declared in the declaration of the generic class, record or routine.

Error: Generic type parameter declared as "arg1"
Shows what the generic type parameter was originally declared as if a mismatch is found between a declaration and the definition.

Error: Record or object type expected
The variable or expression isn't of the type `record` or `object`.

C.6 Code generator messages

This section lists all messages that can be displayed if the code generator encounters an error condition.

Error: Parameter list size exceeds 65535 bytes
The I386 processor limits the parameter list to 65535 bytes. (The `RET` instruction causes this.)

Error: File types must be var parameters
You cannot specify files as value parameters, i.e., they must always be declared `var` parameters.

Error: The use of a far pointer isn't allowed there
Free Pascal doesn't support far pointers, so you cannot take the address of an expression which has a far reference as a result. The `mem` construct has a far reference as a result, so the following code will produce this error:

```
var p : pointer;
...
p:=@mem[a000:000];
```

Error: EXPORT declared functions cannot be called
No longer in use.

Warning: Possible illegal call of constructor or destructor
The compiler detected that a constructor or destructor is called within a a method. This will probably lead to problems, since constructors / destructors require parameters on entry.

Note: Inefficient code
Your statement seems dubious to the compiler.

Warning: unreachable code
You specified a construct which will never be executed. Example:

```
while false do
  begin
  {.. code ...}
  end;
```

Error: Abstract methods cannot be called directly
You cannot call an abstract method directly. Instead, you must call an overriding child method, because an abstract method isn't implemented.

Register arg1 weight arg2 arg3
Debugging message. Shown when the compiler considers a variable for keeping in the registers.

Stack frame is omitted
Some procedure/functions do not need a complete stack-frame, so it is omitted. This message will be displayed when the -vd switch is used.

Error: Object or class methods cannot be inline.
You cannot have inlined object methods.

Error: Procvar calls cannot be inline.
A procedure with a procedural variable call cannot be inlined.

Error: No code for inline procedure stored
The compiler couldn't store code for the inline procedure.

Error: Element zero of an ansi/wide- or longstring cannot be accessed, use (set)length instead
You should use `setlength` to set the length of an ansi/wide/longstring and `length` to get the length of such string type.

Error: Constructors or destructors cannot be called inside a 'with' clause
Inside a `with` clause you cannot call a constructor or destructor for the object you have in the `with` clause.

Error: Cannot call message handler methods directly
A message method handler method cannot be called directly if it contains an explicit `Self` argument.

Error: Jump in or outside of an exception block
It is not allowed to jump in or outside of an exception block like `try..finally..end;`. For example, the following code will produce this error:

```
label 1;

...

try
   if not(final) then
     goto 1;   // this line will cause an error
finally
  ...
end;
1:
...
```

Error: Control flow statements are not allowed in a finally block
It isn't allowed to use the control flow statements `break`, `continue` and `exit` inside a finally statement. The following example shows the problem:

```
...
  try
     p;
  finally
     ...
     exit;  // This exit ISN'T allowed
  end;
...
```

If the procedure `p` raises an exception the finally block is executed. If the execution reaches the exit, it's unclear what to do: exit the procedure or search for another exception handler.

Warning: Parameters size exceeds limit for certain cpu's
This indicates that you are declaring more than 64K of parameters, which might not be supported on other processor targets.

Warning: Local variable size exceed limit for certain cpu's
This indicates that you are declaring more than 32K of local variables, which might not be supported on other processor targets.

Error: Local variables size exceeds supported limit
This indicates that you are declaring more than 32K of local variables, which is not supported by this processor.

Error: BREAK not allowed
You're trying to use `break` outside a loop construction.

Error: CONTINUE not allowed
You're trying to use `continue` outside a loop construction.

Fatal: Unknown compilerproc "arg1". Check if you use the correct run time library.
The compiler expects that the runtime library contains certain subroutines. If you see this error

and you didn't change the runtime library code, it's very likely that the runtime library you're using doesn't match the compiler in use. If you changed the runtime library this error means that you removed a subroutine which the compiler needs for internal use.

Fatal: Cannot find system type "arg1". Check if you use the correct run time library.
The compiler expects that the runtime library contains certain type definitions. If you see this error and you didn't change the runtime library code, it's very likely that the runtime library you're using doesn't match the compiler in use. If you changed the runtime library this error means that you removed a type which the compiler needs for internal use.

Hint: Inherited call to abstract method ignored
This message appears only in Delphi mode when you call an abstract method of a parent class via `inherited;`. The call is then ignored.

Error: Goto label "arg1" not defined or optimized away
The label used in the goto definition is not defined or optimized away by the unreachable code elemination.

Fatal: Cannot find type "arg1" in unit "arg2". Check if you use the correct run time library.
The compiler expects that the runtime library contains certain type definitions. If you see this error and you didn't change the runtime library code, it's very likely that the runtime library you're using doesn't match the compiler in use. If you changed the runtime library this error means that you removed a type which the compiler needs for internal use.

Error: Interprocedural gotos are allowed only to outer subroutines
Gotos between subroutines are only allowed if the goto jumps from an inner to an outer subroutine or from a subroutine to the main program

Error: Label must be defined in the same scope as it is declared
In ISO mode, labels must be defined in the same scope as they are declared.

Error: Leaving procedures containing explicit or implicit exceptions frames using goto is not allowed
Non-local gotos might not be used to leave procedures using exceptions either implicitly or explicitly. Procedures which use automated types like ansistrings or class constructurs are affected by this too.

Error: In ISO mode, the mod operator is defined only for positive quotient
In ISO pascal, only positive values are allowed for the quotient: `n mod m` is only valid if `m>0`.

Auto inlining: arg1
Due to auto inlining turned on, the compiler auto inlines this subroutine.

Error: The function used, is not supported by the selected instruction set: arg1
Some functions cannot be implemented efficiently for certain instruction sets, one example is fused multiply/add. To avoid very inefficient code, the compiler complains in this case, so either select another instruction set or replace the function call by alternative code

Fatal: Maximum number of units (arg1) reached for the current target
Depending of target architecture, the number of units is limited. This limit has been reached. A unit counts only if it contains initialization or finalization count.

Note: Call to subroutine "arg1" marked as inline is not inlined
The directive inline is only a hint to the compiler. Sometimes the compiler ignores this hint, a subroutine marked as inline is not inlined. In this case, this hint is given. Compiling with `-vd` might result in more information why the directive inline is ignored.

C.7 Errors of assembling/linking stage

This section lists errors that occur when the compiler is processing the command line or handling the configuration files.

Warning: Source operating system redefined
The source operating system is redefined.

Info: Assembling (pipe) arg1
Assembling using a pipe to an external assembler.

Error: Can't create assembler file: arg1
The mentioned file cannot be created. Check if you have access permissions to create this file.

Error: Can't create object file: arg1 (error code: arg2)
The mentioned file cannot be created. Check if you have got access permissions to create this file.

Error: Can't create archive file: arg1
The mentioned file cannot be created. Check if you have access permissions to create this file.

Error: Assembler arg1 not found, switching to external assembling
The assembler program was not found. The compiler will produce a script that can be used to assemble and link the program.

Using assembler: arg1
An informational message saying which assembler is being used.

Error: Error while assembling exitcode arg1
There was an error while assembling the file using an external assembler. Consult the documentation of the assembler tool to find out more information on this error.

Error: Can't call the assembler, error arg1 switching to external assembling
An error occurred when calling an external assembler. The compiler will produce a script that can be used to assemble and link the program.

Info: Assembling arg1
An informational message stating which file is being assembled.

Info: Assembling with smartlinking arg1
An informational message stating which file is being assembled using smartlinking.

Warning: Object arg1 not found, Linking may fail !
One of the object files is missing, and linking will probably fail. Check your paths.

Warning: Library arg1 not found, Linking may fail !
One of the library files is missing, and linking will probably fail. Check your paths.

Error: Error while linking
Generic error while linking.

Error: Can't call the linker, switching to external linking
An error occurred when calling an external linker. The compiler will produce a script that can be used to assemble and link the program.

Info: Linking arg1
An informational message, showing which program or library is being linked.

Error: Util arg1 not found, switching to external linking
An external tool was not found. The compiler will produce a script that can be used to assemble and link or postprocess the program.

Using util arg1
An informational message, showing which external program (usually a postprocessor) is being used.

Error: Creation of Executables not supported
Creating executable programs is not supported for this platform, because it was not yet implemented in the compiler.

Error: Creation of Dynamic/Shared Libraries not supported
Creating dynamically loadable libraries is not supported for this platform, because it was not yet implemented in the compiler.

Error: Creation of Static Libraries not supported
Creating static libraries is not supported for this platform, because it was not yet implemented in the compiler.

Info: Closing script arg1
Informational message showing when writing of the external assembling and linking script is finished.

Error: resource compiler "arg1" not found, switching to external mode
An external resource compiler was not found. The compiler will produce a script that can be used to assemble, compile resources and link or postprocess the program.

Info: Compiling resource arg1
An informational message, showing which resource is being compiled.

unit arg1 cannot be statically linked, switching to smart linking
Static linking was requested, but a unit which is not statically linkable was used.

unit arg1 cannot be smart linked, switching to static linking
Smart linking was requested, but a unit which is not smart-linkable was used.

unit arg1 cannot be shared linked, switching to static linking
Shared linking was requested, but a unit which is not shared-linkable was used.

Error: unit arg1 cannot be smart or static linked
Smart or static linking was requested, but a unit which cannot be used for either was used.

Error: unit arg1 cannot be shared or static linked
Shared or static linking was requested, but a unit which cannot be used for either was used.

Calling resource compiler "arg1" with "arg2" as command line
An informational message showing which command line is used for the resource compiler.

Error: Error while compiling resources
The resource compiler or converter returned an error.

Error: Can't call the resource compiler "arg1", switching to external mode
An error occurred when calling a resource compiler. The compiler will produce a script that can be used to assemble, compile resources and link or postprocess the program.

Error: Can't open resource file "arg1"
An error occurred resource file cannot be opened.

Error: Can't write resource file "arg1"
An error occurred resource file cannot be written.

Note: File "arg1" not found for backquoted cat command
The compiler did not find the file that should be expanded into linker parameters

Warning: "arg1" not found, this will probably cause a linking failure
The compiler adds certain startup code files to the linker only when they are found. If they are not found, they are not added and this might cause a linking failure.

C.8 Executable information messages.

This section lists all messages that the compiler emits when an executable program is produced, and only when the internal linker is used.

Fatal: Can't post process executable arg1
Fatal error when the compiler is unable to post-process an executable.

Fatal: Can't open executable arg1
Fatal error when the compiler cannot open the file for the executable.

Size of Code: arg1 bytes
Informational message showing the size of the produced code section.

Size of initialized data: arg1 bytes
Informational message showing the size of the initialized data section.

Size of uninitialized data: arg1 bytes
Informational message showing the size of the uninitialized data section.

Stack space reserved: arg1 bytes
Informational message showing the stack size that the compiler reserved for the executable.

Stack space committed: arg1 bytes
Informational message showing the stack size that the compiler committed for the executable.

C.9 Linker messages

This section lists messages produced by internal linker.

Fatal: Executable image size is too big for arg1 target.
Fatal error when resulting executable is too big.

Warning: Object file "arg1" contains 32-bit absolute relocation to symbol "arg2".
Warning when 64-bit object file contains 32-bit absolute relocations. In such case an executable image can be loaded into lower 4Gb of address space only.

Error: Program segment too large (exceeds 64k by arg1 bytes)
Error when a 16-bit program is compiled in the tiny memory model, but its size exceeds 64k

Error: Code segment "arg1" too large (exceeds 64k by arg2 bytes)
Error when a 16-bit program's code segment exceeds 64k bytes

Error: Data segment "arg1" too large (exceeds 64k by arg2 bytes)
Error when a 16-bit program's data segment exceeds 64k bytes

Error: Segment "arg1" too large (exceeds 64k by arg2 bytes)
Error when a 16-bit program contains a segment that exceeds 64k bytes

Error: Group "arg1" too large (exceeds 64k by arg2 bytes)
Error when a 16-bit program's object modules define a segment group that exceeds 64k bytes

Error: Cannot create a .COM file, because the program contains segment relocations
Error occurs, when creating a tiny model DOS .COM file, but at least one of the program's object modules contains segment relocations. Segment relocations might be caused by the use of the Seg() function or by the SEG assembler directive (either in pascal's built-in inline assembler, or in an externally linked assembly module).

Warning: Program "arg1" uses experimental CheckPointer option

Error: Multiple defined symbol "arg1"
The specified symbol is already defined inside the whole collection of object files.

Error: COMDAT selection mode arg1 not supported (section: "arg1")
The specified COMDAT selection mode is not supported.

Error: Associative section expected for COMDAT section "arg1"
The specified COMDAT section is specified as expecting an associative section, but none is specified.

Error: COMDAT section selection mode doesn't match for section "arg1" and symbol "arg2"
All COMDAT symbols/sections need to use the same selection mode.

Error: Associative COMDAT section for section "arg1" not found
The COMDAT section expects an associative section, but it was not found inside the object file.

Discarding duplicate symbol "arg1" due to COMDAT selection mode
The COMDAT section specifies that any section with the same name might be selected and this specific section was selected to be discarded.

Discarding duplicate symbol "arg1" with same size due to COMDAT selection mode
The COMDAT section specifies that any section with the same name and size might be selected and this specific section was selected to be discarded.

Discarding duplicate symbol "arg1" with same content due to COMDAT selection mode
The COMDAT section specifies that any section with the same name and content might be selected and this specific section was selected to be discarded.

Replacing duplicate symbol "arg1" with smaller size due to COMDAT selection mode
The COMDAT section specifies that the largest section with the same name should be selected this specific section was larger than the previous largest one.

Error: Size of duplicate COMDAT symbol "arg1" differs
The COMDAT section specifies that all sections with the same name need to have the same size, but this section had a different size.

Error: Content of duplicate COMDAT symbol "arg1" differs
The COMDAT section specifies that all sections with the same name need to have the same content, but this section had a different size.

Error: COMDAT selection mode for symbol "arg1" differs

C.10 Unit loading messages.

This section lists all messages that can occur when the compiler is loading a unit from disk into memory. Many of these messages are informational messages.

Unitsearch: arg1
When you use the `-vt` option, the compiler tells you where it tries to find unit files.

PPU Loading arg1
When the `-vt` switch is used, the compiler tells you what units it loads.

PPU Name: arg1
When you use the `-vu` flag, the unit name is shown.

PPU Flags: arg1
When you use the `-vu` flag, the unit flags are shown.

PPU Crc: arg1
When you use the `-vu` flag, the unit CRC check is shown.

PPU Time: arg1
When you use the `-vu` flag, the time the unit was compiled is shown.

PPU File too short
The ppufile is too short, not all declarations are present.

PPU Invalid Header (no PPU at the begin)
A unit file contains as the first three bytes the ASCII codes of the characters `PPU`.

PPU Invalid Version arg1
This unit file was compiled with a different version of the compiler, and cannot be read.

PPU is compiled for another processor
This unit file was compiled for a different processor type, and cannot be read.

PPU is compiled for another target
This unit file was compiled for a different target, and cannot be read.

PPU Source: arg1
When you use the `-vu` flag, the unit source file name is shown.

Writing arg1
When you specify the `-vu` switch, the compiler will tell you where it writes the unit file.

Fatal: Can't Write PPU-File
An error occurred when writing the unit file.

Fatal: Error reading PPU-File
This means that the unit file was corrupted, and contains invalid information. Recompilation will be necessary.

Fatal: unexpected end of PPU-File
Unexpected end of file. This may mean that the PPU file is corrupted.

Fatal: Invalid PPU-File entry: arg1
The unit the compiler is trying to read is corrupted, or generated with a newer version of the compiler.

Fatal: PPU Dbx count problem
There is an inconsistency in the debugging information of the unit.

Error: Illegal unit name: arg1 (expecting arg2)
The name of the unit does not match the file name. There might to two reasons: either there is a spelling mistake in the unit name or there is a unit with a 8.3 name where the 8 characters are equal to first 8 characters of the name of a unit with a longer name. However, this unit is not found. Example: Program contains `uses mytestunit;`, the unit file or source of mytestunit are not available but there is a source with the name `mytestun`. Then compiler tries to compile and use that one, however the expected unit name does not match.

Fatal: Too much units
Free Pascal has a limit of 1024 units in a program. You can change this behavior by changing the `maxunits` constant in the fmodule.pas file of the compiler, and recompiling the compiler.

Fatal: Circular unit reference between arg1 and arg2
Two units are using each other in the interface part. This is only allowed in the `implementation` part. At least one unit must contain the other one in the `implementation` section.

Fatal: Can't compile unit arg1, no sources available
A unit was found that needs to be recompiled, but no sources are available.

Fatal: Can't find unit arg1 used by arg2
You tried to use a unit of which the PPU file isn't found by the compiler. Check your configuration file for the unit paths.

Warning: Unit arg1 was not found but arg2 exists
This error message is no longer used.

Fatal: Unit arg1 searched but arg2 found
DOS truncation of 8 letters for unit PPU files may lead to problems when unit name is longer than 8 letters.

Warning: Compiling the system unit requires the -Us switch
When recompiling the system unit (it needs special treatment), the `-Us` switch must be specified.

Fatal: There were arg1 errors compiling module, stopping
When the compiler encounters a fatal error or too many errors in a module then it stops with this message.

Load from arg1 (arg2) unit arg3
When you use the `-vu` flag, which unit is loaded from which unit is shown.

Recompiling arg1, checksum changed for arg2
The unit is recompiled because the checksum of a unit it depends on has changed.

Recompiling arg1, source found only
When you use the `-vu` flag, these messages tell you why the current unit is recompiled.

Recompiling unit, static lib is older than ppufile
When you use the `-vu` flag, the compiler warns if the static library of the unit is older than the unit file itself.

Recompiling unit, shared lib is older than ppufile
When you use the `-vu` flag, the compiler warns if the shared library of the unit is older than the unit file itself.

Recompiling unit, obj and asm are older than ppufile
When you use the `-vu` flag, the compiler warns if the assembler or object file of the unit is older than the unit file itself.

Recompiling unit, obj is older than asm
When you use the -vu flag, the compiler warns if the assembler file of the unit is older than the object file of the unit.

Parsing interface of arg1
When you use the -vu flag, the compiler warns that it starts parsing the interface part of the unit.

Parsing implementation of arg1
When you use the -vu flag, the compiler warns that it starts parsing the implementation part of the unit.

Second load for unit arg1
When you use the -vu flag, the compiler warns that it starts recompiling a unit for the second time. This can happen with interdependent units.

PPU Check file arg1 time arg2
When you use the -vu flag, the compiler shows the filename and date and time of the file on which a recompile depends.

Warning: Can't recompile unit arg1, but found modified include files
A unit was found to have modified include files, but some source files were not found, so recompilation is impossible.

File arg1 is newer than the one used for creating PPU file arg2
A modified source file for a compiler unit was found.

Trying to use a unit which was compiled with a different FPU mode
Trying to compile code while using units which were not compiled with the same floating point format mode. Either all code should be compiled with FPU emulation on, or with FPU emulation off.

Loading interface units from arg1
When you use the -vu flag, the compiler warns that it is starting to load the units defined in the interface part of the unit.

Loading implementation units from arg1
When you use the -vu flag, the compiler warns that it is starting to load the units defined in the implementation part of the unit.

Interface CRC changed for unit arg1
When you use the -vu flag, the compiler warns that the CRC calculated for the interface has been changed after the implementation has been parsed.

Implementation CRC changed for unit arg1
When you use the -vu flag, the compiler warns that the CRC calculated has been changed after the implementation has been parsed.

Finished compiling unit arg1
When you use the -vu flag, the compiler warns that it has finished compiling the unit.

Adding dependency: arg1 depends on arg2
When you use the -vu flag, the compiler warns that it has added a dependency between the two units.

No reload, is caller: arg1
When you use the -vu flag, the compiler warns that it will not reload the unit because it is the unit that wants to load this unit.

No reload, already in second compile: arg1
When you use the -vu flag, the compiler warns that it will not reload the unit because it is already in a second recompile.

Flag for reload: arg1
When you use the -vu flag, the compiler warns that it has to reload the unit.

Forced reloading
When you use the -vu flag, the compiler warns that it is reloading the unit because it was required.

Previous state of arg1: arg2
When you use the -vu flag, the compiler shows the previous state of the unit.

Already compiling arg1, setting second compile
When you use the -vu flag, the compiler warns that it is starting to recompile a unit for the second time. This can happen with interdependent units.

Loading unit arg1
When you use the -vu flag, the compiler warns that it starts loading the unit.

Finished loading unit arg1
When you use the -vu flag, the compiler warns that it finished loading the unit.

Registering new unit arg1
When you use the -vu flag, the compiler warns that it has found a new unit and is registering it in the internal lists.

Re-resolving unit arg1
When you use the -vu flag, the compiler warns that it has to recalculate the internal data of the unit.

Skipping re-resolving unit arg1, still loading used units
When you use the -vu flag, the compiler warns that it is skipping the recalculation of the internal data of the unit because there is no data to recalculate.

Unloading resource unit arg1 (not needed)
When you use the -vu flag, the compiler warns that it is unloading the resource handling unit, since no resources are used.

Error: Unit arg1 was compiled using a different whole program optimization feedback input (arg2, arg3); recompile it without wpo or use the same wpo feedback input file for this compilation invocation
When a unit has been compiled using a particular whole program optimization (wpo) feedback file (-FW<x> -OW<x>), this compiled version of the unit is specialised for that particular compilation scenario and cannot be used in any other context. It has to be recompiled before you can use it in another program or with another wpo feedback input file.

Indirect interface (objects/classes) CRC changed for unit arg1
When you use the -vu flag, the compiler warns that the indirect CRC calculated for the unit (this is the CRC of all classes/objects/interfaces/... in the interfaces of units directly or indirectly used by this unit in the interface) has been changed after the implementation has been parsed.

PPU is compiled for another i8086 memory model
This unit file was compiled for a different i8086 memory model and cannot be read.

Loading unit arg1 from package arg2
The unit is loaded from a package.

Fatal: Internal type "arg1" was not found. Check if you use the correct run time library.
The compiler expects that the runtime library contains certain types. If you see this error and you didn't change the runtime library code, it's very likely that the runtime library you're using doesn't match the compiler in use. If you changed the runtime library this error means that you removed a type which the compiler needs for internal use.

Fatal: Internal type "arg1" does not look as expected. Check if you use the correct run time library.
The compiler expects that the runtime library contains certain types. If you see this error and you didn't change the runtime library code, it's very likely that the runtime library you're using doesn't match the compiler in use. If you changed the runtime library this error means that you changed a type which the compiler needs for internal use and which needs to have a certain structure.

C.11 Command line handling errors

This section lists errors that occur when the compiler is processing the command line or handling the configuration files.

Warning: Only one source file supported, changing source file to compile from "arg1" into "arg2"
You can specify only one source file on the command line. The last one will be compiled, others will be ignored. This may indicate that you forgot a `'-'` sign.

Warning: DEF file can be created only for OS/2
This option can only be specified when you're compiling for OS/2.

Error: nested response files are not supported
You cannot nest response files with the `@file` command line option.

Fatal: No source file name in command line
The compiler expects a source file name on the command line.

Note: No option inside arg1 config file
The compiler didn't find any option in that config file.

Error: Illegal parameter: arg1
You specified an unknown option.

Hint: -? writes help pages
When an unknown option is given, this message is displayed.

Fatal: Too many config files nested
You can only nest up to 16 config files.

Fatal: Unable to open file arg1
The option file cannot be found.

Reading further options from arg1
Displayed when you have notes turned on, and the compiler switches to another options file.

Warning: Target is already set to: arg1
Displayed if more than one `-T` option is specified.

Warning: Shared libs not supported on DOS platform, reverting to static
If you specify `-CD` for the DOS platform, this message is displayed. The compiler supports only static libraries under DOS.

Fatal: In options file arg1 at line arg2 too many #IF(N)DEFs encountered
The `#IF(N)DEF` statements in the options file are not balanced with the `#ENDIF` statements.

Fatal: In options file arg1 at line arg2 unexpected #ENDIFs encountered
The `#IF(N)DEF` statements in the options file are not balanced with the `#ENDIF` statements.

Fatal: Open conditional at the end of the options file
The `#IF(N)DEF` statements in the options file are not balanced with the `#ENDIF` statements.

Warning: Debug information generation is not supported by this executable
It is possible to have a compiler executable that doesn't support the generation of debugging info. If you use such an executable with the `-g` switch, this warning will be displayed.

Hint: Try recompiling with -dGDB
It is possible to have a compiler executable that doesn't support the generation of debugging info. If you use such an executable with the `-g` switch, this warning will be displayed.

Warning: You are using the obsolete switch arg1
This warns you when you use a switch that is not needed/supported anymore. It is recommended that you remove the switch to overcome problems in the future, when the meaning of the switch may change.

Warning: You are using the obsolete switch arg1, please use arg2
This warns you when you use a switch that is not supported anymore. You must now use the second switch instead. It is recommended that you change the switch to overcome problems in the future, when the meaning of the switch may change.

Note: Switching assembler to default source writing assembler
This notifies you that the assembler has been changed because you used the -a switch, which cannot be used with a binary assembler writer.

Warning: Assembler output selected "arg1" is not compatible with "arg2"

Warning: "arg1" assembler use forced
The assembler output selected cannot generate object files with the correct format. Therefore, the default assembler for this target is used instead.

Reading options from file arg1
Options are also read from this file.

Reading options from environment arg1
Options are also read from this environment string.

Handling option "arg1"
Debug info that an option is found and will be handled.

***** press enter *****
Message shown when help is shown page per page. When pressing the ENTER Key, the next page of help is shown. If you press q and then ENTER, the compiler exits.

Hint: Start of reading config file arg1
Start of configuration file parsing.

Hint: End of reading config file arg1
End of configuration file parsing.

interpreting option "arg1"
The compiler is interpreting an option

interpreting firstpass option "arg1"
The compiler is interpreting an option for the first time.

interpreting file option "arg1"
The compiler is interpreting an option which it read from the configuration file.

Reading config file "arg1"
The compiler is starting to read the configuration file.

found source file name "arg1"
Additional information about options. Displayed when you have the debug option turned on.

Error: Unknown codepage "arg1"
An unknown codepage for the source files was requested. The compiler is compiled with support for several codepages built-in. The requested codepage is not in that list. You will need to recompile the compiler with support for the codepage you need.

Fatal: Config file arg1 is a directory
Directories cannot be used as configuration files.

Warning: Assembler output selected "arg1" cannot generate debug info, debugging disabled
The selected assembler output cannot generate debugging information, debugging option is therefore disabled.

Warning: Use of ppc386.cfg is deprecated, please use fpc.cfg instead
Using ppc386.cfg is still supported for historical reasons, however, for a multiplatform system the naming makes no sense anymore. Please continue to use fpc.cfg instead.

Fatal: In options file arg1 at line arg2 #ELSE directive without #IF(N)DEF found
An `#ELSE` statement was found in the options file without a matching `#IF(N)DEF` statement.

Fatal: Option "arg1" is not, or not yet, supported on the current target platform
Not all options are supported or implemented for all target platforms. This message informs you that a chosen option is incompatible with the currently selected target platform.

Fatal: The feature "arg1" is not, or not yet, supported on the selected target platform
Not all features are supported or implemented for all target platforms. This message informs you that a chosen feature is incompatible with the currently selected target platform.

Note: DWARF debug information cannot be used with smart linking on this target, switching to static linking
Smart linking is currently incompatible with DWARF debug information on most platforms, so smart linking is disabled in such cases.

Warning: Option "arg1" is ignored for the current target platform.
Not all options are supported or implemented for all target platforms. This message informs you that a chosen option is ignored for the currently selected target platform.

Warning: Disabling external debug information because it is unsupported for the selected target/debug format combination.
Not all debug formats can be stored in an external file on all platforms. In particular, on Mac OS X only DWARF debug information can be stored externally.

Note: DWARF debug information cannot be used with smart linking with external assembler, disabling static library creation.
Smart linking is currently incompatble with DWARF debug information on most platforms, so smart linking is disabled in such cases.

Error: Invalid value for MACOSX_DEPLOYMENT_TARGET environment variable: arg1

Error: Invalid value for IPHONEOS_DEPLOYMENT_TARGET environment variable: arg1
On Mac OS X, the MACOSX_DEPLOYMENT_TARGET/IPHONEOS_DEPLOYMENT_TARGET environment variable can be used to set the default target OS version. In case of Mac OS X, it has to be of the format XY.Z or XY.Z.AB with X, Y,Z , A and B all digits from 0-9. In case of iOS, it has to be X.Z.A, where X, Z and A can all be either 1 or 2 digits from 0-9.

Error: You must use a FPU type of VFPV2, VFPV3 or VFPV3_D16 when using the EABIHF ABI target
The EABIHF (VFP hardfloat) ABI target can only be used with VFP FPUs.

Warning: The selected debug format is not supported on the current target, not changing the current setting
Not all targets support all debug formats (in particular, Stabs is not supported on 64 bit targets).

Error: argument to "arg1" is missing
Displayed when parameter must be followed by an argument.

Error: malformed parameter: arg1
Given argument is not valid for parameter.

Warning: Smart linking requires external linker

Error: Creating .COM files is not supported in the current memory model. Only the tiny memory model supports making .COM files.
Do not enable experimental -gc option if -Ur option is given.

Warning: Experimental CheckPointer option not enabled because it is incomptatible with -Ur option.
The compiler binary only supports a single target architecture. Invoke the fpc binary if you wish to select a compiler binary for a different target architecture.

Error: Unsupported target architecture -Parg1, invoke the "fpc" compiler driver instead.
The ppc<target> executables support only a single target architecture. They do not support the -P switch. The compiler driver "fpc" handles this switch, so you have to invoke compiling by using "fpc" instead

Error: Feature switches are only supported while compiling the system unit.
To selected a certain feature, the system unit must be compiled with this feature enabled. All other units inherited the features set by the system unit through the ppu of the system unit.

Note: The selected debug format is not supported by the internal linker, switching to external linking

Error: You can't use both options (arg1) (arg2) at same time.

C.12 Whole program optimization messages

This section lists errors that occur when the compiler is performing whole program optimization.

Fatal: Cannot open whole program optimization feedback file "arg1"
The compiler cannot open the specified feedback file with whole program optimization information.

Processing whole program optimization information in wpo feedback file "arg1"
The compiler starts processing whole program optimization information found in the named file.

Finished processing the whole program optimization information in wpo feedback file "arg1"
The compiler has finished processing the whole program optimization information found in the named file.

Error: Expected section header, but got "arg2" at line arg1 of wpo feedback file
The compiler expected a section header in the whole program optimization file (starting with %), but did not find it.

Warning: No handler registered for whole program optimization section "arg2" at line arg1 of wpo feedback file, ignoring
The compiler has no handler to deal with the mentioned whole program optimization information section, and will therefore ignore it and skip to the next section.

Found whole program optimization section "arg1" with information about "arg2"
The compiler encountered a section with whole program optimization information, and according to its handler this section contains information usable for the mentioned purpose.

Fatal: The selected whole program optimizations require a previously generated feedback file (use -Fw to specify)
The compiler needs information gathered during a previous compilation run to perform the selected whole program optimizations. You can specify the location of the feedback file containing this information using the -Fw switch.

Error: No collected information necessary to perform "arg1" whole program optimization found
While you pointed the compiler to a file containing whole program optimization feedback, it did not contain the information necessary to perform the selected optimizations. You most likely have to recompile the program using the appropriate -OWxxx switch.

Fatal: Specify a whole program optimization feedback file to store the generated info in (using -FW)
You have to specify the feedback file in which the compiler has to store the whole program optimization feedback that is generated during the compilation run. This can be done using the -FW switch.

Error: Not generating any whole program optimization information, yet a feedback file was specified (using -FW)
The compiler was instructed to store whole program optimization feedback into a file specified using -FW, but not to actually generated any whole program optimization feedback. The classes of to be generated information can be specified using -OWxxx.

Error: Not performing any whole program optimizations, yet an input feedback file was specified (using -Fw)
The compiler was not instructed to perform any whole program optimizations (no -Owxxx parameters), but nevertheless an input file with such feedback was specified (using -Fwyyy). Since this can indicate that you forgot to specify an -Owxxx parameter, the compiler generates an error in this case.

Skipping whole program optimization section "arg1", because not needed by the requested optimizations
The whole program optimization feedback file contains a section with information that is not required by the selected whole program optimizations.

Warning: Overriding previously read information for "arg1" from feedback input file using information in section "arg2"
The feedback file contains multiple sections that provide the same class of information (e.g., information about which virtual methods can be devirtualized). In this case, the information in last encountered section is used. Turn on debugging output (-vd) to see which class of information is provided by each section.

Error: Cannot extract symbol liveness information from program when stripping symbols, use -Xs-
Certain symbol liveness collectors extract the symbol information from the linked program. If the symbol information is stripped (option -Xs), this is not possible.

Error: Cannot extract symbol liveness information from program when when not linking
Certain symbol liveness collectors extract the symbol information from the linked program. If the program is not linked by the compiler, this is not possible.

Fatal: Cannot find "arg1" or "arg2" to extract symbol liveness information from linked program
Certain symbol liveness collectors need a helper program to extract the symbol information from the linked program. This helper program is normally 'nm', which is part of the GNU binutils.

Error: Error during reading symbol liveness information produced by "arg1"
An error occurred during the reading of the symbol liveness file that was generated using the 'nm' or 'objdump' program. The reason can be that it was shorter than expected, or that its format was not understood.

Fatal: Error executing "arg1" (exitcode: arg2) to extract symbol information from linked program
Certain symbol liveness collectors need a helper program to extract the symbol information from the linked program. The helper program produced the reported error code when it was run on the linked program.

Error: Collection of symbol liveness information can only help when using smart linking, use -CX -XX
Whether or not a symbol is live is determined by looking whether it exists in the final linked program. Without smart linking/dead code stripping, all symbols are always included, regardless of whether they are actually used or not. So in that case all symbols will be seen as live, which makes this optimization ineffective.

Error: Cannot create specified whole program optimisation feedback file "arg1"
The compiler is unable to create the file specified using the -FW parameter to store the whole program optimisation information.

C.13 Package loading messages.

This section lists all messages that can occur when the compiler is loading a package from disk into memory, saving a package from memory to disk or when parsing packages in general. Many of these messages are informational messages.

Fatal: Can't find package arg1
You tried to use a package of which the PCP file isn't found by the compiler. Check your configuration file for the package paths.

PCP file for package arg1 found
The PCP file for the specified package was found.

Error: Duplicate package arg1
The package was already specified as required package and may not be specified a second time.

Error: Unit arg1 can not be part of a package
The unit can not be part of a package because the DenyPackageUnit directive is enabled for the unit.

Note: Unit arg1 is implicitely imported into package arg2
The unit was not specified as part of the `contains` section and is also not included in one of the required packages. Add the unit to the `contains` section to increase compatibility with other packages.

Fatal: Failed to create PCP file arg2 for package arg1
The PCP file for the package could not be created.

Fatal: Failed to read PCP file for package arg1
The PCP file for the package could not be read.

PCP loading arg1
When the `-vt` switch is used, the compiler tells you what packages it loads.

PCP Name: arg1
When you use the `-vu` flag, the package name is shown.

PCP Flags: arg1
When you use the `-vu` flag, the package flags are shown.

PCP Crc: arg1
When you use the `-vu` flag, the package CRC check is shown.

PCP Time: arg1
When you use the `-vu` flag, the time the package was compiled is shown.

PCP File too short
The PCP file is too short, not all declarations are present.

PCP Invalid Header (no PCP at the begin)
A package file contains as the first three bytes the ASCII codes of the characters `PCP`.

PCP Invalid Version arg1
This package file was compiled with a different version of the compiler, and cannot be read.

PCP is compiled for another processor
This package file was compiled for a different processor type, and cannot be read.

PCP is compiled for another target
This package file was compiled for a different target, and cannot be read.

Writing arg1
When you specify the `-vu` switch, the compiler will tell you where it writes the package file.

Fatal: Can't Write PCP-File
An error occurred when writing the package file.

Fatal: Error reading PCP-File
This means that the package file was corrupted, and contains invalid information. Recompilation will be necessary.

Fatal: unexpected end of PCP-File
Unexpected end of file. This may mean that the PCP file is corrupted.

Fatal: Invalid PCP-File entry: arg1
The unit the compiler is trying to read is corrupted, or generated with a newer version of the compiler.

Trying to use a unit which was compiled with a different FPU mode
Trying to compile code while using units which were not compiled with the same floating point format mode. Either all code should be compiled with FPU emulation on, or with FPU emulation off.

Packagesearch: arg1
When you use the `-vt` option, the compiler tells you where it tries to find package files.

Required package arg1
When you specify the `-vu` switch, the compiler will tell you which packages a package requires.

Contained unit arg1
When you specify the `-vu` switch, the compiler will tell you which units a package contains.

Error: Unit arg1 is already contained in package arg2
A unit specified in a contains sections must not be part of a required package. Note that a unit might have become part of another package by indirectly including it.

Warning: Unit arg1 is imported from indirectly required package arg2
If a unit from a package that is not part of the `requires` section is used then the package should require this unit directly to avoid confusion.

PPL filename arg1
The name of the binary package library that is stored in the PCP.

C.14 Assembler reader errors.

This section lists the errors that are generated by the inline assembler reader. They are *not* the messages of the assembler itself.

C.14.1 General assembler errors

Divide by zero in asm evaluator This fatal error is reported when a constant assembler expression performs a division by zero.

Evaluator stack overflow, Evaluator stack underflow These fatal error is reported when a constant assembler expression is too big to be evaluated by the constant parser. Try reducing the number of terms.

Invalid numeric format in asm evaluator This fatal error is reported when a non-numeric value is detected by the constant parser. Normally this error should never occur.

Invalid Operator in asm evaluator This fatal error is reported when a mathematical operator is detected by the constant parser. Normally this error should never occur.

Unknown error in asm evaluator This fatal error is reported when an internal error is detected by the constant parser. Normally this error should never occur.

Invalid numeric value This warning is emitted when a conversion from octal, binary or hexadecimal to decimal is outside of the supported range.

Escape sequence ignored This error is emitted when a non ANSI C escape sequence is detected in a C string.

Asm syntax error - Prefix not found This occurs when trying to use a non-valid prefix instruction.

Asm syntax error - Trying to add more than one prefix This occurs when you try to add more than one prefix instruction.

Asm syntax error - Opcode not found You have tried to use an unsupported or unknown opcode.

Constant value out of bounds This error is reported when the constant parser determines that the value you are using is out of bounds, either with the opcode or with the constant declaration used.

Non-label pattern contains @ This only applied to the m68k and Intel styled assembler. This is reported when you try to use a non-label identifier with an '@' prefix.

Internal error in Findtype()

Internal Error in ConcatOpcode()

Internal Errror converting binary

Internal Errror converting hexadecimal

Internal Errror converting octal

Internal Error in BuildScaling()

Internal Error in BuildConstant()

internal error in BuildReference()

internal error in HandleExtend()

Internal error in ConcatLabeledInstr() These errors should never occur. If they do then you have found a new bug in the assembler parsers. Please contact one of the developers.

Opcode not in table, operands not checked This warning only occurs when compiling the system unit, or related files. No checking is performed on the operands of the opcodes.

@CODE and @DATA not supported This Turbo Pascal construct is not supported.

SEG and OFFSET not supported This Turbo Pascal construct is not supported.

Modulo not supported Modulo constant operation is not supported.

Floating point binary representation ignored

Floating point hexadecimal representation ignored

Floating point octal representation ignored These warnings occur when a floating point constant is declared in a base other than decimal. No conversion can be done on these formats. You should use a decimal representation instead.

Identifier supposed external This warning occurs when a symbol is not found in the symbol table. It is therefore considered external.

Functions with void return value can't return any value in asm code Only routines with a return value can have a return value set.

Error in binary constant

Error in octal constant

Error in hexadecimal constant

Error in integer constant These errors are reported when you tried using a constant expression that is invalid or whose value is out of range.

Invalid labeled opcode

Asm syntax error - error in reference

Invalid Opcode

Invalid combination of opcode and operands

Invalid size in reference

Invalid middle sized operand

Invalid three operand opcode

Assembler syntax error

Invalid operand type You tried using an invalid combination of opcode and operands. Check the syntax and if you are sure it is correct, please contact one of the developers.

Unknown identifier The identifier you are trying to access does not exist, or is not within the current scope.

Trying to define an index register more than once

Trying to define a segment register twice

Trying to define a base register twice You are trying to define an index/segment register more than once.

Invalid field specifier The record or object field you are trying to access does not exist, or is incorrect.

Invalid scaling factor

Invalid scaling value

Scaling value only allowed with index Allowed scaling values are 1,2,4 or 8.

Cannot use SELF outside a method You are trying to access the SELF identifier for objects outside a method.

Invalid combination of prefix and opcode This opcode cannot be prefixed by this instruction.

Invalid combination of override and opcode This opcode cannot be overridden by this combination.

Too many operands on line At most three operand instructions exist on the m68k, and i386, you are probably trying to use an invalid syntax for this opcode.

Duplicate local symbol You are trying to redefine a local symbol, such as a local label.

Unknown label identifer

Undefined local symbol

local symbol not found inside asm statement This label does not seem to have been defined in the current scope.

Assemble node syntax error

Not a directive or local symbol The assembler statement is invalid, or you are not using a recognized directive.

C.14.2 I386 specific errors

repeat prefix and a segment override on <= i386 ... A problem with interrupts and a prefix instruction may occur and may cause false results on 386 and earlier computers.

Fwait can cause emulation problems with emu387 This warning is reported when using the FWAIT instruction. It can cause emulation problems on systems which use the em387.dxe emulator.

You need GNU as version >= 2.81 to compile this MMX code MMX assembler code can only be compiled using GAS v2.8.1 or later.

NEAR ignored

FAR ignored `NEAR` and `FAR` are ignored in the Intel assemblers, but are still accepted for compatibility with the 16-bit code model.

Invalid size for MOVSX/MOVZX

16-bit base in 32-bit segment

16-bit index in 32-bit segment 16-bit addressing is not supported. You must use 32-bit addressing.

Constant reference not allowed It is not allowed to try to address a constant memory address in protected mode.

Segment overrides not supported Intel style (eg: rep ds stosb) segment overrides are not supported by the assembler parser.

Expressions of the form [sreg:reg...] are currently not supported To access a memory operand in a different segment, you should use the sreg:[reg...] syntax instead of [sreg:reg...]

Size suffix and destination register do not match In intel AT&T syntax, you are using a register size which does not concord with the operand size specified.

Invalid assembler syntax. No ref with brackets

Trying to use a negative index register

Local symbols not allowed as references

Invalid operand in bracket expression

Invalid symbol name:

Invalid Reference syntax

Invalid string as opcode operand:

Null label references are not allowed

Using a defined name as a local label

Invalid constant symbol

Invalid constant expression

/ at beginning of line not allowed

NOR not supported

Invalid floating point register name

Invalid floating point constant:

Asm syntax error - Should start with bracket

Asm syntax error - register:

Asm syntax error - in opcode operand

Invalid String expression

Constant expression out of bounds

Invalid or missing opcode

Invalid real constant expression

Parenthesis are not allowed

Invalid Reference

Cannot use __SELF outside a method

Cannot use __OLDEBP outside a nested procedure

Invalid segment override expression

Strings not allowed as constants

Switching sections is not allowed in an assembler block

Invalid global definition

Line separator expected

Invalid local common definition

Invalid global common definition

assembler code not returned to text

invalid opcode size

Invalid character: <

Invalid character: >

Unsupported opcode

Invalid suffix for intel assembler

Extended not supported in this mode

Comp not supported in this mode

Invalid Operand:

Override operator not supported

C.14.3 m68k specific errors.

Increment and Decrement mode not allowed together You are trying to use dec/inc mode together.

Invalid Register list in movem/fmovem The register list is invalid. Normally a range of registers should be separated by - and individual registers should be separated by a slash.

Invalid Register list for opcode

68020+ mode required to assemble

Appendix D

Run-time errors

Applications generated by Free Pascal might generate run-time errors when certain abnormal conditions are detected in the application. This appendix lists the possible run-time errors and gives information on why they might be produced.

1 Invalid function number An invalid operating system call was attempted.

2 File not found Reported when trying to erase, rename or open a non-existent file.

3 Path not found Reported by the directory handling routines when a path does not exist or is invalid. Also reported when trying to access a non-existent file.

4 Too many open files The maximum number of files currently opened by your process has been reached. Certain operating systems limit the number of files which can be opened concurrently, and this error can occur when this limit has been reached.

5 File access denied Permission to access the file is denied. This error might be caused by one of several reasons:

- Trying to open for writing a file which is read-only, or which is actually a directory.
- File is currently locked or used by another process.
- Trying to create a new file, or directory while a file or directory of the same name already exists.
- Trying to read from a file which was opened in write-only mode.
- Trying to write from a file which was opened in read-only mode.
- Trying to remove a directory or file while it is not possible.
- No permission to access the file or directory.

6 Invalid file handle If this happens, the file variable you are using is trashed; it indicates that your memory is corrupted.

12 Invalid file access code Reported when a reset or rewrite is called with an invalid `FileMode` value.

15 Invalid drive number The number given to the `Getdir` or `ChDir` function specifies a non-existent disk.

16 Cannot remove current directory Reported when trying to remove the currently active directory.

17 Cannot rename across drives You cannot rename a file such that it would end up on another disk or partition.

100 Disk read error An error occurred when reading from disk. Typically happens when you try to read past the end of a file.

101 Disk write error Reported when the disk is full, and you're trying to write to it.

102 File not assigned This is reported by `Reset`, `Rewrite`, `Append`, `Rename` and `Erase`, if you call them with an unassigned file as a parameter.

103 File not open Reported by the following functions : `Close, Read, Write, Seek, EOf, FilePos, FileSize, Flush, BlockRead,` and `BlockWrite` if the file is not open.

104 File not open for input Reported by `Read, BlockRead, Eof, Eoln, SeekEof` or `SeekEoln` if the file is not opened with `Reset`.

105 File not open for output Reported by write if a text file isn't opened with `Rewrite`.

106 Invalid numeric format Reported when a non-numeric value is read from a text file, and a numeric value was expected.

107 Invalid enumeration Reported when a text representation of an enumerated constant cannot be created in a call to str or write(ln).

150 Disk is write-protected (Critical error)

151 Bad drive request struct length (Critical error)

152 Drive not ready (Critical error)

154 CRC error in data (Critical error)

156 Disk seek error (Critical error)

157 Unknown media type (Critical error)

158 Sector Not Found (Critical error)

159 Printer out of paper (Critical error)

160 Device write fault (Critical error)

161 Device read fault (Critical error)

162 Hardware failure (Critical error)

200 Division by zero The application attempted to divide a number by zero.

201 Range check error If you compiled your program with range checking on, then you can get this error in the following cases:

1. An array was accessed with an index outside its declared range.
2. Trying to assign a value to a variable outside its range (for instance an enumerated type).

202 Stack overflow error The stack has grown beyond its maximum size (in which case the size of local variables should be reduced to avoid this error), or the stack has become corrupt. This error is only reported when stack checking is enabled.

203 Heap overflow error The heap has grown beyond its boundaries. This is caused when trying to allocate memory explicitly with `New`, `GetMem` or `ReallocMem`, or when a class or object instance is created and no memory is left. Please note that, by default, Free Pascal provides a growing heap, i.e. the heap will try to allocate more memory if needed. However, if the heap has reached the maximum size allowed by the operating system or hardware, then you will get this error.

204 Invalid pointer operation You will get this in several cases:

- if you call `Dispose` or `Freemem` with an invalid pointer
- in case `New` or `GetMem` is called, and there is no more memory available. The behavior in this case depends on the setting of `ReturnNilIfGrowHeapFails`. If it is `True`, then `Nil` is returned. if `False`, then runerror 204 is raised.

205 Floating point overflow You are trying to use or produce real numbers that are too large.

206 Floating point underflow You are trying to use or produce real numbers that are too small.

207 Invalid floating point operation Can occur if you try to calculate the square root or logarithm of a negative number.

210 Object not initialized When compiled with range checking on, a program will report this error if you call a virtual method without having called its object's constructor.

211 Call to abstract method Your program tried to execute an abstract virtual method. Abstract methods should be overridden, and the overriding method should be called.

212 Stream registration error This occurs when an invalid type is registered in the objects unit.

213 Collection index out of range You are trying to access a collection item with an invalid index (`objects` unit).

214 Collection overflow error The collection has reached its maximal size, and you are trying to add another element (`objects` unit).

215 Arithmetic overflow error This error is reported when the result of an arithmetic operation is outside of its supported range. Contrary to Turbo Pascal, this error is only reported for 32-bit or 64-bit arithmetic overflows. This is due to the fact that everything is converted to 32-bit or 64-bit before doing the actual arithmetic operation.

216 General Protection fault The application tried to access invalid memory space. This can be caused by several problems:

1. Dereferencing a `nil` pointer.
2. Trying to access memory which is out of bounds (for example, calling `move` with an invalid length).

217 Unhandled exception occurred An exception occurred, and there was no exception handler present. The `sysutils` unit installs a default exception handler which catches all exceptions and exits gracefully.

218 Invalid value specified Error 218 occurs when an invalid value was specified to a system call, for instance when specifying a negative value to a seek() call.

219 Invalid typecast Thrown when an invalid typecast is attempted on a class using the `as` operator. This error is also thrown when an object or class is typecast to an invalid class or object and a virtual method of that class or object is called. This last error is only detected if the `-CR` compiler option is used.

222 Variant dispatch error No dispatch method to call from variant.

223 Variant array create The variant array creation failed. Usually when there is not enough memory.

224 Variant is not an array This error occurs when a variant array operation is attempted on a variant which is not an array.

225 Var Array Bounds check error This error occurs when a variant array index is out of bounds.

227 Assertion failed error An assertion failed, and no `AssertErrorProc` procedural variable was installed.

229 Safecall error check This error occurs is a safecall check fails, and no handler routine is available.

231 Exception stack corrupted This error occurs when the exception object is retrieved and none is available.

232 Threads not supported Thread management relies on a separate driver on some operating systems (notably, Unixes). The unit with this driver needs to be specified on the uses clause of the program, preferably as the first unit (cthreads on unix).

Appendix E

A sample gdb.ini file

Here you have a sample gdb.ini file listing, which gives better results when using `gdb`. Under LINUX you should put this in a .gdbinit file in your home directory or the current directory.

```
set print demangle off
set gnutarget auto
set verbose on
set complaints 1000
set language c++
set print vtbl on
set print object on
set print symbol-filename on
set print pretty on
disp /i $eip
```

The current versions of GDB understand sets and strings, in older versions it was not possible to print them.

Appendix F

Options and settings

In table (F.1) a summary of available boolean compiler directives and the corresponding command line options are listed. Other directives and the corresponding options are shown in table (F.2). For more information about the command-line options, see chapter 5, page 24. For more information about the directives, see the Programmer's Guide.

Table F.1: Boolean Options and directives

Short	long	Opt	Explanation
`$A[+/-]`	`$ALIGN[ON/OFF]`		Data alignment
`$B[+/-]`	`$BOOLEVAL[ON/OFF]`		Boolean evaluation mode
`$C[+/-]`	`$ASSERTIONS[ON/OFF]`	`-Sa`	Include assertions
`$D[+/-]`	`$DEBUGINFO[ON/OFF]`	`-g`	Include debug info
`$E[+/-]`			Coprocessor emulation
`$F[+/-]`			Far or near function (ignored)
`$G[+/-]`			Generate 80286 code (ignored)
	`$GOTO[ON/OFF]`	`-Sg`	Support `GOTO` and `Label`
	`$HINTS[ON/OFF]`	`-vh`	Show hints
`$H[+/-]`	`$LONGSTRINGS[ON/OFF]`	`-Sh`	Use ansistrings
`$I[+/-]`	`$IOCHECKS[ON/OFF]`	`-Ci`	Check I/O operation result
	`$INLINE[ON/OFF]`	`-Si`	Allow inline code
`$L[+/-]`	`$LOCALSYMBOLS[ON/OFF]`		Local symbol information
`$M[+/-]`	`$TYPEINFO[ON/OFF]`		Generate RTTI for classes
	`$MMX[ON/OFF]`		Intel MMX support
`$N[+/-]`			Floating point support
	`$NOTES[ON/OFF]`	`-vn`	Emit notes
`$O[+/-]`			Support overlays (ignored)
`$P[+/-]`	`$OPENSTRINGS[ON/OFF]`		Support open strings
`$Q[+/-]`	`$OVERFLOWCHECKS[ON/OFF]`	`-Co`	Overflow checking
`$R[+/-]`	`$RANGECHECKS[ON/OFF]`	`-Cr`	Range checks
`$S[+/-]`		`-Ct`	Stack checks
	`$SMARTLINK[ON/OFF]`	`-CX`	Use smartlinking
	`$STATIC[ON/OFF]`	`-St`	Allow use of `static`
`$T[+/-]`	`$TYPEDADDRESS[ON/OFF]`		Typed addresses

Table F.2: Options and directives

Short	long	Opt	Explanation
	$APPTYPE	-W	Application type (Win32/OS2)
	$ASMMODE	-R	Assembler reader mode
	$DEFINE	-d	Define symbol
	$DESCRIPTION		Set program description
	$ELSE		Conditional compilation switch
	$ENDIF		Conditional compilation end
	$FATAL		Report fatal error
	$HINT		Emit hint message
$I file	$INCLUDE		Include file or literal text
	$IF		Conditional compilation start
	$IFDEF NAME		Conditional compilation start
	$IFNDEF		Conditional compilation start
	$IFOPT		Conditional compilation start
	$INCLUDEPATH	-Fi	Set include path
	$INFO		Emit information message
$L file	$LINK		Link object file
	$LIBRARYPATH	-Fl	Set library path
	$LINKLIB name		Link library
$M MIN,MAX	$MEMORY		Set memory sizes
	$MACRO	-Sm	Allow use of macros
	$MESSAGE		Emit message
	$MODE		Set compatibility mode
	$NOTE		Emit note message
	$OBJECTPATH	-Fo	Set object path
	$OUTPUT	-A	Set output format
	$PACKENUM		Enumeration type size
	$PACKRECORDS		Record element alignment
	$SATURATION		Saturation (ignored)
	$STOP		Stop compilation
	$UNDEF	-u	Undefine symbol

Appendix G

Getting the latest sources or installers

Free Pascal is under continuous development. From time to time, a new set of installers with what are considered stable sources are made: these are the releases. They can be downloaded from the Free Pascal website. The downloads usually contain the sources from which the release is made.

If for some reason, a newer set of files is needed - for instance, because certain bugs that prevent a program from functioning correctly have been fixed, it is possible to download the latest source files and recompile them.

Note that the latest sources may or may not compile: sometimes things get broken, and then the downloaded sources are useless. For the fixes branches (mentioned below) the sources should always compile, so it may be best to use these only.

There are 3 ways to get the latest version.

G.1 Download via Subversion

All Free Pascal sources are in subversion, and can be downloaded anonymously from the Subversion server. With a suitable Subversion client, the following locations can be used:

```
http://svn.freepascal.org/svn/fpc/trunk/
```

This repository contains the latest sources of the compiler, RTL and packages. This is the active development branch.

The documentation and all examples from the documentation are in the following repository

```
http://svn.freepascal.org/svn/fpcdocs/trunk/
```

All the files needed to make a release can be retrieved from

```
http://svn.freepascal.org/svn/fpcbuild/trunk/
```

This repository contains external links to the other 2 repositories, and contains all scripts, demos and other files needed to construct a new release of Free Pascal.

Free Pascal maintains a fixes branch, which is used to create new releases after a major version change. The branches are located in

```
http://svn.freepascal.org/svn/fpc/branches/fpc_X_Y
```

Where X and Y make up the major release number of Free Pascal. For instance, the fixes used to make the 2.6.x versions of Free Pascal are available in

`http://svn.freepascal.org/svn/fpc/branches/fixes_2_6`

The Subversion archive is mirrored on the server

`svn2.freepascal.org`

G.2 Downloading a source zip

Every day, a zip is made which contains the sources as they are on this day, they are available from the FTP site:

`http://ftp.freepascal.org/develop.var`

This will lead to a download of the sources of the development branch:

`ftp://ftp.freepascal.org/pub/fpc/snapshot/trunk/source/fpc.zip`

and also of the fixes branch:

`ftp://ftp.freepascal.org/pub/fpc/snapshot/fixes/source/fpc.zip`

The creation of the zip files is an automated process, and so these files are created every day.

G.3 Downloading a snapshot

Some members of the Free Pascal team also maintain installable snapshots. These are installers, made with the sources of that day. Since the sources are not guaranteed to work, a snapshot of a certain day may not be available, or the person responsible for it didn't have the opportunity to make one: these snapshots may or may not be available. They can be downloaded from the same page as the daily source zip:

`http://ftp.freepascal.org/develop.var`

The snapshots are made for the development branch as well as for the fixes branch. They are available from

`ftp://ftp.freepascal.org/pub/fpc/snapshot/trunk/`

and

`ftp://ftp.freepascal.org/pub/fpc/snapshot/fixes/`

respectively.

The FTP site is mirrored, it may be faster to use a mirror.