DejaGnu
The GNU Testing Framework

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DejaGnu: The GNU Testing Framework
by Rob Savoye

1.4.1 Edition
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Abstract

This document attempts to describe the functionality of DejaGnu, the GNU Testing Framework. DejaGnu is entirely written in Expect, which uses Tcl as a command language. Expect serves as a very programmable shell; you can run any program, as with the usual Unix command shells—but once the program is started, your test script has fully programmable control of its input and output. This does not just apply to the programs under test; expect can also run any auxiliary program, such as diff or sh, with full control over its input and output.

DejaGnu itself is merely a framework for creation of a test suites. Test suites are distributed separately for each GNU tool.
Chapter 1. Overview

1.1. What is DejaGnu?

DejaGnu is a framework for testing other programs. Its purpose is to provide a single front end for all tests. Think of it as a custom library of Tcl procedures crafted to support writing a test harness. A Test Harness is the testing infrastructure that is created to support a specific program or tool. Each program can have multiple test suites, all supported by a single test harness. DejaGnu is written in Expect, which in turn uses Tcl – Tool command language. There is more information on Tcl at the Scriptics (http://www.scriptics.com) web site, and the Expect web site is at NIST (http://expect.nist.gov).

DejaGnu offers several advantages for testing:

- The flexibility and consistency of the DejaGnu framework make it easy to write tests for any program, with either batch oriented, or interactive programs.
- DejaGnu provides a layer of abstraction which allows you to write tests that are portable to any host or target where a program must be tested. For instance, a test for GDB can run (from any Unix based host) on any target architecture that DejaGnu supports. Currently DejaGnu runs tests on many single board computers, whose operating software ranges from just a boot monitor to a full-fledged, Unix-like realtime OS.
- All tests have the same output format. This makes it easy to integrate testing into other software development processes. DejaGnu’s output is designed to be parsed by other filtering script, and it is also human readable.
- Using Tcl and expect, it's easy to create wrappers for existing test suites. By incorporating existing tests under DejaGnu, it’s easier to have a single set of report analyse programs.

Running tests requires two things: the testing framework, and the test suites themselves. Tests are usually written in Expect using Tcl, but you can also use a Tcl script to run a test suite that is not based on Expect. (expect script filenames
conventionally use .exp as a suffix; for example, the main implementation of the DejaGnu test driver is in the file runtest.exp.)

Julia Menapace first coined the term “Deja Gnu” to describe an earlier testing framework at Cygnus Support she had written for GDB. When we replaced it with the Expect-based framework, it was like DejaGnu all over again... But more importantly, it was also named after my daughter, Deja Snow Savoye (mailto:deja@welcomehome.org) (now 9 years old in Dec of 1998), who was a toddler during DejaGnu’s creation.

1.2. What’s New In This Release

This release has a number of substantial changes over version 1.3. The most visible change is that the version of Expect and Tcl included in the release are up-to-date with the current stable net releases. The biggest change is years of modifications to the target configuration system, used for cross testing. While this greatly improved cross testing, has made that subsystem very complicated. The goal is to have this entirely rewritten using iTcl by the next release. Other changes are:

• More builtin support for building target binaries with the correct linker flags. Currently this only works with GCC as the cross compiler, preferably with a target supported by Libgloss.
• Lots of little bug fixes from years of heavy use at Cygnus Solutions.
• DejaGnu now uses Automake for Makefile configuration.
• Updated documentation, now in SGML (using the free GNU DocBook tools (http://nis-www.lanl.gov/~rosalia/mydocs/docbook-intro.html)) format.
• NT support. There is beta level support for NT that is still a work in progress. This requires the Cygwin (http://sources.redhat.com) POSIX system for NT.
1.2.1. NT Support

To use DejaGnu on NT, you need to first install the Cygwin (http://sources.redhat.com/cygwin) release. This works as of the B20.1 release. Cygwin is a POSIX system for NT. This covers both utility programs, and a library that adds POSIX system calls to NT. Among them is pseudo tty support for NT that emulates the POSIX pty standard. The latest Cygwin is always available from this location (http://sources.redhat.com/cygwin). This works well enough to run "make check" of the GNU development tree on NT after a native build. But the nature of pty's on NT is still evolving. Your mileage may vary...

1.3. Design Goals

DejaGnu grew out of the internal needs of Cygnus Solutions. (then Cygnus Support). Cygnus maintained and enhanced a variety of free programs in many different environments, and we needed a testing tool that:

- was useful to developers while fixing bugs.
- automated running many tests during a software release process.
- was portable among a variety of host computers.
- supported cross-development testing.
- permitted testing interactive programs, like GDB; and
- permitted testing batch oriented programs, like GCC.

Some of the requirements proved challenging. For example, interactive programs do not lend themselves very well to automated testing. But all the requirements are important: for instance, it is imperative to make sure that GDB works as well when cross-debugging as it does in a native configuration.

Probably the greatest challenge was testing in a cross-development environment (which can be a real nightmare). Most cross-development environments are customized by
Chapter 1. Overview

each developer. Even when buying packaged boards from vendors there are many differences. The communication interfaces vary from a serial line to ethernet. DejaGnu was designed with a modular communication setup, so that each kind of communication can be added as required, and supported thereafter. Once a communication procedure is coded, any test can use it. Currently DejaGnu can use rsh, rlogin, telnet, tip, kermit, and mondfe for remote communications.

1.4. A POSIX conforming test framework

DejaGnu conforms to the POSIX 1003.3 standard for test frameworks. I was also a member of that committee.

The POSIX standard 1003.3 defines what a testing framework needs to provide, in order to permit the creation of POSIX conformance test suites. This standard is primarily oriented to running POSIX conformance tests, but its requirements also support testing of features not related to POSIX conformance. POSIX 1003.3 does not specify a particular testing framework, but at this time there is only one other POSIX conforming test framework: TET. TET was created by Unisoft for a consortium comprised of X/Open, Unix International, and the Open Software Foundation.

The POSIX documentation refers to assertions. An assertion is a description of behavior. For example, if a standard says “The sun shall shine”, a corresponding assertion might be “The sun is shining.” A test based on this assertion would pass or fail depending on whether it is daytime or nighttime. It is important to note that the standard being tested is never 1003.3; the standard being tested is some other standard, for which the assertions were written.

As there is no test suite to test testing frameworks for POSIX 1003.3 conformance, verifying conformance to this standard is done by repeatedly reading the standard and experimenting. One of the main things 1003.3 does specify is the set of allowed output messages, and their definitions. Four messages are supported for a required feature of POSIX conforming systems, and a fifth for a conditional feature. DejaGnu supports the use of all five output messages; in this sense a test suite that uses exactly these messages can be considered POSIX conforming. These definitions specify the output of
a test case:

PASS

A test has succeeded. That is, it demonstrated that the assertion is true.

XFAIL

POSIX 1003.3 does not incorporate the notion of expected failures, so PASS, instead of XPASS, must also be returned for test cases which were expected to fail and did not. This means that PASS is in some sense more ambiguous than if XPASS is also used.

FAIL

A test has produced the bug it was intended to capture. That is, it has demonstrated that the assertion is false. The FAIL message is based on the test case only. Other messages are used to indicate a failure of the framework. As with PASS, POSIX tests must return FAIL rather than XFAIL even if a failure was expected.

UNRESOLVED

A test produced indeterminate results. Usually, this means the test executed in an unexpected fashion; this outcome requires that a human being go over results, to determine if the test should have passed or failed. This message is also used for any test that requires human intervention because it is beyond the abilities of the testing framework. Any unresolved test should resolved to PASS or FAIL before a test run can be considered finished.

Note that for POSIX, each assertion must produce a test result code. If the test isn’t actually run, it must produce UNRESOLVED rather than just leaving that test out of the output. This means that you have to be careful when writing tests, to not carelessly use tcl statements like return—if you alter the flow of control of the tcl code you must insure that every test still produces some result code.

Here are some of the ways a test may wind up UNRESOLVED:
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- A test’s execution is interrupted.
- A test does not produce a clear result. This is usually because there was an ERROR from DejaGnu while processing the test, or because there were three or more WARNING messages. Any WARNING or ERROR messages can invalidate the output of the test. This usually requires a human being to examine the output to determine what really happened—and to improve the test case.
- A test depends on a previous test, which fails.
- The test was set up incorrectly.

UNTESTED

A test was not run. This is a placeholder, used when there is no real test case yet. The only remaining output message left is intended to test features that are specified by the applicable POSIX standard as conditional:

UN SUPPORTED

There is no support for the tested case. This may mean that a conditional feature of an operating system, or of a compiler, is not implemented. DejaGnu also uses this message when a testing environment (often a “bare board” target) lacks basic support for compiling or running the test case. For example, a test for the system subroutine gethostname would never work on a target board running only a boot monitor.

DejaGnu uses the same output procedures to produce these messages for all test suites, and these procedures are already known to conform to POSIX 1003.3. For a DejaGnu test suite to conform to POSIX 1003.3, you must avoid the setupxfail} procedure as described in the PASS section above, and you must be careful to return UNRESOLVED where appropriate, as described in the UNRESOLVED section above.
Chapter 2. Running Tests

There are two ways to execute a test suite. The most common way is when there is existing support in the Makefile. This support consists of a check target. The other way is to execute the runtest program directly. To run runtest directly from the command line requires either all the correct options, or the Local Config File must be setup correctly.

2.1. Make check

To run tests from an existing collection, first use configure as usual to set up the build directory. Then try typing:

    make check

If the check target exists, it usually saves you some trouble. For instance, it can set up any auxiliary programs or other files needed by the tests. The most common file the check builds is the site.exp. The site.exp file contains various variables that DejaGnu used to determine the configuration of the program being tested. This is mostly for supporting remote testing.

The check target is supported by GNU Automake. To have DejaGnu support added to your generated Makefile.in, just add the keyword dejagnu to the AUTOMAKE_OPTIONS variable in your Makefile.am file.

Once you have run make check to build any auxiliary files, you can invoke the test driver runtest directly to repeat the tests. You will also have to execute runtest directly for test collections with no check target in the Makefile.
2.2. Runtest

runtest is the executable test driver for DejaGnu. You can specify two kinds of things on the runtest command line: command line options, and Tcl variables for the test scripts. The options are listed alphabetically below.

runtest returns an exit code of 1 if any test has an unexpected result; otherwise (if all tests pass or fail as expected) it returns 0 as the exit code.

2.2.1. Output States

runtest flags the outcome of each test as one of these cases. A POSIX Conforming Test Framework for a discussion of how POSIX specifies the meanings of these cases.

PASS
The most desirable outcome: the test succeeded, and was expected to succeed.

XPASS
A pleasant kind of failure: a test was expected to fail, but succeeded. This may indicate progress; inspect the test case to determine whether you should amend it to stop expecting failure.

FAIL
A test failed, although it was expected to succeed. This may indicate regress; inspect the test case and the failing software to locate the bug.

XFAIL
A test failed, but it was expected to fail. This result indicates no change in a known bug. If a test fails because the operating system where the test runs lacks some facility required by the test, the outcome is UNSUPPORTED instead.

UNRESOLVED
Output from a test requires manual inspection; the test suite could not
automatically determine the outcome. For example, your tests can report this outcome is when a test does not complete as expected.

**UNTESTED**

A test case is not yet complete, and in particular cannot yet produce a PASS or FAIL. You can also use this outcome in dummy “tests” that note explicitly the absence of a real test case for a particular property.

**UN_SUPPORTED**

A test depends on a conditionally available feature that does not exist (in the configured testing environment). For example, you can use this outcome to report on a test case that does not work on a particular target because its operating system support does not include a required subroutine.

runtest may also display the following messages:

**ERROR**

Indicates a major problem (detected by the test case itself) in running the test. This is usually an unrecoverable error, such as a missing file or loss of communication to the target. (POSIX test suites should not emit this message; use **UNSUPPORTED**, **UNTESTED**, or **UNRESOLVED** instead, as appropriate.)

**WARNING**

Indicates a possible problem in running the test. Usually warnings correspond to recoverable errors, or display an important message about the following tests.

**NOTE**

An informational message about the test case.

### 2.2.2. Invoking Runtest

This is the full set of command line options that runtest recognizes. Arguments may
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be abbreviated to the shortest unique string.

-all (-a)
Display all test output. By default, runtest shows only the output of tests that produce unexpected results; that is, tests with status \texttt{FAIL} (unexpected failure), \texttt{XPASS} (unexpected success), or \texttt{ERROR} (a severe error in the test case itself). Specify \texttt{-all} to see output for tests with status \texttt{PASS} (success, as expected) \texttt{XFAIL} (failure, as expected), or \texttt{WARNING} (minor error in the test case itself).

-build [string]
\texttt{string} is a full configuration “triple” name as used by \texttt{configure}. This is the type of machine DejaGnu and the tools to be tested are built on. For a normal cross this is the same as the host, but for a Canadian cross, they are separate.

-host [string]
\texttt{string} is a full configuration “triple” name as used by \texttt{configure}. Use this option to override the default string recorded by your configuration’s choice of host. This choice does not change how anything is actually configured unless \texttt{-build} is also specified; it affects only DejaGnu procedures that compare the host string with particular values. The procedures \texttt{ishost}, \texttt{istarget}, \texttt{isnative}, and \texttt{setupxfail} are affected by \texttt{-host}. In this usage, \texttt{host} refers to the machine that the tests are to be run on, which may not be the same as the \texttt{build} machine. If \texttt{-build} is also specified, then \texttt{-host} refers to the machine that the tests will be run on, not the machine DejaGnu is run on.

-host_board [name]
The host board to use.

-target [string]
Use this option to override the default setting (running native tests). \texttt{string} is a full configuration “triple” name of the form \texttt{cpu-vendor-os} as used by \texttt{configure}. This option changes the configuration runtest uses for the default tool names, and other setup information.
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- **debug (-de)**
  
  Turns on the `expect` internal debugging output. Debugging output is displayed as part of the `runtest` output, and logged to a file called `dbg.log`. The extra debugging output does *not* appear on standard output, unless the verbose level is greater than 2 (for instance, to see debug output immediately, specify `-debug-v` `-v`). The debugging output shows all attempts at matching the test output of the tool with the scripted patterns describing expected output. The output generated with `-strace` also goes into `dbg.log`.

- **help (-he)**
  
  Prints out a short summary of the `runtest` options, then exits (even if you also specify other options).

- **ignore [name(s)]**
  
  The names of specific tests to ignore.

- **objdir [path]**
  
  Use `path` as the top directory containing any auxiliary compiled test code. This defaults to `..`. Use this option to locate pre-compiled test code. You can normally prepare any auxiliary files needed with `make`.

- **outdir [path]**
  
  Write output logs in directory `path`. The default is `./`, the directory where you start `runtest`. This option affects only the summary and the detailed log files `tool.sum` and `tool.log`. The DejaGnu debug log `dbg.log` always appears (when requested) in the local directory.

- **reboot [name]**
  
  Reboot the target board when `runtest` initializes. Usually, when running tests on a separate target board, it is safer to reboot the target to be certain of its state. However, when developing test scripts, rebooting takes a lot of time.
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-srcdir [path]
Use path as the top directory for test scripts to run. runtest looks in this directory for any subdirectory whose name begins with the toolname (specified with –tool). For instance, with –tool gdb, runtest uses tests in subdirectories gdb.* (with the usual shell-like filename expansion). If you do not use –srcdir, runtest looks for test directories under the current working directory.

-strace [number]
Turn on internal tracing for expect, to n levels deep. By adjusting the level, you can control the extent to which your output expands multi-level Tcl statements. This allows you to ignore some levels of case or if statements. Each procedure call or control structure counts as one “level”. The output is recorded in the same file, dbg.log, used for output from –debug.

-connect [program]
Connect to a target testing environment as specified by type, if the target is not the computer running runtest. For example, use –connect to change the program used to connect to a “bare board” boot monitor. The choices for type in the DejaGnu 1.4 distribution are rlogin, telnet, rsh, tip, kermit, and mondfe.

The default for this option depends on the configuration most convenient communication method available, but often other alternatives work as well; you may find it useful to try alternative connect methods if you suspect a communication problem with your testing target.

-baud [number]
Set the default baud rate to something other than 9600. (Some serial interface programs, like tip, use a separate initialization file instead of this value.)

-target_board [name(s)]
The list of target boards to run tests on.
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(tool[name(s)])

Specifies which test suite to run, and what initialization module to use. -tool is used only for these two purposes. It is not used to name the executable program to test. Executable tool names (and paths) are recorded in site.exp and you can override them by specifying Tcl variables on the command line.

For example, including "-tool gcc" on the runtest command line runs tests from all test subdirectories whose names match gcc.*, and uses one of the initialization modules named config/*/gcc.exp. To specify the name of the compiler (perhaps as an alternative path to what runtest would use by default), use GCC=binname on the runtest command line.

(tool_exec [name])

The path to the tool executable to test.

(tool_opts [options])

A list of additional options to pass to the tool.

(verbatim (-v))

Turns on more output. Repeating this option increases the amount of output displayed. Level one (-v) is simply test output. Level two (-v-v) shows messages on options, configuration, and process control. Verbose messages appear in the detailed (*.log) log file, but not in the summary (*.sum) log file.

(version (-V))

Prints out the version numbers of DejaGnu, expect and Tcl, and exits without running any tests.

(D[0-1])

Start the internal Tcl debugger. The Tcl debugger supports breakpoints, single stepping, and other common debugging activities. See the document "Debugger for Tcl Applications" by Don Libes. (Distributed in PostScript form with expect as the file expect/tcl-debug.ps.) If you specify -D1, the expect shell stops at a
breakpoint as soon as DejaGnu invokes it. If you specify -D0, DejaGnu starts as usual, but you can enter the debugger by sending an interrupt (e.g. by typing C-c).

**testfile.exp[=arg(s)]**

Specify the names of testsuites to run. By default, runtest runs all tests for the tool, but you can restrict it to particular testsuites by giving the names of the .exp expect scripts that control them. testsuite.exp may not include path information; use plain filenames.

**testfile.exp="testfile1 ..."**

Specify a subset of tests in a suite to run. For compiler or assembler tests, which often use a single .exp script covering many different source files, this option allows you to further restrict the tests by listing particular source files to compile. Some tools even support wildcards here. The wildcards supported depend upon the tool, but typically they are ?, *, and [chars].

**tclvar=value**

You can define Tcl variables for use by your test scripts in the same style used with make for environment variables. For example, runtest GDB=gdb.old defines a variable called GDB; when your scripts refer to $GDB in this run, they use the value gdb.old.

The default Tcl variables used for most tools are defined in the main DejaGnu Makefile; their values are captured in the site.exp file.

### 2.2.3. Common Options

Typically, you don’t need must to use any command-line options. -tool used is only required when there are more than one test suite in the same directory. The default options are in the local site.exp file, created by "make site.exp".

For example, if the directory gdb/testsuite contains a collection of DejaGnu tests for GDB, you can run them like this:
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```
eg$ cd gdb/testsuite
eg$ runtest -tool gdb

Test output follows, ending with:

=== gdb Summary ===

# of expected passes 508
# of expected failures 103
/usr/latest/bin/gdb version 4.14.4 -nx

You can use the option –srcdir to point to some other directory containing a collection of tests:

```
eg$ runtest-srcdir /devo/gdb/testsuite

By default, runtest prints only the names of the tests it runs, output from any tests that have unexpected results, and a summary showing how many tests passed and how many failed. To display output from all tests (whether or not they behave as expected), use the –all option. For more verbose output about processes being run, communication, and so on, use –verbose. To see even more output, use multiple –verbose options. For a more detailed explanation of each runtest option.

Test output goes into two files in your current directory: summary output in tool.sum, and detailed output in tool.log. (tool refers to the collection of tests; for example, after a run with –tool gdb, look for output files gdb.sum and gdb.log.)

2.3. The files DejaGnu produces.

DejaGnu always writes two kinds of output files: summary logs and detailed logs. The contents of both of these are determined by your tests.

For troubleshooting, a third kind of output file is useful: use –debug to request an output file showing details of what Expect is doing internally.
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2.3.1. Summary File

DejaGnu always produces a summary output file tool.sum. This summary shows the names of all test files run; for each test file, one line of output from each pass command (showing status PASS or XPASS) or fail command (status FAIL or XFAIL); trailing summary statistics that count passing and failing tests (expected and unexpected); and the full pathname and version number of the tool tested. (All possible outcomes, and all errors, are always reflected in the summary output file, regardless of whether or not you specify -all.)

If any of your tests use the procedures unresolved, unsupported, or runtested, the summary output also tabulates the corresponding outcomes.

For example, after runtest –tool binutils, look for a summary log in binutils.sum. Normally, DejaGnu writes this file in your current working directory; use the -outdir option to select a different directory.

Example 2-1. Here is a short sample summary log

Test Run By rob on Mon May 25 21:40:57 PDT 1992
=== gdb tests ===
Running ./gdb.t00/echo.exp ...
PASS: Echo test
Running ./gdb.all/help.exp ...
PASS: help add-symbol-file
PASS: help aliases
PASS: help breakpoint "bre" abbreviation
FAIL: help run "r" abbreviation
Running ./gdb.t10/crossload.exp ...
PASS: m68k-elf (elf-big) explicit format; loaded
XFAIL: mips-ecoff (ecoff-bigmips) "ptype v_signed_char" signed C types
=== gdb Summary ===
# of expected passes 5
# of expected failures 1
# of unexpected failures 1
/usr/latest/bin/gdb version 4.6.5 -q
2.3.2. Log File

DejaGnu also saves a detailed log file tool.log, showing any output generated by tests as well as the summary output. For example, after runtest –tool binutils, look for a detailed log in binutils.log. Normally, DejaGnu writes this file in your current working directory; use the -outdir option to select a different directory.

Example 2-2. Here is a brief example showing a detailed log for G++ tests

Test Run By rob on Mon May 25 21:40:43 PDT 1992

=== g++ tests ===

-- Running ./g++.other/t01-1.exp --
PASS:  operate delete

-- Running ./g++.other/t01-2.exp --
FAIL:  i960 bug EOF
p0000646.C: In function ‘int warn_return_1 ()’:  
p0000646.C:109: warning: control reaches end of non-void function
p0000646.C: In function ‘int warn_return_arg (int)’:  
p0000646.C:117: warning: control reaches end of non-void function
p0000646.C: In function ‘int warn_return_sum (int, int)’:  
p0000646.C:125: warning: control reaches end of non-void function
p0000646.C: In function ‘struct foo warn_return_foo ()’:  
p0000646.C:132: warning: control reaches end of non-void function

-- Running ./g++.other/t01-4.exp --
FAIL:  abort
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900403_04.C:8: zero width for bit-field ‘foo’
-- Running ./g++.other/t01-3.exp --
   FAIL: segment violation
900519_12.C:9: parse error before ‘;’
900519_12.C:12: Segmentation violation
/usr/latest/bin/gcc: Internal compiler error: program cclplus got fatal signal

   === g++ Summary ===

# of expected passes 1
# of expected failures 3
/usr/latest/bin/g++ version cygnus-2.0.1

2.3.3. Debug Log File

With the -debug option, you can request a log file showing the output from Expect itself, running in debugging mode. This file (dbg.log, in the directory where you start runtest) shows each pattern Expect considers in analyzing test output.

This file reflects each send command, showing the string sent as input to the tool under test; and each Expect command, showing each pattern it compares with the tool output.

Example 2-3. The log messages begin with a message of the form

expect: does {tool output} (spawn_id n)
   match pattern {expected pattern}?

For every unsuccessful match, Expect issues a no after this message; if other patterns are specified for the same Expect command, they are reflected also, but without the first part of the message (expect... match pattern).
When Expect finds a match, the log for the successful match ends with yes, followed by a record of the Expect variables set to describe a successful match.

**Example 2-4. Here is an excerpt from the debugging log for a GDB test:**

```plaintext
send: sent {break gdbme.c:34\n} to spawn id 6
expect: does {} (spawn_id 6) match pattern {Breakpoint.*at.* file gdbme.c, line 34.*\(gdb\) $}? no
{.*(gdb)$}? no
expect: does {} (spawn_id 0) match pattern {return} ? no
{(y or n)}? no
{buffer_full}? no
{virtual}? no
{memory}? no
{exhausted}? no
{Undefined}? no
{command}? no
break gdbme.c:34
Breakpoint 8 at 0x23d8: file gdbme.c, line 34.
(gdb) expect: does {break gdbme.c:34\nBreakpoint 8 at 0x23d8: file gdbme.c, line 34.\n(gdb) } (spawn_id 6) match pattern {Breakpoint.*at.* file gdbme.c, line 34.*\(gdb\) $}? yes
expect: set expect_out(0,start) {18}
expect: set expect_out(0,end) {71}
extpect: set expect_out(0,string) {Breakpoint 8 at 0x23d8: file gdbme.c, line 34.\n\n(gdb) }
extpect: set expect_out(spawn_id) {6}
extpect: set expect_out(buffer) {break gdbme.c:34\nBreakpoint 8 at 0x23d8: file gdbme.c, line 34.\n\n(gdb) }
PASS: 70 0 breakpoint line number in file
```

This example exhibits three properties of Expect and DejaGnu that might be surprising at first glance:
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• Empty output for the first attempted match. The first set of attempted matches shown ran against the output `{}` — that is, no output. Expect begins attempting to match the patterns supplied immediately; often, the first pass is against incomplete output (or completely before all output, as in this case).

• Interspersed tool output. The beginning of the log entry for the second attempted match may be hard to spot: this is because the prompt `{(gdb) }` appears on the same line, just before the `expect`: that marks the beginning of the log entry.

• Fail-safe patterns. Many of the patterns tested are fail-safe patterns provided by GDB testing utilities, to reduce possible indeterminacy. It is useful to anticipate potential variations caused by extreme system conditions (GDB might issue the message `virtual memory exhausted` in rare circumstances), or by changes in the tested program (`Undefined command` is the likeliest outcome if the name of a tested command changes).

   The pattern `{return}` is a particularly interesting fail-safe to notice: it checks for an unexpected `RET` prompt. This may happen, for example, if the tested tool can filter output through a pager.

   These fail-safe patterns (like the debugging log itself) are primarily useful while developing test scripts. Use the `error` procedure to make the actions for fail-safe patterns produce messages starting with `ERROR` on standard output, and in the detailed log file.
Chapter 3. Customizing DejaGnu

The site configuration file, site.exp, captures configuration-dependent values and propagates them to the DejaGnu test environment using Tcl variables. This ties the DejaGnu test scripts into the configure and make programs. If this file is setup correctly, it is possible to execute a test suite merely by typing runtest.

DejaGnu supports two site.exp files. The multiple instances of site.exp are loaded in a fixed order built into DejaGnu. The first file loaded is the local file site.exp, and then the optional global site.exp file as pointed to by the DEJAGNU environment variable.

There is an optional master site.exp, capturing configuration values that apply to DejaGnu across the board, in each configuration-specific subdirectory of the DejaGnu library directory. runtest loads these values first. The master site.exp contains the default values for all targets and hosts supported by DejaGnu. This master file is identified by setting the environment variable DEJAGNU to the name of the file. This is also referred to as the “global” config file.

Any directory containing a configured test suite also has a local site.exp, capturing configuration values specific to the tool under test. Since runtest loads these values last, the individual test configuration can either rely on and use, or override, any of the global values from the global site.exp file.

You can usually generate or update the testsuite’s local site.exp by typing make site.exp in the test suite directory, after the test suite is configured.

You can also have a file in your home directory called .dejagnurc. This gets loaded first before the other config files. Usually this is used for personal stuff, like setting the all_flag so all the output gets printed, or your own verbosity levels. This file is usually restricted to setting command line options.

You can further override the default values in a user-editable section of any site.exp, or by setting variables on the runtest command line.
Chapter 3. Customizing DejaGnu

3.1. Local Config File

It is usually more convenient to keep these manual overrides in the site.exp local to each test directory, rather than in the global site.exp in the installed DejaGnu library. This file is mostly for supplying tool specific info that is required by the test suite.

All local site.exp files have two sections, separated by comment text. The first section is the part that is generated by make. It is essentially a collection of Tcl variable definitions based on Makefile environment variables. Since they are generated by make, they contain the values as specified by configure. (You can also customize these values by using the -site option to configure.) In particular, this section contains the Makefile variables for host and target configuration data. Do not edit this first section; if you do, your changes are replaced next time you run make.

Example 3-1. The first section starts with

```plaintext
## these variables are automatically generated by make ##
# Do not edit here. If you wish to override these values
# add them to the last section
```

In the second section, you can override any default values (locally to DejaGnu) for all the variables. The second section can also contain your preferred defaults for all the command line options to runtest. This allows you to easily customize runtest for your preferences in each configured test-suite tree, so that you need not type options repeatedly on the command line. (The second section may also be empty, if you do not wish to override any defaults.)

Example 3-2. The first section ends with this line

```plaintext
## All variables above are generated by configure. Do Not Edit ##
```

You can make any changes under this line. If you wish to redefine a variable in the top section, then just put a duplicate value in this second section. Usually the values defined in this config file are related to the configuration of the test run. This is the ideal
place to set the variables host_triplet, build_triplet, target_triplet. All other variables are

tool dependant. ie for testing a compiler, the value for CC might be set to a freshly built
binary, as opposed to one in the user’s path.

Here’s an example local site.exp file, as used for GCC/G++ testing.

Example 3-3. Local Config File

```tcl
## these variables are automatically generated by make ##
# Do not edit here. If you wish to override these values
# add them to the last section
set rootme "/build/devo-builds/i586-pc-linux-gnulibc1/gcc"
set host_triplet i586-pc-linux-gnulibc1
set build_triplet i586-pc-linux-gnulibc1
set target_triplet i586-pc-linux-gnulibc1
set target_alias i586-pc-linux-gnulibc1
set CFLAGS ""
append LDFLAGS " -L/build/devo-builds/i586-pc-linux-gnulibc1/gcc/../../ld"
set tmpdir /build/devo-builds/i586-pc-linux-gnulibc1/gcc/testsuite
set srcdir "${srcdir}/testsuite"
## All variables above are generated by configure. Do Not Edit ##
```

This file defines the required fields for a local config file, namely the three config

triplets, and the srcdir. It also defines several other Tcl variables that are used exclusively

by the GCC test suite. For most test cases, the CXXFLAGS and LDFLAGS are
supplied by DejaGnu itself for cross testing, but to test a compiler, GCC needs to manipulate these itself.

3.2. Global Config File

The master config file is where all the target specific config variables get set for a whole site get set. The idea is that for a centralized testing lab where people have to share a target between multiple developers. There are settings for both remote targets and remote hosts. Here’s an example of a Master Config File (also called the Global config file) for a *canadian cross*. A canadian cross is when you build and test a cross compiler on a machine other than the one it’s to be hosted on.

Here we have the config settings for our California office. Note that all config values are site dependant. Here we have two sets of values that we use for testing m68k-aout cross compilers. As both of these target boards has a different debugging protocol, we test on both of them in sequence.

**Example 3-4. Global Config file**

```bash
# Make sure we look in the right place for the board description files.
if !info exists boards_dir {
    set boards_dir {};
}
lappend boards_dir "/nfs/cygint/s1/cygnus/dejagnu/boards"

verbose "Global Config File: target_triplet is $target_triplet" 2
global target_list

case "$target_triplet" in
    { "native" } {
        set target_list "unix"
    }
```
In this case, we have support for several cross compilers, that all run on this host. For testing on operating systems that don’t support Expect, DejaGnu can be run on the local build machine, and it can connect to the remote host and run all the tests for this cross compiler on that host. All the remote OS requires is a working telnetd.

As you can see, all one does is set the variable target_list to the list of targets and options to test. The simple settings, like for sparc64-elf only require setting the name of the single board config file. The mips-elf target is more complicated. Here it sets the list to three target boards. One is the default mips target, and both wilma barney are symbolic names for other mips boards. Symbolic names are covered in the Adding A New Board chapter. The more complicated example is the one for mips-lsi-elf. This one runs the tests with multiple iterations using all possible combinations of the -soft-float and the -el (little endian) option. Needless to say, this last feature is mostly compiler specific.

### 3.3. Board Config File

The board config file is where board specific config data is stored. A board config file contains all the higher-level configuration settings. There is a rough inheritance
scheme, where it is possible to base a new board description file on an existing one. There are also collections of custom procedures for common environments. For more information on adding a new board config file, go to the Adding A New Board chapter.

An example board config file for a GNU simulator is as follows. `set_board_info` is a procedure that sets the field name to the specified value. The procedures in square brackets `[]` are helper procedures. They are used to find parts of a tool chain required to build an executable image that may reside in various locations. This is mostly of use for when the startup code, the standard C libraries, or the tool chain itself is part of your build tree.

**Example 3-5. Board Config File**

```plaintext
# This is a list of toolchains that are supported on this board.
set_board_info target_install {sparc64-elf}

# Load the generic configuration for this board. This will define any
# routines needed by the tool to communicate with the board.
load_generic_config "sim"

# We need this for find_gcc and *_include_flags/*_link_flags.
load_base_board_description "basic-sim"

# Use long64 by default.
process_multilib_options "long64"

setup_sim sparc64

# We only support newlib on this target. We assume that all multilib
# options have been specified before we get here.
set_board_info compiler "[find_gcc]"
set_board_info cflags "[lib-gloss_include_flags] [newlib_include_flags]"
```
set_board_info ldflags "[libgloss_link_flags] [newlib_link_flags]"
   # No linker script.
set_board_info ldscript ""

   # Used by a few gcc.c-torture testcases to delimit how large the
   # stack can be.
set_board_info gcc,stack_size 16384
   # The simulator doesn’t return exit statuses and we need to indicate this
   # the standard GCC wrapper will work with this target.
set_board_info needs_status_wrapper 1
   # We can’t pass arguments to programs.
set_board_info noargs 1

There are five helper procedures used in this example. The first one, find gcc looks
for a copy of the GNU compiler in your build tree, or it uses the one in your path. This
will also return the proper transformed name for a cross compiler if you whole build
tree is configured for one. The next helper procedures are libgloss_include_flags
& libgloss_link_flags. These return the proper flags to compiler and link an
executable image using Libgloss, the GNU BSP (Board Support Package). The final
procedures are newlib_include_flag & newlib_include_flag. These find the
Newlib C library, which is a reentrant standard C library for embedded systems
comprising of non GPL’d code.

3.4. Remote Host Testing

Note: Thanks to Dj Delorie for the original paper that this section is based on.

DejaGnu also supports running the tests on a remote host. To set this up, the remote
host needs an ftp server, and a telnet server. Currently foreign operating systems used
as remote hosts are VxWorks, VRTX, Dos/Win3.1, MacOS, and win95/win98/NT.

The recommended source for a win95/win98/NT based ftp server is to get IIS (either IIS 1 or Personal Web Server) from http://www.microsoft.com. When you install it, make sure you install the FTP server - it’s not selected by default. Go into the IIS manager and change the FTP server so that it does not allow anonymous ftp. Set the home directory to the root directory (i.e. c:\) of a suitable drive. Allow writing via ftp.

It will create an account like IUSR_FOOBAR where foobar is the name of your machine. Go into the user editor and give that account a password that you don’t mind hanging around in the clear (i.e. not the same as your admin or personal passwords). Also, add it to all the various permission groups.

You’ll also need a telnet server. For win95/win98/NT, go to the Ataman (http://ataman.com) web site, pick up the Ataman Remote Logon Services for Windows, and install it. You can get started on the eval period anyway. Add IUSR_FOOBAR to the list of allowed users, set the HOME directory to be the same as the FTP default directory. Change the Mode prompt to simple.

Ok, now you need to pick a directory name to do all the testing in. For the sake of this example, we’ll call it piggy (i.e. c:\piggy). Create this directory.

You’ll need a unix machine. Create a directory for the scripts you’ll need. For this example, we’ll use /usr/local/swamp/testing. You’ll need to have a source tree somewhere, say /usr/src/devo. Now, copy some files from releng’s area in SV to your machine:

**Example 3-6. Remote host setup**

```
cd /usr/local/swamp/testing
mkdir boards
scp darkstar.welcomehome.org:/dejagnu/cst/bin/MkTestDir .
scp darkstar.welcomehome.org:/dejagnu/site.exp .
scp darkstar.welcomehome.org:/dejagnu/boards/useless98r2.exp boards/foobar.exp
echo DEJAGNU=/usr/local/swamp/testing/site.exp
```
You must edit the boards/foobar.exp file to reflect your machine; change the hostname (foobar.com), username (iusr_foobar), password, and ftp_directory (c:/piggy) to match what you selected.

Edit the global site.exp to reflect your boards directory:

**Example 3-7. Add The Board Directory**

lappend boards_dir "/usr/local/swamp/testing/boards"

Now run MkTestDir, which is in the contrib directory. The first parameter is the toolchain prefix, the second is the location of your devo tree. If you are testing a cross compiler (ex: you have sh-hms-gcc.exe in your PATH on the PC), do something like this:

**Example 3-8. Setup Cross Remote Testing**

./MkTestDir sh-hms /usr/dejagnu/src/devo

If you are testing a native PC compiler (ex: you have gcc.exe in your PATH on the PC), do this:

**Example 3-9. Setup Native Remote Testing**

./MkTestDir " /usr/dejagnu/src/devo

To test the setup, ftp to your PC using the username (iusr_foobar) and password you selected. CD to the test directory. Upload a file to the PC. Now telnet to your PC using the same username and password. CD to the test directory. Make sure the file is there. Type "set" and/or "gcc -v" (or sh-hms-gcc -v) and make sure the default PATH contains the installation you want to test.

**Example 3-10. Run Test Remotely**

cd /usr/local/swamp/testing
make -k -w check RUNTESTFLAGS="-host_board foobar -target_board foobar -v -v" > check.out 2>&1

To run a specific test, use a command like this (for this example, you’d run this from the gcc directory that MkTestDir created):

Example 3-11. Run a Test Remotely

make check RUNTESTFLAGS="-host_board sloth -target_board sloth -v compile.exp=921202-1.c"

Note: if you are testing a cross-compiler, put in the correct target board. You’ll also have to download more .exp files and modify them for your local configuration. The -v’s are optional.

3.5. Config File Values

DejaGnu uses a named array in Tcl to hold all the info for each machine. In the case of a canadian cross, this means host information as well as target information. The named array is called target_info, and it has two indices. The following fields are part of the array.

3.5.1. Command Line Option Variables

In the user editable second section of the Personal Config File you can not only override the configuration variables captured in the first section, but also specify default values for all on the runtest command line options. Save for -debug, -help, and -version, each command line option has an associated Tcl variable. Use the Tcl set command to specify a new default value (as for the configuration variables). The following table describes the correspondence between command line options and variables you can set in site.exp. Invoking Runtest, for explanations of the command-line options.
### Table 3-1. Tcl Variables For Command Line Options

<table>
<thead>
<tr>
<th>runtest</th>
<th>Tcl</th>
<th>option description</th>
</tr>
</thead>
<tbody>
<tr>
<td>–all</td>
<td>all_flag</td>
<td>display all test results if set</td>
</tr>
<tr>
<td>–baud</td>
<td>baud</td>
<td>set the default baud rate to something other than 9600.</td>
</tr>
<tr>
<td>–connect</td>
<td>connectmode</td>
<td>rlogin, telnet, rsh, kermit, tip, or mondfe</td>
</tr>
<tr>
<td>–outdir</td>
<td>outdir</td>
<td>directory for tool.sum and tool.log.</td>
</tr>
<tr>
<td>–objdir</td>
<td>objdir</td>
<td>directory for pre-compiled binaries</td>
</tr>
<tr>
<td>–reboot</td>
<td>reboot</td>
<td>reboot the target if set to &quot;1&quot;; do not reboot if set to &quot;0&quot; (the default).</td>
</tr>
<tr>
<td>–srcdir</td>
<td>srcdir</td>
<td>directory of test subdirectories</td>
</tr>
<tr>
<td>–strace</td>
<td>tracelevel</td>
<td>a number: Tcl trace depth</td>
</tr>
<tr>
<td>–tool</td>
<td>tool</td>
<td>name of tool to test; identifies init, test subdir</td>
</tr>
<tr>
<td>–verbose</td>
<td>verbose</td>
<td>verbosity level. As option, use multiple times; as variable, set a number, 0 or greater.</td>
</tr>
<tr>
<td>–target</td>
<td>target_triplet</td>
<td>The canonical configuration string for the target.</td>
</tr>
<tr>
<td>–host</td>
<td>host_triplet</td>
<td>The canonical configuration string for the host.</td>
</tr>
<tr>
<td>–build</td>
<td>build_triplet</td>
<td>The canonical configuration string for the build host.</td>
</tr>
</tbody>
</table>
Chapter 3. Customizing DejaGnu

<table>
<thead>
<tr>
<th>runtest</th>
<th>Tcl</th>
<th>option</th>
<th>variable description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-mail</td>
<td>address</td>
<td>Email the output log to the specified address.</td>
<td></td>
</tr>
</tbody>
</table>

### 3.5.2. Personal Config File

The personal config file is used to customize runtest’s behaviour for each person. It’s typically used to set the user preferred setting for verbosity, and any experimental Tcl procedures. My personal ~/.dejagnurc file looks like:

**Example 3-12. Personal Config File**

```bash
set all_flag 1
set RLOGIN /usr/ucb/rlogin
set RSH /usr/local/sbin/ssh
```

Here I set all_flag so I see all the test cases that PASS along with the ones that FAIL. I also set RLOGIN to the BSD version. I have Kerberos installed, and when I rlogin to a target board, it usually isn’t supported. So I use the non secure version rather than the default that’s in my path. I also set RSH to the SSH secure shell, as rsh is mostly used to test unix machines within a local network here.
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4.1. Adding A New Test Suite

The testsuite for a new tool should always be located in that tools source directory. DejaGnu require the directory be named testsuite. Under this directory, the test cases go in a subdirectory whose name begins with the tool name. For example, for a tool named flubber, each subdirectory containing testsuites must start with "flubber."

4.2. Adding A New Tool

In general, the best way to learn how to write (code or even prose) is to read something similar. This principle applies to test cases and to test suites. Unfortunately, well-established test suites have a way of developing their own conventions: as test writers become more experienced with DejaGnu and with Tcl, they accumulate more utilities, and take advantage of more and more features of Expect and Tcl in general.

Inspecting such established test suites may make the prospect of creating an entirely new test suite appear overwhelming. Nevertheless, it is quite straightforward to get a new test suite going.

There is one test suite that is guaranteed not to grow more elaborate over time: both it and the tool it tests were created expressly to illustrate what it takes to get started with DejaGnu. The example/ directory of the DejaGnu distribution contains both an interactive tool called calc, and a test suite for it. Reading this test suite, and experimenting with it, is a good way to supplement the information in this section. (Thanks to Robert Lupton for creating calc and its test suite—and also the first version of this section of the manual!)

To help orient you further in this task, here is an outline of the steps to begin building a test suite for a program example.
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• Create or select a directory to contain your new collection of tests. Change into that directory (shown here as testsuite):

Create a configure.in file in this directory, to control configuration-dependent choices for your tests. So far as DejaGnu is concerned, the important thing is to set a value for the variable target_abbrev; this value is the link to the init file you will write soon. (For simplicity, we assume the environment is Unix, and use unix as the value.)

What else is needed in configure.in depends on the requirements of your tool, your intended test environments, and which configure system you use. This example is a minimal configure.in for use with GNU Autoconf.

• Create Makefile.in (if you are using Autoconf), or Makefile.am (if you are using Automake), the source file used by configure to build your Makefile. If you are using GNU Automake, just add the keyword dejagnu to the AUTOMAKE_OPTIONS variable in your Makefile.am file. This will add all the Makefile support needed to run DejaGnu, and support the Make Check target.

You also need to include two targets important to DejaGnu: check, to run the tests, and site.exp, to set up the Tcl copies of configuration-dependent values. This is called the Local Config File. The check target must run the runtest program to execute the tests.

The site.exp target should usually set up (among other things) the $tool variable for the name of your program. If the local site.exp file is setup correctly, it is possible to execute the tests by merely typing runtest on the command line.

Example 4-1. Sample Makefile.in Fragment

```bash
# Look for a local version of DejaGnu, otherwise use one in the path
RUNTEST = 'if test -f $(top_srcdir)/../dejagnu/runtest; then \
    echo $(top_srcdir) ../dejagnu/runtest; \
else \n    echo runtest; \
fi'
```
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# The flags to pass to runtest
RUNTESTFLAGS =

# Execute the tests
check: site.exp all

$(RUNTEST) $(RUNTESTFLAGS) \
   -tool ${example} -srcdir $(srcdir)

# Make the local config file
site.exp: ./config.status Makefile
   @echo "Making a new config file..."
   -@rm -f ./tmp?
   @touch site.exp

   -@mv site.exp site.bak
   @echo "## these variables are automatically" \
   generated by make ##" > ./tmp0
   @echo "# Do not edit here. If you wish to\" \
   override these values" » ./tmp0
   @echo "# add them to the last section" » ./tmp0
   @echo "set host_os ${host_os}" » ./tmp0
   @echo "set host_alias ${host_alias}" » ./tmp0
   @echo "set host_cpu ${host_cpu}" » ./tmp0
   @echo "set host_vendor ${host_vendor}" » ./tmp0
   @echo "set target_os ${target_os}" » ./tmp0
   @echo "set target_cpu ${target_cpu}" » ./tmp0
   @echo "set target_vendor ${target_vendor}" » ./tmp0
   @echo "set tool binutils" » ./tmp0
   @echo "set $get_triplet ${target_canonical}" » ./tmp0
   @echo "set tool binutils" » ./tmp0
   @echo "set srcdir $(srcdir)" » ./tmp0
   @echo "set objdir 'pwd'" » ./tmp0
   @echo "set $example $example" » ./tmp0
   @echo "## All variables above are generated by\"
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configure. Do Not Edit " » ./tmp0
@cat ./tmp0 > site.exp
@sed < site.bak \
- e '1,/^## All variables above are.*##/ d' \
» site.exp
-@rm -f ./tmp?

- Create a directory (in testsuite) called config. Make a Tool Init File in this
directory. Its name must start with the target_abbrev value, or be named
default.exp so call it config/unix.exp for our Unix based example. This is the
file that contains the target-dependent procedures. Fortunately, on Unix, most of
them do not have to do very much in order for runtest to run.

If the program being tested is not interactive, you can get away with this minimal
unix.exp to begin with:

Example 4-2. Simple Batch Program Tool Init File

    proc foo_exit {} {}
    proc foo_version {} {} 

If the program being tested is interactive, however, you might as well define a start
routine and invoke it by using an init file like this:

Example 4-3. Simple Interactive Program Tool Init File

    proc foo_exit {} {}
    proc foo_version {} {}

    proc foo_start {} {
        global ${examplename}
        spawn ${examplename}
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```tcl
expect {
  -re "" {}
}
}

# Start the program running we want to test
foo_start
```

- Create a directory whose name begins with your tool’s name, to contain tests. For example, if your tool’s name is `gcc`, then the directories all need to start with "gcc.".

- Create a sample test file. Its name must end with `.exp`. You can use `first-try.exp`. To begin with, just write there a line of Tcl code to issue a message.

**Example 4-4. Testing A New Tool Config**

```tcl
send_user "Testing: one, two...
```

- Back in the testsuite (top level) directory, run `configure`. Typically you do this while in the build directory. You may have to specify more of a path, if a suitable configure is not available in your execution path.

- e now ready to triumphantly type `make check` or `runtest`. You should see something like this:

**Example 4-5. Example Test Case Run**

```
Test Run By rhl on Fri Jan 29 16:25:44 EST 1993

=== example tests ===

Running ./example.0/first-try.exp ...
```
Chapter 4. Extending DejaGnu

Testing: one, two...

=== example Summary ===

There is no output in the summary, because so far the example does not call any of the procedures that establish a test outcome.

- Write some real tests. For an interactive tool, you should probably write a real exit routine in fairly short order. In any case, you should also write a real version routine soon.

4.3. Adding A New Target

DejaGnu has some additional requirements for target support, beyond the general-purpose provisions of configure. DejaGnu must actively communicate with the target, rather than simply generating or managing code for the target architecture. Therefore, each tool requires an initialization module for each target. For new targets, you must supply a few Tcl procedures to adapt DejaGnu to the target. This permits DejaGnu itself to remain target independent.

Usually the best way to write a new initialization module is to edit an existing initialization module; some trial and error will be required. If necessary, you can use the @samp{–debug} option to see what is really going on.

When you code an initialization module, be generous in printing information controlled by the verbose procedure.

For cross targets, most of the work is in getting the communications right. Communications code (for several situations involving IP networks or serial lines) is available in a DejaGnu library file.

If you suspect a communication problem, try running the connection interactively from Expect. (There are three ways of running Expect as an interactive interpreter. You can
run Expect with no arguments, and control it completely interactively; or you can use `expect -i` together with other command-line options and arguments; or you can run the command `interpreter` from any Expect procedure. Use `return` to get back to the calling procedure (if any), or `return -tcl` to make the calling procedure itself return to its caller; use `exit` or end-of-file to leave Expect altogether.) Run the program whose name is recorded in `$connectmode`, with the arguments in `$targetname`, to establish a connection. You should at least be able to get a prompt from any target that is physically connected.

### 4.4. Adding A New Board

Adding a new board consists of creating a new board config file. Examples are in `dejagnu/baseboards`. Usually to make a new board file, it’s easiest to copy an existing one. It is also possible to have your file be based on a `baseboard` file with only one or two changes needed. Typically, this can be as simple as just changing the linker script. Once the new baseboard file is done, add it to the `boards_DATA` list in the `dejagnu/baseboards/Makefile.am`, and regenerate the Makefile.in using automake. Then just rebuild and install DejaGnu. You can test it by:

There is a crude inheritance scheme going on with board files, so you can include one board file into another. The two main procedures used to do this are `load_generic_config` and `load_base_board_description`. The `generic config` file contains other procedures used for a certain class of target. The board description file is where the board specific settings go. Commonly there are similar target environments with just different processors.

#### Example 4-6. Testing a New Board Config File

```
make check RUNTESTFLAGS="-target_board=newboardfile".
```

Here’s an example of a board config file. There are several `helper procedures` used in this example. A helper procedure is one that look for a tool of files in commonly
installed locations. These are mostly used when testing in the build tree, because the executables to be tested are in the same tree as the new dejagnu files. The helper procedures are the ones in square braces /[], which is the Tcl execution characters.

**Example 4-7. Example Board Config File**

```tcl
# Load the generic configuration for this board. This will define a basic set of routines needed by the tool to communicate with the board.
load_generic_config "sim"

# basic-sim.exp is a basic description for the standard Cygnus simulator.
load_base_board_description "basic-sim"

# The compiler used to build for this board. This has *nothing* to do with what compiler is tested if we’re testing gcc.
set_board_info compiler "[find_gcc]"

# We only support newlib on this target.
# However, we include libgloss so we can find the linker scripts.
set_board_info cflags "[newlib_include_flags] [libgloss_include_flags]"
set_board_info ldflags "[newlib_link_flags]"

# No linker script for this board.
set_board_info ldscript "-Tsim.ld"

# The simulator doesn’t return exit statuses and we need to indicate this.
set_board_info needs_status_wrapper 1

# Can’t pass arguments to this target.
set_board_info noargs 1
```
4.5. Board Config File Values

These fields are all in the board_info. These are all set by using the set_board_info procedure. The parameters are the field name, followed by the value to set the field to.

Table 4-1. Common Board Info Fields

<table>
<thead>
<tr>
<th>Field</th>
<th>Sample Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>compiler</td>
<td>&quot;[find_gcc]&quot;</td>
<td>The path to the compiler to use.</td>
</tr>
<tr>
<td>cflags</td>
<td>&quot;-mca&quot;</td>
<td>Compilation flags for the compiler.</td>
</tr>
<tr>
<td>ldflags</td>
<td>&quot;[libgloss_link_flags] [newlib_link_flags]&quot;</td>
<td>Linking flags for the compiler.</td>
</tr>
<tr>
<td>ldscript</td>
<td>&quot;-Wl,-Tidt.ld&quot;</td>
<td>The linker script to use when cross compiling.</td>
</tr>
<tr>
<td>libs</td>
<td>&quot;-lgcc&quot;</td>
<td>Any additional libraries to link in.</td>
</tr>
<tr>
<td>shell_prompt</td>
<td>&quot;cygmon&gt;&quot;</td>
<td>The command prompt of the remote shell.</td>
</tr>
<tr>
<td>hex_startadr</td>
<td>&quot;0xa0020000&quot;</td>
<td>The Starting address as a string.</td>
</tr>
</tbody>
</table>
### Chapter 4. Extending DejaGnu

<table>
<thead>
<tr>
<th>Field</th>
<th>Sample Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>start_addr</td>
<td>0xa0008000</td>
<td>The starting address as a value.</td>
</tr>
<tr>
<td>startaddr</td>
<td>&quot;a0020000&quot;</td>
<td></td>
</tr>
<tr>
<td>exit_statuses_bad</td>
<td>1</td>
<td>Whether there is an accurate exit status.</td>
</tr>
<tr>
<td>reboot_delay</td>
<td>10</td>
<td>The delay between power off and power on.</td>
</tr>
<tr>
<td>unreliable</td>
<td>1</td>
<td>Whether communication with the board is unreliable.</td>
</tr>
<tr>
<td>sim</td>
<td>[find_sim]</td>
<td>The path to the simulator to use.</td>
</tr>
<tr>
<td>objcopy</td>
<td>$tempfil</td>
<td>The path to the objcopy program.</td>
</tr>
<tr>
<td>support_libs</td>
<td>&quot;${prefix_dir}/i386-coff/&quot;</td>
<td>Support libraries needed for cross compiling.</td>
</tr>
<tr>
<td>addl_link_flags</td>
<td>&quot;-N&quot;</td>
<td>Additional link flags, rarely used.</td>
</tr>
</tbody>
</table>

These fields are used by the GCC and GDB tests, and are mostly only useful to somewhat trying to debug a new board file for one of these tools. Many of these are used only by a few testcases, and their purpose is esoteric. These are listed with sample values as a guide to better guessing if you need to change any of these.

**Table 4-2. Board Info Fields For GCC & GDB**

<table>
<thead>
<tr>
<th>Field</th>
<th>Sample Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>strip</td>
<td>$tempfile</td>
<td>Strip the executable of symbols.</td>
</tr>
<tr>
<td>Field</td>
<td>Sample Value</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>gdb_load_offset</td>
<td>&quot;0x40050000&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb_protocol</td>
<td>&quot;remote&quot;</td>
<td>The GDB debugging protocol to use.</td>
</tr>
<tr>
<td>gdb_sect_offset</td>
<td>&quot;0x41000000&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb_stub_ldscript</td>
<td>&quot;-Wl,-Teva-stub.ld&quot;</td>
<td>The linker script to use with a GDB stub.</td>
</tr>
<tr>
<td>gdb_init_command</td>
<td>&quot;set mipsfpu none&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb,cannot_call_functions</td>
<td>1</td>
<td>Whether GDB can call functions on the target,</td>
</tr>
<tr>
<td>gdb,noargs</td>
<td>1</td>
<td>Whether the target can take command line</td>
</tr>
<tr>
<td>gdb,nosignals</td>
<td>1</td>
<td>Whether there are signals on the target.</td>
</tr>
<tr>
<td>gdb,short_int</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>gdb,start_symbol</td>
<td>&quot;_start&quot;;</td>
<td>The starting symbol in the executable.</td>
</tr>
<tr>
<td>gdb,target_sim_options</td>
<td>&quot;-sparclite&quot;</td>
<td>Special options to pass to the simulator.</td>
</tr>
<tr>
<td>gdb,timeout</td>
<td>540</td>
<td>Timeout value to use for remote communication.</td>
</tr>
<tr>
<td>gdb_init_command</td>
<td>&quot;print/x $fsr = 0x0&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb_load_offset</td>
<td>&quot;0x12020000&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb_opts</td>
<td>&quot;--command gdbinit&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb_prompt</td>
<td>&quot;(gdb960)&quot;</td>
<td>The prompt GDB is using.</td>
</tr>
<tr>
<td>gdb_run_command</td>
<td>&quot;jump start&quot;</td>
<td></td>
</tr>
<tr>
<td>gdb_stub_offset</td>
<td>&quot;0x12010000&quot;</td>
<td></td>
</tr>
</tbody>
</table>
4.6. Writing A Test Case

The easiest way to prepare a new test case is to base it on an existing one for a similar
situation. There are two major categories of tests: batch or interactive. Batch oriented
tests are usually easier to write.

The GCC tests are a good example of batch oriented tests. All GCC tests consist
primarily of a call to a single common procedure, Since all the tests either have no output, or only have a few warning messages when successfully compiled. Any non-warning output is a test failure. All the C code needed is kept in the test directory. The test driver, written in Tcl, need only get a listing of all the C files in the directory, and compile them all using a generic procedure. This procedure and a few others supporting for these tests are kept in the library module lib/c-torture.exp in the GCC test suite. Most tests of this kind use very few expect features, and are coded almost purely in Tcl.

Writing the complete suite of C tests, then, consisted of these steps:

- Copying all the C code into the test directory. These tests were based on the C-torture test created by Torbjorn Granlund (on behalf of the Free Software Foundation) for GCC development.
- Writing (and debugging) the generic Tcl procedures for compilation.
- Writing the simple test driver: its main task is to search the directory (using the Tcl procedure glob for filename expansion with wildcards) and call a Tcl procedure with each filename. It also checks for a few errors from the testing procedure.

Testing interactive programs is intrinsically more complex. Tests for most interactive programs require some trial and error before they are complete.

However, some interactive programs can be tested in a simple fashion reminiscent of batch tests. For example, prior to the creation of DejaGnu, the GDB distribution already included a wide-ranging testing procedure. This procedure was very robust, and had already undergone much more debugging and error checking than many recent DejaGnu test cases. Accordingly, the best approach was simply to encapsulate the existing GDB tests, for reporting purposes. Thereafter, new GDB tests built up a family of Tcl procedures specialized for GDB testing.

### 4.7. Debugging A Test Case

These are the kinds of debugging information available from DejaGnu:
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- Output controlled by test scripts themselves, explicitly allowed for by the test author. This kind of debugging output appears in the detailed output recorded in the DejaGnu log file. To do the same for new tests, use the `verbose` procedure (which in turn uses the variable also called `verbose`) to control how much output to generate. This will make it easier for other people running the test to debug it if necessary. Whenever possible, if $verbose$ is 0, there should be no output other than the output from `pass`, `fail`, `error`, and `warning`. Then, to whatever extent is appropriate for the particular test, allow successively higher values of $verbose$ to generate more information. Be kind to other programmers who use your tests: provide for a lot of debugging information.

- Output from the internal debugging functions of Tcl and Expect. There is a command line options for each; both forms of debugging output are recorded in the file `dbg.log` in the current directory. Use `-debug` for information from the `expect` level; it generates displays of the `expect` attempts to match the tool output with the patterns specified. This output can be very helpful while developing test scripts, since it shows precisely the characters received. Iterating between the latest attempt at a new test script and the corresponding `dbg.log` can allow you to create the final patterns by “cut and paste”. This is sometimes the best way to write a test case.

- Use `-strace` to see more detail at the Tcl level; this shows how Tcl procedure definitions expand, as they execute. The associated number controls the depth of definitions expanded.

- Finally, if the value of `verbose` is 3 or greater, DejaGnu turns on the `expect` command `log_user`. This command prints all `expect` actions to the `expect` standard output, to the detailed log file, and (if `-debug` is on) to `dbg.log`.

4.8. Adding A Test Case To A Test Suite.

There are two slightly different ways to add a test case. One is to add the test case to an existing directory. The other is to create a new directory to hold your test. The existing
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Test directories represent several styles of testing, all of which are slightly different; examine the directories for the tool of interest to see which (if any) is most suitable.

Adding a GCC test can be very simple: just add the C code to any directory beginning with `gcc` and it runs on the next run:

```
runtest -tool
gcc
```

To add a test to GDB, first add any source code you will need to the test directory. Then you can either create a new expect file, or add your test to an existing one (any file with a `.exp` suffix). Creating a new `.exp` file is probably a better idea if the test is significantly different from existing tests. Adding it as a separate file also makes upgrading easier. If the C code has to be already compiled before the test will run, then you’ll have to add it to the `Makefile.in` file for that test directory, then run `configure` and `make`.

Adding a test by creating a new directory is very similar:

- Create the new directory. All subdirectory names begin with the name of the tool to test; e.g. G++ tests might be in a directory called `g++.other`. There can be multiple test directories that start with the same tool name (such as `g++`).
- Add the new directory name to the `configdirs` definition in the `configure.in` file for the test suite directory. This way when `make` and `configure` next run, they include the new directory.
- Add the new test case to the directory, as above.
- To add support in the new directory for configure and make, you must also create a `Makefile.in` and a `configure.in`.

4.9. Hints On Writing A Test Case

It is safest to write patterns that match all the output generated by the tested program;
this is called closure. If a pattern does not match the entire output, any output that remains will be examined by the next `expect` command. In this situation, the precise boundary that determines which `expect` command sees what is very sensitive to timing between the Expect task and the task running the tested tool. As a result, the test may sometimes appear to work, but is likely to have unpredictable results. (This problem is particularly likely for interactive tools, but can also affect batch tools—especially for tests that take a long time to finish.) The best way to ensure closure is to use the `-re` option for the `expect` command to write the pattern as a full regular expressions; then you can match the end of output using a `$`. It is also a good idea to write patterns that match all available output by using `.\n` after the text of interest; this will also match any intervening blank lines. Sometimes an alternative is to match end of line using `\r` or `\n`, but this is usually too dependent on terminal settings.

Always escape punctuation, such as `(` or `)`, in your patterns; for example, write `\`. If you forget to escape punctuation, you will usually see an error message like

```
extra characters after close-quote.
```

If you have trouble understanding why a pattern does not match the program output, try using the `-debug` option to `runtest`, and examine the debug log carefully.

Be careful not to neglect output generated by setup rather than by the interesting parts of a test case. For example, while testing GDB, I issue a send `set height 0\n` command. The purpose is simply to make sure GDB never calls a paging program. The `set height` command in GDB does not generate any output; but running any command makes GDB issue a new `(gdb)` prompt. If there were no `expect` command to match this prompt, the output `(gdb)` begins the text seen by the next `expect` command—which might make that pattern fail to match.

To preserve basic sanity, I also recommended that no test ever pass if there was any kind of problem in the test case. To take an extreme case, tests that pass even when the tool will not spawn are misleading. Ideally, a test in this sort of situation should not fail either. Instead, print an error message by calling one of the DejaGnu procedures `error` or `warning`. 
4.10. Special variables used by test cases.

There are special variables used by test cases. These contain other information from DejaGnu. Your test cases can use these variables, with conventional meanings (as well as the variables saved in site.exp. You can use the value of these variables, but they should never be changed.

$prms_id
The tracking system (e.g. GNATS) number identifying a corresponding bugreport. (0) if you do not specify it in the test script.)

$item bug_id
An optional bug id; may reflect a bug identification from another organization. (0 if you do not specify it.)

$subdir
The subdirectory for the current test case.

$expect_out(buffer)
The output from the last command. This is an internal variable set by Expect. More information can be found in the Expect manual.

$exec_output
This is the output from a ${tool}_load command. This only applies to tools like GCC and GAS which produce an object file that must in turn be executed to complete a test.

$comp_output
This is the output from a ${tool}_start command. This is conventionally used for batch oriented programs, like GCC and GAS, that may produce interesting output (warnings, errors) without further interaction.
Chapter 5. Unit Testing

5.1. What Is Unit Testing?

Most regression testing as done by DejaGnu is system testing. This is the complete application is tested all at once. Unit testing is for testing single files, or small libraries. In this case, each file is linked with a test case in C or C++, and each function or class and method is tested in series, with the test case having to check private data or global variables to see if the function or method worked.

This works particularly well for testing APIs and at level where it is easier to debug them, than by needing to trace through the entire application. Also if there is a specification for the API to be tested, the testcase can also function as a compliance test.

5.2. The dejagnu.h Header File

DejaGnu uses a single header file to assist in unit testing. As this file also produces it’s one test state output, it can be run standalone, which is very useful for testing on embedded systems. This header file has a C and C++ API for the test states, with simple totals, and standardized output. Because the output has been standardized, DejaGnu can be made to work with this test case, without writing almost any Tcl. The library module, dejagnu.exp, will look for the output messages, and then merge them into DejaGnu’s.
Chapter 6. Reference

6.1. Obtaining DejaGnu

You can obtain DejaGnu from the DejaGnu web site at the Free Software Foundation (http://www.gnu.org), which is at www.gnu.org/software/dejagnu/ (http://www.gnu.org/software/dejagnu/)

6.2. Installation

Once you have the DejaGnu source unpacked and available, you must first configure the software to specify where it is to run (and the associated defaults); then you can proceed to installing it.

6.2.1. Configuring DejaGnu

It is usually best to configure in a directory separate from the source tree, specifying where to find the source with the optional –sdir option to configure. DejaGnu uses the GNU autoconf to configure itself. For more info on using autoconf, read the GNU autoconf manual. To configure, execute the configure program, no other options are required. For an example, to configure in a separate tree for objects, execute the configure script from the source tree like this:

```
../dejagnu-1.4.1/configure
```

DejaGnu doesn’t care at config time if it’s for testing a native system or a cross system. That is determined at runtime by using the config files.

You may also want to use the configure option –prefix to specify where you want DejaGnu and its supporting code installed. By default, installation is in subdirectories
of /usr/local, but you can select any alternate directory altdir by including
-prefix{altdir}} on the configure command line. (This value is captured in the
Makefile variables prefix and execprefix}.)

Save for a small number of example tests, the DejaGnu distribution itself does not
include any test suites; these are available separately. Test suites for the GNU
development tools are included in those releases. After configuring the top-level
DejaGnu directory, unpack and configure the test directories for the tools you want to
test; then, in each test directory, run make check to build auxiliary programs required by
some of the tests, and run the test suites.

### 6.2.2. Installing DejaGnu

To install DejaGnu in your filesystem (either in /usr/local, or as specified by your
–prefix option to configure), execute.

```bash
eg$ make install
```

*make install* does these things for DejaGnu:

- Look in the path specified for executables $exec_prefix) for directories called lib
  and bin. If these directories do not exist, make install creates them.
- Create another directory in the share directory, called dejagnu, and copy all the
  library files into it.
- Create a directory in the dejagnu/share directory, called config, and copy all the
  configuration files into it.
- Copy the runtest shell script into $exec_prefix/bin.
- Copy runtest.exp into $exec_prefix/lib/dejagnu. This is the main Tcl code
  implementing DejaGnu.
6.3. Builtin Procedures

DejaGnu provides these Tcl procedures.

6.3.1. Core Internal Procedures

6.3.1.1. Mail_file Procedure

\texttt{mail\_file(file to subject);}

6.3.1.2. Open_logs Procedure

\texttt{open\_logs();}

6.3.1.3. Close_logs Procedure

\texttt{close\_logs();}

6.3.1.4. Isbuild Procedure

Tests for a particular build host environment. If the currently configured host matches the argument string, the result is 1; otherwise the result is 0. \textit{host} must be a full three-part configure host name; in particular, you may not use the shorter nicknames supported by configure (but you can use wildcard characters, using shell syntax, to
specify sets of names). If it is passed a NULL string, then it returns the name of the build canonical configuration.

\texttt{isbuild}(pattern);

\textit{pattern}

\subsection*{6.3.1.5. \texttt{Is\_remote} Procedure}

\texttt{is\_remote}(board);

\subsection*{6.3.1.6. \texttt{is3way} Procedure}

Tests for a canadian cross. This is when the tests will be run on a remotely hosted cross compiler. If it is a canadian cross, then the result is 1; otherwise the result is 0.

\texttt{is3way}();

\subsection*{6.3.1.7. \texttt{Ishost} Procedure}

Tests for a particular host environment. If the currently configured host matches the argument string, the result is 1; otherwise the result is 0. \textit{host} must be a full three-part configure host name; in particular, you may not use the shorter nicknames supported by configure (but you can use wildcard characters, using shell syntax, to specify sets of names).
6.3.1.8. Istarget Procedure

Tests for a particular target environment. If the currently configured target matches the argument string, the result is 1; otherwise the result is 0. target must be a full three-part configure target name; in particular, you may not use the shorter nicknames supported by configure (but you can use wildcard characters, using shell syntax, to specify sets of names). If it is passed a NULL string, then it returns the name of the build canonical configuration.

istarget(args);

6.3.1.9. Isnative Procedure

Tests whether the current configuration has the same host and target. When it runs in a native configuration this procedure returns a 1; otherwise it returns a 0.

isnative();

6.3.1.10. Unknown Procedure

unknown(args);
6.3.1.11. Clone_output Procedure

clone_output(message);

message

6.3.1.12. Reset_vars Procedure

reset_vars();

6.3.1.13. Log_and_exit Procedure

log_and_exit();

6.3.1.14. Log_summary Procedure

log_summary(args);
6.3.1.15. Cleanup Procedure

cleanup();

6.3.1.16. Setup_xfail Procedure

Declares that the test is expected to fail on a particular set of configurations. The config argument must be a list of full three-part configure target name; in particular, you may not use the shorter nicknames supported by configure (but you can use the common shell wildcard characters to specify sets of names). The bugid argument is optional, and used only in the logging file output; use it as a link to a bug-tracking system such as GNATS.

Once you use setup_xfail, the fail and pass procedures produce the messages XFAIL and XPASS respectively, allowing you to distinguish expected failures (and unexpected success!) from other test outcomes.

Warning

Warning you must clear the expected failure after using setup_xfail in a test case. Any call to pass or fail clears the expected failure implicitly; if the test has some other outcome, e.g. an error, you can call clear_xfail to clear the expected failure explicitly. Otherwise, the expected-failure declaration applies to whatever test runs next, leading to surprising results.

setup_xfail(config bugid);
Chapter 6. Reference

config

The config triplet to trigger whether this is an unexpected or expect failure.

bugid

The optional bugid, used to tie it this test case to a bug tracking system.

6.3.1.17. Record_test Procedure

record_test(type message args);

type

message

args

6.3.1.18. Pass Procedure

Declares a test to have passed. pass writes in the log files a message beginning with PASS (or XPASS, if failure was expected), appending the argument string.

pass(string);

string

The string to use for this PASS message.
6.3.1.19. Fail Procedure

Declares a test to have failed. fail writes in the log files a message beginning with \textit{FAIL} (or \textit{XFAIL}, if failure was expected), appending the argument \textit{string}.

\texttt{fail(string);}

\textit{string}

The string to use for this FAIL message.

6.3.1.20. Xpass Procedure

Declares a test to have unexpectably passed, when it was expected to be a failure. xpass writes in the log files a message beginning with \textit{XPASS} (or \textit{XFAIL}, if failure was expected), appending the argument \textit{string}.

\texttt{xpass(string);}

\textit{string}

The string to use for this output state.

6.3.1.21. Xfail Procedure

Declares a test to have expectably failed. xfail writes in the log files a message beginning with \textit{XFAIL} (or \textit{PASS}, if success was expected), appending the argument \textit{string}.

\texttt{xpass(string);}
Chapter 6. Reference

string

The string to use for this output state.

6.3.1.22. Set_warning_threshold Procedure

Sets the value of warning_threshold. A value of 0 disables it: calls to warning will not turn a PASS or FAIL into an UNRESOLVED.

set_warning_threshold(threshold);

threshold

This is the value of the new warning threshold.

6.3.1.23. Get_warning_threshold Procedure

Returns the current value of {warning_threshold. The default value is 3. This value controls how many warning procedures can be called before becoming UNRESOLVED.

get_warning_threshold();

6.3.1.24. Warning Procedure

Declares detection of a minor error in the test case itself. warning writes in the log files a message beginning with WARNING, appending the argument string. Use warning rather than perror for cases (such as communication failure to be followed by a retry) where the test case can recover from the error. If the optional number is supplied, then this is used to set the internal count of warnings to that value.
As a side effect, warning_threshold or more calls to warning in a single test case also changes the effect of the next pass or fail command: the test outcome becomes UNRESOLVED since an automatic PASS or FAIL may not be trustworthy after many warnings. If the optional numeric value is 0, then there are no further side effects to calling this function, and the following test outcome doesn’t become UNRESOLVED. This can be used for errors with no known side effects.

```plaintext
warning(string number );
```

```plaintext
string
```

```plaintext
number
```

The optional number to set the error counter. This is only used to fake out the counter when using the xfail procedure to control when it flips the output over to UNRESOLVED state.

### 6.3.1.25. Perror Procedure

Declares a severe error in the testing framework itself. perror writes in the log files a message beginning with ERROR, appending the argument string.

As a side effect, perror also changes the effect of the next pass or fail command: the test outcome becomes UNRESOLVED, since an automatic PASS or FAIL cannot be trusted after a severe error in the test framework. If the optional numeric value is 0, then there are no further side effects to calling this function, and the following test outcome doesn’t become UNRESOLVED. This can be used for errors with no known side effects.

```plaintext
perror(string number );
```
Chapter 6. Reference

string

number

The optional number to set the error counter. This is only used to fake out the counter when using the xfail procedure to control when it flips the output over to UNRESOLVED state.

6.3.1.26. Note Procedure

Appends an informational message to the log file. note writes in the log files a message beginning with NOTE, appending the argument string. Use note sparingly. The verbose should be used for most such messages, but in cases where a message is needed in the log file regardless of the verbosity level use note.

note(string);

string

The string to use for this note.

6.3.1.27. Untested Procedure

Declares a test was not run. untested writes in the log file a message beginning with UNTESTED, appending the argument string. For example, you might use this in a dummy test whose only role is to record that a test does not yet exist for some feature.

untested(string);
6.3.1.28. Unresolved Procedure

Declares a test to have an unresolved outcome. `unresolved` writes in the log file a message beginning with `UNRESOLVED`, appending the argument `string`. This usually means the test did not execute as expected, and a human being must go over results to determine if it passed or failed (and to improve the test case).

`unresolved(string);`

6.3.1.29. Unsupported Procedure

Declares that a test case depends on some facility that does not exist in the testing environment. `unsupported` writes in the log file a message beginning with `UNSUPPORTED`, appending the argument `string`.

`unsupported(string);`

6.3.1.30. Init_testcounts Procedure
6.3.1.31. Incr_count Procedure

```c
incr_count(name args);
```

**name**

**args**

6.3.1.32. transform Procedure

Generates a string for the name of a tool as it was configured and installed, given its native name (as the argument `toolname`). This makes the assumption that all tools are installed using the same naming conventions: For example, for a cross compiler supporting the `m68k-vxworks` configuration, the result of `transform gcc` is `m68k-vxworks-gcc`.

```c
transform(toolname);
```

**toolname**

The name of the cross-development program to transform.

6.3.1.33. Check_conditional_xfail Procedure

This procedure adds a condition `xfail`, based on compiler options used to create a test
case executable. If an include options is found in the compiler flags, and it’s the right architecture, it’ll trigger an XFAIL. Otherwise it’ll produce an ordinary FAIL. You can also specify flags to exclude. This makes a result be a FAIL, even if the included options are found. To set the conditional, set the variable compiler_conditional_xfail_data to the fields

"[message string] [targets list] [includes list] [excludes list]"

(descriptions below). This is the checked at pass/fail decision time, so there is no need to call the procedure yourself, unless you wish to know if it gets triggered. After a pass/fail, the variable is reset, so it doesn’t effect other tests. It returns 1 if the conditional is true, or 0 if the conditional is false.

\[\text{check\_conditional\_xfail}(\text{message targets includes excludes});\]

\textit{message}

This is the message to print with the normal test result.

\textit{targets}

This is a string with the list targets to activate this conditional on.

\textit{includes}

This is a list of sets of options to search for in the compiler options to activate this conditional. If any set of the options matches, then this conditional is true.

\textit{excludes}

This is a list of sets of options to search for in the compiler options to activate this conditional. If any set of the options matches, (regardless of whether any of the include sets match) then this conditional is de-activated.
Example 6-1. Specifying the conditional xfail data

```c
set compiler_conditional_xfail_data { \
    "I sure wish I knew why this was hosed" \ 
    "sparc*-sun*- *-pc-*-*" \ 
    \{"-Wall -v" "-O3"\} \ 
    \{"-O1" "-Map"\} \ 
}
```

What this does is it matches only for these two targets if "-Wall -v" or "-O3" is set, but neither "-O1" or "-Map" is set. For a set to match, the options specified are searched for independantly of each other, so a "-Wall -v" matches either "-Wall -v" or "-v -Wall". A space seperates the options in the string. Glob-style regular expressions are also permitted.

### 6.3.1.34. Clear_xfail Procedure

Cancel an expected failure (previously declared with `setup_xfail`) for a particular set of configurations. The `config` argument is a list of configuration target names. It is only necessary to call `clear_xfail` if a test case ends without calling either `pass` or `fail`, after calling `setup_xfail`.

```c
clear_xfail(config);
```

`config`

The configuration triplets to clear.

### 6.3.1.35. Verbose Procedure

Test cases can use this function to issue helpful messages depending on the number of `-verbose` options on the runtest command line. It prints string if the value of the
variable verbose is higher than or equal to the optional number. The default value for number is 1. Use the optional -log argument to cause string to always be added to the log file, even if it won’t be printed. Use the optional -n argument to print string without a trailing newline. Use the optional -r argument if string begins with ".-".

\texttt{verbose(-log -n -r string number);}

-log

-n

-\texttt{string} \texttt{number}

\textbf{6.3.1.36. Load\_lib Procedure}

Loads a DejaGnu library file by searching a fixed path built into DejaGnu. If DejaGnu has been installed, it looks in a path starting with the installed library directory. If you are running DejaGnu directly from a source directory, without first running \texttt{make install}, this path defaults to the current directory. In either case, it then looks in the current directory for a directory called \texttt{lib}. If there are duplicate definitions, the last one loaded takes precedence over the earlier ones.
6.3.2. Procedures For Remote Communication

lib/remote.exp defines these functions, for establishing and managing communications. Each of these procedures tries to establish the connection up to three times before returning. Warnings (if retries will continue) or errors (if the attempt is abandoned) report on communication failures. The result for any of these procedures is either -1, when the connection cannot be established, or the spawn ID returned by the Expect command spawn.

It uses the value of the connect field in the target_info array (was connectmode as the type of connection to make. Current supported connection types are tip, kermit, telnet, rsh, rlogin, and netdata. If the -reboot option was used on the runtest command line, then the target is rebooted before the connection is made.

6.3.2.1. Call_remote Procedure

call_remote(type proc dest args);

proc

dest
6.3.2.2. Check_for_board_status Procedure

check_for_board_status(variable);

variable

6.3.2.3. File_on_build Procedure

file_on_build(op file args);

op

file

args

6.3.2.4. File_on_host Procedure
Chapter 6. Reference

\texttt{file_on_host}(op\ file\ args); \\

\texttt{op}\ \\

\texttt{file}\ \\

\texttt{args}\ \\

6.3.2.5. Local\_exec Procedure

\texttt{local\_exec}(commandline\ inp\ outp\ timeout); \\

\texttt{inp}\ \\

\texttt{outp}\ \\

\texttt{timeout}\ \\

6.3.2.6. Remote\_binary Procedure

\texttt{remote\_binary}(host);
host

6.3.2.7. Remote_close Procedure

remote_close(shellid);

shellid
This is the value returned by a call to remote_open. This closes the connection to
the target so resources can be used by others. This parameter can be left off if the
fileid field in the target_info array is set.

6.3.2.8. Remote_download Procedure

remote_download(dest file args);

dest

file

args
6.3.2.9. Remote_exec Procedure

remote_exec(hostname program args);

hostname

program

args

6.3.2.10. Remote_expect Procedure

remote_expect(board timeout args);

board

timeout

args

6.3.2.11. Remote_file Procedure
remote_file(dest args);

dest

args

6.3.2.12. Remote_ld Procedure

remote_ld(dest prog);

dest

prog

6.3.2.13. Remote_load Procedure

remote_load(dest prog args);

dest
6.3.2.14. Remote_open Procedure

remote_open(type);

type
This is passed host or target. Host or target refers to whether it is a connection to a remote target, or a remote host. This opens the connection to the desired target or host using the default values in the configuration system. It returns that spawn_id of the process that manages the connection. This value can be used in Expect or exp_send statements, or passed to other procedures that need the connection process’s id. This also sets the fileid field in the target_info array.

6.3.2.15. Remote_pop_conn Procedure

remote_pop_conn(host);

host
6.3.2.16. Remote_push_conn Procedure

remote_push_conn(host);

host

6.3.2.17. Remote_raw_binary Procedure

remote_raw_binary(host);

host

6.3.2.18. Remote_raw_close Procedure

remote_raw_close(host);

host

6.3.2.19. Remote_raw_file Procedure

remote_raw_file(dest args);
Chapter 6. Reference

6.3.2.20. remote_raw_ld Procedure

remote_raw_ld(dest prog);

dest

prog

6.3.2.21. Remote_raw_load Procedure

remote_raw_load(dest prog args);

dest

prog
6.3.2.22. Remote_raw_open Procedure

remote_raw_open(args);

6.3.2.23. Remote_raw_send Procedure

remote_raw_send(dest string);

6.3.2.24. Remote_raw_spawn Procedure

remote_raw_spawn(dest commandline);
6.3.2.25. Remote_raw_transmit Procedure

\texttt{remote\_raw\_transmit}\(\textit{\texttt{dest file}}\); 

\texttt{dest} 

\texttt{file} 

6.3.2.26. Remote_raw_wait Procedure

\texttt{remote\_raw\_wait}\(\textit{\texttt{dest timeout}}\); 

\texttt{dest} 

\texttt{timeout}
6.3.2.27. Remote_reboot Procedure

remote_reboot(host);

host

6.3.2.28. Remote_send Procedure

remote_send(dest string);

dest

string

6.3.2.29. Remote_spawn Procedure

remote_spawn(dest commandline args);

dest

commandline
6.3.2.30. Remote_swap_conn Procedure

remote_swap_conn(host);

6.3.2.31. Remote_transmit Procedure

remote_transmit(dest file);

dest

file

6.3.2.32. Remote_upload Procedure

remote_upload(dest srcfile arg);
6.3.2.33. Remote_wait Procedure

```
remote_wait(dest timeout);
```

6.3.2.34. Standard_close Procedure

```
standard_close(host);
```
6.3.2.35. Standard_download Procedure

\texttt{standard\_download(dest file destfile);}

dest

defile

destfile

6.3.2.36. Standard_exec Procedure

\texttt{standard\_exec(hostname args);}

hostname

args

6.3.2.37. Standard\_file Procedure

\texttt{standard\_file(dest, op, args);}
6.3.2.38. Standard_load Procedure

\[ \text{standard_load}(\text{dest prog args}); \]

\[ \text{dest} \]

\[ \text{prog} \]

\[ \text{args} \]

6.3.2.39. Standard_reboot Procedure

\[ \text{standard_reboot}(\text{host}); \]

\[ \text{host} \]

6.3.2.40. Standard_send Procedure

\[ \text{standard_send}(\text{dest string}); \]
6.3.2.41. Standard_spawn Procedure

\texttt{standard\_spawn(dest\ commandline);}
6.3.2.43. Standard_upload Procedure

```plaintext
standard_upload(dest srcfile destfile);
```

- `dest`
- `srcfile`
- `destfile`

6.3.2.44. Standard_wait Procedure

```plaintext
standard_wait(dest timeout);
```

- `dest`
- `timeout`

6.3.2.45. Unix_clean_filename Procedure

```plaintext
unix_clean_filename(dest file);
```
6.3.3. Procedures For Using Utilities to Connect
telnet, rsh, tip, kermit

6.3.3.1. telnet Procedure

telnet(hostname port);

rlogin(hostname);

6.3.3.2. rsh Procedure

rsh(hostname);

hostname

This refers to the IP address or name (for example, an entry in /etc/hosts) for this target. The procedure names reflect the Unix utility used to establish a connection. The optional port is used to specify the IP port number. The value of the netport field in the target_info array is used. (was $netport) This value has
two parts, the hostname and the port number, separated by a :. If host or target is used in the hostname field, than the config array is used for all information.

### 6.3.3.3. Tip Procedure

```plaintext
tip(port);
```

`port`

Connect using the Unix utility `tip`. `Port` must be a name from the tip configuration file `/etc/remote`. Often, this is called hardwire, or something like ttya. This file holds all the configuration data for the serial port. The value of the serial field in the target_info array is used. (was $serialport) If `host` or `target` is used in the `port` field, than the config array is used for all information. The config array is used for all information.

### 6.3.3.4. Kermit Procedure

```plaintext
kermit(port bps);
```

`port`

Connect using the program `kermit`. `Port` is the device name, e.g. `/dev/ttyb`.

`bps`

`bps` is the line speed to use (in its per second) for the connection. The value of the serial field in the target_info array is used. (was $serialport) If `host` or `target` is used in the `port` field, than the config array is used for all information. The config array is used for all information.
6.3.3.5. kermit_open Procedure

kermit_open(dest args);

dest

args

6.3.3.6. Kermit_command Procedure

kermit_command(dest args);

dest

args

6.3.3.7. Kermit_send Procedure

kermit_send(dest string args);

dest
string

args

6.3.3.8. Kermit_transmit Procedure

kermit_transmit(dest file args);

dest

file

args

6.3.3.9. Telnet_open Procedure

telnet_open(hostname args);

hostname
6.3.3.10. Telnet_binary Procedure

telnet_binary(hostname);

hostname

6.3.3.11. Telnet_transmit Procedure

telnet_transmit(dest file args);

dest

file

args

6.3.3.12. Tip_open Procedure
6.3.3.13. Rlogin_open Procedure

rlogin_open(arg);

arg

6.3.3.14. Rlogin_spawn Procedure

rlogin_spawn(dest cmdline);

dest
cmdline

6.3.3.15. Rsh_open Procedure

rsh_open(hostname);
6.3.3.16. Rsh_download Procedure

\texttt{rsh\_download(desthost srcfile destfile);}

desthost

call

call

6.3.3.17. Rsh_upload Procedure

\texttt{rsh\_upload(desthost srcfile destfile);}

desthost

call

call
6.3.3.18. Rsh_exec Procedure

\texttt{rsh\_exec(boardname cmd args);} ;

\texttt{boardname}

\texttt{cmd}

\texttt{args}

6.3.3.19. Ftp_open Procedure

\texttt{ftp\_open(host);} ;

\texttt{host}

6.3.3.20. Ftp_upload Procedure
Chapter 6. Reference

\[ \text{ftp-upload}(\text{host remotefile localfile}); \]

\text{host}

\text{remotefile}

\text{localfile}

6.3.3.21. Ftp_download Procedure

\[ \text{ftp-download}(\text{host localfile remotefile}); \]

\text{host}

\text{localfile}

\text{remotefile}

6.3.3.22. Ftp_close Procedure

\[ \text{ftp-close}(\text{host}); \]
host

6.3.3.23. Tip_download Procedure

tip_download(spawnid file);

spawnid

Download file to the process spawnid (the value returned when the connection was established), using the ~put command under tip. Most often used for single board computers that require downloading programs in ASCII S-records. Returns 1 if an error occurs, 0 otherwise.

file

This is the filename to download.

6.3.4. Procedures For Target Boards

6.3.4.1. Default_link Procedure

default_link(board objects destfile flags);

board
Chapter 6. Reference

objects

destfile

flags

6.3.4.2. Default_target_assemble Procedure

default_target_assemble(source destfile flags);

source

destfile

flags

6.3.4.3. default_target_compile Procedure

default_target_compile(source destfile type options);
source

destfile

type

6.3.4.4. Pop_config Procedure

pop_config(type);

type

6.3.4.5. Prune_warnings Procedure

prune_warnings(text);

text
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6.3.4.6. Push_build Procedure

\texttt{push\_build(name);} 

name

6.3.4.7. push_config Procedure

\texttt{push\_config(type name);} 

type

name

6.3.4.8. Reboot_target Procedure

\texttt{reboot\_target();} 

6.3.4.9. Target_assemble Procedure

\texttt{target\_assemble(source destfile flags);}
source

destfile

flags

6.3.4.10. Target_compile Procedure

target_compile(source destfile type options);

source

destfile

type

options
6.3.5. Target Database Procedures

6.3.5.1. Board_info Procedure

\texttt{board\_info(machine\ op\ args);}

\texttt{machine}

\texttt{op}

\texttt{args}

6.3.5.2. Host_info Procedure

\texttt{host\_info(op\ args);}

\texttt{op}

\texttt{args}

6.3.5.3. Set_board_info Procedure
set_board_info(entry value);

entry

value

6.3.5.4. Set_currtarget_info Procedure

set_currtarget_info(entry value);

entry

value

6.3.5.5. Target_info Procedure

target_info(op args);

op
6.3.5.6. Unset_board_info Procedure

unset_board_info(entry);

entry

6.3.5.7. Unset_currtarget_info Procedure

unset_currtarget_info(entry);

entry

6.3.5.8. Push_target Procedure

This makes the target named name be the current target connection. The value of name is an index into the target_info array and is set in the global config file.

push_target(name);
The name of the target to make current connection.

6.3.5.9. Pop_target Procedure
This unsets the current target connection.

\texttt{pop\_target();}

6.3.5.10. List_targets Procedure
This lists all the supported targets for this architecture.

\texttt{list\_targets();}

6.3.5.11. Push_host Procedure
This makes the host named \texttt{name} be the current remote host connection. The value of \texttt{name} is an index into the target\_info array and is set in the global config file.

\texttt{push\_host(name);}

6.3.5.12. Pop_host Procedure
This unsets the current host connection.
6.3.5.13. Compile Procedure

This invokes the compiler as set by CC to compile the file file. The default options for many cross compilation targets are guessed by DejaGnu, and these options can be added to by passing in more parameters as arguments to compile. Optionally, this will also use the value of the cflags field in the target config array. If the host is not the same as the build machines, then then compiler is run on the remote host using execute_anywhere.

compile(file);

6.3.5.14. Archive Procedure

This produces an archive file. Any parameters passed to archive are used in addition to the default flags. Optionally, this will also use the value of the arflags field in the target config array. If the host is not the same as the build machines, then then archiver is run on the remote host using execute_anywhere.

archive(file);
6.3.5.15. Ranlib Procedure

This generates an index for the archive file for systems that aren’t POSIX yet. Any parameters passed to ranlib are used in for the flags.

\texttt{ranlib(file)};

\texttt{file}

6.3.5.16. Execute\textunderscore anywhere Procedure

This executes the \textit{cmdline} on the proper host. This should be used as a replacement for the Tcl command \texttt{exec} as this version utilizes the target config info to execute this command on the build machine or a remote host. All config information for the remote host must be setup to have this command work. If this is a canadian cross, (where we test a cross compiler that runs on a different host then where DejaGnu is running) then a connection is made to the remote host and the command is executed there. It returns either REMOTERROR (for an error) or the output produced when the command was executed. This is used for running the tool to be tested, not a test case.

\texttt{execute\_anywhere(cmdline)};

\texttt{cmdline}

6.3.6. Platform Dependant Procedures

Each combination of target and tool requires some target-dependent procedures. The
names of these procedures have a common form: the tool name, followed by an
underbar _, and finally a suffix describing the procedure’s purpose. For example, a
procedure to extract the version from GDB is called gdb_version.

runtest itself calls only two of these procedures, ${tool}_exit and ${tool}_version;
these procedures use no arguments.

The other two procedures, ${tool}_start and ${tool}_load}, are only called by the test
suites themselves (or by testsuite-specific initialization code); they may take arguments
or not, depending on the conventions used within each test suite.

The usual convention for return codes from any of these procedures (although it is not
required by runtest) is to return 0 if the procedure succeeded, 1 if it failed, and -1 if
there was a communication error.

6.3.6.1. ${tool}_start Procedure

Starts a particular tool. For an interactive tool, ${tool}_start starts and initializes
the tool, leaving the tool up and running for the test cases; an example is gdb_start,
the start function for GDB. For a batch oriented tool, ${tool}_start is optional; the
recommended convention is to let ${tool}_start run the tool, leaving the output in a
variable called comp_output. Test scripts can then analyze $comp_output to
determine the test results. An example of this second kind of start function is
gcc_start, the start function for GCC.

DejaGnu itself does not call ${tool}_start. The initialization module
${tool}_init.exp must call ${tool}_start for interactive tools; for
batch-oriented tools, each individual test script calls ${tool}_start (or makes other
arrangements to run the tool).

${tool}_start();

6.3.6.2. ${tool}_load Procedure

Loads something into a tool. For an interactive tool, this conditions the tool for a
particular test case; for example, \texttt{gdb\_load} loads a new executable file into the debugger. For batch oriented tools, \texttt{${tool}\_load} may do nothing—though, for example, the GCC support uses \texttt{gcc\_load} to load and run a binary on the target environment. Conventionally, \texttt{${tool}\_load} leaves the output of any program it runs in a variable called \texttt{$exec\_output}}. Writing \texttt{${tool}\_load} can be the most complex part of extending DejaGnu to a new tool or a new target, if it requires much communication coding or file downloading. Test scripts call \texttt{${tool}\_load}.

\texttt{${tool}\_load()};

\textbf{6.3.6.3. \texttt{${tool}\_exit} Procedure}

Cleans up (if necessary) before DejaGnu exits. For interactive tools, this usually ends the interactive session. You can also use \texttt{${tool}\_exit} to remove any temporary files left over from the tests. \texttt{runtest} calls \texttt{${tool}\_exit}.

\texttt{${tool}\_exit();}

\textbf{6.3.6.4. \texttt{${tool}\_version} Procedure}

Prints the version label and number for \texttt{${tool}}. This is called by the DejaGnu procedure that prints the final summary report. The output should consist of the full path name used for the tested tool, and its version number.

\texttt{${tool}\_version();}
6.3.7. Utility Procedures

6.3.7.1. Getdirs Procedure

Returns a list of all the directories in the single directory a single directory that match an optional pattern.

\texttt{getdirs(rootdir pattern)};

\textit{args}

\textit{pattern}

If you do not specify \textit{pattern}, \texttt{Getdirs} assumes a default pattern of \texttt{*}. You may use the common shell wildcard characters in the pattern. If no directories match the pattern, then a NULL string is returned.

6.3.7.2. Find Procedure

Search for files whose names match \textit{pattern} (using shell wildcard characters for filename expansion). Search subdirectories recursively, starting at \texttt{rootdir}. The result is the list of files whose names match; if no files match, the result is empty. Filenames in the result include all intervening subdirectory names. If no files match the pattern, then a NULL string is returned.

\texttt{find(rootdir pattern)};

\textit{rootdir}

The top level directory to search the search from.
pattern

A csh "glob" style regular expression representing the files to find.

6.3.7.3. Which Procedure

Searches the execution path for an executable file binary, like the BSD which utility. This procedure uses the shell environment variable PATH. It returns 0 if the binary is not in the path, or if there is no PATH environment variable. If binary is in the path, it returns the full path to binary.

\texttt{which\(\text{file}\);} 

binary

The executable program or shell script to look for.

6.3.7.4. Grep Procedure

Search the file called filename (a fully specified path) for lines that contain a match for regular expression regexp. The result is a list of all the lines that match. If no lines match, the result is an empty string. Specify regexp using the standard regular expression style used by the Unix utility program grep.

Use the optional third argument line to start lines in the result with the line number in filename. (This argument is simply an option flag; type it just as shown -line.)

\texttt{grep\(\text{filename} \text{regexp} -\text{line}\);} 

filename

The file to search.
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regexp

The Unix style regular expression (as used by the grep Unix utility) to search for.

-line

Prefix the line number to each line where the regexp matches.

6.3.7.5. Prune Procedure

Remove elements of the Tcl list list. Elements are fields delimited by spaces. The result is a copy of list, without any elements that match pattern. You can use the common shell wildcard characters to specify the pattern.

prune(list pattern);

list

A Tcl list containing the original data. Commonly this is the output of a batch executed command, like running a compiler.

pattern

The csh shell "glob" style pattern to search for.

6.3.7.6. Slay Procedure

This look in the process table for name and send it a unix SIGINT, killing the process. This will only work under NT if you have Cygwin or another Unix system for NT installed.

slay(name);
name

The name of the program to kill.

6.3.7.7. Absolute Procedure

This procedure takes the relative path, and converts it to an absolute path.

absolute(path);

path

The path to convert.

6.3.7.8. Psoure Procedure

This sources the file filename, and traps all errors. It also ignores all extraneous output. If there was an error it returns a 1, otherwise it returns a 0.

psoure(file);

filename

The filename to Tcl script to source.

6.3.7.9. Runtest_file_p Procedure

Search runtests for testcase and return 1 if found, 0 if not. runtests is a list of two elements. The first is the pathname of the testsuite expect script running. The second is a copy of what was on the right side of the = if

foo.exp="..."
Chapter 6. Reference

" was specified, or an empty string if no such argument is present. This is used by tools like compilers where each testcase is a file.

\[
\text{runtest\_file\_p}(\text{runtests } \text{testcase});
\]

\text{runtests}

The pathname of the testsuite expect script running

\text{testcase}

The test case filename.

6.3.7.10. Diff Procedure

Compares the two files and returns a 1 if they match, or a 0 if they don’t. If verbose is set, then it’ll print the differences to the screen.

\[
\text{diff}(\text{file\_1 } \text{file\_2});
\]

\text{file\_1}

The first file to compare.

\text{file\_2}

The second file to compare.

6.3.7.11. Setenv Procedure

Sets the environment variable \text{var} to the value \text{val}.

\[
\text{setenv}(\text{var } \text{val});
\]
6.3.7.12. unsetenv Procedure
Unsets the environment variable var.

\texttt{unsetenv(var);} 

6.3.7.13. Getenv Procedure
Returns the value of var in the environment if it exists, otherwise it returns NULL.

\texttt{getenv(var);} 

6.3.7.14. Prune\_system\_crud Procedure
For system system, delete text the host or target operating system might issue that will interfere with pattern matching of program output in text. An example is the message that is printed if a shared library is out of date.
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```
prune_system_crud(system test);
```

```
system

The system error messages to look for to screen out .
```

```
text

The Tcl variable containing the text.
```

6.3.8. Libgloss, A Free BSP

Libgloss is a free BSP (Board Support Package) commonly used with GCC and G++ to produce a fully linked executable image for an embedded systems.

6.3.8.1. Libgloss_link_flags Procedure

```
libgloss_link_flags(args);
```

```
args
```

6.3.8.2. Libgloss_include_flags Procedure

```
libgloss_include_flags(args);
```
6.3.8.3. Newlib_link_flags Procedure

newlib_link_flags(args);

6.3.8.4. Newlib_include_flags Procedure

newlib_include_flags(args);

6.3.8.5. Libio_include_flags Procedure

libio_include_flags(args);
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6.3.8.6. Libio_link_flags Procedure

libio_link_flags(args);

args

6.3.8.7. G++_include_flags Procedure

g++_include_flags(args);

args

6.3.8.8. G++_link_flags Procedure

g++_link_flags(args);

args

6.3.8.9. Libstdc++_include_flags Procedure

libstdc++_include_flags(args);
6.3.8.10. Libstdc++_link_flags Procedure

```c
libstdc++_link_flags(args);
```

6.3.8.11. Get_multilibs Procedure

```c
get_multilibs(args);
```

6.3.8.12. Find_binutils_progs Procedure

```c
find_binutils_progs(name);
```
6.3.8.13. Find_gcc Procedure

find_gcc();

6.3.8.14. Find_gcj Procedure

find_gcj();

6.3.8.15. Find_g++ Procedure

find_g++;

6.3.8.16. Find_g77 Procedure

find_g77();

6.3.8.17. Process_multilib_options Procedure

process_multilib_options(args);

args
6.3.8.18. Add_multilib_option Procedure

\texttt{add\_multilib\_option(args);}

\textit{args}

6.3.8.19. Find_gas Procedure

\texttt{find\_gas();}

6.3.8.20. Find_ld Procedure

\texttt{find\_ld();}

6.3.8.21. Build_wrapper Procedure

\texttt{build\_wrapper(gluefile);}

\textit{gluefile}

6.3.8.22. Winsup_include_flags Procedure
6.3.8.23. Winsup_link_flags Procedure

winsup_link_flags(args);

args

6.3.9. Procedures for debugging your Tcl code.

lib/debugger.exp defines these utility procedures:

6.3.9.1. Dumpvars Procedure

This takes a csh style regular expression (glob rules) and prints the values of the global variable names that match. It is abbreviated as dv.

dumpvars(vars);

vars

The variables to dump.
6.3.9.2. Dumplocals Procedure

This takes a csh style regular expression (glob rules) and prints the values of the local variable names that match. It is abbreviated as \textit{dl}.

\texttt{dumplocals(args);}

\texttt{args}

6.3.9.3. Dumprocs Procedure

This takes a csh style regular expression (glob rules) and prints the body of all procs that match. It is abbreviated as \textit{dp}.

\texttt{dumprocs(pattern);}

\texttt{pattern}

The csh "glob" style pattern to look for.

6.3.9.4. Dumpwatch Procedure

This takes a csh style regular expression (glob rules) and prints all the watchpoints. It is abbreviated as \textit{dw}.

\texttt{dumpwatch(pattern);}

\texttt{pattern}

The csh "glob" style pattern to look for.
6.3.9.5. Watcharray Procedure

\texttt{watcharray(element type);} \\
\textit{type} \\
The csh "glob" style pattern to look for.

6.3.9.6. Watchvar Procedure

\texttt{watchvar(var type);} \\
\textit{args}

6.3.9.7. Watchunset Procedure

This breaks program execution when the variable var is unset. It is abbreviated as \textit{wu}.

\texttt{watchunset(arg);} \\
\textit{args}

6.3.9.8. Watchwrite Procedure

This breaks program execution when the variable var is written. It is abbreviated as \textit{ww}. 

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\texttt{watchwrite}(\texttt{var});

\texttt{var}
\hspace{1cm} \text{The variable to watch.}

\textbf{6.3.9.9. Watchread Procedure}

This breaks program execution when the variable \texttt{var} is read. It is abbreviated as \texttt{wr}.

\texttt{watchread}(\texttt{var});

\texttt{var}
\hspace{1cm} \text{The variable to watch.}

\textbf{6.3.9.10. Watchdel Procedure}

This deletes a the watchpoint from the watch list. It is abbreviated as \texttt{wd}.

\texttt{watchdel}(\texttt{args});

\texttt{args}

\textbf{6.3.9.11. Print Procedure}

This prints the value of the variable \texttt{var}. It is abbreviated as \texttt{p}.

\texttt{print}(\texttt{var});
6.3.9.12. Quit Procedure

This makes runtest exit. It is abbreviated as $q$.

`quit();`

6.4. File Map

This is a map of the files in DejaGnu.

- runtest
- runtest.exp
- stub-loader.c
- testglue.c
- config
- baseboards
- lib/debugger.exp
- lib/dg.exp
- lib/framework.exp
- lib/ftp.exp
• lib/kermit.exp
• lib/libgloss.exp
• lib/mondfe.exp
• lib/remote.exp
• lib/rlogin.exp
• lib/rsh.exp
• lib/standard.exp
• lib/target.exp
• lib/targetdb.exp
• lib/telnet.exp
• lib/tip.exp
• lib/util-defs.exp
• lib/utils.exp
• lib/xsh.exp
• lib/dejagnu.exp
Chapter 7. Unit Testing API

7.1. C Unit Testing API

All of the functions that take a \textit{msg} parameter use a C char * that is the message to be displayed. There currently is no support for variable length arguments.

7.1.1. Pass Function

This prints a message for a successful test completion.

\texttt{pass}(\textit{msg});

7.1.2. Fail Function

This prints a message for an unsuccessful test completion.

\texttt{fail}(\textit{msg});

7.1.3. Untested Function

This prints a message for an test case that isn’t run for some technical reason.

\texttt{untested}(\textit{msg});
7.1.4. Unresolved Function

This prints a message for a test case that is run, but there is no clear result. These output states require a human to look over the results to determine what happened.

\texttt{unresolved}(msg);

7.1.5. Totals Function

This prints out the total numbers of all the test state outputs.

\texttt{totals}();

7.2. C++ Unit Testing API

All of the methods that take a \textit{msg} parameter use a C char * or STL string, that is the message to be displayed. There currently is no support for variable length arguments.

7.2.1. Pass Method

This prints a message for a successful test completion.

\texttt{TestState::pass}(msg);

7.2.2. Fail Method

This prints a message for an unsuccessful test completion.
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7.2.3. Untested Method

This prints a message for a test case that isn’t run for some technical reason.

`TestState::untested(msg);`

7.2.4. Unresolved Method

This prints a message for a test case that is run, but there is no clear result. These output states require a human to look over the results to determine what happened.

`TestState::unresolved(msg);`

7.2.5. Totals Method

This prints out the total numbers of all the test state outputs.

`TestState::totals();`