4.2 Starting your Program

`run`
`r`

Use the `run` command to start your program under GDB. You must first specify the program name with an argument to GDB (see Getting In and Out of GDB), or by using the `file` or `exec-file` command (see Commands to Specify Files).

If you are running your program in an execution environment that supports processes, `run` creates an inferior process and makes that process run your program. In some environments without processes, `run` jumps to the start of your program. Other targets, like '`remote`', are always running. If you get an error message like this one:

```
The "remote" target does not support "run".
Try "help target" or "continue".
```

then use `continue` to run your program. You may need `load` first (see load).

The execution of a program is affected by certain information it receives from its superior. GDB provides ways to specify this information, which you must do *before* starting your program. (You can change it after starting your program, but such changes only affect your program the next time you start it.) This information may be divided into four categories:

The *arguments.*

Specify the arguments to give your program as the arguments of the `run` command. If a shell is available on your target, the shell is used to pass the arguments, so that you may use normal conventions (such as wildcard expansion or variable substitution) in describing the arguments. In Unix systems, you can control which shell is used with the `SHELL` environment variable. If you do not define `SHELL`, GDB uses the default shell (`/bin/sh`). You can disable use of any shell with the `set startup-with-shell` command (see below for details).

The *environment.*

Your program normally inherits its environment from GDB, but you can use the GDB commands `set environment` and `unset environment` to change parts of the environment that affect your program. See Your Program's Environment.

The *working directory.*

You can set your program's working directory with the command `set cwd`. If you do not set any working directory with this command, your program will inherit GDB's working directory if native debugging, or the remote server's working directory if remote debugging. See Your Program's Working Directory.

The *standard input and output.*

Your program normally uses the same device for standard input and standard output as GDB is using. You can redirect input and output in the `run` command line, or you can use the `tty` command to set a different device for your program. See Your Program's Input and Output.

Warning: While input and output redirection work, you cannot use pipes to pass the output of the program you are debugging to another program; if you attempt this, GDB is likely to wind up debugging the wrong program.

When you issue the `run` command, your program begins to execute immediately. See Stopping and Continuing, for discussion of how to arrange for your program to stop. Once your program has stopped, you may call functions in your program, using the `print` or `call` commands. See Examining Data.

If the modification time of your symbol file has changed since the last time GDB read its symbols, GDB discards its symbol table, and reads it again. When it does this, GDB tries to retain your current breakpoints.

`start`

The name of the main procedure can vary from language to language. With C or C++, the main procedure name is always `main`, but other languages such as Ada do not require a specific name for their main procedure. The debugger provides a convenient way to start the execution of the program and to stop at the beginning of the main procedure, depending on the language used.

The '`start`' command does the equivalent of setting a temporary breakpoint at the beginning of the main procedure and then invoking the '`run`' command.

Some programs contain an *elaboration* phase where some startup code is executed before the main procedure is called. This depends on the languages used to write your program. In C++, for instance, constructors for static and global objects are executed before `main` is called. It is therefore possible that the debugger stops before reaching the main procedure. However, the temporary breakpoint will remain to halt execution.

Specify the arguments to give to your program as arguments to the '`start`' command. These arguments will be given verbatim to the underlying '`run`' command. Note that the same arguments will be reused if no argument is provided during subsequent calls to '`start`' or '`run`'.

It is sometimes necessary to debug the program during elaboration. In these cases, using the `start` command would stop the execution of your program too late, as the program would have already completed the elaboration phase. Under these circumstances, either insert breakpoints in your elaboration code before running your program or use the `starti` command.

`starti`

The '`starti`' command does the equivalent of setting a temporary breakpoint at the first instruction of a program's execution and then invoking the '`run`' command. For programs containing an elaboration phase, the `starti` command will stop execution at the start of the elaboration phase.

`set exec-wrapper` *`wrapper`*
`show exec-wrapper`
`unset exec-wrapper`

When '`exec-wrapper`' is set, the specified wrapper is used to launch programs for debugging. GDB starts your program with a shell command of the form `exec` *`wrapper program`*. Quoting is added to *program* and its arguments, but not to *wrapper*, so you should add quotes if appropriate for your shell. The wrapper runs until it executes your program, and then GDB takes control.

You can use any program that eventually calls `execve` with its arguments as a wrapper. Several standard Unix utilities do this, e.g. `env` and `nohup`. Any Unix shell script ending with `exec "$@"` will also work.

For example, you can use `env` to pass an environment variable to the debugged program, without setting the variable in your shell's environment:

```
(gdb) set exec-wrapper env 'LD_PRELOAD=libtest.so'
(gdb) run
```

This command is available when debugging locally on most targets, excluding DJGPP, Cygwin, MS Windows, and QNX Neutrino.

`set startup-with-shell`
`set startup-with-shell on`
`set startup-with-shell off`
`show startup-with-shell`

On Unix systems, by default, if a shell is available on your target, GDB) uses it to start your program. Arguments of the `run` command are passed to the shell, which does variable substitution, expands wildcard characters and performs redirection of I/O. In some circumstances, it may be useful to disable such use of a shell, for example, when debugging the shell itself or diagnosing startup failures such as:

```
(gdb) run
Starting program: ./a.out
During startup program terminated with signal SIGSEGV, Segmentation fault.
```

which indicates the shell or the wrapper specified with '`exec-wrapper`' crashed, not your program. Most often, this is caused by something odd in your shell's non-interactive mode initialization file—such as `.cshrc` for C-shell, `$.zshenv` for the Z shell, or the file specified in the '`BASH_ENV`' environment variable for BASH.

`set auto-connect-native-target`
`set auto-connect-native-target on`
`set auto-connect-native-target off`
`show auto-connect-native-target`

By default, if the current inferior is not connected to any target yet (e.g., with `target remote`), the `run` command starts your program as a native process under GDB, on your local machine. If you're sure you don't want to debug programs on your local machine, you can tell GDB to not connect to the native target automatically with the `set auto-connect-native-target off` command.

If `on`, which is the default, and if the current inferior is not connected to a target already, the `run` command automaticaly connects to the native target, if one is available.

If `off`, and if the current inferior is not connected to a target already, the `run` command fails with an error:

```
(gdb) run
Don't know how to run.  Try "help target".
```

If the current inferior is already connected to a target, GDB always uses it with the `run` command.

In any case, you can explicitly connect to the native target with the `target native` command. For example,

```
(gdb) set auto-connect-native-target off
(gdb) run
Don't know how to run.  Try "help target".
(gdb) target native
(gdb) run
Starting program: ./a.out
[Inferior 1 (process 10421) exited normally]
```

In case you connected explicitly to the `native` target, GDB remains connected even if all inferiors exit, ready for the next `run` command. Use the `disconnect` command to disconnect.

Examples of other commands that likewise respect the `auto-connect-native-target` setting: `attach`, `info proc`, `info os`.

`set disable-randomization`
`set disable-randomization on`

This option (enabled by default in GDB) will turn off the native randomization of the virtual address space of the started program. This option is useful for multiple debugging sessions to make the execution better reproducible and memory addresses reusable across debugging sessions.

This feature is implemented only on certain targets, including GNU/Linux. On GNU/Linux you can get the same behavior using

```
(gdb) set exec-wrapper setarch `uname -m` -R
```

`set disable-randomization off`

Leave the behavior of the started executable unchanged. Some bugs rear their ugly heads only when the program is loaded at certain addresses. If your bug disappears when you run the program under GDB, that might be because GDB by default disables the address randomization on platforms, such as GNU/Linux, which do that for stand-alone programs. Use `set disable-randomization off` to try to reproduce such elusive bugs.

On targets where it is available, virtual address space randomization protects the programs against certain kinds of security attacks. In these cases the attacker needs to know the exact location of a concrete executable code. Randomizing its location makes it impossible to inject jumps misusing a code at its expected addresses.

Prelinking shared libraries provides a startup performance advantage but it makes addresses in these libraries predictable for privileged processes by having just unprivileged access at the target system. Reading the shared library binary gives enough information for assembling the malicious code misusing it. Still even a prelinked shared library can get loaded at a new random address just requiring the regular relocation process during the startup. Shared libraries not already prelinked are always loaded at a randomly chosen address.

Position independent executables (PIE) contain position independent code similar to the shared libraries and therefore such executables get loaded at a randomly chosen address upon startup. PIE executables always load even already prelinked shared libraries at a random address. You can build such executable using `gcc -fPIE -pie`.

Heap (malloc storage), stack and custom mmap areas are always placed randomly (as long as the randomization is enabled).

`show disable-randomization`

Show the current setting of the explicit disable of the native randomization of the virtual address space of the started program.