The GNU Go Compiler

For GCC version 17.0.0 (pre-release)

(GCC)

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1 Invoking gccgo

The gccgo command is a frontend to gcc and supports many of the same options. See Section "Option Summary" in *Using the GNU Compiler Collection (GCC)*. This manual only documents the options specific to gccgo.

The gccgo command may be used to compile Go source code into an object file, link a collection of object files together, or do both in sequence.

Go source code is compiled as packages. A package consists of one or more Go source files. All the files in a single package must be compiled together, by passing all the files as arguments to gccgo. A single invocation of gccgo may only compile a single package.

One Go package may import a different Go package. The imported package must have already been compiled; gccgo will read the import data directly from the compiled package. When this package is later linked, the compiled form of the package must be included in the link command.

Go programs must generally be compiled with debugging information, and -g1 is the default as described below. Stripping a Go program will generally cause it to misbehave or fail.

-I*dir*
: Specify a directory to use when searching for an import package at compile time.

-L*dir*
: When linking, specify a library search directory, as with gcc.

-fgo-pkgpath=*string*
: Set the package path to use. This sets the value returned by the PkgPath method of reflect.Type objects. It is also used for the names of globally visible symbols. The argument to this option should normally be the string that will be used to import this package after it has been installed; in other words, a pathname within the directories specified by the -I option.

-fgo-prefix=*string*
: An alternative to -fgo-pkgpath. The argument will be combined with the package name from the source file to produce the package path. If -fgo-pkgpath is used, -fgo-prefix will be ignored.

  Go permits a single program to include more than one package with the same name in the package clause in the source file, though obviously the two packages must be imported using different pathnames. In order for this to work with gccgo, either -fgo-pkgpath or -fgo-prefix must be specified when compiling a package.

  Using either -fgo-pkgpath or -fgo-prefix disables the special treatment of the main package and permits that package to be imported like any other.

-fgo-relative-import-path=*dir*
: A relative import is an import that starts with ./ or ../. If this option is used, gccgo will use *dir* as a prefix for the relative import when searching for it.

`-frequire-return-statement`
`-fno-require-return-statement`
By default `gccgo` will warn about functions which have one or more return parameters but lack an explicit `return` statement. This warning may be disabled using `-fno-require-return-statement`.

`-fgo-check-divide-zero`
Add explicit checks for division by zero. In Go a division (or modulos) by zero causes a panic. On Unix systems this is detected in the runtime by catching the `SIGFPE` signal. Some processors, such as PowerPC, do not generate a SIGFPE on division by zero. Some runtimes do not generate a signal that can be caught. On those systems, this option may be used. Or the checks may be removed via `-fno-go-check-divide-zero`. This option is currently on by default, but in the future may be off by default on systems that do not require it.

`-fgo-check-divide-overflow`
Add explicit checks for division overflow. For example, division overflow occurs when computing `INT_MIN / -1`. In Go this should be wrapped, to produce `INT_MIN`. Some processors, such as x86, generate a trap on division overflow. On those systems, this option may be used. Or the checks may be removed via `-fno-go-check-divide-overflow`. This option is currently on by default, but in the future may be off by default on systems that do not require it.

`-fno-go-optimize-allocs`
Disable escape analysis, which tries to allocate objects on the stack rather than the heap.

`-fgo-debug-escape`*`n`*
Output escape analysis debugging information. Larger values of *n* generate more information.

`-fgo-debug-escape-hash=`*`n`*
A hash value to debug escape analysis. *n* is a binary string. This runs escape analysis only on functions whose names hash to values that match the given suffix *n*. This can be used to binary search across functions to uncover escape analysis bugs.

`-fgo-debug-optimization`
Output optimization diagnostics.

`-fgo-c-header=`*`file`*
Write top-level named Go struct definitions to *file* as C code. This is used when compiling the runtime package.

`-fgo-compiling-runtime`
Apply special rules for compiling the runtime package. Implicit memory allocation is forbidden. Some additional compiler directives are supported.

`-fgo-embedcfg=`*`file`*
Identify a JSON file used to map patterns used with special `//go:embed` comments to the files named by the patterns. The JSON file should have two components: `Patterns` maps each pattern to a list of file names, and `Files`

maps each file name to a full path to the file. This option is intended for use by the `go` command to implement `//go:embed`.

`-fgo-importcfg=`*`file`*
: Identify a file that provides mappings for import package paths found in the Go source files. The file can contain two commands: `importpath` to rename import paths for vendoring and `packagefile` to map from package path to files containing export data. This option is intended for use by the `go` command.

`-g`
: This is the standard `gcc` option (see Section "Debugging Options" in *Using the GNU Compiler Collection (GCC)*). It is mentioned here because by default `gccgo` turns on debugging information generation with the equivalent of the standard option `-g1`. This is because Go programs require debugging information to be available in order to get backtrace information. An explicit `-g0` may be used to disable the generation of debugging information, in which case certain standard library functions, such as `runtime.Callers`, will not operate correctly.

2 Import and Export

When `gccgo` compiles a package which exports anything, the export information will be stored directly in the object file. When a package is imported, `gccgo` must be able to find the file.

When Go code imports the package *gopackage*, `gccgo` will look for the import data using the following filenames, using the first one that it finds.

gopackage`.gox`
`lib`*gopackage*`.so`
`lib`*gopackage*`.a`
gopackage`.o`

The compiler will search for these files in the directories named by any `-I` options, in order in which the directories appear on the command line. The compiler will then search several standard system directories. Finally the compiler will search the current directory (to search the current directory earlier, use '`-I.`').

The compiler will extract the export information directly from the compiled object file. The file *gopackage*`.gox` will typically contain nothing but export data. This can be generated from *gopackage*`.o` via

```
objcopy -j .go_export gopackage.o gopackage.gox
```

For example, it may be desirable to extract the export information from several different packages into their independent *gopackage*`.gox` files, and then to combine the different package object files together into a single shared library or archive.

At link time you must explicitly tell `gccgo` which files to link together into the executable, as is usual with `gcc`. This is different from the behavior of other Go compilers.

3 Compiler Directives

The Go compiler supports a few compiler directives. A compiler directive uses a `//` comment at the start of a line. There must be no space between the `//` and the name of the directive.

`//line` *`file`*`:`*`line`*
: The `//line` directive specifies that the source line that follows should be recorded as having come from the given file path and line number. Successive lines are recorded using increasing line numbers, until the next directive. This directive typically appears in machine-generated code, so that compilers and debuggers will show lines in the original input to the generator.

`//extern` *`extern_name`*
: The `extern` directive sets the externally visible name of the next function declaration. See Section 4.2 [Function Names], page 26.

`//go:compile` *`go_name extern_name`*
: The `go:compile` directives sets the externally visible name of a function definition or declaration. See Section 4.2 [Function Names], page 26.

`//go:noescape`
: The `//go:noescape` directive specifies that the next declaration in the file, which must be a func without a body (meaning that it has an implementation not written in Go) does not allow any of the pointers passed as arguments to escape into the heap or into the values returned from the function. This information can be used during the compiler's escape analysis of Go code calling the function.

`//go:nosplit`
: The `//go:nosplit` directive specifies that the next function declared in the file must not include a stack overflow check. This is most commonly used by low-level runtime sources invoked at times when it is unsafe for the calling goroutine to be preempted.

`//go:noinline`
: The `//go:noinline` directive specifies that the next function defined in the file may not be inlined.

4 C Interoperability

When using gccgo there is limited interoperability with C, or with C++ code compiled using extern "C".

This information is provided largely for documentation purposes. For ordinary use it is best to build programs with the go tool and then use import "C", as described at https://pkg.go.dev/cmd/cgo.

4.1 C Type Interoperability

Basic types map directly: an int in Go is an int in C, etc. Go byte is equivalent to C unsigned char. Pointers in Go are pointers in C. A Go struct is the same as C struct with the same field names and types.

The Go string type is currently defined as a two-element structure:

```
struct __go_string {
  const unsigned char *__data;
  int __length;
};
```

You can't pass arrays between C and Go. However, a pointer to an array in Go is equivalent to a C pointer to the equivalent of the element type. For example, Go *[10]int is equivalent to C int*, assuming that the C pointer does point to 10 elements.

A slice in Go is a structure. The current definition is:

```
struct __go_slice {
  void *__values;
  int __count;
  int __capacity;
};
```

The type of a Go function with no receiver is equivalent to a C function whose parameter types are equivalent. When a Go function returns more than one value, the C function returns a struct. For example, these functions have equivalent types:

```
func GoFunction(int) (int, float)
struct { int i; float f; } CFunction(int)
```

A pointer to a Go function is equivalent to a pointer to a C function when the functions have equivalent types.

Go interface, channel, and map types have no corresponding C type (interface is a two-element struct and channel and map are pointers to structs in C, but the structs are deliberately undocumented). C enum types correspond to some integer type, but precisely which one is difficult to predict in general; use a cast. C union types have no corresponding Go type. C struct types containing bitfields have no corresponding Go type. C++ class types have no corresponding Go type.

Memory allocation is completely different between C and Go, as Go uses garbage collection. The exact guidelines in this area are undetermined, but it is likely that it will be permitted to pass a pointer to allocated memory from C to Go. The responsibility of eventually freeing the pointer will remain with C side, and of course if the C side frees the pointer while the Go side still has a copy the program will fail. When passing a pointer from Go to C, the Go function must retain a visible copy of it in some Go variable. Otherwise the Go garbage collector may delete the pointer while the C function is still using it.

4.2 Function Names

Go code can call C functions directly using the `//extern` or `//go:linkname` compiler directives. An `//extern` directive must be at the beginning of the line and must start with `//extern`. This must be followed by a space and then the external name of the function. The function declaration must be on the line immediately after the comment. For example, here is how the C function `open` can be declared in Go:

```
//extern open
func c_open(name *byte, mode int, perm int) int
```

You can do the same thing using the `//go:linkname` compiler directive. The `//go:linkname` directive must be at the start of the line. It is followed by whitespace, the name of the Go function, more whitespace, and the external name of the function. Unlike `//extern`, `//go:linkname` does not need to appear immediately adjacent to the function definition or declaration.

```
//go:linkname c_open open
func c_open(name *byte, mode int, perm int) int
```

The C function naturally expects a nul terminated string, which in Go is equivalent to a pointer to an array (not a slice!) of `byte` with a terminating zero byte. So a sample call from Go would look like (after importing the `os` package):

```
var name = [4]byte{'f', 'o', 'o', 0};
i := c_open(&name[0], os.O_RDONLY, 0);
```

Note that this serves as an example only. To open a file in Go please use Go's `os.Open` function instead.

The name of Go functions accessed from C is subject to change. At present the name of a Go function that does not have a receiver is `pkgpath.Functionname`. The *pkgpath* is set by the `-fgo-pkgpath` option used when the package is compiled; if the option is not used, the default is `go.`*`packagename`*. To call the function from C you must set the name using the `gcc` `__asm__` extension.

```
extern int go_function(int) __asm__ ("mypkgpath.Function");
```

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