NAME

scons − a software construction tool

SYNOPSIS

scons [*options*...] [*name*=*val*...] [*targets*...]

DESCRIPTION

The **scons** utility builds software (or other files) by determining which component pieces must be rebuilt and executing the necessary commands to rebuild them.

By default, **scons** searches for a file named *SConstruct*, *Sconstruct*, or *sconstruct* (in that order) in the current directory and reads its configuration from the first file found. An alternate file name may be specified via the **-f** option.

The *SConstruct* file can specify subsidiary configuration files using the **SConscript()** function. By convention, these subsidiary files are named *SConscript*, although any name may be used. (Because of this naming convention, the term "SConscript files" is sometimes used to refer generically to all **scons** configuration files, regardless of actual file name.)

The configuration files specify the target files to be built, and (optionally) the rules to build those targets. Reasonable default rules exist for building common software components (executable programs, object files, libraries), so that for most software projects, only the target and input files need be specified.

scons reads and executes the SConscript files as Python scripts, so you may use normal Python scripting capabilities (such as flow control, data manipulation, and imported Python libraries) to handle complicated build situations. **scons**, however, reads and executes all of the SConscript files *before* it begins building any targets. To make this obvious, **scons** prints the following messages about what it is doing:

```
$ scons foo.out
scons: Reading SConscript files ...
scons: done reading SConscript files.
scons: Building targets  ...
cp foo.in foo.out
scons: done building targets.
$
```

The status messages (everything except the line that reads "cp foo.in foo.out") may be suppressed using the **-Q** option.

scons does not automatically propagate the external environment used to execute **scons** to the commands used to build target files. This is so that builds will be guaranteed repeatable regardless of the environment variables set at the time **scons** is invoked. This also means that if the compiler or other commands that you want to use to build your target files are not in standard system locations, **scons** will not find them unless you explicitly set the PATH to include those locations. Whenever you create an **scons** construction environment, you can propagate the value of PATH from your external environment as follows:

```
import os
env = Environment(ENV = {'PATH' : os.environ['PATH']})
```

scons can scan known input files automatically for dependency information (for example, #include statements in C or C++ files) and will rebuild dependent files appropriately whenever any "included" input file changes. **scons** supports the ability to define new scanners for unknown input file types.

scons knows how to fetch files automatically from SCCS or RCS subdirectories using SCCS, RCS or BitKeeper.

scons is normally executed in a top-level directory containing a *SConstruct* file, optionally specifying as command-line arguments the target file or files to be built.

By default, the command

scons

will build all target files in or below the current directory. Explicit default targets (to be built when no targets are specified on the command line) may be defined the SConscript file(s) using the **Default()** function, described below.

Even when **Default()** targets are specified in the SConscript file(s), all target files in or below the current directory may be built by explicitly specifying the current directory (.) as a command-line target:

scons .

Building all target files, including any files outside of the current directory, may be specified by supplying a command-line target of the root directory (on POSIX systems):

scons /

or the path name(s) of the volume(s) in which all the targets should be built (on Windows systems):

scons C:\ D:\

To build only specific targets, supply them as command-line arguments:

scons foo bar

in which case only the specified targets will be built (along with any derived files on which they depend).

Specifying "cleanup" targets in SConscript files is not necessary. The **-c** flag removes all files necessary to build the specified target:

scons -c .

to remove all target files, or:

scons -c build export

to remove target files under build and export. Additional files or directories to remove can be specified using the Clean() function.

A subset of a hierarchical tree may be built by remaining at the top-level directory (where the *SConstruct* file lives) and specifying the subdirectory as the target to be built:

scons src/subdir

or by changing directory and invoking scons with the **-u** option, which traverses up the directory hierarchy until it finds the *SConstruct* file, and then builds targets relatively to the current subdirectory:

cd src/subdir
scons -u .

scons supports building multiple targets in parallel via a **-j** option that takes, as its argument, the number of simultaneous tasks that may be spawned:

```
scons -j 4
```

builds four targets in parallel, for example.

scons can maintain a cache of target (derived) files that can be shared between multiple builds. When caching is enabled in a SConscript file, any target files built by **scons** will be copied to the cache. If an up-to-date target file is found in the cache, it will be retrieved from the cache instead of being rebuilt locally. Caching behavior may be disabled and controlled in other ways by the **--cache-force**, **--cache-disable**, and **--cache-show** command-line options. The **--random** option is useful to prevent multiple builds from trying to update the cache simultaneously.

Values of variables to be passed to the SConscript file(s) may be specified on the command line:

```
scons debug=1 .
```

These variables are available in SConscript files through the ARGUMENTS dictionary, and can be used in the SConscript file(s) to modify the build in any way:

```
if ARGUMENTS.get('debug', 0):
   env = Environment(CCFLAGS = '-g')
else:
   env = Environment()
```

scons requires Python version 1.5.2 or later. There should be no other dependencies or requirements to run **scons.**

By default, **scons** knows how to search for available programming tools on various systems. On WIN32 systems, **scons** searches in order for the Microsoft Visual C++ tools, the MinGW tool chain, the Intel compiler tools, and the PharLap ETS compiler. On OS/2 systems, **scons** searches in order for the OS/2 compiler, the GCC tool chain, and the Microsoft Visual C++ tools, On SGI IRIX, IBM AIX, Hewlett Packard HP-UX, and Sun Solaris systems, **scons** searches for the native compiler tools (MIPSpro, Visual Age, aCC, and Forte tools respectively) and the GCC tool chain. On all other platforms, including POSIX (Linux and UNIX) platforms, **scons** searches in order for the GCC tool chain, the Microsoft Visual C++ tools, and the Intel compiler tools. You may, of course, override these default values by appropriate configuration of Environment construction variables.

OPTIONS

In general, **scons** supports the same command-line options as GNU **make**, and many of those supported by **cons**.

-b Ignored for compatibility with non-GNU versions of **make.**

-c, --clean, --remove
Clean up by removing all target files for which a construction command is specified. Also remove any files or directories associated to the construction command using the Clean() function.

--cache-disable, --no-cache
Disable the derived-file caching specified by **CacheDir**(). **scons** will neither retrieve files from the cache nor copy files to the cache.

--cache-force, --cache-populate
When using **CacheDir**(), populate a cache by copying any already-existing, up-to-date derived files to the cache, in addition to files built by this invocation. This is useful to populate a new cache with all the current derived files, or to add to the cache any derived files recently built with caching disabled via the **--cache-disable** option.

--cache-show
When using **CacheDir**() and retrieving a derived file from the cache, show the command that would have been executed to build the file, instead of the usual report, "Retrieved ‘file’ from cache." This will produce consistent output for build logs, regardless of whether a target file was rebuilt or retrieved from the cache.

-C *directory*, --directory=*directory*
Change to the specified *directory* before searching for the *SConstruct*, *Sconstruct*, or *sconstruct* file, or doing anything else. Multiple **-C** options are interpreted relative to the previous one, and the right-most **-C** option wins. (This option is nearly equivalent to **-f directory/SConstruct**, except that it will search for *SConstruct*, *Sconstruct*, or *sconstruct* in the specified directory.)

-D Works exactly the same way as the **-u** option except for the way default targets are handled. When this option is used and no targets are specified on the command line, all default targets are built, whether or not they are below the current directory.

--debug=*type*
Debug the build process. *type* specifies what type of debugging:

--debug=pdb
Re-run SCons under the control of the pdb Python debugger. The --debug=pdb argument will be stripped from the command-line, but all other arguments will be passed in-order to the SCons invocation run by the debugger.

--debug=tree
Print the dependency tree after each top-level target is built. This prints out the complete dependency tree including implicit dependencies and ignored dependencies.

--debug=dtree
Print the dependency tree after each top-level target is built. This prints out only derived files.

--debug=time
Prints various time profiling information: the time spent executing each build command, the total build time, the total time spent executing build commands, the total time spent executing SConstruct and SConscript files, and the total time spent executing SCons itself.

--debug=includes
Print the include tree after each top-level target is built. This is generally used to find out what files are included by the sources of a given derived file:

$ scons --debug=includes foo.o

-e, --environment-overrides
Variables from the execution environment override construction variables from the SConscript files.

-f *file*, --file=*file*, --makefile=*file*, --sconstruct=*file*
Use *file* as the initial SConscript file.

-h, --help
Print a local help message for this build, if one is defined in the SConscript file(s), plus a line that describes the **-H** option for command-line option help. If no local help message is defined, prints the standard help message about command-line options. Exits after displaying the appropriate message.

-H, --help-options
Print the standard help message about command-line options and exit.

-i, --ignore-errors
Ignore all errors from commands executed to rebuild files.

-I *directory*, --include-dir=*directory*
Specifies a *directory* to search for imported Python modules. If several **-I** options are used, the directories are searched in the order specified.

--implicit-cache
Cache implicit dependencies. This can cause **scons** to miss changes in the implicit dependencies in cases where a new implicit dependency is added earlier in the implicit dependency search path (e.g. CPPPATH) than a current implicit dependency with the same name.

--implicit-deps-changed
Force SCons to ignore the cached implicit dependencies. This causes the implicit dependencies to be rescanned and recached. This implies **--implicit-cache**.

--implicit-deps-unchanged
Force SCons to ignore changes in the implicit dependencies. This causes cached implicit dependencies to always be used. This implies **--implicit-cache**.

-j *N*, --jobs=*N*
Specifies the number of jobs (commands) to run simultaneously. If there is more than one **-j** option, the last one is effective.

-k, --keep-going
Continue as much as possible after an error. The target that failed and those that depend on it will not be remade, but other targets specified on the command line will still be processed.

-m Ignored for compatibility with non-GNU versions of **make**.

--max-drift=*SECONDS*
Set the maximum expected drift in the modification time of files to *SECONDS*. This value determines how old a file must be before its content signature is cached. The default value is 2 days,

which means a file must have a modification time of at least two days ago in order to have its content signature cached. A negative value means to never cache the content signature and to ignore the cached value if there already is one. A value of 0 means to always cache the signature, no matter how old the file is.

-n, --just-print, --dry-run, --recon
No execute. Print the commands that would be executed to build any out-of-date target files, but do not execute the commands.

--profile=*file*
Run SCons under the Python profiler and save the results in the specified *file*. The results may be analyzed using the Python pstats module.

-q, --question
Do not run any commands, or print anything. Just return an exit status that is zero if the specified targets are already up to date, non-zero otherwise.

-Q Quiets SCons status messages about reading SConscript files, building targets and entering directories. Commands that are executed to rebuild target files are still printed.

--random
Build dependencies in a random order. This is useful when building multiple trees simultaneously with caching enabled, to prevent multiple builds from simultaneously trying to build or retrieve the same target files.

-s, --silent, --quiet
Silent. Do not print commands that are executed to rebuild target files. Also suppresses SCons status messages.

-S, --no-keep-going, --stop
Ignored for compatibility with GNU **make**.

-t, --touch
Ignored for compatibility with GNU **make**. (Touching a file to make it appear up-to-date is unnecessary when using **scons**.)

-u, --up, --search-up
Walks up the directory structure until an *SConstruct , Sconstruct* or *sconstruct* file is found, and uses that as the top of the directory tree. If no targets are specified on the command line, only targets at or below the current directory will be built.

-U Works exactly the same way as the **-u** option except for the way default targets are handled. When this option is used and no targets are specified on the command line, all default targets that are defined in the SConscript(s) in the current directory are built, regardless of what directory the resultant targets end up in.

-v, --version
Print the **scons** version, copyright information, list of authors, and any other relevant information. Then exit.

-w, --print-directory
Print a message containing the working directory before and after other processing.

--warn=*type*, --warn=no-*type*
Enable or disable warnings. *type* specifies the type of warnings to be enabled or disabled:

--warn=all, --warn=no-all
Enables or disables all warnings.

--warn=dependency, --warn=no-dependency
Enables or disables warnings about dependencies. These warnings are disabled by default.

--warn=deprecated, --warn=no-deprecated
Enables or disables warnings about use of deprecated features. These warnings are enabled by default.

--no-print-directory
Turn off -w, even if it was turned on implicitly.

-Y *repository*, --repository=*repository*
Search the specified repository for any input and target files not found in the local directory hierarchy. Multiple **-Y** options may specified, in which case the repositories are searched in the order specified.

CONFIGURATION FILE REFERENCE

Construction Environments

A construction environment is the basic means by which the SConscript files communicate build information to **scons**. A new construction environment is created using the **Environment** function:

```
env = Environment()
```

By default, a new construction environment is initialized with a set of builder methods and construction variables that are appropriate for the current platform. An optional platform keyword argument may be used to specify that an environment should be initialized for a different platform:

```
env = Environment(platform = 'cygwin')
env = Environment(platform = 'os2')
env = Environment(platform = 'posix')
env = Environment(platform = 'win32')
```

Specifying a platform initializes the appropriate construction variables in the environment to use and generate file names with prefixes and suffixes appropriate for the platform.

Note that the **win32** platform adds the **SYSTEMROOT** variable from the user's external environment to the construction environment's **ENV** dictionary. This is so that any executed commands that use sockets to connect with other systems (such as fetching source files from external CVS repository specifications like **:pserver:anonymous@cvs.sourceforge.net:/cvsroot/scons**) will work on Win32 systems.

The platform argument may be function or callable object, in which case the Environment() method will call the specified argument to update the new construction environment:

```
def my_platform(env):
  env['VAR'] = 'xyzzy'

env = Environment(platform = my_platform)
```

Additionally, a specific set of tools with which to initialize the environment may specified as an optional keyword argument:

```
env = Environment(tools = ['msvc', 'lex'])
```

The elements of the tools list may also be functions or callable objects, in which case the Environment() method will call the specified elements to update the new construction environment:

```
def my_tool(env):
  env['XYZZY'] = 'xyzzy'

env = Environment(tools = [my_tool])
```

The tool definition (i.e. my_tool()) can use the PLATFORM variable from the environment it receives to customize the tool for different platforms.

If no tool list is specified, then SCons will auto-detect the installed tools using the PATH variable in the ENV construction variable and the platform name when the Environment is constructed. Changing the PATH variable after the Environment is constructed will not cause the tools to be redetected.

SCons supports the following tool specifications out of the box:

386asm
ar
dvipdf
dvips
g++
g77
gs
icc
icl
ifl
ilink
gas
gcc
gnulink
jar
javac
javah
latex
lex
linkloc
m4
masm
midl
mingw
mslib
mslink
msvc
msvs

nasm
pdflatex
pdftex
qt
rmic
sgiar
sgicc
sgilink
sunar
suncc
sunlink
swig
tar
tex
yacc
zip

Additionally, there is a "tool" named **default** which configures the environment with a default set of tools for the current platform.

On posix and cygwin platforms the GNU tools (e.g. gcc) are preferred by SCons, on win32 the Microsoft tools (e.g. msvc) followed by MinGW are preferred by SCons, and in OS/2 the IBM tools (e.g. icc) are preferred by SCons.

Builder Methods

Build rules are specified by calling a construction environment's builder methods. The arguments to the builder methods are **target** (a list of target files) and **source** (a list of source files).

Because long lists of file names can lead to a lot of quoting, **scons** supplies a **Split()** function that splits a single string into a list, separated on strings of white-space characters. (This is similar to the string.split() method from the standard Python library.)

Like all Python arguments, the target and source arguments to a builder can be specified either with or without the "target" and "source" keywords. When the keywords are omitted, the target is first, followed by the source. The following are equivalent examples of calling the Program builder:

```
env.Program('bar', ['bar.c', 'foo.c'])
env.Program('bar', Split('bar.c foo.c'))
env.Program(source = ['bar.c', 'foo.c'], target = 'bar')
env.Program(target = 'bar', Split('bar.c foo.c'))
env.Program('bar', source = string.split('bar.c foo.c'))
```

When the target shares the same base name as the source and only the suffix varies, and if the builder has a suffix defined for the target file type, then the target argument may be omitted completely, and **scons** will deduce the target file name from the source file name. The following examples all build the executable program **bar** (on POSIX systems) or **bar.exe** (on Windows systems) from the bar.c source file:

```
env.Program(target = 'bar', source = 'bar.c')
env.Program('bar', source = 'bar.c')
env.Program(source = 'bar.c')
env.Program('bar.c')
```

It is possible to override or add construction variables when calling a builder by passing additional keyword arguments. These overridden or added variables will only be in effect when building the target, so they will

not affect other parts of the build. For example, if you want to add additional libraries for just one program:

```
env.Program('hello', 'hello.c', LIBS=['gl', 'glut'])
```

or generate a shared library with a nonstandard suffix:

```
env.SharedLibrary('word', 'word.cpp', SHLIBSUFFIX='.ocx')
```

All Builders return a Node or a list of Nodes, representing the target or targets that will be built. A list of Nodes is returned if there is more than one target, and a single Node is returned if there is only one target. A *Node* is an internal SCons object which represents build targets or sources.

The returned Node(s) can be passed to other builder methods as source(s) or passed into to any SCons function or method where a filename would normally be accepted. For example, if it were necessary to add a specific **-D** flag when compiling one specific object file:

```
bar_obj = env.StaticObject('bar.c', CCFLAGS='-DBAR')
env.Program(source = ['foo.c', bar_obj, 'main.c'])
```

Using a Node in this way makes for a more portable build by avoiding having to specify a platform-specific object suffix when calling the Program() builder.

The path name for a Node's file may be used by passing the Node to the Python-builtin **str()** function:

```
bar_obj = env.StaticObject('bar.c', CCFLAGS='-DBAR')
print "The path to bar_obj is:", str(bar_obj)
```

scons provides the following builders:

StaticObject

Builds a static object file from one or more C, C++, or Fortran source files. Source files must have one of the following extensions:

```
.asm    assembly language file
.ASM    assembly language file
.c      C file
.C      WIN32:  C file
        POSIX:  C++ file
.cc     C++ file
.cpp    C++ file
.cxx    C++ file
.cxx    C++ file
.c++    C++ file
.C++    C++ file
.f      Fortran file
.F      WIN32:  Fortran file
        POSIX:  Fortran file + C pre-processor
.for    Fortran file
.FOR    Fortran file
.fpp    Fortran file + C pre-processor
.FPP    Fortran file + C pre-processor
.s      assembly language file
.S      WIN32:  assembly language file
        POSIX:  assembly language file + C pre-processor
.spp    assembly language file + C pre-processor
```

.SPP assembly language file + C pre-processor

The target object file prefix (specified by the $OBJPREFIX construction variable; nothing by default) and suffix (specified by the $OBJSUFFIX construction variable; are automatically added to the target if not already present. Examples:

```
env.StaticObject(target = 'aaa', source = 'aaa.c')
env.StaticObject(target = 'bbb.o', source = 'bbb.c++')
env.StaticObject(target = 'ccc.obj', source = 'ccc.f')
```

SharedObject

Builds an object file for inclusion in a shared library. Source files must have one of the same set of extensions specified above for the **StaticObject** builder. On some platforms building a shared object requires additional compiler options (e.g. -fPIC for gcc) in addition to those needed to build a normal (static) object, but on some platforms there is no difference between a shared object and a normal (static) one. When there is a difference, SCons will only allow shared objects to be linked into a shared library, and will use a different suffix for shared objects. On platforms where there is no difference, SCons will allow both normal (static) and shared objects to be linked into a shared library, and will use the same suffix for shared and normal (static) objects. The target object file prefix (specified by the $SHOBJPREFIX construction variable; by default, the same as $OBJPREFIX) and suffix (specified by the $SHOBJSUFFIX construction variable) are automatically added to the target if not already present. Examples:

```
env.SharedObject(target = 'ddd', source = 'ddd.c')
env.SharedObject(target = 'eee.o', source = 'eee.cpp')
env.SharedObject(target = 'fff.obj', source = 'fff.for')
```

Object A synonym for the **StaticObject** builder.

PCH Builds a Microsoft Visual C++ precompiled header. Calling this builder returns a list of two targets: the PCH as the first element, and the object file as the second element. Normally the object file is ignored. This builder is only provided when Microsoft Visual C++ is being used as the compiler. The PCH builder is generally used in conjuction with the PCH construction variable to force object files to use the precompiled header:

```
env['PCH'] = env.PCH('StdAfx.cpp')[0]
```

Program

Builds an executable given one or more object files or C, C++ or Fortran source files. If any C, C++ or Fortran source files are specified, then they will be automatically compiled to object files using the **Object** builder; see that builder's description for a list of legal source file suffixes and how they are interpreted. The target executable file prefix (specified by the $PROGPREFIX construction variable; nothing by default) and suffix (specified by the $PROGSUFFIX construction variable; by default, .exe on Windows systems, nothing on POSIX systems) are automatically added to the target if not already present. Example:

```
env.Program(target = 'foo', source = ['foo.o', 'bar.c', 'baz.f'])
```

MSVSProject

Builds Microsoft Visual Studio project files. This builds a Visual Studio project file, based on the version of Visual Studio that is configured (either the latest installed version, or the version set by **MSVS_VERSION** in the Environment constructor). For VS 6, it will generate **.dsp** and **.dsw** files, for VS 7, it will generate **.vcproj** and **.sln** files.

It takes several lists of filenames to be placed into the project file, currently these are limited to **srcs, incs, localincs, resources,** and **misc.** These are pretty self explanatory, but it should be noted that the 'srcs' list is NOT added to the $SOURCES environment variable. This is because it represents a list of files to be added to the project file, not the source used to build the project file (in this case, the 'source' is the SConscript file used to call MSVSProject).

In addition to these values (which are all optional, although not specifying any of them results in an empty project file), the following values must be specified:

target: The name of the target .dsp or .vcproj file. The correct suffix for the version of Visual Studio must be used, but the value

env['MSVSPROJECTSUFFIX']

will be defined to the correct value (see example below).

variant: The name of this particular variant. These are typically things like "Debug" or "Release", but really can be anything you want. Multiple calls to MSVSProject with different variants are allowed: all variants will be added to the project file with their appropriate build targets and sources.

buildtarget: A list of SCons.Node.FS objects which is returned from the command which builds the target. This is used to tell SCons what to build when the 'build' button is pressed inside of the IDE.

Example Usage:

```
barsrcs = ['bar.cpp'],
barincs = ['bar.h'],
barlocalincs = ['StdAfx.h']
barresources = ['bar.rc','resource.h']
barmisc = ['bar_readme.txt']

dll = local.SharedLibrary(target = 'bar.dll',
                          source = barsrcs)

local.MSVSProject(target = 'Bar' + env['MSVSPROJECTSUFFIX'],
                  srcs = barsrcs,
                  incs = barincs,
                  localincs = barlocalincs,
                  resources = barresources,
                  misc = barmisc,
                  buildtarget = dll,
                  variant = 'Release')
```

RES Builds a Microsoft Visual C++ resource file. This builder is only provided when Microsoft Visual C++ or MinGW is being used as the compiler. The *.res* (or *.o* for MinGW) suffix is added to the target name if no other suffix is given. The source file is scanned for implicit dependencies as though it were a C file. Example:

env.RES('resource.rc')

StaticLibrary

Builds a static library given one or more object files or C, C++ or Fortran source files. If any source files are given, then they will be automatically compiled to object files. The static library prefix and suffix (if any) are automatically added to the target. The target library file prefix (specified by the $LIBPREFIX construction variable; by default, lib on POSIX systems, nothing on Windows systems) and suffix (specified by the $LIBSUFFIX construction variable; by default, .lib on Windows systems, .a on POSIX systems) are automatically added to the target if not already present. Example:

env.StaticLibrary(target = 'bar', source = ['bar.c', 'foo.o'])

Any object files listed in the **source** must have been built for a static library (that is, using the **StaticObject** builder). **scons** will raise an error if there is any mismatch.

SharedLibrary

Builds a shared library (.so on a POSIX system, .dll on WIN32) given one or more object files or C, C++ or Fortran source files. If any source files are given, then they will be automatically compiled to object files. The static library prefix and suffix (if any) are automatically added to the target. The target library file prefix (specified by the $SHLIBPREFIX construction variable; by default, lib on POSIX systems, nothing on Windows systems) and suffix (specified by the $SHLIBSUFFIX construction variable; by default, .dll on Windows systems, .so on POSIX systems) are automatically added to the target if not already present. Example:

env.SharedLibrary(target = 'bar', source = ['bar.c', 'foo.o'])

On WIN32 systems, the **SharedLibrary** builder will always build an import (.lib) library in addition to the shared (.dll) library, adding a .lib library with the same basename if there is not already a .lib file explicitly listed in the targets.

Any object files listed in the **source** must have been built for a shared library (that is, using the **SharedObject** builder). **scons** will raise an error if there is any mismatch.

On WIN32 systems, specifying "register=1" will cause the dll to be registered after it is built using REGSVR32. The command that is run ("regsvr32" by default) is determined by $REGSVR construction variable, and the flags passed are determined by $REGSVRFLAGS. By default, $REGSVRFLAGS includes "/s", to prevent dialogs from popping up and requiring user attention when it is run. If you change $REGSVRFLAGS, be sure to include "/s". For example,

```
env.SharedLibrary(target = 'bar',
                  source = ['bar.cxx', 'foo.obj'],
                  register=1)
```

will register "bar.dll" as a COM object when it is done linking it.

Library A synonym for the **StaticLibrary** builder.

CFile Builds a C source file given a lex (.l) or yacc (.y) input file. The suffix specified by the $CFILESUFFIX construction variable (.c by default) is automatically added to the target if it is not already present. Example:

```
# builds foo.c
env.CFile(target = 'foo.c', source = 'foo.l')
# builds bar.c
env.CFile(target = 'bar', source = 'bar.y')
```

CXXFile

Builds a C++ source file given a lex (.ll), yacc (.yy) or uic (.ui) input file. The suffix specified by the $CXXFILESUFFIX construction variable (.cc by default) is automatically added to the target if it is not already present. Example:

```
# builds foo.cc
env.CXXFile(target = 'foo.cc', source = 'foo.ll')
# builds bar.cc
env.CXXFile(target = 'bar', source = 'bar.yy')
```

M4 Builds an output file from an M4 input file. This uses a default $M4FLAGS value of **-E**, which considers all warnings to be fatal and stops on the first warning when using the GNU version of m4. Example:

```
env.M4(target = 'foo.c', source = 'foo.c.m4')
```

Jar Builds a Java archive (.jar) file from a source tree of .class files.

```
env.Jar(target = 'foo.jar', source = 'classes')
```

Java Builds one or more Java class files from a source tree of .java files. The class files will be placed underneath the specified target directory. SCons will parse each source .java file to find the classes (including inner classes) defined within that file, and from that figure out the target .class files that will be created. SCons will also search each Java file for the Java package name, which it assumes can be found on a line beginning with the string **package** in the first column; the resulting .class files will be placed in a directory reflecting the specified package name. For example, the file *Foo.java* defining a single public *Foo* class and containing a package name of *sub.dir* will generate a corresponding *sub/dir/Foo.class* class file.

Example:

```
env.Java(target = 'classes', source = 'src')
```

JavaH Builds C header and source files for implementing Java native methods. The target can be either a directory in which the header files will be written, or a header file name which will contain all of the definitions. The source can be either the names of .class files, or the objects returned from the **Java** builder.

If the construction variable **JAVACLASSDIR** is set, either in the environment or in the call to the **JavaH** builder itself, then the value of the variable will be stripped from the beginning of any .class file names.

Examples:

```
# builds java_native.h
classes = env.Java(target = 'classdir', source = 'src')
env.JavaH(target = 'java_native.h', source = classes)

# builds include/package_foo.h and include/package_bar.h
env.JavaH(target = 'include',
      source = ['package/foo.class', 'package/bar.class'])

# builds export/foo.h and export/bar.h
env.JavaH(target = 'export',
```

```
source = ['classes/foo.class', 'classes/bar.class'],
JAVACLASSDIR = 'classes')
```

RMIC Builds stub and skeleton class files for remote objects from Java .class files. The target is a directory relative to which the stub and skeleton class files will be written. The source can be the names of .class files, or the objects return from the **Java** builder.

If the construction variable **JAVACLASSDIR** is set, either in the environment or in the call to the **RMIC** builder itself, then the value of the variable will be stripped from the beginning of any .class file names.

```
classes = env.Java(target = 'classdir', source = 'src')
env.RMIC(target = 'outdir1', source = classes)

env.RMIC(target = 'outdir2',
    source = ['package/foo.class', 'package/bar.class'])

env.RMIC(target = 'outdir3',
    source = ['classes/foo.class', 'classes/bar.class'],
    JAVACLASSDIR = 'classes')
```

TypeLibrary
Builds a Windows type library (.tlb) file from and input IDL file (.idl). In addition, it will build the associated inteface stub and proxy source files. It names them according to the base name of the .idl file.

For example,

```
env.TypeLibrary(source="foo.idl")
```

Will create foo.tlb, foo.h, foo_i.c, foo_p.c, and foo_data.c.

DVI Builds a .dvi file from a .tex, .ltx or .latex input file. The suffix .dvi (hard-coded within TeX itself) is automatically added to the target if it is not already present. Example:

```
# builds from aaa.tex
env.DVI(target = 'aaa.dvi', source = 'aaa.tex')
# builds bbb.dvi
env.DVI(target = 'bbb', source = 'bbb.ltx')
# builds from ccc.latex
env.DVI(target = 'ccc.dvi', source = 'ccc.latex')
```

PDF Builds a .pdf file from a .dvi input file (or, by extension, a .tex, .ltx, or .latex input file). The suffix specified by the $PDFSUFFIX construction variable (.pdf by default) is added automatically to the target if it is not already present. Example:

```
# builds from aaa.tex
env.PDF(target = 'aaa.pdf', source = 'aaa.tex')
# builds bbb.pdf from bbb.dvi
env.PDF(target = 'bbb', source = 'bbb.dvi')
```

PostScript
Builds a .ps file from a .dvi input file (or, by extension, a .tex, .ltx, or .latex input file). The suffix specified by the $PSSUFFIX construction variable (.ps by default) is added automatically to the

target if it is not already present. Example:

```
# builds from aaa.tex
env.PostScript(target = 'aaa.ps', source = 'aaa.tex')
# builds bbb.ps from bbb.dvi
env.PostScript(target = 'bbb', source = 'bbb.dvi')
```

Tar Builds a tar archive of the specified files and/or directories. Unlike most builders, the **Tar** builder may be called multiple times for a given target; each additional call adds to the list of entries that will be built into the archive.

```
env.Tar('src.tar', 'src')

# Create the stuff.tar file.
env.Tar('stuff', ['subdir1', 'subdir2'])
# Also add "another" to the stuff.tar file.
env.Tar('stuff', 'another')

# Set TARFLAGS to create a gzip-filtered archive.
env = Environment(TARFLAGS = '-c -z')
env.Tar('foo.tar.gz', 'foo')

# Also set the suffix to .tgz.
env = Environment(TARFLAGS = '-c -z',
                  TARSUFFIX = '.tgz')
env.Tar('foo')
```

Zip Builds a zip archive of the specified files and/or directories. Unlike most builders, the **Zip** builder may be called multiple times for a given target; each additional call adds to the list of entries that will be built into the archive.

```
env.Zip('src.zip', 'src')

# Create the stuff.zip file.
env.Zip('stuff', ['subdir1', 'subdir2'])
# Also add "another" to the stuff.tar file.
env.Zip('stuff', 'another')
```

scons automatically scans C source files, C++ source files, Fortran source files with **.F** (POSIX systems only), **.fpp,** or **.FPP** file extensions, and assembly language files with **.S** (POSIX systems only), **.spp,** or **.SPP** files extensions for C preprocessor dependencies, so the dependencies do not need to be specified explicitly. In addition, all builder targets automatically depend on their sources. An explicit dependency can be specified using the **Depends** method of a construction environment (see below).

Other Construction Environment Methods

Additional construction environment methods include:

Alias(*alias*, *targets*)

Creates a phony target that expands to one or more other targets. Returns the Node object representing the alias, which exists outside of any file system. This Node object, or the alias name, may be used as a dependency of any other target, including another alias. Alias can be called multiple times for the same alias to add additional targets to the alias. There is also an Alias global function for creating or referencing an alias independently of any construction environment.

env.Alias('install', ['/usr/local/bin', '/usr/local/lib'])
env.Alias('install', ['/usr/local/man'])

Append(*key*=*val*, [...])

Appends the specified keyword arguments to the end of construction variables in the environment. If the Environment does not have the specified construction variable, it is simply added to the environment. If the values of the construction variable and the keyword argument are the same type, then the two values will be simply added together. Otherwise, the construction variable and the value of the keyword argument are both coerced to lists, and the lists are added together. (See also the Prepend method, below.)

env.Append(CCFLAGS = ' -g', FOO = ['foo.yyy'])

PrependENVPath(*name*, *newpath*, [*envname*, *sep*])

This appends new path elements to the given path in the specified external environment (**ENV** by default). This will only add any particular path once (leaving the first one it encounters and ignoring the rest, to preserve path order), and to help assure this, will normalize all paths (using **os.path.normpath** and **os.path.normcase**). This can also handle the case where the given old path variable is a list instead of a string, in which case a list will be returned instead of a string. Example:

print 'before:',env['ENV']['INCLUDE']
include_path = '/foo/bar:/foo'
env.PrependENVPath('INCLUDE', include_path)
print 'after:',env['ENV']['INCLUDE']

yields:
before: /biz:/foo
after: /foo/bar:/foo:/biz

AppendENVPath(*name*, *newpath*, [*envname*, *sep*])

This appends new path elements to the given path in the specified external environment (**ENV** by default). This will only add any particular path once (leaving the last one it encounters and ignoring the rest, to preserve path order), and to help assure this, will normalize all paths (using **os.path.normpath** and **os.path.normcase**). This can also handle the case where the given old path variable is a list instead of a string, in which case a list will be returned instead of a string. Example:

print 'before:',env['ENV']['INCLUDE']
include_path = '/foo/bar:/foo'
env.PrependENVPath('INCLUDE', include_path)
print 'after:',env['ENV']['INCLUDE']

yields:
before: /foo:/biz
after: /biz:/foo/bar:/foo

BitKeeper()

A factory function that returns a Builder object to be used to fetch source files using BitKeeper. The returned Builder is intended to be passed to the **SourceCode** function.
env.SourceCode('.', env.BitKeeper())

Command(*target*, *source*, *commands*)

Executes a specific action (or list of actions) to build a target file or files. This is more convenient than defining a separate Builder object for a single special-case build.

Note that an action can be an external command, specified as a string, or a callable Python object; see "Action Objects," below. Examples:

```
env.Command('foo.out', 'foo.in',
        "$FOO_BUILD < $SOURCES > $TARGET")

env.Command('bar.out', 'bar.in',
        ["rm -f $TARGET",
         "$BAR_BUILD < $SOURCES > $TARGET"])

def rename(env, target, source):
   import os
   os.rename('.tmp', str(target[0]))

env.Command('baz.out', 'baz.in',
        ["$BAZ_BUILD < $SOURCES > .tmp",
            rename ])
```

Copy([*key*=*val*, ...])

Return a separate copy of a construction environment. If there are any keyword arguments specified, they are added to the returned copy, overwriting any existing values for the keywords.

```
env2 = env.Copy()
env3 = env.Copy(CCFLAGS = '-g')
```

Additionally, a list of tools may be specified, as in the Environment constructor:

```
def MyTool(env): env['FOO'] = 'bar'
env4 = env.Copy(tools = ['msvc', MyTool])
```

CVS(*repository*, *module*)

A factory function that returns a Builder object to be used to fetch source files from the specified CVS *repository*. The returned Builder is intended to be passed to the **SourceCode** function.

The optional specified *module* will be added to the beginning of all repository path names; this can be used, in essence, to strip initial directory names from the repository path names, so that you only have to replicate part of the repository directory hierarchy in your local build directory:

```
# Will fetch foo/bar/src.c
# from /usr/local/CVSROOT/foo/bar/src.c.
env.SourceCode('.', env.CVS('/usr/local/CVSROOT'))

# Will fetch bar/src.c
# from /usr/local/CVSROOT/foo/bar/src.c.
env.SourceCode('.', env.CVS('/usr/local/CVSROOT', 'foo'))

# Will fetch src.c
# from /usr/local/CVSROOT/foo/bar/src.c.
env.SourceCode('.', env.CVS('/usr/local/CVSROOT', 'foo/bar'))
```

Depends(*target*, *dependency*)

Specifies an explicit dependency; the target file(s) will be rebuilt whenever the dependency file(s) has changed. This should only be necessary for cases where the dependency is not caught by a Scanner for the file.

env.Depends('foo', 'other-input-file-for-foo')

Dictionary([*vars*])

Returns a dictionary object containing copies of all of the construction variables in the environment. If there are any variable names specified, only the specified construction variables are returned in the dictionary.

dict = env.Dictionary()
cc_dict = env.Dictionary('CC', 'CCFLAGS', 'CCCOM')

Ignore(*target*, *dependency*)

The specified dependency file(s) will be ignored when deciding if the target file(s) need to be rebuilt.

env.Ignore('foo', 'foo.c')
env.Ignore('bar', ['bar1.h', 'bar2.h'])

Install(*dir*, *source*)

Installs one or more files in a destination directory. The file names remain the same.

env.Install(dir = '/usr/local/bin', source = ['foo', 'bar'])

InstallAs(*target*, *source*)

Installs one or more files as specific file names, allowing changing a file name as part of the installation. It is an error if the target and source list different numbers of files.

env.InstallAs(target = '/usr/local/bin/foo',
source = 'foo_debug')
env.InstallAs(target = ['../lib/libfoo.a', '../lib/libbar.a'],
source = ['libFOO.a', 'libBAR.a'])

Perforce()

A factory function that returns a Builder object to be used to fetch source files from the Perforce source code management system. The returned Builder is intended to be passed to the **SourceCode** function:
env.SourceCode('.', env.Perforce())

Perforce uses a number of external environment variables for its operation. Consequently, this function adds the following variables from the user's external environment to the construction environment's ENV dictionary: P4CHARSET, P4CLIENT, P4LANGUAGE, P4PASSWD, P4PORT, P4USER, SYSTEMROOT, USER, and USERNAME.

AlwaysBuild(*target*, ...)

Marks each given *target* so that it is always assumed to be out of date, and will always be rebuilt if needed. Note, however, that **AlwaysBuild**() does not add its target(s) to the default target list, so the targets will only be built if they are specified on the command line, or are a dependent of a target specified on the command line--but they will *always* be built if so specified. Multiple targets can be passed in to a single call to **AlwaysBuild**().

Precious(*target*, ...)

Marks each given *target* as precious so it is not deleted before it is rebuilt. Normally **scons** deletes a target before building it. Multiple targets can be passed in to a single call to **Precious**().

Prepend(*key*=*val*, [...])

Appends the specified keyword arguments to the beginning of construction variables in the environment. If the Environment does not have the specified construction variable, it is simply added to the environment. If the values of the construction variable and the keyword argument are the same type, then the two values will be simply added together. Otherwise, the construction variable and the value of the keyword argument are both coerced to lists, and the lists are added together. (See also the Append method, above.)

env.Prepend(CCFLAGS = '-g ', FOO = ['foo.yyy'])

RCS() A factory function that returns a Builder object to be used to fetch source files from RCS. The returned Builder is intended to be passed to the **SourceCode** function:
env.SourceCode('.', env.RCS())

Note that **scons** will fetch source files from RCS subdirectories automatically, so configuring RCS as demonstrated in the above example should only be necessary if you are fetching from RCS,v files in the same directory as the source files, or if you need to explicitly specify RCS for a specific subdirectory.

Replace(*key*=*val*, [...])

Replaces construction variables in the Environment with the specified keyword arguments.

env.Replace(CCFLAGS = '-g', FOO = 'foo.xxx')

SCCS()

A factory function that returns a Builder object to be used to fetch source files from SCCS. The returned Builder is intended to be passed to the **SourceCode** function:
env.SourceCode('.', env.SCCS())

Note that **scons** will fetch source files from SCCS subdirectories automatically, so configuring SCCS as demonstrated in the above example should only be necessary if you are fetching from *s.SCCS* files in the same directory as the source files, or if you need to explicitly specify SCCS for a specific subdirectory.

SideEffect(*side_effect*, *target*)

Declares *side_effect* as a side effect of building *target*. Both *side_effect* and *target* can be a list, a file name, or a node. A side effect is a target that is created as a side effect of building other targets. For example, a Windows PDB file is created as a side effect of building the .obj files for a static library. If a target is a side effect of multiple build commands, **scons** will ensure that only one set of commands is executed at a time. Consequently, you only need to use this method for side-effect targets that are built as a result of multiple build commands.

SourceCode(*entries*, *builder*)

Arrange for non-existent source files to be fetched from a source code management system using the specified *builder*. The specified *entries* may be a Node, string or list of both, and may represent either individual source files or directories in which source files can be found.

For any non-existent source files, **scons** will search up the directory tree and use the first **SourceCode** builder it finds. The specified *builder* may be **None**, in which case **scons** will not use a

builder to fetch source files for the specified *entries*, even if a **SourceCode** builder has been specified for a directory higher up the tree.

scons will, by default, fetch files from SCCS or RCS subdirectories without explicit configuration. This takes some extra processing time to search for the necessary source code management files on disk. You can avoid these extra searches and speed up your build a little by disabling these searches as follows:
env.SourceCode('.', None)

Note that if the specified *builder* is one you create by hand, it must have an associated construction environment to use when fetching a source file.

scons provides a set of canned factory functions that return appropriate Builders for various popular source code management systems. Canonical examples of invocation include:
env.SourceCode('.', env.BitKeeper('/usr/local/BKsources'))
env.SourceCode('src', env.CVS('/usr/local/CVSROOT'))
env.SourceCode('/', env.RCS())
env.SourceCode(['f1.c', 'f2.c'], env.SCCS())
env.SourceCode('no_source.c', None)

Construction Variables

A construction environment has an associated dictionary of *construction variables* that are used by built-in or user-supplied build rules. Construction variables must follow the same rules for Python identifiers: the initial character must be an underscore or letter, followed by any number of underscores, letters, or digits.

A number of useful construction variables are automatically defined by scons for each supported platform, and additional construction variables can be defined by the user. The following is a list of the automatically defined construction variables:

AR The static library archiver.

ARCOM
The command line used to generate a static library from object files.

ARFLAGS
General options passed to the static library archiver.

AS The assembler.

ASCOM
The command line used to generate an object file from an assembly-language source file.

ASFLAGS
General options passed to the assembler.

ASPPCOM
The command line used to assemble an assembly-language source file into an object file after first running the file through the C preprocessor. Any options specified in the $ASFLAGS and $CPPFLAGS construction variables are included on this command line.

BITKEEPER
The BitKeeper executable.

BITKEEPERCOM
The command line for fetching source files using BitKEeper.

BITKEEPERGET
The command ($BITKEEPER) and subcommand for fetching source files using BitKeeper.

BITKEEPERGETFLAGS
Options that are passed to the BitKeeper **get** subcommand.

BUILDERS
A dictionary mapping the names of the builders available through this environment to underlying Builder objects. Builders named Alias, CFile, CXXFile, DVI, Library, Object, PDF, PostScript, and Program are available by default. If you initialize this variable when an Environment is created:
env = Environment(BUILDERS = {'NewBuilder' : foo})

the default Builders will no longer be available. To use a new Builder object in addition to the default Builders, add your new Builder object like this:
env = Environment()
env.Append(BUILDERS = {'NewBuilder' : foo})

or this:
env = Environment()
env['BUILDERS]['NewBuilder'] = foo

CC The C compiler.

CCCOM
The command line used to compile a C source file to a (static) object file. Any options specified in the $CCFLAGS and $CPPFLAGS construction variables are included on this command line.

CCFLAGS
General options that are passed to the C compiler.

CFILESUFFIX
The suffix for C source files. This is used by the internal CFile builder when generating C files from Lex (.l) or YACC (.y) input files. The default suffix, of course, is *.c* (lower case). On case-insensitive systems (like Win32), SCons also treats *.C* (upper case) files as C files.

_concat
A function used to produce variables like $_CPPINCFLAGS. It takes five arguments: a prefix to concatenate onto each element, a list of elements, a suffix to concatenate onto each element, an environment for variable interpolation, and an optional function that will be called to transform the list before concatenation.

env['_CPPINCFLAGS'] = '$(${_concat(INCPREFIX, CPPPATH, INCSUFFIX, __env__, RDirs)} $)',

CPPDEFINES

A platform independent specification of C preprocessor definitions. The definitions will be added to command lines through the automatically-generated $_CPPDEFFLAGS construction variable (see below), which is constructed according to the type of value of $CPPDEFINES:

If $CPPDEFINES is a string, the values of the $CPPDEFPREFIX and $CPPDEFSUFFIX construction variables will be added to the beginning and end.

```
# Will add -Dxyz to POSIX compiler command lines,
# and /Dxyz to Microsoft Visual C++ command lines.
env = Environment(CPPDEFINES='xyz')
```

If $CPPDEFINES is a list, the values of the $CPPDEFPREFIX and $CPPDEFSUFFIX construction variables will be appended to the beginning and end of each element in the list. If any element is a list or tuple, then the first item is the name being defined and the second item is its value:

```
# Will add -DB=2 -DA to POSIX compiler command lines,
# and /DB=2 /DA to Microsoft Visual C++ command lines.
env = Environment(CPPDEFINES=[('B', 2), 'A'])
```

If $CPPDEFINES is a dictionary, the values of the $CPPDEFPREFIX and $CPPDEFSUFFIX construction variables will be appended to the beginning and end of each item from the dictionary. The key of each dictionary item is a name being defined to the dictionary item's corresponding value; if the value is **None**, then the name is defined without an explicit value. Note that the resulting flags are sorted by keyword to ensure that the order of the options on the command line is consistent each time **scons**
is run.

```
# Will add -DA -DB=2 to POSIX compiler command lines,
# and /DA /DB=2 to Microsoft Visual C++ command lines.
env = Environment(CPPDEFINES={'B':2, 'A':None})
```

_CPPDEFFLAGS

An automatically-generated construction variable containing the C preprocessor command-line options to define values. The value of $_CPPDEFFLAGS is created by appending $CPPDEFPREFIX and $CPPDEFSUFFIX to the beginning and end of each directory in $CPPDEFINES.

CPPDEFPREFIX

The prefix used to specify preprocessor definitions on the C compiler command line. This will be appended to the beginning of each definition in the $CPPDEFINES construction variable when the $_CPPDEFFLAGS variable is automatically generated.

CPPDEFSUFFIX

The suffix used to specify preprocessor definitions on the C compiler command line. This will be appended to the end of each definition in the $CPPDEFINES construction variable when the $_CPPDEFFLAGS variable is automatically generated.

CPPFLAGS

User-specified C preprocessor options. These will be included in any command that uses the C preprocessor, including not just compilation of C and C++ source files via the $CCCOM, $SHCCCOM, $CXXCOM and $SHCXXCOM command lines, but also the $F77PPCOM and $SHF77PPCOM command lines used to compile a Fortran source file, and the $ASPPCOM

command line used to assemble an assembly language source file, after first running each file through the C preprocessor. Note that this variable does *not* contain **-I** (or similar) include search path options that scons generates automatically from $CPPPATH. See **_CPPINCFLAGS**, below, for the variable that expands to those options.

_CPPINCFLAGS
An automatically-generated construction variable containing the C preprocessor command-line options for specifying directories to be searched for include files. The value of $_CPPINCFLAGS is created by appending $INCPREFIX and $INCSUFFIX to the beginning and end of each directory in $CPPPATH.

CPPPATH
The list of directories that the C preprocessor will search for include directories. The C/C++ implicit dependency scanner will search these directories for include files. Don't explicitly put include directory arguments in CCFLAGS or CXXFLAGS because the result will be non-portable and the directories will not be searched by the dependency scanner. Note: directory names in CPPPATH will be looked-up relative to the SConscript directory when they are used in a command. To force **scons** to look-up a directory relative to the root of the source tree use #:

env = Environment(CPPPATH='#/include')

The directory look-up can also be forced using the **Dir**() function:

include = Dir('include')
env = Environment(CPPPATH=include)

The directory list will be added to command lines through the automatically-generated $_CPPINCFLAGS construction variable, which is constructed by appending the values of the $INCPREFIX and $INCSUFFIX construction variables to the beginning and end of each directory in $CPPPATH. Any command lines you define that need the CPPPATH directory list should include $_CPPINCFLAGS:

env = Environment(CCCOM="my_compiler $_CPPINCFLAGS -c -o $TARGET $SOURCE")

CVS The CVS executable.

CVSCOFLAGS
Options that are passed to the CVS checkout subcommand.

CVSCOM
The command line used to fetch source files from a CVS repository.

CVSFLAGS
General options that are passed to CVS. By default, this is set to "-d $CVSREPOSITORY" to specify from where the files must be fetched.

CVSREPOSITORY
The path to the CVS repository. This is referenced in the default $CVSFLAGS value.

CXX The C++ compiler.

CXXFILESUFFIX
The suffix for C++ source files. This is used by the internal CXXFile builder when generating C++ files from Lex (.ll) or YACC (.yy) input files. The default suffix is *.cc*. SCons also treats files with the suffixes *.cpp*, *.cxx*, *.c++*, and *.C++* as C++ files. On case-sensitive systems (Linux, UNIX, and other POSIX-alikes), SCons also treats *.C* (upper case) files as C++ files.

CXXCOM
The command line used to compile a C++ source file to an object file. Any options specified in the $CXXFLAGS and $CPPFLAGS construction variables are included on this command line.

CXXFLAGS
General options that are passed to the C++ compiler.

Dir A function that converts a file name into a Dir instance relative to the target being built.

DVIPDF
The TeX DVI file to PDF file converter.

DVIPDFFLAGS
General options passed to the TeX DVI file to PDF file converter.

DVIPDFCOM
The command line used to convert TeX DVI files into a PDF file.

DVIPS The TeX DVI file to PostScript converter.

DVIPSFLAGS
General options passed to the TeX DVI file to PostScript converter.

ENV A dictionary of environment variables to use when invoking commands. Note that, by default, **scons** does *not* propagate the environment in force when you execute **scons** to the commands used to build target files. This is so that builds will be guaranteed repeatable regardless of the environment variables set at the time **scons** is invoked.

If you want to propagate your environment variables to the commands executed to build target files, you must do so explicitly:

```
import os
env = Environment(ENV = os.environ)
```

Note that you can choose only to propagate certain environment variables. A common example is the system **PATH** environment variable, so that **scons** uses the same utilities as the invoking shell (or other process):

```
import os
env = Environment(ENV = {'PATH' : os.environ['PATH']})
```

ESCAPE
A function that will be called to escape shell special characters in command lines. The function should take one argument: the command line string to escape; and should return the escaped command line.

F77 The Fortran compiler.

F77COM
The command line used to compile a Fortran source file to an object file.

F77FLAGS
General user-specified options that are passed to the Fortran compiler. Note that this variable does *not* contain **-I** (or similar) include search path options that scons generates automatically from $F77PATH. See **_F77INCFLAGS**, below, for the variable that expands to those options.

_F77INCFLAGS
An automatically-generated construction variable containing the Fortran compiler command-line options for specifying directories to be searched for include files. The value of $_F77INCFLAGS is created by appending $INCPREFIX and $INCSUFFIX to the beginning and end of each directory in $F77PATH.

F77PATH
The list of directories that the Fortran compiler will search for include directories. The Fortran implicit dependency scanner will search these directories for include files. Don't explicitly put include directory arguments in F77FLAGS because the result will be non-portable and the directories will not be searched by the dependency scanner. Note: directory names in F77PATH will be looked-up relative to the SConscript directory when they are used in a command. To force **scons** to look-up a directory relative to the root of the source tree use #:

env = Environment(F77PATH='#/include')

The directory look-up can also be forced using the **Dir**() function:

include = Dir('include')
env = Environment(F77PATH=include)

The directory list will be added to command lines through the automatically-generated $_F77INCFLAGS construction variable, which is constructed by appending the values of the $INCPREFIX and $INCSUFFIX construction variables to the beginning and end of each directory in $F77PATH. Any command lines you define that need the F77PATH directory list should include $_F77INCFLAGS:

env = Environment(F77COM="my_compiler $_F77INCFLAGS -c -o $TARGET $SOURCE")

F77PPCOM
The command line used to compile a Fortran source file to an object file after first running the file through the C preprocessor. Any options specified in the $F77FLAGS and $CPPFLAGS construction variables are included on this command line.

File A function that converts a file name into a File instance relative to the target being built.

GS The Ghostscript program used to convert PostScript to PDF files.

GSFLAGS
General options passed to the Ghostscript program when converting PostScript to PDF files.

GSCOM
The Ghostscript command line used to convert PostScript to PDF files.

INCPREFIX
The prefix used to specify an include directory on the C compiler command line. This will be appended to the beginning of each directory in the $CPPPATH and $F77PATH construction variables when the $_CPPINCFLAGS and $_F77INCFLAGS variables are automatically generated.

INCSUFFIX
The suffix used to specify an include directory on the C compiler command line. This will be appended to the end of each directory in the $CPPPATH and $F77PATH construction variables when the $_CPPINCFLAGS and $_F77INCFLAGS variables are automatically generated.

INSTALL
A function to be called to install a file into a destination file name. The default function copies the file into the destination (and sets the destination file's mode and permission bits to match the source file's). The function takes the following arguments:

def install(dest, source, env):

dest is the path name of the destination file. *source* is the path name of the source file. *env* is the construction environment (a dictionary of construction values) in force for this file installation.

JAR The Java archive tool.

JARCOM
The command line used to call the Java archive tool.

JARFLAGS
General options passed to the Java archive tool. By default this is set to **cf** to create the necessary *jar* file.

JARSUFFIX
The suffix for Java archives: **.jar** by default.

JAVAC The Java compiler.

JAVACCOM
The command line used to compile a directory tree containing Java source files to corresponding Java class files. Any options specified in the $JAVACFLAGS construction variable are included on this command line.

JAVACFLAGS
General options that are passed to the Java compiler.

JAVACLASSDIR
The directory in which Java class files may be found. This is stripped from the beginning of any Java .class file names supplied to the **JavaH** builder.

JAVACLASSSUFFIX
The suffix for Java class files; **.class** by default.

JAVAH The Java generator for C header and stub files.

JAVAHCOM
The command line used to generate C header and stub files from Java classes. Any options specified in the $JAVAHFLAGS construction variable are included on this command line.

JAVAHFLAGS
General options passed to the C header and stub file generator for Java classes.

JAVASUFFIX
The suffix for Java files; **.java** by default.

LATEX
The LaTeX structured formatter and typesetter.

LATEXCOM
The command line used to call the LaTeX structured formatter and typesetter.

LATEXFLAGS
General options passed to the LaTeX structured formatter and typesetter.

LEX The lexical analyzer generator.

LEXFLAGS
General options passed to the lexical analyzer generator.

LEXCOM
The command line used to call the lexical analyzer generator to generate a source file.

_LIBDIRFLAGS
An automatically-generated construction variable containing the linker command-line options for specifying directories to be searched for library. The value of $_LIBDIRFLAGS is created by appending $LIBDIRPREFIX and $LIBDIRSUFFIX to the beginning and end of each directory in $LIBPATH.

LIBDIRPREFIX
The prefix used to specify a library directory on the linker command line. This will be appended to the beginning of each directory in the $LIBPATH construction variable when the $_LIBDIRFLAGS variable is automatically generated.

LIBDIRSUFFIX
The suffix used to specify a library directory on the linker command line. This will be appended to the end of each directory in the $LIBPATH construction variable when the $_LIBDIRFLAGS variable is automatically generated.

_LIBFLAGS
An automatically-generated construction variable containing the linker command-line options for specifying libraries to be linked with the resulting target. The value of $_LIBFLAGS is created by appending $LIBLINKPREFIX and $LIBLINKSUFFIX to the beginning and end of each directory in $LIBS.

LIBLINKPREFIX
The prefix used to specify a library to link on the linker command line. This will be appended to the beginning of each library in the $LIBS construction variable when the $_LIBFLAGS variable is automatically generated.

LIBLINKSUFFIX
The suffix used to specify a library to link on the linker command line. This will be appended to the end of each library in the $LIBS construction variable when the $_LIBFLAGS variable is automatically generated.

LIBPATH
The list of directories that will be searched for libraries. The implicit dependency scanner will search these directories for include files. Don't explicitly put include directory arguments in $LINKFLAGS or $SHLINKFLAGS because the result will be non-portable and the directories will not be searched by the dependency scanner. Note: directory names in LIBPATH will be looked-up relative to the SConscript directory when they are used in a command. To force **scons** to look-up a directory relative to the root of the source tree use #:

env = Environment(LIBPATH='#/libs')

The directory look-up can also be forced using the **Dir**() function:

libs = Dir('libs')
env = Environment(LIBPATH=libs)

The directory list will be added to command lines through the automatically-generated $_LIBDIRFLAGS construction variable, which is constructed by appending the values of the $LIBDIRPREFIX and $LIBDIRSUFFIX construction variables to the beginning and end of each directory in $LIBPATH. Any command lines you define that need the LIBPATH directory list should include $_LIBDIRFLAGS:

env = Environment(LINKCOM="my_linker $_LIBDIRFLAGS $_LIBFLAGS -o $TARGET $SOURCE")

LIBPREFIX
The prefix used for (static) library file names.

LIBPREFIXES
An array of legal prefixes for library file names.

LIBS A list of one or more libraries that will be linked with any executable programs created by this environment.

The library list will be added to command lines through the automatically-generated $_LIBFLAGS construction variable, which is constructed by appending the values of the $LIBLINKPREFIX and $LIBLINKSUFFIX construction variables to the beginning and end of each directory in $LIBS. Any command lines you define that need the LIBS library list should include $_LIBFLAGS:

env = Environment(LINKCOM="my_linker $_LIBDIRFLAGS $_LIBFLAGS -o $TARGET $SOURCE")

LIBSUFFIX
The suffix used for (static) library file names.

LIBSUFFIXES
An array of legal suffixes for library file names.

LINK The linker.

LINKFLAGS
General user options passed to the linker. Note that this variable should *not* contain **-l** (or similar) options for linking with the libraries listed in $LIBS, nor **-L** (or similar) library search path options that scons generates automatically from $LIBPATH. See **_LIBFLAGS**, above, for the variable that expands to library-link options, and **_LIBDIRFLAGS**, above, for the variable that expands to library search path options.

LINKCOM
The command line used to link object files into an executable.

M4 The M4 macro preprocessor.

M4FLAGS
General options passed to the M4 macro preprocessor.

M4COM
The command line used to pass files through the macro preprocessor.

MAXLINELENGTH
The maximum number of characters allowed on an external command line. On Win32 systems, link lines longer than this many characters are linke via a temporary file name.

MSVS When the Microsoft Visual Studio tools are initialized, they set up this dictionary with the following keys:

VERSION: the version of MSVS being used (can be set via MSVS_VERSION)

VERSIONS: the available versions of MSVS installed

VCINSTALLDIR: installed directory of Visual C++

VSINSTALLDIR: installed directory of Visual Studio

FRAMEWORKDIR: installed directory of the .NET framework

FRAMEWORKVERSIONS: list of installed versions of the .NET framework, sorted latest to oldest.

FRAMEWORKVERSION: latest installed version of the .NET framework

FRAMEWORKSDKDIR: installed location of the .NET SDK.

PLATFORMSDKDIR: installed location of the Platform SDK.

PLATFORMSDK_MODULES: dictionary of installed Platform SDK modules, where the dictionary keys are keywords for the various modules, and the values are 2-tuples where the first is the release date, and the second is the version number.

If a value isn't set, it wasn't available in the registry.

MSVS_IGNORE_IDE_PATHS

Tells the MS Visual Studio tools to use minimal INCLUDE, LIB, and PATH settings, instead of the settings from the IDE.

For Visual Studio, SCons will (by default) automatically determine where MSVS is installed, and use the LIB, INCLUDE, and PATH variables set by the IDE. You can override this behavior by setting these variables after Environment initialization, or by setting **MSVS_IGNORE_IDE_PATHS = 1** in the Environment initialization. Specifying this will not leave these unset, but will set them to a minimal set of paths needed to run the tools successfully.

For VS6, the mininimal set is:
INCLUDE:'<VSDir>\VC98\ATL\include;<VSDir>\VC98\MFC\include;<VSDir>\VC98\include'
LIB:'<VSDir>\VC98\MFC\lib;<VSDir>\VC98\lib'
PATH:'<VSDir>\Common\MSDev98\bin;<VSDir>\VC98\bin'
For VS7, it is:
INCLUDE:'<VSDir>\Vc7\atlmfc\include;<VSDir>\Vc7\include'
LIB:'<VSDir>\Vc7\atlmfc\lib;<VSDir>\Vc7\lib'
PATH:'<VSDir>\Common7\Tools\bin;<VSDir>\Common7\Tools;<VSDir>\Vc7\bin'

Where '<VSDir>' is the installed location of Visual Studio.

MSVS_VERSION

Sets the preferred version of MSVS to use.

SCons will (by default) select the latest version of MSVS installed on your machine. So, if you have version 6 and version 7 (MSVS .NET) installed, it will prefer version 7. You can override this by specifying the **MSVS_VERSION** variable in the Environment initialization, setting it to the appropriate version ('6.0' or '7.0', for example). If the given version isn't installed, tool initialization will fail.

MSVSPROJECTCOM

The action used to generate Microsoft Visual Studio project and solution files.

MSVSPROJECTSUFFIX
The suffix used for Microsoft Visual Studio project (DSP) files. The default value is **.vcproj** when using Visual Studio version 7.x (.NET), and **.dsp** when using earlier versions of Visual Studio.

MSVSSOLUTIONSUFFIX
The suffix used for Microsoft Visual Studio solution (DSW) files. The default value is **.sln** when using Visual Studio version 7.x (.NET), and **.dsw** when using earlier versions of Visual Studio.

no_import_lib
When set to non-zero, suppresses creation of a corresponding Win32 static import lib by the **SharedLibrary** builder when used with MinGW or Microsoft Visual Studio. This also suppresses creation of an export (.exp) file when using Microsoft Visual Studio.

OBJPREFIX
The prefix used for (static) object file names.

OBJSUFFIX
The suffix used for (static) object file names.

P4 The Perforce executable.

P4COM
The command line used to fetch source files from Perforce.

P4FLAGS
General options that are passed to Perforce.

PCH The Microsoft Visual C++ precompiled header that will be used when compiling object files. This variable is ignored by tools other than Microsoft Visual C++. When this variable is defined SCons will add options to the compiler command line to cause it to use the precompiled header, and will also set up the dependencies for the PCH file. Example:

env['PCH'] = 'StdAfx.pch'

PCHSTOP
This variable specifies how much of a source file is precompiled. This variable is ignored by tools other than Microsoft Visual C++, or when the PCH variable is not being used. When this variable is define it must be a string that is the name of the header that is included at the end of the precompiled portion of the source files, or the empty string if the "#pragma hrdstop" construct is being used:

env['PCHSTOP'] = 'StdAfx.h'

PDB The Microsoft Visual C++ PDB file that will store debugging information for object files, shared libraries, and programs. This variable is ignored by tools other than Microsoft Visual C++. When this variable is defined SCons will add options to the compiler and linker command line to cause them to generate external debugging information, and will also set up the dependencies for the PDB file. Example:

env['PDB'] = 'hello.pdb'

PDFCOM
A deprecated synonym for $DVIPDFCOM.

PDFPREFIX
The prefix used for PDF file names.

PDFSUFFIX
The suffix used for PDF file names.

PLATFORM
The name of the platform used to create the Environment. If no platform is specified when the Environment is created, **SCons** autodetects the platform.

```
env = Environment(tools = [])
if env['PLATFORM'] == 'cygwin':
   Tool('mingw')(env)
else:
   Tool('msvc')(env)
```

PROGPREFIX
The prefix used for executable file names.

PROGSUFFIX
The suffix used for executable file names.

PSCOM
The command line used to convert TeX DVI files into a PostScript file.

PSPREFIX
The prefix used for PostScript file names.

PSSUFFIX
The prefix used for PostScript file names.

QTDIR The qt tool tries to take this from os.environ. It also initializes all QT_* construction variables listed below. (Note that all paths are constructed with python's os.path.join() method, but listed here with the '/' seperator for easier reading.) In addition, the construction environment variables CPPPATH, LIBPATH, LIBS, PROGEMITTER, SHLIBEMITTER and LIBEMITTER are modified. Because the build-performance is affected when using this tool, you have to explicitly specify it at Environment creation:
Environment(tools=['default','qt']).

You may want to use **Configure** to verify that the qt support really works. The qt tool supports the following operations:

Automatic moc file generation from header files. You do not have to specify moc files explicitly, the tool does it for you. However, there are a few preconditions to do so: Your header file must have the same filebase as your implementation file and must stay in the same directory. It must have one of the suffixes .h, .hpp, .H, .hxx, .hh.

Automatic moc file generation from cxx files. As stated in the qt documentation, include the

moc file at the end of the cxx file. Note that you have to include the file, which is generated by the QT_MOCNAMEGENERATOR function. If you are using BuildDir, you may need to specify duplicate=1.

Automatic handling of .ui files. The implementation files generated from .ui files are handled much the same as yacc or lex files. Because there are also generated headers, you may need to specify duplicate=1 in calls to BuildDir.

QT_LIB
Default value is 'qt'. You may want to set this to 'qt-mt'

QT_MOC
Default value is '$QTDIR/bin/moc'.

QT_UIC
Default value is '$QTDIR/bin/uic'.

QT_UICIMPLFLAGS
Default value is ''. These flags are passed to uic, when creating a cxx file from a .ui file.

QT_UICDECLFLAGS
Default value is ''. These flags are passed to uic, when creating a a h file from a .ui file.

QT_MOCFROMHFLAGS
Default value is ''. These flags are passed to moc, when moccing a header file.

QT_MOCFROMCPPFLAGS
Default value is '-i'. These flags are passed to moc, when moccing a cpp file.

QT_HSUFFIX
Default value is '.h'. Suffix of headers generated with uic.

QT_UISUFFIX
Default value is '.ui'. Suffix of designer files.

QT_UIHSUFFIX
Default value is '.ui.h'.

QT_MOCNAMEGENERATOR
Three-argument function, which generates names of moc output files. This is the most flexible way to support the huge number of conventions for this type of files. The arguments are the *filebase* , which is the file to be moc'd without path and extension, the *src_suffix* , which is the extension of the file to be moc'd and the environment *env* The default value maps 'myfile.myext' to 'moc_myfile.$CXXFILESUFFIX':

lambda filebase, src_suffix, env: 'moc_' + filebase + env['CXXFILESUFFIX']

QT_UICIMPLCOM
Command to generate cxx files from .ui files.

QT_UICDECLCOM
Command to generate header files from .ui files.

QT_MOCFROMHCOM
Command to generate a moc file from a header.

QT_MOCFROMCXXCOM
Command to generate a moc file from a cpp file.

RANLIB
The archive indexer.

RANLIBFLAGS
General options passed to the archive indexer.

RC The resource compiler used by the RES builder.

RCCOM
The command line used by the RES builder.

RCFLAGS
The flags passed to the resource compiler by the RES builder.

RCS The RCS executable. Note that this variable is not actually used for the command to fetch source files from RCS; see the **RCS_CO** construction variable, below.

RCS_CO
The RCS "checkout" executable, used to fetch source files from RCS.

RCS_COCOM
The command line used to fetch (checkout) source files from RCS.

RCS_COFLAGS
Options that are passed to the $RCS_CO command.

RDirs A function that converts a file name into a list of Dir instances by searching the repositories.

RMIC The Java RMI stub compiler.

RMICCOM
The command line used to compile stub and skeleton class files from Java classes that contain RMI implementations. Any options specified in the $RMICFLAGS construction variable are included on this command line.

RMICFLAGS
General options passed to the Java RMI stub compiler.

SCANNERS
A list of the available implicit dependency scanners. [CScan] by default.

SCCS The SCCS executable.

SCCSCOM
The command line used to fetch source files from SCCS.

SCCSFLAGS
General options that are passed to SCCS.

SCCSGETFLAGS
Options that are passed specifically to the SCCS "get" subcommand. This can be set, for example, to *-e* to check out editable files from SCCS.

SHCC The C compiler used for generating shared-library objects.

SHCCCOM
The command line used to compile a C source file to a shared-library object file. Any options specified in the $SHCCFLAGS and $CPPFLAGS construction variables are included on this command line.

SHCCFLAGS
Options that are passed to the C compiler to generate shared-library objects.

SHCXX
The C++ compiler used for generating shared-library objects.

SHCXXCOM
The command line used to compile a C++ source file to a shared-library object file. Any options specified in the $SHCXXFLAGS and $CPPFLAGS construction variables are included on this command line.

SHCXXFLAGS
Options that are passed to the C++ compiler to generate shared-library objects.

SHELL
A string naming the shell program that will be passed to the *SPAWN* function. See the *SPAWN* construction variable for more information.

SHF77 The Fortran compiler used for generating shared-library objects.

SHF77COM
The command line used to compile a Fortran source file to a shared-library object file.

SHF77FLAGS
Options that are passed to the Fortran compiler to generated shared-library objects.

SHF77PPCOM
The command line used to compile a Fortran source file to a shared-library object file after first running the file through the C preprocessor. Any options specified in the $SHF77FLAGS and $CPPFLAGS construction variables are included on this command line.

SHLIBPREFIX
The prefix used for shared library file names.

SHLIBSUFFIX
The suffix used for shared library file names.

SHLINK
The linker for programs that use shared libraries.

SHLINKFLAGS
General user options passed to the linker for programs using shared libraries. Note that this variable should *not* contain **-l** (or similar) options for linking with the libraries listed in $LIBS, nor **-L** (or similar) include search path options that scons generates automatically from $LIBPATH. See **_LIBFLAGS**, above, for the variable that expands to library-link options, and **_LIBDIRFLAGS**, above, for the variable that expands to library search path options.

SHOBJPREFIX
The prefix used for shared object file names.

SHOBJSUFFIX
The suffix used for shared object file names.

SOURCE
A reserved variable name that may not be set or used in a construction environment. (See "Variable Substitution," below.)

SOURCES
A reserved variable name that may not be set or used in a construction environment. (See "Variable Substitution," below.)

SPAWN
A command interpreter function that will be called to execute command line strings. The function must expect 4 arguments:

def spawn(shell, escape, cmd, args, env):

sh is a string naming the shell program to use. *escape* is a function that can be called to escape shell special characters in the command line. *cmd* is the path to the command to be executed. *args* is that arguments to the command. *env* is a dictionary of the environment variables in which the command should be executed.

SWIG The scripting language wrapper and interface generator.

SWIGCFILESUFFIX
The suffix that will be used for intermediate C source files generated by the scripting language wrapper and interface generator. The default value is **_wrap$CFILESUFFIX**. By default, this

value is used whenever the **-c++** option is *not* specified as part of the **SWIGFLAGS** construction variable.

SWIGCOM
The command line used to call the scripting language wrapper and interface generator.

SWIGCXXFILESUFFIX
The suffix that will be used for intermediate C++ source files generated by the scripting language wrapper and interface generator. The default value is **_wrap$CFILESUFFIX**. By default, this value is used whenever the **-c++** option is specified as part of the **SWIGFLAGS** construction variable.

SWIGFLAGS
General options passed to the scripting language wrapper and interface generator. This is where you should set **-python**, **-perl5**, **-tcl**, or whatever other options you want to specify to SWIG. If you set the **-c++** option in this variable, **scons** will, by default, generate a C++ intermediate source file with the extension that is specified as the **$CXXFILESUFFIX** variable.

TAR The tar archiver.

TARCOM
The command line used to call the tar archiver.

TARFLAGS
General options passed to the tar archiver.

TARGET
A reserved variable name that may not be set or used in a construction environment. (See "Variable Substitution," below.)

TARGETS
A reserved variable name that may not be set or used in a construction environment. (See "Variable Substitution," below.)

TARSUFFIX
The suffix used for tar file names.

TEX The TeX formatter and typesetter.

TEXCOM
The command line used to call the TeX formatter and typesetter.

TEXFLAGS
General options passed to the TeX formatter and typesetter.

TOOLS
A list of the names of the Tool specifications that are part of this construction environment.

WIN32_INSERT_DEF
When this is set to true, a library build of a WIN32 shared library (.dll file) will also build a corresponding .def file at the same time, if a .def file is not already listed as a build target. The default is 0 (do not build a .def file).

WIN32DEFPREFIX
The prefix used for WIN32 .def file names.

WIN32DEFSUFFIX
The suffix used for WIN32 .def file names.

YACC The parser generator.

YACCCOM
The command line used to call the parser generator to generate a source file.

YACCFLAGS
General options passed to the parser generator. If $YACCFLAGS contains a −d option, SCons assumes that the call will also create a .h file (if the yacc source file ends in a .y suffix) or a .hpp file (if the yacc source file ends in a .yy suffix)

ZIP The zip compression and file packaging utility.

ZIPCOM
The command line used to call the zip utility.

ZIPFLAGS
General options passed to the zip utility.

Construction variables can be retrieved and set using the **Dictionary** method of the construction environment:

```
dict = env.Dictionary()
dict["CC"] = "cc"
```

or using the [] operator:

```
env["CC"] = "cc"
```

Construction variables can also be passed to the construction environment constructor:

```
env = Environment(CC="cc")
```

or when copying a construction environment using the **Copy** method:

```
env2 = env.Copy(CC="cl.exe")
```

Configure contexts

scons supports *configure contexts,* an integrated mechanism similar to the various AC_CHECK macros in GNU autoconf for testing for the existence of C header files, libraries, etc. In contrast to autoconf, **scons**

does not maintain an explicit cache of the tested values, but uses its normal dependency tracking to keep the checked values up to date. The following methods can be used to perform checks:

Configure(*env*, [*custom_tests*, *conf_dir*, *log_file*])
This creates a configure context, which can be used to perform checks. *env* specifies the environment for building the tests. This environment may be modified when performing checks. *custom_tests* is a dictionary containing custom tests. See also the section about custom tests below. By default, no custom tests are added to the configure context. *conf_dir* specifies a directory where the test cases are built. Note that this directory is not used for building normal targets. The default value is the directory #/.sconf_temp. *log_file* specifies a file which collects the output from commands that are executed to check for the existence of header files, libraries, etc. The default is the file #/config.log. If you are using the **BuildDir** method, you may want to specify a subdirectory under your build directory.

A created **Configure** instance has the following associated methods:

Configure.Finish(*self*)
This method should be called after configuration is done. It returns the environment as modified by the configuration checks performed. After this method is called, no further checks can be performed with this configuration context. However, you can create a new Configure context to perform additional checks. Only one context should be active at a time.

The following Checks are predefined. (This list will likely grow larger as time goes by and developers contribute new useful tests.)

Configure.CheckCHeader(*self*, *header*, [*include_quotes*])
Checks if *header* is usable in the C-language. The optional argument *include_quotes* must be a two character string, where the first character denotes the opening quote and the second character denotes the closing quote (both default to ") Returns 1 on success and 0 on failure.

Configure.CheckCXXHeader(*self*, *header*, [*include_quotes*])
Checks if *header* is usable in the C++ language. The optional argument *include_quotes* must be a two character string, where the first character denotes the opening quote and the second character denotes the closing quote (both default to ") Returns 1 on success and 0 on failure.

Configure.CheckFunc(*self*, *function_name*)
Checks if the specified C or C+++ function is available. *function_name* is the name of the function to check for.

Configure.CheckLib(*self*, [*library*, *symbol*, *autoadd*])
Checks if *library* provides *symbol*. If the value of *autoadd* is 1 and the library provides the specified *symbol*, appends the library to the LIBS construction environment variable. *library* may also be None (the default), in which case *symbol* is checked with the current LIBS variable. The default *symbol* is "main", which just check if you can link against the specified *library*. The default value for *autoadd* is 1. It is assumed, that the C-language is used. This method returns 1 on success and 0 on error.

Configure.CheckLibWithHeader(*self*, *library*, *header*, *language*, [*call*, *autoadd*])

In contrast to the Configure.CheckLib call, this call provides a more sophisticated way to check against libraries. Again, *library* specifies the library to check. *header* specifies a header to check for. *language* may be one of 'C','c','CXX','cxx','C++' and 'c++'. *call* can be any valid

expression (with a trailing ';'). The default is 'main();'. *autoadd* specifies whether to add the library to the environment (only if the check succeeds). This method returns 1 on success and 0 on error.

Configure.CheckType(*self*, *type_name*, [*includes*])
Checks for the existence of a type defined by **typedef**. *type_name* specifies the typedef name to check for. *includes* is a string containing one or more **#include** lines that will be inserted into the program that will be run to test for the existence of the type.

Example of a typical Configure usage:

```
env = Environment()
conf = Configure( env )
if not conf.CheckCHeader( 'math.h' ):
   print 'We really need math.h!'
   Exit(1)
if conf.CheckLibWithHeader( 'qt', 'qapp.h', 'c++', 'QApplication qapp(0,0);' ):
   # do stuff for qt - usage, e.g.
   conf.env.Append( CPPFLAGS = '-DWITH_QT' )
env = conf.Finish()
```

You can define your own custom checks. in addition to the predefined checks. These are passed in a dictionary to the Configure function. This dictionary maps the names of the checks to user defined Python callables (either Python functions or class instances implementing the *__call__* method). The first argument of the call is always a *CheckContext* instance followed by the arguments, which must be supplied by the user of the check. These CheckContext instances define the following methods:

CheckContext.Message(*self*, *text*)

Usually called before the check is started. *text* will be displayed to the user, e.g. 'Checking for library X...'

CheckContext.Result(*self,*, *res*)

Usually called after the check is done. *res* can be either an integer or a string. In the former case, 'ok' (res != 0) or 'failed' (res == 0) is displayed to the user, in the latter case the given string is displayed.

CheckContext.TryCompile(*self*, *text*, *extension*)
Checks if a file with the specified *extension* (e.g. '.c') containing *text* can be compiled using the environment's **Object** builder. Returns 1 on success and 0 on failure.

CheckContext.TryLink(*self*, *text*, *extension*)
Checks, if a file with the specified *extension* (e.g. '.c') containing *text* can be compiled using the environment's **Program** builder. Returns 1 on success and 0 on failure.

CheckContext.TryRun(*self*, *text*, *extension*)
Checks, if a file with the specified *extension* (e.g. '.c') containing *text* can be compiled using the environment's **Program** builder. On success, the program is run. If the program executes successfully (that is, its return status is 0), a tuple *(1, outputStr)* is returned, where *outputStr* is the standard output of the program. If the program fails execution (its return status is non-zero), then (0, '') is returned.

CheckContext.TryAction(*self* , *action*, [*text*, *extension*])

Checks if the specified *action* with an optional source file (contents *text* , extension *extension* = '') can be executed. *action* may be anything which can be converted to a **scons** Action. On success, *(1, outputStr)* is returned, where *outputStr* is the content of the target file. On failure *(0, '')* is returned.

CheckContext.TryBuild(*self* , *builder*, [*text*, *extension*])

Low level implementation for testing specific builds; the methods above are based on this method. Given the Builder instance *builder* and the optional *text* of a source file with optional *extension*, this method returns 1 on success and 0 on failure. In addition, *self.lastTarget* is set to the build target node, if the build was successful.

Example for implementing and using custom tests:

```
def CheckQt(context, qtdir):
   context.Message( 'Checking for qt ...' )
   lastLIBS = context.env['LIBS']
   lastLIBPATH = context.env['LIBPATH']
   lastCPPPATH= context.env['CPPPATH']
   context.env.Append(LIBS = 'qt', LIBPATH = qtdir + '/lib', CPPPATH = qtdir + '/include' )
   ret = context.TryLink("""
#include <qapp.h>
int main(int argc, char **argv) {
 QApplication qapp(argc, argv);
 return 0;
}
""")
   if not ret:
      context.env.Replace(LIBS = lastLIBS, LIBPATH=lastLIBPATH, CPPPATH=lastCPPPATH)
   context.Result( ret )
   return ret

env = Environment()
conf = Configure( env, custom_tests = { 'CheckQt' : CheckQt } )
if not conf.CheckQt('/usr/lib/qt'):
   print 'We really need qt!'
   Exit(1)
env = conf.Finish()
```

Construction Variable Options

Often when building software, various options need to be specified at build time that are not known when the SConstruct/SConscript files are written. For example, libraries needed for the build may be in non-standard locations, or site-specific compiler options may need to be passed to the compiler. **scons** provides a mechanism for overridding construction variables from the command line or a text-based SConscript file through an Options object. To create an Options object, call the Options() function:

Options([*files*], [*args*])

This creates an Options object that will read construction variables from the file or list of filenames specified in *files*. If no files are specified, or the *files* argument is **None**, then no files will be read. The optional argument *args* is a dictionary of values that will override anything read from the specified files; it is primarily intended to be passed the **ARGUMENTS** dictionary that holds variables specified on the command line. Example:

```
opts = Options('custom.py')
opts = Options('overrides.py', ARGUMENTS)
opts = Options(None, {FOO:'expansion', BAR:7})
```

Options objects have the following methods:

Add(*key*, [*help*, *default*, *validator*, *converter*])
: This adds a customizable construction variable to the Options object. *key* is the name of the variable. *help* is the help text for the variable. *default* is the default value of the variable. *validator* is called to validate the value of the variable, and should take three arguments: key, value, and environment *converter* is called to convert the value before putting it in the environment, and should take a single argument: value. Example:

```
opts.Add('CC', 'The C compiler')
```

Update(*env*, [*args*])
: This updates a construction environment *env* with the customized construction variables. Normally this method is not called directly, but is called indirectly by passing the Options object to the Environment() function:

```
env = Environment(options=opts)
```

Save(*filename*, *env*)
: This saves the currently set options into a script file named *filename* that can be used on the next invocation to automatically load the current settings. This method combined with the Options method can be used to support caching of options between runs.

```
env = Environment()
opts = Options(['options.cache', 'custom.py'])
opts.Add(...)
opts.Update(env)
opts.Save('options.cache', env)
```

GenerateHelpText(*env*, [*sort*])
: This generates help text documenting the customizable construction variables suitable to passing in to the Help() function. *env* is the construction environment that will be used to get the actual values of customizable variables. Calling with an optional *sort* function will cause the output to be sorted by the specified argument. The specific *sort* function should take two arguments and return -1, 0 or 1 (like the standard Python *cmp* function).

```
Help(opts.GenerateHelpText(env))
Help(opts.GenerateHelpText(env, sort=cmp))
```

The text based SConscript file is executed as a Python script, and the global variables are queried for customizable construction variables. Example:

```
CC = 'my_cc'
```

Other Functions

scons also provides various additional functions, not associated with a construction environment, that SConscript files can use:

AddPostAction(*target*, *action*)

Arranges for the specified *action* to be performed after the specified *target* has been built. The specified action(s) may be an Action object, or anything that can be converted into an Action object (see below).

AddPreAction(*target*, *action*)

Arranges for the specified *action* to be performed before the specified *target* is built. The specified action(s) may be an Action object, or anything that can be converted into an Action object (see below).

Alias(*name*)

Creates or references an alias independent of the construction environment.

Alias('install')

BuildDir(*build_dir*, *src_dir*, [*duplicate*])

This specifies a build directory *build_dir* in which to build all derived files that would normally be built under *src_dir*. Multiple build directories can be set up for multiple build variants, for example. *src_dir* must be underneath the SConstruct file's directory, and *build_dir* may not be underneath the *src_dir* .

The default behavior is for **scons** to duplicate all of the files in the tree underneath *src_dir* into *build_dir*, and then build the derived files within the copied tree. (The duplication is performed by linking or copying, depending on the platform.) This guarantees correct builds regardless of whether intermediate source files are generated during the build, where preprocessors or other scanners search for included files, or whether individual compilers or other invoked tools are hard-coded to put derived files in the same directory as source files.

This behavior of making a complete copy of the source tree may be disabled by setting *duplicate* to 0. This will cause **scons** to invoke Builders using the path names of source files in *src_dir* and the path names of derived files within *build_dir*. This is always more efficient than *duplicate*=1, and is usually safe for most builds. Specifying *duplicate*=0, however, may cause build problems if source files are generated during the build, if any invoked tools are hard-coded to put derived files in the same directory as the source files.

Note that specifying a **BuildDir** works most naturally with a subsidiary SConscript file in the source directory. However, you would then call the subsidiary SConscript file not in the source directory, but in the *build_dir* , as if **scons** had made a virtual copy of the source tree regardless of the value of *duplicate*. This is how you tell **scons** which variant of a source tree to build. For example:

```
BuildDir('build-variant1', 'src')
SConscript('build-variant1/SConscript')
BuildDir('build-variant2', 'src')
SConscript('build-variant2/SConscript')
```

See also the **SConscript**() function, described below, for another way to specify a build directory in conjunction with calling a subsidiary SConscript file.)

CacheDir(*cache_dir*)

Specifies that **scons** will maintain a cache of derived files in *cache_dir* . The derived files in the cache will be shared among all the builds using the same **CacheDir**() call.

When a **CacheDir**() is being used and **scons** finds a derived file that needs to be rebuilt, it will first look in the cache to see if a derived file has already been built from identical input files and an identical build action (as incorporated into the MD5 build signature). If so, **scons** will retrieve the file from the cache. If the derived file is not present in the cache, **scons** will rebuild it and then place a copy of the built file in the cache (identified by its MD5 build signature), so that it may be retrieved by other builds that need to build the same derived file from identical inputs.

Use of a specified **CacheDir()** may be disabled for any invocation by using the **--cache-disable** option.

If the **--cache-force** option is used, **scons** will place a copy of *all* derived files in the cache, even if they already existed and were not built by this invocation. This is useful to populate a cache the first time **CacheDir**() is added to a build, or after using the **--cache-disable** option.

When using **CacheDir**(), **scons** will report, "Retrieved ‘file’ from cache," unless the **--cache-show** option is being used. When the **--cache-show** option is used, **scons** will print the action that *would* have been used to build the file, without any indication that the file was actually retrieved from the cache. This is useful to generate build logs that are equivalent regardless of whether a given derived file has been built in-place or retrieved from the cache.

Clean(*target*, *files_or_dirs*)

This specifies a list of files or directories which should be removed whenever the target is specified with the **-c** command line option. Multiple calls to **Clean**() are legal, and create a new target or add files and directories to the clean list for the specified target.

Multiple files or directories should be specified either as separate arguments to the **Clean**() method, or as a list. **Clean**() will also accept the return value of any of the construction environment Builder methods. Examples:

Clean(’foo’, [’bar’, ’baz’])
Clean(’dist’, env.Program(’hello’, ’hello.c’))

Default(*targets*)

This specifies a list of default targets, which will be built by **scons** if no explicit targets are given on the command line. Multiple calls to **Default**() are legal, and add to the list of default targets.

Multiple targets should be specified as separate arguments to the **Default**() method, or as a list. **Default**() will also accept the Node returned by any of a construction environment’s builder methods. Examples:

Default(’foo’, ’bar’, ’baz’)
Default([’a’, ’b’, ’c’])
hello = env.Program(’hello’, ’hello.c’)
Default(hello)

An argument to **Default**() of **None** will clear all default targets. Later calls to **Default**() will add to the (now empty) default-target list like normal.

DefaultEnvironment([*args*])

Creates and returns a default construction environment object. This construction environment is used internally by SCons in order to fetch source files transparently from source code management systems.

Dir(*name*, [*directory*])

This returns an object that represents a given directory *name*. *name* can be a relative or absolute path. *directory* is an optional directory that will be used as the parent directory.

EnsurePythonVersion(*major*, *minor*)

Ensure that the Python version is at least *major.minor*. This function will print out an error message and exit SCons with a non-zero exit code if the actual Python version is not late enough.

```
EnsurePythonVersion(2,2)
```

EnsureSConsVersion(*major*, *minor*)

Ensure that the SCons version is at least *major.minor*. This function will print out an error message and exit SCons with a non-zero exit code if the actual SCons version is not late enough.

```
EnsureSConsVersion(0,9)
```

Exit([*value*])

This tells **scons** to exit immediately with the specified *value*. A default exit value of **0** (zero) is used if no value is specified.

Export(*vars*)

This tells **scons** to export a list of variables from the current SConscript file to all other SConscript files. The exported variables are kept in a global collection, so subsequent calls to **Export**() will over-write previous exports that have the same name. Multiple variable names can be passed to **Export**() as separate arguments or as a list. A dictionary can be used to map variables to a different name when exported. Both local variables and global variables can be exported. Examples:

```
env = Environment()
# Make env available for all SConscript files to Import().
Export("env")

package = 'my_name'
# Make env and package available for all SConscript files:.
Export("env", "package")

# Make env and package available for all SConscript files:
Export(["env", "package"])

# Make env available using the name debug:.
Export({"debug":env})
```

Note that the **SConscript**() function supports an *exports* argument that makes it easier to to export a variable or set of variables to a single SConscript file. See the description of the **SConscript**() function, below.

File(*name*, [*directory*])

This returns an object that represents a given file *name*. *name* can be a relative or absolute path. *directory* is an optional directory that will be used as the parent directory.

FindFile(*file*, *dirs*)

Search for *file* in the path specified by *dirs*. *file* may be a list of file names or a single file name. In addition to searching for files that exist in the filesytem, this function also searches for derived

files that have not yet been built.

foo = FindFile('foo', ['dir1', 'dir2'])

GetOption(*name*)
This function provides a way to query a select subset of the scons command line options from a SConscript file. See *SetOption*() for a description of the options available.

Help(*text*)
This specifies help text to be printed if the **-h** argument is given to **scons**. **scons** will exit after printing out the help text.

Import(*vars*)
This tells **scons** to import a list of variables into the current SConscript file. This will import variables that were exported with **Export**() or in the *exports* argument to **SConscript**(). Variables exported by **SConscript**() have precedence. Multiple variable names can be passed to **Import**() as separate arguments or as a list. The variable "*" can be used to import all variables. Examples:

```
Import("env")
Import("env", "variable")
Import(["env", "variable"])
Import("*")
```

Literal(*string*)
The specified *string* will be preserved as-is and not have construction variables expanded.

Local(*targets*)
The specified *targets* will have copies made in the local tree, even if an already up-to-date copy exists in a repository.

ParseConfig(*env*, *command*, [*function*])
Calls the specified *function* to modify the specified environment *env* as specified by the output of *command* . The default *function* expects the output of a typical *-*config command* (for example, **gtk-config**) and parses the returned **-L**, **-l**, **-I** and other options into the **LIBPATH**, **LIBS**, **CPPPATH** and **CCFLAGS** variables, respectively.

Platform(*string*)
Returns a callable object that can be used to initialize a construction environment using the platform keyword of the Environment() method.

env = Environment(platform = Platform('win32'))

Note that the **win32** platform adds the **SYSTEMROOT** variable from the user's external environment to the construction environment's **ENV** dictionary. This is so that any executed commands that use sockets to connect with other systems (such as fetching source files from external CVS repository specifications like **:pserver:anonymous@cvs.sourceforge.net:/cvsroot/scons**) will work on Win32 systems.

Repository(*directory*)
Specifies that *directory* is a repository to be searched for files. Multiple calls to **Repository**() are legal, and each one adds to the list of repositories that will be searched.

To **scons**, a repository is a copy of the source tree, from the top-level directory on down, which may contain both source files and derived files that can be used to build targets in the local source tree. The canonical example would be an official source tree maintained by an integrator. If the repository contains derived files, then the derived files should have been built using **scons**, so that the repository contains the necessary signature information to allow **scons** to figure out when it is appropriate to use the repository copy of a derived file, instead of building one locally.

Note that if an up-to-date derived file already exists in a repository, **scons** will *not* make a copy in the local directory tree. In order to guarantee that a local copy will be made, use the **Local()** method.

Return(*vars*)

This tells **scons** what variable(s) to use as the return value(s) of the current SConscript file. These variables will be returned to the "calling" SConscript file as the return value(s) of **SConscript**(). Multiple variable names should be passed to **Return**() as a list. Example:

```
Return("foo")
Return(["foo", "bar"])
```

SetOption(*name*, *value*)

This function provides a way to set a select subset of the scons command line options from a SConscript file. The options supported are: clean which cooresponds to -c, --clean, and --remove; implicit_cache which corresponds to --implicit-cache; max_drift which corresponds to --max-drift; and num_jobs which corresponds to -j and --jobs. See the documentation for the corresponding command line object for information about each specific option. Example:

```
SetOption('max_drift', 1)
```

SConscript(*scripts*, [*exports*, *build_dir*, *src_dir*, *duplicate*])

SConscript(dirs=*subdirs*, [name=*script*, *exports*, *build_dir*, *src_dir*, *duplicate*])

This tells **scons** to execute one or more subsidiary SConscript (configuration) files. There are two ways to call the **SConscript**() function.

The first way you can call **SConscript**() is to explicitly specify one or more *scripts* as the first argument. A single script may be specified as a string; multiple scripts must be specified as a list (either explicitly or as created by a function like **Split**()).

The second way you can call **SConscript**() is to specify a list of (sub)directory names as a dirs=*subdirs* keyword argument. In this case, **scons** will, by default, execute a subsidiary configuration file named **SConscript** in each of the specified directories. You may specify a name other than **SConscript** by supplying an optional name=*script* keyword argument.

The optional *exports* argument provides a list of variable names or a dictionary of named values to export to the *script(s)*. These variables are locally exported only to the specified *script(s)*, and do not affect the global pool of variables used by the **Export**() function. The subsidiary *script(s)* must use the **Import**() function to import the variables.

The optional *build_dir* argument specifies that all of the target files (for example, object files and executables) that would normally be built in the subdirectory in which *script* resides should actually be built in *build_dir*.

The optional *src_dir* argument specifies that the source files from which the target files should be built can be found in *src_dir*.

By default, **scons** will link or copy (depending on the platform) all the source files into the build directory. This behavior may be disabled by setting the optional *duplicate* argument to 0 (it is set to 1 by default), in which case **scons** will refer directly to the source files in their source directory when building target files. (Setting *duplicate*=0 is usually safe, and always more efficient than the default of *duplicate*=1, but it may cause build problems in certain end-cases, such as compiling from source files that are generated by the build.)

Any variables returned by *script* using **Return**() will be returned by the call to **SConscript**().

Examples:

```
SConscript('subdir/SConscript')
foo = SConscript('sub/SConscript', exports='env')
SConscript('dir/SConscript', exports=['env', 'variable'])
SConscript('src/SConscript', build_dir='build', duplicate=0)
SConscript('bld/SConscript', src_dir='src', exports='env variable')
SConscript(dirs=['sub1', 'sub2'])
SConscript(dirs=['sub3', 'sub4'], name='MySConscript')
```

SConscriptChdir(*value*)

By default, **scons** changes its working directory to the directory in which each subsidiary SConscript file lives. This behavior may be disabled by specifying:
SConscriptChdir(0)

in which case **scons** will stay in the top-level directory while reading all SConscript files. (This may be necessary when building from repositories, when all the directories in which SConscript files may be found don't necessarily exist locally.)

You may enable and disable this ability by calling SConscriptChdir() multiple times:

```
SConscriptChdir(0)
SConscript('foo/SConscript')      # will not chdir to foo
SConscriptChdir(1)
SConscript('bar/SConscript')      # will chdir to bar
```

SourceSignatures(*type*)

This function tells SCons what type of signature to use for source files: **MD5** or **timestamp**. "MD5" means the signature of a source file is the MD5 checksum of its contents. "timestamp" means the signature of a source file is its timestamp (modification time). When using "timestamp" signatures, changes in the command line will not cause files to be rebuilt. "MD5" signatures take longer to compute, but are more accurate than "timestamp" signatures. The default is "MD5".

Split(*arg*)

Returns a list of file names or other objects. If arg is a string, it will be split on strings of white-space characters within the string, making it easier to write long lists of file names. If arg is already a list, the list will be returned untouched. If arg is any other type of object, it will be returned as a list containing just the object.

```
files = Split("f1.c f2.c f3.c")
files = Split("""
        f4.c
        f5.c
        f6.c
""")
```

TargetSignatures(*type*)

This function tells SCons what type of signatures to use for target files: **build** or **content**. "build" means the signature of a target file is made by concatenating all of the signatures of all its source files. "content" means the signature of a target file is an MD5 checksum of its contents. "build" signatures are usually faster to compute, but "content" signatures can prevent unnecessary rebuilds when a target file is rebuilt to the exact same contents as last time. The default is "build".

Tool(*string*)

Returns a callable object that can be used to initialize a construction environment using the tools keyword of the Environment() method.

```
env = Environment(tools = [ Tool('msvc') ])
```

The object may be called with a construction environment as an argument, in which case the object will be add the necessary variables to the construction environment and the name of the tool will be added to the **$TOOLS** construction variable.

```
env = Environment()
t = Tool('msvc')
t(env)  # adds 'msvc' to the TOOLS variable
```

Value(*value*)

Returns a Node object representing the specified Python value. Value nodes can be used as dependencies of targets. If the result of calling **str**(value) changes between SCons runs, any targets depending on **Value**(value) will be rebuilt. When using timestamp source signatures, Value nodes' timestamps are equal to the system time when the node is created.

```
def create(target, source, env):
   f = open(str(target[0]), 'wb')
   f.write('prefix=' + source[0].get_contents())

prefix = ARGUMENTS.get('prefix', '/usr/local')
env = Environment()
env['BUILDERS']['Config'] = Builder(action = create)
env.Config(target = 'package-config', source = Value(prefix))
```

WhereIs(*program*, [*path*, [*pathext*]])

Searches for the specified executable *program,* returning the full path name to the program if it is found, and returning None if not. Searches the specified *path,* or the user's current PATH (os.environ['PATH']) by default. On Win32 systems, searches for executable programs with any of the file extensions listed in the specified *pathext,* or the user's current PATHEXT (os.environ['PATHEXT']) by default.

EXTENDING SCONS

Builder Objects

scons can be extended by adding new builders to a construction environment using the **Builder** function. The **Builder** function accepts the following arguments:

action The command line string used to build the target from the source. **action** can also be: a list of strings representing the command to be executed and its arguments (suitable for enclosing white space in an argument), a dictionary mapping source file name suffixes to any combination of command line strings (if the builder should accept multiple source file extensions), a Python function;

an Action object (see the next section); or a list of any of the above.

An action function takes three arguments: *source* - a list of source nodes, *target* - a list of target nodes, *env* - the construction environment.

multi Specifies whether this builder is allowed to be called multiple times for the same target file(s). The default is 0, which means the builder can not be called multiple times for the same target file(s). Calling a builder multiple times for the same target simply adds additional source files to the target; it is not allowed to change the environment associated with the target, specify addition environment overrides, or associate a different builder with the target.

prefix The prefix that will be prepended to the target file name. This may be a simple string, or a callable object that takes two arguments, a construction environment and a list of sources, and returns a prefix.

```
b = Builder("build_it < $SOURCE > $TARGET"
        prefix = "file-")

def gen_prefix(env, sources):
   return "file-" + env['PLATFORM'] + '-'
b = Builder("build_it < $SOURCE > $TARGET"
        prefix = gen_prefix)
```

suffix The suffix that will be appended to the target file name. This may be a simple string, or a callable object that takes two arguments, a construction environment and a list of sources, and returns a suffix. If the suffix is a string, then **scons** will append a '.' to the beginning of the suffix if it's not already there. The string returned by callable object is untouched and must append its own '.' to the beginning if one is desired.

```
b = Builder("build_it < $SOURCE > $TARGET"
        suffix = "file-"

def gen_suffix(env, sources):
   return "." + env['PLATFORM'] + "-file"
b = Builder("build_it < $SOURCE > $TARGET"
        suffix = gen_suffix)
```

src_suffix
The expected source file name suffix.

src_builder
Specifies a builder to use when a source file name suffix does not match any of the suffixes of the builder. Using this argument produces a multi-stage builder.

emitter A function to manipulate the target and source lists before dependencies are established and the target(s) are actually built. **emitter** can also be string containing a construction variable to expand to an emitter function, or a dictionary mapping source file suffixes to emitter functions. (Only the suffix of the first source file is used to select the actual emitter function from an emitter dictionary.)

An emitter function takes three arguments: *source* - a list of source nodes, *target* - a list of target nodes, *env* - the construction environment. An emitter must return a tuple containing two lists, the

list of targets to be built by this builder, and the list of sources for this builder.

Example:

```
def e(target, source, env):
   return (target + ['foo.foo'], source + ['foo.src'])

# Simple association of an emitter function with a Builder.
b = Builder("my_build < $TARGET > $SOURCE",
        emitter = e)

# Calling an emitter through a construction variable.
env = Environment(MY_EMITTER = e)
b = Builder("my_build < $TARGET > $SOURCE",
        emitter = '$MY_EMITTER')

# Associating multiple emitters with different file
# suffixes using a dictionary.
def e_suf1(target, source, env):
   return (target + ['another_target_file'], source)
def e_suf2(target, source, env):
   return (target, source + ['another_source_file'])
b = Builder("my_build < $TARGET > $SOURCE",
        emitter = {'.suf1' : e_suf1,
                '.suf2' : e_suf2})
```

generator

A function that returns a list of actions that will be executed to build the target(s) from the source(s). The returned action(s) may be an Action object, or anything that can be converted into an Action object (see the next section).

The generator function takes four arguments: *source* - a list of source nodes, *target* - a list of target nodes, *env* - the construction environment, *for_signature* - a Boolean value that specifies whether the generator is being called for generating a build signature (as opposed to actually executing the command). Example:

```
def g(source, target, env, for_signature):
   return [["gcc", "-c", "-o"] + target + source]

b = Builder(generator=g)
```

The *generator* and *action* arguments must not both be used for the same Builder.

env A construction environment that can be used to fetch source code using this Builder. (Note that this environment is *not* used for normal builds of normal target files, which use the environment that was used to call the Builder for the target file.)

overrides

A dictionary of construction variables that will be set in the executing construction environment when this Builder is invoked. The canonical example here would be to set a construction variable to the repository of a source code system.

Any additional keyword arguments supplied when a Builder object is called will be associated

with the target (and any other files built as a result of the call).

```
b = Builder(action="build < $SOURCE > $TARGET")
env = Environment(BUILDERS = {'MyBuild' : b})
env.MyBuild('foo.out', 'foo.in', my_arg = 'xyzzy')
```

These extra keyword arguments are passed to the following functions: command generator functions, function Actions, and emitter functions.

Action Objects

The Builder function will turn its **action** keyword argument into an appropriate internal Action object. Occasionally, it may be more efficient to create an explicit Action object and use it to initialize multiple Builder objects, rather than let each separate Builder object create a separate Action.

The Action method takes one or two arguments and returns an appropriate object for the action represented by the type of the first argument:

Action If the first argument is already an Action object, the object is simply returned.

String If the first argument is a string, a command-line Action is returned.

```
Action('$CC -c -o $TARGET $SOURCES')
```

List If the first argument is a list, then a list of Action objects is returned. An Action object is created as necessary for each element in the list. If an element *within* the list is itself a list, the internal list is the command and arguments to be executed via the command line. This allows white space to be enclosed in an argument by defining a command in a list within a list:
Action([['cc', '-c', '-DWHITE SPACE', '-o', '$TARGET', '$SOURCES']])

Function

If the first argument is a Python function, a function Action is returned. The Python function takes three keyword arguments, **target** (a Node object representing the target file), **source** (a Node object representing the source file) and **env** (the construction environment used for building the target file). The **target** and **source** arguments may be lists of Node objects if there is more than one target file or source file. The actual target and source file name(s) may be retrieved from their Node objects via the built-in Python str() function:
target_file_name = str(target)
source_file_names = map(lambda x: str(x), source)

The function should return **0** or **None** to indicate a successful build of the target file(s). The function may raise an exception or return a non-zero exit status to indicate an unsuccessful build.

```
def build_it(target = None, source = None, env = None):
  # build the target from the source
  return 0

a = Action(build_it)
```

The second, optional argument is a Python function that returns a string to be printed to describe the action being executed. Like the function to build a file, this function takes three arguments: **target** (a Node object representing the target file), **source** (a Node object representing the source file) and **env** (a construction

environment). The **target** and **source** arguments may be lists of Node objects if there is more than one target file or source file. Examples:

```
def build_it(target, source, env):
  # build the target from the source
  return 0

def string_it(target, source, env):
  return "building '%s' from '%s'" % (target[0], source[0])

# Use a positional argument.
a = Action(build_it, string_it)

# Alternatively, use a keyword argument.
a = Action(build_it, strfunction=string_it)
```

The third, also optional argument is a list of construction variables whose values will be included in the signature of the Action when deciding whether a target should be rebuilt because the action changed. This is necessary whenever you want a target to be rebuilt when a specific construction variable changes, because the underlying Python code for a function will not change when the value of the construction variable does.

```
def build_it(target, source, env):
  # build the target from the 'XXX' construction variable
  open(target[0], 'w').write(env['XXX'])
  return 0

def string_it(target, source):
  return "building '%s' from '%s'" % (target[0], source[0])

# Use positional arguments.
a = Action(build_it, string_it, ['XXX'])

# Alternatively, use a keyword argument.
a = Action(build_it, varlist=['XXX'])
```

If the action argument is not one of the above, None is returned.

Variable Substitution

Before executing a command, **scons** performs construction variable interpolation on the strings that make up the command line of builders. Variables are introduced by a **$** prefix. Besides construction variables, scons provides the following variables for each command execution:

TARGET
: The file name of the target being built, or the file name of the first target if multiple targets are being built.

TARGETS
: The file names of all targets being built.

SOURCE
: The file name of the source of the build command, or the file name of the first source if multiple sources are being built.

SOURCES
The file names of the sources of the build command.

(Note that the above variables are reserved and may not be set in a construction environment.)

For example, given the construction variable CC='cc', targets=['foo'], and sources=['foo.c', 'bar.c']:

action='$CC -c -o $TARGET $SOURCES'

would produce the command line:

cc -c -o foo foo.c bar.c

Variable names may be surrounded by curly braces ({}) to separate the name from the trailing characters. Within the curly braces, a variable name may have a Python slice subscript appended to select one or more items from a list. In the previous example, the string:

${SOURCES[1]}

would produce:

bar.c

Additionally, a variable name may have the following special modifiers appended within the enclosing curly braces to modify the interpolated string:

base The base path of the file name, including the directory path but excluding any suffix.

dir The name of the directory in which the file exists.

file The file name, minus any directory portion.

filebase Just the basename of the file, minus any suffix and minus the directory.

suffix Just the file suffix.

abspath The absolute path name of the file.

posix The POSIX form of the path, with directories separated by / (forward slashes) not backslashes. This is sometimes necessary on Win32 systems when a path references a file on other (POSIX) systems.

srcpath The directory and file name to the source file linked to this file through BuildDir. If this file isn't linked, it just returns the directory and filename unchanged.

srcdir The directory containing the source file linked to this file through BuildDir. If this file isn't linked, it just returns the directory part of the filename.

For example, the specified target will expand as follows for the corresponding modifiers:

```
$TARGET             => sub/dir/file.x
${TARGET.base}      => sub/dir/file
${TARGET.dir}       => sub/dir
${TARGET.file}      => file.x
${TARGET.filebase}  => file
${TARGET.suffix}    => .x
${TARGET.abspath}   => /top/dir/sub/dir/file.x

BuildDir('sub/dir','src')
$SOURCE             => sub/dir/file.x
${SOURCE.srcpath}   => src/file.x
${SOURCE.srcdir}    => src
```

Lastly, a variable name may be a callable Python function associated with a construction variable in the environment. The function should take four arguments: *target* - a list of target nodes, *source* - a list of source nodes, *env* - the construction environment, *for_signature* - a Boolean value that specifies whether the function is being called for generating a build signature. SCons will insert whatever the called function returns into the expanded string:

```
def foo(target, source, env, for_signature):
  return "bar"

# Will expand $BAR to "bar baz"
env=Environment(FOO=foo, BAR="$FOO baz")
```

You can use this feature to pass arguments to a Python function by creating a callable class that stores one or more arguments in an object, and then uses them when the **__call__**() method is called. Note that in this case, the entire variable expansion must be enclosed by curly braces so that the arguments will be associated with the instantiation of the class:

```
class foo:
  def __init__(self, arg):
    self.arg = arg

  def __call__(self, target, source, env):
    return arg + " bar"

# Will expand $BAR to "my argument bar baz"
env=Environment(FOO=foo, BAR="${FOO('my argument')} baz")
```

The special pseudo-variables **$(** and **$)** may be used to surround parts of a command line that may change *without* causing a rebuild--that is, which are not included in the signature of target files built with this command. All text between **$(** and **$)** will be removed from the command line before it is added to file signatures, and the **$(** and **$)** will be removed before the command is executed. For example, the command line:

```
echo Last build occurred $( $TODAY $). > $TARGET
```

would execute the command:

```
echo Last build occurred $TODAY. > $TARGET
```

but the command signature added to any target files would be:

```
echo Last build occurred  . > $TARGET
```

SCons uses the following rules when converting construction variables into command lines:

String When the value is a string it is interpreted as a space delimited list of command line arguments.

List When the value is a list it is interpreted as a list of command line arguments. Each element of the list is converted to a string.

Other Anything that is not a list or string is converted to a string and interpreted as a single command line argument.

Newline

Newline characters (\n) delimit lines. The newline parsing is done after all other parsing, so it is not possible for arguments (e.g. file names) to contain embedded newline characters. This limitation will likely go away in a future version of SCons.

Scanner Objects

You can use the **Scanner** function to define objects to scan new file types for implicit dependencies. Scanner accepts the following arguments:

function

A Python function that will process the Node (file) and return a list of strings (file names) representing the implicit dependencies found in the contents. The function takes three or four arguments:

```
def scanner_function(node, env, path):

def scanner_function(node, env, path, arg):
```

The **node** argument is the internal SCons node representing the file. Use **str(node)** to fetch the name of the file, and **node.get_contents()** to fetch contents of the file.

The **env** argument is the construction environment for the scan. Fetch values from it using the **env.Dictionary()** method.

The **path** argument is a tuple (or list) of directories that can be searched for files. This will usually be the tuple returned by the **path_function** argument (see below).

The **arg** argument is the argument supplied when the scanner was created, if any.

name The name of the Scanner. This is mainly used to identify the Scanner internally.

argument

An optional argument that, if specified, will be passed to the scanner function (described above) and the path function (specified below).

skeys An optional list that can be used to determine which scanner should be used for a given Node. In the usual case of scanning for file names, this array will be a list of suffixes for the different file types that this Scanner knows how to scan.

path_function
: A Python function that takes two or three arguments: a construction environment, directory Node, and optional argument supplied when the scanner was created. The **path_function** returns a tuple of directories that can be searched for files to be returned by this Scanner object.

node_class
: The class of Node that should be returned by this Scanner object. Any strings or other objects returned by the scanner function that are not of this class will be run through the **node_factory** function.

node_factory
: A Python function that will take a string or other object and turn it into the appropriate class of Node to be returned by this Scanner object.

scan_check
: An optional Python function that takes a Node (file) as an argument and returns whether the Node should, in fact, be scanned for dependencies. This check can be used to eliminate unnecessary calls to the scanner function when, for example, the underlying file represented by a Node does not yet exist.

recursive
: An optional flag that specifies whether this scanner should be re-invoked on the dependency files returned by the scanner. When this flag is not set, the Node subsystem will only invoke the scanner on the file being scanned, and not (for example) also on the files specified by the #include lines in the file being scanned.

SYSTEM-SPECIFIC BEHAVIOR

SCons and its configuration files are very portable, due largely to its implementation in Python. There are, however, a few portability issues waiting to trap the unwary.

.C file suffix

SCons handles the upper-case **.C** file suffix differently, depending on the capabilities of the underlying system. On a case-sensitive system such as Linux or UNIX, SCons treats a file with a **.C** suffix as a C++ source file. On a case-insensitive system such as Windows, SCons treats a file with a **.C** suffix as a C source file.

.F file suffix

SCons handles the upper-case **.F** file suffix differently, depending on the capabilities of the underlying system. On a case-sensitive system such as Linux or UNIX, SCons treats a file with a **.F** suffix as a Fortran source file that is to be first run through the standard C preprocessor. On a case-insensitive system such as Windows, SCons treats a file with a **.F** suffix as a Fortran source file that should *not* be run through the C preprocessor.

WIN32: Cygwin Tools and Cygwin Python vs. Windows Pythons

Cygwin supplies a set of tools and utilities that let users work on a Windows system using a more POSIX-like environment. The Cygwin tools, including Cygwin Python, do this, in part, by sharing an ability to interpret UNIX-like path names. For example, the Cygwin tools will internally translate a Cygwin path name like /cygdrive/c/mydir to an equivalent Windows pathname of C:/mydir (equivalent to C:\mydir).

Versions of Python that are built for native Windows execution, such as the python.org and ActiveState versions, do not have the Cygwin path name semantics. This means that using a native Windows version of Python to build compiled programs using Cygwin tools (such as gcc, bison, and flex) may yield unpredictable results. "Mixing and matching" in this way can be made to work, but it requires careful attention to the use of path names in your SConscript files.

In practice, users can sidestep the issue by adopting the following rules: When using gcc, use the Cygwin-supplied Python interpreter to run SCons; when using Microsoft Visual C/C++ (or some other Windows compiler) use the python.org or ActiveState version of Python to run SCons.

WIN32: scons.bat file

On WIN32 systems, SCons is executed via a wrapper **scons.bat** file. This has (at least) two ramifications:

First, Windows command-line users that want to use variable assignment on the command line may have to put double quotes around the assignments:

```
scons "FOO=BAR" "BAZ=BLEH"
```

Second, the Cygwin shell does not recognize this file as being the same as an **scons** command issued at the command-line prompt. You can work around this either by executing **scons.bat** from the Cygwin command line, or by creating a wrapper shell script named **scons .**

MinGW

The MinGW bin directory must be in your PATH environment variable or the PATH variable under the ENV construction variable for SCons to detect and use the MinGW tools. When running under the native Windows Python interpreter, SCons will prefer the MinGW tools over the Cygwin tools, if they are both installed, regardless of the order of the bin directories in the PATH variable. If you have both MSVC and MinGW installed and you want to use MinGW instead of MSVC, then you must explictly tell SCons to use MinGW by passing

```
tools=['mingw']
```

to the Environment() function, because SCons will prefer the MSVC tools over the MinGW tools.

EXAMPLES

To help you get started using SCons, this section contains a brief overview of some common tasks.

NOTE: SCons does *not* build all of its targets by default, like other build tools do. The canonical way to invoke SCons is with a target of '.' (dot) to represent all targets in and below the current directory:

```
scons .
```

One or more default targets may be specified via the Default() method in the SConstruct file.

Basic Compilation From a Single Source File

```
env = Environment()
env.Program(target = 'foo', source = 'foo.c')
```

Note: Build the file by specifying the target as an argument ("scons foo" or "scons foo.exe"). or by specifying a dot ("scons .").

Basic Compilation From Multiple Source Files

```
env = Environment()
env.Program(target = 'foo', source = Split('f1.c f2.c f3.c'))
```

Setting a Compilation Flag

```
env = Environment(CCFLAGS = '-g')
env.Program(target = 'foo', source = 'foo.c')
```

Search The Local Directory For .h Files

Note: You do *not* need to set CCFLAGS to specify -I options by hand. SCons will construct the right -I options from CPPPATH.

```
env = Environment(CPPPATH = ['.'])
env.Program(target = 'foo', source = 'foo.c')
```

Search Multiple Directories For .h Files

```
env = Environment(CPPPATH = ['include1', 'include2'])
env.Program(target = 'foo', source = 'foo.c')
```

Building a Static Library

```
env = Environment()
env.StaticLibrary(target = 'foo', source = Split('l1.c l2.c'))
env.StaticLibrary(target = 'bar', source = ['l3.c', 'l4.c'])
```

Building a Shared Library

```
env = Environment()
env.SharedLibrary(target = 'foo', source = ['l5.c', 'l6.c'])
env.SharedLibrary(target = 'bar', source = Split('l7.c l8.c'))
```

Linking a Local Library Into a Program

```
env = Environment(LIBS = 'mylib', LIBPATH = ['.'])
env.Library(target = 'mylib', source = Split('l1.c l2.c'))
env.Program(target = 'prog', source = ['p1.c', 'p2.c'])
```

Defining Your Own Builder Object

Notice that when you invoke the Builder, you can leave off the target file suffix, and SCons will add it automatically.

```
bld = Builder(action = 'pdftex < $SOURCES > $TARGET'
            suffix = '.pdf',
            src_suffix = '.tex')
env = Environment(BUILDERS = {'PDFBuilder' : bld})
env.PDFBuilder(target = 'foo.pdf', source = 'foo.tex')

# The following creates "bar.pdf" from "bar.tex"
env.PDFBuilder(target = 'bar', source = 'bar')
```

Note also that the above initialization overwrites the default Builder objects, so the Environment created above can not be used call Builders like env.Program(), env.Object(), env.StaticLibrary(), etc.

Adding Your Own Builder Object to an Environment

```
bld = Builder(action = 'pdftex < $SOURCES > $TARGET'
            suffix = '.pdf',
            src_suffix = '.tex')
env = Environment()
env.Append(BUILDERS = {'PDFBuilder' : bld})
env.PDFBuilder(target = 'foo.pdf', source = 'foo.tex')
env.Program(target = 'bar', source = 'bar.c')
```

You also can use other Pythonic techniques to add to the BUILDERS construction variable, such as:

```
env = Environment()
env['BUILDERS']['PDFBuilder'] = bld
```

Defining Your Own Scanner Object

```
import re

include_re = re.compile(r'^include\s+(\S+)$', re.M)

def kfile_scan(node, env, path, arg):
  contents = node.get_contents()
  includes = include_re.findall(contents)
  return includes

kscan = Scanner(name = 'kfile',
                function = kfile_scan,
                argument = None,
                skeys = ['.k'])
scanners = Environment().Dictionary('SCANNERS')
env = Environment(SCANNERS = scanners + [kscan])

env.Command('foo', 'foo.k', 'kprocess < $SOURCES > $TARGET')

bar_in = File('bar.in')
env.Command('bar', bar_in, 'kprocess $SOURCES > $TARGET')
bar_in.target_scanner = kscan
```

Creating a Hierarchical Build

Notice that the file names specified in a subdirectory's SConscript file are relative to that subdirectory.

```
SConstruct:

  env = Environment()
  env.Program(target = 'foo', source = 'foo.c')

  SConscript('sub/SConscript')

sub/SConscript:

  env = Environment()
  # Builds sub/foo from sub/foo.c
  env.Program(target = 'foo', source = 'foo.c')

  SConscript('dir/SConscript')

sub/dir/SConscript:

  env = Environment()
  # Builds sub/dir/foo from sub/dir/foo.c
  env.Program(target = 'foo', source = 'foo.c')
```

Sharing Variables Between SConscript Files

You must explicitly Export() and Import() variables that you want to share between SConscript files.

SConstruct:

```
env = Environment()
env.Program(target = 'foo', source = 'foo.c')

Export("env")
SConscript('subdirectory/SConscript')
```

subdirectory/SConscript:

```
Import("env")
env.Program(target = 'foo', source = 'foo.c')
```

Building Multiple Variants From the Same Source

Use the BuildDir() method to establish one or more separate build directories for a given source directory, then use the SConscript() method to specify the SConscript files in the build directories:

SConstruct:

```
ccflags = '-DFOO'
Export("ccflags")
BuildDir('foo', 'src')
SConscript('foo/SConscript')

ccflags = '-DBAR'
Export("ccflags")
BuildDir('bar', 'src')
SConscript('bar/SConscript')
```

src/SConscript:

```
Import("ccflags")
env = Environment(CCFLAGS = ccflags)
env.Program(target = 'src', source = 'src.c')
```

Note the use of the Export() method to set the "ccflags" variable to a different value for each variant build.

Hierarchical Build of Two Libraries Linked With a Program

SConstruct:

```
env = Environment(LIBPATH = ['#libA', '#libB'])
Export('env')
SConscript('libA/SConscript')
SConscript('libB/SConscript')
SConscript('Main/SConscript')
```

libA/SConscript:

```
Import('env')
env.Library('a', Split('a1.c a2.c a3.c'))
```

libB/SConscript:

```
Import('env')
```

```
env.Library('b', Split('b1.c b2.c b3.c'))
```

Main/SConscript:

```
Import('env')
e = env.Copy(LIBS = ['a', ','b'])
e.Program('foo', Split('m1.c m2.c m3.c'))
```

The '#' in the LIBPATH directories specify that they're relative to the top-level directory, so they don't turn into "Main/libA" when they're used in Main/SConscript.

Specifying only 'a' and 'b' for the library names allows SCons to append the appropriate library prefix and suffix for the current platform (for example, 'liba.a' on POSIX systems,

Customizing contruction variables from the command line.

The following would allow the C compiler to be specified on the command line or in the file custom.py.

```
opts = Options('custom.py')
opts.Add('CC', 'The C compiler.')
env = Environment(options=opts)
Help(opts.GenerateHelpText(env))
```

The user could specify the C compiler on the command line:

```
scons "CC=my_cc"
```

or in the custom.py file:

```
CC = 'my_cc'
```

or get documentation on the options:

```
$ scons -h

CC: The C compiler.
  default: None
  actual: cc
```

Using Microsoft Visual C++ precompiled headers

Since windows.h includes everything and the kitchen sink, it can take quite some time to compile it over and over again for a bunch of object files, so Microsoft provides a mechanism to compile a set of headers once and then include the previously compiled headers in any object file. This technology is called precompiled headers. The general recipe is to create a file named "StdAfx.cpp" that includes a single header named "StdAfx.h", and then include every header you want to precompile in "StdAfx.h", and finally include "StdAfx.h" as the first header in all the source files you are compiling to object files. For example:

StdAfx.h:

```
#include <windows.h>
#include <my_big_header.h>
```

StdAfx.cpp:

```
#include <StdAfx.h>
```

Foo.cpp:

```
#include <StdAfx.h>

/* do some stuff */
```

Bar.cpp:

```
#include <StdAfx.h>

/* do some other stuff */
```

SConstruct:

```
env=Environment()
env['PCHSTOP'] = 'StdAfx.h'
env['PCH'] = env.PCH('StdAfx.cpp')[0]
env.Program('MyApp', ['Foo.cpp', 'Bar.cpp'])
```

For more information see the document for the PCH builder, and the PCH and PCHSTOP construction variables. To learn about the details of precompiled headers consult the MSDN documention for /Yc, /Yu, and /Yp.

Using Microsoft Visual C++ external debugging information

Since including debugging information in programs and shared libraries can cause their size to increase significantly, Microsoft provides a mechanism for including the debugging information in an external file called a PDB file. SCons supports PDB files through the PDB construction variable.

SConstruct:

```
env=Environment()
env['PDB'] = 'MyApp.pdb'
env.Program('MyApp', ['Foo.cpp', 'Bar.cpp'])
```

For more information see the document for the PDB construction variable.

ENVIRONMENT

SCONS_LIB_DIR

Specifies the directory that contains the SCons Python module directory (e.g. /home/aroach/scons-src-0.01/src/engine).

SCONSFLAGS

A string of options that will be used by scons in addition to those passed on the command line.

SEE ALSO

scons User Manual, **scons** Design Document, **scons** source code.

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