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Global variables and standard types

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_RTC_GetErrDesc
_RTC_NumErrors
_RTC_SetErrorFunc
_RTC_SetErrorFuncW
_RTC_SetErrorType
_scalb
scalbn, scalbnf, scalbnl, scalbln, scalblnf, scalblnl
scanf, _scanf_l, wscanf, _wscanf_l
scanf_s, _scanf_s_l, wscanf_s, _wscanf_s_l
_scprintf, _scprintf_l, _scwprintf, _scwprintf_l
_scprintf_p, _scprintf_p_l, _scwprintf_p, _scwprintf_p_l
_searchenv, _wsearchenv
_searchenv_s, _wsearchenv_s
__security_init_cookie

_seh_filter_dll, _seh_filter_exe
_set_abort_behavior
setbuf
_set_controlfp
_set_doserrno
_set_errno
_set_error_mode
_set_fmode
_set_invalid_parameter_handler, _set_thread_local_invalid_parameter_handler
setjmp
setlocale, _wsetlocale
_setmaxstdio
_setmbcp
setmode
_setmode
_set_new_handler
_set_new_mode
_set_printf_count_output
_set_se_translator
_set_SSE2_enable
set_terminate (CRT)
set_unexpected (CRT)
setvbuf
signal
signbit
sin, sinf, sinl
sinh, sinhf, sinhl
snprintf, _snprintf, _snprintf_l, _snwprintf, _snwprintf_l
_snprintf_s, _snprintf_s_l, _snwprintf_s, _snwprintf_s_l
_snscanf, _snscanf_l, _snwscanf, _snwscanf_l
_snscanf_s, _snscanf_s_l, _snwscanf_s, _snwscanf_s_l
sopen

_sopen, _wsopen
_sopen_s, _wsopen_s
spawnl
_spawnl, _wspawnl
spawnle
_spawnle, _wspawnle
spawnlp
_spawnlp, _wspawnlp
spawnlpe
_spawnlpe, _wspawnlpe
spawnv
_spawnv, _wspawnv
spawnve
_spawnve, _wspawnve
spawnvp
_spawnvp, _wspawnvp
spawnvpe
_spawnvpe, _wspawnvpe
_splitpath, _wsplitpath
_splitpath_s, _wsplitpath_s
sprintf, _sprintf_l, swprintf, _swprintf_l, __swprintf_l
_sprintf_p, _sprintf_p_l, _swprintf_p, _swprintf_p_l
sprintf_s, _sprintf_s_l, swprintf_s, _swprintf_s_l
sqrt, sqrtf, sqrtl
srand

strchr, wcschr, _mbschr, _mbschr_l
strcmp, wcscmp, _mbscmp, _mbscmp_l
strcmpl
strcoll, wcscoll, _mbscoll, _strcoll_l, _wcscoll_l, _mbscoll_l
strcpy, wcscopy, _mbscopy
strcpy_s, wcscopy_s, _mbscopy_s, _mbscopy_s_l
strcspn, wcscspn, _mbscspn, _mbscspn_l
_strdate, _wstrdate
_strdate_s, _wstrdate_s
_strdec, _wcsdec, _mbsdec, _mbsdec_l
strdup, wcsdup
_strdup, _wcsdup, _mbsdup
_strdup_dbg, _wcsdup_dbg
strerror, _strerror, _wcerror, __wcerror
strerror_s, _strerror_s, _wcerror_s, __wcerror_s
strftime, wcsftime, _strftime_l, _wcsftime_l
strcmp, wcsicmp
_strcmp, _wcsicmp, _mbsicmp, _strcmp_l, _wcsicmp_l, _mbsicmp_l
_stricoll, _wcsicoll, _mbsicoll, _stricoll_l, _wcsicoll_l, _mbsicoll_l
_strinc, _wcsinc, _mbsinc, _mbsinc_l
strlen, wcslen, _mbslen, _mbslen_l, _mbstrlen, _mbstrlen_l
strlwr, wcslwr
_strlwr, _wcslwr, _mbslwr, _strlwr_l, _wcslwr_l, _mbslwr_l
_strlwr_s, _strlwr_s_l, _mbslwr_s, _mbslwr_s_l, _wcslwr_s, _wcslwr_s_l
strncat, _strncat_l, wcsncat, _wcsncat_l, _mbsncat, _mbsncat_l
strncat_s, _strncat_s_l, wcsncat_s, _wcsncat_s_l, _mbsncat_s, _mbsncat_s_l
strcmp, wcsncmp, _mbsncmp, _mbsncmp_l
_strncnt, _wcsncnt, _mbsnbcnt, _mbsnbcnt_l, _mbsnccnt, _mbsnccnt_l
_strncoll, _wcsncoll, _mbsncoll, _strncoll_l, _wcsncoll_l, _mbsncoll_l
strncpy, _strncpy_l, wcsncpy, _wcsncpy_l, _mbsncpy, _mbsncpy_l
strncpy_s, _strncpy_s_l, wcsncpy_s, _wcsncpy_s_l, _mbsncpy_s, _mbsncpy_s_l
_strnextc, _wcsnextc, _mbsnextc, _mbsnextc_l

strcmp, wcsncmp
_strcmp, _wcsncmp, _mbsnicmp, _strnicmp_l, _wcsnicmp_l, _mbsnicmp_l
_strnicoll, _wcsnicoll, _mbsnicoll, _strnicoll_l, _wcsnicoll_l, _mbsnicoll_l
_strninc, _wcsninc, _mbsninc, _mbsninc_l
strnlen, strnlen_s, wcsnlen, wcsnlen_s, _mbsnlen, _mbsnlen_l, _mbstrnlen, _mbstrnlen_l
strnset, wcsnset
_strnset, _strnset_l, _wcsnset, _wcsnset_l, _mbsnset, _mbsnset_l
_strnset_s, _strnset_s_l, _wcsnset_s, _wcsnset_s_l, _mbsnset_s, _mbsnset_s_l
strupr, wcspbrk, _mbspbrk, _mbspbrk_l
strrchr, wcsrchr, _mbsrchr, _mbsrchr_l
strrev, wcsrev
_strrev, _wcsrev, _mbsrev, _mbsrev_l
strset, wcsset
_strset, _strset_l, _wcsset, _wcsset_l, _mbsset, _mbsset_l
_strset_s, _strset_s_l, _wcsset_s, _wcsset_s_l, _mbsset_s, _mbsset_s_l
strspn, wcspn, _mbsspnp, _mbsspnp_l
_strspnp, _wcspnnp, _mbsspnp, _mbsspnp_l
strstr, wcsstr, _mbsstr, _mbsstr_l
_strftime, _wstrftime
_strftime_s, _wstrftime_s
strtod, _strtod_l, wcstod, _wcstod_l
strtodf, _strtodf_l, wcstof, _wcstof_l
_strtoi64, _wcstoi64, _strtoi64_l, _wcstoi64_l
strtoimax, _strtoimax_l, wcstoiimax, _wcstoiimax_l
strtok, _strtok_l, wcstok, _wcstok_l, _mbstok, _mbstok_l
strtok_s, _strtok_s_l, wcstok_s, _wcstok_s_l, _mbstok_s, _mbstok_s_l
strtol, wcstol, _strtol_l, _wcstol_l
strtold, _strtold_l, wcstold, _wcstold_l
strtoll, _strtoll_l, wcstoll, _wcstoll_l
_strtoui64, _wcstoui64, _strtoui64_l, _wcstoui64_l
strtoul, _strtoul_l, wcstoul, _wcstoul_l
strtoull, _strtoull_l, wcstoull, _wcstoull_l

strtoumax, _strtoumax_l, wcstoumax, _wcstoumax_l
strupr, wcsupr
_strupr, _strupr_l, _mbsupr, _mbsupr_l, _wcsupr_l, _wcsupr
_strupr_s, _strupr_s_l, _mbsupr_s, _mbsupr_s_l, _wcsupr_s, _wcsupr_s_l
strxfrm, wcsxfrm, _strxfrm_l, _wcsxfrm_l
swab
_swab
system, _wsystem
tan, tanf, tanl
tanh, tanhf, tanhl
tell
_tell, _telli64
tempnam
_tempnam, _wtempnam, tmpnam, _wtmpnam
_tempnam_dbg, _wtempnam_dbg
terminate (CRT)
tgamma, tgammaf, tgammal
time, _time32, _time64
timespec_get, _timespec32_get, _timespec64_get
tmpfile
tmpfile_s
tmpnam_s, _wtmpnam_s
toascii, __toascii
tolower, _tolower, towlower, _tolower_l, _towlower_l
toupper, _toupper, towupper, _toupper_l, _towupper_l
towctrans
trunc, truncf, trunc_l
tzset
_tzset
umask
_umask
_umask_s

_uncaught_exception
unexpected (CRT)
ungetc, ungetwc
_ungetc_nolock, _ungetwc_nolock
ungetch
_ungetch, _ungetwch, _ungetch_nolock, _ungetwch_nolock
unlink
_unlink, _wunlink
_unlock_file
_utime, _utime32, _utime64, _wutime, _wutime32, _wutime64
va_arg, va_copy, va_end, va_start
_vcprintf, _vcprintf_l, _vcwprintf, _vcwprintf_l
_vcprintf_p, _vcprintf_p_l, _vcwprintf_p, _vcwprintf_p_l
_vcprintf_s, _vcprintf_s_l, _vcwprintf_s, _vcwprintf_s_l
vfprintf, _vfprintf_l, vfwprintf, _vfwprintf_l
_vfprintf_p, _vfprintf_p_l, _vfwprintf_p, _vfwprintf_p_l
vfprintf_s, _vfprintf_s_l, vfwprintf_s, _vfwprintf_s_l
vfscanf, vfwscanf
vfscanf_s, vfwscanf_s
vprintf, _vprintf_l, vwprintf, _vwprintf_l
_vprintf_p, _vprintf_p_l, _vwprintf_p, _vwprintf_p_l
vprintf_s, _vprintf_s_l, vwprintf_s, _vwprintf_s_l
vscanf, vwscanf
vscanf_s, vwscanf_s
_vscprintf, _vscprintf_l, _vscwprintf, _vscwprintf_l
_vscprintf_p, _vscprintf_p_l, _vscwprintf_p, _vscwprintf_p_l
vsnprintf, _vsnprintf, _vsnprintf_l, _vsnwprintf, _vsnwprintf_l
vsnprintf_s, _vsnprintf_s, _vsnprintf_s_l, _vsnwprintf_s, _vsnwprintf_s_l
vsprintf, _vsprintf_l, vswprintf, _vswprintf_l, __vswprintf_l
_vsprintf_p, _vsprintf_p_l, _vswprintf_p, _vswprintf_p_l
vsprintf_s, _vsprintf_s_l, vswprintf_s, _vswprintf_s_l
vsscanf, vswscanf

vsscanf_s, vswscanf_s

wcrtomb

wcrtomb_s

wcsrtombs

wcsrtombs_s

wcstombs, _wcstombs_l

wcstombs_s, _wcstombs_s_l

wctob

wctomb, _wctomb_l

wctomb_s, _wctomb_s_l

wctrans

wctype

write

_write

wcsicoll

xor

xor_eq

y0, y1, yn

Microsoft C runtime library (CRT) reference

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The Microsoft runtime library provides routines for programming the Microsoft Windows operating system. These routines automate many common programming tasks that aren't provided by the C and C++ languages.

Sample programs are included in the individual reference articles for most routines in the library.

In this section

[Universal C runtime routines by category](#)

Provides links to the runtime library by category.

[Global variables and standard types](#)

Provides links to the global variables and standard types provided by the runtime library.

[Global constants](#)

Provides links to the global constants defined by the runtime library.

[Global state](#)

Describes the scope of global state in the C runtime library.

[Generic-text mappings](#)

Provides links to the generic-text mappings defined in Tchar.h.

[Alphabetical function reference](#)

Provides links to the C runtime library functions, organized alphabetically.

[Function family overviews](#)

Provides links to the C runtime library functions, organized by function family.

[Language and country/region strings](#)

Describes how to use the `setlocale` function to set the language and Country/Region strings.

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

List of `.lib` files that make up the C runtime libraries and their associated compiler options and preprocessor directives.

Related sections

[Debug routines](#)

Provides links to the debug versions of the runtime library routines.

[Runtime error checking](#)

Provides links to functions that support runtime error checks.

[DLLs and Visual C++ runtime library behavior](#)

Discusses the entry point and startup code used for a DLL.

[Debugging](#)

Provides links to using the Visual Studio debugger to correct logic errors in your application or stored procedures.

Compatibility

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The Universal C Runtime Library (UCRT) supports most of the C standard library required for C++ conformance. It implements the C99 (ISO/IEC 9899:1999) library, with certain exceptions:

- strict type compatibility in `<complex.h>`.
- `aligned_alloc`, which will probably not be implemented because the Windows operating system doesn't support aligned allocations. Use the non-standard `_aligned_malloc`, instead.
- `strerrorlen_s`
- atomic support in `<stdatomic.h>`
- threading support in `<threads.h>`

The UCRT also implements a large subset of the POSIX.1 (ISO/IEC 9945-1:1996, the POSIX System Application Program Interface) C library. However, it's not fully conformant to any specific POSIX standard. The UCRT also implements several Microsoft-specific functions and macros that aren't part of a standard.

Functions specific to the Microsoft implementation of Visual C++ are found in the `vcruntime` library. Many of these functions are for internal use and can't be called by user code. Some are documented for use in debugging and implementation compatibility.

The C++ standard reserves names that begin with an underscore in the global namespace to the implementation. Both the POSIX functions and Microsoft-specific runtime library functions are in the global namespace, but aren't part of the standard C runtime library. It's why the preferred Microsoft implementations of these functions have a leading underscore. For portability, the UCRT also supports the default names, but the Microsoft C++ compiler issues a deprecation warning when code that uses them is compiled. Only the default names are deprecated, not the functions themselves. To suppress the warning, define `_CRT_NONSTDC_NO_WARNINGS` before including any headers in code that uses the original POSIX names. Because the C standard doesn't allow non-standard names in header files, by default `/std:c11` and `/std:c17` don't expose the default names for POSIX functions, types, and macros. If these names are necessary, define `_CRT_DECLARE_NONSTDC_NAMES` to expose them.

Certain functions in the standard C library have a history of unsafe usage, because of misused parameters and unchecked buffers. These functions are often the source of security issues in code. Microsoft created a set of safer versions of these functions that verify parameter usage. They invoke the invalid parameter handler when an issue is detected at runtime. By default, the Microsoft C++ compiler issues a deprecation warning when a function is used that has a safer variant available. When you compile your code as C++, you can define `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` as 1 to eliminate most warnings. This macro enables template overloads to call the safer variants while maintaining portable source code. To suppress the warning, define `_CRT_SECURE_NO_WARNINGS` before including any headers in code that uses these functions. For more information, see [Security features in the CRT](#).

Except as noted within the documentation for specific functions, the UCRT is compatible with the Windows API. Certain functions aren't supported in Windows Store or Universal Windows Platform ([UWP](#)) apps. These functions are listed in [CRT functions not supported in Universal Windows Platform apps](#).

Related articles

TITLE	DESCRIPTION
UWP apps, the Windows Runtime, and the C runtime	Describes when UCRT routines aren't compatible with Universal Windows apps or Microsoft Store apps.
ANSI C conformance	Describes standard-conforming names in the UCRT.
UNIX	Provides guidelines for porting programs to UNIX.
Windows platforms (CRT)	Lists the operating systems that are the CRT supports.
Backward compatibility	Describes how to map old CRT names to the new ones.
C runtime (CRT) and C++ Standard Library (STL) <small>.lib files</small>	Provides an overview of the CRT library (.lib) files and the associated compiler options.

UWP Apps, the Windows Runtime, and the C Run-Time

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Universal Windows Platform (UWP) apps are programs that run in the Windows Runtime that executes on Windows 8 and later. The Windows Runtime is a trustworthy environment that controls the functions, variables, and resources that are available to a UWP app. However, by design, Windows Runtime restrictions prevent the use of most C Run-Time Library (CRT) features in UWP apps.

UWP apps don't support the following CRT features:

- Most CRT functions that are related to unsupported functionality.

For example, a UWP app can't create a process by using the `exec` and `spawn` families of routines.

When a CRT function isn't supported in a UWP app, that fact is noted in its reference article.

- Most multibyte character and string functions.

However, both Unicode and ANSI text are supported.

- Environment variables.

- The concept of a current working directory.

- UWP apps and DLLs that are statically linked to the CRT and built by using the `/MT` or `/MTd` compiler options.

That is, an app that uses a multithread, static version of the CRT.

- An app that's built by using the `/MDd` compiler option.

That is, a debug, multithread, and DLL-specific version of the CRT. Such an app isn't supported on the Windows Runtime.

For a complete list of CRT functions that aren't available in a UWP app and suggestions for alternative functions, see [CRT functions not supported in Universal Windows Platform apps](#).

See also

[Compatibility](#)

[Windows Runtime unsupported CRT functions](#)

[Universal C runtime routines by category](#)

[Create a Universal Windows Platform console app](#)

ANSI C Conformance

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The naming convention for all Microsoft-specific identifiers in the run-time system (such as functions, macros, constants, variables, and type definitions) conforms to the ANSI/ISO C standards. In this documentation, any run-time function that follows the ANSI/ISO C standards is noted as being ANSI compatible. ANSI-conforming applications should only use these ANSI compatible functions.

The names of Microsoft-specific functions and global variables begin with a single underscore. These names can be overridden only locally, within the scope of your code. For example, when you include Microsoft run-time header files, you can still locally override the Microsoft-specific function named `_open` by declaring a local variable of the same name. However, you can't use this name for your own global function or global variable.

The names of Microsoft-specific macros and manifest constants begin with two underscores, or with a single leading underscore immediately followed by an uppercase letter. The scope of such identifiers is absolute. For example, you can't use the Microsoft-specific identifier `_UPPER` for this reason.

See also

[Compatibility](#)

UNIX

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If you plan to port your programs to UNIX, follow these guidelines:

- Don't remove header files from the SYS subdirectory. You can place the SYS header files elsewhere only if you don't plan to transport your programs to UNIX.
- Use the UNIX-compatible path delimiter in routines that take strings representing paths and filenames as arguments. UNIX supports only the forward slash (/) for this purpose, but Win32 operating systems support both the backslash (\) and the forward slash (/). This documentation uses UNIX-compatible forward slashes as path delimiters in `#include` statements, for example. (However, the Windows operating system command shell, CMD.EXE, doesn't support the forward slash in commands entered at the command prompt.)
- Use paths and filenames that work correctly in UNIX, which is case-sensitive. The file allocation table (FAT) file system in Win32 operating systems isn't case-sensitive. The NTFS file system preserves case for directory listings, but ignores case in file searches and other system operations.

NOTE

In this version of Visual C++, UNIX compatibility information has been removed from the function descriptions.

See also

[Compatibility](#)

Windows platforms (CRT)

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The C run-time libraries for Visual Studio support all versions of Windows and Windows Server that are still in extended support. Visual Studio 2015 supports Windows 8 and 8.1, Windows Server 2012, Windows 7, Windows Server 2008, and Windows Vista. It optionally supports Windows XP Service Pack 3 (SP3) for x86, Windows XP Service Pack 2 (SP2) for x64, and Windows Server 2003 Service Pack 2 (SP2) for both x86 and x64. All of these operating systems support the Windows desktop API (Win32) and provide Unicode support. In addition, any Win32 application can use a multibyte character set (MBCS).

The C run-time libraries for Visual Studio support all versions of Windows and Windows Server that are still in extended support. Libraries are available for x86, x64, and ARM64. All of these operating systems support the Windows desktop API (Win32) and provide Unicode support. In addition, any Win32 application can use a multibyte character set (MBCS).

NOTE

The default installation of the **Desktop development with C++** workload in Visual Studio 2017 does not include support for Windows XP and Windows Server 2003 development. You must install the optional component **Windows XP support for C++** to enable a Windows XP platform toolset.

See also

[Compatibility](#)

Backward compatibility

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For compatibility between product versions, the library OLDNAMES.LIB maps old names to new names. For instance, `open` maps to `_open`. You must explicitly link with OLDNAMES.LIB only when you compile with the following combinations of command-line options:

- `/z1` (omit default library name from object file) and `/ze` (the default: use Microsoft extensions)
- `/link` (linker-control), `/NOD` (no default-library search), and `/Ze`

For more information about compiler command-line options, see [Compiler options](#).

See also

[Compatibility](#)

Required and optional header files

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The description of each run-time routine includes a list of the required and optional include, or header (.H), files for that routine. Required header files need to be included to obtain the function declaration for the routine or a definition used by another routine called internally. Optional header files are often included to take advantage of predefined constants, type definitions, or inline macros. The following table lists some examples of optional header file contents:

DEFINITION	EXAMPLE
Macro definition	If a library routine is implemented as a macro, the macro definition may be in a header file other than the header file for the original routine. For instance, the <code>_toupper</code> macro is defined in the header file CTYPE.H, while the function <code>toupper</code> is declared in STDLIB.H.
Predefined Constant	Many library routines refer to constants that are defined in header files. For instance, the <code>_open</code> routine uses constants such as <code>_O_CREAT</code> , which is defined in the header file FCNTL.H.
Type definition	Some library routines return a structure or take a structure as an argument. For example, stream input/output routines use a structure of type <code>FILE</code> , which is defined in STDIO.H.

The run-time library header files provide function declarations in the ANSI/ISO C standard recommended style. The compiler performs type checking on any routine reference that occurs after its associated function declaration. Function declarations are especially important for routines that return a value of some type other than `int`, which is the default. Routines that don't specify their appropriate return value in their declaration will be considered by the compiler to return an `int`, which can cause unexpected results. For more information, see [Type checking](#).

See also

[Cruntime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Files and streams

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A program communicates with the target environment by reading and writing files. A file can be:

- A data set that you can read and write repeatedly.
- A stream of bytes generated by a program (such as a pipeline).
- A stream of bytes received from or sent to a peripheral device.

The last two items are interactive files. Files are typically the principal means by which to interact with a program. You manipulate all these kinds of files in much the same way: by calling library functions. You include the standard header STDIO.H to declare most of these functions.

Before you can perform many of the operations on a file, the file must be opened. Opening a file associates it with a stream, a data structure within the Standard C Library that glosses over many differences among files of various kinds. The library maintains the state of each stream in an object of type FILE.

The target environment opens three files before program startup. You can open a file by calling the library function `fopen`, `_wfopen` with two arguments. (The `fopen` function has been deprecated, use `fopen_s`, `_wfopen_s` instead.) The first argument is a filename. The second argument is a C string that specifies:

- Whether you intend to read data from the file or write data to it or both.
- Whether you intend to generate new contents for the file (or create a file if it didn't previously exist) or leave the existing contents in place.
- Whether writes to a file can alter existing contents or should only append bytes at the end of the file.
- Whether you want to manipulate a text stream or a binary stream.

Once the file is successfully opened, you can then determine whether the stream is byte oriented (a byte stream) or wide oriented (a wide stream). A stream is initially unbound. Calling certain functions to operate on the stream makes it byte oriented, while certain other functions make it wide oriented. Once established, a stream maintains its orientation until it's closed by a call to `fclose` or `freopen`.

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See also

[Text and binary streams](#)

[Byte and wide streams](#)

[Controlling streams](#)

[Stream states](#)

Text and binary streams

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A text stream consists of one or more lines of text that can be written to a text-oriented display so that they can be read. When it reads from a text stream, the program reads a newline at the end of each line. When it writes to a text stream, the program writes a newline to signal the end of a line. To match differing conventions among target environments for representing text in files, the library functions can alter the number and representations of characters transmitted between the program and a text stream.

Positioning within a text stream is limited. You can obtain the current file-position indicator by calling `fgetpos` or `ftell`. You can position a text stream at a position obtained this way, or at the beginning or end of the stream, by calling `fsetpos` or `fseek`. Any other change of position might well be not supported.

For maximum portability, the program shouldn't write:

- Empty files.
- Space characters at the end of a line.
- Partial lines (by omitting the newline at the end of a file).
- Characters other than the printable characters, newline, and horizontal tab.

If you follow these rules, the sequence of characters you read from a text stream will match the sequence of characters you wrote, whether as bytes or as multibyte characters. Otherwise, the library functions can remove a file you create if the file is empty when you close it. Or, they can alter or delete characters you write to the file.

A binary stream consists of one or more bytes of arbitrary information. You can write the value stored in an arbitrary object to a (byte-oriented) binary stream and read exactly what was stored in the object when you wrote it. The library functions don't alter the bytes you transmit between the program and a binary stream. They can, however, append an arbitrary number of `NULL` bytes to the file that you write with a binary stream. The program must deal with these extra `NULL` bytes at the end of the binary stream.

Positioning within a binary stream is well-defined, except for positioning relative to the end of the stream. You can obtain and alter the current file-position indicator the same as for a text stream. The offsets used by `ftell` and `fseek` count bytes from the beginning of the stream (which is byte zero), so integer arithmetic on these offsets yields predictable results.

A byte stream treats a file as a sequence of bytes. Within the program, the stream looks like the same sequence of bytes, except for the possible alterations described above.

See also

[Files and streams](#)

Byte and wide streams

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A byte stream treats a file as a sequence of bytes. Within the program, the stream is the identical sequence of bytes.

By contrast, a wide stream treats a file as a sequence of generalized multibyte characters, which can have a broad range of encoding rules. (Text and binary files are still read and written as previously described.) Within the program, the stream looks like the corresponding sequence of wide characters. Conversions between the two representations occur within the Standard C Library. The conversion rules can, in principle, be altered by a call to `setlocale` that alters the category `LC_CTYPE`. Each wide stream determines its conversion rules at the time it becomes wide oriented, and retains these rules even if the category `LC_CTYPE` later changes.

Positioning within a wide stream suffers the same limitations as for text streams. Moreover, the file-position indicator may well have to deal with a state-dependent encoding. Typically, it includes both a byte offset within the stream and an object of type `mbstate_t`. Thus, the only reliable way to obtain a file position within a wide stream is by calling `fgetpos`, and the only reliable way to restore a position obtained this way is by calling `fsetpos`.

See also

[Files and streams](#)

`setlocale` , `_wsetlocale`

Controlling streams

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`fopen` returns the address of an object of type `FILE`. You use this address as the `stream` argument to several library functions to perform various operations on an open file. For a byte stream, all input takes place as if each character is read by calling `fgetc`. All output takes place as if each character is written by calling `fputc`. For a wide stream, all input takes place as if each character is read by calling `fgetwc`. All output takes place as if each character is written by calling `fputwc`.

You can close a file by calling `fclose`, after which the address of the `FILE` object is invalid.

A `FILE` object stores the state of a stream, including:

- An error indicator set nonzero by a function that encounters a read or write error.
- An end-of-file indicator set nonzero by a function that encounters the end of the file while reading.
- A file-position indicator specifies the next byte in the stream to read or write, if the file can support positioning requests.
- A `stream state` specifies whether the stream will accept reads and/or writes and whether the stream is unbound, byte oriented, or wide oriented.
- A conversion state remembers the state of any partly assembled or generated generalized multibyte character, and any shift state for the sequence of bytes in the file).
- A file buffer specifies the address and size of an array object. Library functions can use it to improve the performance of read and write operations to the stream.

Don't alter any value stored in a `FILE` object or in a file buffer that you specify for use with that object. You can't copy a `FILE` object and portably use the address of the copy as a `stream` argument to a library function.

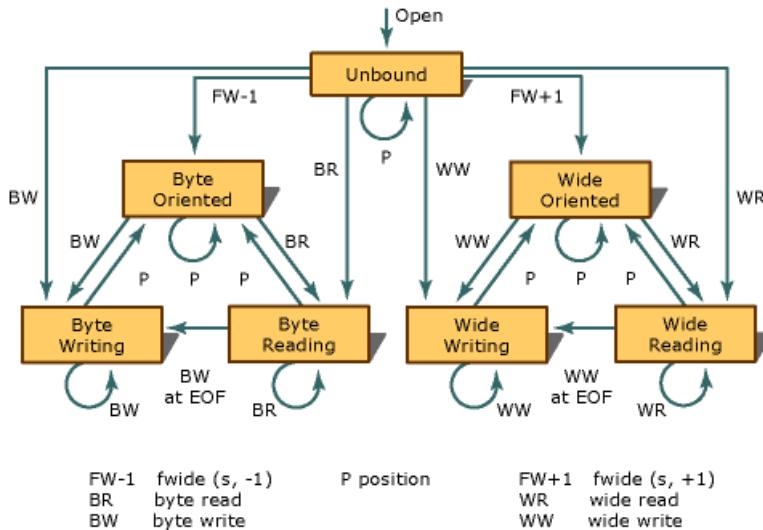
See also

[Files and streams](#)

Stream states

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The valid states, and state transitions, for a stream are shown in the following figure.



Each of the circles denotes a stable state. Each of the lines denotes a transition that can occur as the result of a function call that operates on the stream. Five groups of functions can cause state transitions.

Functions in the first three groups are declared in `<stdio.h>`:

- The byte read functions: `fgetc`, `fgets`, `fread`, `fscanf`, `getc`, `getchar`, `gets`, `scanf`, and `ungetc`
- The byte write functions: `fprintf`, `fputc`, `fputs`, `fwrite`, `printf`, `putc`, `putchar`, `puts`, `vfprintf`, and `vprintf`
- The position functions: `fflush`, `fseek`, `fsetpos`, and `rewind`

Functions in the remaining two groups are declared in `<wchar.h>`:

- The wide read functions: `fgetwc`, `fgetws`, `fwscanf`, `getwc`, `getwchar`, `ungetwc`, and `wscanf`,
- The wide write functions: `fwprintf`, `fputwc`, `fputws`, `putwc`, `putwchar`, `vfwprintf`, `vwprintf`, and `wprintf`,

The state diagram shows that you must call one of the position functions between most write and read operations:

- You can't call a read function if the last operation on the stream was a write.
- You can't call a write function if the last operation on the stream was a read, unless that read operation set the end-of-file indicator.

Finally, the state diagram shows that a position operation never decreases the number of valid function calls that can follow.

See also

[Files and streams](#)

Recommendations for choosing between functions and macros

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Most Microsoft run-time library routines are compiled or assembled functions, but some routines are implemented as macros. When a header file declares both a function and a macro version of a routine, the macro definition takes precedence, because it always appears after the function declaration. When you invoke a routine that is implemented as both a function and a macro, you can force the compiler to use the function version in two ways:

- Enclose the routine name in parentheses.

```
#include <ctype.h>
a = _toupper(a);    // Use macro version of toupper.
a = (_toupper)(a); // Force compiler to use
                   // function version of toupper.
```

- "Undefine" the macro definition with the `#undef` directive:

```
#include <ctype.h>
#undef _toupper
```

If you need to choose between a function and a macro implementation of a library routine, consider the following trade-offs:

- **Speed versus size** The main benefit of using macros is faster execution time. During preprocessing, a macro is expanded (replaced by its definition) inline each time it's used. A function definition occurs only once regardless of how many times it's called. Macros may increase code size but don't have the overhead associated with function calls.
- **Function evaluation** A function evaluates to an address; a macro doesn't. Thus you can't use a macro name in contexts requiring a pointer. For instance, you can declare a pointer to a function, but not a pointer to a macro.
- **Type-checking** When you declare a function, the compiler can check the argument types. Because you can't declare a macro, the compiler can't check macro argument types; although it can check the number of arguments you pass to a macro.

See also

[Type-generic math](#)

[C runtime \(CRT\) and C++ Standard Library \(STL\)](#) `.lib` files

Type checking (CRT)

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The compiler performs limited type checking on functions that can take a variable number of arguments, as follows:

FUNCTION CALL	TYPE-CHECKED ARGUMENTS
<code>_cprintf_s</code> , <code>_cscanf_s</code> , <code>printf_s</code> , <code>scanf_s</code>	First argument (format string)
<code>fprintf_s</code> , <code>fscanf_s</code> , <code>sprintf_s</code> , <code>sscanf_s</code>	First two arguments (file or buffer and format string)
<code>_snprintf_s</code>	First three arguments (file or buffer, count, and format string)
<code>_open</code>	First two arguments (path and <code>_open</code> flag)
<code>_sopen_s</code>	First three arguments (path, <code>_open</code> flag, and sharing mode)
<code>_execl</code> , <code>_execle</code> , <code>_execlp</code> , <code>_execlepe</code>	First two arguments (path and first argument pointer)
<code>_spawnl</code> , <code>_spawnle</code> , <code>_spawnlp</code> , <code>_spawnlpe</code>	First three arguments (mode flag, path, and first argument pointer)

The compiler performs the same limited type checking on the wide-character counterparts of these functions.

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Direction flag

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The direction flag is a CPU flag specific to all Intel x86-compatible CPUs. It applies to all assembly instructions that use the `REP` (repeat) prefix, such as `MOVS`, `MOVSD`, `MOVSW`, and others. Addresses provided to applicable instructions are increased if the direction flag is cleared.

The C run-time routines assume that the direction flag is cleared. If you're using other functions with the C run-time functions, you must ensure that the other functions leave the direction flag alone or restore it to its original condition. Expecting the direction flag to be clear upon entry makes the run-time code faster and more efficient.

The C Run-Time library functions, such as the string-manipulation and buffer-manipulation routines, expect the direction flag to be clear.

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Security Features in the CRT

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Many old CRT functions have newer, more secure versions. If a secure function exists, the older, less secure version is marked as deprecated. The new version has the `_s` ("secure") suffix.

In this context, "deprecated" means that use of the function isn't recommended. It doesn't mean the function will be removed from the CRT.

The secure functions don't prevent or correct security errors. Instead, they catch errors when they occur. They do extra checks for error conditions. If there's an error, they invoke an error handler (see [Parameter validation](#)).

For example, the `strcpy` function can't tell if the string it copies is too large for the destination buffer. Its secure counterpart, `strcpy_s`, takes the size of the buffer as a parameter. So, it can determine if a buffer overrun will occur. If you use `strcpy_s` to copy 11 characters into a 10 character buffer, that's an error on your part; `strcpy_s` can't correct your mistake. But it can detect your error and inform you by invoking the invalid parameter handler.

Eliminating deprecation warnings

There are several ways to eliminate deprecation warnings for the older, less secure functions. The simplest is simply to define `_CRT_SECURE_NO_WARNINGS` or use the `warning` pragma. Either will disable deprecation warnings, but the security issues that caused the warnings still exist. It's better to leave deprecation warnings enabled and take advantage of the new CRT security features.

In C++, the easiest way to eliminate the deprecation warnings is to use [Secure template overloads](#). The overloads eliminate deprecation warnings in many cases. They replace calls to deprecated functions with calls to secure versions of the functions. For example, consider this deprecated call to `strcpy`:

```
char szBuf[10];
strcpy(szBuf, "test"); // warning: deprecated
```

Defining `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` as 1 eliminates the warning by changing the `strcpy` call to `strcpy_s`, which prevents buffer overruns. For more information, see [Secure template overloads](#).

For those deprecated functions without secure template overloads, you should definitely consider manually updating your code to use the secure versions.

Another source of deprecation warnings, unrelated to security, is the POSIX functions. Replace POSIX function names with their standard equivalents (for example, change `access` to `_access`), or disable POSIX-related deprecation warnings by defining `_CRT_NONSTDC_NO_WARNINGS`. For more information, see [Compatibility](#).

More security features

Some of the security features include:

- **Parameter Validation**

Secure functions, and many of their unsecure counterparts, validate parameters. Validation may include:

- Checking for `NULL` values.
- Checking enumerated values for validity.

- Checking that integral values are in valid ranges.

For more information, see [Parameter validation](#).

A handler for invalid parameters is also accessible to the developer. When a function encounters an invalid parameter, instead of asserting and exiting the application, the CRT allows you to check these problems via `_set_invalid_parameter_handler` or `_set_thread_local_invalid_parameter_handler`.

- **Sized Buffers**

You must pass the buffer size to any secure function that writes to a buffer. The secure versions validate that the buffer is large enough before writing to it. The validation helps avoid dangerous buffer overrun errors that could allow malicious code to execute. These functions usually return an `errno` error code and invoke the invalid parameter handler if the size of the buffer is too small. Functions that read from input buffers, such as `gets`, have secure versions that require you to specify a maximum size.

- **Null termination**

Some functions that left potentially non-terminated strings have secure versions, which ensure that strings are properly null-terminated.

- **Enhanced error reporting**

The secure functions return error codes with more error information than was available with the pre-existing functions. The secure functions and many of the pre-existing functions now set `errno` and often return an `errno` code type as well, to provide better error reporting.

- **Filesystem security**

Secure file I/O APIs support secure file access in the default case.

- **Windows security**

Secure process APIs enforce security policies and allow ACLs to be specified.

- **Format string syntax checking**

Invalid strings are detected, for example, when you use incorrect type field characters in `printf` format strings.

See also

[Parameter validation](#)

[Secure template overloads](#)

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Security-enhanced versions of CRT functions

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More secure versions of run-time library routines are available. For more information about security enhancements in the CRT, see [Security features in the CRT](#).

Secure functions

CRT FUNCTION	SECURITY ENHANCED FUNCTION	USE
<code>_access</code> , <code>_waccess</code>	<code>_access_s</code> , <code>_waccess_s</code>	Determine file-access permission
<code>_alloca</code>	<code>_malloca</code>	Allocate memory on the stack
<code>asctime</code> , <code>_wasctime</code>	<code>asctime_s</code> , <code>_wasctime_s</code>	Convert time from type <code>struct tm</code> to character string
<code>bsearch</code>	<code>bsearch_s</code>	Perform a binary search of a sorted array
<code>_cgets</code> , <code>_cgetws</code>	<code>_cgets_s</code> , <code>_cgetws_s</code>	Get a character string from the console
<code>_chsize</code>	<code>_chsize_s</code>	Change the size of a file
<code>clearerr</code>	<code>clearerr_s</code>	Reset the error indicator for a stream
<code>_control87</code> , <code>_controlfp</code> , <code>_control87_2</code>	<code>_controlfp_s</code>	Get and set the floating-point control word
<code>_cprintf</code> , <code>_cprintf_l</code> , <code>_cwprintf</code> , <code>_cwprintf_l</code>	<code>_cprintf_s</code> , <code>_cprintf_s_l</code> , <code>_cwprintf_s</code> , <code>_cwprintf_s_l</code>	Format and print to the console
<code>_cscanf</code> , <code>_cscanf_l</code> , <code>_cwscanf</code> , <code>_cwscanf_l</code>	<code>_cscanf_s</code> , <code>_cscanf_s_l</code> , <code>_cwscanf_s</code> , <code>_cwscanf_s_l</code>	Read formatted data from the console
<code>ctime</code> , <code>_ctime32</code> , <code>_ctime64</code> , <code>_wctime</code> , <code>_wctime32</code> , <code>_wctime64</code>	<code>_ctime_s</code> , <code>_ctime32_s</code> , <code>_ctime64_s</code> , <code>_wctime_s</code> , <code>_wctime32_s</code> , <code>_wctime64_s</code>	Convert time from type <code>time_t</code> , <code>_time32_t</code> or <code>_time64_t</code> to character string
<code>_ecvt</code>	<code>_ecvt_s</code>	Convert a <code>double</code> number to a string
<code>_fcvt</code>	<code>_fcvt_s</code>	Converts a floating-point number to a string
<code>fopen</code> , <code>_wfopen</code>	<code>fopen_s</code> , <code>_wfopen_s</code>	Open a file
<code>fprintf</code> , <code>_fprintf_l</code> , <code>fwprintf</code> , <code>_fwprintf_l</code>	<code>fprintf_s</code> , <code>_fprintf_s_l</code> , <code>fwprintf_s</code> , <code>_fwprintf_s_l</code>	Print formatted data to a stream

CRT FUNCTION	SECURITY ENHANCED FUNCTION	USE
<code>fread</code>	<code>fread_s</code>	Read from a file
<code>_fread_nolock</code>	<code>_fread_nolock_s</code>	Read from a file without using a multi-thread write lock
<code>freopen</code> , <code>_wfreopen</code>	<code>freopen_s</code> , <code>_wfreopen_s</code>	Reopen the file
<code>fscanf</code> , <code>_fscanf_l</code> , <code>fwscanf</code> , <code>_fwscanf_l</code>	<code>fscanf_s</code> , <code>_fscanf_s_l</code> , <code>fwscanf_s</code> , <code>_fwscanf_s_l</code>	Read formatted data from a stream
<code>_ftime</code> , <code>_ftime32</code> , <code>_ftime64</code>	<code>_ftime_s</code> , <code>_ftime32_s</code> , <code>_ftime64_s</code>	Get the current time
<code>_gcvt</code>	<code>_gcvt_s</code>	Convert a floating-point value to a string, and store it in a buffer
<code>getenv</code> , <code>_wgetenv</code>	<code>getenv_s</code> , <code>_wgetenv_s</code>	Get a value from the current environment.
<code>gets</code> , <code>getws</code>	<code>gets_s</code> , <code>_getws_s</code>	Get a line from the <code>stdin</code> stream
<code>gmtime</code> , <code>_gmtime32</code> , <code>_gmtime64</code>	<code>_gmtime32_s</code> , <code>_gmtime64_s</code>	Convert time from type <code>time_t</code> to <code>struct tm</code> or from type <code>_time64_t</code> to <code>struct tm</code>
<code>itoa</code> , <code>_itoa</code> , <code>ltoa</code> , <code>_ltoa</code> , <code>ultoa</code> , <code>_ultoa</code> , <code>_i64toa</code> , <code>_ui64toa</code> , <code>_itow</code> , <code>_ltow</code> , <code>_ultow</code> , <code>_i64tow</code> , <code>_ui64tow</code>	<code>_itoa_s</code> , <code>_ltoa_s</code> , <code>_ultoa_s</code> , <code>_i64toa_s</code> , <code>_ui64toa_s</code> , <code>_itow_s</code> , <code>_ltow_s</code> , <code>_ultow_s</code> , <code>_i64tow_s</code> , <code>_ui64tow_s</code>	Convert an integral type to a string
<code>_lfind</code>	<code>_lfind_s</code>	Perform a linear search for the specified key
<code>localtime</code> , <code>_localtime32</code> , <code>_localtime64</code>	<code>localtime_s</code> , <code>_localtime32_s</code> , <code>_localtime64_s</code>	Convert time from type <code>time_t</code> to <code>struct tm</code> or from type <code>_time64_t</code> to <code>struct tm</code> with local correction
<code>_lsearch</code>	<code>_lsearch_s</code>	Perform a linear search for a value; adds to end of list if not found
<code>_makepath</code> , <code>_wmakepath</code>	<code>_makepath_s</code> , <code>_wmakepath_s</code>	Create a path name from components
<code>_mbccpy</code> , <code>_mbccpy_l</code>	<code>_mbccpy_s</code> , <code>_mbccpy_s_l</code>	Copy a multibyte character from one string to another string
<code>_mbsnbcat</code> , <code>_mbsnbcat_l</code>	<code>_mbsnbcat_s</code> , <code>_mbsnbcat_s_l</code>	Append at most the first <i>n</i> bytes of one multibyte character string to another
<code>_mbsnbcpy</code> , <code>_mbsnbcpy_l</code>	<code>_mbsnbcpy_s</code> , <code>_mbsnbcpy_s_l</code>	Copy <i>n</i> bytes of a string to a destination string

CRT FUNCTION	SECURITY ENHANCED FUNCTION	USE
<code>_mbsnbset</code> , <code>_mbsnbset_1</code>	<code>_mbsnbset_s</code> , <code>_mbsnbset_s_1</code>	Set the first <i>n</i> bytes of a string to a specified character
<code>mbsrtowcs</code>	<code>mbsrtowcs_s</code>	Convert a multibyte character string to a corresponding wide character string
<code>mbstowcs</code> , <code>_mbstowcs_1</code>	<code>mbstowcs_s</code> , <code>_mbstowcs_s_1</code>	Convert a sequence of multibyte characters to a corresponding sequence of wide characters
<code>memcpy</code> , <code>wmemcpy</code>	<code>memcpy_s</code> , <code>wmemcpy_s</code>	Copy characters between buffers
<code>memmove</code> , <code>wmemmove</code>	<code>memmove_s</code> , <code>wmemmove_s</code>	Move one buffer to another
<code>_mktemp</code> , <code>_wmktemp</code>	<code>_mktemp_s</code> , <code>_wmktemp_s</code>	Create a unique filename
<code>printf</code> , <code>_printf_1</code> , <code>wprintf</code> , <code>_wprintf_1</code>	<code>printf_s</code> , <code>_printf_s_1</code> , <code>wprintf_s</code> , <code>_wprintf_s_1</code>	Print formatted output to the standard output stream
<code>_putenv</code> , <code>_wputenv</code>	<code>_putenv_s</code> , <code>_wputenv_s</code>	Create, modify, or remove environment variables
<code>qsort</code>	<code>qsort_s</code>	Perform a quick sort
<code>rand</code>	<code>rand_s</code>	Generate a pseudorandom number
<code>scanf</code> , <code>_scanf_1</code> , <code>wscanf</code> , <code>_wscanf_1</code>	<code>scanf_s</code> , <code>_scanf_s_1</code> , <code>wscanf_s</code> , <code>_wscanf_s_1</code>	Read formatted data from the standard input stream
<code>_searchenv</code> , <code>_wsearchenv</code>	<code>_searchenv_s</code> , <code>_wsearchenv_s</code>	Search for a file using environment paths
<code>snprintf</code> , <code>_snprintf</code> , <code>_snprintf_1</code> , <code>_snwprintf</code> , <code>_snwprintf_1</code>	<code>_snprintf_s</code> , <code>_snprintf_s_1</code> , <code>_snwprintf_s</code> , <code>_snwprintf_s_1</code>	Write formatted data to a string
<code>_snscanf</code> , <code>_snscanf_1</code> , <code>_snwscanf</code> , <code>_snwscanf_1</code>	<code>_snscanf_s</code> , <code>_snscanf_s_1</code> , <code>_snwscanf_s</code> , <code>_snwscanf_s_1</code>	Read formatted data of a specified length from a string.
<code>_sopen</code> , <code>_wsopen</code>	<code>_sopen_s</code> , <code>_wsopen_s</code>	Open a file for sharing
<code>_splitpath</code> , <code>_wsplitpath</code>	<code>_splitpath_s</code> , <code>_wsplitpath_s</code>	Break a path name into components
<code>sprintf</code> , <code>_sprintf_1</code> , <code>swprintf</code> , <code>_swprintf_1</code> , <code>_swprintf_1</code>	<code>sprintf_s</code> , <code>_sprintf_s_1</code> , <code>swprintf_s</code> , <code>_swprintf_s_1</code>	Write formatted data to a string
<code>sscanf</code> , <code>_sscanf_1</code> , <code>swscanf</code> , <code>_swscanf_1</code>	<code>sscanf_s</code> , <code>_sscanf_s_1</code> , <code>swscanf_s</code> , <code>_swscanf_s_1</code>	Read formatted data from a string
<code>strcat</code> , <code>wscat</code> , <code>_mbscat</code>	<code>strcat_s</code> , <code>wscat_s</code> , <code>_mbscat_s</code>	Append a string

CRT FUNCTION	SECURITY ENHANCED FUNCTION	USE
<code>strcpy</code> , <code>wcscpy</code> , <code>_mbscopy</code>	<code>strcpy_s</code> , <code>wcscpy_s</code> , <code>_mbscopy_s</code>	Copy a string
<code>_strdate</code> , <code>_wstrdate</code>	<code>_strdate_s</code> , <code>_wstrdate_s</code>	Return current system date as string
<code>strerror</code> , <code>_strerror</code> , <code>_wcseyror</code> , <code>_wcseyror</code>	<code>strerror_s</code> , <code>_strerror_s</code> , <code>_wcseyror_s</code> , <code>_wcseyror_s</code>	Get a system error message (<code>strerror</code> , <code>_wcseyror</code>) or print a user-supplied error message (<code>_strerror</code> , <code>_wcseyror</code>)
<code>_strlwr</code> , <code>_wcslwr</code> , <code>_mbslwr</code> , <code>_strlwr_l</code> , <code>_wcslwr_l</code> , <code>_mbslwr_l</code>	<code>_strlwr_s</code> , <code>_strlwr_s_l</code> , <code>_mbslwr_s</code> , <code>_mbslwr_s_l</code> , <code>_wcslwr_s</code> , <code>_wcslwr_s_l</code>	Convert a string to lowercase
<code>strncat</code> , <code>_strncat_l</code> , <code>wcsncat</code> , <code>_wcscat_l</code> , <code>_mbsncat</code> , <code>_mbsncat_l</code>	<code>strncat_s</code> , <code>_strncat_s_l</code> , <code>wcsncat_s</code> , <code>_wcscat_s_l</code> , <code>_mbsncat_s</code> , <code>_mbscat_s_l</code>	Append characters to a string
<code>strncpy</code> , <code>_strncpy_l</code> , <code>wcsncpy</code> , <code>_wcscncpy_l</code> , <code>_mbsncpy</code> , <code>_mbsncpy_l</code>	<code>strncpy_s</code> , <code>_strncpy_s_l</code> , <code>wcsncpy_s</code> , <code>_wcscncpy_s_l</code> , <code>_mbsncpy_s</code> , <code>_mbsncpy_s_l</code>	Copy characters of one string to another
<code>_strnset</code> , <code>_strnset_l</code> , <code>_wcsnset</code> , <code>_wcsnset_l</code> , <code>_mbsnset</code> , <code>_mbsnset_l</code>	<code>_strnset_s</code> , <code>_strnset_s_l</code> , <code>_wcsnset_s</code> , <code>_wcsnset_s_l</code> , <code>_mbsnset_s</code> , <code>_mbsnset_s_l</code>	Set the first n characters of a string to the specified character
<code>_strset</code> , <code>_strset_l</code> , <code>_wcsset</code> , <code>_wcsset_l</code> , <code>_mbsset</code> , <code>_mbsset_l</code>	<code>_strset_s</code> , <code>_strset_s_l</code> , <code>_wcsset_s</code> , <code>_wcsset_s_l</code> , <code>_mbsset_s</code> , <code>_mbsset_s_l</code>	Set all the characters of a string to the specified character
<code>_strftime</code> , <code>_wstrftime</code>	<code>_strftime_s</code> , <code>_wstrftime_s</code>	Return current system time as string
<code>strtok</code> , <code>_strtok_l</code> , <code>wcstok</code> , <code>_wcstok_l</code> , <code>_mbstok</code> , <code>_mbstok_l</code>	<code>strtok_s</code> , <code>_strtok_s_l</code> , <code>wcstok_s</code> , <code>_wcstok_s_l</code> , <code>_mbstok_s</code> , <code>_mbstok_s_l</code>	Find the next token in a string, using the current locale or a locale passed in
<code>_strupr</code> , <code>_strupr_l</code> , <code>_mbsupr</code> , <code>_mbsupr_l</code> , <code>_wcsupr_l</code> , <code>_wcstrupr</code>	<code>_strupr_s</code> , <code>_strupr_s_l</code> , <code>_mbsupr_s</code> , <code>_mbsupr_s_l</code> , <code>_wcsupr_s</code> , <code>_wcstrupr_s_l</code>	Convert a string to uppercase
<code>tmpfile</code>	<code>tmpfile_s</code>	Create a temporary file
<code>_tempnam</code> , <code>_wtempnam</code> , <code>tmpnam</code> , <code>_wtmpnam</code>	<code>tmpnam_s</code> , <code>_wtmpnam_s</code>	Generate names you can use to create temporary files
<code>_umask</code>	<code>_umask_s</code>	Set the default file-permission mask
<code>_vcprintf</code> , <code>_vcprintf_l</code> , <code>_vcwprintf</code> , <code>_vcwprintf_l</code>	<code>_vcprintf_s</code> , <code>_vcprintf_s_l</code> , <code>_vcwprintf_s</code> , <code>_vcwprintf_s_l</code>	Write formatted output to the console using a pointer to a list of arguments
<code>vfprintf</code> , <code>_vfprintf_l</code> , <code>vfwprintf</code> , <code>_vfwprintf_l</code>	<code>vfprintf_s</code> , <code>_vfprintf_s_l</code> , <code>vfwprintf_s</code> , <code>_vfwprintf_s_l</code>	Write formatted output using a pointer to a list of arguments

CRT FUNCTION	SECURITY ENHANCED FUNCTION	USE
<code>vscanf</code> , <code>vfwscanf</code>	<code>vscanf_s</code> , <code>vfwscanf_s</code>	Read formatted data from a stream
<code>vprintf</code> , <code>_vprintf_l</code> , <code>vwprintf</code> , <code>_vwprintf_l</code>	<code>vprintf_s</code> , <code>_vprintf_s_l</code> , <code>vwprintf_s</code> , <code>_vwprintf_s_l</code>	Write formatted output using a pointer to a list of arguments
<code>vscanf</code> , <code>vwscanf</code>	<code>vscanf_s</code> , <code>vwscanf_s</code>	Read formatted data from the standard input stream
<code>vsnprintf</code> , <code>_vsnprintf</code> , <code>_vsnprintf_l</code> , <code>_vsnwprintf</code> , <code>_vsnwprintf_l</code>	<code>vsnprintf_s</code> , <code>_vsnprintf_s</code> , <code>_vsnprintf_s_l</code> , <code>_vsnwprintf_s</code> , <code>_vsnwprintf_s_l</code>	Write formatted output using a pointer to a list of arguments
<code>vsprintf</code> , <code>_vsprintf_l</code> , <code>vswprintf</code> , <code>_vswprintf_l</code> , <code>_vswprintf_l</code>	<code>vsprintf_s</code> , <code>_vsprintf_s_l</code> , <code>vswprintf_s</code> , <code>_vswprintf_s_l</code>	Write formatted output using a pointer to a list of arguments
<code>vscanf</code> , <code>vfwscanf</code>	<code>vscanf_s</code> , <code>vfwscanf_s</code>	Read formatted data from a string
<code>wcrtomb</code>	<code>wcrtomb_s</code>	Convert a wide character into its multibyte character representation
<code>wcsrtombs</code>	<code>wcsrtombs_s</code>	Convert a wide character string to its multibyte character string representation
<code>wcstombs</code> , <code>_wcstombs_l</code>	<code>wcstombs_s</code> , <code>_wcstombs_s_l</code>	Convert a sequence of wide characters to a corresponding sequence of multibyte characters
<code>wctomb</code> , <code>_wctomb_l</code>	<code>wctomb_s</code> , <code>_wctomb_s_l</code>	Convert a wide character to the corresponding multibyte character

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Parameter validation

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Most of the security-enhanced CRT functions, and many that aren't, validate their parameters for things like checking pointers for `NULL`, that integers fall into a valid range, or that enumeration values are valid. If an invalid parameter is found, the invalid parameter handler is called.

Invalid parameter handler routine

When a C Runtime Library function detects an invalid parameter, it captures some information about the error, and then calls a macro that wraps an invalid parameter handler dispatch function. Which will be one of `_invalid_parameter`, `_invalid_parameter_noinfo`, or `_invalid_parameter_noinfo_noreturn`. Which dispatch function is called depends on whether your code is, respectively, a debug build, a retail build, or the error isn't considered recoverable.

In debug builds, the invalid parameter macro usually raises a failed assertion and a debugger breakpoint before the dispatch function is called. When the code runs, the assertion may be reported to the user in a dialog box that has "Abort", "Retry", and "Continue" or similar choices that depend on the operating system and CRT version. These options allow the user to immediately terminate the program, to attach a debugger, or to let the existing code continue to run which calls the dispatch function.

The invalid parameter handler dispatch function calls the currently assigned invalid parameter handler. By default, the invalid parameter calls `_invoke_watson`, which causes the application to close and generate a mini-dump. If enabled by the operating system, a dialog box asks the user if they want to send the crash dump to Microsoft for analysis.

You can change this behavior by using the functions `_set_invalid_parameter_handler` or `_set_thread_local_invalid_parameter_handler` to set the invalid parameter handler to your own function. If the function you specify doesn't terminate the application, control is returned to the function that received the invalid parameters. In the CRT, these functions will normally stop function execution, set `errno` to an error code, and return an error code. In many cases, the `errno` value and the return value are both `EINVAL`, to indicate an invalid parameter. In some cases, a more specific error code is returned, such as `EBADF` for a bad file pointer passed in as a parameter.

For more information on `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

See also

[Security features in the CRT](#)

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Secure template overloads

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Microsoft has deprecated many C Runtime library (CRT) functions in favor of security-enhanced versions. For example, `strcpy_s` is the more secure replacement for `strcpy`. The deprecated functions are common sources of security bugs, because they don't prevent operations that can overwrite memory. By default, the compiler produces a deprecation warning when you use one of these functions. The CRT provides C++ template overloads for these functions to help ease the transition to the more secure variants.

For example, this code snippet generates a warning because `strcpy` is deprecated:

```
char szBuf[10];
strcpy(szBuf, "test"); // warning: deprecated
```

The deprecation warning is there to tell you that your code may be unsafe. If you've verified that your code can't overwrite memory, you have several choices. You can choose to ignore the warning, you can define the symbol `_CRT_SECURE_NO_WARNINGS` before the include statements for the CRT headers to suppress the warning, or you can update your code to use `strcpy_s`:

```
char szBuf[10];
strcpy_s(szBuf, 10, "test"); // security-enhanced _s function
```

The template overloads provide more choices. If you define `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` to 1, it enables template overloads of standard CRT functions that call the more secure variants automatically. If `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` is 1, then no changes to your code are necessary. Behind the scenes, the call to `strcpy` is changed to a call to `strcpy_s` with the size argument supplied automatically.

```
#define _CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES 1

// ...

char szBuf[10];
strcpy(szBuf, "test"); // ==> strcpy_s(szBuf, 10, "test")
```

The macro `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` doesn't affect the functions that take a count, such as `strncpy`. To enable template overloads for the count functions, define `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT` to 1. Before doing so, however, make sure that your code passes the count of characters, not the size of the buffer (a common mistake). Also, code that explicitly writes a null terminator at the end of the buffer after the function call is unnecessary if the secure variant is called. If you need truncation behavior, see `_TRUNCATE`.

NOTE

The macro `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT` requires that `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` is also defined as 1. If `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT` is defined as 1 and `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` is defined as 0, the application will not perform any template overloads.

When you define `_CRT_SECURE_CPP_OVERLOAD_SECURE_NAMES` to 1, it enables template overloads of the secure

variants (names ending in "_s"). In this case, if `_CRT_SECURE_CPP_OVERLOAD_SECURE_NAMES` is 1, then one small change must be made to the original code:

```
#define _CRT_SECURE_CPP_OVERLOAD_SECURE_NAMES 1

// ...

char szBuf[10];
strcpy_s(szBuf, "test"); // ==> strcpy_s(szBuf, 10, "test")
```

Only the name of the function needs to be changed (by adding "_s"); the template overload takes care of providing the size argument.

By default, `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES` and `_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT` are defined as 0 (disabled) and `_CRT_SECURE_CPP_OVERLOAD_SECURE_NAMES` is defined as 1 (enabled).

The template overloads only work for static arrays. Dynamically allocated buffers require other source code changes. Revisiting the above examples:

```
#define _CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES 1

// ...

char *szBuf = (char*)malloc(10);
strcpy(szBuf, "test"); // still deprecated; change it to
                      // strcpy_s(szBuf, 10, "test");
```

And this example:

```
#define _CRT_SECURE_CPP_OVERLOAD_SECURE_NAMES 1

// ...

char *szBuf = (char*)malloc(10);
strcpy_s(szBuf, "test"); // doesn't compile; change it to
                        // strcpy_s(szBuf, 10, "test");
```

See also

[Security features in the CRT](#)

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

SAL annotations

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If you examine the library header files, you may notice some unusual annotations, for example, `_In_z` and `_Out_z_cap_(_Size)`. These annotations are examples of the Microsoft source-code annotation language (SAL). SAL provides a set of annotations to describe how a function uses its parameters and return type. For example, it indicates the assumptions it makes about them and the guarantees it makes on finishing. The header file `<sal.h>` defines the annotations.

For more information about using SAL annotations in Visual Studio, see [Using SAL annotations to reduce C/C++ code defects](#).

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Multithreaded libraries performance

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The single-threaded CRT is no longer available. This article discusses how to get the maximum performance from the multithreaded libraries.

Maximizing performance

The performance of the multithreaded libraries has been improved and is close to the performance of the now-eliminated single-threaded libraries. For those situations when even higher performance is required, there are several new features.

- Independent stream locking allows you to lock a stream and then use `_nolock` functions that access the stream directly. This feature allows lock usage to be hoisted outside critical loops.
- Per-thread locale reduces the cost of locale access for multithreaded scenarios (see `_configthreadlocale`).
- Locale-dependent functions (with names ending in `_l`) take the locale as a parameter, removing substantial cost (for example, `printf`, `_printf_l`, `wprintf`, `_wprintf_l`).
- Optimizations for common codepages reduce the cost of many short operations.
- Defining `_CRT_DISABLE_PERFCRIT_LOCKS` forces all I/O operations to assume a single-threaded I/O model and use the `_nolock` forms of the functions. This macro allows highly I/O-based single-threaded applications to get better performance.
- Exposure of the CRT heap handle allows you to enable the Windows Low Fragmentation Heap (LFH) for the CRT heap, which can substantially improve performance in highly scaled scenarios.

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Link options

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The CRT lib directory includes several small object files that enable specific CRT features without any code change. These object files are called "link options" since you only have to add them to the linker command line to use them.

CLR pure mode versions of these objects are deprecated in Visual Studio 2015 and unsupported in Visual Studio 2017. Use the regular versions for native and /clr code.

NATIVE AND /CLR	PURE MODE	DESCRIPTION
<code>binmode.obj</code>	<code>pbinmode.obj</code>	Sets the default file-translation mode to binary. See <code>_fmode</code> .
<code>chkstk.obj</code>	n/a	Provides stack-checking and alloca support when not using the CRT.
<code>commode.obj</code>	<code>pcemode.obj</code>	Sets the global commit flag to "commit". See <code>fopen</code> , <code>_wfopen</code> and <code>fopen_s</code> , <code>_wfopen_s</code> .
<code>exe_initialize_mta.lib</code>	n/a	Initializes the MTA apartment during EXE startup, which allows the use of COM objects in global smart pointers. Because this option leaks an MTA apartment reference during shutdown, don't use it for DLLs. Linking to this file is equivalent to including <code>combase.h</code> and defining <code>_EXE_INITIALIZE_MTA</code> . Using this link option adds <code>oncore.lib</code> to the default library list. If this effect is undesirable (such as using <code>oncore_apiset.lib</code> or other umbrella library), use <code>/NODEFAULTLIB</code> to override this behavior and provide an alternative.
<code>fp10.obj</code>	n/a	Changes the default precision control to 64 bits. See Math and floating-point support .
<code>invalidcontinue.obj</code>	<code>pinvalidcontinue.obj</code>	Sets a default invalid parameter handler that does nothing, meaning that invalid parameters passed to CRT functions will just set errno and return an error result.

NATIVE AND /CLR	PURE MODE	DESCRIPTION
<code>legacy_stdio_float_rounding.obj</code>	n/a	The printing of floating-point values (for example, when using <code>printf</code>) with the Windows 10 19041 Universal C Runtime has been fixed. It now properly rounds exactly representable floating-point numbers, and respects the floating-point rounding requested by <code>fesetround</code> . This behavior update is available in Visual Studio 2019 version 16.2 and later. Legacy behavior is used in earlier versions of Visual Studio, or by providing this link option.
<code>loosefpmath.obj</code>	n/a	Ensures that floating point code tolerates denormal values.
<code>newmode.obj</code>	<code>pnewmode.obj</code>	Causes <code>malloc</code> to call the new handler on failure. See <code>_set_new_mode</code> , <code>_set_new_handler</code> , <code>calloc</code> , and <code>realloc</code> .
<code>noarg.obj</code>	<code>pnoarg.obj</code>	Disables all processing of argc and argv.
<code>nochkclr.obj</code>	n/a	Does nothing. Remove from your project.
<code>noenv.obj</code>	<code>pnoenv.obj</code>	Disables the creation of a cached environment for the CRT.
<code>nothrownew.obj</code>	<code>pnothrownew.obj</code>	Enables the non-throwing version of new in the CRT. See new and delete Operators .
<code>setargv.obj</code>	<code>psetargv.obj</code>	Enables command-line argument wildcard expansion. See Expanding wildcard arguments .
<code>threadlocale.obj</code>	<code>pthreadlocale.obj</code>	Enables per-thread locale for all new threads by default.
<code>wsetargv.obj</code>	<code>pwsetargv.obj</code>	Enables command-line argument wildcard expansion. See Expanding wildcard arguments .

See also

- [C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

Potential errors passing CRT objects across DLL boundaries

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Your code may have errors when you pass C Runtime (CRT) objects such as file handles, locales, and environment variables into or out of a DLL. Function calls across the DLL boundary can cause unexpected behavior if the DLL and any files that call into the DLL use different copies of the CRT libraries.

A related problem can occur when you allocate memory (either explicitly with `new` or `malloc`, or implicitly with `strdup` , `strstreambuf::str` , and so on) and then pass a pointer across a DLL boundary where it's freed. Such pointers can cause a memory access violation, or heap corruption, if the DLL and its consumers are using different copies of the CRT libraries.

Another symptom of this problem is an error in the output window during debugging such as

```
HEAP[]: Invalid Address specified to RtlValidateHeap(#,#)
```

Causes

Each copy of the CRT library has a separate and distinct state, kept in thread local storage by your app or DLL.

CRT objects such as file handles, environment variables, and locales are only valid for the copy of the CRT in the app or DLL where these objects were allocated or set. When a DLL and its clients use different copies of the CRT library, you can't expect these CRT objects to be used correctly when passed across the DLL boundary.

It's especially true of CRT versions before the Universal CRT in Visual Studio 2015 and later. There was a version-specific CRT library for every version of Visual Studio built with Visual Studio 2013 or earlier. Internal implementation details of the CRT, such as data structures and naming conventions, were different in each version. Dynamically linking code that was compiled for one version of the CRT to a different version of the CRT DLL has never been supported. Occasionally it would work, but because of luck rather than design.

Each copy of the CRT library has its own heap manager. It can cause heap corruption if you allocate memory in one CRT library and pass the pointer across a DLL boundary to be freed by a different copy of the CRT library. If your DLL passes CRT objects across the DLL boundary, or allocates memory that's freed outside the DLL, clients of the DLL must use the same copy of the CRT library as the DLL.

The DLL and its clients normally use the same copy of the CRT library only if both are linked at load time to the same version of the CRT DLL. Because the DLL version of the Universal CRT library used by Visual Studio 2015 and later is now a centrally deployed Windows component (`ucrtbase.dll`), it's the same for apps built with Visual Studio 2015 and later versions. However, even when the CRT code is identical, you can't give memory allocated in one heap to a component that uses a different heap.

Example: Pass file handle across DLL boundary

Description

This example passes a file handle across a DLL boundary.

The DLL and .exe files are built with `/MD` , so that they share a single copy of the CRT.

If you rebuild with `/MT` so that they use separate copies of the CRT, running the resulting `test1Main.exe` results in an access violation.

DLL source file `test1Dll.cpp` :

```
// test1Dll.cpp
// compile with: cl /EHsc /W4 /MD test1Dll.cpp
#include <stdio.h>
__declspec(dllexport) void writeFile(FILE *stream)
{
    char s[] = "this is a string\n";
    fprintf( stream, "%s", s );
    fclose( stream );
}
```

Executable source file `test1Main.cpp` :

```
// test1Main.cpp
// compile with: cl /EHsc /W4 /MD test1Main.cpp test1Dll.lib
#include <stdio.h>
#include <process.h>
void writeFile(FILE *stream);

int main(void)
{
    FILE * stream;
    errno_t err = fopen_s( &stream, "fprintf.out", "w" );
    writeFile(stream);
    system( "type fprintf.out" );
}
```

```
this is a string
```

Example: Pass environment variables across DLL boundary

Description

This example passes environment variables across a DLL boundary.

DLL source file `test2Dll.cpp` :

```
// test2Dll.cpp
// compile with: cl /EHsc /W4 /MT /LD test2Dll.cpp
#include <stdio.h>
#include <stdlib.h>

__declspec(dllexport) void readEnv()
{
    char *libvar;
    size_t libvarszie;

    /* Get the value of the MYLIB environment variable. */
    _dupenv_s( &libvar, &libvarszie, "MYLIB" );

    if( libvar != NULL )
        printf( "New MYLIB variable is: %s\n", libvar );
    else
        printf( "MYLIB has not been set.\n" );
    free( libvar );
}
```

Executable source file `test2Main.cpp` :

```
// test2Main.cpp
// compile with: cl /EHsc /W4 /MT test2Main.cpp test2dll.lib
#include <stdlib.h>
#include <stdio.h>

void readEnv();

int main( void )
{
    _putenv( "MYLIB=c:\\mylib;c:\\yourlib" );
    readEnv();
}
```

MYLIB has not been set.

If you build both the DLL and EXE files by using `/MD`, so that only one copy of the CRT is used, the program runs successfully and produces the following output:

```
New MYLIB variable is: c:\\mylib;c:\\yourlib
```

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

CRT initialization

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This article describes how the CRT initializes global state in native code.

By default, the linker includes the CRT library, which provides its own startup code. This startup code initializes the CRT library, calls global initializers, and then calls the user-provided `main` function for console applications.

It's possible, though not recommended, to take advantage of Microsoft-specific linker behavior to insert your own global initializers in a specific order. This code isn't portable, and comes with some important caveats.

Initializing a global object

Consider the following code:

```
int func(void)
{
    return 3;
}

int gi = func();

int main()
{
    return gi;
}
```

According to the C/C++ standard, `func()` must be called before `main()` is executed. But who calls it?

One way to determine the caller is to set a breakpoint in `func()`, debug the application, and examine the stack. It's possible because the CRT source code is included with Visual Studio.

When you browse the functions on the stack, you'll see that the CRT is calling a list of function pointers. These functions are similar to `func()`, or constructors for class instances.

The CRT gets the list of function pointers from the Microsoft C++ compiler. When the compiler sees a global initializer, it generates a dynamic initializer in the `.CRT$XCU` section where `CRT` is the section name and `xcu` is the group name. To get a list of dynamic initializers, run the command `dumpbin /all main.obj`, and then search the `.CRT$XCU` section. The command only applies when `main.cpp` is compiled as a C++ file, not a C file. It should be similar to this example:

```

SECTION HEADER #6
.CRT$XCU name
    0 physical address
    0 virtual address
    4 size of raw data
1F2 file pointer to raw data (000001F2 to 000001F5)
1F6 file pointer to relocation table
    0 file pointer to line numbers
    1 number of relocations
    0 number of line numbers
40300040 flags
    Initialized Data
    4 byte align
    Read Only

RAW DATA #6
00000000: 00 00 00 00 .....  

RELOCATIONS #6
Offset      Type          Applied To      Symbol Index  Symbol Name
-----  -----
00000000  DIR32        00000000          C           ??_Egi@@YAXXZ (void __cdecl `dynamic initializer
for 'gi''(void))

```

The CRT defines two pointers:

- `__xc_a` in `.CRT$XCA`
- `__xc_z` in `.CRT$XCZ`

Neither group has any other symbols defined except `__xc_a` and `__xc_z`.

Now, when the linker reads various `.CRT` subsections (the part after the `$`), it combines them in one section and orders them alphabetically. It means that the user-defined global initializers (which the Microsoft C++ compiler puts in `.CRT$XCU`) always come after `.CRT$XCA` and before `.CRT$XCZ`.

The section should resemble this example:

```

.CRT$XCA
    __xc_a
.CRT$XCU
    Pointer to Global Initializer 1
    Pointer to Global Initializer 2
.CRT$XCZ
    __xc_z

```

So, the CRT library uses both `__xc_a` and `__xc_z` to determine the start and end of the global initializers list because of the way in which they're laid out in memory after the image is loaded.

Linker features for initialization

The C++ Standard doesn't provide a conforming way to specify relative order across translation units for a user-supplied global initializer. However, since the Microsoft linker orders the `.CRT` subsections alphabetically, it's possible to take advantage of this ordering to specify initialization order. We don't recommend this Microsoft-specific technique, and it may break in a future release. We've documented it only to keep you from creating code that's broken in hard-to-diagnose ways.

To help prevent issues in your code, starting in Visual Studio 2019 version 16.11, we've added two new off by default warnings: [C5247](#) and [C5248](#). Enable these warnings to detect problems when creating your own

initializers.

You can add initializers to unused reserved section names to create them in a specific relative order to the compiler generated dynamic initializers:

```
#pragma section(".CRT$XCT", read)
// 'i1' is guaranteed to be called before any compiler generated C++ dynamic initializer
__declspec(allocate(".CRT$XCT")) type i1 = f;

#pragma section(".CRT$XCV", read)
// 'i2' is guaranteed to be called after any compiler generated C++ dynamic initializer
__declspec(allocate(".CRT$XCV")) type i2 = f;
```

The names `.CRT$XCT` and `.CRT$XCV` aren't used by either the compiler or the CRT library right now, but there's no guarantee that they'll remain unused in the future. And, your variables could still be optimized away by the compiler. Consider the potential engineering, maintenance, and portability issues before adopting this technique.

See also

[C runtime \(CRT\) and C++ Standard Library \(STL\)](#) `.lib` files

Global state in the CRT

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Some functions in the Universal C Runtime (UCRT) use global state. For example, `setlocale()` sets the locale for the entire program, which affects the digit separators, text code page, and so on.

The UCRT's global state isn't shared between applications and the OS. For example, if your application calls `setlocale()`, it won't affect the locale for any OS components that uses the C run-time, or the other way around.

OS-specific versions of CRT functions

In the UCRT, functions that interact with global state have a "twin" function, prefixed with `_o_`. For example:

- `setlocale()` affects global state specific to the app.
- `_o_setlocale()` affects global state shared by all OS components, but not apps.

The only difference between these "twin" functions is that when they read/write the global CRT state, the OS-specific versions (that is, the versions that start with `_o_`) use the OS copy of global state instead of the app's copy of global state.

The OS-specific versions of these functions are in `ucrt.osmode.lib`. For example, the OS-specific version of `setlocale()` is `_o_setlocale()`.

There are two ways to isolate your component's CRT state from an app's CRT state:

- Statically link your component by using compiler options `/MT` (release) or `/MTd` (debug). For details, see [/MD, /MT, /LD](#). Static linking can greatly increase binary size.
- Starting in Windows versions beginning with Windows 10 version 2004, dynamically link to the CRT but call the OS-mode exports (the functions that begin with `_o_`). To call the OS-mode exports, statically link as before, but ignore the static UCRT by using linker option `/NODEFAULTLIB:libucrt.lib` (release) or `/NODEFAULTLIB:libcrtd.lib` (debug). And add `ucrt.osmode.lib` to the linker input. See [/NODEFAULTLIB \(Ignore Libraries\)](#) for details.

NOTE

In source code, write `setlocale()`, not `_o_setlocale()`. When you link against `ucrt.osmode.lib`, the linker will automatically substitute the OS-specific version of the function. That is, `setlocale()` will be substituted with `_o_setlocale()`.

Linking against `ucrt.osmode.lib` disables some UCRT calls that are only available in app mode. Attempting to call these functions will result in a link error.

Global state affected by app/OS separation

Global state affected by the separation of app and OS state includes:

- [Locale data](#)
- Signal handlers set by [signal](#)
- Termination routines set by [terminate](#)

- `errno` and `_doserrno`
- Random number generation state used by `rand` and `srand`
- Functions that return a buffer that the user doesn't need to release: `strtok`, `wcstok`, `_mbstok`
`Tmpnam`, `_wtmpnam`
`asctime`, `_wasctime`
`gmtime`, `_gmtime32`, `_gmtime64`
`_fcvt`
`_ecvt`
`strerror`, `_strerror`, `_wcserror`, `__wcserror`
- The buffer used by `_putch`, `_putwch`
- `_set_invalid_parameter_handler`, `_set_thread_local_invalid_parameter_handler`
- `_set_new_handler` and `_set_new_mode`
- `fmode`
- Time zone information

See also

[C Run-Time library reference](#)

Type-generic math

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For ISO C Standard 11 (C11) and later, the `<tgmath.h>` header, in addition to including `<math.h>` and `<complex.h>`, provides macros that invoke a corresponding math function based on the types of the parameters.

C runtime library math functions come in real and complex variants. Each variant comes in three flavors, depending on the type of the argument: `float`, `double`, and `long double`. Because C doesn't support overloading like C++ does, each variant has a different name. For example, to get the absolute value of a real floating-point value, you'd call either `fabsf`, `fabs`, or `fabsl` depending on whether you're passing a `float`, `double`, or `long double` value, respectively. To get the complex absolute value, you'd call one of `cabsf`, `cabs`, or `cabsl` depending on whether you're passing a `float`, `double`, and `long double` complex value, respectively. If the arguments don't match any of the above mentioned types, the function is chosen as though the arguments were doubles.

`<tgmath.h>` contains macros that simplify the selection of the right math function to call. The macros examine the type they're passed and then call the right function. For example, the `sqrt` macro binds `sqrt(9.9f)` to `sqrtf()`, but it binds `sqrt(9.9)` to `sqrt()`. If at least one macro argument for a generic parameter is complex, then the macro binds to a complex function; otherwise, it invokes a real function.

The type-generic macros in `<tgmath.h>` allow you to write more portable code because you don't need to manage casting or selecting different function names depending on the type of argument.

These macros are in their own header so that programs written using the `<math.h>` header won't break. So `double x = sin(42);` behaves as it always has when you include `<math.h>`. Even so, most existing C programs are expected to be unaffected when the `<tgmath.h>` header is included instead of `<math.h>` or `<complex.h>`.

The following table lists the macros that are available in `<tgmath.h>` and what they expand to. `modf` isn't included in this table because it doesn't have a corresponding type-generic macro because it isn't clear how to make it safe without complicating type resolution.

MACRO	REAL FLOAT	REAL DOUBLE	REAL LONG DOUBLE	COMPLEX FLOAT	COMPLEX DOUBLE	COMPLEX LONG DOUBLE
<code>acos</code>	<code>acosf</code>	<code>acos</code>	<code>acosl</code>	<code>cacosf</code>	<code>cacos</code>	<code>cacosl</code>
<code>acosh</code>	<code>acoshf</code>	<code>acosh</code>	<code>acoshl</code>	<code>cacoshf</code>	<code>cacosh</code>	<code>cacoshl</code>
<code>asin</code>	<code>asinf</code>	<code>asin</code>	<code>asinl</code>	<code>casinf</code>	<code>casin</code>	<code>casinl</code>
<code>asinh</code>	<code>asinhf</code>	<code>asinh</code>	<code>asinhl</code>	<code>casinhf</code>	<code>casinh</code>	<code>casinhl</code>
<code>atan</code>	<code>atanf</code>	<code>atan</code>	<code>atanl</code>	<code>catanf</code>	<code>catan</code>	<code>catanl</code>
<code>atanh</code>	<code>atanhf</code>	<code>atanh</code>	<code>atanhl</code>	<code>catanhf</code>	<code>catanh</code>	<code>catanhl</code>
<code>cos</code>	<code>cosf</code>	<code>cos</code>	<code>cosl</code>	<code>ccosf</code>	<code>ccos</code>	<code>ccosl</code>
<code>cosh</code>	<code>coshf</code>	<code>cosh</code>	<code>coshl</code>	<code>ccoshf</code>	<code>ccosh</code>	<code>ccoshl</code>

MACRO	REAL FLOAT	REAL DOUBLE	REAL LONG DOUBLE	COMPLEX FLOAT	COMPLEX DOUBLE	COMPLEX LONG DOUBLE
exp	expf	exp	expl	cexpf	cexp	cexpl
fabs	fabsf	fabs	fabsl	cabsf	cabs	cabsl
log	logf	log	logl	clogf	clog	clogl
pow	powf	pow	powl	cpowf	cpow	cpowl
sin	sinf	sin	sinl	csinf	csin	csinl
sinh	sinhf	sinh	sinhl	csinhf	csinh	csinhl
sqrt	sqrtf	sqrt	sqrtl	csqrif	csqrt	csqril
tan	tanf	tan	tanl	ctanf	ctan	ctanl
tanh	tanhf	tanh	tanhl	ctanhf	ctanh	ctanhl
atan2	atan2f	atan2	atan2l	-	-	-
cbrt	cbrtf	cbrt	cbrtl	-	-	-
ceil	ceilf	ceil	ceill	-	-	-
copysign	copysignf	copysign	copysignl	-	-	-
erf	erff	erf	erfl	-	-	-
erfc	erfcf	erfc	erfc1	-	-	-
exp2	exp2f	exp2	exp2l	-	-	-
expm1	expm1f	expm1	expm1l	-	-	-
fdim	fdimf	fdim	fdiml	-	-	-
floor	floorf	floor	floorl	-	-	-
fma	fmaf	fma	fmal	-	-	-
fmax	fmaxf	fmax	fmaxl	-	-	-
fmin	fminf	fmin	fminl	-	-	-
fmod	fmodf	fmod	fmodl	-	-	-
frexp	frexpf	frexp	frexpl	-	-	-

MACRO	REAL FLOAT	REAL DOUBLE	REAL LONG DOUBLE	COMPLEX FLOAT	COMPLEX DOUBLE	COMPLEX LONG DOUBLE
hypot	hypotf	hypot	hypotl	-	-	-
ilogb	ilogbf	ilogb	ilogbl	-	-	-
ldexp	ldexpf	ldexp	ldexpl	-	-	-
lgamma	lgammaf	lgamma	lgammal	-	-	-
llrint	llrintf	llrint	llrintl	-	-	-
llround	llroundf	llround	llroundl	-	-	-
log10	log10f	log10	log10l	-	-	-
log1p	log1pf	log1p	log1pl	-	-	-
log2	log2f	log2	log2l	-	-	-
logb	logbf	logb	logbl	-	-	-
lrint	lrintf	lrint	lrintl	-	-	-
lround	lroundf	lround	lroundl	-	-	-
nearbyint	nearbyintf	nearbyint	nearbyintl	-	-	-
nextafter	nextafterf	nextafter	nextafterl	-	-	-
nexttoward	nexttowardf	nexttoward	nexttowardl	-	-	-
remainder	remainderf	remainder	remainderl	-	-	-
remquo	remquof	remquo	remquol	-	-	-
rint	rintf	rint	rintl	-	-	-
round	roundf	round	roundl	-	-	-
scalbln	scalblnf	scalbln	scalblnl	-	-	-
scalbn	scalbnf	scalbn	scalbnl	-	-	-
tgamma	tgammaf	tgamma	tgammal	-	-	-
trunc	truncf	trunc	truncl	-	-	-
carg	-	-	-	cargf	carg	cargl

MACRO	REAL FLOAT	REAL DOUBLE	REAL LONG DOUBLE	COMPLEX FLOAT	COMPLEX DOUBLE	COMPLEX LONG DOUBLE
<code>conj</code>	-	-	-	<code>conjf</code>	<code>conj</code>	<code>conjl</code>
<code>creal</code>	-	-	-	<code>crealf</code>	<code>creal</code>	<code>creall</code>
<code>cimag</code>	-	-	-	<code>cimagf</code>	<code>cimag</code>	<code>cimagl</code>
<code>cproj</code>	-	-	-	<code>cprojf</code>	<code>cproj</code>	<code>cprojl</code>

Requirements

Compile with `/std:c11`.

Windows SDK 10.0.20348.0 (version 2104) or later. See [Windows SDK](#) to download the latest SDK. For instructions to install and use the SDK for C11 and C17 development, see [Install C11 and C17 support in Visual Studio](#).

See also

[C Run-Time library reference](#)

C runtime (CRT) and C++ Standard Library (STL) .lib files

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This article lists the Microsoft C runtime library `.lib` files that you can link against when you develop your application, and their associated compiler options and preprocessor directives.

See [Redistributing Visual C++ files](#) if you're looking for information about deploying the C runtime files necessary to support your application.

See [C runtime library reference](#) if you're looking for API reference for the C runtime library.

NOTE

Microsoft's implementation of the C++ Standard Library is often referred to as the *STL* or *Standard Template Library*. Although *C++ Standard Library* is the official name of the library as defined in ISO 14882, due to the popular use of "STL" and "Standard Template Library" in search engines, we occasionally use those names to make it easier to find our documentation.

From a historical perspective, "STL" originally referred to the Standard Template Library written by Alexander Stepanov. Parts of that library were standardized in the C++ Standard Library. The Standard Library also incorporated the ISO C runtime library, parts of the Boost library, and other functionality. Sometimes "STL" is used to refer to the containers and algorithms parts of the C++ Standard Library adapted from Stepanov's STL. In this documentation, Standard Template Library (STL) refers to the C++ Standard Library as a whole.

C runtime `.lib` files

The C runtime Library (CRT) is the part of the C++ Standard Library that incorporates the ISO C standard library. The Visual C++ libraries that implement the CRT support native code development, and both mixed native and managed code. All versions of the CRT support multi-threaded development. Most of the libraries support both static linking, to link the library directly into your code, or dynamic linking to let your code use common DLL files.

In Visual Studio 2015, the CRT was refactored into new binaries. The Universal CRT (UCRT) contains the functions and globals exported by the standard C99 CRT library. The UCRT is now a Windows component, and ships as part of Windows 10 and later versions. The static library, DLL import library, and header files for the UCRT are now found in the Windows SDK. When you install Visual C++, Visual Studio setup installs the subset of the Windows SDK required to use the UCRT. You can use the UCRT on any version of Windows supported by Visual Studio 2015 and later versions. You can redistribute it using vcredist for supported versions of Windows other than Windows 10 or later. For more information, see [Redistributing Visual C++ Files](#).

The following table lists the libraries that implement the UCRT.

LIBRARY	ASSOCIATED DLL	CHARACTERISTICS	OPTION	PREPROCESSOR DIRECTIVES
<code>Libucrt.Lib</code>	None	Statically links the UCRT into your code.	<code>/MT</code>	<code>_MT</code>

LIBRARY	ASSOCIATED DLL	CHARACTERISTICS	OPTION	PREPROCESSOR DIRECTIVES
<code>Libucrt.d.lib</code>	None	Debug version of the UCRT for static linking. Not redistributable.	<code>/MTd</code>	<code>_DEBUG</code> , <code>_MT</code>
<code>ucrt.lib</code>	<code>ucrtbase.dll</code>	DLL import library for the UCRT.	<code>/MD</code>	<code>_MT</code> , <code>_DLL</code>
<code>ucrt.d.lib</code>	<code>ucrtbased.dll</code>	DLL import library for the Debug version of the UCRT. Not redistributable.	<code>/MDd</code>	<code>_DEBUG</code> , <code>_MT</code> , <code>_DLL</code>

The vcruntime library contains Visual C++ CRT implementation-specific code: exception handling and debugging support, runtime checks and type information, implementation details, and certain extended library functions. The vcruntime library version needs to match the version of the compiler you're using.

This table lists the libraries that implement the vcruntime library.

LIBRARY	ASSOCIATED DLL	CHARACTERISTICS	OPTION	PREPROCESSOR DIRECTIVES
<code>Libvcruntime.lib</code>	None	Statically linked into your code.	<code>/MT</code>	<code>_MT</code>
<code>Libvcruntimed.lib</code>	None	Debug version for static linking. Not redistributable.	<code>/MTd</code>	<code>_MT</code> , <code>_DEBUG</code>
<code>vcruntime.lib</code>	<code>vcruntime<version>.dll</code>	DLL import library for the vcruntime.	<code>/MD</code>	<code>_MT</code> , <code>_DLL</code>
<code>vcruntimed.lib</code>	<code>vcruntime<version>.d.dll</code>	DLL import library for the Debug vcruntime. Not redistributable.	<code>/MDd</code>	<code>_DEBUG</code> , <code>_MT</code> , <code>_DLL</code>

NOTE

When the UCRT was refactored, the Concurrency Runtime functions were moved into `concrt140.dll`, which was added to the C++ redistributable package. This DLL is required for C++ parallel containers and algorithms such as `concurrency::parallel_for`. In addition, the C++ Standard Library requires this DLL on Windows XP to support synchronization primitives, because Windows XP doesn't have condition variables.

The code that initializes the CRT is in one of several libraries, based on whether the CRT library is statically or dynamically linked, or native, managed, or mixed code. This code handles CRT startup, internal per-thread data initialization, and termination. It's specific to the version of the compiler used. This library is always statically linked, even when using a dynamically linked UCRT.

This table lists the libraries that implement CRT initialization and termination.

LIBRARY	CHARACTERISTICS	OPTION	PREPROCESSOR DIRECTIVES
<code>libcmt.Lib</code>	Statically links the native CRT startup into your code.	<code>/MT</code>	<code>_MT</code>
<code>libcmtd.Lib</code>	Statically links the Debug version of the native CRT startup. Not redistributable.	<code>/MTd</code>	<code>_DEBUG</code> , <code>_MT</code>
<code>msvcrt.Lib</code>	Static library for the native CRT startup for use with DLL UCRT and vcruntime.	<code>/MD</code>	<code>_MT</code> , <code>_DLL</code>
<code>msvcrt.d.Lib</code>	Static library for the Debug version of the native CRT startup for use with DLL UCRT and vcruntime. Not redistributable.	<code>/MDd</code>	<code>_DEBUG</code> , <code>_MT</code> , <code>_DLL</code>
<code>msvcmrt.Lib</code>	Static library for the mixed native and managed CRT startup for use with DLL UCRT and vcruntime.	<code>/clr</code>	
<code>msvcmrtd.Lib</code>	Static library for the Debug version of the mixed native and managed CRT startup for use with DLL UCRT and vcruntime. Not redistributable.	<code>/clr</code>	
<code>msvcurt.Lib</code>	Deprecated Static library for the pure managed CRT.	<code>/clr:pure</code>	
<code>msvcurtd.Lib</code>	Deprecated Static library for the Debug version of the pure managed CRT. Not redistributable.	<code>/clr:pure</code>	

If you link your program from the command line without a compiler option that specifies a C runtime library, the linker will use the statically linked CRT libraries: `libcmt.Lib`, `libvcruntime.Lib`, and `libucrt.Lib`.

Using the statically linked CRT implies that any state information saved by the C runtime library will be local to that instance of the CRT. For example, if you use `strtok` when using a statically linked CRT, the position of the `strtok` parser is unrelated to the `strtok` state used in code in the same process (but in a different DLL or EXE) that is linked to another instance of the static CRT. In contrast, the dynamically linked CRT shares state for all code within a process that is dynamically linked to the CRT. This concern doesn't apply if you use the new more secure versions of these functions; for example, `strtok_s` doesn't have this problem.

Because a DLL built by linking to a static CRT has its own CRT state, we don't recommend you link statically to the CRT in a DLL unless the consequences are understood and desired. For example, if you call `_set_se_translator` in an executable that loads the DLL linked to its own static CRT, any hardware exceptions generated by the code in the DLL won't be caught by the translator, but hardware exceptions generated by code in the main executable will be caught.

If you're using the `/clr` compiler switch, your code will be linked with a static library, `msvcmrt.lib`. The static library provides a proxy between your managed code and the native CRT. You can't use the statically linked CRT (

`/MT` or `/MTd` options) with `/clr`. Use the dynamically linked libraries (`/MD` or `/MDd`) instead. The pure managed CRT libraries are deprecated in Visual Studio 2015 and unsupported in Visual Studio 2017.

For more information on using the CRT with `/clr`, see [Mixed \(Native and Managed\) Assemblies](#).

To build a debug version of your application, the `_DEBUG` flag must be defined and the application must be linked with a debug version of one of these libraries. For more information about using the debug versions of the library files, see [CRT debugging techniques](#).

This version of the CRT isn't fully conformant with the C99 standard. In versions before Visual Studio 2019 version 16.8, the `<tgmath.h>` header isn't supported. In all versions, the `CX_LIMITED_RANGE` and `FP_CONTRACT` pragma macros aren't supported. Certain elements such as the meaning of parameter specifiers in standard IO functions use legacy interpretations by default. You can use `/zc` compiler conformance options and specify linker options to control some aspects of library conformance.

C++ Standard Library (STL) `.lib` files

C++ STANDARD LIBRARY	CHARACTERISTICS	OPTION	PREPROCESSOR DIRECTIVES
<code>Libcpmt.Lib</code>	Multithreaded, static link	<code>/MT</code>	<code>_MT</code>
<code>msvcprt.Lib</code>	Multithreaded, dynamic link (import library for <code>msvcp<version>.dll</code>)	<code>/MD</code>	<code>_MT</code> , <code>_DLL</code>
<code>Libcpmtd.Lib</code>	Multithreaded, static link	<code>/MTd</code>	<code>_DEBUG</code> , <code>_MT</code>
<code>msvcprtd.Lib</code>	Multithreaded, dynamic link (import library for <code>msvcp<version>d.dll</code>)	<code>/MDd</code>	<code>_DEBUG</code> , <code>_MT</code> , <code>_DLL</code>

When you build a release version of your project, one of the basic C runtime libraries (`Libcmt.Lib`, `msvcmt.Lib`, `msvcrt.Lib`) is linked by default, depending on the compiler option you choose (multithreaded, DLL, `/clr`). If you include one of the [C++ Standard Library header files](#) in your code, a C++ Standard Library will be linked automatically by Visual C++ at compile time. For example:

```
#include <iostream>
```

For binary compatibility, more than one DLL file may be specified by a single import library. Version updates may introduce *dot libraries*, separate DLLs that introduce new library functionality. For example, Visual Studio 2017 version 15.6 introduced `msvcp140_1.dll` to support more standard library functionality without breaking the Application Binary Interface (ABI) supported by `msvcp140.dll`. The `msvcprt.Lib` import library included in the toolset for Visual Studio 2017 version 15.6 supports both DLLs, and the vcredist for this version installs both DLLs. Once shipped, a dot library has a fixed ABI, and will never have a dependency on a later dot library.

What problems exist if an application uses more than one CRT version?

Every executable image (EXE or DLL) can have its own statically linked CRT, or can dynamically link to a CRT. The version of the CRT statically included in or dynamically loaded by a particular image depends on the version of the tools and libraries it was built with. A single process may load multiple EXE and DLL images, each with its own CRT. Each of those CRTs may use a different allocator, may have different internal structure layouts, and may use different storage arrangements. It means allocated memory, CRT resources, or classes passed across a DLL

boundary can cause problems in memory management, internal static usage, or layout interpretation. For example, if a class is allocated in one DLL but passed to and deleted by another, which CRT deallocator is used? The errors caused can range from the subtle to the immediately fatal, and therefore direct transfer of such resources is discouraged.

You can avoid many of these issues by using Application Binary Interface (ABI) technologies instead, as they're designed to be stable and versionable. Design your DLL export interfaces to pass information by value, or to work on memory that is passed in by the caller rather than allocated locally and returned to the caller. Use marshaling techniques to copy structured data between executable images. Encapsulate resources locally and only allow manipulation through handles or functions you expose to clients.

It's also possible to avoid some of these issues if all of the images in your process use the same dynamically loaded version of the CRT. To ensure that all components use the same DLL version of the CRT, build them by using the `/MD` option, and use the same compiler toolset and property settings.

Be careful if your program passes certain CRT resources across DLL boundaries. Resources such as file handles, locales, and environment variables can cause problems, even when using the same version of the CRT. For more information on the issues involved and how to resolve them, see [Potential errors passing CRT objects across DLL boundaries](#).

See also

[C runtime library reference](#)

[Redistributing Visual C++ Files](#)

Universal C runtime routines by category

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This section lists Universal C runtime (UCRT) library routines by category. For reference convenience, some routines are listed in more than one category. Multibyte-character routines and wide-character routines are grouped with single-byte character counterparts, where they exist.

UCRT library routine categories

The main categories of UCRT library routines are:

- [Argument access](#)
- [Buffer manipulation](#)
- [Byte classification](#)
- [Character classification](#)
- [Complex math support](#)
- [Data alignment](#)
- [Data conversion](#)
- [Debug routines](#)
- [Directory control](#)
- [Error handling](#)
- [Exception handling routines](#)
- [File handling](#)
- [Math and floating-point support](#)
- [Input and output](#)
- [Internationalization](#)
- [Memory allocation](#)
- [Process and environment control](#)
- [Robustness](#)
- [Runtime error checking](#)
- [Searching and sorting](#)
- [String manipulation](#)
- [System calls](#)
- [Time management](#)

See also

[C runtime library reference](#)

Argument access

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The `va_arg`, `va_end`, and `va_start` macros provide access to function arguments when the number of arguments is variable. These macros are defined in `<stdarg.h>` for ANSI/ISO C compatibility and in `<varargs.h>` for compatibility with UNIX System V.

Argument-access macros

MACRO	USE
<code>va_arg</code>	Retrieve argument from list
<code>va_end</code>	Reset pointer
<code>va_start</code>	Set pointer to beginning of argument list

See also

[Universal C runtime routines by category](#)

Buffer manipulation

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Use these routines to work with areas of memory on a byte-by-byte basis.

Buffer-manipulation routines

ROUTINE	USE
_memccpy	Copy characters from one buffer to another until given character or given number of characters has been copied
memchr , wmemchr	Return pointer to first occurrence, within specified number of characters, of given character in buffer
memcmp , wmemcmp	Compare specified number of characters from two buffers
memcpy , wmemcpy , memcpy_s , wmemcpy_s	Copy specified number of characters from one buffer to another
_memicmp , _memicmp_l	Compare specified number of characters from two buffers without regard to case
memmove , wmemmove , memmove_s , wmemmove_s	Copy specified number of characters from one buffer to another
memset , wmemset	Use given character to initialize specified number of bytes in the buffer
_swab	Swap bytes of data and store them at specified location

When the source and target areas overlap, only [memmove](#) is guaranteed to copy the full source properly.

See also

[Universal C runtime routines by category](#)

Byte classification

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Each of these routines tests a specified byte of a multibyte character for satisfaction of a condition. Except where specified otherwise, the output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead.

NOTE

By definition, the ASCII characters between 0 and 127 are a subset of all multibyte-character sets. For example, the Japanese katakana character set includes ASCII as well as non-ASCII characters.

The predefined constants in the following table are defined in `<ctype.h>`.

Multibyte-character byte-classification routines

ROUTINE	BYTE TEST CONDITION
<code>isleadbyte</code> , <code>_isleadbyte_1</code>	Lead byte; test result depends on <code>LC_CTYPE</code> category setting of current locale
<code>_ismbbalnum</code> , <code>_ismbbalnum_1</code>	<code>isalnum _ismbbkalnum</code>
<code>_ismbbalpha</code> , <code>_ismbbalpha_1</code>	<code>isalpha _ismbbkalpha</code>
<code>_ismbbgraph</code> , <code>_ismbbgraph_1</code>	Same as <code>_ismbbprint</code> , but <code>_ismbbgraph</code> doesn't include the space character (0x20)
<code>_ismbbkalnum</code> , <code>_ismbbkalnum_1</code>	Non-ASCII text symbol other than punctuation. For example, in code page 932 only, <code>_ismbbkalnum</code> tests for katakana alphanumeric
<code>_ismbbkana</code> , <code>_ismbbkana_1</code>	Katakana (0xA1 - 0xDF), code page 932 only
<code>_ismbbkprint</code> , <code>_ismbbkprint_1</code>	Non-ASCII text or non-ASCII punctuation symbol. For example, in code page 932 only, <code>_ismbbkprint</code> tests for katakana alphanumeric or katakana punctuation (range: 0xA1 - 0xDF).
<code>_ismbbkpunct</code> , <code>_ismbbkpunct_1</code>	Non-ASCII punctuation. For example, in code page 932 only, <code>_ismbbkpunct</code> tests for katakana punctuation.
<code>_ismbblead</code> , <code>_ismbblead_1</code>	First byte of multibyte character. For example, in code page 932 only, valid ranges are 0x81 - 0x9F, 0xE0 - 0xFC.
<code>_ismbbprint</code> , <code>_ismbbprint_1</code>	<code>isprint _ismbbkprint</code> . <code>ismbbprint</code> includes the space character (0x20)

ROUTINE	BYTE TEST CONDITION
<code>_ismbbpunct</code> , <code>_ismbbpunct_l</code>	<code>ispunct _ismbbkpunct</code>
<code>_ismbbtrail</code> , <code>_ismbbtrail_l</code>	Second byte of multibyte character. For example, in code page 932 only, valid ranges are 0x40 - 0x7E, 0x80 - 0xEC.
<code>_ismbslead</code> , <code>_ismbslead_l</code>	Lead byte (in string context)
<code>ismbstrail</code> , <code>_ismbstrail_l</code>	Trail byte (in string context)
<code>_mbbtype</code> , <code>_mbbtype_l</code>	Return byte type based on previous byte
<code>_mbsbtype</code> , <code>_mbsbtype_l</code>	Return type of byte within string
<code>mbsinit</code>	Tracks the state of a multibyte character conversion.

The `MB_LEN_MAX` macro, defined in `<limits.h>`, expands to the maximum length in bytes that any multibyte character can have. `MB_CUR_MAX`, defined in `<stdlib.h>`, expands to the maximum length in bytes of any multibyte character in the current locale.

See also

[Universal C runtime routines by category](#)

Character classification

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Each of these routines tests a specified single-byte character, wide character, or multibyte character for satisfaction of a condition. (By definition, the ASCII character set between 0 and 127 are a subset of all multibyte-character sets. For example, Japanese katakana includes both ASCII and non-ASCII characters.)

The test conditions are affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the `locale` parameter passed in instead.

Generally these routines execute faster than tests you might write and should be favored over. For example, the following code executes slower than a call to `isalpha(c)`:

```
if ((c >= 'A') && (c <= 'Z')) || ((c >= 'a') && (c <= 'z'))
    return TRUE;
```

Character-classification routines

ROUTINE	CHARACTER TEST CONDITION
<code>isalnum</code> , <code>iswalnum</code> , <code>_isalnum_1</code> , <code>_iswalnum_1</code> , <code>_ismbcalnum</code> , <code>_ismbcalnum_1</code> , <code>_ismbcalpha</code> , <code>_ismbcalpha_1</code> , <code>_ismbcdigit</code> , <code>_ismbcdigit_1</code>	Alphanumeric
<code>_ismbcalnum</code> , <code>_ismbcalnum_1</code> , <code>_ismbcalpha</code> , <code>_ismbcalpha_1</code> , <code>_ismbcdigit</code> , <code>_ismbcdigit_1</code>	Multibyte alphanumeric
<code>isalpha</code> , <code>iswalpha</code> , <code>_isalpha_1</code> , <code>_iswalpha_1</code> , <code>_ismbcalnum</code> , <code>_ismbcalnum_1</code> , <code>_ismbcalpha</code> , <code>_ismbcalpha_1</code> , <code>_ismbcdigit</code> , <code>_ismbcdigit_1</code>	Alphabetic
<code>isascii</code> , <code>_isascii</code> , <code>iswascii</code>	ASCII
<code>isblank</code> , <code>iswblank</code> , <code>_isblank_1</code> , <code>_iswblank_1</code> , <code>_ismbcsblank</code> , <code>_ismbcsblank_1</code>	Blank (space or horizontal tab)
<code>iscntrl</code> , <code>iswcntrl</code> , <code>_iscntrl_1</code> , <code>_iswcntrl_1</code>	Control
<code>iscsym</code> , <code>iscsymf</code> , <code>_iscsym</code> , <code>_iswcsym</code> , <code>_iscsymf</code> , <code>_iswcsymf</code> , <code>_iscsym_1</code> , <code>_iswcsym_1</code> , <code>_iscsymf_1</code> , <code>_iswcsymf_1</code>	Letter, underscore, or digit
<code>iscsym</code> , <code>iscsymf</code> , <code>_iscsym</code> , <code>_iswcsym</code> , <code>_iscsymf</code> , <code>_iswcsymf</code> , <code>_iscsym_1</code> , <code>_iswcsym_1</code> , <code>_iscsymf_1</code> , <code>_iswcsymf_1</code>	Letter or underscore

ROUTINE	CHARACTER TEST CONDITION
<code>isdigit</code> , <code>iswdigit</code> , <code>_isdigit_l</code> , <code>_iswdigit_l</code> , <code>_ismbcalnum</code> , <code>_ismbcalnum_l</code> , <code>_ismbcalpha</code> , <code>_ismbcalpha_l</code> , <code>_ismbcdigit</code> , <code>_ismbcdigit_l</code>	Decimal digit
<code>isgraph</code> , <code>iswgraph</code> , <code>_isgraph_l</code> , <code>_iswgraph_l</code> , <code>_ismbcgraph</code> , <code>_ismbcgraph_l</code> , <code>_ismbcprint</code> , <code>_ismbcprint_l</code> , <code>_ismbcpunct</code> , <code>_ismbcpunct_l</code> , <code>_ismbcblank</code> , <code>_ismbcblank_l</code> , <code>_ismbcspace</code> , <code>_ismbcspace_l</code>	Printable other than space
<code>islower</code> , <code>iswlower</code> , <code>_islower_l</code> , <code>_iswlower_l</code> , <code>_ismbclower</code> , <code>_ismbclower_l</code> , <code>_ismbcupper</code> , <code>_ismbcupper_l</code>	Lowercase
<code>_ismbchira</code> , <code>_ismbchira_l</code> , <code>_ismbckata</code> , <code>_ismbckata_l</code>	Hiragana
<code>_ismbchira</code> , <code>_ismbchira_l</code> , <code>_ismbckata</code> , <code>_ismbckata_l</code>	Katakana
<code>_ismbclegal</code> , <code>_ismbclegal_l</code> , <code>_ismbcsymbol</code> , <code>_ismbcsymbol_l</code>	Legal multibyte character
<code>_ismbc10</code> , <code>_ismbc10_l</code> , <code>_ismbc11</code> , <code>_ismbc11_l</code> , <code>_ismbc12</code> , <code>_ismbc12_l</code>	Japan-level 0 multibyte character
<code>_ismbc10</code> , <code>_ismbc10_l</code> , <code>_ismbc11</code> , <code>_ismbc11_l</code> , <code>_ismbc12</code> , <code>_ismbc12_l</code>	Japan-level 1 multibyte character
<code>_ismbc10</code> , <code>_ismbc10_l</code> , <code>_ismbc11</code> , <code>_ismbc11_l</code> , <code>_ismbc12</code> , <code>_ismbc12_l</code>	Japan-level 2 multibyte character
<code>_ismbclegal</code> , <code>_ismbclegal_l</code> , <code>_ismbcsymbol</code> , <code>_ismbcsymbol_l</code>	Non-alphanumeric multibyte character
<code>isprint</code> , <code>iswprint</code> , <code>_isprint_l</code> , <code>_iswprint_l</code> , <code>_ismbcgraph</code> , <code>_ismbcgraph_l</code> , <code>_ismbcprint</code> , <code>_ismbcprint_l</code> , <code>_ismbcpunct</code> , <code>_ismbcpunct_l</code> , <code>_ismbcblank</code> , <code>_ismbcblank_l</code> , <code>_ismbcspace</code> , <code>_ismbcspace_l</code>	Printable
<code>ispunct</code> , <code>iswpunct</code> , <code>_ispunct_l</code> , <code>_iswpunct_l</code> , <code>_ismbcgraph</code> , <code>_ismbcgraph_l</code> , <code>_ismbcprint</code> , <code>_ismbcprint_l</code> , <code>_ismbcpunct</code> , <code>_ismbcpunct_l</code> , <code>_ismbcblank</code> , <code>_ismbcblank_l</code> , <code>_ismbcspace</code> , <code>_ismbcspace_l</code>	Punctuation
<code>isspace</code> , <code>iswspace</code> , <code>_isspace_l</code> , <code>_iswspace_l</code> , <code>_ismbcgraph</code> , <code>_ismbcgraph_l</code> , <code>_ismbcprint</code> , <code>_ismbcprint_l</code> , <code>_ismbcpunct</code> , <code>_ismbcpunct_l</code> , <code>_ismbcblank</code> , <code>_ismbcblank_l</code> , <code>_ismbcspace</code> , <code>_ismbcspace_l</code>	White-space

ROUTINE	CHARACTER TEST CONDITION
<code>isupper</code> , <code>iswupper</code> , <code>_ismbclower</code> , <code>_ismbclower_l</code> , <code>_ismbcupper</code> , <code>_ismbcupper_l</code>	Uppercase
<code>_isctype</code> , <code>iswctype</code> , <code>_isctype_l</code> , <code>_iswctype_l</code>	Property specified by <code>desc</code> argument
<code>isxdigit</code> , <code>iswxdigit</code> , <code>_isxdigit_l</code> , <code>_iswxdigit_l</code>	Hexadecimal digit
<code>_mbclen</code> , <code>mblen</code> , <code>_mblen_l</code>	Return length of valid multibyte character; result depends on <code>LC_CTYPE</code> category setting of current locale

See also

[Universal C runtime routines by category](#)

C complex math support

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The Microsoft C Runtime library (CRT) provides complex math library functions, including all of the ones required by ISO C99. The compiler doesn't directly support a `complex` or `_Complex` keyword, therefore the Microsoft implementation uses structure types to represent complex numbers.

These functions are implemented to balance performance with correctness. Because producing the correctly rounded result may be prohibitively expensive, these functions are designed to efficiently produce a close approximation to the correctly rounded result. In most cases, the result produced is within +/-1 unit of least precision (ULP) of the correctly rounded result, though there may be cases where there's greater inaccuracy.

The complex math routines rely on the floating point math library functions for their implementation. These functions have different implementations for different CPU architectures. For example, the 32-bit x86 CRT may have a different implementation than the 64-bit x64 CRT. In addition, some of the functions may have multiple implementations for a given CPU architecture. The most efficient implementation is selected dynamically at run-time depending on the instruction sets supported by the CPU. For example, in the 32-bit x86 CRT, some functions have both an x87 implementation and an SSE2 implementation. When running on a CPU that supports SSE2, the faster SSE2 implementation is used. When running on a CPU that doesn't support SSE2, the slower x87 implementation is used. Because different implementations of the math library functions may use different CPU instructions and different algorithms to produce their results, the functions may produce different results across CPUs. In most cases, the results are within +/-1 ULP of the correctly rounded result, but the actual results may vary across CPUs.

Types used in complex math

The Microsoft implementation of the `complex.h` header defines these types as equivalents for the C99 standard native complex types:

STANDARD TYPE	MICROSOFT TYPE
<code>float complex</code> or <code>float _Complex</code>	<code>_Fcomplex</code>
<code>double complex</code> or <code>double _Complex</code>	<code>_Dcomplex</code>
<code>long double complex</code> or <code>long double _Complex</code>	<code>_Lcomplex</code>

The `math.h` header defines a separate type, `struct _complex`, used for the `cabs` function. The `struct _complex` type isn't used by the equivalent complex math functions `cabs`, `cabsf`, `cabsl`.

Complex constants and macros

`I` is defined as the complex type `_Fcomplex` initialized by `{ 0.0f, 1.0f }`.

Trigonometric functions

FUNCTION	DESCRIPTION
<code>cacos</code> , <code>cacosf</code> , <code>cacosl</code>	Compute the complex arc cosine of a complex number

FUNCTION	DESCRIPTION
<code>casin</code> , <code>casinf</code> , <code>casinl</code>	Compute the complex arc sine of a complex number
<code>catan</code> , <code>catanf</code> , <code>catanl</code>	Compute the complex arc tangent of a complex number
<code>ccos</code> , <code>ccosf</code> , <code>ccosl</code>	Compute the complex cosine of a complex number
<code>csin</code> , <code>csinf</code> , <code>csinl</code>	Compute the complex sine of a complex number
<code>ctan</code> , <code>ctanf</code> , <code>ctanl</code>	Compute the complex tangent of a complex number

Hyperbolic functions

FUNCTION	DESCRIPTION
<code>cacosh</code> , <code>cacoshf</code> , <code>cacoshl</code>	Compute the complex arc hyperbolic cosine of a complex number
<code>casinh</code> , <code>casinhf</code> , <code>casinhl</code>	Compute the complex arc hyperbolic sine of a complex number
<code>catanh</code> , <code>catanhf</code> , <code>catanhl</code>	Compute the complex arc hyperbolic tangent of a complex number
<code>ccosh</code> , <code>ccoshf</code> , <code>ccoshl</code>	Compute the complex hyperbolic cosine of a complex number
<code>csinh</code> , <code>csinhf</code> , <code>csinhl</code>	Compute the complex hyperbolic sine of a complex number
<code>ctanh</code> , <code>ctanhf</code> , <code>ctanhl</code>	Compute the complex hyperbolic tangent of a complex number

Exponential and logarithmic functions

FUNCTION	DESCRIPTION
<code>cexp</code> , <code>cexpf</code> , <code>cexpl</code>	Compute the complex base- e exponential of a complex number
<code>clog</code> , <code>clogf</code> , <code>clogl</code>	Compute the complex natural (base- e) logarithm of a complex number
<code>clog10</code> , <code>clog10f</code> , <code>clog10l</code>	Compute the complex base- 10 logarithm of a complex number

Power and absolute-value functions

FUNCTION	DESCRIPTION

FUNCTION	DESCRIPTION
<code>cabs</code> , <code>cabsf</code> , <code>cabsl</code>	Compute the complex absolute value (also called the norm, modulus, or magnitude) of a complex number
<code>cpow</code> , <code>cpowf</code> , <code>cpowl</code>	Compute the complex power function
<code>csqrt</code> , <code>csqrft</code> , <code>csqrtr</code>	Compute the complex square root of a complex number

Manipulation functions

FUNCTION	DESCRIPTION
<code>_Cbuild</code> , <code>_FCbuild</code> , <code>_LCbuild</code>	Construct a complex number from real and imaginary parts
<code>carg</code> , <code>cargf</code> , <code>cargl</code>	Compute the argument (also called the phase angle) of a complex number
<code>cimag</code> , <code>cimagf</code> , <code>cimagl</code>	Compute the imaginary part of a complex number
<code>conj</code> , <code>conjf</code> , <code>conjl</code>	Compute the complex conjugate of a complex number
<code>cproj</code> , <code>cprojf</code> , <code>cprojl</code>	Compute a projection of a complex number onto the Riemann sphere
<code>creal</code> , <code>crealf</code> , <code>creall</code>	Compute the real part of a complex number
<code>norm</code> , <code>normf</code> , <code>norml</code>	Compute the squared magnitude of a complex number

Operation functions

Because complex numbers aren't a native type in the Microsoft compiler, the standard arithmetic operators aren't defined on complex types. For convenience, these complex math library functions are provided to enable limited manipulation of complex numbers in user code:

FUNCTION	DESCRIPTION
<code>_Cmulcc</code> , <code>_FCmulcc</code> , <code>_LCmulcc</code>	Multiply two complex numbers
<code>_Cmulcr</code> , <code>_FCmulcr</code> , <code>_LCmulcr</code>	Multiply a complex and a floating-point number

See also

[Type-generic math](#)

[Universal C runtime routines by category](#)

Data alignment

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The following C run-time functions support data alignment.

Data-alignment routines

ROUTINE	USE
<code>_aligned_free</code>	Frees a block of memory that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> .
<code>_aligned_free_dbg</code>	Frees a block of memory that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> (debug only).
<code>_aligned_malloc</code>	Allocates memory on a specified alignment boundary.
<code>_aligned_malloc_dbg</code>	Allocates memory on a specified alignment boundary with extra space for a debugging header and overwrite buffers (debug version only).
<code>_aligned_msize</code>	Returns the size of a memory block allocated in the heap.
<code>_aligned_msize_dbg</code>	Returns the size of a memory block allocated in the heap (debug version only).
<code>_aligned_offset_malloc</code>	Allocates memory on a specified alignment boundary.
<code>_aligned_offset_malloc_dbg</code>	Allocates memory on a specified alignment boundary (debug version only).
<code>_aligned_offset_realloc</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> .
<code>_aligned_offset_realloc_dbg</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> (debug version only).
<code>_aligned_offset_realloc</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> and initializes the memory to 0.
<code>_aligned_offset_realloc_dbg</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> and initializes the memory to 0 (debug version only).
<code>_aligned_realloc</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> .

ROUTINE	USE
<code>_aligned_realloc_dbg</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> (debug version only).
<code>_aligned_realloc</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> and initializes the memory to 0.
<code>_aligned_realloc_dbg</code>	Changes the size of a memory block that was allocated with <code>_aligned_malloc</code> or <code>_aligned_offset_malloc</code> and initializes the memory to 0 (debug version only).

See also

[Universal C runtime routines by category](#)

Data conversion

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These routines convert data from one form to another. Generally these routines execute faster than conversions you might write. Each routine that begins with a `to` prefix is implemented as a function and as a macro. See [Recommendations for choosing between functions and macros](#) for information about choosing an implementation.

Data-conversion routines

ROUTINE	USE
<code>abs</code>	Find absolute value of integer
<code>atof</code> , <code>_atof_l</code>	Convert string to <code>float</code>
<code>atoi</code> , <code>_atoi_l</code>	Convert string to <code>int</code>
<code>_atoi64</code> , <code>_atoi64_l</code>	Convert string to <code>__int64</code> or <code>long long</code>
<code>atol</code> , <code>_atol_l</code>	Convert string to <code>long</code>
<code>c16rtomb</code> , <code>c32rtomb</code>	Convert UTF-16 or UTF-32 character to equivalent multibyte character
<code>_ecvt</code> , <code>_ecvt_s</code>	Convert <code>double</code> to string of specified length
<code>_fcvt</code> , <code>_fcvt_s</code>	Convert <code>double</code> to string with specified number of digits following decimal point
<code>_gcvt</code> , <code>_gcvt_s</code>	Convert <code>double</code> number to string; store string in buffer
<code>_itoa</code> , <code>_ltoa</code> , <code>_ultoa</code> , <code>_i64toa</code> , <code>_ui64toa</code> , <code>_itow</code> , <code>_ltow</code> , <code>ultow</code> , <code>_i64tow</code> , <code>_ui64tow</code> , <code>_itoa_s</code> , <code>_ltoa_s</code> , <code>_ultoa_s</code> , <code>_i64toa_s</code> , <code>_ui64toa_s</code> , <code>_itow_s</code> , <code>_ltow_s</code> , <code>_ultow_s</code> , <code>_i64tow_s</code> , <code>_ui64tow_s</code>	Convert integer types to string
<code>labs</code>	Find absolute value of <code>long</code> integer
<code>llabs</code>	Find absolute value of <code>long long</code> integer
<code>_mbbtombc</code> , <code>_mbbtombc_l</code>	Convert 1-byte multibyte character to corresponding 2-byte multibyte character
<code>_mbcjistojms</code> , <code>_mbcjistojms_l</code> , <code>_mbcjmstojis</code> , <code>_mbcjmstojis_l</code>	Convert Japan Industry Standard (JIS) character to Japan Microsoft (JMS) character

ROUTINE	USE
<code>_mbcjistojms</code> , <code>_mbcjistojms_1</code> , <code>_mbcjmstojis</code> , <code>_mbcjmstojis_1</code>	Convert JMS character to JIS character
<code>_mbctohira</code> , <code>_mbctohira_1</code> , <code>_mbctokata</code> , <code>_mbctokata_1</code>	Convert multibyte character to 1-byte hiragana code
<code>_mbctohira</code> , <code>_mbctohira_1</code> , <code>_mbctokata</code> , <code>_mbctokata_1</code>	Convert multibyte character to 1-byte katakana code
<code>_mbctombb</code> , <code>_mbctombb_1</code>	Convert 2-byte multibyte character to corresponding 1-byte multibyte character
<code>mbrtoc16</code> , <code>mbrtoc32</code>	Convert multibyte character to equivalent UTF-16 or UTF-32 character
<code>mbstowcs</code> , <code>_mbstowcs_1</code> , <code>mbstowcs_s</code> , <code>_mbstowcs_s_1</code>	Convert sequence of multibyte characters to corresponding sequence of wide characters
<code>mbtowc</code> , <code>_mbtowc_1</code>	Convert multibyte character to corresponding wide character
<code>strtod</code> , <code>_strtod_1</code> , <code>wcstod</code> , <code>_wcstod_1</code>	Convert string to <code>double</code>
<code>strtol</code> , <code>wcstol</code> , <code>_strtol_1</code> , <code>_wcstol_1</code>	Convert string to <code>long</code> integer
<code>strtoul</code> , <code>_strtoul_1</code> , <code>wcstoul</code> , <code>_wcstoul_1</code>	Convert string to <code>unsigned long</code> integer
<code>strxfrm</code> , <code>wcsxfrm</code> , <code>_strxfrm_1</code> , <code>_wcsxfrm_1</code>	Transform string into collated form based on locale-specific information
<code>toascii</code> , <code>_toascii</code>	Convert character to ASCII code
<code>tolower</code> , <code>_tolower</code> , <code>towlower</code> , <code>_tolower_1</code> , <code>_tolower_1</code> , <code>_mbctolower</code> , <code>_mbctolower_1</code> , <code>_mbctoupper</code> , <code>_mbctoupper_1</code>	Test character and convert to lowercase if currently uppercase
<code>tolower</code> , <code>_tolower</code> , <code>towlower</code> , <code>_tolower_1</code> , <code>_tolower_1</code>	Convert character to lowercase unconditionally
<code>toupper</code> , <code>_toupper</code> , <code>towupper</code> , <code>_toupper_1</code> , <code>_towupper_1</code> , <code>_mbctolower</code> , <code>_mbctolower_1</code> , <code>_mbctoupper</code> , <code>_mbctoupper_1</code>	Test character and convert to uppercase if currently lowercase
<code>toupper</code> , <code>_toupper</code> , <code>towupper</code> , <code>_toupper_1</code> , <code>_towupper_1</code>	Convert character to uppercase unconditionally
<code>wcstombs</code> , <code>_wcstombs_1</code> , <code>wcstombs_s</code> , <code>_wcstombs_s_1</code>	Convert sequence of wide characters to corresponding sequence of multibyte characters
<code>wctomb</code> , <code>_wctomb_1</code> , <code>wctomb_s</code> , <code>_wctomb_s_1</code>	Convert wide character to corresponding multibyte character

ROUTINE	USE
<code>_wtof</code> , <code>_wtof_l</code>	Convert wide-character string to a <code>double</code>
<code>_wtoi</code> , <code>_wtoi_l</code>	Convert wide-character string to <code>int</code>
<code>_wtoi64</code> , <code>_wtoi64_l</code>	Convert wide-character string to <code>__int64</code> or <code>long long</code>
<code>_wtol</code> , <code>_wtol_l</code>	Convert wide-character string to <code>long</code>

See also

[Universal C runtime routines by category](#)

Debug routines

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The debug version of the C runtime library supplies many diagnostic services that make debugging programs easier and allow developers to:

- Step directly into run-time functions during debugging
- Resolve assertions, errors, and exceptions
- Trace heap allocations and prevent memory leaks
- Report debug messages to the user

Debug versions of the C runtime library routines

To use these routines, the `_DEBUG` flag must be defined. All of these routines do nothing in a retail build of an application. For more information on how to use the new debug routines, see [CRT debugging techniques](#).

ROUTINE	USE
<code>_ASSERT</code>	Evaluate an expression and generates a debug report when the result is <code>FALSE</code>
<code>_ASSERTE</code>	Similar to <code>_ASSERT</code> , but includes the failed expression in the generated report
<code>_CrtCheckMemory</code>	Confirm the integrity of the memory blocks allocated on the debug heap
<code>_CrtDbgBreak</code>	Sets a break point.
<code>_CrtDbgReport</code> , <code>_CrtDbgReportw</code>	Generate a debug report with a user message and send the report to three possible destinations
<code>_CrtDoForAllClientObjects</code>	Call an application-supplied function for all <code>_CLIENT_BLOCK</code> types on the heap
<code>_CrtDumpMemoryLeaks</code>	Dump all of the memory blocks on the debug heap when a significant memory leak has occurred
<code>_CrtIsMemoryBlock</code>	Verify that a specified memory block is located within the local heap and that it has a valid debug heap block type identifier
<code>_CrtIsValidHeapPointer</code>	Verifies that a specified pointer is in the local heap
<code>_CrtIsValidPointer</code>	Verify that a specified memory range is valid for reading and writing
<code>_CrtMemCheckpoint</code>	Obtain the current state of the debug heap and store it in an application-supplied <code>_CrtMemState</code> structure

ROUTINE	USE
<code>_CrtMemDifference</code>	Compare two memory states for significant differences and return the results
<code>_CrtMemDumpAllObjectsSince</code>	Dump information about objects on the heap since a specified checkpoint was taken or from the start of program execution
<code>_CrtMemDumpStatistics</code>	Dump the debug header information for a specified memory state in a user-readable form
<code>_CrtReportBlockType</code>	Returns the block type/subtype associated with a given debug heap block pointer.
<code>_CrtSetAllocHook</code>	Install a client-defined allocation function by hooking it into the C run-time debug memory allocation process
<code>_CrtSetBreakAlloc</code>	Set a breakpoint on a specified object allocation order number
<code>_CrtSetDbgFlag</code>	Retrieve or modify the state of the <code>_crtDbgFlag</code> flag to control the allocation behavior of the debug heap manager
<code>_CrtSetDumpClient</code>	Install an application-defined function that is called every time a debug dump function is called to dump <code>_CLIENT_BLOCK</code> type memory blocks
<code>_CrtSetReportFile</code>	Identify the file or stream to be used as a destination for a specific report type by <code>_CrtDbgReport</code>
<code>_CrtSetReportHook</code>	Install a client-defined reporting function by hooking it into the C run-time debug reporting process
<code>_CrtSetReportHook2</code> , <code>_CrtSetReportHookW2</code>	Installs or uninstalls a client-defined reporting function by hooking it into the C run-time debug reporting process.
<code>_CrtSetReportMode</code>	Specify the general destination(s) for a specific report type generated by <code>_CrtDbgReport</code>
<code>_RPT[0,1,2,3,4]</code>	Track the application's progress by generating a debug report by calling <code>_CrtDbgReport</code> with a format string and a variable number of arguments. Provides no source file and line number information.
<code>_RPTF[0,1,2,3,4]</code>	Similar to the <code>_RPTn</code> macros, but provides the source file name and line number where the report request originated
<code>_calloc_dbg</code>	Allocate a specified number of memory blocks on the heap with extra space for a debugging header and overwrite buffers
<code>_expand_dbg</code>	Resize a specified block of memory on the heap by expanding or contracting the block

ROUTINE	USE
<code>_free_dbg</code>	Free a block of memory on the heap
<code>_fullpath_dbg</code> , <code>_wfullpath_dbg</code>	Create an absolute or full path name for the specified relative path name, using <code>_malloc_dbg</code> to allocate memory.
<code>_getcwd_dbg</code> , <code>_wgetcwd_dbg</code>	Get the current working directory, using <code>_malloc_dbg</code> to allocate memory.
<code>_malloc_dbg</code>	Allocate a block of memory on the heap with extra space for a debugging header and overwrite buffers
<code>_msize_dbg</code>	Calculate the size of a block of memory on the heap
<code>_realloc_dbg</code>	Reallocate a specified block of memory on the heap by moving and/or resizing the block
<code>_strupdup_dbg</code> , <code>_wcstrupdup_dbg</code>	Duplicates a string, using <code>_malloc_dbg</code> to allocate memory.
<code>_tempnam_dbg</code> , <code>_wtempnam_dbg</code>	Generate names you can use to create temporary files, using <code>_malloc_dbg</code> to allocate memory.

C runtime routines that aren't available in source code form

The debugger can be used to step through the source code for most of the C runtime routines during the debugging process. However, Microsoft considers some technology to be proprietary and, therefore, doesn't provide the source code for a subset of these routines. Most of these routines belong to either the exception handling or floating-point processing groups, but a few others are included as well. The following table lists these routines.

<code>acos</code>
<code>acosh</code>
<code>asin</code>
<code>asinh</code>
<code>atan</code> , <code>atan2</code>
<code>atanh</code>
<code>Bessel functions</code>
<code>_cabs</code>
<code>ceil</code>
<code>_chgsign</code>
<code>_clear87</code> , <code>_clearfp</code>
<code>_control87</code> , <code>_controlfp</code>
<code>copysign</code>
<code>cos</code>
<code>cosh</code>
<code>Exp</code>
<code>fabs</code>
<code>_finite</code>
<code>floor</code>
<code>fmod</code>

```
_fpclass  
_fpieee_flt  
_fpreset  
frexp  
  
_hypot  
isnan  
ldexp  
log  
_logb  
log10  
longjmp  
_matherr  
modf  
_nextafter  
pow  
printf_s  
  
printf  
_scalb  
scanf_s  
scanf  
setjmp  
sin  
sinh  
sqrt  
_status87 , _statusfp  
tan  
tanh
```

Although source code is available for most of the `printf` and `scanf` routines, they make an internal call to another routine for which source code isn't provided.

Routines that behave differently in a debug build of an application

Some C run-time functions and C++ operators behave differently when called from a debug build of an application. (You can create a debug build of an application by either defining the `_DEBUG` flag or by linking with a debug version of the C run-time library.) The behavioral differences usually consist of extra features or information provided by the routine to support the debugging process. The following table lists these routines.

C `abort` routine

C `assert` routine

C++ `delete` operator

C++ `new` operator

See also

[Universal C runtime routines by category](#)

[Runtime error checking](#)

Directory control

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These routines access, modify, and obtain information about the directory structure.

Directory-control routines

ROUTINE	USE
<code>_chdir</code> , <code>_wchdir</code>	Change current working directory
<code>_chdrive</code>	Change current drive
<code>_getcwd</code> , <code>_wgetcwd</code>	Get current working directory for default drive
<code>_getdcwd</code> , <code>_wgetdcwd</code>	Get current working directory for specified drive
<code>_getdiskfree</code>	Populates a <code>_diskfree_t</code> structure with information about a disk drive.
<code>_getdrive</code>	Get current (default) drive
<code>_getdrives</code>	Returns a bitmask representing the currently available disk drives.
<code>_mkdir</code> , <code>_wmkdir</code>	Make new directory
<code>_rmdir</code> , <code>_wrmdir</code>	Remove directory
<code>_searchenv</code> , <code>_wsearchenv</code> , <code>_searchenv_s</code> , <code>_wsearchenv_s</code>	Search for given file on specified paths

See also

[Universal C runtime routines by category](#)

[File handling](#)

[System calls](#)

Error handling (CRT)

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Use these routines to handle program errors.

Error-handling routines

ROUTINE	USE
<code>assert</code> macro	Test for programming logic errors; available in both the release and debug versions of the run-time library.
<code>_ASSERT</code> , <code>_ASERTE</code> macros	Similar to <code>assert</code> , but only available in the debug versions of the run-time library.
<code>clearerr</code>	Reset error indicator. Calling <code>rewind</code> or closing a stream also resets the error indicator.
<code>_eof</code>	Check for end of file in low-level I/O.
<code>feof</code>	Test for end of file. End of file is also indicated when <code>_read</code> returns 0.
<code>ferror</code>	Test for stream I/O errors.
<code>_RPT</code> , <code>_RPTF</code> macros	Generate a report similar to <code>printf</code> , but only available in the debug versions of the run-time library.
<code>_set_error_mode</code>	Modifies <code>__error_mode</code> to determine a non-default location where the C run time writes an error message for an error that will possibly end the program.
<code>_set_purecall_handler</code>	Sets the handler for a pure virtual function call.

See also

- [Universal C runtime routines by category](#)

Exception handling routines

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Use the C++ exception-handling functions to recover from unexpected events during program execution.

Exception-handling functions

FUNCTION	USE
<code>_set_se_translator</code>	Handle Win32 exceptions (C structured exceptions) as C++ typed exceptions
<code>set_terminate</code>	Install your own termination routine to be called by <code>terminate</code>
<code>set_unexpected</code>	Install your own termination function to be called by <code>unexpected</code>
<code>terminate</code>	Called automatically under certain circumstances after exception is thrown. The <code>terminate</code> function calls <code>abort</code> or a function you specify using <code>set_terminate</code>
<code>unexpected</code>	Calls <code>terminate</code> or a function you specify using <code>set_unexpected</code> . The <code>unexpected</code> function isn't used in current Microsoft C++ exception-handling implementation

See also

[Universal C runtime routines by category](#)

File handling

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Use these routines to create, delete, and manipulate files and to set and check file-access permissions.

The C run-time libraries have a 512 limit for the number of files that can be open at any one time. Attempting to open more than the maximum number of file descriptors or file streams causes program failure. Use [`_setmaxstdio`](#) to change this number.

File-handling routines (file descriptor)

These routines operate on files designated by a file descriptor.

ROUTINE	USE
<code>_chsize</code> , <code>_chsize_s</code>	Change file size
<code>_filelength</code> , <code>_filelengthi64</code>	Get file length
<code>_fstat</code> , <code>_fstat32</code> , <code>_fstat64</code> , <code>_fstatati64</code> , <code>_fstat32i64</code> , <code>_fstat64i32</code>	Get file-status information on descriptor
<code>_get_osfhandle</code>	Return operating-system file handle associated with existing C run-time file descriptor
<code>_isatty</code>	Check for character device
<code>_locking</code>	Lock areas of file
<code>_open_osfhandle</code>	Associate C run-time file descriptor with existing operating-system file handle
<code>_setmode</code>	Set file-translation mode

File-Handling Routines (Path or Filename)

These routines operate on files specified by a path or filename.

ROUTINE	USE
<code>_access</code> , <code>_waccess</code> , <code>_access_s</code> , <code>_waccess_s</code>	Check file-permission setting
<code>_chmod</code> , <code>_wchmod</code>	Change file-permission setting
<code>_fullpath</code> , <code>_wfullpath</code>	Expand a relative path to its absolute path name
<code>_makepath</code> , <code>_wmakepath</code> , <code>_makepath_s</code> , <code>_wmakepath_s</code>	Merge path components into single, full path
<code>_mktemp</code> , <code>_wmktemp</code> , <code>_mktemp_s</code> , <code>_wmktemp_s</code>	Create unique filename

ROUTINE	USE
<code>remove</code> , <code>_wremove</code>	Delete file
<code>rename</code> , <code>_wrename</code>	Rename file
<code>_splitpath</code> , <code>_wsplitpath</code> , <code>_splitpath_s</code> , <code>_wsplitpath_s</code>	Parse path into components
<code>_stat</code> , <code>_stat64</code> , <code>_stati64</code> , <code>_wstat</code> , <code>_wstat64</code> , <code>_wstati64</code>	Get file-status information on named file
<code>_umask</code> , <code>_umask_s</code>	Set default permission mask for new files created by program
<code>_unlink</code> , <code>_wunlink</code>	Delete file

File-Handling Routines (Open File)

These routines open files.

ROUTINE	USE
<code>fopen</code> , <code>_wfopen</code> , <code>fopen_s</code> , <code>_wfopen_s</code>	Opens a file and returns a pointer to the open file.
<code>_fsopen</code> , <code>_wfopen</code>	Open a stream with file sharing and returns a pointer to the open file.
<code>_open</code> , <code>_wopen</code>	Opens a file and returns a file descriptor to the opened file.
<code>_sopen</code> , <code>_wsopen</code> , <code>_sopen_s</code> , <code>_wsopen_s</code>	Open a file with file sharing and returns a file descriptor to the open file.
<code>_pipe</code>	Creates a pipe for reading and writing.
<code>freopen</code> , <code>_wfreopen</code> , <code>freopen_s</code> , <code>_wfreopen_s</code>	Reassign a file pointer.

These routines provide a way to change the representation of the file between a `FILE` structure, a file descriptor, and a Win32 file handle.

ROUTINE	USE
<code>_fdopen</code> , <code>_wfopen</code>	Associates a stream with a file that was previously opened for low-level I/O and returns a pointer to the open stream.
<code>_fileno</code>	Gets the file descriptor associated with a stream.
<code>_get_osfhandle</code>	Return operating-system file handle associated with existing C run-time file descriptor
<code>_open_osfhandle</code>	Associates C run-time file descriptor with an existing operating-system file handle.

The following Win32 functions also open files and pipes:

- [CreateFile](#)
- [CreatePipe](#)
- [CreateNamedPipe](#)

See also

[Universal C runtime routines by category](#)

[Directory control](#)

[System calls](#)

Math and floating-point support

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The Universal C Runtime library (UCRT) provides many integral and floating-point math library functions, including all of the functions required by ISO C99. The floating-point functions are implemented to balance performance with correctness. Because producing the correctly rounded result may be prohibitively expensive, these functions are designed to efficiently produce a close approximation to the correctly rounded result. In most cases, the result produced is within +/-1 ULP (unit of least precision) of the correctly rounded result, though there may be cases where there's greater inaccuracy.

For ISO C Standard 11 (C11) and later, the `<tgmath.h>` header, in addition to including `<math.h>` and `<complex.h>`, provides macros that invoke a corresponding math function based on the types of the parameters. See [Type-generic math](#) for details.

Many of the floating point math library functions have different implementations for different CPU architectures. For example, the 32-bit x86 CRT may have a different implementation than the 64-bit x64 CRT. In addition, some of the functions may have multiple implementations for a given CPU architecture. The most efficient implementation is selected dynamically at run-time depending on the instruction sets supported by the CPU. For example, in the 32-bit x86 CRT, some functions have both an x87 implementation and an SSE2 implementation. When running on a CPU that supports SSE2, the faster SSE2 implementation is used. When running on a CPU that doesn't support SSE2, the slower x87 implementation is used. Because different implementations of the math library functions may use different CPU instructions and different algorithms to produce their results, the functions may produce different results across CPUs. In most cases, the results are within +/-1 ULP of the correctly rounded result, but the actual results may vary across CPUs.

Previous 16-bit versions of Microsoft C/C++ and Microsoft Visual C++ supported the `long double` type as an 80-bit precision floating-point data type. In later versions of Visual C++, the `long double` data type is a 64-bit precision floating-point data type identical to the `double` type. The compiler treats `long double` and `double` as distinct types, but the `long double` functions are identical to their `double` counterparts. The CRT provides `long double` versions of the math functions for ISO C99 source code compatibility, but note that the binary representation may differ from other compilers.

Supported math and floating-point routines

ROUTINE	USE
<code>abs</code> , <code>labs</code> , <code>llabs</code> , <code>_abs64</code>	Computes the absolute value of an integer type
<code>acos</code> , <code>acosf</code> , <code>acosl</code>	Computes the arc cosine
<code>acosh</code> , <code>acoshf</code> , <code>acoshl</code>	Computes the hyperbolic arc cosine
<code>asin</code> , <code>asinf</code> , <code>asinl</code>	Computes the arc sine
<code>asinh</code> , <code>asinhf</code> , <code>asinhl</code>	Computes the hyperbolic arc sine
<code>atan</code> , <code>atanf</code> , <code>atanl</code> , <code>atan2</code> , <code>atan2f</code> , <code>atan2l</code>	Computes the arc tangent
<code>atanh</code> , <code>atanhf</code> , <code>atanhl</code>	Computes the hyperbolic arc tangent

ROUTINE	USE
<code>_atodbl</code> , <code>_atodbl_l</code>	Converts a locale-specific string to a <code>double</code>
<code>atof</code> , <code>_atof_l</code>	Converts a string to a <code>double</code>
<code>_atoflt</code> , <code>_atoflt_l</code> , <code>_atoldbl</code> , <code>_atoldbl_l</code>	Converts a locale-specific string to a <code>float</code> or <code>long double</code>
<code>cbrt</code> , <code>cbrtf</code> , <code>cbrtl</code>	Computes the cube root
<code>ceil</code> , <code>ceilf</code> , <code>ceill</code>	Computes the ceiling
<code>_chgsign</code> , <code>_chgsignf</code> , <code>_chgsignl</code>	Computes the additive inverse
<code>_clear87</code> , <code>_clearfp</code>	Gets and clears the floating-point status register
<code>_control87</code> , <code>_controlfp</code> , <code>__control87_2</code>	Gets and sets the floating-point control word
<code>_controlfp_s</code>	Secure version of <code>_controlfp</code>
<code>copysign</code> , <code>copysignf</code> , <code>copysignl</code> , <code>_copysign</code> , <code>_copysignf</code> , <code>_copysignl</code>	Returns a value that has the magnitude of one argument and the sign of another
<code>cos</code> , <code>cosf</code> , <code>cosl</code>	Computes the sine
<code>cosh</code> , <code>coshf</code> , <code>coshl</code>	Computes the hyperbolic sine
<code>div</code> , <code>ldiv</code> , <code>lldiv</code>	Computes the quotient and the remainder of two integer values
<code>_ecvt</code> , <code>ecvt</code>	Converts a <code>double</code> to a string
<code>_ecvt_s</code>	Secure version of <code>_ecvt</code>
<code>erf</code> , <code>erff</code> , <code>erfl</code>	Computes the error function
<code>erfc</code> , <code>erfcf</code> , <code>erfc1</code>	Computes the complementary error function
<code>exp</code> , <code>expf</code> , <code>expl</code>	Computes the exponential e^x
<code>exp2</code> , <code>exp2f</code> , <code>exp2l</code>	Computes the exponential 2^x
<code>expm1</code> , <code>expm1f</code> , <code>expm1l</code>	Computes $e^x - 1$
<code>fabs</code> , <code>fabsf</code> , <code>fabsl</code>	Computes the absolute value of a floating-point type
<code>_fcvt</code> , <code>fcvt</code>	Converts a floating-point number to a string

ROUTINE	USE
<code>_fcvt_s</code>	Secure version of <code>_fcvt</code>
<code>fdim</code> , <code>fdimf</code> , <code>fdiml</code>	Determines the positive difference between two values
<code>feclearexcept</code>	Clears specified floating-point exceptions
<code>fegetenv</code>	Stores the current floating-point environment
<code>fegetexceptflag</code>	Gets the specified floating-point exception status
<code>fegetround</code>	Gets the floating-point rounding mode
<code>feholdexcept</code>	Sets non-stop floating-point exception mode
<code>feraiseexcept</code>	Raises the specified floating-point exceptions
<code>fesetenv</code>	Sets the current floating-point environment
<code>fesetexceptflag</code>	Sets the specified floating-point status flags
<code>fesetround</code>	Sets the specified floating-point rounding mode
<code>fetestexcept</code>	Determines which floating-point exception status flags are set
<code>feupdateenv</code>	Restores a floating-point environment then raises previous exceptions
<code>floor</code> , <code>floorf</code> , <code>floorl</code>	Computes the floor
<code>fma</code> , <code>fmaf</code> , <code>fmal</code>	Computes a fused multiply-add
<code>fmax</code> , <code>fmaxf</code> , <code>fmaxl</code>	Computes the maximum of the arguments
<code>fmin</code> , <code>fminf</code> , <code>fminl</code>	Computes the minimum of the arguments
<code>fmod</code> , <code>fmodf</code> , <code>fmodl</code>	Computes the floating-point remainder
<code>_fpclass</code> , <code>_fpclassf</code>	Returns the classification of a floating-point value
<code>fpclassify</code>	Returns the classification of a floating-point value
<code>_fpieee_flt</code>	Sets a handler for floating-point exceptions
<code>_fpreset</code>	Resets the floating-point environment
<code>frexp</code> , <code>frexpf</code> , <code>frexl</code>	Gets the mantissa and exponent of a floating-point number
<code>_gcvt</code> , <code>gcvt</code>	Converts a floating-point number to a string

ROUTINE	USE
<code>_gcvt_s</code>	Secure version of <code>_gcvt</code>
<code>_get_FMA3_enable</code> , <code>_set_FMA3_enable</code>	Gets or sets a flag for use of FMA3 instructions on x64
<code>hypot</code> , <code>hypotf</code> , <code>hypotl</code> , <code>_hypot</code> , <code>_hypotf</code> , <code>_hypotl</code>	Computes the hypotenuse
<code>ilogb</code> , <code>ilogbf</code> , <code>ilogbl</code>	Computes the integer base-2 exponent
<code>imaxabs</code>	Computes the absolute value of an integer type
<code>imaxdiv</code>	Computes the quotient and the remainder of two integer values
<code>isfinite</code> , <code>_finite</code> , <code>_finitef</code>	Determines whether a value is finite
<code>isgreater</code> , <code>isgreaterequal</code> , <code>isless</code> , <code>islessequal</code> , <code>islessgreater</code> , <code>isunordered</code>	Compare the order of two floating point values
<code>isinf</code>	Determines whether a floating-point value is infinite
<code>isnan</code> , <code>_isnan</code> , <code>_isnanf</code>	Tests a floating-point value for NaN
<code>isnormal</code>	Tests whether a floating-point value is both finite and not subnormal
<code>_j0</code> , <code>_j1</code> , <code>_jn</code>	Computes the Bessel function
<code>ldexp</code> , <code>ldexpf</code> , <code>ldexpl</code>	Computes $x \cdot 2^n$
<code>lgamma</code> , <code>lgammaf</code> , <code>lgammal</code>	Computes the natural logarithm of the absolute value of the gamma function
<code>llrint</code> , <code>llrintf</code> , <code>llrintl</code>	Rounds a floating-point value to the nearest <code>long long</code> value
<code>llround</code> , <code>llroundf</code> , <code>llroundl</code>	Rounds a floating-point value to the nearest <code>long long</code> value
<code>log</code> , <code>logf</code> , <code>logl</code> , <code>log10</code> , <code>log10f</code> , <code>log10l</code>	Computes the natural or base-10 logarithm
<code>log1p</code> , <code>log1pf</code> , <code>log1pl</code>	Computes the natural logarithm of $1+x$
<code>log2</code> , <code>log2f</code> , <code>log2l</code>	Computes the base-2 logarithm
<code>logb</code> , <code>logbf</code> , <code>logbl</code> , <code>_logb</code> , <code>_logbf</code>	Returns the exponent of a floating-point value
<code>lrint</code> , <code>lrintf</code> , <code>lrintl</code>	Rounds a floating-point value to the nearest <code>long</code> value
<code>_lrotl</code> , <code>_lrotr</code>	Rotates an integer value left or right

ROUTINE	USE
<code>lround</code> , <code>lroundf</code> , <code>lroundl</code>	Rounds a floating-point value to the nearest <code>long</code> value
<code>_matherr</code>	The default math error handler
<code>__max</code>	Macro that returns the larger of two values
<code>__min</code>	Macro that returns the smaller of two values
<code>modf</code> , <code>modff</code> , <code>modfl</code>	Splits a floating-point value into fractional and integer parts
<code>nan</code> , <code>nanf</code> , <code>nanl</code>	Returns a quiet NaN value
<code>nearbyint</code> , <code>nearbyintf</code> , <code>nearbyintl</code>	Returns the rounded value
<code>nextafter</code> , <code>nextafterf</code> , <code>nextafterl</code> , <code>_nextafter</code> , <code>_nextafterf</code>	Returns the next representable floating-point value
<code>nexttoward</code> , <code>nexttowardf</code> , <code>nexttowardl</code>	Returns the next representable floating-point value
<code>pow</code> , <code>powf</code> , <code>powl</code>	Returns the value of x^y
<code>remainder</code> , <code>remainderf</code> , <code>remainderl</code>	Computes the remainder of the quotient of two floating-point values
<code>remquo</code> , <code>remquof</code> , <code>remquol</code>	Computes the remainder of two integer values
<code>rint</code> , <code>rintf</code> , <code>rintl</code>	Rounds a floating-point value
<code>_rotl</code> , <code>_rotl64</code> , <code>_rotr</code> , <code>_rotr64</code>	Rotates bits in integer types
<code>round</code> , <code>roundf</code> , <code>roundl</code>	Rounds a floating-point value
<code>_scalb</code> , <code>_scalbf</code>	Scales argument by a power of 2
<code>scalbn</code> , <code>scalbnf</code> , <code>scalbnl</code> , <code>scalbln</code> , <code>scalblnf</code> , <code>scalblnl</code>	Multiplies a floating-point number by an integral power of <code>FLOAT_RADIX</code>
<code>_set_controlfp</code>	Sets the floating-point control word
<code>_set_SSE2_enable</code>	Enables or disables SSE2 instructions
<code>signbit</code>	Tests the sign bit of a floating-point value
<code>sin</code> , <code>sinf</code> , <code>sinl</code>	Computes the sine
<code>sinh</code> , <code>sinhf</code> , <code>sinhl</code>	Computes the hyperbolic sine
<code>sqrt</code> , <code>sqrtf</code> , <code>sqrtl</code>	Computes the square root

ROUTINE	USE
<code>_status87</code> , <code>_statusfp</code> , <code>_statusfp2</code>	Gets the floating-point status word
<code>strtof</code> , <code>_strtof_1</code>	Converts a string to a <code>float</code>
<code>strtold</code> , <code>_strtold_1</code>	Converts a string to a <code>long double</code>
<code>tan</code> , <code>tanf</code> , <code>tanl</code>	Computes the tangent
<code>tanh</code> , <code>tanhf</code> , <code>tanhl</code>	Computes the hyperbolic tangent
<code>tgamma</code> , <code>tgammaf</code> , <code>tgammal</code>	Computes the gamma function
<code>trunc</code> , <code>truncf</code> , <code>truncl</code>	Truncates the fractional part
<code>_wtof</code> , <code>_wtof_1</code>	Converts a wide string to a <code>double</code>
<code>_y0</code> , <code>_y1</code> , <code>_yn</code>	Computes the Bessel function

See also

[Universal C runtime routines by category](#)

[Floating-point primitives](#)

Input and output

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The I/O functions read and write data to and from files and devices. File I/O operations take place in text mode or binary mode. The Microsoft run-time library has three types of I/O functions:

- [Stream I/O](#) functions treat data as a stream of individual characters.
- [Low-level I/O](#) functions invoke the operating system directly for lower-level operation than that provided by stream I/O.
- [Console and port I/O](#) functions read or write directly to a console (keyboard and screen) or an I/O port (such as a printer port).

NOTE

Because stream functions are buffered and low-level functions are not, these two types of functions are generally incompatible. For processing a particular file, use either stream or low-level functions exclusively.

See also

[Universal C runtime routines by category](#)

Text and binary mode file I/O

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File I/O operations take place in one of two translation modes, *text* or *binary*, depending on the mode in which the file is opened. Data files are often processed in text mode. To control the file translation mode, one can:

- Retain the current default setting and specify the alternative mode only when you open selected files.
- Use the function `_set_fmode` to change the default mode for newly opened files. Use `_get_fmode` to find the current default mode. The initial default setting is text mode (`_O_TEXT`).
- Change the default translation mode directly by setting the global variable `_fmode` in your program. The function `_set_fmode` sets the value of this variable, but it can also be set directly.

When you call a file-open function such as `_open`, `fopen`, `fopen_s`, `freopen`, `freopen_s`, `_fsopen` or `_sopen_s`, you can override the current default setting of `_fmode` by specifying the appropriate argument to the function `_set_fmode`. The `stdin`, `stdout`, and `stderr` streams always open in text mode by default; you can also override this default when opening any of these files. Use `_setmode` to change the translation mode using the file descriptor after the file is open.

See also

[Input and output](#)

[Universal C runtime routines by category](#)

Unicode stream I/O in text and binary modes

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When a Unicode stream I/O routine (such as `fwprintf`, `fwscanf`, `fgetwc`, `fputwc`, `fgetws`, or `fputws`) operates on a file that is open in text mode (the default), two kinds of character conversions take place:

- Unicode-to-MBCS or MBCS-to-Unicode conversion. When a Unicode stream-I/O function operates in text mode, the source or destination stream is assumed to be a sequence of multibyte characters. Therefore, the Unicode stream-input functions convert multibyte characters to wide characters (as if by a call to the `mbtowc` function). For the same reason, the Unicode stream-output functions convert wide characters to multibyte characters (as if by a call to the `wctomb` function).
- Carriage return-line feed (CR-LF) translation. This translation occurs before the MBCS - Unicode conversion (for Unicode stream input functions) and after the Unicode - MBCS conversion (for Unicode stream output functions). During input, each carriage return-line feed combination is translated into a single line feed character. During output, each line feed character is translated into a carriage return-line feed combination.

However, when a Unicode stream-I/O function operates in binary mode, the file is assumed to be Unicode, and no CR-LF translation or character conversion occurs during input or output. Use the

`_setmode(_fileno(stdin), _O_BINARY);` instruction in order to correctly use `wcin` on a UNICODE text file.

See also

[Universal C runtime routines by category](#)

[Input and output](#)

Stream I/O

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These functions process data in different sizes and formats, from single characters to large data structures. They also provide buffering, which can improve performance. The default size of a stream buffer is 4K. These routines affect only buffers created by the run-time library routines, and have no effect on buffers created by the operating system.

Stream I/O routines

ROUTINE	USE
<code>clearerr</code> , <code>clearerr_s</code>	Clear error indicator for stream
<code>fclose</code>	Close stream
<code>_fcloseall</code>	Close all open streams except <code>stdin</code> , <code>stdout</code> , and <code>stderr</code>
<code>_fdopen</code> , <code>wfdopen</code>	Associate stream with file descriptor of open file
<code>feof</code>	Test for end of file on stream
<code>ferror</code>	Test for error on stream
<code>fflush</code>	Flush stream to buffer or storage device
<code>fgetc</code> , <code>fgetwc</code>	Read character from stream (function versions of <code>getc</code> and <code>getwc</code>)
<code>_fgetchar</code> , <code>_fgetwchar</code>	Read character from <code>stdin</code> (function versions of <code>getchar</code> and <code>getwchar</code>)
<code>fgetpos</code>	Get position indicator of stream
<code>fgets</code> , <code>fgetws</code>	Read string from stream
<code>_fileno</code>	Get file descriptor associated with stream
<code>_flushall</code>	Flush all streams to buffer or storage device
<code>fopen</code> , <code>_wfopen</code> , <code>fopen_s</code> , <code>_wfopen_s</code>	Open stream
<code>fprintf</code> , <code>_fprintf_l</code> , <code>fwprintf</code> , <code>_fwprintf_l</code> , <code>fprintf_s</code> , <code>_fprintf_s_l</code> , <code>fwprintf_s</code> , <code>_fwprintf_s_l</code>	Write formatted data to stream

ROUTINE	USE
<code>fputc</code> , <code>fputwc</code>	Write a character to a stream (function versions of <code>putc</code> and <code>putwc</code>)
<code>_fputchar</code> , <code>_fputwchar</code>	Write character to <code>stdout</code> (function versions of <code>putchar</code> and <code>putwchar</code>)
<code>fputs</code> , <code>fputws</code>	Write string to stream
<code>fread</code>	Read unformatted data from stream
<code>freopen</code> , <code>_wfreopen</code> , <code>freopen_s</code> , <code>_wfreopen_s</code>	Reassign <code>FILE</code> stream pointer to new file or device
<code>fscanf</code> , <code>fwscanf</code> , <code>fscanf_s</code> , <code>_fscanf_s_1</code> , <code>fwscanf_s</code> , <code>_fwscanf_s_1</code>	Read formatted data from stream
<code>fseek</code> , <code>_fseeki64</code>	Move file position to given location
<code>fsetpos</code>	Set position indicator of stream
<code>_fopen</code> , <code>_wfopen</code>	Open stream with file sharing
<code>ftell</code> , <code>_ftelli64</code>	Get current file position
<code>fwrite</code>	Write unformatted data items to stream
<code>getc</code> , <code>getwc</code>	Read character from stream (macro versions of <code>fgetc</code> and <code>fgetwc</code>)
<code>getchar</code> , <code>getwchar</code>	Read character from <code>stdin</code> (macro versions of <code>fgetchar</code> and <code>fgetwchar</code>)
<code>_getmaxstdio</code>	Returns the number of simultaneously open files permitted at the stream I/O level.
<code>gets_s</code> , <code>_getws_s</code>	Read line from <code>stdin</code>
<code>_getw</code>	Read binary <code>int</code> from stream
<code>printf</code> , <code>_printf_l</code> , <code>wprintf</code> , <code>_wprintf_l</code> , <code>printf_s</code> , <code>_printf_s_l</code> , <code>wprintf_s</code> , <code>_wprintf_s_l</code>	Write formatted data to <code>stdout</code>
<code>putc</code> , <code>putwc</code>	Write character to a stream (macro versions of <code>fputc</code> and <code>fputwc</code>)
<code>putchar</code> , <code>putwchar</code>	Write character to <code>stdout</code> (macro versions of <code>fputchar</code> and <code>fputwchar</code>)
<code>puts</code> , <code>_putws</code>	Write line to stream

ROUTINE	USE
<code>_putw</code>	Write binary <code>int</code> to stream
<code>rewind</code>	Move file position to beginning of stream
<code>_rmtmp</code>	Remove temporary files created by <code>tmpfile</code>
<code>scanf</code> , <code>_scanf_l</code> , <code>wscanf</code> , <code>_wscanf_l</code> , <code>scanf_s</code> , <code>_scanf_s_l</code> , <code>wscanf_s</code> , <code>_wscanf_s_l</code>	Read formatted data from <code>stdin</code>
<code>setbuf</code>	Control stream buffering
<code>_setmaxstdio</code>	Set a maximum for the number of simultaneously open files at the stream I/O level.
<code>setvbuf</code>	Control stream buffering and buffer size
<code>_snprintf</code> , <code>_snwprintf</code> , <code>_snprintf_s</code> , <code>_snprintf_s_l</code> , , <code>_snwprintf_s</code> , <code>_snwprintf_s_l</code>	Write formatted data of specified length to string
<code>_snscanf</code> , <code>_snwscanf</code> , <code>_snscanf_s</code> , <code>_snscanf_s_l</code> , , <code>_snwscanf_s</code> , <code>_snwscanf_s_l</code>	Read formatted data of a specified length from the standard input stream.
<code>sprintf</code> , <code>swprintf</code> , <code>sprintf_s</code> , <code>_sprintf_s_l</code> , , <code>swprintf_s</code> , <code>_swprintf_s_l</code>	Write formatted data to string
<code>sscanf</code> , <code>swscanf</code> , <code>sscanf_s</code> , <code>_sscanf_s_l</code> , <code>swscanf_s</code> , , <code>_swscanf_s_l</code>	Read formatted data from string
<code>_tempnam</code> , <code>_wtempnam</code>	Generate temporary filename in given directory
<code>tmpfile</code> , <code>tmpfile_s</code>	Create temporary file
<code>tmpnam</code> , <code>_wtmpnam</code> , <code>tmpnam_s</code> , <code>_wtmpnam_s</code>	Generate temporary filename
<code>ungetc</code> , <code>ungetwc</code>	Push character back onto stream
<code>_vcprintf</code> , <code>_vcwprintf</code> , <code>_vcprintf_s</code> , <code>_vcprintf_s_l</code> , , <code>_vcwprintf_s</code> , <code>_vcwprintf_s_l</code>	Write formatted data to the console.
<code>vfprintf</code> , <code>vfwprintf</code> , <code>vfprintf_s</code> , <code>_vfprintf_s_l</code> , , <code>vfwprintf_s</code> , <code>_vfwprintf_s_l</code>	Write formatted data to stream
<code>vprintf</code> , <code>vwprintf</code> , <code>vprintf_s</code> , <code>_vprintf_s_l</code> , , <code>vwprintf_s</code> , <code>_vwprintf_s_l</code>	Write formatted data to <code>stdout</code>
<code>_vsnprintf</code> , <code>_vsnwprintf</code> , <code>vsnprintf_s</code> , , <code>_vsnprintf_s</code> , <code>_vsnprintf_s_l</code> , <code>_vsnwprintf_s</code> , , <code>_vsnwprintf_s_l</code>	Write formatted data of specified length to buffer

ROUTINE	USE
<code>vsprintf</code> , <code>vswprintf</code> , <code>vsprintf_s</code> , <code>_vsprintf_s_l</code> , <code>vswprintf_s</code> , <code>_vswprintf_s_l</code>	Write formatted data to buffer

When a program begins execution, the startup code automatically opens several streams: standard input (pointed to by `stdin`), standard output (pointed to by `stdout`), and standard error (pointed to by `stderr`). These streams are directed to the console (keyboard and screen) by default. Use `freopen` to redirect `stdin`, `stdout`, or `stderr` to a disk file or a device.

Files opened using the stream routines are buffered by default. The `stdout` and `stderr` functions are flushed whenever they're full or, if you're writing to a character device, after each library call. If a program terminates abnormally, output buffers may not be flushed, resulting in loss of data. Use `fflush` or `_flushall` to ensure that the buffer associated with a specified file is flushed to the operating system, or all open buffers are flushed. The operating system can cache data before writing it to disk. The commit-to-disk feature ensures that the flushed buffer contents aren't lost if there's a system failure.

There are two ways to commit buffer contents to disk:

- Link with the file COMMODE.OBJ to set a global commit flag. The default setting of the global flag is `n`, for "no-commit."
- Set the mode flag to `c` with `fopen` or `_fdopen`.

Any file specifically opened with either the `c` or the `n` flag behaves according to the flag, regardless of the state of the global commit/no-commit flag.

If your program doesn't explicitly close a stream, the stream is automatically closed when the program terminates. However, you should close a stream when your program finishes with it, as the number of streams that can be open at one time is limited. See `setmaxstdio` for information on this limit.

Input can follow output directly only with an intervening call to `fflush` or to a file-positioning function (`fseek`, `fsetpos`, or `rewind`). Input can be followed by output without an intervening call to a file-positioning function, if the input operation encounters the end of the file.

See also

[Input and output](#)

[Universal C runtime routines by category](#)

Low-level I/O

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These functions invoke the operating system directly for lower-level operation than that provided by stream I/O. Low-level input and output calls don't buffer or format data.

Low-level routines can access the standard streams opened at program startup using the following predefined file descriptors.

STREAM	FILE DESCRIPTOR
<code>stdin</code>	0
<code>stdout</code>	1
<code>stderr</code>	2

Low-level I/O routines set the `errno` global variable when an error occurs. You must include `STDIO.H` when you use low-level functions only if your program requires a constant that is defined in `STDIO.H`, such as the end-of-file indicator (`EOF`).

Low-level I/O functions

FUNCTION	USE
<code>_close</code>	Close file
<code>_commit</code>	Flush file to disk
<code>_creat</code> , <code>_wcreat</code>	Create file
<code>_dup</code>	Return next available file descriptor for given file
<code>_dup2</code>	Create second descriptor for given file
<code>_eof</code>	Test for end of file
<code>_lseek</code> , <code>_lseeki64</code>	Reposition file pointer to given location
<code>_open</code> , <code>_wopen</code>	Open file
<code>_read</code>	Read data from file
<code>_sopen</code> , <code>_wsopen</code> , <code>_sopen_s</code> , <code>_wsopen_s</code>	Open file for file sharing
<code>_tell</code> , <code>_telli64</code>	Get current file-pointer position
<code>_umask</code> , <code>_umask_s</code>	Set file-permission mask

FUNCTION	USE
<code>_write</code>	Write data to file

`_dup` and `_dup2` are typically used to associate the predefined file descriptors with different files.

See also

[Input and output](#)

[Universal C runtime routines by category](#)

[System calls](#)

Console and port I/O

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These routines read and write on your console or on the specified port. The console I/O routines aren't compatible with stream I/O or low-level I/O library routines. The console or port doesn't have to be opened or closed before I/O is performed, so there are no open or close routines in this category. In the Windows operating systems, the output from these functions is always directed to the console and can't be redirected.

Console and port I/O routines

ROUTINE	USE
<code>_cgets</code> , <code>_cgetws</code> , <code>_cgets_s</code> , <code>_cgetws_s</code>	Read string from console
<code>_cprintf</code> , <code>_cwprintf</code> , <code>_cprintf_s</code> , <code>_cprintf_s_l</code> , <code>_cwprintf_s</code> , <code>_cwprintf_s_l</code>	Write formatted data to console
<code>_cputs</code>	Write string to console
<code>_cscanf</code> , <code>_cwscanf</code> , <code>_cscanf_s</code> , <code>_cscanf_s_l</code> , <code>_cwscanf_s</code> , <code>_cwscanf_s_l</code>	Read formatted data from console
<code>_getch</code> , <code>_getwch</code>	Read character from console
<code>_getche</code> , <code>_getwche</code>	Read character from console and echo it
<code>_inp</code>	Read a byte from the specified I/O port
<code>_inpdd</code>	Read double word from specified I/O port
<code>_inpww</code>	Read 2-byte word from specified I/O port
<code>_kbhit</code>	Check for keystroke at console; use before attempting to read from console
<code>_outp</code>	Write a byte to the specified I/O port
<code>_outpdd</code>	Write double word to specified I/O port
<code>_outpww</code>	Write word to specified I/O port
<code>_putch</code> , <code>_putwch</code>	Write character to console
<code>_ungetch</code> , <code>_ungetwch</code>	"Unget" last character read from console so it becomes next character read

See also

[Input and output](#)

[Universal C runtime routines by category](#)

`_nolock` functions

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The `_nolock` functions are versions of I/O functions that don't perform any locking. They're provided for users requiring maximum performance. For more information, see [Multithreaded libraries performance](#).

Use `_nolock` functions only if your program is truly single-threaded or if it does its own locking.

No lock routines

[`_fclose_nolock`](#)

[`_fflush_nolock`](#)

[`_fgetc_nolock`](#), [`_fgetwc_nolock`](#)

[`_fread_nolock`](#)

[`_fseek_nolock`](#), [`_fseeki64_nolock`](#)

[`_ftell_nolock`](#), [`_ftelli64_nolock`](#)

[`_fwrite_nolock`](#)

[`_getc_nolock`](#), [`_getwc_nolock`](#)

[`_getch_nolock`](#), [`_getwch_nolock`](#)

[`_getchar_nolock`](#), [`_getwchar_nolock`](#)

[`_getche_nolock`](#), [`_getwche_nolock`](#)

[`_getdcwd_nolock`](#), [`_wgetdcwd_nolock`](#)

[`_putc_nolock`](#), [`_putwc_nolock`](#)

[`_putch_nolock`](#), [`_putwch_nolock`](#)

[`_putchar_nolock`](#), [`_putwchar_nolock`](#)

[`_ungetc_nolock`](#), [`_ungetwc_nolock`](#)

[`_ungetch_nolock`](#), [`_ungetwch_nolock`](#)

See also

[Input and output](#)

[Universal C runtime routines by category](#)

Internationalization

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The Microsoft runtime library provides many routines that you can use to customize your app for international markets such as:

- [locale-related routines](#)
- wide-character routines
- multibyte-character routines
- generic-text routines

For convenience, most locale-related routines are also categorized by what they do.

Multibyte routines and wide-character routines are described alongside their single-byte-character counterparts, when they exist.

ISO646 operator alternatives are also included.

See also

[Universal C runtime routines by category](#)

Locale

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Locale refers to country/region and language settings that you can use to customize your program. Some locale-dependent categories include the display formats for dates and monetary values. For more information, see [Locale categories](#).

Use the `setlocale` function to change or query some or all of the current program or thread locale information while using functions without the `_1` suffix. The functions with the `_1` suffix will use the locale parameter passed in for their locale information during the execution of that specific function only. To create a locale for use with a function with a `_1` suffix, use `_create_locale`. To free this locale, use `_free_locale`. To get the current locale, use `_get_current_locale`.

Use `_configthreadlocale` to control whether each thread has its own locale, or all threads in a program share the same locale. For more information, see [Locales and code pages](#).

More secure versions of the functions in the following table are available, indicated by the `_s` ("secure") suffix. For more information, see [Security features in the CRT](#).

Locale-dependent routines

ROUTINE	USE	SETLOCALE CATEGORY SETTING DEPENDENCE
<code>atof</code> , <code>_atof_1</code> , <code>_wtof</code> , <code>_wtof_1</code>	Convert character to floating-point value	<code>LC_NUMERIC</code>
<code>atoi</code> , <code>_atoi_1</code> , <code>_wtoi</code> , <code>_wtoi_1</code>	Convert character to integer value	<code>LC_NUMERIC</code>
<code>_atoi64</code> , <code>_atoi64_1</code> , <code>_wtoi64</code> , <code>_wtoi64_1</code>	Convert character to 64-bit integer value	<code>LC_NUMERIC</code>
<code>atol</code> , <code>_atol_1</code> , <code>_wtol</code> , <code>_wtol_1</code>	Convert character to long value	<code>LC_NUMERIC</code>
<code>_atodbl</code> , <code>_atodbl_1</code> , <code>_atoldbl</code> , <code>_atoldbl_1</code> , <code>_atoflt</code> , <code>_atoflt_1</code>	Convert character to double-long value	<code>LC_NUMERIC</code>
<code>is</code> , <code>isw</code> routines	Test given integer for particular condition.	<code>LC_CTYPE</code>
<code>isleadbyte</code> , <code>_isleadbyte_1</code>	Test for lead byte	<code>LC_CTYPE</code>
<code>localeconv</code>	Read appropriate values for formatting numeric quantities	<code>LC_MONETARY, LC_NUMERIC</code>
<code>MB_CUR_MAX</code>	Maximum length in bytes of any multibyte character in current locale (macro defined in <code>STDLIB.H</code>)	<code>LC_CTYPE</code>

ROUTINE	USE	SETLOCALE CATEGORY SETTING DEPENDENCE
<code>_mbccpy</code> , <code>_mbccpy_1</code> , <code>_mbccpy_s</code> , <code>_mbccpy_s_1</code>	Copy one multibyte character	<code>LC_CTYPE</code>
<code>_mbclen</code> , <code>mblen</code> , <code>_mblen_1</code>	Validate and return number of bytes in multibyte character	<code>LC_CTYPE</code>
<code>strlen</code> , <code>wcslen</code> , <code>_mbslen</code> , <code>_mbslen_1</code> , <code>_mbstrlen</code> , <code>_mbstrlen_1</code>	For multibyte-character strings: validate each character in string; return string length	<code>LC_CTYPE</code>
<code>mbstowcs</code> , <code>_mbstowcs_1</code> , <code>mbstowcs_s</code> , <code>_mbstowcs_s_1</code>	Convert sequence of multibyte characters to corresponding sequence of wide characters	<code>LC_CTYPE</code>
<code>mbtowc</code> , <code>_mbtowc_1</code>	Convert multibyte character to corresponding wide character	<code>LC_CTYPE</code>
<code>printf</code> functions	Write formatted output	<code>LC_NUMERIC</code> (determines radix character output)
<code>scanf</code> functions	Read formatted input	<code>LC_NUMERIC</code> (determines radix character recognition)
<code>setlocale</code> , <code>_wsetlocale</code>	Select locale for program	Not applicable
<code>strcoll</code> , <code>wcscoll</code> , <code>_mbscoll</code> , <code>_strcoll_1</code> , <code>_wcscoll_1</code> , <code>_mbscoll_1</code>	Compare characters of two strings	<code>LC_COLLATE</code>
<code>_stricmp</code> , <code>_wcsicmp</code> , <code>_mbsicmp</code> , <code>_stricmp_1</code> , <code>_wcsicmp_1</code> , <code>_mbsicmp_1</code>	Compare two strings without regard to case	<code>LC_CTYPE</code>
<code>_stricoll</code> , <code>_wcsicoll</code> , <code>_mbsicoll</code> , <code>_stricoll_1</code> , <code>_wcsicoll_1</code> , <code>_mbsicoll_1</code>	Compare characters of two strings (case insensitive)	<code>LC_COLLATE</code>
<code>_strncoll</code> , <code>_wcsncoll</code> , <code>_mbsncoll</code> , <code>_strncoll_1</code> , <code>_wcsncoll_1</code> , <code>_mbsncoll_1</code>	Compare first <code>n</code> characters of two strings	<code>LC_COLLATE</code>
<code>_strnicmp</code> , <code>_wcsnicmp</code> , <code>_mbsnicmp</code> , <code>_strnicmp_1</code> , <code>_wcsnicmp_1</code> , <code>_mbsnicmp_1</code>	Compare characters of two strings without regard to case.	<code>LC_CTYPE</code>
<code>_strnicoll</code> , <code>_wcsnicoll</code> , <code>_mbsnicoll</code> , <code>_strnicoll_1</code> , <code>_wcsnicoll_1</code> , <code>_mbsnicoll_1</code>	Compare first <code>n</code> characters of two strings (case insensitive)	<code>LC_COLLATE</code>
<code>strftime</code> , <code>wcsftime</code> , <code>_strftime_1</code> , <code>_wcsftime_1</code>	Format date and time value according to supplied <code>format</code> argument	<code>LC_TIME</code>

ROUTINE	USE	SETLOCALE CATEGORY SETTING DEPENDENCE
<code>_strlwr</code> , <code>_wcslwr</code> , <code>_mbslwr</code> , <code>_strlwr_l</code> , <code>_wcslwr_l</code> , <code>_mbslwr_l</code> , <code>_strlwr_s</code> , <code>_strlwr_s_l</code> , <code>_mbslwr_s</code> , <code>_mbslwr_s_l</code> , <code>_wcslwr_s</code> , <code>_wcslwr_s_l</code>	Convert, in place, each uppercase letter in given string to lowercase	<code>LC_CTYPE</code>
<code>strtod</code> , <code>_strtod_l</code> , <code>wcstod</code> , <code>_wcstod_l</code>	Convert character string to <code>double</code> value	<code>LC_NUMERIC</code> (determines radix character recognition)
<code>strtol</code> , <code>wcstol</code> , <code>_strtol_l</code> , <code>_wcstol_l</code>	Convert character string to <code>long</code> value	<code>LC_NUMERIC</code> (determines radix character recognition)
<code>strtoul</code> , <code>_strtoul_l</code> , <code>wcstoul</code> , <code>_wcstoul_l</code>	Convert character string to unsigned long value	<code>LC_NUMERIC</code> (determines radix character recognition)
<code>_strupr</code> , <code>_strupr_l</code> , <code>_mbsupr</code> , <code>_mbsupr_l</code> , <code>_wcsupr_l</code> , <code>_wcsupr</code> , <code>_strupr_s</code> , <code>_strupr_s_l</code> , <code>_mbsupr_s</code> , <code>_mbsupr_s_l</code> , <code>_wcsupr_s</code> , <code>_wcsupr_s_l</code>	Convert, in place, each lowercase letter in string to uppercase	<code>LC_CTYPE</code>
<code>strxfrm</code> , <code>wcsxfrm</code> , <code>_strxfrm_l</code> , <code>_wcsxfrm_l</code>	Transform string into collated form according to locale	<code>LC_COLLATE</code>
<code>tolower</code> , <code>_tolower</code> , <code>towlower</code> , <code>_tolower_l</code> , <code>_towlower_l</code> , <code>_mbctolower</code> , <code>_mbctolower_l</code> , <code>_mbctoupper</code> , <code>_mbctoupper_l</code>	Convert given character to corresponding lowercase character	<code>LC_CTYPE</code>
<code>toupper</code> , <code>_toupper</code> , <code> towupper</code> , <code>_toupper_l</code> , <code>_towupper_l</code> , <code>_mbctolower</code> , <code>_mbctolower_l</code> , <code>_mbctoupper</code> , <code>_mbctoupper_l</code>	Convert given character to corresponding uppercase letter	<code>LC_CTYPE</code>
<code>wcstombs</code> , <code>_wcstombs_l</code> , <code>wcstombs_s</code> , <code>_wcstombs_s_l</code>	Convert sequence of wide characters to corresponding sequence of multibyte characters	<code>LC_CTYPE</code>
<code>wctomb</code> , <code>_wctomb_l</code> , <code>wctomb_s</code> , <code>_wctomb_s_l</code>	Convert wide character to corresponding multibyte character	<code>LC_CTYPE</code>

NOTE

For multibyte routines, the multibyte code page must be equivalent to the locale set with `setlocale`. `_setmbcp`, with an argument of `_MB_CP_LOCALE` makes the multibyte code page the same as the `setlocale` code page.

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

Code pages

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A *code page* is a character set, which can include numbers, punctuation marks, and other glyphs. Different languages and locales may use different code pages. For example, ANSI code page 1252 is used for English and most European languages; OEM code page 932 is used for Japanese Kanji.

A code page can be represented in a table as a mapping of characters to single-byte or multibyte values. Many code pages share the ASCII character set for characters in the range 0x00 - 0x7F.

The Microsoft runtime library uses the following types of code pages:

- System-default ANSI code page. By default, at startup, the runtime system automatically sets the multibyte code page to the system-default ANSI code page, which is obtained from the operating system.

The call:

```
setlocale ( LC_ALL, "" );
```

also sets the locale to the system-default ANSI code page.

- Locale code page. The behavior of several run-time routines is dependent on the current locale setting, which includes the locale code page. (For more information, see [Locale](#).) By default, all locale-dependent routines in the Microsoft run-time library use the code page that corresponds to the "C" locale. At run time, you can change or query the locale code page in use with a call to [`setlocale`](#).
- Multibyte code page. The behavior of most of the multibyte-character routines in the run-time library depends on the current multibyte code page setting. By default, these routines use the system-default ANSI code page. At run-time you can query and change the multibyte code page with [`_getmbcp`](#) and [`_setmbcp`](#), respectively.
- The "C" locale is defined by ANSI to correspond to the locale in which C programs have traditionally executed. The code page for the "C" locale ("C" code page) corresponds to the ASCII character set. For example, in the "C" locale, [`islower`](#) returns true for the values 0x61 - 0x7A only. In another locale, [`islower`](#) may return [`true`](#) for these and other values, as defined by that locale.

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

Interpretation of multibyte-character sequences

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Most multibyte-character routines in the Microsoft run-time library recognize multibyte-character sequences relating to a multibyte code page. The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior. The versions with the `_1` suffix are identical, except they use the locale parameter instead of the current locale.

Locale-dependent multibyte routines

ROUTINE	USE
<code>_mbclen</code> , <code>mblen</code> , <code>_mblen_1</code>	Validate and return number of bytes in multibyte character
<code>strlen</code> , <code>wcslen</code> , <code>_mbslen</code> , <code>_mbslen_1</code> , <code>_mbstrlen</code> , <code>_mbstrlen_1</code>	For multibyte character strings: validate each character in string; return string length. For wide character strings: return string length.
<code>mbstowcs</code> , <code>_mbstowcs_1</code> , <code>mbstowcs_s</code> , <code>_mbstowcs_s_1</code>	Convert sequence of multibyte characters to corresponding sequence of wide characters
<code>mbtowc</code> , <code>_mbtowc_1</code>	Convert multibyte character to corresponding wide character
<code>wcstombs</code> , <code>_wcstombs_1</code> , <code>wcstombs_s</code> , <code>_wcstombs_s_1</code>	Convert sequence of wide characters to corresponding sequence of multibyte characters
<code>wctomb</code> , <code>_wctomb_1</code> , <code>wctomb_s</code> , <code>_wctomb_s_1</code>	Convert wide character to corresponding multibyte character

Locale-independent multibyte routines

ROUTINE	USE
<code>mbrtoc16</code> , <code>mbrtoc32</code>	Convert multibyte UTF-8 character to equivalent UTF-16 or UTF-32 character
<code>c16rtomb</code> , <code>c32rtomb</code>	Convert UTF-16 or UTF-32 character to equivalent UTF-8 multibyte character

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

ISO646 operators

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Provides readable alternatives to certain operators or punctuators. The standard header <iso646.h> is available even in a freestanding implementation.

Macros

NAME	DESCRIPTION
<code>and</code>	An alternative to the <code>&&</code> operator.
<code>and_eq</code>	An alternative to the <code>&=</code> operator.
<code>bitand</code>	An alternative to the <code>&</code> operator.
<code>bitor</code>	An alternative to the <code> </code> operator.
<code>compl</code>	An alternative to the <code>~</code> operator.
<code>not</code>	An alternative to the <code>!</code> operator.
<code>not_eq</code>	An alternative to the <code>!=</code> operator.
<code>or</code>	An alternative to the <code> </code> operator.
<code>or_eq</code>	An alternative to the <code> =</code> operator.
<code>xor</code>	An alternative to the <code>^</code> operator.
<code>xor_eq</code>	An alternative to the <code>^=</code> operator.

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

Single-byte and multibyte character sets

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The ASCII character set defines characters in the range 0x00 - 0x7F. There are many other character sets, primarily European, that define the characters within the range 0x00 - 0x7F identically to the ASCII character set and also define an extended character set from 0x80 - 0xFF. An 8-bit, single-byte-character set (SBCS) is sufficient to represent the ASCII character set and the character sets for many European languages. However, some non-European character sets, such as Japanese Kanji, include many more characters than can be represented in a single-byte coding scheme, and so require multibyte-character set (MBCS) encoding.

NOTE

Many Microsoft run-time library SBCS routines handle multibyte bytes, characters, and strings as appropriate. Many multibyte-character sets define the ASCII character set as a subset. In many multibyte character sets, each character in the range 0x00 - 0x7F is identical to the character that has the same value in the ASCII character set. For example, in both ASCII and MBCS character strings, the one-byte null character ('\0') has value 0x00 and indicates the terminating null character.

A multibyte character set can consist of both 1-byte and 2-byte characters. A multibyte-character string can contain a mixture of single-byte and double-byte characters. A two-byte multibyte character has a lead byte and a trail byte. In a particular multibyte-character set, the lead bytes fall within a certain range, as do the trail bytes. When these ranges overlap, you may need to evaluate the context to determine whether a given byte is functioning as a lead byte or a trail byte.

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

SBCS and MBCS data types

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Any Microsoft MBCS run-time library routine that handles only a single multibyte character, or a single byte of a multibyte character, expects an `unsigned int` argument (where `0x0000 <= character value <= 0xFFFF` and `0x00 <= byte value <= 0xFF`). An MBCS routine that handles multibyte bytes or characters in a string context expects a multibyte-character string to be represented as an `unsigned char` pointer.

Caution

Each byte of a multibyte character can be represented in an 8-bit `char`. However, an SBCS or MBCS single-byte character of type `char` with a value greater than `0x7F` is negative. When such a character is converted directly to an `int` or a `long`, the result is sign-extended by the compiler and can therefore yield unexpected results.

It's best to represent a byte of a multibyte character as an 8-bit `unsigned char`. Or, to avoid a negative result, convert a single-byte character of type `char` to an `unsigned char` before converting it to an `int` or a `long`.

Because some SBCS string-handling functions take (signed) `char *` parameters, a type mismatch compiler warning will result when `_MBCS` is defined. There are three ways to avoid this warning, listed in order of efficiency:

1. Use the type-safe inline functions in TCHAR.H. This behavior is the default.
2. Use the direct macros in TCHAR.H by defining `_MB_MAP_DIRECT` on the command line. If you do, you must manually match types. This method is the fastest but isn't type-safe.
3. Use the type-safe statically linked library functions in TCHAR.H. To do so, define the constant `_NO_INLINING` on the command line. This method is the slowest, but the most type-safe.

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

Unicode: The wide-character set

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A wide character is a 2-byte multilingual character code. Any character in use in modern computing worldwide, including technical symbols and special publishing characters, can be represented according to the Unicode specification as a wide character. Developed and maintained by a large consortium that includes Microsoft, the Unicode standard is now widely accepted.

A wide character is of type `wchar_t`. A wide-character string is represented as a `wchar_t[]` array. You point to the array with a `wchar_t*` pointer.

You can represent any ASCII character as a wide character by prefixing the letter `L`. For example, `L'\0'` is the terminating wide (16-bit) null character.

You can represent any ASCII string literal as a wide-character string literal by prefixing the letter `L`. For example, `L"Hello"`.

Generally, wide characters use more space in memory than multibyte characters. But wide characters are faster to process. Only one locale can be represented at a time in multibyte encoding. All character sets in the world are represented simultaneously by the Unicode representation.

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

Using generic-text mappings

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Microsoft Specific

To simplify code development for various international markets, the Microsoft run-time library provides Microsoft-specific "generic-text" mappings for many data types, routines, and other objects. These mappings are defined in TCHAR.H. You can use these name mappings to write generic code that can be compiled for any of the three kinds of character sets: ASCII (SBCS), MBCS, or Unicode, depending on a manifest constant you define using a `#define` statement. Generic-text mappings are Microsoft extensions that aren't ANSI compatible.

Preprocessor directives for generic-text mappings

#DEFINE	COMPILED VERSION	EXAMPLE
<code>_UNICODE</code>	Unicode (wide-character)	<code>_tcsrev</code> maps to <code>_wcsrev</code>
<code>_MBCS</code>	Multibyte-character	<code>_tcsrev</code> maps to <code>_mbsrev</code>
None (the default: both <code>_UNICODE</code> and <code>_MBCS</code> not defined)	SBCS (ASCII)	<code>_tcsrev</code> maps to <code>strrev</code>

For example, the generic-text function `_tcsrev`, defined in TCHAR.H, maps to `mbsrev` if `MBCS` has been defined in your program, or to `wcsrev` if `_UNICODE` has been defined. Otherwise `_tcsrev` maps to `strrev`.

The generic-text data type `_TCHAR`, also defined in TCHAR.H, maps to type `char` if `_MBCS` is defined, to type `wchar_t` if `_UNICODE` is defined, and to type `char` if neither constant is defined. Other data type mappings are provided in TCHAR.H for programming convenience, but `_TCHAR` is the type that is most useful.

Generic-Text Data Type Mappings

GENERIC-TEXT DATA TYPE NAME	SBCS (_UNICODE, _MBCS NOT DEFINED)	_MBCS DEFINED	_UNICODE DEFINED
<code>_TCHAR</code>	<code>char</code>	<code>char</code>	<code>wchar_t</code>
<code>_TINT</code>	<code>int</code>	<code>int</code>	<code>wint_t</code>
<code>_TSCHAR</code>	<code>signed char</code>	<code>signed char</code>	<code>wchar_t</code>
<code>_T UCHAR</code>	<code>unsigned char</code>	<code>unsigned char</code>	<code>wchar_t</code>
<code>_TXCHAR</code>	<code>char</code>	<code>unsigned char</code>	<code>wchar_t</code>
<code>_T</code> or <code>_TEXT</code>	No effect (removed by preprocessor)	No effect (removed by preprocessor)	L (converts following character or string to its Unicode counterpart)

For a complete list of generic-text mappings of routines, variables, and other objects, see [Generic-text mappings](#).

The following code fragments illustrate the use of `_TCHAR` and `_tcsrev` for mapping to the MBCS, Unicode, and SBCS models.

```
_TCHAR *RetVal, *szString;  
RetVal = _tcsrev(szString);
```

If `_MBCS` has been defined, the preprocessor maps the preceding fragment to the following code:

```
char *RetVal, *szString;  
RetVal = _mbsrev(szString);
```

If `_UNICODE` has been defined, the preprocessor maps the same fragment to the following code:

```
wchar_t *RetVal, *szString;  
RetVal = _wcsrev(szString);
```

If both `_MBCS` and `_UNICODE` haven't been defined, the preprocessor maps the fragment to single-byte ASCII code, as follows:

```
char *RetVal, *szString;  
RetVal = strrev(szString);
```

These macros let you write, maintain, and compile a single source code file using routines specific to all three kinds of character sets.

END Microsoft Specific

See also

[Generic-text mappings](#)

[Data type mappings](#)

[Constant and global variable mappings](#)

[Routine mappings](#)

[A sample generic-text program](#)

A sample generic-text program

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Microsoft Specific

The following program, GENTEXT.C, provides a more detailed illustration of the use of generic-text mappings defined in TCHAR.H:

```
// GENTEXT.C
// use of generic-text mappings defined in TCHAR.H

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <direct.h>
#include <errno.h>
#include <tchar.h>

int __cdecl _tmain(int argc, _TCHAR **argv, _TCHAR **envp)
{
    _TCHAR buff[_MAX_PATH];
    _TCHAR *str = _T("Astring");
    char *amsg = "Reversed";
    wchar_t *wmsg = L"Is";

#ifndef _UNICODE
    printf("Unicode version\n");
#else /* _UNICODE */
#ifndef _MBCS
    printf("MBCS version\n");
#else
    printf("SBCS version\n");
#endif
#endif /* _UNICODE */

    if (_tgetcwd(buff, _MAX_PATH) == NULL)
        printf("Can't Get Current Directory - errno=%d\n", errno);
    else
        _tprintf(_T("Current Directory is '%s'\n"), buff);
    _tprintf(_T("%s %ls\n"), str, amsg, wmsg);
    _tprintf(_T("%s\n"), _tcsrev(_tcsdup(str)));
    return 0;
}
```

If `_MBCS` has been defined, GENTEXT.C maps to the following MBCS program:

```
// crt_mbcsgtxt.c

/*
 * Use of generic-text mappings defined in TCHAR.H
 * Generic-Text-Mapping example program
 * MBCS version of GENTEXT.C
 */

#include <stdio.h>
#include <stdlib.h>
#include <mbstring.h>
#include <direct.h>

int __cdecl main(int argc, char **argv, char **envp)
{
    char buff[_MAX_PATH];
    char *str = "Astring";
    char *amsg = "Reversed";
    wchar_t *wmsg = L"Is";

    printf("MBCS version\n");

    if (_getcwd(buff, _MAX_PATH) == NULL) {
        printf("Can't Get Current Directory - errno=%d\n", errno);
    }
    else {
        printf("Current Directory is '%s'\n", buff);
    }

    printf("%s' %hs %ls:\n", str, amsg, wmsg);
    printf("%s'\n", _mbsrev(_mbsdup((unsigned char*) str)));
    return 0;
}
```

If `_UNICODE` has been defined, GENTEXT.C maps to the following Unicode version of the program. For more information about using `wmain` in Unicode programs as a replacement for `main`, see [Using `wmain` in C Language Reference](#).

```

// crt_unicetxt.c

/*
 * Use of generic-text mappings defined in TCHAR.H
 * Generic-Text-Mapping example program
 * Unicode version of GENTEXT.C
 */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <direct.h>

int __cdecl wmain(int argc, wchar_t **argv, wchar_t **envp)
{
    wchar_t buff[_MAX_PATH];
    wchar_t *str = L"Astring";
    char *amsg = "Reversed";
    wchar_t *wmsg = L"Is";

    printf("Unicode version\n");

    if (_wgetcwd(buff, _MAX_PATH) == NULL) {
        printf("Can't Get Current Directory - errno=%d\n", errno);
    }
    else {
        wprintf(L"Current Directory is '%s'\n", buff);
    }

    wprintf(L"'%s' %hs %ls:\n", str, amsg, wmsg);
    wprintf(L"'%s'\n", wcsrev(wcsdup(str)));
    return 0;
}

```

If `_MBCS` or `_UNICODE` hasn't been defined, GENTEXT.C maps to single-byte ASCII code, as follows:

```
// crt_sbcsgtxt.c
/*
 * Use of generic-text mappings defined in TCHAR.H
 * Generic-Text-Mapping example program
 * Single-byte (SBCS) Ascii version of GENTEXT.C
 */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <direct.h>

int __cdecl main(int argc, char **argv, char **envp)
{
    char buff[_MAX_PATH];
    char *str = "Astring";
    char *amsg = "Reversed";
    wchar_t *wmsg = L"Is";

    printf("SBCS version\n");

    if (_getcwd(buff, _MAX_PATH) == NULL) {
        printf("Can't Get Current Directory - errno=%d\n", errno);
    }
    else {
        printf("Current Directory is '%s'\n", buff);
    }

    printf("'%s' %hs %ls:\n", str, amsg, wmsg);
    printf("%s\n", strrev(strdup(str)));
    return 0;
}
```

END Microsoft Specific

See also

[Generic-text mappings](#)

[Data type mappings](#)

[Constant and global variable mappings](#)

[Routine mappings](#)

[Using generic-text mappings](#)

Using tchar.h data types with _MBCS

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Microsoft Specific

As the table of generic-text routine mappings indicates (see [Generic-text mappings](#)), when the manifest constant `_MBCS` is defined, a given generic-text routine will map to one of the following kinds of routines:

- An SBCS routine that handles multibyte bytes, characters, and strings appropriately. In this case, the string arguments are expected to be of type `char*`. For example, `_tprintf` maps to `printf`, the string arguments to `printf` are of type `char*`. If you use the `_TCHAR` generic-text data type for your string types, the formal and actual parameter types for `printf` match because `_TCHAR*` maps to `char*`.
- An MBCS-specific routine. In this case, the string arguments are expected to be of type `unsigned char*`. For example, `_tcsrev` maps to `_mbsrev`, which expects and returns a string of type `unsigned char*`. Again, if you use the `_TCHAR` generic-text data type for your string types, there's a potential type conflict because `_TCHAR` maps to type `char`.

Following are three solutions for preventing this type conflict (and the C compiler warnings or C++ compiler errors that would result):

- Use the default behavior. TCHAR.H provides generic-text routine prototypes for routines in the run-time libraries, as in the following example.

```
char *_tcsrev(char *);
```

In the default case, the prototype for `_tcsrev` maps to `_mbsrev` through a thunk in LIBC.LIB. This thunk changes the types of the `_mbsrev` incoming parameters and outgoing return value from `_TCHAR*` (such as `char*`) to `unsigned char*`. This method ensures type matching when you're using `_TCHAR`, but it's relatively slow because of the function call overhead.

- Use function inlining by incorporating the following preprocessor statement in your code.

```
#define _USE_INLINING
```

This method causes an inline function thunk, provided in TCHAR.H, to map the generic-text routine directly to the appropriate MBCS routine. The following code excerpt from TCHAR.H provides an example of how it's done.

```
_inline char *_tcsrev(char *_s1)
{return (char *)_mbsrev((unsigned char *)_s1);}
```

If you can use inlining, it's the best solution, because it guarantees type matching and has no extra time cost.

- Use "direct mapping" by incorporating the following preprocessor statement in your code.

```
#define _MB_MAP_DIRECT
```

This approach provides a quick alternative if you don't want to use the default behavior or can't use

inlining. A macro maps the generic-text routine to the MBCS version of the routine, as in the following example from TCHAR.H.

```
#define _tcschr _mbschr
```

When you take this approach, be careful to ensure that appropriate data types are used for string arguments and string return values. You can use type casting to ensure proper type matching or you can use the `_TXCHAR` generic-text data type. `_TXCHAR` maps to type `char` in SBCS code but maps to type `unsigned char` in MBCS code. For more information about generic-text macros, see [Generic-text mappings](#).

END Microsoft Specific

See also

[Internationalization](#)

[Universal C runtime routines by category](#)

Memory allocation

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These routines allocate, free, and reallocate memory.

Memory-allocation routines

ROUTINE	USE
<code>_alloca</code> , <code>_malloca</code>	Allocate memory from the stack
<code>calloc</code>	Allocate an array and initialize its elements to 0 (zero)
<code>_calloc_dbg</code>	Debug version of <code>calloc</code> . Only available in the debug versions of the run-time libraries
<code>operator delete</code> , <code>operator delete[]</code>	Free memory allocated on the heap
<code>_expand</code>	Expand or shrink a block of memory without moving it
<code>_expand_dbg</code>	Debug version of <code>_expand</code> . Only available in the debug versions of the run-time libraries
<code>free</code>	Free memory allocated on the heap
<code>_free_dbg</code>	Debug version of <code>free</code> . Only available in the debug versions of the run-time libraries
<code>_freea</code>	Free memory allocated on the stack
<code>_get_heap_handle</code>	Get a Win32 <code>HANDLE</code> to the C runtime (CRT) heap.
<code>_heapadd</code>	Add memory to the heap
<code>_heapchk</code>	Check the heap for consistency
<code>_heapmin</code>	Release unused memory in the heap
<code>_heapset</code>	Fill free heap entries with a value
<code>_heapwalk</code>	Get info about each entry in the heap
<code>malloc</code>	Allocate memory from the heap
<code>_malloc_dbg</code>	Debug version of <code>malloc</code> ; only available in the debug versions of the run-time libraries
<code>_msize</code>	Return the size of an allocated block of memory

ROUTINE	USE
<code>_msize_dbg</code>	Debug version of <code>_msize</code> ; only available in the debug versions of the run-time libraries
<code>new</code> , <code>new[]</code>	Allocate a block of memory from the heap
<code>_query_new_handler</code>	Get the address of the current new handler routine set by <code>_set_new_handler</code>
<code>_query_new_mode</code>	Get the new handler mode set by <code>_set_new_mode</code> for <code>malloc</code>
<code>realloc</code>	Reallocate a block to a new size
<code>_realloc_dbg</code>	Debug version of <code>realloc</code> ; only available in the debug versions of the run-time libraries
<code>_set_new_handler</code>	Enable error-handling mechanism when the <code>new</code> operator fails to allocate memory, and enable compilation of the C++ Standard Libraries
<code>_set_new_mode</code>	Set the new handler mode for <code>malloc</code>

See also

[Universal C runtime routines by category](#)

Process and environment control

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Use the process-control routines to start, stop, and manage processes from within a program. Use the environment-control routines to get and change information about the operating-system environment.

Process and environment control functions

ROUTINE	USE
<code>abort</code>	Abort process without flushing buffers or calling functions registered by <code>atexit</code> and <code>_onexit</code>
<code>assert</code>	Test for logic error
<code>_ASSERT</code> , <code>_ASERTE</code> macros	Similar to <code>assert</code> , but only available in the debug versions of the run-time libraries
<code>atexit</code>	Schedule routines for execution at program termination
<code>_beginthread</code> , <code>_beginthreadex</code>	Create a new thread on a Windows operating system process
<code>_cexit</code>	Perform <code>exit</code> termination procedures (such as flushing buffers), then return control to calling program without terminating process
<code>_c_exit</code>	Perform <code>_exit</code> termination procedures, then return control to calling program without terminating process
<code>_cwait</code>	Wait until another process terminates
<code>_endthread</code> , <code>_endthreadex</code>	Terminate a Windows operating system thread
<code>_execl</code> , <code>_wexecl</code>	Execute new process with argument list
<code>_execle</code> , <code>_wexecle</code>	Execute new process with argument list and given environment
<code>_execlp</code> , <code>_wexeclp</code>	Execute new process using <code>PATH</code> variable and argument list
<code>_execlepe</code> , <code>_wexeclepe</code>	Execute new process using <code>PATH</code> variable, given environment, and argument list
<code>_execv</code> , <code>_wexecv</code>	Execute new process with argument array
<code>_execve</code> , <code>_wexecve</code>	Execute new process with argument array and given environment

ROUTINE	USE
<code>_execvp</code> , <code>_wexecvp</code>	Execute new process using <code>PATH</code> variable and argument array
<code>_execvpe</code> , <code>_wexecvpe</code>	Execute new process using <code>PATH</code> variable, given environment, and argument array
<code>exit</code>	Call functions registered by <code>atexit</code> and <code>_onexit</code> , flush all buffers, close all open files, and terminate process
<code>_exit</code>	Terminate process immediately without calling <code>atexit</code> or <code>_onexit</code> or flushing buffers
<code>getenv</code> , <code>_wgetenv</code> , <code>getenv_s</code> , <code>_wgetenv_s</code>	Get value of environment variable
<code>_getpid</code>	Get process ID number
<code>longjmp</code>	Restore saved stack environment; use it to execute a nonlocal <code>goto</code>
<code>_onexit</code>	Schedule routines for execution at program termination; use for compatibility with Microsoft C/C++ version 7.0 and earlier
<code>_pclose</code>	Wait for new command processor and close stream on associated pipe
<code>perror</code> , <code>_wperror</code>	Print error message
<code>_pipe</code>	Create pipe for reading and writing
<code>_popen</code> , <code>_wpopen</code>	Create pipe and execute command
<code>_putenv</code> , <code>_wputenv</code> , <code>putenv_s</code> , <code>_wputenv_s</code>	Add or change value of environment variable
<code>raise</code>	Send signal to calling process
<code>setjmp</code>	Save stack environment; use to execute non local <code>goto</code>
<code>signal</code>	Handle interrupt signal
<code>_spawnl</code> , <code>_wspawnl</code>	Create and execute new process with specified argument list
<code>_spawnle</code> , <code>_wspawnle</code>	Create and execute new process with specified argument list and environment
<code>_spawnlp</code> , <code>_wspawnlp</code>	Create and execute new process using <code>PATH</code> variable and specified argument list
<code>_spawnlpe</code> , <code>_wspawnlpe</code>	Create and execute new process using <code>PATH</code> variable, specified environment, and argument list

ROUTINE	USE
<code>_spawnv</code> , <code>_wspawnv</code>	Create and execute new process with specified argument array
<code>_spawnve</code> , <code>_wspawnve</code>	Create and execute new process with specified environment and argument array
<code>_spawnvp</code> , <code>_wspawnvp</code>	Create and execute new process using <code>PATH</code> variable and specified argument array
<code>_spawnvpe</code> , <code>_wspawnvpe</code>	Create and execute new process using <code>PATH</code> variable, specified environment, and argument array
<code>system</code> , <code>_wsystem</code>	Execute operating-system command

In the Windows operating system, the spawned process is equivalent to the spawning process. Any process can use `_cwait` to wait for any other process for which the process ID is known.

The difference between the `_exec` and `_spawn` families is that a `_spawn` function can return control from the new process to the calling process. In a `_spawn` function, both the calling process and the new process are present in memory unless `_P_OVERLAY` is specified. In an `_exec` function, the new process overlays the calling process, so control can't return to the calling process unless an error occurs in the attempt to start execution of the new process.

The differences among the functions in the `_exec` and `_spawn` families involve the method of locating the file to be executed as the new process, the form in which arguments are passed to the new process, and the method of setting the environment, as shown in the following table. Use a function that passes an argument list when the number of arguments is constant or is known at compile time. Use a function that passes a pointer to an array containing the arguments when the number of arguments is to be determined at run time. The information in the following table also applies to the wide-character counterparts of the `_spawn` and `_exec` functions.

`_spawn` and `_exec` Function Families

FUNCTIONS	USE <code>PATH</code> VARIABLE TO LOCATE FILE	ARGUMENT-PASSING CONVENTION	ENVIRONMENT SETTINGS
<code>_exec1</code> , <code>_spawn1</code>	No	List	Inherited from calling process
<code>_execle</code> , <code>_spawnle</code>	No	List	Pointer to environment table for new process passed as last argument
<code>_execlp</code> , <code>_spawnlp</code>	Yes	List	Inherited from calling process
<code>_execvpe</code> , <code>_spawnvpe</code>	Yes	Array	Pointer to environment table for new process passed as last argument
<code>_execlpe</code> , <code>_spawnlpe</code>	Yes	List	Pointer to environment table for new process passed as last argument

FUNCTIONS	USE <code>PATH</code> VARIABLE TO LOCATE FILE	ARGUMENT-PASSING CONVENTION	ENVIRONMENT SETTINGS
<code>_execv</code> , <code>_spawnv</code>	No	Array	Inherited from calling process
<code>_execve</code> , <code>_spawnve</code>	No	Array	Pointer to environment table for new process passed as last argument
<code>_execvp</code> , <code>_spawnvp</code>	Yes	Array	Inherited from calling process

See also

[Universal C runtime routines by category](#)

Robustness

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Use the following C run-time library functions to improve the robustness of your program.

Run-time robustness functions

FUNCTION	USE
<code>_set_new_handler</code>	Transfers control to your error-handling mechanism if the <code>new</code> operator fails to allocate memory.
<code>_set_se_translator</code>	Handles Win32 exceptions (C structured exceptions) as C++ typed exceptions.
<code>set_terminate</code>	Installs your own termination function to be called by <code>terminate</code> .
<code>set_unexpected</code>	Installs your own termination function to be called by <code>unexpected</code> .

See also

[Universal C runtime routines by category](#)

[SetUnhandledExceptionFilter](#)

Runtime error checking

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The C runtime library contains the functions that support runtime error checks (RTC). Runtime error checking allows you to build your program such that certain kinds of runtime errors are reported. You specify how the errors are reported and which kinds of errors are reported. For more information, see [How to: Use native runtime checks](#).

Use the following functions to customize the way your program does runtime error checking.

Runtime error checking functions

FUNCTION	USE
_RTC_GetErrDesc	Returns a brief description of a runtime error check type.
_RTC_NumErrors	Returns the total number of errors that can be detected by runtime error checks.
_RTC_SetErrorFunc	Designates a function as the handler for reporting runtime error checks.
_RTC_SetErrorHandler	Associates an error that is detected by runtime error checks with a type.

See also

[Universal C runtime routines by category](#)

[/RTC \(Runtime error checks\)](#)

[runtime_checks](#)

[Debug routines](#)

Searching and sorting

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Use the following functions for searching and sorting.

Searching and sorting functions

FUNCTION	SEARCH OR SORT
<code>bsearch</code>	Binary search
<code>bsearch_s</code>	A more secure version of <code>bsearch</code>
<code>_lfind</code>	Linear search for given value
<code>_lfind_s</code>	A more secure version of <code>_lfind</code>
<code>_lsearch</code>	Linear search for given value, which is added to array if not found
<code>_lsearch_s</code>	A more secure version of <code>_lsearch</code>
<code>qsort</code>	Quick sort
<code>qsort_s</code>	A more secure version of <code>qsort</code>

See also

[Universal C runtime routines by category](#)

String manipulation (CRT)

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These routines operate on null-terminated single-byte character, wide-character, and multibyte-character strings. Use the buffer-manipulation routines, described in [Buffer manipulation](#), to work with character arrays that don't end with a `\NULL` character.

String-manipulation routines

ROUTINE	USE
<code>strcoll</code> , <code>wcscoll</code> , <code>_mbscoll</code> , <code>_strcoll_1</code> , <code>_wcscoll_1</code> , <code>_mbscoll_1</code> , <code>_stricoll</code> , <code>_wcsicoll</code> , <code>_mbsicoll</code> , <code>_stricoll_1</code> , <code>_wcsicoll_1</code> , <code>_mbsicoll_1</code> , <code>_strncoll</code> , <code>_wcsncoll</code> , <code>_mbsncoll</code> , <code>_strncoll_1</code> , <code>_wcsncoll_1</code> , <code>_mbsncoll_1</code> , <code>_strnicoll</code> , <code>_wcsnicoll</code> , <code>_mbsnicoll</code> , <code>_strnicoll_1</code> , <code>_wcsnicoll_1</code> , <code>_mbsnicoll_1</code>	Compare two character strings using code page information (<code>_mbsicoll</code> and <code>_mbsnicoll</code> are case-insensitive)
<code>_strdec</code> , <code>_wcsdec</code> , <code>_mbsdec</code> , <code>_mbsdec_1</code>	Move string pointer back one character
<code>_strinc</code> , <code>_wcsinc</code> , <code>_mbsinc</code> , <code>_mbsinc_1</code>	Advance string pointer by one character
<code>_mbsnbcat</code> , <code>_mbsnbcat_1</code> , <code>_mbsnbcat_s</code> , <code>_mbsnbcat_s_1</code>	Append, at most, first <i>n</i> bytes of one character string to another
<code>_mbsnbcmp</code> , <code>_mbsnbcmp_1</code>	Compare first <i>n</i> bytes of two character strings
<code>_strncnt</code> , <code>_wcsncnt</code> , <code>_mbsnbcnt</code> , <code>_mbsnbcnt_1</code> , <code>_mbsncnt</code> , <code>_mbsncnt_1</code>	Return number of character bytes within supplied character count
<code>_mbsnbcpy</code> , <code>_mbsnbcpy_1</code> , <code>_mbsnbcpy_s</code> , <code>_mbsnbcpy_s_1</code>	Copy <i>n</i> bytes of string
<code>_mbsnbicmp</code> , <code>_mbsnbicmp_1</code>	Compare <i>n</i> bytes of two character strings, ignoring case
<code>_mbsnbset</code> , <code>_mbsnbset_1</code>	Set first <i>n</i> bytes of character string to specified character
<code>_strnccnt</code> , <code>_wcsncnt</code> , <code>_mbsnbcnt</code> , <code>_mbsnbcnt_1</code> , <code>_mbsncnt</code> , <code>_mbsncnt_1</code>	Return number of characters within supplied byte count
<code>_strnextc</code> , <code>_wcsnextc</code> , <code>_mbsnextc</code> , <code>_mbsnextc_1</code>	Find next character in string
<code>_strninc</code> , <code>_wcsninc</code> , <code>_mbsninc</code> , <code>_mbsninc_1</code>	Advance string pointer by <i>n</i> characters
<code>_strspnp</code> , <code>_wcspnp</code> , <code>_mbsspnp</code> , <code>_mbsspnp_1</code>	Return pointer to first character in given string that isn't in another given string
<code>_scprintf</code> , <code>_scprintf_1</code> , <code>_scwprintf</code> , <code>_scwprintf_1</code>	Return the number of characters in a formatted string

ROUTINE	USE
<code>_snscanf</code> , <code>_snscanf_1</code> , <code>_snwscanf</code> , <code>_snwscanf_1</code> , <code>_snscanf_s</code> , <code>_snscanf_s_1</code> , <code>_snwscanf_s</code> , <code>_snwscanf_s_1</code>	Read formatted data of a specified length from the standard input stream.
<code>sscanf</code> , <code>_sscanf_1</code> , <code>swscanf</code> , <code>_swscanf_1</code> , <code>sscanf_s</code> , <code>_sscanf_s_1</code> , <code>swscanf_s</code> , <code>_swscanf_s_1</code>	Read formatted data of a specified length from the standard input stream.
<code>sprintf</code> , <code>_sprintf_1</code> , <code>swprintf</code> , <code>_swprintf_1</code> , <code>_swprintf_1</code> , <code>sprintf_s</code> , <code>_sprintf_s_1</code> , <code>swprintf_s</code> , <code>_swprintf_s_1</code> , <code>sprintf_p</code> , <code>_sprintf_p_1</code> , <code>_swprintf_p</code> , <code>_swprintf_p_1</code>	Write formatted data to a string
<code>strcat</code> , <code>wcscat</code> , <code>_mbscat</code> , <code>strcat_s</code> , <code>wcscat_s</code> , <code>_mbscat_s</code>	Append one string to another
<code>strchr</code> , <code>wcschr</code> , <code>_mbschr</code> , <code>_mbschr_1</code>	Find first occurrence of specified character in string
<code>strcmp</code> , <code>wcsncmp</code> , <code>_mbsncmp</code>	Compare two strings
<code>strcoll</code> , <code>wcscoll</code> , <code>_mbscoll</code> , <code>_strcoll_1</code> , <code>_wcscoll_1</code> , <code>_mbscoll_1</code> , <code>_stricoll</code> , <code>_wcsicoll</code> , <code>_mbsicoll</code> , <code>_stricoll_1</code> , <code>_wcscoll_1</code> , <code>_mbsicoll_1</code> , <code>_strncoll</code> , <code>_wcscncoll</code> , <code>_mbscncoll</code> , <code>_strncoll_1</code> , <code>_wcscncoll_1</code> , <code>_mbscncoll_1</code> , <code>_strnicoll</code> , <code>_wcscnicoll</code> , <code>_mbscnicoll</code> , <code>_strnicoll_1</code> , <code>_wcscnicoll_1</code> , <code>_mbscnicoll_1</code>	Compare two strings using current locale code page information (<code>_stricoll</code> , <code>_wcscoll</code> , <code>_strnicoll</code> , and <code>_wcscnicoll</code> are case-insensitive)
<code>strcpy</code> , <code>wcscpy</code> , <code>_mbscopy</code> , <code>strcpy_s</code> , <code>wcscpy_s</code> , <code>_mbscopy_s</code>	Copy one string to another
<code>strcspn</code> , <code>wcscspn</code> , <code>_mbscspn</code> , <code>_mbscspn_1</code>	Find first occurrence of character from specified character set in string
<code>_strupr</code> , <code>_wcstrupr</code> , <code>_mbsupr</code> , <code>_strupr_dbg</code> , <code>_wcstrupr_dbg</code>	Duplicate string
<code>strerror</code> , <code>_strerror</code> , <code>_wcrror</code> , <code>_wcrror_1</code> , <code>strerror_s</code> , <code>_strerror_s</code> , <code>_wcrror_s</code> , <code>_wcrror_s</code>	Map error number to message string
<code>strftime</code> , <code>wcsftime</code> , <code>_strftime_1</code> , <code>_wcsftime_1</code>	Format date-and-time string
<code>_stricmp</code> , <code>_wcscicmp</code> , <code>_mbsicmp</code> , <code>_stricmp_1</code> , <code>_wcscicmp_1</code> , <code>_mbsicmp_1</code>	Compare two strings without regard to case
<code>strlen</code> , <code>wcslen</code> , <code>_mbstrlen</code> , <code>_mbstrlen_1</code> , <code>_mbstrlen</code> , <code>_mbstrlen_1</code> , <code>strnlen</code> , <code>strnlen_s</code> , <code>wcsnlen</code> , <code>wcsnlen_s</code> , <code>_mbsnlen</code> , <code>_mbsnlen_1</code> , <code>_mbstrlen</code> , <code>_mbstrlen_1</code>	Find length of string

ROUTINE	USE
<code>_strlwr</code> , <code>_wslwr</code> , <code>_mbslwr</code> , <code>_strlwr_1</code> , <code>_wslwr_1</code> , <code>_mbslwr_1</code> , <code>_strlwr_s</code> , <code>_strlwr_s_1</code> , <code>_mbslwr_s</code> , <code>_mbslwr_s_1</code> , <code>_wslwr_s</code> , <code>_wslwr_s_1</code>	Convert string to lowercase
<code>strncat</code> , <code>_strncat_1</code> , <code>wcsncat</code> , <code>_wcsncat_1</code> , <code>_mbsncat</code> , <code>_mbsncat_1</code> , <code>strncat_s</code> , <code>_strncat_s_1</code> , <code>wcsncat_s</code> , <code>_wcsncat_s_1</code> , <code>_mbsncat_s</code> , <code>_mbsncat_s_1</code>	Append characters of string
<code>strcmp</code> , <code>wcsncmp</code> , <code>_mbsncmp</code> , <code>_mbsncmp_1</code>	Compare characters of two strings
<code>strncpy</code> , <code>_strncpy_1</code> , <code>wcsncpy</code> , <code>_wcsncpy_1</code> , <code>_mbsncpy</code> , <code>_mbsncpy_1</code> , <code>strncpy_s</code> , <code>_strncpy_s_1</code> , <code>wcsncpy_s</code> , <code>_wcsncpy_s_1</code> , <code>_mbsncpy_s</code> , <code>_mbsncpy_s_1</code>	Copy characters of one string to another
<code>_strnicmp</code> , <code>_wcnicmp</code> , <code>_mbsnicmp</code> , <code>_strnicmp_1</code> , <code>_wcnicmp_1</code> , <code>_mbsnicmp_1</code>	Compare characters of two strings without regard to case
<code>_strnset</code> , <code>_strnset_1</code> , <code>_wcsnset</code> , <code>_wcsnset_1</code> , <code>_mbsnset</code> , <code>_mbsnset_1</code>	Set first <i>n</i> characters of string to specified character
<code>strupr</code> , <code>wcspbrk</code> , <code>_mbspbrk</code> , <code>_mbspbrk_1</code>	Find first occurrence of character from one string in another string
<code>strrchr</code> , <code>wcsrchr</code> , <code>_mbsrchr</code> , <code>_mbsrchr_1</code>	Find last occurrence of given character in string
<code>_strrev</code> , <code>_wcsrev</code> , <code>_mbsrev</code> , <code>_mbsrev_1</code>	Reverse string
<code>_strset</code> , <code>_strset_1</code> , <code>_wcset</code> , <code>_wcset_1</code> , <code>_mbsset</code> , <code>_mbsset_1</code>	Set all characters of string to specified character
<code>strspn</code> , <code>wcsspn</code> , <code>_mbsspn</code> , <code>_mbsspn_1</code>	Find first occurrence in a string of a character not found in another string
<code>strstr</code> , <code>wcsstr</code> , <code>_mbsstr</code> , <code>_mbsstr_1</code>	Find first occurrence of specified string in another string
<code>strtok</code> , <code>_strtok_1</code> , <code>wcstok</code> , <code>_wcstok_1</code> , <code>_mbstok</code> , <code>_mbstok_1</code> , <code>strtok_s</code> , <code>_strtok_s_1</code> , <code>wcstok_s</code> , <code>_wcstok_s_1</code> , <code>_mbstok_s</code> , <code>_mbstok_s_1</code>	Find next token in string
<code>_strupr</code> , <code>_strupr_1</code> , <code>_mbsupr</code> , <code>_mbsupr_1</code> , <code>_wcupr_1</code> , <code>_wcupr</code> , <code>_strupr_s</code> , <code>_strupr_s_1</code> , <code>_mbsupr_s</code> , <code>_mbsupr_s_1</code> , <code>_wcupr_s</code> , <code>_wcupr_s_1</code>	Convert string to uppercase
<code>strxfrm</code> , <code>wcsxfrm</code> , <code>_strxfrm_1</code> , <code>_wcsxfrm_1</code>	Transform string into collated form based on locale-specific information
<code>vsprintf</code> , <code>_vsprintf_1</code> , <code>vswprintf</code> , <code>_vswprintf_1</code> , <code>_vswprintf_1</code> , <code>vsprintf_s</code> , <code>_vsprintf_s_1</code> , <code>vswprintf_s</code> , <code>_vswprintf_s_1</code> , <code>_vsprintf_p</code> , <code>_vsprintf_p_1</code> , <code>_vswprintf_p</code> , <code>_vswprintf_p_1</code>	Write formatted output using a pointer to a list of arguments

ROUTINE	USE
<code>vsnprintf</code> , <code>_vsnprintf</code> , <code>_vsnprintf_l</code> , <code>_vsnwprintf</code> , <code>_vsnwprintf_l</code> , <code>vsnprintf_s</code> , <code>_vsnprintf_s</code> , <code>_vsnprintf_s_l</code> , <code>_vsnwprintf_s</code> , <code>_vsnwprintf_s_l</code>	Write formatted output using a pointer to a list of arguments

See also

[Universal C runtime routines by category](#)

System calls

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The following functions are Windows operating system calls.

System call functions

FUNCTION	USE
<code>_findclose</code>	Release resources from previous find operations
<code>_findfirst</code> , <code>_findfirst32</code> , <code>_findfirst64</code> , <code>_findfirsti64</code> , <code>_findfirst32i64</code> , <code>_findfirst64i32</code> , <code>_wfindfirst</code> , <code>_wfindfirst32</code> , <code>_wfindfirst64</code> , <code>_wfindfirsti64</code> , <code>_wfindfirst32i64</code> , <code>_wfindfirst64i32</code>	Find file with specified attributes
<code>_findnext</code> , <code>_findnext32</code> , <code>_findnext64</code> , <code>_findnexti64</code> , , <code>_findnext32i64</code> , <code>_findnext64i32</code> , <code>_wfindnext</code> , <code>_wfindnext32</code> , <code>_wfindnexti64</code> , <code>_wfindnext64</code> , <code>_wfindnexti64</code>	Find next file with specified attributes

See also

[Universal C runtime routines by category](#)

[File handling](#)

[Directory control](#)

[Low-level I/O](#)

Time management

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Use these functions to get the current time and convert, adjust, and store it as necessary. The current time is the system time.

The `_ftime` and `localtime` routines use the `TZ` environment variable. If `TZ` isn't set, the run-time library attempts to use the time-zone information specified by the operating system. If this information is unavailable, these functions use the default value of PST8PDT. For more information on `TZ`, see [`_tzset`](#); also see [`_daylight`](#), [`timezone`](#), and [`_tzname`](#).

Time routines

FUNCTION	USE
<code>asctime</code> , <code>_wasctime</code> , <code>asctime_s</code> , <code>_wasctime_s</code>	Convert time from type <code>struct tm</code> to character string. The versions of these functions with the <code>_s</code> suffix are more secure.
<code>clock</code>	Return elapsed wall-clock time for process.
<code>ctime</code> , <code>_ctime32</code> , <code>_ctime64</code> , <code>_wctime</code> , <code>_wctime32</code> , <code>_wctime64</code> , <code>_ctime_s</code> , <code>_ctime32_s</code> , <code>_ctime64_s</code> , <code>_wctime_s</code> , <code>_wctime32_s</code> , <code>_wctime64_s</code>	Convert time from type <code>time_t</code> , <code>_time32_t</code> or <code>_time64_t</code> to character string. The versions of these functions with the <code>_s</code> suffix are more secure.
<code>difftime</code> , <code>_difftime32</code> , <code>_difftime64</code>	Compute difference between two times.
<code>_ftime</code> , <code>_ftime32</code> , <code>_ftime64</code> , <code>_ftime_s</code> , <code>_ftime32_s</code> , <code>_ftime64_s</code>	Store current system time in variable of type <code>struct _timeb</code> or type <code>struct __timeb64</code> . The versions of these functions with the <code>_s</code> suffix are more secure.
<code>_futime</code> , <code>_futime32</code> , <code>_futime64</code>	Set modification time on open file
<code>gmtime</code> , <code>_gmtime32</code> , <code>_gmtime64</code> , <code>gmtime_s</code> , <code>_gmtime32_s</code> , <code>_gmtime64_s</code>	Convert time from type <code>time_t</code> to <code>struct tm</code> or from type <code>_time64_t</code> to <code>struct tm</code> . The versions of these functions with the <code>_s</code> suffix are more secure.
<code>localtime</code> , <code>_localtime32</code> , <code>_localtime64</code> , <code>localtime_s</code> , <code>_localtime32_s</code> , <code>_localtime64_s</code>	Convert time from type <code>time_t</code> to <code>struct tm</code> or from type <code>_time64_t</code> to <code>struct tm</code> with local correction. The versions of these functions with the <code>_s</code> suffix are more secure.
<code>_mkgmtime</code> , <code>_mkgmtime32</code> , <code>_mkgmtime64</code>	Convert time to calendar value in Greenwich Mean Time.
<code>mktime</code> , <code>_mktime32</code> , <code>_mktime64</code>	Convert time to calendar value.
<code>_strdate</code> , <code>_wstrdate</code> , <code>_strdate_s</code> , <code>_wstrdate_s</code>	Return current system date as string. The versions of these functions with the <code>_s</code> suffix are more secure.
<code>strftime</code> , <code>wcsftime</code> , <code>_strftime_l</code> , <code>_wcsftime_l</code>	Format date-and-time string for international use.

FUNCTION	USE
<code>_strtime</code> , <code>_wstrtime</code> , <code>_strtime_s</code> , <code>_wstrtime_s</code>	Return current system time as string. The versions of these functions with the <code>_s</code> suffix are more secure.
<code>time</code> , <code>_time32</code> , <code>_time64</code>	Get current system time as type <code>time_t</code> , <code>_time32_t</code> or as type <code>_time64_t</code> .
<code>_tzset</code>	Set external time variables from environment time variable <code>TZ</code> .
<code>_utime</code> , <code>_utime32</code> , <code>_utime64</code> , <code>_wutime</code> , <code>_wutime32</code> , <code>_wutime64</code>	Set modification time for specified file using either current time or time value stored in structure.

NOTE

In all versions of Microsoft C/C++ except Microsoft C/C++ version 7.0, and in all versions of Visual C++, the `time` function returns the current time as the number of seconds elapsed since midnight on January 1, 1970. In Microsoft C/C++ version 7.0, `time` returned the current time as the number of seconds elapsed since midnight on December 31, 1899.

NOTE

In versions of Visual C++ and Microsoft C/C++ before Visual Studio 2005, `time_t` was a `long int` (32 bits) and hence could not be used for dates past 3:14:07 January 19, 2038, UTC. `time_t` is now equivalent to `_time64_t` by default, but defining `_USE_32BIT_TIME_T` changes `time_t` to `_time32_t` and forces many time functions to call versions that take the 32-bit `time_t`. For more information, see [Standard types](#) and comments in the documentation for the individual time functions.

See also

[Universal C runtime routines by category](#)

Windows Runtime unsupported CRT functions

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Many C run-time (CRT) APIs can't be used in Universal Windows Platform (UWP) apps that execute in the Windows Runtime. These apps are built by using the /ZW compiler flag. For a list of unsupported CRT functions, see [CRT functions not supported in Universal Windows Platform apps](#).

All CRT APIs are described in the [Alphabetical function reference](#) section of the documentation.

See also

[Universal C runtime routines by category](#)

[Alphabetical function reference](#)

Internal CRT globals and functions

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The C runtime (CRT) library contains functions and global variables that are used only to support the public library interface. Some of them are exposed in public headers as implementation details. Although these functions and global variables are accessible through public exports, they're not intended for use by your code. We recommend that you change any code that uses these functions and variables to use public library equivalents instead. These functions may change from version to version. They're listed here to help you identify them. Links are provided when other documentation exists, but in general, these implementation details aren't documented.

Internal CRT globals and value macros

These global variables and macro definitions are used to implement the CRT.

NAME
__badioinfo
_acmdln
_commode
_crtAssertBusy
_crtBreakAlloc
__initenv
__lconv
__mb_cur_max
__pioinfo
__unguarded_readlc_active
_wcmdln
__winitenv

Internal CRT functions and function macros

These functions and function macros are used to implement the CRT and the C++ Standard Library.

NAME
__acrt_iob_func

NAME

__AdjustPointer

_assert

__BuildCatchObject

__BuildCatchObjectHelper

__C_specific_handler

_calloc_base

_chkesp

__chkstk

_chkstk

_chvalidator

__chvalidator_1

_CIacos

_CIasin

_CIatan

_CIatan2

_Cicos

_CIcosh

_CIexp

_CIfmod

_CIlog

_CIlog10

_CIpow

_CIsin

_CIsinh

NAME

`_CIsqrt`

`_CItan`

`_CItanh`

`__clean_type_info_names_internal`

`_configure_narrow_argv`

`_configure_wide_argv`

`__conio_common_vcprintf`

`__conio_common_vcprintf_p`

`__conio_common_vcprintf_s`

`__conio_common_vcscanf`

`__conio_common_vcprintf`

`__conio_common_vcprintf_p`

`__conio_common_vcprintf_s`

`__conio_common_vcwscanf`

`__CppXcptFilter`

`__create_locale`

`_crt_atexit`

`_crt_at_quick_exit`

`__crtCompareStringA`

`__crtCompareStringEx`

`__crtCompareStringW`

`__crtCreateEventExW`

`__crtCreateSemaphoreExW`

`__crtCreateSymbolicLinkW`

NAME

`_crt_debugger_hook`

`__crtEnumSystemLocalesEx`

`__crtFlsAlloc`

`__crtFlsFree`

`__crtFlsGetValue`

`__crtFlsSetValue`

`_CrtGetCheckCount`

`__crtGetDateFormatEx`

`__crtGetFileInformationByHandleEx`

`__crtGetLocaleInfoEx`

`__crtGetShowWindowMode`

`__crtGetTickCount64`

`__crtGetTimeFormatEx`

`__crt GetUserDefaultLocaleName`

`__crtInitializeCriticalSectionEx`

`__crtIsPackagedApp`

`__crtIsValidLocaleName`

`__crtLCMapStringA`

`__crtLCMapStringEx`

`__crtLCMapStringW`

`_CrtSetCheckCount`

`_CrtSetDbgBlockType`

`__crtSetFileInformationByHandle`

`__crtSetThreadStackGuarantee`

NAME

`__crtSetUnhandledExceptionFilter`

`__crtSleep`

`__crtTerminateProcess`

`__crtUnhandledException`

`__CxxDetectRethrow`

`__CxxExceptionFilter`

`__CxxFrameHandler`

`__CxxFrameHandler2`

`__CxxFrameHandler3`

`__CxxLongjmpUnwind`

`__CxxQueryExceptionSize`

`__CxxRegisterExceptionObject`

`_CxxThrowException`

`__CxxUnregisterExceptionObject`

`__daylight`

`_dclass`

`__DestructExceptionObject`

`__dлонexit`

`_doserrno`

`_dosmaperr`

`_dpcomp`

`_dsign`

`__dstbias`

`_dtest`

NAME

_EH_prolog

_errno

_except_handler2

_except_handler3

_except_handler4_common

_except1

_execute_onexit_table

_fdclass

_fdpcomp

_fdsign

_fdtest

_filbuf

_FindAndUnlinkFrame

_flsbuf

_fpe_flt_rounds

_FPE_Raise

_fpecode

_FrameUnwindFilter

_fread_nolock_s

_free_base

_free_locale

_freea_s

_freefls

_ftol

NAME

`__get_current_locale`

`_get_flsindex`

`_get_initial_narrow_environment`

`_get_initial_wide_environment`

`_get_narrow_winmain_command_line`

`_get_stream_buffer_pointers`

`__get_tlsindex`

`_get_wide_winmain_command_line`

`_Getdays`

`__getmainargs`

`_Getmonths`

`__GetPlatformExceptionInfo`

`_getptd`

`_Gettnames`

`_global_unwind2`

`_inconsistency`

`_initialize_lconv_for_unsigned_char`

`_initialize_narrow_environment`

`_initialize_onexit_table`

`_initialize_wide_environment`

`_initptd`

`_invalid_parameter`

`_invoke_watson`

`__iob_func`

NAME

`_IsExceptionObjectToBeDestroyed`

`__lc_codepage_func`

`__lc_collate_cp_func`

`__lc_locale_name_func`

`__lconv_init`

`_ldclass`

`_lpcomp`

`_ldsign`

`_ldtest`

`__libm_sse2_acos`

`__libm_sse2_acos_precise`

`__libm_sse2_acosf`

`__libm_sse2_asin`

`__libm_sse2_asin_precise`

`__libm_sse2_asinf`

`__libm_sse2_atan`

`__libm_sse2_atan_precise`

`__libm_sse2_atan2`

`__libm_sse2_atanf`

`__libm_sse2_cos`

`__libm_sse2_cos_precise`

`__libm_sse2_cosf`

`__libm_sse2_exp`

`__libm_sse2_exp_precise`

NAME

[__libm_sse2_expf](#)

[__libm_sse2_log](#)

[_libm_sse2_log_precise](#)

[__libm_sse2_log10](#)

[_libm_sse2_log10_precise](#)

[__libm_sse2_log10f](#)

[__libm_sse2_logf](#)

[__libm_sse2_pow](#)

[_libm_sse2_pow_precise](#)

[__libm_sse2_powf](#)

[__libm_sse2_sin](#)

[_libm_sse2_sin_precise](#)

[__libm_sse2_sinf](#)

[_libm_sse2_sqrt_precise](#)

[__libm_sse2_tan](#)

[_libm_sse2_tan_precise](#)

[__libm_sse2_tanf](#)

[local_unwind2](#)

[local_unwind4](#)

[lock_locales](#)

[longjmpex](#)

[malloc_base](#)

[mb_cur_max_func](#)

[mb_cur_max_l_func](#)

NAME

_mbctype

_NLG_Dispatch2

_NLG_Return

_NLG_Return2

__p___argc

__p___argv

__p___initenv

__p___mb_cur_max

__p___wargv

__p___winitenv

__p___acmdln

__p___commode

__p___crtAssertBusy

__p___crtBreakAlloc

__p___crtDbgFlag

__p___daylight

__p___dstbias

__p___environ

__p___fmode

__p___iob

__p___mbcasemap

__p___mbctype

__p___pctype

__p___pgmptr

NAME

`__p__pwctype`

`__p__timezone`

`__p__tzname`

`__p__wcmdln`

`__p__wenviron`

`__p__wpgmptr`

`_pctype`

`__pctype_func`

`_pwctype`

`__pwctype_func`

`__pxcptinfoptrs`

`_query_app_type`

`_realloc_base`

`_register_onexit_function`

`_register_thread_local_exe_atexit_callback`

`__report_gsfailure`

`__RTCastToVoid`

`__RTDynamicCast`

`__RTtypeid`

`_seh_filter_dll`

`_seh_filter_exe`

`_seh_longjmp_unwind`

`_seh_longjmp_unwind4`

`__set_app_type`

NAME

_set_malloc_crt_max_wait

_setjmp3

__setlc_active

__setlc_active_func

__setusermatherr

_SetWinRTOutOfMemoryExceptionCallback

_sopen_dispatch

__std_exception_copy

__std_exception_destroy

__std_type_info_destroy_list

__std_type_info_name

__stdio_common_vfprintf

__stdio_common_vfprintf_p

__stdio_common_vfprintf_s

__stdio_common_vfscanf

__stdio_common_vfwprintf

__stdio_common_vfwprintf_p

__stdio_common_vfwprintf_s

__stdio_common_vfwscanf

__stdio_common_vsnprintf_s

__stdio_common_vsprintf_s

__stdio_common_vsprintf

__stdio_common_vsprintf_p

__stdio_common_vsprintf_s

NAME

`__stdio_common_vscanf`

`__stdio_common_vswprintf`

`__stdio_common_vswprintf_p`

`__stdio_common_vswprintf_s`

`__stdio_common_vswscanf`

`_Strftime`

`__STRINGTOLD`

`__STRINGTOLD_L`

`__strncnt`

`__sys_errlist`

`__sys_nerr`

`__threadhandle`

`__threadid`

`__timezone`

`__TypeMatch`

`__tzname`

`__unDName`

`__unDNameEx`

`__unDNameHelper`

`__unguarded_readlc_active`

`__unguarded_readlc_active_add_func`

`_unloaddll`

`_unlock_locales`

`_vcopy`

NAME
<code>_ValidateExecute</code>
<code>_ValidateRead</code>
<code>_ValidateWrite</code>
<code>_VCrtDbgReportA</code>
<code>_VCrtDbgReportW</code>
<code>_W_Getdays</code>
<code>_W_Getmonths</code>
<code>_W_Getnames</code>
<code>_W_Gettnames</code>
<code>_wassert</code>
<code>_Wcsftime</code>
<code>__wcsncnt</code>
<code>__wgetmainargs</code>
<code>_wsopen_dispatch</code>
<code>_Xbad_alloc</code>
<code>_Xlength_error</code>

See also

[Universal C runtime routines by category](#)

`_abnormal_termination`

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Indicates whether the `__finally` block of a [try-finally statement](#) is entered while the system is executing an internal list of termination handlers.

Syntax

```
int _abnormal_termination()  
);
```

Return value

`true` if the system is unwinding the stack; otherwise, `false`.

Remarks

`_abnormal_termination` is an internal function used to manage unwinding exceptions, and isn't intended to be called from user code.

Requirements

ROUTINE	REQUIRED HEADER
<code>_abnormal_termination</code>	<code><excpt.h></code>

See also

[try-finally Statement](#)

`_acmdln`, `_tcmdln`, `_wcmdln`

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Internal CRT global variable. The command line.

Syntax

```
char * _acmdln;  
wchar_t * _wcmdln;  
  
#ifdef WPRFLAG  
    #define _tcmdln _wcmdln  
#else  
    #define _tcmdln _acmdln
```

Remarks

These CRT internal variables store the complete command line. They're exposed in the exported symbols for the CRT, but aren't intended for use in your code. `_acmdln` stores the data as a character string. `_wcmdln` stores the data as a wide character string. `_tcmdln` can be defined as either `_acmdln` or `_wcmdln`, depending on which is appropriate.

See also

[Global variables](#)

Calculates the arctangent of the top value on the stack.

Syntax

```
void __cdecl _CIatan();
```

Remarks

This version of the `atan` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[atan](#) , [atanf](#) , [atanl](#) , [atan2](#) , [atan2f](#) , [atan2l](#)

_CIatan2

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Calculates the arctangent of x / y where x and y are values on the top of the stack.

Syntax

```
void __cdecl _CIatan2();
```

Remarks

This version of the `atan2` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[atan](#) , [atanf](#) , [atanl](#) , [atan2](#) , [atan2f](#) , [atan2l](#)

Calculates the cosine of the top value in the floating-point stack.

Syntax

```
void __cdecl _CIcos();
```

Remarks

This version of the `cos` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the floating-point stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

`cos` , `cosf` , `cosl`

Calculates the exponential of the top value on the stack.

Syntax

```
void __cdecl _Cexp();
```

Remarks

This version of the `exp` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[exp](#) , [expf](#) , [expl](#)

Calculates the floating-point remainder of the top two values on the stack.

Syntax

```
void __cdecl _CIfmod();
```

Remarks

This version of the `fmod` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

`fmod` , `fmodf`

Calculates the natural logarithm of the top value in the stack.

Syntax

```
void __cdecl _CIlog();
```

Remarks

This version of the `log` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[log](#) , [logf](#) , [log10](#) , [log10f](#)

_CIlog10

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs a `log10` operation on the top value in the stack.

Syntax

```
void __cdecl _CIlog10();
```

Remarks

This version of the `log10` function has a specialized calling convention that the compiler understands. The function speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[log](#) , [logf](#) , [log10](#) , [log10f](#)

_CIpow

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates x raised to the y power based on the top values in the stack.

Syntax

```
void __cdecl _CIpow();
```

Remarks

This version of the `pow` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[pow](#) , [powf](#) , [powl](#)

Calculates the sine of the top value in the floating-point stack.

Syntax

```
void __cdecl _CIsin();
```

Remarks

This intrinsic version of the [sin](#) function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the floating-point stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[sin](#) , [sinf](#) , [sinl](#)

_CIsqrt

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the square root of the top value in the stack.

Syntax

```
void __cdecl _CIsqrt();
```

Remarks

This version of the `sqrt` function has a specialized calling convention that the compiler understands. It speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

`sqrt`, `sqrtf`, `sqrtl`

_CItan

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the tangent of the top value on the floating-point stack.

Syntax

```
void __cdecl _CItan();
```

Remarks

This version of the [tan](#) function has a specialized calling convention that the compiler understands. The function speeds up the execution because it prevents copies from being generated and helps with register allocation.

The resulting value is pushed onto the top of the floating-point stack.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

Platform: x86

See also

[Alphabetical function reference](#)

[tan](#) , [tanf](#) , [tanl](#)

`_crtLCMapStringW`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Maps one character string to another, performing a specified locale-dependent transformation. This function can also be used to generate a sort key for the input string.

Syntax

```
int __crtLCMapStringW(
    LCID    Locale,
    DWORD   dwMapFlags,
    LPCWSTR lpSrcStr,
    int     cchSrc,
    LPWSTR  lpDestStr,
    int     cchDest)
```

Parameters

`Locale`

The locale identifier. The locale provides a context for the string mapping or sort key generation. An application can use the `MAKELCID` macro to create a locale identifier.

`dwMapFlags`

The type of transformation to be used during string mapping or sort key generation.

`LpSrcStr`

Pointer to a source string that the function maps or uses for sort key generation. This parameter is assumed to be a Unicode string.

`cchSrc`

Size, in characters, of the string pointed to by the `lpSrcStr` parameter. This count can include the null terminator, or not include it.

A `cchSrc` value of -1 specifies that the string pointed to by `lpSrcStr` is null-terminated. If so, and this function is being used in its string-mapping mode, the function calculates the string's length itself, and null-terminates the mapped string stored into `*lpDestStr`.

`LpDestStr`

Long pointer to a buffer into which the function stores the mapped string or sort key.

`cchDest`

Size, in characters, of the buffer pointed to by `lpDestStr`.

Return value

If the value of `cchDest` is nonzero, the number of characters, or bytes if `LCMAP_SORTKEY` is specified, written to the buffer indicates success. This count includes room for a null terminator.

If the value of `cchDest` is zero, the size of the buffer in characters, or bytes if `LCMAP_SORTKEY` is specified, required to receive the translated string or sort key indicates success. This size includes room for a null terminator.

Zero indicates failure. To get extended error information, call the `GetLastError` function.

Remarks

If `cchSrc` is greater than zero and `lpszSrcStr` is a null-terminated string, `_crtLCMapStringW` sets `cchSrc` to the length of the string. Then `_crtLCMapStringW` calls the wide string (Unicode) version of the `LCMapString` function with the specified parameters. For more information about the parameters and return value of this function, see the [LCMapString](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_crtLCMapStringW</code>	<code><awint.h></code>

`__CxxFrameHandler`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. Used by the CRT to handle structured exception frames.

Syntax

```
EXCEPTION_DISPOSITION __CxxFrameHandler(
    EHExceptionRecord *pExcept,
    EHRegistrationNode *pRN,
    void             *pContext,
    DispatcherContext *pDC
);
```

Parameters

`pExcept`

Exception record that is passed to the possible `catch` statements.

`pRN`

Dynamic information about the stack frame that is used to handle the exception. For more information, see `ehdata.h`.

`pContext`

Context. (Not used on Intel processors.)

`pDC`

Additional information about the function entry and stack frame.

Return value

One of the *filter expression* values used by the [try-except Statement](#).

Remarks

Requirements

ROUTINE	REQUIRED HEADER
<code>__CxxFrameHandler</code>	<code><excpt.h></code> , <code><ehdata.h></code>

`__dлонexit`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Registers a routine to be called at exit time.

Syntax

```
_onexit_t __dлонexit(
    _onexit_t func,
    _PVFV ** pbegin,
    _PVFV ** pend
);
```

Parameters

`func`

Pointer to a function to be executed upon exit.

`pbegin`

Pointer to a variable that points to the beginning of a list of functions to execute on detach.

`pend`

Pointer to variable that points to the end of a list of functions to execute on detach.

Return value

If successful, a pointer to the user's function. Otherwise, a `NULL` pointer.

Remarks

The `__dлонexit` function is analogous to the `_onexit` function except that the global variables used by that function aren't visible to this routine. Instead of global variables, this function uses the `pbegin` and `pend` parameters.

The `_onexit` and `atexit` functions in a DLL linked with MSVCRT.LIB must maintain their own `atexit/_onexit` list. This routine is the worker that gets called by such DLLs.

The `_PVFV` type is defined as `typedef void (_cdecl *_PVFV)(void)`.

Requirements

ROUTINE	REQUIRED FILE
<code>__dлонexit</code>	<code>onexit.c</code>

See also

[_onexit](#), [_onexit_m](#)

_except_handler3

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. Used by a framework to find the appropriate exception handler to process the current exception.

Syntax

```
int _except_handler3(
    PEXCEPTION_RECORD exception_record,
    PEXCEPTION_REGISTRATION registration,
    PCONTEXT context,
    PEXCEPTION_REGISTRATION dispatcher
);
```

Parameters

exception_record

[in] Information about the specific exception.

registration

[in] The record that indicates which scope table should be used to find the exception handler.

context

[in] Reserved.

dispatcher

[in] Reserved.

Return value

If an exception should be dismissed, returns `DISPOSITION_DISMISS`. If the exception should be passed up a level to the encapsulating exception handlers, returns `DISPOSITION_CONTINUE_SEARCH`.

Remarks

If this method finds an appropriate exception handler, it passes the exception to the handler. In this situation, this method doesn't return to the code that called it and the return value is irrelevant.

See also

[Alphabetical function reference](#)

```
_execute_onexit_table , _initialize_onexit_table ,  
_register_onexit_function
```

11/2/2022 • 2 minutes to read • [Edit Online](#)

Manages the routines to be called at exit time.

Syntax

```
int _initialize_onexit_table(  
    _onexit_table_t* table  
);  
  
int _register_onexit_function(  
    _onexit_table_t* table,  
    _onexit_t          function  
);  
  
int _execute_onexit_table(  
    _onexit_table_t* table  
);
```

Parameters

`table`

[in, out] Pointer to the `onexit` function table.

`function`

[in] Pointer to a function to add to the `onexit` function table.

Return value

If successful, the function returns 0. Otherwise, it returns a negative value.

Remarks

These functions are infrastructure implementation details used to support the C runtime, and shouldn't be called directly from your code. The C runtime uses an `onexit` function table to represent the sequence of functions registered by calls to `atexit`, `at_quick_exit`, and `_onexit`. The `onexit` function table data structure is an opaque implementation detail of the C runtime; the order and meaning of its data members may change. They shouldn't be inspected by external code.

The `_initialize_onexit_table` function initializes the `onexit` function table to its initial value. This function must be called before the `onexit` function table is passed to either `_register_onexit_function` or `_execute_onexit_table`.

The `_register_onexit_function` function appends a function to the end of the `onexit` function table.

The `_execute_onexit_table` function executes all of the functions in the `onexit` function table, clears the table, and then returns. After a call to `_execute_onexit_table`, the table is in a non-valid state; it must be reinitialized by a call to `_initialize_onexit_table` before it's used again.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the](#)

Requirements

ROUTINE	REQUIRED HEADER
<code>_initialize_onexit_table</code> , <code>_register_onexit_function</code> , <code>_execute_onexit_table</code>	C, C++: <process.h>

The `_initialize_onexit_table`, `_register_onexit_function`, and `_execute_onexit_table` functions are Microsoft-specific. For compatibility information, see [Compatibility](#).

See also

[atexit](#)
[exit](#), [_Exit](#), [_exit](#)
[_onexit](#), [_onexit_m](#)

`__getmainargs`, `__wgetmainargs`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Invokes command-line parsing and copies the arguments to `main()` back through the passed pointers.

Syntax

```
int __getmainargs(
    int * argc,
    char *** argv,
    char *** env,
    int doWildCard,
    _startupinfo * startInfo);

int __wgetmainargs (
    int *argc,
    wchar_t ***argv,
    wchar_t ***env,
    int doWildCard,
    _startupinfo * startInfo)
```

Parameters

`argc`

An integer that contains the number of arguments that follow in `argv`. The `argc` parameter is always greater than or equal to 1.

`argv`

An array of null-terminated strings representing command-line arguments entered by the user of the program. By convention, `argv[0]` is the command with which the program is invoked, `argv[1]` is the first command-line argument, and so on, until `argv[argc]`, which is always `NULL`. The first command-line argument is always `argv[1]` and the last one is `argv[argc - 1]`.

`env`

An array of strings that represent the variables set in the user's environment. This array is terminated by a `NULL` entry.

`doWildCard`

An integer that if set to 1 expands the wildcards in the command line arguments, or if set to 0 does nothing.

`startInfo`

Other information to be passed to the CRT DLL.

Return value

0 if successful; a negative value if unsuccessful.

Remarks

Use `__getmainargs` on non-wide character platforms, and `__wgetmainargs` on wide-character (Unicode) platforms.

Requirements

ROUTINE	REQUIRED HEADER
<code>__getmainargs</code>	<code>internal.h</code>
<code>__wgetmainargs</code>	<code>internal.h</code>

`__lc_codepage_func`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. Retrieves the current code page of the thread.

Syntax

```
UINT __lc_codepage_func(void);
```

Return value

The current code page of the thread.

Remarks

`__lc_codepage_func` is an internal CRT function that is used by other CRT functions to get the current code page from the thread local storage for CRT data. This information is also available by using the [`_get_current_locale`](#) function.

A *code page* is a mapping of single-byte or double-byte codes to individual characters. Different code pages include different special characters, typically customized for a language or a group of languages. For more information about code pages, see [Code pages](#).

Internal CRT functions are implementation-specific and subject to change with each release. We don't recommend their use in your code.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>__lc_codepage_func</code>	<code>crt\src\setlocal.h</code>

See also

[`_get_current_locale`](#)
[`setlocale`](#) , [`_wsetlocale`](#)
[`_create_locale`](#) , [`_wcreate_locale`](#)
[`_free_locale`](#)

`__lc_collate_cp_func`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. Retrieves the current collation code page of the thread.

Syntax

```
UINT __lc_codepage_func(void);
```

Return value

The current collation code page of the thread.

Remarks

`__lc_collate_cp_func` is an internal CRT function that is used by other CRT functions to get the current collation code page from the thread local storage for CRT data. This information is also available by using the [`_get_current_locale`](#) function.

Internal CRT functions are implementation-specific and subject to change with each release. We don't recommend their use in your code.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>__lc_collate_cp_func</code>	crt\src\setlocal.h

See also

[`_get_current_locale`](#)
[`setlocale`](#) , [`_wsetlocale`](#)
[`_create_locale`](#) , [`_wcreate_locale`](#)
[`_free_locale`](#)

`__lc_locale_name_func`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. Retrieves the current locale name of the thread.

Syntax

```
wchar_t** __lc_locale_name_func(void);
```

Return value

A pointer to a string that contains the current locale name of the thread.

Remarks

`__lc_locale_name_func` is an internal CRT function that is used by other CRT functions to get the current locale name from the thread local storage for CRT data. This information is also available by using the `_get_current_locale` function or the `setlocale`, `_wsetlocale` functions.

Internal CRT functions are implementation-specific and subject to change with each release. We don't recommend their use in your code.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>__lc_locale_name_func</code>	<code>crt\src\setlocal.h</code>

See also

[`_get_current_locale`](#)
[`setlocale`](#), [`_wsetlocale`](#)
[`_create_locale`](#), [`_wcreate_locale`](#)
[`_free_locale`](#)

_local_unwind2

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT Function. Runs all termination handlers that are listed in the indicated scope table.

Syntax

```
void _local_unwind2(
    PEXCEPTION_REGISTRATION xr,
    int stop
);
```

Parameters

`xr`

[in] A registration record that is associated with one scope table.

`stop`

[in] The lexical level that indicates where `_local_unwind2` should stop.

Remarks

This method is used only by the run-time environment. Don't call the method in your code.

When this method executes termination handlers, it starts at the current lexical level, and works upward in lexical levels until it reaches the level that's indicated by `stop`. It doesn't execute termination handlers at the level that's indicated by `stop`.

See also

[Alphabetical function reference](#)

`__mb_cur_max_func`, `__mb_cur_max_l_func`,
`_p__mb_cur_max`, `__mb_cur_max`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. Retrieves the maximum number of bytes in a multibyte character for the current or specified locale.

Syntax

```
int __mb_cur_max_func(void);
int __mb_cur_max_l_func(_locale_t locale);
int * _p__mb_cur_max(void);
#define __mb_cur_max (__mb_cur_max_func())
```

Parameters

`Locale`

The locale structure to retrieve the result from. If this value is null, the current thread locale is used.

Return value

The maximum number of bytes in a multibyte character for the current thread locale or the specified locale.

Remarks

`__mb_cur_max_func` is an internal function that the CRT uses to retrieve the current value of the `MB_CUR_MAX` macro from thread local storage. We recommend that you use the `MB_CUR_MAX` macro in your code for portability.

The `__mb_cur_max` macro is a convenient way to call the `__mb_cur_max_func` function. The `_p__mb_cur_max` function is defined for compatibility with Visual C++ 5.0 and earlier versions.

Internal CRT functions are implementation-specific and subject to change with each release. We don't recommend their use in your code.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>__mb_cur_max_func</code> , <code>__mb_cur_max_l_func</code> , <code>_p__mb_cur_max</code>	<code><ctype.h></code> , <code><stdlib.h></code>

See also

`MB_CUR_MAX`

`__p_commode`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Points to the `_commode` global variable, which specifies the default *file commit mode* for file I/O operations.

Syntax

```
int * __p_commode(  
);
```

Return value

Pointer to the `_commode` global variable.

Remarks

The `__p_commode` function is for internal use only, and shouldn't be called from user code.

File commit mode specifies when critical data is written to disk. For more information, see [fflush](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>__p_commode</code>	<code>internal.h</code>

`_p_fmode`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Points to the `_fmode` global variable, which specifies the default *file translation mode* for file I/O operations.

Syntax

```
int* __p_fmode(  
    );
```

Return value

Pointer to the `_fmode` global variable.

Remarks

The `_p_fmode` function is for internal use only, and shouldn't be called from user code.

File translation mode specifies either `binary` or `text` translation for `_open` and `_pipe` I/O operations. For more information, see [_fmode](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_p_fmode</code>	<code><stdlib.h></code>

`__ctype_func`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves a pointer to an array of character classification information.

Syntax

```
const unsigned short *__ctype_func(  
    )
```

Return value

A pointer to an array of character classification information.

Remarks

The information in the character classification table is for internal use only, and is used by various functions that classify characters of type `char`. For more information, see the Remarks section of [`_ctype`](#), [`_pwctype`](#), [`_wctype`](#), [`_mbctype`](#), [`_mbcasemap`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>__ctype_func</code>	<code><ctype.h></code>

See also

[`_ctype`](#), [`_pwctype`](#), [`_wctype`](#), [`_mbctype`](#), [`_mbcasemap`](#)

`__RTDynamicCast`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Runtime implementation of the `dynamic_cast` operator.

Syntax

```
PVOID __RTDynamicCast (
    PVOID inptr,
    LONG VfDelta,
    PVOID SrcType,
    PVOID TargetType,
    BOOL isReference
) throw(...)
```

Parameters

`inptr`

Pointer to a polymorphic object.

`VfDelta`

Offset of virtual function pointer in object.

`SrcType`

Static type of object pointed to by the `inptr` parameter.

`TargetType`

Intended result of cast.

`isReference`

`true` if input is a reference; `false` if input is a pointer.

Return value

Pointer to the appropriate subobject, if successful; otherwise, `NULL`.

Exceptions

`bad_cast()` if the input to `dynamic_cast<>` is a reference and the cast fails.

Remarks

Converts `inptr` to an object of type `TargetType`. The type of `inptr` must be a pointer if `TargetType` is a pointer, or an l-value if `TargetType` is a reference. `TargetType` must be a pointer or a reference to a previously defined class type, or a pointer to void.

Requirements

ROUTINE	REQUIRED HEADER
<code>__RTDynamicCast</code>	<code><rtti.h></code>

`__set_app_type`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the current application type.

Syntax

```
void __set_app_type (
    int at
)
```

Parameters

`at`

A value that indicates the application type. The possible values are:

VALUE	DESCRIPTION
<code>_UNKNOWN_APP</code>	Unknown application type.
<code>_CONSOLE_APP</code>	Console (command-line) application.
<code>_GUI_APP</code>	GUI (Windows) application.

Remarks

Requirements

ROUTINE	REQUIRED HEADER
<code>__set_app_type</code>	<code>internal.h</code>

_set_app_type

11/2/2022 • 2 minutes to read • [Edit Online](#)

An internal function used at startup to tell the CRT whether the app is a console app or a GUI app.

Syntax

```
typedef enum _crt_app_type
{
    _crt_unknown_app,
    _crt_console_app,
    _crt_gui_app
} _crt_app_type;

void __cdecl _set_app_type(
    _crt_app_type appType
);
```

Parameters

`appType`

A value that indicates the application type. The possible values are:

VALUE	DESCRIPTION
<code>_crt_unknown_app</code>	Unknown application type.
<code>_crt_console_app</code>	Console (command-line) application.
<code>_crt_gui_app</code>	GUI (Windows) application.

Remarks

Normally, you don't need to call this function. It's part of the C runtime startup code that executes before `main` is called in your app.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_set_app_type</code>	<code><process.h></code>

_setjmp3

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal CRT function. A new implementation of the `setjmp` function.

Syntax

```
int _setjmp3(
    OUT jmp_buf env,
    int count,
    (optional parameters)
);
```

Parameters

`env`

[out] Address of the buffer for storing state information.

`count`

[in] The number of `DWORD`s of information stored in the `optional parameters`.

`optional parameters`

[in] Extra data pushed down by the `setjmp` intrinsic. The first `DWORD` is a function pointer that is used to unwind extra data and return to a nonvolatile register state. The second `DWORD` is the try level to be restored. Any further data is saved in the generic data array in the `jmp_buf`.

Return value

Always returns 0.

Remarks

Don't use this function in a C++ program. It's an intrinsic function that doesn't support C++. For more information about how to use `setjmp`, see [Using setjmp/longjmp](#).

Requirements

See also

[Alphabetical function reference](#)

`setjmp`

`__setlc_active_func`,

`__unguarded_readlc_active_add_func`

11/2/2022 • 2 minutes to read • [Edit Online](#)

OBSOLETE. The CRT exports these internal functions only to preserve binary compatibility.

Syntax

```
int __setlc_active_func(void);
int * __unguarded_readlc_active_add_func(void);
```

Return value

The value returned isn't significant.

Remarks

Although the internal CRT functions `__setlc_active_func` and `__unguarded_readlc_active_add_func` are obsolete and no longer used, they're exported by the CRT library to preserve binary compatibility. The original purpose of `__setlc_active_func` was to return the number of currently active calls to the `setlocale` function. The original purpose of `__unguarded_readlc_active_add_func` was to return the number of functions that referenced the locale without locking it.

Requirements

ROUTINE	REQUIRED HEADER
<code>__setlc_active_func</code> , <code>__unguarded_readlc_active_add_func</code>	none

See also

`setlocale`, `_wsetlocale`

`__setusermatherr`

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Specifies a user-supplied routine to handle math errors, instead of the `_matherr` routine.

Syntax

```
void __setusermatherr(  
    _HANDLE_MATH_ERROR pf  
)
```

Parameters

`pf`

Pointer to an implementation of `_matherr` that is supplied by the user.

The type of the `pf` parameter is declared as `typedef int (_cdecl * _HANDLE_MATH_ERROR)(struct _exception *)`.

Remarks

Requirements

ROUTINE	REQUIRED HEADER
<code>__setusermatherr</code>	<code>matherr.c</code>

Global variables and standard types

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The Microsoft run-time library contains definitions for [global variables](#), [control flags](#), and [standard types](#) used by library routines. Access these variables, flags, and types by declaring them in your program or by including the appropriate header files.

See also

[C runtime library reference](#)

[Global constants](#)

Global variables

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The Microsoft C run-time library provides the following global variables or macros. Several of these global variables or macros have been deprecated in favor of more-secure functional versions, which we recommend you use instead of the global variables.

VARIABLE	DESCRIPTION
<code>__argc</code> , <code>__argv</code> , <code>__wargv</code>	Contains the command-line arguments.
<code>_daylight</code> , <code>_dstbias</code> , <code>_timezone</code> , and <code>_tzname</code>	Deprecated. Instead, use <code>_get_daylight</code> , <code>_get_dstbias</code> , <code>_get_timezone</code> , and <code>_get_tzname</code> . Adjusts for local time; used in some date and time functions.
<code>errno</code> , <code>_doserrno</code> , <code>_sys_errlist</code> , and <code>_sys_nerr</code>	Deprecated. Instead, use <code>_get_errno</code> , <code>_set_errno</code> , <code>_get_doserrno</code> , <code>_set_doserrno</code> , <code>perror</code> and <code>strerror</code> . Stores error codes and related information.
<code>_environ</code> , <code>_wenviron</code>	Deprecated. Instead, use <code> getenv_s</code> , <code>_wgetenv_s</code> , <code>_dupenv_s</code> , <code>_wdupenv_s</code> , <code>_putenv_s</code> , and <code>_wputenv_s</code> . Pointers to arrays of pointers to the process environment strings; initialized at startup.
<code>_fmode</code>	Deprecated. Instead, use <code>_get_fmode</code> or <code>_set_fmode</code> . Sets default file-translation mode.
<code>_iob</code>	Array of I/O control structures for the console, files, and devices.
<code>_pctype</code> , <code>_pwctype</code> , <code>_wctype</code> , <code>_mbctype</code> , <code>_mbcasemap</code>	Contains information used by the character-classification functions.
<code>_pgmptr</code> , <code>_wpgmptr</code>	Deprecated. Instead, use <code>_get_pgmptr</code> or <code>_get_wpgmptr</code> . Based on how the program is invoked, the runtime initializes these values at program startup: either to the fully qualified or relative path of the program, the full program name, or the program name without its file name extension.

See also

[C runtime library reference](#)

[Global constants](#)

`__argc`, `__argv`, `__wargv`
`_get_daylight`
`_get_dstbias`

```
_get_timezone  
_get_tzname  
perror  
strerror  
_get_doserrno  
_set_doserrno  
_get_errno  
_set_errno  
_dupenv_s , _wdupenv_s  
getenv , _wgetenv  
getenv_s , _wgetenv_s  
_putenv , _wputenv  
_putenv_s , _wputenv_s  
_get_fmode  
_set_fmode
```

`_argc`, `_argv`, `_wargv`

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The `_argc` global variable is a count of the number of command-line arguments passed to the program. `_argv` is a pointer to an array of single-byte-character or multi-byte-character strings that contain the program arguments, and `_wargv` is a pointer to an array of wide-character strings that contain the program arguments. These global variables provide the arguments to `main` or `wmain`.

Syntax

```
extern int _argc;
extern char ** _argv;
extern wchar_t ** _wargv;
```

Remarks

In a program that uses the `main` function, `_argc` and `_argv` are initialized at program startup by using the command line that's used to start the program. The command line is parsed into individual arguments, and wildcards are expanded. The count of arguments is assigned to `_argc` and the argument strings are allocated on the heap, and a pointer to the array of arguments is assigned to `_argv`. In a program compiled to use wide characters and a `wmain` function, the arguments are parsed and wildcards are expanded as wide-character strings, and a pointer to the array of argument strings is assigned to `_wargv`.

For portable code, we recommend you use the arguments passed to `main` to get the command-line arguments in your program.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> NOT DEFINED	<code>_UNICODE</code> DEFINED
<code>_targv</code>	<code>_argv</code>	<code>_wargv</code>

Requirements

GLOBAL VARIABLE	REQUIRED HEADER
<code>_argc</code> , <code>_argv</code> , <code>_wargv</code>	<code><stdlib.h></code> , <code><cstdlib></code> (C++)

`_argc`, `_argv`, and `_wargv` are Microsoft extensions. For compatibility information, see [Compatibility](#).

See also

Global variables

[main function and command-line arguments \(C++\)](#)

[Using `wmain` instead of `main`](#)

`_daylight`, `_dstbias`, `_timezone`, and `_tzname`

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`_daylight`, `_dstbias`, `_timezone`, and `_tzname` are used in some time and date routines to make local-time adjustments. These global variables have been deprecated for the more secure functional versions, which should be used in place of the global variables.

GLOBAL VARIABLE	FUNCTIONAL EQUIVALENT
<code>_daylight</code>	<code>_get_daylight</code>
<code>_dstbias</code>	<code>_get_dstbias</code>
<code>_timezone</code>	<code>_get_timezone</code>
<code>_tzname</code>	<code>_get_tzname</code>

They're declared in Time.h as follows.

Syntax

```
extern int _daylight;
extern int _dstbias;
extern long _timezone;
extern char *_tzname[2];
```

Remarks

On a call to `_ftime`, `localtime`, or `_tzset`, the values of `_daylight`, `_dstbias`, `_timezone`, and `_tzname` are determined from the value of the `TZ` environment variable. If you don't explicitly set the value of `TZ`, `_tzname[0]` and `_tzname[1]` contain the default settings of "PST" and "PDT" respectively. The time-manipulation functions (`_tzset`, `_ftime`, and `localtime`) attempt to set the values of `_daylight`, `_dstbias` and `_timezone` by querying the operating system for the default value of each variable. The time-zone global variable values are shown in the following table.

VARIABLE	VALUE
<code>_daylight</code>	Nonzero if daylight saving time (DST) zone is specified in <code>TZ</code> or determined from the operating system; otherwise, 0. The default value is 1.
<code>_dstbias</code>	Offset for daylight saving time.
<code>_timezone</code>	Difference in seconds between coordinated universal time and local time. The default value is 28,800.
<code>_tzname[0]</code>	Time-zone name derived from the <code>TZ</code> environment variable. The default value is "PST".

VARIABLE	VALUE
<code>_tzname[1]</code>	DST zone name derived from the <code>TZ</code> environment variable. The default value is "PDT" (Pacific daylight time).

See also

Global variables

[_get_daylight](#)
[_get_dstbias](#)
[_get_timezone](#)
[_get_tzname](#)

`errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`

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Global macros that hold error codes that are set during program execution, and string equivalents of the error codes for display.

Syntax

```
#define errno (*_errno())
#define _doserrno (*_doserrno())
#define _sys_errlist (_sys_errlist())
#define _sys_nerr (*_sys_nerr())
```

Remarks

Both `errno` and `_doserrno` are set to 0 by the runtime during program startup. `errno` is set on an error in a system-level call. Because `errno` holds the value for the last call that set it, this value may be changed by succeeding calls. Run-time library calls that set `errno` on an error don't clear `errno` on success. Always clear `errno` by calling `_set_errno(0)` immediately before a call that may set it, and check it immediately after the call.

On an error, `errno` isn't necessarily set to the same value as the error code returned by a system call. For I/O operations, `_doserrno` stores the operating-system error-code equivalents of `errno` codes. For most non-I/O operations, the value of `_doserrno` isn't set.

Each `errno` value is associated with an error message in `_sys_errlist` that can be printed by using one of the `perror` functions, or stored in a string by using one of the `strerror` or `strerror_s` functions. The `perror` and `strerror` functions use the `_sys_errlist` array and `_sys_nerr`—the number of elements in `_sys_errlist`—to process error information. Direct access to `_sys_errlist` and `_sys_nerr` is deprecated for code-security reasons. We recommend that you use the more secure, functional versions instead of the global macros, as shown here:

GLOBAL MACRO	FUNCTIONAL EQUIVALENTS
<code>_doserrno</code>	<code>_get_doserrno</code> , <code>_set_doserrno</code>
<code>errno</code>	<code>_get_errno</code> , <code>_set_errno</code>
<code>_sys_errlist</code> , <code>_sys_nerr</code>	<code>strerror_s</code> , <code>_strerror_s</code> , <code>_wcstrerror_s</code> , <code>___wcstrerror_s</code>

Library math routines set `errno` by calling `_matherr`. To handle math errors differently, write your own routine according to the `_matherr` reference description and name it `_matherr`.

All `errno` values are predefined constants in `<errno.h>`, and are UNIX-compatible. Only `ERANGE`, `EILSEQ`, and `EDOM` are specified in the ISO C99 standard. For a complete list, see [errno constants](#).

Requirements

GLOBAL MACRO	REQUIRED HEADER	OPTIONAL HEADER
<code>errno</code>	<code><errno.h></code> or <code><stdlib.h></code> , <code><cerrno></code> or <code><cstdlib></code> (C++)	
<code>_doserrno</code> , <code>_sys_errlist</code> , <code>_sys_nerr</code>	<code><stdlib.h></code> , <code><cstdlib></code> (C++)	<code><errno.h></code> , <code><cerrno></code> (C++)

The `_doserrno`, `_sys_errlist`, and `_sys_nerr` macros are Microsoft extensions. For more compatibility information, see [Compatibility](#).

See also

Global variables

`errno` constants
`perror`, `_wperror`
`strerror`, `_strerror`, `_wcserror`, `__wcserror`
`strerror_s`, `_strerror_s`, `_wcserror_s`, `__wcserror_s`
`_get_doserrno`
`_set_doserrno`
`_get_errno`
`_set_errno`

`_environ`, `_wenviron`

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The `_environ` variable is a pointer to an array of pointers to the multibyte-character strings that constitute the process environment. This global variable has been deprecated for the more secure functional versions `getenv_s`, `wgetenv_s` and `putenv_s`, `wputenv_s`, which should be used in place of the global variable. `_environ` is declared in `Stdlib.h`.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
extern char **_environ;
```

Remarks

In a program that uses the `main` function, `_environ` is initialized at program startup according to settings taken from the operating-system environment. The environment consists of one or more entries of the form

`ENVVARNAMEx =string`

`getenv_s` and `putenv_s` use the `_environ` variable to access and modify the environment table. When `putenv` is called to add or delete environment settings, the environment table changes size. Its location in memory may also change, depending on the program's memory requirements. The value of `_environ` is automatically adjusted accordingly.

The `_wenviron` variable, declared in `Stdlib.h` as:

```
extern wchar_t **_wenviron;
```

is a wide-character version of `_environ`. In a program that uses the `wmain` function, `_wenviron` is initialized at program startup according to settings taken from the operating-system environment.

In a program that uses `main`, `_wenviron` is initially `NULL` because the environment is composed of multibyte-character strings. On the first call to `wgetenv` or `wputenv`, a corresponding wide-character string environment is created and is pointed to by `_wenviron`.

Similarly, in a program that uses `wmain`, `_environ` is initially `NULL` because the environment is composed of wide-character strings. On the first call to `getenv` or `putenv`, a corresponding multibyte-character string environment is created and is pointed to by `_environ`.

When two copies of the environment (MBCS and Unicode) exist simultaneously in a program, the run-time system must maintain both copies, resulting in slower execution time. For example, whenever you call `putenv`, a call to `wputenv` is also executed automatically, so that the two environment strings correspond.

Caution

In rare instances, when the run-time system is maintaining both a Unicode version and a multibyte version of the environment, these two environment versions might not correspond exactly. This is because, although any unique multibyte-character string maps to a unique Unicode string, the mapping from a unique Unicode string to a multibyte-character string is not necessarily unique. Therefore, two distinct Unicode strings might map to the same multibyte string.

Polling `_environ` in a Unicode context is meaningless when `/MD` or `/MDd` linkage is used. For the CRT DLL, the type (wide or multibyte) of the program is unknown. Only the multibyte type is created because that is the most likely scenario.

The following pseudo-code illustrates how this creation can happen.

```
int i, j;
i = _wputenv( "env_var_x=string1" ); // results in the implicit call:
// putenv ("env_var_z=string1")
j = _wputenv( "env_var_y=string2" ); // also results in implicit call:
// putenv("env_var_z=string2")
```

In the notation used for this example, the character strings aren't C string literals; rather, they're placeholders that represent Unicode environment string literals in the `_wputenv` call and multibyte environment strings in the `putenv` call. The character placeholders '`x`' and '`y`' in the two distinct Unicode environment strings don't map uniquely to characters in the current MBCS. Instead, both map to some MBCS character '`z`' that is the default result of the attempt to convert the strings.

Thus, in the multibyte environment, the value of "`env_var_z`" after the first implicit call to `putenv` would be "`string1`", but this value would be overwritten on the second implicit call to `putenv`, when the value of "`env_var_z`" is set to "`string2`". The Unicode environment (in `_wenviron`) and the multibyte environment (in `_environ`) would therefore differ following this series of calls.

See also

Global variables

`getenv` , `_wgetenv`
`getenv_s` , `_wgetenv_s`
`_putenv` , `_wputenv`
`_putenv_s` , `_wputenv_s`

The `_fmode` variable sets the default file-translation mode for text or binary translation. This global variable has been deprecated for the more secure functional versions `_get_fmode` and `_set_fmode`, which should be used in place of the global variable. It's declared in Stdlib.h as follows.

Syntax

```
extern int _fmode;
```

Remarks

The default setting of `_fmode` is `_O_TEXT` for text-mode translation. `_O_BINARY` is the setting for binary mode.

You can change the value of `_fmode` in three ways:

- Link with Binmode.obj. This object file changes the initial setting of `_fmode` to `_O_BINARY`, causing all files except `stdin`, `stdout`, and `stderr` to be opened in binary mode.
- Make a call to `_get_fmode` or `_set_fmode` to get or set the `_fmode` global variable, respectively.
- Change the value of `_fmode` directly by setting it in your program.

See also

Global variables

[`_get_fmode`](#)[`_set_fmode`](#)



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The array of `stdio` control structures.

Syntax

```
FILE _iob[_IOB_ENTRIES];
```

Remarks

`_IOB_ENTRIES` is defined as 3 in `stdio.h`.

See also

[Global variables](#)

`_pctype`, `_pwctype`, `_wctype`, `_mbctype`,
`_mbcasemap`

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These global variables contain information used by the character classification functions. They are for internal use only.

Syntax

```
extern const unsigned short *_pctype;
extern const wctype_t *_pwctype;
extern const unsigned short _wctype[];
extern unsigned char _mbctype[];
extern unsigned char _mbcasemap[];
```

Remarks

The information in `_pctype`, `_pwctype`, and `_wctype` is used internally by `isupper`, `_isupper_l`, `iswupper`, `_iswupper_l`, `islower`, `_islower`, `iswlower`, `_iswlower_l`, `iswlower_l`, `isdigit`, `_isdigit`, `iswdigit`, `_iswdigit_l`, `iswdigit_l`, `isxdigit`, `_isxdigit`, `iswxdigit`, `_iswxdigit_l`, `isspace`, `_isspace`, `iswspace`, `_iswspace_l`, `iswspace_l`, `isalnum`, `_isalnum`, `iswalnum`, `_iswalnum`, `ispunct`, `_ispunct`, `iswpunct`, `_iswpunct_l`, `iswpunct_l`, `isgraph`, `_isgraph`, `iswgraph`, `_isgraph_l`, `iswgraph_l`, `iscntrl`, `_iscntrl`, `iswcntrl`, `_iswcntrl_l`, `iswcntrl_l`, `toupper`, `_toupper`, `towupper`, `_towupper`, `toupper_l`, `_toupper_l`, `tolower`, `_tolower`, `towlower`, `_towlower_l`, and `_towlower_l` functions. These functions should be used instead of accessing these global variables.

The information in `_mbctype` and `_mbcasemap` is used internally by `_ismbbkalnum`, `_ismbbkalnum_l`, `_ismbbkana`, `_ismbbkana_l`, `_ismbbkpunct`, `_ismbbkpunct_l`, `_ismbbkprint`, `_ismbbkprint_l`, `_ismbbalpha`, `_ismbbpunct`, `_ismbbpunct_l`, `_ismbbalnum`, `_ismbbalnum_l`, `_ismbbprint`, `_ismbbprint_l`, `_ismbbgraph`, `_ismbbgraph_l`, `_ismbblead`, `_ismbblead_l`, `_ismbbtrail`, `_ismbbtrail_l`, `_ismsblead`, `_ismbstrail`, `_ismsblead_l`, `_ismbstrail_l`, `_ismsbleslead`, `_ismbstrail_l`, `_ismsbleslead_l`, and `_ismbstrail_l`. Use these functions instead of accessing the global variables.

Requirements

Not for public use.

See also

`is`, `isw` routines
`_pctype_func`

`_pgmptr`, `_wpgmptr`

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The path of the executable file. Deprecated; use `_get_pgmptr` and `_get_wpgmptr`.

Syntax

```
extern char *_pgmptr;
extern wchar_t *_wpgmptr;
```

Remarks

When a program is run from the command interpreter (Cmd.exe), `_pgmptr` is automatically initialized to the full path of the executable file. For example, if Hello.exe is in C:\BIN and C:\BIN is in the path, `_pgmptr` is set to `C:\BIN\Hello.exe` when you execute:

```
C> hello
```

When a program isn't run from the command line, `_pgmptr` might be initialized to the program name (the file's base name without the file name extension) or to a file name, relative path, or full path.

`_wpgmptr` is the wide-character counterpart of `_pgmptr` for use with programs that use `wmain`.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tpgmptr</code>	<code>_pgmptr</code>	<code>_pgmptr</code>	<code>_wpgmptr</code>

Requirements

VARIABLE	REQUIRED HEADER
<code>_pgmptr</code> , <code>_wpgmptr</code>	<code><stdlib.h></code>

Example

The following program demonstrates the use of `_pgmptr`.

```
// crt_pgmptr.c
// compile with: /W3
// The following program demonstrates the use of _pgmptr.
//
#include <stdio.h>
#include <stdlib.h>
int main( void )
{
    printf("The full path of the executing program is : %Fs\n",
        _pgmptr); // C4996
    // Note: _pgmptr is deprecated; use _get_pgmptr instead
}
```

You could use `_wpgmptr` by changing `%Fs` to `%s` and `main` to `wmain`.

See also

[Global variables](#)

Control flags

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The debug version of the Microsoft C run-time library uses the following flags to control the heap allocation and reporting process. For more information, see [CRT debugging techniques](#).

FLAG	DESCRIPTION
<code>_CRTDBG_MAP_ALLOC</code>	Maps the base heap functions to their debug version counterparts
<code>_DEBUG</code>	Enables the use of the debugging versions of the run-time functions
<code>_crtDbgFlag</code>	Controls how the debug heap manager tracks allocations

These flags can be defined with a /D command-line option or with a `#define` directive. When the flag is defined with `#define`, the directive must appear before the header file `#include` directive for the routine declarations.

See also

[Global variables and standard types](#)

`_CRTDBG_MAP_ALLOC`

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When the `_CRTDBG_MAP_ALLOC` flag is defined in the debug version of an application, the base versions of the heap functions are directly mapped to their debug versions. The flag is used in Crtdbg.h to do the mapping. This flag is only available when the `_DEBUG` flag has been defined in the application.

For more information about using the debug version versus the base version of a heap function, see [Using the debug version versus the base version](#).

See also

[Control flags](#)

`_DEBUG`

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The compiler defines `_DEBUG` when you specify the /MTd or /MDd option. These options specify debug versions of the C run-time library.

For more information, see [CRT debugging techniques](#).

See also

[Control flags](#)

`_crtDbgFlag`

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The `_crtDbgFlag` flag consists of five bit-fields that control how memory allocations on the debug version of the heap are tracked, verified, reported, and dumped. The bit fields of the flag are set using the `_CrtSetDbgFlag` function. This flag and its bit fields are declared in Crtdbg.h. This flag is only available when the `_DEBUG` flag has been defined in the application.

For more information about using this flag along with other debug functions, see [Heap state reporting functions](#).

See also

[Control flags](#)

Standard types

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The Microsoft run-time library defines the following standard types and typedefs.

Fixed-width integral types (`stdint.h`)

NAME	EQUIVALENT BUILT-IN TYPE
<code>int8_t</code> , <code>uint8_t</code>	<code>signed char</code> , <code>unsigned char</code>
<code>int16_t</code> , <code>uint16_t</code>	<code>short</code> , <code>unsigned short</code>
<code>int32_t</code> , <code>uint32_t</code>	<code>int</code> , <code>unsigned int</code>
<code>int64_t</code> , <code>uint64_t</code>	<code>long long</code> , <code>unsigned long long</code>
<code>int_least8_t</code> , <code>uint_least8_t</code>	<code>signed char</code> , <code>unsigned char</code>
<code>int_least16_t</code> , <code>uint_least16_t</code>	<code>short</code> , <code>unsigned short</code>
<code>int_least32_t</code> , <code>uint_least32_t</code>	<code>int</code> , <code>unsigned int</code>
<code>int_least64_t</code> , <code>uint_least64_t</code>	<code>long long</code> , <code>unsigned long long</code>
<code>int_fast8_t</code> , <code>uint_fast8_t</code>	<code>signed char</code> , <code>unsigned char</code>
<code>int_fast16_t</code> , <code>uint_fast16_t</code>	<code>int</code> , <code>unsigned int</code>
<code>int_fast32_t</code> , <code>uint_fast32_t</code>	<code>int</code> , <code>unsigned int</code>
<code>int_fast64_t</code> , <code>uint_fast64_t</code>	<code>long long</code> , <code>unsigned long long</code>
<code>intmax_t</code> , <code>uintmax_t</code>	<code>long long</code> , <code>unsigned long long</code>

TYPE	DESCRIPTION	DECLARED IN
<code>clock_t</code> (long)	Stores time values; used by <code>clock</code> .	<code>TIME.H</code>
<code>_complex</code> structure	Stores real and imaginary parts of complex numbers; used by <code>_cabs</code> .	<code>MATH.H</code>
<code>_CRT_ALLOC_HOOK</code>	A type definition for the user-defined hook function. Used in <code>_CrtSetAllocHook</code> .	<code>CRTDBG.H</code>

TYPE	DESCRIPTION	DECLARED IN
<code>_CRT_DUMP_CLIENT</code> , <code>_CRT_DUMP_CLIENT_M</code>	A type definition for a call-back function that will get called in _CrtMemDumpAllObjectsSince .	<code>CRTDBG.H</code>
<code>_CrtMemState</code> structure	Provides information about the current state of the C run-time debug heap.	<code>CRTDBG.H</code>
<code>_CRT_REPORT_HOOK</code> , <code>_CRT_REPORT_HOOKW</code> , <code>_CRT_REPORT_HOOKW_M</code>	A type definition for a call-back function that will get called in _CrtDbgReport . The parameters for this function are: report type, output message and the return value from the call-back function.	<code>CRTDBG.H</code>
<code>dev_t</code> , <code>_dev_t</code> short or unsigned integer	Represents device handles.	<code>SYS\TYPES.H</code>
<code>_diskfree_t</code> structure	Contains information about a disk drive. Used by _getdiskfree .	<code>DOS.H</code> and <code>DIRECT.H</code>
<code>div_t</code> , <code>ldiv_t</code> and <code>lldiv_t</code> structures	Store values returned by <code>div</code> , <code>ldiv</code> , and <code>lldiv</code> , respectively.	<code>STDLIB.H</code>
<code>errno_t</code> integer	Used for a function return type or parameter that deals with the error codes of <code>errno</code> .	<code>STDDEF.H</code> , <code>CRTDEFS.H</code>
<code>_exception</code> structure	Stores error information for _matherr .	<code>MATH.H</code>
<code>_EXCEPTION_POINTERS</code>	Contains an exception record. For more information, see EXCEPTION_POINTERS .	<code>FPIEEE.H</code>
<code>FILE</code> structure	Stores information about current state of stream; used in all stream I/O operations.	<code>STDIO.H</code>
<code>_finddata_t</code> , <code>_wfinddata_t</code> , <code>_finddata32_t</code> , <code>_wfinddata32_t</code> , <code>_finddatai64_t</code> , <code>_wfinddatai64_t</code> , <code>_finddata64_t</code> , <code>_wfinddata64_t</code> , <code>_finddata32i64_t</code> , <code>_wfinddata32i64_t</code> , <code>_finddata64i32_t</code> , <code>_wfinddata64i32_t</code> structures	Store file-attribute information returned by _findfirst , _wfindfirst , and related functions and _findnext , _wfindnext and related functions. See Filename search functions for information on structure members.	<code>IO.H</code> , <code>WCHAR.H</code>
<code>_FPIEEE_RECORD</code> structure	Contains information pertaining to IEEE floating-point exception; passed to user-defined trap handler by _fpieee_flt .	<code>FPIEEE.H</code>

TYPE	DESCRIPTION	DECLARED IN
<code>fpos_t</code> (<code>long integer</code> , <code>__int64</code> , or structure, depending on the target platform)	Used by <code>fgetpos</code> and <code>fsetpos</code> to record information for uniquely specifying every position within a file.	<code>STDIO.H</code>
<code>_fsize_t</code> (<code>unsigned long integer</code>)	Used to represent the size of a file.	<code>I0.H</code> , <code>WCHAR.H</code>
<code>_HEAPINFO</code> structure	Contains information about next heap entry for <code>heapwalk</code> .	<code>MALLOC.H</code>
<code>_HFILE</code> (<code>void *</code>)	An operating system file handle.	<code>CRTDBG.H</code>
<code>imaxdiv_t</code>	The type of value that's returned by the <code>imaxdiv</code> function, containing both the quotient and the remainder.	<code>inttypes.h</code>
<code>ino_t</code> , <code>_ino_t</code> (<code>unsigned short</code>)	For returning status information.	<code>WCHAR.H</code>
<code>intmax_t</code>	A signed integer type capable of representing any value of any signed integer type.	<code>stdint.h</code>
<code>intptr_t</code> (<code>long integer</code> or <code>__int64</code> , depending on the target platform)	Stores a pointer (or <code>HANDLE</code>) on both Win32 and Win64 platforms.	<code>STDDEF.H</code> and other include files
<code>jmp_buf</code> array	Used by <code>setjmp</code> and <code>longjmp</code> to save and restore program environment.	<code>SETJMP.H</code>
<code>lconv</code> structure	Contains formatting rules for numeric values in different countries/regions. Used by <code>localeconv</code> .	<code>LOCALE.H</code>
<code>_LDOUBLE</code> , <code>_LONGDOUBLE</code> , <code>_LDBL12</code> (long double or an unsigned char array)	Use to represent a long double value.	<code>STDLIB.H</code>
<code>_locale_t</code> structure	Stores current locale values; used in all locale specific C run-time libraries.	<code>CRTDEFS.H</code>
<code>mbstate_t</code>	Tracks the state of a multibyte character conversion.	<code>WCHAR.H</code>
<code>off_t</code> , <code>_off_t</code> <code>long integer</code>	Represents file-offset value.	<code>WCHAR.H</code> , <code>SYS\TYPES.H</code>
<code>_onexit_t</code> , <code>_onexit_m_t</code> pointer	Returned by <code>_onexit</code> , <code>_onexit_m</code> .	<code>STDLIB.H</code>

TYPE	DESCRIPTION	DECLARED IN
<code>_PNH</code> pointer to function	Type of argument to <code>_set_new_handler</code> .	<code>NEW.H</code>
<code>ptrdiff_t</code> (long integer or <code>_int64</code> , depending on the target platform)	Result of subtraction of two pointers.	<code>CRTDEFS.H</code>
<code>_purecall_handler</code> , <code>_purecall_handler_m</code>	A type definition for a call-back function that is called when a pure virtual function is called. Used by <code>_get_purecall_handler</code> , <code>_set_purecall_handler</code> . A <code>_purecall_handler</code> function should have a void return type.	<code>STDLIB.H</code>
<code>_RTC_error_fn</code> type definition	A type definition for a function that will handle run-time error checks. Used in <code>_RTC_SetErrorFunc</code> .	<code>RTCAPI.H</code>
<code>_RTC_error_fnw</code> type definition	A type definition for a function that will handle run-time error checks. Used in <code>_RTC_SetErrorFuncW</code> .	<code>RTCAPI.H</code>
<code>_RTC_ErrorNumber</code> enumeration	Defines error conditions for <code>_RTC_GetErrDesc</code> and <code>_RTC_SetErrorType</code> .	<code>RTCAPI.H</code>
<code>_se_translator_function</code>	A type definition for a call-back function that translates an exception. The first parameter is the exception code and the second parameter is the exception record. Used by <code>_set_se_translator</code> .	<code>EH.H</code>
<code>sig_atomic_t</code> integer	Type of object that can be modified as atomic entity, even in presence of asynchronous interrupts; used with <code>signal</code> .	<code>SIGNAL.H</code>
<code>size_t</code> (<code>unsigned __int64</code> or <code>unsigned integer</code> , depending on the target platform)	Result of <code>sizeof</code> operator.	<code>CRTDEFS.H</code> and other include files
<code>_stat</code> structure	Contains file-status information returned by <code>_stat</code> and <code>_fstat</code> .	<code>SYS\STAT.H</code>
<code>_stat64</code> structure	Contains file-status information returned by <code>_fstat64</code> and <code>_stat64</code> , and <code>_wstat64</code> .	<code>SYS\STAT.H</code>
<code>_stati64</code> structure	Contains file-status information returned by <code>_fstat64</code> , <code>_stati64</code> , and <code>_wstati64</code> .	<code>SYS\STAT.H</code>

TYPE	DESCRIPTION	DECLARED IN
<code>terminate_function</code> type definition	A type definition for a call-back function that is called when <code>terminate</code> is called. Used by <code>set_terminate</code> .	<code>EH.H</code>
<code>time_t</code> (<code>__int64</code> or <code>long integer</code>)	Represents time values in <code>mktime</code> , <code>time</code> , <code>ctime</code> , <code>_ctime32</code> , <code>_ctime64</code> , <code>_wctime</code> , <code>_wctime32</code> , <code>_wctime64</code> , <code>ctime_s</code> , <code>_ctime32_s</code> , <code>_ctime64_s</code> , <code>_wctime_s</code> , <code>_wctime32_s</code> , <code>_wctime64_s</code> , <code>ctime</code> , <code>_ctime32</code> , <code>_ctime64</code> , <code>_wctime</code> , <code>_wctime32</code> , <code>_wctime64</code> and <code>gmtime</code> , <code>gmtime32</code> , <code>gmtime64</code> . The number of seconds since January 1, 1970, 0:00 UTC. If <code>_USE_32BIT_TIME_T</code> is defined, <code>time_t</code> is a long integer. If not defined, it's a 64-bit integer.	<code>TIME.H</code> , <code>SYS\STAT.H</code> , <code>SYS\TIMEB.H</code>
<code>_time32_t</code> (<code>long integer</code>)	Represents time values in <code>mktime</code> , <code>_mktime32</code> , <code>_mktime64</code> , <code>ctime</code> , <code>_ctime32</code> , <code>_ctime64</code> , <code>_wctime</code> , <code>_wctime32</code> , <code>_wctime64</code> , <code>ctime_s</code> , <code>_ctime32_s</code> , <code>_ctime64_s</code> , <code>_wctime_s</code> , <code>_wctime32_s</code> , <code>_wctime64_s</code> , <code>gmtime</code> , <code>gmtime32</code> , <code>gmtime64</code> and <code>localtime</code> , <code>_localtime32</code> , <code>_localtime64</code> .	<code>CRTDEFS.H</code> , <code>SYS\STAT.H</code> , <code>SYS\TIMEB.H</code>
<code>_time64_t</code> (<code>__int64</code>)	Represents time values in <code>mktime</code> , <code>_mktime32</code> , <code>_mktime64</code> , <code>_ctime64</code> , <code>_wctime64</code> , <code>ctime_s</code> , <code>_ctime32_s</code> , <code>_ctime64_s</code> , <code>_wctime_s</code> , <code>_wctime32_s</code> , <code>_wctime64_s</code> , <code>gmtime64</code> , <code>_localtime64</code> and <code>_time64</code> .	<code>TIME.H</code> , <code>SYS\STAT.H</code> , <code>SYS\TIMEB.H</code>
<code>_timeb</code> structure	The <code>_ftime</code> and <code>_ftime_s</code> , <code>_ftime32_s</code> , <code>_ftime64_s</code> functions use it to store current system time.	<code>SYS\TIMEB.H</code>
<code>_timeb32</code> structure	The <code>_ftime</code> , <code>_ftime32</code> , <code>_ftime64</code> and <code>_ftime_s</code> , <code>_ftime32_s</code> , <code>_ftime64_s</code> functions use it to store current system time.	<code>SYS\TIMEB.H</code>
<code>_timeb64</code> structure	The <code>_ftime64</code> and <code>_ftime_s</code> , <code>_ftime32_s</code> , <code>_ftime64_s</code> functions use it to store current system time.	<code>SYS\TIMEB.H</code>

TYPE	DESCRIPTION	DECLARED IN
<code>tm</code> structure	The <code>asctime</code> , <code>_wasctime</code> , <code>asctime_s</code> , <code>_wasctime_s</code> , <code>gmtime</code> , <code>_gmtime32</code> , <code>_gmtime64</code> , <code>gmtime_s</code> , <code>_gmtime32_s</code> , <code>_gmtime64_s</code> , <code>localtime</code> , <code>_localtime32</code> , <code>_localtime64</code> , <code>localtime_s</code> , <code>_localtime32_s</code> , <code>_localtime64_s</code> , <code>mktime</code> , <code>_mktime32</code> , <code>_mktime64</code> and <code>strftime</code> , <code>wcsftime</code> , <code>_strftime_l</code> , <code>_wcsftime_l</code> functions use it to store and retrieve time information.	<code>TIME.H</code>
<code>uintmax_t</code>	An <code>unsigned integer</code> type capable of representing any value of any <code>unsigned integer</code> type.	<code>stdint.h</code>
<code>uintptr_t</code> (<code>long integer</code> or <code>_int64</code> , depending on the target platform)	An <code>unsigned integer</code> or <code>unsigned __int64</code> version of <code>intptr_t</code> .	<code>STDDEF.H</code> and other include files
<code>unexpected_function</code>	A type definition for a call-back function that is called when <code>unexpected</code> is called. Used by <code>set_unexpected</code> .	<code>EH.H</code>
<code>_utimbuf</code> structure	Stores file access and modification times used by <code>_utime</code> , <code>_wutime</code> and <code>_futime</code> , <code>_futime32</code> , <code>_futime64</code> to change file-modification dates.	<code>SYS\UTIME.H</code>
<code>_utimbuf32</code> structure	Stores file access and modification times used by <code>_utime</code> , <code>_utime32</code> , <code>_utime64</code> , <code>_wutime</code> , <code>_wutime32</code> , <code>_wutime64</code> and <code>_futime</code> , <code>_futime32</code> , <code>_futime64</code> to change file-modification dates.	<code>SYS\UTIME.H</code>
<code>_utimbuf64</code> structure	The <code>_utime64</code> , <code>_wutime64</code> and <code>_futime64</code> functions use it to store the current time.	<code>SYS\UTIME.H</code>
<code>va_list</code> structure	Used to hold information needed by <code>va_arg</code> and <code>va_end</code> macros. Called function declares variable of type <code>va_list</code> that can be passed as argument to another function.	<code>STDARG.H</code> , <code>CRTDEFS.H</code>
<code>wchar_t</code> wide character	Useful for writing portable programs for international markets.	<code>STDDEF.H</code> , <code>STDLIB.H</code> , <code>CRTDEFS.H</code> , <code>SYS\STAT.H</code>

TYPE	DESCRIPTION	DECLARED IN
<code>wctrans_t</code> integer	Represents locale-specific character mappings.	<code>WCTYPE.H</code>
<code>wctype_t</code> integer	Can represent all characters of any language character set.	<code>WCHAR.H</code> , <code>CRTDEFS.H</code>
<code>wint_t</code> integer	Type of data object that can hold any wide character or wide end-of-file value.	<code>WCHAR.H</code> , <code>CRTDEFS.H</code>

See also

[C runtime library reference](#)

Global constants

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The Microsoft run-time library contains definitions for global constants used by library routines. To use these constants, include the appropriate header files as indicated in the description for each constant. The global constant articles follow in this section.

Global constant articles

[32-Bit Windows Time/Date Formats](#)

[BUFSIZ](#)

[CLOCKS_PER_SEC](#), [CLK_TCK](#)

[Commit-to-disk constants](#)

[_CRT_DISABLE_PERFCRIT_LOCKS](#)

[Data type constants](#)

[Environmental constants](#)

[EOF](#), [WEOF](#)

[errno constants](#)

[Exception-handling constants](#)

[EXIT_SUCCESS](#), [EXIT_FAILURE](#)

[File attribute constants](#)

[File constants](#)

[File permission constants](#)

[File read/write access constants](#)

[File translation constants](#)

[FILENAME_MAX](#)

[FOPEN_MAX](#), [_SYS_OPEN](#)

[_FREEENTRY](#), [_USEDENTRY](#)

[fseek](#), [_lseek](#) constants

[Heap constants](#)

[_HEAP_MAXREQ](#)

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[Locale categories](#)

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[_MAX_ENV](#)

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[Path field limits](#)

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[setvbuf constants](#)

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[signal constants](#)

[signal action constants](#)

[spawn constants](#)

[_stat structure](#) [st_mode](#) field constants

[stdin](#), [stdout](#), [stderr](#)

[TMP_MAX](#) , [L_tmpnam](#)

Translation mode constants

[_TRUNCATE](#)

[TZNAME_MAX](#)

[_WAIT_CHILD](#) , [_WAIT_GRANDCHILD](#)

[WCHAR_MAX](#)

[WCHAR_MIN](#)

See also

[C runtime library reference](#)

[Global variables](#)

[Considerations for writing prolog/epilog code](#)

32-Bit Windows time/date formats

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The file time and the date are stored individually, using unsigned integers as bit fields. File time and date are packed as follows:

Time

BIT POSITION:	0 1 2 3 4	5 6 7 8 9 A	B C D E F
Length:	5	6	5
Contents:	hours	minutes	2-second increments
Value Range:	0-23	0-59	0-29 in 2-second intervals

Date

BIT POSITION:	0 1 2 3 4 5 6	7 8 9 A	B C D E F
Length:	7	4	5
Contents:	year	month	day
Value Range:	0-119	1-12	1-31
	(relative to 1980)		

See also

[Global constants](#)

BUFSIZ

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Syntax

```
#include <stdio.h>
```

Remarks

`BUFSIZ` is the required user-allocated buffer for the `setvbuf` routine.

See also

[Stream I/O](#)

[Global constants](#)

`CLOCKS_PER_SEC`, `CLK_TCK`

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Syntax

```
#include <time.h>
```

Remarks

The time in seconds is the value returned by the `clock` function, divided by `CLOCKS_PER_SEC`. `CLK_TCK` is equivalent, but considered obsolete.

See also

`clock`

[Global constants](#)

Commit-to-disk constants

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Microsoft Specific

Syntax

```
#include <stdio.h>
```

Remarks

These Microsoft-specific constants specify whether the buffer associated with the open file is flushed to operating system buffers or to disk. The mode is included in the string specifying the type of read/write access ("r", "w", "a", "r+", "w+", "a+").

The commit-to-disk modes are as follows:

- **c**

Writes the unwritten contents of the specified buffer to disk. This commit-to-disk functionality only occurs at explicit calls to either the `fflush` or the `_flushall` function. This mode is useful when dealing with sensitive data. For example, if your program terminates after a call to `fflush` or `_flushall`, you can be sure that your data reached the operating system's buffers. However, unless a file is opened with the **c** option, the data might never make it to disk if the operating system also terminates.

- **n**

Writes the unwritten contents of the specified buffer to the operating system's buffers. The operating system can cache data and then determine an optimal time to write to disk. Under many conditions, this behavior makes for efficient program behavior. However, if the retention of data is critical (such as bank transactions or airline ticket information) consider using the **c** option. The **n** mode is the default.

NOTE

The **c** and **n** options are not part of the ANSI standard for `fopen`, but are Microsoft extensions and should not be used where ANSI portability is desired.

Using the commit-to-disk feature with existing code

By default, calls to the `fflush` or `_flushall` library functions write data to buffers maintained by the operating system. The operating system determines the optimal time to actually write the data to disk. The commit-to-disk feature of the run-time library lets you ensure that critical data is written directly to disk rather than to the operating system's buffers. You can give this capability to an existing program without rewriting it by linking its object files with COMMODE.OBJ.

In the resulting executable file, calls to `fflush` write the contents of the buffer directly to disk, and calls to `_flushall` write the contents of all buffers to disk. These two functions are the only ones affected by COMMODE.OBJ.

END Microsoft Specific

See also

Stream I/O

[_fdopen](#) , [_wfopen](#)

[fopen](#) , [_wfopen](#)

Global constants

_CRT_DISABLE_PERFCRIT_LOCKS

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Disables performance-critical locking in I/O operations.

Syntax

```
#define _CRT_DISABLE_PERFCRIT_LOCKS
```

Remarks

Defining this symbol can improve performance in single-threaded I/O-bound programs by forcing all I/O operations to assume a single-threaded I/O model. For more information, see [Multithreaded libraries performance](#).

See also

[Global constants](#)

Data type constants

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Data type constants are implementation-dependent ranges of values allowed for integral and floating-point data types.

Integral type constants

These constants give the ranges for the integral data types. To use these constants, include the limits.h header in your source file:

```
#include <limits.h>
```

NOTE

The `/J` compiler option changes the default `char` type from `signed char` to `unsigned char`.

CONSTANT	VALUE	DESCRIPTION
<code>CHAR_BIT</code>	8	Number of bits in a <code>char</code>
<code>SCHAR_MIN</code>	(-128)	Minimum <code>signed char</code> value
<code>SCHAR_MAX</code>	127	Maximum <code>signed char</code> value
<code>UCHAR_MAX</code>	255 (0xff)	Maximum <code>unsigned char</code> value
<code>CHAR_MIN</code>	(-128) (0 if <code>/J</code> option used)	Minimum <code>char</code> value
<code>CHAR_MAX</code>	127 (255 if <code>/J</code> option used)	Maximum <code>char</code> value
<code>MB_LEN_MAX</code>	5	Maximum number of bytes in multibyte <code>char</code>
<code>SHRT_MIN</code>	-32768	Minimum <code>signed short</code> value
<code>SHRT_MAX</code>	32767	Maximum <code>signed short</code> value
<code>USHRT_MAX</code>	65535 (0xffff)	Maximum <code>unsigned short</code> value
<code>INT_MIN</code>	(-2147483647 - 1)	Minimum <code>signed int</code> value
<code>INT_MAX</code>	2147483647	Maximum <code>signed int</code> value
<code>UINT_MAX</code>	4294967295 (0xffffffff)	Maximum <code>unsigned int</code> value

CONSTANT	VALUE	DESCRIPTION
<code>LONG_MIN</code>	(-2147483647L - 1)	Minimum <code>signed long</code> value
<code>LONG_MAX</code>	2147483647L	Maximum <code>signed long</code> value
<code>ULONG_MAX</code>	4294967295UL (0xfffffffful)	Maximum <code>unsigned long</code> value
<code>LLONG_MIN</code>	(-9223372036854775807LL - 1)	Minimum <code>signed long long</code> or <code>_int64</code> value
<code>LLONG_MAX</code>	9223372036854775807LL	Maximum <code>signed long long</code> or <code>_int64</code> value
<code>ULLONG_MAX</code>	0xfffffffffffffffffffffull	Maximum <code>unsigned long long</code> value
<code>_I8_MIN</code>	(-127i8 - 1)	Minimum signed 8-bit value
<code>_I8_MAX</code>	127i8	Maximum signed 8-bit value
<code>_UI8_MAX</code>	0xffui8	Maximum unsigned 8-bit value
<code>_I16_MIN</code>	(-32767i16 - 1)	Minimum signed 16-bit value
<code>_I16_MAX</code>	32767i16	Maximum signed 16-bit value
<code>_UI16_MAX</code>	0xffffui16	Maximum unsigned 16-bit value
<code>_I32_MIN</code>	(-2147483647i32 - 1)	Minimum signed 32-bit value
<code>_I32_MAX</code>	2147483647i32	Maximum signed 32-bit value
<code>_UI32_MAX</code>	0xffffffffui32	Maximum unsigned 32-bit value
<code>_I64_MIN</code>	(-9223372036854775807 - 1)	Minimum signed 64-bit value
<code>_I64_MAX</code>	9223372036854775807	Maximum signed 64-bit value
<code>_UI64_MAX</code>	0xffffffffffffffffui64	Maximum unsigned 64-bit value
<code>_I128_MIN</code>	(-170141183460469231731687303715884105727i128 - 1)	Minimum signed 128-bit value
<code>_I128_MAX</code>	170141183460469231731687303715884105727i128	Maximum signed 128-bit value
<code>_UI128_MAX</code>	0xffffffffffffffffffffffffffui128	Maximum unsigned 128-bit value
<code>SIZE_MAX</code>	same as <code>_UI64_MAX</code> if <code>_WIN64</code> is defined, or <code>UINT_MAX</code>	Maximum native integer size

CONSTANT	VALUE	DESCRIPTION
<code>RSIZE_MAX</code>	same as (<code>SIZE_MAX</code> >> 1)	Maximum secure library integer size

Floating-point type constants

The following constants give the range and other characteristics of the `long double`, `double` and `float` data types. To use these constants, include the `float.h` header in your source file:

```
#include <float.h>
```

CONSTANT	VALUE	DESCRIPTION
<code>DBL_DECIMAL_DIG</code>	17	# of decimal digits of rounding precision
<code>DBL_DIG</code>	15	# of decimal digits of precision
<code>DBL_EPSILON</code>	2.2204460492503131e-016	Smallest such that $1.0 + \text{DBL_EPSILON} \neq 1.0$
<code>DBL_HAS_SUBNORM</code>	1	Type supports subnormal (denormal) numbers
<code>DBL_MANT_DIG</code>	53	# of bits in significand (mantissa)
<code>DBL_MAX</code>	1.7976931348623158e+308	Maximum value
<code>DBL_MAX_10_EXP</code>	308	Maximum decimal exponent
<code>DBL_MAX_EXP</code>	1024	Maximum binary exponent
<code>DBL_MIN</code>	2.2250738585072014e-308	Minimum normalized positive value
<code>DBL_MIN_10_EXP</code>	(-307)	Minimum decimal exponent
<code>DBL_MIN_EXP</code>	(-1021)	Minimum binary exponent
<code>_DBL_RADIX</code>	2	Exponent radix
<code>DBL_TRUE_MIN</code>	4.9406564584124654e-324	Minimum positive subnormal value
<code>FLT_DECIMAL_DIG</code>	9	Number of decimal digits of rounding precision
<code>FLT_DIG</code>	6	Number of decimal digits of precision
<code>FLT_EPSILON</code>	1.192092896e-07F	Smallest such that $1.0 + \text{FLT_EPSILON} \neq 1.0$

CONSTANT	VALUE	DESCRIPTION
<code>FLT_HAS_SUBNORM</code>	1	Type supports subnormal (denormal) numbers
<code>FLT_MANT_DIG</code>	24	Number of bits in significand (mantissa)
<code>FLT_MAX</code>	3.402823466e+38F	Maximum value
<code>FLT_MAX_10_EXP</code>	38	Maximum decimal exponent
<code>FLT_MAX_EXP</code>	128	Maximum binary exponent
<code>FLT_MIN</code>	1.175494351e-38F	Minimum normalized positive value
<code>FLT_MIN_10_EXP</code>	(-37)	Minimum decimal exponent
<code>FLT_MIN_EXP</code>	(-125)	Minimum binary exponent
<code>FLT_RADIX</code>	2	Exponent radix
<code>FLT_TRUE_MIN</code>	1.401298464e-45F	Minimum positive subnormal value
<code>LDBL_DIG</code>	15	# of decimal digits of precision
<code>LDBL_EPSILON</code>	2.2204460492503131e-016	Smallest such that $1.0 + \text{LDBL_EPSILON} \neq 1.0$
<code>LDBL_HAS_SUBNORM</code>	1	Type supports subnormal (denormal) numbers
<code>LDBL_MANT_DIG</code>	53	# of bits in significand (mantissa)
<code>LDBL_MAX</code>	1.7976931348623158e+308	Maximum value
<code>LDBL_MAX_10_EXP</code>	308	Maximum decimal exponent
<code>LDBL_MAX_EXP</code>	1024	Maximum binary exponent
<code>LDBL_MIN</code>	2.2250738585072014e-308	Minimum normalized positive value
<code>LDBL_MIN_10_EXP</code>	(-307)	Minimum decimal exponent
<code>LDBL_MIN_EXP</code>	(-1021)	Minimum binary exponent
<code>_LDBL_RADIX</code>	2	Exponent radix
<code>LDBL_TRUE_MIN</code>	4.9406564584124654e-324	Minimum positive subnormal value

CONSTANT	VALUE	DESCRIPTION
<code>DECIMAL_DIG</code>	same as <code>DBL_DECIMAL_DIG</code>	Default (double) decimal digits of rounding precision

See also

[Global constants](#)

Environmental constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <stdlib.h>
```

Remarks

The `_MAX_ENV` constant defines the environmental length for strings.

CONSTANT	MEANING
<code>_MAX_ENV</code>	Maximum string size of an environmental string.

See also

[Global constants](#)

`EOF`, `WEOF`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <stdio.h>
```

Remarks

`EOF` is returned by an I/O routine when the end-of-file (or in some cases, an error) is encountered.

`WEOF` yields the return value, of type `wint_t`, used to signal the end of a wide stream, or to report an error condition.

See also

`putc`, `putwc`
`ungetc`, `ungetwc`
`scanf`, `_scanf_l`, `wscanf`, `_wscanf_l`
`fflush`
`fclose`, `_fcloseall`
`_ungetch`, `_ungetwch`, `_ungetch_nolock`, `_ungetwch_nolock`
`_putch`, `_putwch`
`isascii`, `_isascii`, `iswascii`

[Global constants](#)

errno constants

11/2/2022 • 4 minutes to read • [Edit Online](#)

Syntax

```
#include <errno.h>
```

Remarks

The `errno` constants are values assigned to `errno` for various error conditions.

`ERRNO.H` contains the definitions of the `errno` values. However, not all the definitions given in `ERRNO.H` are used in 32-bit Windows operating systems. Some of the values in `ERRNO.H` are present to maintain compatibility with the UNIX family of operating systems. The `errno` values in a 32-bit Windows operating system are a subset of the values for `errno` in UNIX systems.

The `errno` value isn't necessarily the same as the actual error code returned by a system call from the Windows operating system. To access the actual operating system error code, use the `_doserrno` variable, which contains this value.

The following `errno` values are supported:

CONSTANT	DESCRIPTION	VALUE
<code>E2BIG</code>	Argument list too long.	7
<code>EACCES</code>	<p>Permission denied. The file's permission setting doesn't allow the specified access. An attempt was made to access a file (or, in some cases, a directory) in a way that's incompatible with the file's attributes.</p> <p>For example, the error can occur when an attempt is made to read from a file that isn't open. Or, on an attempt to open an existing read-only file for writing, or to open a directory instead of a file. Under MS-DOS operating system versions 3.0 and later, <code>EACCES</code> may also indicate a locking or sharing violation.</p> <p>The error can also occur in an attempt to rename a file or directory or to remove an existing directory.</p>	13

CONSTANT	DESCRIPTION	VALUE
EAGAIN	No more processes or not enough memory or maximum nesting level reached. An attempt to create a new process failed because there are no more process slots, or there isn't enough memory, or the maximum nesting level has been reached.	11
EBADF	Bad file number. There are two possible causes: 1) The specified file descriptor isn't a valid value or doesn't refer to an open file. 2) An attempt was made to write to a file or device opened for read-only access.	9
EBUSY	Device or resource busy.	16
ECHILD	No spawned processes.	10
EDEADLK	Resource deadlock would occur.	36
EDEADLOCK	Same as EDEADLK for compatibility with older Microsoft C versions.	36
EDOM	Math argument. The argument to a math function isn't in the domain of the function.	33
EEXIST	File exists. An attempt has been made to create a file that already exists. For example, the _O_CREAT and _O_EXCL flags are specified in an open call, but the named file already exists.	17
EFAULT	Bad address.	14
EFBIG	File too large.	27
EILSEQ	Illegal sequence of bytes (for example, in an MBCS string).	42
EINTR	Interrupted function.	4
EINVAL	Invalid argument. An invalid value was given for one of the arguments to a function. For example, the value given for the origin when positioning a file pointer (by a call to fseek) is before the beginning of the file.	22
EIO	I/O error.	5
EISDIR	Is a directory.	21

CONSTANT	DESCRIPTION	VALUE
<code>EMFILE</code>	Too many open files. No more file descriptors are available, so no more files can be opened.	24
<code>EMLINK</code>	Too many links.	31
<code>ENAMETOOLONG</code>	Filename too long.	38
<code>ENFILE</code>	Too many files open in system.	23
<code>ENODEV</code>	No such device.	19
<code>ENOENT</code>	No such file or directory. The specified file or directory doesn't exist or can't be found. This message can occur whenever a specified file doesn't exist or a component of a path doesn't specify an existing directory.	2
<code>ENOEXEC</code>	Exec format error. An attempt was made to execute a file that isn't executable or that has an invalid executable-file format.	8
<code>ENOLCK</code>	No locks available.	39
<code>ENOMEM</code>	Not enough memory is available for the attempted operator. For example, this message can occur when insufficient memory is available to execute a child process, or when the allocation request in a <code>_getcwd</code> call can't be satisfied.	12
<code>ENOSPC</code>	No space left on device. No more space for writing is available on the device (for example, when the disk is full).	28
<code>ENOSYS</code>	Function not supported.	40
<code>ENOTDIR</code>	Not a directory.	20
<code>ENOTEMPTY</code>	Directory not empty.	41
<code>ENOTTY</code>	Inappropriate I/O control operation.	25
<code>ENXIO</code>	No such device or address.	6
<code>EPERM</code>	Operation not permitted.	1
<code>EPIPE</code>	Broken pipe.	32

CONSTANT	DESCRIPTION	VALUE
<code>ERANGE</code>	Result too large. An argument to a math function is too large, resulting in partial or total loss of significance in the result. This error can also occur in other functions when an argument is larger than expected (for example, when the <code>buffer</code> argument to <code>_getcwd</code> is longer than expected).	34
<code>EROFS</code>	Read only file system.	30
<code>ESPIPE</code>	Invalid seek.	29
<code>ESRCH</code>	No such process.	3
<code>EXDEV</code>	Cross-device link. An attempt was made to move a file to a different device (using the <code>rename</code> function).	18
<code>STRUNCATE</code>	A string copy or concatenation resulted in a truncated string. See _TRUNCATE .	80

The following values are supported for compatibility with POSIX:

CONSTANT	DESCRIPTION	VALUE
<code>EADDRINUSE</code>	Address in use.	100
<code>EADDRNOTAVAIL</code>	Address not available.	101
<code>EAFNOSUPPORT</code>	Address family not supported.	102
<code>EALREADY</code>	Connection already in progress.	103
<code>EBADMSG</code>	Bad message.	104
<code>ECANCELED</code>	Operation canceled.	105
<code>ECONNABORTED</code>	Connection aborted.	106
<code>ECONNREFUSED</code>	Connection refused.	107
<code>ECONNRESET</code>	Connection reset.	108
<code>EDESTADDRREQ</code>	Destination address required.	109
<code>EHOSTUNREACH</code>	Host unreachable.	110
<code>EIDRM</code>	Identifier removed.	111

CONSTANT	DESCRIPTION	VALUE
EINPROGRESS	Operation in progress.	112
EISCONN	Already connected.	113
ELOOP	Too many symbolic link levels.	114
EMSGSIZE	Message size.	115
ENETDOWN	Network down.	116
ENETRESET	Network reset.	117
ENETUNREACH	Network unreachable.	118
ENOBUFS	No buffer space.	119
ENODATA	No message available.	120
ENOLINK	No link.	121
ENOMSG	No message.	122
ENOPROTOOPT	No protocol option.	123
ENOSR	No stream resources.	124
ENOSTR	Not a stream.	125
ENOTCONN	Not connected.	126
ENOTRECOVERABLE	State not recoverable.	127
ENOTSOCK	Not a socket.	128
ENOTSUP	Not supported.	129
EOPNOTSUPP	Operation not supported.	130
EOTHER	Other.	131
EOVERFLOW	Value too large.	132
EOWNERDEAD	Owner dead.	133
EPROTO	Protocol error.	134
EPROTONOSUPPORT	Protocol not supported.	135

CONSTANT	DESCRIPTION	VALUE
EPROTOTYPE	Wrong protocol type.	136
ETIME	Stream timeout.	137
ETIMEDOUT	Timed out.	138
ETXTBSY	Text file busy.	139
EWOULD_BLOCK	Operation would block.	140

See also

[Global constants](#)

Exception-handling constants

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The constant `EXCEPTION_CONTINUE_SEARCH`, `EXCEPTION_CONTINUE_EXECUTION`, or `EXCEPTION_EXECUTE_HANDLER` is returned when an exception occurs during execution of the guarded section of a `try-except` statement. The return value determines how the exception is handled. For more information, see [try-except Statement](#) in the *C++ Language Reference*.

See also

[Global constants](#)

`EXIT_SUCCESS`, `EXIT_FAILURE`

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Required header

```
#include <stdlib.h>
```

Remarks

The `EXIT_SUCCESS` and `EXIT_FAILURE` constants are arguments for the `exit` and `_exit` functions, and the return values for the `atexit` and `_onexit` functions.

CONSTANT	DEFINED VALUE
<code>EXIT_SUCCESS</code>	0
<code>EXIT_FAILURE</code>	1

See also

[Global constants](#)

File attribute constants

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Syntax

```
#include <io.h>
```

Remarks

These constants specify the current attributes of the file or directory specified by the function.

The attributes are represented by the following manifest constants:

CONSTANT	DESCRIPTION
_A_ARCH	Archive. Set whenever the file is changed, and cleared by the BACKUP command. Value: 0x20
_A_HIDDEN	Hidden file. Not normally seen with the DIR command, unless the /AH option is used. Returns information about both normal files and files with this attribute. Value: 0x02
_A_NORMAL	Normal. File can be read or written to without restriction. Value: 0x00
_A_RDONLY	Read-only. File can't be opened for writing, and a file with the same name can't be created. Value: 0x01
_A_SUBDIR	Subdirectory. Value: 0x10
_A_SYSTEM	System file. Not normally seen with the DIR command, unless the /AS option is used. Value: 0x04

Multiple constants can be combined with the OR operator (|).

See also

[Filename search functions](#)

[Global constants](#)

File constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <fcntl.h>
```

Remarks

The integer expression formed from one or more of these constants determines the type of reading or writing operations permitted. It's formed by combining one or more constants with a translation-mode constant.

The file constants are as follows:

CONSTANT	DESCRIPTION
<code>_O_APPEND</code>	Repositions the file pointer to the end of the file before every write operation.
<code>_O_CREAT</code>	Creates and opens a new file for writing; the constant has no effect if the file specified by <code>filename</code> exists.
<code>_O_EXCL</code>	Returns an error value if the file specified by <code>filename</code> exists. Only applies when used with <code>_O_CREAT</code> .
<code>_O_RDONLY</code>	Opens file for reading only; if this flag is given, <code>_O_RDWR</code> and <code>_O_WRONLY</code> can't be given.
<code>_O_RDWR</code>	Opens file for both reading and writing; if this flag is given, <code>_O_RDONLY</code> and <code>_O_WRONLY</code> can't be given.
<code>_O_TRUNC</code>	Opens and truncates an existing file to zero length; the file must have write permission. The contents of the file are destroyed. If this flag is given, you can't specify <code>_O_RDONLY</code> .
<code>_O_WRONLY</code>	Opens file for writing only; if this flag is given, <code>_O_RDONLY</code> and <code>_O_RDWR</code> can't be given.

See also

[_open](#) , [_wopen](#)
[_sopen](#) , [_wsopen](#)

[Global constants](#)

File permission constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <sys/stat.h>
```

Remarks

One of these constants is required when `_O_CREAT` (`_open`, `_sopen`) is specified.

The `pmode` argument specifies the file's permission settings as follows.

CONSTANT	MEANING
<code>_S_IREAD</code>	Reading permitted
<code>_S_IWRITE</code>	Writing permitted
<code>_S_IREAD _S_IWRITE</code>	Reading and writing permitted

When used as the `pmode` argument for `_umask`, the manifest constant sets the permission setting, as follows.

CONSTANT	MEANING
<code>_S_IREAD</code>	Writing not permitted (file is read-only)
<code>_S_IWRITE</code>	Reading not permitted (file is write-only)
<code>_S_IREAD _S_IWRITE</code>	Both reading and writing not permitted

See also

[_open](#), [_wopen](#)
[_sopen](#), [_wsopen](#)
[_umask](#)

[Standard types](#)

[Global constants](#)

File read/write access constants

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Syntax

```
#include <stdio.h>
```

Remarks

These constants specify the access type ("a", "r", or "w") requested for the file. Both the [translation mode](#) ("b" or "t") and the [commit-to-disk mode](#) ("c" or "n") can be specified with the type of access.

The access types are described in this table:

ACCESS TYPE	DESCRIPTION
" <code>r</code> "	Opens for reading. If the file doesn't exist or can't be found, the call to open the file fails.
" <code>w</code> "	Opens an empty file for writing. If the given file exists, its contents are destroyed.
" <code>a</code> "	Opens for writing at the end of the file (appending); creates the file first if it doesn't exist. All write operations occur at the end of the file. Although the file pointer can be repositioned using <code>fseek</code> or <code>rewind</code> , it's always moved back to the end of the file before any write operation is carried out.
" <code>r+</code> "	Opens for both reading and writing. If the file doesn't exist or can't be found, the call to open the file fails.
" <code>w+</code> "	Opens an empty file for both reading and writing. If the given file exists, its contents are destroyed.
" <code>a+</code> "	The same as " <code>a</code> " but also allows reading.

When the "`r+`", "`w+`", or "`a+`" type is specified, both reading and writing are allowed (the file is said to be open for "update"). However, when you switch between reading and writing, there must be an intervening `fflush`, `fsetpos`, `fseek`, or `rewind` operation. The current position can be specified for the `fsetpos` or `fseek` operation.

See also

[_fdopen](#) , [_wfopen](#)
[fopen](#) , [_wfopen](#)
[freopen](#) , [_wfreopen](#)
[_fsopen](#) , [_wfsopen](#)
[_popen](#) , [_wpopen](#)

[Global constants](#)

File translation constants

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Syntax

```
#include <stdio.h>
```

Remarks

These constants specify the mode of translation ("b" or "t"). The mode is included in the string specifying the type of access ("r", "w", "a", "r+", "w+", "a+").

The translation modes are as follows:

- **t**

Opens in text (translated) mode. In this mode, carriage return-line feed (CR-LF) combinations are translated into single line feeds (LF) on input, and LF characters are translated into CR-LF combinations on output. Also, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading or reading and writing, `fopen` checks for CTRL+Z at the end of the file and removes it, if possible. It's removed because using the `fseek` and `fteell` functions to move within a file ending with CTRL+Z may cause `fseek` to behave improperly near the end of the file.

NOTE

The **t** option is not part of the ANSI standard for `fopen` and `freopen`. It is a Microsoft extension and should not be used where ANSI portability is desired.

- **b**

Opens in binary (untranslated) mode. The above translations are suppressed.

If **t** or **b** isn't given in `mode`, the translation mode is defined by the default-mode variable `_fmode`. For more information about using text and binary modes, see [Text and binary mode file I/O](#).

See also

[_fdopen](#) , [_wfopen](#)
[fopen](#) , [_wfopen](#)
[freopen](#) , [_wfreopen](#)
[_fsopen](#) , [_wfsopen](#)

[Global constants](#)

FILENAME_MAX

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The maximum permissible length for a `filename` string buffer size.

Syntax

```
#include <stdio.h>
```

See also

[Path field limits](#)

[Global constants](#)

`FOPEN_MAX`, `_SYS_OPEN`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <stdio.h>
```

Remarks

`FOPEN_MAX` and `_SYS_OPEN` are the maximum number of files that can be opened simultaneously. `FOPEN_MAX` is the ANSI-compatible name. `_SYS_OPEN` is provided for compatibility with existing code.

See also

[Global constants](#)

`_FREEENTRY`, `_USEDENTRY`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <malloc.h>
```

Remarks

These constants represent values assigned by the `_heapwalk` routines to the `_useflag` element of the `_HEAPINFO` structure. They indicate the status of the heap entry.

See also

[_heapwalk](#)

[Global constants](#)

fseek , _lseek constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <stdio.h>
```

Remarks

The `origin` argument specifies the initial position and can be one of the following manifest constants:

CONSTANT	MEANING
SEEK_END	End of file
SEEK_CUR	Current position of file pointer
SEEK_SET	Beginning of file

See also

[fseek , _fseeki64](#)
[_lseek , _lseeki64](#)

[Global constants](#)

Heap constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <malloc.h>
```

Remarks

These constants give the return value indicating status of the heap.

CONSTANT	MEANING
<code>_HEAPBADBEGIN</code>	Initial header information wasn't found or was invalid.
<code>_HEAPBADNODE</code>	Bad node was found, or heap is damaged.
<code>_HEAPBADPTR</code>	<code>_pentry</code> field of <code>_HEAPINFO</code> structure doesn't contain valid pointer into heap (<code>_heapwalk</code> routine only).
<code>_HEAPEMPTY</code>	Heap hasn't been initialized.
<code>_HEAPEND</code>	End of heap was reached successfully (<code>_heapwalk</code> routine only).
<code>_HEAPOK</code>	Heap is consistent (<code>_heapset</code> and <code>_heapchk</code> routines only). No errors so far; <code>_HEAPINFO</code> structure contains information about next entry (<code>_heapwalk</code> routine only).

See also

[_heapchk](#)
[_heapset](#)
[_heapwalk](#)

[Global constants](#)

_HEAP_MAXREQ

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <malloc.h>
```

Remarks

The maximum size of a user request for memory that can be granted.

See also

[malloc](#)

[calloc](#)

[Global constants](#)

`HUGE_VAL`, `_HUGE`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <math.h>
```

Remarks

`HUGE_VAL` is the largest representable double value. This value is returned by many run-time math functions when an error occurs. For some functions, `-HUGE_VAL` is returned. `HUGE_VAL` is defined as `_HUGE`, but run-time math functions return `HUGE_VAL`. You should also use `HUGE_VAL` in your code for consistency.

See also

[Global constants](#)

Locale categories

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <locale.h>
```

Remarks

Locale categories are manifest constants used by the localization routines to specify which portion of a program's locale information will be used. The locale refers to the locality (or Country/Region) for which certain aspects of your program can be customized. Locale-dependent areas include, for example, the formatting of dates or the display format for monetary values.

LOCALE CATEGORY	PARTS OF PROGRAM AFFECTED
LC_ALL	All locale-specific behavior (all categories)
LC_COLLATE	Behavior of <code>strcoll</code> and <code>strxfrm</code> functions
LC_CTYPE	Behavior of character-handling functions (except <code>isdigit</code> , <code>isxdigit</code> , <code>mbstowcs</code> , and <code>mbtowc</code> , which are unaffected)
LC_MAX	Same as LC_TIME
LC_MIN	Same as LC_ALL
LC_MONETARY	Monetary formatting information returned by the <code>localeconv</code> function
LC_NUMERIC	Decimal-point character for formatted output routines (for example, <code>printf</code>), data conversion routines, and nonmonetary formatting information returned by <code>localeconv</code> function
LC_TIME	Behavior of <code>strftime</code> function

See `setlocale`, `_wsetlocale` for an example.

See also

`localeconv`
`setlocale`, `_wsetlocale`
`strcoll` functions
`strftime`, `wcsftime`, `_strftime_l`, `_wcsftime_l`
`strxfrm`, `wcsxfrm`, `_strxfrm_l`, `_wcsxfrm_l`

Global constants

_locking constants

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Syntax

```
#include <sys/locking.h>
```

Remarks

The `mode` argument in the call to the `_locking` function specifies the locking action to be performed.

The `mode` argument must be one of the following manifest constants.

VALUE	DESCRIPTION
<code>_LK_LOCK</code>	Locks the specified bytes. If the bytes can't be locked, the function tries again after 1 second. If the bytes can't be locked after 10 attempts, the function returns an error.
<code>_LK_RLCK</code>	Same as <code>_LK_LOCK</code> .
<code>_LK_NBLCK</code>	Locks the specified bytes. If bytes can't be locked, the function returns an error.
<code>_LK_NBRLCK</code>	Same as <code>_LK_NBLCK</code> .
<code>_LK_UNLCK</code>	Unlocks the specified bytes. (The bytes must have been previously locked.)

See also

[_locking](#)
[Global constants](#)

Math constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Microsoft provides several predefined preprocessor macros for common math constants.

Syntax

```
#define _USE_MATH_DEFINES // for C++
#include <cmath>

#define _USE_MATH_DEFINES // for C
#include <math.h>
```

Remarks

The following symbols are defined for the values of their indicated expressions:

SYMBOL	EXPRESSION	VALUE
M_E	e	2.71828182845904523536
M_LOG2E	log2(e)	1.44269504088896340736
M_LOG10E	log10(e)	0.434294481903251827651
M_LN2	ln(2)	0.693147180559945309417
M_LN10	ln(10)	2.30258509299404568402
M_PI	pi	3.14159265358979323846
M_PI_2	pi/2	1.57079632679489661923
M_PI_4	pi/4	0.785398163397448309616
M_1_PI	1/pi	0.318309886183790671538
M_2_PI	2/pi	0.636619772367581343076
M_2_SQRTPI	2/sqrt(pi)	1.12837916709551257390
M_SQRT2	sqrt(2)	1.41421356237309504880
M_SQRT1_2	1/sqrt(2)	0.707106781186547524401

The math constants aren't defined in Standard C/C++. To use them, you must first define `_USE_MATH_DEFINES`, and then include `<cmath>` or `<math.h>`.

The file `<ATLComTime.h>` includes `<math.h>` when your project is built in Release mode. If you use one or more of the math constants in a project that also includes `<ATLComTime.h>`, you must define `_USE_MATH_DEFINES` before you include `<ATLComTime.h>`.

See also

[Global constants](#)

Math error constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <math.h>
```

Remarks

The math routines of the run-time library can generate math error constants.

These errors, described as follows, correspond to the exception types defined in MATH.H and are returned by the `_matherr` function when a math error occurs.

CONSTANT	MEANING
<code>_DOMAIN</code>	Argument to function is outside domain of function.
<code>_OVERFLOW</code>	Result is too large to be represented in function's return type.
<code>_PLOSS</code>	Partial loss of significance occurred.
<code>_SING</code>	Argument singularity: argument to function has illegal value. (For example, value 0 is passed to function that requires nonzero value.)
<code>_TLOSS</code>	Total loss of significance occurred.
<code>_UNDERFLOW</code>	Result is too small to be represented.

See also

[_matherr](#)
[Global constants](#)

`_MAX_ENV`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The maximum permissible string length of an environmental variable.

Syntax

```
#include <stdio.h>
```

See also

[Environmental constants](#)

[Global constants](#)

MB_CUR_MAX

11/2/2022 • 2 minutes to read • [Edit Online](#)

A macro that indicates the maximum number of bytes in a multibyte character for the current locale.

Syntax

```
#include <stdlib.h>
```

Remarks

Context: ANSI multibyte- and wide-character conversion functions

The value of `MB_CUR_MAX` is the maximum number of bytes in a multibyte character for the current locale.

See also

`_mbclen`, `mblen`, `_mblen_l`
`mbstowcs`, `_mbstowcs_l`
`mbtowc`, `_mbtowc_l`
`__mb_cur_max_func`, `__mb_cur_max_l_func`, `_p__mb_cur_max`, `__mb_cur_max`

Standard types

`wcstombs`, `_wcstombs_l`
`wctomb`, `_wctomb_l`

Data type constants

Global constants

NULL (CRT)

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`NULL` is the null-pointer value used with many pointer operations and functions. It's equivalent to 0. `NULL` is defined in the following header files: CRTDBG.H, LOCALE.H, STDDEF.H, STDIO.H, STDLIB.H, STRING.H, TCHAR.H, TIME.H and WCHAR.H.

See also

[Global constants](#)

Path field limits

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <stdlib.h>
```

Remarks

These constants define the maximum length for the path and for the individual fields within the path.

CONSTANT	MEANING
<code>_MAX_DIR</code>	Maximum length of directory component
<code>_MAX_DRIVE</code>	Maximum length of drive component
<code>_MAX_EXT</code>	Maximum length of extension component
<code>_MAX_FNAME</code>	Maximum length of filename component
<code>_MAX_PATH</code>	Maximum length of full path

NOTE

The C Runtime supports path lengths up to 32768 characters in length, but it is up to the operating system, specifically the file system, to support these longer paths. The sum of the fields should not exceed `_MAX_PATH` for full backwards compatibility with FAT32 file systems. The Windows NTFS file system supports paths up to 32768 characters in length, but only when using the Unicode APIs. When using long path names, prefix the path with the characters `\?\` and use the Unicode versions of the C Runtime functions.

See also

[Global constants](#)

RAND_MAX

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <stdlib.h>
```

Remarks

The constant `RAND_MAX` is the maximum value that can be returned by the `rand` function. `RAND_MAX` is defined as the value 0x7fff.

See also

`rand`

[Global constants](#)

setvbuf constants

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Syntax

```
#include <stdio.h>
```

Remarks

These constants represent the type of buffer for `setvbuf`.

The possible values are given by the following manifest constants:

CONSTANT	MEANING
<code>_IOFBF</code>	Full buffering: Buffer specified in call to <code>setvbuf</code> is used and its size is as specified in <code>setvbuf</code> call. If buffer pointer is <code>NULL</code> , automatically allocated buffer of specified size is used.
<code>_IOLBF</code>	Same as <code>_IOFBF</code> .
<code>_IONBF</code>	No buffer is used, regardless of arguments in call to <code>setvbuf</code> .

See also

[setbuf](#)

[Global constants](#)

Sharing constants

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Constants for file-sharing modes.

Syntax

```
#include <share.h>
```

Remarks

The `shflag` argument determines the sharing mode, which consists of one or more manifest constants. These constants can be combined with the `oflag` arguments (see [File constants](#)).

The following table lists the constants and their meanings:

CONSTANT	MEANING
<code>_SH_DENYRW</code>	Denies read and write access to file
<code>_SH_DENYWR</code>	Denies write access to file
<code>_SH_DENYRD</code>	Denies read access to file
<code>_SH_DENYNO</code>	Permits read and write access
<code>_SH_SECURE</code>	Sets secure mode (shared read, exclusive write access).

See also

[_sopen](#) , [_wsopen](#)
[_fopen](#) , [_wfopen](#)

[Global constants](#)

signal constants

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Syntax

```
#include <signal.h>
```

Remarks

The `sig` argument must be one of the manifest constants listed below (defined in SIGNAL.H).

CONSTANT	DESCRIPTION
<code>SIGABRT</code>	Abnormal termination. The default action terminates the calling program with exit code 3.
<code>SIGABRT_COMPAT</code>	Same as <code>SIGABRT</code> . For compatibility with other platforms.
<code>SIGFPE</code>	Floating-point error, such as overflow, division by zero, or invalid operation. The default action terminates the calling program.
<code>SIGILL</code>	Illegal instruction. The default action terminates the calling program.
<code>SIGINT</code>	CTRL+C interrupt. The default action terminates the calling program with exit code 3.
<code>SIGSEGV</code>	Illegal storage access. The default action terminates the calling program.
<code>SIGTERM</code>	Termination request sent to the program. The default action terminates the calling program with exit code 3.
<code>SIG_ERR</code>	A return type from a signal indicating an error has occurred.

See also

[signal](#)
[raise](#)
[Global constants](#)

signal action constants

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The action taken when the interrupt signal is received depends on the value of `func`.

Syntax

```
#include <signal.h>
```

Remarks

The `func` argument must be either a function address or one of the manifest constants listed below and defined in SIGNAL.H.

CONSTANT	DESCRIPTION
<code>SIG_DFL</code>	Uses system-default response. If the calling program uses stream I/O, buffers created by the run-time library aren't flushed.
<code>SIG_IGN</code>	Ignores interrupt signal. This value should never be given for <code>SIGFPE</code> , since the floating-point state of the process is left undefined.
<code>SIG_SGE</code>	Indicates an error occurred in the signal.
<code>SIG_ACK</code>	Indicates an acknowledgment was received.
<code>SIG_ERR</code>	A return type from a signal indicating an error has occurred.

See also

[signal](#)
[Global constants](#)

spawn constants

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Syntax

```
#include <process.h>
```

Remarks

The `mode` argument determines the action taken by the calling process before and during a `spawn` operation.

The following values for `mode` are possible:

CONSTANT	MEANING
<code>_P_OVERLAY</code>	Overlays calling process with new process, destroying calling process (same effect as <code>_exec</code> calls).
<code>_P_WAIT</code>	Suspends calling thread until execution of new process is complete (synchronous <code>_spawn</code>).
<code>_P_NOWAIT</code> , <code>_P_NOWAITO</code>	Continues to execute calling process concurrently with new process (asynchronous <code>_spawn</code>).
<code>_P_DETACH</code>	Continues to execute calling process; new process is run in background with no access to console or keyboard. Calls to <code>_cwait</code> against new process will fail. This <code>_spawn</code> is asynchronous.

See also

[`_spawn`, `_wspawn` functions](#)

[Global constants](#)

`_stat` structure `st_mode` field constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <sys/stat.h>
```

Remarks

These constants are used to indicate file type in the `st_mode` field of the `_stat` structure.

The bit mask constants are described below:

CONSTANT	MEANING
<code>_S_IFMT</code>	File type mask
<code>_S_IFDIR</code>	Directory
<code>_S_IFCHR</code>	Character special (indicates a device if set)
<code>_S_IFREG</code>	Regular
<code>_S_IREAD</code>	Read permission, owner
<code>_S_IWRITE</code>	Write permission, owner
<code>_S_IEXEC</code>	Execute/search permission, owner

See also

[`_stat`, `_wstat` functions](#)
[`_fstat`, `_fstat32`, `_fstat64`, `_fstat16`, `_fstat32i64`, `_fstat64i32`](#)

[Standard types](#)

[Global constants](#)

`stdin`, `stdout`, `stderr`

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Syntax

```
FILE *stdin;
FILE *stdout;
FILE *stderr;
#include <stdio.h>
```

Remarks

The `stdin`, `stdout`, and `stderr` global constant pointers are standard streams for input, output, and error output.

By default, standard input is read from the keyboard, while standard output and standard error are printed to the screen.

The following stream pointers are available to access the standard streams:

POINTER	STREAM
<code>stdin</code>	Standard input
<code>stdout</code>	Standard output
<code>stderr</code>	Standard error

These pointers can be used as arguments to functions. Some functions, such as `getchar` and `putchar`, use `stdin` and `stdout` automatically.

These pointers are constants, and can't be assigned new values. The `freopen` function can be used to redirect the streams to disk files or to other devices. The operating system allows you to redirect a program's standard input and output at the command level.

See also

[Stream I/O](#)

[Global constants](#)

`TMP_MAX`, `L_tmpnam`

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Syntax

```
#include <stdio.h>
```

Remarks

`TMP_MAX` is the maximum number of unique filenames that the `tmpnam` function can generate. `L_tmpnam` is the length of temporary filenames generated by `tmpnam`.

See also

[Global constants](#)

Translation mode constants

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <fcntl.h>
```

Remarks

The `_O_BINARY` and `_O_TEXT` manifest constants determine the translation mode for files (`_open` and `_sopen`) or the translation mode for streams (`_setmode`).

The allowed values are:

VALUE	DESCRIPTION
<code>_O_TEXT</code>	Opens file in text (translated) mode. Carriage return-line feed (CR-LF) combinations are translated into a single line feed (LF) on input. Line feed characters are translated into CR-LF combinations on output. Also, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading, and for reading and writing, <code>fopen</code> checks for CTRL+Z at the end of the file and removes it, if possible. It's removed because using the <code>fseek</code> and <code>ftell</code> functions to move within a file ending with CTRL+Z may cause <code>fseek</code> to behave improperly near the end of the file.
<code>_O_BINARY</code>	Opens file in binary (untranslated) mode. The above translations are suppressed.
<code>_O_RAW</code>	Same as <code>_O_BINARY</code> . Supported for C 2.0 compatibility.

For more information, see [Text and binary mode file I/O](#) and [File translation constants](#).

See also

[_open](#) , [_wopen](#)
[_pipe](#)
[_sopen](#) , [_wsopen](#)
[_setmode](#)

[Global constants](#)

_TRUNCATE

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Specifies string truncation behavior.

Syntax

```
#include <stdlib.h>
```

Remarks

`_TRUNCATE` enables truncation behavior when passed as the `count` parameter to these functions:

```
_strncpy_s, _strncpy_s_1, wcsncpy_s, _wcsncpy_s_1, _mbsncpy_s, _mbscopy_s_1  
strncat_s, _strncat_s_1, wcsncat_s, _wcsncat_s_1, _mbsncat_s, _mbscopy_s_1  
mbstowcs_s, _mbstowcs_s_1  
mbsrtowcs_s  
wcstombs_s, _wcstombs_s_1  
wcsrtombs_s  
_snprintf_s, _snprintf_s_1, _snwprintf_s, _snwprintf_s_1  
vsnprintf_s, _vsnprintf_s, _vsnprintf_s_1, _vsnwprintf_s, _vsnwprintf_s_1
```

If the destination buffer is too small to hold the entire string, the normal behavior of these functions is to treat it as an error situation (see [Parameter validation](#)). However, if string truncation is enabled by passing `_TRUNCATE`, these functions will copy only as much of the string as will fit, leaving the destination buffer null-terminated, and return successfully.

String truncation changes the return values of the affected functions. The following functions return 0 if no truncation occurs, or `STRUNCATE` if truncation does occur:

```
_strncpy_s, _strncpy_s_1, wcsncpy_s, _wcsncpy_s_1, _mbsncpy_s, _mbscopy_s_1  
strncat_s, _strncat_s_1, wcsncat_s, _wcsncat_s_1, _mbsncat_s, _mbscopy_s_1  
wcstombs_s, _wcstombs_s_1  
mbstowcs_s, _mbstowcs_s_1
```

The following functions return the number of characters copied if no truncation occurs, or -1 if truncation does occur (matching the behavior of the original `snprintf` functions):

```
_snprintf_s, _snprintf_s_1, _snwprintf_s, _snwprintf_s_1  
vsnprintf_s, _vsnprintf_s, _vsnprintf_s_1, _vsnwprintf_s, _vsnwprintf_s_1
```

Example

```
// crt_truncate.c
#include <stdlib.h>
#include <errno.h>

int main()
{
    char src[] = "1234567890";
    char dst[5];
    errno_t err = strncpy_s(dst, _countof(dst), src, _TRUNCATE);
    if (err == STRUNCATE)
        printf( "truncation occurred!\n" );
    printf( "'%s'\n", dst );
}
```

```
truncation occurred!
'1234'
```

See also

[Global constants](#)

`TZNAME_MAX`

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Obsolete. The maximum permissible string length for a time zone name variable. This macro was defined in `<limits.h>` in Visual Studio 2012 and earlier versions. It isn't defined in Visual Studio 2013 and later versions. To get the length required to hold the current time zone name, use [`_get_tzname`](#).

Syntax

```
#include <limits.h>
```

See also

[Environmental constants](#)

[Global constants](#)

[`_get_tzname`](#)

`_WAIT_CHILD` , `_WAIT_GRANDCHILD`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Syntax

```
#include <process.h>
```

Remarks

The `_cwait` function can be used by any process to wait for any other process (if the process ID is known). The action argument can be one of the following values:

CONSTANT	MEANING
<code>_WAIT_CHILD</code>	Calling process waits until specified new process terminates.
<code>_WAIT_GRANDCHILD</code>	Calling process waits until specified new process, and all processes created by that new process, terminate.

See also

[_cwait](#)

[Global constants](#)

WCHAR_MAX

11/2/2022 • 2 minutes to read • [Edit Online](#)

Maximum value for type `wchar_t`.

Syntax

```
#include <wchar.h>
```

See also

[Global constants](#)

WCHAR_MIN

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Minimum value for type `wchar_t`.

Syntax

```
#include <wchar.h>
```

See also

[Global constants](#)

Generic-text mappings

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To simplify writing code for international markets, generic-text mappings are defined in TCHAR.H for:

- [Data types](#)
- [Constants and global variables](#)
- [Routine mappings](#)

For more information, see [Using generic-text mappings](#). Generic-text mappings are Microsoft extensions that aren't ANSI compatible.

See also

[Data type mappings](#)

[A sample generic-text program](#)

Data type mappings

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These data-type mappings are defined in TCHAR.H and depend on whether the constant `_UNICODE` or `_MBCS` has been defined in your program.

For related information, see [Using TCHAR.H Data Types with _MBCS Code](#).

Generic-text data type mappings

DATA TYPE NAME	SBCS (<code>_UNICODE</code> , <code>_MBCS NOT DEFINED)</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_TCHAR</code>	<code>char</code>	<code>char</code>	<code>wchar_t</code>
<code>_tfinddata_t</code>	<code>_finddata_t</code>	<code>_finddata_t</code>	<code>_wfinddata_t</code>
<code>_tfinddata64_t</code>	<code>_finddata64_t</code>	<code>_finddata64_t</code>	<code>_wfinddata64_t</code>
<code>_tfinddatai64_t</code>	<code>_finddatai64_t</code>	<code>_finddatai64_t</code>	<code>_wfinddatai64_t</code>
<code>_TINT</code>	<code>int</code>	<code>int</code>	<code>wint_t</code>
<code>_TSCHAR</code>	<code>signed char</code>	<code>signed char</code>	<code>wchar_t</code>
<code>_T UCHAR</code>	<code>unsigned char</code>	<code>unsigned char</code>	<code>wchar_t</code>
<code>_TXCHAR</code>	<code>char</code>	<code>unsigned char</code>	<code>wchar_t</code>
<code>_T</code> or <code>_TEXT</code>	No effect (removed by preprocessor)	No effect (removed by preprocessor)	L (converts following character or string to its Unicode counterpart)

See also

[Generic-text mappings](#)

[Constant and global variable mappings](#)

[Routine mappings](#)

[A sample generic-text program](#)

[Using generic-text mappings](#)

Constant and global variable mappings

11/2/2022 • 2 minutes to read • [Edit Online](#)

These generic-text constant, global variable, and standard-type mappings are defined in TCHAR.H and depend on whether the constant `_UNICODE` or `_MBCS` has been defined in your program.

Generic-text constant and global variable mappings

GENERIC-TEXT - OBJECT NAME	SBCS (<code>_UNICODE</code> , <code>_MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_TEOF</code>	<code>EOF</code>	<code>EOF</code>	<code>WEOF</code>
<code>_t environ</code>	<code>_environ</code>	<code>_environ</code>	<code>_wenviron</code>
<code>_tpgmptr</code>	<code>_pgmptr</code>	<code>_pgmptr</code>	<code>_wpgmptr</code>

See also

[Generic-text mappings](#)

[Data type mappings](#)

[Routine mappings](#)

[A sample generic-text program](#)

[Using generic-text mappings](#)

Routine mappings

11/2/2022 • 5 minutes to read • [Edit Online](#)

The generic-text routine mappings are defined in TCHAR.H. `_tccpy` and `_tcrlen` map to functions in the MBCS model; they're mapped to macros or inline functions in the SBCS and Unicode models for completeness. For information on a generic text routine, see the help article about the corresponding `SBCS`-, `MBCS`-, or `UNICODE`-related routine.

More specific information about individual routines listed in the left column in the following table isn't available in this documentation. However, you can easily look up the information on a corresponding `SBCS`-, `MBCS`-, or `UNICODE`-related routine. Use the **Search** command on the **Help** menu to look up any generic-text routine listed below.

For related information, see [Generic-text mappings in tchar.h](#).

Generic-text routine mappings

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>MBCS</code> DEFINED	<code>UNICODE</code> DEFINED
<code>_cgetts</code>	<code>_cgetts</code>	<code>_cgetts</code>	<code>_cgetws</code>
<code>_cgetts_s</code>	<code>_cgetts_s</code>	<code>_cgetts_s</code>	<code>_cgetws_s</code>
<code>_cputts</code>	<code>_cputts</code>	<code>_cputts</code>	<code>_cputws</code>
<code>_fgettc</code>	<code>fgetc</code>	<code>fgetc</code>	<code>fgetwc</code>
<code>_fgettchar</code>	<code>_fgettchar</code>	<code>_fgettchar</code>	<code>_fgetwchar</code>
<code>_fgetts</code>	<code>fgets</code>	<code>fgets</code>	<code>fgetws</code>
<code>_fputtc</code>	<code>fputc</code>	<code>fputc</code>	<code>fputwc</code>
<code>_fputtchar</code>	<code>_fputtchar</code>	<code>_fputtchar</code>	<code>_fputwchar</code>
<code>_fputts</code>	<code>fputs</code>	<code>fputs</code>	<code>fputws</code>
<code>_ftprintf</code>	<code>fprintf</code>	<code>fprintf</code>	<code>fwprintf</code>
<code>_ftprintf_s</code>	<code>fprintf_s</code>	<code>fprintf_s</code>	<code>fwprintf_s</code>
<code>_ftscanf</code>	<code>fscanf</code>	<code>fscanf</code>	<code>fwscanf</code>
<code>_ftscanf_s</code>	<code>fscanf_s</code>	<code>fscanf_s</code>	<code>fwscanf_s</code>
<code>_gettc</code>	<code>getc</code>	<code>getc</code>	<code>getwc</code>
<code>_gettch</code>	<code>_getch</code>	<code>_getch</code>	<code>_getwch</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettchar</code>	<code>getchar</code>	<code>getchar</code>	<code>getwchar</code>
<code>_gettche</code>	<code>_getche</code>	<code>_getche</code>	<code>_getwche</code>
<code>_getts</code>	<code>gets</code>	<code>gets</code>	<code>getws</code>
<code>_getts_s</code>	<code>gets_s</code>	<code>gets_s</code>	<code>getws_s</code>
<code>_istalnum</code>	<code>isalnum</code>	<code>_ismbcalnum</code>	<code>iswalnum</code>
<code>_istalpha</code>	<code>isalpha</code>	<code>_ismbcalpha</code>	<code>iswalpha</code>
<code>_istascii</code>	<code>isascii</code>	<code>isascii</code>	<code>iswascii</code>
<code>_istcntrl</code>	<code>iscntrl</code>	<code>iscntrl</code>	<code>iswcntrl</code>
<code>_istdigit</code>	<code>isdigit</code>	<code>_ismbcdigit</code>	<code>iswdigit</code>
<code>_istgraph</code>	<code>isgraph</code>	<code>_ismbcgraph</code>	<code>iswgraph</code>
<code>_istlead</code>	Always returns false	<code>_ismbblead</code>	Always returns false
<code>_istleadbyte</code>	Always returns false	<code>isleadbyte</code>	Always returns false
<code>_istlegal</code>	Always returns true	<code>_ismbclegal</code>	Always returns true
<code>_istlower</code>	<code>islower</code>	<code>_ismbclower</code>	<code>islower</code>
<code>_istprint</code>	<code>isprint</code>	<code>_ismbcprint</code>	<code>iswprint</code>
<code>_istpunct</code>	<code>ispunct</code>	<code>_ismbcpunct</code>	<code>iswpunct</code>
<code>_istspace</code>	<code>isspace</code>	<code>_ismbcspace</code>	<code>iswspace</code>
<code>_istupper</code>	<code>isupper</code>	<code>_ismbcupper</code>	<code>iswupper</code>
<code>_istxdigit</code>	<code>isxdigit</code>	<code>isxdigit</code>	<code>iswdx digit</code>
<code>_itot</code>	<code>_itoa</code>	<code>_itoa</code>	<code>_itow</code>
<code>_itot_s</code>	<code>_itoa_s</code>	<code>_itoa_s</code>	<code>_itow_s</code>
<code>_ltot</code>	<code>_ltoa</code>	<code>_ltoa</code>	<code>_ltow</code>
<code>_ltot_s</code>	<code>_ltoa_s</code>	<code>_ltoa_s</code>	<code>_ltow_s</code>
<code>_puttc</code>	<code>putc</code>	<code>putc</code>	<code>putwc</code>

GENERIC-TEXT ROUTINE NAME	SBCS (_UNICODE AND MBCS NOT DEFINED)	_MBCS DEFINED	_UNICODE DEFINED
_puttch	_putch	_putch	_putwch
_puttchar	putchar	putchar	putwchar
_putts	puts	puts	_putws
_sctprintf	_scprintf	_scprintf	_scwprintf
_snprintf	_snprintf	_snprintf	_snwprintf
_snprintf_s	_snprintf_s	_snprintf_s	_snwprintf_s
_snscanf	_snscanf	_snscanf	_snwscanf
_snscanf_s	_snscanf_s	_snscanf_s	_snwscanf_s
_stprintf	sprintf	sprintf	swprintf
_stprintf_s	sprintf_s	sprintf_s	swprintf_s
_stscanf	sscanf	sscanf	swscanf
_stscanf_s	sscanf_s	sscanf_s	swscanf_s
_taccess	_access	_access	_waccess
_taccess_s	_access_s	_access_s	_waccess_s
_tasctime	asctime	asctime	_wasctime
_tasctime_s	asctime_s	asctime_s	_wasctime_s
_tccmp	Maps to macro or inline function	_mbsnncmp	Maps to macro or inline function
_tccpy	Maps to macro or inline function	_mbccpy	Maps to macro or inline function
_tccpy_s	strcpy_s	_mbccpy_s	wcsncpy_s
_tchdir	_chdir	_chdir	_wchdir
_tcrlen	Maps to macro or inline function	_mbclen	Maps to macro or inline function
_tchmod	_chmod	_chmod	_wchmod
_tcpprintf	_cprintf	_cprintf	_cwprintf

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcprintf_s</code>	<code>_cprintf_s</code>	<code>_cprintf_s</code>	<code>_cwprintf_s</code>
<code>_tcreat</code>	<code>_creat</code>	<code>_creat</code>	<code>_wcreat</code>
<code>_tcscanf</code>	<code>_cscanf</code>	<code>_cscanf</code>	<code>_cwscanf</code>
<code>_tcscanf_s</code>	<code>_cscanf_s</code>	<code>_cscanf_s</code>	<code>_cwscanf_s</code>
<code>_tcscat</code>	<code>strcat</code>	<code>_mbscat</code>	<code>wcscat</code>
<code>_tcscat_s</code>	<code>strcat_s</code>	<code>_mbscat_s</code>	<code>wcscat_s</code>
<code>_tcschr</code>	<code>strchr</code>	<code>_mbschr</code>	<code>wcschr</code>
<code>_tcsclen</code>	<code>strlen</code>	<code>_mbslen</code>	<code>wcslen</code>
<code>_tcsclen_s</code>	<code>strlen_s</code>	<code>_mbslen_s</code>	<code>wcslen_s</code>
<code>_tcscmp</code>	<code>strcmp</code>	<code>_mbscmp</code>	<code>wcscmp</code>
<code>_tcscoll</code>	<code>strcoll</code>	<code>_mbscoll</code>	<code>wcscoll</code>
<code>_tcscopy</code>	<code>strcpy</code>	<code>_mbscopy</code>	<code>wcscopy</code>
<code>_tcscopy_s</code>	<code>strcpy_s</code>	<code>_mbscopy_s</code>	<code>wcscopy_s</code>
<code>_tcscspn</code>	<code>strcspn</code>	<code>_mbscspn</code>	<code>wcscspn</code>
<code>_tcsdec</code>	<code>_strdec</code>	<code>_mbsdec</code>	<code>_wcsdec</code>
<code>_tcsdup</code>	<code>_strupd</code>	<code>_mbsdup</code>	<code>_wcstdup</code>
<code>_tcSError</code>	<code>strerror</code>	<code>strerror</code>	<code>_wcSError</code>
<code>_tcSError_s</code>	<code>strerror_s</code>	<code>strerror_s</code>	<code>_wcSError_s</code>
<code>_tcsftime</code>	<code>strftime</code>	<code>strftime</code>	<code>wcsftime</code>
<code>_tcsicmp</code>	<code>_stricmp</code>	<code>_mbsicmp</code>	<code>_wcsicmp</code>
<code>_tcsicoll</code>	<code>_stricoll</code>	<code>_mbsicoll</code>	<code>_wcsicoll</code>
<code>_tcsinc</code>	<code>_strinc</code>	<code>_mbsinc</code>	<code>_wcscinc</code>
<code>_tcslen</code>	<code>strlen</code>	<code>strlen</code>	<code>wcslen</code>
<code>_tcslwr</code>	<code>_strlwr</code>	<code>_mbslwr</code>	<code>_wcslwr</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcslwrs</code>	<code>_strlwrs</code>	<code>_mbslwrs</code>	<code>_wcslwrs</code>
<code>_tcsnbcnt</code>	<code>_strncnt</code>	<code>_mbsnbcnt</code>	<code>_wcsncnt</code>
<code>_tcsncat</code>	<code>strncat</code>	<code>_mbsnbcat</code>	<code>wcsncat</code>
<code>_tcsncat_s</code>	<code>strncat_s</code>	<code>_mbsnbcat_s</code>	<code>wcsncat_s</code>
<code>_tcsncat</code>	<code>strncat</code>	<code>_mbsnbcat</code>	<code>wcsncat</code>
<code>_tcsncmp</code>	<code>strcmp</code>	<code>_mbsncmp</code>	<code>wcsncmp</code>
<code>_tcsncmp_s</code>	<code>strcmp_s</code>	<code>_mbsncmp_s</code>	<code>wcsncmp_s</code>
<code>_tcsncoll</code>	<code>strncoll</code>	<code>_mbsncoll</code>	<code>wcsncoll</code>
<code>_tcsncmp</code>	<code>strcmp</code>	<code>_mbsnbcmp</code>	<code>wcsncmp</code>
<code>_tcsncnt</code>	<code>_strncnt</code>	<code>_mbsnccnt</code>	<code>_wcsncnt</code>
<code>_tcsncpy</code>	<code>strncpy</code>	<code>_mbsncpy</code>	<code>wcsncpy</code>
<code>_tcsncpy_s</code>	<code>strncpy_s</code>	<code>_mbsncpy_s</code>	<code>wcsncpy_s</code>
<code>_tcsnicmp</code>	<code>_strnicmp</code>	<code>_mbsnicmp</code>	<code>wcsnicmp</code>
<code>_tcsnicoll</code>	<code>_strnicoll</code>	<code>_mbsnicoll</code>	<code>wcsnicoll</code>
<code>_tcsncpy</code>	<code>strncpy</code>	<code>_mbsnbcpy</code>	<code>wcsncpy</code>
<code>_tcsncpy_s</code>	<code>strncpy_s</code>	<code>_mbsnbcpy_s</code>	<code>wcsncpy_s</code>
<code>_tcsncset</code>	<code>_strnset</code>	<code>_mbsnset</code>	<code>_wcsnset</code>
<code>_tcsnextc</code>	<code>_strnextc</code>	<code>_mbsnextc</code>	<code>_wcsnextc</code>
<code>_tcsnicmp</code>	<code>_strnicmp</code>	<code>_mbsnbcmp</code>	<code>wcsnicmp</code>
<code>_tcsnicoll</code>	<code>_strnicoll</code>	<code>_mbsnbcoll</code>	<code>wcsnicoll</code>
<code>_tcsninc</code>	<code>_strninc</code>	<code>_mbsninc</code>	<code>wcsninc</code>
<code>_tcsncnt</code>	<code>_strncnt</code>	<code>_mbsnccnt</code>	<code>_wcsncnt</code>
<code>_tcsnset</code>	<code>_strnset</code>	<code>_mbsnbset</code>	<code>wcsnset</code>
<code>_tcspbrk</code>	<code>strupr</code>	<code>_mbspbrk</code>	<code>wcspbrk</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsspnp</code>	<code>_strspnp</code>	<code>_mbsspnp</code>	<code>_wcsspnp</code>
<code>_tcsrchr</code>	<code>strrchr</code>	<code>_mbsrchr</code>	<code>wcsrchr</code>
<code>_tcsrev</code>	<code>_strrev</code>	<code>_mbsrev</code>	<code>_wcsrev</code>
<code>_tcsset</code>	<code>_strset</code>	<code>_mbsset</code>	<code>_wcsset</code>
<code>_tcsspn</code>	<code>strspn</code>	<code>_mbsspn</code>	<code>wcsspn</code>
<code>_tcsstr</code>	<code>strstr</code>	<code>_mbsstr</code>	<code>wcsstr</code>
<code>_tcstod</code>	<code>strtod</code>	<code>strtod</code>	<code>wcstod</code>
<code>_tcstoi64</code>	<code>_strtoi64</code>	<code>_strtoi64</code>	<code>_wcstoi64</code>
<code>_tcstok</code>	<code>strtok</code>	<code>_mbstok</code>	<code>wcstok</code>
<code>_tcstok_s</code>	<code>strtok_s</code>	<code>_mbstok_s</code>	<code>wcstok_s</code>
<code>_tcstol</code>	<code>strtol</code>	<code>strtol</code>	<code>wcstol</code>
<code>_tcstoui64</code>	<code>_strtoui64</code>	<code>_strtoui64</code>	<code>_wcstoui64</code>
<code>_tcstoul</code>	<code>strtoul</code>	<code>strtoul</code>	<code>wcstoul</code>
<code>_tcsupr</code>	<code>_strupr</code>	<code>_mbsupr</code>	<code>_wcsupr</code>
<code>_tcsupr_s</code>	<code>_strupr_s</code>	<code>_mbsupr_s</code>	<code>_wcsupr_s</code>
<code>_tcsxfrm</code>	<code>strxfrm</code>	<code>strxfrm</code>	<code>wcsxfrm</code>
<code>_tctime</code>	<code>ctime</code>	<code>ctime</code>	<code>_wctime</code>
<code>_tctime_s</code>	<code>ctime_s</code>	<code>ctime_s</code>	<code>_wctime_s</code>
<code>_tctime32</code>	<code>ctime32</code>	<code>ctime32</code>	<code>_wctime32</code>
<code>_tctime32_s</code>	<code>ctime32_s</code>	<code>ctime32_s</code>	<code>_wctime32_s</code>
<code>_tctime64</code>	<code>ctime64</code>	<code>ctime64</code>	<code>_wctime64</code>
<code>_tctime64_s</code>	<code>ctime64_s</code>	<code>ctime64_s</code>	<code>_wctime64_s</code>
<code>_texecl</code>	<code>_execl</code>	<code>_execl</code>	<code>_wexecl</code>
<code>_texecle</code>	<code>_execle</code>	<code>_execle</code>	<code>_wexecle</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_texeclp</code>	<code>_execlp</code>	<code>_execlp</code>	<code>_wexeclp</code>
<code>_texeclepe</code>	<code>_execlepe</code>	<code>_execlepe</code>	<code>_wexeclepe</code>
<code>_texecv</code>	<code>_execv</code>	<code>_execv</code>	<code>_wexecv</code>
<code>_texecve</code>	<code>_execve</code>	<code>_execve</code>	<code>_wexecve</code>
<code>_texecvp</code>	<code>_execvp</code>	<code>_execvp</code>	<code>_wexecvp</code>
<code>_texecvpe</code>	<code>_execvpe</code>	<code>_execvpe</code>	<code>_wexecvpe</code>
<code>_tfopen</code>	<code>_fdopen</code>	<code>_fdopen</code>	<code>_wfopen</code>
<code>_tfindfirst</code>	<code>_findfirst</code>	<code>_findfirst</code>	<code>_wfindfirst</code>
<code>_tfindnext</code>	<code>_findnext</code>	<code>_findnext</code>	<code>_wfindnext</code>
<code>_tfindnext32</code>	<code>_findnext32</code>	<code>_findnext32</code>	<code>_wfindnext32</code>
<code>_tfindnext64</code>	<code>_findnext64</code>	<code>_findnext64</code>	<code>_wfindnext64</code>
<code>_tfindnexti64</code>	<code>_findnexti64</code>	<code>_findnexti64</code>	<code>_wfindnexti64</code>
<code>_tfindnexti6432</code>	<code>_findnexti6432</code>	<code>_findnexti6432</code>	<code>_wfindnexti6432</code>
<code>_tfindnext32i64</code>	<code>_findnext32i64</code>	<code>_findnext32i64</code>	<code>_wfindnext32i64</code>
<code>_tfopen</code>	<code>fopen</code>	<code>fopen</code>	<code>_wfopen</code>
<code>_tfopen_s</code>	<code>fopen_s</code>	<code>fopen_s</code>	<code>_wfopen_s</code>
<code>_tfreopen</code>	<code>freopen</code>	<code>freopen</code>	<code>_wfreopen</code>
<code>_tfreopen_s</code>	<code>freopen_s</code>	<code>freopen_s</code>	<code>_wfreopen_s</code>
<code>_tfopen</code>	<code>_fsopen</code>	<code>_fsopen</code>	<code>_wfsopen</code>
<code>_tfullpath</code>	<code>_fullpath</code>	<code>_fullpath</code>	<code>_wfullpath</code>
<code>_tgetcwd</code>	<code>_getcwd</code>	<code>_getcwd</code>	<code>_wgetcwd</code>
<code>_tgetdcwd</code>	<code>_getdcwd</code>	<code>_getdcwd</code>	<code>_wgetdcwd</code>
<code>_tgetenv</code>	<code>getenv</code>	<code>getenv</code>	<code>_wgetenv</code>
<code>_tgetenv_s</code>	<code>getenv_s</code>	<code>getenv_s</code>	<code>_wgetenv_s</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tmain</code>	<code>main</code>	<code>main</code>	<code>wmain</code>
<code>_tmakepath</code>	<code>_makepath</code>	<code>_makepath</code>	<code>_wmakepath</code>
<code>_tmakepath_s</code>	<code>_makepath_s</code>	<code>_makepath_s</code>	<code>_wmakepath_s</code>
<code>_tmkdir</code>	<code>_mkdir</code>	<code>_mkdir</code>	<code>_wmkdir</code>
<code>_tmktemp</code>	<code>_mktemp</code>	<code>_mktemp</code>	<code>_wmktemp</code>
<code>_tmktemp_s</code>	<code>_mktemp_s</code>	<code>_mktemp_s</code>	<code>_wmktemp_s</code>
<code>_topen</code>	<code>_open</code>	<code>_open</code>	<code>_wopen</code>
<code>_topen_s</code>	<code>_open_s</code>	<code>_open_s</code>	<code>_wopen_s</code>
<code>_totlower</code>	<code>tolower</code>	<code>_mbctolower</code>	<code>towlower</code>
<code>_totupper</code>	<code>toupper</code>	<code>_mbctoupper</code>	<code>towupper</code>
<code>_tperror</code>	<code>perror</code>	<code>perror</code>	<code>_wperror</code>
<code>_tpopen</code>	<code>_popen</code>	<code>_popen</code>	<code>_wpopen</code>
<code>_tpprintf</code>	<code>printf</code>	<code>printf</code>	<code>wprintf</code>
<code>_tpprintf_s</code>	<code>printf_s</code>	<code>printf_s</code>	<code>wprintf_s</code>
<code>_tputenv</code>	<code>_putenv</code>	<code>_putenv</code>	<code>_wputenv</code>
<code>_tputenv_s</code>	<code>_putenv_s</code>	<code>_putenv_s</code>	<code>_wputenv_s</code>
<code>_tremove</code>	<code>remove</code>	<code>remove</code>	<code>_wremove</code>
<code>_trename</code>	<code>rename</code>	<code>rename</code>	<code>_wrename</code>
<code>_trmdir</code>	<code>_rmdir</code>	<code>_rmdir</code>	<code>_wrmdir</code>
<code>_tsearchenv</code>	<code>_searchenv</code>	<code>_searchenv</code>	<code>_wsearchenv</code>
<code>_tsearchenv_s</code>	<code>_searchenv_s</code>	<code>_searchenv_s</code>	<code>_wsearchenv_s</code>
<code>_tscanf</code>	<code>scanf</code>	<code>scanf</code>	<code>wscanf</code>
<code>_tscanf_s</code>	<code>scanf_s</code>	<code>scanf_s</code>	<code>wscanf_s</code>
<code>_tsetlocale</code>	<code>setlocale</code>	<code>setlocale</code>	<code>_wsetlocale</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tsopen</code>	<code>_sopen</code>	<code>_sopen</code>	<code>_wsopen</code>
<code>_tsopen_s</code>	<code>_sopen_s</code>	<code>_sopen_s</code>	<code>_wsopen_s</code>
<code>_tspawnl</code>	<code>_spawnl</code>	<code>_spawnl</code>	<code>_wspawnl</code>
<code>_tspawnle</code>	<code>_spawnle</code>	<code>_spawnle</code>	<code>_wspawnle</code>
<code>_tspawnlp</code>	<code>_spawnlp</code>	<code>_spawnlp</code>	<code>_wspawnlp</code>
<code>_tspawnlpe</code>	<code>_spawnlpe</code>	<code>_spawnlpe</code>	<code>_wspawnlpe</code>
<code>_tspawnv</code>	<code>_spawnv</code>	<code>_spawnv</code>	<code>_wspawnv</code>
<code>_tspawnve</code>	<code>_spawnve</code>	<code>_spawnve</code>	<code>_wspawnve</code>
<code>_tspawnvp</code>	<code>_spawnvp</code>	<code>_spawnvp</code>	<code>_wspawnvp</code>
<code>_tspawnvpe</code>	<code>_spawnvpe</code>	<code>_spawnvpe</code>	<code>_wspawnvpe</code>
<code>_tsplitpath</code>	<code>_splitpath</code>	<code>_splitpath</code>	<code>_wsplitpath</code>
<code>_tstat</code>	<code>_stat</code>	<code>_stat</code>	<code>_wstat</code>
<code>_tstat32</code>	<code>_stat32</code>	<code>_stat32</code>	<code>_wstat32</code>
<code>_tstati32</code>	<code>_stati32</code>	<code>_stati32</code>	<code>_wstati32</code>
<code>_tstat64</code>	<code>_stat64</code>	<code>_stat64</code>	<code>_wstat64</code>
<code>_tstati64</code>	<code>_stati64</code>	<code>_stati64</code>	<code>_wstati64</code>
<code>_tstof</code>	<code>atof</code>	<code>atof</code>	<code>_wtotf</code>
<code>_tstoi</code>	<code>atoi</code>	<code>atoi</code>	<code>_wtoi</code>
<code>_tstoi64</code>	<code>_atoi64</code>	<code>_atoi64</code>	<code>_wtoi64</code>
<code>_tstol</code>	<code>atol</code>	<code>atol</code>	<code>_wtol</code>
<code>_tstrdate</code>	<code>_strdate</code>	<code>_strdate</code>	<code>_wstrdate</code>
<code>_tstrdate_s</code>	<code>_strdate_s</code>	<code>_strdate_s</code>	<code>_wstrdate_s</code>
<code>_tstrftime</code>	<code>_strftime</code>	<code>_strftime</code>	<code>_wstrftime</code>
<code>_tstrftime_s</code>	<code>_strftime_s</code>	<code>_strftime_s</code>	<code>_wstrftime_s</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tsystem</code>	<code>system</code>	<code>system</code>	<code>_wsystem</code>
<code>_ttempnam</code>	<code>_tempnam</code>	<code>_tempnam</code>	<code>_wtempnam</code>
<code>_ttmpnam</code>	<code>tmpnam</code>	<code>tmpnam</code>	<code>_wttmpnam</code>
<code>_ttmpnam_s</code>	<code>tmpnam_s</code>	<code>tmpnam_s</code>	<code>_wttmpnam_s</code>
<code>_ttoi</code>	<code>atoi</code>	<code>atoi</code>	<code>_wtoi</code>
<code>_ttoi64</code>	<code>_atoi64</code>	<code>_atoi64</code>	<code>_wtoi64</code>
<code>_ttol</code>	<code>atol</code>	<code>atol</code>	<code>_wtol</code>
<code>_tunlink</code>	<code>_unlink</code>	<code>_unlink</code>	<code>_wunlink</code>
<code>_tutime</code>	<code>_utime</code>	<code>_utime</code>	<code>_wutime</code>
<code>_tutime32</code>	<code>_utime32</code>	<code>_utime32</code>	<code>_wutime32</code>
<code>_tutime64</code>	<code>_utime64</code>	<code>_utime64</code>	<code>_wutime64</code>
<code>_twinMain</code>	<code>WinMain</code>	<code>WinMain</code>	<code>wWinMain</code>
<code>_ui64tot</code>	<code>_ui64toa</code>	<code>_ui64toa</code>	<code>_ui64tow</code>
<code>_ui64tot_s</code>	<code>_ui64toa_s</code>	<code>_ui64toa_s</code>	<code>_ui64tow_s</code>
<code>_ultot</code>	<code>_ultoa</code>	<code>_ultoa</code>	<code>_ultow</code>
<code>_ultot_s</code>	<code>_ultoa_s</code>	<code>_ultoa_s</code>	<code>_ultow_s</code>
<code>_ungettc</code>	<code>ungetc</code>	<code>ungetc</code>	<code>ungetwc</code>
<code>_ungettch</code>	<code>_ungetch</code>	<code>_ungetch</code>	<code>_ungetwch</code>
<code>_vfprintf</code>	<code>vfprintf</code>	<code>vfprintf</code>	<code>vfwprintf</code>
<code>_vfprintf_s</code>	<code>vfprintf_s</code>	<code>vfprintf_s</code>	<code>vfwprintf_S</code>
<code>_vsctprintf</code>	<code>_vscprintf</code>	<code>_vscprintf</code>	<code>_vscwprintf</code>
<code>_vsctprintf_s</code>	<code>_vscprintf_s</code>	<code>_vscprintf_s</code>	<code>_vscwprintf_S</code>
<code>_vsnprintf</code>	<code>_vsnprintf</code>	<code>_vsnprintf</code>	<code>_vsnwprintf</code>
<code>_vsnprintf_s</code>	<code>_vsnprintf_s</code>	<code>_vsnprintf_s</code>	<code>_vsnwprintf_s</code>

GENERIC-TEXT ROUTINE NAME	<code>SBCS</code> (<code>_UNICODE</code> AND <code>MBCS</code> NOT DEFINED)	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vstprintf</code>	<code>vsprintf</code>	<code>vsprintf</code>	<code>vswprintf</code>
<code>_vstprintf_s</code>	<code>vsprintf_s</code>	<code>vsprintf_s</code>	<code>vswprintf_s</code>
<code>_vtprintf</code>	<code>vprintf</code>	<code>vprintf</code>	<code>vwprintf</code>
<code>_vtprintf_s</code>	<code>vprintf_s</code>	<code>vprintf_s</code>	<code>vwprintf_s</code>

See also

[Generic-text mappings](#)

[Data type mappings](#)

[Constant and global variable mappings](#)

[A sample generic-text program](#)

[Using generic-text mappings](#)

UCRT Locale names, Languages, and Country/Region strings

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You can set the `Locale` argument to the `setlocale`, `_wsetlocale`, `_create_locale`, and `_wcreate_locale` functions in several ways. The locale can be set by using the locale names, languages, country/region codes, and code pages that are supported by the Windows NLS API. The `Locale` argument takes one of the following forms:

```
Locale :: "locale-name"  
| "language[_country-region[.code-page]]"  
| ".code-page"  
| "C"  
| ""  
| NULL
```

The *locale-name* form is a short, IETF-standardized string; for example, `en-US` for English (United States) or `bs-Cyr1-BA` for Bosnian (Cyrillic, Bosnia and Herzegovina). These forms are preferred. For a list of supported locale names by Windows operating system version, see the **Language tag** column of the table in [Appendix A: Product Behavior](#) in [MS-LCID]: Windows Language Code Identifier (LCID) Reference. This resource lists the supported language, script, and region parts of the locale names. For information about the supported locale names that have non-default sort orders, see the **Locale name** column in [Sort order identifiers](#). Under Windows 10 or later, locale names that correspond to valid [BCP-47](#) language tags are allowed. For example, `jp-US` is a valid BCP-47 tag, but it's effectively only `US` for locale functionality.

The *language[_country-region[.code-page]]* form is stored in the locale setting for a category when a language string, or language string and country or region string, is used to create the locale. The set of supported language strings is described in [Language strings](#), and the list of supported country and region strings is listed in [Country/Region strings](#). If the specified language isn't associated with the specified country or region, the default language for the specified country or region is stored in the locale setting. We don't recommend this form for locale strings embedded in code or serialized to storage: These strings are more likely to be changed by an operating system update than the locale name form.

The *code-page* is the ANSI/OEM code page that's associated with the locale. The code page is determined for you when you specify a locale by language or by language and country/region alone. The special value `.ACP` specifies the ANSI code page for the country/region. The special value `.OCP` specifies the OEM code page for the country/region. For example, if you specify `"Greek_Greece.ACP"` as the locale, the locale is stored as `Greek_Greece.1253` (the ANSI code page for Greek), and if you specify `"Greek_Greece.OCP"` as the locale, it's stored as `Greek_Greece.737` (the OEM code page for Greek). For more information about code pages, see [Code pages](#). For a list of supported code pages on Windows, see [Code page identifiers](#).

If you use only the code page to specify the locale, the user's default language and country/region as reported by `GetUserDefaultLocaleName` are used. For example, if you specify `".1254"` (ANSI Turkish) as the locale for a user that's configured for English (United States), the locale that's stored is `English_United States.1254`. We don't recommend this form, because it could lead to inconsistent behavior.

A `Locale` argument value of `C` specifies the minimal ANSI conforming environment for C translation. The `C` locale assumes that every `char` data type is 1 byte and its value is always less than 256. If `Locale` points to an empty string, the locale is the implementation-defined native environment.

You can specify all of the locale categories at the same time for the `setlocale` and `_wsetlocale` functions by using the `LC_ALL` category. The categories can all be set to the same locale, or you can set each category individually by using a locale argument that has this form:

```
LC-ALL-specifier :: Locale  
| [ LC_COLLATE= Locale ][ ;LC_CTYPE= Locale ][ ;LC_MONETARY= Locale ][ ;LC_NUMERIC= Locale ][ ;LC_TIME= Locale ]
```

You can specify multiple category types, separated by semicolons. Category types that aren't specified use the current locale setting. For example, this code snippet sets the current locale for all categories to `de-DE`, and then sets the categories `LC_MONETARY` to `en-GB` and `LC_TIME` to `es-ES`:

```
_wsetlocale(LC_ALL, L"de-DE");  
_wsetlocale(LC_ALL, L"LC_MONETARY=en-GB;LC_TIME=es-ES");
```

UTF-8 Support

UTF-8 support can be enabled by using the UTF-8 code page in your locale string. For more information, see the [UTF-8 support section of `setlocale`](#).

See also

[C runtime library reference](#)

```
_get_current_locale  
setlocale , _wsetlocale  
_create_locale , _wcreate_locale
```

[Language strings](#)

[Country/Region strings](#)

Language strings

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The `setlocale` and `_create_locale` functions can use the Windows NLS API supported languages on operating systems that don't use the Unicode code page. For a list of supported languages by operating system version, see [Appendix A: Product Behavior](#) in [MS-LCID]: Windows Language Code Identifier (LCID) Reference. The language string can be any of the values in the **Language** and **Language tag** columns of the list of supported languages. For example code that enumerates available locale names and related values, see [NLS: Name-based APIs Sample](#).

Supported language strings

The Microsoft C run-time library implementation also supports these language strings:

LANGUAGE STRING	EQUIVALENT LOCALE NAME
american	en-US
american english	en-US
american-english	en-US
australian	en-AU
belgian	nl-BE
canadian	en-CA
chh	zh-HK
chi	zh-SG
chinese	zh
chinese-hongkong	zh-HK
chinese-simplified	zh-CN
chinese-singapore	zh-SG
chinese-traditional	zh-TW
dutch-belgian	nl-BE
english-american	en-US
english-aus	en-AU

LANGUAGE STRING	EQUIVALENT LOCALE NAME
english-belize	en-BZ
english-can	en-CA
english-caribbean	en-029
english-ire	en-IE
english-jamaica	en-JM
english-nz	en-NZ
english-south africa	en-ZA
english-trinidad y tobago	en-TT
english-uk	en-GB
english-us	en-US
english-usa	en-US
french-belgian	fr-BE
french-canadian	fr-CA
french-luxembourg	fr-LU
french-swiss	fr-CH
german-austrian	de-AT
german-lichtenstein	de-LI
german-luxembourg	de-LU
german-swiss	de-CH
irish-english	en-IE
italian-swiss	it-CH
norwegian	no
norwegian-bokmal	nb-NO
norwegian-nynorsk	nn-NO

LANGUAGE STRING	EQUIVALENT LOCALE NAME
portuguese-brazilian	pt-BR
spanish-argentina	es-AR
spanish-bolivia	es-BO
spanish-chile	es-CL
spanish-colombia	es-CO
spanish-costa rica	es-CR
spanish-dominican republic	es-DO
spanish-ecuador	es-EC
spanish-el salvador	es-SV
spanish-guatemala	es-GT
spanish-honduras	es-HN
spanish-mexican	es-MX
spanish-modern	es-ES
spanish-nicaragua	es-NI
spanish-panama	es-PA
spanish-paraguay	es-PY
spanish-peru	es-PE
spanish-puerto rico	es-PR
spanish-uruguay	es-UY
spanish-venezuela	es-VE
swedish-finland	sv-FI
swiss	de-CH
uk	en-GB
us	en-US

LANGUAGE STRING	EQUIVALENT LOCALE NAME
usa	en-US

See also

- [Locale names, Languages, and Country/Region strings](#)\
- [Country/Region strings](#)\
- [`setlocale`](#) , [`_wsetlocale`](#) \
- [`_create_locale`](#) , [`_wcreate_locale`](#)

Country/region strings

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Country and region strings can be combined with a language string to create a locale specification for the

`setlocale`, `_wsetlocale`, `_create_locale`, and `_wcreate_locale` functions.

For lists of country and region names that are supported by various Windows operating system versions, see the **Language**, **Location**, and **Language tag** columns of the table in [Appendix A: Product Behavior](#) in [MS-LCID]: Windows Language Code Identifier (LCID) Reference. For an example of code that enumerates available locale names and related values, see [NLS: Name-based APIs Sample](#).

Other supported country and region strings

The Microsoft C run-time library implementation also supports the following country/region strings and abbreviations:

COUNTRY/REGION STRING	ABBREVIATION	EQUIVALENT LOCALE NAME
<code>america</code>	<code>USA</code>	<code>en-US</code>
<code>britain</code>	<code>GBR</code>	<code>en-GB</code>
<code>china</code>	<code>CHN</code>	<code>zh-CN</code>
<code>czech</code>	<code>CZE</code>	<code>cs-CZ</code>
<code>england</code>	<code>GBR</code>	<code>en-GB</code>
<code>great britain</code>	<code>GBR</code>	<code>en-GB</code>
<code>holland</code>	<code>NLD</code>	<code>nl-NL</code>
<code>hong-kong</code>	<code>HKG</code>	<code>zh-HK</code>
<code>new-zealand</code>	<code>NZL</code>	<code>en-NZ</code>
<code>nz</code>	<code>NZL</code>	<code>en-NZ</code>
<code>pr china</code>	<code>CHN</code>	<code>zh-CN</code>
<code>pr-china</code>	<code>CHN</code>	<code>zh-CN</code>
<code>puerto-rico</code>	<code>PRI</code>	<code>es-PR</code>
<code>slovak</code>	<code>SVK</code>	<code>sk-SK</code>
<code>south africa</code>	<code>ZAF</code>	<code>af-ZA</code>

COUNTRY/REGION STRING	ABBREVIATION	EQUIVALENT LOCALE NAME
south korea	KOR	ko-KR
south-africa	ZAF	af-ZA
south-korea	KOR	ko-KR
trinidad & tobago	TTO	en-TT
uk	GBR	en-GB
united-kingdom	GBR	en-GB
united-states	USA	en-US
us	USA	en-US

See also

[Locale names, Languages, and Country/Region strings](#)

[Language strings](#)

[setlocale](#) , [_wsetlocale](#)

[_create_locale](#) , [_wcreate_locale](#)

Function family overview

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This section lists C runtime library routines by function family.

CRT library routine families

`_exec`, `_wexec`

Functions to load and execute a new process.

Filename search functions

Functions to search for specified file names, and to close searches.

Format specification syntax for `printf` and `wprintf`

Describes the format string and arguments for `printf` and `wprintf`.

Format specification field characters: `scanf` and `wscanf`

Describes the format specification fields for parsing an input stream for the entire `scanf` family of functions.

`is`, `isw` functions

Functions for testing characters for things like whether they're uppercase, ASCII, numeric, punctuation, and so on.

`_ismbb` functions

Functions for testing an integer value for whether it represents an alpha character, blank character, a print character, and so on.

`_ismbc` functions

Functions for testing a multibyte character for whether it represents an alpha character, blank character, a print character, and so on.

operator `delete` (CRT)

Beginning in Visual Studio 2013, the Universal C Runtime (UCRT) no longer supports the C++-specific operator `delete` function. It's now part of the C++ Standard Library.

operator `new` (CRT)

Beginning in Visual Studio 2013, the Universal C Runtime (UCRT) no longer supports the C++-specific operator `new` function. It's now part of the C++ Standard Library.

`printf` positional parameter functions

Positional parameters specify by number the argument to substitute into a field in a format string.

`scanf` type field characters

The type character determines whether the associated argument is interpreted as a character, string, or number for any of the `scanf` family of functions, including the secure versions, such as `scanf_s`.

`scanf` width specification

The width field is a positive decimal integer that controls the maximum number of characters to be read for that field. Applies to any of the `scanf` family of functions, including the secure versions, such as `scanf_s`.

`_spawn`, `_wspawn` functions

Functions to create and execute a new process.

`strcoll` functions

The `strcoll` and `wcscol1` functions compare two strings according to the `LC_COLLATE` category setting of the locale code page.

String to numeric value functions

The `strtod` family of functions convert a null-terminated string to a numeric value.

`vprintf` functions

The `vprintf` functions take a pointer to an argument list, format it, and write the result to the specified destination. The functions differ in several ways: the parameter validation performed; whether they take wide or single-byte character strings; the output destination; and support for specifying the order in which parameters are used in the format string.

See also

[C Runtime library reference](#)

`_exec`, `_wexec` Functions

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Each function in this family loads and executes a new process:

<code>_exec1</code>	<code>_wexec1</code>
<code>_execv</code>	<code>_wexecv</code>
<code>_execle</code>	<code>_wexecle</code>
<code>_execve</code>	<code>_wexecve</code>
<code>_execlp</code>	<code>_wexeclp</code>
<code>_execvp</code>	<code>_wexecvp</code>
<code>_execlpe</code>	<code>_wexeclpe</code>
<code>_execvpe</code>	<code>_wexecvpe</code>

The letter at the end of the function name determines the variation.

<code>_EXEC</code> FUNCTION SUFFIX	DESCRIPTION
e	<code>envp</code> , array of pointers to environment settings, is passed to the new process.
l	Command-line arguments are passed individually to <code>_exec</code> function. Typically used when the number of parameters to the new process is known in advance.
p	<code>PATH</code> environment variable is used to find the file to execute.
v	<code>argv</code> , array of pointers to command-line arguments, is passed to <code>_exec</code> . Typically used when the number of parameters to the new process is variable.

Remarks

Each `_exec` function loads and executes a new process. All `_exec` functions use the same operating-system function (`CreateProcess`). The `_exec` functions automatically handle multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use. The `_wexec` functions are wide-character versions of the `_exec` functions. The `_wexec` functions behave identically to their `_exec` family counterparts except that they don't handle multibyte-character strings.

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_texec1</code>	<code>_exec1</code>	<code>_exec1</code>	<code>_wexec1</code>
<code>_texecle</code>	<code>_execle</code>	<code>_execle</code>	<code>_wexecle</code>

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_texeclp</code>	<code>_execlp</code>	<code>_execlp</code>	<code>_wexeclp</code>
<code>_texeclepe</code>	<code>_execlepe</code>	<code>_execlepe</code>	<code>_wexeclepe</code>
<code>_texecv</code>	<code>_execv</code>	<code>_execv</code>	<code>_wexecv</code>
<code>_texecve</code>	<code>_execve</code>	<code>_execve</code>	<code>_wexecve</code>
<code>_texecvp</code>	<code>_execvp</code>	<code>_execvp</code>	<code>_wexecvp</code>
<code>_texecvpe</code>	<code>_execvpe</code>	<code>_execvpe</code>	<code>_wexecvpe</code>

The `cmdname` parameter specifies the file to be executed as the new process. It can specify a full path (from the root), a partial path (from the current working directory), or a file name. If `cmdname` doesn't have a file name extension or doesn't end with a period (.), the `_exec` function searches for the named file. If the search is unsuccessful, it tries the same base name with the .com file name extension and then with the .exe, .bat, and .cmd file name extensions. If `cmdname` has a file name extension, only that extension is used in the search. If `cmdname` ends with a period, the `_exec` function searches for `cmdname` with no file name extension. `_execlp`, `_execlepe`, `_execvp`, and `_execvpe` search for `cmdname` (using the same procedures) in the directories specified by the `PATH` environment variable. If `cmdname` contains a drive specifier or any slashes (that is, if it's a relative path), the `_exec` call searches only for the specified file; the path isn't searched.

Parameters are passed to the new process by giving one or more pointers to character strings as parameters in the `_exec` call. These character strings form the parameter list for the new process. The combined length of the inherited environment settings and the strings forming the parameter list for the new process must not exceed 32 kilobytes. The terminating `NULL` character (`\0`) for each string isn't included in the count, but space characters (inserted automatically to separate the parameters) are counted.

NOTE

Spaces embedded in strings may cause unexpected behavior; for example, passing `_exec` the string `"hi there"` will result in the new process getting two arguments, `"hi"` and `"there"`. If the intent was to have the new process open a file named "hi there", the process would fail. You can avoid this by quoting the string: `"\"hi there\""`.

IMPORTANT

Do not pass user input to `_exec` without explicitly checking its content. `_exec` will result in a call to `CreateProcess` so keep in mind that unqualified path names could lead to potential security vulnerabilities.

The `_exec` functions validate their parameters. If expected parameters are null pointers, empty strings, or omitted, the `_exec` functions invoke the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1. No new process is executed.

The argument pointers can be passed as separate parameters (in `_execl`, `_execle`, `_execlp`, and `_execlepe`) or as an array of pointers (in `_execv`, `_execve`, `_execvp`, and `_execvpe`). At least one parameter, `arg0`, must be passed to the new process; this parameter is `argv[0]` of the new process. Usually, this parameter is a copy of `cmdname`. (A different value doesn't produce an error.)

The `_exec1`, `_execle`, `_execlp`, and `_execlpe` calls are typically used when the number of parameters is known in advance. The parameter `arg0` is usually a pointer to `cmdname`. The parameters `arg1` through `argn` point to the character strings forming the new parameter list. A null pointer must follow `argn` to mark the end of the parameter list.

The `_execv`, `_execve`, `_execvp`, and `_execvpe` calls are useful when the number of parameters to the new process is variable. Pointers to the parameters are passed as an array, `argv`. The parameter `argv[0]` is usually a pointer to `cmdname`. The parameters `argv[1]` through `argv[n]` point to the character strings forming the new parameter list. The parameter `argv[n+1]` must be a `NULL` pointer to mark the end of the parameter list.

Files that are open when an `_exec` call is made remain open in the new process. In `_exec1`, `_execlp`, `_execv`, and `_execvp` calls, the new process inherits the environment of the calling process. `_execle`, `_execlpe`, `_execve`, and `_execvpe` calls alter the environment for the new process by passing a list of environment settings through the `envp` parameter. `envp` is an array of character pointers, each element of which (except for the final element) points to a null-terminated string defining an environment variable. Such a string usually has the form `NAME=value` where `NAME` is the name of an environment variable and `value` is the string value to which that variable is set. (The `value` isn't enclosed in double quotation marks.) The final element of the `envp` array should be `NULL`. When `envp` itself is `NULL`, the new process inherits the environment settings of the calling process.

A program executed with one of the `_exec` functions is always loaded into memory as if the maximum allocation field in the program's .exe file header were set to the default value of `0xFFFFH`.

The `_exec` calls don't preserve the translation modes of open files. If the new process must use files inherited from the calling process, use the `_setmode` routine to set the translation mode of these files to the desired mode. You must explicitly flush (using `fflush` or `_flushall`) or close any stream before the `_exec` function call. Signal settings aren't preserved in new processes that are created by calls to `_exec` routines. The signal settings are reset to the default in the new process.

Example

```
// crt_args.c
// Illustrates the following variables used for accessing
// command-line arguments and environment variables:
// argc  argv  envp
// This program will be executed by crt_exec which follows.

#include <stdio.h>

int main( int argc, // Number of strings in array argv
char *argv[],      // Array of command-line argument strings
char **envp )       // Array of environment variable strings
{
    int count;

    // Display each command-line argument.
    printf( "\nCommand-line arguments:\n" );
    for( count = 0; count < argc; count++ )
        printf( "  argv[%d]  %s\n", count, argv[count] );

    // Display each environment variable.
    printf( "\nEnvironment variables:\n" );
    while( *envp != NULL )
        printf( "  %s\n", *(envp++) );

    return;
}
```

Run the following program to execute Crt_args.exe:

```
// crt_exec.c
// Illustrates the different versions of exec, including
//      _execl      _execle      _execlp      _execlepe
//      _execv      _execve      _execvp      _execvpe
//
// Although CRT_EXEC.C can exec any program, you can verify how
// different versions handle arguments and environment by
// compiling and specifying the sample program CRT_ARGS.C. See
// "_spawn, _wspawn Functions" for examples of the similar spawn
// functions.

#include <stdio.h>
#include <conio.h>
#include <process.h>

char *my_env[] =      // Environment for exec?
{
    "THIS=environment will be",
    "PASSED=to new process by",
    "the EXEC=functions",
    NULL
};

int main( int ac, char* av[] )
{
    char *args[4];
    int ch;
    if( ac != 3 ){
        fprintf( stderr, "Usage: %s <program> <number (1-8)>\n", av[0] );
        return;
    }

    // Arguments for _execv?
    args[0] = av[1];
    args[1] = "exec??";
    args[2] = "two";
    args[3] = NULL;

    switch( atoi( av[2] ) )
    {
    case 1:
        _execl( av[1], av[1], "_execl", "two", NULL );
        break;
    case 2:
        _execle( av[1], av[1], "_execle", "two", NULL, my_env );
        break;
    case 3:
        _execlp( av[1], av[1], "_execlp", "two", NULL );
        break;
    case 4:
        _execlepe( av[1], av[1], "_execlepe", "two", NULL, my_env );
        break;
    case 5:
        _execv( av[1], args );
        break;
    case 6:
        _execve( av[1], args, my_env );
        break;
    case 7:
        _execvp( av[1], args );
        break;
    case 8:
        _execvpe( av[1], args, my_env );
        break;
    default:
        break;
    }
}
```

```
}

// This point is reached only if exec fails.
printf( "\nProcess was not exected." );
exit( 0 );
}
```

Requirements

Header: `process.h`

See also

Process and environment control

`abort`
`atexit`
`_exit`, `_Exit`, `_exit`
`_onexit`, `_onexit_m`
`_spawn`, `_wspawn` functions
`system`, `_wsystem`

Filename search functions

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These functions search for and close searches for specified file names:

- `_findnext`, `_wfindnext`
- `_findfirst`, `_wfindfirst`
- `_findclose`

Remarks

The `_findfirst` function provides information about the first instance of a file name that matches the file specified in the `filespec` argument. You can use in `filespec` any combination of wildcard characters that is supported by the host operating system.

The functions return file information in a `_finddata_t` structure, which is defined in `io.h`. Various functions in the family use many variations on the `_finddata_t` structure. The basic `_finddata_t` structure includes the following elements:

`unsigned attrib`

File attribute.

`time_t time_create`

Time of file creation (`-1L` for FAT file systems). This time is stored in UTC format. To convert to the local time, use `localtime_s`.

`time_t time_access`

Time of the last file access (`-1L` for FAT file systems). This time is stored in UTC format. To convert to the local time, use `localtime_s`.

`time_t time_write`

Time of the last write to file. This time is stored in UTC format. To convert to the local time, use `localtime_s`.

`_fsize_t size`

Length of the file in bytes.

`char name [_MAX_PATH] NULL` -terminated name of matched file or directory, without the path.

In file systems that don't support the creation and last access times of a file, such as the FAT system, the `time_create` and `time_access` fields are always `-1L`.

`_MAX_PATH` is defined in `stdlib.h` as 260 bytes.

You can't specify target attributes (such as `_A_RDONLY`) to limit the find operation. These attributes are returned in the `attrib` field of the `_finddata_t` structure and can have the following values (defined in `io.h`). Users shouldn't rely on these attributes being the only values possible for the `attrib` field.

`_A_ARCH`

Archive. Set whenever the file is changed and cleared by the `BACKUP` command. Value: `0x20`.

`_A_HIDDEN`

Hidden file. Not often seen with the `DIR` command, unless you use the `/AH` option. Returns information about

normal files and files that have this attribute. Value: `0x02`.

`_A_NORMAL`

Normal. File has no other attributes set and can be read or written to without restriction. Value: `0x00`.

`_A_RDONLY`

Read-only. File can't be opened for writing and a file that has the same name can't be created. Value: `0x01`.

`_A_SUBDIR`

Subdirectory. Value: `0x10`.

`_A_SYSTEM`

System file. Not ordinarily seen with the `DIR` command, unless the `/A` or `/A:S` option is used. Value: `0x04`.

`_findnext` finds the next name, if any, that matches the `filespec` argument specified in an earlier call to `_findfirst`. The `fileinfo` argument should point to a structure initialized by the previous call to `_findfirst`. If a match is found, the `fileinfo` structure contents are changed as described earlier. Otherwise, it's left unchanged. `_findclose` closes the specified search handle and releases all associated resources for both `_findfirst` and `_findnext`. The handle returned by either `_findfirst` or `_findnext` must first be passed to `_findclose`, before modification operations, such as deleting, can be performed on the directories that form the paths passed to them.

You can nest the `_find` functions. For example, if a call to `_findfirst` or `_findnext` finds the file that is a subdirectory, a new search can be initiated with another call to `_findfirst` or `_findnext`.

`_wfindfirst` and `_wfindnext` are wide-character versions of `_findfirst` and `_findnext`. The structure argument of the wide-character versions has the `_wfinddata_t` data type, which is defined in `io.h` and in `Wchar.h`. The fields of this data type are the same as the fields of the `_finddata_t` data type, except that in `_wfinddata_t` the `name` field is of type `wchar_t` instead of type `char`. Otherwise, `_wfindfirst` and `_wfindnext` behave identically to `_findfirst` and `_findnext`.

`_findfirst` and `_findnext` use the 64-bit time type. If you must use the old 32-bit time type, you can define `_USE_32BIT_TIME_T`. The versions of these functions that have the `32` suffix in their names use the 32-bit time type, and the ones with the `64` suffix use the 64-bit time type.

Functions `_findfirst32i64`, `_findnext32i64`, `_wfindfirst32i64`, and `_wfindnext32i64` also behave identically to the 32-bit time type versions of these functions except they use and return 64-bit file lengths. Functions `_findfirst64i32`, `_findnext64i32`, `_wfindfirst64i32`, and `_wfindnext64i32` use the 64-bit time type but use 32-bit file lengths. These functions use appropriate variations of the `_finddata_t` type in which the fields have different types for the time and the file size.

`_finddata_t` is actually a macro that evaluates to `_finddata64i32_t` (or `_finddata32_t` if `_USE_32BIT_TIME_T` is defined). The following table summarizes the variations on `_finddata_t`:

STRUCTURE	TIME TYPE	FILE SIZE TYPE
<code>_finddata_t</code> , <code>_wfinddata_t</code>	<code>__time64_t</code>	<code>_fsize_t</code>
<code>_finddata32_t</code> , <code>_wfinddata32_t</code>	<code>__time32_t</code>	<code>_fsize_t</code>
<code>_finddata64_t</code> , <code>_wfinddata64_t</code>	<code>__time64_t</code>	<code>_int64</code>
<code>_finddata32i64_t</code> , <code>_wfinddata32i64_t</code>	<code>__time32_t</code>	<code>_int64</code>

STRUCTURE	TIME TYPE	FILE SIZE TYPE
<code>_finddata64i32_t</code> , <code>_wfinddata64i32_t</code>	<code>_time64_t</code>	<code>_fsize_t</code>

`_fsize_t` is a `typedef` for `unsigned long` (32 bits).

Example

```
// crt_find.c
// This program uses the 32-bit _find functions to print
// a list of all files (and their attributes) with a .C extension
// in the current directory.

#include <stdio.h>
#include <stdlib.h>
#include <io.h>
#include <time.h>

int main( void )
{
    struct _finddata_t c_file;
    intptr_t hFile;

    // Find first .c file in current directory
    if( (hFile = _findfirst( "*.c", &c_file ) ) == -1L )
        printf( "No *.c files in current directory!\n" );
    else
    {
        printf( "Listing of .c files\n\n" );
        printf( "RDO HID SYS ARC FILE           DATE %25c SIZE\n", ' ' );
        printf( "--- --- --- --- -----           ---- %25c ----\n", ' ' );
        do {
            char buffer[30];
            printf( ( c_file.attrib & _A_RDONLY ) ? " Y " : " N " );
            printf( ( c_file.attrib & _A_HIDDEN ) ? " Y " : " N " );
            printf( ( c_file.attrib & _A_SYSTEM ) ? " Y " : " N " );
            printf( ( c_file.attrib & _A_ARCH ) ? " Y " : " N " );
            ctime_s( buffer, _countof(buffer), &c_file.time_write );
            printf( " %-12s %.24s %9ld\n",
                    c_file.name, buffer, c_file.size );
        } while( _findnext( hFile, &c_file ) == 0 );
        _findclose( hFile );
    }
}
```

Listing of .c files

RDO	HID	SYS	ARC	FILE	DATE	SIZE
---	---	---	---	---	---	---
N	N	N	Y	blah.c	Wed Feb 13 09:21:42 2002	1715
N	N	N	Y	test.c	Wed Feb 06 14:30:44 2002	312

See also

[System calls](#)

Format specification syntax: `printf` and `wprintf` functions

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The various `printf` and `wprintf` functions take a format string and optional arguments and produce a formatted sequence of characters for output. The format string contains zero or more *directives*, which are either literal characters for output or encoded *conversion specifications* that describe how to format an argument in the output. This article describes the syntax used to encode conversion specifications in the format string. For a listing of these functions, see [Stream I/O](#).

A conversion specification consists of optional and required fields in this form:

```
%[flags][width][.precision][size]type
```

Each field of the conversion specification is a character or a number that signifies a particular format option or conversion specifier. The required *type* field specifies the kind of conversion to be applied to an argument. The optional *flags*, *width*, and *precision* fields control other format aspects such as leading spaces or zeroes, justification, and displayed precision. The *size* field specifies the size of the argument consumed and converted.

A basic conversion specification contains only the percent sign and a *type* character. For example, `%s` specifies a string conversion. To print a percent-sign character, use `%%`. If a percent sign is followed by a character that has no meaning as a format field, the invalid parameter handler is invoked. For more information, see [Parameter validation](#).

IMPORTANT

For security and stability, ensure that format conversion specification strings aren't end-user defined. For example, consider a program that prompts the user to enter a name and stores the input in a string variable that's named `user_name`. To print `user_name`, never do this:

```
printf( user_name ); /* Danger! If user_name contains "%s", program will crash */
```

Instead, do this:

```
printf( "%s", user_name );
```

NOTE

In Visual Studio 2015 The `printf` and `scanf` family of functions were declared as `inline` and moved to the `<stdio.h>` and `<conio.h>` headers. If you are migrating older code you might see LNK2019 in connection with these functions. For more information, see [Visual C++ change history 2003 - 2015](#).

Type conversion specifier

The *type* conversion specifier character specifies whether to interpret the corresponding argument as a character, a string, a pointer, an integer, or a floating-point number. The *type* character is the only required conversion specification field, and it appears after any optional fields.

The arguments that follow the format string are interpreted according to the corresponding *type* character and

the optional `size` prefix. Conversions for character types `char` and `wchar_t` are specified by using `c` or `C`, and single-byte and multi-byte or wide character strings are specified by using `s` or `S`, depending on which formatting function is being used. Character and string arguments that are specified by using `c` and `s` are interpreted as `char` and `char*` by `printf` family functions, or as `wchar_t` and `wchar_t*` by `wprintf` family functions. Character and string arguments that are specified by using `C` and `S` are interpreted as `wchar_t` and `wchar_t*` by `printf` family functions, or as `char` and `char*` by `wprintf` family functions. This behavior is Microsoft-specific.

Integer types such as `short`, `int`, `long`, `long long`, and their `unsigned` variants, are specified by using `d`, `i`, `o`, `u`, `x`, and `X`. Floating-point types such as `float`, `double`, and `long double`, are specified by using `a`, `A`, `e`, `E`, `f`, `F`, `g`, and `G`. By default, unless they're modified by a `size` prefix, integer arguments are coerced to `int` type, and floating-point arguments are coerced to `double`. On 64-bit systems, an `int` is a 32-bit value; so, 64-bit integers will be truncated when they're formatted for output unless a `size` prefix of `ll` or `I64` is used. Pointer types that are specified by `p` use the default pointer size for the platform.

NOTE

Microsoft-specific:

The `z` type character, and the behavior of the `c`, `C`, `s`, and `S` type characters when they're used with the `printf` and `wprintf` functions, are Microsoft extensions. The ISO C standard uses `c` and `s` consistently for narrow characters and strings, and `C` and `S` for wide characters and strings, in all formatting functions.

Type field characters

TYPE CHARACTER	ARGUMENT	OUTPUT FORMAT
<code>c</code>	Character	When used with <code>printf</code> functions, specifies a single-byte character; when used with <code>wprintf</code> functions, specifies a wide character.
<code>C</code>	Character	When used with <code>printf</code> functions, specifies a wide character; when used with <code>wprintf</code> functions, specifies a single-byte character.
<code>d</code>	Integer	Signed decimal integer.
<code>i</code>	Integer	Signed decimal integer.
<code>o</code>	Integer	Unsigned octal integer.
<code>u</code>	Integer	Unsigned decimal integer.
<code>x</code>	Integer	Unsigned hexadecimal integer; uses " <code>abcdef</code> ".
<code>X</code>	Integer	Unsigned hexadecimal integer; uses " <code>ABCDEF</code> ".

Type Character	Argument	Output Format
e	Floating-point	Signed value that has the form [-]d.ddda _e [+ -]dd[d], where d is one decimal digit, ddd is one or more decimal digits depending on the specified precision, or six by default, and dd[d] is two or three decimal digits depending on the output format and size of the exponent.
E	Floating-point	Identical to the e format except that E rather than e introduces the exponent.
f	Floating-point	Signed value that has the form [-]ddd.a _{ddd} , where ddd is one or more decimal digits. The number of digits before the decimal point depends on the magnitude of the number, and the number of digits after the decimal point depends on the requested precision, or six by default.
F	Floating-point	Identical to the f format except that infinity and NaN output is capitalized.
g	Floating-point	Signed values are displayed in f or e format, whichever is more compact for the given value and precision. The e format is used only when the exponent of the value is less than -4 or greater than or equal to the <i>precision</i> argument. Trailing zeros are truncated, and the decimal point appears only if one or more digits follow it.
G	Floating-point	Identical to the g format, except that E, rather than e, introduces the exponent (where appropriate).
a	Floating-point	Signed hexadecimal double-precision floating-point value that has the form [-]0x <h>hhhh</h> p[+ -]dd, where hhhh are the hex digits (using lower case letters) of the mantissa, and dd are one or more digits for the exponent. The precision specifies the number of digits after the point.
A	Floating-point	Signed hexadecimal double-precision floating-point value that has the form [-]0X <h>hhhh</h> P[+ -]dd, where hhhh are the hex digits (using capital letters) of the mantissa, and dd are one or more digits for the exponent. The precision specifies the number of digits after the point.

Type character	Argument	Output format
n	Pointer to integer	Number of characters that are successfully written so far to the stream or buffer. This value is stored in the integer whose address is given as the argument. The size of the integer pointed at can be controlled by an argument size specification prefix. The n specifier is disabled by default; for information see the important security note.
p	Pointer type	Display the argument as an address in hexadecimal digits.
s	String	When used with <code>printf</code> functions, specifies a single-byte or multi-byte character string; when used with <code>wprintf</code> functions, specifies a wide-character string. Characters are displayed up to the first null character or until the <i>precision</i> value is reached.
S	String	When used with <code>printf</code> functions, specifies a wide-character string; when used with <code>wprintf</code> functions, specifies a single-byte or multi-byte character string. Characters are displayed up to the first null character or until the <i>precision</i> value is reached.
z	<code>ANSI_STRING</code> or <code>UNICODE_STRING</code> structure	<p>When the address of an <code>ANSI_STRING</code> or <code>UNICODE_STRING</code> structure is passed as the argument, display the string contained in the buffer pointed to by the <code>Buffer</code> field of the structure. Use a <i>size</i> modifier prefix of w to specify a <code>UNICODE_STRING</code> argument—for example, <code>%wZ</code>. The <code>Length</code> field of the structure must be set to the length, in bytes, of the string. The <code>MaximumLength</code> field of the structure must be set to the length, in bytes, of the buffer.</p> <p>Typically, the z type character is used only in driver debugging functions that use a conversion specification, such as <code>dbgPrint</code> and <code>kdPrint</code>.</p>

In Visual Studio 2015 and later versions, if the argument that corresponds to a floating-point conversion specifier (a, A, e, E, f, F, g, G) is infinite, indefinite, or NaN, the formatted output conforms to the C99 standard. This table lists the formatted output:

Value	Output
Infinity	inf

VALUE	OUTPUT
Quiet NaN	nan
Signaling NaN	nan(snan)
Indefinite NaN	nan(ind)

Any of these strings may be prefixed by a sign. If a floating-point *type* conversion specifier character is a capital letter, then the output is also formatted in capital letters. For example, if the format specifier is `%F` instead of `%f`, an infinity is formatted as `INF` instead of `inf`. The `scanf` functions can also parse these strings, so these values can make a round trip through `printf` and `scanf` functions.

Before Visual Studio 2015, the CRT used a different, non-standard format for output of infinite, indefinite, and NaN values:

VALUE	OUTPUT
+ Infinity	<code>1.#INF random-digits</code>
- Infinity	<code>-1.#INF random-digits</code>
Indefinite (same as quiet NaN)	<code>digit .#IND random-digits</code>
NaN	<code>digit .#NAN random-digits</code>

Any of these strings may have been prefixed by a sign, and may have been formatted differently depending on field width and precision, sometimes with unusual effects. For example, `printf("%.2f\n", INFINITY)` prints `1.#J` because the `#INF` would be "rounded" to two digits of precision.

NOTE

If the argument that corresponds to `%s` or `%S`, or the `Buffer` field of the argument that corresponds to `%z`, is a null pointer, "(null)" is displayed.

NOTE

In all exponential formats, the minimum number of digits of exponent to display is two, using three only if necessary. By using the `_set_output_format` function, you can set the number of digits displayed to three for backward compatibility with code written for Visual Studio 2013 and before.

IMPORTANT

Because the `%n` format is inherently insecure, it's disabled by default. If `%n` is encountered in a format string, the invalid parameter handler is invoked, as described in [Parameter validation](#). To enable `%n` support, see `_set_printf_count_output`.

Flag directives

The first optional field in a conversion specification contains *flag directives*. This field contains zero or more flag characters that specify output justification and control output of signs, blanks, leading zeros, decimal points, and

octal and hexadecimal prefixes. More than one flag directive may appear in a conversion specification, and the flag characters can appear in any order.

Flag characters

FLAG	MEANING	DEFAULT
-	Left align the result within the given field width.	Right align.
+	Use a sign (+ or -) to prefix the output value if it's of a signed type.	Sign appears only for negative signed values (-).
0	If <i>width</i> is prefixed by 0, leading zeros are added until the minimum width is reached. If both 0 and - appear, the 0 is ignored. If 0 is specified for an integer format (i, u, x, X, o, d) and a precision specification is also present—for example, %04.2—the 0 is ignored. If 0 is specified for the a or A floating-point format, leading zeros are prepended to the mantissa, after the 0x or 0X prefix.	No padding.
blank (' ')	Use a blank to prefix the output value if it's signed and positive. The blank is ignored if both the blank and + flags appear.	No blank appears.
#	When it's used with the o, x, or X format, the # flag uses 0, 0x, or 0X, respectively, to prefix any nonzero output value.	No prefix appears.
	When it's used with the e, E, f, F, a, or A format, the # flag forces the output value to contain a decimal point.	Decimal point appears only if digits follow it.
	When it's used with the g or G format, the # flag forces the output value to contain a decimal point and prevents the truncation of trailing zeros. Ignored when used with c, d, i, u, or s.	Decimal point appears only if digits follow it. Trailing zeros are truncated.

Width specification

In a conversion specification, the optional width specification field appears after any *flags* characters. The *width* argument is a non-negative decimal integer that controls the minimum number of characters that are output. If the number of characters in the output value is less than the specified width, blanks are added to the left or the right of the values—depending on whether the left-alignment flag (-) is specified—until the minimum width is reached. If *width* is prefixed by 0, leading zeros are added to integer or floating-point conversions until the

minimum width is reached, except when conversion is to an infinity or `NaN`.

The width specification never causes a value to be truncated. If the number of characters in the output value is greater than the specified width, or if `width` isn't provided, all characters of the value are output, subject to the precision specification.

If the width specification is an asterisk (`*`), an `int` argument from the argument list supplies the value. The `width` argument must precede the value that's being formatted in the argument list, as shown in this example:

```
printf("%0*d", 5, 3); /* 00003 is output */
```

A missing or small `width` value in a conversion specification doesn't cause the truncation of an output value. If the result of a conversion is wider than the `width` value, the field expands to contain the conversion result.

Precision specification

In a conversion specification, the third optional field is the precision specification. It consists of a period (`.`) followed by a non-negative decimal integer that, depending on the conversion type, specifies the number of string characters, the number of decimal places, or the number of significant digits to be output.

Unlike the width specification, the precision specification can cause either truncation of the output value or rounding of a floating-point value. If `precision` is specified as 0, and the value to be converted is 0, the result is no characters output, as shown in this example:

```
printf( "%.0d", 0 ); /* No characters output */
```

If the precision specification is an asterisk (`*`), an `int` argument from the argument list supplies the value. In the argument list, the `precision` argument must precede the value that's being formatted, as shown in this example:

```
printf( "%.*f", 3, 3.14159265 ); /* 3.142 output */
```

The `type` character determines either the interpretation of `precision` or the default precision when `precision` is omitted, as shown in the following table.

How precision values affect type

TYPE	MEANING	DEFAULT
<code>a</code> , <code>A</code>	The precision specifies the number of digits after the point.	Default precision is 13. If precision is 0, no decimal point is printed unless the <code>#</code> flag is used.
<code>c</code> , <code>C</code>	The precision has no effect.	Character is printed.
<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , <code>X</code>	The precision specifies the minimum number of digits to be printed. If the number of digits in the argument is less than <code>precision</code> , the output value is padded on the left with zeros. The value isn't truncated when the number of digits exceeds <code>precision</code> .	Default precision is 1.
<code>e</code> , <code>E</code>	The precision specifies the number of digits to be printed after the decimal point. The last printed digit is rounded.	Default precision is 6. If <code>precision</code> is 0 or the period (<code>.</code>) appears without a number following it, no decimal point is printed.

TYPE	MEANING	DEFAULT
<code>f</code> , <code>F</code>	The precision value specifies the number of digits after the decimal point. If a decimal point appears, at least one digit appears before it. The value is rounded to the appropriate number of digits.	Default precision is 6. If <i>precision</i> is 0, or if the period (.) appears without a number following it, no decimal point is printed.
<code>g</code> , <code>G</code>	The precision specifies the maximum number of significant digits printed.	Six significant digits are printed, and any trailing zeros are truncated.
<code>s</code> , <code>S</code>	The precision specifies the maximum number of characters to be printed. Characters in excess of <i>precision</i> aren't printed.	Characters are printed until a null character is found.

Argument size specification

In a conversion specification, the *size* field is an argument length modifier for the *type* conversion specifier. The *size* field prefixes to the *type* field—`hh` , `h` , `j` , `l` (lowercase L), `L` , `ll` , `t` , `w` , `z` , `I` (uppercase i), `I32` , and `I64`—specify the "size" of the corresponding argument—long or short, 32-bit or 64-bit, single-byte character or wide character—depending on the conversion specifier that they modify. These size prefixes are used with *type* characters in the `printf` and `wprintf` families of functions to specify the interpretation of argument sizes, as shown in the following table. The *size* field is optional for some argument types. When no size prefix is specified, the formatter consumes integer arguments—for example, signed or unsigned `char` , `short` , `int` , `long` , and enumeration types—as 32-bit `int` types, and `float` , `double` , and `long double` floating-point arguments are consumed as 64-bit `double` types. This behavior matches the default argument promotion rules for variable argument lists. For more information about argument promotion, see Ellipsis and Default Arguments in [Postfix expressions](#). On both 32-bit and 64-bit systems, the conversion specification of a 64-bit integer argument must include a size prefix of `ll` or `I64`. Otherwise, the behavior of the formatter is undefined.

Some types are different sizes in 32-bit and 64-bit code. For example, `size_t` is 32 bits long in code compiled for x86, and 64 bits in code compiled for x64. To create platform-agnostic formatting code for variable-width types, you can use a variable-width argument size modifier. Instead, use a 64-bit argument size modifier and explicitly promote the variable-width argument type to 64 bits. The Microsoft-specific `I` (uppercase i) argument size modifier handles variable-width integer arguments, but we recommend the type-specific `j` , `t` , and `z` modifiers for portability.

Size prefixes for `printf` and `wprintf` format-type specifiers

TO SPECIFY	USE PREFIX	WITH TYPE SPECIFIER
<code>char</code> <code>unsigned char</code>	<code>hh</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>short int</code> <code>short unsigned int</code>	<code>h</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>_int32</code> <code>unsigned _int32</code>	<code>I32</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>

TO SPECIFY	USE PREFIX	WITH TYPE SPECIFIER
<code>__int64</code> <code>unsigned __int64</code>	<code>I64</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>intmax_t</code> <code>uintmax_t</code>	<code>j</code> or <code>I64</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>long double</code>	<code>l</code> (lowercase L) or <code>L</code>	<code>a</code> , <code>A</code> , <code>e</code> , <code>E</code> , <code>f</code> , <code>F</code> , <code>g</code> , or <code>G</code>
<code>long int</code> <code>long unsigned int</code>	<code>l</code> (lowercase L)	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>long long int</code> <code>unsigned long long int</code>	<code>ll</code> (lowercase LL)	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>ptrdiff_t</code>	<code>t</code> or <code>I</code> (uppercase i)	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
<code>size_t</code>	<code>z</code> or <code>I</code> (uppercase i)	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
Single-byte character	<code>h</code>	<code>c</code> or <code>C</code>
Wide character	<code>l</code> (lowercase L) or <code>w</code>	<code>c</code> or <code>C</code>
Single-byte character string	<code>h</code>	<code>s</code> , <code>S</code> , or <code>Z</code>
Wide-character string	<code>l</code> (lowercase L) or <code>w</code>	<code>s</code> , <code>S</code> , or <code>Z</code>

The `ptrdiff_t` and `size_t` types are `__int32` or `unsigned __int32` on 32-bit platforms, and `__int64` or `unsigned __int64` on 64-bit platforms. The `I` (uppercase i), `j`, `t`, and `z` size prefixes take the correct argument width for the platform.

In Visual C++, although `long double` is a distinct type, it has the same internal representation as `double`.

An `hc` or `hc` type specifier is synonymous with `c` in `printf` functions and with `c` in `wprintf` functions. A `lc`, `1C`, `wc`, or `wc` type specifier is synonymous with `c` in `printf` functions and with `c` in `wprintf` functions. An `hs` or `hs` type specifier is synonymous with `s` in `printf` functions and with `s` in `wprintf` functions. An `ls`, `1S`, `ws`, or `ws` type specifier is synonymous with `S` in `printf` functions and with `s` in `wprintf` functions.

NOTE

Microsoft-specific:

The `I` (uppercase i), `I32`, `I64`, and `w` argument size modifier prefixes are Microsoft extensions and are not ISO C-compatible. The `h` prefix when it's used with data of type `char` and the `l` (lowercase L) prefix when it's used with data of type `double` are Microsoft extensions.

See also

[printf](#), [_printf_l](#), [wprintf](#), [_wprintf_l](#)
[printf_s](#), [_printf_s_l](#), [wprintf_s](#), [_wprintf_s_l](#)
[printf_p](#) Positional Parameters

Format specification fields: `scanf` and `wscanf` functions

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The information here applies to the entire `scanf` family of functions, including the secure versions. It describes the symbols used to tell the `scanf` functions how to parse the input stream, such as the input stream `stdin`, into values that are inserted into program variables.

The `format` argument is a string that specifies the interpretation of the input and can contain one or more of:

- White-space characters: blank (); tab (`\t`); or newline (`\n`). A white-space character causes `scanf` to read, but not store, all consecutive white-space characters in the input up to the next non-white-space character. One white-space character in the format matches any number (including 0) and combination of white-space characters in the input.
- Non-white-space characters, except for the percent sign (`%`). A non-white-space character causes `scanf` to read, but not store, a matching non-white-space character. If the next character in the input stream doesn't match, `scanf` terminates.
- Format specifications, introduced by the percent sign (`%`). A format specification causes `scanf` to read and convert characters in the input into a value of a specified type. The value is assigned to an argument in the argument list.

A format specification has the following form:

```
% [*][ width ][{ h | l | ll | I64 | L }] type
```

Here, `width`, `h`, `l`, `ll`, `I64`, and `L` represent a `scanf` [width specification](#), and `type` represents a `scanf` [type field character](#).

The `format` argument string is read from left to right. Characters outside format specifications are expected to match the sequence of characters in the input stream. The matching characters in the input stream are scanned but not stored. If a character in the input stream conflicts with the format specification, `scanf` terminates, and the character is left in the input stream as if it hadn't been read.

When the first format specification is encountered, the value of the first input field is converted according to this specification. This value is stored in the location specified by the first argument that follows the `format` argument. The second format specification causes the second input field to be converted and stored in the next argument, and so on, through the end of the format string.

An input field is defined as: All characters up to the first white-space character (space, tab, or newline), or up to the first character that can't be converted according to the format specification, or until the field width (if specified) is reached. If there are too many arguments for the given specifications, the extra arguments are evaluated but ignored. The results are unpredictable if there aren't enough arguments for the format specification.

Each field of the format specification is a single character or a number signifying a particular format option. The `type` character, which appears after the last optional format field, determines whether the input field is interpreted as a character, a string, or a number.

The simplest format specification contains only the percent sign and a `type` character (for example, `%s`). If a

percent sign (%) is followed by a character that has no meaning as a format-control character, that character and the following characters (up to the next percent sign) are treated as an ordinary sequence of characters. That is, they're treated as a sequence of characters that must match the input. For example, to specify that a percent-sign character is to be input, use %%.

An asterisk (*) following the percent sign suppresses assignment of the next input field, which is interpreted as a field of the specified type. The field is scanned but not stored in an argument.

The secure versions (the ones with the _s suffix) of the `scanf` family of functions require each parameter of type `c`, `C`, `s`, `S` or `[` to have a buffer size parameter passed immediately following. For more information on the secure versions of the `scanf` family of functions, see `scanf_s`, `_scanf_s_1`, `wscanf_s`, `_wscanf_s_1`.

See also

`scanf` Width specification

`scanf` Type field characters

`scanf`, `_scanf_1`, `wscanf`, `_wscanf_1`

`scanf_s`, `_scanf_s_1`, `wscanf_s`, `_wscanf_s_1`

is, isw routines

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```
isalnum, iswalnum, _isalnum_l, _iswalnum_l  
isalpha, iswalpha, _isalpha_l, _iswalpha_l  
isascii, __isascii, iswasascii  
isblank, iswblank, _isblank_l, _iswblank_l  
iscntrl, iswcntrl, _iscntrl_l, _iswcntrl_l  
iscsym, iscsmf, __iscsym, __iscsymf, __iswcsymf, __iscsym_l, _iswcsym_l, _iscsymf_l,  
_iswcsymf_l  
_isctype, iswctype, _isctype_l, _iswctype_l  
isdigit, iswdigit, _isdigit_l, _iswdigit_l isgraph, iswgraph, _isgraph_l, _iswgraph_l  
isleadbyte, _isleadbyte_l  
islower, iswlower, _islower_l, _iswlower_l  
isprint, iswprint, _isprint_l, _iswprint_l  
ispunct, iswpunct, _ispunct_l, _iswpunct_l  
isspace, iswspace, _isspace_l, _iswspace_l  
isupper, _isupper_l, iswupper, _iswupper_l  
isxdigit, iswdx digit, _isxdigit_l, _iswdx digit_l
```

Remarks

These routines test characters for specified conditions.

The `is` routines produce meaningful results for any integer argument from -1 (`EOF`) to `UCHAR_MAX` (0xFF), inclusive. The expected argument type is `int`.

Caution

For the `is` routines, passing an argument of type `char` may yield unpredictable results. An SBCS or MBCS single-byte character of type `char` with a value greater than 0x7F is negative. If a `char` is passed, the compiler may convert the value to a `signed int` or a `signed long`. This value may be sign-extended by the compiler, with unexpected results.

The `isw` routines produce meaningful results for any integer value from -1 (`WEOF`) to 0xFFFF, inclusive. The `wint_t` data type is defined in `<WCHAR.H>` as an `unsigned short`. It can hold any wide character or the wide-character end-of-file (`WEOF`) value.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see `setlocale`. The versions of these functions without the `_l` suffix use the current locale for this locale-dependent behavior; the versions with the `_l` suffix are identical except that they use the locale parameter passed in instead.

In the "C" locale, the test conditions for the `is` routines are as follows:

`isalnum`

Alphanumeric (A - Z, a - z, or 0 - 9).

`isalpha`

Alphabetic (A - Z or a - z).

`__isascii`

ASCII character (0x00 - 0x7F).

`isblank`

Horizontal tab or space character (0x09 or 0x20).

`iscntrl`

Control character (0x00 - 0x1F or 0x7F).

`_iscsym`

Letter, underscore, or digit.

`_iscsymf`

Letter or underscore.

`isdigit`

Decimal digit (0 - 9).

`isgraph`

Printable character except space (0x20).

`islower`

Lowercase letter (a - z).

`isprint`

Printable character including space (0x20 - 0x7E).

`ispunct`

Punctuation character.

`isspace`

White-space character (0x09 - 0x0D or 0x20).

`isupper`

Uppercase letter (A - Z).

`isxdigit`

Hexadecimal digit (A - F, a - f, or 0 - 9).

For the `isw` routines, the result of the test for the specified condition is independent of locale. The test conditions for the `isw` functions are as follows:

`iswalnum`

`iswalpha` or `iswdigit`.

`iswalpha`

Any wide character that is one of an implementation-defined set for which none of `iswcntrl`, `iswdigit`, `iswpunct`, or `iswspace` is nonzero. `iswalpha` returns nonzero only for wide characters for which `iswupper` or `iswlower` is nonzero.

`iswascii`

Wide-character representation of ASCII character (0x0000 - 0x007F).

`iswblank`

Wide character that corresponds to the standard space character or is one of an implementation-defined set of wide characters for which `iswalnum` is false. Standard blank characters are space (`L' '`) and horizontal tab (`L'\t'`).

`iswcntrl`

Control wide character.

`__iswcsym`

Any wide character for which `isalnum` is true, or the '_' character.

`__iswcsymf`

Any wide character for which `iswalpha` is true, or the '_' character.

`iswctype`

Character has property specified by the `desc` argument. For each valid value of the `desc` argument of `iswctype`, there's an equivalent wide-character classification routine, as shown in the following table:

Equivalence of `iswctype(c, desc)` to other `isw` testing routines

VALUE OF <code>DESC</code> ARGUMENT	<code>ISWCTYPE(C, DESC)</code> EQUIVALENT
<code>_ALPHA</code>	<code>iswalpha(c)</code>
<code>_ALPHA _DIGIT</code>	<code>iswalnum(c)</code>
<code>_BLANK</code>	<code>iswblank(c)</code>
<code>_CONTROL</code>	<code>iswcntrl(c)</code>
<code>_DIGIT</code>	<code>iswdigit(c)</code>
<code>_ALPHA _DIGIT _PUNCT</code>	<code>iswgraph(c)</code>
<code>_LOWER</code>	<code>iswlower(c)</code>
<code>_ALPHA _BLANK _DIGIT _PUNCT</code>	<code>iswprint(c)</code>
<code>_PUNCT</code>	<code>iswpunct(c)</code>
<code>_BLANK</code>	<code>iswblank(c)</code>
<code>_SPACE</code>	<code>iswspace(c)</code>
<code>_UPPER</code>	<code>iswupper(c)</code>
<code>_HEX</code>	<code>iswdxdigit(c)</code>

`iswdigit`

Wide character corresponding to a decimal-digit character.

`iswgraph`

Printable wide character except space wide character (`L' '`).

`iswlower`

Lowercase letter, or one of implementation-defined set of wide characters for which none of `iswcntrl`, `iswdigit`, `iswpunct`, or `iswspace` is nonzero. `iswlower` returns nonzero only for wide characters that correspond to lowercase letters.

`iswprint`

Printable wide character, including space wide character (`L' '`).

iswpunct

Printable wide character that's both not a space wide character (`L' '`) and not a wide character for which `iswalnum` is nonzero.

iswspace

Wide character that corresponds to standard white-space character or is one of implementation-defined set of wide characters for which `iswalnum` is false. Standard white-space characters are: space (`L' '`), form feed (`L'\f'`), newline (`L'\n'`), carriage return (`L'\r'`), horizontal tab (`L'\t'`), and vertical tab (`L'\v'`).

iswupper

Wide character that is uppercase or is one of an implementation-defined set of wide characters for which none of `iswcntrl`, `iswdigit`, `iswpunct`, or `iswspace` is nonzero. `iswupper` returns nonzero only for wide characters that correspond to uppercase characters.

iswdx digit

Wide character that corresponds to a hexadecimal-digit character.

Example

```
// crt_isfam.c
/* This program tests all characters between 0x0
 * and 0x7F, then displays each character with abbreviations
 * for the character-type codes that apply.
 */

#include <stdio.h>
#include <ctype.h>

int main( void )
{
    int ch;
    for( ch = 0; ch <= 0x7F; ch++ )
    {
        printf( "%.2x ", ch );
        printf( " %c", isprint( ch ) ? ch : ' ' );
        printf( "%4s", isalnum( ch ) ? "AN" : "" );
        printf( "%3s", isalpha( ch ) ? "A" : "" );
        printf( "%3s", __isascii( ch ) ? "AS" : "" );
        printf( "%3s", iscntrl( ch ) ? "C" : "" );
        printf( "%3s", __iscsym( ch ) ? "CS" : "" );
        printf( "%3s", __iscsymf( ch ) ? "CSF" : "" );
        printf( "%3s", isdigit( ch ) ? "D" : "" );
        printf( "%3s", isgraph( ch ) ? "G" : "" );
        printf( "%3s", islower( ch ) ? "L" : "" );
        printf( "%3s", ispunct( ch ) ? "PU" : "" );
        printf( "%3s", isspace( ch ) ? "S" : "" );
        printf( "%3s", isprint( ch ) ? "PR" : "" );
        printf( "%3s", isupper( ch ) ? "U" : "" );
        printf( "%3s", isxdigit( ch ) ? "X" : "" );
        printf( ".\n" );
    }
}
```

Output

00	AS C	.
01	AS C	.
02	AS C	.
03	AS C	.
04	AS C	.
05	AS C	.

05		AS	C		.			
06		AS	C		.			
07		AS	C		.			
08		AS	C		.			
09		AS	C	S	.			
0a		AS	C	S	.			
0b		AS	C	S	.			
0c		AS	C	S	.			
0d		AS	C	S	.			
0e		AS	C		.			
0f		AS	C		.			
10		AS	C		.			
11		AS	C		.			
12		AS	C		.			
13		AS	C		.			
14		AS	C		.			
15		AS	C		.			
16		AS	C		.			
17		AS	C		.			
18		AS	C		.			
19		AS	C		.			
1a		AS	C		.			
1b		AS	C		.			
1c		AS	C		.			
1d		AS	C		.			
1e		AS	C		.			
1f		AS	C		.			
20		AS		S PR	.			
21	!	AS		G PU PR	.			
22	"	AS		G PU PR	.			
23	#	AS		G PU PR	.			
24	\$	AS		G PU PR	.			
25	%	AS		G PU PR	.			
26	&	AS		G PU PR	.			
27	'	AS		G PU PR	.			
28	(AS		G PU PR	.			
29)	AS		G PU PR	.			
2a	*	AS		G PU PR	.			
2b	+	AS		G PU PR	.			
2c	,	AS		G PU PR	.			
2d	-	AS		G PU PR	.			
2e	.	AS		G PU PR	.			
2f	/	AS		G PU PR	.			
30	0 AN	AS CS	D G		PR X.			
31	1 AN	AS CS	D G		PR X.			
32	2 AN	AS CS	D G		PR X.			
33	3 AN	AS CS	D G		PR X.			
34	4 AN	AS CS	D G		PR X.			
35	5 AN	AS CS	D G		PR X.			
36	6 AN	AS CS	D G		PR X.			
37	7 AN	AS CS	D G		PR X.			
38	8 AN	AS CS	D G		PR X.			
39	9 AN	AS CS	D G		PR X.			
3a	:	AS	G PU PR	.				
3b	;	AS	G PU PR	.				
3c	<	AS	G PU PR	.				
3d	=	AS	G PU PR	.				
3e	>	AS	G PU PR	.				
3f	?	AS	G PU PR	.				
40	@	AS	G PU PR	.				
41	A AN A AS	CS CSF	G	PR U X.				
42	B AN A AS	CS CSF	G	PR U X.				
43	C AN A AS	CS CSF	G	PR U X.				
44	D AN A AS	CS CSF	G	PR U X.				
45	E AN A AS	CS CSF	G	PR U X.				
46	F AN A AS	CS CSF	G	PR U X.				
47	G AN A AS	CS CSF	G	PR U .				
48	H AN A AS	CS CSF	G	PR U .				
49	I AN A AS	CS CSF	G	PR U .				

4a	J	AN	A AS	CS CSF	G	PR	U	.
4b	K	AN	A AS	CS CSF	G	PR	U	.
4c	L	AN	A AS	CS CSF	G	PR	U	.
4d	M	AN	A AS	CS CSF	G	PR	U	.
4e	N	AN	A AS	CS CSF	G	PR	U	.
4f	O	AN	A AS	CS CSF	G	PR	U	.
50	P	AN	A AS	CS CSF	G	PR	U	.
51	Q	AN	A AS	CS CSF	G	PR	U	.
52	R	AN	A AS	CS CSF	G	PR	U	.
53	S	AN	A AS	CS CSF	G	PR	U	.
54	T	AN	A AS	CS CSF	G	PR	U	.
55	U	AN	A AS	CS CSF	G	PR	U	.
56	V	AN	A AS	CS CSF	G	PR	U	.
57	W	AN	A AS	CS CSF	G	PR	U	.
58	X	AN	A AS	CS CSF	G	PR	U	.
59	Y	AN	A AS	CS CSF	G	PR	U	.
5a	Z	AN	A AS	CS CSF	G	PR	U	.
5b	[AS			G PU	PR		.
5c	\	AS			G PU	PR		.
5d]	AS			G PU	PR		.
5e	^	AS			G PU	PR		.
5f	-	AS	CS CSF		G PU	PR		.
60	`	AS			G PU	PR		.
61	a	AN	A AS	CS CSF	G L	PR	X.	.
62	b	AN	A AS	CS CSF	G L	PR	X.	.
63	c	AN	A AS	CS CSF	G L	PR	X.	.
64	d	AN	A AS	CS CSF	G L	PR	X.	.
65	e	AN	A AS	CS CSF	G L	PR	X.	.
66	f	AN	A AS	CS CSF	G L	PR	X.	.
67	g	AN	A AS	CS CSF	G L	PR		.
68	h	AN	A AS	CS CSF	G L	PR		.
69	i	AN	A AS	CS CSF	G L	PR		.
6a	j	AN	A AS	CS CSF	G L	PR		.
6b	k	AN	A AS	CS CSF	G L	PR		.
6c	l	AN	A AS	CS CSF	G L	PR		.
6d	m	AN	A AS	CS CSF	G L	PR		.
6e	n	AN	A AS	CS CSF	G L	PR		.
6f	o	AN	A AS	CS CSF	G L	PR		.
70	p	AN	A AS	CS CSF	G L	PR		.
71	q	AN	A AS	CS CSF	G L	PR		.
72	r	AN	A AS	CS CSF	G L	PR		.
73	s	AN	A AS	CS CSF	G L	PR		.
74	t	AN	A AS	CS CSF	G L	PR		.
75	u	AN	A AS	CS CSF	G L	PR		.
76	v	AN	A AS	CS CSF	G L	PR		.
77	w	AN	A AS	CS CSF	G L	PR		.
78	x	AN	A AS	CS CSF	G L	PR		.
79	y	AN	A AS	CS CSF	G L	PR		.
7a	z	AN	A AS	CS CSF	G L	PR		.
7b	{	AS			G PU	PR		.
7c		AS			G PU	PR		.
7d	}	AS			G PU	PR		.
7e	~	AS			G PU	PR		.
7f		AS C						.

See also

[Character classification](#)

[Locale](#)

`setlocale`, `_wsetlocale`

[Interpretation of multibyte-character sequences](#)

`to` functions

`_ismbb` routines

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Tests the given integer value `c` for a particular condition, by using the current locale or a specified `LC_CTYPE` conversion state category.

`_ismbbalnum`, `_ismbbalnum_1`
`_ismbbalpha`, `_ismbbalpha_1`
`_ismbbblank`, `_ismbbblank_1`
`_ismbbgraph`, `_ismbbgraph_1`
`_ismbbkalnum`, `_ismbbkalnum_1`
`_ismbbkana`, `_ismbbkana_1`
`_ismbbkprint`, `_ismbbkprint_1`
`_ismbbkpunct`, `_ismbbkpunct_1`
`_ismbblead`, `_ismbblead_1`
`_ismbbprint`, `_ismbbprint_1`
`_ismbbpunct`, `_ismbbpunct_1`
`_ismbbtrail`, `_ismbbtrail_1`\

Remarks

Every routine in the `_ismbb` family tests the given integer value `c` for a particular condition. The test result depends on the multibyte code page that's in effect. By default, the multibyte code page is set to the ANSI code page that's obtained from the operating system at program startup. You can use `_getmbcp` to query for the multibyte code page that's in use, or `_setmbcp` to change it.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale; for more information, see `setlocale`, `wsetlocale`. The versions of these functions that don't have the `_1` suffix use the current locale for this locale-dependent behavior; the versions that do have the `_1` suffix are identical except that instead they use the locale parameter that's passed in.

The routines in the `_ismbb` family test the given integer `c` as follows.

ROUTINE	BYTE TEST CONDITION
<code>_ismbbalnum</code>	<code>isalnum(c) _ismbbkalnum(c)</code>
<code>_ismbbalpha</code>	<code>isalpha(c) _ismbbalpha(c)</code>
<code>_ismbbblank</code>	<code>isblank(c)</code>
<code>_ismbbgraph</code>	Same as <code>_ismbbprint</code> , but <code>_ismbbgraph</code> doesn't include the space character (0x20)
<code>_ismbbkalnum</code>	Non-ASCII text symbol other than punctuation. For example, in code page 932 only, <code>_ismbbkalnum</code> tests for katakana alphanumeric
<code>_ismbbkana</code>	Katakana (0xA1 - 0xDF). Specific to code page 932

ROUTINE	BYTE TEST CONDITION
<code>_ismbbkprint</code>	Non-ASCII text or non-ASCII punctuation symbol. For example, in code page 932 only, <code>_ismbbkprint</code> tests for katakana alphanumeric or katakana punctuation (range: 0xA1 - 0xDF)
<code>_ismbbkpunct</code>	Non-ASCII punctuation. For example, in code page 932 only, <code>_ismbbkpunct</code> tests for katakana punctuation
<code>_ismbblead</code>	First byte of multibyte character. For example, in code page 932 only, valid ranges are 0x81 - 0x9F, 0xE0 - 0xFC
<code>_ismbbprint</code>	<code>isprint(c) _ismbbkprint(c)</code> . <code>ismbbprint</code> includes the space character (0x20)
<code>_ismbbpunct</code>	<code>ispunct(c) _ismbbkpunct(c)</code> .
<code>_ismbbtrail</code>	Second byte of multibyte character. For example, in code page 932 only, valid ranges are 0x40 - 0x7E, 0x80 - 0xEC

The following table shows the `|`-combined values that compose the test conditions for these routines. The manifest constants `_BLANK`, `_DIGIT`, `_LOWER`, `_PUNCT`, and `_UPPER` are defined in `ctype.h`.

ROUTINE	<code>_BLANK</code>	<code>_DIGIT</code>	<code>_LOWER</code>	<code>_PUNCT</code>	<code>_UPPER</code>	NON-ASCII TEXT	NON-ASCII PUNCTUATION
<code>_ismbbalnum</code>	—	X	X	—	X	X	—
<code>_ismbbalpha</code>	—	—	X	—	X	X	—
<code>_ismbbblank</code>	X	—	—	—	—	—	—
<code>_ismbbgraph</code>	—	X	X	X	X	X	X
<code>_ismbbkalnum</code>	—	—	—	—	—	X	—
<code>_ismbbkprint</code>	—	—	—	—	—	X	X
<code>_ismbbkpunct</code>	—	—	—	—	—	—	X
<code>_ismbbprint</code>	X	X	X	X	X	X	X
<code>_ismbbpunct</code>	—	—	—	X	—	—	X

The `_ismbb` routines are implemented both as functions and as macros. For more information about how to choose either implementation, see [Recommendations for choosing between functions and macros](#).

See also

[Byte classification](#)
[is , isw routines](#)

`_mbbtombc` , `_mbbtombc_1`

`_mbctombb` , `_mbctombb_1`

_ismbc routines

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Each `_ismbc` routine tests a given multibyte character `c` for a particular condition.

- `_ismbcalnum`, `_ismbcalnum_1`, `_ismbcalpha`, `_ismbcalpha_1`, `_ismbcdigit`, `_ismbcdigit_1`\
- `_ismbcl0`, `_ismbcl0_1`, `_ismbcl1`, `_ismbcl1_1`, `_ismbcl2`, `_ismbcl2_1`\
- `_ismbcgraph`, `_ismbcgraph_1`, `_ismbcprint`, `_ismbcprint_1`, `_ismbcpunct`, `_ismbcpunct_1`, `_ismbcblank`,
`_ismbcblank_1`, `_ismbcspace`, `_ismbcspace_1`\
- `_ismbclegal`, `_ismbclegal_1`, `_ismbcsymbol`, `_ismbcsymbol_1`\
- `_ismbchira`, `_ismbchira_1`, `_ismbckata`, `_ismbckata_1`\
- `_ismbclower`, `_ismbclower_1`, `_ismbcupper`, `_ismbcupper_1`

Remarks

The test result of each `_ismbc` routine depends on the multibyte code page in effect. Multibyte code pages have single-byte alphabetic characters. By default, the multibyte code page is set to the system-default ANSI code page obtained from the operating system at program startup. You can query or change the multibyte code page in use with `_getmbcp` or `_setmbcp`, respectively.

The output value is affected by the `LC_CTYPE` category setting of the locale. For more information, see `setlocale`. The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead.

ROUTINE	TEST CONDITION	CODE PAGE 932 EXAMPLE
<code>_ismbcalnum</code> , <code>_ismbcalnum_1</code>	Alphanumeric	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII English letter: See examples for <code>_ismbcdigit</code> and <code>_ismbcalpha</code> .
<code>_ismbcalpha</code> , <code>_ismbcalpha_1</code>	Alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII English letter: See examples for <code>_ismbcupper</code> and <code>_ismbclower</code> ; or a katakana letter: <code>0xA6<= c <=0xDF</code> .
<code>_ismbcdigit</code> , <code>_ismbcdigit_1</code>	Digit	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII digit: <code>0x30<= c <=0x39</code> .
<code>_ismbcgraph</code> , <code>_ismbcgraph_1</code>	Graphic	Returns nonzero if and only if <code>c</code> is a single-byte representation of any ASCII or katakana printable character except a white space (). See examples for <code>_ismbcdigit</code> , <code>_ismbcalpha</code> , and <code>_ismbcpunct</code> .

ROUTINE	TEST CONDITION	CODE PAGE 932 EXAMPLE
<code>_ismbclegal</code> , <code>_ismbclegal_1</code>	Valid multibyte character	Returns nonzero if and only if the first byte of <code>c</code> is within ranges 0x81 - 0x9F or 0xE0 - 0xFC, while the second byte is within ranges 0x40 - 0x7E or 0x80 - FC.
<code>_ismbclower</code> , <code>_ismbclower_1</code>	Lowercase alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII lowercase English letter: $0x61 \leq c \leq 0x7A$.
<code>_ismbcprint</code> , <code>_ismbcprint_1</code>	Printable	Returns nonzero if and only if <code>c</code> is a single-byte representation of any ASCII or katakana printable character including a white space (): See examples for <code>_ismbcspace</code> , <code>_ismbcdigit</code> , <code>_ismbcalpha</code> , and <code>_ismbcpunct</code> .
<code>_ismbcpunct</code> , <code>_ismbcpunct_1</code>	Punctuation	Returns nonzero if and only if <code>c</code> is a single-byte representation of any ASCII or katakana punctuation character.
<code>_ismbcblank</code> , <code>_ismbcblank_1</code>	Space or horizontal tab	Returns nonzero if and only if <code>c</code> is a single-byte representation of a space character or a horizontal tab character: <code>c = 0x20</code> or <code>c = 0x09</code> .
<code>_ismbcspace</code> , <code>_ismbcspace_1</code>	Whitespace	Returns nonzero if and only if <code>c</code> is a white space character: <code>c = 0x20</code> or $0x09 \leq c \leq 0x0D$.
<code>_ismbcsymbol</code> , <code>_ismbcsymbol_1</code>	Multibyte symbol	Returns nonzero if and only if $0x8141 \leq c \leq 0x81AC$.
<code>_ismbcupper</code> , <code>_ismbcupper_1</code>	Uppercase alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII uppercase English letter: $0x41 \leq c \leq 0x5A$.

Code Page 932 Specific

The following routines are specific to code page 932.

ROUTINE	TEST CONDITION (CODE PAGE 932 ONLY)
<code>_ismbchira</code> , <code>_ismbchira_1</code>	Double-byte Hiragana: $0x829F \leq c \leq 0x82F1$.
<code>_ismbckata</code> , <code>_ismbckata_1</code>	Double-byte katakana: $0x8340 \leq c \leq 0x8396$.
<code>_ismbc10</code> , <code>_ismbc10_1</code>	JIS non-Kanji: $0x8140 \leq c \leq 0x889E$.
<code>_ismbc11</code> , <code>_ismbc11_1</code>	JIS level-1: $0x889F \leq c \leq 0x9872$.

ROUTINE	TEST CONDITION (CODE PAGE 932 ONLY)
<code>_ismbc12</code> , <code>_ismbc12_1</code>	JIS level-2: $0x989F \leq c \leq 0xEA9E$.

`_ismbc10` , `_ismbc11` , and `_ismbc12` check that the specified value `c` matches the test conditions described in the preceding table, but don't check that `c` is a valid multibyte character. If the lower byte is in the ranges 0x00 - 0x3F, 0x7F, or 0xFD - 0xFF, these functions return a nonzero value, indicating that the character satisfies the test condition. Use `_ismbbtrail` , `_ismbbtrail_1` to test whether the multibyte character is defined.

END Code Page 932 Specific

See also

[Character classification](#)

[`is` , `isw` routines](#)
[`_ismbb` routines](#)

`operator new` (CRT)

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Beginning in Visual Studio 2013, the Universal C Runtime (UCRT) no longer supports the C++-specific `operator new` and `operator delete` functions. These functions are now part of the C++ Standard Library. For more information, see [new](#) and [delete](#) operators and [new operator](#) in the C++ Language Reference.

`operator delete` (CRT)

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Beginning in Visual Studio 2013, the Universal C Runtime (UCRT) no longer supports the C++-specific `operator new` and `operator delete` functions. These functions are now part of the C++ Standard Library. For more information, see [new](#) and [delete](#) operators and [delete operator](#) in the C++ Language Reference.

printf_p | positional parameters

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Positional parameters let you specify by number the argument to substitute into a field in a format string. The following positional parameter `printf` functions are available:

NON-POSITIONAL PRINTF FUNCTIONS	POSITIONAL PARAMETER EQUIVALENTS
<code>printf</code> , <code>_printf_l</code> , <code>wprintf</code> , <code>_wprintf_l</code>	<code>_printf_p</code> , <code>_printf_p_l</code> , <code>_wprintf_p</code> , <code>_wprintf_p_l</code>
<code>sprintf</code> , <code>_sprintf_l</code> , <code>swprintf</code> , <code>_swprintf_l</code> , <code>_swprintf_l</code>	<code>_sprintf_p</code> , <code>_sprintf_p_l</code> , <code>_swprintf_p</code> , <code>_swprintf_p_l</code>
<code>cprintf</code> , <code>_cprintf_l</code> , <code>cwprintf</code> , <code>_cwprintf_l</code>	<code>_cprintf_p</code> , <code>_cprintf_p_l</code> , <code>_cwprintf_p</code> , <code>_cwprintf_p_l</code>
<code>fprintf</code> , <code>_fprintf_l</code> , <code>fwprintf</code> , <code>_fwprintf_l</code>	<code>_fprintf_p</code> , <code>_fprintf_p_l</code> , <code>_fwprintf_p</code> , <code>_fwprintf_p_l</code>
<code>vprintf</code> , <code>_vprintf_l</code> , <code>vwprintf</code> , <code>_vwprintf_l</code>	<code>_vprintf_p</code> , <code>_vprintf_p_l</code> , <code>_vwprintf_p</code> , <code>_vwprintf_p_l</code>
<code>vfprintf</code> , <code>_vfprintf_l</code> , <code>vfwprintf</code> , <code>_vfwprintf_l</code>	<code>_vfprintf_p</code> , <code>_vfprintf_p_l</code> , <code>_vfwprintf_p</code> , <code>_vfwprintf_p_l</code>
<code>vsprintf</code> , <code>_vsprintf_l</code> , <code>vswprintf</code> , <code>_vswprintf_l</code> , <code>_vswprintf_l</code>	<code>_vsprintf_p</code> , <code>_vsprintf_p_l</code> , <code>_vswprintf_p</code> , <code>_vswprintf_p_l</code>

How to specify positional parameters

Parameter indexing

By default, if no positional formatting is present, the positional functions behave identically to the non-positional ones. You specify the positional parameter to format by using `%n$` at the beginning of the format specifier, where `n` is the position of the parameter to format in the parameter list. The parameter position starts at 1 for the first argument after the format string. The remainder of the format specifier follows the same rules as the `printf` format specifier. For more information about format specifiers, see [Format specification syntax: printf and wprintf functions](#).

Here's an example of positional formatting:

```
_printf_p("%1$s %2$s", "November", "10");
```

This example prints:

```
November 10
```

The order of the numbers used doesn't need to match the order of the arguments. For example, here's a valid format string:

```
_printf_p("%2$s %1$s", "November", "10");
```

This example prints:

```
10 November
```

Unlike traditional format strings, positional parameters may be used more than once in a format string. For example,

```
_printf_p("%1$d times %1$d is %2$d", 10, 100);
```

This example prints:

```
10 times 10 is 100
```

All arguments must be used at least once somewhere in the format string. The maximum number of positional parameters allowed in a format string is given by `_ARGMAX`.

Width and precision

You can use `*n$` to specify a positional parameter as a width or precision specifier, where `n` is the position of the width or precision parameter in the parameter list. The position of the width or precision value must appear immediately following the * symbol. For example,

```
_printf_p("%1$*2$s", "Hello", 10);
```

or

```
_printf_p("%2$*1$s", 10, "Hello");
```

Mixing positional and non-positional arguments

Positional parameters may not be mixed with non-positional parameters in the same format string. If any positional formatting is used, all format specifiers must use positional formatting. However, `printf_p` and related functions still support non-positional parameters in format strings containing no positional parameters.

Example

```

// positional_args.c
// Build by using: cl /W4 positional_args.c
// Positional arguments allow the specification of the order
// in which arguments are consumed in a formatting string.

#include <stdio.h>

int main()
{
    int      i = 1,
            j = 2,
            k = 3;
    double   x = 0.1,
             y = 2.22,
             z = 333.3333;
    char    *s1 = "abc",
            *s2 = "def",
            *s3 = "ghi";

    // If positional arguments are unspecified,
    // normal input order is used.
    _printf_p("%d %d %d\n", i, j, k);

    // Positional arguments are numbers followed by a $ character.
    _printf_p("%3$d %1$d %2$d\n", i, j, k);

    // The same positional argument may be reused.
    _printf_p("%1$d %2$d %1$d\n", i, j);

    // The positional arguments may appear in any order.
    _printf_p("%1$s %2$s %3$s\n", s1, s2, s3);
    _printf_p("%3$s %1$s %2$s\n", s1, s2, s3);

    // Precision and width specifiers must be int types.
    _printf_p("%3$*5$f %2$.*4$f %1$*4$.*5$f\n", x, y, z, j, k);
}

```

```

1 2 3
3 1 2
1 2 1
abc def ghi
ghi abc def
333.333300 2.22 0.100

```

See also

Format specification syntax: [printf](#) and [wprintf](#) functions

scanf type field characters

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The following information applies to any of the `scanf` family of functions, including the secure versions, such as `scanf_s`.

The `type` character is the only required format field; it appears after any optional format fields. The `type` character determines whether the associated argument is interpreted as a character, string, or number.

type Characters for `scanf` functions

CHARACTER	TYPE OF INPUT EXPECTED	TYPE OF ARGUMENT	SIZE ARGUMENT IN SECURE VERSION?
<code>c</code>	Character. When used with <code>scanf</code> functions, specifies single-byte character; when used with <code>wscanf</code> functions, specifies wide character. White-space characters that are ordinarily skipped are read when <code>c</code> is specified. Unlike with other type fields, the field width specifier indicates the exact number of characters, not the maximum. To read next non-white-space single-byte character, use <code>%1s</code> ; to read next non-white-space wide character, use <code>%1ws</code> .	Pointer to <code>char</code> when used with <code>scanf</code> functions, pointer to <code>wchar_t</code> when used with <code>wscanf</code> functions.	Required. Size doesn't include space for a null terminator.
<code>C</code>	Opposite size character. When used with <code>scanf</code> functions, specifies wide character; when used with <code>wscanf</code> functions, specifies single-byte character. White-space characters that are ordinarily skipped are read when <code>C</code> is specified. Unlike with other type fields, the field width specifier indicates the exact number of characters, not the maximum. To read next non-white-space single-byte character, use <code>%1s</code> ; to read next non-white-space wide character, use <code>%1ws</code> .	Pointer to <code>wchar_t</code> when used with <code>scanf</code> functions, pointer to <code>char</code> when used with <code>wscanf</code> functions.	Required. Size argument doesn't include space for a null terminator.
<code>d</code>	Decimal integer.	Pointer to <code>int</code> .	No.

CHARACTER	TYPE OF INPUT EXPECTED	TYPE OF ARGUMENT	SIZE ARGUMENT IN SECURE VERSION?
i	An integer. Hexadecimal if the input string begins with "0x" or "0X", octal if the string begins with "0", otherwise decimal.	Pointer to <code>int</code> .	No.
o	Octal integer.	Pointer to <code>int</code> .	No.
p	A pointer address in hexadecimal digits. The maximum number of digits read depends on the size of a pointer (32 bits or 64 bits), which depends on the machine architecture. "0x" or "0X" are accepted as prefixes.	Pointer to <code>void*</code> .	No.
u	Unsigned decimal integer.	Pointer to <code>unsigned int</code> .	No.
x	Hexadecimal integer.	Pointer to <code>int</code> .	No.
e , E , f , F , g , G	Floating-point value consisting of optional sign (+ or -), series of one or more decimal digits containing decimal point, and optional exponent ("e" or "E") followed by an optionally signed integer value.	Pointer to <code>float</code> .	No.
a , A	Floating-point value consisting of a series of one or more hexadecimal digits containing an optional decimal point, and an exponent ("p" or "P") followed by a decimal value.	Pointer to <code>float</code> .	No.
n	No input read from stream or buffer.	Pointer to <code>int</code> , into which is stored number of characters successfully read from stream or buffer up to that point in current call to <code>scanf</code> functions or <code>wscanf</code> functions.	No.

CHARACTER	TYPE OF INPUT EXPECTED	TYPE OF ARGUMENT	SIZE ARGUMENT IN SECURE VERSION?
s	String, up to first white-space character (space, tab or newline). To read strings not delimited by space characters, use set of square brackets ([]), as discussed in scanf Width Specification .	When used with <code>scanf</code> functions, signifies single-byte character array; when used with <code>wscanf</code> functions, signifies wide-character array. In either case, character array must be large enough for input field plus terminating null character, which is automatically appended.	Required. Size includes space for a null terminator.
S	Opposite-size character string, up to first white-space character (space, tab or newline). To read strings not delimited by space characters, use set of square brackets ([]), as discussed in scanf Width Specification .	When used with <code>scanf</code> functions, signifies wide-character array; when used with <code>wscanf</code> functions, signifies single-byte-character array. In either case, character array must be large enough for input field plus terminating null character, which is automatically appended.	Required. Size includes space for a null terminator.

The size arguments, if necessary, should be passed in the parameter list immediately following the argument they apply to. For example, the following code:

```
char string1[11], string2[9];
scanf_s("%10s %8s", string1, 11, string2, 9);
```

reads a string with a maximum length of 10 into `string1`, and a string with a maximum length of 8 into `string2`. The buffer sizes should be at least one more than the width specifications since space must be reserved for the null terminator.

The format string can handle single-byte or wide character input regardless of whether the single-byte character or wide-character version of the function is used. Thus, to read single-byte or wide characters with `scanf` functions and `wscanf` functions, use format specifiers as follows.

TO READ CHARACTER AS	USE THIS FUNCTION	WITH THESE FORMAT SPECIFIERS
single byte	<code>scanf</code> functions	<code>c</code> , <code>hc</code> , or <code>hc</code>
single byte	<code>wscanf</code> functions	<code>C</code> , <code>hc</code> , or <code>hc</code>
wide	<code>wscanf</code> functions	<code>c</code> , <code>1c</code> , or <code>1C</code>
wide	<code>scanf</code> functions	<code>C</code> , <code>1c</code> , or <code>1C</code>

To scan strings with `scanf` functions, and `wscanf` functions, use the above table with format type-specifiers `s` and `S` instead of `c` and `C`.

See also

`scanf`, `_scanf_1`, `wscanf`, `_wscanf_1`

scanf width specification

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This information applies to the interpretation of format strings in the `scanf` family of functions, including the secure versions such as `scanf_s`. These functions normally assume the input stream is divided into a sequence of tokens. Tokens are separated by whitespace (space, tab, or newline), or for numerical types, by the natural end of a numerical data type as indicated by the first character that can't be converted into numerical text. However, the width specification may be used to cause parsing of the input to stop before the natural end of a token.

The `width` specification consists of characters between the `%` and the type field specifier, which may include a positive integer called the `width` field and one or more characters indicating the size of the field, which may also be considered as modifiers of the type of the field, such as an indication of whether the integer type is `short` or `long`. Such characters are referred to as the size prefix.

The `width` field

The `width` field is a positive decimal integer that controls the maximum number of characters to be read for that field. No more than `width` characters get converted and stored in the corresponding `argument`. Fewer than `width` characters may be read if a whitespace character or a character that can't be converted according to the given format occurs before `width` is reached.

The width specification is separate and distinct from the buffer size argument required by the secure versions of these functions (for instance, `scanf_s`, `wscanf_s`, and so on). In the following example, the width specification is 20, indicating that up to 20 characters are to be read from the input stream. The buffer length is 21, which includes room for the possible 20 characters plus the null terminator:

```
char str[21];
scanf_s("%20s", str, 21);
```

If the `width` field isn't used, `scanf_s` attempts to read the entire token into the string. If the size specified isn't large enough to hold the entire token, nothing gets written to the destination string. If the `width` field is specified, then the first `width` characters in the token get written to the destination string, along with the null terminator.

The size prefix

The optional prefixes `h`, `hh`, `l`, `ll`, `I64`, and `L` indicate the size of the `argument` (long or short, single-byte character or wide character, depending upon the type character that they modify). These format-specification characters are used with type characters in `scanf` or `wscanf` functions to specify interpretation of arguments as shown in the following table. The type prefix `I64` is a Microsoft extension and isn't compatible with Standard C. The type characters and their meanings are described in the "Type Characters for scanf functions" table in [scanf type field characters](#).

NOTE

The `h`, `l`, and `L` prefixes are Microsoft extensions when used with data of type `char`.

TO SPECIFY	USE PREFIX	WITH TYPE SPECIFIER
<code>double</code>	<code>l</code>	<code>e</code> , <code>E</code> , <code>f</code> , <code>g</code> , or <code>G</code>
<code>long double</code> (same as <code>double</code>)	<code>L</code>	<code>e</code> , <code>E</code> , <code>f</code> , <code>g</code> , or <code>G</code>
<code>long int</code>	<code>l</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>x</code> , or <code>X</code>
<code>long unsigned int</code>	<code>l</code>	<code>u</code>
<code>long long</code>	<code>ll</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>x</code> , or <code>X</code>
<code>short int</code>	<code>h</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>x</code> , or <code>X</code>
<code>short unsigned int</code>	<code>h</code>	<code>u</code>
<code>char</code>	<code>hh</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>x</code> , or <code>X</code>
<code>unsigned char</code>	<code>hh</code>	<code>u</code>
<code>int64</code>	<code>I64</code>	<code>d</code> , <code>i</code> , <code>o</code> , <code>u</code> , <code>x</code> , or <code>X</code>
Single-byte character with <code>scanf</code>	<code>h</code>	<code>c</code> or <code>C</code>
Single-byte character with <code>wscanf</code>	<code>h</code>	<code>c</code> or <code>C</code>
Wide character with <code>scanf</code>	<code>l</code>	<code>c</code> or <code>C</code>
Wide character with <code>wscanf</code>	<code>l</code>	<code>c</code> , or <code>C</code>
Single-byte character string with <code>scanf</code>	<code>h</code>	<code>s</code> or <code>S</code>
Single-byte character string with <code>wscanf</code>	<code>h</code>	<code>s</code> or <code>S</code>
Wide character string with <code>scanf</code>	<code>l</code>	<code>s</code> or <code>S</code>
Wide character string with <code>wscanf</code>	<code>l</code>	<code>s</code> or <code>S</code>

The following examples use `h` and `l` with `scanf_s` functions and `wscanf_s` functions:

```
scanf_s("%ls", &x, 2);      // Read a wide-character string
wscanf_s(L"%hc", &x, 2);    // Read a single-byte character
```

If using an unsecure function in the `scanf` family, omit the size parameter indicating the buffer length of the preceding argument.

Reading undelimited strings

To read strings not delimited by whitespace characters, a set of characters in brackets (`[]`) can be substituted

for the `s` (string) type character. The set of characters in brackets is referred to as a *control string*. The corresponding input field is read up to the first character that doesn't appear in the control string. If the first character in the set is a caret (`^`), the effect is reversed: The input field is read up to the first character that does appear in the rest of the character set.

Both `%[a-z]` and `%[z-a]` are interpreted as equivalent to `%[abcde...z]`. It's a common `scanf` function extension, but isn't required by Standard C.

Reading unterminated strings

To store a string without storing a terminating null character ('\0'), use the specification `%Nc`, where `N` is a decimal integer. In this case, the `c` type character indicates that the argument is a pointer to a character array. The next `N` characters are read from the input stream into the specified location, and no null character ('\0') is appended. If `N` isn't specified, its default value is 1.

When `scanf` stops reading a field

The `scanf` function scans each input field, character by character. It may stop reading a particular input field before it reaches a space character for one of several reasons:

- The specified width has been reached.
- The next character can't be converted as specified.
- The next character conflicts with a character in the control string that it's supposed to match.
- The next character fails to appear in a given character set.

For whatever reason, when the `scanf` function stops reading an input field, the next input field is considered to begin at the first unread character. The conflicting character, if any, is considered unread. It's the first character of the next input field, or the first character in subsequent read operations on the input stream.

See also

`scanf`, `_scanf_l`, `wscanf`, `_wscanf_l`

`scanf_s`, `_scanf_s_l`, `wscanf_s`, `_wscanf_s_l`

Format specification fields: `scanf` and `wscanf` functions

`scanf` type field characters

`_spawn`, `_wspawn` functions

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Each of the `_spawn` functions creates and executes a new process:

`_spawnl`, `_wspawnl`
`_spawnle`, `_wspawnle`
`_spawnlp`, `_wspawnlp`
`_spawnlpe`, `_wspawnlpe`

`_spawnv`, `_wspawnv`
`_spawnve`, `_wspawnve`
`_spawnvp`, `_wspawnvp`
`_spawnvpe`, `_wspawnvpe`

The letters at the end of the function name determine the variation.

LETTER	VARIANT
e	<code>envp</code> , array of pointers to environment settings, is passed to new process.
l	Command-line arguments are passed individually to <code>_spawn</code> function. This suffix is typically used when some parameters to a new process are known in advance.
p	<code>PATH</code> environment variable is used to find the file to execute.
v	<code>argv</code> , array of pointers to command-line arguments, is passed to <code>_spawn</code> function. This suffix is typically used when several parameters to a new process are variable.

Remarks

The `_spawn` functions each create and execute a new process. They automatically handle multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use. The `_wspawn` functions are wide-character versions of the `_spawn` functions; they don't handle multibyte-character strings. Otherwise, the `_wspawn` functions behave identically to their `_spawn` counterparts.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tspawnl</code>	<code>_spawnl</code>	<code>_spawnl</code>	<code>_wspawnl</code>
<code>_tspawnle</code>	<code>_spawnle</code>	<code>_spawnle</code>	<code>_wspawnle</code>

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tspawnlp</code>	<code>_spawnlp</code>	<code>_spawnlp</code>	<code>_wspawnlp</code>
<code>_tspawnlpe</code>	<code>_spawnlpe</code>	<code>_spawnlpe</code>	<code>_wspawnlpe</code>
<code>_tspawnv</code>	<code>_spawnv</code>	<code>_spawnv</code>	<code>_wspawnv</code>
<code>_tspawnve</code>	<code>_spawnve</code>	<code>_spawnve</code>	<code>_wspawnve</code>
<code>_tspawnvp</code>	<code>_spawnvp</code>	<code>_spawnvp</code>	<code>_wspawnvp</code>
<code>_tspawnvpe</code>	<code>_spawnvpe</code>	<code>_spawnvpe</code>	<code>_wspawnvpe</code>

Enough memory must be available for loading and executing the new process. The `mode` argument determines the action taken by the calling process before and during `_spawn`. The following values for `mode` are defined in `Process.h`:

VALUE	DESCRIPTION
<code>_P_OVERLAY</code>	Overlays a calling process with a new process, destroying the calling process (same effect as <code>_exec</code> calls).
<code>_P_WAIT</code>	Suspends a calling thread until execution of the new process is complete (synchronous <code>_spawn</code>).
<code>_P_NOWAIT</code> or <code>_P_NOWAITO</code>	Continues to execute a calling process concurrently with the new process (asynchronous <code>_spawn</code>).
<code>_P_DETACH</code>	Continues to execute the calling process; the new process is run in the background with no access to the console or keyboard. Calls to <code>_cwait</code> against the new process fail (asynchronous <code>_spawn</code>).

The `cmdname` argument specifies the file that is executed as the new process and can specify a full path (from the root), a partial path (from the current working directory), or just a file name. If `cmdname` doesn't have a file name extension or doesn't end with a period (.), the `_spawn` function first tries the .com file name extension and then the .exe file name extension, the .bat file name extension, and finally the .cmd file name extension.

If `cmdname` has a file name extension, only that extension is used. If `cmdname` ends with a period, the `_spawn` call searches for `cmdname` with no file name extension. The `_spawnlp`, `_spawnlpe`, `_spawnvp`, and `_spawnvpe` functions search for `cmdname` (using the same procedures) in the directories specified by the `PATH` environment variable.

If `cmdname` contains a drive specifier or any slashes (that is, if it's a relative path), the `_spawn` call searches only for the specified file; no path searching is done.

In the past, some of these functions set `errno` to zero on success; the current behavior is to leave `errno` untouched on success, as specified by the C standard. If you need to emulate the old behavior, set `errno` to zero just before calling these functions.

NOTE

To ensure proper overlay initialization and termination, do not use the `setjmp` or `longjmp` function to enter or leave an overlay routine.

Arguments for the spawned process

To pass arguments to the new process, give one or more pointers to character strings as arguments in the `_spawn` call. These character strings form the argument list for the spawned process. The combined length of the strings forming the argument list for the new process must not exceed 1024 bytes. The terminating null character ('\0') for each string isn't included in the count, but space characters (automatically inserted to separate arguments) are included.

NOTE

Spaces embedded in strings may cause unexpected behavior; for example, passing `_spawn` the string `"hi there"` will result in the new process getting two arguments, `"hi"` and `"there"`. If the intent was to have the new process open a file named "hi there", the process would fail. You can avoid this by quoting the string: `"\"hi there\""`.

IMPORTANT

Do not pass user input to `_spawn` without explicitly checking its content. `_spawn` will result in a call to [CreateProcess](#) so keep in mind that unqualified path names could lead to potential security vulnerabilities.

You can pass argument pointers as separate arguments (in `_spawnl`, `_spawnle`, `_spawnlp`, and `_spawnlpe`) or as an array of pointers (in `_spawnv`, `_spawnve`, `_spawnvp`, and `_spawnvpe`). You must pass at least one argument, `arg0` or `argv[0]`, to the spawned process. By convention, this argument is the name of the program as you would type it on the command line. A different value doesn't produce an error.

The `_spawnl`, `_spawnle`, `_spawnlp`, and `_spawnlpe` calls are typically used in cases where the number of arguments is known in advance. The `arg0` argument is usually a pointer to `cmdname`. The arguments `arg1` through `argn` are pointers to the character strings forming the new argument list. Following `argn`, there must be a `NULL` pointer to mark the end of the argument list.

The `_spawnv`, `_spawnve`, `_spawnvp`, and `_spawnvpe` calls are useful when there's a variable number of arguments to the new process. Pointers to the arguments are passed as an array, `argv`. The argument `argv[0]` is usually a pointer to a path in real mode or to the program name in protected mode, and `argv[1]` through `argv[n]` are pointers to the character strings forming the new argument list. The argument `argv[n + 1]` must be a `NULL` pointer to mark the end of the argument list.

Environment of the Spawning Process

Files that are open when a `_spawn` call is made remain open in the new process. In the `_spawnl`, `_spawnlp`, `_spawnv`, and `_spawnvp` calls, the new process inherits the environment of the calling process. You can use the `_spawnle`, `_spawnlpe`, `_spawnve`, and `_spawnvpe` calls to alter the environment for the new process by passing a list of environment settings through the `envp` argument. The argument `envp` is an array of character pointers, each element (except the final element) of which points to a null-terminated string defining an environment variable. Such a string usually has the form `NAME = value` where `NAME` is the name of an environment variable and `value` is the string value to which that variable is set. (The `value` isn't enclosed in double quotation marks.) The final element of the `envp` array should be `NULL`. When `envp` itself is `NULL`, the spawned process inherits the environment settings of the parent process.

The `_spawn` functions can pass all information about open files, including the translation mode, to the new process. This information is passed in real mode through the `C_FILE_INFO` entry in the environment. The startup code normally processes this entry and then deletes it from the environment. However, if a `_spawn` function spawns a non-C process, this entry remains in the environment. Printing the environment shows graphics characters in the definition string for this entry because the environment information is passed in binary form in real mode. It shouldn't have any other effect on normal operations. In protected mode, the environment information is passed in text form and therefore contains no graphics characters.

You must explicitly flush (using `fflush` or `_flushall`) or close any stream before calling a `_spawn` function.

New processes created by calls to `_spawn` routines don't preserve signal settings. Instead, the spawned process resets signal settings to the default.

Redirecting Output

If you're calling `_spawn` from a DLL or a GUI application and want to redirect the output to a pipe, you have two options:

- Use the Win32 API to create a pipe, then call `AllocConsole`, set the handle values in the startup structure, and call `CreateProcess`.
- Call `_popen` or `_wpopen`, which will create a pipe and invoke the app using `cmd.exe /c` (or `command.exe /c`).

Example

```
// crt_spawn.c
// This program accepts a number in the range
// 1-8 from the command line. Based on the number it receives,
// it executes one of the eight different procedures that
// spawn the process named child. For some of these procedures,
// the CHILD.EXE file must be in the same directory; for
// others, it only has to be in the same path.
//

#include <stdio.h>
#include <process.h>

char *my_env[] =
{
    "THIS=environment will be",
    "PASSED=to child.exe by the",
    "_SPAWNLE=and",
    "_SPAWNLP=and",
    "_SPAWNVE=and",
    "_SPAWNVP=functions",
    NULL
};

int main( int argc, char *argv[] )
{
    char *args[4];

    // Set up parameters to be sent:
    args[0] = "child";
    args[1] = "spawn??";
    args[2] = "two";
    args[3] = NULL;

    if (argc <= 2)
    {
        printf( "SYNTAX: SPAWN <1-8> <childprogram>\n" );
    }
}
```

```

        exit( 1 );
    }

    switch (argv[1][0]) // Based on first letter of argument
    {
    case '1':
        _spawnl( _P_WAIT, argv[2], argv[2], "_spawnl", "two", NULL );
        break;
    case '2':
        _spawnle( _P_WAIT, argv[2], argv[2], "_spawnle", "two",
                  NULL, my_env );
        break;
    case '3':
        _spawnlp( _P_WAIT, argv[2], argv[2], "_spawnlp", "two", NULL );
        break;
    case '4':
        _spawnlpe( _P_WAIT, argv[2], argv[2], "_spawnlpe", "two",
                   NULL, my_env );
        break;
    case '5':
        _spawnnv( _P_OVERLAY, argv[2], args );
        break;
    case '6':
        _spawnnve( _P_OVERLAY, argv[2], args, my_env );
        break;
    case '7':
        _spawnnvp( _P_OVERLAY, argv[2], args );
        break;
    case '8':
        _spawnnvpe( _P_OVERLAY, argv[2], args, my_env );
        break;
    default:
        printf( "SYNTAX: SPAWN <1-8> <childprogram>\n" );
        exit( 1 );
    }
    printf( "from SPAWN!\n" );
}

```

child process output
from SPAWN!

See also

[Process and environment control](#)

[abort](#)
[atexit](#)
[_exec](#), [_wexec](#) functions
[exit](#), [_Exit](#), [_exit](#)
[_flushall](#)
[_getmbcp](#)
[_onexit](#), [_onexit_m](#)
[_setmbcp](#)
[system](#), [_wsystem](#)

strcoll functions

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Each of the `strcoll` and `wcscol1` functions compares two strings according to the `LC_COLLATE` category setting of the locale code page currently in use. Each of the `_mbscol1` functions compares two strings according to the multibyte code page currently in use. Use the `col1` functions for string comparisons when there's a difference between the character set order and the lexicographic character order in the current code page if the difference is of interest for the comparison. Use the corresponding `cmp` functions to test only for string equality.

strcoll Functions

SBCS	UNICODE	MBCS	DESCRIPTION
<code>strcoll</code>	<code>wcscol1</code>	<code>_mbscol1</code>	Collate two strings
<code>_stricoll</code>	<code>_wcsicoll</code>	<code>_mbsicoll</code>	Collate two strings (case insensitive)
<code>_strncoll</code>	<code>_wcsncoll</code>	<code>_mbsncoll</code>	Collate first <code>count</code> characters of two strings
<code>_strnicoll</code>	<code>_wcsnicoll</code>	<code>_mbsnicoll</code>	Collate first <code>count</code> characters of two strings (case-insensitive)

Remarks

The single-byte character (SBCS) versions of these functions (`strcoll`, `stricoll`, `_strncoll`, and `_strnicoll`) compare `string1` and `string2` according to the `LC_COLLATE` category setting of the current locale. These functions differ from the corresponding `strcmp` functions in that the `strcoll` functions use locale code page information that provides collating sequences. For string comparisons in locales in which the character set order and the lexicographic character order differ, the `strcoll` functions should be used rather than the corresponding `strcmp` functions. For more information on `LC_COLLATE`, see [setlocale](#).

For some code pages and corresponding character sets, the order of characters in the character set may differ from the lexicographic character order. In the "C" locale, it isn't the case: the order of characters in the ASCII character set is the same as the lexicographic order of the characters. However, in certain European code pages, for example, the character 'a' (value 0x61) precedes the character 'ä' (value 0xE4) in the character set, but the character 'ä' precedes the character 'a' lexicographically. To perform a lexicographic comparison in such an instance, use `strcoll` rather than `strcmp`. Alternatively, you can use `strxfrm` on the original strings, then use `strcmp` on the resulting strings.

`strcoll`, `stricoll`, `_strncoll`, and `_strnicoll` automatically handle multibyte-character strings according to the locale code page currently in use, as do their wide-character (Unicode) counterparts. The multibyte-character (MBCS) versions of these functions, however, collate strings on a character basis according to the multibyte code page currently in use.

Because the `col1` functions collate strings lexicographically for comparison, whereas the `cmp` functions simply test for string equality, the `col1` functions are much slower than the corresponding `cmp` versions. Therefore, the `col1` functions should be used only when there's a difference between the character set order and the

lexicographic character order in the current code page and this difference is of interest for the string comparison.

See also

[Locale](#)

[String manipulation](#)

`localeconv`
`_mbsnbcoll`, `_mbsnbcoll_1`, `_mbsnbicoll`, `_mbsnbicoll_1`
`setlocale`, `_wsetlocale`
`strcmp`, `wcsncmp`, `_mbscmp`
`strncmp`, `wcsncmp`, `_mbsncmp`, `_mbsncmp_1`
`_strnicmp`, `_wcsnicmp`, `_mbsnicmp`, `_strnicmp_1`, `_wcsnicmp_1`, `_mbsnicmp_1`
`strxfrm`, `wcsxfrm`, `_strxfrm_1`, `_wcsxfrm_1`

String to numeric value functions

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- `strtod`, `_strtod_l`, `wcstod`, `_wcstod_l`
- `strtol`, `wcstol`, `_strtol_l`, `_wcstol_l`
- `strtoul`, `_strtoul_l`, `wcstoul`, `_wcstoul_l`
- `_strtoi64`, `_wcstoi64`, `_strtoi64_l`, `_wcstoi64_l`
- `_strtoui64`, `_wcstoui64`, `_strtoui64_l`, `_wcstoui64_l`

Remarks

Each function in the `strtos*` family converts a null-terminated string to a numeric value. The available functions are listed in the following table.

FUNCTION	DESCRIPTION
<code>strtod</code>	Convert string to double-precision floating point value
<code>strtol</code>	Convert string to long integer
<code>strtoul</code>	Convert string to unsigned long integer
<code>_strtoi64</code>	Convert string to 64-bit <code>__int64</code> integer
<code>_strtoui64</code>	Convert string to unsigned 64-bit <code>__int64</code> integer

`wcstod`, `wcstol`, `wcstoul`, and `_wcstoi64` are wide-character versions of `strtod`, `strtol`, `strtoul`, and `_strtoi64`, respectively. The string argument to each of these wide-character functions is a wide-character string; each function behaves identically to its single-byte-character counterpart otherwise.

The `strtod` function takes two arguments: the first is the input string, and the second a pointer to the character that ends the conversion process. `strtol`, `strtoul`, `_strtoi64` and `_strtoui64` take a third argument as the number base to use in the conversion process.

The input string is a sequence of characters that can be interpreted as a numerical value of the specified type. Each function stops reading the string at the first character it can't recognize as part of a number. This character may be the terminating null character. For `strtol`, `strtoul`, `_strtoi64`, and `_strtoui64`, this terminating character can also be the first numeric character greater than or equal to the user-supplied number base.

If the user-supplied pointer to an end-of-conversion character isn't set to `NULL` or `nullptr` at call time, a pointer to the character that stopped the scan will be stored there instead. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of the string pointer is stored at that address.

`strtod` expects a string of the following form:

[`whitespace`] [`sign`] [`digits`] [. `digits`] [{ `d` | `D` | `e` | `E` } [`sign`] `digits`]

A `whitespace` may consist of space or tab characters, which are ignored; `sign` is either plus (+) or minus (-);

and `digits` are one or more decimal digits. If no digits appear before the radix character, at least one must appear after the radix character. The decimal digits can be followed by an exponent, which consists of an introductory letter (`d`, `D`, `e`, or `E`) and an optionally signed integer. If no exponent part or radix character appears, a radix character is assumed to follow the last digit in the string. The first character that doesn't fit this form stops the scan.

The `strtol`, `strtoul`, `_strtoi64`, and `_strtoui64` functions expect a string of the following form:

`[whitespace] [{ + | - }] [0 [{ x | X }]] [digits]`

If the base argument is between 2 and 36, then it's used as the base of the number. If it's 0, the initial characters referenced to by the end-of-conversion pointer are used to determine the base. If the first character is 0 and the second character isn't 'x' or 'X', the string is interpreted as an octal integer; otherwise, it's interpreted as a decimal number. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. `strtoul` and `_strtoui64` allow a plus (+) or minus (-) sign prefix; a leading minus sign indicates that the return value is negated.

The output value is affected by the setting of the `LC_NUMERIC` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead.

When the value returned by these functions would cause an overflow or underflow, or when conversion isn't possible, special case values are returned as shown:

FUNCTION	CONDITION	VALUE RETURNED
<code>strtod</code>	Overflow	+/- <code>HUGE_VAL</code>
<code>strtod</code>	Underflow or no conversion	0
<code>strtol</code>	+ Overflow	<code>LONG_MAX</code>
<code>strtol</code>	- Overflow	<code>LONG_MIN</code>
<code>strtol</code>	Underflow or no conversion	0
<code>_strtoi64</code>	+ Overflow	<code>_I64_MAX</code>
<code>_strtoi64</code>	- Overflow	<code>_I64_MIN</code>
<code>_strtoi64</code>	No conversion	0
<code>_strtoui64</code>	Overflow	<code>_UI64_MAX</code>
<code>_strtoui64</code>	No conversion	0

`_I64_MAX`, `_I64_MIN`, and `_UI64_MAX` are defined in `<LIMITS.H>`.

`wcstod`, `wcstol`, `wcstoul`, `_wcstoi64`, and `_wcstoui64` are wide-character versions of `strtod`, `strtol`, `strtoul`, `_strtoi64`, and `_strtoui64`, respectively; the pointer to an end-of-conversion argument to each of these wide-character functions is a wide-character string. Otherwise, each of these wide-character functions

behaves identically to its single-byte-character counterpart.

See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[Math and floating-point support](#)

[atof](#) , [_atof_1](#) , [_wtof](#) , [_wtof_1](#)

to functions

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Each of the `to` functions and its associated macro, if any, converts a single character to another character.

<code>_toascii</code>
<code>tolower</code> , <code>_tolower</code> , <code>towlower</code>
<code>toupper</code> , <code>_toupper</code> , <code>towupper</code>

Remarks

The `to` functions and macro conversions are as follows.

ROUTINE	MACRO	DESCRIPTION
<code>_toascii</code>	<code>_toascii</code>	Converts <code>c</code> to ASCII character
<code>tolower</code>	<code>tolower</code>	Converts <code>c</code> to lowercase if appropriate
<code>_tolower</code>	<code>_tolower</code>	Converts <code>c</code> to lowercase
<code>towlower</code>	None	Converts <code>c</code> to corresponding wide-character lowercase letter
<code>toupper</code>	<code>toupper</code>	Converts <code>c</code> to uppercase if appropriate
<code>_toupper</code>	<code>_toupper</code>	Converts <code>c</code> to uppercase
<code>towupper</code>	None	Converts <code>c</code> to corresponding wide-character uppercase letter

To use the function versions of the `to` routines that are also defined as macros, either remove the macro definitions with `#undef` directives or don't include CTYPE.H. If you use the /Za compiler option, the compiler uses the function version of `toupper` or `tolower`. Declarations of the `toupper` and `tolower` functions are in STDLIB.H.

The `_toascii` routine sets all but the low-order 7 bits of `c` to 0, so that the converted value represents a character in the ASCII character set. If `c` already represents an ASCII character, `c` is unchanged.

The `tolower` and `toupper` routines:

- Are dependent on the `LC_CTYPE` category of the current locale (`tolower` calls `isupper` and `toupper` calls `islower`).
- Convert `c` if `c` represents a convertible letter of the appropriate case in the current locale and the opposite case exists for that locale. Otherwise, `c` is unchanged.

The `_tolower` and `_toupper` routines:

- Are locale-independent, much faster versions of `tolower` and `toupper`.
- Can be used only when `isascii(c)` and either `isupper(c)` or `islower(c)`, respectively, are nonzero.
- Have undefined results if `c` isn't an ASCII letter of the appropriate case for converting.

The `towlower` and `toupper` functions return a converted copy of `c` if and only if both of the following conditions are nonzero. Otherwise, `c` is unchanged.

- `c` is a wide character of the appropriate case (that is, for which `iswupper` or `iswlower`, respectively, is nonzero).
- There's a corresponding wide character of the target case (that is, for which `iswlower` or `iswupper`, respectively, is nonzero).

Example

```
// crt_toupper.c
/* This program uses toupper and tolower to
 * analyze all characters between 0x0 and 0x7F. It also
 * applies _toupper and _tolower to any code in this
 * range for which these functions make sense.
 */

#include <ctype.h>
#include <string.h>

char msg[] = "Some of THESE letters are Capitals.";
char *p;

int main( void )
{
    printf( "%s\n", msg );

    /* Reverse case of message. */
    for( p = msg; p < msg + strlen( msg ); p++ )
    {
        if( islower( *p ) )
            putchar( _toupper( *p ) );
        else if( isupper( *p ) )
            putchar( _tolower( *p ) );
        else
            putchar( *p );
    }
}
```

```
Some of THESE letters are Capitals.
SOME OF these LETTERS ARE cAPITALS.
```

See also

[Data conversion](#)

[Locale](#)

[is , isw routines](#)

vprintf functions

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Each of the `vprintf` functions takes a pointer to an argument list, then formats and writes the given data to a particular destination. The functions differ in several ways: in the parameter validation, whether the functions take single-byte or wide character strings, the output destination, and the support for specifying the order parameters are used in the format string.

```
_vcprintf, _vcwprintf  
vfprintf, vfwprintf  
_vfprintf_p, _vfprintf_p_l, _vfwprintf_p, _vfwprintf_p_l  
_vfprintf_s, _vfprintf_s_l, _vfwprintf_s, _vfwprintf_s_l  
vprintf, vwprintf  
_vprintf_p, _vprintf_p_l, _vwprintf_p, _vwprintf_p_l  
vprintf_s, _vprintf_s_l, _vwprintf_s, _vwprintf_s_l  
_vscprintf, _vscprintf_l, _vscwprintf, _vscwprintf_l  
_vsnprintf, _vsnwprintf, vsprintf, vswprintf  
_vsprintf_p, _vsprintf_p_l, _vswprintf_p, _vswprintf_p_l  
vsprintf_s, _vsprintf_s_l, _vswprintf_s, _vswprintf_s_l
```

Remarks

The `vprintf` functions are similar to their counterpart functions as listed in the following table. However, each `vprintf` function accepts a pointer to an argument list, whereas each of the counterpart functions accepts an argument list.

These functions format data for output to destinations as follows.

FUNCTION	COUNTERPART FUNCTION	OUTPUT DESTINATION	PARAMETER VALIDATION	POSITIONAL PARAMETER SUPPORT
<code>_vcprintf</code>	<code>_cprintf</code>	console	Check for null.	no
<code>_vcwprintf</code>	<code>_cwprintf</code>	console	Check for null.	no
<code>vfprintf</code>	<code>fprintf</code>	<code>stream</code>	Check for null.	no
<code>vfprintf_p</code>	<code>fprintf_p</code>	<code>stream</code>	Check for null and valid format.	yes
<code>vfprintf_s</code>	<code>fprintf_s</code>	<code>stream</code>	Check for null and valid format.	no
<code>vfwprintf</code>	<code>fwprintf</code>	<code>stream</code>	Check for null.	no
<code>vfwprintf_p</code>	<code>fwprintf_p</code>	<code>stream</code>	Check for null and valid format.	yes

FUNCTION	COUNTERPART FUNCTION	OUTPUT DESTINATION	PARAMETER VALIDATION	POSITIONAL PARAMETER SUPPORT
<code>vfwprintf_s</code>	<code>fwprintf_s</code>	<code>stream</code>	Check for null and valid format.	no
<code>vprintf</code>	<code>printf</code>	<code>stdout</code>	Check for null.	no
<code>vprintf_p</code>	<code>printf_p</code>	<code>stdout</code>	Check for null and valid format.	yes
<code>vprintf_s</code>	<code>printf_s</code>	<code>stdout</code>	Check for null and valid format.	no
<code>vwprintf</code>	<code>wprintf</code>	<code>stdout</code>	Check for null.	no
<code>vwprintf_p</code>	<code>wprintf_p</code>	<code>stdout</code>	Check for null and valid format.	yes
<code>vwprintf_s</code>	<code>wprintf_s</code>	<code>stdout</code>	Check for null and valid format.	no
<code>vsprintf</code>	<code>sprintf</code>	memory pointed to by <code>buffer</code>	Check for null.	no
<code>vsprintf_p</code>	<code>sprintf_p</code>	memory pointed to by <code>buffer</code>	Check for null and valid format.	yes
<code>vsprintf_s</code>	<code>sprintf_s</code>	memory pointed to by <code>buffer</code>	Check for null and valid format.	no
<code>vswprintf</code>	<code>swprintf</code>	memory pointed to by <code>buffer</code>	Check for null.	no
<code>vswprintf_p</code>	<code>swprintf_p</code>	memory pointed to by <code>buffer</code>	Check for null and valid format.	yes
<code>vswprintf_s</code>	<code>swprintf_s</code>	memory pointed to by <code>buffer</code>	Check for null and valid format.	no
<code>_vscprintf</code>	<code>_vscprintf</code>	memory pointed to by <code>buffer</code>	Check for null.	no
<code>_vscwprintf</code>	<code>_vscwprintf</code>	memory pointed to by <code>buffer</code>	Check for null.	no
<code>_vsnprintf</code>	<code>_snprintf</code>	memory pointed to by <code>buffer</code>	Check for null.	no
<code>_vsnwprintf</code>	<code>_snwprintf</code>	memory pointed to by <code>buffer</code>	Check for null.	no

The `argptr` argument has type `va_list`, which is defined in VARARGS.H and STDARG.H. The `argptr` variable must be initialized by `va_start`, and may be reinitialized by subsequent `va_arg` calls; `argptr` then points to the

beginning of a list of arguments that are converted and transmitted for output according to the corresponding specifications in the `format` argument. `format` has the same form and function as the `format` argument for `printf`. None of these functions invoke `va_end`. For a more complete description of each `vprintf` function, see the description of its counterpart function as listed in the preceding table.

`_vsnprintf` differs from `vsprintf` in that it writes no more than `count` bytes to `buffer`.

The versions of these functions with the `w` infix in the name are wide-character versions of the corresponding functions without the `w` infix; in each of these wide-character functions, `buffer` and `format` are wide-character strings. Otherwise, each wide-character function behaves identically to its SBCS counterpart function.

The versions of these functions with `_s` and `_p` suffixes are the more secure versions. These versions validate the format strings. They'll generate an exception if the format string isn't well formed (for example, if invalid formatting characters are used).

The versions of these functions with the `_p` suffix let you specify the order in which the supplied arguments are substituted in the format string. For more information, see [printf_p Positional Parameters](#).

For `vsprintf`, `vswprintf`, `_vsnprintf` and `_vsnwprintf`, if copying occurs between strings that overlap, the behavior is undefined.

IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). If using the secure versions of these functions (either the `_s` or `_p` suffixes), a user-supplied format string could trigger an invalid parameter exception if the user-supplied string contains invalid formatting characters.

See also

Stream I/O

`fprintf`, `_fprintf_l`, `fwprintf`, `_fwprintf_l`
`printf`, `_printf_l`, `wprintf`, `_wprintf_l`
`sprintf`, `_sprintf_l`, `swprintf`, `_swprintf_l`, `_swprintf_l`
`va_arg`, `va_copy`, `va_end`, `va_start`

Obsolete functions

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Certain library functions are obsolete and have more recent equivalents. We recommend you change these functions to the updated versions. Other obsolete functions have been removed from the CRT. This article lists the functions deprecated as obsolete, and the functions removed in a particular version of Visual Studio.

Deprecated as obsolete in Visual Studio 2015

OBSOLETE FUNCTION	ALTERNATIVE
<code>is_wctype</code>	<code>iswctype</code>
<code>_loaddll</code>	<code>LoadLibrary</code> , <code>LoadLibraryEx</code> , or <code>LoadPackagedLibrary</code>
<code>_unloaddll</code>	<code>FreeLibrary</code>
<code>_getdllprocaddr</code>	<code>GetProcAddress</code>
<code>_seterrormode</code>	<code>SetErrorMode</code>
<code>_beep</code>	<code>Beep</code>
<code>_sleep</code>	<code>Sleep</code>
<code>_getsysime</code>	<code>GetLocalTime</code>
<code>_setsysime</code>	<code>SetLocalTime</code>

Removed from the CRT in Visual Studio 2015

OBSOLETE FUNCTION	ALTERNATIVE
<code>_cgets</code> , <code>_cgetws</code>	<code>_cgets_s</code> , <code>_cgetws_s</code>
<code>gets</code> , <code>_getws</code>	<code>gets_s</code> , <code>_getws_s</code>
<code>_get_output_format</code>	None
<code>_heapadd</code>	None
<code>_heapset</code>	None
<code>inp</code> , <code>inpw</code> , <code>_inp</code> , <code>_inpw</code> , <code>_inpd</code>	None
<code>outp</code> , <code>outpw</code> , <code>_outp</code> , <code>_outpw</code> , <code>_outpd</code>	None

OBSOLETE FUNCTION	ALTERNATIVE
<code>_set_output_format</code>	None

Removed from the CRT in earlier versions of Visual Studio

<code>_lock</code>
<code>_unlock</code>

`_cgets`, `_cgetws`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a character string from the console. More secure versions of these functions are available; see [`_cgets_s`](#), [`_cgetws_s`](#).

IMPORTANT

These functions are obsolete. Beginning in Visual Studio 2015, they are not available in the CRT. The secure versions of these functions, `_cgets_s` and `_cgetws_s`, are still available. For information on these alternative functions, see [`_cgets_s`](#), [`_cgetws_s`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
char *_cgets(
    char *buffer
);
wchar_t *_cgetws(
    wchar_t *buffer
);
template <size_t size>
char *_cgets(
    char (&buffer)[size]
); // C++ only
template <size_t size>
wchar_t *_cgetws(
    wchar_t (&buffer)[size]
); // C++ only
```

Parameters

`buffer`

Storage location for data.

Return value

`_cgets` and `_cgetws` return a pointer to the start of the string, at `buffer[2]`. If `buffer` is `NULL`, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, they return `NULL` and set `errno` to `EINVAL`.

Remarks

These functions read a string of characters from the console and store the string and its length in the location pointed to by `buffer`. The `buffer` parameter must be a pointer to a character array. The first element of the array, `buffer[0]`, must contain the maximum length (in characters) of the string to be read. The array must contain enough elements to hold the string, a terminating null character ('\0'), and 2 extra bytes. The function

reads characters until a carriage return-line feed (CR-LF) combination or the specified number of characters is read. The string is stored starting at `buffer[2]`. If the function reads a CR-LF, it stores the null character ('\0'). The function then stores the actual length of the string in the second array element, `buffer[1]`.

Because all editing keys are active when `_cgets` or `_cgetws` is called while in a console window, pressing the F3 key repeats the last entered entry.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_cgetts</code>	<code>_cgets</code>	<code>_cgets</code>	<code>_cgetws</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cgets</code>	<code><conio.h></code>
<code>_cgetws</code>	<code><conio.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cgets.c
// compile with: /c /W3
// This program creates a buffer and initializes
// the first byte to the size of the buffer. Next, the
// program accepts an input string using _cgets and displays
// the size and text of that string.

#include <conio.h>
#include <stdio.h>
#include <errno.h>

int main( void )
{
    char buffer[83] = { 80 }; // Maximum characters in 1st byte
    char *result;

    printf( "Input line of text, followed by carriage return:\n");

    // Input a line of text:
    result = _cgets( buffer ); // C4996
    // Note: _cgets is deprecated; consider using _cgets_s
    if (!result)
    {
        printf( "An error occurred reading from the console:"
               " error code %d\n", errno);
    }
    else
    {
        printf( "\nLine length = %d\nText = %s\n",
               buffer[1], result );
    }
}
```

```
A line of input.Input line of text, followed by carriage return:
Line Length = 16
Text = A line of input.
```

See also

[Console and port I/O](#)

[_getch](#) , [_getwch](#)

_get_output_format

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current value of the output format flag.

IMPORTANT

This function is obsolete. Beginning in Visual Studio 2015, it is not available in the CRT.

Syntax

```
unsigned int _get_output_format();
```

Return value

The current value of the output format flag.

Remarks

The output format flag controls features of formatted I/O. The flag has two possible values: 0 and `_TWO_DIGIT_EXPONENT`. If `_TWO_DIGIT_EXPONENT` is set, the floating point number is printed with only two digits in the exponent unless a third digit is required by the size of the exponent. If the flag is zero, the floating point output displays three digits of exponent, using zeroes if necessary to pad the value to three digits.

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_output_format</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#) in the Introduction.

See also

Format specification syntax: `printf` and `wprintf` functions

`printf`, `_printf_l`, `wprintf`, `_wprintf_l`
`printf_s`, `_printf_s_l`, `wprintf_s`, `_wprintf_s_l`
`_set_output_format`

`gets`, `_getws`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a line from the `stdin` stream. More secure versions of these functions are available; see [`gets_s`](#), [`_getws_s`](#).

IMPORTANT

These functions are obsolete. Beginning in Visual Studio 2015, they are not available in the CRT. The secure versions of these functions, `gets_s` and `_getws_s`, are still available. For information on these alternative functions, see [`gets_s`](#), [`_getws_s`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
char *gets(
    char *buffer
);
wchar_t *_getws(
    wchar_t *buffer
);
template <size_t size>
char *gets(
    char (&buffer)[size]
); // C++ only
template <size_t size>
wchar_t *_getws(
    wchar_t (&buffer)[size]
); // C++ only
```

Parameters

`buffer`

Storage location for input string.

Return value

Returns its argument if successful. A `NULL` pointer indicates an error or end-of-file condition. Use `ferror` or `feof` to determine which one has occurred. If `buffer` is `NULL`, these functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `NULL` and set `errno` to `EINVAL`.

Remarks

The `gets` function reads a line from the standard input stream `stdin` and stores it in `buffer`. The line consists of all characters up to and including the first newline character ('\n'). `gets` then replaces the newline character

with a null character ('\0') before returning the line. In contrast, the `fgets` function retains the newline character. `_getws` is a wide-character version of `gets`; its argument and return value are wide-character strings.

IMPORTANT

Because there is no way to limit the number of characters read by `gets`, untrusted input can easily cause buffer overruns. Use `fgets` instead.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_getts</code>	<code>gets</code>	<code>gets</code>	<code>_getws</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>gets</code>	<code><stdio.h></code>
<code>_getws</code>	<code><stdio.h></code> OR <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_gets.c
// compile with: /WX /W3

#include <stdio.h>

int main( void )
{
    char line[21]; // room for 20 chars + '\0'
    gets( line ); // C4996
    // Danger: No way to limit input to 20 chars.
    // Consider using gets_s instead.
    printf( "The line entered was: %s\n", line );
}
```

Input longer than 20 characters will overrun the line buffer and almost certainly cause the program to crash.

```
Hello there!The line entered was: Hello there!
```

See also

Stream I/O

`fgets` , `fgetws`
`fputs` , `fputws`
`puts` , `_putws`

_heapadd

11/2/2022 • 2 minutes to read • [Edit Online](#)

Adds memory to the heap.

IMPORTANT

This function is obsolete. Beginning in Visual Studio 2015, it is not available in the CRT.

Syntax

```
int _heapadd(
    void *memblock,
    size_t size
);
```

Parameters

`memblock`

Pointer to the heap memory.

`size`

Size of memory to add, in bytes.

Return value

If successful, `_heapadd` returns 0; otherwise, the function returns -1 and sets `errno` to `ENOSYS`.

For more information about this and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

Beginning with Visual C++ version 4.0, the underlying heap structure was moved to the C run-time libraries to support the new debugging features. As a result, `_heapadd` is no longer supported on any platform that is based on the Win32 API.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_heapadd</code>	<malloc.h>	<errno.h>

For more compatibility information, see [Compatibility](#) in the Introduction.

See also

Memory allocation

`free`

`_heapchk`

`_heapmin`

`_heapset`

`_heapwalk`

`malloc`

`realloc`

_heapset

11/2/2022 • 2 minutes to read • [Edit Online](#)

Checks heaps for minimal consistency and sets the free entries to a specified value.

IMPORTANT

This function is obsolete. Beginning in Visual Studio 2015, it is not available in the CRT.

Syntax

```
int _heapset(
    unsigned int fill
);
```

Parameters

`fill`

Fill character.

Return value

`_heapset` returns one of the following integer manifest constants defined in Malloc.h.

VALUE	DESCRIPTION
<code>_HEAPBADBEGIN</code>	Initial header information invalid or not found.
<code>_HEAPBADNODE</code>	Heap damaged or bad node found.
<code>_HEAPEMPTY</code>	Heap not initialized.
<code>_HEAPOK</code>	Heap appears to be consistent.

In addition, if an error occurs, `_heapset` sets `errno` to `ENOSYS`.

Remarks

The `_heapset` function shows free memory locations or nodes that have been unintentionally overwritten.

`_heapset` checks for minimal consistency on the heap and then sets each byte of the heap's free entries to the `fill` value. This known value shows which memory locations of the heap contain free nodes and which contain data that were unintentionally written to freed memory. If the operating system doesn't support `_heapset` (for example, Windows 98), the function returns `_HEAPOK` and sets `errno` to `ENOSYS`.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_heapset</code>	<malloc.h>	<errno.h>

For more compatibility information, see [Compatibility](#) in the Introduction.

Example

```
// crt_heapset.c
// This program checks the heap and
// fills in free entries with the character 'Z'.

#include <malloc.h>
#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    int heapstatus;
    char *buffer;

    if( (buffer = malloc( 1 )) == NULL ) // Make sure heap is
        exit( 0 );                      //     initialized
    heapstatus = _heapset( 'Z' );        // Fill in free entries
    switch( heapstatus )
    {
        case _HEAPOK:
            printf( "OK - heap is fine\n" );
            break;
        case _HEAPEMPTY:
            printf( "OK - heap is empty\n" );
            break;
        case _HEAPBADBEGIN:
            printf( "ERROR - bad start of heap\n" );
            break;
        case _HEAPBADNODE:
            printf( "ERROR - bad node in heap\n" );
            break;
    }
    free( buffer );
}
```

OK - heap is fine

See also

Memory allocation

<code>_heapadd</code>
<code>_heapchk</code>
<code>_heapmin</code>
<code>_heapwalk</code>

`_inp`, `_inp`, `_inpw`, `_inpw`, `_inpd`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Inputs, from a port, a byte (`_inp`, `_inp`), a word (`_inpw`, `_inpw`), or a double word (`_inpd`).

IMPORTANT

These functions are obsolete. Beginning in Visual Studio 2015, they are not available in the CRT.

This API can't be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _inp(
    unsigned short port
);
unsigned short _inpw(
    unsigned short port
);
unsigned long _inpd(
    unsigned short port
);
```

Parameters

`port`

I/O port number.

Return value

The functions return the byte, word, or double word read from `port`. There's no error return.

Remarks

The `_inp`, `_inpw`, and `_inpd` functions read a byte, a word, and a double word, respectively, from the specified input port. The input value can be any unsigned short integer in the range 0 - 65,535.

Because these functions read directly from an I/O port, they can't be used in user code.

The `inp` and `inpw` names are older, deprecated names for the `_inp` and `_inpw` functions. For more information, see [POSIX function names](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_inp</code>	<code><conio.h></code>
<code>_inpw</code>	<code><conio.h></code>

ROUTINE	REQUIRED HEADER
<code>_inp</code>	<conio.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Console and port I/O](#)

[`outp`](#) , [`outpw`](#) , [`_outp`](#) , [`_outpw`](#) , [`_outpd`](#)

`_inp`, `_inp`, `_inpw`, `_inpw`, `_inpd`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Inputs, from a port, a byte (`_inp`, `_inp`), a word (`_inpw`, `_inpw`), or a double word (`_inpd`).

IMPORTANT

These functions are obsolete. Beginning in Visual Studio 2015, they are not available in the CRT.

This API can't be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _inp(
    unsigned short port
);
unsigned short _inpw(
    unsigned short port
);
unsigned long _inpd(
    unsigned short port
);
```

Parameters

`port`

I/O port number.

Return value

The functions return the byte, word, or double word read from `port`. There's no error return.

Remarks

The `_inp`, `_inpw`, and `_inpd` functions read a byte, a word, and a double word, respectively, from the specified input port. The input value can be any unsigned short integer in the range 0 - 65,535.

Because these functions read directly from an I/O port, they can't be used in user code.

The `inp` and `inpw` names are older, deprecated names for the `_inp` and `_inpw` functions. For more information, see [POSIX function names](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_inp</code>	<code><conio.h></code>
<code>_inpw</code>	<code><conio.h></code>

ROUTINE	REQUIRED HEADER
<code>_inp</code>	<code><conio.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Console and port I/O](#)

[`outp`](#) , [`outpw`](#) , [`_outp`](#) , [`_outpw`](#) , [`_outpd`](#)

_lock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Acquires a multi-thread lock.

IMPORTANT

This function is obsolete. Beginning in Visual Studio 2015, it is not available in the CRT.

Syntax

```
void __cdecl _lock  
    int locknum  
);
```

Parameters

Locknum

[in] The identifier of the lock to acquire.

Remarks

If the lock has already been acquired, this method acquires the lock anyway and causes an internal C run-time (CRT) error. If the method can't acquire a lock, it exits with a fatal error and sets the error code to `_RT_LOCK`.

Requirements

Source: mlock.c

See also

[Alphabetical function reference](#)

[_unlock](#)

`outp`, `outpw`, `_outp`, `_outpw`, `_outpd`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Outputs, at a port, a byte (`outp`, `_outp`), a word (`outpw`, `_outpw`), or a double word (`_outpd`).

IMPORTANT

These functions are obsolete. Beginning in Visual Studio 2015, they are not available in the CRT.
This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _outp(
    unsigned short port,
    int data_byte
);
unsigned short _outpw(
    unsigned short port,
    unsigned short data_word
);
unsigned long _outpd(
    unsigned short port,
    unsigned long data_word
);
```

Parameters

`port`

Port number.

`data_byte`, `data_word`

Output values.

Return value

The functions return the data output. There's no error return.

Remarks

The `_outp`, `_outpw`, and `_outpd` functions write a byte, a word, and a double word, respectively, to the specified output port. The `port` argument can be any unsigned integer in the range 0 - 65,535. `data_byte` can be any integer in the range 0 - 255. `data_word` can be any value in the range of an integer, an unsigned short integer, and an unsigned long integer, respectively.

Because these functions write directly to an I/O port, they can't be used in user-mode Windows code.

For information about using I/O ports in the Windows operating system, see [Serial communications](#).

The `outp` and `outpw` names are older, deprecated names for the `_outp` and `_outpw` functions. For more information, see [POSIX function names](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_outp</code>	<conio.h>
<code>_outpw</code>	<conio.h>
<code>_outpd</code>	<conio.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Console and port I/O](#)

[`inp`](#) , [`inpw`](#) , [`_inp`](#) , [`_inpw`](#) , [`_inpd`](#)

`outp`, `outpw`, `_outp`, `_outpw`, `_outpd`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Outputs, at a port, a byte (`outp`, `_outp`), a word (`outpw`, `_outpw`), or a double word (`_outpd`).

IMPORTANT

These functions are obsolete. Beginning in Visual Studio 2015, they are not available in the CRT.
This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _outp(
    unsigned short port,
    int data_byte
);
unsigned short _outpw(
    unsigned short port,
    unsigned short data_word
);
unsigned long _outpd(
    unsigned short port,
    unsigned long data_word
);
```

Parameters

`port`

Port number.

`data_byte`, `data_word`

Output values.

Return value

The functions return the data output. There's no error return.

Remarks

The `_outp`, `_outpw`, and `_outpd` functions write a byte, a word, and a double word, respectively, to the specified output port. The `port` argument can be any unsigned integer in the range 0 - 65,535. `data_byte` can be any integer in the range 0 - 255. `data_word` can be any value in the range of an integer, an unsigned short integer, and an unsigned long integer, respectively.

Because these functions write directly to an I/O port, they can't be used in user-mode Windows code.

For information about using I/O ports in the Windows operating system, see [Serial communications](#).

The `outp` and `outpw` names are older, deprecated names for the `_outp` and `_outpw` functions. For more information, see [POSIX function names](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_outp</code>	<conio.h>
<code>_outpw</code>	<conio.h>
<code>_outpd</code>	<conio.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Console and port I/O](#)

[`inp`](#) , [`inpw`](#) , [`_inp`](#) , [`_inpw`](#) , [`_inpd`](#)

_set_output_format

11/2/2022 • 2 minutes to read • [Edit Online](#)

Customizes output formats used by formatted I/O functions.

IMPORTANT

This function is obsolete. Beginning in Visual Studio 2015, it is not available in the CRT.

Syntax

```
unsigned int _set_output_format(  
    unsigned int format  
)
```

Parameters

`format`

[in] An value representing the format to use.

Return value

The previous output format.

Remarks

`_set_output_format` is used to configure the output of formatted I/O functions such as `printf_s`. The only formatting convention that can be changed by this function is the number of digits displayed in exponents in the output of floating point numbers.

By default, the output of floating point numbers by functions such as `printf_s`, `wprintf_s`, and related functions in the Visual C++ Standard C library prints three digits for the exponent, even if three digits aren't required to represent the value of the exponent. Zeroes are used to pad the value to three digits.

`_set_output_format` allows you to change this behavior so that only two digits are printed in the exponent unless a third digit is required by the size of the exponent.

To enable two-digit exponents, call this function with the parameter `_TWO_DIGIT_EXPONENT`, as shown in the example. To disable two digit exponents, call this function with an argument of 0.

Requirements

ROUTINE	REQUIRED HEADER
<code>_set_output_format</code>	<stdio.h>

For more compatibility information, see [Compatibility](#) in the Introduction.

Example

```

// crt_set_output_format.c
#include <stdio.h>

void printvalues(double x, double y)
{
    printf_s("%11.4e %11.4e\n", x, y);
    printf_s("%11.4E %11.4E\n", x, y);
    printf_s("%11.4g %11.4g\n", x, y);
    printf_s("%11.4G %11.4G\n", x, y);
}

int main()
{
    double x = 1.211E-5;
    double y = 2.3056E-112;
    unsigned int old_exponent_format;

    // Use the default format
    printvalues(x, y);

    // Enable two-digit exponent format
    old_exponent_format = _set_output_format(_TWO_DIGIT_EXPONENT);

    printvalues(x, y);

    // Disable two-digit exponent format
    _set_output_format( old_exponent_format );

    printvalues(x, y);
}

```

```

1.2110e-005 2.3056e-112
1.2110E-005 2.3056E-112
1.211e-005 2.306e-112
1.211E-005 2.306E-112
1.2110e-005 2.3056e-112
1.2110E-005 2.3056E-112
1.211e-005 2.306e-112
1.211E-005 2.306E-112
1.2110e-005 2.3056e-112
1.2110E-005 2.3056E-112
1.211e-005 2.306e-112
1.211E-005 2.306E-112

```

See also

[printf_s](#) , [_printf_s_l](#) , [wprintf_s](#) , [_wprintf_s_l](#)
[_get_output_format](#)

_unlock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Releases a multi-thread lock.

IMPORTANT

This function is obsolete. Beginning in Visual Studio 2015, it is not available in the CRT.

Syntax

```
void __cdecl _unlock(
    int locknum
);
```

Parameters

Locknum

[in] The identifier of the lock to release.

Requirements

Source: mlock.c

See also

[Alphabetical function reference](#)

[_lock](#)

UCRT alphabetical function reference

11/2/2022 • 8 minutes to read • [Edit Online](#)

The Universal C Runtime (UCRT, often just CRT) Library reference documentation is arranged alphabetically by routine. To find a CRT routine based on functionality, see [Universal C runtime routines by category](#).

A

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`_mbsncat_1`

`_mbsncat_s`

`_mbsncat_s_1`

`_mbsncnt`

`_mbsncnt_1`

`_mbsncmp`

`_mbsncmp_1`

`_mbsncoll`

`_mbsncoll_1`

`_mbsncpy`

`_mbsncpy_1`

`_mbsncpy_s`

`_mbsncpy_s_1`

`_mbsnextc`

`_mbsnextc_1`

`_mbsnicmp`

`_mbsnicmp_1`

`_mbsnicoll`

`_mbsnicoll_1`

`_mbsninc`

`_mbsninc_1`

`_mbsnlen`

`_mbsnlen_1`

`_mbsnset`

`_mbsnset_1`

`_mbsnset_s`

`_mbsnset_s_1`

`_mbspbrk`

`_mbspbrk_1`

`_mbsrchr`

`_mbsrchr_1`

`_mbsrev`

`_mbsrev_1`

`mbsrtowcs`

`mbsrtowcs_s`

`_mbsset`

`_mbsset_1`

`_mbsset_s`

`_mbsset_s_1`

`_mbsspn`

`_mbsspn_1`

`_mbsspnp`

`_mbsspnp_1`

`_mbsstr`

`_mbsstr_1`

`_mbstok`

`_mbstok_1`

`_mbstok_s`

`_mbstok_s_1`

`mbstowcs`

`_mbstowcs_1`

`mbstowcs_s`

`_mbstowcs_s_1`

`_mbstrlen`

`_mbstrlen_1`

`_mbstrnlen`

`_mbstrnlen_1`

`_mbsupr`

`_mbsupr_1`

`_mbsupr_s`

`_mbsupr_s_1`

`mbtowc`

`_mbtowc_1`

`memccpy`

`_memccpy`

`memchr`

`memcmp`

`memcpy`

`memcpy_s`

`memicmp`

`_memicmp`

`_memicmp_1`

`memmove`

`memmove_s`

`memset`

`__min`

`mkdir`

`_mkdir`

`_mkgmtime`

`_mkgmtime32`

`_mkgmtime64`

`mktemp`

`_mktemp`

`_mktemp_s`

`mktimes`

`_mktimes32`

`_mktimes64`

`modf`

`modff`

`_msize`

`_msize_dbg`

N

`nan`

`nanf`

`nanl`

`nearbyint`

`nearbyintf`

`nearbyintl`

`nextafter`

`_nextafter`

`nextafterf`

`_nextafterf`

`nextafterl`

`nexttoward`

`nexttowardf`

`nexttowardl`

`norm`

`normf`

`norml`

`not`

`not_eq`

O

`offsetof`

`_onexit`

`_onexit_m`

`open`

`_open`

`_open_osfhandle`

`or`

`or_eq`

P

_pclose
_perror
_pipe
_popen
pow
powf
powl
printf
_printf_l
_printf_p
_printf_p_l
printf_s
_printf_s_l
_purecall
putc
_putc_nolock
putch
_putch
_putch_nolock
putchar
_putchar_nolock
putenv
_putenv
_putenv_s
puts
putw
_putw
putwc
_putwc_nolock
_putwch
_putwch_nolock
putwchar
_putwchar_nolock

`_putws`

Q

`qsort`

`qsort_s`

`_query_new_handler`

`_query_new_mode`

`quick_exit`

R

`raise`

`rand`

`rand_s`

`read`

`_read`

`realloc`

`_realloc_dbg`

`_recalloc`

`_recalloc_dbg`

`remainder`

`remainderf`

`remainderl`

`remove`

`remquo`

`remquof`

`remquol`

`rename`

`_resetstkoflw`

`rewind`

`rint`

`rintf`

`rintl`

`rmdir`

`_rmdir`

`rmtmp`

`_rmtmp`

`_rotl`

`_rotl64`

`_rotr`

`_rotr64`

`round`

`roundf`

`roundl`

`_RPT`

`_RPTF`

`_RPTFW`

`_RPTW`

`_RTC_GetErrDesc`

`_RTC_NumErrors`

`_RTC_SetErrorFunc`

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S

`_scalb`

`scalbln`

`scalblnf`

`scalblnl`

`scalbn`

`scalbnf`

`scalbnl`

`scanf`

`_scanf_l`

`scanf_s`

`_scanf_s_l`

`_scprintf`

`_scprintf_l`

_scprintf_p
_scprintf_p_l
_scwprintf
_scwprintf_l
_scwprintf_p
_scwprintf_p_l
_searchenv
_searchenv_s
__security_init_cookie
_seh_filter_dll
_seh_filter_exe
_set_abort_behavior
_set_controlfp
_set_doserrno
_set_errno
_set_error_mode
_set_FMA3_enable
_set_fmode
_set_invalid_parameter_handler
_set_new_handler
_set_new_mode
_set_printf_count_output
_set_purecall_handler
_set_se_translator
_set_SSE2_enable
set_terminate
_set_thread_local_invalid_parameter_handler
set_unexpected
setbuf
setjmp
setlocale
_setmaxstdio
_setmbcp

`setmode`

`_setmode`

`setvbuf`

`signal`

`signbit`

`sin`

`sinf`

`sinh`

`sinhf`

`sinhl`

`sinl`

`snprintf`

`_snprintf`

`_snprintf_l`

`_snprintf_s`

`_snprintf_s_l`

`_snscanf`

`_snscanf_l`

`_snscanf_s`

`_snscanf_s_l`

`_snwprintf`

`_snwprintf_l`

`_snwprintf_s`

`_snwprintf_s_l`

`_snwscanf`

`_snwscanf_l`

`_snwscanf_s`

`_snwscanf_s_l`

`sopen`

`_sopen`

`_sopen_s`

`spawnl`

`_spawnl`

`spawnle`

`_spawnle`

`spawnlp`

`_spawnlp`

`spawnlpe`

`_spawnlpe`

`spawnv`

`_spawnv`

`spawnve`

`_spawnve`

`spawnvp`

`_spawnvp`

`spawnvpe`

`_spawnvpe`

`_splitpath`

`_splitpath_s`

`sprintf`

`_sprintf_l`

`_sprintf_p`

`_sprintf_p_l`

`sprintf_s`

`_sprintf_s_l`

`sqrt`

`sqrtf`

`sqrtl`

`srand`

`sscanf`

`_sscanf_l`

`sscanf_s`

`_sscanf_s_l`

`_stat`

`_stat32`

`_stat32i64`

`_stat64`

`_stat64i32`

`_stati64`

`_STATIC_ASSERT`

`_status87`

`_statusfp`

`_statusfp2`

`strcat`

`strcat_s`

`strchr`

`strcmp`

`strcmpi`

`strcoll`

`_strcoll_l`

`strcpy`

`strcpy_s`

`strcspn`

`_strdate`

`_strdate_s`

`_strdec`

`_strdup`

`strdup`

`_strdup_dbg`

`strerror`

`_strerror`

`strerror_s`

`_strerror_s`

`strftime`

`_strftime_l`

`_stricmp`

`strcmp`

`_stricmp_l`

`_stricoll`

`_stricoll_1`

`_strinc`

`strlen`

`_strlwr`

`strlwr`

`_strlwr_1`

`_strlwr_s`

`_strlwr_s_1`

`strncat`

`_strncat_1`

`strncat_s`

`_strncat_s_1`

`strcmp`

`_strncnt`

`_strncoll`

`_strncoll_1`

`strncpy`

`_strncpy_1`

`strncpy_s`

`_strncpy_s_1`

`_strnextc`

`_strnicmp`

`strnicmp`

`_strnicmp_1`

`_strnicoll`

`_strnicoll_1`

`_strninc`

`strnlen`

`strnlen_s`

`_strnset`

`strnset`

`_strnset_1`

`_strnset_s`

`_strnset_s_1`

`strupr`

`strrchr`

`_strrev`

`strrev`

`_strset`

`strset`

`_strset_1`

`_strset_s`

`_strset_s_1`

`strspn`

`_strspnp`

`strstr`

`_strptime`

`_strtime_s`

`strtod`

`_strtod_1`

`strtof`

`_strtof_1`

`_strtoi64`

`_strtoi64_1`

`strtoimax`

`_strtoimax_1`

`strtok`

`_strtok_1`

`strtok_s`

`_strtok_s_1`

`strtol`

`_strtol_1`

`strtold`

`_strtold_1`

`strtoll`

`_strtoll_1`

`_strtoui64`

`_strtoui64_l`

`strtoul`

`_strtoul_l`

`strtoull`

`_strtoull_l`

`strtoumax`

`_strtoumax_l`

`_strupr`

`strupr`

`_strupr_l`

`_strupr_s`

`_strupr_s_l`

`strxfrm`

`_strxfrm_l`

`swab`

`_swab`

`swprintf`

`_swprintf_l`

`__swprintf_l`

`_swprintf_p`

`_swprintf_p_l`

`swprintf_s`

`_swprintf_s_l`

`swscanf`

`_swscanf_l`

`swscanf_s`

`_swscanf_s_l`

`system`

T

`tan`

`tanf`

`tanh`
`tanhf`
`tanhl`
`tanl`
`tell`
`_tell`
`_telli64`
`tempnam`
`_tempnam`
`_tempnam_dbg`
`terminate`
`tgamma`
`tgammaf`
`tgammal`
`time`
`_time32`
`_time64`
`timespec_get`
`_timespec32_get`
`_timespec64_get`
`tmpfile`
`tmpfile_s`
`tmpnam`
`tmpnam_s`
`__toascii`
`toascii`
`tolower`
`_tolower`
`_tolower_l`
`toupper`
`_toupper`
`_toupper_l`
`towctrans`

`towlower`

`_towlower_l`

`toupper`

`_toupper_l`

`trunc`

`truncf`

`truncl`

`tzset`

`_tzset`

U

`_ui64toa`

`_ui64toa_s`

`_ui64tow`

`_ui64tow_s`

`ultoa`

`_ultoa`

`_ultoa_s`

`_ultow`

`_ultow_s`

`umask`

`_umask`

`_umask_s`

`__uncaught_exception`

`unexpected`

`ungetc`

`_ungetc_nolock`

`ungetch`

`_ungetch`

`_ungetch_nolock`

`ungetwc`

`_ungetwc_nolock`

`_ungetwch`

`_ungetwch_nolock`

`unlink`

`_unlink`

`_unlock_file`

`_utime`

`_utime32`

`_utime64`

V

`va_arg`

`va_copy`

`va_end`

`va_start`

`_vcprintf`

`_vcprintf_l`

`_vcprintf_p`

`_vcprintf_p_l`

`_vcprintf_s`

`_vcprintf_s_l`

`_vcwprintf`

`_vcwprintf_l`

`_vcwprintf_p`

`_vcwprintf_p_l`

`_vcwprintf_s`

`_vcwprintf_s_l`

`vfprintf`

`_vfprintf_l`

`_vfprintf_p`

`_vfprintf_p_l`

`vfprintf_s`

`_vfprintf_s_l`

`vfscanf`

`vfscanf_s`

`vfwprintf`

`_vfwprintf_l`

`_vfwprintf_p`

`_vfwprintf_p_l`

`vfwprintf_s`

`_vfwprintf_s_l`

`vfwscanf`

`vfwscanf_s`

`vprintf`

`_vprintf_l`

`_vprintf_p`

`_vprintf_p_l`

`vprintf_s`

`_vprintf_s_l`

`vscanf`

`vscanf_s`

`_vscprintf`

`_vscprintf_l`

`_vscprintf_p`

`_vscprintf_p_l`

`_vscwprintf`

`_vscwprintf_l`

`_vscwprintf_p`

`_vscwprintf_p_l`

`vsnprintf`

`_vsnprintf`

`_vsnprintf_l`

`vsnprintf_s`

`_vsnprintf_s`

`_vsnprintf_s_l`

`_vsnwprintf`

`_vsnwprintf_l`

`_vsnwprintf_s`

`_vsnwprintf_s_l`

`vsprintf`

`_vsprintf_l`

`_vsprintf_p`

`_vsprintf_p_l`

`vsprintf_s`

`_vsprintf_s_l`

`vscanf`

`vscanf_s`

`vswprintf`

`_vswprintf_l`

`__vswprintf_l`

`_vswprintf_p`

`_vswprintf_p_l`

`vswprintf_s`

`_vswprintf_s_l`

`vwscanf`

`vwsprintf_s`

`vwprintf`

`_vwprintf_l`

`_vwprintf_p`

`_vwprintf_p_l`

`vwprintf_s`

`_vwprintf_s_l`

`vwscanf`

`vwsprintf_s`

W

`_waccess`

`_waccess_s`

`_wasctime`

`_wasctime_s`

`_wassert`

_wchdir
_wchmod
_wcreat
_wcreate_locale
wcrtomb
wcrtomb_s
wcscat
wcscat_s
wcschr
wcsncmp
wcscoll
_wcscoll_l
wcscopy
wcscopy_s
wcscspn
_wcsdec
_wcsdup
wcsdup
_wcscdup_dbg
_wcscerror
__wcscerror
_wcscerror_s
__wcscerror_s
wcsftime
_wcsftime_l
_wcsicmp
wcsicmp
_wcscicmp_1
_wcscicoll
wcsicoll
_wcscicoll_l
_wcsinc
wcslen

`_wcslwr`

`wcslwr`

`_wcslwr_1`

`_wcslwr_s`

`_wcslwr_s_1`

`wcsncat`

`_wcsncat_1`

`wcsncat_s`

`_wcsncat_s_1`

`wcsncmp`

`_wcsncnt`

`_wcsncoll`

`_wcsncoll_1`

`wcsncpy`

`_wcsncpy_1`

`wcsncpy_s`

`_wcsncpy_s_1`

`_wcsnextc`

`_wcsnicmp`

`wcsnicmp`

`_wcsnicmp_1`

`_wcsnicoll`

`_wcsnicoll_1`

`_wcsninc`

`wcsnlen`

`wcsnlen_s`

`_wcsnset`

`wcsnset`

`_wcsnset_1`

`_wcsnset_s`

`_wcsnset_s_1`

`wcspbrk`

`wcsrchr`

_wcsrev
wcsrev
wcstombs
wcstombs_s
_wcsset
wcsset
_wcsset_l
_wcsset_s
_wcsset_s_l
wcsspn
_wcsspnp
wcsstr
wcstod
_wcstod_l
wcstof
_wcstof_l
_wcstoi64
_wcstoi64_l
wcstoimax
_wcstoimax_l
wcstok
_wcstok_l
wcstok_s
_wcstok_s_l
wcstol
_wcstol_l
wcstold
_wcstold_l
wcstoll
_wcstoll_l
wcstombs
_wcstombs_l
wcstombs_s

`_wcstombs_s_l`

`_wcstoui64`

`_wcstoui64_l`

`wcstoul`

`_wcstoul_l`

`wcstoull`

`_wcstoull_l`

`wcstoumax`

`_wcstoumax_l`

`_wcsupr`

`wcsupr`

`_wcsupr_l`

`_wcsupr_s`

`_wcsupr_s_l`

`wcsxfrm`

`_wcsxfrm_l`

`_wctime`

`_wctime_s`

`_wctime32`

`_wctime32_s`

`_wctime64`

`_wctime64_s`

`wctob`

`wctomb`

`_wctomb_l`

`wctomb_s`

`_wctomb_s_l`

`wctrans`

`wctype`

`_wdupenv_s`

`_wdupenv_s_dbg`

`_wexec1`

`_wexecle`

_wexeclp
_wexeclpe
_wexecv
_wexecve
_wexecvp
_wexecvpe

_wfopen

_wfindfirst
_wfindfirst32
_wfindfirst32i64
_wfindfirst64
_wfindfirst64i32
_wfindfirsti64

_wfindnext
_wfindnext32
_wfindnext32i64
_wfindnext64
_wfindnext64i32
_wfindnexti64

_wfopen
_wfopen_s
_wfreopen
_wfreopen_s
_wfsopen
_wfullpath
_wfullpath_dbg

_wgetcwd
_wgetcwd_dbg
_wgetdcwd
_wgetdcwd_dbg
_wgetdcwd_nolock

_wgetenv
_wgetenv_s

`_wmakepath`

`_wmakepath_s`

`wmemchr`

`wmemcmp`

`wmemcpy`

`wmemcpy_s`

`wmemmove`

`wmemmove_s`

`wmemset`

`_wmkdir`

`_wmktemp`

`_wmktemp_s`

`_wopen`

`_wperror`

`_wpopen`

`wprintf`

`_wprintf_l`

`_wprintf_p`

`_wprintf_p_l`

`wprintf_s`

`_wprintf_s_l`

`_wputenv`

`_wputenv_s`

`_wremove`

`_wrename`

`_write`

`write`

`_wrmdir`

`wscanf`

`_wscanf_l`

`wscanf_s`

`_wscanf_s_l`

`_wsearchenv`

`_wsearchenv_s`

`_wsetlocale`

`_wsopen`

`_wsopen_s`

`_wpawnl`

`_wpawnle`

`_wpawnlp`

`_wpawnlpe`

`_wpawnv`

`_wpawnve`

`_wpawnvp`

`_wpawnvpe`

`_wsplitpath`

`_wsplitpath_s`

`_wstat`

`_wstat32`

`_wstat32i64`

`_wstat64`

`_wstat64i32`

`_wstati64`

`_wstrdate`

`_wstrdate_s`

`_wstrtime`

`_wstrtime_s`

`_wsystem`

`_wtmpnam`

`_wtmpnam_dbg`

`_wtmpnam`

`_wtmpnam_s`

`_wtof`

`_wtof_l`

`_wtoi`

`_wtoi_l`

[_wtoi64](#)

[_wtoi64_1](#)

[_wtol](#)

[_wtol_1](#)

[_wtoll](#)

[_wtoll_1](#)

[_wunlink](#)

[_wutime](#)

[_wutime32](#)

[_wutime64](#)

X

[xor](#)

[xor_eq](#)

Y

[_y0](#)

[y0](#)

[_y1](#)

[y1](#)

[_yn](#)

[yn](#)

See also

[C runtime library reference](#)

Aborts the current process and returns an error code.

NOTE

Do not use this method to shut down a Microsoft Store app or Universal Windows Platform (UWP) app, except in testing or debugging scenarios. Programmatic or UI ways to close a Store app are not permitted according to the [Microsoft Store policies](#). For more information, see [UWP app lifecycle](#).

Syntax

```
void abort( void );
```

Return value

`abort` doesn't return control to the calling process. By default, it checks for an abort signal handler and raises `SIGABRT` if one is set. Then `abort` terminates the current process and returns an exit code to the parent process.

Remarks

Microsoft Specific

By default, when an app is built with the debug runtime library, the `abort` routine displays an error message before `SIGABRT` is raised. For console apps running in console mode, the message is sent to `STDERR`. Windows desktop apps and console apps running in windowed mode display the message in a message box. To suppress the message, use `_set_abort_behavior` to clear the `_WRITE_ABORT_MSG` flag. The message displayed depends on the version of the runtime environment used. For applications built by using the most recent versions of Visual C++, the message resembles this one:

```
R6010 - abort() has been called
```

In previous versions of the C runtime library, this message was displayed:

This application has requested the Runtime to terminate it in an unusual way. Please contact the application's support team for more information.

When the program is compiled in debug mode, the message box displays options to **Abort**, **Retry**, or **Ignore**. If the user chooses **Abort**, the program terminates immediately and returns an exit code of 3. If the user chooses **Retry**, a debugger is invoked for just-in-time debugging, if available. If the user chooses **Ignore**, `abort` continues normal processing.

In both retail and debug builds, `abort` then checks whether an abort signal handler is set. If a non-default signal handler is set, `abort` calls `raise(SIGABRT)`. Use the `signal` function to associate an abort signal handler function with the `SIGABRT` signal. You can perform custom actions—for example, clean up resources or log information—and terminate the app with your own error code in the handler function. If no custom signal

handler is defined, `abort` doesn't raise the `SIGABRT` signal.

By default, in non-debug builds of desktop or console apps, `abort` then invokes the Windows Error Reporting Service mechanism (formerly known as Dr. Watson) to report failures to Microsoft. This behavior can be enabled or disabled by calling `_set_abort_behavior` and setting or masking the `_CALL_REPORTFAULT` flag. When the flag is set, Windows displays a message box that has text something like "A problem caused the program to stop working correctly." The user can choose to invoke a debugger with a **Debug** button, or choose the **Close program** button to terminate the app with an error code that's defined by the operating system.

If the Windows error reporting handler isn't invoked, then `abort` calls `_exit` to terminate the process with exit code 3 and returns control to the parent process or the operating system. `_exit` doesn't flush stream buffers or do `atexit` / `_onexit` processing.

For Windows compatibility reasons, when `abort` calls `_exit`, it may invoke the Windows `ExitProcess` API, which in turn allows DLL termination routines to run. Destructors aren't run in the executable, but the same may not be true of DLLs loaded in the executable's process space. This behavior doesn't strictly conform to the C++ standard. To immediately terminate a process including any DLLs, use the Windows `TerminateProcess` API. You can also register an abort signal handler that invokes `TerminateProcess` for standard-compliant behavior. Compliant behavior may come at some cost in Windows compatibility.

For more information about CRT debugging, see [CRT debugging techniques](#).

End Microsoft Specific

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>abort</code>	<code><process.h></code> or <code><stdlib.h></code>

Example

The following program tries to open a file and aborts if the attempt fails.

```
// crt_abort.c
// compile with: /TC
// This program demonstrates the use of
// the abort function by attempting to open a file
// and aborts if the attempt fails.

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    FILE *stream = NULL;
    errno_t err = 0;

    err = fopen_s(&stream, "NOSUCHFILE", "r" );
    if ((err != 0) || (stream == NULL))
    {
        perror( "File could not be opened" );
        abort();
    }
    else
    {
        fclose( stream );
    }
}
```

```
File could not be opened: No such file or directory
```

See also

Using [abort](#)

[abort](#) function

Process and environment control

[_exec](#), [_wexec](#) functions

[exit](#), [_Exit](#), [_exit](#)

[raise](#)

[signal](#)

[_spawn](#), [_wspawn](#) functions

[_DEBUG](#)

[_set_abort_behavior](#)

`abs`, `labs`, `llabs`, `_abs64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the absolute value of the argument.

Syntax

```
int abs( int n );
long labs( long n );
long long llabs( long long n );
__int64 _abs64( __int64 n );
```

```
long abs( long n );    // C++ only
long long abs( long long n );    // C++ only
double abs( double n );    // C++ only
long double abs( long double n );    // C++ only
float abs( float n );    // C++ only
```

Parameters

`n`

Numeric value.

Return value

The `abs`, `labs`, `llabs`, and `_abs64` functions return the absolute value of the parameter `n`. There's no error return.

Remarks

Because C++ allows overloading, you can call overloads of `abs` that take and return `long`, `long long`, `float`, `double`, and `long double` values. These overloads are defined in the `<cmath>` header. In a C program, `abs` always takes and returns an `int`.

Microsoft-specific: The range of negative integers representable in any integral type is larger than the range of positive integers representable in that type. So, it's possible to supply an argument to these functions that can't be converted. If the absolute value of the argument can't be represented by the return type, the `abs` functions return the argument value unchanged. Specifically, `abs(INT_MIN)` returns `INT_MIN`, `labs(LONG_MIN)` returns `LONG_MIN`, `llabs(LLONG_MIN)` returns `LLONG_MIN`, and `_abs64(_I64_MIN)` returns `_I64_MIN`. Effectively, the `abs` functions can't be used to guarantee a positive value.

Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>abs</code> , <code>labs</code> , <code>llabs</code>	<code><math.h></code> or <code><stdlib.h></code>	<code><cmath></code> , <code><cstdlib></code> , <code><stdlib.h></code> OR <code><math.h></code>
<code>_abs64</code>	<code><stdlib.h></code>	<code><cstdlib></code> or <code><stdlib.h></code>

To use the overloaded versions of `abs` in C++, you must include the `<cmath>` header.

Example

This program computes and displays the absolute values of several numbers.

```
// crt_abs.c
// Build: cl /W3 /TC crt_abs.c
// This program demonstrates the use of the abs function
// by computing and displaying the absolute values of
// several numbers.

#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include <limits.h>

int main( void )
{
    int ix = -4;
    long lx = -41567L;
    long long llx = -9876543210LL;
    __int64 wx = -1;

    // absolute 32 bit integer value
    printf_s("The absolute value of %d is %d\n", ix, abs(ix));

    // absolute long integer value
    printf_s("The absolute value of %ld is %ld\n", lx, labs(lx));

    // absolute long long integer value
    printf_s("The absolute value of %lld is %lld\n", llx, llabs(llx));

    // absolute 64 bit integer value
    printf_s("The absolute value of 0x%.16I64x is 0x%.16I64x\n", wx,
            _abs64(wx));

    // Integer error cases:
    printf_s("Microsoft implementation-specific results:\n");
    printf_s(" abs(INT_MIN) returns %d\n", abs(INT_MIN));
    printf_s(" labs(LONG_MIN) returns %ld\n", labs(LONG_MIN));
    printf_s(" llabs(LLONG_MIN) returns %lld\n", llabs(LLONG_MIN));
    printf_s(" _abs64(_I64_MIN) returns 0x%.16I64x\n", _abs64(_I64_MIN));
}
```

```
The absolute value of -4 is 4
The absolute value of -41567 is 41567
The absolute value of -9876543210 is 9876543210
The absolute value of 0xffffffffffff is 0x0000000000000001
Microsoft implementation-specific results:
abs(INT_MIN) returns -2147483648
labs(LONG_MIN) returns -2147483648
llabs(LLONG_MIN) returns -9223372036854775808
_abs64(_I64_MIN) returns 0x8000000000000000
```

See also

[Data conversion](#)

[Math and floating-point support](#)

[_cabs](#)

[fabs](#), [fabsf](#), [fabsl](#)

imaxabs

access (CRT)

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `access` is a deprecated alias for the `_access` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_access` or the security-enhanced `_access_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_access`, `_waccess`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines if a file is read-only or not. More secure versions are available; see [`_access_s`](#), [`_waccess_s`](#).

Syntax

```
int _access(
    const char *path,
    int mode
);
int _waccess(
    const wchar_t *path,
    int mode
);
```

Parameters

`path`

File or directory path.

`mode`

Read/write attribute.

Return value

Each function returns 0 if the file has the given mode. The function returns -1 if the named file doesn't exist or doesn't have the given mode; in this case, `errno` is set as shown in the following table.

VALUE	DESCRIPTION
<code>EACCES</code>	Access denied: the file's permission setting doesn't allow specified access.
<code>ENOENT</code>	File name or path not found.
<code>EINVAL</code>	Invalid parameter.

For more information about these and other return codes, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#).

Remarks

When used with files, the `_access` function determines whether the specified file or directory exists and has the attributes specified by the value of `mode`. When used with directories, `_access` determines only whether the specified directory exists; in Windows 2000 and later operating systems, all directories have read and write access.

MODE	VALUE	CHECKS FILE FOR
------	-------	-----------------

MODE	VALUE	CHECKS FILE FOR
00		Existence only
02		Write-only
04		Read-only
06		Read and write

This function only checks whether the file and directory are read-only or not, it doesn't check the filesystem security settings. For that you need an access token. For more information on filesystem security, see [Access tokens](#). An ATL class exists to provide this functionality; see [CAccessToken Class](#).

`_waccess` is a wide-character version of `_access`; the `path` argument to `_waccess` is a wide-character string. `_waccess` and `_access` behave identically otherwise.

This function validates its parameters. If `path` is `NULL` or `mode` doesn't specify a valid mode, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function sets `errno` to `EINVAL` and returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_taccess</code>	<code>_access</code>	<code>_access</code>	<code>_waccess</code>

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_access</code>	<code><iostream.h></code>	<code><errno.h></code>
<code>_waccess</code>	<code><wchar.h></code> or <code><iostream.h></code>	<code><errno.h></code>

Example

The following example uses `_access` to check the file named `crt_ACCESS.c` to see whether it exists and whether writing is allowed.

```
// crt_access.c
// compile with: /W1
// This example uses _access to check the file named
// crt_ACCESS.C to see if it exists and if writing is allowed.

#include <io.h>
#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    // Check for existence.
    if( (_access( "crt_ACCESS.C", 0 ) != -1 ) )
    {
        printf_s( "File crt_ACCESS.C exists.\n" );

        // Check for write permission.
        // Assume file is read-only.
        if( (_access( "crt_ACCESS.C", 2 ) == -1 ) )
            printf_s( "File crt_ACCESS.C does not have write permission.\n" );
    }
}
```

```
File crt_ACCESS.C exists.
File crt_ACCESS.C does not have write permission.
```

See also

File handling

[_chmod](#) , [_wchmod](#)
[_fstat](#) , [_fstat32](#) , [_fstat64](#) , [_fstat164](#) , [_fstat32i64](#) , [_fstat64i32](#)
[_open](#) , [_wopen](#)
[_stat](#) , [_wstat](#) functions

`_access_s`, `_waccess_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines file read/write permissions. These functions are versions of `_access`, `_waccess` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _access_s(
    const char *path,
    int mode
);
errno_t _waccess_s(
    const wchar_t *path,
    int mode
);
```

Parameters

`path`

File or directory path.

`mode`

Permission setting.

Return value

Each function returns 0 if the file has the given mode. The function returns an error code if the named file doesn't exist or isn't accessible in the given mode. In this case, the function returns an error code from the set as follows and also sets `errno` to the same value.

ERRNO	VALUE	CONDITION
EACCES		Access denied. The file's permission setting doesn't allow specified access.
ENOENT		File name or path not found.
EINVAL		Invalid parameter.

For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

When used with files, the `_access_s` function determines whether the specified file exists and can be accessed as specified by the value of `mode`. When used with directories, `_access_s` determines only whether the specified directory exists. In Windows 2000 and later operating systems, all directories have read and write access.

MODE	VALUE	CHECKS FILE FOR
00		Existence only.
02		Write permission.
04		Read permission.
06		Read and write permission.

Permission to read or write the file isn't enough to ensure the ability to open a file. For example, if a file is locked by another process, it might not be accessible even though `_access_s` returns 0.

`_waccess_s` is a wide-character version of `_access_s`, where the `path` argument to `_waccess_s` is a wide-character string. Otherwise, `_waccess_s` and `_access_s` behave identically.

These functions validate their parameters. If `path` is `NULL` or `mode` doesn't specify a valid mode, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_taccess_s</code>	<code>_access_s</code>	<code>_access_s</code>	<code>_waccess_s</code>

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_access_s</code>	<code><io.h></code>	<code><errno.h></code>
<code>_waccess_s</code>	<code><wchar.h></code> or <code><io.h></code>	<code><errno.h></code>

Example

This example uses `_access_s` to check the file named crt_access_s.c to see whether it exists and whether writing is allowed.

```
// crt_access_s.c

#include <io.h>
#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    errno_t err = 0;

    // Check for existence.
    if ((err = _access_s( "crt_access_s.c", 0 )) == 0 )
    {
        printf_s( "File crt_access_s.c exists.\n" );

        // Check for write permission.
        if ((err = _access_s( "crt_access_s.c", 2 )) == 0 )
        {
            printf_s( "File crt_access_s.c does have "
                      "write permission.\n" );
        }
        else
        {
            printf_s( "File crt_access_s.c does not have "
                      "write permission.\n" );
        }
    }
    else
    {
        printf_s( "File crt_access_s.c does not exist.\n" );
    }
}
```

```
File crt_access_s.c exists.
File crt_access_s.c does not have write permission.
```

See also

File handling

[_access](#) , [_waccess](#)
[_chmod](#) , [_wchmod](#)
[_fstat](#) , [_fstat32](#) , [_fstat64](#) , [_fstat16](#) , [_fstat32i64](#) , [_fstat64i32](#)
[_open](#) , [_wopen](#)
[_stat](#) , [_wstat](#) functions

`acos`, `acosf`, `acosl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the arccosine.

Syntax

```
double acos( double x );
float acosf( float x );
long double acosl( long double x );
#define acos(X) // Requires C11 or higher

float acos( float x );    // C++ only
long double acos( long double x );    // C++ only
```

Parameters

`x`

Value between -1 and 1, for which to calculate the arccosine (the inverse cosine).

Return value

The `acos` function returns the arccosine of `x` in the range 0 to π radians.

By default, if `x` is less than -1 or greater than 1, `acos` returns an indefinite.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{INF}$	<code>INVALID</code>	<code>_DOMAIN</code>
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>
$ x > 1$	<code>INVALID</code>	<code>_DOMAIN</code>

Remarks

Because C++ allows overloading, you can call overloads of `acos` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `acos` always takes and returns a `double`.

If you use the `acos` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>acos</code> , <code>acosf</code> , <code>acosl</code>	<code><math.h></code>	<code><errno.h></code>
<code>acos</code> macro	<code><tgmath.h></code>	

Example

This program prompts for a value in the range -1 to 1. Input values outside this range produce `_DOMAIN` error messages. If a valid value is entered, the program prints the arcsine and the arccosine of that value.

```
// crt_asincos.c
// arguments: 0

#include <math.h>
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main( int ac, char* av[] )
{
    double x,
           y;
    errno_t err;

    // argument checking
    if (ac != 2)
    {
        fprintf_s( stderr, "Usage: %s <number between -1 and 1>\n",
                   av[0]);
        return 1;
    }

    // Convert argument into a double value
    if ((err = sscanf_s( av[1], "%lf", &x )) != 1)
    {
        fprintf_s( stderr, "Error converting argument into ",
                   "double value.\n");
        return 1;
    }

    // Arcsine of X
    y = asin( x );
    printf_s( "Arcsine of %f = %f\n", x, y );

    // Arccosine of X
    y = acos( x );
    printf_s( "Arccosine of %f = %f\n", x, y );
}
```

```
Arcsine of 0.000000 = 0.000000
Arccosine of 0.000000 = 1.570796
```

See also

Math and floating-point support

<code>asin</code>	<code>asinf</code>	<code>asinl</code>
<code>atan</code>	<code>atanf</code>	<code>atanl</code>
<code>cos</code>	<code>cosf</code>	<code>cosl</code>
<code>atan2</code>	<code>atan2f</code>	<code>atan2l</code>

`_matherr`

`sin` , `sinf` , `sinl`

`tan` , `tanf` , `tanl`

`acosh`, `acoshf`, `acoshl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the inverse hyperbolic cosine.

Syntax

```
double acosh( double x );
float acoshf( float x );
long double acoshl( long double x );
#define acosh(X) // Requires C11 or higher

float acosh( float x ); // C++ only
long double acosh( long double x ); // C++ only
```

Parameters

`x`

Floating-point value.

Return value

The `acosh` functions return the inverse hyperbolic cosine (arc hyperbolic cosine) of `x`. These functions are valid over the domain $x \geq 1$. If `x` is less than 1, `errno` is set to `EDOM`, and the result is a quiet NaN. If `x` is a quiet NaN, indefinite, or infinity, the same value is returned.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}, \text{INF}$	none	none
$x < 1$	none	none

Remarks

When you use C++, you can call overloads of `acosh` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `acosh` always takes and returns `double`.

If you use the `<tgmath.h>` `acosh()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>acosh</code> , <code>acoshf</code> , <code>acoshl</code>	<code><math.h></code>	<code><cmath></code>

FUNCTION	C HEADER	C++ HEADER
acosh macro	<tgmath.h>	

For more compatibility information, see [Compatibility](#).

Example

```
// crt_acosh.c
// Compile by using: cl /W4 crt_acosh.c
// This program displays the hyperbolic cosine of pi / 4
// and the arc hyperbolic cosine of the result.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double pi = 3.1415926535;
    double x, y;

    x = cosh( pi / 4 );
    y = acosh( x );
    printf( "cosh( %f ) = %f\n", pi/4, x );
    printf( "acosh( %f ) = %f\n", x, y );
}
```

```
cosh( 0.785398 ) = 1.324609
acosh( 1.324609 ) = 0.785398
```

See also

[Math and floating-point support](#)

asinh	asinhf	asinhl
atanh	atanhf	atanhl
cosh	coshf	coshl
sinh	sinhf	sinhl
tanh	tanhf	tanhl

_aligned_free

11/2/2022 • 2 minutes to read • [Edit Online](#)

Frees a block of memory that was allocated with `_aligned_malloc` or `_aligned_offset_malloc`.

Syntax

```
void _aligned_free (
    void *memblock
);
```

Parameters

`memblock`

A pointer to the memory block that was returned to the `_aligned_malloc` or `_aligned_offset_malloc` function.

Remarks

`_aligned_free` is marked `__declspec(noalias)`, meaning that the function is guaranteed not to modify global variables. For more information, see [noalias](#).

This function doesn't validate its parameter, unlike the other `_aligned` CRT functions. If `memblock` is a `NULL` pointer, this function simply performs no actions. It doesn't change `errno` and it doesn't invoke the invalid parameter handler. If an error occurs in the function because `_aligned` functions weren't used to allocate the block of memory, or a misalignment of memory occurs due to some unforeseen calamity, the function generates a debug report from the `_RPT`, `_RPTF`, `_RPTW`, `_RPTFW` macros.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_free</code>	<malloc.h>

Example

For more information, see [_aligned_malloc](#).

See also

[Data alignment](#)

_aligned_free_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Frees a block of memory that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` (debug only).

Syntax

```
void _aligned_free_dbg(  
    void *memblock  
)
```

Parameters

`memblock`

A pointer to the memory block that was returned to the `_aligned_malloc` or `_aligned_offset_malloc` function.

Remarks

The `_aligned_free_dbg` function is a debug version of the `_aligned_free` function. When `_DEBUG` isn't defined, each call to `_aligned_free_dbg` is reduced to a call to `_aligned_free`. Both `_aligned_free` and `_aligned_free_dbg` free a memory block in the base heap, but `_aligned_free_dbg` accommodates a debugging feature: the ability to keep freed blocks in the heap's linked list to simulate low memory conditions.

`_aligned_free_dbg` performs a validity check on all specified files and block locations before performing the free operation. The application isn't expected to provide this information. When a memory block is freed, the debug heap manager automatically checks the integrity of the buffers on either side of the user portion. It issues an error report if overwriting has occurred. If the `_CRTDBG_DELAY_FREE_MEM_DF` bit field of the `_crtDbgFlag` flag is set, the freed block is filled with the value 0xDD, assigned the `_FREE_BLOCK` block type, and kept in the heap's linked list of memory blocks.

If an error occurs in freeing the memory, `errno` is set with information from the operating system on the nature of the failure. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_free_dbg</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

See also

[Debug routines](#)

_aligned_malloc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates memory on a specified alignment boundary.

Syntax

```
void * _aligned_malloc(
    size_t size,
    size_t alignment
);
```

Parameters

`size`

Size of the requested memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

Return value

A pointer to the memory block that was allocated or `NULL` if the operation failed. The pointer is a multiple of `alignment`.

Remarks

`_aligned_malloc` is based on `malloc`.

`_aligned_malloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables and that the pointer returned isn't aliased. For more information, see `noalias` and `restrict`.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_malloc` validates its parameters. If `alignment` isn't a power of 2 or `size` is zero, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

Use `_aligned_free` to deallocate memory obtained by both `_aligned_malloc` and `_aligned_offset_malloc`. Don't use `free`, which doesn't reclaim the aligned memory correctly and can lead to hard-to-diagnose bugs.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED C HEADER	C++ HEADER
<code>_aligned_malloc</code>	<code><malloc.h></code>	<code><cstdlib></code>

Example

```
// crt_aligned_malloc.c

#include <malloc.h>
#include <stdio.h>

int main() {
    void     *ptr;
    size_t   alignment,
             off_set;

    // Note alignment should be 2^N where N is any positive int.
    alignment = 16;
    off_set = 5;

    // Using _aligned_malloc
    ptr = _aligned_malloc(100, alignment);
    if (ptr == NULL)
    {
        printf_s( "Error allocation aligned memory.");
        return -1;
    }
    if (((unsigned long long)ptr % alignment) == 0)
        printf_s( "This pointer, %p, is aligned on %zu\n",
                  ptr, alignment);
    else
        printf_s( "This pointer, %p, is not aligned on %zu\n",
                  ptr, alignment);

    // Using _aligned_realloc
    ptr = _aligned_realloc(ptr, 200, alignment);
    if ( ((unsigned long long)ptr % alignment) == 0)
        printf_s( "This pointer, %p, is aligned on %zu\n",
                  ptr, alignment);
    else
        printf_s( "This pointer, %p, is not aligned on %zu\n",
                  ptr, alignment);
    _aligned_free(ptr);

    // Using _aligned_offset_malloc
    ptr = _aligned_offset_malloc(200, alignment, off_set);
    if (ptr == NULL)
    {
        printf_s( "Error allocation aligned offset memory.");
        return -1;
    }
    if ( ( ((unsigned long long)ptr) + off_set ) % alignment == 0)
        printf_s( "This pointer, %p, is offset by %zu on alignment of %zu\n",
                  ptr, off_set, alignment);
    else
        printf_s( "This pointer, %p, does not satisfy offset %zu "
                  "and alignment %zu\n", ptr, off_set, alignment);

    // Using _aligned_offset_realloc
    ptr = _aligned_offset_realloc(ptr, 200, alignment, off_set);
    if (ptr == NULL)
    {
        printf_s( "Error reallocation aligned offset memory.");
        return -1;
    }
    if ( ( ((unsigned long long)ptr) + off_set ) % alignment == 0)
        printf_s( "This pointer, %p, is offset by %zu on alignment of %zu\n",
                  ptr, off_set, alignment);
    else
        printf_s( "This pointer, %p, does not satisfy offset %zu and "
                  "alignment %zu\n", ptr, off_set, alignment);
```

```
// Note that _aligned_free works for both _aligned_malloc  
// and _aligned_offset_malloc. Using free is illegal.  
_aligned_free(ptr);  
}
```

```
This pointer, 3280880, is aligned on 16  
This pointer, 3280880, is aligned on 16  
This pointer, 3280891, is offset by 5 on alignment of 16  
This pointer, 3280891, is offset by 5 on alignment of 16
```

See also

[Data alignment](#)

_aligned_malloc_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates memory on a specified alignment boundary with extra space for a debugging header and overwrite buffers (debug version only).

Syntax

```
void * _aligned_malloc_dbg(  
    size_t size,  
    size_t alignment,  
    const char *filename,  
    int linenumber  
)
```

Parameters

`size`

Size of the requested memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

`filename`

Pointer to the name of the source file that requested the allocation operation or `NULL`.

`linenumber`

Line number in the source file where the allocation operation was requested or `NULL`.

Return value

A pointer to the memory block that was allocated or `NULL` if the operation failed.

Remarks

`_aligned_malloc_dbg` is a debug version of the `_aligned_malloc` function. When `_DEBUG` isn't defined, each call to `_aligned_malloc_dbg` is reduced to a call to `_aligned_malloc`. Both `_aligned_malloc` and `_aligned_malloc_dbg` allocate a block of memory in the base heap, but `_aligned_malloc_dbg` offers several debugging features: buffers on either side of the user portion of the block to test for leaks, and `filename` / `linenumber` information to determine the origin of allocation requests. Tracking specific allocation types with a block type parameter isn't a supported debug feature for aligned allocations. Aligned allocations will appear as a `_NORMAL_BLOCK` block type.

`_aligned_malloc_dbg` allocates the memory block with slightly more space than the requested `size`. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. When the block is allocated, the user portion of the block is filled with the value 0xCD, and each of the overwrite buffers are filled with 0xFD.

`_aligned_malloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails or if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_malloc_dbg` validates its parameters. If `alignment` isn't a power of 2 or `size` is zero, this function invokes the invalid parameter handler,

as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_malloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

_aligned_mszie

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the size of a memory block allocated in the heap.

Syntax

```
size_t _aligned_mszie(
    void *memblock,
    size_t alignment,
    size_t offset
);
```

Parameters

`memblock`

Pointer to the memory block.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

Return value

Returns the size (in bytes) as an unsigned integer.

Remarks

The `_aligned_mszie` function returns the size, in bytes, of the memory block allocated by a call to `_aligned_malloc` or `_aligned_realloc`. The `alignment` and `offset` values must be the same as the values passed to the function that allocated the block.

When the application is linked with a debug version of the C run-time libraries, `_aligned_mszie` resolves to `_aligned_mszie_dbg`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

This function validates its parameter. If `memblock` is a null pointer or `alignment` isn't a power of 2, `_aligned_mszie` invokes an invalid parameter handler, as described in [Parameter validation](#). If the error is handled, the function sets `errno` to `EINVAL` and returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_mszie</code>	<code><malloc.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Memory allocation](#)

_aligned_msize_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the size of a memory block allocated in the heap (debug version only).

Syntax

```
size_t _aligned_msize_dbg(  
    void *memblock,  
    size_t alignment,  
    size_t offset  
)
```

Parameters

`memblock`

Pointer to the memory block.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

Return value

Returns the size (in bytes) as an unsigned integer.

Remarks

The `alignment` and `offset` values must be the same as the values passed to the function that allocated the block.

`_aligned_msize_dbg` is a debug version of the `_aligned_msize` function. When `_DEBUG` isn't defined, each call to `_aligned_msize_dbg` is reduced to a call to `_aligned_msize`. Both `_aligned_msize` and `_aligned_msize_dbg` calculate the size of a memory block in the base heap, but `_aligned_msize_dbg` adds a debugging feature: It includes the buffers on either side of the user portion of the memory block in the returned size.

This function validates its parameter. If `memblock` is a null pointer or `alignment` isn't a power of 2, `_msize` invokes an invalid parameter handler, as described in [Parameter validation](#). If the error is handled, the function sets `errno` to `EINVAL` and returns -1.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_msize_dbg</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Memory allocation](#)

_aligned_offset_malloc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates memory on a specified alignment boundary.

Syntax

```
void * _aligned_offset_malloc(
    size_t size,
    size_t alignment,
    size_t offset
);
```

Parameters

`size`

The size of the requested memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

Return value

A pointer to the memory block that was allocated or `NULL` if the operation failed.

Remarks

`_aligned_offset_malloc` is useful in situations where alignment is needed on a nested element; for example, if alignment was needed on a nested class.

`_aligned_offset_malloc` is based on `malloc`; for more information, see [malloc](#).

`_aligned_offset_malloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables and that the pointer returned isn't aliased. For more information, see [noalias](#) and [restrict](#).

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see [errno](#), [doserrno](#), [_sys_errlist](#), and [_sys_nerr](#). Also, `_aligned_offset_malloc` validates its parameters. If `alignment` isn't a power of 2, or if `offset` is non-zero and greater than or equal to `size`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_offset_malloc</code>	<malloc.h>

Example

For more information, see [`_aligned_malloc`](#).

See also

[Data alignment](#)

`_aligned_offset_malloc_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates memory on a specified alignment boundary (debug version only).

Syntax

```
void * _aligned_offset_malloc_dbg(  
    size_t size,  
    size_t alignment,  
    size_t offset,  
    const char *filename,  
    int linenumber  
) ;
```

Parameters

`size`

The size of the requested memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

`filename`

Pointer to the name of the source file that requested the allocation operation or `NULL`.

`linenumber`

Line number in the source file where the allocation operation was requested or `NULL`.

Return value

A pointer to the memory block that was allocated or `NULL` if the operation failed.

Remarks

`_aligned_offset_malloc_dbg` is a debug version of the `_aligned_offset_malloc` function. When `_DEBUG` isn't defined, each call to `_aligned_offset_malloc_dbg` is reduced to a call to `_aligned_offset_malloc`. Both `_aligned_offset_malloc` and `_aligned_offset_malloc_dbg` allocate a block of memory in the base heap, but `_aligned_offset_malloc_dbg` offers several debugging features: buffers on either side of the user portion of the block to test for leaks, and `filename` / `linenumber` information to determine the origin of allocation requests. Tracking specific allocation types with a block type parameter isn't a supported debug feature for aligned allocations. Aligned allocations will appear as a `_NORMAL_BLOCK` block type.

`_aligned_offset_malloc_dbg` allocates the memory block with slightly more space than the requested `size`. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. When the block is allocated, the user portion of the block is filled with the value 0xCD, and each of the overwrite buffers are filled with 0xFD.

`_aligned_offset_malloc_dbg` is useful in situations where alignment is needed on a nested element; for example,

if alignment was needed on a nested class.

`_aligned_offset_malloc_dbg` is based on `malloc`; for more information, see [malloc](#).

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#). Also, `_aligned_offset_malloc` validates its parameters. If `alignment` isn't a power of 2, or if `offset` is non-zero and greater than or equal to `size`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_offset_malloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

`_aligned_offset_realloc`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc`.

Syntax

```
void * _aligned_offset_realloc(
    void *memblock,
    size_t size,
    size_t alignment,
    size_t offset
);
```

Parameters

`memblock`

The current memory block pointer.

`size`

The size of the memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

Return value

`_aligned_offset_realloc` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second case, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than `void`, use a type cast on the return value.

`_aligned_offset_realloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables and that the pointer returned isn't aliased. For more information, see `noalias` and `restrict`.

Remarks

Like `_aligned_offset_malloc`, `_aligned_offset_realloc` allows a structure to be aligned at an offset within the structure.

`_aligned_offset_realloc` is based on `malloc`. For more information about using `_aligned_offset_malloc`, see `malloc`. If `memblock` is `NULL`, the function calls `_aligned_offset_malloc` internally.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_offset_realloc` validates its parameters. If `alignment` isn't a power of 2 or if `offset` is non-zero and greater than or equal to `size`, this function invokes the invalid parameter handler, as described in [Parameter](#)

[validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_offset_realloc</code>	<code><malloc.h></code>

Example

For more information, see [`_aligned_malloc`](#).

See also

[Data alignment](#)

`_aligned_offset_realloc_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` (debug version only).

Syntax

```
void * _aligned_offset_realloc_dbg(
    void *memblock,
    size_t size,
    size_t alignment,
    size_t offset,
    const char *filename,
    int linenumber
);
```

Parameters

`memblock`

The current memory block pointer.

`size`

The size of the memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

`filename`

Pointer to the name of the source file that requested the `_aligned_offset_realloc` operation or `NULL`.

`linenumber`

Line number in the source file where the `_aligned_offset_realloc` operation was requested or `NULL`.

Return value

`_aligned_offset_realloc_dbg` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second case, the original block is unchanged. The return value points to a storage space that's suitably aligned for storage of any type of object. To get a pointer to a type other than void, use a type cast on the return value.

Remarks

`_aligned_offset_realloc_dbg` is a debug version of the `_aligned_offset_realloc` function. When `_DEBUG` isn't defined, each call to `_aligned_offset_realloc_dbg` is reduced to a call to `_aligned_offset_realloc`. Both `_aligned_offset_realloc` and `_aligned_offset_realloc_dbg` reallocate a memory block in the base heap, but `_aligned_offset_realloc_dbg` accommodates several debugging features: buffers on either side of the user portion of the block to test for leaks, and `filename / Linenumber` information to determine the origin of

allocation requests. Tracking specific allocation types with a block type parameter isn't a supported debug feature for aligned allocations. Aligned allocations will appear as a `_NORMAL_BLOCK` block type.

Like `_aligned_offset_malloc`, `_aligned_offset_realloc_dbg` allows a structure to be aligned at an offset within the structure.

`_realloc_dbg` reallocates the specified memory block with slightly more space than the requested `newSize`. `newSize` might be greater or less than the size of the originally allocated memory block. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The reallocation might both move the original memory block to a different location in the heap, and also change the size of the memory block. If the memory block is moved, the contents of the original block are overwritten.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_offset_realloc_dbg` validates its parameters. If `alignment` isn't a power of 2 or if `offset` is non-zero and greater than or equal to `size`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_offset_realloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

`_aligned_offset_realloc`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` and initializes the memory to 0.

Syntax

```
void * _aligned_offset_realloc(
    void *memblock,
    size_t num,
    size_t size,
    size_t alignment,
    size_t offset
);
```

Parameters

`memblock`

The current memory block pointer.

`number`

Number of elements.

`size`

Length in bytes of each element.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

Return value

`_aligned_offset_realloc` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second case, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than void, use a type cast on the return value.

`_aligned_offset_realloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables and that the pointer returned isn't aliased. For more information, see `noalias` and `restrict`.

Remarks

Like `_aligned_offset_malloc`, `_aligned_offset_realloc` allows a structure to be aligned at an offset within the structure.

`_aligned_offset_realloc` is based on `malloc`. For more information about using `_aligned_offset_malloc`, see `malloc`. If `memblock` is `NULL`, the function calls `_aligned_offset_malloc` internally.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size (`number * size`) was greater than `_HEAP_MAXREQ`. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_offset_realloc` validates its parameters. If `alignment` isn't a power of 2, or if `offset` is non-zero and greater than or equal to the requested `size`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_offset_realloc</code>	<code><malloc.h></code>

See also

[Data alignment](#)

`_realloc`

`_aligned_realloc`

_aligned_offset_realloc_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` and initializes the memory to 0 (debug version only).

Syntax

```
void * _aligned_offset_realloc_dbg(
    void *memblock,
    size_t num,
    size_t size,
    size_t alignment,
    size_t offset,
    const char *filename,
    int linenumber
);
```

Parameters

`memblock`

The current memory block pointer.

`number`

Number of elements.

`size`

Length in bytes of each element.

`alignment`

The alignment value, which must be an integer power of 2.

`offset`

The offset into the memory allocation to force the alignment.

`filename`

Pointer to the name of the source file that requested the realloc operation or `NULL`.

`linenumber`

Line number in the source file where the realloc operation was requested or `NULL`.

Return value

`_aligned_offset_realloc_dbg` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second case, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than `void`, use a type cast on the return value.

Remarks

`_aligned_offset_realloc_dbg` is a debug version of the `_aligned_offset_realloc` function. When `_DEBUG` isn't defined, each call to `_aligned_offset_realloc_dbg` is reduced to a call to `_aligned_offset_realloc`. Both

`_aligned_offset_realloc` and `_aligned_offset_realloc_dbg` reallocate a memory block in the base heap, but `_aligned_offset_realloc_dbg` accommodates several debugging features: buffers on either side of the user portion of the block to test for leaks, and `filename / Linenumber` information to determine the origin of allocation requests. Tracking specific allocation types with a block type parameter isn't a supported debug feature for aligned allocations. Aligned allocations will appear as a `_NORMAL_BLOCK` block type.

`_aligned_offset_realloc_dbg` reallocates the specified memory block with slightly more space than the requested `newSize`. `newSize` might be greater or less than the size of the originally allocated memory block. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The reallocation might both move the original memory block to a different location in the heap, and also change the size of the memory block. If the memory block is moved, the contents of the original block are overwritten.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size (`number * size`) was greater than `_HEAP_MAXREQ`. For more information about `errno`, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#). Also, `_aligned_offset_realloc_dbg` validates its parameters. If `alignment` isn't a power of 2, or if `offset` is non-zero and greater than or equal to the requested `size`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_offset_realloc_dbg</code>	<code><malloc.h></code>

See also

[Data alignment](#)

_aligned_realloc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc`.

Syntax

```
void * _aligned_realloc(
    void *memblock,
    size_t size,
    size_t alignment
);
```

Parameters

`memblock`

The current memory block pointer.

`size`

The size of the requested memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

Return value

`_aligned_realloc` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than void, use a type cast on the return value.

It's an error to reallocate memory and change the alignment of a block.

Remarks

`_aligned_realloc` is based on `malloc`. For more information about using `_aligned_offset_malloc`, see `malloc`.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_realloc` validates its parameters. If `alignment` isn't a power of 2, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_realloc</code>	<malloc.h>

Example

For more information, see [`_aligned_malloc`](#).

See also

[Data alignment](#)

_aligned_realloc_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` (debug version only).

Syntax

```
void * _aligned_realloc_dbg(  
    void *memblock,  
    size_t size,  
    size_t alignment,  
    const char *filename,  
    int linenumber  
) ;
```

Parameters

`memblock`

The current memory block pointer.

`size`

The size of the requested memory allocation.

`alignment`

The alignment value, which must be an integer power of 2.

`filename`

Pointer to the name of the source file that requested the `realloc` operation or `NULL`.

`Linenumber`

Line number in the source file where the `realloc` operation was requested or `NULL`.

Return value

`_aligned_realloc_dbg` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than void, use a type cast on the return value.

It's an error to reallocate memory and change the alignment of a block.

Remarks

`_aligned_realloc_dbg` is a debug version of the `_aligned_realloc` function. When `DEBUG` isn't defined, each call to `_aligned_realloc_dbg` is reduced to a call to `_aligned_realloc`. Both `_aligned_realloc` and `_aligned_realloc_dbg` reallocate a memory block in the base heap, but `_aligned_realloc_dbg` accommodates several debugging features: buffers on either side of the user portion of the block to test for leaks, and `filename` / `Linenumber` information to determine the origin of allocation requests. Tracking specific allocation types with a block type parameter isn't a supported debug feature for aligned allocations. Aligned allocations will appear as a `_NORMAL_BLOCK` block type.

`_aligned_realloc_dbg` reallocates the specified memory block with slightly more space than the requested `newSize`. `newSize` might be greater or less than the size of the originally allocated memory block. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The reallocation might both move the original memory block to a different location in the heap, and change the size of the memory block. If the memory block is moved, the contents of the original block are overwritten.

`_aligned_realloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails or if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Also, `_aligned_realloc_dbg` validates its parameters. If `alignment` isn't a power of 2, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_realloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

_aligned_realloc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` and initializes the memory to 0.

Syntax

```
void * _aligned_realloc(
    void *memblock,
    size_t num,
    size_t size,
    size_t alignment
);
```

Parameters

`memblock`

The current memory block pointer.

`number`

The number of elements.

`size`

The size in bytes of each element.

`alignment`

The alignment value, which must be an integer power of 2.

Return value

`_aligned_realloc` returns a void pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second case, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than void, use a type cast on the return value.

It's an error to reallocate memory and change the alignment of a block.

Remarks

`_aligned_realloc` is based on `malloc`. For more information about using `_aligned_offset_malloc`, see `malloc`.

This function sets `errno` to `ENOMEM` if the memory allocation failed or if the requested size was greater than `_HEAP_MAXREQ`. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`. Also, `_aligned_realloc` validates its parameters. If `alignment` isn't a power of 2, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_realloc</code>	<code><malloc.h></code>

See also

[Data alignment](#)

[`_realloc`](#)

[`_aligned_offset_realloc`](#)

_aligned_realloc_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block that was allocated with `_aligned_malloc` or `_aligned_offset_malloc` and initializes the memory to 0 (debug version only).

Syntax

```
void * _aligned_realloc_dbg(
    void * memblock,
    size_t num,
    size_t size,
    size_t alignment,
    const char *filename,
    int linenumber
);
```

Parameters

`memblock`

The current memory block pointer.

`number`

The number of elements.

`size`

The size in bytes of each element.

`alignment`

The alignment value, which must be an integer power of 2.

`filename`

Pointer to name of the source file that requested allocation operation or `NULL`.

`linenumber`

Line number in the source file where allocation operation was requested or `NULL`.

Return value

`_aligned_realloc_dbg` returns a `void` pointer to the reallocated (and possibly moved) memory block. The return value is `NULL` if the size is zero and the buffer argument isn't `NULL`, or if there isn't enough available memory to expand the block to the given size. In the first case, the original block is freed. In the second case, the original block is unchanged. The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than `void`, use a type cast on the return value.

It's an error to reallocate memory and change the alignment of a block.

Remarks

`_aligned_realloc_dbg` is a debug version of the `_aligned_realloc` function. When `_DEBUG` isn't defined, each call to `_aligned_realloc_dbg` is reduced to a call to `_aligned_realloc`. Both `_aligned_realloc` and `_aligned_realloc_dbg` reallocate a memory block in the base heap, but `_aligned_realloc_dbg` accommodates

several debugging features: buffers on either side of the user portion of the block to test for leaks, and `filename / Linenumber` information to determine the origin of allocation requests. Tracking specific allocation types with a block type parameter isn't a supported debug feature for aligned allocations. Aligned allocations will appear as a `_NORMAL_BLOCK` block type.

`_aligned_realloc_dbg` reallocates the specified memory block with slightly more space than the requested size (`number * size`) which might be greater or less than the size of the originally allocated memory block. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The reallocation might both move the original memory block to a different location in the heap, and change the size of the memory block. The user portion of the block is filled with the value 0xCD, and the overwrite buffers are filled with 0xFD.

`_aligned_realloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails; `EINVAL` is returned if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Also, `_aligned_realloc_dbg` validates its parameters. If `alignment` isn't a power of 2, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `NULL` and sets `errno` to `EINVAL`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and their debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_aligned_realloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

_alloca

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates memory on the stack. This function is deprecated because a more secure version is available; see [_malloca](#).

Syntax

```
void *_alloca(  
    size_t size  
) ;
```

Parameters

`size`

Bytes to be allocated from the stack.

Return value

The `_alloca` routine returns a `void` pointer to the allocated space, which is suitably aligned for storage of any type of object. If `size` is 0, `_alloca` allocates a zero-length item and returns a valid pointer to that item.

A stack overflow exception is generated if the space can't be allocated. The stack overflow exception isn't a C++ exception; it's a structured exception. Instead of using C++ exception handling, you must use [Structured exception handling](#) (SEH).

Remarks

`_alloca` allocates `size` bytes from the program stack. The allocated space is automatically freed when the calling function exits (not when the allocation merely passes out of scope). Therefore, don't pass the pointer value returned by `_alloca` as an argument to `free`.

There are restrictions to explicitly calling `_alloca` in an exception handler (EH). EH routines that run on x86-class processors operate in their own memory frame: They perform their tasks in memory space that isn't based on the current location of the stack pointer of the enclosing function. The most common implementations include Windows structured exception handling (SEH) and C++ catch clause expressions. Therefore, explicitly calling `_alloca` in any of the following scenarios results in program failure during the return to the calling EH routine:

- Windows SEH exception filter expression: `_except (_alloca())`
- Windows SEH final exception handler: `_finally { _alloca() }`
- C++ EH catch clause expression

However, `_alloca` can be called directly from within an EH routine or from an application-supplied callback that gets invoked by one of the EH scenarios previously listed.

IMPORTANT

If `_alloca` is called inside a try block, you must call `_resetstkoflw` in the catch block.

In addition to the above restrictions, when using the [/clr](#) (Common Language Runtime Compilation) option, `_alloca` can't be used in `__except` blocks. For more information, see [/clr](#) Restrictions.

Requirements

ROUTINE	REQUIRED HEADER
<code>_alloca</code>	<code><malloc.h></code>

Example

```
// crt_alloca.c
// This program demonstrates the use of
// _alloca and trapping any exceptions
// that may occur.

#include <windows.h>
#include <stdio.h>
#include <malloc.h>

int main()
{
    int      size = 1000;
    int      errcode = 0;
    void    *pData = NULL;

    // Note: Do not use try/catch for _alloca,
    // use __try/__except, since _alloca throws
    // Structured Exceptions, not C++ exceptions.

    __try {
        // An unbounded _alloca can easily result in a
        // stack overflow.
        // Checking for a size < 1024 bytes is recommended.
        if (size > 0 && size < 1024)
        {
            pData = _alloca( size );
            printf_s( "Allocated %d bytes of stack at 0x%p",
                      size, pData);
        }
        else
        {
            printf_s("Tried to allocate too many bytes.\n");
        }
    }

    // If an exception occurred with the _alloca function
    __except( GetExceptionCode() == STATUS_STACK_OVERFLOW )
    {
        printf_s("_alloca failed!\n");

        // If the stack overflows, use this function to restore.
        errcode = _resetstkoflw();
        if (errcode == 0) // _resetstkoflw() returns 0 on failure
        {
            printf_s("Could not reset the stack!\n");
            _exit(1);
        }
    };
}
```

```
Allocated 1000 bytes of stack at 0x0012FB50
```

See also

Memory allocation

[calloc](#)

[malloc](#)

[realloc](#)

[_resetstkoflw](#)

[_malloca](#)

_amsg_exit

11/2/2022 • 2 minutes to read • [Edit Online](#)

Emits a specified runtime error message and then exits your application with error code 255.

Syntax

```
void _amsg_exit ( int rterrnum );
```

Parameters

rterrnum

The identification number of a system-defined runtime error message.

Remarks

This function emits the runtime error message to `stderr` for console applications, or displays the message in a message box for Windows applications. In debug mode, you can choose to invoke the debugger before exiting.

Requirements

ROUTINE	REQUIRED HEADER
<code>_amsg_exit</code>	internal.h

and

11/2/2022 • 2 minutes to read • [Edit Online](#)

An alternative to the `&&` operator.

Syntax

```
#define and &&
```

Remarks

The macro yields the operator `&&`.

Example

```
// iso646_and.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    bool a = true, b = false, result;

    boolalpha(cout);

    result= a && b;
    cout << result << endl;

    result= a and b;
    cout << result << endl;
}
```

```
false
false
```

Requirements

Header: `<iso646.h>`

and_eq

11/2/2022 • 2 minutes to read • [Edit Online](#)

An alternative to the &= operator.

Syntax

```
#define and_eq &=
```

Remarks

The macro yields the operator &=.

Example

```
// iso646_and_eq.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 3, b = 2, result;

    result= a &= b;
    cout << result << endl;

    result= a and_eq b;
    cout << result << endl;
}
```

```
2
2
```

Requirements

Header: <iso646.h>

`asctime`, `_wasctime`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert a `tm` time structure to a character string. More secure versions of these functions are available; see [`asctime_s`](#), [`_wasctime_s`](#).

Syntax

```
char *asctime(
    const struct tm *timeptr
);
wchar_t *_wasctime(
    const struct tm *timeptr
);
```

Parameters

`timeptr`

Time/date structure.

Return value

`asctime` returns a pointer to the character string result; `_wasctime` returns a pointer to the wide-character string result. There's no error return value.

Remarks

More secure versions of these functions are available; see [`asctime_s`](#), [`_wasctime_s`](#).

The `asctime` function converts a time stored as a structure to a character string. The `timeptr` value is typically obtained from a call to `gmtime` or `localtime`, which both return a pointer to a `tm` structure, defined in TIME.H.

TIMEPTR MEMBER	VALUE
<code>tm_hour</code>	Hours since midnight (0-23)
<code>tm_isdst</code>	Positive if daylight saving time is in effect; 0 if daylight saving time isn't in effect; negative if status of daylight saving time is unknown. The C run-time library assumes the United States' rules for implementing the calculation of Daylight Saving Time (DST).
<code>tm_mday</code>	Day of month (1-31)
<code>tm_min</code>	Minutes after hour (0-59)
<code>tm_mon</code>	Month (0-11; January = 0)
<code>tm_sec</code>	Seconds after minute (0-59)

TIMEPTR MEMBER	VALUE
<code>tm_wday</code>	Day of week (0-6; Sunday = 0)
<code>tm_yday</code>	Day of year (0-365; January 1 = 0)
<code>tm_year</code>	Year (current year minus 1900)

The converted character string is also adjusted according to the local time zone settings. For information about configuring the local time, see the `time`, `ftime`, and `localtime` functions. For information about defining the time zone environment and global variables, see the `tzset` function.

The string result produced by `asctime` contains exactly 26 characters and has the form

`Wed Jan 2 02:03:55 1980\n\0`. A 24-hour clock is used. All fields have a constant width. The newline character and the null character occupy the last two positions of the string. `asctime` uses a single, statically allocated buffer to hold the return string. Each call to this function destroys the result of the previous call.

`_wasctime` is a wide-character version of `asctime`. `_wasctime` and `asctime` behave identically otherwise.

These functions validate their parameters. If `timeptr` is a null pointer, or if it contains out-of-range values, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mapping

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tasctime</code>	<code>asctime</code>	<code>asctime</code>	<code>_wasctime</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>asctime</code>	<code><time.h></code>
<code>_wasctime</code>	<code><time.h></code> or <code><wchar.h></code>

Example

This program places the system time in the long integer `aclock`, translates it into the structure `newtime` and then converts it to string form for output, using the `asctime` function.

```
// crt_asctime.c
// compile with: /W3

#include <time.h>
#include <stdio.h>

int main( void )
{
    struct tm    *newTime;
    time_t        szClock;

    // Get time in seconds
    time( &szClock );

    // Convert time to struct tm form
    newTime = localtime( &szClock );

    // Print local time as a string.
    printf_s( "Current date and time: %s", asctime( newTime ) ); // C4996
    // Note: asctime is deprecated; consider using asctime_s instead
}
```

```
Current date and time: Sun Feb  3 11:38:58 2002
```

See also

Time management

[ctime](#) , [_ctime32](#) , [_ctime64](#) , [_wctime](#) , [_wctime32](#) , [_wctime64](#)
[_ftime](#) , [_ftime32](#) , [_ftime64](#)
[gmtime](#) , [_gmtime32](#) , [_gmtime64](#)
[localtime](#) , [_localtime32](#) , [_localtime64](#)
[time](#) , [_time32](#) , [_time64](#)
[_tzset](#)
[asctime_s](#) , [_wasctime_s](#)

`asctime_s`, `_wasctime_s`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Convert a `tm` time structure to a character string. These functions are versions of `asctime`, `_wasctime` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t asctime_s(
    char* buffer,
    size_t numberOfElements,
    const struct tm *tmSource
);
errno_t _wasctime_s(
    wchar_t* buffer,
    size_t numberOfElements
    const struct tm *tmSource
);
template <size_t size>
errno_t asctime_s(
    char (&buffer)[size],
    const struct tm *tmSource
); // C++ only
template <size_t size>
errno_t _wasctime_s(
    wchar_t (&buffer)[size],
    const struct tm *tmSource
); // C++ only
```

Parameters

`buffer`

A pointer to a buffer to store the character string result. This function assumes a pointer to a valid memory location with a size specified by `numberOfElements`.

`numberOfElements`

The size of the buffer used to store the result.

`tmSource`

Time/date structure. This function assumes a pointer to a valid `struct tm` object.

Return value

Zero if successful. If there's a failure, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the return value is an error code. Error codes are defined in `ERRNO.H`. For more information, see [errno constants](#). The actual error codes returned for each error condition are shown in the following table.

Error conditions

<code>BUFFER</code>	<code>NUMBEROFELEMENTS</code>	<code>TMSOURCE</code>	<code>RETURN</code>	<code>VALUE IN BUFFER</code>
<code>NULL</code>	Any	Any	<code>EINVAL</code>	Not modified

BUFFER	NUMBEROFELEMENTS	TMSOURCE	RETURN	VALUE IN BUFFER
Not <code>NULL</code> (points to valid memory)	0	Any	<code>EINVAL</code>	Not modified
Not <code>NULL</code>	$0 < \text{numberOfElements} < 26$	Any	<code>EINVAL</code>	Empty string
Not <code>NULL</code>	≥ 26	<code>NULL</code>	<code>EINVAL</code>	Empty string
Not <code>NULL</code>	≥ 26	Invalid time structure or out of range values for components of the time	<code>EINVAL</code>	Empty string

NOTE

Error conditions for `wasctime_s` are similar to `asctime_s` with the exception that the size limit is measured in words.

Remarks

The `asctime` function converts a time stored as a structure to a character string. The `tmSource` value is typically obtained from a call to `gmtime` or `localtime`. Both functions can be used to fill in a `tm` structure, as defined in TIME.H.

TIMEPTR MEMBER	VALUE
<code>tm_hour</code>	Hours since midnight (0-23)
<code>tm_isdst</code>	Positive if daylight saving time is in effect; 0 if daylight saving time isn't in effect; negative if status of daylight saving time is unknown. The C run-time library assumes the United States' rules for implementing the calculation of Daylight Saving Time (DST).
<code>tm_mday</code>	Day of month (1-31)
<code>tm_min</code>	Minutes after hour (0-59)
<code>tm_mon</code>	Month (0-11; January = 0)
<code>tm_sec</code>	Seconds after minute (0-59)
<code>tm_wday</code>	Day of week (0-6; Sunday = 0)
<code>tm_yday</code>	Day of year (0-365; January 1 = 0)
<code>tm_year</code>	Year (current year minus 1900)

The converted character string is also adjusted according to the local time zone settings. For information about configuring the local time, see the `time`, `_time32`, `_time64`, `_ftime`, `_ftime32`, `_ftime64`, and `localtime_s`,

`_localtime32_s`, `_localtime64_s` functions. For information about defining the time zone environment and global variables, see [_tzset](#).

The string result produced by `asctime_s` contains exactly 26 characters and has the form
`Wed Jan 2 02:03:55 1980\n\0`. A 24-hour clock is used. All fields have a constant width. The new line character and the null character occupy the last two positions of the string. The value passed in as `numberOfElements` should be at least this size. If it's less, an error code, `EINVAL`, will be returned.

`_wasctime_s` is a wide-character version of `asctime_s`. `_wasctime_s` and `asctime_s` behave identically otherwise.

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [_CrtSetDebugFillThreshold](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mapping

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tasctime_s</code>	<code>asctime_s</code>	<code>asctime_s</code>	<code>_wasctime_s</code>

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>asctime_s</code>	<code><time.h></code>
<code>_wasctime_s</code>	<code><time.h></code> or <code><wchar.h></code>

Security

If the buffer pointer isn't `NULL` and the pointer doesn't point to a valid buffer, the function will overwrite whatever is at the location. This error can also result in an access violation.

A [buffer overrun](#) can occur if the size argument passed in is greater than the actual size of the buffer.

Example

This program places the system time in the long integer `aclock`, translates it into the structure `newtime`, and then converts it to string form for output, using the `asctime_s` function.

```
// crt_asctime_s.c
#include <time.h>
#include <stdio.h>

struct tm newtime;
__time32_t aclock;

int main( void )
{
    char buffer[32];
    errno_t errNum;
    _time32( &aclock );      // Get time in seconds.
    _localtime32_s( &newtime, &aclock );    // Convert time to struct tm form.

    // Print local time as a string.

    errNum = asctime_s(buffer, 32, &newtime);
    if (errNum)
    {
        printf("Error code: %d", (int)errNum);
        return 1;
    }
    printf( "Current date and time: %s", buffer );
    return 0;
}
```

```
Current date and time: Wed May 14 15:30:17 2003
```

See also

Time management

[ctime_s](#), [_ctime32_s](#), [_ctime64_s](#), [_wctime_s](#), [_wctime32_s](#), [_wctime64_s](#)
[_ftime](#), [_ftime32](#), [_ftime64](#)
[gmtime_s](#), [_gmtime32_s](#), [_gmtime64_s](#)
[localtime_s](#), [_localtime32_s](#), [_localtime64_s](#)
[time](#), [_time32](#), [_time64](#)
[_tzset](#)

asin, asinf, asinl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the arcsine.

Syntax

```
double asin( double x );
float asinf ( float x );
long double asinl( long double x );
#define asin(X) // Requires C11 or higher

float asin( float x ); // C++ only
long double asin( long double x ); // C++ only
```

Parameters

x

Value whose arcsine is to be calculated.

Return value

The `asin` function returns the arcsine (the inverse sine function) of `x` in the range $-\pi/2$ to $\pi/2$ radians.

By default, if `x` is less than -1 or greater than 1, `asin` returns an indefinite.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{INF}$	INVALID	_DOMAIN
$\pm \text{QNaN}, \text{IND}$	none	_DOMAIN
$ x > 1$	INVALID	_DOMAIN

Remarks

Because C++ allows overloading, you can call overloads of `asin` with `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `asin` always takes and returns a `double`.

If you use the `asin` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>asin</code> , <code>asinf</code> , <code>asinl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>asin</code> macro	<code><tgmath.h></code>	

Example

For more information, see [acos](#), [acosf](#), [acosl](#).

See also

Math and floating-point support

<code>acos</code> , <code>acosf</code> , <code>acosl</code>
<code>atan</code> , <code>atanf</code> , <code>atanl</code> , <code>atan2</code> , <code>atan2f</code> , <code>atan2l</code>
<code>cos</code> , <code>cosf</code> , <code>cosl</code>
<code>_matherr</code>
<code>sin</code> , <code>sinf</code> , <code>sinl</code>
<code>tan</code> , <code>tanf</code> , <code>tanl</code>

`asinh`, `asinhf`, `asinhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the inverse hyperbolic sine.

Syntax

```
double asinh( double x );
float asinhf( float x );
long double asinhl( long double x );
#define asinh(X) // Requires C11 or higher

float asinh( float x ); // C++ only
long double asinh( long double x ); // C++ only
```

Parameters

`x`

Floating-point value.

Return value

The `asinh` functions return the inverse hyperbolic sine (arc hyperbolic sine) of `x`. This function is valid over the floating-point domain. If `x` is a quiet NaN, indefinite, or infinity, the same value is returned.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}, \text{INF}$	none	none

Remarks

When you use C++, you can call overloads of `asinh` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `asinh` always takes and returns `double`.

If you use the `<tgmath.h>` `asinh()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>asinh</code> , <code>asinhf</code> , <code>asinhl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>asinh()</code> macro	<code><tgmath.h></code>	

For additional compatibility information, see [Compatibility](#).

Example

```
// crt_asinh.c
// Compile by using: cl /W4 crt_asinh.c
// This program displays the hyperbolic sine of pi / 4
// and the arc hyperbolic sine of the result.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double pi = 3.1415926535;
    double x, y;

    x = sinh( pi / 4 );
    y = asinh( x );
    printf( "sinh( %f ) = %f\n", pi/4, x );
    printf( "asinh( %f ) = %f\n", x, y );
}
```

```
sinh( 0.785398 ) = 0.868671
asinh( 0.868671 ) = 0.785398
```

See also

Math and floating-point support

acosh	acoshf	acoshl
atanh	atanhf	atanhl
cosh	coshf	coshl
sinh	sinhf	sinhl
tanh	tanhf	tanhl

assert macro, _assert, _wassert

11/2/2022 • 4 minutes to read • [Edit Online](#)

Evaluates an expression and, when the result is `false`, prints a diagnostic message and aborts the program.

Syntax

```
assert(  
    expression  
);  
void _assert(  
    char const* message,  
    char const* filename,  
    unsigned line  
);  
void _wassert(  
    wchar_t const* message,  
    wchar_t const* filename,  
    unsigned line  
);
```

Parameters

`expression`

A scalar expression (including pointer expressions) that evaluates to nonzero (`true`) or 0 (`false`).

`message`

The message to display.

`filename`

The name of the source file the assertion failed in.

`Line`

The line number in the source file of the failed assertion.

Remarks

The `assert` macro is typically used to identify logic errors during program development. Use it to stop program execution when unexpected conditions occur by implementing the `expression` argument to evaluate to `false` only when the program is operating incorrectly. Assertion checks can be turned off at compile time by defining the macro `NDEBUG`. You can turn off the `assert` macro without modifying your source files by using a `/DNDEBUG` command-line option. You can turn off the `assert` macro in your source code by using a `#define NDEBUG` directive before `<cassert.h>` is included.

The `assert` macro prints a diagnostic message when `expression` evaluates to `false` (0) and calls `abort` to stop program execution. No action is taken if `expression` is `true` (nonzero). The diagnostic message includes the failed expression, the name of the source file and line number where the assertion failed.

The diagnostic message is printed in wide (`wchar_t`) characters. Therefore, it will work as expected even if there are Unicode characters in the expression.

The destination of the diagnostic message depends on the type of application that called the routine. Console applications receive the message through `stderr`. In a Windows-based application, `assert` calls the Windows

`MessageBox` function to create a message box to display the message with three buttons: **Abort**, **Retry**, and **Ignore**. If the user chooses **Abort**, the program aborts immediately. If the user chooses **Retry**, the debugger is called, and the user can debug the program if just-in-time (JIT) debugging is enabled. If the user chooses **Ignore**, the program will continue with normal execution. Clicking **Ignore** when an error condition exists can result in undefined behavior since preconditions of the calling code weren't met.

To override the default output behavior regardless of the app type, call `_set_error_mode` to select between the output-to-stderr and display-dialog-box behavior.

After `assert` displays its message, it calls `abort`, which displays a dialog box with **Abort**, **Retry**, and **Ignore** buttons. `abort` exits the program, so the **Retry** and **Ignore** button won't resume program execution following the `assert` call. If `assert` displayed a dialog box, the `abort` dialog box isn't shown. The only time the `abort` dialog box is shown, is when `assert` sends its output to stderr.

As a consequence of the above behavior, a dialog box is always displayed following an `assert` call in debug mode. The behavior of each button is captured in the below table.

ERROR MODE	OUTPUT TO <code>STDERR</code> (CONSOLE/ <code>_OUT_TO_STDERR</code>)	DISPLAY DIALOG BOX (WINDOWS/ <code>_OUT_TO_MSGBOX</code>)
<code>Abort</code>	Exit immediately with exit code 3	Exit immediately with exit code 3
<code>Retry</code>	Break into debugger during <code>abort</code>	Break into debugger during <code>assert</code>
<code>Ignore</code>	Finish exiting via <code>abort</code>	Continue program as though <code>assert</code> didn't fire (may result in undefined behavior since preconditions of the calling code weren't met)

For more information about CRT debugging, see [CRT debugging techniques](#).

The `_assert` and `_wassert` functions are internal CRT functions. They help minimize the code required in your object files to support assertions. We don't recommend that you call these functions directly.

The `assert` macro is enabled in both the release and debug versions of the C run-time libraries when `NDEBUG` isn't defined. When `NDEBUG` is defined, the macro is available, but doesn't evaluate its argument and has no effect. When it's enabled, the `assert` macro calls `_wassert` for its implementation. Other assertion macros, `_ASSERT`, `_ASERTE` and `_ASSERT_EXPR`, are also available, but they only evaluate the expressions passed to them when the `_DEBUG` macro has been defined and when they are in code linked with the debug version of the C run-time libraries.

Requirements

ROUTINE	REQUIRED HEADER
<code>assert</code> , <code>_wassert</code>	<code><cassert.h></code>

The signature of the `_assert` function isn't available in a header file. The signature of the `_wassert` function is only available when the `NDEBUG` macro isn't defined.

Example

In this program, the `analyze_string` function uses the `assert` macro to test several conditions related to string and length. If any of the conditions fails, the program prints a message indicating what caused the failure.

```

// crt_assert.c
// compile by using: cl /W4 crt_assert.c
#include <stdio.h>
#include <assert.h>
#include <string.h>

void analyze_string( char *string ); // Prototype

int main( void )
{
    char test1[] = "abc", *test2 = NULL, test3[] = "";

    printf( "Analyzing string '%s'\n", test1 ); fflush( stdout );
    analyze_string( test1 );
    printf( "Analyzing string '%s'\n", test2 ); fflush( stdout );
    analyze_string( test2 );
    printf( "Analyzing string '%s'\n", test3 ); fflush( stdout );
    analyze_string( test3 );
}

// Tests a string to see if it is NULL,
// empty, or longer than 0 characters.
void analyze_string( char * string )
{
    assert( string != NULL ); // Cannot be NULL
    assert( *string != '\0' ); // Cannot be empty
    assert( strlen( string ) > 2 ); // Length must exceed 2
}

```

The program generates this output:

```

Analyzing string 'abc'
Analyzing string '(null)'
Assertion failed: string != NULL, file crt_assert.c, line 25

```

After the assertion failure, depending on the version of the operating system and run-time library, you may see a message box that contains something similar to:

A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.

If a debugger is installed, choose the **Debug** button to start the debugger, or **Close program** to exit.

See also

[Error handling](#)

[Process and environment control](#)

[abort](#)

[raise](#)

[signal](#)

[_ASSERT](#) , [_ASERTE](#) , [_ASSERT_EXPR](#) Macros

[_DEBUG](#)

Evaluate an expression and generate a debug report when the result is `false` (debug version only).

Syntax

```
// Typical usage:  
_ASSERT_EXPR( booleanExpression, message );  
_ASSERT( booleanExpression );  
_ASSERTE( booleanExpression );
```

Parameters

`booleanExpression`

A scalar expression (including pointer expressions) that evaluates to nonzero (`true`) or 0 (`false`).

`message`

A wide string to display as part of the report.

Remarks

The `_ASSERT_EXPR`, `_ASSERT` and `_ASSERTE` macros provide an application with a clean and simple mechanism for checking assumptions during the debugging process. They're flexible because they don't need to be enclosed in `#ifdef` statements to prevent them from being called in a retail build of an application. This flexibility is achieved by using the `_DEBUG` macro. `_ASSERT_EXPR`, `_ASSERT` and `_ASSERTE` are only available when `_DEBUG` is defined at compile time. When `_DEBUG` isn't defined, calls to these macros are removed during preprocessing.

`_ASSERT_EXPR`, `_ASSERT` and `_ASSERTE` evaluate their `booleanExpression` argument and when the result is `false` (0), they print a diagnostic message and call `_CrtDbgReportW` to generate a debug report. The `_ASSERT` macro prints a simple diagnostic message, `_ASSERTE` includes a string representation of the failed expression in the message, and `_ASSERT_EXPR` includes the `message` string in the diagnostic message. These macros do nothing when `booleanExpression` evaluates to nonzero.

`_ASSERT_EXPR`, `_ASSERT` and `_ASSERTE` invoke `_CrtDbgReportW`, which causes all output to be in wide characters. `_ASSERTE` properly prints Unicode characters in `booleanExpression` and `_ASSERT_EXPR` prints Unicode characters in `message`.

Because the `_ASSERTE` macro specifies the failed expression, and `_ASSERT_EXPR` lets you specify a message in the generated report, they enable users to identify the problem without referring to the application source code. However, a disadvantage exists in that every `message` printed by `_ASSERT_EXPR` and every expression evaluated by `_ASSERTE` is included in the output (debug version) file of your application as a string constant. Therefore, if a large number of calls are made to `_ASSERT_EXPR` or `_ASSERTE`, these expressions can greatly increase the size of your output file.

Unless you specify otherwise with the `_CrtSetReportMode` and `_CrtSetReportFile` functions, messages appear in a pop-up dialog box equivalent to setting:

```
_CrtSetReportMode(CRT_ASSERT, _CRTDBG_MODE_WNDW);
```

`_CrtDbgReportW` generates the debug report and determines its destination or destinations, based on the current report mode or modes and file defined for the `_CRT_ASSERT` report type. By default, assertion failures and errors are directed to a debug message window. The `_CrtSetReportMode` and `_CrtSetReportFile` functions are used to define the destinations for each report type.

When the destination is a debug message window and the user selects the **Retry** button, `_CrtDbgReportW` returns 1, causing the `_ASSERT_EXPR`, `_ASSERT` and `_ASERTE` macros to start the debugger if just-in-time (JIT) debugging is enabled.

For more information about the reporting process, see the `_CrtDbgReport`, `_CrtDbgReportW` function. For more information about resolving assertion failures and using these macros as a debugging error handling mechanism, see [Using macros for verification and reporting](#).

In addition to the `_ASSERT` macros, the `assert` macro can be used to verify program logic. This macro is available in both the debug and release versions of the libraries. The `_RPT`, `_RPTF` debug macros are also available for generating a debug report, but they don't evaluate an expression. The `_RPT` macros generate a simple report. The `_RPTF` macros include the source file and line number where the report macro was called in the generated report. Wide character versions of these macros are available (`_RPTW`, `_RPTFW`). The wide character versions are identical to the narrow character versions except that wide character strings are used for all string parameters and output.

Although `_ASSERT_EXPR`, `_ASSERT` and `_ASERTE` are macros and are available by including `<crtdbg.h>`, the application must link with a debug version of the C run-time library when `_DEBUG` is defined because these macros call other run-time functions.

Requirements

MACRO	REQUIRED HEADER
<code>_ASSERT_EXPR</code> , <code>_ASSERT</code> , <code>_ASERTE</code>	<code><crtdbg.h></code>

Example

In this program, calls are made to the `_ASSERT` and `_ASERTE` macros to test the condition `string1 == string2`. If the condition fails, these macros print a diagnostic message. The `_RPT` and `_RPTF` group of macros is also exercised in this program, as an alternative to the `printf` function.

```
// crt_ASSERT_macro.c
// compile with: /D_DEBUG /MTd /Od /Zi /link /verbose:lib /debug
//
// This program uses the _ASSERT and _ASERTE debugging macros.
//

#include <stdio.h>
#include <string.h>
#include <malloc.h>
#include <crtdbg.h>

int main()
{
    char *p1, *p2;

    // The Reporting Mode and File must be specified
    // before generating a debug report via an assert
    // or report macro.
    // This program sends all report types to STDOUT.
    _CrtSetReportMode(_CRT_WARN, _CRTDBG_MODE_FILE);
    _CrtSetReportFile(_CRT_WARN, _CRTDBG_FILE_STDOUT);
    _CrtSetReportMode(_CRT_ERROR, _CRTDBG_MODE_FILE);
    _CrtSetReportFile(_CRT_ERROR, _CRTDBG_FILE_STDOUT);
    _CrtSetReportMode(_CRT_ASSERT, _CRTDBG_MODE_FILE);
    _CrtSetReportFile(_CRT_ASSERT, _CRTDBG_FILE_STDOUT);

    // Allocate and assign the pointer variables.
    p1 = (char *)malloc(10);
    strcpy_s(p1, 10, "I am p1");
    p2 = (char *)malloc(10);
    strcpy_s(p2, 10, "I am p2");

    // Use the report macros as a debugging
    // warning mechanism, similar to printf.
    // Use the assert macros to check if the
    // p1 and p2 variables are equivalent.
    // If the expression fails, _ASERTE will
    // include a string representation of the
    // failed expression in the report.
    // _ASSERT does not include the
    // expression in the generated report.
    _RPT0(_CRT_WARN,
        "Use the assert macros to evaluate the expression p1 == p2.\n");
    _RPTF2(_CRT_WARN, "\n Will _ASSERT find '%s' == '%s' ?\n", p1, p2);
    _ASSERT(p1 == p2);

    _RPTF2(_CRT_WARN, "\n\n Will _ASERTE find '%s' == '%s' ?\n",
        p1, p2);
    _ASERTE(p1 == p2);

    _RPT2(_CRT_ERROR, "'%s' != '%s'\n", p1, p2);

    free(p2);
    free(p1);

    return 0;
}
```

Use the assert macros to evaluate the expression p1 == p2.

crt_ASSERT_macro.c(54) :

Will _ASSERT find 'I am p1' == 'I am p2' ?

crt_ASSERT_macro.c(55) : Assertion failed!

crt_ASSERT_macro.c(58) :

Will _ASERTE find 'I am p1' == 'I am p2' ?

crt_ASSERT_macro.c(59) : Assertion failed: p1 == p2

'I am p1' != 'I am p2'

See also

Debug routines

[assert Macro](#), [_assert](#), [_wassert](#)
[_RPT](#), [_RPTF](#), [_RPTW](#), [_RPTFW](#) Macros

`atan`, `atanf`, `atanl`, `atan2`, `atan2f`, `atan2l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the arctangent of x (`atan`, `atanf`, and `atanl`) or the arctangent of y/x (`atan2`, `atan2f`, and `atan2l`).

Syntax

```
double atan( double x );
float atanf( float x );
long double atanl( long double x );
#define atan(X) // Requires C11 or higher

float atan( float x ); // C++ only
long double atan( long double x ); // C++ only

double atan2( double y, double x );
float atan2f( float y, float x );
long double atan2l( long double y, long double x );
#define atan2(Y, X) // Requires C11 or higher

float atan2( float y, float x ); // C++ only
long double atan2( long double y, long double x ); // C++ only
```

Parameters

x , y

Any numbers.

Return value

`atan` returns the arctangent of x in the range $-\pi/2$ to $\pi/2$ radians. `atan2` returns the arctangent of y/x in the range $-\pi$ to π radians. If x is 0, `atan` returns 0. If both parameters of `atan2` are 0, the function returns 0. All results are in radians.

`atan2` uses the signs of both parameters to determine the quadrant of the return value.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

Remarks

The `atan` function calculates the arctangent (the inverse tangent function) of x . `atan2` calculates the arctangent of y/x (if x equals 0, `atan2` returns $\pi/2$ if y is positive, $-\pi/2$ if y is negative, or 0 if y is 0.)

If you use the `atan` or `atan2` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

`atan` has an implementation that uses Streaming SIMD Extensions 2 (SSE2). For information and restrictions about using the SSE2 implementation, see [`_set_SSE2_enable`](#).

Because C++ allows overloading, you can call overloads of `atan` and `atan2` that take `float` or `long double`

arguments. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `atan` and `atan2` always take `double` arguments and return a `double`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>atan</code> , <code>atan2</code> , <code>atanf</code> , <code>atan2f</code> , <code>atanl</code> , <code>atan2l</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>atan</code> , <code>atan2</code> macros	<code><tgmath.h></code>	

Example

```
// crt_atan.c
// arguments: 5 0.5
#include <math.h>
#include <stdio.h>
#include <errno.h>

int main( int ac, char* av[] )
{
    double x, y, theta;
    if( ac != 3 ){
        fprintf( stderr, "Usage: %s <x> <y>\n", av[0] );
        return 1;
    }
    x = atof( av[1] );
    theta = atan( x );
    printf( "Arctangent of %f: %f\n", x, theta );
    y = atof( av[2] );
    theta = atan2( y, x );
    printf( "Arctangent of %f / %f: %f\n", y, x, theta );
    return 0;
}
```

```
Arctangent of 5.000000: 1.373401
Arctangent of 0.500000 / 5.000000: 0.099669
```

See also

Math and floating-point support

`acos`, `acosf`, `acosl`
`asin`, `asinf`, `asinl`
`cos`, `cosf`, `cosl`
`_matherr`
`sin`, `sinf`, `sinl`
`tan`, `tanf`, `tanl`
`_CIatan`
`_CIatan2`

`atanh`, `atanhf`, `atanhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the inverse hyperbolic tangent.

Syntax

```
double atanh( double x );
float atanhf( float x );
long double atanhl( long double x );
#define atanh(X) // Requires C11 or higher

float atanh( float x ); // C++ only
long double atanh( long double x ); // C++ only
```

Parameters

`x`

Floating-point value.

Return value

The `atanh` functions return the inverse hyperbolic tangent (arc hyperbolic tangent) of `x`. If `x` is greater than 1, or less than -1, `errno` is set to `EDOM` and the result is a quiet NaN. If `x` is equal to 1 or -1, a positive or negative infinity is returned, respectively, and `errno` is set to `ERANGE`.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	none
$x \geq 1; x \leq -1$	none	none

Remarks

Because C++ allows overloading, you can call overloads of `atanh` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `atanh` always takes and returns `double`.

If you use the `<tgmath.h>` `atanh()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>atanh</code> , <code>atanhf</code> , <code>atanhl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>

FUNCTION	C HEADER	C++ HEADER
<code>atanh</code> macro	<tgmath.h>	

For more compatibility information, see [Compatibility](#).

Example

```
// crt_atanh.c
// This program displays the hyperbolic tangent of pi / 4
// and the arc hyperbolic tangent of the result.
//

#include <math.h>
#include <stdio.h>

int main( void )
{
    double pi = 3.1415926535;
    double x, y;

    x = tanh( pi / 4 );
    y = atanh( x );
    printf( "tanh( %f ) = %f\n", pi/4, x );
    printf( "atanh( %f ) = %f\n", x, y );
}
```

```
tanh( 0.785398 ) = 0.655794
atanh( 0.655794 ) = 0.785398
```

See also

[Math and floating-point support](#)

acosh	acoshf	acoshl
asinh	asinhf	asinhl
cosh	coshf	coshl
sinh	sinhf	sinhl
tanh	tanhf	tanhl

atexit

11/2/2022 • 2 minutes to read • [Edit Online](#)

Processes the specified function at exit.

Syntax

```
int atexit(
    void (__cdecl *func )( void )
);
```

Parameters

`func`

Function to be called.

Return value

`atexit` returns 0 if successful, or a nonzero value if an error occurs.

Remarks

The `atexit` function is passed the address of a function `func` to be called when the program terminates normally. Successive calls to `atexit` create a register of functions that are executed in last-in, first-out (LIFO) order. The functions passed to `atexit` can't take parameters. `atexit` and `_onexit` use the heap to hold the register of functions. Thus, the number of functions that can be registered is limited only by heap memory.

The code in the `atexit` function shouldn't contain any dependency on any DLL that could have already been unloaded when the `atexit` function is called.

To generate an ANSI-conformant application, use the ANSI-standard `atexit` function (rather than the similar `_onexit` function).

Requirements

ROUTINE	REQUIRED HEADER
<code>atexit</code>	<code><stdlib.h></code>

Example

This program pushes four functions onto the stack of functions to be executed when `atexit` is called. When the program exits, these programs are executed on a last in, first out basis.

```
// crt_atexit.c
#include <stdlib.h>
#include <stdio.h>

void fn1( void ), fn2( void ), fn3( void ), fn4( void );

int main( void )
{
    atexit( fn1 );
    atexit( fn2 );
    atexit( fn3 );
    atexit( fn4 );
    printf( "This is executed first.\n" );
}

void fn1()
{
    printf( "next.\n" );
}

void fn2()
{
    printf( "executed " );
}

void fn3()
{
    printf( "is " );
}

void fn4()
{
    printf( "This " );
}
```

```
This is executed first.
This is executed next.
```

See also

[Process and environment control](#)

[abort](#)

[exit](#) , [_Exit](#) , [_exit](#)

[_onexit](#) , [_onexit_m](#)

`_atodbl`, `_atodbl_l`, `_atoldbl`, `_atoldbl_l`,
`_atoflt`, `_atoflt_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a string to a double (`_atodbl`), long double (`_atoldbl`), or float (`_atoflt`).

Syntax

```
int _atodbl( _CRT_DOUBLE * value, char * str );
int _atodbl_l ( _CRT_DOUBLE * value, char * str, _locale_t locale );
int _atoldbl( _LDOUBLE * value, char * str );
int _atoldbl_l ( _LDOUBLE * value, char * str, _locale_t locale );
int _atoflt( _CRT_FLOAT * value, const char * str );
int _atoflt_l( _CRT_FLOAT * value, const char * str, _locale_t locale );
```

Parameters

`value`

The double, long double, or float value that's produced by converting the string to a floating-point value. These values are wrapped in a structure.

`str`

The string to be parsed to convert into a floating-point value.

`Locale`

The locale to use.

Return value

Returns 0 if successful. Possible error codes are `_UNDERFLOW` or `_OVERFLOW`, which are defined in the header file `<math.h>`.

Remarks

These functions convert a string to a floating-point value. The difference between these functions and the `atof` family of functions is that these functions don't generate floating-point code and don't cause hardware exceptions. Instead, error conditions are reported as error codes.

If a string doesn't have a valid interpretation as a floating-point value, `value` is set to zero, and the return value is zero.

The versions of these functions that have the `_l` suffix are identical to the versions that don't have the suffix, except that they use the `Locale` parameter that's passed in instead of the current thread locale.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINES	REQUIRED HEADER
<code>_atodbl</code> , <code>_atoldbl</code> , <code>_atoflt</code>	<code><stdlib.h></code>
<code>_atodbl_l</code> , <code>_atoldbl_l</code> , <code>_atoflt_l</code>	

Example

```
// crt_atodbl.c
// Uses _atodbl to convert a string to a double precision
// floating point value.

#include <stdlib.h>
#include <stdio.h>

int main()
{
    char str1[256] = "3.141592654";
    char abc[256] = "abc";
    char oflow[256] = "1.0E+5000";
    _CRT_DOUBLE dblval;
    _CRT_FLOAT fltval;
    int retval;

    retval = _atodbl(&dblval, str1);

    printf("Double value: %lf\n", dblval.x);
    printf("Return value: %d\n\n", retval);

    retval = _atoflt(&fltval, str1);
    printf("Float value: %f\n", fltval.f);
    printf("Return value: %d\n\n", retval);

    // A non-floating point value: returns 0.
    retval = _atoflt(&fltval, abc);
    printf("Float value: %f\n", fltval.f);
    printf("Return value: %d\n\n", retval);

    // Overflow.
    retval = _atoflt(&fltval, oflow);
    printf("Float value: %f\n", fltval.f);
    printf("Return value: %d\n\n", retval);

    return 0;
}
```

```
Double value: 3.141593
Return value: 0

Float value: 3.141593
Return value: 0

Float value: 0.000000
Return value: 0

Float value: inf
Return value: 3
```

See also

[Data conversion](#)

[Math and floating-point support](#)

[Locale](#)

[atof](#), [_atof_1](#), [_wtof](#), [_wtof_1](#)

`atof`, `_atof_l`, `_wtotf`, `_wtotf_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Convert a string to double.

Syntax

```
double atof(
    const char *str
);
double _atof_l(
    const char *str,
    _locale_t locale
);
double _wtotf(
    const wchar_t *str
);
double _wtotf_l(
    const wchar_t *str,
    _locale_t locale
);
```

Parameters

`str`

String to be converted.

`Locale`

Locale to use.

Return value

Each function returns the `double` value produced by interpreting the input characters as a number. The return value is 0.0 if the input can't be converted to a value of that type.

In all out-of-range cases, `errno` is set to `ERANGE`. If the parameter passed in is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return 0.

Remarks

These functions convert a character string to a double-precision, floating-point value.

The input string is a sequence of characters that can be interpreted as a numerical value of the specified type. The function stops reading the input string at the first character that it can't recognize as part of a number. This character may be the null character ('\0' or L'\0') terminating the string.

The `str` argument to `atof` and `_wtotf` has the following form:

`[whitespace] [sign] [digits] [. digits] [{ e | E } [sign] digits]`

A `whitespace` consists of space or tab characters, which are ignored; `sign` is either plus (+) or minus (-); and `digits` are one or more decimal digits. If no digits appear before the decimal point, at least one must appear

after the decimal point. The decimal digits may be followed by an exponent, which consists of an introductory letter (`e` , or `E`) and an optionally signed decimal integer.

The UCRT versions of these functions don't support conversion of Fortran-style (`d` or `D`) exponent letters. This non-standard extension was supported by earlier versions of the CRT, and may be a breaking change for your code.

The versions of these functions with the `_1` suffix are identical except that they use the `Locale` parameter passed in instead of the current locale.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstof</code>	<code>atof</code>	<code>atof</code>	<code>_wtos</code>
<code>_tosf</code>	<code>atof</code>	<code>atof</code>	<code>_wtos</code>

Requirements

ROUTINE(S)	REQUIRED HEADER
<code>atof</code> , <code>_atof_1</code>	C: <code><math.h></code> or <code><stdlib.h></code> C++: <code><cstdlib></code> , <code><stdlib.h></code> , <code><ccmath></code> or <code><math.h></code>
<code>_wtos</code> , <code>_wtos_1</code>	C: <code><stdlib.h></code> or <code><wchar.h></code> C++: <code><cstdlib></code> , <code><stdlib.h></code> or <code><wchar.h></code>

Example

This program shows how numbers stored as strings can be converted to numeric values using the `atof` and `_atof_1` functions.

```

// crt_atof.c
//
// This program shows how numbers stored as
// strings can be converted to numeric
// values using the atof and _atof_l functions.

#include <stdlib.h>
#include <stdio.h>
#include <locale.h>

int main(void)
{
    char    *str = NULL;
    double value = 0;
    _locale_t fr = _create_locale(LC_NUMERIC, "fr-FR");

    // An example of the atof function
    // using leading and trailing spaces.
    str = " 3336402735171707160320 ";
    value = atof(str);
    printf("Function: atof(\"%s\") = %e\n", str, value);

    // Another example of the atof function
    // using the 'E' exponential formatting keyword.
    str = "3.1412764583E210";
    value = atof(str);
    printf("Function: atof(\"%s\") = %e\n", str, value);

    // An example of the atof and _atof_l functions
    // using the 'e' exponential formatting keyword
    // and showing different decimal point interpretations.
    str = " -2,309e-25";
    value = atof(str);
    printf("Function: atof(\"%s\") = %e\n", str, value);
    value = _atof_l(str, fr);
    printf("Function: _atof_l(\"%s\", fr)) = %e\n", str, value);
}

```

```

Function: atof(" 3336402735171707160320 ") = 3.336403e+21
Function: atof("3.1412764583E210") = 3.141276e+210
Function: atof(" -2,309e-25") = -2.000000e+00
Function: _atof_l(" -2,309e-25", fr)) = -2.309000e-25

```

See also

[Data conversion](#)

[Math and floating-point support](#)

[Locale](#)

[_ecvt](#)

[_fcvt](#)

[_gcvt](#)

[setlocale](#), [_wsetlocale](#)

[_atodbl](#), [_atodbl_l](#), [_atoldbl](#), [_atoldbl_l](#), [_atoflt](#), [_atoflt_l](#)

`atoi`, `_atoi_l`, `_wtoi`, `_wtoi_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert a string to integer.

Syntax

```
int atoi(
    const char *str
);
int _wtoi(
    const wchar_t *str
);
int _atoi_l(
    const char *str,
    _locale_t locale
);
int _wtoi_l(
    const wchar_t *str,
    _locale_t locale
);
```

Parameters

`str`

String to be converted.

`Locale`

Locale to use.

Return value

Each function returns the `int` value produced by interpreting the input characters as a number. The return value is 0 for `atoi` and `_wtoi`, if the input can't be converted to a value of that type.

When the functions overflow with large negative integral values, `LONG_MIN` is returned. `atoi` and `_wtoi` return `INT_MAX` and `INT_MIN` on these conditions. In all out-of-range cases, `errno` is set to `ERANGE`. If the parameter passed in is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return 0.

Remarks

These functions convert a character string to an integer value (`atoi` and `_wtoi`). The input string is a sequence of characters that can be interpreted as a numerical value of the specified type. The function stops reading the input string at the first character that it can't recognize as part of a number. This character may be the null character ('\0' or L'\0') terminating the string.

The `str` argument to `atoi` and `_wtoi` has the following form:

`[whitespace] [sign] [digits]`

A `whitespace` consists of space or tab characters, which are ignored; `sign` is either plus (+) or minus (-); and

`digits` are one or more digits.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tstoi</code>	<code>atoi</code>	<code>atoi</code>	<code>_wtoi</code>
<code>_ttoi</code>	<code>atoi</code>	<code>atoi</code>	<code>_wtoi</code>

Requirements

ROUTINES	REQUIRED HEADER
<code>atoi</code>	<code><stdlib.h></code>
<code>_atoi_l</code> , <code>_wtoi</code> , <code>_wtoi_l</code>	<code><stdlib.h></code> or <code><wchar.h></code>

Example

This program shows how numbers stored as strings can be converted to numeric values using the `atoi` functions.

```

// crt_atoi.c
// This program shows how numbers
// stored as strings can be converted to
// numeric values using the atoi functions.

#include <stdlib.h>
#include <stdio.h>
#include <errno.h>

int main( void )
{
    char    *str = NULL;
    int     value = 0;

    // An example of the atoi function.
    str = " -2309 ";
    value = atoi( str );
    printf( "Function: atoi( \"%s\" ) = %d\n", str, value );

    // Another example of the atoi function.
    str = "31412764";
    value = atoi( str );
    printf( "Function: atoi( \"%s\" ) = %d\n", str, value );

    // Another example of the atoi function
    // with an overflow condition occurring.
    str = "3336402735171707160320";
    value = atoi( str );
    printf( "Function: atoi( \"%s\" ) = %d\n", str, value );
    if (errno == ERANGE)
    {
        printf("Overflow condition occurred.\n");
    }
}

```

```

Function: atoi( " -2309 " ) = -2309
Function: atoi( "31412764" ) = 31412764
Function: atoi( "3336402735171707160320" ) = 2147483647
Overflow condition occurred.

```

See also

[Data conversion](#)

[Math and floating-point support](#)

[Locale](#)

_ecvt
_fcvt
_gcvt
setlocale
_wsetlocale
_atodbl
_atodbl_l
_atoldbl
_atoldbl_l
_atoflt
_atoflt_l

`_atoi64`, `_atoi64_l`, `_wtoi64`, `_wtoi64_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a string to a 64-bit integer.

Syntax

```
__int64 _atoi64(
    const char *str
);
__int64 _wtoi64(
    const wchar_t *str
);
__int64 _atoi64_l(
    const char *str,
    _locale_t locale
);
__int64 _wtoi64_l(
    const wchar_t *str,
    _locale_t locale
);
```

Parameters

`str`

String to be converted.

`Locale`

Locale to use.

Return value

Each function returns the `__int64` value produced by interpreting the input characters as a number. The return value is 0 for `_atoi64` if the input can't be converted to a value of that type.

If the functions overflow with large positive integral values, they return `I64_MAX`. The functions return `I64_MIN` if they overflow with large negative integral values.

In all out-of-range cases, `errno` is set to `ERANGE`. If the parameter passed in is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return 0.

Remarks

These functions convert a character string to a 64-bit integer value.

The input string is a sequence of characters that can be interpreted as a numerical value of the specified type. The function stops reading the input string at the first character that it can't recognize as part of a number. This character might be the null character ('\0' or L'\0') terminating the string.

The `str` argument to `_atoi64` has the following form:

`[whitespace] [sign] [digits]`

A `whitespace` consists of space or tab characters, which are ignored; `sign` is either plus (+) or minus (-); and `digits` are one or more digits.

`_wtoi64` is identical to `_atoi64` except that it takes a wide character string as a parameter.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstoi64</code>	<code>_atoi64</code>	<code>_atoi64</code>	<code>_wtoi64</code>
<code>_ttoi64</code>	<code>_atoi64</code>	<code>_atoi64</code>	<code>_wtoi64</code>

Requirements

ROUTINES	REQUIRED HEADER
<code>_atoi64</code> , <code>_atoi64_1</code>	<code><stdlib.h></code>
<code>_wtoi64</code> , <code>_wtoi64_1</code>	<code><stdlib.h></code> or <code><wchar.h></code>

Example

This program shows how numbers stored as strings can be converted to numeric values using the `_atoi64` functions.

```

// crt_atoi64.c
// This program shows how numbers stored as
// strings can be converted to numeric values
// using the _atoi64 functions.
#include <stdlib.h>
#include <stdio.h>
#include <errno.h>

int main( void )
{
    char      *str = NULL;
    __int64 value = 0;

    // An example of the _atoi64 function
    // with leading and trailing white spaces.
    str = " -2309 ";
    value = _atoi64( str );
    printf( "Function: _atoi64( \"%s\" ) = %d\n", str, value );

    // Another example of the _atoi64 function
    // with an arbitrary decimal point.
    str = "314127.64";
    value = _atoi64( str );
    printf( "Function: _atoi64( \"%s\" ) = %d\n", str, value );

    // Another example of the _atoi64 function
    // with an overflow condition occurring.
    str = "3336402735171707160320";
    value = _atoi64( str );
    printf( "Function: _atoi64( \"%s\" ) = %d\n", str, value );
    if (errno == ERANGE)
    {
        printf("Overflow condition occurred.\n");
    }
}

```

```

Function: _atoi64( " -2309 " ) = -2309
Function: _atoi64( "314127.64" ) = 314127
Function: _atoi64( "3336402735171707160320" ) = -1
Overflow condition occurred.

```

See also

[Data conversion](#)

[Math and floating-point support](#)

[Locale](#)

[_ecvt](#)

[_fcvt](#)

[_gcvt](#)

[setlocale](#), [_wsetlocale](#)

[_atodbl](#), [_atodbl_l](#), [_atoldbl](#), [_atoldbl_l](#), [_atoflt](#), [_atoflt_l](#)

`atol`, `_atol_l`, `wtol`, `_wtol_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert a string to a long integer.

Syntax

```
long atol(
    const char *str
);
long _atol_l(
    const char *str,
    _locale_t locale
);
long wtol(
    const wchar_t *str
);
long _wtol_l(
    const wchar_t *str,
    _locale_t locale
);
```

Parameters

`str`

String to be converted.

`Locale`

Locale to use.

Return value

Each function returns the `long` value produced by interpreting the input characters as a number. The return value is `0L` for `atol` if the input can't be converted to a value of that type.

If these functions overflow with large positive integral values, they return `LONG_MAX`. If the functions overflow with large negative integral values, `LONG_MIN` is returned. In all out-of-range cases, `errno` is set to `ERANGE`. If the parameter passed in is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return 0.

Remarks

These functions convert a character string to a long integer value (`atol`).

The input string is a sequence of characters that can be interpreted as a numerical value of the specified type. The function stops reading the input string at the first character that it can't recognize as part of a number. This character may be the null character (`\0` or `L\0`) terminating the string.

The `str` argument to `atol` has the following form:

`[whitespace] [sign] [digits]`

A `whitespace` consists of space or tab characters, which are ignored; `sign` is either plus (+) or minus (-); and

`digits` are one or more digits.

`_wtol` is identical to `atol` except that it takes a wide character string.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstol</code>	<code>atol</code>	<code>atol</code>	<code>_wtol</code>
<code>_ttol</code>	<code>atol</code>	<code>atol</code>	<code>_wtol</code>

Requirements

ROUTINES	REQUIRED HEADER
<code>atol</code>	<code><stdlib.h></code>
<code>_atol_1</code> , <code>_wtol</code> , <code>_wtol_1</code>	<code><stdlib.h></code> and <code><wchar.h></code>

Example

This program shows how numbers stored as strings can be converted to numeric values using the `atol` function.

```

// crt_atol.c
// This program shows how numbers stored as
// strings can be converted to numeric values
// using the atol functions.
#include <stdlib.h>
#include <stdio.h>
#include <errno.h>

int main( void )
{
    char    *str = NULL;
    long    value = 0;

    // An example of the atol function
    // with leading and trailing white spaces.
    str = " -2309 ";
    value = atol( str );
    printf( "Function: atol( \"%s\" ) = %d\n", str, value );

    // Another example of the atol function
    // with an arbitrary decimal point.
    str = "314127.64";
    value = atol( str );
    printf( "Function: atol( \"%s\" ) = %d\n", str, value );

    // Another example of the atol function
    // with an overflow condition occurring.
    str = "3336402735171707160320";
    value = atol( str );
    printf( "Function: atol( \"%s\" ) = %d\n", str, value );
    if (errno == ERANGE)
    {
        printf("Overflow condition occurred.\n");
    }
}

```

```

Function: atol( " -2309 " ) = -2309
Function: atol( "314127.64" ) = 314127
Function: atol( "3336402735171707160320" ) = 2147483647
Overflow condition occurred.

```

See also

[Data conversion](#)

[Math and floating-point support](#)

[Locale](#)

[_ecvt](#)

[_fcvt](#)

[_gcvt](#)

[setlocale](#), [_wsetlocale](#)

[_atodbl](#), [_atodbl_l](#), [_atoldbl](#), [_atoldbl_l](#), [_atoflt](#), [_atoflt_l](#)

`atoll`, `_atoll_l`, `_wtoll`, `_wtoll_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a string to a `long long` integer.

Syntax

```
long long atoll(
    const char *str
);
long long _wtoll(
    const wchar_t *str
);
long long _atoll_l(
    const char *str,
    _locale_t locale
);
long long _wtoll_l(
    const wchar_t *str,
    _locale_t locale
);
```

Parameters

`str`

String to be converted.

`Locale`

Locale to use.

Return value

Each function returns the `long long` value that's produced by interpreting the input characters as a number. The return value for `atoll` is 0 if the input can't be converted to a value of that type.

For overflow with large positive integral values, `atoll` returns `LLONG_MAX`, and for overflow with large negative integral values, it returns `LLONG_MIN`.

In all out-of-range cases, `errno` is set to `ERANGE`. If the parameter that's passed in is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return 0.

Remarks

These functions convert a character string to a `long long` integer value.

The input string is a sequence of characters that can be interpreted as a numerical value of the specified type. The function stops reading the input string at the first character that it can't recognize as part of a number. This character might be the null character ('\0' or L'\0') that terminates the string.

The `str` argument to `atoll` has the following form:

`[whitespace] [sign] [digits]`

A `whitespace` consists of space or tab characters, which are ignored; `sign` is either plus (+) or minus (-); and `digits` are one or more digits.

`_wtoll` is identical to `atoll` except that it takes a wide character string as a parameter.

The versions of these functions that have the `_1` suffix are identical to the versions that don't have it, except that they use the locale parameter that's passed in instead of the current locale. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstoll</code>	<code>atoll</code>	<code>atoll</code>	<code>_wtoll</code>
<code>_tstoll_1</code>	<code>_atoll_1</code>	<code>_atoll_1</code>	<code>_wtoll_1</code>
<code>_ttoll</code>	<code>_atoll</code>	<code>_atoll</code>	<code>_wtoll</code>

Requirements

ROUTINES	REQUIRED HEADER
<code>atoll</code> , <code>_atoll_1</code>	<code><stdlib.h></code>
<code>_wtoll</code> , <code>_wtoll_1</code>	<code><stdlib.h></code> or <code><wchar.h></code>

Example

This program shows how to use the `atoll` functions to convert numbers stored as strings to numeric values.

```

// crt_atoll.c
// Build with: cl /W4 /Tc crt_atoll.c
// This program shows how to use the atoll
// functions to convert numbers stored as
// strings to numeric values.
#include <stdlib.h>
#include <stdio.h>
#include <errno.h>

int main(void)
{
    char *str = NULL;
    long long value = 0;

    // An example of the atoll function
    // with leading and trailing white spaces.
    str = " -27182818284 ";
    value = atoll(str);
    printf("Function: atoll(\"%s\") = %lld\n", str, value);

    // Another example of the atoll function
    // with an arbitrary decimal point.
    str = "314127.64";
    value = atoll(str);
    printf("Function: atoll(\"%s\") = %lld\n", str, value);

    // Another example of the atoll function
    // with an overflow condition occurring.
    str = "3336402735171707160320";
    value = atoll(str);
    printf("Function: atoll(\"%s\") = %lld\n", str, value);
    if (errno == ERANGE)
    {
        printf("Overflow condition occurred.\n");
    }
}

```

```

Function: atoll(" -27182818284 ") = -27182818284
Function: atoll("314127.64") = 314127
Function: atoll("3336402735171707160320") = 9223372036854775807
Overflow condition occurred.

```

See also

[Data conversion](#)

[Math and floating-point support](#)

[Locale](#)

_ecvt
_fcvt
_gcvt
setlocale
, _wsetlocale
_atodbl
, _atodbl_1
, _atoldbl
, _atoldbl_1
, _atoflt
, _atoflt_1

`_beginthread`, `_beginthreadex`

11/2/2022 • 9 minutes to read • [Edit Online](#)

Creates a thread.

Syntax

```
uintptr_t _beginthread( // NATIVE CODE
    void( __cdecl *start_address )( void * ),
    unsigned stack_size,
    void *arglist
);
uintptr_t _beginthread( // MANAGED CODE
    void( __clrcall *start_address )( void * ),
    unsigned stack_size,
    void *arglist
);
uintptr_t _beginthreadex( // NATIVE CODE
    void *security,
    unsigned stack_size,
    unsigned ( __stdcall *start_address )( void * ),
    void *arglist,
    unsigned initflag,
    unsigned *thrdaddr
);
uintptr_t _beginthreadex( // MANAGED CODE
    void *security,
    unsigned stack_size,
    unsigned ( __clrcall *start_address )( void * ),
    void *arglist,
    unsigned initflag,
    unsigned *thrdaddr
);
```

Parameters

`start_address`

Start address of a routine that begins execution of a new thread. For `_beginthread`, the calling convention is either `__cdecl` (for native code) or `__clrcall` (for managed code). For `_beginthreadex`, the calling convention is either `__stdcall` (for native code) or `__clrcall` (for managed code).

`stack_size`

Stack size for a new thread, or 0.

`arglist`

Argument list to be passed to a new thread, or `NULL`.

`Security`

Pointer to a `SECURITY_ATTRIBUTES` structure that determines whether the returned handle can be inherited by child processes. If `Security` is `NULL`, the handle can't be inherited.

`initflag`

Flags that control the initial state of a new thread. Set `initflag` to 0 to run immediately, or to `CREATE_SUSPENDED` to create the thread in a suspended state; use `ResumeThread` to execute the thread. Set `initflag` to `STACK_SIZE_PARAM_IS_A_RESERVATION` flag to use `stack_size` as the initial reserve size of the stack in bytes; if this

flag isn't specified, `stack_size` specifies the commit size.

`thrdaddr`

Points to a 32-bit variable that receives the thread identifier. If it's `NULL`, it's not used.

Return value

If successful, each of these functions returns a handle to the newly created thread; however, if the newly created thread exits too quickly, `_beginthread` might not return a valid handle. (See the discussion in the Remarks section.) On an error, `_beginthread` returns -1L, and `errno` is set to `EAGAIN` if there are too many threads, to `EINVAL` if the argument is invalid or the stack size is incorrect, or to `EACCES` if there are insufficient resources (such as memory). On an error, `_beginthreadex` returns 0, and `errno` and `_doserrno` are set.

If `start_address` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For more information about `uintptr_t`, see [Standard types](#).

Remarks

The `_beginthread` function creates a thread that begins execution of a routine at `start_address`. The routine at `start_address` must use the `__cdecl` (for native code) or `__clrcall` (for managed code) calling convention and should have no return value. When the thread returns from that routine, it's terminated automatically. For more information about threads, see [Multithreading support for older code \(Visual C++\)](#).

`_beginthreadex` resembles the Win32 `CreateThread` API more closely than `_beginthread` does. `_beginthreadex` differs from `_beginthread` in the following ways:

- `_beginthreadex` has three more parameters: `initflag`, `Security`, and `threadaddr`. The new thread can be created in a suspended state, with a specified security, and can be accessed by using `thrdaddr`, which is the thread identifier.
- The routine at `start_address` that's passed to `_beginthreadex` must use the `__stdcall` (for native code) or `__clrcall` (for managed code) calling convention and must return a thread exit code.
- `_beginthreadex` returns 0 on failure, rather than -1L.
- A thread that's created by using `_beginthreadex` is terminated by a call to `_endthreadex`.

The `_beginthreadex` function gives you more control over how the thread is created than `_beginthread` does. The `_endthreadex` function is also more flexible. For example, with `_beginthreadex`, you can use security information, set the initial state of the thread (running or suspended), and get the thread identifier of the newly created thread. You can also use the thread handle that's returned by `_beginthreadex` with the synchronization APIs, which you can't do with `_beginthread`.

`_beginthreadex` is safer to use than `_beginthread`. If the thread that's generated by `_beginthread` exits quickly, the handle that's returned to the caller of `_beginthread` might be invalid or point to another thread. However, the handle that's returned by `_beginthreadex` has to be closed by the caller of `_beginthreadex`, so it's guaranteed to be a valid handle if `_beginthreadex` didn't return an error.

You can call `_endthread` or `_endthreadex` explicitly to terminate a thread; however, `_endthread` or `_endthreadex` is called automatically when the thread returns from the routine that's passed as a parameter. Terminating a thread with a call to `_endthread` or `_endthreadex` helps ensure correct recovery of resources that are allocated

for the thread.

`_endthread` automatically closes the thread handle, whereas `_endthreadex` doesn't. Therefore, when you use `_beginthread` and `_endthread`, don't explicitly close the thread handle by calling the Win32 `CloseHandle` API. This behavior differs from the Win32 `ExitThread` API.

NOTE

For an executable file linked with Libcmt.lib, do not call the Win32 `ExitThread` API so that you don't prevent the runtime system from reclaiming allocated resources. `_endthread` and `_endthreadex` reclaim allocated thread resources and then call `ExitThread`.

The operating system handles the allocation of the stack when either `_beginthread` or `_beginthreadex` is called; you don't have to pass the address of the thread stack to either of these functions. In addition, the `stack_size` argument can be 0, in which case the operating system uses the same value as the stack that's specified for the main thread.

`arglist` is a parameter to be passed to the newly created thread. Typically, it's the address of a data item, such as a character string. `argList` can be `NULL` if it isn't needed, but `_beginthread` and `_beginthreadex` must be given some value to pass to the new thread. All threads are terminated if any thread calls `abort`, `exit`, `_exit`, or `ExitProcess`.

The locale of the new thread is initialized by using the per-process global current locale info. If per-thread locale is enabled by a call to `configthreadlocale` (either globally or for new threads only), the thread can change its locale independently from other threads by calling `setlocale` or `wsetlocale`. Threads that don't have the per-thread locale flag set can affect the locale info in all other threads that also don't have the per-thread locale flag set, and also all newly created threads. For more information, see [Locale](#).

For `/clr` code, `_beginthread` and `_beginthreadex` each have two overloads. One takes a native calling-convention function pointer, and the other takes a `__clrcall` function pointer. The first overload isn't application domain-safe and never will be. If you're writing `/clr` code, you must ensure that the new thread enters the correct application domain before it accesses managed resources. You can do so, for example, by using `call_in_appdomain`. The second overload is application domain-safe; the newly created thread will always end up in the application domain of the caller of `_beginthread` or `_beginthreadex`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_beginthread</code>	<code><process.h></code>
<code>_beginthreadex</code>	<code><process.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Multithreaded versions of the [C run-time libraries](#) only.

To use `_beginthread` or `_beginthreadex`, the application must link with one of the multithreaded C run-time libraries.

Examples

The following example uses `_beginthread` and `_endthread`.

```
// crt_BEGTHR.D.C
// compile with: /MT /D "_X86_" /c
// processor: x86
#include <windows.h>
#include <process.h> /* _beginthread, _endthread */
#include <stddef.h>
#include <stdlib.h>
#include <conio.h>

void Bounce( void * );
void CheckKey( void * );

// GetRandom returns a random integer between min and max.
#define GetRandom( min, max ) ((rand() % (int)((max) + 1) - (min))) + (min)
// GetGlyph returns a printable ASCII character value
#define GetGlyph( val ) ((char)((val + 32) % 93 + 33))

BOOL repeat = TRUE;           // Global repeat flag
HANDLE hStdOut;              // Handle for console window
CONSOLE_SCREEN_BUFFER_INFO csbi; // Console information structure

int main()
{
    int param = 0;
    int * pparam = &param;

    // Get display screen's text row and column information.
    hStdOut = GetStdHandle( STD_OUTPUT_HANDLE );
    GetConsoleScreenBufferInfo( hStdOut, &csbi );

    // Launch CheckKey thread to check for terminating keystroke.
    _beginthread( CheckKey, 0, NULL );

    // Loop until CheckKey terminates program or 1000 threads created.
    while( repeat && param < 1000 )
    {
        // launch another character thread.
        _beginthread( Bounce, 0, (void *) pparam );

        // increment the thread parameter
        param++;

        // Wait one second between loops.
        Sleep( 1000L );
    }
}

// CheckKey - Thread to wait for a keystroke, then clear repeat flag.
void CheckKey( void * ignored )
{
    _getch();
    repeat = 0;      // _endthread implied
}

// Bounce - Thread to create and control a colored letter that moves
// around on the screen.
//
// Params: parg - the value to create the character from
void Bounce( void * parg )
{
    char     blankcell = 0x20;
    CHAR_INFO ci;
    COORD   oldcoord, cellsize, origin;
```

```

DWORD      result;
SMALL_RECT region;

cellsize.X = cellsize.Y = 1;
origin.X = origin.Y = 0;

// Generate location, letter and color attribute from thread argument.
 srand( _threadid );
oldcoord.X = region.Left = region.Right =
    GetRandom(csbi.srWindow.Left, csbi.srWindow.Right - 1);
oldcoord.Y = region.Top = region.Bottom =
    GetRandom(csbi.srWindow.Top, csbi.srWindow.Bottom - 1);
ci.Char.AsciiChar = GetGlyph(*((int *)parg));
ci.Attributes = GetRandom(1, 15);

while (repeat)
{
    // Pause between loops.
    Sleep( 100L );

    // Blank out our old position on the screen, and draw new letter.
    WriteConsoleOutputCharacterA(hStdOut, &blankcell, 1, oldcoord, &result);
    WriteConsoleOutputA(hStdOut, &ci, cellsize, origin, &region);

    // Increment the coordinate for next placement of the block.
    oldcoord.X = region.Left;
    oldcoord.Y = region.Top;
    region.Left = region.Right += GetRandom(-1, 1);
    region.Top = region.Bottom += GetRandom(-1, 1);

    // Correct placement (and beep) if about to go off the screen.
    if (region.Left < csbi.srWindow.Left)
        region.Left = region.Right = csbi.srWindow.Left + 1;
    else if (region.Right >= csbi.srWindow.Right)
        region.Left = region.Right = csbi.srWindow.Right - 2;
    else if (region.Top < csbi.srWindow.Top)
        region.Top = region.Bottom = csbi.srWindow.Top + 1;
    else if (region.Bottom >= csbi.srWindow.Bottom)
        region.Top = region.Bottom = csbi.srWindow.Bottom - 2;

    // If not at a screen border, continue, otherwise beep.
    else
        continue;
    Beep((ci.Char.AsciiChar - 'A') * 100, 175);
}

// _endthread given to terminate
_endthread();
}

```

Press any key to end the sample application.

The following sample code demonstrates how you can use the thread handle that's returned by `_beginthreadex` with the synchronization API `WaitForSingleObject`. The main thread waits for the second thread to terminate before it continues. When the second thread calls `_endthreadex`, it causes its thread object to go to the signaled state, which allows the primary thread to continue running. It can't be done with `_beginthread` and `_endthread`, because `_endthread` calls `CloseHandle`, which destroys the thread object before it can be set to the signaled state.

```

// crt_begthrddex.cpp
// compile with: /MT
#include <windows.h>
#include <stdio.h>
#include <process.h>

unsigned Counter;
unsigned __stdcall SecondThreadFunc( void* pArguments )
{
    printf( "In second thread...\n" );

    while ( Counter < 1000000 )
        Counter++;

    _endthreadex( 0 );
    return 0;
}

int main()
{
    HANDLE hThread;
    unsigned threadID;

    printf( "Creating second thread...\n" );

    // Create the second thread.
    hThread = (HANDLE)_beginthreadex( NULL, 0, &SecondThreadFunc, NULL, 0, &threadID );

    // Wait until second thread terminates. If you comment out the line
    // below, Counter will not be correct because the thread has not
    // terminated, and Counter most likely has not been incremented to
    // 1000000 yet.
    WaitForSingleObject( hThread, INFINITE );
    printf( "Counter should be 1000000; it is-> %d\n", Counter );
    // Destroy the thread object.
    CloseHandle( hThread );
}

```

```

Creating second thread...
In second thread...
Counter should be 1000000; it is-> 1000000

```

See also

- [Process and environment control](#)
- [_endthread](#) , [_endthreadex](#)
- [abort](#)
- [exit](#) , [_Exit](#) , [_exit](#)
- [GetExitCodeThread](#)

Bessel functions: `_j0`, `_j1`, `_jn`, `_y0`, `_y1`, `_yn`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the Bessel function of the first or second kind, of orders 0, 1, or n. The Bessel functions are commonly used in the mathematics of electromagnetic wave theory.

Syntax

```
double _j0(
    double x
);
double _j1(
    double x
);
double _jn(
    int n,
    double x
);
double _y0(
    double x
);
double _y1(
    double x
);
double _yn(
    int n,
    double x
);
```

Parameters

`x`

Floating-point value.

`n`

Integer order of Bessel function.

Return value

Each of these routines returns a Bessel function of `x`. If `x` is negative in the `_y0`, `_y1`, or `_yn` functions, the routine sets `errno` to `EDOM`, prints a `_DOMAIN` error message to `stderr`, and returns `HUGE_VAL`. You can modify error handling by using `_matherr`.

Remarks

The `_j0`, `_j1`, and `_jn` routines return Bessel functions of the first kind: orders 0, 1, and n, respectively.

INPUT	SEH EXCEPTION	<code>_MATHERR</code> EXCEPTION
$\pm \text{QNaN}, \text{IND}$	<code>INVALID</code>	<code>_DOMAIN</code>

The `_y0`, `_y1`, and `_yn` routines return Bessel functions of the second kind: orders 0, 1, and n, respectively.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	INVALID	_DOMAIN
± 0	ZERODIVIDE	_SING
$ x < 0.0$	INVALID	_DOMAIN

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_j0</code> , <code>_j1</code> , <code>_jn</code> , <code>_y0</code> , <code>_y1</code> , <code>_yn</code>	<cmath> (C++), <math.h> (C, C++)

For more compatibility information, see [Compatibility](#).

Example

```
// crt_bessel1.c
#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 2.387;
    int n = 3, c;

    printf( "Bessel functions for x = %f:\n", x );
    printf( "   Kind   Order   Function      Result\n\n" );
    printf( "   First  0       _j0( x )      %f\n", _j0( x ) );
    printf( "   First  1       _j1( x )      %f\n", _j1( x ) );
    for( c = 2; c < 5; c++ )
        printf( "   First %d       _jn( %d, x )  %f\n", c, c, _jn( c, x ) );
    printf( "   Second 0      _y0( x )      %f\n", _y0( x ) );
    printf( "   Second 1      _y1( x )      %f\n", _y1( x ) );
    for( c = 2; c < 5; c++ )
        printf( "   Second %d      _yn( %d, x )  %f\n", c, c, _yn( c, x ) );
}
```

```
Bessel functions for x = 2.387000:
   Kind   Order   Function      Result

   First  0       _j0( x )      0.009288
   First  1       _j1( x )      0.522941
   First  2       _jn( 2, x )   0.428870
   First  3       _jn( 3, x )   0.195734
   First  4       _jn( 4, x )   0.063131
   Second 0      _y0( x )      0.511681
   Second 1      _y1( x )      0.094374
   Second 2      _yn( 2, x )   -0.432608
   Second 3      _yn( 3, x )   -0.819314
   Second 4      _yn( 4, x )   -1.626833
```

See also

[Math and floating-point support](#)

[_matherr](#)

An alternative to the & operator.

Syntax

```
#define bitand &
```

Remarks

The macro yields the operator

Example

```
// iso646_bitand.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 1, b = 2, result;

    result = a & b;
    cout << result << endl;

    result= a bitand b;
    cout << result << endl;
}
```

```
0
0
```

Requirements

Header: <iso646.h>

An alternative to the `|` operator.

Syntax

```
#define bitor |
```

Remarks

The macro yields the operator `|`.

Example

```
// iso646_bitor.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 1, b = 2, result;

    result = a | b;
    cout << result << endl;

    result= a bitor b;
    cout << result << endl;
}
```

```
3
3
```

Requirements

Header: `<iso646.h>`

bsearch

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs a binary search of a sorted array. A more secure version of this function is available; see [bsearch_s](#).

Syntax

```
void *bsearch(
    const void *key,
    const void *base,
    size_t num,
    size_t width,
    int ( __cdecl *compare ) (const void *key, const void *datum)
);
```

Parameters

`key`

Pointer to the key to search for.

`base`

Pointer to the base of the search data.

`number`

Number of elements.

`width`

Width of elements.

`compare`

Callback function that compares two elements. The first is a pointer to the key for the search, and the second is a pointer to the array element to be compared with the key.

Return value

`bsearch` returns a pointer to an occurrence of `key` in the array pointed to by `base`. If `key` isn't found, the function returns `NULL`. If the array isn't in ascending sort order or contains duplicate records with identical keys, the result is unpredictable.

Remarks

The `bsearch` function performs a binary search of a sorted array of `number` elements, each of `width` bytes in size. The `base` value is a pointer to the base of the array to be searched, and `key` is the value being sought. The `compare` parameter is a pointer to a user-supplied routine that compares the requested key to an array element. It returns one of the following values that specify their relationship:

VALUE RETURNED BY <code>COMPARE</code> ROUTINE	DESCRIPTION
<code>< 0</code>	Key is less than array element.
<code>0</code>	Key is equal to array element.

VALUE RETURNED BY COMPARE ROUTINE	DESCRIPTION
> 0	Key is greater than array element.

This function validates its parameters. If `compare`, `key` or `number` is `NULL`, or if `base` is `NULL` and `number` is nonzero, or if `width` is zero, the function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>bsearch</code>	<code><stdlib.h></code> and <code><search.h></code>

For more compatibility information, see [Compatibility](#).

Example

This program sorts a string array with `qsort`, and then uses `bsearch` to find the word "cat".

```
// crt_bsearch.c
#include <search.h>
#include <string.h>
#include <stdio.h>

int compare( char **arg1, char **arg2 )
{
    /* Compare all of both strings: */
    return _strcmpl( *arg1, *arg2 );
}

int main( void )
{
    char *arr[] = {"dog", "pig", "horse", "cat", "human", "rat", "cow", "goat"};
    char **result;
    char *key = "cat";
    int i;

    /* Sort using Quicksort algorithm: */
    qsort( (void *)arr, sizeof(arr)/sizeof(arr[0]), sizeof( char * ), (int (*)(const void*, const void*))compare );

    for( i = 0; i < sizeof(arr)/sizeof(arr[0]); ++i )      /* Output sorted list */
        printf( "%s ", arr[i] );

    /* Find the word "cat" using a binary search algorithm: */
    result = (char **)bsearch( (char *) &key, (char *)arr, sizeof(arr)/sizeof(arr[0]),
                                sizeof( char * ), (int (*)(const void*, const void*))compare );
    if( result )
        printf( "\n%s found at %Fp\n", *result, result );
    else
        printf( "\nCat not found!\n" );
}
```

```
cat cow dog goat horse human pig rat
cat found at 002F0F04
```

See also

Searching and sorting

[_lfind](#)

[_lsearch](#)

[qsort](#)

bsearch_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Performs a binary search of a sorted array. This function is a version of `bsearch` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
void *bsearch_s(
    const void *key,
    const void *base,
    size_t number,
    size_t width,
    int ( __cdecl *compare ) ( void *, const void *key, const void *datum),
    void * context
);
```

Parameters

`key`

Pointer to the key to search for.

`base`

Pointer to the base of the search data.

`number`

Number of elements.

`width`

Width of elements.

`compare`

Callback function that compares two elements. The first argument is the `context` pointer. The second argument is a pointer to the `key` for the search. The third argument is a pointer to the array element to be compared with `key`.

`context`

A pointer to an object that can be accessed in the comparison function.

Return value

`bsearch_s` returns a pointer to an occurrence of `key` in the array pointed to by `base`. If `key` isn't found, the function returns `NULL`. If the array isn't in ascending sort order or contains duplicate records with identical keys, the result is unpredictable.

If invalid parameters are passed to the function, it invokes the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Error conditions

KEY	BASE	COMPARE	NUMBER	WIDTH	ERRNO VALUE
NULL	any	any	any	any	EINVAL
any	NULL	any	!= 0	any	EINVAL
any	any	any	any	= 0	EINVAL
any	any	NULL	an	any	EINVAL

Remarks

The `bsearch_s` function performs a binary search of a sorted array of `number` elements, each of `width` bytes in size. The `base` value is a pointer to the base of the array to be searched, and `key` is the value being sought. The `compare` parameter is a pointer to a user-supplied routine that compares the requested key to an array element and returns one of the following values specifying their relationship:

VALUE RETURNED BY COMPARE ROUTINE	DESCRIPTION
< 0	Key is less than array element.
0	Key is equal to array element.
> 0	Key is greater than array element.

The `context` pointer may be useful if the searched data structure is part of an object, and the compare function needs to access members of the object. The `compare` function may cast the void pointer into the appropriate object type and access members of that object. The addition of the `context` parameter makes `bsearch_s` more secure, since the context may be used to avoid reentrancy bugs associated with using static variables to make data available to the `compare` function.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>bsearch_s</code>	<code><stdlib.h></code> and <code><search.h></code>

For more compatibility information, see [Compatibility](#).

Example

This program sorts a string array with `qsort_s`, and then uses `bsearch_s` to find the word "cat".

```
// crt_bsearch_s.cpp
// This program uses bsearch_s to search a string array,
// passing a locale as the context.
// compile with: /EHsc
#include <stdlib.h>
#include <stdio.h>
#include <search.h>
#include <process.h>
```

```

#include <process.h>
#include <locale.h>
#include <locale>
#include <windows.h>
using namespace std;

// The sort order is dependent on the code page. Use 'chcp' at the
// command line to change the codepage. When executing this application,
// the command prompt codepage must match the codepage used here:

#define CODEPAGE_850

#ifndef CODEPAGE_850
#define ENGLISH_LOCALE "English_US.850"
#endif

#ifndef CODEPAGE_1252
#define ENGLISH_LOCALE "English_US.1252"
#endif

// The context parameter lets you create a more generic compare.
// Without this parameter, you would have stored the locale in a
// static variable, thus making it vulnerable to thread conflicts
// (if this were a multithreaded program).

int compare( void *pvlocale, char **str1, char **str2)
{
    char *s1 = *str1;
    char *s2 = *str2;

    locale& loc = *( reinterpret_cast< locale * > ( pvlocale));

    return use_facet< collate<char> >(loc).compare(
        s1, s1+strlen(s1),
        s2, s2+strlen(s2) );
}

int main( void )
{
    char *arr[] = {"dog", "pig", "horse", "cat", "human", "rat", "cow", "goat"};

    char *key = "cat";
    char **result;
    int i;

    /* Sort using Quicksort algorithm: */
    qsort_s( arr,
              sizeof(arr)/sizeof(arr[0]),
              sizeof( char * ),
              (int (*)(void*, const void*, const void*))compare,
              &locale(ENGLISH_LOCALE) );

    for( i = 0; i < sizeof(arr)/sizeof(arr[0]); ++i )      /* Output sorted list */
        printf( "%s ", arr[i] );

    /* Find the word "cat" using a binary search algorithm: */
    result = (char **)bsearch_s( &key,
                                arr,
                                sizeof(arr)/sizeof(arr[0]),
                                sizeof( char * ),
                                (int (*)(void*, const void*, const void*))compare,
                                &locale(ENGLISH_LOCALE) );

    if( result )
        printf( "\n%s found at %Fp\n", *result, result );
    else
        printf( "\nCat not found!\n" );
}

```

```
cat cow dog goat horse human pig rat
cat found at 002F0F04
```

See also

Searching and sorting

[_lfind](#)

[_lsearch](#)

[qsort](#)

Determine whether an integer represents a valid single-byte character in the initial shift state.

Syntax

```
wint_t btowc(  
    int character  
)
```

Parameters

character

Integer to test.

Return value

Returns the wide-character representation of the character if the integer represents a valid single-byte character in the initial shift state. Returns `WEOF` if the integer is `EOF` or isn't a valid single-byte character in the initial shift state. The output of this function is affected by the current `LC_TYPE` locale.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>btowc</code>	<code><stdio.h></code> or <code><wcharh></code>

For more compatibility information, see [Compatibility](#).

See also

[mbtowc](#) , [_mbtowc_1](#)

`_byteswap_ushort`, `_byteswap_ulong`,
`_byteswap_uint64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reverses the order of bytes in an integer.

Syntax

```
unsigned short _byteswap_ushort ( unsigned short val );
unsigned long _byteswap_ulong ( unsigned long val );
unsigned __int64 _byteswap_uint64 ( unsigned __int64 val );
```

Parameters

`val`

The integer to reverse byte order.

Requirements

ROUTINE	REQUIRED HEADER
<code>_byteswap_ushort</code>	<code><stdlib.h></code>
<code>_byteswap_ulong</code>	<code><stdlib.h></code>
<code>_byteswap_uint64</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_bytesswap.c
#include <stdlib.h>

int main()
{
    unsigned __int64 u64 = 0x0102030405060708;
    unsigned long ul = 0x01020304;

    printf("byteswap of %I64x = %I64x\n", u64, _byteswap_uint64(u64));
    printf("byteswap of %Ix = %Ix", ul, _byteswap_ulong(ul));
}
```

```
byteswap of 102030405060708 = 807060504030201
byteswap of 1020304 = 4030201
```

See also

Universal C runtime routines by category

c16rtomb , c32rtomb

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert a UTF-16 or UTF-32 wide character into a UTF-8 multibyte character.

Syntax

```
size_t c16rtomb(
    char *mbchar,
    char16_t wchar,
    mbstate_t *state
);
size_t c32rtomb(
    char *mbchar,
    char32_t wchar,
    mbstate_t *state
);
```

Parameters

`mbchar`

Pointer to an array to store the converted UTF-8 multibyte character.

`wchar`

A wide character to convert.

`state`

A pointer to an `mbstate_t` object.

Return value

The number of bytes stored in array object `mbchar`, including any shift sequences. If `wchar` isn't a valid wide character, the value (`size_t`)(-1) is returned, `errno` is set to `EILSEQ`, and the value of `state` is unspecified.

Remarks

The `c16rtomb` function converts the UTF-16 LE character `wchar` to the equivalent UTF-8 multibyte narrow character sequence. If `mbchar` isn't a null pointer, the function stores the converted sequence in the array object pointed to by `mbchar`. Up to `MB_CUR_MAX` bytes are stored in `mbchar`, and `state` is set to the resulting multibyte shift state.

If `wchar` is a null wide character, a sequence required to restore the initial shift state is stored, if needed, followed by the null character. `state` is set to the initial conversion state. The `c32rtomb` function is identical, but converts a UTF-32 character.

If `mbchar` is a null pointer, the behavior is equivalent to a call to the function that substitutes an internal buffer for `mbchar` and a wide null character for `wchar`.

The `state` conversion state object allows you to make subsequent calls to this function and other restartable functions that maintain the shift state of the multibyte output characters. Results are undefined when you mix the use of restartable and non-restartable functions.

To convert UTF-16 characters into non-UTF-8 multibyte characters, use the `wcstombs` , `_wcstombs_1` ,

`wcstombs_s`, or `_wcstombs_s_l` functions.

Requirements

ROUTINE	REQUIRED HEADER
<code>c16rtomb</code> , <code>c32rtomb</code>	C, C++: <uchar.h>

For compatibility information, see [Compatibility](#).

See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`mbrtoc16` , `mbrtoc32`

`wcrtomb`

`wcrtomb_s`

`cabs`, `cabsf`, `cabsl`

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Retrieves the absolute value of a complex number.

Syntax

```
double cabs(
    _Dcomplex z
);
float cabs(
    _Fcomplex z
); // C++ only
long double cabs(
    _Lcomplex z
); // C++ only
float cabsf(
    _Fcomplex z
);
long double cabsl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number.

Return value

The absolute value of `z`.

Remarks

Because C++ allows overloading, you can call overloads of `cabs` that take `_Fcomplex` or `_Lcomplex` values, and return `float` or `long double` values. In a C program, `cabs` always takes a `_Dcomplex` value and returns a `double` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cabs</code> , <code>cabsf</code> , <code>cabsl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`norm`, `normf`, `norml`
`creal`, `crealf`, `creall`
`cproj`, `cprojf`, `cprojl`

`conj`, `conjf`, `conjl`

`cimag`, `cimagf`, `cimagl`

`carg`, `cargf`, `cargl`

_cabs

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Calculates the absolute value of a complex number.

Syntax

```
double _cabs(
    struct _complex z
);
```

Parameters

`z`

Complex number.

Return value

`_cabs` returns the absolute value of its argument if successful. On overflow, `_cabs` returns `HUGE_VAL` and sets `errno` to `ERANGE`. You can change error handling with `_matherr`.

Remarks

The `_cabs` function calculates the absolute value of a complex number, which must be a structure of type `_complex`. The structure `z` is composed of a real component `x` and an imaginary component `y`. A call to `_cabs` produces a value equivalent to that of the expression `sqrt(z.x * z.x + z.y * z.y)`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_cabs</code>	<code><math.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cabs.c
// Using _cabs, this program calculates
// the absolute value of a complex number.

#include <math.h>
#include <stdio.h>

int main( void )
{
    struct _complex number = { 3.0, 4.0 };
    double d;

    d = _cabs( number );
    printf( "The absolute value of %f + %fi is %f\n",
           number.x, number.y, d );
}
```

```
The absolute value of 3.000000 + 4.000000i is 5.000000
```

See also

[Math and floating-point support](#)

[abs](#) , [labs](#) , [llabs](#) , [_abs64](#)
[fabs](#) , [fabsf](#) , [fabsl](#)

`cacos`, `cacosf`, `cacosl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the arccosine of a complex number, with branch cuts outside the interval [-1, +1] along the real axis.

Syntax

```
_Dcomplex cacos( _Dcomplex z );
_Fcomplex cacosf( _Fcomplex z );
_Lcomplex cacosl( _Lcomplex z );
```

```
_Fcomplex cacos( _Fcomplex z ); // C++ only
_Lcomplex cacos( _Lcomplex z ); // C++ only
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The arc cosine of `z`, in radians. The result is unbounded along the imaginary axis, and bounded in the interval [0, π] along the real axis. A domain error will occur if `z` is outside the interval [-1, +1].

Remarks

Because C++ allows overloading, you can call overloads of `cacos` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `cacos` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cacos</code> , <code>cacosf</code> , <code>cacosl</code>	<complex.h>	<ccomplex>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`catanh`, `catanhf`, `catanh1`
`ctanh`, `ctanhf`, `ctanh1`
`catan`, `catanf`, `catanl`
`csinh`, `csinhf`, `csinhl`
`casinh`, `casinhf`, `casinhl`
`ccosh`, `ccoshf`, `ccosh1`
`cacosh`, `cacosf`, `cacoshl`
`ctan`, `ctanf`, `ctanl`

`csin`, `csinf`, `csinl`

`casin`, `casinf`, `casinl`

`ccos`, `ccosf`, `ccosl`

`csqrt`, `csqrft`, `csqr tl`

`cacosh` , `cacoshf` , `cacoshl`

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Retrieves the inverse hyperbolic cosine of a complex number with a branch cut at values less than 1 along the real axis.

Syntax

```
_Dcomplex cacosh(
    _Dcomplex z
);
_Fcomplex cacosh(
    _Fcomplex z
); // C++ only
_Lcomplex cacosh(
    _Lcomplex z
); // C++ only
_Fcomplex cacoshf(
    _Fcomplex z
);
_Lcomplex cacoshl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The inverse hyperbolic cosine of `z`, in radians. The result is unbounded and non-negative along the real axis, and in the interval $[-i\pi, +i\pi]$ along the imaginary axis.

Remarks

Because C++ allows overloading, you can call overloads of `cacosh` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `cacosh` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cacosh</code> , <code>cacoshf</code> , <code>cacoshl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`catanh` , `catanhf` , `catanhl`
`ctanh` , `ctanhf` , `ctanhhl`

<code>catan</code>	<code>catanf</code>	<code>catanl</code>
<code>csinh</code>	<code>csinhf</code>	<code>csinhl</code>
<code>casinh</code>	<code>casinhf</code>	<code>casinhl</code>
<code>ccosh</code>	<code>ccoshf</code>	<code>ccoshl</code>
<code>cacos</code>	<code>cacosf</code>	<code>cacosl</code>
<code>ctan</code>	<code>ctanf</code>	<code>ctanl</code>
<code>csin</code>	<code>csinf</code>	<code>csinl</code>
<code>casin</code>	<code>casinf</code>	<code>casinl</code>
<code>ccos</code>	<code>ccosf</code>	<code>ccosl</code>
<code>csqrt</code>	<code>csqrft</code>	<code>csqrtl</code>

_callnewh

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Calls the currently installed `new` handler.

Syntax

```
int _callnewh(  
    size_t size  
)
```

Parameters

`size`

The amount of memory that the `new` operator tried to allocate.

Return value

VALUE	DESCRIPTION
0	Failure: Either no <code>new</code> handler is installed or no <code>new</code> handler is active.
1	Success: The <code>new</code> handler is installed and active. The memory allocation can be retried.

Exceptions

This function throws `bad_alloc` if the `new` handler can't be located.

Remarks

The `new` handler is called if the `new` operator fails to successfully allocate memory. The `new` handler might then initiate some appropriate action, such as freeing memory so that subsequent allocations succeed.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_callnewh</code>	internal.h

See also

[_set_new_handler](#)
[_set_new_mode](#)

calloc

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Allocates an array in memory with elements initialized to 0.

Syntax

```
void *calloc(  
    size_t number,  
    size_t size  
)
```

Parameters

`number`

Number of elements.

`size`

Length in bytes of each element.

Return value

`calloc` returns a pointer to the allocated space. The storage space pointed to by the return value is suitably aligned for storage of any type of object. To get a pointer to a type other than `void`, use a type cast on the return value.

Remarks

The `calloc` function allocates storage space for an array of `number` elements, each of length `size` bytes. Each element is initialized to 0.

`calloc` sets `errno` to `ENOMEM` if a memory allocation fails or if the amount of memory requested exceeds `_HEAP_MAXREQ`. For information on this and other error codes, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#).

In the Microsoft implementation, if `number` or `size` is zero, `calloc` returns a pointer to an allocated block of non-zero size. An attempt to read or write through the returned pointer leads to undefined behavior.

`calloc` uses the C++ `_set_new_mode` function to set the *new handler mode*. The new handler mode indicates whether, on failure, `calloc` is to call the new handler routine as set by `_set_new_handler`. By default, `calloc` doesn't call the new handler routine on failure to allocate memory. You can override this default behavior so that, when `calloc` fails to allocate memory, it calls the new handler routine in the same way that the `new` operator does when it fails for the same reason. To override the default, call

```
_set_new_mode(1);
```

early in your program, or link with `NEWMODE.OBJ` (see [Link options](#)).

When the application is linked with a debug version of the C run-time libraries, `calloc` resolves to `_calloc_dbg`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

`calloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables, and that the pointer returned isn't aliased. For more information, see [noalias](#) and [restrict](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>calloc</code>	<code><stdlib.h></code> and <code><malloc.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_malloc.c
// This program uses malloc to allocate space for
// 40 long integers. It initializes each element to zero.

#include <stdio.h>
#include <malloc.h>

int main( void )
{
    long *buffer;

    buffer = (long *)calloc( 40, sizeof( long ) );
    if( buffer != NULL )
        printf( "Allocated 40 long integers\n" );
    else
        printf( "Can't allocate memory\n" );
    free( buffer );
}
```

```
Allocated 40 long integers
```

See also

Memory allocation

[free](#)
[malloc](#)
[realloc](#) \

_calloc_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates memory blocks in the heap with extra space for a debugging header and overwrite buffers (debug version only).

Syntax

```
void *_calloc_dbg(  
    size_t num,  
    size_t size,  
    int blockType,  
    const char *filename,  
    int linenumber  
) ;
```

Parameters

`number`

Requested number of memory blocks.

`size`

Requested size of each memory block (bytes).

`blockType`

Requested type of memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#).

`filename`

Pointer to name of the source file that requested allocation operation or `NULL`.

`linenumber`

Line number in the source file where allocation operation was requested or `NULL`.

The `filename` and `linenumber` parameters are only available when `_calloc_dbg` has been called explicitly or the `_CRTDBG_MAP_ALLOC` preprocessor constant has been defined.

Return value

On successful completion, this function returns a pointer to the user portion of the last allocated memory block, calls the new handler function, or returns `NULL`. For a complete description of the return behavior, see the Remarks section. For more information about how the new handler function is used, see the `calloc` function.

Remarks

`_calloc_dbg` is a debug version of the `calloc` function. When `_DEBUG` isn't defined, each call to `_calloc_dbg` is reduced to a call to `calloc`. Both `calloc` and `_calloc_dbg` allocate `number` memory blocks in the base heap, but `_calloc_dbg` offers several debugging features:

- Buffers on either side of the user portion of the block to test for leaks.
- A block type parameter to track specific allocation types.

- `filename / Linenumber` information to determine the origin of allocation requests.

`_calloc_dbg` allocates each memory block with slightly more space than the requested `size`. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. When the block is allocated, the user portion of the block is filled with the value 0xCD, and each of the overwrite buffers are filled with 0xFD.

`_calloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails; `EINVAL` is returned if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the differences between calling a standard heap function and the debug version, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_calloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_mallocd.c
// This program uses _calloc_dbg to allocate space for
// 40 long integers. It initializes each element to zero.

#include <stdio.h>
#include <malloc.h>
#include <crtdbg.h>

int main( void )
{
    long *bufferN, *bufferC;

    // Call _calloc_dbg to include the filename and line number
    // of our allocation request in the header and also so we can
    // allocate CLIENT type blocks specifically
    bufferN = (long *)_calloc_dbg( 40, sizeof(long), _NORMAL_BLOCK, __FILE__, __LINE__ );
    bufferC = (long *)_calloc_dbg( 40, sizeof(long), _CLIENT_BLOCK, __FILE__, __LINE__ );
    if( bufferN != NULL && bufferC != NULL )
        printf( "Allocated memory successfully\n" );
    else
        printf( "Problem allocating memory\n" );

    / _free_dbg must be called to free CLIENT type blocks
    free( bufferN );
    _free_dbg( bufferC, _CLIENT_BLOCK );
}
```

```
Allocated memory successfully
```

See also

[Debug routines](#)

`calloc`

`_malloc_dbg`

`_DEBUG`

`carg`, `cargf`, `cargl`

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Retrieves the argument of a complex number, with a branch cut along the negative real axis.

Syntax

```
double carg(
    _Dcomplex z
);
float carg(
    _Fcomplex z
); // C++ only
long double carg(
    _Lcomplex z
); // C++ only
float cargf(
    _Fcomplex z
);
long double cargl(
    _Lcomplex z
);
#define carg(X) // Requires C11 or higher
```

Parameters

`z`

A complex number.

Return value

The argument (also known as the phase) of `z`. The result is in the interval $[-\pi, +\pi]$.

Remarks

Because C++ allows overloading, you can call overloads of `carg` that take `_Fcomplex` or `_Lcomplex` values, and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `carg` always takes a `_Dcomplex` value and returns a `double` value.

If you use the `<tgmath.h>` `carg()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>carg</code> , <code>cargf</code> , <code>cargl</code>	<code><complex.h></code>	<code><ccomplex></code>
<code>carg</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[norm](#), [normf](#), [norml](#)
[creal](#), [crealf](#), [creall](#)
[cproj](#), [cprojf](#), [cprojl](#)
[conj](#), [conjf](#), [conjl](#)
[cimag](#), [cimagf](#), [cimagl](#)
[cabs](#), [cabsf](#), [cabsl](#)

`casin`, `casinf`, `casinl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the arcsine of a complex number, with branch cuts outside the interval [-1, +1] along the real axis.

Syntax

```
_Dcomplex casin(
    _Dcomplex z
);
_Fcomplex casin(
    _Fcomplex z
); // C++ only
_Lcomplex casin(
    _Lcomplex z
); // C++ only
_Fcomplex casinf(
    _Fcomplex z
);
_Lcomplex casinl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The arcsine of `z`, in radians. The result is unbounded along the imaginary axis, and in the interval [- $\pi/2$, + $\pi/2$] along the real axis.

Remarks

Because C++ allows overloading, you can call overloads of `casin` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `casin` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>casin</code> , <code>casinf</code> , <code>casinl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`catanh`, `catanhf`, `catanhl`

`ctanh`, `ctanhf`, `ctanhl`

`catan`, `catanf`, `catanl`

```
csinh , csinhf , csinhl  
casinh , casinhf , casinhl  
ccosh , ccoshf , ccoshl  
cacosh , cacoshf , cacoshl  
cacos , cacosf , cacosl  
ctan , ctanf , ctanl  
csin , csinf , csinl  
ccos , ccosf , ccosl  
csqrt , csqrtf , csqrnl
```

`casinh`, `casinhf`, `casinhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the inverse hyperbolic sine of a complex number, with branch cuts outside the interval $[-i, +i]$ along the imaginary axis.

Syntax

```
_Dcomplex casinh(
    _Dcomplex z
);
_Fcomplex casinh(
    _Fcomplex z
); // C++ only
_Lcomplex casinh(
    _Lcomplex z
); // C++ only
_Fcomplex casinhf(
    _Fcomplex z
);
_Lcomplex casinhl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The inverse hyperbolic sine of `z`, in radians. The result is unbound along the real axis, and in the interval $[-i\pi/2, +i\pi/2]$ along the imaginary axis.

Remarks

Because C++ allows overloading, you can call overloads of `casinh` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `casinh` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>casinh</code> , <code>casinhf</code> , <code>casinhl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`catanh`, `catanhf`, `catanhl`

`ctanh`, `ctanhf`, `ctanhl`

<code>catan</code>	<code>catanf</code>	<code>catanl</code>
<code>csinh</code>	<code>csinhf</code>	<code>csinhl</code>
<code>ccosh</code>	<code>ccoshf</code>	<code>ccoshl</code>
<code>cacosh</code>	<code>cacoshf</code>	<code>cacoshl</code>
<code>cacos</code>	<code>cacosf</code>	<code>cacosl</code>
<code>ctan</code>	<code>ctanf</code>	<code>ctanl</code>
<code>csin</code>	<code>csinf</code>	<code>csinl</code>
<code>casin</code>	<code>casinf</code>	<code>casinl</code>
<code>ccos</code>	<code>ccosf</code>	<code>ccosl</code>
<code>csqrt</code>	<code>csqrft</code>	<code>csqrtl</code>

`catan`, `catanf`, `catanl`

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Retrieves the arctangent of a complex number with branch cuts outside the interval [-1; +1] along the imaginary axis.

Syntax

```
_Dcomplex catan( _Dcomplex z );
_Fcomplex catanf( _Fcomplex z );
_Lcomplex catanl( _Lcomplex z );
```

```
_Fcomplex catan( _Fcomplex z ); // C++ only
_Lcomplex catan( _Lcomplex z ); // C++ only
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The arctangent of `z`, in radians. The result is unbounded along the imaginary axis, and in the interval [- $\pi/2$; + $\pi/2$] along the real axis.

Remarks

Because C++ allows overloading, you can call overloads of `catan` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `catan` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>catan</code> , <code>catanf</code> , <code>catanl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`catanh`, `catanhf`, `catanhl`
`ctanh`, `ctanhf`, `ctanhl`
`csinh`, `csinhf`, `csinhl`
`casinh`, `casinhf`, `casinhl`
`ccosh`, `ccoshf`, `ccoshl`
`cacosh`, `cacoshf`, `cacoshl`
`cacos`, `cacosf`, `cacosl`

<code>ctan</code>	<code>ctanf</code>	<code>ctanl</code>
<code>csin</code>	<code>csinf</code>	<code>csinl</code>
<code>casin</code>	<code>casinf</code>	<code>casinl</code>
<code>ccos</code>	<code>ccosf</code>	<code>ccosl</code>
<code>csqrt</code>	<code>csqrtf</code>	<code>csqrta</code>

`catanh`, `catanhf`, `catanhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the inverse hyperbolic tangent of a complex number, with branch cuts outside the interval [-1; +1] along the real axis.

Syntax

```
_Dcomplex catanh(
    _Dcomplex z
);
_Fcomplex catanh(
    _Fcomplex z
); // C++ only
_Lcomplex catanh(
    _Lcomplex z
); // C++ only
_Fcomplex catanhf(
    _Fcomplex z
);
_Lcomplex catanhl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The inverse hyperbolic tangent of `z`, in radians. The result is unbounded along the real axis, and in the interval $[-i\pi/2; +i\pi/2]$ along the imaginary axis. A domain error will occur if `z` is outside the interval [-1, +1]. A pole error will occur if `z` is -1 or +1.

Remarks

Because C++ allows overloading, you can call overloads of `catanh` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `catanh` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>catanh</code> , <code>catanhf</code> , <code>catanhl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`ctanh`, `ctanhf`, `ctanhl`

<code>catan</code>	<code>catanf</code>	<code>catanl</code>
<code>csinh</code>	<code>csinhf</code>	<code>csinhl</code>
<code>casinh</code>	<code>casinhf</code>	<code>casinhl</code>
<code>ccosh</code>	<code>ccoshf</code>	<code>ccoshl</code>
<code>cacosh</code>	<code>cacoshf</code>	<code>cacoshl</code>
<code>cacos</code>	<code>cacosf</code>	<code>cacosl</code>
<code>ctan</code>	<code>ctanf</code>	<code>ctanl</code>
<code>csin</code>	<code>csinf</code>	<code>csinl</code>
<code>casin</code>	<code>casinf</code>	<code>casinl</code>
<code>ccos</code>	<code>ccosf</code>	<code>ccosl</code>
<code>csqrt</code>	<code>csqrtf</code>	<code>csqrta</code>

`cbrt`, `cbrtf`, `cbrtl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the cube root.

Syntax

```
double cbrt(
    double x
);
float cbrt(
    float x
); // C++ only
long double cbrel(
    long double x
); // C++ only
float cbrtf(
    float x
);
long double cbrel(
    long double x
);
#define cbrt(X) // Requires C11 or higher
```

Parameters

`x`

Floating-point value

Return value

The `cbrt` functions return the cube-root of `x`.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
<code>± INF, QNaN, IND</code>	none	none

Remarks

Because C++ allows overloading, you can call overloads of `cbrt` that take `float` or `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `cbrt` always takes and returns `double`.

If you use the `<tgmath.h>` `cbrt()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>cbrt</code> , <code>cbrtf</code> , <code>cbrtl</code>	<code><math.h></code>	<code><cmath></code>
<code>cbrt</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cbrt.c
// Compile using: cl /W4 crt_cbrt.c
// This program calculates a cube root.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double question = -64.64;
    double answer;

    answer = cbrt(question);
    printf("The cube root of %.2f is %.6f\n", question, answer);
}
```

The cube root of -64.64 is -4.013289

See also

[Math and floating-point support](#)

<code>exp</code>	<code>expf</code>	<code>expl</code>
<code>log</code>	<code>logf</code>	<code>log10</code>
<code>log10</code>	<code>log10f</code>	
<code>pow</code>	<code>powf</code>	<code>powl</code>

`_Cbuild`, `_FCbuild`, `_LCbuild`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Constructs a complex number from real and imaginary parts.

Syntax

```
_Dcomplex _Cbuild( double real, double imaginary );
_Fcomplex _FCbuild( float real, float imaginary );
_Lcomplex _LCbuild( long double real, long double imaginary );
```

Parameters

`real`

The real part of the complex number to construct.

`imaginary`

The imaginary part of the complex number to construct.

Return value

A `_Dcomplex`, `_Fcomplex`, or `_Lcomplex` structure that represents the complex number (`real`, `imaginary` * i) for values of the specified floating-point type.

Remarks

The `_Cbuild`, `_FCbuild`, and `_LCbuild` functions simplify creation of complex types. Use the `creal`, `crealf`, `creall` and `cimag`, `cimaf`, `cimagl` functions to retrieve the real and imaginary portions of the represented complex numbers.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>_Cbuild</code> , <code>_FCbuild</code> , <code>_LCbuild</code>	<complex.h>	<ccomplex>

These functions are Microsoft-specific. The types `_Dcomplex`, `_Fcomplex`, and `_Lcomplex` are Microsoft-specific equivalents to the unimplemented C99 native types `double _Complex`, `float _Complex`, and `long double _Complex`, respectively. For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`_Cmulcc`, `_FCmulcc`, `_LCmulcc`
`_Cmulcr`, `_FCmulcr`, `_LCmulcr`
`norm`, `normf`, `norml`
`cproj`, `cprojf`, `cprojl`
`conj`, `conjf`, `conjl`
`creal`, `crealf`, `creall`

[cimag](#), [cimagf](#), [cimagl](#)

[carg](#), [cargf](#), [cargl](#)

[cabs](#), [cabsf](#), [cabsl](#)

`ccos`, `ccosf`, `ccosl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the cosine of a complex number.

Syntax

```
_Dcomplex ccos(
    _Dcomplex z
);
_Fcomplex ccos(
    _Fcomplex z
); // C++ only
_Lcomplex ccos(
    _Lcomplex z
); // C++ only
_Fcomplex ccosf(
    _Fcomplex z
);
_Lcomplex ccosl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents the angle, in radians.

Return value

The cosine of `z`, in radians.

Remarks

Because C++ allows overloading, you can call overloads of `ccos` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `ccos` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>ccos</code> , <code>ccosf</code> , <code>ccosl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`catanh`, `cataanhf`, `cataanh1`
`ctanh`, `ctanhf`, `ctanh1`
`catan`, `catanf`, `catanl`
`csinh`, `csinhf`, `csinhl`

casinh	casinhf	casinhl
ccosh	ccoshf	ccoshl
cacosh	cacoshf	cacoshl
cacos	cacosf	cacosl
ctan	ctanf	ctanl
csin	csinf	csinl
casin	casinf	casinl
csqrt	csqrta	csqrta

`ccosh`, `ccoshf`, `ccoshl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the hyperbolic cosine of a complex number.

Syntax

```
_Dcomplex ccosh(
    _Dcomplex z
);
_Fcomplex ccosh(
    _Fcomplex z
); // C++ only
_Lcomplex ccosh(
    _Lcomplex z
); // C++ only
_Fcomplex ccoshf(
    _Fcomplex z
);
_Lcomplex ccoshl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents the angle, in radians.

Return value

The hyperbolic cosine of `z`, in radians.

Remarks

Because C++ allows overloading, you can call overloads of `ccosh` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `ccosh` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>ccosh</code> , <code>ccoshf</code> , <code>ccoshl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`catanh`, `catanhf`, `catanhl`
`ctanh`, `ctanhf`, `ctanhl`
`catan`, `catanf`, `catanl`
`csinh`, `csinhf`, `csinhl`

casinh	casinhf	casinhl
cacosh	cacoshf	cacoshl
cacos	cacosf	acosl
ctan	ctanf	ctanl
csin	csinf	csinl
casin	casinf	casinl
ccos	ccosf	ccosl
csqrt	csqrtf	csqr1

`ceil`, `ceilf`, `ceill`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the ceiling of a value.

Syntax

```
double ceil(
    double x
);
float ceil(
    float x
); // C++ only
long double ceil(
    long double x
); // C++ only
float ceilf(
    float x
);
long double ceill(
    long double x
);
#define ceil(X) // Requires C11 or higher
```

Parameters

`x`

Floating-point value.

Return value

The `ceil` functions return a floating-point value that represents the smallest integer that is greater than or equal to `x`. There's no error return.

INPUT	SEH EXCEPTION	<code>_MATHERR</code> EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

`ceil` has an implementation that uses Streaming SIMD Extensions 2 (SSE2). For information and restrictions about using the SSE2 implementation, see [`_set_SSE2_enable`](#).

Remarks

Because C++ allows overloading, you can call overloads of `ceil` that take `float` or `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `ceil` always takes and returns a `double`.

If you use the `<tgmath.h>` `ceil()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this state, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>ceil</code> , <code>ceilf</code> , <code>ceill</code>	<code><math.h></code>
<code>ceil</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`floor`](#).

See also

[Math and floating-point support](#)

<code>floor</code> , <code>floorf</code> , <code>floorl</code>
<code>fmod</code> , <code>fmodf</code>
<code>round</code> , <code>roundf</code> , <code>roundl</code>

`_cexit`, `_c_exit`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs cleanup operations and returns without terminating the process.

Syntax

```
void _cexit( void );
void _c_exit( void );
```

Remarks

The `_cexit` function calls, in last-in, first-out (LIFO) order, the functions registered by `atexit` and `_onexit`. Then `_cexit` flushes all I/O buffers and closes all open streams before returning. `_c_exit` is the same as `_exit` but returns to the calling process without processing `atexit` or `_onexit` or flushing stream buffers. The behavior of `exit`, `_exit`, `_cexit`, and `_c_exit` is shown in the following table.

FUNCTION	BEHAVIOR
<code>exit</code>	Performs complete C library termination procedures, terminates process, and exits with supplied status code.
<code>_exit</code>	Performs quick C library termination procedures, terminates process, and exits with supplied status code.
<code>_cexit</code>	Performs complete C library termination procedures and returns to caller, but doesn't terminate process.
<code>_c_exit</code>	Performs quick C library termination procedures and returns to caller, but doesn't terminate process.

When you call the `_cexit` or `_c_exit` functions, the destructors for any temporary or automatic objects that exist at the time of the call aren't called. An automatic object is an object that is defined in a function where the object isn't declared to be static. A temporary object is an object created by the compiler. To destroy an automatic object before calling `_cexit` or `_c_exit`, explicitly call the destructor for the object, as follows:

```
myObject.myClass::~myClass( );
```

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_cexit</code>	<process.h>

ROUTINE	REQUIRED HEADER
<code>_c_exit</code>	<process.h>

For more compatibility information, see [Compatibility](#).

See also

Process and environment control

[abort](#)
[atexit](#)
[_exec](#), [_wexec](#) functions
[exit](#), [_Exit](#), [_exit](#)
[_onexit](#), [_onexit_m](#)
[_spawn](#), [_wspawn](#) functions
[system](#), [_wsystem](#)

`cexp`, `cexpf`, `cexpl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Compute the base-e exponential of a complex number.

Syntax

```
_Dcomplex cexp( _Dcomplex z );
_Fcomplex cexpf( _Fcomplex z );
_Lcomplex cexpl( _Lcomplex z );

_Fcomplex cexp( _Fcomplex z ); // C++ only
_Lcomplex cexp( _Lcomplex z ); // C++ only
```

Parameters

`z`

A complex number that represents the exponent.

Return value

The value of e raised to the power of `z`.

Remarks

Because C++ allows overloading, you can call overloads of `cexp` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `cexp` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cexp</code> , <code>cexpf</code> , <code>cexpl</code>	<code><complex.h></code>	<code><complex.h></code>

For compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`cpow`, `cpowf`, `cpowl`
`clog10`, `clog10f`, `clog10l`
`clog`, `clogf`, `clogl`

cgets

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `cgets` is a deprecated alias for the `_cgets` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use the security-enhanced `_cgets_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_cgets_s`, `_cgetws_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a character string from the console. These versions of `_cgets` and `_cgetws` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _cgets_s(
    char *buffer,
    size_t numberOfElements,
    size_t *pSizeRead
);
errno_t _cgetws_s(
    wchar_t *buffer
    size_t numberOfElements,
    size_t *pSizeRead
);
template <size_t size>
errno_t _cgets_s(
    char (&buffer)[size],
    size_t *pSizeRead
); // C++ only
template <size_t size>
errno_t _cgetws_s(
    wchar_t (&buffer)[size],
    size_t *pSizeRead
); // C++ only
```

Parameters

`buffer`

Storage location for data.

`numberOfElements`

The size of the buffer in single-byte or wide characters, which is also the maximum number of characters to be read.

`pSizeRead`

The number of characters actually read.

Return value

The return value is zero if successful; otherwise, an error code if a failure occurs.

Error conditions

BUFFER	NUMBEROFELEMENTS	PSIZEREAD	RETURN	CONTENTS OF BUFFER
NULL	any	any	EINVAL	n/a
not NULL	zero	any	EINVAL	not modified
not NULL	any	NULL	EINVAL	zero-length string

Remarks

`_cgets_s` and `_cgetws_s` read a string from the console and copy the string (with a null terminator) into `buffer`. `_cgetws_s` is the wide character version of the function; other than the character size, the behavior of these two functions is identical. The maximum size of the string to be read is passed in as the `numberOfElements` parameter. This size should include an extra character for the terminating null. The actual number of characters read is placed in `pSizeRead`.

If an error occurs during the operation or in the validating of the parameters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and `EINVAL` is returned.

In C++, the use of these functions is simplified by template overloads. The overloads can infer buffer length automatically, which eliminates the need to specify a size argument. They can also automatically replace older, less-secure functions with their newer, more secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_cgetts_s</code>	<code>_cgets_s</code>	<code>_cgets_s</code>	<code>_cgetws_s</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cgets_s</code>	<code><conio.h></code>
<code>_cgetws_s</code>	<code><conio.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Console and port I/O](#)

`_getch` , `_getwch`

chdir

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `chdir` is a deprecated alias for the `_chdir` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_chdir` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_chdir`, `_wchdir`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the current working directory.

Syntax

```
int _chdir(
    const char *dirname
);
int _wchdir(
    const wchar_t *dirname
);
```

Parameters

`dirname`

Path of new working directory.

Return value

These functions return a value of 0 if successful. A return value of -1 indicates failure. If the specified path couldn't be found, `errno` is set to `ENOENT`. If `dirname` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns -1.

Remarks

The `_chdir` function changes the current working directory to the directory specified by `dirname`. The `dirname` parameter must refer to an existing directory. This function can change the current working directory on any drive. If a new drive letter is specified in `dirname`, the default drive letter is changed as well. For example, assume `A` is the default drive letter and `\BIN` is the current working directory. The following call changes the current working directory for drive `C` to `\temp` and establishes `C` as the new default drive:

```
_chdir("c:\\\\temp");
```

When you use the optional backslash character (`\`) in paths, you must place two backslashes (`\\`) in a C string literal to represent a single backslash (`\`).

`_wchdir` is a wide-character version of `_chdir`; the `dirname` argument to `_wchdir` is a wide-character string. `_wchdir` and `_chdir` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mapping

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tchdir</code>	<code>_chdir</code>	<code>_chdir</code>	<code>_wchdir</code>

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_chdir</code>	<code><direct.h></code>	<code><errno.h></code>
<code>_wchdir</code>	<code><direct.h></code> or <code><wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_chdir.c
// arguments: C:\WINDOWS

/* This program uses the _chdir function to verify
   that a given directory exists. */

#include <direct.h>
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main( int argc, char *argv[] )
{

    if(_chdir( argv[1] ) )
    {
        switch (errno)
        {
        case ENOENT:
            printf( "Unable to locate the directory: %s\n", argv[1] );
            break;
        case EINVAL:
            printf( "Invalid buffer.\n");
            break;
        default:
            printf( "Unknown error.\n");
        }
    }
    else
        system( "dir *.exe");
}
```

```
Volume in drive C has no label.  
Volume Serial Number is 2018-08A1
```

```
Directory of c:\windows
```

08/29/2002 04:00 AM	1,004,032	explorer.exe
12/17/2002 04:43 PM	10,752	hh.exe
03/03/2003 09:24 AM	33,792	ieuninst.exe
10/29/1998 04:45 PM	306,688	IsUninst.exe
08/29/2002 04:00 AM	66,048	NOTEPAD.EXE
03/03/2003 09:24 AM	33,792	Q330994.exe
08/29/2002 04:00 AM	134,144	regedit.exe
02/28/2003 06:26 PM	46,352	setdebug.exe
08/29/2002 04:00 AM	15,360	TASKMAN.EXE
08/29/2002 04:00 AM	49,680	twunk_16.exe
08/29/2002 04:00 AM	25,600	twunk_32.exe
08/29/2002 04:00 AM	256,192	winhelp.exe
08/29/2002 04:00 AM	266,752	winhlp32.exe
13 File(s)	2,249,184	bytes
0 Dir(s)	67,326,029,824	bytes free

See also

[Directory control](#)

_mkdir	_wmkdir
_rmdir	_wrmdir
system	_wsystem

_chdrive

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the current working drive.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _chdrive(  
    int drive  
)
```

Parameters

`drive`

An integer from 1 through 26 that specifies the current working drive (1=A, 2=B, and so forth).

Return value

Zero (0) if the current working drive was changed successfully; otherwise, -1.

Remarks

If `drive` isn't in the range from 1 through 26, the invalid-parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, the `_chdrive` function returns -1, `errno` is set to `EACCES`, and `_doserrno` is set to `ERROR_INVALID_DRIVE`.

The `_chdrive` function isn't thread-safe because it depends on the `SetCurrentDirectory` function, which is itself not thread-safe. To use `_chdrive` safely in a multi-threaded application, you must provide your own thread synchronization. For more information, see [SetCurrentDirectory](#).

The `_chdrive` function changes only the current working drive; `_chdir` changes the current working directory.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_chdrive</code>	<direct.h>

For more information, see [Compatibility](#).

Example

See the example for [`_getdrive`](#).

See also

Directory control

<code>_chdir</code>	<code>_wchdir</code>
<code>_fullpath</code>	<code>_wfullpath</code>
<code>_getcwd</code>	<code>_wgetcwd</code>
<code>_getdrive</code>	
<code>_mkdir</code>	<code>_wmkdir</code>
<code>_rmdir</code>	<code>_wrmdir</code>
<code>system</code>	<code>_wsystem</code>

`_chgsign`, `_chgsignf`, `_chgsignl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reverses the sign of a floating-point argument.

Syntax

```
double _chgsign(
    double x
);
float _chgsignf(
    float x
);
long double _chgsignl(
    long double x
);
```

Parameters

`x`

The floating-point value to be changed.

Return value

The `_chgsign` functions return a value that's equal to the floating-point argument `x`, but with its sign reversed. There's no error return.

Requirements

ROUTINE	REQUIRED HEADER
<code>_chgsign</code>	<code><float.h></code>
<code>_chgsignf</code> , <code>_chgsignl</code>	<code><math.h></code>

For more compatibility information, see [Compatibility](#).

See also

Math and floating-point support

`fabs`, `fabsf`, `fabsl`

`copysign`, `copysignf`, `copysignl`, `_copysign`, `_copysignf`, `_copysignl`

chmod

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `chmod` is a deprecated alias for the `_chmod` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_chmod` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_chmod`, `_wchmod`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the file-permission settings.

Syntax

```
int _chmod( const char *filename, int pmode );
int _wchmod( const wchar_t *filename, int pmode );
```

Parameters

`filename`

Name of the existing file.

`pmode`

Permission setting for the file.

Return value

These functions return 0 if the permission setting is successfully changed. A return value of -1 indicates failure. If the specified file couldn't be found, `errno` is set to `ENOENT`; if a parameter is invalid, `errno` is set to `EINVAL`.

Remarks

The `_chmod` function changes the permission setting of the file specified by `filename`. The permission setting controls the read and write access to the file. The integer expression `pmode` contains one or both of the following manifest constants, defined in SYS\Stat.h.

<code>PMODE</code>	MEANING
<code>_S_IREAD</code>	Only reading permitted.
<code>_S_IWRITE</code>	Writing permitted. (In effect, permits reading and writing.)
<code>_S_IREAD _S_IWRITE</code>	Reading and writing permitted.

When both constants are given, they're joined with the bitwise or operator (`|`). If write permission isn't given, the file is read-only. Note that all files are always readable; it isn't possible to give write-only permission. Thus, the modes `_S_IWRITE` and `_S_IREAD | _S_IWRITE` are equivalent.

`_wchmod` is a wide-character version of `_chmod`; the `filename` argument to `_wchmod` is a wide-character string. `_wchmod` and `_chmod` behave identically otherwise.

This function validates its parameters. If `pmode` isn't a combination of one of the manifest constants or incorporates an alternate set of constants, the function simply ignores them. If `filename` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns -1.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tchmod</code>	<code>_chmod</code>	<code>_chmod</code>	<code>_wchmod</code>

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_chmod</code>	<code><io.h></code>	<code><sys/types.h>, <sys/stat.h>, <errno.h></code>
<code>_wchmod</code>	<code><io.h> or <wchar.h></code>	<code><sys/types.h>, <sys/stat.h>, <errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_chmod.c
// This program uses _chmod to
// change the mode of a file to read-only.
// It then attempts to modify the file.
//



#include <sys/types.h>
#include <sys/stat.h>
#include <io.h>
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

// Change the mode and report error or success
void set_mode_and_report(char * filename, int mask)
{
    // Check for failure
    if( _chmod( filename, mask ) == -1 )
    {
        // Determine cause of failure and report.
        switch (errno)
        {
            case EINVAL:
                fprintf( stderr, "Invalid parameter to chmod.\n");
                break;
            case ENOENT:
                fprintf( stderr, "File %s not found\n", filename );
                break;
            default:
                // Should never be reached
                fprintf( stderr, "Unexpected error in chmod.\n" );
        }
    }
    else
    {
        if (mask == _S_IREAD)
            printf( "Mode set to read-only\n" );
        else if (mask & _S_IWRITE)
            printf( "Mode set to read/write\n" );
    }
    fflush(stderr);
}

int main( void )
{
    // Create or append to a file.
    system( "echo /* End of file */ >> crt_chmod.c_input" );

    // Set file mode to read-only:
    set_mode_and_report("crt_chmod.c_input ", _S_IREAD );

    system( "echo /* End of file */ >> crt_chmod.c_input " );

    // Change back to read/write:
    set_mode_and_report("crt_chmod.c_input ", _S_IWRITE );

    system( "echo /* End of file */ >> crt_chmod.c_input " );
}

```

A line of text.

A line of text.Mode set to read-only
Access is denied.
Mode set to read/write

See also

File handling

[_access](#) , [_waccess](#)
[_creat](#) , [_wcreat](#)
[_fstat](#) , [_fstat32](#) , [_fstat64](#) , [_fstat64i32](#) , [_fstat32i64](#) , [_fstat64i32](#)
[_open](#) , [_wopen](#)
[_stat](#) , [_wstat](#) functions

chsize

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `chsize` is a deprecated alias for the `_chsize` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_chsize` or the security-enhanced `_chsize_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_chsize

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a file. A more secure version is available; see [_chsize_s](#).

Syntax

```
int _chsize(
    int fd,
    long size
);
```

Parameters

`fd`

File descriptor referring to an open file.

`size`

New length of the file in bytes.

Return value

`_chsize` returns the value 0 if the file size is successfully changed. A return value of -1 indicates an error: `errno` is set to `EACCES` if the specified file is read-only or the specified file is locked against access, to `EBADF` if the descriptor is invalid, `ENOSPC` if no space is left on the device, or `EINVAL` if `size` is less than zero.

For more information about return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

The `_chsize` function extends or truncates the file associated with `fd` to the length specified by `size`. The file must be open in a mode that permits writing. Null characters ('\0') are appended if the file is extended. If the file is truncated, all data from the end of the shortened file to the original length of the file is lost.

This function validates its parameters. If `size` is less than zero or `fd` is a bad file descriptor, the invalid parameter handler is invoked, as described in [Parameter validation](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_chsize</code>	<iostream.h>	<errno.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_chsize.c
// This program uses _filelength to report the size
// of a file before and after modifying it with _chsize.

#include <io.h>
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <stdio.h>
#include <share.h>

int main( void )
{
    int fh, result;
    unsigned int nbytes = BUFSIZ;

    // Open a file
    if( _sopen_s( &fh, "data", _O_RDWR | _O_CREAT, _SH_DENYNO,
                  _S_IREAD | _S_IWRITE ) == 0 )
    {
        printf( "File length before: %ld\n", _filelength( fh ) );
        if( ( result = _chsize( fh, 329678 ) ) == 0 )
            printf( "Size successfully changed\n" );
        else
            printf( "Problem in changing the size\n" );
        printf( "File length after: %ld\n", _filelength( fh ) );
        _close( fh );
    }
}
```

```
File length before: 0
Size successfully changed
File length after: 329678
```

See also

[File handling](#)

[_close](#)
[_sopen](#) , [_wsopen](#)
[_open](#) , [_wopen](#)

_chsize_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a file. This function is a version of [_chsize](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _chsize_s(  
    int fd,  
    __int64 size  
) ;
```

Parameters

`fd`

File descriptor referring to an open file.

`size`

New length of the file in bytes.

Return value

`_chsize_s` returns the value 0 if the file size is successfully changed. A nonzero return value indicates an error: the return value is `EACCES` if the specified file is locked against access, `EBADF` if the specified file is read-only or the descriptor is invalid, `ENOSPC` if no space is left on the device, or `EINVAL` if size is less than zero. `errno` is set to the same value.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

The `_chsize_s` function extends or truncates the file associated with `fd` to the length specified by `size`. The file must be open in a mode that permits writing. Null characters ('\0') are appended if the file is extended. If the file is truncated, all data from the end of the shortened file to the original length of the file is lost.

`_chsize_s` takes a 64-bit integer as the file size, and therefore can handle file sizes greater than 4 GB. `_chsize` is limited to 32-bit file sizes.

This function validates its parameters. If `fd` isn't a valid file descriptor or `size` is less than zero, the invalid parameter handler is invoked, as described in [Parameter validation](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_chsize_s</code>	<io.h>	<errno.h>

ROUTINE

REQUIRED HEADER

OPTIONAL HEADER

For more compatibility information, see [Compatibility](#).

See also

File handling

[_chsize](#)
[_close](#)
[_creat](#) , [_wcreat](#)
[_open](#) , [_wopen](#)

cimag , cimagf , cimags

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the imaginary part of a complex number.

Syntax

```
double cimag( _Dcomplex z );
float cimagf( _Fcomplex z );
long double cimags( _Lcomplex z );
#define cimag(X) // Requires C11 or higher

float cimag( _Fcomplex z ); // C++ only
long double cimags( _Lcomplex z ); // C++ only
```

Parameters

`z`

A complex number.

Return value

The imaginary part of `z`.

Remarks

Because C++ allows overloading, you can call overloads of `cimag` that take `_Fcomplex` or `_Lcomplex` values, and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `cimag` always takes a `_Dcomplex` value and returns a `double` value.

If you use the `<tgmath.h>` `cimag()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cimag</code> , <code>cimagf</code> , <code>cimags</code>	<code><complex.h></code>	<code><ccomplex></code>
<code>cimag</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`norm` , `normf` , `norml`
`creal` , `crealf` , `creall`
`cproj` , `cprojf` , `cprojl`
`conj` , `conjf` , `conjl`

carg	cargf	cargl
cabs	cabsf	cabsl

`_clear87`, `_clearfp`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets and clears the floating-point status word.

Syntax

```
unsigned int _clear87( void );
unsigned int _clearfp( void );
```

Return value

The bits in the value returned indicate the floating-point status before the call to `_clear87` or `_clearfp`. For a complete definition of the bits returned by `_clear87`, see `Float.h`. Many of the math library functions modify the 8087/80287 status word, with unpredictable results. Return values from `_clear87` and `_status87` become more reliable as fewer floating-point operations are performed between known states of the floating-point status word.

Remarks

The `_clear87` function clears the exception flags in the floating-point status word, sets the busy bit to 0, and returns the status word. The floating-point status word is a combination of the 8087/80287 status word and other conditions detected by the 8087/80287 exception handler, such as floating-point stack overflow and underflow.

`_clearfp` is a platform-independent, portable version of the `_clear87` routine. It's identical to `_clear87` on Intel (x86) platforms and is also supported by the x64 and ARM platforms. To ensure that your floating-point code is portable to x64 and ARM, use `_clearfp`. If you're only targeting x86 platforms, you can use either `_clear87` or `_clearfp`.

These functions are deprecated when compiling with [/clr \(Common Language Runtime Compilation\)](#) because the common language runtime only supports the default floating-point precision.

Requirements

ROUTINE	REQUIRED HEADER
<code>_clear87</code>	<code><float.h></code>
<code>_clearfp</code>	<code><float.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_clear87.c
// compile with: /Od

// This program creates various floating-point
// problems, then uses _clear87 to report on these problems.
// Compile this program with Optimizations disabled (/Od).
// Otherwise the optimizer will remove the code associated with
// the unused floating-point values.
//

#include <stdio.h>
#include <float.h>

int main( void )
{
    double a = 1e-40, b;
    float x, y;

    printf( "Status: %.4x - clear\n", _clear87() );

    // Store into y is inexact and underflows:
    y = a;
    printf( "Status: %.4x - inexact, underflow\n", _clear87() );

    // y is denormal:
    b = y;
    printf( "Status: %.4x - denormal\n", _clear87() );
}
```

```
Status: 0000 - clear
Status: 0003 - inexact, underflow
Status: 80000 - denormal
```

See also

[Math and floating-point support](#)

[_control87](#) , [_controlfp](#) , [__control87_2](#)
[_status87](#) , [_statusfp](#) , [_statusfp2](#)

clearerr

11/2/2022 • 2 minutes to read • [Edit Online](#)

Resets the error indicator for a stream. A more secure version of this function is available; see [clearerr_s](#).

Syntax

```
void clearerr(  
    FILE *stream  
>;
```

Parameters

stream

Pointer to `FILE` structure.

Remarks

The `clearerr` function resets the error indicator and end-of-file indicator for *stream*. Error indicators aren't automatically cleared; once the error indicator for a specified stream is set, operations on that stream continue to return an error value until `clearerr`, `fseek`, `fsetpos`, or `rewind` is called.

If *stream* is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns. For more information on `errno` and error codes, see [errno constants](#).

A more secure version of this function is available; see [clearerr_s](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>clearerr</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_clearerr.c
// This program creates an error
// on the standard input stream, then clears
// it so that future reads won't fail.

#include <stdio.h>

int main( void )
{
    int c;
    // Create an error by writing to standard input.
    putc( 'c', stdin );
    if( ferror( stdin ) )
    {
        perror( "Write error" );
        clearerr( stdin );
    }

    // See if read causes an error.
    printf( "Will input cause an error? " );
    c = getc( stdin );
    if( ferror( stdin ) )
    {
        perror( "Read error" );
        clearerr( stdin );
    }
    else
        printf( "No read error\n" );
}
```

Input

```
n
```

Output

```
Write error: No error
Will input cause an error? n
No read error
```

See also

[Error handling](#)

[Stream I/O](#)

[_eof](#)

[feof](#)

[ferror](#)

[perror](#) , [_wperror](#)

clearerr_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Resets the error indicator for a stream. This function is a version of `clearerr` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t clearerr_s(  
    FILE *stream  
) ;
```

Parameters

`stream`
Pointer to `FILE` structure

Return value

Zero if successful; `EINVAL` if `stream` is `NULL`.

Remarks

The `clearerr_s` function resets the error indicator and end-of-file indicator for `stream`. Error indicators aren't automatically cleared; once the error indicator for a specified stream is set, operations on that stream continue to return an error value until `clearerr_s`, `clearerr`, `fseek`, `fsetpos`, or `rewind` is called.

If `stream` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>clearerr_s</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_clearerr_s.c
// This program creates an error
// on the standard input stream, then clears
// it so that future reads won't fail.

#include <stdio.h>

int main( void )
{
    int c;
    errno_t err;

    // Create an error by writing to standard input.
    putc( 'c', stdin );
    if( ferror( stdin ) )
    {
        perror( "Write error" );
        err = clearerr_s( stdin );
        if (err != 0)
        {
            abort();
        }
    }

    // See if read causes an error.
    printf( "Will input cause an error? " );
    c = getc( stdin );
    if( ferror( stdin ) )
    {
        perror( "Read error" );
        err = clearerr_s( stdin );
        if (err != 0)
        {
            abort();
        }
    }
}
```

Input

```
n
```

Output

```
Write error: Bad file descriptor
Will input cause an error? n
```

See also

[Error handling](#)

[Stream I/O](#)

[clearerr](#)

[_eof](#)

[feof](#)

[ferror](#)

[perror](#), [_wperror](#)



11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the wall-clock time used by the calling process.

Syntax

```
clock_t clock( void );
```

Return value

The elapsed time since the CRT initialization at the start of the process, measured in `CLOCKS_PER_SEC` units per second. If the elapsed time is unavailable or has exceeded the maximum positive time that can be recorded as a `clock_t` type, the function returns the value `(clock_t)(-1)`.

Remarks

The `clock` function tells how much wall-clock time has passed since the CRT initialization during process start. This function doesn't strictly conform to ISO C, which specifies net CPU time as the return value. To obtain CPU times, use the Win32 [GetProcessTimes](#) function. To determine the elapsed time in seconds, divide the value returned by the `clock` function by the macro `CLOCKS_PER_SEC`.

Given enough time, the value returned by `clock` can exceed the maximum positive value of `clock_t`. When the process has run longer, the value returned by `clock` is always `(clock_t)(-1)`, as specified by the ISO C99 standard (7.23.2.1) and ISO C11 standard (7.27.2.1). Microsoft implements `clock_t` as a `long`, a signed 32-bit integer, and the `CLOCKS_PER_SEC` macro is defined as 1000. This macro gives a maximum `clock` function return value of 2147483.647 seconds, or about 24.8 days. Don't rely on the value returned by `clock` in processes that have run for longer than this amount of time. You can use the 64-bit `time` function or the Windows [QueryPerformanceCounter](#) function to record process elapsed times of many years.

Requirements

ROUTINE	REQUIRED HEADER
<code>clock</code>	<code><time.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_clock.c
// This sample uses clock() to 'sleep' for three
// seconds, then determines how long it takes
// to execute an empty loop 600000000 times.

#include <stdio.h>
#include <stdlib.h>
#include <time.h>

// Pauses for a specified number of clock cycles.
void do_sleep( clock_t wait )
{
    clock_t goal;
    goal = wait + clock();
    while( goal > clock() )
        ;
}

const long num_loops = 600000000L;

int main( void )
{
    long    i = num_loops;
    clock_t start, finish;
    double duration;

    // Delay for a specified time.
    printf( "Delay for three seconds\n" );
    do_sleep( (clock_t)3 * CLOCKS_PER_SEC );
    printf( "Done!\n" );

    // Measure the duration of an event.
    start = clock();
    while( i-- )
        ;
    finish = clock();
    duration = (double)(finish - start) / CLOCKS_PER_SEC;
    printf( "Time to do %ld empty loops is ", num_loops );
    printf( "%2.3f seconds\n", duration );
}

```

```

Delay for three seconds
Done!
Time to do 600000000 empty loops is 1.354 seconds

```

See also

Time management

difftime	_difftime32	_difftime64
time	_time32	_time64

clog, clogf, clogl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the natural logarithm of a complex number, with a branch cut along the negative real axis.

Syntax

```
_Dcomplex clog(
    _Dcomplex z
);
_Fcomplex clog(
    _Fcomplex z
); // C++ only
_Lcomplex clog(
    _Lcomplex z
); // C++ only
_Fcomplex clogf(
    _Fcomplex z
);
_Lcomplex clogl(
    _Lcomplex z
);
```

Parameters

`z`

The base of the logarithm.

Return value

The natural logarithm of `z`. The result is unbounded along the real axis and in the interval $[-i\pi, +i\pi]$ along the imaginary axis.

The possible return values are:

<code>z</code> PARAMETER	RETURN VALUE
Positive	The logarithm (base 10) of <code>z</code>
Zero	- INF
Negative	NaN
NaN	NaN
+ INF	+ INF

Remarks

Because C++ allows overloading, you can call overloads of `clog` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `clog` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>clog</code> , <code>clogf</code> , <code>clogl</code>	<complex.h>	<ccomplex>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

<code>cexp</code> , <code>cexpf</code> , <code>cexpl</code>
<code>cpow</code> , <code>cpowf</code> , <code>cpowl</code>
<code>clog10</code> , <code>clog10f</code> , <code>clog10l</code>

`clog10`, `clog10f`, `clog10l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the logarithm (base 10) of a complex number.

Syntax

```
_Dcomplex clog10( _Dcomplex z );
_Fcomplex clog10f( _Fcomplex z );
_Lcomplex clog10l( _Lcomplex z );
```

```
_Fcomplex clog10( _Fcomplex z ); // C++ only
_Lcomplex clog10( _Lcomplex z ); // C++ only
```

Parameters

`z`

The base of the logarithm.

Return value

The possible return values are:

<code>z</code> PARAMETER	RETURN VALUE
Positive	The logarithm (base 10) of <code>z</code>
Zero	- INF
Negative	NaN
NaN	NaN
+ INF	+ INF

Remarks

Because C++ allows overloading, you can call overloads of `clog10` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `clog10` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>clog10</code> , <code>clog10f</code> , <code>clog10l</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

cexp	cexpf	cexpl
cpow	cpowf	cpowl
clog	clogf	clogl

_close

11/2/2022 • 2 minutes to read • [Edit Online](#)

Closes a file.

Syntax

```
int _close(  
    int fd  
)
```

Parameters

`fd`

File descriptor referring to the open file.

Return value

`_close` returns 0 if the file was successfully closed. A return value of -1 indicates an error.

Remarks

The `_close` function closes the file associated with `fd`.

The file descriptor and the underlying OS file handle are closed. Thus, it isn't necessary to call `CloseHandle` if the file was originally opened using the Win32 function `CreateFile` and converted to a file descriptor using `_open_osfhandle`.

This function validates its parameters. If `fd` is a bad file descriptor, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and `errno` is set to `EBADF`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_close</code>	<code><io.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for `_open`.

See also

[Low-level I/O](#)

`_chsize`
`_creat`, `_wcreat`
`_dup`, `_dup2`
`_open`, `_wopen`
`_unlink`, `_wunlink`

[close](#)

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The Microsoft-implemented POSIX function name `close` is a deprecated alias for the `_close` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_close` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_Cmulcc`, `_FCmulcc`, `_LCmulcc`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Multiples two complex numbers.

Syntax

```
_Dcomplex _Cmulcc( _Dcomplex x, _Dcomplex y );
_Fcomplex _FCmulcc( _Fcomplex x, _Fcomplex y );
_Lcomplex _LCmulcc( _Lcomplex x, _Lcomplex y );
```

Parameters

`x`

One of the complex operands to multiply.

`y`

The other complex operand to multiply.

Return value

A `_Dcomplex`, `_Fcomplex`, or `_Lcomplex` structure that represents the complex product of the complex numbers `x` and `y`.

Remarks

Because the built-in arithmetic operators don't work on the Microsoft implementation of the complex types, the `_Cmulcc`, `_FCmulcc`, and `_LCmulcc` functions simplify multiplication of complex types.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>_Cmulcc</code> , <code>_FCmulcc</code> , <code>_LCmulcc</code>	<complex.h>	<complex.h>

These functions are Microsoft-specific. The types `_Dcomplex`, `_Fcomplex`, and `_Lcomplex` are Microsoft-specific equivalents to the unimplemented C99 native types `double _Complex`, `float _Complex`, and `long double _Complex`, respectively. For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`_Cbuild`, `_FCbuild`, `_LCbuild`
`_Cmulcr`, `_FCmulcr`, `_LCmulcr`
`norm`, `normf`, `norml`
`cproj`, `cprojf`, `cprojl`
`conj`, `conjf`, `conjl`
`creal`, `crealf`, `creall`
`cimag`, `cimagf`, `cimagl`

carg	cargf	cargl
cabs	cabsf	cabsl

`_Cmulcr`, `_FCmulcr`, `_LCmulcr`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Multiples a complex number by a floating-point number.

Syntax

```
_Dcomplex _Cmulcr( _Dcomplex x, double y );
_Fcomplex _FCmulcr( _Fcomplex x, float y );
_Lcomplex _LCmulcr( _Lcomplex x, long double y );
```

Parameters

`x`

One of the complex operands to multiply.

`y`

The floating-point operand to multiply.

Return value

A `_Dcomplex`, `_Fcomplex`, or `_Lcomplex` structure that represents the complex product of the complex number `x` and floating-point number `y`.

Remarks

Because the built-in arithmetic operators don't work on the Microsoft implementation of the complex types, the `_Cmulcr`, `_FCmulcr`, and `_LCmulcr` functions simplify multiplication of complex types by floating-point types.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>_Cmulcr</code> , <code>_FCmulcr</code> , <code>_LCmulcr</code>	<complex.h>	<complex.h>

These functions are Microsoft-specific. The types `_Dcomplex`, `_Fcomplex`, and `_Lcomplex` are Microsoft-specific equivalents to the unimplemented C99 native types `double _Complex`, `float _Complex`, and `long double _Complex`, respectively. For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

<code>_Cbuild</code>	<code>_FCbuild</code>	<code>_LCbuild</code>
<code>_Cmulcc</code>	<code>_FCmulcc</code>	<code>_LCmulcc</code>
<code>norm</code>	<code>normf</code>	<code>norml</code>
<code>cproj</code>	<code>cprojf</code>	<code>cprojl</code>
<code>conj</code>	<code>conjf</code>	<code>conjl</code>
<code>creal</code>	<code>crealf</code>	<code>creall</code>
<code>cimag</code>	<code>cimagf</code>	<code>cimagl</code>

carg	cargf	cargl
cabs	cabsf	cabsl

_commit

11/2/2022 • 2 minutes to read • [Edit Online](#)

Flushes a file directly to disk.

Syntax

```
int _commit(
    int fd
);
```

Parameters

`fd`

File descriptor referring to the open file.

Return value

`_commit` returns 0 if the file was successfully flushed to disk. A return value of -1 indicates an error.

Remarks

The `_commit` function forces the operating system to write the file associated with `fd` to disk. This call ensures that the specified file is flushed immediately, not at the operating system's discretion.

If `fd` is an invalid file descriptor, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and `errno` is set to `EBADF`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_commit</code>	<code><io.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

See also

Low-level I/O

`_creat`, `_wcreat`
`_open`, `_wopen`
`_read`
`_write`

An alternative to the `~` operator.

Syntax

```
#define compl ~
```

Remarks

The macro yields the operator `~`.

Example

```
// iso646_compl.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 1, result;

    result = ~a;
    cout << result << endl;

    result= compl(a);
    cout << result << endl;
}
```

```
-2
-2
```

Requirements

Header: `<iso646.h>`

_configthreadlocale

11/2/2022 • 3 minutes to read • [Edit Online](#)

Configures per-thread locale options.

Syntax

```
int _configthreadlocale( int per_thread_locale_type );
```

Parameters

`per_thread_locale_type`

The option to set. One of the options listed in the following table.

Return value

The previous per-thread locale status (`_DISABLE_PER_THREAD_LOCALE` or `_ENABLE_PER_THREAD_LOCALE`), or -1 on failure.

Remarks

The `_configthreadlocale` function is used to control the use of thread-specific locales. Use one of these `per_thread_locale_type` options to specify or determine the per-thread locale status:

OPTION	DESCRIPTION
<code>_ENABLE_PER_THREAD_LOCALE</code>	Make the current thread use a thread-specific locale. Subsequent calls to <code>setlocale</code> in this thread affect only the thread's own locale.
<code>_DISABLE_PER_THREAD_LOCALE</code>	Make the current thread use the global locale. Subsequent calls to <code>setlocale</code> in this thread affect other threads using the global locale.
0	Retrieves the current setting for this particular thread.

These functions affect the behavior of `setlocale`, `_tsetlocale`, `_wsetlocale`, and `_setmbcp`. When per-thread locale is disabled, any subsequent call to `setlocale` or `_wsetlocale` changes the locale of all threads that use the global locale. When per-thread locale is enabled, `setlocale` or `_wsetlocale` only affects the current thread's locale.

If you use `_configthreadlocale` to enable a per-thread locale, set the preferred locale in that thread immediately afterward by a call to `setlocale` or `_wsetlocale`.

If `per_thread_locale_type` isn't one of the values listed in the table, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
_configthreadlocale	`<locale.h>`

Example

```
// crt_configthreadlocale.cpp
//
// This program demonstrates the use of _configthreadlocale when
// using two independent threads.
//
// Compile by using: cl /EHsc /W4 crt_configthreadlocale.cpp

#include <locale.h>
#include <mbctype.h>
#include <process.h>
#include <windows.h>
#include <stdio.h>
#include <time.h>

#define BUFF_SIZE 100

// Retrieve the date and time in the current
// locale's format.
int get_time(unsigned char* str)
{
    __time64_t ltime;
    struct tm thetime;

    // Retieve the time
    _time64(&ltime);
    _gmtime64_s(&thetime, &ltime);

    // Format the current time structure into a string
    // using %#x is the long date representation,
    // appropriate to the current locale
    if (!strftime((char *)str, BUFF_SIZE, "%#x",
                  (const struct tm*)&thetime))
    {
        printf("strftime failed!\n");
        return -1;
    }
    return 0;
}

// This thread sets its locale to German
// and prints the time.
unsigned __stdcall SecondThreadFunc( void* /*pArguments*/ )
{
    unsigned char str[BUFF_SIZE];

    _configthreadlocale(_ENABLE_PER_THREAD_LOCALE);

    // Set the thread code page
    _setmbcp(_MB_CP_ANSI);

    // Set the thread locale
    printf("The thread locale is now set to %s.\n",
           setlocale(LC_ALL, "German"));

    // Retrieve the time string from the helper function
    if (get_time(str) == 0)
    {
```

```

        printf("The time in German locale is: '%s'\n", str);
    }

_endthreadex( 0 );
return 0;
}

// The main thread spawns a second thread (above) and then
// sets the locale to English and prints the time.
int main()
{
    HANDLE          hThread;
    unsigned        threadID;
    unsigned char   str[BUFF_SIZE];

    // Enable per-thread locale causes all subsequent locale
    // setting changes in this thread to only affect this thread.
    _configthreadlocale(_ENABLE_PER_THREAD_LOCALE);

    // Retrieve the time string from the helper function
    printf("The thread locale is now set to %.n",
           setlocale(LC_ALL, "English"));

    // Create the second thread.
    hThread = (HANDLE)_beginthreadex( NULL, 0, &SecondThreadFunc,
                                      NULL, 0, &threadID );

    if (get_time(str) == 0)
    {
        // Retrieve the time string from the helper function
        printf("The time in English locale is: '%s'\n\n", str);
    }

    // Wait for the created thread to finish.
    WaitForSingleObject( hThread, INFINITE );

    // Destroy the thread object.
    CloseHandle( hThread );
}

```

The thread locale is now set to English_United States.1252.
The time in English locale is: 'Wednesday, May 12, 2004'

The thread locale is now set to German_Germany.1252.
The time in German locale is: 'Mittwoch, 12. Mai 2004'

See also

[setlocale](#) , [_wsetlocale](#)
[_beginthread](#) , [_beginthreadex](#)

[Locale](#)

[Multithreading and locales](#)

`conj`, `conjf`, `conjl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the complex conjugate of a complex number.

Syntax

```
_Dcomplex conj(
    _Dcomplex z
);
_Fcomplex conj(
    _Fcomplex z
); // C++ only
_Lcomplex conj(
    _Lcomplex z
); // C++ only
_Fcomplex conjf(
    _Fcomplex z
);
_Lcomplex conjl(
    _Lcomplex z
);
#define conj(X) // Requires C11 or higher
```

Parameters

`z`

A complex number.

Return value

The complex conjugate of `z`. The result has the same real and imaginary part as `z`, but with the opposite sign.

Remarks

Because C++ allows overloading, you can call overloads of `conj` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `conj` always takes and returns a `_Dcomplex` value.

If you use the `<tgmath.h>` `conj()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>conj</code> , <code>conjf</code> , <code>conjl</code>	<code><complex.h></code>	<code><ccomplex></code>
<code>conj</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

norm	normf	norml
creal	crealf	creall
cproj	cprojf	cprojl
cimag	cimagf	cimagl
carg	cargf	cargl
cabs	cabsf	cabsl

`_control187`, `_controlfp`, `_control187_2`

11/2/2022 • 5 minutes to read • [Edit Online](#)

Gets and sets the floating-point control word. A more secure version of `_controlfp` is available; see [`_controlfp_s`](#).

Syntax

```
unsigned int _control187(
    unsigned int new,
    unsigned int mask
);
unsigned int _controlfp(
    unsigned int new,
    unsigned int mask
);
int __control187_2(
    unsigned int new,
    unsigned int mask,
    unsigned int* x86_cw,
    unsigned int* sse2_cw
);
```

Parameters

`new`

New control-word bit values.

`mask`

Mask for new control-word bits to set.

`x86_cw`

Filled in with the control word for the x87 floating-point unit. Pass in 0 (`NULL`) to set only the SSE2 control word.

`sse2_cw`

Control word for the SSE floating-point unit. Pass in 0 (`NULL`) to set only the x87 control word.

Return value

For `_control187` and `_controlfp`, the bits in the value returned indicate the floating-point control state. For a complete definition of the bits that are returned by `_control187`, see [`FLOAT.H`](#).

For `__control187_2`, the return value is 1, which indicates success.

Remarks

The `_control187` function gets and sets the floating-point control word. The floating-point control word enables the program to change the precision, rounding, and infinity modes, depending on the platform. You can also use `_control187` to mask or unmask floating-point exceptions. If the value for `mask` is equal to 0, `_control187` gets the floating-point control word. If `mask` is nonzero, a new value for the control word is set: For any bit that is on (that is, equal to 1) in `mask`, the corresponding bit in `new` is used to update the control word. In other words, $fpcntrl = ((fpcntrl \& \sim mask) | (new \& mask))$ where `fpcntrl` is the floating-point control word.

NOTE

By default, the run-time libraries mask all floating-point exceptions.

`_controlfp` is a platform-independent, portable version of `_control87` that's nearly identical to the `_control87` function. If your code targets more than one platform, use `_controlfp` or `_controlfp_s`. The difference between `_control87` and `_controlfp` is in how they treat `DENORMAL` values. For x86, x64, ARM, and ARM64 platforms, `_control87` can set and clear the `DENORMAL OPERAND` exception mask. `_controlfp` doesn't modify the `DENORMAL OPERAND` exception mask. This example demonstrates the difference:

```
_control87( _EM_INVALID, _MCW_EM );
// DENORMAL is unmasked by this call
_controlfp( _EM_INVALID, _MCW_EM );
// DENORMAL exception mask remains unchanged
```

The possible values for the mask constant (`mask`) and new control values (`new`) are shown in the Control word masks and values table. Use the portable constants listed below (`_MCW_EM`, `_EM_INVALID`, and so forth) as arguments to these functions, rather than supplying the hexadecimal values explicitly.

Intel x86-derived platforms support the `DENORMAL` input and output values in hardware. The x86 behavior is to preserve `DENORMAL` values. The ARM and ARM64 platforms and the x64 platforms that have SSE2 support enable `DENORMAL` operands and results to be flushed, or forced to zero. The `_controlfp` and `_control87` functions provide a mask to change this behavior. The following example demonstrates the use of this mask.

```
_controlfp(_DN_SAVE, _MCW_DN);
// Denormal values preserved on ARM platforms and on x64 processors with
// SSE2 support. NOP on x86 platforms.
_controlfp(_DN_FLUSH, _MCW_DN);
// Denormal values flushed to zero by hardware on ARM platforms
// and x64 processors with SSE2 support. Ignored on other x86 platforms.
```

On ARM and ARM64 platforms, the `_control87` and `_controlfp` functions apply to the FPSCR register. Only the SSE2 control word that's stored in the MXCSR register is affected on x64 platforms. On x86 platforms, `_control87` and `_controlfp` affect the control words for both the x87 and the SSE2, if present.

The function `_control87_2` enables both the x87 and SSE2 floating-point units to be controlled together or separately. To affect both units, pass in the addresses of two integers to `x86_cw` and `sse2_cw`. If you only want to affect one unit, pass in an address for that parameter, but pass in 0 (`NULL`) for the other. If 0 is passed for one of these parameters, the function has no effect on that floating-point unit. It's useful when part of your code uses the x87 floating-point unit, and another part uses the SSE2 floating-point unit.

If you use `_control87_2` to set different values for the floating-point control words, then `_control87` or `_controlfp` might be unable to return a single control word to represent the state of both floating-point units. In such a case, these functions set the `EM_AMBIGUOUS` flag in the returned integer value to indicate an inconsistency between the two control words. The `EM_AMBIGUOUS` flag is a warning that the returned control word might not represent the state of both floating-point control words accurately.

On the ARM, ARM64, and x64 platforms, changing the infinity mode or the floating-point precision isn't supported. If the precision control mask is used on the x64 platform, the function raises an assertion, and the invalid parameter handler is invoked, as described in [Parameter validation](#).

NOTE

`__control187_2` is not supported on the ARM, ARM64, or x64 platforms. If you use `__control187_2` and compile your program for the ARM, ARM64, or x64 platforms, the compiler generates an error.

These functions are ignored when you use `/clr` (Common Language Runtime Compilation) to compile. The common language runtime (CLR) only supports the default floating-point precision.

Control word masks and values

For the `_MCW_EM` mask, clearing the mask sets the exception, which allows the hardware exception; setting the mask hides the exception. If a `_EM_UNDERFLOW` or `_EM_OVERFLOW` occurs, no hardware exception is thrown until the next floating-point instruction is executed. To generate a hardware exception immediately after `_EM_UNDERFLOW` or `_EM_OVERFLOW`, call the `FWAIT` MASM instruction.

MASK	HEX VALUE	CONSTANT	HEX VALUE
<code>_MCW_DN</code> (Denormal control)	0x03000000	<code>_DN_SAVE</code> <code>_DN_FLUSH</code>	0x00000000 0x01000000
<code>_MCW_EM</code> (Interrupt exception mask)	0x0008001F	<code>_EM_INVALID</code> <code>_EM_DENORMAL</code> <code>_EM_ZERODIVIDE</code> <code>_EM_OVERFLOW</code> <code>_EM_UNDERFLOW</code> <code>_EM_INEXACT</code>	0x00000010 0x00080000 0x00000008 0x00000004 0x00000002 0x00000001
<code>_MCW_IC</code> (Infinity control) (Not supported on ARM or x64 platforms.)	0x00040000	<code>_IC_AFFINE</code> <code>_IC_PROJECTIVE</code>	0x00040000 0x00000000
<code>_MCW_RC</code> (Rounding control)	0x00000300	<code>_RC_CHOP</code> <code>_RC_UP</code> <code>_RC_DOWN</code> <code>_RC_NEAR</code>	0x00000300 0x00000200 0x00000100 0x00000000
<code>_MCW_PC</code> (Precision control) (Not supported on ARM or x64 platforms.)	0x00030000	<code>_PC_24</code> (24 bits) <code>_PC_53</code> (53 bits) <code>_PC_64</code> (64 bits)	0x00020000 0x00010000 0x00000000

Requirements

ROUTINE	REQUIRED HEADER
<code>_control87</code> , <code>_controlfp</code> , <code>_control87_2</code>	<code><float.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cntrl87.c
// processor: x86
// compile by using: cl /W4 /arch:IA32 crt_cntrl87.c
// This program uses __control87_2 to output the x87 control
// word, set the precision to 24 bits, and reset the status to
// the default.

#include <stdio.h>
#include <float.h>
#pragma fenv_access (on)

int main( void )
{
    double a = 0.1;
    unsigned int control_word_x87 = 0;
    int result;

    // Show original x87 control word and do calculation.
    result = __control87_2(0, 0, &control_word_x87, 0 );
    printf( "Original: 0x%.8x\n", control_word_x87 );
    printf( "%1.1f * %1.1f = %.15e\n", a, a, a * a );

    // Set precision to 24 bits and recalculate.
    result = __control87_2(_PC_24, MCW_PC, &control_word_x87, 0 );
    printf( "24-bit: 0x%.8x\n", control_word_x87 );
    printf( "%1.1f * %1.1f = %.15e\n", a, a, a * a );

    // Restore default precision-control bits and recalculate.
    result = __control87_2( _CW_DEFAULT, MCW_PC, &control_word_x87, 0 );
    printf( "Default: 0x%.8x\n", control_word_x87 );
    printf( "%1.1f * %1.1f = %.15e\n", a, a, a * a );
}
```

```
Original: 0x0009001f
0.1 * 0.1 = 1.000000000000000e-02
24-bit: 0x000a001f
0.1 * 0.1 = 9.999999776482582e-03
Default: 0x0009001f
0.1 * 0.1 = 1.000000000000000e-02
```

See also

[Math and floating-point support](#)

<code>_clear87</code>	<code>_clearfp</code>
<code>_status87</code>	<code>_statusfp</code> , <code>_statusfp2</code>
<code>_controlfp_s</code>	

_controlfp_s

11/2/2022 • 5 minutes to read • [Edit Online](#)

Gets and sets the floating-point control word. This version of `_control187`, `_controlfp`, or `_control187_2` has security enhancements, as described in [Security features in the CRT](#).

Syntax

```
errno_t _controlfp_s(
    unsigned int *currentControl,
    unsigned int newControl,
    unsigned int mask
);
```

Parameters

`currentControl`

The current control-word bit value.

`newControl`

New control-word bit values.

`mask`

Mask for new control-word bits to set.

Return value

Zero if successful, or an `errno` value error code.

Remarks

The `_controlfp_s` function is a platform-independent and more secure version of `_control187`, which gets the floating-point control word into the address that's stored in `currentControl` and sets it by using `newControl`. The bits in the values indicate the floating-point control state. The floating-point control state enables the program to change the precision, rounding, and infinity modes in the floating-point math package, depending on the platform. You can also use `_controlfp_s` to mask or unmask floating-point exceptions.

If the value for `mask` is equal to 0, `_controlfp_s` gets the floating-point control word and stores the retrieved value in `currentControl`.

If `mask` is nonzero, a new value for the control word is set: For any bit that is set (that is, equal to 1) in `mask`, the corresponding bit in `new` is used to update the control word. In other words,

`fpcntrl = ((fpcntrl & ~mask) | (newControl & mask))` where `fpcntrl` is the floating-point control word. In this scenario, `currentControl` is set to the value after the change completes; it isn't the old control-word bit value.

NOTE

By default, the run-time libraries mask all floating-point exceptions.

`_controlfp_s` is nearly identical to the `_control187` function on Intel (x86), x64, and ARM platforms. If you're targeting x86, x64, or ARM platforms, you can use `_control187` or `_controlfp_s`.

The difference between `_control187` and `_controlfp_s` is in how they treat denormal values. For Intel (x86), x64, and ARM platforms, `_control187` can set and clear the `DENORMAL OPERAND` exception mask. `_controlfp_s` doesn't modify the `DENORMAL OPERAND` exception mask. This example demonstrates the difference:

```
_control187( _EM_INVALID, _MCW_EM );
// DENORMAL is unmasked by this call.
unsigned int current_word = 0;
_controlfp_s( &current_word, _EM_INVALID, _MCW_EM );
// DENORMAL exception mask remains unchanged.
```

The possible values for the mask constant (`mask`) and new control values (`newControl`) are shown in the following Hexadecimal Values table. Use the portable constants listed below (`_MCW_EM`, `_EM_INVALID`, and so on) as arguments to these functions, rather than supplying the hexadecimal values explicitly.

Intel (x86)-derived platforms support the `DENORMAL` input and output values in hardware. The x86 behavior is to preserve `DENORMAL` values. The ARM platform and the x64 platforms that have SSE2 support enable `DENORMAL` operands and results to be flushed, or forced to zero. The `_controlfp_s`, `_controlfp`, and `_control187` functions provide a mask to change this behavior. The following example demonstrates the use of this mask:

```
unsigned int current_word = 0;
_controlfp_s(&current_word, _DN_SAVE, _MCW_DN);
// Denormal values preserved on ARM platforms and on x64 processors with
// SSE2 support. NOP on x86 platforms.
_controlfp_s(&current_word, _DN_FLUSH, _MCW_DN);
// Denormal values flushed to zero by hardware on ARM platforms
// and x64 processors with SSE2 support. Ignored on other x86 platforms.
```

On ARM platforms, the `_controlfp_s` function applies to the FPSCR register. On x64 architectures, only the SSE2 control word that's stored in the MXCSR register is affected. On Intel (x86) platforms, `_controlfp_s` affects the control words for both the x87 and the SSE2, if present. It's possible for the two control words to be inconsistent with each other (because of a previous call to `_control187_2`, for example); if there's an inconsistency between the two control words, `_controlfp_s` sets the `EM_AMBIGUOUS` flag in `currentControl`. It's a warning that the returned control word might not represent the state of both floating-point control words accurately.

On the ARM and x64 architectures, changing the infinity mode or the floating-point precision isn't supported. If the precision control mask is used on the x64 platform, the function raises an assertion and the invalid parameter handler is invoked, as described in [Parameter validation](#).

If the mask isn't set correctly, this function generates an invalid parameter exception, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `EINVAL` and sets `errno` to `EINVAL`.

This function is ignored when you use `/clr` (Common Language Runtime Compilation) to compile because the common language runtime (CLR) only supports the default floating-point precision.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Mask constants and values

For the `_MCW_EM` mask, clearing it sets the exception, which allows the hardware exception; setting it hides the exception. If a `_EM_UNDERFLOW` or `_EM_OVERFLOW` occurs, no hardware exception is thrown until the next floating-point instruction is executed. To generate a hardware exception immediately after `_EM_UNDERFLOW` or `_EM_OVERFLOW`, call the `FWAIT MASM` instruction.

MASK	HEX VALUE	CONSTANT	HEX VALUE
<code>_MCW_DN</code> (Denormal control)	0x03000000	<code>_DN_SAVE</code> <code>_DN_FLUSH</code>	0x00000000 0x01000000
<code>_MCW_EM</code> (Interrupt exception mask)	0x0008001F	<code>_EM_INVALID</code> <code>_EM_DENORMAL</code> <code>_EM_ZERODIVIDE</code> <code>_EM_OVERFLOW</code> <code>_EM_UNDERFLOW</code> <code>_EM_INEXACT</code>	0x00000010 0x00080000 0x00000008 0x00000004 0x00000002 0x00000001
<code>_MCW_IC</code> (Infinity control) (Not supported on ARM or x64 platforms.)	0x00040000	<code>_IC_AFFINE</code> <code>_IC_PROJECTIVE</code>	0x00040000 0x00000000
<code>_MCW_RC</code> (Rounding control)	0x00000300	<code>_RC_CHOP</code> <code>_RC_UP</code> <code>_RC_DOWN</code> <code>_RC_NEAR</code>	0x00000300 0x00000200 0x00000100 0x00000000
<code>_MCW_PC</code> (Precision control) (Not supported on ARM or x64 platforms.)	0x00030000	<code>_PC_24</code> (24 bits) <code>_PC_53</code> (53 bits) <code>_PC_64</code> (64 bits)	0x00020000 0x00010000 0x00000000

Requirements

ROUTINE	REQUIRED HEADER
<code>_controlfp_s</code>	<code><float.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_ctrlfp_s.c
// processor: x86
// This program uses _controlfp_s to output the FP control
// word, set the precision to 24 bits, and reset the status to
// the default.

#include <stdio.h>
#include <float.h>
#pragma fenv_access (on)

int main( void )
{
    double a = 0.1;
    unsigned int control_word;
    int err;

    // Show original FP control word and do calculation.
    err = _controlfp_s(&control_word, 0, 0);
    if ( err ) /* handle error here */;

    printf( "Original: 0x%.4x\n", control_word );
    printf( "%1.1f * %1.1f = %.15e\n", a, a, a * a );

    // Set precision to 24 bits and recalculate.
    err = _controlfp_s(&control_word, _PC_24, MCW_PC);
    if ( err ) /* handle error here */;

    printf( "24-bit: 0x%.4x\n", control_word );
    printf( "%1.1f * %1.1f = %.15e\n", a, a, a * a );

    // Restore default precision-control bits and recalculate.
    err = _controlfp_s(&control_word, _CW_DEFAULT, MCW_PC);
    if ( err ) /* handle error here */;

    printf( "Default: 0x%.4x\n", control_word );
    printf( "%1.1f * %1.1f = %.15e\n", a, a, a * a );
}

```

```

Original: 0x9001f
0.1 * 0.1 = 1.000000000000000e-002
24-bit: 0xa001f
0.1 * 0.1 = 9.999999776482582e-003
Default: 0x9001f
0.1 * 0.1 = 1.000000000000000e-002

```

See also

[Math and floating-point support](#)

[_clear87](#), [_clearfp](#)
[_status87](#), [_statusfp](#), [_statusfp2](#)
[_control87](#), [_controlfp](#), [__control87_2](#)

`copysign`, `copysignf`, `copysignl`, `_copysign`,
`_copysignf`, `_copysignl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns a value that has the magnitude of one argument and the sign of another.

Syntax

```
double copysign(
    double x,
    double y
);
float copysign(
    float x,
    float y
); // C++ only
long double copysign(
    long double x,
    long double y
); // C++ only
float copysignf(
    float x,
    float y
); // C++ only
long double copysignl(
    long double x,
    long double y
); // C++ only
double _copysign(
    double x,
    double y
);
long double _copysignl(
    long double x,
    long double y
);
#define copysign(X, Y) // Requires C11 or higher
```

Parameters

`x`

The floating-point value that's returned as the magnitude of the result.

`y`

The floating-point value that's returned as the sign of the result.

[Math and floating-point support](#)

Return value

The `copysign` functions return a floating-point value that combines the magnitude of `x` and the sign of `y`. There's no error return.

Remarks

Because C++ allows overloading, you can call overloads of `copysign` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `copysign` always takes and returns a `double`.

If you use the `<tgmath.h>` `copysign()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	REQUIRED HEADER
<code>_copysign</code>	<code><float.h></code>
<code>copysign</code> , <code>copysignf</code> , <code>copysignl</code> , <code>_copysignf</code> , <code>_copysignl</code>	<code><math.h></code>
<code>copysign</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

See also

`fabs`, `fabsf`, `fabsl`
`_chgsign`, `_chgsignf`, `_chgsignl`

`cos`, `cosf`, `cosl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the cosine.

Syntax

```
double cos( double x );
float cosf( float x );
long double cosl( long double x );
#define cos(X) // Requires C11 or higher

float cos( float x ); // C++ only
long double cos( long double x ); // C++ only
```

Parameters

`x`

Angle in radians.

Return value

The cosine of `x`. If `x` is greater than or equal to 263, or less than or equal to -263, a loss of significance in the result occurs.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>
$\pm \text{INF}$	<code>INVALID</code>	<code>_DOMAIN</code>

Remarks

Because C++ allows overloading, you can call overloads of `cos` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `cos` always takes and returns a `double`.

If you use the `<tgmath.h>` `cos()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>cos</code> , <code>cosh</code> , <code>cosf</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>cos()</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

Example

See the example in [sin](#), [sinf](#), [sinl](#).

See also

Math and floating-point support

[acos](#), [acosf](#), [acosl](#)
[asin](#), [asinf](#), [asinl](#)
[atan](#), [atanf](#), [atanl](#), [atan2](#), [atan2f](#), [atan2l](#)
[_matherr](#)
[sin](#), [sinf](#), [sinl](#)
[tan](#), [tanf](#), [tanl](#)

`cosh`, `coshf`, `coshl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the hyperbolic cosine.

Syntax

```
double cosh( double x );
float coshf( float x );
long double coshl( long double x );
#define cosh(X) // Requires C11 or higher

float cosh( float x ); // C++ only
long double cosh( long double x ); // C++ only
```

Parameters

`x`

Angle in radians.

Return value

The hyperbolic cosine of `x`.

By default, if the result is too large in a `cosh`, `coshf`, or `coshl` call, the function returns `HUGE_VAL` and sets `errno` to `ERANGE`.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>
$x \geq 7.104760e+002$	<code>INEXACT + OVERFLOW</code>	<code>OVERFLOW</code>

Remarks

Because C++ allows overloading, you can call overloads of `cosh` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `cosh` always takes and returns a `double`.

If you use the `cosh` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>coshf</code> , <code>cosl</code> , <code>coshl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>coshf</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

Example

See the example in [`sinh`](#), [`sinhf`](#), [`sinhl`](#).

See also

Math and floating-point support

<code>acosh</code>	<code>acoshf</code>	<code>acoshl</code>
<code>asinh</code>	<code>asinhf</code>	<code>asinhl</code>
<code>atanh</code>	<code>atanhf</code>	<code>atanhl</code>
<code>_matherr</code>		
<code>sinh</code>	<code>sinhf</code>	<code>sinhl</code>
<code>tanh</code>	<code>tanhf</code>	<code>tanhl</code>

_countof Macro

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the number of elements in a statically allocated array.

Syntax

```
#define _countof(array) (sizeof(array) / sizeof(array[0]))
```

Parameters

`array`

The name of an array.

Return value

The number of elements in the array, expressed as a `size_t`.

Remarks

`_countof` is implemented as a function-like preprocessor macro. The C++ version has extra template machinery to detect at compile time if a pointer is passed instead of a statically declared array.

Ensure that `array` is actually an array, not a pointer. In C, `_countof` produces erroneous results if `array` is a pointer. In C++, `_countof` fails to compile if `array` is a pointer. An array passed as a parameter to a function *decays to a pointer*, which means that within the function, you can't use `_countof` to determine the extent of the array.

Requirements

MACRO	REQUIRED HEADER
<code>_countof</code>	<code><stdlib.h></code>

Example

```
// crt_countof.cpp
#define _UNICODE
#include <stdio.h>
#include <stdlib.h>
#include <tchar.h>

int main( void )
{
    _TCHAR arr[20], *p;
    printf( "sizeof(arr) = %zu bytes\n", sizeof(arr) );
    printf( "_countof(arr) = %zu elements\n", _countof(arr) );
    // In C++, the following line would generate a compile-time error:
    // printf( "%zu\n", _countof(p) ); // error C2784 (because p is a pointer)

    _tcscpy_s( arr, _countof(arr), _T("a string") );
    // unlike sizeof, _countof works here for both narrow- and wide-character strings
}
```

```
sizeof(arr) = 40 bytes
_countof(arr) = 20 elements
```

See also

[sizeof Operator](#)

`cpow`, `cpowf`, `cpowl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the value of a number raised to the specified power, where the base and exponent are complex numbers. This function has a branch cut for the exponent along the negative real axis.

Syntax

```
_Dcomplex cpow(
    _Dcomplex x, _Dcomplex y
);
_Fcomplex cpow(
    _Fcomplex x, _Fcomplex y
); // C++ only
_Lcomplex cpow(
    _Lcomplex x, _Lcomplex y
); // C++ only
_Fcomplex cpowf(
    _Fcomplex x, _Fcomplex y
);
_Lcomplex cpowl(
    _Lcomplex x, _Lcomplex y
);
```

Parameters

`x`

The base.

`y`

The exponent.

Return value

The value of `x` raised to the power of `y` with a branch cut for `x` along the negative real axis.

Remarks

Because C++ allows overloading, you can call overloads of `cpow` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `cpow` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cpow</code> , <code>cpowf</code> , <code>cpowl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`cexp`, `cexpf`, `cexpl`

`clog10`, `clog10f`, `clog10l`

`clog`, `clogf`, `clogl`

cprintf

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The Microsoft-specific function name `cprintf` is a deprecated alias for the `_cprintf` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use the `_cprintf` or security-enhanced `_cprintf_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

`_cprintf`, `_cprintf_l`, `_cwprintf`, `_cwprintf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Formats and prints to the console. More-secure versions are available; see `_cprintf_s`, `_cprintf_s_l`, `_cwprintf_s`, `_cwprintf_s_l`.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _cprintf(
    const char * format [, argument_list]
);
int _cprintf_l(
    const char * format,
    _locale_t locale [, argument_list]
);
int _cwprintf(
    const wchar * format [, argument_list]
);
int _cwprintf_l(
    const wchar * format,
    _locale_t locale [, argument_list]
);
```

Parameters

`format`

Format-control string.

`argument_List`

Optional parameters for the format string.

`Locale`

The locale to use.

Return value

The number of characters printed.

Remarks

These functions format and print a series of characters and values directly to the console, using the `_putch` function (`_putwch` for `_cwprintf`) to output characters. Each argument in `argument_List` (if any) is converted and output according to the corresponding format specification in `format`. The `format` argument uses the [format specification syntax for printf and wprintf functions](#). Unlike the `fprintf`, `printf`, and `sprintf` functions, `_cprintf` and `_cwprintf` don't translate line-feed characters into carriage return-line feed (CR-LF) combinations when output.

An important distinction is that `_cwprintf` displays Unicode characters when used in Windows. Unlike `_cprintf`, `_cwprintf` uses the current console locale settings.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale.

`_cprintf` validates the `format` parameter. If `format` is a null pointer, the function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EINVAL`.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with [legacy_stdio_float_rounding.obj](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcprintf</code>	<code>_cprintf</code>	<code>_cprintf</code>	<code>_cwprintf</code>
<code>_tcprintf_1</code>	<code>_cprintf_1</code>	<code>_cprintf_1</code>	<code>_cwprintf_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cprintf</code> , <code>_cprintf_1</code>	<code><conio.h></code>
<code>_cwprintf</code> , <code>_cwprintf_1</code>	<code><conio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cprintf.c
// compile with: /c
// This program displays some variables to the console.

#include <conio.h>

int main( void )
{
    int      i = -16,
            h = 29;
    unsigned u = 62511;
    char     c = 'A';
    char     s[] = "Test";

    // Note that console output does not translate \n as
    // standard output does. Use \r\n instead.
    //
    _cprintf( "%d %x %u %c %s\r\n", i, h, u, c, s );
}
```

```
-16 001d 62511 A Test
```

See also

Console and port I/O

[_cscanf](#), [_cscanf_l](#), [_cwscanf](#), [_cwscanf_l](#)
[fprintf](#), [_fprintf_l](#), [fwprintf](#), [_fwprintf_l](#)
[printf](#), [_printf_l](#), [wprintf](#), [_wprintf_l](#)
[sprintf](#), [_sprintf_l](#), [swprintf](#), [_swprintf_l](#), [__swprintf_l](#)
[vfprintf](#), [_vfprintf_l](#), [vfwprintf](#), [_vfwprintf_l](#)
[_cprintf_s](#), [_cprintf_s_l](#), [_cwprintf_s](#), [_cwprintf_s_l](#)
[_cprintf_p](#), [_cprintf_p_l](#), [_cwprintf_p](#), [_cwprintf_p_l](#)
Format specification syntax: [printf](#) and [wprintf](#) functions

`_cprintf_p`, `_cprintf_p_l`, `_cwprintf_p`,
`_cwprintf_p_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Formats and prints to the console, and supports positional parameters in the format string.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _cprintf_p(
    const char * format [, 
    argument] ...
);
int _cprintf_p_l(
    const char * format,
    _locale_t locale [, 
    argument] ...
);
int _cwprintf_p(
    const wchar * format [, 
    argument] ...
);
int _cwprintf_p_l(
    const wchar * format,
    _locale_t locale [, 
    argument] ...
);
```

Parameters

`format`

Format-control string.

`argument`

Optional parameters.

`Locale`

The locale to use.

Return value

The number of characters printed or a negative value if an error occurs.

Remarks

These functions format and print a series of characters and values directly to the console, using the `_putch` and `_putwch` functions to output characters. Each `argument` (if any) is converted and output according to the corresponding format specification in `format`. The format has the same form and function as the `format`

parameter for the `printf_p` function. The difference between `_cprintf_p` and `cprintf_s` is that `_cprintf_p` supports positional parameters, which allows specifying the order in which the arguments are used in the format string. For more information, see [printf_p Positional Parameters](#).

Unlike the `fprintf_p`, `printf_p`, and `sprintf_p` functions, `_cprintf_p` and `_cwprintf_p` don't translate line-feed characters into carriage return-line feed (CR-LF) combinations when output. An important distinction is that `_cwprintf_p` displays Unicode characters when used in Windows NT. Unlike `_cprintf_p`, `_cwprintf_p` uses the current console locale settings.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale.

Also, like `_cprintf_s` and `_cwprintf_s`, they validate the input pointer and the format string. If `format` or `argument` are `NULL`, or if the format string contains invalid formatting characters, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fecleartag`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with [legacy_stdio_float_rounding.obj](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcprintf_p</code>	<code>_cprintf_p</code>	<code>_cprintf_p</code>	<code>_cwprintf_p</code>
<code>_tcprintf_p_1</code>	<code>_cprintf_p_1</code>	<code>_cprintf_p_1</code>	<code>_cwprintf_p_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cprintf_p</code> , <code>_cprintf_p_1</code>	<code><conio.h></code>
<code>_cwprintf_p</code> , <code>_cwprintf_p_1</code>	<code><conio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cprintf_p.c
// This program displays some variables to the console
// using the _cprintf_p function.

#include <conio.h>

int main( void )
{
    int      i = -16,
             h = 29;
    unsigned u = 62511;
    char     c = 'A';
    char     s[] = "Test";

    // Note that console output does not translate
    // \n as standard output does. Use \r\n instead.
    _cprintf_p( "%2$d %1$.4x %3$u %4$c %5$s\r\n",
                h, i, u, c, s );
}
```

```
-16 001d 62511 A Test
```

See also

Console and port I/O

[_cscanf](#), [_cscanf_l](#), [_cwscanf](#), [_cwscanf_l](#)
[_cscanf_s](#), [_cscanf_s_l](#), [_cwscanf_s](#), [_cwscanf_s_l](#)
[_fprintf_p](#), [_fprintf_p_l](#), [_fwprintf_p](#), [_fwprintf_p_l](#)
[fprintf_s](#), [fprintf_s_l](#), [fwprintf_s](#), [fwprintf_s_l](#)
[_printf_p](#), [_printf_p_l](#), [_wprintf_p](#), [_wprintf_p_l](#)
[printf_s](#), [printf_s_l](#), [wprintf_s](#), [wprintf_s_l](#)
[_sprintf_p](#), [_sprintf_p_l](#), [_swprintf_p](#), [_swprintf_p_l](#)
[_vfprintf_p](#), [_vfprintf_p_l](#), [_vfwprintf_p](#), [_vfwprintf_p_l](#)
[_cprintf_s](#), [_cprintf_s_l](#), [_cwprintf_s](#), [_cwprintf_s_l](#)

[printf_p Positional Parameters](#)

Format specification syntax: [printf](#) and [wprintf](#) functions

`_cprintf_s`, `_cprintf_s_l`, `_cwprintf_s`,
`_cwprintf_s_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Formats and prints to the console. These versions of `_cprintf`, `_cprintf_l`, `_cwprintf`, `_cwprintf_l` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _cprintf_s(
    const char * format [, 
    argument] ...
);
int _cprintf_s_l(
    const char * format,
    _locale_t locale [, 
    argument] ...
);
int _cwprintf_s(
    const wchar * format [, 
    argument] ...
);
int _cwprintf_s_l(
    const wchar * format,
    _locale_t locale [, 
    argument] ...
);
```

Parameters

`format`

Format-control string.

`argument`

Optional parameters.

`Locale`

The locale to use.

Return value

The number of characters printed.

Remarks

These functions format and print a series of characters and values directly to the console, using the `_putch` function (`_putwch` for `_cwprintf_s`) to output characters. Each `argument` (if any) is converted and output

according to the corresponding format specification in `format`. The format has the same form and function as the `format` parameter for the `printf_s` function. Unlike the `fprintf_s`, `printf_s`, and `sprintf_s` functions, `_cprintf_s` and `_cwprintf_s` don't translate line-feed characters into carriage return-line feed (CR-LF) combinations when output.

An important distinction is that `_cwprintf_s` displays Unicode characters when used in Windows NT. Unlike `_cprintf_s`, `_cwprintf_s` uses the current console locale.

The versions of these functions with the `_l` suffix are identical except that they use the locale parameter passed in instead of the current locale.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fegetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

Like the non-secure versions (see `_cprintf`, `_cprintf_l`, `_cwprintf`, `_cwprintf_l`), these functions validate their parameters and invoke the invalid parameter handler, as described in [Parameter validation](#), if `format` is a null pointer. These functions differ from the non-secure versions in that the format string itself is also validated. If there are any unknown or badly formed formatting specifiers, these functions invoke the invalid parameter handler. In all cases, If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcprintf_s</code>	<code>_cprintf_s</code>	<code>_cprintf_s</code>	<code>_cwprintf_s</code>
<code>_tcprintf_s_l</code>	<code>_cprintf_s_l</code>	<code>_cprintf_s_l</code>	<code>_cwprintf_s_l</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cprintf_s</code> , <code>_cprintf_s_l</code>	<code><conio.h></code>
<code>_cwprintf_s</code> , <code>_cwprintf_s_l</code>	<code><conio.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the C run-time libraries.

Example

```
// crt_cprintf_s.c
// compile with: /c
// This program displays some variables to the console.

#include <conio.h>

int main( void )
{
    int      i = -16, h = 29;
    unsigned u = 62511;
    char     c = 'A';
    char     s[] = "Test";

    /* Note that console output does not translate \n as
     * standard output does. Use \r\n instead.
     */
    _cprintf_s( "%d  %.4x  %u  %c %s\r\n", i, h, u, c, s );
}
```

```
-16  001d  62511  A Test
```

See also

Console and port I/O

[_cscanf](#), [_cscanf_l](#), [_cwscanf](#), [_cwscanf_l](#)
[fprintf_s](#), [fprintf_s_l](#), [fwprintf_s](#), [fwprintf_s_l](#)
[printf_s](#), [printf_s_l](#), [wprintf_s](#), [wprintf_s_l](#)
[sprintf_s](#), [sprintf_s_l](#), [swprintf_s](#), [swprintf_s_l](#)
[vfprintf_s](#), [vfprintf_s_l](#), [vfwprintf_s](#), [vfwprintf_s_l](#)

Format specification syntax: [printf](#) and [wprintf](#) functions

`cproj`, `cprojf`, `cprojl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the projection of a complex number on the Riemann sphere.

Syntax

```
_Dcomplex cproj(
    _Dcomplex z
);
_Fcomplex cproj(
    _Fcomplex z
); // C++ only
_Lcomplex cproj(
    _Lcomplex z
); // C++ only
_Fcomplex cprojf(
    _Fcomplex z
);
_Lcomplex cprojl(
    _Lcomplex z
);
#define cproj(X) // Requires C11 or higher
```

Parameters

`z`

A complex number.

Return value

The projection of `z` on the Riemann sphere.

Remarks

Because C++ allows overloading, you can call overloads of `cproj` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `cproj` always takes and returns a `_Dcomplex` value.

If you use the `<tgmath.h>` `cproj()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>cproj</code> , <code>cprojf</code> , <code>cprojl</code>	<code><complex.h></code>	<code><ccomplex></code>
<code>cproj</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[norm](#), [normf](#), [norml](#)
[creal](#), [crealf](#), [creall](#)
[conj](#), [conjf](#), [conjl](#)
[cimag](#), [cimagf](#), [cimagl](#)
[carg](#), [cargf](#), [cargl](#)
[cabs](#), [cabsf](#), [cabsl](#)

The Microsoft-specific function name `cputs` is a deprecated alias for the `_cputs` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_cputs` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_cputs`, `_cputws`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Puts a string to the console.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _cputs(
    const char *str
);
int _cputws(
    const wchar_t *str
);
```

Parameters

`str`

Output string.

Return value

If successful, `_cputs` returns 0. If the function fails, it returns a nonzero value.

Remarks

The `_cputs` function writes the null-terminated string that's pointed to by `str` directly to the console. A carriage return-line feed (CR-LF) combination isn't automatically appended to the string.

This function validates its parameter. If `str` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and -1 is returned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_cputs</code>	<code>_cputs</code>	<code>_cputs</code>	<code>_cputws</code>

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
_cputs	<conio.h>	<errno.h>
_cputws	<conio.h>	<errno.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_cputs.c
// compile with: /c
// This program first displays a string to the console.

#include <conio.h>
#include <errno.h>

void print_to_console(char* buffer)
{
    int retval;
    retval = _cputs( buffer );
    if (retval)
    {
        if (errno == EINVAL)
        {
            _cputs( "Invalid buffer in print_to_console.\r\n");
        }
        else
            _cputs( "Unexpected error in print_to_console.\r\n");
    }
}

void wprint_to_console(wchar_t* wbuffer)
{
    int retval;
    retval = _cputws( wbuffer );
    if (retval)
    {
        if (errno == EINVAL)
        {
            _cputws( L"Invalid buffer in wprint_to_console.\r\n");
        }
        else
            _cputws( L"Unexpected error in wprint_to_console.\r\n");
    }
}

int main()
{
    // String to print at console.
    // Notice the \r (return) character.
    char* buffer = "Hello world (courtesy of _cputs)!`r`n";
    wchar_t *wbuffer = L"Hello world (courtesy of _cputws)!`r`n";
    print_to_console(buffer);
    wprint_to_console( wbuffer );
}
```

```
Hello world (courtesy of _cputs)!  
Hello world (courtesy of _cputws)!
```

See also

Console and port I/O

[_putch](#) , [_putwch](#)

creal , crealf , creall

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the real part of a complex number.

Syntax

```
double creal( _Dcomplex z );
float crealf( _Fcomplex z );
long double creall( _Lcomplex z );
#define creal(X) // Requires C11 or higher

float creal( _Fcomplex z ); // C++ only
long double creal( _Lcomplex z ); // C++ only
```

Parameters

`z`

A complex number.

Return value

The real part of `z`.

Remarks

Because C++ allows overloading, you can call overloads of `creal` that take `_Fcomplex` or `_Lcomplex` values, and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `creal` always takes a `_Dcomplex` value and returns a `double` value.

If you use the `<tgmath.h>` `creal()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>creal</code> , <code>crealf</code> , <code>creall</code>	<code><complex.h></code>	<code><ccomplex></code>
<code>creal</code> macro	<code><tgmath.h></code>	

The `_Fcomplex` , `_Dcomplex` , and `_Lcomplex` types are Microsoft-specific equivalents of the unimplemented native C99 types `float _Complex`, `double _Complex`, and `long double _Complex`, respectively. For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`_Cbuild` , `_FCbuild` , `_LCbuild`
`norm` , `normf` , `norml`

`cproj`, `cprojf`, `cprojl`

`conj`, `conjf`, `conjl`

`cimag`, `cimagf`, `cimagl`

`carg`, `cargf`, `cargl`

`cabs`, `cabsf`, `cabsl`

creat

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `creat` is a deprecated alias for the `_creat` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_creat` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_creat`, `_wcreat`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates a new file. `_creat` and `_wcreat` have been deprecated; use `_open_s`, `_wsopen_s` instead.

Syntax

```
int _creat(
    const char *filename,
    int pmode
);
int _wcreat(
    const wchar_t *filename,
    int pmode
);
```

Parameters

`filename`

Name of new file.

`pmode`

Permission setting.

Return value

These functions, if successful, return a file descriptor to the created file. Otherwise, the functions return -1 and set `errno` as shown in the following table.

ERRNO	VALUE	DESCRIPTION
<code>EACCES</code>		<code>filename</code> specifies an existing read-only file or specifies a directory instead of a file.
<code>EMFILE</code>		No more file descriptors are available.
<code>ENOENT</code>		Specified file couldn't be found.

If `filename` is `NULL`, these functions invoke the invalid parameter handler, as described in [Parameter validation](#).

If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`

Remarks

The `_creat` function creates a new file or opens and truncates an existing one. `_wcreat` is a wide-character version of `_creat`; the `filename` argument to `_wcreat` is a wide-character string. `_wcreat` and `_creat` behave identically otherwise.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcreat</code>	<code>_creat</code>	<code>_creat</code>	<code>_wcreat</code>

If the file specified by `filename` doesn't exist, a new file is created with the given permission setting and is opened for writing. If the file already exists and its permission setting allows writing, `_creat` truncates the file to length 0, destroying the previous contents, and opens it for writing. The permission setting, `pmode`, applies to newly created files only. The new file receives the specified permission setting after it's closed for the first time. The integer expression `pmode` contains one or both of the manifest constants `_S_IWRITE` and `_S_IREAD`, defined in SYS\Stat.h. When both constants are given, they're joined with the bitwise or operator (`|`). The `pmode` parameter is set to one of the following values.

VALUE	DEFINITION
<code>_S_IWRITE</code>	Writing permitted.
<code>_S_IREAD</code>	Reading permitted.
<code>_S_IREAD _S_IWRITE</code>	Reading and writing permitted.

If write permission isn't given, the file is read-only. All files are always readable; it's impossible to give write-only permission. The modes `_S_IWRITE` and `_S_IREAD | _S_IWRITE` are then equivalent. Files opened using `_creat` are always opened in compatibility mode (see `_open`) with `_SH_DENYNO`.

`_creat` applies the current file-permission mask to `pmode` before setting the permissions (see `_umask`). `_creat` is provided primarily for compatibility with previous libraries. A call to `_open` with `_O_CREAT` and `_O_TRUNC` in the `oflag` parameter is equivalent to `_creat` and is preferable for new code.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_creat</code>	<code><io.h></code>	<code><sys/types.h>, <sys/stat.h>, <errno.h></code>
<code>_wcreat</code>	<code><io.h> or <wchar.h></code>	<code><sys/types.h>, <sys/stat.h>, <errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_creat.c
// compile with: /W3
// This program uses _creat to create
// the file (or truncate the existing file)
// named data and open it for writing.

#include <sys/types.h>
#include <sys/stat.h>
#include <io.h>
#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    int fh;

    fh = _creat( "data", _S_IREAD | _S_IWRITE ); // C4996
    // Note: _creat is deprecated; use _sopen_s instead
    if( fh == -1 )
        perror( "Couldn't create data file" );
    else
    {
        printf( "Created data file.\n" );
        _close( fh );
    }
}
```

Created data file.

See also

Low-level I/O

[_chmod](#) , [_wchmod](#)
[_chsize](#)
[_close](#)
[_dup](#) , [_dup2](#)
[_open](#) , [_wopen](#)
[_sopen](#) , [_wsopen](#)
[_umask](#)

`_create_locale`, `_wcreate_locale`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Creates a locale object.

Syntax

```
_locale_t _create_locale(  
    int category,  
    const char *locale  
)  
_locale_t _wcreate_locale(  
    int category,  
    const wchar_t *locale  
)
```

Parameters

`category`

Category.

`Locale`

Locale specifier.

Return value

If a valid `Locale` and `category` are given, the functions return the specified locale settings as a `_locale_t` object. The current locale settings of the program aren't changed.

Remarks

The `_create_locale` function allows you to create an object that represents certain region-specific settings, for use in locale-specific versions of many CRT functions (functions with the `_1` suffix). The behavior is similar to `setlocale`, except that instead of applying the specified locale settings to the current environment, the settings are saved in a `_locale_t` structure that is returned. The `_locale_t` structure should be freed using `_free_locale` when it's no longer needed.

`_wcreate_locale` is a wide-character version of `_create_locale`; the `Locale` argument to `_wcreate_locale` is a wide-character string. `_wcreate_locale` and `_create_locale` behave identically otherwise.

The `category` argument specifies the parts of the locale-specific behavior that are affected. The flags used for `category` and the parts of the program they affect are as shown in this table:

CATEGORY FLAG	AFFECTS
<code>LC_ALL</code>	All categories, as listed below.
<code>LC_COLLATE</code>	The <code>strcoll</code> , <code>_stricoll</code> , <code>wcscoll</code> , <code>_wcsicoll</code> , <code>strxfrm</code> , <code>_strncoll</code> , <code>_strnicoll</code> , <code>_wcsncoll</code> , <code>_wcsnicoll</code> , and <code>wcsxfrm</code> functions.

CATEGORY	FLAG	AFFECTS
	LC_CTYPE	The character-handling functions (except <code>isdigit</code> , <code>isxdigit</code> , <code>mbstowcs</code> , and <code>mbtowc</code> , which are unaffected).
	LC_MONETARY	Monetary-formatting information returned by the <code>localeconv</code> function.
	LC_NUMERIC	Decimal-point character for the formatted output routines (such as <code>printf</code>), for the data-conversion routines, and for the non-monetary formatting information returned by <code>localeconv</code> . In addition to the decimal-point character, <code>LC_NUMERIC</code> sets the thousands separator and the grouping control string returned by <code>localeconv</code> .
	LC_TIME	The <code>strftime</code> and <code>wcsftime</code> functions.

This function validates the `category` and `Locale` parameters. If the category parameter isn't one of the values given in the previous table or if `Locale` is `NULL`, the function returns `NULL`.

The `Locale` argument is a pointer to a string that specifies the locale. For information about the format of the `Locale` argument, see [Locale names, Languages, and Country/Region strings](#).

The `Locale` argument can take several kinds of values: a locale name, a language string, a language string and country/region code, a code page, or a combination of language string, country/region code, and code page. The set (of available locale names, languages, country/region codes, and code pages) includes all that are supported by the Windows NLS API. The set of locale names `_create_locale` supports is described in [Locale names, Languages, and Country/Region strings](#). The set of language and country/region strings supported by `_create_locale` are listed in [Language strings](#) and [Country/Region strings](#).

For more information about locale settings, see [`setlocale`](#), [`_wsetlocale`](#).

The previous name of this function, `__create_locale` (with two leading underscores), has been deprecated.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_create_locale</code>	<code><locale.h></code>
<code>_wcreate_locale</code>	<code><locale.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_create_locale.c
// Sets the current locale to "de-CH" using the
// setlocale function and demonstrates its effect on the strftime
// function.

#include <stdio.h>
#include <locale.h>
#include <time.h>

int main(void)
{
    time_t ltime;
    struct tm thetime;
    unsigned char str[100];
    _locale_t locale;

    // Create a locale object representing the German (Switzerland) locale
    locale = _create_locale(LC_ALL, "de-CH");
    time (&ltime);
    _gmtime64_s(&thetime, &ltime);

    // %#x is the long date representation, appropriate to
    // the current locale
    if (!_strftime_l((char *)str, 100, "%#x",
                      (const struct tm *)&thetime, locale))
    {
        printf("_strftime_l failed!\n");
    }
    else
    {
        printf("In de-CH locale, _strftime_l returns '%s'\n", str);
    }

    _free_locale(locale);

    // Create a locale object representing the default C locale
    locale = _create_locale(LC_ALL, "C");
    time(&ltime);
    _gmtime64_s(&thetime, &ltime);

    if (!_strftime_l((char *)str, 100, "%#x",
                      (const struct tm *)&thetime, locale))
    {
        printf("_strftime_l failed!\n");
    }
    else
    {
        printf("In 'C' locale, _strftime_l returns '%s'\n", str);
    }

    _free_locale(locale);
}

```

In de-CH locale, _strftime_l returns 'Samstag, 9. Februar 2002'
In 'C' locale, _strftime_l returns 'Saturday, February 09, 2002'

See also

[Locale names, Languages, and Country/Region strings](#)

[Language strings](#)

[Country/Region strings](#)

[_free_locale](#)

```
_configthreadlocale  
setlocale  
Locale  
localeconv  
_mbclen , _mblen , _mblen_l  
strlen , wcslen , _mbslen , _mbslen_l , _mbstrlen , _mbstrlen_l  
mbstowcs , _mbstowcs_l  
mbtowc , _mbtowc_l  
_setmbcp  
setlocale , _wsetlocale  
strcoll functions  
strftime , wcsftime , _strftime_l , _wcsftime_l  
strxfrm , wcsxfrm , _strxfrm_l , _wcsxfrm_l  
wcstombs , _wcstombs_l  
wctomb , _wctomb_l
```

_CrtCheckMemory

11/2/2022 • 2 minutes to read • [Edit Online](#)

Confirms the integrity of the memory blocks allocated in the debug heap (debug version only).

Syntax

```
int _CrtCheckMemory( void );
```

Return value

If successful, `_CrtCheckMemory` returns `TRUE`; otherwise, the function returns `FALSE`.

Remarks

The `_CrtCheckMemory` function validates memory allocated by the debug heap manager by verifying the underlying base heap and inspecting every memory block. If an error or memory inconsistency is encountered in the underlying base heap, the debug header information, or the overwrite buffers, `_CrtCheckMemory` generates a debug report with information describing the error condition. When `_DEBUG` isn't defined, calls to `_CrtCheckMemory` are removed during preprocessing.

The behavior of `_CrtCheckMemory` can be controlled by setting the bit fields of the `_crtDbgFlag` flag using the `_CrtSetDbgFlag` function. Turning the `_CRTDBG_CHECK_ALWAYS_DF` bit field ON results in `_CrtCheckMemory` being called every time a memory allocation operation is requested. Although this method slows down execution, it's useful for catching errors quickly. Turning the `_CRTDBG_ALLOC_MEM_DF` bit field OFF causes `_CrtCheckMemory` to not verify the heap and immediately return `TRUE`.

Because this function returns `TRUE` or `FALSE`, it can be passed to one of the `_ASSERT` macros to create a basic debugging error handling mechanism. The following example causes an assertion failure if corruption is detected in the heap:

```
_ASSERT(_CrtCheckMemory());
```

For more information about how `_CrtCheckMemory` can be used with other debug functions, see [Heap state reporting functions](#). For an overview of memory management and the debug heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtCheckMemory</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

For a sample of how to use `_CrtCheckMemory`, see [crt_dbg1](#).

See also

Debug routines

[_crtDbgFlag](#)

[_CrtSetDbgFlag](#)

_CrtDbgBreak

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a break point on a particular line of code. (Used in debug mode only.)

Syntax

```
void _CrtDbgBreak( void );
```

Return value

There's no return value.

Remarks

The `_CrtDbgBreak` function sets a debug breakpoint on the particular line of code where the function resides. This function is used in debug mode only and is dependent on `_DEBUG` being previously defined.

For more information about using other hook-capable run-time functions and writing your own client-defined hook functions, see [Writing your own debug hook functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtDbgBreak</code>	<CRTDBG.h>

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

[__debugbreak](#)

`_CrtDbgReport`, `_CrtDbgReportW`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Generates a report with a debugging message and sends the report to three possible destinations (debug version only).

Syntax

```
int _CrtDbgReport(
    int reportType,
    const char *filename,
    int linenumber,
    const char *moduleName,
    const char *format [, 
    argument] ...
);
int _CrtDbgReportW(
    int reportType,
    const wchar_t *filename,
    int linenumber,
    const wchar_t *moduleName,
    const wchar_t *format [, 
    argument] ...
);
```

Parameters

`reportType`

Report type: `_CRT_WARN`, `_CRT_ERROR`, and `_CRT_ASSERT`.

`filename`

Pointer to name of source file where assert/report occurred or `NULL`.

`LineNumber`

Line number in source file where assert/report occurred or `NULL`.

`moduleName`

Pointer to name of module (.exe or .dll) where assert or report occurred.

`format`

Pointer to format-control string used to create the user message.

`argument`

Optional substitution arguments used by `format`.

Return value

For all report destinations, `_CrtDbgReport` and `_CrtDbgReportW` return -1 if an error occurs and 0 if no errors are encountered. However, when the report destination is a debug message window and the user chooses the **Retry** button, these functions return 1. If the user chooses the **Abort** button in the Debug Message window, these functions immediately abort and don't return a value.

The `_RPT`, `_RPTFW` debug macros call `_CrtDbgReport` to generate their debug reports. The wide-character versions of these macros, along with `_ASSERT`, `_ASSERTE`, `_RPTW` and `_RPTFW`, use `_CrtDbgReportW` to generate

their debug reports. When `_CrtDbgReport` or `_CrtDbgReportW` return 1, these macros start the debugger, if just-in-time (JIT) debugging is enabled.

Remarks

`_CrtDbgReport` and `_CrtDbgReportW` can send the debug report to three different destinations: a debug report file, a debug monitor (the Visual Studio debugger), or a debug message window. Two configuration functions, `_CrtSetReportMode` and `_CrtSetReportFile`, are used to specify the destination or destinations for each report type. These functions allow the reporting destination or destinations for each report type to be separately controlled. For example, it's possible to specify that a `reportType` of `_CRT_WARN` only goes to the debug monitor, while a `reportType` of `_CRT_ASSERT` goes to both a debug message window and a user-defined report file.

`_CrtDbgReportW` is the wide-character version of `_CrtDbgReport`. All its output and string parameters are in wide-character strings; otherwise it's identical to the single-byte character version.

`_CrtDbgReport` and `_CrtDbgReportW` create the user message for the debug report by substituting the `argument[n]` arguments into the `format` string, using the same rules defined by the `printf` or `wprintf` functions. These functions then generate the debug report and determine the destination or destinations, based on the current report modes and file defined for `reportType`. When the report is sent to a debug message window, the `filename`, `LineNumber`, and `moduleName` are included in the information displayed in the window.

The following table lists the available choices for the report mode or modes and file and the resulting behavior of `_CrtDbgReport` and `_CrtDbgReportW`. These options are defined as bit flags in `<crtdbg.h>`.

REPORT MODE	REPORT FILE	<code>_CRTDBGREPORT</code> , <code>_CRTDBGREPORTW</code> BEHAVIOR
<code>_CRTDBG_MODE_DEBUG</code>	Not applicable	Writes message by using Windows <code>OutputDebugString</code> API.
<code>_CRTDBG_MODE_WNDW</code>	Not applicable	Calls Windows <code>MessageBox</code> API to create message box to display the message along with Abort , Retry , and Ignore buttons. If a user chooses Abort , <code>_CrtDbgReport</code> or <code>_CrtDbgReportW</code> immediately aborts. If a user chooses Retry , it returns 1. If a user chooses Ignore , execution continues and <code>_CrtDbgReport</code> and <code>_CrtDbgReportW</code> return 0. Choosing Ignore when an error condition exists often results in undefined behavior.
<code>_CRTDBG_MODE_FILE</code>	<code>__HFILE</code>	Writes message to user-supplied <code>HANDLE</code> , using the Windows <code>WriteFile</code> API and doesn't verify validity of file handle; the application is responsible for opening the report file and passing a valid file handle.
<code>_CRTDBG_MODE_FILE</code>	<code>_CRTDBG_FILE_STDERR</code>	Writes message to <code>stderr</code> .
<code>_CRTDBG_MODE_FILE</code>	<code>_CRTDBG_FILE_STDOUT</code>	Writes message to <code>stdout</code> .

The report can be sent to one, two, or three destinations or to no destination at all. For more information about specifying the report mode or modes and report file, see the `_CrtSetReportMode` and `_CrtSetReportFile` functions. For more information about using the debug macros and reporting functions, see [Macros for](#)

reporting.

If your application needs more flexibility than that provided by `_CrtDbgReport` and `_CrtDbgReportW`, you can write your own reporting function and hook it into the C run-time library reporting mechanism by using the `_CrtSetReportHook` function.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtDbgReport</code>	<code><crtdbg.h></code>
<code>_CrtDbgReportW</code>	<code><crtdbg.h></code>

`_CrtDbgReport` and `_CrtDbgReportW` are Microsoft extensions. For more information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```
// crt_crtdbgreport.c
#include <crtdbg.h>

int main(int argc, char *argv[]) {
#ifndef _DEBUG
    _CrtDbgReport(_CRT_ASSERT, __FILE__, __LINE__, argv[0], NULL);
#endif
}
```

See [crt_dbg2](#) for an example of how to change the report function.

See also

Debug routines

[_CrtSetReportMode](#)
[_CrtSetReportFile](#)
[printf](#), [_printf_l](#), [wprintf](#), [_wprintf_l](#)
[_DEBUG](#)

_CrtDoForAllClientObjects

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calls an application-supplied function for all `_CLIENT_BLOCK` types in the heap (debug version only).

Syntax

```
void _CrtDoForAllClientObjects(
    void ( * pfn )( void *, void * ),
    void *context
);
```

Parameters

`pfn`

Pointer to the application-supplied function callback function. The first parameter to this function points to the data. The second parameter is the context pointer that is passed to the call to `_CrtDoForAllClientObjects`.

`context`

Pointer to the application-supplied context to pass to the application-supplied function.

Remarks

The `_CrtDoForAllClientObjects` function searches the heap's linked list for memory blocks with the `_CLIENT_BLOCK` type and calls the application-supplied function when a block of this type is found. The found block and the `context` parameter are passed as arguments to the application-supplied function. During debugging, an application can track a specific group of allocations by explicitly calling the debug heap functions to allocate the memory and specifying that the blocks be assigned the `_CLIENT_BLOCK` block type. These blocks can then be tracked separately and reported on differently during leak detection and memory state reporting.

If the `_CRTDBG_ALLOC_MEM_DF` bit field of the `_crtDbgFlag` flag isn't turned on, `_CrtDoForAllClientObjects` immediately returns. When `_DEBUG` isn't defined, calls to `_CrtDoForAllClientObjects` are removed during preprocessing.

For more information about the `_CLIENT_BLOCK` type and how it can be used by other debug functions, see [Types of blocks on the debug heap](#). For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

If `pfn` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr` is set to `EINVAL` and the function returns.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtDoForAllClientObjects</code>	<code><crtdbg.h>, <errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: Debug versions of universal C run-time libraries only.

See also

Debug routines

[_CrtSetDbgFlag](#)

Heap state reporting functions

[_CrtReportBlockType](#)

_CrtDumpMemoryLeaks

11/2/2022 • 2 minutes to read • [Edit Online](#)

Dumps all the memory blocks in the debug heap when a memory leak has occurred (debug version only).

Syntax

```
int _CrtDumpMemoryLeaks( void );
```

Return value

`_CrtDumpMemoryLeaks` returns `TRUE` if a memory leak is found. Otherwise, the function returns `FALSE`.

Remarks

The `_CrtDumpMemoryLeaks` function determines whether a memory leak has occurred since the start of program execution. When a leak is found, the debug header information for all the objects in the heap is dumped in a user-readable form. When `_DEBUG` isn't defined, calls to `_CrtDumpMemoryLeaks` are removed during preprocessing.

`_CrtDumpMemoryLeaks` is frequently called at the end of program execution to verify that all memory allocated by the application has been freed. The function can be called automatically at program termination by turning on the `_CRTDBG_LEAK_CHECK_DF` bit field of the `_crtDbgFlag` flag using the `_CrtSetDbgFlag` function.

`_CrtDumpMemoryLeaks` calls `_CrtMemCheckpoint` to obtain the current state of the heap and then scans the state for blocks that haven't been freed. When an unfreed block is encountered, `_CrtDumpMemoryLeaks` calls `_CrtMemDumpAllObjectsSince` to dump information for all the objects allocated in the heap from the start of program execution.

By default, internal C run-time blocks (`_CRT_BLOCK`) aren't included in memory dump operations. The `_CrtSetDbgFlag` function can be used to turn on the `_CRTDBG_CHECK_CRT_DF` bit of `_crtDbgFlag` to include these blocks in the leak detection process.

For more information about heap state functions and the `_CrtMemState` structure, see [Heap state reporting functions](#). For more information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtDumpMemoryLeaks</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

For a sample of how to use `_CrtDumpMemoryLeaks`, see [crt_dbg1](#).

See also

[Debug routines](#)

_CrtGetAllocHook

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the current client-defined allocation function for hooking into the C run-time debug memory allocation process (debug version only).

Syntax

```
_CRT_ALLOC_HOOK _CrtGetAllocHook( void );
```

Return value

Returns the currently defined allocation hook function.

Remarks

`_CrtGetAllocHook` retrieves the current client-defined application hook function for the C run-time debug library memory allocation process.

For more information about using other hook-capable run-time functions and writing your own client-defined hook functions, see [Debug hook function writing](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtGetAllocHook</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

`_CrtSetAllocHook`

_CrtGetDumpClient

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the current application-defined function for dumping the `_CLIENT_BLOCK` type memory blocks (debug version only).

Syntax

```
_CRT_DUMP_CLIENT _CrtGetDumpClient( void );
```

Return value

Returns the current dump routine.

Remarks

The `_CrtGetDumpClient` function retrieves the current hook function for dumping objects stored in the `_CLIENT_BLOCK` memory blocks.

For more information about using other hook-capable run-time functions and writing your own client-defined hook functions, see [Debug hook function writing](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtGetDumpClient</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

[_CrtReportBlockType](#)
[_CrtSetDumpClient](#)

_CrtGetReportHook

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the client-defined reporting function for hooking it into the C run time for the debug reporting process (debug version only).

Syntax

```
_CRT_REPORT_HOOK _CrtGetReportHook( void );
```

Return value

Returns the current client-defined reporting function.

Remarks

`_CrtGetReportHook` allows an application to retrieve the current reporting function for the C run-time debug library reporting process.

For more information about using other hook-capable run-time functions and writing your own client-defined hook functions, see [Debug hook function writing](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtGetReportHook</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

For a sample of how to use `_CrtSetReportHook`, see [report](#).

See also

[Debug routines](#)

`_CrtSetReportHook`

_CrtIsMemoryBlock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Verifies that a specified memory block is in the local heap and that it has a valid debug heap block type identifier (debug version only).

Syntax

```
int _CrtIsMemoryBlock(
    const void *userData,
    unsigned int size,
    long *requestNumber,
    char **filename,
    int *lineNumber
);
```

Parameters

`userData`

Pointer to the beginning of the memory block to verify.

`size`

Size of the specified block (in bytes).

`requestNumber`

Pointer to the allocation number of the block or `NULL`.

`filename`

Pointer to the name of the source file that requested the block or `NULL`.

`LineNumber`

Pointer to the line number in the source file or `NULL`.

Return value

`_CrtIsMemoryBlock` returns `TRUE` if the specified memory block is located within the local heap and has a valid debug heap block type identifier; otherwise, the function returns `FALSE`.

Remarks

The `_CrtIsMemoryBlock` function verifies that a specified memory block is located within the application's local heap and that it has a valid block type identifier. This function can also be used to obtain the object allocation order number and the source file name/line number where the memory block allocation was originally requested. A non-`NULL` value passed in a `requestNumber`, `filename`, or `LineNumber` parameter causes `_CrtIsMemoryBlock` to set the parameter to the value in the memory block's debug header, if it finds the block in the local heap. When `_DEBUG` isn't defined, calls to `_CrtIsMemoryBlock` are removed during preprocessing.

If `_CrtIsMemoryBlock` fails, it returns `FALSE`, and the output parameters are initialized to default values:

`requestNumber` and `LineNumber` are set to 0 and `filename` is set to `NULL`.

Because this function returns `TRUE` or `FALSE`, it can be passed to one of the `_ASSERT` macros to create a basic debugging error handling mechanism. The following example causes an assertion failure if the specified address

isn't located within the local heap:

```
_ASSERTE( _CrtIsMemoryBlock( userData, size, &requestNumber,
    &filename, &linenumber ) );
```

For more information about how `_CrtIsMemoryBlock` can be used with other debug functions and macros, see [Macros for reporting](#). For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtIsMemoryBlock</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

See the example for the [`_CrtIsValidHeapPointer`](#) article.

See also

[Debug routines](#)

_CrtIsValidHeapPointer

11/2/2022 • 3 minutes to read • [Edit Online](#)

Verifies that a specified pointer is in a heap allocated by some C run-time library, but not necessarily by the caller's CRT library. In versions of the CRT before Visual Studio 2010, this function verifies that the specified pointer is in the local heap (debug version only).

Syntax

```
int _CrtIsValidHeapPointer(
    const void *userData
);
```

Parameters

`userData`

Pointer to the beginning of an allocated memory block.

Return value

`_CrtIsValidHeapPointer` returns `TRUE` if the specified pointer is in the heap shared by all CRT library instances. In versions of the CRT before Visual Studio 2010, this function returns `TRUE` if the specified pointer is in the local heap. Otherwise, the function returns `FALSE`.

Remarks

We don't recommend that you use this function. Starting with the Visual Studio 2010 CRT library, all CRT libraries share one OS heap, the *process heap*. The `_CrtIsValidHeapPointer` function reports whether the pointer was allocated in a CRT heap, but not that it was allocated by the caller's CRT library. For example, consider a block allocated by using the Visual Studio 2010 version of the CRT library. If the `_CrtIsValidHeapPointer` function exported by the Visual Studio 2012 version of the CRT library tests the pointer, it returns `TRUE`. This test is no longer useful. In versions of the CRT library before Visual Studio 2010, the function is used to ensure that a specific memory address is within the local heap. The local heap refers to the heap created and managed by a particular instance of the C run-time library. If a dynamic-link library (DLL) contains a static link to the run-time library, it has its own instance of the run-time heap, and therefore its own heap, independent of the application's local heap. When `_DEBUG` isn't defined, calls to `_CrtIsValidHeapPointer` are removed during preprocessing.

Because this function returns `TRUE` or `FALSE`, it can be passed to one of the `_ASSERT` macros to create a basic debugging error handling mechanism. The following example causes an assertion failure if the specified address isn't located within the local heap:

```
_ASSERTE( _CrtIsValidHeapPointer( userData ) );
```

For more information about how `_CrtIsValidHeapPointer` can be used with other debug functions and macros, see [Macros for reporting](#). For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtIsValidHeapPointer</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

The following example demonstrates how to test whether memory is valid when it's used with C run-time libraries before Visual Studio 2010. This example is provided for users of legacy CRT library code.

```
// crt_isvalid.c
// This program allocates a block of memory using _malloc_dbg
// and then tests the validity of this memory by calling
// _CrtIsMemoryBlock,_CrtIsValidPointer, and _CrtIsValidHeapPointer.

#include <stdio.h>
#include <string.h>
#include <malloc.h>
#include <crtdbg.h>

#define TRUE 1
#define FALSE 0

int main( void )
{
    char *my_pointer;

    // Call _malloc_dbg to include the filename and line number
    // of our allocation request in the header information
    my_pointer = (char *)_malloc_dbg( sizeof(char) * 10,
        _NORMAL_BLOCK, __FILE__, __LINE__ );

    // Ensure that the memory got allocated correctly
    _CrtIsMemoryBlock((const void *)my_pointer, sizeof(char) * 10,
        NULL, NULL, NULL );

    // Test for read/write accessibility
    if (_CrtIsValidPointer((const void *)my_pointer,
        sizeof(char) * 10, TRUE))
        printf("my_pointer has read and write accessibility.\n");
    else
        printf("my_pointer only has read access.\n");

    // Make sure my_pointer is within the local heap
    if (_CrtIsValidHeapPointer((const void *)my_pointer))
        printf("my_pointer is within the local heap.\n");
    else
        printf("my_pointer is not located within the local"
            " heap.\n");

    free(my_pointer);
}
```

```
my_pointer has read and write accessibility.  
my_pointer is within the local heap.
```

See also

[Debug routines](#)

_CrtIsValidPointer

11/2/2022 • 2 minutes to read • [Edit Online](#)

Verifies that a pointer isn't null. In versions of the C run-time library before Visual Studio 2010, verifies that a specified memory range is valid for reading and writing (debug version only).

Syntax

```
int _CrtIsValidPointer(
    const void *address,
    unsigned int size,
    int access
);
```

Parameters

`address`

Points to the beginning of the memory range to test for validity.

`size`

Size of the specified memory range (in bytes).

`access`

Read/write accessibility to determine for the memory range.

Return value

`_CrtIsValidPointer` returns `TRUE` if the specified pointer isn't null. In CRT library versions before Visual Studio 2010, returns `TRUE` if the memory range is valid for the specified operation or operations. Otherwise, the function returns `FALSE`.

Remarks

In the CRT library in Visual Studio 2010 and later versions, the `size` and `access` parameters are ignored, and `_CrtIsValidPointer` only verifies that the specified `address` isn't null. Because this test is easy to perform yourself, we don't recommend you use this function. In versions before Visual Studio 2010, the function verifies that the memory range beginning at `address` and extending for `size` bytes is valid for the specified accessibility operation or operations. When `access` is set to `TRUE`, the memory range is verified for both reading and writing. When `access` is `FALSE`, the memory range is only validated for reading. When `_DEBUG` isn't defined, calls to `_CrtIsValidPointer` are removed during preprocessing.

Because this function returns `TRUE` or `FALSE`, it can be passed to one of the `_ASSERT` macros to create a basic debugging error handling mechanism. The following example causes an assertion failure if the memory range isn't valid for both reading and writing operations:

```
_ASERTE( _CrtIsValidPointer( address, size, TRUE ) );
```

For more information about how `_CrtIsValidPointer` can be used with other debug functions and macros, see [Macros for reporting](#). For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtIsValidPointer</code>	<code><crtdbg.h></code>

`_CrtIsValidPointer` is a Microsoft extension. For compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

See the example for the `_CrtIsValidHeapPointer` article.

See also

[Debug routines](#)

_CrtMemCheckpoint

11/2/2022 • 2 minutes to read • [Edit Online](#)

Obtains the current state of the debug heap and stores in an application-supplied `_CrtMemState` structure (debug version only).

Syntax

```
void _CrtMemCheckpoint(  
    _CrtMemState *state  
)
```

Parameters

`state`

Pointer to `_CrtMemState` structure to fill with the memory checkpoint.

Remarks

The `_CrtMemCheckpoint` function creates a snapshot of the current state of the debug heap at any given moment. This snapshot can be used by other heap state functions such as `_CrtMemDifference` to help detect memory leaks and other problems. When `_DEBUG` isn't defined, calls to `_CrtMemState` are removed during preprocessing.

The application must pass a pointer to a previously allocated instance of the `_CrtMemState` structure, defined in `Crtdbg.h`, in the `state` parameter. If `_CrtMemCheckpoint` encounters an error during the checkpoint creation, the function generates a `_CRT_WARN` debug report describing the problem.

For more information about heap state functions and the `_CrtMemState` structure, see [Heap state reporting functions](#). For more information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

If `state` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr` is set to `EINVAL` and the function returns.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtMemCheckpoint</code>	<code><crtdbg.h>, <errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: Debug versions of the UCRT only.

See also

[Debug routines](#)

`_CrtMemDifference`

_CrtMemDifference

11/2/2022 • 2 minutes to read • [Edit Online](#)

Compares two memory states and returns their differences (debug version only).

Syntax

```
int _CrtMemDifference(
    _CrtMemState *stateDiff,
    const _CrtMemState *oldState,
    const _CrtMemState *newState
);
```

Parameters

`stateDiff`

Pointer to a `_CrtMemState` structure that is used to store the differences between the two memory states (returned).

`oldState`

Pointer to an earlier memory state (`_CrtMemState` structure).

`newState`

Pointer to a later memory state (`_CrtMemState` structure).

Return value

If the difference in memory states is significant, `_CrtMemDifference` returns `TRUE`. Otherwise, the function returns `FALSE`.

Remarks

The `_CrtMemDifference` function compares `oldState` and `newState` and stores their differences in `stateDiff`, which can then be used by the app to detect memory leaks and other memory problems. When `_DEBUG` isn't defined, calls to `_CrtMemDifference` are removed during preprocessing.

`newState` and `oldState` must each be a valid pointer to a `_CrtMemState` structure, defined in `crtdbg.h`, that `_CrtMemCheckpoint` has filled in before the call to `_CrtMemDifference`. `stateDiff` must be a pointer to a previously allocated instance of the `_CrtMemState` structure. If `stateDiff`, `newState`, or `oldState` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr` is set to `EINVAL` and the function returns `FALSE`.

`_CrtMemDifference` compares the `_CrtMemState` field values of the blocks in `oldState` to the ones in `newState` and stores the result in `stateDiff`. When the number of allocated block types or total number of allocated blocks for each type differs between the two memory states, the difference in states is considered significant. The difference between the largest amount ever allocated at once for the two states and the difference between total allocations for the two states are also stored in `stateDiff`.

By default, internal C run-time blocks (`_CRT_BLOCK`) aren't included in memory state operations. The `_CrtSetDbgFlag` function can be used to turn on the `_CRTDBG_CHECK_CRT_DF` bit of `_crtDbgFlag` to include these blocks in leak detection and other memory state operations. Freed memory blocks (`_FREE_BLOCK`) don't cause

`_CrtMemDifference` to return `TRUE`.

For more information about heap state functions and the `_CrtMemState` structure, see [Heap state reporting functions](#). For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_CrtMemDifference</code>	<code><crtdbg.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: Debug versions of the [C runtime libraries](#) only.

See also

[Debug routines](#)

`_crtDbgFlag` \

_CrtMemDumpAllObjectsSince

11/2/2022 • 2 minutes to read • [Edit Online](#)

Dumps information about objects in the heap from the start of program execution or from a specified heap state (debug version only).

Syntax

```
void _CrtMemDumpAllObjectsSince(  
    const _CrtMemState *state  
)
```

Parameters

`state`

Pointer to the heap state to begin dumping from or `NULL`.

Remarks

The `_CrtMemDumpAllObjectsSince` function dumps the debug header information of objects allocated in the heap in a user-readable form. The dump information can be used by the application to track allocations and detect memory problems. When `_DEBUG` isn't defined, calls to `_CrtMemDumpAllObjectsSince` are removed during preprocessing.

`_CrtMemDumpAllObjectsSince` uses the value of the `state` parameter to determine where to initiate the dump operation. To begin dumping from a specified heap state, the `state` parameter must be a pointer to a `_CrtMemState` structure that has been filled in by `_CrtMemCheckpoint` before `_CrtMemDumpAllObjectsSince` was called. When `state` is `NULL`, the function begins the dump from the start of program execution.

If the application has installed a dump hook function by calling `_CrtSetDumpClient`, then every time `_CrtMemDumpAllObjectsSince` dumps information about a `_CLIENT_BLOCK` type of block, it calls the application-supplied dump function as well. By default, internal C run-time blocks (`_CRT_BLOCK`) aren't included in memory dump operations. The `_CrtSetDbgFlag` function can be used to turn on the `_CRTDBG_CHECK_CRT_DF` bit of `_crtDbgFlag` to include these blocks. In addition, blocks marked as freed or ignored (`_FREE_BLOCK`, `_IGNORE_BLOCK`) aren't included in the memory dump.

For more information about heap state functions and the `_CrtMemState` structure, see [Heap state reporting functions](#). For more information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtMemDumpAll-ObjectsSince</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

For a sample of how to use `_CrtMemDumpAllObjectsSince`, see [crt_dbg2](#).

See also

[Debug routines](#)

[_crtDbgFlag](#)

_CrtMemDumpStatistics

11/2/2022 • 2 minutes to read • [Edit Online](#)

Dumps the debug header information for a specified heap state in a user-readable form (debug version only).

Syntax

```
void _CrtMemDumpStatistics(
    const _CrtMemState *state
);
```

Parameters

`state`

Pointer to the heap state to dump.

Remarks

The `_CrtMemDumpStatistics` function dumps the debug header information for a specified state of the heap in a user-readable form. The dump statistics can be used by the application to track allocations and detect memory problems. The memory state can contain a specific heap state or the difference between two states. When `_DEBUG` isn't defined, calls to `_CrtMemDumpStatistics` are removed during preprocessing.

The `state` parameter must be a pointer to a `_CrtMemState` structure that has been filled in by `_CrtMemCheckpoint` or returned by `_CrtMemDifference` before `_CrtMemDumpStatistics` is called. If `state` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and no action is taken. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For more information about heap state functions and the `_CrtMemState` structure, see [Heap state reporting functions](#). For more information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_CrtMemDumpStatistics</code>	<code><crtdbg.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: Debug versions of the [C runtime libraries](#) only.

See also

[Debug routines](#)\

_CrtReportBlockType

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the block type/subtype associated with a given debug heap block pointer.

Syntax

```
int _CrtReportBlockType(  
    const void * pBlock  
);
```

Parameters

pBlock

Pointer to a valid debug heap block.

Return value

When passed a valid debug heap pointer, the `_CrtReportBlockType` function returns the block type and subtype in the form of an `int`. When passed an invalid pointer, the function returns -1.

Remarks

To extract the type and subtype returned by `_CrtReportBlockType`, use the macros `_BLOCK_TYPE` and `_BLOCK_SUBTYPE` (both defined in `Crtdbg.h`) on the return value.

For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtReportBlockType</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```

// crt_crtreportblocktype.cpp
// compile with: /MDd

#include <malloc.h>
#include <stdio.h>
#include <crtdbg.h>

void __cdecl Dumper(void *ptr, void *)
{
    int block = _CrtReportBlockType(ptr);
    _RPT3(_CRT_WARN, "Dumper found block at %p: type %d, subtype %d\n", ptr,
          _BLOCK_TYPE(block), _BLOCK_SUBTYPE(block));
}

void __cdecl LeakDumper(void *ptr, size_t sz)
{
    int block = _CrtReportBlockType(ptr);
    _RPT4(_CRT_WARN, "LeakDumper found block at %p:"
          " type %d, subtype %d, size %d\n", ptr,
          _BLOCK_TYPE(block), _BLOCK_SUBTYPE(block), sz);
}

int main(void)
{
    _CrtSetDbgFlag(_CrtSetDbgFlag(_CRTDBG_REPORT_FLAG) |
    _CRTDBG_LEAK_CHECK_DF);
    _CrtSetReportMode( _CRT_WARN, _CRTDBG_MODE_FILE );
    _CrtSetReportFile( _CRT_WARN, _CRTDBG_FILE_STDOUT );
    _malloc_dbg(10, _NORMAL_BLOCK , __FILE__, __LINE__);
    _malloc_dbg(10, _CLIENT_BLOCK | (1 << 16), __FILE__, __LINE__);
    _malloc_dbg(20, _CLIENT_BLOCK | (2 << 16), __FILE__, __LINE__);
    _malloc_dbg(30, _CLIENT_BLOCK | (3 << 16), __FILE__, __LINE__);
    _CrtDoForAllClientObjects(Dumper, NULL);
    _CrtSetDumpClient(LeakDumper);
}

```

Sample output

```

Dumper found block at 00314F78: type 4, subtype 3
Dumper found block at 00314F38: type 4, subtype 2
Dumper found block at 00314F00: type 4, subtype 1
Detected memory leaks!
Dumping objects ->
crt_crtreportblocktype.cpp(30) : {55} client block at 0x00314F78, subtype 3, 30 bytes long.
Data: <          > CD CD
crt_crtreportblocktype.cpp(29) : {54} client block at 0x00314F38, subtype 2, 20 bytes long.
Data: <          > CD CD
crt_crtreportblocktype.cpp(28) : {53} client block at 0x00314F00, subtype 1, 10 bytes long.
Data: <          > CD CD CD CD CD CD CD CD CD
crt_crtreportblocktype.cpp(27) : {52} normal block at 0x00314EC8, 10 bytes long.
Data: <          > CD CD CD CD CD CD CD CD CD
Object dump complete.

```

See also

[_CrtDoForAllClientObjects](#)
[_CrtSetDumpClient](#)
[_CrtMemDumpAllObjectsSince](#)
[_CrtDumpMemoryLeaks](#)

_CrtSetAllocHook

11/2/2022 • 2 minutes to read • [Edit Online](#)

Installs a client-defined allocation function by hooking it into the C run-time debug memory allocation process (debug version only).

Syntax

```
_CRT_ALLOC_HOOK _CrtSetAllocHook(  
    _CRT_ALLOC_HOOK allocHook  
)
```

Parameters

`allocHook`

New client-defined allocation function to hook into the C run-time debug memory allocation process.

Return value

Returns the previously defined allocation hook function, or `NULL` if `allocHook` is `NULL`.

Remarks

`_CrtSetAllocHook` allows an application to hook its own allocation function into the C run-time debug library memory allocation process. As a result, every call to a debug allocation function to allocate, reallocate, or free a memory block triggers a call to the application's hook function. `_CrtSetAllocHook` provides an application with an easy method for testing how the application handles insufficient memory situations, the ability to examine allocation patterns, and the opportunity to log allocation information for later analysis. When `_DEBUG` isn't defined, calls to `_CrtSetAllocHook` are removed during preprocessing.

The `_CrtSetAllocHook` function installs the new client-defined allocation function specified in `allocHook` and returns the previously defined hook function. The following example demonstrates how a client-defined allocation hook should be prototyped:

```
int YourAllocHook( int allocType, void *userData, size_t size,  
                   int blockType, long requestNumber,  
                   const unsigned char *filename, int lineNumber);
```

The `allocType` argument specifies the type of allocation operation (`_HOOK_ALLOC`, `_HOOK_REALLOC`, and `_HOOK_FREE`) that triggered the call to the allocation's hook function. When the triggering allocation type is `_HOOK_FREE`, `userData` is a pointer to the user data section of the memory block about to be freed. However, when the triggering allocation type is `_HOOK_ALLOC` or `_HOOK_REALLOC`, `userData` is `NULL` because the memory block hasn't been allocated yet.

`size` specifies the size of the memory block in bytes, `blockType` indicates the type of the memory block, `requestNumber` is the object allocation order number of the memory block, and, if available, `filename` and `LineNumber` specify the source file name and line number where the triggering allocation operation was initiated.

After the hook function has finished processing, it must return a Boolean value, which tells the main C run-time

allocation process how to continue. When the hook function wants the main allocation process to continue as if the hook function had never been called, then the hook function should return `TRUE`, which causes the original triggering allocation operation to be executed. The hook function can gather and save allocation information for later analysis, without interfering with the current allocation operation or state of the debug heap.

When the hook function wants the main allocation process to continue as if the triggering allocation operation was called and it failed, then the hook function should return `FALSE`. The hook function can simulate a wide range of memory conditions and debug heap states to test how the application handles each situation.

To clear the hook function, pass `NULL` to `_CrtSetAllocHook`.

For more information about how `_CrtSetAllocHook` can be used with other memory management functions or how to write your own client-defined hook functions, see [Debug hook function writing](#).

NOTE

`_CrtSetAllocHook` is not supported under `/clr:pure`. The `/clr:pure` and `/clr:safe` compiler options are deprecated in Visual Studio 2015 and removed in Visual Studio 2017.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtSetAllocHook</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

For a sample of how to use `_CrtSetAllocHook`, see [crt_dbg2](#).

See also

Debug routines

[_CrtGetAllocHook](#)

_CrtSetBreakAlloc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a breakpoint on a specified object allocation order number (debug version only).

Syntax

```
long _CrtSetBreakAlloc(  
    long lBreakAlloc  
)
```

Parameters

lBreakAlloc

Allocation order number, for which to set the breakpoint.

Return value

Returns the previous object allocation order number that had a breakpoint set.

Remarks

`_CrtSetBreakAlloc` allows an application to perform memory leak detection by breaking at a specific point of memory allocation and tracing back to the origin of the request. The function uses the sequential object allocation order number assigned to the memory block when it was allocated in the heap. When `_DEBUG` isn't defined, calls to `_CrtSetBreakAlloc` are removed during preprocessing.

The object allocation order number is stored in the `lRequest` field of the `_CrtMemBlockHeader` structure, defined in Crtdbg.h. When information about a memory block is reported by one of the debug dump functions, this number is enclosed in braces, such as {36}.

For more information about how `_CrtSetBreakAlloc` can be used with other memory management functions, see [Tracking heap allocation requests](#). For more information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtSetBreakAlloc</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```
// crt_setbrk.c
// compile with: -D_DEBUG /MTd -Od -Zi -W3 /c /link -verbose:lib -debug

/*
 * In this program, a call is made to the _CrtSetBreakAlloc routine
 * to verify that the debugger halts program execution when it reaches
 * a specified allocation number.
 */

#include <malloc.h>
#include <crtdbg.h>

int main( )
{
    long allocReqNum;
    char *my_pointer;

    /*
     * Allocate "my_pointer" for the first
     * time and ensure that it gets allocated correctly
     */
    my_pointer = malloc(10);
    _CrtIsMemoryBlock(my_pointer, 10, &allocReqNum, NULL, NULL);

    /*
     * Set a breakpoint on the allocation request
     * number for "my_pointer"
     */
    _CrtSetBreakAlloc(allocReqNum+2);

    /*
     * Alternate freeing and reallocating "my_pointer"
     * to verify that the debugger halts program execution
     * when it reaches the allocation request
     */
    free(my_pointer);
    my_pointer = malloc(10);
    free(my_pointer);
    my_pointer = malloc(10);
    free(my_pointer);
}
```

See also

[Debug routines](#)\

_CrtSetDbgFlag

11/2/2022 • 6 minutes to read • [Edit Online](#)

Retrieves or modifies the state of the `_crtDbgFlag` flag to control the allocation behavior of the debug heap manager (debug version only).

Syntax

```
int _CrtSetDbgFlag(  
    int newFlag  
);
```

Parameters

`newFlag`

New state for `_crtDbgFlag`.

Return value

Returns the previous state of `_crtDbgFlag`.

Remarks

The `_CrtSetDbgFlag` function allows the application to control how the debug heap manager tracks memory allocations by modifying the bit fields of the `_crtDbgFlag` flag. By setting the bit fields, the application can instruct the debug heap manager to perform special debugging operations. There are several possible operations:

- Checking for memory leaks when the application exits and reporting if any are found,
- Simulating low-memory conditions by specifying that freed memory blocks should remain in the heap's linked list,
- Verifying the integrity of the heap by inspecting each memory block at every allocation request.

When `_DEBUG` isn't defined, calls to `_CrtSetDbgFlag` are removed during preprocessing.

The following table lists the bit fields for `_crtDbgFlag` and describes their behavior. Because setting the bits results in increased diagnostic output and reduced program execution speed, these bits aren't set (turned off) by default. For more information about these bit fields, see [Heap state reporting functions](#).

BIT FIELD	DEFAULT	DESCRIPTION
<code>_CRTDBG_ALLOC_MEM_DF</code>	ON	<p>ON: Enable debug heap allocations and use of memory block type identifiers, such as <code>_CLIENT_BLOCK</code>. OFF: Add new allocations to heap's linked list, but set block type to <code>_IGNORE_BLOCK</code>.</p> <p>Can also be combined with any of the heap-frequency check macros.</p>

BIT FIELD	DEFAULT	DESCRIPTION
<code>_CRTDBG_CHECK_ALWAYS_DF</code>	OFF	ON: Call <code>_CrtCheckMemory</code> at every allocation and deallocation request. OFF: <code>_crtCheckMemory</code> must be called explicitly. Heap-frequency check macros have no effect when this flag is set.
<code>_CRTDBG_CHECK_CRT_DF</code>	OFF	ON: Include <code>_CRT_BLOCK</code> types in leak detection and memory state difference operations. OFF: Memory used internally by the run-time library is ignored by these operations. Can also be combined with any of the heap-frequency check macros.
<code>_CRTDBG_DELAY_FREE_MEM_DF</code>	OFF	ON: Keep freed memory blocks in the heap's linked list, assign them the <code>_FREE_BLOCK</code> type, and fill them with the byte value 0xDD. OFF: Don't keep freed blocks in the heap's linked list. Can also be combined with any of the heap-frequency check macros.
<code>_CRTDBG_LEAK_CHECK_DF</code>	OFF	ON: Perform automatic leak checking at program exit through a call to <code>_CrtDumpMemoryLeaks</code> and generate an error report if the application failed to free all the memory it allocated. OFF: Don't automatically perform leak checking at program exit. Can also be combined with any of the heap-frequency check macros.

Heap-Check Frequency Macros

You can specify how often the C run-time library performs validation of the debug heap (`_CrtCheckMemory`) based on the number of calls to `malloc`, `realloc`, `free`, and `_msize`.

`_CrtSetDbgFlag` then inspects the upper 16 bits of the `newFlag` parameter for a value. The value specified is the number of `malloc`, `realloc`, `free`, and `_msize` calls between `_CrtCheckMemory` calls. Four predefined macros are provided for this purpose.

MACRO	NUMBER OF <code>MALLOC</code> , <code>REALLOC</code> , <code>FREE</code> , AND <code>_MSIZE</code> CALLS BETWEEN CALLS TO <code>_CRTCHECKMEMORY</code>
<code>_CRTDBG_CHECK_EVERY_16_DF</code>	16
<code>_CRTDBG_CHECK_EVERY_128_DF</code>	128
<code>_CRTDBG_CHECK_EVERY_1024_DF</code>	1024
<code>_CRTDBG_CHECK_DEFAULT_DF</code>	0 (by default, no heap checks)

By default, `_CrtCheckMemory` isn't called during memory operations. You can change that by sending the flags shown above to `_CrtSetDbgFlag()`.

For example, you can specify a heap check every 16 `malloc`, `realloc`, `free`, and `_msize` operations with the following code:

```
#include <crtdbg.h>
int main( )
{
    int tmp;

    // Get the current bits
    tmp = _CrtSetDbgFlag(_CRTDBG_REPORT_FLAG);

    // Clear the upper 16 bits and OR in the desired frequency
    tmp = (tmp & 0x0000FFFF) | _CRTDBG_CHECK_EVERY_16_DF;

    // Set the new bits
    _CrtSetDbgFlag(tmp);
}
```

The upper 16 bits of the `newFlag` parameter are ignored when `_CRTDBG_CHECK_ALWAYS_DF` is specified. In this case, `_CrtCheckMemory` is called each time you call `malloc`, `realloc`, `free`, and `_msize`.

`newFlag` is the new state to apply to the `_crtDbgFlag` and is a combination of the values for each of the bit fields.

To change one or more of these bit fields and create a new state for the flag

1. Call `_CrtSetDbgFlag` with `newFlag` equal to `_CRTDBG_REPORT_FLAG` to obtain the current `_crtDbgFlag` state and store the returned value in a temporary variable.
2. Turn on any bits by a bitwise "or" (`|`) of the temporary variable with the corresponding bitmasks (represented in the application code by manifest constants).
3. Turn off the other bits with a bitwise "and" (`&`) of the variable with a bitwise "not" (`~`) of the appropriate bitmasks.
4. Call `_CrtSetDbgFlag` with `newFlag` equal to the value stored in the temporary variable to set the new state for `_crtDbgFlag`.

The following code demonstrates how to simulate low-memory conditions by keeping freed memory blocks in the heap's linked list and prevent `_CrtCheckMemory` from being called at every allocation request:

```
// Get the current state of the flag
// and store it in a temporary variable
int tmpFlag = _CrtSetDbgFlag( _CRTDBG_REPORT_FLAG );

// Turn On (OR) - Keep freed memory blocks in the
// heap's linked list and mark them as freed
tmpFlag |= _CRTDBG_DELAY_FREE_MEM_DF;

// Turn Off (AND) - prevent _CrtCheckMemory from
// being called at every allocation request
tmpFlag &= ~_CRTDBG_CHECK_ALWAYS_DF;

// Set the new state for the flag
_CrtSetDbgFlag( tmpFlag );
```

For an overview of memory management and the debug heap, see [CRT debug heap details](#).

To disable a flag with the `_CrtSetDbgFlag` function, use a bitwise "and" (`&`) of the variable with the bitwise "not" (`~`) of the bitmask.

If `newFlag` isn't a valid value, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns the previous state of `_crtDbgFlag`.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtSetDbgFlag</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```

// crt_crtsetdfag.c
// compile with: /c -D_DEBUG /MTd -Od -Zi -W3 /link -verbose:lib /debug

// This program concentrates on allocating and freeing memory
// blocks to test the functionality of the _crtDbgFlag flag.

#include <string.h>
#include <malloc.h>
#include <crtdbg.h>

int main( )
{
    char *p1, *p2;
    int tmpDbgFlag;

    _CrtSetReportMode( _CRT_ERROR, _CRTDBG_MODE_FILE );
    _CrtSetReportFile( _CRT_ERROR, _CRTDBG_FILE_STDERR );

    // Set the debug-heap flag to keep freed blocks in the
    // heap's linked list - This will allow us to catch any
    // inadvertent use of freed memory
    tmpDbgFlag = _CrtSetDbgFlag(_CRTDBG_REPORT_FLAG);
    tmpDbgFlag |= _CRTDBG_DELAY_FREE_MEM_DF;
    tmpDbgFlag |= _CRTDBG_LEAK_CHECK_DF;
    _CrtSetDbgFlag(tmpDbgFlag);

    // Allocate 2 memory blocks and store a string in each
    p1 = malloc( 34 );
    p2 = malloc( 38 );
    strcpy_s( p1, 34, "p1 points to a Normal allocation block" );
    strcpy_s( p2, 38, "p2 points to a Client allocation block" );

    // Free both memory blocks
    free( p2 );
    free( p1 );

    // Set the debug-heap flag to no longer keep freed blocks in the
    // heap's linked list and turn on Debug type allocations (CLIENT)
    tmpDbgFlag = _CrtSetDbgFlag(_CRTDBG_REPORT_FLAG);
    tmpDbgFlag |= _CRTDBG_ALLOC_MEM_DF;
    tmpDbgFlag &= ~_CRTDBG_DELAY_FREE_MEM_DF;
    _CrtSetDbgFlag(tmpDbgFlag);

    // Explicitly call _malloc_dbg to obtain the filename and
    // line number of our allocation request and also so we can
    // allocate CLIENT type blocks specifically for tracking
    p1 = _malloc_dbg( 40, _NORMAL_BLOCK, __FILE__, __LINE__ );
    p2 = _malloc_dbg( 40, _CLIENT_BLOCK, __FILE__, __LINE__ );
    strcpy_s( p1, 40, "p1 points to a Normal allocation block" );
    strcpy_s( p2, 40, "p2 points to a Client allocation block" );

    // _free_dbg must be called to free the CLIENT block
    _free_dbg( p2, _CLIENT_BLOCK );
    free( p1 );

    // Allocate p1 again and then exit - this will leave unfreed
    // memory on the heap
    p1 = malloc( 10 );
}

```

See also

Debug routines

[_crtDbgFlag](#)

[_CrtCheckMemory](#)

_CrtSetDebugFillThreshold

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves or modifies the threshold controlling buffer-filling behavior in debug functions.

Syntax

```
size_t _CrtSetDebugFillThreshold( size_t newThreshold );
```

Parameters

newThreshold

New threshold size in bytes.

Return value

The previous threshold value.

Remarks

The debug versions of some security-enhanced CRT functions fill the buffer passed to them with a special character (0xFE). This fill character helps to find cases where the incorrect size was passed to the function. Unfortunately, it also reduces performance. To improve performance, use `_CrtSetDebugFillThreshold` to disable buffer-filling for buffers larger than the *newThreshold* threshold. A *newThreshold* value of 0 disables it for all buffers.

The default threshold is `SIZE_T_MAX`.

Here's a list of the affected functions:

- `asctime_s`, `_wasctime_s`
- `_cgetss_s`, `_cgetws_s`
- `ctime_s`, `_ctime32_s`, `_ctime64_s`, `_wctime_s`, `_wctime32_s`, `_wctime64_s`
- `_ecvt_s`
- `_fcvt_s`
- `_gcvt_s`
- `_itoa_s`, `_ltoa_s`, `_ultoa_s`, `_i64toa_s`, `_ui64toa_s`, `_itow_s`, `_ltow_s`, `_ultow_s`, `_i64tow_s`, `_ui64tow_s`
- `_makepath_s`, `_wmakepath_s`
- `_mbsnbcat_s`, `_mbsnbcat_s_1`
- `_mbsnbcpy_s`, `_mbsnbcpy_s_1`
- `_mbsnbset_s`, `_mbsnbset_s_1`
- `_mktemp_s`, `_wmktemp_s`

- `_splitpath_s`, `_wsplitpath_s`
- `strcat_s`, `wcscat_s`, `_mbscat_s`
- `strcpy_s`, `wcscopy_s`, `_mbscopy_s`
- `_strdate_s`, `_wstrdate_s`
- `strerror_s`, `_strerror_s`, `_wcsetError_s`, `_wcssetError_s`
- `_strlwr_s`, `_strlwr_s_1`, `_mbslwr_s`, `_mbslwr_s_1`, `_wcsLwr_s`, `_wcsLwr_s_1`
- `strncat_s`, `_strncat_s_1`, `wcsncat_s`, `_wcsncat_s_1`, `_mbsncat_s`, `_mbsncat_s_1`
- `strncpy_s`, `_strncpy_s_1`, `wcsncpy_s`, `_wcsncpy_s_1`, `_mbsncpy_s`, `_mbsncpy_s_1`
- `_strnset_s`, `_strnset_s_1`, `_wcsnset_s`, `_wcsnset_s_1`, `_mbsnset_s`, `_mbsnset_s_1`
- `_strset_s`, `_strset_s_1`, `_wcsset_s`, `_wcsset_s_1`, `_mbsset_s`, `_mbsset_s_1`
- `_strftime_s`, `_wstrftime_s`
- `_strupr_s`, `_strupr_s_1`, `_mbsupr_s`, `_mbsupr_s_1`, `_wcssupr_s`, `_wcssupr_s_1`

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtSetDebugFillThreshold</code>	<code><crtdbg.h></code>

This function is Microsoft-specific. For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of the [C run-time libraries](#) only.

Example

```

// crt_crtsetdebugfillthreshold.c
// compile with: cl /MTd crt_crtsetdebugfillthreshold.c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <crtdbg.h>

void Clear( char buff[], size_t size )
{
    for( int i=0; i<size; ++i )
        buff[i] = 0;
}

void Print( char buff[], size_t size )
{
    for( int i=0; i<size; ++i )
        printf( "%02x %c\n", (unsigned char)buff[i], buff[i] );
}

int main( void )
{
    char buff[10];

    printf( "With buffer-filling on:\n" );
    strcpy_s( buff, _countof(buff), "howdy" );
    Print( buff, _countof(buff) );

    _CrtSetDebugFillThreshold( 0 );

    printf( "With buffer-filling off:\n" );
    Clear( buff, _countof(buff) );
    strcpy_s( buff, _countof(buff), "howdy" );
    Print( buff, _countof(buff) );
}

```

With buffer-filling on:

```

68 h
6f o
77 w
64 d
79 y
00
fe ■
fe ■
fe ■
fe ■

```

With buffer-filling off:

```

68 h
6f o
77 w
64 d
79 y
00
00
00
00

```

See also

[Debug routines](#)

_CrtSetDumpClient

11/2/2022 • 2 minutes to read • [Edit Online](#)

Installs an application-defined function to dump `_CLIENT_BLOCK` type memory blocks (debug version only).

Syntax

```
_CRT_DUMP_CLIENT _CrtSetDumpClient( _CRT_DUMP_CLIENT dumpClient );
```

Parameters

`dumpClient`

New client-defined memory dump function to hook.

Return value

Returns the previously defined client block dump function.

Remarks

The `_CrtSetDumpClient` function allows the application to hook its own function to dump objects stored in `_CLIENT_BLOCK` memory blocks. As a result, every time a debug dump function such as `_CrtMemDumpAllObjectsSince` or `_CrtDumpMemoryLeaks` dumps a `_CLIENT_BLOCK` memory block, the application's dump function is called as well. `_CrtSetDumpClient` provides an application with an easy method for detecting memory leaks and validating or reporting the contents of data stored in `_CLIENT_BLOCK` blocks. When `_DEBUG` isn't defined, calls to `_CrtSetDumpClient` are removed during preprocessing.

The `_CrtSetDumpClient` function installs the new application-defined dump function specified in `dumpClient` and returns the previously defined dump function. An example of a client block dump function is as follows:

```
void DumpClientFunction( void *userPortion, size_t blockSize );
```

The `userPortion` argument is a pointer to the beginning of the user data portion of the memory block and `blockSize` specifies the size of the allocated memory block in bytes. The client block dump function must return `void`. The pointer to the client dump function that is passed to `_CrtSetDumpClient` is of type `_CRT_DUMP_CLIENT`, as defined in Crtdbg.h:

```
typedef void (__cdecl *_CRT_DUMP_CLIENT)( void *, size_t );
```

For more information about functions that operate on `_CLIENT_BLOCK` type memory blocks, see [Client block hook functions](#). The `_CrtReportBlockType` function can be used to return information about block types and subtypes.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtSetDumpClient</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

Debug routines

[`_CrtReportBlockType`](#)

[`_CrtGetDumpClient`](#)

_CrtSetReportFile

11/2/2022 • 2 minutes to read • [Edit Online](#)

After you use [_CrtSetReportMode](#) to specify [_CRTDBG_MODE_FILE](#), you can specify the file handle to receive the message text. [_CrtSetReportFile](#) is also used by [_CrtDbgReport](#), [_CrtDbgReportW](#) to specify the destination of text (debug version only).

Syntax

```
_HFILE _CrtSetReportFile(
    int reportType,
    _HFILE reportFile
);
```

Parameters

`reportType`

Report type: [_CRT_WARN](#), [_CRT_ERROR](#), and [_CRT_ASSERT](#).

`reportFile`

New report file for `reportType`.

Return value

On successful completion, [_CrtSetReportFile](#) returns the previous report file defined for the report type specified in `reportType`. If an invalid value is passed in for `reportType`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to [EINVAL](#), and the function returns [_CRTDBG_HFILE_ERROR](#). For more information, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

[_CrtSetReportFile](#) is used with the [_CrtSetReportMode](#) function to define the destination or destinations for a specific report type generated by [_crtDbgReport](#). When you call [_CrtSetReportMode](#) to assign the [_CRTDBG_MODE_FILE](#) reporting mode for a specific report type, also call [_CrtSetReportFile](#) to specify the destination file or stream. When [_DEBUG](#) isn't defined, calls to [_CrtSetReportFile](#) are removed during preprocessing.

The following list shows the available choices for `reportFile` and the resulting behavior of [_CrtDbgReport](#). These options are defined as bit flags in Crtdbg.h.

- **file handle**

A handle to the file that will be the destination for messages. No attempt is made to verify the validity of the handle. You must open and close the handle to the file. For example:

```

HANDLE hLogFile;
hLogFile = CreateFile("c:\\log.txt", GENERIC_WRITE,
    FILE_SHARE_WRITE, NULL, CREATE_ALWAYS,
    FILE_ATTRIBUTE_NORMAL, NULL);
_CrtSetReportMode(_CRT_WARN, _CRTDBG_MODE_FILE);
_CrtSetReportFile(_CRT_WARN, hLogFile);

_RPT0(_CRT_WARN, "file message\n");
CloseHandle(hLogFile);

```

- `_CRTDBG_FILE_STDERR`

Writes message to `stderr`, which can be redirected as follows:

```

freopen( "c:\\log2.txt", "w", stderr);
_CrtSetReportMode(_CRT_ERROR, _CRTDBG_MODE_FILE);
_CrtSetReportFile(_CRT_ERROR, _CRTDBG_FILE_STDERR);

_RPT0(_CRT_ERROR, "1st message\n");

```

- `_CRTDBG_FILE_STDOUT`

Writes message to `stdout`, which you can redirect.

- `_CRTDBG_REPORT_FILE`

Returns the current report mode.

You can control the report file used by each report type separately. For example, it's possible to specify that a `reportType` of `_CRT_ERROR` reports through `stderr`, while a `reportType` of `_CRT_ASSERT` reports through a user-defined file handle or stream.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_CrtSetReportFile</code>	<code><crtdbg.h></code>	<code><errno.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Libraries: Debug versions of [CRT library features](#) only.

See also

[Debug routines](#)\

_CrtSetReportHook

11/2/2022 • 2 minutes to read • [Edit Online](#)

Installs a client-defined reporting function by hooking it into the C run-time debug reporting process (debug version only).

Syntax

```
_CRT_REPORT_HOOK _CrtSetReportHook(  
    _CRT_REPORT_HOOK reportHook  
)
```

Parameters

`reportHook`

New client-defined reporting function to hook into the C run-time debug reporting process.

Return value

Returns the previous client-defined reporting function.

Remarks

`_CrtSetReportHook` allows an application to use its own reporting function into the C run-time debug library reporting process. As a result, whenever `_CrtDbgReport` is called to generate a debug report, the application's reporting function is called first. This functionality enables an application to perform operations such as filtering debug reports so it can focus on specific allocation types or send a report to destinations not available by using `_CrtDbgReport`. When `_DEBUG` isn't defined, calls to `_CrtSetReportHook` are removed during preprocessing.

For a more robust version of `_CrtSetReportHook`, see `_CrtSetReportHook2`.

The `_CrtSetReportHook` function installs the new client-defined reporting function specified in `reportHook` and returns the previous client-defined hook. The following example demonstrates how a client-defined report hook should be prototyped:

```
int YourReportHook( int reportType, char *message, int *returnValue );
```

where `reportType` is the debug report type (`_CRT_WARN`, `_CRT_ERROR`, or `_CRT_ASSERT`), `message` is the fully assembled debug user message to be contained in the report, and `returnValue` is the value specified by the client-defined reporting function that should be returned by `_CrtDbgReport`. For a complete description of the available report types, see the `_CrtSetReportMode` function.

If the client-defined reporting function completely handles the debug message such that no further reporting is required, then the function should return `TRUE`. When the function returns `FALSE`, `_CrtDbgReport` is called to generate the debug report using the current settings for the report type, mode, and file. In addition, by specifying the `_CrtDbgReport` return value in `returnValue`, the application can also control whether a debug break occurs. For a complete description of how the debug report is configured and generated, see `_CrtSetReportMode`, `_CrtSetReportFile`, and `_CrtDbgReport`.

For more information about using other hook-capable run-time functions and writing your own client-defined

hook functions, see [Debug hook function writing](#).

NOTE

If your application is compiled with /clr and the reporting function is called after the application has exited main, the CLR will throw an exception if the reporting function calls any CRT functions.

Requirements

ROUTINE	REQUIRED HEADER
<code>_CrtSetReportHook</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

See also

[Debug routines](#)

`_CrtGetReportHook`

[_CrtSetReportHook2](#) , [_CrtSetReportHookW2](#)

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Installs or uninstalls a client-defined reporting function by hooking it into the C run-time debug reporting process (debug version only).

Syntax

```
int _CrtSetReportHook2(
    int mode,
    _CRT_REPORT_HOOK pfnNewHook
);
int _CrtSetReportHookW2(
    int mode,
    _CRT_REPORT_HOOKW pfnNewHook
);
```

Parameters

`mode`

The action to take: `_CRT_RPTHOOK_INSTALL` or `_CRT_RPTHOOK_REMOVE`.

`pfnNewHook`

Report hook to install or remove in the narrow-character or wide-character version of this function.

Return value

-1 if an error was encountered, with `EINVAL` or `ENOMEM` set; otherwise returns the reference count of `pfnNewHook` after the call.

Remarks

`_CrtSetReportHook2` and `_CrtSetReportHookW2` let you hook or unhook a function, whereas `_CrtSetReportHook` only lets you hook a function.

`_CrtSetReportHook2` or `_CrtSetReportHookW2` should be used instead of `_CrtSetReportHook` when the hook call is made in a DLL and when multiple DLLs might be loaded and setting their own hook functions. In such a situation, DLLs can be unloaded in a different order than they were loaded and the hook function can be left pointing at an unloaded DLL. Any debug output crashes the process if the hook functions were added with `_CrtSetReportHook`.

Any hook functions added with `_CrtSetReportHook` are called if there are no hook functions added with `_CrtSetReportHook2` or `_CrtSetReportHookW2` or if all hook functions added with `_CrtSetReportHook2` and `_CrtSetReportHookW2` return `FALSE`.

The wide-character version of this function is available. The report hook functions take a string whose type (wide or narrow characters) must match the version of this function used. Use the following function prototype for the report hooks used with the wide-character version of this function:

```
int YourReportHook( int reportType, wchar_t *message, int *returnValue );
```

Use the following prototype for the narrow-character report hooks:

```
int YourReportHook( int reportType, char *message, int *returnValue );
```

These functions validate their parameters. If `mode` or `pfnNewHook` is invalid, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1.

NOTE

If your application is compiled with `/clr` and the reporting function is called after the application has exited main, the CLR will throw an exception if the reporting function calls any CRT functions.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_CrtSetReportHook2</code>	<code><crtdbg.h></code>	<code><errno.h></code>
<code>_CrtSetReportHookW2</code>	<code><crtdbg.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```
// crt_setreporthook2.c
#include <windows.h>
#include <stdio.h>
#include <crtdbg.h>
#include <assert.h>

int __cdecl TestHook1(int nReportType, char* szMsg, int* pnRet)
{
    int nRet = FALSE;

    printf("CRT report hook 1.\n");
    printf("CRT report type is \"%\"");
    switch (nReportType)
    {
        case _CRT_ASSERT:
        {
            printf("_CRT_ASSERT");
            // nRet = TRUE;    // Always stop for this type of report
            break;
        }

        case _CRT_WARN:
        {
            printf("_CRT_WARN");
            break;
        }

        case _CRT_ERROR:
        {
```

```

        printf("_CRT_ERROR");
        break;
    }

    default:
    {
        printf("???Unknown??");
        break;
    }
}

printf("\n.CRT report message is:\n\t");
printf(szMsg);

if  (pnRet)
    *pnRet = 0;

return  nRet;
}

int __cdecl  TestHook2(int nReportType, char* szMsg, int* pnRet)
{
    int    nRet = FALSE;

printf("CRT report hook 2.\n");
printf("CRT report type is \'%');
switch  (nReportType)
{
    case _CRT_WARN:
    {
        printf("_CRT_WARN");
        break;
    }

    case _CRT_ERROR:
    {
        printf("_CRT_ERROR");
        break;
    }

    case _CRT_ASSERT:
    {
        printf("_CRT_ASSERT");
        nRet = TRUE; // Always stop for this type of report
        break;
    }

    default:
    {
        printf("???Unknown??");
        break;
    }
}

printf("\n.CRT report message is: \t");
printf(szMsg);

if  (pnRet)
    *pnRet = 0;
// printf("CRT report code is %d.\n", *pnRet);
return  nRet;
}

int  main(int argc, char* argv[])
{
    int    nRet = 0;

nRet = _CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook1);
printf(" CrtSetReportHook2( CRT_RPTHOOK_INSTALL, TestHook1)"
```

```

    " returned %d\n", nRet);
nRet = _CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook2);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook2)"
    " returned %d\n", nRet);
nRet = _CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook1);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook1)"
    " returned %d\n", nRet);
nRet = _CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook1);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook1)"
    " returned %d\n", nRet);

_ASSERT(0);

nRet = _CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2)"
    " returned %d\n", nRet);
nRet = _CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2)"
    " returned %d\n", nRet);
nRet = _CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2)"
    " returned %d\n", nRet);
nRet = _CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook1);
printf("_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook1)"
    " returned %d\n", nRet);

return nRet;
}

```

Output

```

_CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook1) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook2) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook2) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook1) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_INSTALL, TestHook1) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook2) returned 0
_CrtSetReportHook2(_CRT_RPTHOOK_REMOVE, TestHook1) returned 0

```

See also

[Debug routines](#)

_CrtSetReportMode

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Specifies the destination or destinations for a specific report type generated by `_CrtDbgReport` and any macros that call `_CrtDbgReport`, `_CrtDbgReportW`, such as `_ASSERT`, `_ASERTE`, `_ASSERT_EXPR` macros and `_RPT`, `_RPTF`, `_RPTW`, `_RPTFW` macros (debug version only).

Syntax

```
int _CrtSetReportMode(
    int reportType,
    int reportMode
);
```

Parameters

`reportType`

Report type: `_CRT_WARN`, `_CRT_ERROR`, and `_CRT_ASSERT`.

`reportMode`

New report mode or modes for `reportType`.

Return value

On successful completion, `_CrtSetReportMode` returns the previous report mode or modes for the report type specified in `reportType`. If an invalid value is passed in as `reportType` or an invalid mode is specified for `reportMode`, `_CrtSetReportMode` invokes the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns -1. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

`_CrtSetReportMode` specifies the output destination for `_CrtDbgReport`. Because the macros `_ASSERT`, `_ASERTE`, `_RPT`, and `_RPTF` call `_CrtDbgReport`, `_CrtSetReportMode` specifies the output destination of text specified with those macros.

When `_DEBUG` isn't defined, calls to `_CrtSetReportMode` are removed during preprocessing.

If you don't call `_CrtSetReportMode` to define the output destination of messages, then the following defaults are in effect:

- Assertion failures and errors are directed to a debug message window.
- Warnings from Windows applications are sent to the debugger's output window.
- Warnings from console applications aren't displayed.

The following table lists the report types defined in `Crtdbg.h`.

REPORT TYPE	DESCRIPTION
<code>_CRT_WARN</code>	Warnings, messages, and information that doesn't need immediate attention.
<code>_CRT_ERROR</code>	Errors, unrecoverable problems, and issues that require immediate attention.
<code>_CRT_ASSERT</code>	Assertion failures (asserted expressions that evaluate to <code>FALSE</code>).

The `_CrtSetReportMode` function assigns the new report mode specified in `reportMode` to the report type specified in `reportType` and returns the previously defined report mode for `reportType`. The following table lists the available choices for `reportMode` and the resulting behavior of `_CrtDbgReport`. These options are defined as bit flags in `Crtdbg.h`.

REPORT MODE	_CRTDBGREPORT BEHAVIOR
<code>_CRTDBG_MODE_DEBUG</code>	Writes the message to the debugger's output window.
<code>_CRTDBG_MODE_FILE</code>	Writes the message to a user-supplied file handle. <code>_CrtSetReportFile</code> should be called to define the specific file or stream to use as the destination.
<code>_CRTDBG_MODE_WNDW</code>	Creates a message box to display the message along with the Abort , Retry , and Ignore buttons.
<code>_CRTDBG_REPORT_MODE</code>	Returns <code>reportMode</code> for the specified <code>reportType</code> : <ul style="list-style-type: none"> 1 <code>_CRTDBG_MODE_FILE</code> 2 <code>_CRTDBG_MODE_DEBUG</code> 4 <code>_CRTDBG_MODE_WNDW</code>

Each report type can be reported using one, two, or three modes or no mode at all. Therefore, it's possible to have more than one destination defined for a single report type. For example, the following code fragment causes assertion failures to be sent to both a debug message window and to `stderr`:

```
_CrtSetReportMode( _CRT_ASSERT, _CRTDBG_MODE_FILE | _CRTDBG_MODE_WNDW );
_CrtSetReportFile( _CRT_ASSERT, _CRTDBG_FILE_STDERR );
```

In addition, you can control the reporting mode or modes for each report type separately. For example, it's possible to specify that a `reportType` of `_CRT_WARN` goes to an output debug string, while `_CRT_ASSERT` is displayed using a debug message window and is sent to `stderr`, as previously illustrated.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_CrtSetReportMode</code>	<code><crtdbg.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: Debug versions of the [C runtime libraries](#) only.

See also

[Debug routines](#)

cscanf

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The Microsoft-specific function name `cscanf` is a deprecated alias for the `_cscanf` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_cscanf` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_cscanf`, `_cscanf_l`, `_cwscanf`, `_cwscanf_l`

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Reads formatted data from the console. More secure versions of these functions are available; see `_cscanf_s`, `_cscanf_s_l`, `_cwscanf_s`, `_cwscanf_s_l`.

NOTE

In Visual Studio 2015 The `printf` and `scanf` family of functions were declared as `inline` and moved to the `<stdio.h>` and `<conio.h>` headers. If you are migrating older code you might see Linker Error LNK2019 in connection with these functions. For more information, see [Visual C++ change history 2003 - 2015](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _cscanf(
    const char *format [,,
    argument] ...
);
int _cscanf_l(
    const char *format,
    _locale_t locale [,,
    argument] ...
);
int _cwscanf(
    const wchar_t *format [,,
    argument] ...
);
int _cwscanf_l(
    const wchar_t *format,
    _locale_t locale [,,
    argument] ...
);
```

Parameters

`format`

Format-control string.

`argument`

Optional parameters.

`Locale`

The locale to use.

Return value

The number of fields that were successfully converted and assigned. The return value doesn't include fields that

were read but not assigned. The return value is `EOF` for an attempt to read at end of file. An `EOF` can also be returned when keyboard input is redirected at the operating-system command-line level. A return value of zero means that no fields were assigned.

Remarks

The `_cscanf` function reads data directly from the console into the locations given by `argument`. The `_getch` function is used to read characters. Each optional parameter must be a pointer to a variable with a type that corresponds to a type specifier in `format`. The format controls the interpretation of the input fields and has the same form and function as the `format` parameter for the `scanf` function. While `_cscanf` normally echoes the input character, it doesn't do so if the last call was to `_ungetch`.

This function validates its parameters. If `format` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `EOF`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tscanf</code>	<code>_cscanf</code>	<code>_cscanf</code>	<code>_cwscanf</code>
<code>_tscanf_1</code>	<code>_cscanf_1</code>	<code>_cscanf_1</code>	<code>_cwscanf_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cscanf</code> , <code>_cscanf_1</code>	<code><conio.h></code>
<code>_cwscanf</code> , <code>_cwscanf_1</code>	<code><conio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_cscanf.c
// compile with: /c /W3
/* This program prompts for a string
* and uses _cscanf to read in the response.
* Then _cscanf returns the number of items
* matched, and the program displays that number.
*/
#include <stdio.h>
#include <conio.h>

int main( void )
{
    int    result, i[3];

    _cprintf_s( "Enter three integers: " );
    result = _cscanf( "%i %i %i", &i[0], &i[1], &i[2] ); // C4996
    // Note: _cscanf is deprecated; consider using _cscanf_s instead
    _cprintf_s( "\r\nYou entered " );
    while( result-- )
        _cprintf_s( "%i ", i[result] );
    _cprintf_s( "\r\n" );
}
```

```
1 2 3
```

```
Enter three integers: 1 2 3
You entered 3 2 1
```

See also

Console and port I/O

[_cprintf](#), [_cprintf_l](#), [_cwprintf](#), [_cwprintf_l](#)
[fscanf](#), [fscanf_l](#), [fwscanf](#), [_fwscanf_l](#)
[scanf_s](#), [_scanf_s_l](#), [wscanf_s](#), [_wscanf_s_l](#)
[sscanf](#), [_sscanf_l](#), [swscanf](#), [_swscanf_l](#)

`_cscanf_s`, `_cscanf_s_l`, `_cwscanf_s`,
`_cwscanf_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data from the console. These more secure versions of `_cscanf`, `_cscanf_l`, `_cwscanf`, `_cwscanf_l` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _cscanf_s(
    const char *format [,,
    argument] ...
);
int _cscanf_s_l(
    const char *format,
    _locale_t locale [,,
    argument] ...
);
int _cwscanf_s(
    const wchar_t *format [,,
    argument] ...
);
int _cwscanf_s_l(
    const wchar_t *format,
    _locale_t locale [,,
    argument] ...
);
```

Parameters

`format`

Format-control string.

`argument`

Optional parameters.

`Locale`

The locale to use.

Return value

The number of fields that were successfully converted and assigned. The return value doesn't include fields that were read but not assigned. The return value is `EOF` for an attempt to read at end of file. An `EOF` can also be returned when keyboard input is redirected at the operating-system command-line level. A return value of zero means that no fields were assigned.

These functions validate their parameters. If `format` is a null pointer, these functions invoke the invalid

parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF`, and `errno` is set to `EINVAL`.

Remarks

The `_cscanf_s` function reads data directly from the console into the locations given by `argument`. The `_getche` function is used to read characters. Each optional parameter must be a pointer to a variable with a type that corresponds to a type specifier in `format`. The format controls the interpretation of the input fields and has the same form and function as the `format` parameter for the `scanf_s` function. While `_cscanf_s` normally echoes the input character, it doesn't do so if the last call was to `_ungetch`.

Like other secure versions of functions in the `scanf` family, `_cscanf_s` and `_cwscanf_s` require size arguments for the type field characters `c`, `C`, `s`, `S`, and `[`. For more information, see [scanf Width Specification](#).

NOTE

The size parameter is of type `unsigned`, not `size_t`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscanf_s</code>	<code>_cscanf_s</code>	<code>_cscanf_s</code>	<code>_cwscanf_s</code>
<code>_tcscanf_s_1</code>	<code>_cscanf_s_1</code>	<code>_cscanf_s_1</code>	<code>_cwscanf_s_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_cscanf_s</code> , <code>_cscanf_s_1</code>	<code><conio.h></code>
<code>_cwscanf_s</code> , <code>_cwscanf_s_1</code>	<code><conio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_cscanf_s.c
// compile with: /c
/* This program prompts for a string
* and uses _cscanf_s to read in the response.
* Then _cscanf_s returns the number of items
* matched, and the program displays that number.
*/
#include <stdio.h>
#include <conio.h>

int main( void )
{
    int result, n[3];
    int i;

    result = _cscanf_s( "%i %i %i", &n[0], &n[1], &n[2] );
    _cprintf_s( "\r\nYou entered " );
    for( i=0; i<result; i++ )
        _cprintf_s( "%i ", n[i] );
    _cprintf_s( "\r\n" );
}
```

```
1 2 3
```

```
You entered 1 2 3
```

See also

Console and port I/O

[_cprintf](#) , [_cprintf_l](#) , [_cwprintf](#) , [_cwprintf_l](#)
[fscanf_s](#) , [fscanf_s_l](#) , [fwscanf_s](#) , [fwscanf_s_l](#)
[scanf_s](#) , [scanf_s_l](#) , [wscanf_s](#) , [wscanf_s_l](#)
[sscanf_s](#) , [sscanf_s_l](#) , [swscanf_s](#) , [swscanf_s_l](#)

`csin`, `csinf`, `csinl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the sine of a complex number.

Syntax

```
_Dcomplex csin(
    _Dcomplex z
);
_Fcomplex csin(
    _Fcomplex z
); // C++ only
_Lcomplex csin(
    _Lcomplex z
); // C++ only
_Fcomplex csinf(
    _Fcomplex z
);
_Lcomplex csinl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The sine of `z`, in radians.

Remarks

Because C++ allows overloading, you can call overloads of `csin` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `csin` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>csin</code> , <code>csinf</code> , <code>csinl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`catanh`, `cataanhf`, `cataanh1`
`ctanh`, `ctanhf`, `ctanh1`
`catan`, `catanf`, `catanl`
`csinh`, `csinhf`, `csinhl`

casinh	casinhf	casinhl
ccosh	ccoshf	ccoshl
cacosh	cacoshf	cacoshl
cacos	cacosf	cacosl
ctan	ctanf	ctanl
casin	casinf	casinl
ccos	ccosf	ccosl
csqrt	csqrtf	csqr1

`csinh`, `csinhf`, `csinhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the hyperbolic sine of a complex number.

Syntax

```
_Dcomplex csinh(
    _Dcomplex z
);
_Fcomplex csinh(
    _Fcomplex z
); // C++ only
_Lcomplex csinh(
    _Lcomplex z
); // C++ only
_Fcomplex csinhf(
    _Fcomplex z
);
_Lcomplex csinhl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The hyperbolic sine of `z`, in radians.

Remarks

Because C++ allows overloading, you can call overloads of `csinh` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `csinh` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>csinh</code> , <code>csinhf</code> , <code>csinhl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`catanh`, `catanhf`, `catanhl`
`ctanh`, `ctanhf`, `ctanhl`
`catan`, `catanf`, `catanl`
`casinh`, `casinhf`, `casinhl`

`ccosh`, `ccoshf`, `ccoshl`
`cacosh`, `cacoshf`, `cacoshl`
`cacos`, `cacosf`, `cacosl`
`ctan`, `ctanf`, `ctanl`
`csin`, `csinf`, `csinl`
`casin`, `casinf`, `casinl`
`ccos`, `ccosf`, `ccosl`
`csqrt`, `csqrtf`, `csqr1`

`csqrt`, `csqrtf`, `csqr1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the square root of a complex number, with a branch cut along the negative real axis.

Syntax

```
_Dcomplex csqrt(
    _Dcomplex z
);
_Fcomplex csqrt(
    _Fcomplex z
); // C++ only
_Lcomplex csqrt(
    _Lcomplex z
); // C++ only
_Fcomplex csqrtf(
    _Fcomplex z
);
_Lcomplex csqr1(
    _Lcomplex z
);
```

Parameters

`z`

A complex number.

Return value

The square root of `z`. The result is in the right half-plane.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
<code>± QNaN, IND</code>	none	<code>_DOMAIN</code>
<code>- INF</code>	none	<code>_DOMAIN</code>

Remarks

Because C++ allows overloading, you can call overloads of `csqrt` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `csqrt` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>csqrt</code> , <code>csqrtf</code> , <code>csqr1</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[catanh](#), [catanhf](#), [catanhl](#)
[ctanh](#), [ctanhf](#), [ctanhl](#)
[catan](#), [catanf](#), [catanl](#)
[csinh](#), [csinhf](#), [csinhl](#)
[casinh](#), [casinhf](#), [casinhl](#)
[ccosh](#), [ccoshf](#), [ccoshl](#)
[cacosh](#), [cacoshf](#), [cacoshl](#)
[cacos](#), [cacosf](#), [cacosl](#)
[ctan](#), [ctanf](#), [ctanl](#)
[csin](#), [csinf](#), [csinl](#)
[casin](#), [casinf](#), [casinl](#)
[ccos](#), [ccosf](#), [ccosl](#)

`ctan`, `ctanf`, `ctanl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the tangent of a complex number.

Syntax

```
_Dcomplex ctan(
    _Dcomplex z
);
_Fcomplex ctan(
    _Fcomplex z
); // C++ only
_Lcomplex ctan(
    _Lcomplex z
); // C++ only
_Fcomplex ctanf(
    _Fcomplex z
);
_Lcomplex ctanl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents the angle, in radians.

Return value

The tangent of `z`.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{INF}$, QNaN , IND	none	_DOMAIN
$\pm \text{INF}$ (<code>tan</code> , <code>tanf</code>)	INVALID	_DOMAIN

Remarks

Because C++ allows overloading, you can call overloads of `ctan` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `ctan` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>ctan</code> , <code>ctanf</code> , <code>ctanl</code>	<code><complex.h></code>	<code><ccomplex></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[catanh](#), [catanhf](#), [catanhl](#)
[ctanh](#), [ctanhf](#), [ctanhl](#)
[catan](#), [catanf](#), [catanl](#)
[csinh](#), [csinhf](#), [csinhl](#)
[casinh](#), [casinhf](#), [casinhl](#)
[ccosh](#), [ccoshf](#), [ccoshl](#)
[cacosh](#), [cacoshf](#), [cacoshl](#)
[acos](#), [acosf](#), [acosl](#)
[csin](#), [csinf](#), [csinl](#)
[casin](#), [casinf](#), [casinl](#)
[ccos](#), [ccosf](#), [ccosl](#)
[csqrt](#), [csqrif](#), [csqril](#)

`ctanh`, `ctanhf`, `ctanhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the complex hyperbolic tangent of a complex number.

Syntax

```
_Dcomplex ctanh(
    _Dcomplex z
);
_Fcomplex ctanh(
    _Fcomplex z
); // C++ only
_Lcomplex ctanh(
    _Lcomplex z
); // C++ only
_Fcomplex ctanhf(
    _Fcomplex z
);
_Lcomplex ctanhl(
    _Lcomplex z
);
```

Parameters

`z`

A complex number that represents an angle, in radians.

Return value

The complex hyperbolic tangent of `z`.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{INF}$, QNaN , IND	none	$_DOMAIN$
$\pm \text{INF}$ (\tan , \tanf)	INVALID	$_DOMAIN$

Remarks

Because C++ allows overloading, you can call overloads of `ctanh` that take and return `_Fcomplex` and `_Lcomplex` values. In a C program, `ctanh` always takes and returns a `_Dcomplex` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>ctanh</code> , <code>ctanhf</code> , <code>ctanhl</code>	<code><complex.h></code>	<code><ccomplex></code>

For compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[catanh](#), [catanhf](#), [catanhl](#)
[atan](#), [atanf](#), [atanl](#)
[csinh](#), [csinhf](#), [csinhl](#)
[casinh](#), [casinhf](#), [casinhl](#)
[ccosh](#), [ccoshf](#), [ccoshl](#)
[cacosh](#), [cacoshf](#), [cacoshl](#)
[acos](#), [acosf](#), [acosl](#)
[ctan](#), [ctanf](#), [ctanl](#)
[csin](#), [csinf](#), [csinl](#)
[casin](#), [casinf](#), [casinl](#)
[ccos](#), [ccosf](#), [ccosl](#)
[csqrt](#), [csqrif](#), [csqril](#)

`ctime`, `_ctime32`, `_ctime64`, `_wctime`, `_wctime32`,
`_wctime64`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Convert a time value to a string and adjust for local time zone settings. More secure versions of these functions are available; see `ctime_s`, `_ctime32_s`, `_ctime64_s`, `_wctime_s`, `_wctime32_s`, `_wctime64_s`.

Syntax

```
char *ctime( const time_t *sourceTime );
char *_ctime32( const __time32_t *sourceTime );
char *_ctime64( const __time64_t *sourceTime );
wchar_t *_wctime( const time_t *sourceTime );
wchar_t *_wctime32( const __time32_t *sourceTime );
wchar_t *_wctime64( const __time64_t *sourceTime );
```

Parameters

`sourceTime`

Pointer to stored time to convert.

Return value

A pointer to the character string result. `NULL` is returned when:

- `sourceTime` represents a date before midnight, January 1, 1970, UTC.
- You use `_ctime32` or `_wctime32`, and `sourceTime` represents a date after 23:59:59 January 18, 2038, UTC.
- You use `_ctime64` or `_wctime64`, and `sourceTime` represents a date after 23:59:59, December 31, 3000, UTC.

`ctime` is an inline function that evaluates to `_ctime64`, and `time_t` is equivalent to `__time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`. This macro causes `ctime` to evaluate to `_ctime32`. We don't recommend you use it, because your application may fail after January 18, 2038, and it isn't allowed on 64-bit platforms.

Remarks

The `ctime` function converts a time value stored as a `time_t` value into a character string. The `sourceTime` value is typically obtained from a call to `time`, which returns the number of seconds elapsed since midnight (00:00:00), January 1, 1970, coordinated universal time (UTC). The return value string contains exactly 26 characters and has the form:

```
Wed Jan 02 02:03:55 1980\n\0
```

A 24-hour clock is used. All fields have a constant width. The newline character ('\n') and the null character ('\0') occupy the last two positions of the string.

The converted character string is also adjusted according to the local time zone settings. For information on

configuring the local time, see the `time`, `_ftime`, and `localtime` functions. For details about defining the time zone environment and global variables, see the `_tzset` function.

A call to `ctime` modifies the single statically allocated buffer used by the `gmtime` and `localtime` functions. Each call to one of these routines destroys the result of the previous call. `ctime` shares a static buffer with the `asctime` function. Thus, a call to `ctime` destroys the results of any previous call to `asctime`, `localtime`, or `gmtime`.

`_wctime` and `_wctime64` are the wide-character version of `ctime` and `_ctime64`; returning a pointer to wide-character string. Otherwise, `_ctime64`, `_wctime`, and `_wctime64` behave identically to `ctime`.

These functions validate their parameters. If `sourceTime` is a null pointer, or if the `sourceTime` value is negative, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `NULL` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tctime</code>	<code>ctime</code>	<code>ctime</code>	<code>_wctime</code>
<code>_tctime32</code>	<code>_ctime32</code>	<code>_ctime32</code>	<code>_wctime32</code>
<code>_tctime64</code>	<code>_ctime64</code>	<code>_ctime64</code>	<code>_wctime64</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>ctime</code>	<code><time.h></code>
<code>_ctime32</code>	<code><time.h></code>
<code>_ctime64</code>	<code><time.h></code>
<code>_wctime</code>	<code><time.h> or <wchar.h></code>
<code>_wctime32</code>	<code><time.h> or <wchar.h></code>
<code>_wctime64</code>	<code><time.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_ctime64.c
// compile with: /W3
/* This program gets the current
 * time in _time64_t form, then uses ctime to
 * display the time in string form.
*/
#include <time.h>
#include <stdio.h>

int main( void )
{
    __time64_t ltime;

    _time64( &ltime );
    printf( "The time is %s\n", _ctime64( &ltime ) ); // C4996
    // Note: _ctime64 is deprecated; consider using _ctime64_s
}
```

```
The time is Wed Feb 13 16:04:43 2002
```

See also

Time management

[asctime](#) , [_wasctime](#)
[ctime_s](#) , [_ctime32_s](#) , [_ctime64_s](#) , [_wctime_s](#) , [_wctime32_s](#) , [_wctime64_s](#)
[_ftime](#) , [_ftime32](#) , [_ftime64](#)
[gmtime](#) , [_gmtime32](#) , [_gmtime64](#)
[localtime](#) , [_localtime32](#) , [_localtime64](#)
[time](#) , [_time32](#) , [_time64](#)

`_ctime_s`, `_ctime32_s`, `_ctime64_s`, `_wctime_s`,
`_wctime32_s`, `_wctime64_s`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Convert a time value to a string and adjust for local time zone settings. These functions are versions of `ctime`, `_ctime64`, `wctime`, `_wctime64` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t ctime_s(
    char* buffer,
    size_t numberOfElements,
    const time_t *sourceTime
);
errno_t _ctime32_s(
    char* buffer,
    size_t numberOfElements,
    const __time32_t *sourceTime
);
errno_t _ctime64_s(
    char* buffer,
    size_t numberOfElements,
    const __time64_t *sourceTime )
;
errno_t _wctime_s(
    wchar_t* buffer,
    size_t numberOfElements,
    const time_t *sourceTime
);
errno_t _wctime32_s(
    wchar_t* buffer,
    size_t numberOfElements,
    const __time32_t *sourceTime
);
errno_t _wctime64_s(
    wchar_t* buffer,
    size_t numberOfElements,
    const __time64_t *sourceTime
);
```

```

template <size_t size>
errno_t _ctime32_s(
    char (&buffer)[size],
    const __time32_t *sourceTime
); // C++ only
template <size_t size>
errno_t _ctime64_s(
    char (&buffer)[size],
    const __time64_t *sourceTime
); // C++ only
template <size_t size>
errno_t _wctime32_s(
    wchar_t (&buffer)[size],
    const __time32_t *sourceTime
); // C++ only
template <size_t size>
errno_t _wctime64_s(
    wchar_t (&buffer)[size],
    const __time64_t *sourceTime
); // C++ only

```

Parameters

`buffer`

Must be large enough to hold 26 characters. A pointer to the character string result, or `NULL` if:

- `sourceTime` represents a date before midnight, January 1, 1970, UTC.
- If you use `_ctime32_s` or `_wctime32_s` and `sourceTime` represents a date after 23:59:59 January 18, 2038, UTC.
- If you use `_ctime64_s` or `_wctime64_s` and `sourceTime` represents a date after 23:59:59, December 31, 3000, UTC.
- If you use `_ctime_s` or `_wctime_s`, these functions are wrappers to the previous functions. See the Remarks section.

`numberOfElements`

The size of the buffer.

`sourceTime`

Pointer to stored time.

Return value

Zero if successful. If there's a failure due to an invalid parameter, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, an error code is returned. Error codes are defined in `ERRNO.H`; for a listing of these errors, see `errno`. The actual error codes thrown for each error condition are shown in the following table.

Error conditions

<code>BUFFER</code>	<code>NUMBEROFELEMENTS</code>	<code>SOURCETIME</code>	<code>RETURN</code>	<code>VALUE IN BUFFER</code>
<code>NULL</code>	any	any	<code>EINVAL</code>	Not modified
Not <code>NULL</code> (points to valid memory)	0	any	<code>EINVAL</code>	Not modified

BUFFER	NUMBEROFELEMENTS	SOURCETIME	RETURN	VALUE IN BUFFER
Not <code>NULL</code>	$0 < \text{size} < 26$	any	<code>EINVAL</code>	Empty string
Not <code>NULL</code>	≥ 26	<code>NULL</code>	<code>EINVAL</code>	Empty string
Not <code>NULL</code>	≥ 26	< 0	<code>EINVAL</code>	Empty string

Remarks

The `ctime_s` function converts a time value stored as a `time_t` structure into a character string. The `sourceTime` value is typically obtained from a call to `time`, which returns the number of seconds elapsed since midnight (00:00:00), January 1, 1970, coordinated universal time (UTC). The return value string contains exactly 26 characters and has the form:

```
Wed Jan 02 02:03:55 1980\n\0
```

A 24-hour clock is used. All fields have a constant width. The new line character ('\n') and the null character ('\0') occupy the last two positions of the string.

The converted character string is also adjusted according to the local time zone settings. For information on configuring the local time, see the `time`, `ftime`, and `localtime` functions. For details about defining the time zone environment and global variables, see the `_tzset` function.

`_wctime32_s` and `_wctime64_s` are the wide-character version of `_ctime32_s` and `_ctime64_s`; returning a pointer to wide-character string. Otherwise, `_ctime64_s`, `_wctime32_s`, and `_wctime64_s` behave identically to `_ctime32_s`.

`ctime_s` is an inline function that evaluates to `_ctime64_s` and `time_t` is equivalent to `_time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`. This macro causes `ctime_s` to evaluate to `_ctime32_s`. We don't recommend it, because your application may fail after January 18, 2038, and it isn't allowed on 64-bit platforms.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tctime_s</code>	<code>ctime_s</code>	<code>ctime_s</code>	<code>_wctime_s</code>
<code>_tctime32_s</code>	<code>_ctime32_s</code>	<code>_ctime32_s</code>	<code>_wctime32_s</code>
<code>_tctime64_s</code>	<code>_ctime64_s</code>	<code>_ctime64_s</code>	<code>_wctime64_s</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>ctime_s</code> , <code>_ctime32_s</code> , <code>_ctime64_s</code>	<code><time.h></code>
<code>_wctime_s</code> , <code>_wctime32_s</code> , <code>_wctime64_s</code>	<code><time.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_wctime_s.c
// This program gets the current
// time in time_t form and then uses _wctime_s to
// display the time in string form.

#include <time.h>
#include <stdio.h>

#define SIZE 26

int main( void )
{
    time_t ltime;
    wchar_t buf[SIZE];
    errno_t err;

    time( &ltime );

    err = _wctime_s( buf, SIZE, &ltime );
    if (err != 0)
    {
        printf("Invalid Arguments for _wctime_s. Error Code: %d\n", err);
    }
    wprintf_s( L"The time is %s\n", buf );
}
```

```
The time is Fri Apr 25 13:03:39 2003
```

See also

Time management

`asctime_s`, `_wasctime_s`
`ctime`, `_ctime32`, `_ctime64`, `_wctime`, `_wctime32`, `_wctime64`
`_ftime`, `_ftime32`, `_ftime64`
`gmtime_s`, `_gmtime32_s`, `_gmtime64_s`
`localtime_s`, `_localtime32_s`, `_localtime64_s`
`time`, `_time32`, `_time64`

The Microsoft-specific function name `cwait` is a deprecated alias for the `_cwait` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_cwait` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_cwait

11/2/2022 • 3 minutes to read • [Edit Online](#)

Waits until another process terminates.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _cwait(
    int *termstat,
    intptr_t procHandle,
    int action
);
```

Parameters

`termstat`

Pointer to a buffer where the result code of the specified process will be stored, or `NULL`.

`procHandle`

The handle to the process to wait on (that is, the process that has to terminate before `_cwait` can return).

`action`

`NULL`: Ignored by Windows operating system applications; for other applications: action code to perform on `procHandle`.

Return value

When the specified process has successfully completed, returns the handle of the specified process and sets `termstat` to the result code that's returned by the specified process. Otherwise, returns -1 and sets `errno` as follows.

ERRNO	VALUE	DESCRIPTION
<code>ECHILD</code>		No specified process exists, <code>procHandle</code> is invalid, or the call to the <code>GetExitCodeProcess</code> or <code>WaitForSingleObject</code> API failed.
<code>EINVAL</code>		<code>action</code> is invalid.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_cwait` function waits for the termination of the process ID of the specified process that's provided by

`procHandle`. The value of `procHandle` that's passed to `_cwait` should be the value that's returned by the call to the `_spawn` function that created the specified process. If the process ID terminates before `_cwait` is called, `_cwait` returns immediately. `_cwait` can be used by any process to wait for any other known process for which a valid handle (`procHandle`) exists.

`termstat` points to a buffer where the return code of the specified process will be stored. The value of `termstat` indicates whether the specified process terminated normally by calling the Windows `ExitProcess` API. `ExitProcess` is called internally if the specified process calls `exit` or `_exit`, returns from `main`, or reaches the end of `main`. For more information about the value that's passed back through `termstat`, see [GetExitCodeProcess](#). If `_cwait` is called by using a `NULL` value for `termstat`, the return code of the specified process isn't stored.

The `action` parameter is ignored by the Windows operating system because parent-child relationships aren't implemented in these environments.

Unless `procHandle` is -1 or -2 (handles to the current process or thread), the handle will be closed. In this situation, don't use the returned handle.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_cwait</code>	<code><process.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_cwait.c
// compile with: /c
// This program launches several processes and waits
// for a specified process to finish.

#define _CRT_RAND_S

#include <windows.h>
#include <process.h>
#include <stdlib.h>
#include <stdio.h>
#include <time.h>

// Macro to get a random integer within a specified range
#define getrandom( min, max ) (( (rand_s (&number), number) % (int)(( max ) + 1 ) - ( min )) + ( min ))

struct PROCESS
{
    intptr_t hProcess;
    char name[40];
} process[4] = { { 0, "Ann" }, { 0, "Beth" }, { 0, "Carl" }, { 0, "Dave" } };

int main(int argc, char* argv[])
{
    int termstat, c;
    unsigned int number;

    srand((unsigned)time(NULL));      // Seed randomizer

    // If no arguments, this is the calling process
    if (argc == 1)
    {
        // Spawn processes in numeric order
        for (c = 0; c < 4; c++) {
            _flushall();
            process[c].hProcess = _spawnl(_P_NOWAIT, argv[0], argv[0],
                process[c].name, NULL);
        }

        // Wait for randomly specified process, and respond when done
        c = getrandom(0, 3);
        printf("Come here, %s.\n", process[c].name);
        _cwait(&termstat, process[c].hProcess, _WAIT_CHILD);
        printf("Thank you, %s.\n", process[c].name);

    }
    // If there are arguments, this must be a spawned process
    else
    {
        // Delay for a period that's determined by process number
        Sleep((argv[1][0] - 'A' + 1) * 1000L);
        printf("Hi, Dad. It's %s.\n", argv[1]);
    }
}

```

The order of the output varies from run to run.

```

Hi, Dad. It's Ann.
Come here, Ann.
Thank you, Ann.
Hi, Dad. It's Beth.
Hi, Dad. It's Carl.
Hi, Dad. It's Dave.

```

See also

Process and environment control

`_spawn`, `_wspawn` functions

_CxxThrowException

11/2/2022 • 2 minutes to read • [Edit Online](#)

Builds the exception record and calls the runtime environment to start processing the exception.

Syntax

```
extern "C" void __stdcall _CxxThrowException(
    void* pExceptionObject
    _ThrowInfo* pThrowInfo
);
```

Parameters

pExceptionObject

The object that generated the exception.

pThrowInfo

The information that is required to process the exception.

Remarks

This method is included in a compiler-only file that the compiler uses to process exceptions. Don't call the method directly from your code.

Requirements

Source: Throw.cpp

See also

[Alphabetical function reference](#)

`difftime`, `_difftime32`, `_difftime64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Finds the difference between two times.

Syntax

```
double difftime( time_t timeEnd, time_t timeStart );
double _difftime32( __time32_t timeEnd, __time32_t timeStart );
double _difftime64( __time64_t timeEnd, __time64_t timeStart );
```

Parameters

`timeEnd`

Ending time.

`timeStart`

Beginning time.

Return value

`difftime` returns the elapsed time in seconds, from `timeStart` to `timeEnd`. The value returned is a double precision floating-point number. The return value may be 0, indicating an error.

Remarks

The `difftime` function computes the difference between the two supplied time values `timeStart` and `timeEnd`.

The time value supplied must fit within the range of `time_t`. `time_t` is a 64-bit value. Thus, the end of the range was extended from 23:59:59 January 18, 2038, UTC to 23:59:59, December 31, 3000. The lower range of `time_t` is still midnight, January 1, 1970.

`difftime` is an inline function that evaluates to either `_difftime32` or `_difftime64` depending on whether `_USE_32BIT_TIME_T` is defined. `_difftime32` and `_difftime64` can be used directly to force the use of a particular size of the time type.

These functions validate their parameters. If either of the parameters is zero or negative, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return 0 and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>difftime</code>	<code><time.h></code>
<code>_difftime32</code>	<code><time.h></code>

ROUTINE	REQUIRED HEADER
_difftime64	<time.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_difftime.c
// This program calculates the amount of time
// needed to do a floating-point multiply 100 million times.
//

#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <float.h>

double RangedRand( float range_min, float range_max)
{
    // Generate random numbers in the half-closed interval
    // [range_min, range_max). In other words,
    // range_min <= random number < range_max
    return ((double)rand() / (RAND_MAX + 1) * (range_max - range_min)
            + range_min);
}

int main( void )
{
    time_t    start, finish;
    long      loop;
    double   result, elapsed_time;
    double   arNums[3];

    // Seed the random-number generator with the current time so that
    // the numbers will be different every time we run.
    srand( (unsigned)time( NULL ) );

    arNums[0] = RangedRand(1, FLT_MAX);
    arNums[1] = RangedRand(1, FLT_MAX);
    arNums[2] = RangedRand(1, FLT_MAX);
    printf( "Using floating point numbers %.5e %.5e %.5e\n", arNums[0], arNums[1], arNums[2] );

    printf( "Multiplying 2 numbers 100 million times...\n" );

    time( &start );
    for( loop = 0; loop < 100000000; loop++ )
        result = arNums[loop%3] * arNums[(loop+1)%3];
    time( &finish );

    elapsed_time = difftime( finish, start );
    printf( "\nProgram takes %6.0f seconds.\n", elapsed_time );
}
```

```
Using random floating point numbers 1.04749e+038 2.01482e+038 1.72737e+038
Multiplying 2 floating point numbers 100 million times...
Program takes      3 seconds.
```

See also

[Math and floating-point support](#)

Time management

`time` , `_time32` , `_time64`

`div`, `ldiv`, `lldiv`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the quotient and the remainder of two integer values.

Syntax

```
div_t div(
    int numer,
    int denom
);
ldiv_t ldiv(
    long numer,
    long denom
);
lldiv_t lldiv(
    long long numer,
    long long denom
);
```

```
ldiv_t div(
    long numer,
    long denom
); /* C++ only */
lldiv_t div(
    long long numer,
    long long denom
); /* C++ only */
```

Parameters

`numer`

The numerator.

`denom`

The denominator.

Return value

`div` called by using arguments of type `int` returns a structure of type `div_t`, which contains the quotient and the remainder. The return value with arguments of type `long` is `ldiv_t`, and the return value with arguments of type `long long` is `lldiv_t`. The `div_t`, `ldiv_t`, and `lldiv_t` types are defined in `<stdlib.h>`.

Remarks

The `div` function divides `numer` by `denom` and computes the quotient and the remainder. The `div_t` structure contains the quotient, `quot`, and the remainder, `rem`. The sign of the quotient is the same as the sign of the mathematical quotient. Its absolute value is the largest integer that's less than the absolute value of the mathematical quotient. If the denominator is 0, the program terminates with an error message.

The overloads of `div` that take arguments of type `long` or `long long` are only available to C++ code. The return types `ldiv_t` and `lldiv_t` contain members `quot` and `rem`, which have the same meanings as the members of `div_t`.

Requirements

ROUTINE	REQUIRED HEADER
<code>div</code> , <code>ldiv</code> , <code>lldiv</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_div.c
// arguments: 876 13

// This example takes two integers as command-line
// arguments and displays the results of the integer
// division. This program accepts two arguments on the
// command line following the program name, then calls
// div to divide the first argument by the second.
// Finally, it prints the structure members quot and rem.
//

#include <stdlib.h>
#include <stdio.h>
#include <math.h>

int main( int argc, char *argv[] )
{
    int x,y;
    div_t div_result;

    x = atoi( argv[1] );
    y = atoi( argv[2] );

    printf( "x is %d, y is %d\n", x, y );
    div_result = div( x, y );
    printf( "The quotient is %d, and the remainder is %d\n",
           div_result.quot, div_result.rem );
}
```

```
x is 876, y is 13
The quotient is 67, and the remainder is 5
```

See also

[Math and floating-point support](#)

[imaxdiv](#)

dup , dup2

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function names `dup` and `dup2` are deprecated aliases for the `_dup` and `_dup2` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_dup` and `_dup2` instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_dup`, `_dup2`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates a second file descriptor for an open file (`_dup`), or reassigns a file descriptor (`_dup2`).

Syntax

```
int _dup( int fd );
int _dup2( int fd1, int fd2 );
```

Parameters

`fd`, `fd1`

File descriptors referring to open file.

`fd2`

Any file descriptor.

Return value

`_dup` returns a new file descriptor. `_dup2` returns 0 to indicate success. If an error occurs, each function returns -1 and sets `errno` to `EBADF` if the file descriptor is invalid, or to `EMFILE` if no more file descriptors are available. When passed an invalid file descriptor, the function also invokes the invalid parameter handler, as described in [Parameter validation](#).

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_dup` and `_dup2` functions associate a second file descriptor with a currently open file. These functions can be used to associate a predefined file descriptor, such as that for `stdout`, with a different file. Operations on the file can be carried out using either file descriptor. The type of access allowed for the file is unaffected by the creation of a new descriptor. `_dup` returns the next available file descriptor for the given file. `_dup2` forces `fd2` to refer to the same file as `fd1`. If `fd2` is associated with an open file at the time of the call, that file is closed.

Both `_dup` and `_dup2` accept file descriptors as parameters. To pass a stream (`FILE *`) to either of these functions, use `_fileno`. The `fileno` routine returns the file descriptor currently associated with the given stream. The following example shows how to associate `stderr` (defined as `FILE *` in `stdio.h`) with a file descriptor:

```
int cstderr = _dup( _fileno( stderr ));
```

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
_dup	<io.h>
_dup2	<io.h>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_dup.c
// This program uses the variable old to save
// the original stdout. It then opens a new file named
// DataFile and forces stdout to refer to it. Finally, it
// restores stdout to its original state.

#include <io.h>
#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    int old;
    FILE *DataFile;

    old = _dup( 1 );    // "old" now refers to "stdout"
                        // Note: file descriptor 1 == "stdout"
    if( old == -1 )
    {
        perror( "_dup( 1 ) failure" );
        exit( 1 );
    }
    _write( old, "This goes to stdout first\n", 26 );
    if( fopen_s( &DataFile, "data", "w" ) != 0 )
    {
        puts( "Can't open file 'data'\n" );
        exit( 1 );
    }

    // stdout now refers to file "data"
    if( -1 == _dup2( _fileno( DataFile ), 1 ) )
    {
        perror( "Can't _dup2 stdout" );
        exit( 1 );
    }
    puts( "This goes to file 'data'\n" );

    // Flush stdout stream buffer so it goes to correct file
    fflush( stdout );
    fclose( DataFile );

    // Restore original stdout
    _dup2( old, 1 );
    puts( "This goes to stdout\n" );
    puts( "The file 'data' contains:" );
    _flushall();
    system( "type data" );
}
```

```
This goes to stdout first  
This goes to stdout
```

```
The file 'data' contains:  
This goes to file 'data'
```

See also

[Low-level I/O](#)

[_close](#)

[_creat](#) , [_wcreat](#)

[_open](#) , [_wopen](#)

`_dupenv_s`, `_wdupenv_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a value from the current environment.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _dupenv_s(
    char **buffer,
    size_t *numberOfElements,
    const char *varname
);
errno_t _wdupenv_s(
    wchar_t **buffer,
    size_t *numberOfElements,
    const wchar_t *varname
);
```

Parameters

`buffer`

Buffer to store the variable's value.

`numberOfElements`

Size of `buffer`.

`varname`

Environment variable name.

Return value

Zero on success, an error code on failure.

These functions validate their parameters; if `buffer` or `varname` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, the functions set `errno` to `EINVAL` and return `EINVAL`.

If these functions can't allocate enough memory, they set `buffer` to `NULL` and `numberOfElements` to 0, and return `ENOMEM`.

Remarks

The `_dupenv_s` function searches the list of environment variables for `varname`. If the variable is found, `_dupenv_s` allocates a buffer and copies the variable's value into the buffer. The buffer's address and length are returned in `buffer` and `numberOfElements`. Because it allocates the buffer itself, `_dupenv_s` provides a more convenient alternative to `getenv_s`, `_wgetenv_s`.

NOTE

It's the calling program's responsibility to free the memory by calling `free`.

If the variable isn't found, then `buffer` is set to `NULL`, `numberOfElements` is set to 0, and the return value is 0 because this situation isn't considered to be an error condition.

If you aren't interested in the size of the buffer, you can pass `NULL` for `numberOfElements`.

`_dupenv_s` isn't case sensitive in the Windows operating system. `_dupenv_s` uses the copy of the environment pointed to by the global variable `_environ` to access the environment. See the Remarks in [_getenv_s](#), [_wgetenv_s](#) for a discussion of `_environ`.

The value in `buffer` is a copy of the environment variable's value; modifying it has no effect on the environment. Use the [_putenv_s](#), [_wputenv_s](#) function to modify the value of an environment variable.

`_wdupenv_s` is a wide-character version of `_dupenv_s`; the arguments of `_wdupenv_s` are wide-character strings. The `_wenviron` global variable is a wide-character version of `_environ`. See the Remarks in [_getenv_s](#), [_wgetenv_s](#) for more on `_wenviron`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tdupenv_s</code>	<code>_dupenv_s</code>	<code>_dupenv_s</code>	<code>_wdupenv_s</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_dupenv_s</code>	<code><stdlib.h></code>
<code>_wdupenv_s</code>	<code><stdlib.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_dupenv_s.c
#include <stdlib.h>

int main( void )
{
    char *pValue;
    size_t len;
    errno_t err = _dupenv_s( &pValue, &len, "pathext" );
    if ( err ) return -1;
    printf( "pathext = %s\n", pValue );
    free( pValue );
    err = _dupenv_s( &pValue, &len, "nonexistentvariable" );
    if ( err ) return -1;
    printf( "nonexistentvariable = %s\n", pValue );
    free( pValue ); // It's OK to call free with NULL
}
```

```
pathext = .COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.pl
nonexistentvariable = (null)
```

See also

[Process and environment control](#)

[Environmental constants](#)

[_dupenv_s_dbg](#) , [_wdupenv_s_dbg](#)
 [getenv_s](#) , [_wgetenv_s](#)
[_putenv_s](#) , [_wputenv_s](#)

`_dupenv_s_dbg`, `_wdupenv_s_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Get a value from the current environment. Versions of `_dupenv_s`, `_wdupenv_s` that allocate memory with `_malloc_dbg` to provide more debugging information.

Syntax

```
errno_t _dupenv_s_dbg(
    char **buffer,
    size_t *numberOfElements,
    const char *varname,
    int blockType,
    const char *filename,
    int lineNumber
);
errno_t _wdupenv_s_dbg(
    wchar_t **buffer,
    size_t * numberOfElements,
    const wchar_t *varname,
    int blockType,
    const char *filename,
    int lineNumber
);
```

Parameters

`buffer`

Buffer to store the variable's value.

`numberOfElements`

Size of `buffer`.

`varname`

Environment variable name.

`blockType`

Requested type of the memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file or `NULL`.

`LineNumber`

Line number in source file or `NULL`.

Return value

Zero on success, an error code on failure.

These functions validate their parameters; if `buffer` or `varname` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, the functions set `errno` to `EINVAL`, and return `EINVAL`.

If these functions can't allocate enough memory, they set `buffer` to `NULL` and `numberOfElements` to 0, and

```
return ENOMEM.
```

Remarks

The `_dupenv_s_dbg` and `_wdupenv_s_dbg` functions are identical to `_dupenv_s` and `_wdupenv_s` except that, when `_DEBUG` is defined, these functions use the debug version of `malloc`, `_malloc_dbg`, to allocate memory for the value of the environment variable. For information on the debugging features of `_malloc_dbg`, see [_malloc_dbg](#).

You don't need to call these functions explicitly in most cases. Instead, you can define the flag `_CRTDBG_MAP_ALLOC`. When `_CRTDBG_MAP_ALLOC` is defined, calls to `_dupenv_s` and `_wdupenv_s` are remapped to `_dupenv_s_dbg` and `_wdupenv_s_dbg`, respectively, with the `blockType` set to `_NORMAL_BLOCK`. Thus, you don't need to call these functions explicitly unless you want to mark the heap blocks as `_CLIENT_BLOCK`. For more information on block types, see [Types of blocks on the debug heap](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tdupenv_s_dbg</code>	<code>_dupenv_s_dbg</code>	<code>_dupenv_s_dbg</code>	<code>_wdupenv_s_dbg</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_dupenv_s_dbg</code>	<crtdbg.h>
<code>_wdupenv_s_dbg</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_dupenv_s_dbg.c
#include <stdlib.h>
#include <crtdbg.h>

int main( void )
{
    char *pValue;
    size_t len;
    errno_t err = _dupenv_s_dbg( &pValue, &len, "pathext",
        _NORMAL_BLOCK, __FILE__, __LINE__ );
    if ( err ) return -1;
    printf( "pathext = %s\n", pValue );
    free( pValue );
    err = _dupenv_s_dbg( &pValue, &len, "nonexistentvariable",
        _NORMAL_BLOCK, __FILE__, __LINE__ );
    if ( err ) return -1;
    printf( "nonexistentvariable = %s\n", pValue );
    free( pValue ); // It's OK to call free with NULL
}
```

```
pathext = .COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.pl
nonexistentvariable = (null)
```

See also

[Process and environment control](#)

[Environmental constants](#)

[`getenv_s`](#) , [`_wgetenv_s`](#)

[`_putenv_s`](#) , [`_wputenv_s`](#)

The Microsoft-specific function name `ecvt` is a deprecated alias for the `_ecvt` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_ecvt` or the security-enhanced `_ecvt_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

Converts a `double` number to a string. A more secure version of this function is available; see [`_ecvt_s`](#).

Syntax

```
char *_ecvt(
    double value,
    int count,
    int *dec,
    int *sign
);
```

Parameters

`value`

Number to be converted.

`count`

Number of digits stored.

`dec`

Stored decimal-point position.

`sign`

Sign of the converted number.

Return value

`_ecvt` returns a pointer to the string of digits; `NULL` if an error occurred.

Remarks

The `_ecvt` function converts a floating-point number to a character string. The `value` parameter is the floating-point number to be converted. This function stores up to `count` digits of `value` as a string and appends a null character ('\0'). If the number of digits in `value` exceeds `count`, the low-order digit is rounded. If there are fewer than `count` digits, the string is padded with zeros.

The total number of digits returned by `_ecvt` won't exceed `_CVTBUFSIZE`.

Only digits are stored in the string. The position of the decimal point and the sign of `value` can be obtained from `dec` and `sign` after the call. The `dec` parameter points to an integer value giving the position of the decimal point with respect to the beginning of the string. A 0 or negative integer value indicates that the decimal point lies to the left of the first digit. The `sign` parameter points to an integer that indicates the sign of the converted number. If the integer value is 0, the number is positive. Otherwise, the number is negative.

The difference between `_ecvt` and `_fcvt` is in the interpretation of the `count` parameter. `_ecvt` interprets `count` as the total number of digits in the output string, whereas `_fcvt` interprets `count` as the number of digits after the decimal point.

`_ecvt` and `_fcvt` use a single statically allocated buffer for the conversion. Each call to one of these routines

destroys the result of the previous call.

This function validates its parameters. If `dec` or `sign` is `NULL`, or `count` is 0, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and `NULL` is returned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_ecvt</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_ecvt.c
// compile with: /W3
// This program uses _ecvt to convert a
// floating-point number to a character string.

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    int      decimal,    sign;
    char    *buffer;
    int      precision = 10;
    double   source = 3.1415926535;

    buffer = _ecvt( source, precision, &decimal, &sign ); // C4996
    // Note: _ecvt is deprecated; consider using _ecvt_s instead
    printf( "source: %2.10f    buffer: '%s'    decimal: %d    sign: %d\n",
            source, buffer, decimal, sign );
}
```

```
source: 3.1415926535    buffer: '3141592654'    decimal: 1    sign: 0
```

See also

[Data conversion](#)

[Math and floating-point support](#)

`atof` , `_atof_1` , `_wtod` , `_wtod_1`
`_fcvt`
`_gcvt`

_ecvt_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a `double` number to a string. This function is a version of [_ecvt](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _ecvt_s(
    char * buffer,
    size_t sizeInBytes,
    double value,
    int count,
    int *dec,
    int *sign
);
template <size_t size>
errno_t _ecvt_s(
    char (&buffer)[size],
    double value,
    int count,
    int *dec,
    int *sign
); // C++ only
```

Parameters

`buffer`

Filled with the pointer to the string of digits, the result of the conversion.

`sizeInBytes`

Size of the buffer in bytes.

`value`

Number to be converted.

`count`

Number of digits stored.

`dec`

Stored decimal-point position.

`sign`

Sign of the converted number.

Return value

Zero if successful. The return value is an error code if there's a failure. Error codes are defined in Errno.h. For more information, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

If there's an invalid parameter, as listed in the following table, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL`, and returns `EINVAL`.

Error conditions

BUFFER	SIZEINBYTES	VALUE	COUNT	DEC	SIGN	RETURN VALUE	VALUE IN BUFFER
NULL	any	any	any	any	any	EINVAL	Not modified.
Not NULL (points to valid memory)	<=0	any	any	any	any	EINVAL	Not modified.
any	any	any	any	NULL	any	EINVAL	Not modified.
any	any	any	any	any	NULL	EINVAL	Not modified.

Security issues

`_ecvt_s` might generate an access violation if `buffer` doesn't point to valid memory and isn't `NULL`.

Remarks

The `_ecvt_s` function converts a floating-point number to a character string. The `value` parameter is the floating-point number to be converted. This function stores up to `count` digits of `value` as a string and appends a null character ('\0'). If the number of digits in `value` exceeds `count`, the low-order digit is rounded. If there are fewer than `count` digits, the string is padded with zeros.

Only digits are stored in the string. The position of the decimal point and the sign of `value` can be obtained from `dec` and `sign` after the call. The `dec` parameter points to an integer value giving the position of the decimal point with respect to the beginning of the string. A 0 or negative integer value indicates that the decimal point lies to the left of the first digit. The `sign` parameter points to an integer that indicates the sign of the converted number. If the integer value is 0, the number is positive. Otherwise, the number is negative.

A buffer of length `_CVTBUFSIZE` is sufficient for any floating-point value.

The difference between `_ecvt_s` and `_fcvt_s` is in the interpretation of the `count` parameter. `_ecvt_s` interprets `count` as the total number of digits in the output string, whereas `_fcvt_s` interprets `count` as the number of digits after the decimal point.

In C++, using this function is simplified by a template overload; the overload can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug version of this function first fills the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_ecvt_s</code>	<code><stdlib.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// ecvt_s.c
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main( )
{
    char * buf = 0;
    int decimal;
    int sign;
    int err;

    buf = (char*) malloc(_CVTBUFSIZE);
    err = _ecvt_s(buf, _CVTBUFSIZE, 1.2, 5, &decimal, &sign);

    if (err != 0)
    {
        printf("_ecvt_s failed with error code %d\n", err);
        exit(1);
    }

    printf("Converted value: %s\n", buf);
}
```

```
Converted value: 12000
```

See also

[Data conversion](#)

[Math and floating-point support](#)

[atof](#) , [_atof_1](#) , [_wtof](#) , [_wtof_1](#)
[_ecvt](#)
[_fcvt_s](#)
[_gcvt_s](#)

`_endthread`, `_endthreadex`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Terminates a thread; `_endthread` terminates a thread that's created by `_beginthread` and `_endthreadex` terminates a thread that's created by `_beginthreadex`.

Syntax

```
void _endthread( void );
void _endthreadex(
    unsigned retval
);
```

Parameters

`retval`

Thread exit code.

Remarks

You can call `_endthread` or `_endthreadex` explicitly to terminate a thread; however, `_endthread` or `_endthreadex` is called automatically when the thread returns from the routine passed as a parameter to `_beginthread` or `_beginthreadex`. Terminating a thread with a call to `endthread` or `endthreadex` helps ensure proper recovery of resources allocated for the thread.

NOTE

For an executable file linked with Libcmt.lib, do not call the Win32 `ExitThread` API; this prevents the run-time system from reclaiming allocated resources. `_endthread` and `_endthreadex` reclaim allocated thread resources and then call `ExitThread`.

`_endthread` automatically closes the thread handle. (This behavior differs from the Win32 `ExitThread` API). Therefore, when you use `_beginthread` and `_endthread`, don't explicitly close the thread handle by calling the Win32 `CloseHandle` API.

Like the Win32 `ExitThread` API, `_endthreadex` doesn't close the thread handle. Therefore, when you use `_beginthreadex` and `_endthreadex`, you must close the thread handle by calling the Win32 `CloseHandle` API.

NOTE

`_endthread` and `_endthreadex` cause C++ destructors pending in the thread not to be called.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_endthread</code>	<code><process.h></code>
<code>_endthreadex</code>	<code><process.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Multithreaded versions of the [C run-time libraries](#) only.

Example

See the example for [`_beginthread`](#).

See also

[Process and environment control](#)

[`_beginthread`](#) , [`_beginthreadex`](#)



11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `eof` is a deprecated alias for the `_eof` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_eof` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

Tests for end of file (EOF).

Syntax

```
int _eof(  
    int fd  
);
```

Parameters

`fd`

File descriptor referring to the open file.

Return value

`_eof` returns 1 if the current position is end of file, or 0 if it isn't. A return value of -1 indicates an error; in this case, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EBADF`, which indicates an invalid file descriptor.

Remarks

The `_eof` function determines whether the end of the file associated with `fd` has been reached.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_eof</code>	<code><iostream.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_eof.c
// This program reads data from a file
// ten bytes at a time until the end of the
// file is reached or an error is encountered.
//
#include <io.h>
#include <fcntl.h>
#include <stdio.h>
#include <stdlib.h>
#include <share.h>

int main( void )
{
    int fh, count, total = 0;
    char buf[10];
    if( _sopen_s( &fh, "crt_eof.txt", _O_RDONLY, _SH_DENYNO, 0 ) )
    {
        perror( "Open failed" );
        exit( 1 );
    }
    // Cycle until end of file reached:
    while( !_eof( fh ) )
    {
        // Attempt to read in 10 bytes:
        if( (count = _read( fh, buf, 10 )) == -1 )
        {
            perror( "Read error" );
            break;
        }
        // Total actual bytes read
        total += count;
    }
    printf( "Number of bytes read = %d\n", total );
    _close( fh );
}

```

Input: crt_eof.txt

This file contains some text.

Output

Number of bytes read = 29

See also

[Error handling](#)

[Low-level I/O](#)

[clearerr](#)

[feof](#)

[ferror](#)

[perror](#), [_wperror](#)

`erf`, `erff`, `erfl`, `erfc`, `erfcf`, `erfccl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the error function or the complementary error function of a value.

Syntax

```
double erf(
    double x
);
float erf(
    float x
); // C++ only
long double erf(
    long double x
); // C++ only
float erff(
    float x
);
long double erfl(
    long double x
);
double erfc(
    double x
);
float erfc(
    float x
); // C++ only
long double erfc(
    long double x
); // C++ only
float erfcf(
    float x
);
long double erfccl(
    long double x
);
#define erf(X) // Requires C11 or higher
#define erfc(X) // Requires C11 or higher
```

Parameters

`x`

A floating-point value.

Return value

The `erf` functions return the Gauss error function of `x`. The `erfc` functions return the complementary Gauss error function of `x`.

Remarks

The `erf` functions calculate the Gauss error function of `x`, which is defined as:

$$\text{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

The complementary Gauss error function is defined as $1 - \text{erf}(x)$. The `erf` functions return a value in the range -1.0 to 1.0. There's no error return. The `erfc` functions return a value in the range 0 to 2. If `x` is too large for `erfc`, the `errno` variable is set to `ERANGE`.

Because C++ allows overloading, you can call `erf` and `erfc` overloads that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `erf` and `erfc` always take and return a `double`.

If you use the `<tgmath.h>` `erf()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>erf</code> , <code>erff</code> , <code>erfl</code> , <code>erfc</code> , <code>erfcf</code> , <code>erfccl</code>	<code><math.h></code>
<code>erf</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

exec1

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `exec1` is a deprecated alias for the `_exec1` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_exec1` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_exec`, `_wexec`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _exec(
    const char *cmdname,
    const char *arg0,
    ... const char *argn,
    NULL
);
intptr_t _wexec(
    const wchar_t *cmdname,
    const wchar_t *arg0,
    ... const wchar_t *argn,
    NULL
);
```

Parameters

`cmdname`

Path of the file to be executed.

`arg0`, ... `argN`

List of pointers to the parameters.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO	VALUE	DESCRIPTION
	<code>E2BIG</code>	The space required for the arguments and environment settings exceeds 32 KB.
	<code>EACCES</code>	The specified file has a locking or sharing violation.
	<code>EINVAL</code>	Invalid parameter (one or more of the parameters was a null pointer or empty string).
	<code>EMFILE</code>	Too many files open (the specified file must be opened to determine whether it's executable).

ERRNO	VALUE	DESCRIPTION
	ENOENT	The file or path isn't found.
	ENOEXEC	The specified file isn't executable or has an invalid executable-file format.
	ENOMEM	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, indicating that the calling process wasn't allocated properly.

Remarks

Each of these functions loads and executes a new process, passing each command-line argument as a separate parameter. The first argument is the command or executable file name, and the second argument should be the same as the first. It becomes `argv[0]` in the executed process. The third argument is the first argument, `argv[1]`, of the process being executed.

The `_exec1` functions validate their parameters. If either `cmdname` or `arg0` is a null pointer or empty string, these functions invoke the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1. No new process is executed.

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_exec1</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexec1</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [`_exec`](#), [`_wexec`](#) functions.

See also

Process and environment control

<code>_exec</code>	<code>_wexec</code>	functions
<code>abort</code>		
<code>atexit</code>		
<code>exit</code>	<code>_Exit</code>	<code>_exit</code>
<code>_onexit</code>	<code>_onexit_m</code>	
<code>_spawn</code>	<code>_wspawn</code>	functions
<code>system</code>	<code>_wsystem</code>	

execle

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The Microsoft-implemented POSIX function name `execle` is a deprecated alias for the `_execle` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_execle` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_execle , _wexecle

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execle(
    const char *cmdname,
    const char *arg0,
    ... const char *argn,
    NULL,
    const char *const *envp
);
intptr_t _wexecle(
    const wchar_t *cmdname,
    const wchar_t *arg0,
    ... const wchar_t *argn,
    NULL,
    const char *const *envp
);
```

Parameters

`cmdname`

Path of the file to execute.

`arg0 , ... argN`

List of pointers to parameters.

`envp`

Array of pointers to environment settings.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO VALUE	DESCRIPTION
E2BIG	The space that's required for the arguments and the environment settings exceeds 32 KB.
EACCES	The specified file has a locking or sharing violation.
EINVAL	Invalid parameter.

ERRNO	VALUE	DESCRIPTION
	<code>EMFILE</code>	Too many files are open. (The specified file must be opened to determine whether it's executable.)
	<code>ENOENT</code>	The file or path isn't found.
	<code>ENOEXEC</code>	The specified file isn't executable or has an invalid executable-file format.
	<code>ENOMEM</code>	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, which indicates that the calling process wasn't allocated correctly.

For more information about these return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, and passes each command-line argument as a separate parameter and passes an array of pointers to environment settings.

The `_execle` functions validate their parameters. If `cmdname` or `arg0` is a null pointer or an empty string, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1. No new process is launched.

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_execle</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexecle</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

Process and environment control

_exec , _wexec functions
abort
atexit
exit , _Exit , _exit
_onexit , _onexit_m
_spawn , _wspawn functions
system , _wsystem

exec1p

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `exec1p` is a deprecated alias for the `_execlp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_execlp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_execlp , _wexeclp

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execlp(
    const char *cmdname,
    const char *arg0,
    ... const char *argn,
    NULL
);
intptr_t _wexeclp(
    const wchar_t *cmdname,
    const wchar_t *arg0,
    ... const wchar_t *argn,
    NULL
);
```

Parameters

`cmdname`

Path of the file to execute.

`arg0` , ... `argN`

List of pointers to parameters.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO	VALUE	DESCRIPTION
	E2BIG	The space required for the arguments and environment settings exceeds 32 KB.
	EACCES	The specified file has a locking or sharing violation.
	EINVAL	Invalid parameter.
	EMFILE	Too many files open (the specified file must be opened to determine whether it's executable).
	ENOENT	The file or path not found.

ERRNO	VALUE	DESCRIPTION
	ENOEXEC	The specified file isn't executable or has an invalid executable-file format.
	ENOMEM	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, indicating that the calling process wasn't allocated properly.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, passing each command-line argument as a separate parameter and using the [PATH](#) environment variable to find the file to execute.

The [_execlp](#) functions validate their parameters. If [cmdname](#) or [arg0](#) is a null pointer or empty string, these functions invoke the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, these functions set [errno](#) to [EINVAL](#) and return -1. No new process is launched.

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
_execlp	<process.h>	<errno.h>
_wexeclp	<process.h> or <wchar.h>	<errno.h>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

Process and environment control

_exec , _wexec functions
abort
atexit
exit , _Exit , _exit
_onexit , _onexit_m
_spawn , _wspawn functions
system , _wsystem

`exec1pe`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `exec1pe` is a deprecated alias for the `_exec1pe` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_exec1pe` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_execle`, `_wexecle`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execle(
    const char *cmdname,
    const char *arg0,
    ... const char *argn,
    NULL,
    const char *const *envp
);
intptr_t _wexecle(
    const wchar_t *cmdname,
    const wchar_t *arg0,
    ... const wchar_t *argn,
    NULL,
    const wchar_t *const *envp
);
```

Parameters

`cmdname`

Path of the file to execute.

`arg0`, ... `argN`

List of pointers to parameters.

`envp`

Array of pointers to environment settings.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO VALUE	DESCRIPTION
<code>E2BIG</code>	The space required for the arguments and environment settings exceeds 32 KB.
<code>EACCES</code>	The specified file has a locking or sharing violation.
<code>EINVAL</code>	Invalid parameter.

ERRNO	VALUE	DESCRIPTION
	<code>EMFILE</code>	Too many files open (the specified file must be opened to determine whether it's executable).
	<code>ENOENT</code>	The file or path not found.
	<code>ENOEXEC</code>	The specified file isn't executable or has an invalid executable-file format.
	<code>ENOMEM</code>	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, indicating that the calling process wasn't allocated properly.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, passing each command-line argument as a separate parameter and also passing an array of pointers to environment settings. These functions use the [PATH](#) environment variable to find the file to execute.

The [_execle](#) functions validate their parameters. If either `cmdname` or `arg0` is a null pointers or empty string, these functions invoke the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1. No new process is launched.

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_execle</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexecle</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

Process and environment control

[_exec](#), [_wexec](#) functions
[abort](#)
[atexit](#)
[exit](#), [_Exit](#), [_exit](#)
[_onexit](#), [_onexit_m](#)
[_spawn](#), [_wspawn](#) functions
[system](#), [_wsystem](#)

execv

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `execv` is a deprecated alias for the `_execv` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_execv` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_execv`, `_wexecv`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execv(
    const char *cmdname,
    const char *const *argv
);
intptr_t _wexecv(
    const wchar_t *cmdname,
    const wchar_t *const *argv
);
```

Parameters

`cmdname`

Path of the file to execute.

`argv`

Array of pointers to parameters.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO	VALUE	DESCRIPTION
	<code>E2BIG</code>	The space required for the arguments and environment settings exceeds 32 KB.
	<code>EACCES</code>	The specified file has a locking or sharing violation.
	<code>EINVAL</code>	Invalid parameter.
	<code>EMFILE</code>	Too many files open (the specified file must be opened to determine whether it's executable).
	<code>ENOENT</code>	The file or path not found.
	<code>ENOEXEC</code>	The specified file isn't executable or has an invalid executable-file format.

ERRNO	VALUE	DESCRIPTION
	ENOMEM	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, indicating that the calling process wasn't allocated properly.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, passing an array of pointers to command-line arguments.

The `_execv` functions validate their parameters. If `cmdname` is a null pointer, or if `argv` is a null pointer, pointer to an empty array, or if the array contains an empty string as the first argument, the `_execv` functions invoke the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1. No process is launched.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_execv</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexecv</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

Process and environment control

_exec , _wexec functions
abort
atexit
exit , _Exit , _exit
_onexit , _onexit_m
_spawn , _wspawn functions
system , _wsystem

execve

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `execve` is a deprecated alias for the `_execve` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_execve` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_execve, _wexecve

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execve(
    const char *cmdname,
    const char *const *argv,
    const char *const *envp
);
intptr_t _wexecve(
    const wchar_t *cmdname,
    const wchar_t *const *argv,
    const wchar_t *const *envp
);
```

Parameters

cmdname

Path of the file to execute.

argv

Array of pointers to parameters.

envp

Array of pointers to environment settings.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO	VALUE	DESCRIPTION
E2BIG		The space required for the arguments and environment settings exceeds 32 KB.
EACCES		The specified file has a locking or sharing violation.
EINVAL		Invalid parameter.
EMFILE		Too many files open (the specified file must be opened to determine whether it's executable).

ERRNO	VALUE	DESCRIPTION
	ENOENT	The file or path not found.
	ENOEXEC	The specified file isn't executable or has an invalid executable-file format.
	ENOMEM	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, indicating that the calling process wasn't allocated properly.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, passing an array of pointers to command-line arguments and an array of pointers to environment settings.

`_execve` and `_wexecve` validate their parameters. These functions invoke the invalid parameter handler, as described in [Parameter validation](#), when:

- `cmdname` is a null pointer,
- `argv` is either a null pointer or pointer to an empty array,
- the array contains an empty string as the first argument.

If execution is allowed to continue by the handler, these functions set `errno` to `EINVAL`, and return -1. No process is launched.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_execve</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexecve</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

[Process and environment control](#)

<code>_exec</code>	,	<code>_wexec</code>	functions
<code>abort</code>			
<code>atexit</code>			
<code>exit</code>	,	<code>_Exit</code>	,

[_onexit](#) , [_onexit_m](#)

[_spawn](#) , [_wspawn](#) functions

[system](#) , [_wsystem](#)

execvp

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `execvp` is a deprecated alias for the `_execvp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_execvp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_execvp, _wexecvp

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and executes new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execvp(
    const char *cmdname,
    const char *const *argv
);
intptr_t _wexecvp(
    const wchar_t *cmdname,
    const wchar_t *const *argv
);
```

Parameters

`cmdname`

Path of the file to execute.

`argv`

Array of pointers to parameters.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO	VALUE	DESCRIPTION
E2BIG		The space required for the arguments and environment settings exceeds 32 KB.
EACCES		The specified file has a locking or sharing violation.
EINVAL		Invalid parameter.
EMFILE		Too many files open (the specified file must be opened to determine whether it's executable).
ENOENT		The file or path not found.
ENOEXEC		The specified file isn't executable or has an invalid executable-file format.

ERRNO	VALUE	DESCRIPTION
	ENOMEM	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, indicating that the calling process wasn't allocated properly.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, passing an array of pointers to command-line arguments and using the `PATH` environment variable to find the file to execute.

The `_execvp` functions validate their parameters. These functions invoke the invalid parameter handler, as described in [Parameter validation](#), when:

- `cmdname` is a null pointer,
- `argv` is either a null pointer or pointer to an empty array,
- the array contains an empty string as the first argument.

If execution is allowed to continue by the handler, these functions set `errno` to `EINVAL`, and return -1. No process is launched.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_execvp</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexecvp</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

[Process and environment control](#)

[_exec](#), [_wexec](#) functions
[abort](#)
[atexit](#)
[exit](#), [_Exit](#), [_exit](#)
[_onexit](#), [_onexit_m](#)
[_spawn](#), [_wspawn](#) functions
[system](#), [_wsystem](#)

execvpe

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `execvpe` is a deprecated alias for the `_execvpe` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_execvpe` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_execvpe`, `_wexecvpe`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Loads and runs new child processes.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
intptr_t _execvpe(
    const char *cmdname,
    const char *const *argv,
    const char *const *envp
);
intptr_t _wexecvpe(
    const wchar_t *cmdname,
    const wchar_t *const *argv,
    const wchar_t *const *envp
);
```

Parameters

`cmdname`

Path of the file to execute.

`argv`

Array of pointers to parameters.

`envp`

Array of pointers to environment settings.

Return value

If successful, these functions don't return to the calling process. A return value of -1 indicates an error, in which case the `errno` global variable is set.

ERRNO	VALUE	DESCRIPTION
E2BIG		The space that's required for the arguments and environment settings exceeds 32 KB.
EACCES		The specified file has a locking or sharing violation.
EMFILE		Too many files are open. (The specified file must be opened to determine whether it's executable.)
ENOENT		The file or path isn't found.

ERRNO	VALUE	DESCRIPTION
	ENOEXEC	The specified file isn't executable or has an invalid executable-file format.
	ENOMEM	Not enough memory is available to execute the new process; the available memory has been corrupted; or an invalid block exists, which indicates that the calling process wasn't allocated correctly.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions loads and executes a new process, and passes an array of pointers to command-line arguments and an array of pointers to environment settings. These functions use the [PATH](#) environment variable to find the file to execute.

The [_execvpe](#) functions validate their parameters. These functions invoke the invalid parameter handler, as described in [Parameter validation](#), when:

- `cmdname` is a null pointer,
- `argv` is either a null pointer or pointer to an empty array,
- the array contains an empty string as the first argument.

If execution is allowed to continue by the handler, these functions set `errno` to `EINVAL`, and return -1. No process is launched.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_execvpe</code>	<code><process.h></code>	<code><errno.h></code>
<code>_wexecvpe</code>	<code><process.h> or <wchar.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_exec](#), [_wexec](#) functions.

See also

Process and environment control

[_exec](#), [_wexec](#) functions

[abort](#)

[atexit](#)

[exit](#), [_Exit](#), [_exit](#)

[_onexit](#), [_onexit_m](#)

[_spawn](#) , [_wspawn](#) functions

[system](#) , [_wsystem](#)

`exit`, `_Exit`, `_exit`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Terminates the calling process. The `exit` function terminates it after cleanup; `_exit` and `_Exit` terminate it immediately.

NOTE

Do not use this method to shut down a Universal Windows Platform (UWP) app, except in testing or debugging scenarios. Programmatic or UI ways to close a Store app are not permitted according to the [Microsoft Store policies](#). For more information, see [UWP app lifecycle](#). For more information about UWP apps, see [Universal Windows Platform documentation](#).

Syntax

```
void exit(  
    int const status  
);  
void _Exit(  
    int const status  
);  
void _exit(  
    int const status  
);
```

Parameters

`status`

Exit status code.

Remarks

The `exit`, `_Exit` and `_exit` functions terminate the calling process. The `exit` function calls destructors for thread-local objects, then calls—in last-in-first-out (LIFO) order—the functions that are registered by `atexit` and `_onexit`, and then flushes all file buffers before it terminates the process. The `_Exit` and `_exit` functions terminate the process without destroying thread-local objects or processing `atexit` or `_onexit` functions, and without flushing stream buffers.

Although the `exit`, `_Exit` and `_exit` calls don't return a value, the value in `status` is made available to the host environment or waiting calling process, if one exists, after the process exits. Typically, the caller sets the `status` value to 0 to indicate a normal exit, or to some other value to indicate an error. The `status` value is available to the operating-system batch command `ERRORLEVEL` and is represented by one of two constants: `EXIT_SUCCESS`, which represents a value of 0, or `EXIT_FAILURE`, which represents a value of 1.

The `exit`, `_Exit`, `_exit`, `quick_exit`, `_cexit`, and `_c_exit` functions behave as follows.

FUNCTION	DESCRIPTION
<code>exit</code>	Performs complete C library termination procedures, terminates the process, and provides the supplied status code to the host environment.

FUNCTION	DESCRIPTION
<code>_Exit</code>	Performs minimal C library termination procedures, terminates the process, and provides the supplied status code to the host environment.
<code>_exit</code>	Performs minimal C library termination procedures, terminates the process, and provides the supplied status code to the host environment.
<code>quick_exit</code>	Performs quick C library termination procedures, terminates the process, and provides the supplied status code to the host environment.
<code>_cexit</code>	Performs complete C library termination procedures and returns to the caller. Doesn't terminate the process.
<code>_c_exit</code>	Performs minimal C library termination procedures and returns to the caller. Doesn't terminate the process.

When you call the `exit`, `_Exit` or `_exit` function, the destructors for any temporary or automatic objects that exist at the time of the call aren't called. An automatic object is a non-static local object defined in a function. A temporary object is an object that's created by the compiler, such as a value returned by a function call. To destroy an automatic object before you call `exit`, `_Exit`, or `_exit`, explicitly call the destructor for the object, as shown here:

```
void last_fn() {}
    struct SomeClass {} myInstance{};
    // ...
    myInstance.~SomeClass(); // explicit destructor call
    exit(0);
}
```

Don't use `DLL_PROCESS_ATTACH` to call `exit` from `DllMain`. To exit the `DllMain` function, return `FALSE` from `DLL_PROCESS_ATTACH`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>exit</code> , <code>_Exit</code> , <code>_exit</code>	<code><process.h></code> or <code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_exit.c
// This program returns an exit code of 1. The
// error code could be tested in a batch file.

#include <stdlib.h>

int main( void )
{
    exit( 1 );
}
```

See also

Process and environment control

[abort](#)
[atexit](#)
[_cexit](#), [_c_exit](#)
[_exec](#), [_wexec](#) functions
[_onexit](#), [_onexit_m](#)
[quick_exit](#)
[_spawn](#), [_wspawn](#) functions
[system](#), [_wsystem](#)

`exp`, `expf`, `expl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the exponential.

Syntax

```
double exp(
    double x
);
float exp(
    float x
); // C++ only
long double exp(
    long double x
); // C++ only
float expf(
    float x
);
long double expl(
    long double x
);
#define exp(z) // Requires C11 or higher
```

Parameters

`x`

The floating-point value to exponentiate the natural logarithm base e by.

Return value

The `exp` functions return the exponential value of the floating-point parameter, `x`, if successful. That is, the result is e^x , where e is the base of the natural logarithm. On overflow, the function returns `INF` (infinity) and on underflow, `exp` returns 0.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
\pm Quiet NaN, indeterminate	None	<code>DOMAIN</code>
\pm Infinity	<code>INVALID</code>	<code>DOMAIN</code>
$x \geq 7.097827e+002$	<code>INEXACT</code> + <code>OVERFLOW</code>	<code>OVERFLOW</code>
$x \leq -7.083964e+002$	<code>INEXACT</code> + <code>UNDERFLOW</code>	<code>UNDERFLOW</code>

The `exp` function has an implementation that uses Streaming SIMD Extensions 2 (SSE2). See [set_SSE2_enable](#) for information and restrictions on using the SSE2 implementation.

Remarks

C++ allows overloading, so you can call overloads of `exp` that take a `float` or `long double` argument. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `exp` always takes and returns a

```
double .
```

If you use the `exp` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>exp</code> , <code>expf</code> , <code>expl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>exp</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

Example

```
// crt_exp.c

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 2.302585093, y;

    y = exp( x );
    printf( "exp( %f ) = %f\n", x, y );
}
```

```
exp( 2.302585 ) = 10.000000
```

See also

[Math and floating-point support](#)

`log`, `logf`, `log10`, `log10f`
`_CIEexp`

`exp2`, `exp2f`, `exp2l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes 2 raised to the specified value.

Syntax

```
double exp2(
    double x
);

float exp2(
    float x
); // C++ only

long double exp2(
    long double x
); // C++ only

float exp2f(
    float x
);

long double exp2l(
    long double x
);
#define exp2(X) // Requires C11 or higher
```

Parameters

`x`

The value of the exponent.

Return value

If successful, returns the base-2 exponent of `x`, that is, 2^x . Otherwise, it returns one of the following values:

ISSUE	RETURN
<code>x</code> = ±0	1
<code>x</code> = -INFINITY	+0
<code>x</code> = +INFINITY	+INFINITY
<code>x</code> = NaN	NaN
Overflow range error	+HUGE_VAL, +HUGE_VALF, or +HUGE_VALL
Underflow range error	Correct result, after rounding

Errors are reported as specified in `matherr`.

Remarks

Because C++ allows overloading, you can call overloads of `exp2` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `exp2` always takes and returns a `double`, unless you use the macro in `<tgmath.h>`.

If you use the `<tgmath.h>` `exp2()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>exp2</code> , <code>expf2</code> , <code>expl2</code>	<code><math.h></code>	<code><cmath></code>
<code>exp2</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[exp](#), [expf](#), [expl](#), [log2](#), [log2f](#), [log2l](#)

_expand

11/2/2022 • 2 minutes to read • [Edit Online](#)

Changes the size of a memory block.

Syntax

```
void *_expand(  
    void *memblock,  
    size_t size  
)
```

Parameters

`memblock`

Pointer to previously allocated memory block.

`size`

New size in bytes.

Return value

`_expand` returns a void pointer to the reallocated memory block. `_expand`, unlike `realloc`, can't move a block to change its size. Thus, if there's sufficient memory available to expand the block without moving it, the `memblock` parameter to `_expand` is the same as the return value.

`_expand` returns `NULL` when an error is detected during its operation. For example, if `_expand` is used to shrink a memory block, it might detect corruption in the small block heap or an invalid block pointer and return `NULL`.

If there isn't sufficient memory available to expand the block without moving it, the function returns `NULL`.

`_expand` never returns a block expanded to a size less than requested. If a failure occurs, `errno` indicates the nature of the failure. For more information about `errno`, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

The return value points to a storage space that is suitably aligned for storage of any type of object. To check the new size of the item, use `_msize`. To get a pointer to a type other than `void`, use a type cast on the return value.

Remarks

The `_expand` function changes the size of a previously allocated memory block by trying to expand or contract the block without moving its location in the heap. The `memblock` parameter points to the beginning of the block. The `size` parameter gives the new size of the block, in bytes. The contents of the block are unchanged up to the shorter of the new and old sizes. `memblock` shouldn't be a block that has been freed.

NOTE

On 64-bit platforms, `_expand` might not contract the block if the new size is less than the current size; in particular, if the block was less than 16K in size and therefore allocated in the Low Fragmentation Heap, `_expand` leaves the block unchanged and returns `memblock`.

When the application is linked with a debug version of the C run-time libraries, `_expand` resolves to

[_expand_dbg](#). For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

This function validates its parameters. If `membLock` is a null pointer, this function invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`. If `size` is greater than `_HEAP_MAXREQ`, `errno` is set to `ENOMEM`, and the function returns `NULL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_expand</code>	<code><malloc.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_expand.c

#include <stdio.h>
#include <malloc.h>
#include <stdlib.h>

int main( void )
{
    char *bufchar;
    printf( "Allocate a 512 element buffer\n" );
    if( (bufchar = (char *)calloc( 512, sizeof( char ) )) == NULL )
        exit( 1 );
    printf( "Allocated %d bytes at %Fp\n",
            _msize( bufchar ), (void *)bufchar );
    if( (bufchar = (char *)_expand( bufchar, 1024 )) == NULL )
        printf( "Can't expand" );
    else
        printf( "Expanded block to %d bytes at %Fp\n",
                _msize( bufchar ), (void *)bufchar );
    // Free memory
    free( bufchar );
    exit( 0 );
}
```

```
Allocate a 512 element buffer
Allocated 512 bytes at 002C12BC
Expanded block to 1024 bytes at 002C12BC
```

See also

[Memory allocation](#)

`calloc`
`free`
`malloc`
`_msize`

`realloc`

_expand_dbg

11/2/2022 • 3 minutes to read • [Edit Online](#)

Resizes a specified block of memory in the heap by expanding or contracting the block (debug version only).

Syntax

```
void *_expand_dbg(
    void *userData,
    size_t newSize,
    int blockType,
    const char *filename,
    int lineNumber
);
```

Parameters

`userData`

Pointer to the previously allocated memory block.

`newSize`

Requested new size for the block (in bytes).

`blockType`

Requested type for resized block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file that requested expand operation or `NULL`.

`LineNumber`

Line number in the source file where the expand operation was requested or `NULL`.

The `filename` and `LineNumber` parameters are only available when `_expand_dbg` has been called explicitly or the `_CRTDBG_MAP_ALLOC` preprocessor constant has been defined.

Return value

On successful completion, `_expand_dbg` returns a pointer to the resized memory block. Because the memory isn't moved, the address is the same as the `userData`. If an error occurred or the block couldn't be expanded to the requested size, it returns `NULL`. If a failure occurs, `errno` is with information from the operating system about the nature of the failure. For more information about `errno`, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_expand_dbg` function is a debug version of the `_expand` function. When `_DEBUG` isn't defined, each call to `_expand_dbg` is reduced to a call to `_expand`. Both `_expand` and `_expand_dbg` resize a memory block in the base heap, but `_expand_dbg` accommodates several debugging features: buffers on either side of the user portion of the block to test for leaks, a block type parameter to track specific allocation types, and `filename` / `LineNumber` information to determine the origin of allocation requests.

`_expand_dbg` resizes the specified memory block with slightly more space than the requested `newSize`. `newSize`

might be greater or less than the size of the originally allocated memory block. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The resize is accomplished by either expanding or contracting the original memory block. `_expand_dbg` doesn't move the memory block, as does the `_realloc_dbg` function.

When `newSize` is greater than the original block size, the memory block is expanded. During an expansion, if the memory block can't be expanded to accommodate the requested size, `NULL` is returned. When `newSize` is less than the original block size, the memory block is contracted until the new size is obtained.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and debug versions, see [Debug versions of heap allocation functions](#).

This function validates its parameters. If `userData` is a null pointer, or if size is greater than `_HEAP_MAXREQ`, this function invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`.

Requirements

ROUTINE	REQUIRED HEADER
<code>_expand_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```

// crt_expand_dbg.c
//
// This program allocates a block of memory using _malloc_dbg
// and then calls _msize_dbg to display the size of that block.
// Next, it uses _expand_dbg to expand the amount of
// memory used by the buffer and then calls _msize_dbg again to
// display the new amount of memory allocated to the buffer.
//

#include <stdio.h>
#include <malloc.h>
#include <stdlib.h>
#include <crtdbg.h>

int main( void )
{
    long *buffer;
    size_t size;

    // Call _malloc_dbg to include the filename and line number
    // of our allocation request in the header
    buffer = (long *)_malloc_dbg( 40 * sizeof(long),
                                 _NORMAL_BLOCK, __FILE__, __LINE__ );
    if( buffer == NULL )
        exit( 1 );

    // Get the size of the buffer by calling _msize_dbg
    size = _msize_dbg( buffer, _NORMAL_BLOCK );
    printf( "Size of block after _malloc_dbg of 40 longs: %u\n", size );

    // Expand the buffer using _expand_dbg and show the new size
    buffer = (long *)_expand_dbg( buffer, size + sizeof(long),
                                 _NORMAL_BLOCK, __FILE__, __LINE__ );

    if( buffer == NULL )
        exit( 1 );
    size = _msize_dbg( buffer, _NORMAL_BLOCK );
    printf( "Size of block after _expand_dbg of 1 more long: %u\n",
            size );

    free( buffer );
    exit( 0 );
}

```

```

Size of block after _malloc_dbg of 40 longs: 160
Size of block after _expand_dbg of 1 more long: 164

```

Comment

The output of this program depends on your computer's ability to expand all the sections. If all sections are expanded, the output is reflected in the Output section.

See also

[Debug routines](#)

[_malloc_dbg](#)

`expm1` , `expm1f` , `expm1l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the base-e exponential of a value, minus one.

Syntax

```
double expm1(
    double x
);
float expm1(
    float x
); // C++ only
long double expm1(
    long double x
); // C++ only
float expm1f(
    float x
);
long double expm1l(
    long double x
);
#define expm1(X) // Requires C11 or higher
```

Parameters

`x`

The floating-point exponential value.

Return value

The `expm1` functions return a floating-point value that represents $e^x - 1$, if successful. On overflow, `expm1` returns `HUGE_VAL`, `expm1f` returns `HUGE_VALF`, `expm1l` returns `HUGE_VALL`, and `errno` is set to `ERANGE`. For more information about return codes, see [errno](#) , [_doserrno](#) , [_sys_errlist](#) , and [_sys_nerr](#) .

Remarks

Because C++ allows overloading, you can call overloads of `expm1` that take and return `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `expm1` always takes and returns a `double`.

If you use the `<tgmath.h>` `expm1()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	REQUIRED HEADER
<code>expm1</code> , <code>expm1f</code> , <code>expm1l</code>	<code><math.h></code>
<code>expm1</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

See also

Math and floating-point support

[exp2](#), [exp2f](#), [exp2l](#)
[pow](#), [powf](#), [powl](#)

`fabs`, `fabsf`, `fabsl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the absolute value of the floating-point argument.

Syntax

```
double fabs(
    double x
);
float fabs(
    float x
); // C++ only
long double fabs(
    long double x
); // C++ only
float fabsf(
    float x
);
long double fabsl(
    long double x
);

#define fabs(X) // Requires C11 or higher
```

Parameters

`x`

Floating-point value.

Return value

The `fabs` functions return the absolute value of the argument `x`. There's no error return.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

Remarks

C++ allows overloading, so you can call overloads of `fabs` if you include the `<cmath>` header. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `fabs` always takes and returns a `double`.

If you use the `fabs` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>fabs</code> , <code>fabsf</code> , <code>fabsl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>fabs</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

Example

See the example for [abs](#).

See also

[Math and floating-point support](#)

[`abs`](#), [`labs`](#), [`llabs`](#), [`_abs64`](#)
[`_cabs`](#)

`fclose`, `_fcloseall`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Closes a stream (`fclose`) or closes all open streams (`_fcloseall`).

Syntax

```
int fclose(
    FILE *stream
);
int _fcloseall( void );
```

Parameters

`stream`

Pointer to `FILE` structure.

Return value

`fclose` returns 0 if the stream is successfully closed. `_fcloseall` returns the total number of streams closed. Both functions return `EOF` to indicate an error.

Remarks

The `fclose` function closes `stream`. If `stream` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `fclose` sets `errno` to `EINVAL` and returns `EOF`. It's recommended that you always check the `stream` pointer before you call this function.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

The `_fcloseall` function closes all open streams except `stdin`, `stdout`, `stderr` (and, in MS-DOS, `_stdaux` and `_stdprn`). It also closes and deletes any temporary files created by `tmpfile`. In both functions, all buffers associated with the stream are flushed prior to closing. System-allocated buffers are released when the stream is closed. Buffers assigned by the user with `setbuf` and `setvbuf` aren't automatically released.

NOTE

When `fclose` or `_fcloseall` functions are used to close a stream, the underlying file descriptor and OS file handle (or socket) are closed as well. Thus, if the file was originally opened as a file handle or file descriptor and is closed with `fclose`, don't also call `_close` to close the file descriptor; and don't call the Win32 function `CloseHandle` to close the file handle.

`fclose` and `_fcloseall` include code to protect against interference from other threads. For non-locking version of a `fclose`, see `_fclose_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fclose</code>	<code><stdio.h></code>
<code>_fcloseall</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`fopen`](#).

See also

Stream I/O

<code>_close</code>
<code>_fdopen</code> , <code>_wfopen</code>
<code>fflush</code>
<code>fopen</code> , <code>_wfopen</code>
<code>freopen</code> , <code>_wfreopen</code>

_fclose_nolock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Closes a stream without thread-locking.

Syntax

```
int _fclose_nolock(
    FILE *stream
);
```

Parameters

stream

Pointer to the `FILE` structure.

Return value

`_fclose_nolock` returns 0 if the stream is successfully closed. Returns `EOF` to indicate an error.

Remarks

This function is a non-locking version of `fclose`. It's identical except that it isn't protected from interference by other threads. It might be faster because it doesn't incur the overhead of locking out other threads. Use this function only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fclose_nolock</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

See also

Stream I/O

`_close`

`_fdopen`, `_wfopen`

`fflush`

`fopen`, `_wfopen`

`freopen`, `_wfreopen`

`fcloseall`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `fcloseall` is a deprecated alias for the `_fcloseall` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_fcloseall` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

The Microsoft-specific function name `fcvt` is a deprecated alias for the `_fcvt` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_fcvt` or the security-enhanced `_fcvt_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).



11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a floating-point number to a string. A more secure version of this function is available; see [_fcvt_s](#).

Syntax

```
char *_fcvt(
    double value,
    int count,
    int *dec,
    int *sign
);
```

Parameters

`value`

Number to be converted.

`count`

Number of digits after the decimal point.

`dec`

Pointer to the stored decimal-point position.

`sign`

Pointer to the stored sign indicator.

Return value

`_fcvt` returns a pointer to the string of digits, `NULL` on error.

Remarks

The `_fcvt` function converts a floating-point number to a null-terminated character string. The `value` parameter is the floating-point number to be converted. `_fcvt` stores the digits of `value` as a string and appends a null character ('\0'). The `count` parameter specifies the number of digits to be stored after the decimal point. Excess digits are rounded off to `count` places. If there are fewer than `count` digits of precision, the string is padded with zeros.

The total number of digits returned by `_fcvt` won't exceed `_CVTBUFSIZE`.

Only digits are stored in the string. The position of the decimal point and the sign of `value` can be obtained from `dec` and `sign` after the call. The `dec` parameter points to an integer value; this integer value gives the position of the decimal point with respect to the beginning of the string. A zero or negative integer value indicates that the decimal point lies to the left of the first digit. The parameter `sign` points to an integer indicating the sign of `value`. The integer is set to 0 if `value` is positive and is set to a nonzero number if `value` is negative.

The difference between `_ecvt` and `_fcvt` is in the interpretation of the `count` parameter. `_ecvt` interprets `count` as the total number of digits in the output string, whereas `_fcvt` interprets `count` as the number of digits after the decimal point.

`_ecvt` and `_fcvt` use a single statically allocated buffer for the conversion. Each call to one of these routines destroys the results of the previous call.

This function validates its parameters. If `dec` or `sign` is `NULL`, or `count` is 0, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and `NULL` is returned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fcvt</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fcvt.c
// compile with: /W3
// This program converts the constant
// 3.1415926535 to a string and sets the pointer
// buffer to point to that string.

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    int decimal, sign;
    char *buffer;
    double source = 3.1415926535;

    buffer = _fcvt( source, 7, &decimal, &sign ); // C4996
    // Note: _fcvt is deprecated; consider using _fcvt_s instead
    printf( "source: %2.10f    buffer: '%s'    decimal: %d    sign: %d\n",
            source, buffer, decimal, sign );
}
```

```
source: 3.1415926535    buffer: '31415927'    decimal: 1    sign: 0
```

See also

[Data conversion](#)

[Math and floating-point support](#)

[_atof](#) , [_atof_1](#) , [_wtof](#) , [_wtof_1](#)
[_ecvt](#)
[_gcvt](#)

_fcvt_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a floating-point number to a string. This function is a version of [_fcvt](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _fcvt_s(
    char* buffer,
    size_t sizeInBytes,
    double value,
    int count,
    int *dec,
    int *sign
);
template <size_t size>
errno_t _fcvt_s(
    char (&buffer)[size],
    double value,
    int count,
    int *dec,
    int *sign
); // C++ only
```

Parameters

`buffer`

The supplied buffer that will hold the result of the conversion.

`sizeInBytes`

The size of the buffer in bytes.

`value`

Number to be converted.

`count`

Number of digits after the decimal point.

`dec`

Pointer to the stored decimal-point position.

`sign`

Pointer to the stored sign indicator.

Return value

Zero if successful. The return value is an error code if there's a failure. Error codes are defined in [errno.h](#). For a listing of these errors, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

When there's an invalid parameter, as listed in the following table, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets [errno](#) to [EINVAL](#) and returns [EINVAL](#).

Error conditions

<code>BUFFER</code>	<code>SIZEINBYTES</code>	<code>VALUE</code>	<code>COUNT</code>	<code>DEC</code>	<code>SIGN</code>	<code>RETURN</code>	<code>VALUE IN BUFFER</code>
<code>NULL</code>	any	any	any	any	any	<code>EINVAL</code>	Not modified.
Not <code>NULL</code> (points to valid memory)	$<= 0$	any	any	any	any	<code>EINVAL</code>	Not modified.
any	any	any	any	<code>NULL</code>	any	<code>EINVAL</code>	Not modified.
any	any	any	any	any	<code>NULL</code>	<code>EINVAL</code>	Not modified.

Security Issues

`_fcvt_s` might generate an access violation if `buffer` doesn't point to valid memory and isn't `NULL`.

Remarks

The `_fcvt_s` function converts a floating-point number to a null-terminated character string. The `value` parameter is the floating-point number to be converted. `_fcvt_s` stores the digits of `value` as a string and appends a null character ('\0'). The `count` parameter specifies the number of digits to be stored after the decimal point. Excess digits are rounded off to `count` places. If there are fewer than `count` digits of precision, the string is padded with zeros.

Only digits are stored in the string. The position of the decimal point and the sign of `value` can be obtained from `dec` and `sign` after the call. The `dec` parameter points to an integer value; this integer value gives the position of the decimal point with respect to the beginning of the string. A zero or negative integer value indicates that the decimal point lies to the left of the first digit. The parameter `sign` points to an integer indicating the sign of `value`. The integer is set to 0 if `value` is positive and is set to a nonzero number if `value` is negative.

A buffer of length `CVTBUFSIZE` is sufficient for any floating point value.

The difference between `_ecvt_s` and `_fcvt_s` is in the interpretation of the `count` parameter. `_ecvt_s` interprets `count` as the total number of digits in the output string, and `_fcvt_s` interprets `count` as the number of digits after the decimal point.

In C++, using this function is simplified by a template overload; the overload can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug version of this function first fills the buffer with 0xFE. To disable this behavior, use [`_CrtSetDebugFillThreshold`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_fcvt_s</code>	<code><stdlib.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: All versions of the [C runtime libraries](#).

Example

```
// fcvt_s.c
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main()
{
    char * buf = 0;
    int decimal;
    int sign;
    int err;

    buf = (char*) malloc(_CVTBUFSIZE);
    err = _fcvt_s(buf, _CVTBUFSIZE, 1.2, 5, &decimal, &sign);

    if (err != 0)
    {
        printf("_fcvt_s failed with error code %d\n", err);
        exit(1);
    }

    printf("Converted value: %s\n");
}
```

Converted value: 120000

See also

[Data conversion](#)

[Math and floating-point support](#)

[atof](#) , [_atof_1](#) , [_wtof](#) , [_wtof_1](#)
[_ecvt_s](#)
[_gcvt_s](#)
[_fcvt](#)

`fdim`, `fdimf`, `fdiml`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines the positive difference between the first and second values.

Syntax

```
double fdim(
    double x,
    double y
);

float fdim(
    float x,
    float y
); //C++ only

long double fdim(
    long double x,
    long double y
); //C++ only

float fdimf(
    float x,
    float y
);

long double fdiml(
    long double x,
    long double y
);

#define fdim(X) // Requires C11 or higher
```

Parameters

`x`

The first value.

`y`

The second value.

Return value

Returns the positive difference between `x` and `y`:

RETURN VALUE	SCENARIO
<code>x-y</code>	if <code>x > y</code>
0	if <code>x <= y</code>

Otherwise, may return one of the following errors:

ISSUE	RETURN
Overflow range error	+HUGE_VAL, +HUGE_VALF, or +HUGE_VALL
Underflow range error	correct value (after rounding)
x or y is NaN	NaN

Errors are reported as specified in [_matherr](#).

Remarks

Because C++ allows overloading, you can call overloads of `fdim` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `fdim` always takes and returns a `double`.

If you use the `<tgmath.h>` `fdim()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Except for the NaN handling, this function is equivalent to `fmax(x - y, 0)`.

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fdim</code> , <code>fdimf</code> , <code>fdiml</code>	<code><math.h></code>	<code><cmath></code>
<code>fdim</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[fmax](#), [fmaxf](#), [fmaxl](#)
[abs](#), [labs](#), [llabs](#), [_abs64](#)\

fdopen

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `fdopen` is a deprecated alias for the `_fdopen` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_fdopen` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_fdopen`, `_wfdopen`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Associates a stream with a file that was previously opened for low-level I/O.

Syntax

```
FILE *_fdopen(
    int fd,
    const char *mode
);
FILE *_wfdopen(
    int fd,
    const wchar_t *mode
);
```

Parameters

`fd`

File descriptor of the open file.

`mode`

Type of file access.

Return value

Each of these functions returns a pointer to the open stream. A null pointer value indicates an error. When an error occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set either to `EBADF`, which indicates a bad file descriptor, or `EINVAL`, which indicates that `mode` was a null pointer.

For more information about these and other error codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

The `_fdopen` function associates an I/O stream with the file that is identified by `fd`, and thus allows a file that is opened for low-level I/O to be buffered and formatted. `_wfdopen` is a wide-character version of `_fdopen`; the `mode` argument to `_wfdopen` is a wide-character string. `_wfdopen` and `_fdopen` otherwise behave identically.

File descriptors passed into `_fdopen` are owned by the returned `FILE *` stream. If `_fdopen` is successful, don't call `_close` on the file descriptor. Calling `fclose` on the returned `FILE *` also closes the file descriptor.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

The `mode` character string specifies the type of file access requested for the file:

MODE	ACCESS
"r"	Opens for reading. If the file doesn't exist or can't be found, the <code>fopen</code> call fails.

MODE	ACCESS
"w"	Opens an empty file for writing. If the given file exists, its contents are destroyed.
"a"	Opens for writing at the end of the file (appending). Creates the file if it doesn't exist.
"r+"	Opens for both reading and writing. The file must exist.
"w+"	Opens an empty file for both reading and writing. If the file exists, its contents are destroyed.
"a+"	Opens for reading and appending. Creates the file if it doesn't exist.

When a file is opened with the "a" or "a+" access type, all write operations occur at the end of the file. The file pointer can be repositioned by using `fseek` or `rewind`, but it's always moved back to the end of the file before any write operation is carried out. Thus, existing data can't be overwritten. When the "r+", "w+", or "a+" access type is specified, both reading and writing are allowed (the file is said to be open for "update"). However, when you switch between reading and writing, there must be an intervening `fflush`, `fsetpos`, `fseek`, or `rewind` operation. You can specify the current position for the `fsetpos` or `fseek` operation, if you want to.

In addition to the above values, the following characters can also be included in `mode` to specify the translation mode for newline characters:

MODE MODIFIER	BEHAVIOR
t	Open in text (translated) mode. In this mode, carriage return-line feed (CR-LF) combinations are translated into one-line feeds (LF) on input, and LF characters are translated to CR-LF combinations on output. Also, Ctrl+Z is interpreted as an end-of-file character on input.
b	Open in binary (untranslated) mode. Any translations from t mode are suppressed.
c	Enable the commit flag for the associated <code>filename</code> so that the contents of the file buffer are written directly to disk if either <code>fflush</code> or <code>_flushall</code> is called.
n	Reset the commit flag for the associated <code>filename</code> to "no-commit." This flag is the default. It also overrides the global commit flag if you link your program with <code>Commode.obj</code> . The global commit flag default is "no-commit" unless you explicitly link your program with <code>Commode.obj</code> .

The t, c, and n mode options are Microsoft extensions for `fopen` and `_fdopen`. Don't use them if you want to preserve ANSI portability.

If t or b isn't given in `mode`, the default translation mode is defined by the global variable `_fmode`. If t or b is prefixed to the argument, the function fails and returns `NULL`. For a discussion of text and binary modes, see [Text and binary mode file I/O](#).

Valid characters for the `mode` string used in `fopen` and `_fdopen` correspond to `oflag` arguments used in

`_open` and `_sopen`, as shown in this table:

CHARACTERS IN <code>MODE</code> STRING	EQUIVALENT <code>OFLAG</code> VALUE FOR <code>_OPEN</code> AND <code>_SOPEN</code>
<code>a</code>	<code>_O_WRONLY _O_APPEND</code> (usually <code>_O_WRONLY _O_CREAT _O_APPEND</code>)
<code>a+</code>	<code>_O_RDWR _O_APPEND</code> (usually <code>_O_RDWR _O_APPEND _O_CREAT</code>)
<code>r</code>	<code>_O_RDONLY</code>
<code>r+</code>	<code>_O_RDWR</code>
<code>w</code>	<code>_O_WRONLY</code> (usually <code>_O_WRONLY _O_CREAT _O_TRUNC</code>)
<code>w+</code>	<code>_O_RDWR</code> (usually <code>_O_RDWR _O_CREAT _O_TRUNC</code>)
<code>b</code>	<code>_O_BINARY</code>
<code>t</code>	<code>_O_TEXT</code>
<code>c</code>	None
<code>n</code>	None

Requirements

FUNCTION	REQUIRED HEADER	C++ HEADER
<code>_fdopen</code>	<code><stdio.h></code>	<code><cstdio></code>
<code>_wfopen</code>	<code><stdio.h></code> or <code><wchar.h></code>	<code><cstdio></code>

For more information on standards conformance and naming conventions in the C runtime library, see [Compatibility](#).

Generic-text routine mappings

<code><TCHAR.H></code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfopen</code>	<code>_fdopen</code>	<code>_fdopen</code>	<code>_wfopen</code>

Example

```

// crt_fdopen.c
// This program opens a file by using low-level
// I/O, then uses _fdopen to switch to stream
// access. It counts the lines in the file.

#include <stdlib.h>
#include <stdio.h>
#include <fcntl.h>
#include <io.h>
#include <share.h>

int main( void )
{
    FILE *stream;
    int fd, count = 0;
    char inbuf[128];

    // Open a file.
    if( _sopen_s( &fd, "crt_fdopen.txt", _O_RDONLY, _SH_DENYNO, 0 ) )
        exit( 1 );

    // Get stream from file descriptor.
    if( (stream = _fdopen( fd, "r" )) == NULL )
        exit( 1 );

    while( fgets( inbuf, 128, stream ) != NULL )
        count++;

    // After _fdopen, close by using fclose, not _close.
    fclose( stream );
    printf( "Lines in file: %d\n", count );
}

```

Input: crt_fdopen.txt

Line one
Line two

Output

Lines in file: 2

See also

Stream I/O

_dup	_dup2
fclose	_fcloseall
fopen	_wfopen
freopen	_wfreopen
_open	_wopen

feclearexcept

11/2/2022 • 2 minutes to read • [Edit Online](#)

`feclearexcept` attempts to clear the floating-point exception flags specified by the argument.

Syntax

```
int feclearexcept(  
    int excepts  
>);
```

Parameters

`excepts`

The exception status flags to clear.

Return value

Returns zero if `excepts` is zero, or if all the specified exceptions were successfully cleared. Otherwise, it returns a nonzero value.

Remarks

The `feclearexcept` function attempts to clear the floating point exception status flags specified by `excepts`. The function supports these exception macros, defined in fenv.h:

EXCEPTION MACRO	DESCRIPTION
<code>FE_DIVBYZERO</code>	A singularity or pole error occurred in an earlier floating-point operation; an infinity value was created.
<code>FE_INEXACT</code>	The function was forced to round the stored result of an earlier floating-point operation.
<code>FE_INVALID</code>	A domain error occurred in an earlier floating-point operation.
<code>FE_OVERFLOW</code>	A range error occurred; an earlier floating-point operation result was too large to be represented.
<code>FE_UNDERFLOW</code>	An earlier floating-point operation result was too small to be represented at full precision; a denormal value was created.
<code>FE_ALL_EXCEPT</code>	The bitwise OR of all supported floating-point exceptions.

The `excepts` argument may be zero, or the bitwise OR of one or more of the supported exception macros. The result of any other argument value is undefined.

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>feclearexcept</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[`fetestexcept`](#)

fegetenv

11/2/2022 • 2 minutes to read • [Edit Online](#)

Stores the current floating-point environment in the specified object.

Syntax

```
int fegetenv(  
    fenv_t *penv  
)
```

Parameters

`penv`

Pointer to an `fenv_t` object to contain the current floating-point environment values.

Return value

Returns 0 if the floating-point environment was successfully stored in `penv`. Otherwise, it returns a non-zero value.

Remarks

The `fegetenv` function stores the current floating-point environment in the object pointed to by `penv`. The floating point environment is the set of status flags and control modes that affect floating-point calculations. This environment includes the rounding direction mode and the status flags for floating-point exceptions. If `penv` doesn't point to a valid `fenv_t` object, subsequent behavior is undefined.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fegetenv</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[fesetenv](#)

fegetexceptflag

11/2/2022 • 2 minutes to read • [Edit Online](#)

Stores the current state of the specified floating-point exception flags.

Syntax

```
int fegetexceptflag(
    fexcept_t* pstatus,
    int excepts
);
```

Parameters

`pstatus`

A pointer to a `fexcept_t` object to contain the current values of the exception flags specified by `excepts`.

`excepts`

The floating-point exception flags to store in `pstatus`.

Return value

On success, returns 0. Otherwise, it returns a non-zero value.

Remarks

The `fegetexceptflag` function stores the current state of the floating-point exception status flags specified by `excepts` in the `fexcept_t` object pointed to by `pstatus`. `pstatus` must point to a valid `fexcept_t` object, or subsequent behavior is undefined. The `fegetexceptflag` function supports these exception macros, defined in `<fenv.h>`:

EXCEPTION MACRO	DESCRIPTION
<code>FE_DIVBYZERO</code>	A singularity or pole error occurred in an earlier floating-point operation; an infinity value was created.
<code>FE_INEXACT</code>	The function was forced to round the stored result of an earlier floating-point operation.
<code>FE_INVALID</code>	A domain error occurred in an earlier floating-point operation.
<code>FE_OVERFLOW</code>	A range error occurred; an earlier floating-point operation result was too large to be represented.
<code>FE_UNDERFLOW</code>	An earlier floating-point operation result was too small to be represented at full precision; a denormal value was created.
<code>FE_ALL_EXCEPT</code>	The bitwise OR of all supported floating-point exceptions.

The `excepts` argument may be zero, one of the supported floating-point exception macros, or the bitwise OR of

two or more of the macros. The effect of any other argument value is undefined.

To use this function, you must turn off floating-point optimizations that could prevent access by using the

`#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fegetexceptflag</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[fesetexceptflag](#)

fegetround, fesetround

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets or sets the current floating-point rounding mode.

Syntax

```
int fegetround(void);  
  
int fesetround(  
    int round_mode  
>;
```

Parameters

`round_mode`

The rounding mode to set, as one of the floating-point rounding macros. If the value isn't equal to one of the floating-point rounding macros, the rounding mode isn't changed.

Return value

On success, `fegetround` returns the rounding mode as one of the floating point rounding macro values. It returns a negative value if the current rounding mode can't be determined.

On success, `fesetround` returns 0. Otherwise, a non-zero value is returned.

Remarks

Floating-point operations can use one of several rounding modes. These modes control which direction the results of floating-point operations are rounded toward when the results are stored. Here are the names and behaviors of the floating-point rounding macros defined in <fenv.h>:

MACRO	DESCRIPTION
<code>FE_DOWNWARD</code>	Round towards negative infinity.
<code>FE_TONEAREST</code>	Round towards the nearest.
<code>FE_TOWARDZERO</code>	Round towards zero.
<code>FE_UPWARD</code>	Round towards positive infinity.

The default behavior of `FE_TONEAREST` is to round results midway between representable values toward the nearest value with an even (0) least significant bit.

The current rounding mode affects these operations:

- String conversions.
- The results of floating-point arithmetic operators outside of constant expressions.
- The library rounding functions, such as `rint` and `nearbyint`.

- Return values from standard library mathematical functions.

The current rounding mode doesn't affect these operations:

- The `trunc`, `ceil`, `floor`, and `lround` library functions.
- Floating-point to integer implicit casts and conversions, which always round towards zero.
- The results of floating-point arithmetic operators in constant expressions, which always round to the nearest value.

To use these functions, you must turn off floating-point optimizations that could prevent access by using the

`#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fegetround</code> , <code>fesetround</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[nearbyint](#), [nearbyintf](#), [nearbyintl](#)
[rint](#), [rintf](#), [rintl](#)
[lrint](#), [lrintf](#), [lrintl](#), [llrint](#), [llrintf](#), [llrintl](#)

feholdexcept

11/2/2022 • 2 minutes to read • [Edit Online](#)

Saves the current floating-point environment in the specified object, clears the floating-point status flags, and, if possible, puts the floating-point environment into non-stop mode.

Syntax

```
int feholdexcept(  
    fenv_t *penv  
)
```

Parameters

`penv`

Pointer to an `fenv_t` object to contain a copy of the floating-point environment.

Return value

Returns zero if and only if the function is able to successfully turn on non-stop floating-point exception handling.

Remarks

The `feholdexcept` function is used to store the state of the current floating point environment in the `fenv_t` object pointed to by `penv`, and to set the environment to not interrupt execution on floating-point exceptions. This mode is known as *non-stop mode*. This mode continues until the environment is restored using `fesetenv` or `feupdateenv`.

You can use this function at the beginning of a subroutine that needs to hide one or more floating-point exceptions from the caller. To report an exception, you can clear the unwanted exceptions by using `feclearexcept`, and then end the non-stop mode with a call to `feupdateenv`.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>feholdexcept</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`feclearexcept`
`fesetenv`
`feupdateenv`

feof

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tests for end-of-file on a stream.

Syntax

```
int feof(  
    FILE *stream  
)
```

Parameters

stream

Pointer to `FILE` structure.

Return value

The `feof` function returns a nonzero value if a read operation has attempted to read past the end of the file; it returns 0 otherwise. If the stream pointer is `NULL`, the function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the `feof` returns 0.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `feof` routine (implemented both as a function and as a macro) determines whether the end of *stream* has been passed. When the end of file is passed, read operations return an end-of-file indicator until the stream is closed or until `rewind`, `fsetpos`, `fseek`, or `clearerr` is called against it.

For example, if a file contains 10 bytes and you read 10 bytes from the file, `feof` will return 0 because, even though the file pointer is at the end of the file, you haven't attempted to read beyond the end. Only after you try to read an 11th byte will `feof` return a nonzero value.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>feof</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_feof.c
// This program uses feof to indicate when
// it reaches the end of the file CRT_FEOF.TXT. It also
// checks for errors with perror.
//

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    int count, total = 0;
    char buffer[100];
    FILE *stream;

    fopen_s( &stream, "crt_feof.txt", "r" );
    if( stream == NULL )
        exit( 1 );

    // Cycle until end of file reached:
    while( !feof( stream ) )
    {
        // Attempt to read in 100 bytes:
        count = fread( buffer, sizeof( char ), 100, stream );
        if( ferror( stream ) )
        {
            perror( "Read error" );
            break;
        }

        // Total up actual bytes read
        total += count;
    }
    printf( "Number of bytes read = %d\n", total );
    fclose( stream );
}

```

Input: crt_feof.txt

Line one.
Line two.

Output

Number of bytes read = 19

See also

[Error handling](#)

[Stream I/O](#)

[clearerr](#)

[_eof](#)

[ferror](#)

[perror](#) , [_wperror](#)

feraiseexcept

11/2/2022 • 2 minutes to read • [Edit Online](#)

Raises the specified floating-point exceptions.

Syntax

```
int feraiseexcept(  
    int excepts  
);
```

Parameters

`excepts`

The floating-point exceptions to raise.

Return value

If all specified exceptions are raised successfully, returns 0.

Remarks

The `feraiseexcept` function attempts to raise the floating-point exceptions specified by `excepts`. The `feraiseexcept` function supports these exception macros, defined in <fenv.h>:

EXCEPTION MACRO	DESCRIPTION
<code>FE_DIVBYZERO</code>	A singularity or pole error occurred in an earlier floating-point operation; an infinity value was created.
<code>FE_INEXACT</code>	The function was forced to round the stored result of an earlier floating-point operation.
<code>FE_INVALID</code>	A domain error occurred in an earlier floating-point operation.
<code>FE_OVERFLOW</code>	A range error occurred; an earlier floating-point operation result was too large to be represented.
<code>FE_UNDERFLOW</code>	An earlier floating-point operation result was too small to be represented at full precision; a denormal value was created.
<code>FE_ALL_EXCEPT</code>	The bitwise OR of all supported floating-point exceptions.

The `excepts` argument may be zero, one of the exception macro values, or the bitwise OR of two or more of the supported exception macros. If one of the specified exception macros is `FE_OVERFLOW` or `FE_UNDERFLOW`, the `FE_INEXACT` exception may be raised as a side-effect.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Microsoft-specific: The exceptions specified in `excepts` are raised in the order `FE_INVALID`, `FE_DIVBYZERO`, `FE_OVERFLOW`, `FE_UNDERFLOW`, `FE_INEXACT`. However, `FE_INEXACT` can be raised when `FE_OVERFLOW` or `FE_UNDERFLOW` is raised, even if not specified in `excepts`.

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>feraiseexcept</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[`fesetexceptflag`](#)
[`feholdexcept`](#)
[`fetestexcept`](#)
[`feupdateenv`](#)

Tests for an error on a stream.

Syntax

```
int ferror(
    FILE *stream
);
```

Parameters

`stream`

Pointer to `FILE` structure.

Return value

If no error has occurred on `stream`, `ferror` returns 0. Otherwise, it returns a nonzero value. If `stream` is `NULL`, `ferror` invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns 0.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `ferror` routine (implemented both as a function and as a macro) tests for a reading or writing error on the file associated with `stream`. If an error has occurred, the error indicator for the stream remains set until the stream is closed or rewound, or until `clearerr` is called against it.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>ferror</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for `feof`.

See also

[Error handling](#)

[Stream I/O](#)

`clearerr`

`_eof`

`feof`

`fopen` , `_wfopen`

`perror` , `_wperror`

fesetenv

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the current floating-point environment.

Syntax

```
int fesetenv(
    const fenv_t *penv
);
```

Parameters

penv

Pointer to a `fenv_t` object that contains a floating-point environment as set by a call to `fegetenv` or `feholdexcept`. You can also specify the default startup floating-point environment by using the `FE_DFL_ENV` macro.

Return value

Returns 0 if the environment was successfully set. Otherwise, it returns a nonzero value.

Remarks

The `fesetenv` function sets the current floating-point environment from the value stored in the `fenv_t` object pointed to by `penv`. The floating point environment is the set of status flags and control modes that affect floating-point calculations. The environment includes the rounding mode and the status flags for floating-point exceptions. If `penv` isn't `FE_DFL_ENV` or doesn't point to a valid `fenv_t` object, subsequent behavior is undefined.

A call to this function sets the exception status flags that are in the `penv` object, but it doesn't raise those exceptions.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see `fenv_access`.

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fesetenv</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see `Compatibility`.

See also

[Alphabetical function reference](#)

`fegetenv`

`feclearexcept`

`feholdexcept`

```
fesetexceptflag
```

fesetexceptflag

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the specified floating-point status flags in the current floating-point environment.

Syntax

```
int fesetexceptflag(
    const fexcept_t *pstatus,
    int excepts
);
```

Parameters

`pstatus`

Pointer to an `fexcept_t` object containing the values to set the exception status flags to. The object may be set by a previous call to `fegetexceptflag`.

`excepts`

The floating-point exception status flags to set.

Return value

If all the specified exception status flags are set successfully, returns 0. Otherwise, it returns a nonzero value.

Remarks

The `fesetexceptflag` function sets the state of the floating-point exception status flags specified by `excepts` to the corresponding values set in the `fexcept_t` object pointed to by `pstatus`. It doesn't raise the exceptions. The `pstatus` pointer must point to a valid `fexcept_t` object, or subsequent behavior is undefined. The `fesetexceptflag` function supports these exception macro values in `excepts`, defined in <fenv.h>:

EXCEPTION MACRO	DESCRIPTION
<code>FE_DIVBYZERO</code>	A singularity or pole error occurred in an earlier floating-point operation; an infinity value was created.
<code>FE_INEXACT</code>	The function was forced to round the stored result of an earlier floating-point operation.
<code>FE_INVALID</code>	A domain error occurred in an earlier floating-point operation.
<code>FE_OVERFLOW</code>	A range error occurred; an earlier floating-point operation result was too large to be represented.
<code>FE_UNDERFLOW</code>	An earlier floating-point operation result was too small to be represented at full precision; a denormal value was created.
<code>FE_ALL_EXCEPT</code>	The bitwise OR of all supported floating-point exceptions.

The `excepts` argument may be zero, one of the supported floating-point exception macros, or the bitwise OR of two or more of the macros. The effect of any other argument value is undefined.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fesetexceptflag</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[fegetexceptflag](#)

fetestexcept

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines which of the specified floating-point exception status flags are currently set.

Syntax

```
int fetestexcept(  
    int excepts  
)
```

Parameters

`excepts`

A bitwise OR of the floating-point status flags to test.

Return value

On success, returns a bitmask containing a bitwise OR of the floating-point exception macros that correspond to the exception status flags currently set. Returns 0 if none of the exceptions are set.

Remarks

Use the `fetestexcept` function to determine which exceptions were raised by a floating point operation. Use the `excepts` parameter to specify which exception status flags to test. The `fetestexcept` function uses these exception macros defined in `<fenv.h>` in `excepts` and the return value:

EXCEPTION MACRO	DESCRIPTION
<code>FE_DIVBYZERO</code>	A singularity or pole error occurred in an earlier floating-point operation; an infinity value was created.
<code>FE_INEXACT</code>	The function was forced to round the stored result of an earlier floating-point operation.
<code>FE_INVALID</code>	A domain error occurred in an earlier floating-point operation.
<code>FE_OVERFLOW</code>	A range error occurred; an earlier floating-point operation result was too large to be represented.
<code>FE_UNDERFLOW</code>	An earlier floating-point operation result was too small to be represented at full precision; a denormal value was created.
<code>FE_ALL_EXCEPT</code>	The bitwise OR of all supported floating-point exceptions.

The specified `excepts` argument may be 0, one of the supported floating-point exception macros, or the bitwise OR of two or more of the macros. The effect of any other `excepts` argument value is undefined.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see [fenv_access](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fetestexcept</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[`feclearexcept`](#)
[`feraiseexcept`](#)

feupdateenv

11/2/2022 • 2 minutes to read • [Edit Online](#)

Saves the currently raised floating-point exceptions, restores the specified floating-point environment state, and then raises the saved floating-point exceptions.

Syntax

```
int feupdateenv(  
    const fenv_t* penv  
);
```

Parameters

`penv`

Pointer to a `fenv_t` object that contains a floating-point environment as set by a call to `fegetenv` or `feholdexcept`. You can also specify the default startup floating-point environment by using the `FE_DFL_ENV` macro.

Return value

Returns 0 if all actions completed successfully. Otherwise, it returns a nonzero value.

Remarks

The `feupdateenv` function performs multiple actions. First, it stores the current raised floating-point exception status flags in automatic storage. Then, it sets the current floating-point environment from the value stored in the `fenv_t` object pointed to by `penv`. If `penv` isn't `FE_DFL_ENV` or doesn't point to a valid `fenv_t` object, subsequent behavior is undefined. Finally, `feupdateenv` raises the locally stored floating-point exceptions.

To use this function, you must turn off floating-point optimizations that could prevent access by using the `#pragma fenv_access(on)` directive prior to the call. For more information, see `fenv_access`.

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>feupdateenv</code>	<code><fenv.h></code>	<code><cfenv></code>

For more compatibility information, see [Compatibility](#).

See also

[fegetenv](#)
[feclearexcept](#)
[feholdexcept](#)
[fesetexceptflag](#)

fflush

11/2/2022 • 2 minutes to read • [Edit Online](#)

Flushes a stream.

Syntax

```
int fflush(
    FILE *stream
);
```

Parameters

`stream`

Pointer to `FILE` structure.

Return value

`fflush` returns 0 if the buffer was successfully flushed. The value 0 is also returned in cases in which the specified stream has no buffer or is open for reading only. A return value of `EOF` indicates an error.

NOTE

If `fflush` returns `EOF`, data may have been lost due to a write failure. When setting up a critical error handler, it is safest to turn buffering off with the `setvbuf` function or to use low-level I/O routines such as `_open`, `_close`, and `_write` instead of the stream I/O functions.

Remarks

The `fflush` function flushes the stream `stream`. If the stream was opened in write mode, or it was opened in update mode and the last operation was a write, `fflush` writes the contents of the stream buffer to the underlying file or device, and the buffer is discarded. If the stream was opened in read mode, or if the stream has no buffer, the call to `fflush` has no effect, and any buffer is retained. A call to `fflush` negates the effect of any prior call to `ungetc` for the stream. The stream remains open after the call.

If `stream` is `NULL`, the behavior is the same as a call to `fflush` on each open stream. All streams opened in write mode and all streams opened in update mode where the last operation was a write are flushed. The call has no effect on other streams.

Buffers are normally maintained by the operating system, which determines the optimal time to write the data automatically to disk: when a buffer is full, when a stream is closed, or when a program terminates normally without closing the stream. The commit-to-disk feature of the run-time library lets you ensure that critical data is written directly to disk rather than to the operating-system buffers. Without rewriting an existing program, you can enable this feature by linking the program's object files with `COMMODE.OBJ`. In the resulting executable file, calls to `_flushall` write the contents of all buffers to disk. Only `_flushall` and `fflush` are affected by `COMMODE.OBJ`.

For information about controlling the commit-to-disk feature, see [Stream I/O](#), `fopen`, and `_fdopen`.

This function locks the calling thread and is therefore thread-safe. For a non-locking version, see

```
_fflush_nolock .
```

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
fflush	<stdio.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fflush.c
// Compile with: cl /W4 crt_fflush.c
// This sample gets a number from the user, then writes it to a file.
// It ensures the write isn't lost on crash by calling fflush.
#include <stdio.h>

int * crash_the_program = 0;

int main(void)
{
    FILE * my_file;
    errno_t err = fopen_s(&my_file, "myfile.txt", "w");
    if (my_file && !err)
    {
        printf("Write a number: ");

        int my_number = 0;
        scanf_s("%d", &my_number);

        fprintf(my_file, "User selected %d\n", my_number);

        // Write data to a file immediately instead of buffering.
        fflush(my_file);

        if (my_number == 5)
        {
            // Without using fflush, no data was written to the file
            // prior to the crash, so the data is lost.
            *crash_the_program = 5;
        }

        // Normally, fflush is not needed as closing the file will write the buffer.
        // Note that files are automatically closed and flushed during normal termination.
        fclose(my_file);
    }
    return 0;
}
```

5

User selected 5

See also

Stream I/O

```
fclose , _fcloseall  
_flushall  
setvbuf
```

_fflush_nolock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Flushes a stream without locking the thread.

Syntax

```
int _fflush_nolock(
    FILE *stream
);
```

Parameters

stream

Pointer to the `FILE` structure.

Return value

See [fflush](#).

Remarks

This function is a non-locking version of `fflush`. It's identical to `fflush` except that it isn't protected from interference by other threads. It might be faster because it doesn't incur the overhead of locking out other threads. Use this function only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fflush_nolock</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

See also

Stream I/O

`fclose`, `_fcloseall`

`_flushall`

`setvbuf`

fgetc, fgetwc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Read a character from a stream.

Syntax

```
int fgetc(  
    FILE *stream  
>;  
wint_t fgetwc(  
    FILE *stream  
>;
```

Parameters

`stream`

Pointer to `FILE` structure.

Return value

`fgetc` returns the character read as an `int` or returns `EOF` to indicate an error or end of file. `fgetwc` returns, as a `wint_t`, the wide character that corresponds to the character read or returns `WEOF` to indicate an error or end of file. For both functions, use `feof` or `ferror` to distinguish between an error and an end-of-file condition. If a read error occurs, the error indicator for the stream is set. If `stream` is `NULL`, `fgetc` and `fgetwc` invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EOF`.

Remarks

Each of these functions reads a single character from the current position of the file associated with `stream`. The function then increments the associated file pointer (if defined) to point to the next character. If the stream is at end of file, the end-of-file indicator for the stream is set.

`fgetc` is equivalent to `getc`, but is implemented only as a function, rather than as a function and a macro.

`fgetwc` is the wide-character version of `fgetc`; it reads `c` as a multibyte character or a wide character when `stream` is opened in text mode or binary mode, respectively.

The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads.

For more information about processing wide characters and multibyte characters in text and binary modes, see [Unicode stream I/O in text and binary modes](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<input type="checkbox"/> _UNICODE AND <input type="checkbox"/> _MBCS NOT DEFINED	<input type="checkbox"/> _MBCS DEFINED	<input type="checkbox"/> _UNICODE DEFINED
_fgettc	fgetc	fgetc	fgetwc

Requirements

FUNCTION	REQUIRED HEADER
fgetc	<stdio.h>
fgetwc	<stdio.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fgetc.c
// This program uses getc to read the first
// 80 input characters (or until the end of input)
// and place them into a string named buffer.

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    FILE *stream;
    char buffer[81];
    int i, ch;

    // Open file to read line from:
    fopen_s( &stream, "crt_fgetc.txt", "r" );
    if( stream == NULL )
        exit( 0 );

    // Read in first 80 characters and place them in "buffer":
    ch = fgetc( stream );
    for( i=0; (i < 80) && ( feof( stream ) == 0 ); i++ )
    {
        buffer[i] = (char)ch;
        ch = fgetc( stream );
    }

    // Add null to end string
    buffer[i] = '\0';
    printf( "%s\n", buffer );
    fclose( stream );
}
```

Input: crt_fgetc.txt

```
Line one.
Line two.
```

Output

Line one.
Line two.

See also

Stream I/O

[fputc](#), [fputwc](#)

[getc](#), [getwc](#)

`_fgetc_nolock`, `_fgetwc_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads a character from a stream without locking the thread.

Syntax

```
int _fgetc_nolock(
    FILE *stream
);
wint_t _fgetwc_nolock(
    FILE *stream
);
```

Parameters

`stream`

Pointer to the `FILE` structure.

Return value

See [fgetc](#), [fgetwc](#).

Remarks

`_fgetc_nolock` and `_fgetwc_nolock` are identical to `fgetc` and `fgetwc`, respectively, except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fgettc_nolock</code>	<code>_fgetc_nolock</code>	<code>_fgetc_nolock</code>	<code>_fgetwc_nolock</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>_fgetc_nolock</code>	<code><stdio.h></code>
<code>_fgetwc_nolock</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fgetc_nolock.c
// This program uses getc to read the first
// 80 input characters (or until the end of input)
// and place them into a string named buffer.

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    FILE *stream;
    char buffer[81];
    int i, ch;

    // Open file to read line from:
    if( fopen_s( &stream, "crt_fgetc_nolock.txt", "r" ) != 0 )
        exit( 0 );

    // Read in first 80 characters and place them in "buffer":
    ch = fgetc( stream );
    for( i=0; (i < 80) && (feof( stream ) == 0); i++ )
    {
        buffer[i] = (char)ch;
        ch = _fgetc_nolock( stream );
    }

    // Add null to end string
    buffer[i] = '\0';
    printf( "%s\n", buffer );
    fclose( stream );
}
```

Input: crt_fgetc_nolock.txt

```
Line one.
Line two.
```

Output

```
Line one.
Line two.
```

See also

Stream I/O

[fputc](#) , [fputwc](#)
[getc](#) , [getwc](#)

fgetchar

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `fgetchar` is a deprecated alias for the `_fgetchar` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_fgetchar` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_fgetchar`, `_fgetwchar`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads a character from `stdin`.

Syntax

```
int _fgetchar( void );
wint_t _fgetwchar( void );
```

Return value

`_fgetchar` returns the character read as an `int` or returns `EOF` to indicate an error or end of file. `_fgetwchar` returns, as a `wint_t`, the wide character that corresponds to the character read or returns `WEOF` to indicate an error or end of file. For both functions, use `feof` or `ferror` to distinguish between an error and an end-of-file condition.

Remarks

These functions read a single character from `stdin`. The function then increments the associated file pointer (if defined) to point to the next character. If the stream is at end of file, the end-of-file indicator for the stream is set.

`_fgetchar` is equivalent to `fgetc(stdin)`. It's also equivalent to `getchar`, but implemented only as a function, rather than as a function and a macro. `_fgetwchar` is the wide-character version of `_fgetchar`.

These functions aren't compatible with the ANSI standard.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fgettchar</code>	<code>_fgetchar</code>	<code>_fgetchar</code>	<code>_fgetwchar</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>_fgetchar</code>	<code><stdio.h></code>
<code>_fgetwchar</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console—`stdin`, `stdout`, and `stderr`—must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_fgetchar.c
// This program uses _fgetchar to read the first
// 80 input characters (or until the end of input)
// and place them into a string named buffer.
//

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    char buffer[81];
    int i, ch;

    // Read in first 80 characters and place them in "buffer":
    ch = _fgetchar();
    for( i=0; (i < 80) && ( feof( stdin ) == 0 ); i++ )
    {
        buffer[i] = (char)ch;
        ch = _fgetchar();
    }

    // Add null to end string
    buffer[i] = '\0';
    printf( "%s\n", buffer );
}
```

```
Line one.
Line two.Line one.
Line two.
```

See also

Stream I/O

[fputc](#) , [fputwc](#)
[getc](#) , [getwc](#)

fgetpos

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a stream's file-position indicator.

Syntax

```
int fgetpos(
    FILE *stream,
    fpos_t *pos
);
```

Parameters

`stream`

Target stream.

`pos`

Position-indicator storage.

Return value

If successful, `fgetpos` returns 0. On failure, it returns a nonzero value and sets `errno` to one of the following manifest constants (defined in STDIO.H): `EBADF`, which means the specified stream isn't a valid file pointer or isn't accessible, or `EINVAL`, which means the `stream` value or the value of `pos` is invalid, such as if either is a null pointer. If `stream` or `pos` is a `NULL` pointer, the function invokes the invalid parameter handler, as described in [Parameter validation](#).

Remarks

The `fgetpos` function gets the current value of the `stream` argument's file-position indicator and stores it in the object pointed to by `pos`. The `fsetpos` function can later use information stored in `pos` to reset the `stream` argument's pointer to its position at the time `fgetpos` was called. The `pos` value is stored in an internal format and is intended for use only by `fgetpos` and `fsetpos`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fgetpos</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fgetpos.c
// This program uses fgetpos and fsetpos to
// return to a location in a file.

#include <stdio.h>

int main( void )
{
    FILE *stream;
    fpos_t pos;
    char buffer[20];

    if( fopen_s( &stream, "crt_fgetpos.txt", "rb" ) ) {
        perror( "Trouble opening file" );
        return -1;
    }

    // Read some data and then save the position.
    fread( buffer, sizeof( char ), 8, stream );
    if( fgetpos( stream, &pos ) != 0 ) {
        perror( "fgetpos error" );
        return -1;
    }

    fread( buffer, sizeof( char ), 13, stream );
    printf( "after fgetpos: %.13s\n", buffer );

    // Restore to old position and read data
    if( fsetpos( stream, &pos ) != 0 ) {
        perror( "fsetpos error" );
        return -1;
    }

    fread( buffer, sizeof( char ), 13, stream );
    printf( "after fsetpos: %.13s\n", buffer );
    fclose( stream );
}

```

Input: crt_fgetpos.txt

fgetpos gets a stream's file-position indicator.

Output crt_fgetpos.txt

after fgetpos: gets a stream
 after fsetpos: gets a stream

See also

[Stream I/O](#)

[fsetpos](#)

fgets , fgetws

11/2/2022 • 2 minutes to read • [Edit Online](#)

Get a string from a stream.

Syntax

```
char *fgets(  
    char *str,  
    int numChars,  
    FILE *stream  
>;  
wchar_t *fgetws(  
    wchar_t *str,  
    int numChars,  
    FILE *stream  
>;
```

Parameters

`str`

Storage location for data.

`numChars`

Maximum number of characters to read.

`stream`

Pointer to `FILE` structure.

Return value

Each of these functions returns `str`. `NULL` is returned to indicate an error or an end-of-file condition. Use `feof` or `ferror` to determine whether an error occurred. If `str` or `stream` is a null pointer, or `numChars` is less than or equal to zero, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`.

For more information about return codes, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#).

Remarks

The `fgets` function reads a string from the input `stream` argument and stores it in `str`. `fgets` reads characters from the current stream position to and including the first newline character, to the end of the stream, or until the number of characters read is equal to `numChars` - 1, whichever comes first. The result stored in `str` is appended with a null character. The newline character, if read, is included in the string.

`fgetws` is a wide-character version of `fgets`.

`fgetws` reads the wide-character argument `str` as a multibyte-character string or as a wide-character string when `stream` is opened in text mode or binary mode, respectively. For more information about using text and binary modes in Unicode and multibyte stream-I/O, see [Text and binary mode file I/O](#) and [Unicode stream I/O in text and binary modes](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the](#)

Generic-text routine mappings

<code>_TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fgetts</code>	<code>fgets</code>	<code>fgets</code>	<code>fgetws</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>fgets</code>	<code><stdio.h></code>
<code>fgetws</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fgets.c
// This program uses fgets to display
// the first line from a file.

#include <stdio.h>

int main( void )
{
    FILE *stream;
    char line[100];

    if( fopen_s( &stream, "crt_fgets.txt", "r" ) == 0 )
    {
        if( fgets( line, 100, stream ) == NULL)
            printf( "fgets error\nnumChars" );
        else
            printf( "%s", line);
        fclose( stream );
    }
}
```

Input: `crt_fgets.txt`

```
Line one.
Line two.
```

Output

```
Line one.
```

See also

[Stream I/O](#)

`fputs` , `fputws`

`gets` , `_getws`

`puts` , `_putws`

filelength

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `filelength` is a deprecated alias for the `_filelength` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_filelength` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_filelength`, `_filelengthi64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the length of a file.

Syntax

```
long _filelength(
    int fd
);
__int64 _filelengthi64(
    int fd
);
```

Parameters

`fd`

Target the file descriptor.

Return value

Both `_filelength` and `_filelengthi64` return the file length, in bytes, of the target file associated with `fd`. If `fd` is an invalid file descriptor, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, both functions return -1L to indicate an error and set `errno` to `EBADF`.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_filelength</code>	<io.h>
<code>_filelengthi64</code>	<io.h>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`_chsize`](#).

See also

File handling

`_chsize`
`_fileno`

`_fstat`, `_fstat32`, `_fstat64`, `_fstat64i32`,
`_fstat32i64`, `_fstat64i32`
`_stat`, `_wstat` functions

fileno

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `fileno` is a deprecated alias for the `_fileno` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_fileno` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_fileno

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the file descriptor associated with a stream.

Syntax

```
int _fileno(  
    FILE *stream  
)
```

Parameters

`stream`

Pointer to the `FILE` structure.

Return value

`_fileno` returns the file descriptor. There's no error return. The result is undefined if `stream` doesn't specify an open file. If `stream` is `NULL`, `_fileno` invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function returns -1 and sets `errno` to `EINVAL`.

For more information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

NOTE

If `stdout` or `stderr` is not associated with an output stream (for example, in a Windows application without a console window), the file descriptor returned is -2. In previous versions, the file descriptor returned was -1. This change allows applications to distinguish this condition from an error.

Remarks

The `_fileno` routine returns the file descriptor currently associated with `stream`. This routine is implemented both as a function and as a macro. For information about choosing either implementation, see [Recommendations for choosing between functions and macros](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fileno</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fileno.c
// This program uses _fileno to obtain
// the file descriptor for some standard C streams.
//

#include <stdio.h>

int main( void )
{
    printf( "The file descriptor for stdin is %d\n", _fileno( stdin ) );
    printf( "The file descriptor for stdout is %d\n", _fileno( stdout ) );
    printf( "The file descriptor for stderr is %d\n", _fileno( stderr ) );
}
```

```
The file descriptor for stdin is 0
The file descriptor for stdout is 1
The file descriptor for stderr is 2
```

See also

Stream I/O

[_fdopen](#) , [_wfdopen](#)

[_filelength](#) , [_filelengthi64](#)

[fopen](#) , [_wfopen](#)

[freopen](#) , [_wfreopen](#)

_findclose

11/2/2022 • 2 minutes to read • [Edit Online](#)

Closes the specified search handle and releases associated resources.

Syntax

```
int _findclose(
    intptr_t handle
);
```

Parameters

handle

The search handle returned by a previous call to [_findfirst](#).

Return value

If successful, [_findclose](#) returns 0. Otherwise, it returns -1 and sets [errno](#) to [ENOENT](#), indicating that no more matching files could be found.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
_findclose	<io.h>

For more compatibility information, see [Compatibility](#).

See also

[System calls](#)

[Filename search functions](#)

```
_findfirst, _findfirst32, _findfirst32i64,  
_findfirst64, _findfirst64i32, _findfirsti64,  
_wfindfirst, _wfindfirst32, _wfindfirst32i64,  
_wfindfirst64, _wfindfirst64i32,  
_wfindfirsti64
```

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Provide information about the first instance of a file name that matches the file specified in the `fileSpec` argument.

Syntax

```
intptr_t _findfirst(
    const char *filespec,
    struct _finddata_t *fileinfo
);
intptr_t _findfirst32(
    const char *filespec,
    struct _finddata32_t *fileinfo
);
intptr_t _findfirst64(
    const char *filespec,
    struct _finddata64_t *fileinfo
);
intptr_t _findfirsti64(
    const char *filespec,
    struct _finddatai64_t *fileinfo
);
intptr_t _findfirst32i64(
    const char *filespec,
    struct _finddata32i64_t *fileinfo
);
intptr_t _findfirst64i32(
    const char *filespec,
    struct _finddata64i32_t *fileinfo
);
intptr_t _wfindfirst(
    const wchar_t *filespec,
    struct _wfinddata_t *fileinfo
);
intptr_t _wfindfirst32(
    const wchar_t *filespec,
    struct _wfinddata32_t *fileinfo
);
intptr_t _wfindfirst64(
    const wchar_t *filespec,
    struct _wfinddata64_t *fileinfo
);
intptr_t _wfindfirsti64(
    const wchar_t *filespec,
    struct _wfinddatai64_t *fileinfo
);
intptr_t _wfindfirst32i64(
    const wchar_t *filespec,
    struct _wfinddata32i64_t *fileinfo
);
intptr_t _wfindfirst64i32(
    const wchar_t *filespec,
    struct _wfinddata64i32_t *fileinfo
);
```

Parameters

`filespec`

Target file specification (can include wildcard characters).

`fileinfo`

File information buffer.

Return value

If successful, `_findfirst` returns a unique search handle identifying the file or group of files that match the `filespec` specification, which can be used in a subsequent call to `_findnext` or to `_findclose`. Otherwise, `_findfirst` returns -1 and sets `errno` to one of the following values.

ERRNO VALUE	CONDITION
<code>EINVAL</code>	Invalid parameter: <code>filespec</code> or <code>fileinfo</code> was <code>NULL</code> . Or, the operating system returned an unexpected error.
<code>ENOENT</code>	File specification that couldn't be matched.
<code>ENOMEM</code>	Insufficient memory.
<code>EINVAL</code>	Invalid file name specification or the file name given was larger than <code>MAX_PATH</code> .

For more information about these and other return codes, see [errno](#), [doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

If an invalid parameter is passed in, these functions invoke the invalid parameter handler, as described in [Parameter validation](#).

Remarks

You must call `_findclose` after you're finished with either the `_findfirst` or `_findnext` function (or any variants). `_findclose` frees resources used by these functions in your application.

The variations of these functions that have the `w` prefix are wide-character versions; otherwise, they're identical to the corresponding single-byte functions.

Variations of these functions support 32-bit or 64-bit time types and 32-bit or 64-bit file sizes. The first numeric suffix (`32` or `64`) indicates the size of the time type; the second suffix is either `i32` or `i64`, and indicates whether the file size is represented as a 32-bit or 64-bit integer. For information about which versions support 32-bit and 64-bit time types and file sizes, see the following table. The `i32` or `i64` suffix is omitted if it's the same as the size of the time type, so `_findfirst64` also supports 64-bit file lengths and `_findfirst32` supports only 32-bit file lengths.

These functions use various forms of the `_finddata_t` structure for the `fileinfo` parameter. For more information about the structure, see [Filename search functions](#).

The variations that use a 64-bit time type enable file-creation dates to be expressed up through 23:59:59, December 31, 3000, UTC. The ones that use 32-bit time types represent dates only through 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for all these functions.

Unless you have a specific reason to use the versions that specify the time size explicitly, use `_findfirst` or `_wfindfirst` or, if you need to support file sizes larger than 3 GB, use `_findfirsti64` or `_wfindfirsti64`. All these functions use the 64-bit time type. In earlier versions, these functions used a 32-bit time type. If this change is a breaking change for an application, you might define `_USE_32BIT_TIME_T` to revert to the old behavior. If `_USE_32BIT_TIME_T` is defined, `_findfirst`, `_findfirsti64`, and their corresponding Unicode versions use a 32-bit time.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Time Type and File Length Type Variations of `_findfirst`

FUNCTIONS	_USE_32BIT_TIME_T DEFINED?	TIME TYPE	FILE LENGTH TYPE
<code>_findfirst</code> , <code>_wfindfirst</code>	Not defined	64-bit	32-bit
<code>_findfirst</code> , <code>_wfindfirst</code>	Defined	32-bit	32-bit
<code>_findfirst32</code> , <code>_wfindfirst32</code>	Not affected by the macro definition	32-bit	32-bit
<code>_findfirst64</code> , <code>_wfindfirst64</code>	Not affected by the macro definition	64-bit	64-bit
<code>_findfirsti64</code> , <code>_wfindfirsti64</code>	Not defined	64-bit	64-bit
<code>_findfirsti64</code> , <code>_wfindfirsti64</code>	Defined	32-bit	64-bit
<code>_findfirst32i64</code> , <code>_wfindfirst32i64</code>	Not affected by the macro definition	32-bit	64-bit
<code>_findfirst64i32</code> , <code>_wfindfirst64i32</code>	Not affected by the macro definition	64-bit	32-bit

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tfindfirst</code>	<code>_findfirst</code>	<code>_findfirst</code>	<code>_wfindfirst</code>
<code>_tfindfirst32</code>	<code>_findfirst32</code>	<code>_findfirst32</code>	<code>_wfindfirst32</code>
<code>_tfindfirst64</code>	<code>_findfirst64</code>	<code>_findfirst64</code>	<code>_wfindfirst64</code>
<code>_tfindfirsti64</code>	<code>_findfirsti64</code>	<code>_findfirsti64</code>	<code>_wfindfirsti64</code>
<code>_tfindfirst32i64</code>	<code>_findfirst32i64</code>	<code>_findfirst32i64</code>	<code>_wfindfirst32i64</code>
<code>_tfindfirst64i32</code>	<code>_findfirst64i32</code>	<code>_findfirst64i32</code>	<code>_wfindfirst64i32</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>_findfirst</code>	<code><io.h></code>
<code>_findfirst32</code>	<code><io.h></code>

FUNCTION	REQUIRED HEADER
<code>_findfirst64</code>	<code><io.h></code>
<code>_findfirsti64</code>	<code><io.h></code>
<code>_findfirst32i64</code>	<code><io.h></code>
<code>_findfirst64i32</code>	<code><io.h></code>
<code>_wfindfirst</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindfirst32</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindfirst64</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindfirsti64</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindfirst32i64</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindfirst64i32</code>	<code><io.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[System calls](#)

[Filename search functions](#)

```
_findnext, _findnext32, _findnext32i64,  
_findnext64, _findnext64i32, _findnexti64,  
_wfindnext, _wfindnext32, _wfindnext32i64,  
_wfindnext64, _wfindnext64i32, _wfindnexti64
```

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Find the next name, if any, that matches the `filespec` argument in a previous call to `_findfirst`, and then alter the `fileinfo` structure contents accordingly.

Syntax

```
int _findnext(
    intptr_t handle,
    struct _finddata_t *fileinfo
);
int _findnext32(
    intptr_t handle,
    struct _finddata32_t *fileinfo
);
int _findnext64(
    intptr_t handle,
    struct _finddata64_t *fileinfo
);
int _findnexti64(
    intptr_t handle,
    struct _finddatai64_t *fileinfo
);
int _findnext32i64(
    intptr_t handle,
    struct _finddata32i64_t *fileinfo
);
int _findnext64i32(
    intptr_t handle,
    struct _finddata64i32_t *fileinfo
);
int _wfindnext(
    intptr_t handle,
    struct _wfinddata_t *fileinfo
);
int _wfindnext32(
    intptr_t handle,
    struct _wfinddata32_t *fileinfo
);
int _wfindnext64(
    intptr_t handle,
    struct _wfinddata64_t *fileinfo
);
int _wfindnexti64(
    intptr_t handle,
    struct _wfinddatai64_t *fileinfo
);
int _wfindnext32i64(
    intptr_t handle,
    struct _wfinddata32i64_t *fileinfo
);
int _wfindnext64i32(
    intptr_t handle,
    struct _wfinddata64i32_t *fileinfo
);
```

Parameters

`handle`

The search handle returned by a previous call to `_findfirst`.

`fileinfo`

File information buffer.

Return value

If successful, returns 0. Otherwise, returns -1 and sets `errno` to a value indicating the nature of the failure. Possible error codes are shown in the following table.

ERRNO	VALUE	CONDITION
EINVAL		Invalid parameter: <code>fileinfo</code> was <code>NULL</code> . Or, the operating system returned an unexpected error.
ENOENT		No more matching files could be found.
ENOMEM		Not enough memory or the file name's length exceeded <code>MAX_PATH</code> .

If an invalid parameter is passed in, these functions invoke the invalid parameter handler, as described in [Parameter validation](#).

Remarks

You must call `_findclose` after you're finished using either the `_findfirst` or `_findnext` function (or any variants). `_findclose` frees up resources used by these functions in your application.

The variations of these functions with the `w` prefix are wide-character versions; otherwise, they're identical to the corresponding single-byte functions.

Variations of these functions support 32-bit or 64-bit time types and 32-bit or 64-bit file sizes. The first numerical suffix (`32` or `64`) indicates the size of the time type used; the second suffix is either `i32` or `i64`, indicating whether the file size is represented as a 32-bit or 64-bit integer. For information about which versions support 32-bit and 64-bit time types and file sizes, see the following table. The variations that use a 64-bit time type allow file-creation dates to be expressed up through 23:59:59, December 31, 3000, UTC; whereas those using 32-bit time types only represent dates through 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for all these functions.

Unless you have a specific reason to use the versions that specify the time size explicitly, use `_findnext` or `_wfindnext` or, if you need to support file sizes greater than 3 GB, use `_findnexti64` or `_wfindnexti64`. All these functions use the 64-bit time type. In previous versions, these functions used a 32-bit time type. If this change is a breaking change for an application, you might define `_USE_32BIT_TIME_T` to get the old behavior. If `_USE_32BIT_TIME_T` is defined, `_findnext`, `_findnexti64` and their corresponding Unicode versions use a 32-bit time.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Time Type and File Length Type Variations of `_findnext`

FUNCTIONS	<code>_USE_32BIT_TIME_T</code> DEFINED?	TIME TYPE	FILE LENGTH TYPE
<code>_findnext</code> , <code>_wfindnext</code>	Not defined	64-bit	32-bit
<code>_findnext</code> , <code>_wfindnext</code>	Defined	32-bit	32-bit
<code>_findnext32</code> , <code>_wfindnext32</code>	Not affected by the macro definition	32-bit	32-bit
<code>_findnext64</code> , <code>_wfindnext64</code>	Not affected by the macro definition	64-bit	64-bit

FUNCTIONS	<code>_USE_32BIT_TIME_T</code> DEFINED?	TIME TYPE	FILE LENGTH TYPE
<code>_findnexti64</code> , <code>_wfindnexti64</code>	Not defined	64-bit	64-bit
<code>_findnexti64</code> , <code>_wfindnexti64</code>	Defined	32-bit	64-bit
<code>_findnext32i64</code> , <code>_wfindnext32i64</code>	Not affected by the macro definition	32-bit	64-bit
<code>_findnext64i32</code> , <code>_wfindnext64i32</code>	Not affected by the macro definition	64-bit	32-bit

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfindnext</code>	<code>_findnext</code>	<code>_findnext</code>	<code>_wfindnext</code>
<code>_tfindnext32</code>	<code>_findnext32</code>	<code>_findnext32</code>	<code>_wfindnext32</code>
<code>_tfindnext64</code>	<code>_findnext64</code>	<code>_findnext64</code>	<code>_wfindnext64</code>
<code>_tfindnexti64</code>	<code>_findnexti64</code>	<code>_findnexti64</code>	<code>_wfindnexti64</code>
<code>_tfindnext32i64</code>	<code>_findnext32i64</code>	<code>_findnext32i64</code>	<code>_wfindnext32i64</code>
<code>_tfindnext64i32</code>	<code>_findnext64i32</code>	<code>_findnext64i32</code>	<code>_wfindnext64i32</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>_findnext</code>	<code><io.h></code>
<code>_findnext32</code>	<code><io.h></code>
<code>_findnext64</code>	<code><io.h></code>
<code>_findnexti64</code>	<code><io.h></code>
<code>_findnext32i64</code>	<code><io.h></code>
<code>_findnext64i32</code>	<code><io.h></code>
<code>_wfindnext</code>	<code><io.h> or <wchar.h></code>
<code>_wfindnext32</code>	<code><io.h> or <wchar.h></code>

FUNCTION	REQUIRED HEADER
<code>_wfindnext64</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindnexti64</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindnext32i64</code>	<code><io.h></code> or <code><wchar.h></code>
<code>_wfindnext64i32</code>	<code><io.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[System calls](#)

[Filename search functions](#)

Floating-point primitives

11/2/2022 • 7 minutes to read • [Edit Online](#)

Microsoft-specific primitive functions that are used to implement some standard C runtime library (CRT) floating-point functions. They're documented here for completeness, but aren't recommended for use. Some of these functions are noted as unused, because they're known to have issues in precision, exception handling, and conformance to IEEE-754 behavior. They exist in the library only for backward compatibility. For correct behavior, portability, and adherence to standards, prefer the standard floating-point functions over these functions.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

`_dclass`, `_ldclass`, `_fdclass`

Syntax

```
short __cdecl _dclass(double x);
short __cdecl _ldclass(long double x);
short __cdecl _fdclass(float x);
```

Parameters

`x`

Floating-point function argument.

Remarks

These floating-point primitives implement the C versions of the CRT macro `fpclassify` for floating-point types. The classification of the argument `x` is returned as one of these constants, defined in math.h:

VALUE	DESCRIPTION
<code>FP_NAN</code>	A quiet, signaling, or indeterminate NaN
<code>FP_INFINITE</code>	A positive or negative infinity
<code>FP_NORMAL</code>	A positive or negative normalized non-zero value
<code>FP_SUBNORMAL</code>	A positive or negative subnormal (denormalized) value
<code>FP_ZERO</code>	A positive or negative zero value

For more detail, you can use the Microsoft-specific `_fpclass`, `_fpclassify` functions. Use the `fpclassify` macro or function for portability.

`_dsign`, `_ldsing`, `_fdsign`

Syntax

```
int __cdecl _dsign(double x);
int __cdecl _ldsign(long double x);
int __cdecl _fdsign(float x);
```

Parameters

x

Floating-point function argument.

Remarks

These floating-point primitives implement the `signbit` macro or function in the CRT. They return a non-zero value if the sign bit is set in the significand (mantissa) of the argument x. Otherwise, they return 0 if the sign bit isn't set.

_dpcomp, _ldpcomp, _fdpcomp

Syntax

```
int __cdecl _dpcomp(double x, double y);
int __cdecl _ldpcomp(long double x, long double y);
int __cdecl _fdpcomp(float x, float y);
```

Parameters

x, y

Floating-point function arguments.

Remarks

These floating-point primitives take two arguments, x and y, and return a value that shows their ordering relationship, expressed as the bitwise or of these constants, defined in math.h:

VALUE	DESCRIPTION
<code>_FP_LT</code>	x can be considered less than y
<code>_FP_EQ</code>	x can be considered equal to y
<code>_FP_GT</code>	x can be considered greater than y

These primitives implement the `isgreater`, `isgreaterequal`, `isless`, `islessequal`, `islessgreater`, and `isunordered` macros and functions in the CRT.

_dtest, _ldtest, _fdtest

Syntax

```
short __cdecl _dtest(double* px);
short __cdecl _ldtest(long double* px);
short __cdecl _fdtest(float* px);
```

Parameters

px

Pointer to a floating-point argument.

Remarks

These floating-point primitives implement the C++ versions of the CRT function [fpclassify](#) for floating-point types. The argument x is evaluated and the classification is returned as one of these constants, defined in math.h:

VALUE	DESCRIPTION
FP_NAN	A quiet, signaling, or indeterminate NaN
FP_INFINITE	A positive or negative infinity
FP_NORMAL	A positive or negative normalized non-zero value
FP_SUBNORMAL	A positive or negative subnormal (denormalized) value
FP_ZERO	A positive or negative zero value

For more detail, you can use the Microsoft-specific [_fpclass](#), [_fpclassf](#) functions. Use the [fpclassify](#) function for portability.

_d_int, _ld_int, _fd_int

Syntax

```
short __cdecl _d_int(double* px, short exp);
short __cdecl _ld_int(long double* px, short exp);
short __cdecl _fd_int(float* px, short exp);
```

Parameters

px

Pointer to a floating-point argument.

exp

An exponent as an integral type.

Remarks

These floating-point primitives take a pointer to a floating-point value px and an exponent value exp , and remove the fractional part of the floating-point value below the given exponent, if possible. The value returned is the result of [fpclassify](#) on the input value in px if it's a NaN or infinity, and on the output value in px otherwise.

_dscale, _ldscale, _fdscale

Syntax

```
short __cdecl _dscale(double* px, long exp);
short __cdecl _ldscale(long double* px, long exp);
short __cdecl _fdscale(float* px, long exp);
```

Parameters

px

Pointer to a floating-point argument.

`exp`

An exponent as an integral type.

Remarks

These floating-point primitives take a pointer to a floating-point value `px` and an exponent value `exp`, and scale the value in `px` by 2^{\exp} , if possible. The value returned is the result of `fpclassify` on the input value in `px` if it's a NaN or infinity, and on the output value in `px` otherwise. For portability, prefer the `ldexp`, `ldexpf`, `ldexp1` functions.

_dunscale, _ldunscale, _fdunscale

Syntax

```
short __cdecl _dunscale(short* pexp, double* px);
short __cdecl _ldunscale(short* pexp, long double* px);
short __cdecl _fdunscale(short* pexp, float* px);
```

Parameters

`pexp`

A pointer to an exponent as an integral type.

`px`

Pointer to a floating-point argument.

Remarks

These floating-point primitives break down the floating-point value pointed at by `px` into a significand (mantissa) and an exponent, if possible. The significand is scaled such that the absolute value is greater than or equal to 0.5 and less than 1.0. The exponent is the value `n`, where the original floating-point value is equal to the scaled significand times 2^n . This integer exponent `n` is stored at the location pointed to by `pexp`. The value returned is the result of `fpclassify` on the input value in `px` if it's a NaN or infinity, and on the output value otherwise. For portability, prefer the `frexp`, `frexpf`, `frexpl` functions.

_dexp, _ldexp, _fdexp

Syntax

```
short __cdecl _dexp(double* px, double y, long exp);
short __cdecl _ldexp(long double* px, long double y, long exp);
short __cdecl _fdexp(float* px, float y, long exp);
```

Parameters

`y`

Floating-point function argument.

`px`

Pointer to a floating-point argument.

`exp`

An exponent as an integral type.

Remarks

These floating-point primitives construct a floating-point value in the location pointed at by `px` equal to $y * 2^{\exp}$. The value returned is the result of `fpclassify` on the input value in `y` if it's a NaN or infinity, and on the

output value in `px` otherwise. For portability, prefer the `ldepx`, `ldepxf`, `ldepxl` functions.

_dnorm, _fdnorm

Syntax

```
short __cdecl _dnorm(unsigned short* ps);
short __cdecl _fdnorm(unsigned short* ps);
```

Parameters

`ps`

Pointer to the bitwise representation of a floating-point value expressed as an array of `unsigned short`.

Remarks

These floating-point primitives normalize the fractional part of an underflowed floating-point value and adjust the *characteristic*, or biased exponent, to match. The value is passed as the bitwise representation of the floating-point type converted to an array of `unsigned short` through the `_double_val`, `_ldouble_val`, or `_float_val` type-punning union declared in math.h. The return value is the result of `fpclassify` on the input floating-point value if it's a NaN or infinity, and on the output value otherwise.

_dpoly, _ldpoly, _fdpoly

Syntax

```
double __cdecl _dpoly(double x, double const* table, int n);
long double __cdecl _ldpoly(long double x, long double const* table, int n);
float __cdecl _fdpoly(float x, float const* table, int n);
```

Parameters

`x`

Floating-point function argument.

`table`

Pointer to a table of constant coefficients for a polynomial.

`n`

Order of the polynomial to evaluate.

Remarks

These floating-point primitives return the evaluation of `x` in the polynomial of order `n` whose coefficients are represented by the corresponding constant values in `table`. For example, if `table[0] = 3.0`, `table[1] = 4.0`, `table[2] = 5.0`, and `n = 2`, it represents the polynomial $5.0x^2 + 4.0x + 3.0$. If this polynomial is evaluated for `x` of 2.0, the result is 31.0. These functions aren't used internally.

_dlog, _dlog, _dlog

Syntax

```
double __cdecl _dlog(double x, int base_flag);
long double __cdecl _ldlog(long double x, int base_flag);
float __cdecl _fdlog(float x, int base_flag);
```

Parameters

x

Floating-point function argument.

base_flag

Flag that controls the base to use, 0 for base e and non-zero for base 10.

Remarks

These floating-point primitives return the natural log of x (ln(x) or $\log_e(x)$), when base_flag is 0. They return the log base 10 of x, or $\log_{10}(x)$, when base_flag is non-zero. These functions aren't used internally. For portability, prefer the functions [log](#), [logf](#), [logl](#), [log10](#), [log10f](#), and [log10l](#).

_dsin, _ldsin, _fdsin

Syntax

```
double __cdecl _dsin(double x, unsigned int quadrant);
long double __cdecl _ldsin(long double x, unsigned int quadrant);
float __cdecl _fdsin(float x, unsigned int quadrant);
```

Parameters

x

Floating-point function argument.

quadrant

Quadrant offset of 0, 1, 2, or 3 to use to produce [sin](#), [cos](#), [-sin](#), and [-cos](#) results.

Remarks

These floating-point primitives return the sine of x offset by the quadrant modulo 4. Effectively, they return the sine, cosine, -sine, and -cosine of x when quadrant modulo 4 is 0, 1, 2, or 3, respectively. These functions aren't used internally. For portability, prefer the [sin](#), [sinf](#), [sinl](#), [cos](#), [cosf](#), [cosl](#) functions.

Requirements

Header: <math.h>

For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

[fpclassify](#)

[_fpclass](#), [_fpclassf](#)

[isfinite](#), [_finite](#), [_finitef](#)

[isinf](#)

[isnan](#), [_isnan](#), [_isnanf](#)

[isnormal](#)

[cos](#), [cosf](#), [cosl](#)

[frexp](#), [frexpf](#), [frexpl](#)

[ldexp](#), [ldexpf](#), [ldexpl](#)

[log](#), [logf](#), [logl](#), [log10](#), [log10f](#), [log10l](#)

[sin](#), [sinf](#), [sinl](#)

`floor`, `floorf`, `floorl`

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Calculates the floor of a value.

Syntax

```
double floor(
    double x
);
float floor(
    float x
); // C++ only
long double floor(
    long double x
); // C++ only
float floorf(
    float x
);
long double floorl(
    long double x
);
#define floor(X) // Requires C11 or higher
```

Parameters

`x`

Floating-point value.

Return value

The `floor` functions return a floating-point value that represents the largest integer that is less than or equal to `x`. There's no error return.

INPUT	SEH EXCEPTION	<code>_MATHERR</code> EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

`floor` has an implementation that uses Streaming SIMD Extensions 2 (SSE2). For information and restrictions about using the SSE2 implementation, see [`_set_SSE2_enable`](#).

Remarks

C++ allows overloading, so you can call overloads of `floor` that take and return `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `floor` always takes and returns a `double`.

If you use the `<tgmath.h>` `floor()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>floor</code> , <code>floorf</code> , <code>floorl</code>	<code><math.h></code>
<code>floor</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_floor.c
// This example displays the largest integers
// less than or equal to the floating-point values 2.8
// and -2.8. It then shows the smallest integers greater
// than or equal to 2.8 and -2.8.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double y;

    y = floor( 2.8 );
    printf( "The floor of 2.8 is %f\n", y );
    y = floor( -2.8 );
    printf( "The floor of -2.8 is %f\n", y );

    y = ceil( 2.8 );
    printf( "The ceil of 2.8 is %f\n", y );
    y = ceil( -2.8 );
    printf( "The ceil of -2.8 is %f\n", y );
}
```

```
The floor of 2.8 is 2.000000
The floor of -2.8 is -3.000000
The ceil of 2.8 is 3.000000
The ceil of -2.8 is -2.000000
```

See also

[Math and floating-point support](#)

[`ceil`](#), [`ceilf`](#), [`ceill`](#)
[`round`](#), [`roundf`](#), [`roundl`](#)
[`fmod`](#), [`fmodf`](#)

flushall

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The Microsoft-specific function name `flushall` is a deprecated alias for the `_flushall` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_flushall` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_flushall

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Flushes all streams; clears all buffers.

Syntax

```
int _flushall( void );
```

Return value

`_flushall` returns the number of open streams (input and output). There's no error return.

Remarks

By default, the `_flushall` function writes to appropriate files the contents of all buffers associated with open output streams. All buffers associated with open input streams are cleared of their current contents. (These buffers are normally maintained by the operating system, which determines the optimal time to write the data automatically to disk: when a buffer is full, when a stream is closed, or when a program terminates normally without closing streams.)

If a read follows a call to `_flushall`, new data is read from the input files into the buffers. All streams remain open after the call to `_flushall`.

The commit-to-disk feature of the run-time library lets you ensure that critical data is written directly to disk rather than to the operating system buffers. Without rewriting an existing program, you can enable this feature by linking the program's object files with `Commode.obj`. In the resulting executable file, calls to `_flushall` write the contents of all buffers to disk. Only `_flushall` and `fflush` are affected by `Commode.obj`.

For information about controlling the commit-to-disk feature, see [Stream I/O](#), `fopen`, and `_fdopen`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_flushall</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_flushall.c
// This program uses _flushall
// to flush all open buffers.

#include <stdio.h>

int main( void )
{
    int numflushed;

    numflushed = _flushall();
    printf( "There were %d streams flushed\n", numflushed );
}
```

```
There were 3 streams flushed
```

See also

Stream I/O

[_commit](#)
[fclose](#) , [_fcloseall](#)
[fflush](#)
[setvbuf](#)

fma , fmaf , fmwl

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Multiples two values together, adds a third value, and then rounds the result, without losing any precision due to intermediary rounding.

Syntax

```
double fma(
    double x,
    double y,
    double z
);

float fma(
    float x,
    float y,
    float z
); //C++ only

long double fmwl(
    long double x,
    long double y,
    long double z
); //C++ only

float fmaf(
    float x,
    float y,
    float z
);

long double fmwl(
    long double x,
    long double y,
    long double z
);

#define fma(X, Y, Z) // Requires C11 or higher
```

Parameters

x

The first value to multiply.

y

The second value to multiply.

z

The value to add.

Return value

Returns $(x * y) + z$. The return value is then rounded using the current rounding format.

Otherwise, may return one of the following values:

ISSUE	RETURN
$x = \text{INFINITY}$, $y = 0$ or $x = 0$, $y = \text{INFINITY}$	NaN
x or y = exact $\pm \text{INFINITY}$, $z = \text{INFINITY}$ with the opposite sign	NaN
x or y = NaN	NaN
not ($x = 0$, y = indefinite) and $z = \text{NaN}$	NaN
not (x = indefinite, $y = 0$) and $z = \text{NaN}$	
Overflow range error	$\pm \text{HUGE_VAL}$, $\pm \text{HUGE_VALF}$, or $\pm \text{HUGE_VALL}$
Underflow range error	correct value, after rounding.

Errors are reported as specified in [_matherr](#).

Remarks

Because C++ allows overloading, you can call overloads of `fma` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `fma` always takes and returns a `double`.

If you use the `<tgmath.h>` `fma()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

This function computes the value as though it were taken to infinite precision, and then rounds the final result.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fma</code> , <code>fmaf</code> , <code>fmal</code>	<code><math.h></code>	<code><cmath></code>
<code>fma</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`remainder`, `remainderf`, `remainderl`
`remquo`, `remquof`, `remquol`

`fmax`, `fmaxf`, `fmaxl`

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Determine the larger of two specified numeric values.

Syntax

```
double fmax(
    double x,
    double y
);

float fmax(
    float x,
    float y
); //C++ only

long double fmax(
    long double x,
    long double y
); //C++ only

float fmaxf(
    float x,
    float y
);

long double fmaxl(
    long double x,
    long double y
);

#define fmax(X, Y) // Requires C11 or higher
```

Parameters

`x`

The first value to compare.

`y`

The second value to compare.

Return value

If successful, returns the larger of `x` or `y`. The value returned is exact, and doesn't depend on any form of rounding.

Otherwise, may return one of the following values:

ISSUE	RETURN
<code>x</code> = NaN	<code>y</code>
<code>y</code> = NaN	<code>x</code>

ISSUE	RETURN
<code>x</code> and <code>y</code> = NaN	NaN

This function doesn't use the errors specified in [_matherr](#).

Remarks

Because C++ allows overloading, you can call overloads of `fmax` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `fmax` always takes and returns a double.

If you use the `<tgmath.h>` `fmax()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>fmax</code> , <code>fmaxf</code> , <code>fmaxl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>fmax</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`fmin`, `fminf`, `fminl`

`fmin`, `fminf`, `fminl`

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Determines the smaller of the two specified values.

Syntax

```
double fmin(
    double x,
    double y
);

float fmin(
    float x,
    float y
); //C++ only

long double fmin(
    long double x,
    long double y
); //C++ only

float fminf(
    float x,
    float y
);

long double fminl(
    long double x,
    long double y
);

#define fmin(x) // Requires C11 or higher
```

Parameters

`x`

The first value to compare.

`y`

The second value to compare.

Return value

If successful, returns the smaller of `x` or `y`.

INPUT	RESULT
<code>x</code> is NaN	<code>y</code>
<code>y</code> is NaN	<code>x</code>
<code>x</code> and <code>y</code> are NaN	NaN

The function doesn't cause `_matherr` to be invoked, cause any floating-point exceptions, or change the value of

`errno`.

Remarks

Because C++ allows overloading, you can call overloads of `fmin` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `fmin` always takes and returns a `double`.

If you use the `<tgmath.h>` `fmin()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Requirements

ROUTINE	REQUIRED HEADER
<code>fmin</code> , <code>fminf</code> , <code>fminl</code>	C: <code><math.h></code> C++: <code><math.h></code> or <code><cmath></code>
<code>fmin</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`fmax`, `fmaxf`, `fmaxl`

`fmod`, `fmodf`, `fmodl`

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Calculates the floating-point remainder.

Syntax

```
double fmod(
    double x,
    double y
);
float fmod(
    float x,
    float y
); // C++ only
long double fmod(
    long double x,
    long double y
); // C++ only
float fmodf(
    float x,
    float y
);
long double fmodl(
    long double x,
    long double y
);

#define fmod(X, Y) // Requires C11 or higher
```

Parameters

`x`, `y`

Floating-point values.

Return value

`fmod` returns the floating-point remainder of x / y . If the value of `y` is 0.0, `fmod` returns a quiet `Nan`. For information about representation of a quiet `Nan` by the `printf` family, see `printf`.

Remarks

The `fmod` function calculates the floating-point remainder `f` of x / y such that $x = i * y + f$, where `i` is an integer, `f` has the same sign as `x`, and the absolute value of `f` is less than the absolute value of `y`.

C++ allows overloading, so you can call overloads of `fmod` that take and return `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `fmod` always takes two `double` arguments and returns a `double`.

If you use the `fmod` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fmod</code> , <code>fmodf</code> , <code>fmodl</code>	<code><math.h></code>
<code>fmod</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fmod.c
// This program displays a floating-point remainder.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double w = -10.0, x = 3.0, z;

    z = fmod( w, x );
    printf( "The remainder of %.2f / %.2f is %f\n", w, x, z );
}
```

```
The remainder of -10.00 / 3.00 is -1.000000
```

See also

Math and floating-point support

`ceil`, `ceilf`, `ceill`
`fabs`, `fabsf`, `fabsl`
`floor`, `floorf`, `floorl`
`_CIfmod`

`fopen`, `_wfopen`

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Opens a file. More-secure versions of these functions that perform more parameter validation and return error codes are available; see [`fopen_s`](#), [`_wfopen_s`](#).

Syntax

```
FILE *fopen(
    const char *filename,
    const char *mode
);
FILE *_wfopen(
    const wchar_t *filename,
    const wchar_t *mode
);
```

Parameters

`filename`

File name.

`mode`

Kind of access that's enabled.

Return value

Each of these functions returns a pointer to the open file. A null pointer value indicates an error. If `filename` or `mode` is `NULL` or an empty string, these functions trigger the invalid parameter handler, which is described in [Parameter validation](#). If execution is allowed to continue, these functions return `NULL` and set `errno` to `EINVAL`.

For more information, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#).

Remarks

The `fopen` function opens the file that is specified by `filename`. By default, a narrow `filename` string is interpreted using the ANSI codepage (`CP_ACP`). In Windows Desktop applications, it can be changed to the OEM codepage (`CP_OEMCP`) by using the `SetFileApisToOEM` function. You can use the `AreFileApisANSI` function to determine whether `filename` is interpreted using the ANSI or the system default OEM codepage. `_wfopen` is a wide-character version of `fopen`; the `_wfopen` arguments are wide-character strings. Otherwise, `_wfopen` and `fopen` behave identically. Just using `_wfopen` doesn't affect the coded character set that's used in the file stream.

`fopen` accepts paths that are valid on the file system at the point of execution; `fopen` accepts UNC paths and paths that involve mapped network drives as long as the system that executes the code has access to the share or mapped drive at the time of execution. When you construct paths for `fopen`, make sure that drives, paths, or network shares will be available in the execution environment. You can use either forward slashes (`/`) or backslashes (`\`) as the directory separators in a path.

Always check the return value to see whether the pointer is `NULL` before you perform any other operations on the file. If an error occurs, the global variable `errno` is set, and may be used to obtain specific error information.

For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

Unicode support

`fopen` supports Unicode file streams. To open a Unicode file, pass a `ccs=encoding` flag that specifies the desired encoding to `fopen`, as follows.

```
FILE *fp = fopen("newfile.txt", "rt+", ccs=UTF-8");
```

Allowed values for `ccs` encoding are `UNICODE`, `UTF-8`, and `UTF-16LE`.

When a file is opened in Unicode mode, input functions translate the data that's read from the file into UTF-16 data stored as type `wchar_t`. Functions that write to a file opened in Unicode mode expect buffers that contain UTF-16 data stored as type `wchar_t`. If the file is encoded as UTF-8, then UTF-16 data is translated into UTF-8 when it's written. The file's UTF-8-encoded content is translated into UTF-16 when it's read. An attempt to read or write an odd number of bytes in Unicode mode causes a [parameter validation](#) error. To read or write data that's stored in your program as UTF-8, use a text or binary file mode instead of a Unicode mode. You're responsible for any required encoding translation.

If the file already exists and is opened for reading or appending, then any byte order mark (BOM) in the file determines the encoding. The BOM encoding takes precedence over the encoding that's specified by the `ccs` flag. The `ccs` encoding is only used when no BOM is present or the file is a new file.

NOTE

BOM detection only applies to files that are opened in Unicode mode (that is, by passing the `ccs` flag).

The following table summarizes the modes that are used for various `ccs` flags given to `fopen` and Byte Order Marks in the file.

Encodings used based on ccs flag and BOM

CCS FLAG	NO BOM (OR NEW FILE)	BOM: UTF-8	BOM: UTF-16
<code>UNICODE</code>	<code>UTF-16LE</code>	<code>UTF-8</code>	<code>UTF-16LE</code>
<code>UTF-8</code>	<code>UTF-8</code>	<code>UTF-8</code>	<code>UTF-16LE</code>
<code>UTF-16LE</code>	<code>UTF-16LE</code>	<code>UTF-8</code>	<code>UTF-16LE</code>

Files opened for writing in Unicode mode have a BOM written to them automatically.

If `mode` is `a`, `ccs=encoding` for some `encoding` value, `fopen` first tries to open the file by using both read and write access. If this action succeeds, the function reads the BOM to determine the encoding for the file. If it fails, the function uses the default encoding for the file. In either case, `fopen` will then reopen the file by using write-only access. (This behavior applies to `"a"` mode only, not to `"a+"` mode.)

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfopen</code>	<code>fopen</code>	<code>fopen</code>	<code>_wfopen</code>

The character string `mode` specifies the kind of access that is requested for the file, as follows.

MODE	ACCESS
<code>"r"</code>	Opens for reading. If the file doesn't exist or can't be found, the <code>fopen</code> call fails.
<code>"w"</code>	Opens an empty file for writing. If the given file exists, its contents are destroyed.
<code>"a"</code>	Opens for writing at the end of the file (appending) without removing the end-of-file (EOF) marker before new data is written to the file. Creates the file if it doesn't exist.
<code>"r+"</code>	Opens for both reading and writing. The file must exist.
<code>"w+"</code>	Opens an empty file for both reading and writing. If the file exists, its contents are destroyed.
<code>"a+"</code>	Opens for reading and appending. The appending operation includes the removal of the EOF marker before new data is written to the file. The EOF marker isn't restored after writing is completed. Creates the file if it doesn't exist.

When a file is opened by using the `"a"` access type or the `"a+"` access type, all write operations occur at the end of the file. The file pointer can be repositioned by using `fseek` or `rewind`, but is always moved back to the end of the file before any write operation is performed. Therefore, existing data can't be overwritten.

The `"a"` mode doesn't remove the EOF marker before it appends to the file. After appending has occurred, the MS-DOS TYPE command only shows data up to the original EOF marker and not any data appended to the file. Before it appends to the file, the `"a+"` mode does remove the EOF marker. After appending, the MS-DOS TYPE command shows all data in the file. The `"a+"` mode is required for appending to a stream file that is terminated with the `CTRL +Z` EOF marker.

When the `"r+"`, `"w+"`, or `"a+"` access type is specified, both reading and writing are enabled (the file is said to be open for "update"). However, when you switch from reading to writing, the input operation must encounter an EOF marker. If there's no EOF, you must use an intervening call to a file positioning function. The file positioning functions are `fsetpos`, `fseek`, and `rewind`. When you switch from writing to reading, you must use an intervening call to either `fflush` or to a file positioning function.

In addition to the earlier values, the following characters can be appended to `mode` to specify the translation mode for newline characters.

MODE MODIFIER	TRANSLATION MODE
<code>t</code>	Open in text (translated) mode.
<code>b</code>	Open in binary (untranslated) mode; translations involving carriage-return and line feed characters are suppressed.

In text mode, `CTRL +Z` is interpreted as an EOF character on input. In files that are opened for reading/writing by using `"a+"`, `fopen` checks for a `CTRL +Z` at the end of the file and removes it, if it's possible. It's removed because using `fseek` and `ftell` to move within a file that ends with `CTRL +Z` may cause `fseek` to behave incorrectly near the end of the file.

In text mode, carriage return-line feed (CRLF) combinations are translated into single line feed (LF) characters on input, and LF characters are translated to CRLF combinations on output. When a Unicode stream-I/O function operates in text mode (the default), the source or destination stream is assumed to be a sequence of multibyte characters. Therefore, the Unicode stream-input functions convert multibyte characters to wide characters (as if by a call to the `mbtowc` function). For the same reason, the Unicode stream-output functions convert wide characters to multibyte characters (as if by a call to the `wctomb` function).

If `t` or `b` isn't given in `mode`, the default translation mode is defined by the global variable `_fmode`. If `t` or `b` is prefixed to the argument, the function fails and returns `NULL`.

For more information about how to use text and binary modes in Unicode and multibyte stream-I/O, see [Text and binary mode file I/O](#) and [Unicode stream I/O in text and binary modes](#).

The following options can be appended to `mode` to specify more behaviors.

MODE MODIFIER	BEHAVIOR
<code>x</code>	Forces the function to fail if <code>filename</code> already exists. Can only be used with the "w" or "w+" specifiers.
<code>c</code>	Enable the commit flag for the associated <code>filename</code> so that the contents of the file buffer are written directly to disk if either <code>fflush</code> or <code>_flushall</code> is called.
<code>n</code>	Reset the commit flag for the associated <code>filename</code> to "no-commit." This flag is the default. It also overrides the global commit flag if you link your program with COMMODE.OBJ. The global commit flag default is "no-commit" unless you explicitly link your program with COMMODE.OBJ (see Link options).
<code>N</code>	Specifies that the file isn't inherited by child processes.
<code>S</code>	Specifies that caching is optimized for, but not restricted to, sequential access from disk.
<code>R</code>	Specifies that caching is optimized for, but not restricted to, random access from disk.
<code>T</code>	Specifies a file as temporary. If possible, it isn't flushed to disk.
<code>D</code>	Specifies a file as temporary. It's deleted when the last file pointer is closed.
<code>ccs=encoding</code>	Specifies the encoded character set to use (one of <code>UTF-8</code> , <code>UTF-16LE</code> , or <code>UNICODE</code>) for this file. Leave unspecified if you want ANSI encoding.

Valid characters for the `mode` string that is used in `fopen` and `_fdopen` correspond to `oflag` arguments that are used in `_open` and `_sopen`, as follows.

CHARACTERS IN MODE STRING	EQUIVALENT OFLAG VALUE FOR _OPEN / _SOPEN
---------------------------	---

CHARACTERS IN MODE STRING	EQUIVALENT OFLAG VALUE FOR _OPEN / _SOPEN
a	_O_WRONLY _O_APPEND (usually _O_WRONLY _O_CREAT _O_APPEND)
a+	_O_RDWR _O_APPEND (usually _O_RDWR _O_APPEND _O_CREAT)
r	_O_RDONLY
r+	_O_RDWR
w	_O_WRONLY (usually _O_WRONLY _O_CREAT _O_TRUNC)
w+	_O_RDWR (usually _O_RDWR _O_CREAT _O_TRUNC)
b	_O_BINARY
t	_O_TEXT
x	_O_EXCL
c	None
n	None
s	_O_SEQUENTIAL
R	_O_RANDOM
T	_O_SHORTLIVED
D	_O_TEMPORARY
ccs=UNICODE	_O_WTEXT
* ccs=UTF-8*	_O_UTF8
ccs=UTF-16LE	_O_UTF16

If you're using `rb` mode, you don't have to port your code, and if you expect to read most of a large file or aren't concerned about network performance, you might also consider whether to use memory mapped Win32 files as an option.

Requirements

FUNCTION	REQUIRED HEADER
<code>fopen</code>	<code><stdio.h></code>

FUNCTION	REQUIRED HEADER
<code>_wfopen</code>	<code><stdio.h></code> or <code><wchar.h></code>

`_wfopen` is a Microsoft extension. For more information about compatibility, see [Compatibility](#).

The `c`, `n`, `t`, `S`, `R`, `T`, and `D` `mode` options are Microsoft extensions for `fopen` and `_fdopen` and shouldn't be used where ANSI portability is desired.

Example 1

The following program opens two files. It uses `fclose` to close the first file and `_fcloseall` to close all remaining files.

```
// crt_fopen.c
// compile with: /W3
// This program opens two files. It uses
// fclose to close the first file and
// _fcloseall to close all remaining files.

#include <stdio.h>

FILE *stream, *stream2;

int main( void )
{
    int numclosed;

    // Open for read (will fail if file "crt_fopen.c" does not exist)
    if( (stream = fopen( "crt_fopen.c", "r" )) == NULL ) // C4996
        // Note: fopen is deprecated; consider using fopen_s instead
        printf( "The file 'crt_fopen.c' was not opened\n" );
    else
        printf( "The file 'crt_fopen.c' was opened\n" );

    // Open for write
    if( (stream2 = fopen( "data2", "w+" )) == NULL ) // C4996
        printf( "The file 'data2' was not opened\n" );
    else
        printf( "The file 'data2' was opened\n" );

    // Close stream if it is not NULL
    if( stream )
    {
        if ( fclose( stream ) )
        {
            printf( "The file 'crt_fopen.c' was not closed\n" );
        }
    }

    // All other files are closed:
    numclosed = _fcloseall( );
    printf( "Number of files closed by _fcloseall: %u\n", numclosed );
}
```

```
The file 'crt_fopen.c' was opened
The file 'data2' was opened
Number of files closed by _fcloseall: 1
```

Example 2

The following program creates a file (or overwrites one if it exists), in text mode that has Unicode encoding. It then writes two strings into the file and closes the file. The output is a file named `_wfopen_test.xml`, which contains the data from the output section.

```
// crt_wfopen.c
// compile with: /W3
// This program creates a file (or overwrites one if
// it exists), in text mode using Unicode encoding.
// It then writes two strings into the file
// and then closes the file.

#include <stdio.h>
#include <stddef.h>
#include <stdlib.h>
#include <wchar.h>

#define BUFFER_SIZE 50

int main(int argc, char** argv)
{
    wchar_t str[BUFFER_SIZE];
    size_t strSize;
    FILE* fileHandle;

    // Create an the xml file in text and Unicode encoding mode.
    if ((fileHandle = _wfopen( L"_wfopen_test.xml",L"wt+,ccs=UNICODE")) == NULL) // C4996
    // Note: _wfopen is deprecated; consider using _wfopen_s instead
    {
        wprintf(L"_wfopen failed!\n");
        return(0);
    }

    // Write a string into the file.
    wcscpy_s(str, sizeof(str)/sizeof(wchar_t), L"<xmlTag>\n");
    strSize = wcslen(str);
    if (fwrite(str, sizeof(wchar_t), strSize, fileHandle) != strSize)
    {
        wprintf(L"fwrite failed!\n");
    }

    // Write a string into the file.
    wcscpy_s(str, sizeof(str)/sizeof(wchar_t), L"</xmlTag>");
    strSize = wcslen(str);
    if (fwrite(str, sizeof(wchar_t), strSize, fileHandle) != strSize)
    {
        wprintf(L"fwrite failed!\n");
    }

    // Close the file.
    if (fclose(fileHandle))
    {
        wprintf(L"fclose failed!\n");
    }
    return 0;
}
```

See also

[Stream I/O](#)

[Interpretation of multibyte-character sequences](#)

[fclose](#) , [_fcloseall](#)
[_fdopen](#) , [_wfdopen](#)
[ferror](#)

[_fileno](#)

[freopen](#) , [_wfreopen](#)

[_open](#) , [_wopen](#)

[_setmode](#)

[_sopen](#) , [_wsopen](#)

`fopen_s`, `_wfopen_s`

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Opens a file. These versions of `fopen`, `_wfopen` have security enhancements, as described in [Security features in the CRT](#).

Syntax

```
errno_t fopen_s(
    FILE** pFile,
    const char *filename,
    const char *mode
);
errno_t _wfopen_s(
    FILE** pFile,
    const wchar_t *filename,
    const wchar_t *mode
);
```

Parameters

`pFile`

A pointer to the file pointer that will receive the pointer to the opened file.

`filename`

Filename.

`mode`

Type of access permitted.

Return value

Zero if successful; an error code on failure. For more information about these error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Error conditions

<code>PFILE</code>	<code>FILENAME</code>	<code>MODE</code>	RETURN VALUE	CONTENTS OF <code>PFILE</code>
<code>NULL</code>	any	any	<code>EINVAL</code>	unchanged
any	<code>NULL</code>	any	<code>EINVAL</code>	unchanged
any	any	<code>NULL</code>	<code>EINVAL</code>	unchanged

Remarks

The `fopen_s` and `_wfopen_s` functions can't open a file for sharing. If you need to share the file, use `_fsopen` or `_wfsopen` with the appropriate sharing mode constant—for example, use `_SH_DENYNO` for read/write sharing.

The `fopen_s` function opens the file that's specified by `filename`. `_wfopen_s` is a wide-character version of `fopen_s`; the arguments to `_wfopen_s` are wide-character strings. `_wfopen_s` and `fopen_s` behave identically

otherwise.

`fopen_s` accepts paths that are valid on the file system at the point of execution; UNC paths and paths that involve mapped network drives are accepted by `fopen_s` as long as the system that's executing the code has access to the share or mapped network drive at the time of execution. When you construct paths for `fopen_s`, don't make assumptions about the availability of drives, paths, or network shares in the execution environment. You can use either forward slashes (/) or backslashes (\) as the directory separators in a path.

These functions validate their parameters. If `pFile`, `filename`, or `mode` is a null pointer, these functions generate an invalid parameter exception, as described in [Parameter validation](#).

Always check the return value to see if the function succeeded before you do any further operations on the file. If an error occurs, the error code is returned, and the global variable `errno` is set. For more information, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

Unicode support

`fopen_s` supports Unicode file streams. To open a new or existing Unicode file, pass a `ccs` flag that specifies the desired encoding to `fopen_s`, for example:

```
fopen_s(&fp, "newfile.txt", "w+", ccs=UNICODE");
```

Allowed values of the `ccs` flag are `UNICODE`, `UTF-8`, and `UTF-16LE`. If no value is specified for `ccs`, `fopen_s` uses ANSI encoding.

If the file already exists and is opened for reading or appending, the byte order mark (BOM), if present in the file, determines the encoding. The BOM encoding takes precedence over the encoding that's specified by the `ccs` flag. The `ccs` encoding is only used when no BOM is present or if the file is a new file.

NOTE

BOM-detection only applies to files that are opened in Unicode mode; that is, by passing the `ccs` flag.

The following table summarizes the modes for various `ccs` flag values that are given to `fopen_s` and for BOMs in the file.

Encodings used based on `ccs` flag and BOM

<code>CCS</code> FLAG	NO BOM (OR NEW FILE)	BOM: UTF-8	BOM: UTF-16
<code>UNICODE</code>	<code>UTF-8</code>	<code>UTF-8</code>	<code>UTF-16LE</code>
<code>UTF-8</code>	<code>UTF-8</code>	<code>UTF-8</code>	<code>UTF-16LE</code>
<code>UTF-16LE</code>	<code>UTF-16LE</code>	<code>UTF-8</code>	<code>UTF-16LE</code>

Files that are opened for writing in Unicode mode have a BOM written to them automatically.

If `mode` is `"a, ccs=UNICODE"`, `"a, ccs=UTF-8"`, or `"a, ccs=UTF-16LE"`, `fopen_s` first tries to open the file with both read access and write access. If successful, the function reads the BOM to determine the encoding for the file; if unsuccessful, the function uses the default encoding for the file. In either case, `fopen_s` then reopens the file with write-only access. (This behavior applies to `a` mode only, not `a+`.)

The character string `mode` specifies the kind of access that's requested for the file, as follows.

MODE	ACCESS
"r"	Opens for reading. If the file doesn't exist or can't be found, the <code>fopen_s</code> call fails.
"w"	Opens an empty file for writing. If the given file exists, its contents are destroyed.
"a"	Opens for writing at the end of the file (appending) without removing the end-of-file (EOF) marker before new data is written to the file. Creates the file if it doesn't exist.
"r+"	Opens for both reading and writing. The file must exist.
"w+"	Opens an empty file for both reading and writing. If the file exists, its contents are destroyed.
"a+"	Opens for reading and appending. The appending operation includes the removal of the EOF marker before new data is written to the file. The EOF marker isn't restored after writing is completed. Creates the file if it doesn't exist.

When a file is opened by using the "a" or "a+" access type, all write operations occur at the end of the file. The file pointer can be repositioned by using `fseek` or `rewind`, but it's always moved back to the end of the file before any write operation is carried out so that existing data can't be overwritten.

The "a" mode doesn't remove the EOF marker before appending to the file. After appending has occurred, the MS-DOS `TYPE` command only shows data up to the original EOF marker and not any data that's appended to the file. The "a+" mode does remove the EOF marker before appending to the file. After appending, the MS-DOS `TYPE` command shows all data in the file. The "a+" mode is required for appending to a stream file that is terminated with the `CTRL +Z` EOF marker.

When the "r+", "w+", or "a+" access type is specified, both reading and writing are allowed. (The file is said to be open for "update".) However, when you switch from reading to writing, the input operation must come across an EOF marker. If there's no EOF marker, you must use an intervening call to a file-positioning function. The file-positioning functions are `fsetpos`, `fseek`, and `rewind`. When you switch from writing to reading, you must use an intervening call to either `fflush` or to a file-positioning function.

Starting in C11, you can append "x" to "w" or "w+" to cause the function fail if the file exists, instead of overwriting it.

In addition to the values above, the following characters can be included in `mode` to specify the translation mode for newline characters:

MODE MODIFIER	TRANSLATION MODE
t	Open in text (translated) mode.
b	Open in binary (untranslated) mode; translations involving carriage-return and line feed characters are suppressed.

In text (translated) mode, `CTRL +Z` is interpreted as an end-of-file character on input. In files opened for reading/writing with "a+", `fopen_s` checks for a `CTRL +Z` at the end of the file and removes it, if possible. It's removed because using `fseek` and `ftell` to move within a file that ends with a `CTRL +Z`, may cause `fseek` to behave improperly near the end of the file.

Also, in text mode, carriage return/line feed (CRLF) combinations are translated into single line feed (LF) characters on input, and LF characters are translated to CRLF combinations on output. When a Unicode stream-I/O function operates in text mode (the default), the source or destination stream is assumed to be a sequence of multibyte characters. The Unicode stream-input functions convert multibyte characters to wide characters (as if by a call to the `mbtowc` function). For the same reason, the Unicode stream-output functions convert wide characters to multibyte characters (as if by a call to the `wctomb` function).

If `t` or `b` isn't given in `mode`, the default translation mode is defined by the global variable `_fmode`. If `t` or `b` is prefixed to the argument, the function fails and returns `NULL`.

For more information about using text and binary modes in Unicode and multibyte stream-I/O, see [Text and binary mode file I/O](#) and [Unicode stream I/O in text and binary modes](#).

MODE MODIFIER	BEHAVIOR
<code>c</code>	Enable the commit flag for the associated <code>filename</code> so that the contents of the file buffer are written directly to disk if either <code>fflush</code> or <code>_flushall</code> is called.
<code>n</code>	Reset the commit flag for the associated <code>filename</code> to "no-commit." This flag is the default. It also overrides the global commit flag if you link your program with <code>COMMODE.OBJ</code> . The global commit flag default is "no-commit" unless you explicitly link your program with <code>COMMODE.OBJ</code> (see Link options).
<code>N</code>	Specifies that the file isn't inherited by child processes.
<code>S</code>	Specifies that caching is optimized for, but not restricted to, sequential access from disk.
<code>R</code>	Specifies that caching is optimized for, but not restricted to, random access from disk.
<code>t</code>	Specifies a file as temporary. If possible, it isn't flushed to disk.
<code>D</code>	Specifies a file as temporary. It's deleted when the last file pointer is closed.
<code>ccs=UNICODE</code>	Specifies UNICODE as the encoded character set to use for this file. Leave unspecified if you want ANSI encoding.
<code>ccs=UTF-8</code>	Specifies UTF-8 as the encoded character set to use for this file. Leave unspecified if you want ANSI encoding.
<code>ccs=UTF-16LE</code>	Specifies UTF-16LE as the encoded character set to use for this file. Leave unspecified if you want ANSI encoding.

Valid characters for the `mode` string used in `fopen_s` and `_fdopen` correspond to `oflag` arguments used in `_open` and `_sopen`, as follows.

CHARACTERS IN MODE STRING	EQUIVALENT OFLAG VALUE FOR <code>_OPEN</code> / <code>_SOPEN</code>
---------------------------	---

CHARACTERS IN MODE STRING	EQUIVALENT OFLAG VALUE FOR _OPEN / _SOPEN
a	_O_WRONLY _O_APPEND (usually _O_WRONLY _O_CREAT _O_APPEND)
a+	_O_RDWR _O_APPEND (usually _O_RDWR _O_APPEND _O_CREAT)
R	_O_RDONLY
r+	_O_RDWR
w	_O_WRONLY (usually _O_WRONLY _O_CREAT _O_TRUNC)
w+	_O_RDWR (usually ** _O_RDWR _O_CREAT _O_TRUNC)
b	_O_BINARY
t	_O_TEXT
c	None
n	None
s	_O_SEQUENTIAL
r	_O_RANDOM
t	_O_SHORTLIVED
D	_O_TEMPORARY
ccs=UNICODE	_O_WTEXT
ccs=UTF-8	_O_UTF8
ccs=UTF-16LE	_O_UTF16

The `c`, `n`, and `t` `mode` options are Microsoft extensions for `fopen_s` and `fdopen` and shouldn't be used where you want ANSI portability.

If you're using `rb` mode, memory mapped Win32 files might also be an option if you don't need to port your code, you expect to read much of the file, or you don't care about network performance.

Requirements

FUNCTION	REQUIRED HEADER	C++ HEADER
<code>fopen_s</code>	<code><stdio.h></code>	<code><cstdio></code>
<code>_wfopen_s</code>	<code><stdio.h></code> or <code><wchar.h></code>	<code><cstdio></code>

For more information on standards conformance and naming conventions in the C runtime library, see [Compatibility](#).

Generic-text routine mappings

<code><TCHAR.H></code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfopen_s</code>	<code>fopen_s</code>	<code>fopen_s</code>	<code>_wfopen_s</code>

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_fopen_s.c
// This program opens two files. It uses
// fclose to close the first file and
// _fcloseall to close all remaining files.

#include <stdio.h>

FILE *stream, *stream2;

int main( void )
{
    errno_t err;

    // Open for read (will fail if file "crt_fopen_s.c" doesn't exist)
    err = fopen_s( &stream, "crt_fopen_s.c", "r" );
    if( err == 0 )
    {
        printf( "The file 'crt_fopen_s.c' was opened\n" );
    }
    else
    {
        printf( "The file 'crt_fopen_s.c' was not opened\n" );
    }

    // Open for write
    err = fopen_s( &stream2, "data2", "w+", ccs=UTF-8" );
    if( err == 0 )
    {
        printf( "The file 'data2' was opened\n" );
    }
    else
    {
        printf( "The file 'data2' was not opened\n" );
    }

    // Close stream if it isn't NULL
    if( stream )
    {
        err = fclose( stream );
        if ( err == 0 )
        {
            printf( "The file 'crt_fopen_s.c' was closed\n" );
        }
        else
        {
            printf( "The file 'crt_fopen_s.c' was not closed\n" );
        }
    }

    // All other files are closed:
    int numclosed = _fcloseall( );
    printf( "Number of files closed by _fcloseall: %u\n", numclosed );
}

```

The file 'crt_fopen_s.c' was opened
The file 'data2' was opened
Number of files closed by _fcloseall: 1

See also

Stream I/O

fclose	_fcloseall
_fdopen	_wfopen

`ferror`

`_fileno`

`freopen`, `_wfreopen`

`_open`, `_wopen`

`_setmode`

`_fpclass`, `_fpclassf`

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Returns a value indicating the floating-point classification of the argument.

Syntax

```
int _fpclass(
    double x
);

int _fpclassf(
    float x
); /* x64 only */
```

Parameters

`x`

The floating-point value to test.

Return value

The `_fpclass` and `_fpclassf` functions return an integer value that indicates the floating-point classification of the argument `x`. The classification may have one of the following values, defined in `<float.h>`.

VALUE	DESCRIPTION
<code>_FPCLASS_SNAN</code>	Signaling NaN
<code>_FPCLASS_QNAN</code>	Quiet NaN
<code>_FPCLASS_NINF</code>	Negative infinity (<code>-INF</code>)
<code>_FPCLASS_NN</code>	Negative normalized non-zero
<code>_FPCLASS_ND</code>	Negative denormalized
<code>_FPCLASS_NZ</code>	Negative zero (<code>-0</code>)
<code>_FPCLASS_PZ</code>	Positive 0 (<code>+0</code>)
<code>_FPCLASS_PD</code>	Positive denormalized
<code>_FPCLASS_PN</code>	Positive normalized non-zero
<code>_FPCLASS_PINF</code>	Positive infinity (<code>+INF</code>)

Remarks

The `_fpclass` and `_fpclassf` functions are Microsoft-specific. They're similar to `fpclassify`, but return more detailed information about the argument. The `_fpclassf` function is only available when compiled for the x64 platform.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fpclass</code> , <code>_fpclassf</code>	<code><float.h></code>

For more compatibility and conformance information, see [Compatibility](#).

See also

[Math and floating-point support](#)

`isnan` , `_isnan` , `_isnanf`
`fpclassify`

fpclassify

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Returns the floating-point classification of the argument.

Syntax

```
int fpclassify(
    /* floating-point */ x
);

int fpclassify(
    float x
); // C++ only

int fpclassify(
    double x
); // C++ only

int fpclassify(
    long double x
); // C++ only
```

Parameters

x

The floating-point value to test.

Return value

`fpclassify` returns an integer value that indicates the floating-point class of the argument `x`. This table shows the possible values returned by `fpclassify`, defined in `<math.h>`.

VALUE	DESCRIPTION
<code>FP_NAN</code>	A quiet, signaling, or indeterminate NaN
<code>FP_INFINITE</code>	A positive or negative infinity
<code>FP_NORMAL</code>	A positive or negative normalized non-zero value
<code>FP_SUBNORMAL</code>	A positive or negative denormalized value
<code>FP_ZERO</code>	A positive or negative zero value

Remarks

In C, `fpclassify` is a macro; in C++, `fpclassify` is a function overloaded using argument types of `float`, `double`, or `long double`. In either case, the value returned depends on the effective type of the argument expression, and not on any intermediate representation. For example, a normal `double` or `long double` value can become an infinity, denormal, or zero value when converted to a `float`.

Requirements

FUNCTION/MACRO	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>fpclassify</code>	<code><math.h></code>	<code><math.h> or <cmath></code>

The `fpclassify` macro and `fpclassify` functions conform to the ISO C99 and C++11 specifications. For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

[`isnan`](#) , [`_isnan`](#) , [`_isnanf`](#)

_fpieee_flt

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Invokes a user-defined trap handler for IEEE floating-point exceptions.

Syntax

```
int _fpieee_flt(
    unsigned long excCode,
    struct _EXCEPTION_POINTERS *excInfo,
    int handler(_FPIEEE_RECORD *)  
);
```

Parameters

`excCode`

Exception code.

`excInfo`

Pointer to the Windows NT exception information structure.

`handler`

Pointer to the user's IEEE trap-handler routine.

Return value

The return value of `_fpieee_flt` is the value returned by `handler`. As such, the IEEE filter routine might be used in the except clause of a structured exception-handling (SEH) mechanism.

Remarks

The `_fpieee_flt` function invokes a user-defined trap handler for IEEE floating-point exceptions and provides it with all relevant information. This routine serves as an exception filter in the SEH mechanism, which invokes your own IEEE exception handler when necessary.

The `_FPIEEE_RECORD` structure, defined in Fpieee.h, contains information pertaining to an IEEE floating-point exception. This structure is passed to the user-defined trap handler by `_fpieee_flt`.

<code>_FPIEEE_RECORD</code> FIELD	DESCRIPTION
<code>RoundingMode</code>	These <code>unsigned int</code> fields contain information about the floating-point environment at the time the exception occurred.
<code>Precision</code>	

_FPIEEE_RECORD FIELD	DESCRIPTION
<code>Operation</code>	This <code>unsigned int</code> field indicates the type of operation that caused the trap. If the type is a comparison (<code>_FpCodeCompare</code>), you can supply one of the special <code>_FPIEEE_COMPARE_RESULT</code> values (as defined in <code>Fpieee.h</code>) in the <code>Result.Value</code> field. The conversion type (<code>_FpCodeConvert</code>) indicates that the trap occurred during a floating-point conversion operation. You can look at the <code>Operand1</code> and <code>Result</code> types to determine the type of conversion being attempted.
<code>Operand1</code> <code>Operand2</code> <code>Result</code>	These <code>_FPIEEE_VALUE</code> structures indicate the types and values of the proposed result and operands. Each structure contains these fields:
<code>Cause</code> <code>Enable</code> <code>Status</code>	<code>_FPIEEE_EXCEPTION_FLAGS</code> contains a bit field for each type of floating point exception. There's a correspondence between these fields and the arguments used to mask the exceptions supplied to <code>_controlfp</code> . The exact meaning of each bit depends on context:

Pending exceptions that are disabled are raised when you enable them. These exceptions can result in undefined behavior when using `_fpieee_flt` as an exception filter. Always call `_clearfp` before enabling floating point exceptions.

Requirements

FUNCTION	REQUIRED HEADER
<code>_fpieee_flt</code>	<code><fpieee.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fpieee.c
// This program demonstrates the implementation of
// a user-defined floating-point exception handler using the
// _fpieee_flt function.

#include <fpieee.h>
#include <excpt.h>
#include <float.h>
#include <stddef.h>

int fpieee_handler( _FPIEEE_RECORD * );

int fpieee_handler( _FPIEEE_RECORD *pieee )
{
    // user-defined ieee trap handler routine:
    // there is one handler for all
    // IEEE exceptions

    // Assume the user wants all invalid
    // operations to return 0.

    if ((pieee->Cause.InvalidOperation) &&
        (pieee->Result.Format == _FpFormatFp32))
    {
        pieee->Result.Value.Fp32Value = 0.0F;

        return EXCEPTION_CONTINUE_EXECUTION;
    }
    else
        return EXCEPTION_EXECUTE_HANDLER;
}

#define _EXC_MASK      \
    _EM_UNDERFLOW + \
    _EM_OVERFLOW   + \
    _EM_ZERODIVIDE + \
    _EM_INEXACT

int main( void )
{
    // ...

    __try {
        // unmask invalid operation exception
        _controlfp_s(NULL, _EXC_MASK, _MCW_EM);

        // code that may generate
        // fp exceptions goes here
    }
    __except ( _fpieee_flt( GetExceptionCode(),
                           GetExceptionInformation(),
                           fpieee_handler ) ){

        // code that gets control

        // if fpieee_handler returns
        // EXCEPTION_EXECUTE_HANDLER goes here

    }
    // ...
}

```

See also

Math and floating-point support

[_control87](#) , [_controlfp](#) , [__control87_2](#)
[_controlfp_s](#)

_fpreset

11/2/2022 • 2 minutes to read • [Edit Online](#)

Resets the floating-point package.

Syntax

```
void _fpreset( void );
```

Remarks

The `_fpreset` function reinitializes the floating-point math package. `_fpreset` is often used with `signal`, `system`, or the `_exec` or `_spawn` functions. If a program traps floating-point error signals (`SIGFPE`) with `signal`, it can safely recover from floating-point errors by invoking `_fpreset` and using `longjmp`.

This function is deprecated when compiling with [/clr \(Common Language Runtime Compilation\)](#) because the common language runtime only supports the default floating-point precision.

Requirements

FUNCTION	REQUIRED HEADER
<code>_fpreset</code>	<code><float.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fpreset.c
// This program uses signal to set up a
// routine for handling floating-point errors.

#include <stdio.h>
#include <signal.h>
#include <setjmp.h>
#include <stdlib.h>
#include <float.h>
#include <math.h>
#include <string.h>

jmp_buf mark;           // Address for long jump to jump to
int     fperr;          // Global error number

void __cdecl fphandler( int sig, int num ); // Prototypes
void fpcheck( void );

int main( void )
{
    double n1 = 5.0;
    double n2 = 0.0;
    double r;
    int jmprst;
```

```

// unmask all floating-point exceptions.
_control87( 0, _MCW_EM );
// Set up floating-point error handler. The compiler
// will generate a warning because it expects
// signal-handling functions to take only one argument.
if( signal( SIGFPE, (void (__cdecl *) (int)) fphandler ) == SIG_ERR )
{
    fprintf( stderr, "Couldn't set SIGFPE\n" );
    abort();
}

// Save stack environment for return in case of error. First
// time through, jmpret is 0, so true conditional is executed.
// If an error occurs, jmpret will be set to -1 and false
// conditional will be executed.
jmpret = setjmp( mark );
if( jmpret == 0 )
{
    printf( "Dividing %4.3g by %4.3g...\n", n1, n2 );
    r = n1 / n2;
    // This won't be reached if error occurs.
    printf( "\n\n%4.3g / %4.3g = %4.3g\n", n1, n2, r );

    r = n1 * n2;
    // This won't be reached if error occurs.
    printf( "\n\n%4.3g * %4.3g = %4.3g\n", n1, n2, r );
}
else
    fpcheck();
}

// fphandler handles SIGFPE (floating-point error) interrupt. Note
// that this prototype accepts two arguments and that the
// prototype for signal in the run-time library expects a signal
// handler to have only one argument.
//
// The second argument in this signal handler allows processing of
// _FPE_INVALID, _FPE_OVERFLOW, _FPE_UNDERFLOW, and
// _FPE_ZERODIVIDE, all of which are Microsoft-specific symbols
// that augment the information provided by SIGFPE. The compiler
// will generate a warning, which is harmless and expected.

void fphandler( int sig, int num )
{
    // Set global for outside check since we don't want
    // to do I/O in the handler.
    fperr = num;

    // Initialize floating-point package. */
    _fpreset();

    // Restore calling environment and jump back to setjmp. Return
    // -1 so that setjmp will return false for conditional test.
    longjmp( mark, -1 );
}

void fpcheck( void )
{
    char fpstr[30];
    switch( fperr )
    {
        case _FPE_INVALID:
            strcpy_s( fpstr, sizeof(fpstr), "Invalid number" );
            break;
        case _FPE_OVERFLOW:
            strcpy_s( fpstr, sizeof(fpstr), "Overflow" );
            break;
        case _FPE_UNDERFLOW:
            strcpy_s( fpstr, sizeof(fpstr), "Underflow" );
    }
}

```

```
        break;
    case _FPE_ZERODIVIDE:
        strcpy_s( fpstr, sizeof(fpstr), "Divide by zero" );
        break;
    default:
        strcpy_s( fpstr, sizeof(fpstr), "Other floating point error" );
        break;
    }
    printf( "Error %d: %s\n", fperr, fpstr );
}
```

```
Dividing      5 by      0...
Error 131: Divide by zero
```

See also

[Math and floating-point support](#)

[_exec](#) , [_wexec](#) functions

[signal](#)

[_spawn](#) , [_wspawn](#) functions

[system](#) , [_wsystem](#)

`fprintf`, `_fprintf_l`, `fwprintf`, `_fwprintf_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Print formatted data to a stream. More secure versions of these functions are available; see `fprintf_s`, `_fprintf_s_l`, `fwprintf_s`, `_fwprintf_s_l`.

Syntax

```
int fprintf(
    FILE *stream,
    const char *format [,,
    argument ]...
);
int _fprintf_l(
    FILE *stream,
    const char *format,
    _locale_t locale [,,
    argument ]...
);
int fwprintf(
    FILE *stream,
    const wchar_t *format [,,
    argument ]...
);
int _fwprintf_l(
    FILE *stream,
    const wchar_t *format,
    _locale_t locale [,,
    argument ]...
);
```

Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

`fprintf` returns the number of bytes written. `fwprintf` returns the number of wide characters written. Each of these functions returns a negative value instead when an output error occurs. If `stream` or `format` is `NULL`, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`. The format string isn't checked for valid formatting characters as it is when using `fprintf_s` or `fwprintf_s`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

`fprintf` formats and prints a series of characters and values to the output `stream`. Each function `argument` (if any) is converted and output according to the corresponding format specification in `format`. For `fprintf`, the `format` argument has the same syntax that it has in `printf`.

`fwprintf` is a wide-character version of `fprintf`; in `fwprintf`, `format` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `fprintf` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fegetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ftprintf</code>	<code>fprintf</code>	<code>fprintf</code>	<code>fwprintf</code>
<code>_ftprintf_1</code>	<code>_fprintf_1</code>	<code>_fprintf_1</code>	<code>_fwprintf_1</code>

For more information, see [Format specification syntax](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fprintf</code> , <code>_fprintf_1</code>	<code><stdio.h></code>
<code>fwprintf</code> , <code>_fwprintf_1</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fprintf.c
/* This program uses fprintf to format various
 * data and print it to the file named FPRINTF.OUT. It
 * then displays FPRINTF.OUT on the screen using the system
 * function to invoke the operating-system TYPE command.
*/
#include <stdio.h>
#include <process.h>

FILE *stream;

int main( void )
{
    int     i = 10;
    double fp = 1.5;
    char    s[] = "this is a string";
    char    c = '\n';

    fopen_s( &stream, "fprintf.out", "w" );
    fprintf( stream, "%s%c", s, c );
    fprintf( stream, "%d\n", i );
    fprintf( stream, "%f\n", fp );
    fclose( stream );
    system( "type fprintf.out" );
}
```

```
this is a string
10
1.500000
```

See also

Stream I/O

[_cprintf](#) | [_cprintf_l](#) | [_cwprintf](#) | [_cwprintf_l](#)
[fscanf](#) | [_fscanf_l](#) | [fwscanf](#) | [_fwscanf_l](#)
[sprintf](#) | [_sprintf_l](#) | [swprintf](#) | [_swprintf_l](#) | [_swprintf_l](#)

Format specification syntax: [printf](#) and [wprintf](#) functions

`_fprintf_p`, `_fprintf_p_l`, `_fwprintf_p`,
`_fwprintf_p_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Prints formatted data to a stream.

Syntax

```
int _fprintf_p(
    FILE *stream,
    const char *format [,,
    argument ]...
);
int _fprintf_p_l(
    FILE *stream,
    const char *format,
    _locale_t locale [,,
    argument ]...
);
int _fwprintf_p(
    FILE *stream,
    const wchar_t *format [,,
    argument ]...
);
int _fwprintf_p_l(
    FILE *stream,
    const wchar_t *format,
    _locale_t locale [,,
    argument ]...
);
```

Parameters

`stream`

Pointer to the `FILE` structure.

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

`_fprintf_p` and `_fwprintf_p` return the number of characters written or return a negative value when an output error occurs.

Remarks

`_fprintf_p` formats and prints a series of characters and values to the output `stream`. Each function `argument` (if any) is converted and output according to the corresponding format specification in `format`. For `_fprintf_p`,

the `format` argument has the same syntax that it has in `_printf_p`. These functions support positional parameters, meaning that the order of the parameters used by the format string can be changed. For more information about positional parameters, see [printf_p Positional Parameters](#).

`_fwprintf_p` is a wide-character version of `_fprintf_p`; in `_fwprintf_p`, `format` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `_fprintf_p` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

Like the non-secure versions (see `fprintf`, `_fprintf_1`, `fwprintf`, `_fwprintf_1`), these functions validate their parameters and invoke the invalid parameter handler, as described in [Parameter validation](#), if either `stream` or `format` is a null pointer or if there are any unknown or badly formed formatting specifiers. If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ftprintf_p</code>	<code>_fprintf_p</code>	<code>_fprintf_p</code>	<code>_fwprintf_p</code>
<code>_ftprintf_p_1</code>	<code>_fprintf_p_1</code>	<code>_fprintf_p_1</code>	<code>_fwprintf_p_1</code>

For more information, see [Format specification syntax](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fprintf_p</code> , <code>_fprintf_p_1</code>	<code><stdio.h></code>
<code>_fwprintf_p</code> , <code>_fwprintf_p_1</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fprintf_p.c
// This program uses _fprintf_p to format various
// data and print it to the file named FPRINTF_P.OUT. It
// then displays FPRINTF_P.OUT on the screen using the system
// function to invoke the operating-system TYPE command.
//

#include <stdio.h>
#include <process.h>

int main( void )
{
    FILE    *stream = NULL;
    int     i = 10;
    double  fp = 1.5;
    char    s[] = "this is a string";
    char    c = '\n';

    // Open the file
    if ( fopen_s( &stream, "fprintf_p.out", "w" ) == 0 )
    {
        // Format and print data
        _fprintf_p( stream, "%2$s%1$c", c, s );
        _fprintf_p( stream, "%d\n", i );
        _fprintf_p( stream, "%f\n", fp );

        // Close the file
        fclose( stream );
    }

    // Verify our data
    system( "type fprintf_p.out" );
}

```

```

this is a string
10
1.500000

```

See also

Stream I/O

[_cprintf](#), [_cprintf_l](#), [_cwprintf](#), [_cwprintf_l](#)
[fscanf](#), [_fscanf_l](#), [fwscanf](#), [_fwscanf_l](#)
[sprintf](#), [_sprintf_l](#), [swprintf](#), [_swprintf_l](#), [_swprintf_l](#)

printf_p Positional Parameters

[_cprintf_p](#), [_cprintf_p_l](#), [_cwprintf_p](#), [_cwprintf_p_l](#)
[_cprintf_s](#), [_cprintf_s_l](#), [_cwprintf_s](#), [_cwprintf_s_l](#)

printf_p Positional Parameters

[fscanf_s](#), [_fscanf_s_l](#), [fwscanf_s](#), [_fwscanf_s_l](#)

`fprintf_s`, `_fprintf_s_l`, `fwprintf_s`,
`_fwprintf_s_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Print formatted data to a stream. These functions are versions of `fprintf`, `_fprintf_l`, `fwprintf`, `_fwprintf_l` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
int fprintf_s(
    FILE *stream,
    const char *format [,,
    argument_list ]
);
int _fprintf_s_l(
    FILE *stream,
    const char *format,
    _locale_t locale [,,
    argument_list ]
);
int fwprintf_s(
    FILE *stream,
    const wchar_t *format [,,
    argument_list ]
);
int _fwprintf_s_l(
    FILE *stream,
    const wchar_t *format,
    _locale_t locale [,,
    argument_list ]
);
```

Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format-control string.

`argument_list`

Optional arguments to the format string.

`Locale`

The locale to use.

Return value

`fprintf_s` returns the number of bytes written. `fwprintf_s` returns the number of wide characters written.

Each of these functions returns a negative value instead when an output error occurs.

Remarks

`fprintf_s` formats and prints a series of characters and values to the output `stream`. Each argument in

`argument_List` (if any) is converted and output according to the corresponding format specification in `format`. The `format` argument uses the [format specification syntax for `printf` and `wprintf` functions](#).

`fwprintf_s` is a wide-character version of `fprintf_s`; in `fwprintf_s`, `format` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `fprintf_s` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fegetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

Like the non-secure versions (see `fprintf`, `_fprintf_l`, `fwprintf`, `_fwprintf_l`), these functions validate their parameters and invoke the invalid parameter handler, as described in [Parameter validation](#), if either `stream` or `format` is a `NULL` pointer. The format string itself is also validated. If there are any unknown or badly formed formatting specifiers, these functions generate the invalid parameter exception. In all cases, if execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`. For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ftprintf_s</code>	<code>fprintf_s</code>	<code>fprintf_s</code>	<code>fwprintf_s</code>
<code>_ftprintf_s_l</code>	<code>_fprintf_s_l</code>	<code>_fprintf_s_l</code>	<code>_fwprintf_s_l</code>

For more information, see [Format specification syntax](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fprintf_s</code> , <code>_fprintf_s_l</code>	<code><stdio.h></code>
<code>fwprintf_s</code> , <code>_fwprintf_s_l</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fprintf_s.c
// This program uses fprintf_s to format various
// data and print it to the file named FPRINTF_S.OUT. It
// then displays FPRINTF_S.OUT on the screen using the system
// function to invoke the operating-system TYPE command.

#include <stdio.h>
#include <process.h>

FILE *stream;

int main( void )
{
    int     i = 10;
    double fp = 1.5;
    char    s[] = "this is a string";
    char    c = '\n';

    fopen_s( &stream, "fprintf_s.out", "w" );
    fprintf_s( stream, "%s%c", s, c );
    fprintf_s( stream, "%d\n", i );
    fprintf_s( stream, "%f\n", fp );
    fclose( stream );
    system( "type fprintf_s.out" );
}
```

```
this is a string
10
1.500000
```

See also

Stream I/O

[_cprintf](#), [_cprintf_l](#), [_cwprintf](#), [_cwprintf_l](#)
[fscanf](#), [_fscanf_l](#), [fwscanf](#), [_fwscanf_l](#)
[sprintf](#), [_sprintf_l](#), [swprintf](#), [_swprintf_l](#), [__swprintf_l](#)

fputc, fputwc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to a stream.

Syntax

```
int fputc(
    int c,
    FILE *stream
);
wint_t fputwc(
    wchar_t c,
    FILE *stream
);
```

Parameters

`c`

Character to be written.

`stream`

Pointer to `FILE` structure.

Return value

Each of these functions returns the character written. For `fputc`, a return value of `EOF` indicates an error. For `fputwc`, a return value of `WEOF` indicates an error. If `stream` is `NULL`, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, they return `EOF` and set `errno` to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

Each of these functions writes the single character `c` to a file at the position indicated by the associated file position indicator, if defined. The functions advance the indicator as appropriate. In `fputc` and `fputwc`, the file is associated with `stream`. If the file can't support positioning requests or was opened in append mode, the character is appended to the end of the stream.

The two functions behave identically if the stream is opened in ANSI mode. `fputc` doesn't currently support output into a UNICODE stream.

The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads. For more information, see [`_fputc_nolock`](#), [`_fputwc_nolock`](#).

Routine-specific remarks follow.

ROUTINE	REMARKS
<code>fputc</code>	Equivalent to <code>putc</code> , but implemented only as a function, rather than as a function and a macro.

ROUTINE	REMARKS
<code>fputwc</code>	Wide-character version of <code>fputc</code> . Writes <code>c</code> as a multibyte character or a wide character when <code>stream</code> is opened in text mode or binary mode, respectively.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fputtc</code>	<code>fputc</code>	<code>fputc</code>	<code>fputwc</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>fputc</code>	<code><stdio.h></code>
<code>fputwc</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console—`stdin`, `stdout`, and `stderr`—must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_fputc.c
// This program uses fputc
// to send a character array to stdout.

#include <stdio.h>

int main( void )
{
    char strptr1[] = "This is a test of fputc!!\n";
    char *p;

    // Print line to stream using fputc.
    p = strptr1;
    while( (*p != '\0') && fputc( *(p++), stdout ) != EOF ) ;

}
```

```
This is a test of fputc!!
```

See also

Stream I/O

`fgetc`, `fgetwc`
`putc`, `putwc`

`_fputc_nolock`, `_fputwc_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to a stream without locking the thread.

Syntax

```
int _fputc_nolock(
    int c,
    FILE *stream
);
wint_t _fputwc_nolock(
    wchar_t c,
    FILE *stream
);
```

Parameters

`c`

Character to be written.

`stream`

Pointer to the `FILE` structure.

Return value

Each of these functions returns the character written. For error information, see [fputc](#), [fputwc](#).

Remarks

`_fputc_nolock` and `_fputwc_nolock` are identical to `fputc` and `fputwc`, respectively, except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

The two functions behave identically if the stream is opened in ANSI mode. `_fputc_nolock` doesn't currently support output into a UNICODE stream.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fputtc_nolock</code>	<code>_fputtc_nolock</code>	<code>_fputtc_nolock</code>	<code>_fputwc_nolock</code>

Requirements

FUNCTION	REQUIRED HEADER
_fputc_nolock	<stdio.h>
_fputwc_nolock	<stdio.h> or <wchar.h>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console—`stdin`, `stdout`, and `stderr`—must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_fputc_nolock.c
// This program uses _fputc_nolock
// to send a character array to stdout.

#include <stdio.h>

int main( void )
{
    char strptr1[] = "This is a test of _fputc_nolock!!\n";
    char *p;

    // Print line to stream using fputc.
    p = strptr1;
    while( (*p != '\0') && _fputc_nolock( *(p++), stdout ) != EOF ) ;

}
```

```
This is a test of _fputc_nolock!!
```

See also

Stream I/O

[fgetc](#) , [fgetwc](#)
[putc](#) , [putwc](#)

fputchar

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `fputchar` is a deprecated alias for the `_fputchar` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_fputchar` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_fputchar`, `_fputwchar`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to `stdout`.

Syntax

```
int _fputchar(
    int c
);
wint_t _fputwchar(
    wchar_t c
);
```

Parameters

`c`

Character to be written.

Return value

Each of these functions returns the character written. For `_fputchar`, a return value of `EOF` indicates an error. For `_fputwchar`, a return value of `WEOF` indicates an error. If `c` is `NULL`, these functions generate an invalid parameter exception, as described in [Parameter validation](#). If execution is allowed to continue, `_fputchar` returns `EOF` (`_fputwchar` returns `WEOF`), and they set `errno` to `EINVAL`.

For more information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

Both of these functions write the single character argument `c` to `stdout` and advance the indicator as appropriate. `_fputchar` is equivalent to `fputc(stdout)`. It's also equivalent to `putchar`, but implemented only as a function, rather than as a function and a macro. Unlike `fputc` and `putchar`, these functions aren't compatible with the ANSI standard.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fputchar</code>	<code>_fputchar</code>	<code>_fputchar</code>	<code>_fputwchar</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>_fputchar</code>	<code><stdio.h></code>

FUNCTION	REQUIRED HEADER
<code>_fputwchar</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console—`stdin`, `stdout`, and `stderr`—must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_fputchar.c
// This program uses _fputchar
// to send a character array to stdout.

#include <stdio.h>

int main( void )
{
    char strptr[] = "This is a test of _fputchar!!\n";
    char *p = NULL;

    // Print line to stream using _fputchar.
    p = strptr;
    while( (*p != '\0') && _fputchar( *(p++) ) != EOF )
        ;
}
```

This is a test of _fputchar!!

See also

Stream I/O

<code>fgetc</code>	<code>fgetwc</code>
<code>putc</code>	<code>putwc</code>

fputs , fputws

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a string to a stream.

Syntax

```
int fputs(
    const char *str,
    FILE *stream
);
int fputws(
    const wchar_t *str,
    FILE *stream
);
```

Parameters

`str`

Output string.

`stream`

Pointer to `FILE` structure.

Return value

Each of these functions returns a nonnegative value if it's successful. On an error, `fputs` and `fputws` return `EOF`. If `str` or `stream` is a null pointer, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and then return `EOF`.

For more information on error codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each of these functions copies `str` to the output `stream` at the current position. `fputws` copies the wide-character argument `str` to `stream` as a multibyte-character string or a wide-character string when `stream` is opened in text mode or binary mode, respectively. Neither function copies the terminating null character.

The two functions behave identically if the stream is opened in ANSI mode. `fputs` doesn't currently support output into a UNICODE stream.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_fputts</code>	<code>fputs</code>	<code>fputs</code>	<code>fputws</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>fputs</code>	<code><stdio.h></code>
<code>fputws</code>	<code><stdio.h> or <wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console—`stdin`, `stdout`, and `stderr`—must be redirected before C runtime functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_fputs.c
// This program uses fputs to write
// a single line to the stdout stream.

#include <stdio.h>

int main( void )
{
    fputs( "Hello world from fputs.\n", stdout );
}
```

```
Hello world from fputs.
```

See also

Stream I/O

<code>fgets</code>	<code>fgetws</code>
<code>gets</code>	<code>_getws</code>
<code>puts</code>	<code>_putws</code>

fread

11/2/2022 • 3 minutes to read • [Edit Online](#)

Reads data from a stream.

Syntax

```
size_t fread(  
    void *buffer,  
    size_t size,  
    size_t count,  
    FILE *stream  
) ;
```

Parameters

`buffer`

Storage location for data.

`size`

Item size in bytes.

`count`

Maximum number of items to be read.

`stream`

Pointer to `FILE` structure.

Return value

`fread` returns the number of full items the function read, which may be less than `count` if an error occurs, or if it encounters the end of the file before reaching `count`. Use the `feof` or `ferror` function to distinguish a read error from an end-of-file condition. If `size` or `count` is 0, `fread` returns 0 and the buffer contents are unchanged. If `stream` or `buffer` is a null pointer, `fread` invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns 0.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `fread` function reads up to `count` items of `size` bytes from the input `stream` and stores them in `buffer`. The file pointer associated with `stream` (if one exists) is advanced by the number of bytes `fread` read. If the given stream is opened in [text mode](#), Windows-style newlines are converted into Unix-style newlines. That is, carriage return-line feed (CRLF) pairs are replaced by single line feed (LF) characters. The replacement has no effect on the file pointer or the return value. The file-pointer position is indeterminate if an error occurs. The value of a partially read item can't be determined.

When used on a text mode stream, if the amount of data requested (that is, `size * count`) is greater than or equal to the internal `FILE` * buffer size (by default the size is 4096 bytes, configurable by using `setvbuf`), stream data is copied directly into the user-provided buffer, and newline conversion is done in that buffer. Since the converted data may be shorter than the stream data copied into the buffer, data past `buffer` [`return_value`

* `size`] (where `return_value` is the return value from `fread`) may contain unconverted data from the file. For this reason, we recommend you null-terminate character data at `buffer [return_value * size]` if the intent of the buffer is to act as a C-style string. See `fopen` for details on the effects of text mode and binary mode.

This function locks out other threads. If you need a non-locking version, use `_fread_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fread</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fread.c
// This program opens a file named FREAD.OUT and
// writes 25 characters to the file. It then tries to open
// FREAD.OUT and read in 25 characters. If the attempt succeeds,
// the program displays the number of actual items read.

#include <stdio.h>

int main( void )
{
    FILE *stream;
    char list[30];
    int i, numread, numwritten;

    // Open file in text mode:
    if( fopen_s( &stream, "fwrite.out", "w+t" ) == 0 )
    {
        for ( i = 0; i < 25; i++ )
            list[i] = (char)('z' - i);
        // Write 25 characters to stream
        numwritten = fwrite( list, sizeof( char ), 25, stream );
        printf( "Wrote %d items\n", numwritten );
        fclose( stream );
    }
    else
        printf( "Problem opening the file\n" );

    if( fopen_s( &stream, "fwrite.out", "r+t" ) == 0 )
    {
        // Attempt to read in 25 characters
        numread = fread( list, sizeof( char ), 25, stream );
        printf( "Number of items read = %d\n", numread );
        printf( "Contents of buffer = %.25s\n", list );
        fclose( stream );
    }
    else
        printf( "File could not be opened\n" );
}
```

```
Wrote 25 items
Number of items read = 25
Contents of buffer = zyxwvutsrqponmlkjihgfedcb
```

See also

[Stream I/O](#)

[Text and binary mode file I/O](#)

[fopen](#)

[fwrite](#)

[_read](#)

fread_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads data from a stream. This version of `fread` has security enhancements, as described in [Security features in the CRT](#).

Syntax

```
size_t fread_s(
    void *buffer,
    size_t bufferSize,
    size_t elementSize,
    size_t count,
    FILE *stream
);
```

Parameters

`buffer`

Storage location for data.

`bufferSize`

Size of the destination buffer in bytes.

`elementSize`

Size of the item to read in bytes.

`count`

Maximum number of items to be read.

`stream`

Pointer to `FILE` structure.

Return value

`fread_s` returns the number of (whole) items that were read into the buffer, which may be less than `count` if a read error or the end of the file is encountered before `count` is reached. Use the `feof` or `ferror` function to distinguish an error from an end-of-file condition. If `size` or `count` is 0, `fread_s` returns 0 and the buffer contents are unchanged. If `stream` or `buffer` is a null pointer, `fread_s` invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns 0.

For more information about error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `fread_s` function reads up to `count` items of `elementSize` bytes from the input `stream` and stores them in `buffer`. The file pointer that's associated with `stream` (if there's one) is advanced by the number of bytes `fread_s` read. If the given stream is opened in text mode, carriage return-line feed pairs are replaced with single line feed characters. The replacement has no effect on the file pointer or the return value. The file-pointer position is indeterminate if an error occurs. The value of a partially read item can't be determined.

This function locks out other threads. If you require a non-locking version, use `_fread_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fread_s</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fread_s.c
// Command line: cl /EHsc /nologo /W4 crt_fread_s.c
//
// This program opens a file that's named FREAD.OUT and
// writes characters to the file. It then tries to open
// FREAD.OUT and read in characters by using fread_s. If the attempt succeeds,
// the program displays the number of actual items read.

#include <stdio.h>

#define BUFFERSIZE 30
#define DATASIZE 22
#define ELEMENTCOUNT 2
#define ELEMENTSIZE (DATASIZE/ELEMENTCOUNT)
#define FILENAME "FREAD.OUT"

int main( void )
{
    FILE *stream;
    char list[30];
    int i, numread, numwritten;

    for ( i = 0; i < DATASIZE; i++ )
        list[i] = (char)('z' - i);
    list[DATASIZE] = '\0'; // terminal null so we can print it

    // Open file in text mode:
    if( fopen_s( &stream, FILENAME, "w+t" ) == 0 )
    {
        // Write DATASIZE characters to stream
        printf( "Contents of buffer before write/read:\n\t%s\n\n", list );
        numwritten = fwrite( list, sizeof( char ), DATASIZE, stream );
        printf( "Wrote %d items\n\n", numwritten );
        fclose( stream );
    } else {
        printf( "Problem opening the file\n" );
        return -1;
    }

    if( fopen_s( &stream, FILENAME, "r+t" ) == 0 ) {
        // Attempt to read in characters in 2 blocks of 11
        numread = fread_s( list, BUFFERSIZE, ELEMENTSIZE, ELEMENTCOUNT, stream );
        printf( "Number of %d-byte elements read = %d\n\n", ELEMENTSIZE, numread );
        printf( "Contents of buffer after write/read:\n\t%s\n", list );
        fclose( stream );
    } else {
        printf( "File could not be opened\n" );
        return -1;
    }
}

```

```

Contents of buffer before write/read:
zyxwvutsrqponmlkjihgfedcba

Wrote 22 items

Number of 11-byte elements read = 2

Contents of buffer after write/read:
zyxwvutsrqponmlkjihgfedcba

```

See also

[Stream I/O](#)

[fwrite](#)

[_read](#)

_fread_nolock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads data from a stream, without locking other threads.

Syntax

```
size_t _fread_nolock(
    void *buffer,
    size_t size,
    size_t count,
    FILE *stream
);
```

Parameters

`buffer`

Storage location for data.

`size`

Item size in bytes.

`count`

Maximum number of items to be read.

`stream`

Pointer to the `FILE` structure.

Return value

See [fread](#).

Remarks

This function is a non-locking version of `fread`. It's identical to `fread` except that it isn't protected from interference by other threads. It might be faster because it doesn't incur the overhead of locking out other threads. Use this function only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fread_nolock</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

See also

Stream I/O

[fwrite](#)

[_read](#)

_fread_nolock_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads data from a stream, without locking other threads. This version of [fread_nolock](#) has security enhancements, as described in [Security features in the CRT](#).

Syntax

```
size_t _fread_nolock_s(  
    void *buffer,  
    size_t bufferSize,  
    size_t elementSize,  
    size_t elementCount,  
    FILE *stream  
) ;
```

Parameters

`buffer`

Storage location for data.

`bufferSize`

Size of the destination buffer in bytes.

`elementSize`

Size of the item to read in bytes.

`elementCount`

Maximum number of items to be read.

`stream`

Pointer to `FILE` structure.

Return value

See [fread_s](#).

Remarks

This function is a non-locking version of `fread_s`. It's identical to `fread_s` except that it isn't protected from interference by other threads. It might be faster because it doesn't incur the overhead of locking out other threads. Use this function only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fread_nolock_s</code>	C: <stdio.h>; C++: <cstdio> or <stdio.h>

For more compatibility information, see [Compatibility](#).

See also

Stream I/O

[`fwrite`](#)

[`_read`](#)

Deallocates or frees a memory block.

Syntax

```
void free(  
    void *memblock  
) ;
```

Parameters

`memblock`

Previously allocated memory block to be freed.

Remarks

The `free` function deallocates a memory block (`memblock`) that was previously allocated by a call to `calloc`, `malloc`, or `realloc`. The number of freed bytes is equivalent to the number of bytes requested when the block was allocated (or reallocated, for `realloc`). If `memblock` is `NULL`, the pointer is ignored, and `free` immediately returns. Attempting to free an invalid pointer (a pointer to a memory block that wasn't allocated by `calloc`, `malloc`, or `realloc`) may affect subsequent allocation requests and cause errors.

If an error occurs in freeing the memory, `errno` is set with information from the operating system on the nature of the failure. For more information, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

After a memory block has been freed, `_heapmin` minimizes the amount of free memory on the heap by coalescing the unused regions and releasing them back to the operating system. Freed memory that isn't released to the operating system is restored to the free pool and is available for allocation again.

When the application is linked with a debug version of the C run-time libraries, `free` resolves to `_free_dbg`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

`free` is marked `__declspec(noalias)`, meaning that the function is guaranteed not to modify global variables. For more information, see [noalias](#).

To free memory allocated with `_alloca`, use `_freea`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>free</code>	<code><stdlib.h></code> and <code><malloc.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for [malloc](#).

See also

Memory allocation

[_alloca](#)

[calloc](#)

[malloc](#)

[realloc](#)

[_free_dbg](#)

[_heapmin](#)

[_freea](#)

_free_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Frees a block of memory in the heap (debug version only).

Syntax

```
void _free_dbg(
    void *userData,
    int blockType
);
```

Parameters

`userData`

Pointer to the allocated memory block to be freed.

`blockType`

Type of allocated memory block to be freed: `_CLIENT_BLOCK`, `_NORMAL_BLOCK`, or `_IGNORE_BLOCK`.

Remarks

The `_free_dbg` function is a debug version of the `free` function. When `_DEBUG` isn't defined, each call to `_free_dbg` is reduced to a call to `free`. Both `free` and `_free_dbg` free a memory block in the base heap, but `_free_dbg` accommodates two debugging features: the ability to keep freed blocks in the heap's linked list to simulate low memory conditions and a block type parameter to free specific allocation types.

`_free_dbg` performs a validity check on all specified files and block locations before performing the free operation. The application isn't expected to provide this information. When a memory block is freed, the debug heap manager automatically checks the integrity of the buffers on either side of the user portion. It issues an error report if it detects an overwrite. If the `_CRTDBG_DELAY_FREE_MEM_DF` bit field of the `_crtDbgFlag` flag is set, the freed block is filled with the value 0xDD, assigned the `_FREE_BLOCK` block type, and kept in the heap's linked list of memory blocks.

If an error occurs in freeing the memory, `errno` is set with information from the operating system on the nature of the failure. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between calling a standard heap function and the debug version, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_free_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Example

For a sample of how to use `_free_dbg`, see [crt_dbg2](#).

See also

[Debug routines](#)

[_malloc_dbg](#)

_free_locale

11/2/2022 • 2 minutes to read • [Edit Online](#)

Frees a locale object.

Syntax

```
void _free_locale(  
    _locale_t locale  
)
```

Parameters

Locale

Locale object to free.

Remarks

The `_free_locale` function is used to free the locale object obtained from a call to `_get_current_locale` or `_create_locale`.

The previous name of this function, `__free_locale` (with two leading underscores) has been deprecated.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_free_locale</code>	<locale.h>

For more compatibility information, see [Compatibility](#).

See also

[_get_current_locale](#)
[_create_locale](#) , [_wcreate_locale](#)

_freea

11/2/2022 • 2 minutes to read • [Edit Online](#)

Deallocates or frees a memory block.

Syntax

```
void _freea(  
    void *memblock  
)
```

Parameters

`memblock`

Previously allocated memory block to be freed.

Return value

None.

Remarks

The `_freea` function deallocates a memory block (`memblock`) that was previously allocated by a call to `_malloc`. `_freea` checks to see if the memory was allocated on the heap or the stack. If it was allocated on the stack, `_freea` does nothing. If it was allocated on the heap, the number of freed bytes is equivalent to the number of bytes requested when the block was allocated. If `memblock` is `NULL`, the pointer is ignored, and `_freea` immediately returns. Attempting to free an invalid pointer (a pointer to a memory block that wasn't allocated by `_malloc`) might affect subsequent allocation requests and cause errors.

`_freea` calls `free` internally if it finds that the memory is allocated on the heap. Whether the memory is on the heap or the stack is determined by a marker placed in memory at the address immediately preceding the allocated memory.

If an error occurs in freeing the memory, `errno` is set with information from the operating system on the nature of the failure. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

After a memory block has been freed, `_heapmin` minimizes the amount of free memory on the heap by coalescing the unused regions and releasing them back to the operating system. Freed memory that isn't released to the operating system is restored to the free pool and is available for allocation again.

A call to `_freea` must accompany all calls to `_malloc`. It's also an error to call `_freea` twice on the same memory. When the application is linked with a debug version of the C run-time libraries, particularly with `_malloc_dbg` features enabled by defining `_CRTDBG_MAP_ALLOC`, it's easier to find missing or duplicated calls to `_freea`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

`_freea` is marked `__declspec(noalias)`, meaning that the function is guaranteed not to modify global variables. For more information, see [noalias](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_freea</code>	<stdlib.h> and <malloc.h>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`_malloc`](#).

See also

[Memory allocation](#)

[`_malloc`](#)

[`calloc`](#)

[`malloc`](#)

[`_malloc_dbg`](#)

[`realloc`](#)

[`_free_dbg`](#)

[`_heapmin`](#)

`freopen`, `_wfreopen`

11/2/2022 • 5 minutes to read • [Edit Online](#)

Reassigns a file pointer. More secure versions of the functions are available; see [`freopen_s`](#), [`_wfreopen_s`](#).

Syntax

```
FILE *freopen(
    const char *path,
    const char *mode,
    FILE *stream
);
FILE *_wfreopen(
    const wchar_t *path,
    const wchar_t *mode,
    FILE *stream
);
```

Parameters

`path`

Path of new file.

`mode`

Type of access permitted.

`stream`

Pointer to `FILE` structure.

Return value

Each of these functions returns a pointer to the newly opened file. If an error occurs, the original file is closed, and the function returns a `NULL` pointer value. If `path`, `mode`, or `stream` is a null pointer, or if `filename` is an empty string, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `NULL`.

For more information on error codes, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#).

Remarks

More secure versions of these functions exist, see [`freopen_s`](#), [`_wfreopen_s`](#).

The `freopen` function closes the file currently associated with `stream` and reassigns `stream` to the file specified by `path`. `_wfreopen` is a wide-character version of `_freopen`; the `path` and `mode` arguments to `_wfreopen` are wide-character strings. `_wfreopen` and `_freopen` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tfreopen</code>	<code>freopen</code>	<code>freopen</code>	<code>_wfreopen</code>

`freopen` is typically used to redirect the pre-opened files `stdin`, `stdout`, and `stderr` to files specified by the user. The new file associated with `stream` is opened with `mode`, which is a character string specifying the type of access requested for the file, as follows:

MODE	ACCESS
<code>"r"</code>	Opens for reading. If the file doesn't exist or can't be found, the <code>freopen</code> call fails.
<code>"w"</code>	Opens an empty file for writing. If the given file exists, its contents are destroyed.
<code>"a"</code>	Opens for writing at the end of the file (appending) without removing the end-of-file (EOF) marker before new data is written to the file. Creates the file if it doesn't exist.
<code>"r+"</code>	Opens for both reading and writing. The file must exist.
<code>"w+"</code>	Opens an empty file for both reading and writing. If the file exists, its contents are destroyed.
<code>"a+"</code>	Opens for reading and appending. The appending operation includes the removal of the EOF marker before new data is written to the file. The EOF marker isn't restored after writing is completed. Creates the file if it doesn't exist.

Use the `"w"` and `"w+"` types with care, as they can destroy existing files. Starting in C11, you can append `"x"` to `"w"` or `"w+"` to cause the function fail if the file exists, instead of overwriting it.

When a file is opened with the `"a"` or `"a+"` access type, all write operations take place at the end of the file. Although the file pointer can be repositioned using `fseek` or `rewind`, the file pointer is always moved back to the end of the file before any write operation is carried out. Thus, existing data can't be overwritten.

The `"a"` mode doesn't remove the EOF marker before appending to the file. After appending has occurred, the MS-DOS TYPE command only shows data up to the original EOF marker and not any data appended to the file. The `"a+"` mode does remove the EOF marker before appending to the file. After appending, the MS-DOS TYPE command shows all data in the file. The `"a+"` mode is required for appending to a stream file that is terminated with the CTRL+Z EOF marker.

When the `"r+"`, `"w+"`, or `"a+"` access type is specified, both reading and writing are allowed (the file is said to be open for "update"). However, when you switch between reading and writing, there must be an intervening `fsetpos`, `fseek`, or `rewind` operation. The current position can be specified for the `fsetpos` or `fseek` operation, if you want. In addition to the above values, one of the following characters may be included in the `mode` string to specify the translation mode for new lines.

MODE MODIFIER	TRANSLATION MODE
<code>t</code>	Open in text (translated) mode.

MODE MODIFIER	TRANSLATION MODE
b	Open in binary (untranslated) mode; translations involving carriage-return and line feed characters are suppressed.

In text (translated) mode, carriage return-line feed (CR-LF) combinations are translated into single line feed (LF) characters on input; LF characters are translated to CR-LF combinations on output. Also, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading or for writing and reading with "a+", the run-time library checks for a CTRL+Z at the end of the file and removes it, if possible. It's removed because using `fseek` and `ftell` to move within a file may cause `fseek` to behave improperly near the end of the file. Don't use the `t` option if you want ANSI portability because it's a Microsoft extension.

If `t` or `b` isn't given in `mode`, the default translation mode is defined by the global variable `_fmode`. If `t` or `b` is prefixed to the argument, the function fails and returns `NULL`.

For a discussion of text and binary modes, see [Text and binary mode file I/O](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>freopen</code>	<code><stdio.h></code>
<code>_wfreopen</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_freopen.c
// compile with: /W3
// This program reassigns stderr to the file
// named FREOPEN.OUT and writes a line to that file.
#include <stdio.h>
#include <stdlib.h>

FILE *stream;

int main( void )
{
    // Reassign "stderr" to "freopen.out":
    stream = freopen( "freopen.out", "w", stderr ); // C4996
    // Note: freopen is deprecated; consider using freopen_s instead

    if( stream == NULL )
        fprintf( stdout, "error on freopen\n" );
    else
    {
        fprintf( stdout, "successfully reassigned\n" );
        fflush( stdout );
        fprintf( stream, "This will go to the file 'freopen.out'\n" );
        fclose( stream );
    }
    system( "type freopen.out" );
}
```

```
successfully reassigned  
This will go to the file 'freopen.out'
```

See also

Stream I/O

[fclose](#), [_fcloseall](#)

[_fdopen](#), [_wfopen](#)

[_fileno](#)

[fopen](#), [_wfopen](#)

[_open](#), [_wopen](#)

[_setmode](#)\

`freopen_s`, `_wfreopen_s`

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Closes the file currently associated with `oldStream` and reassigns `stream` to the file specified by `fileName`.

These versions of `freopen`, `_wfreopen` have security enhancements, as described in [Security features in the CRT](#).

Syntax

```
errno_t freopen_s(
    FILE ** stream,
    const char * fileName,
    const char * mode,
    FILE* oldStream
);

errno_t _wfreopen_s(
    FILE ** stream,
    const wchar_t * fileName,
    const wchar_t * mode,
    FILE * oldStream
);
```

Parameters

`stream`

An out parameter that will point to the reopened stream when the function returns.

`fileName`

Path of the file to reopen.

`mode`

The mode for the reopened stream.

`oldStream`

The stream to reopen. It's flushed and any files associated with it are closed.

Return value

Zero on success; otherwise an error code. If an error occurs, the original file is closed, and `NULL` is written to `stream` unless `stream` is also `NULL`.

For more information about error codes, see [errno](#), [doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

The `freopen_s` function is typically used to attach the pre-opened streams associated with `stdin`, `stdout` and `stderr` to another file.

The `freopen_s` function closes the file currently associated with `stream` and reassigns `stream` to the file specified by `path`. `_wfreopen_s` is a wide-character version of `freopen_s`; the `path` and `mode` arguments to `_wfreopen_s` are wide-character strings. `_wfreopen_s` and `freopen_s` behave identically otherwise.

If any of `pFile`, `path`, `mode`, or `stream` are `NULL`, or if `path` is an empty string, these functions invoke the

invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.h</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfreopen_s</code>	<code>freopen_s</code>	<code>freopen_s</code>	<code>_wfreopen_s</code>

`freopen_s` is typically used to redirect the pre-opened files `stdin`, `stdout`, and `stderr` to files specified by the user. The new file associated with `stream` is opened with `mode`, which is a character string specifying the type of access requested for the file, as follows:

<code>MODE</code>	<code>ACCESS</code>
<code>"r"</code>	Opens for reading. If the file doesn't exist or can't be found, the <code>fopen_s</code> call fails.
<code>"w"</code>	Opens an empty file for writing. If the given file exists, its contents are destroyed.
<code>"a"</code>	Opens for writing at the end of the file (appending) without removing the end-of-file (EOF) marker before new data is written to the file. Creates the file if it doesn't exist.
<code>"r+"</code>	Opens for both reading and writing. The file must exist.
<code>"w+"</code>	Opens an empty file for both reading and writing. If the file exists, its contents are destroyed.
<code>"a+"</code>	Opens for reading and appending. The appending operation includes the removal of the EOF marker before new data is written to the file. The EOF marker isn't restored after writing is completed. Creates the file if it doesn't exist.

Use the `"w"` and `"w+"` types with care, as they can destroy existing files. Starting in C11, you can append `"x"` to `"w"` or `"w+"` to cause the function to fail if the file exists, instead of overwriting it.

When a file is opened with the `"a"` or `"a+"` access type, all write operations take place at the end of the file. Although the file pointer can be repositioned using `fseek` or `rewind`, the file pointer is always moved back to the end of the file before any write operation is carried out. Thus, existing data can't be overwritten.

The `"a"` mode doesn't remove the EOF marker before appending to the file. After appending has occurred, the MS-DOS TYPE command only shows data up to the original EOF marker and not any data appended to the file. The `"a+"` mode does remove the EOF marker before appending to the file. After appending, the MS-DOS TYPE command shows all data in the file. The `"a+"` mode is required for appending to a stream file that is terminated with the CTRL+Z EOF marker.

When the `"r+"`, `"w+"`, or `"a+"` access type is specified, both reading and writing are allowed (the file is said to be open for "update"). However, when you switch between reading and writing, there must be an intervening `fsetpos`, `fseek`, or `rewind` operation. The current position can be specified for the `fsetpos` or `fseek` operation, if you want. In addition to the above values, one of the following characters may be included in the

`mode` string to specify the translation mode for new lines.

MODE MODIFIER	TRANSLATION MODE
<code>t</code>	Open in text (translated) mode.
<code>b</code>	Open in binary (untranslated) mode; translations involving carriage-return and line feed characters are suppressed.

In text (translated) mode, carriage return-line feed (CR-LF) combinations are translated into single line feed (LF) characters on input; LF characters are translated to CR-LF combinations on output. Also, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading or for writing and reading with `"a+"`, the run-time library checks for a CTRL+Z at the end of the file and removes it, if possible. It's removed because using `fseek` and `ftell` to move within a file may cause `fseek` to behave improperly near the end of the file. Don't use the `t` option when you want ANSI portability because it's a Microsoft extension.

If `t` or `b` isn't given in `mode`, the default translation mode is defined by the global variable `_fmode`. If `t` or `b` is prefixed to the argument, the function fails and returns `NULL`.

For a discussion of text and binary modes, see [Text and binary mode file I/O](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>freopen_s</code>	<code><stdio.h></code>
<code>_wfreopen_s</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps.

For more compatibility information, see [Compatibility](#).

Example

```
// crt_freopen_s.c
// This program reassigns stderr to the file
// named FREOPEN.OUT and writes a line to that file.

#include <stdio.h>
#include <stdlib.h>

FILE *stream;

int main( void )
{
    errno_t err;
    // Reassign "stderr" to "freopen.out":
    err = freopen_s( &stream, "freopen.out", "w", stderr );

    if( err != 0 )
        fprintf( stdout, "error on freopen\n" );
    else
    {
        fprintf( stdout, "successfully reassigned\n" );
        fflush( stdout );
        fprintf( stream, "This will go to the file 'freopen.out'\n" );
        fclose( stream );
    }
    system( "type freopen.out" );
}
```

```
successfully reassigned
This will go to the file 'freopen.out'
```

See also

[Stream I/O](#)

[freopen](#) , [_wfreopen](#)

[fclose](#) , [_fcloseall](#)

[_fdopen](#) , [_wfdopen](#)

[_fileno](#)

[fopen](#) , [_wfopen](#)

[_open](#) , [_wopen](#)

[_setmode](#)

frexp, frexpf, frexpl

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Gets the mantissa and exponent of a floating-point number.

Syntax

```
double frexp(
    double x,
    int *exp_ptr
);
float frexpf(
    float x,
    int *exp_ptr
);
long double frexpl(
    long double x,
    int *exp_ptr
);
#define frexpl(X, INT_PTR) // Requires C11 or higher
```

```
float frexp(
    float x,
    int *exp_ptr
); // C++ only
long double frexpl(
    long double x,
    int *exp_ptr
); // C++ only
```

Parameters

x

Floating-point value.

exp_ptr

Pointer to stored integer exponent.

Return value

`frexp` returns the mantissa. If `x` is 0, the function returns 0 for both the mantissa and the exponent. If `exp_ptr` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns 0.

Remarks

The `frexp` function breaks down the floating-point value (`x`) into a mantissa (`m`) and an exponent (`n`), such that the absolute value of `m` is greater than or equal to 0.5 and less than 1.0, and `x = m * 2^n`. The integer exponent `n` is stored at the location pointed to by `exp_ptr`.

C++ allows overloading, so you can call overloads of `frexp`. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `frexp` always takes a `double` and an `int` pointer and returns a `double`.

If you use the `<tgmath.h>` `frexp()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>frexp</code> , <code>frexpf</code> , <code>frexpl</code>	<code><math.h></code>
<code>frexp</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_frexp.c
// This program calculates frexp( 16.4, &n )
// then displays y and n.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x, y;
    int n;

    x = 16.4;
    y = frexp( x, &n );
    printf( "frexp( %f, &n ) = %f, n = %d\n", x, y, n );
}
```

```
frexp( 16.400000, &n ) = 0.512500, n = 5
```

See also

[Math and floating-point support](#)

`ldexp`
`modf` , `modff` , `modfl`

`fscanf`, `_fscanf_l`, `fwscanf`, `_fwscanf_l`

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Read formatted data from a stream. More secure versions of these functions are available; see `fscanf_s`, `_fscanf_s_l`, `fwscanf_s`, `_fwscanf_s_l`.

Syntax

```
int fscanf(
    FILE *stream,
    const char *format [,,
    argument ]...
);
int _fscanf_l(
    FILE *stream,
    const char *format,
    _locale_t locale [,,
    argument ]...
);
int fwscanf(
    FILE *stream,
    const wchar_t *format [,,
    argument ]...
);
int _fwscanf_l(
    FILE *stream,
    const wchar_t *format,
    _locale_t locale [,,
    argument ]...
);
```

Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

Each of these functions returns the number of fields successfully converted and assigned; the return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. If an error occurs, or if the end of the file stream is reached before the first conversion, the return value is `EOF` for `fscanf` and `fwscanf`.

These functions validate their parameters. If `stream` or `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

Remarks

The `fscanf` function reads data from the current position of `stream` into the locations given by `argument` (if any). Each `argument` must be a pointer to a variable of a type that corresponds to a type specifier in `format`. `format` controls the interpretation of the input fields and has the same form and function as the `format` argument for `scanf`; see `scanf` for a description of `format`.

`fwscanf` is a wide-character version of `fscanf`; the format argument to `fwscanf` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `fscanf` doesn't currently support input from a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ftscanf</code>	<code>fscanf</code>	<code>fscanf</code>	<code>fwscanf</code>
<code>_ftscanf_1</code>	<code>_fscanf_1</code>	<code>_fscanf_1</code>	<code>_fwscanf_1</code>

For more information, see [Format specification fields: `scanf` and `wscanf` functions](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fscanf</code> , <code>_fscanf_1</code>	<code><stdio.h></code>
<code>fwscanf</code> , <code>_fwscanf_1</code>	<code><stdio.h></code> OR <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fscanf.c
// compile with: /W3
// This program writes formatted
// data to a file. It then uses fscanf to
// read the various data back from the file.

#include <stdio.h>

FILE *stream;

int main( void )
{
    long l;
    float fp;
    char s[81];
    char c;

    if( fopen_s( &stream, "fscanf.out", "w+" ) != 0 )
        printf( "The file fscanf.out was not opened\n" );
    else
    {
        fprintf( stream, "%s %ld %f%c", "a-string",
            65000, 3.14159, 'x' );
        // Security caution!
        // Beware loading data from a file without confirming its size,
        // as it may lead to a buffer overrun situation.

        // Set pointer to beginning of file:
        fseek( stream, 0L, SEEK_SET );

        // Read data back from file:
        fscanf( stream, "%s", s ); // C4996
        fscanf( stream, "%ld", &l ); // C4996

        fscanf( stream, "%f", &fp ); // C4996
        fscanf( stream, "%c", &c ); // C4996
        // Note: fscanf is deprecated; consider using fscanf_s instead

        // Output data read:
        printf( "%s\n", s );
        printf( "%ld\n", l );
        printf( "%f\n", fp );
        printf( "%c\n", c );

        fclose( stream );
    }
}

```

```

a-string
65000
3.141590
x

```

See also

Stream I/O

_cscanf	_cscanf_l	_cwscanf	_cwscanf_l
fprintf	_fprintf_l	fwprintf	_fwprintf_l
scanf	_scanf_l	wscanf	_wscanf_l
sscanf	_sscanf_l	swscanf	_swscanf_l
fscanf_s	_fscanf_s_l	fwscanf_s	_fwscanf_s_l

`fscanf_s`, `_fscanf_s_l`, `fwscanf_s`, `_fwscanf_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data from a stream. These versions of `fscanf`, `_fscanf_l`, `fwscanf`, `_fwscanf_l` have security enhancements, as described in [Security features in the CRT](#).

Syntax

```
int fscanf_s(
    FILE *stream,
    const char *format [,,
    argument ]...
);
int _fscanf_s_l(
    FILE *stream,
    const char *format,
    _locale_t locale [,,
    argument ]...
);
int fwscanf_s(
    FILE *stream,
    const wchar_t *format [,,
    argument ]...
);
int _fwscanf_s_l(
    FILE *stream,
    const wchar_t *format,
    _locale_t locale [,,
    argument ]...
);
```

Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

Each of these functions returns the number of fields that it successfully converts and assigns. The return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. If an error occurs, or if the end of the file stream is reached before the first conversion, the return value is `EOF` for `fscanf_s` and `fwscanf_s`.

These functions validate their parameters. If `stream` is an invalid file pointer, or `format` is a null pointer, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

Remarks

The `fscanf_s` function reads data from the current position of `stream` into the locations that are given by `argument` (if any). Each `argument` must be a pointer to a variable of a type that corresponds to a type specifier in `format`. `format` controls the interpretation of the input fields and has the same form and function as the `format` argument for `scanf_s`; see [Format specification fields: `scanf` and `wscanf` functions](#) for a description of `format`. `fwscanf_s` is a wide-character version of `fscanf_s`; the format argument to `fwscanf_s` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `fscanf_s` doesn't currently support input from a UNICODE stream.

The main difference between the more secure functions (that have the `_s` suffix) and the other versions is that the more secure functions require the size in characters of each `c`, `C`, `s`, `S`, and `[` type field to be passed as an argument immediately following the variable. For more information, see [`scanf_s`](#), [`_scanf_s_1`](#), [`wscanf_s`](#), [`_wscanf_s_1`](#) and [`scanf` Width Specification](#).

NOTE

The size parameter is of type `unsigned`, not `size_t`.

The versions of these functions that have the `_1` suffix are identical except that they use the locale parameter that's passed in instead of the current thread locale.

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ftscanf_s</code>	<code>fscanf_s</code>	<code>fscanf_s</code>	<code>fwscanf_s</code>
<code>_ftscanf_s_1</code>	<code>_fscanf_s_1</code>	<code>_fscanf_s_1</code>	<code>_fwscanf_s_1</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>fscanf_s</code> , <code>_fscanf_s_1</code>	<code><stdio.h></code>
<code>fwscanf_s</code> , <code>_fwscanf_s_1</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fscanf_s.c
// This program writes formatted
// data to a file. It then uses fscanf to
// read the various data back from the file.

#include <stdio.h>
#include <stdlib.h>

FILE *stream;

int main( void )
{
    long l;
    float fp;
    char s[81];
    char c;

    errno_t err = fopen_s( &stream, "fscanf.out", "w+" );
    if( err )
        printf_s( "The file fscanf.out was not opened\n" );
    else
    {
        fprintf_s( stream, "%s %ld %f%c", "a-string",
                   65000, 3.14159, 'x' );
        // Set pointer to beginning of file:
        fseek( stream, 0L, SEEK_SET );

        // Read data back from file:
        fscanf_s( stream, "%s", s, _countof(s) );
        fscanf_s( stream, "%ld", &l );

        fscanf_s( stream, "%f", &fp );
        fscanf_s( stream, "%c", &c, 1 );

        // Output data read:
        printf( "%s\n", s );
        printf( "%ld\n", l );
        printf( "%f\n", fp );
        printf( "%c\n", c );

        fclose( stream );
    }
}

```

```

a-string
65000
3.141590
x

```

See also

Stream I/O

_cscanf_s	_cscanf_s_l	_cwscanf_s	_cwscanf_s_l
fprintf_s	fprintf_s_l	fwprintf_s	fwprintf_s_l
scanf_s	scanf_s_l	wscanf_s	wscanf_s_l
sscanf_s	sscanf_s_l	swscanf_s	swscanf_s_l
fscanf	fscanf_l	fwscanf	fwscanf_l

fseek, _fseeki64

11/2/2022 • 3 minutes to read • [Edit Online](#)

Moves the file pointer to a specified location.

Syntax

```
int fseek(
    FILE *stream,
    long offset,
    int origin
);
int _fseeki64(
    FILE *stream,
    __int64 offset,
    int origin
);
```

Parameters

`stream`

Pointer to `FILE` structure.

`offset`

Number of bytes from `origin`.

`origin`

Initial position.

Return value

If successful, `fseek` and `_fseeki64` returns 0. Otherwise, it returns a nonzero value. On devices incapable of seeking, the return value is undefined. If `stream` is a null pointer, or if `origin` isn't one of allowed values described below, `fseek` and `_fseeki64` invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1.

Remarks

The `fseek` and `_fseeki64` functions moves the file pointer (if any) associated with `stream` to a new location that is `offset` bytes from `origin`. The next operation on the stream takes place at the new location. On a stream open for update, the next operation can be either a read or a write. The argument `origin` must be one of the following constants, defined in `STDIO.H`:

ORIGIN VALUE	MEANING
<code>SEEK_CUR</code>	Current position of file pointer.
<code>SEEK_END</code>	End of file.
<code>SEEK_SET</code>	Beginning of file.

You can use `fseek` and `_fseeki64` to reposition the pointer anywhere in a file. The pointer can also be positioned beyond the end of the file. `fseek` and `_fseeki64` clears the end-of-file indicator and negates the effect of any prior `ungetc` calls against `stream`.

When a file is opened for appending data, the current file position is determined by the last I/O operation, not by where the next write would occur. If no I/O operation has yet occurred on a file opened for appending, the file position is the start of the file.

For streams opened in text mode, `fseek` and `_fseeki64` have limited use, because carriage return-line feed translations can cause `fseek` and `_fseeki64` to produce unexpected results. The only `fseek` and `_fseeki64` operations guaranteed to work on streams opened in text mode are:

- Seeking with an offset of 0 relative to any of the origin values.
- Seeking from the beginning of the file with an offset value returned from a call to `fseek` when using `fseek` or `_fseeki64` when using `_fseeki64`.

Also in text mode, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading/writing, `fopen` and all related routines check for a CTRL+Z at the end of the file and remove it if possible. It's removed because using the combination of `fseek` and `fseek` or `_fseeki64` and `_fseeki64`, to move within a file that ends with a CTRL+Z may cause `fseek` or `_fseeki64` to behave improperly near the end of the file.

When the CRT opens a file that begins with a Byte Order Mark (BOM), the file pointer is positioned after the BOM. (That is, it's positioned at the start of the file's actual content). If you have to `fseek` to the beginning of the file, use `fseek` to get the initial position, and then `fseek` to that position rather than to position 0.

This function locks out other threads during execution and is therefore thread-safe. For a non-locking version, see `_fseek_nolock`, `_fseeki64_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fseek</code>	<code><stdio.h></code>
<code>_fseeki64</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_fseek.c
// This program opens the file FSEEK.OUT and
// moves the pointer to the file's beginning.

#include <stdio.h>

int main( void )
{
    FILE *stream;
    char line[81];
    int result;

    if ( fopen_s( &stream, "fseek.out", "w+" ) != 0 )
    {
        printf( "The file fseek.out was not opened\n" );
        return -1;
    }
    printf( stream, "The fseek begins here: "
            "This is the file 'fseek.out'.\n" );
    result = fseek( stream, 23L, SEEK_SET);
    if( result )
        perror( "Fseek failed" );
    else
    {
        printf( "File pointer is set to middle of first line.\n" );
        fgets( line, 80, stream );
        printf( "%s", line );
    }
    fclose( stream );
}
```

```
File pointer is set to middle of first line.
This is the file 'fseek.out'.
```

See also

Stream I/O

[_fopen](#) , [_wfopen](#)
[_ftell](#) , [_ftelli64](#)
[_lseek](#) , [_lseeki64](#)
[rewind](#)

`_fseek_nolock`, `_fseeki64_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Moves the file pointer to a specified location.

Syntax

```
int _fseek_nolock(
    FILE *stream,
    long offset,
    int origin
);
int _fseeki64_nolock(
    FILE *stream,
    __int64 offset,
    int origin
);
```

Parameters

`stream`

Pointer to the `FILE` structure.

`offset`

Number of bytes from `origin`.

`origin`

Initial position.

Return value

Same as `fseek` and `_fseeki64`, respectively.

Remarks

These functions are the non-locking versions of `fseek` and `_fseeki64`, respectively. These functions are identical to `fseek` and `_fseeki64`, except that they aren't protected from interference by other threads. These functions might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fseek_nolock</code> , <code>_fseeki64_nolock</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

See also

Stream I/O

[ftell](#) , [_ftelli64](#)
[_lseek](#) , [_lseeki64](#)
[rewind](#)

fsetpos

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the stream-position indicator.

Syntax

```
int fsetpos(
    FILE *stream,
    const fpos_t *pos
);
```

Parameters

`stream`

Pointer to `FILE` structure.

`pos`

Position-indicator storage.

Return value

If successful, `fsetpos` returns 0. On failure, the function returns a nonzero value and sets `errno` to one of the following manifest constants (defined in `ERRNO.H`): `EBADF`, which means the file isn't accessible or the object that `stream` points to isn't a valid file structure; or `EINVAL`, which means an invalid value for `stream` or `pos` was passed. If an invalid parameter is passed in, these functions invoke the invalid parameter handler, as described in [Parameter validation](#).

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `fsetpos` function sets the file-position indicator for `stream` to the value of `pos`, which is obtained in a prior call to `fgetpos` against `stream`. The function clears the end-of-file indicator and undoes any effects of `ungetc` on `stream`. After a call to `fsetpos`, the next operation on `stream` may be either input or output.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>fsetpos</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for `fgetpos`.

See also

[Stream I/O](#)

[`fgetpos`](#)

`_fsopen`, `_wfsopen`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Opens a stream with file sharing.

Syntax

```
FILE *_fsopen(
    const char *filename,
    const char *mode,
    int shflag
);
FILE *_wfsopen(
    const wchar_t *filename,
    const wchar_t *mode,
    int shflag
);
```

Parameters

`filename`

Name of the file to open.

`mode`

Type of access permitted.

`shflag`

Type of sharing allowed.

Return value

Each of these functions returns a pointer to the stream. A null pointer value indicates an error. If `filename` or `mode` is `NULL` or an empty string, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `NULL` and set `errno` to `EINVAL`.

For more information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_fsopen` function opens the file specified by `filename` as a stream and prepares the file for subsequent shared reading or writing, as defined by the mode and `shflag` arguments. `_wfsopen` is a wide-character version of `_fsopen`; the `filename` and `mode` arguments to `_wfsopen` are wide-character strings. `_wfsopen` and `_fsopen` behave identically otherwise.

The character string `mode` specifies the type of access requested for the file, as shown in the following table.

TERM	DEFINITION
"r"	Opens for reading. If the file doesn't exist or can't be found, the <code>_fsopen</code> call fails.

TERM	DEFINITION
" <code>w</code> "	Opens an empty file for writing. If the given file exists, its contents are destroyed.
" <code>a</code> "	Opens for writing at the end of the file (appending); creates the file first if it doesn't exist.
" <code>r+</code> "	Opens for both reading and writing. (The file must exist.)
" <code>w+</code> "	Opens an empty file for both reading and writing. If the given file exists, its contents are destroyed.
" <code>a+</code> "	Opens for reading and appending; creates the file first if it doesn't exist.

Use the "`w`" and "`w+`" types with care, as they can destroy existing files.

When a file is opened with the "`a`" or "`a+`" access type, all write operations occur at the end of the file. The file pointer can be repositioned using `fseek` or `rewind`, but it's always moved back to the end of the file before any write operation is carried out. Thus, existing data can't be overwritten. When the "`r+`", "`w+`", or "`a+`" access type is specified, both reading and writing are allowed (the file is said to be open for update). However, when switching between reading and writing, there must be an intervening `fsetpos`, `fseek`, or `rewind` operation. The current position can be specified for the `fsetpos` or `fseek` operation, if desired. In addition to the above values, one of the following characters can be included in `mode` to specify the translation mode for new lines, and for file management.

TERM	DEFINITION
<code>t</code>	Opens a file in text (translated) mode. In this mode, carriage return-line feed (CR-LF) combinations are translated into single line feeds (LF) on input and LF characters are translated to CR-LF combinations on output. Also, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading or reading/writing, <code>_fopen</code> checks for a CTRL+Z at the end of the file and removes it, if possible. It's removed because using <code>fseek</code> and <code>ftell</code> to move within a file that ends with a CTRL+Z might cause <code>fseek</code> to behave improperly near the end of the file.
<code>b</code>	Opens a file in binary (untranslated) mode; the above translations are suppressed.
<code>s</code>	Specifies that caching is optimized for, but not restricted to, sequential access from disk.
<code>R</code>	Specifies that caching is optimized for, but not restricted to, random access from disk.
<code>T</code>	Specifies a file as temporary. If possible, it isn't flushed to disk.
<code>D</code>	Specifies a file as temporary. It's deleted when the last file pointer is closed.

If `t` or `b` isn't given in `mode`, the translation mode is defined by the default-mode variable `_fmode`. If `t` or `b`

is prefixed to the argument, the function fails and returns `NULL`. For a discussion of text and binary modes, see [Text and binary mode file I/O](#).

The argument `shFlag` is a constant expression consisting of one of the following manifest constants, defined in `Share.h`.

TERM	DEFINITION
<code>_SH_COMPAT</code>	Sets Compatibility mode for 16-bit applications.
<code>_SH_DENYNO</code>	Permits read and write access.
<code>_SH_DENYRD</code>	Denies read access to the file.
<code>_SH_DENYRW</code>	Denies read and write access to the file.
<code>_SH_DENYWR</code>	Denies write access to the file.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfopen</code>	<code>_fopen</code>	<code>_fopen</code>	<code>_wfopen</code>

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADERS
<code>_fopen</code>	<code><stdio.h></code>	<code><share.h></code> For manifest constant for <code>shFlag</code> parameter.
<code>_wfopen</code>	<code><stdio.h></code> or <code><wchar.h></code>	<code><share.h></code> For manifest constant for <code>shFlag</code> parameter.

Example

```
// crt_fsopen.c

#include <stdio.h>
#include <stdlib.h>
#include <share.h>

int main( void )
{
    FILE *stream;

    // Open output file for writing. Using _fsopen allows us to
    // ensure that no one else writes to the file while we are
    // writing to it.
    //
    if( (stream = _fsopen( "outfile", "wt", _SH_DENYWR )) != NULL )
    {
        fprintf( stream, "No one else in the network can write "
                 "to this file until we are done.\n" );
        fclose( stream );
    }
    // Now others can write to the file while we read it.
    system( "type outfile" );
}
```

No one else in the network can write to this file until we are done.

See also

Stream I/O

[fclose](#) , [_fcloseall](#)
[_fdopen](#) , [_wfdopen](#)
[ferror](#)
[_fileno](#)
[fopen](#) , [_wfopen](#)
[freopen](#) , [_wfreopen](#)
[_open](#) , [_wopen](#)
[_setmode](#)
[_sopen](#) , [_wsopen](#)

`_fstat`, `_fstat32`, `_fstat64`, `_fstat64i64`,
`_fstat32i64`, `_fstat64i32`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Gets information about an open file.

Syntax

```
int _fstat(
    int fd,
    struct _stat *buffer
);
int _fstat32(
    int fd,
    struct __stat32 *buffer
);
int _fstat64(
    int fd,
    struct __stat64 *buffer
);
int _fstat64i64(
    int fd,
    struct __stat64i64 *buffer
);
int _fstat32i64(
    int fd,
    struct __stat32i64 *buffer
);
int _fstat64i32(
    int fd,
    struct __stat64i32 *buffer
);
```

Parameters

`fd`

File descriptor of the open file.

`buffer`

Pointer to the structure to store results.

Return value

Returns 0 if the file-status information is obtained. A return value of -1 indicates an error. If the file descriptor is invalid or `buffer` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EBADF` for an invalid file descriptor, or to `EINVAL` if `buffer` is `NULL`.

Remarks

The `_fstat` function obtains information about the open file associated with `fd` and stores it in the structure pointed to by `buffer`. The `_stat` structure, defined in `sys\stat.h`, contains the following fields.

FIELD	MEANING
<code>st_atime</code>	Time of the last file access.
<code>st_ctime</code>	Time of the creation of the file.
<code>st_dev</code>	If a device, <code>fd</code> ; otherwise 0.
<code>st_mode</code>	Bit mask for file-mode information. The <code>_S_IFCHR</code> bit is set if <code>fd</code> refers to a device. The <code>_S_IFREG</code> bit is set if <code>fd</code> refers to an ordinary file. The read/write bits are set according to the file's permission mode. <code>_S_IFCHR</code> and other constants are defined in <code>SYS\Stat.h</code> .
<code>st_mtime</code>	Time of the last modification of the file.
<code>st_nlink</code>	Always 1 on non-NTFS file systems.
<code>st_rdev</code>	If a device, <code>fd</code> ; otherwise 0.
<code>st_size</code>	Size of the file in bytes.

If `fd` refers to a device, the `st_atime`, `st_ctime`, `st_mtime`, and `st_size` fields aren't meaningful.

Because `Stat.h` uses the `_dev_t` type, which is defined in `Types.h`, you must include `Types.h` before `Stat.h` in your code.

`_fstat64`, which uses the `_stat64` structure, allows file-creation dates to be expressed up through 23:59:59, December 31, 3000, UTC; whereas the other functions only represent dates through 23:59:59 January 18, 2038, UTC. The lower bound of the date range for all these functions is Midnight, January 1, 1970.

Variations of these functions support 32-bit or 64-bit time types and 32-bit or 64-bit file lengths. The first numerical suffix (`32` or `64`) indicates the size of the time type used; the second suffix is either `i32` or `i64`, indicating whether the file size is represented as a 32-bit or 64-bit integer.

Unless `_USE_32BIT_TIME_T` is defined, `_fstat` is equivalent to `_fstat64i32`, and `_stat` contains a 64-bit time. When `_USE_32BIT_TIME_T` is defined, `_fstat` uses a 32-bit time, and `_stat` contains a 32-bit time. The same is true for `_fstat64`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Time type and file length type variations of `_stat`

FUNCTIONS	<code>_USE_32BIT_TIME_T</code> DEFINED?	TIME TYPE	FILE LENGTH TYPE
<code>_fstat</code>	Not defined	64-bit	32-bit
<code>_fstat</code>	Defined	32-bit	32-bit
<code>_fstat32</code>	Not affected by the macro definition	32-bit	32-bit

FUNCTIONS	<code>_USE_32BIT_TIME_T</code> DEFINED?	TIME TYPE	FILE LENGTH TYPE
<code>_fstat64</code>	Not affected by the macro definition	64-bit	64-bit
<code>_fstat64i32</code>	Not defined	64-bit	64-bit
<code>_fstat64i64</code>	Defined	32-bit	64-bit
<code>_fstat32i64</code>	Not affected by the macro definition	32-bit	64-bit
<code>_fstat32i32</code>	Not affected by the macro definition	64-bit	32-bit

Requirements

FUNCTION	REQUIRED HEADER
<code>_fstat</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>
<code>_fstat32</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>
<code>_fstat64</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>
<code>_fstat64i32</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>
<code>_fstat64i64</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>
<code>_fstat32i64</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>
<code>_fstat64i32</code>	<code><sys/stat.h></code> and <code><sys/types.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_fstat.c
// This program uses _fstat to report
// the size of a file named F_STAT.OUT.

#include <io.h>
#include <fcntl.h>
#include <time.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <errno.h>
#include <share.h>

int main( void )
{
    struct _stat buf;
    int fd, result;
    char buffer[] = "A line to output";
    char timebuf[26];
    errno_t err;

    _sopen_s( &fd,
              "f_stat.out",
              _O_CREAT | _O_WRONLY | _O_TRUNC,
              _SH_DENYNO,
              _S_IREAD | _S_IWRITE );
    if( fd != -1 )
        _write( fd, buffer, strlen( buffer ) );

    // Get data associated with "fd":
    result = _fstat( fd, &buf );

    // Check if statistics are valid:
    if( result != 0 )
    {
        if (errno == EBADF)
            printf( "Bad file descriptor.\n" );
        else if (errno == EINVAL)
            printf( "Invalid argument to _fstat.\n" );
    }
    else
    {
        printf( "File size      : %ld\n", buf.st_size );
        err = ctime_s(timebuf, 26, &buf.st_mtime);
        if (err)
        {
            printf("Invalid argument to ctime_s.");
            exit(1);
        }
        printf( "Time modified : %s", timebuf );
    }
    _close( fd );
}

```

```

File size      : 16
Time modified : Wed May 07 15:25:11 2003

```

See also

File handling

[_access](#) , [_waccess](#)

`_chmod`, `_wchmod`

`_filelength`, `_filelengthi64`

`_stat`, `_wstat` functions

`ftell`, `_ftelli64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current position of a file pointer.

Syntax

```
long ftell(
    FILE *stream
);
__int64 _ftelli64(
    FILE *stream
);
```

Parameters

`stream`
Target `FILE` structure.

Return value

`ftell` and `_ftelli64` return the current file position. The value returned by `ftell` and `_ftelli64` may not reflect the physical byte offset for streams opened in text mode, because text mode causes carriage return-line feed translation. Use `ftell` with `fseek` or `_ftelli64` with `_fseeki64` to return to file locations correctly. On error, `ftell` and `_ftelli64` invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1L and set `errno` to one of two constants, defined in `ERRNO.H`. The `EBADF` constant means the `stream` argument isn't a valid file pointer value or doesn't refer to an open file. `EINVAL` means an invalid `stream` argument was passed to the function. On devices incapable of seeking (such as terminals and printers), or when `stream` doesn't refer to an open file, the return value is undefined.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `ftell` and `_ftelli64` functions retrieve the current position of the file pointer (if any) associated with `stream`. The position is expressed as an offset relative to the beginning of the stream.

When a file is opened for appending data, the current file position is determined by the last I/O operation, not by where the next write would occur. For example, assume a file is opened for an append and the last operation was a read. The file position is the point where the next read operation would start, not where the next write would start. (When a file is opened for appending, the file position is moved to end of file before any write operation.) If no I/O operation has yet occurred on a file opened for appending, the file position is the beginning of the file.

In text mode, CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading/writing, `fclose` and all related routines check for a CTRL+Z at the end of the file and remove it if possible. It's because using the combination of `ftell` and `fseek`, or `_ftelli64` and `_fseeki64`, to move within a file that ends with a CTRL+Z may cause `ftell` or `_ftelli64` to behave improperly near the end of the file.

This function locks the calling thread during execution and is therefore thread-safe. For a non-locking version, see `_ftell_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADERS
<code>fseek</code>	<code><stdio.h></code>	<code><errno.h></code>
<code>_fseeki64</code>	<code><stdio.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_ftell.c
// This program opens a file named CRT_FTELL.C
// for reading and tries to read 100 characters. It
// then uses ftell to determine the position of the
// file pointer and displays this position.

#include <stdio.h>

FILE *stream;

int main( void )
{
    long position;
    char list[100];
    if( fopen_s( &stream, "crt_ftell.c", "rb" ) == 0 )
    {
        // Move the pointer by reading data:
        fread( list, sizeof( char ), 100, stream );
        // Get position after read:
        position = ftell( stream );
        printf( "Position after trying to read 100 bytes: %ld\n",
            position );
        fclose( stream );
    }
}
```

```
Position after trying to read 100 bytes: 100
```

See also

Stream I/O

`fopen` , `_wfopen`
`fgetpos`
`fseek` , `_fseeki64`
`_lseek` , `_lseeki64`

`_ftell_nolock`, `_ftelli64_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current position of a file pointer, without locking the thread.

Syntax

```
long _ftell_nolock(
    FILE *stream
);
__int64 _ftelli64_nolock(
    FILE *stream
);
```

Parameters

`stream`

Target the `FILE` structure.

Return value

Same as `ftell` and `_ftelli64`. For more information, see [ftell](#), [_ftelli64](#).

Remarks

These functions are non-locking versions of `ftell` and `_ftelli64`, respectively. They're identical to `ftell` and `_ftelli64` except that they aren't protected from interference by other threads. These functions might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>ftell_nolock</code>	<code><stdio.h></code>	<code><errno.h></code>
<code>_ftelli64_nolock</code>	<code><stdio.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

See also

Stream I/O

`fgetpos`

`fseek`, `_fseeki64`

`_lseek`, `_lseeki64`

`ftell`, `_ftelli64`

`_ftime`, `_ftime32`, `_ftime64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Get the current time. More secure versions of these functions are available; see [`_ftime_s`](#), [`_ftime32_s`](#), [`_ftime64_s`](#).

Syntax

```
void _ftime( struct _timeb *timeptr );
void _ftime32( struct __timeb32 *timeptr );
void _ftime64( struct __timeb64 *timeptr );
```

Parameters

`timeptr`

Pointer to a `_timeb`, `__timeb32`, or `__timeb64` structure.

Remarks

The `_ftime` function gets the current local time and stores it in the structure pointed to by `timeptr`. The `_timeb`, `__timeb32`, and `__timeb64` structures are defined in `<sys\timeb.h>`. They contain four fields, which are listed in the following table.

FIELD	DESCRIPTION
<code>dstflag</code>	Nonzero if daylight savings time is currently in effect for the local time zone. (See <code>_tzset</code> for an explanation of how daylight savings time is determined.)
<code>millitm</code>	Fraction of a second in milliseconds.
<code>time</code>	Time in seconds since midnight (00:00:00), January 1, 1970, coordinated universal time (UTC).
<code>timezone</code>	Difference in minutes, moving westward, between UTC and local time. The value of <code>timezone</code> is set from the value of the global variable <code>_timezone</code> (see <code>_tzset</code>).

The `_ftime64` function, which uses the `__timeb64` structure, allows file-creation dates to be expressed up through 23:59:59, December 31, 3000, UTC; whereas `_ftime32` only represents dates through 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for all these functions.

The `_ftime` function is equivalent to `_ftime64`, and `_timeb` contains a 64-bit time unless `_USE_32BIT_TIME_T` is defined, in which case the old behavior is in effect; `_ftime` uses a 32-bit time and `_timeb` contains a 32-bit time.

`_ftime` validates its parameters. If passed a null pointer as `timeptr`, the function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the](#)

Requirements

FUNCTION	REQUIRED HEADER
_ftime	<sys/types.h> and <sys/timeb.h>
_ftime32	<sys/types.h> and <sys/timeb.h>
_ftime64	<sys/types.h> and <sys/timeb.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_ftime.c
// compile with: /W3
// This program uses _ftime to obtain the current
// time and then stores this time in timebuffer.

#include <stdio.h>
#include <sys/timeb.h>
#include <time.h>

int main( void )
{
    struct _timeb timebuffer;
    char timeline[26];
    errno_t err;
    time_t time1;
    unsigned short millitm1;
    short timezone1;
    short dstflag1;

    _ftime( &timebuffer ); // C4996
    // Note: _ftime is deprecated; consider using _ftime_s instead

    time1 = timebuffer.time;
    millitm1 = timebuffer.millitm;
    timezone1 = timebuffer.timezone;
    dstflag1 = timebuffer.dstflag;

    printf( "Seconds since midnight, January 1, 1970 (UTC): %I64d\n",
            time1 );
    printf( "Milliseconds: %d\n", millitm1 );
    printf( "Minutes between UTC and local time: %d\n", timezone1 );
    printf( "Daylight savings time flag (1 means Daylight time is in "
            "effect): %d\n", dstflag1 );

    err = ctime_s( timeline, 26, &( timebuffer.time ) );
    if (err)
    {
        printf("Invalid argument to ctime_s. ");
    }
    printf( "The time is %.19s.%hu %s",
            timeline, timebuffer.millitm,
            &timeline[20] );
}
```

```
Seconds since midnight, January 1, 1970 (UTC): 1051553334
Milliseconds: 230
Minutes between UTC and local time: 480
Daylight savings time flag (1 means Daylight time is in effect): 1
The time is Mon Apr 28 11:08:54.230 2003
```

See also

[Time management](#)

[asctime](#), [_wasctime](#)
[ctime](#), [_ctime32](#), [_ctime64](#), [_wctime](#), [_wctime32](#), [_wctime64](#)
[gmtime](#), [_gmtime32](#), [_gmtime64](#)
[localtime](#), [_localtime32](#), [_localtime64](#)
[time](#), [_time32](#), [_time64](#)

`_ftime_s`, `_ftime32_s`, `_ftime64_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current time. These functions are versions of `_ftime`, `_ftime32`, `_ftime64` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _ftime_s( struct _timeb *timeptr );
errno_t _ftime32_s( struct __timeb32 *timeptr );
errno_t _ftime64_s( struct __timeb64 *timeptr );
```

Parameters

`timeptr`

Pointer to a `_timeb`, `__timeb32`, or `__timeb64` structure.

Return value

Zero if successful, an error code on failure. If `timeptr` is `NULL`, the return value is `EINVAL`.

Remarks

The `_ftime_s` function gets the current local time and stores it in the structure pointed to by `timeptr`. The `_timeb`, `__timeb32`, and `__timeb64` structures are defined in `SYS\Timeb.h`. They contain four fields, which are listed in the following table.

FIELD	DESCRIPTION
<code>dstflag</code>	Nonzero if daylight savings time is currently in effect for the local time zone. (See <code>_tzset</code> for an explanation of how daylight savings time is determined.)
<code>millitm</code>	Fraction of a second in milliseconds.
<code>time</code>	Time in seconds since midnight (00:00:00), January 1, 1970, coordinated universal time (UTC).
<code>timezone</code>	Difference in minutes, moving westward, between UTC and local time. The value of <code>timezone</code> is set from the value of the global variable <code>_timezone</code> (see <code>_tzset</code>).

The `_ftime64_s` function, which uses the `__timeb64` structure, allows file-creation dates to be expressed up through 23:59:59, December 31, 3000, UTC; whereas `_ftime32_s` only represents dates through 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for all these functions.

The `_ftime_s` function is equivalent to `_ftime64_s`, and `_timeb` contains a 64-bit time, unless `_USE_32BIT_TIME_T` is defined, in which case the old behavior is in effect; `_ftime_s` uses a 32-bit time and `_timeb` contains a 32-bit time.

`_ftime_s` validates its parameters. If passed a null pointer as `timeptr`, the function invokes the invalid

parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_ftime_s</code>	<code><sys/types.h></code> and <code><sys/timeb.h></code>
<code>_ftime32_s</code>	<code><sys/types.h></code> and <code><sys/timeb.h></code>
<code>_ftime64_s</code>	<code><sys/types.h></code> and <code><sys/timeb.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_ftime64_s.c
// This program uses _ftime64_s to obtain the current
// time and then stores this time in timebuffer.

#include <stdio.h>
#include <sys/timeb.h>
#include <time.h>

int main( void )
{
    struct _timeb timebuffer;
    char timeline[26];
    errno_t err;
    time_t time1;
    unsigned short millitm1;
    short timezone1;
    short dstflag1;

    _ftime64_s( &timebuffer );

    time1 = timebuffer.time;
    millitm1 = timebuffer.millitm;
    timezone1 = timebuffer.timezone;
    dstflag1 = timebuffer.dstflag;

    printf( "Seconds since midnight, January 1, 1970 (UTC): %I64d\n",
            time1 );
    printf( "Milliseconds: %d\n", millitm1 );
    printf( "Minutes between UTC and local time: %d\n", timezone1 );
    printf( "Daylight savings time flag (1 means Daylight time is in "
            "effect): %d\n", dstflag1 );

    err = ctime_s( timeline, 26, &( timebuffer.time ) );
    if (err)
    {
        printf("Invalid argument to ctime_s. ");
    }
    printf( "The time is %.19s.%hu %s",
            timeline, timebuffer.millitm,
            &timeline[20] );
}

```

```

Seconds since midnight, January 1, 1970 (UTC): 1051553334
Milliseconds: 230
Minutes between UTC and local time: 480
Daylight savings time flag (1 means Daylight time is in effect): 1
The time is Mon Apr 28 11:08:54.230 2003

```

See also

Time management

asctime	_wasctime				
ctime	_ctime32	_ctime64	_wctime	_wctime32	_wctime64
gmtime	_gmtime32	_gmtime64			
localtime	_localtime32	_localtime64			
time	_time32	_time64			

`_fullpath`, `_wfullpath`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Creates an absolute or full path name for the specified relative path name.

Syntax

```
char *_fullpath(
    char *absPath,
    const char *relPath,
    size_t maxLength
);
wchar_t *_wfullpath(
    wchar_t *absPath,
    const wchar_t *relPath,
    size_t maxLength
);
```

Parameters

`absPath`

Pointer to a buffer containing the absolute or full path name, or `NULL`.

`relPath`

Relative path name.

`maxLength`

Maximum length of the absolute path name buffer (`absPath`). This length is in bytes for `_fullpath` but in wide characters (`wchar_t`) for `_wfullpath`.

Return value

Each of these functions returns a pointer to a buffer containing the absolute path name (`absPath`). If there's an error (for example, if the value passed in `relPath` includes a drive letter that isn't valid or can't be found, or if the length of the created absolute path name (`absPath`) is greater than `maxLength`), the function returns `NULL`.

Remarks

The `_fullpath` function expands the relative path name in `relPath` to its fully qualified or absolute path and stores this name in `absPath`. If `absPath` is `NULL`, `malloc` is used to allocate a buffer of sufficient length to hold the path name. It's the responsibility of the caller to free this buffer. A relative path name specifies a path to another location from the current location (such as the current working directory: `.`). An absolute path name is the expansion of a relative path name that states the entire path required to reach the desired location from the root of the file system. Unlike `_makepath`, `_fullpath` can be used to obtain the absolute path name for relative paths (`relPath`) that include `./` or `../` in their names.

For example, to use C run-time routines, the application must include the header files that contain the declarations for the routines. Each header file `#include` directive references the location of the file in a relative manner (from the application's working directory):

```
#include <stdlib.h>
```

when the absolute path (actual file system location) of the file might be:

```
\machine\shareName\msvcSrc\crt\headerFiles\stdlib.h
```

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

`_fullpath` automatically handles multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use. `_wfullpath` is a wide-character version of `_fullpath`; the string arguments to `_wfullpath` are wide-character strings. `_wfullpath` and `_fullpath` behave identically except that `_wfullpath` doesn't handle multibyte-character strings.

If `_DEBUG` and `_CRTDBG_MAP_ALLOC` are both defined, calls to `_fullpath` and `_wfullpath` are replaced by calls to `_fullpath_dbg` and `_wfullpath_dbg`, to allow you to debug memory allocations. For more information, see [_fullpath_dbg](#), [_wfullpath_dbg](#).

This function invokes the invalid parameter handler, as described in [Parameter validation](#), if `maxLength` is less than or equal to 0. If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `NULL`.

Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tfullpath</code>	<code>_fullpath</code>	<code>_fullpath</code>	<code>_wfullpath</code>

If the `absPath` buffer is `NULL`, `_fullpath` calls `malloc` to allocate a buffer and ignores the `maxLength` argument. It's the caller's responsibility to deallocate this buffer (using `free`) as appropriate. If the `relPath` argument specifies a disk drive, the current directory of this drive is combined with the path.

Requirements

FUNCTION	REQUIRED HEADER
<code>_fullpath</code>	<code><stdlib.h></code>
<code>_wfullpath</code>	<code><stdlib.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crtFullPath.c
// This program demonstrates how _fullpath
// creates a full path from a partial path.

#include <stdio.h>
#include <conio.h>
#include <stdlib.h>
#include <direct.h>

void PrintFullPath( char * partialPath )
{
    char full[_MAX_PATH];
    if( _fullpath( full, partialPath, _MAX_PATH ) != NULL )
        printf( "Full path is: %s\n", full );
    else
        printf( "Invalid path\n" );
}

int main( void )
{
    PrintFullPath( "test" );
    PrintFullPath( "\\test" );
    PrintFullPath( "..\\\\test" );
}
```

```
Full path is: C:\Documents and Settings\user\My Documents\test
Full path is: C:\test
Full path is: C:\Documents and Settings\user\test
```

See also

File handling

[_getcwd](#) , [_wgetcwd](#)
[_getdcwd](#) , [_wgetdcwd](#)
[_makepath](#) , [_wmakepath](#)
[_splitpath](#) , [_wsplitpath](#)

`_fullpath_dbg`, `_wfullpath_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Versions of `_fullpath`, `_wfullpath` that use the debug version of `malloc` to allocate memory.

Syntax

```
char *_fullpath_dbg(
    char *absPath,
    const char *relPath,
    size_t maxLength,
    int blockType,
    const char *filename,
    int linenumber
);
wchar_t *_wfullpath_dbg(
    wchar_t *absPath,
    const wchar_t *relPath,
    size_t maxLength,
    int blockType,
    const char *filename,
    int linenumber
);
```

Parameters

`absPath`

Pointer to a buffer containing the absolute or full path name, or `NULL`.

`relPath`

Relative path name.

`maxLength`

Maximum length of the absolute path name buffer (`absPath`). This length is in bytes for `_fullpath_dbg` but in wide characters (`wchar_t`) for `_wfullpath_dbg`.

`blockType`

Requested type of memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file that requested allocation operation or `NULL`.

`linenumber`

Line number in the source file where the allocation operation was requested or `NULL`.

Return value

Each function returns a pointer to a buffer containing the absolute path name (`absPath`). If there's an error (for example, if the value passed in `relPath` includes a drive letter that isn't valid or can't be found, or if the length of the created absolute path name (`absPath`) is greater than `maxLength`) the function returns `NULL`.

Remarks

The `_fullpath_dbg` and `_wfullpath_dbg` functions are identical to `_fullpath` and `_wfullpath` except that, when

`_DEBUG` is defined, these functions use the debug version of `malloc`, `_malloc_dbg`, to allocate memory if `NULL` is passed as the first parameter. For information on the debugging features of `_malloc_dbg`, see [_malloc_dbg](#).

You don't need to call these functions explicitly in most cases. Instead, you can define the `_CRTDBG_MAP_ALLOC` flag. When `_CRTDBG_MAP_ALLOC` is defined, calls to `_fullpath` and `_wfullpath` are remapped to `_fullpath_dbg` and `_wfullpath_dbg`, respectively, with the `bLockType` set to `_NORMAL_BLOCK`. Thus, you don't need to call these functions explicitly unless you want to mark the heap blocks as `_CLIENT_BLOCK`. For more information, see [Types of blocks on the debug heap](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tfullpath_dbg</code>	<code>_fullpath_dbg</code>	<code>_fullpath_dbg</code>	<code>_wfullpath_dbg</code>

Requirements

FUNCTION	REQUIRED HEADER
<code>_fullpath_dbg</code>	<code><crtdbg.h></code>
<code>_wfullpath_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

See also

File handling

`_fullpath`, `_wfullpath`

[Debug versions of heap allocation functions](#)

`_futime`, `_futime32`, `_futime64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the modification time on an open file.

Syntax

```
int _futime(
    int fd,
    struct _utimbuf *filetime
);
int _futime32(
    int fd,
    struct __utimbuf32 *filetime
);
int _futime64(
    int fd,
    struct __utimbuf64 *filetime
);
```

Parameters

`fd`

File descriptor to the open file.

`filetime`

Pointer to the structure containing the new modification date.

Return value

Return 0 if successful. If an error occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and `errno` is set to `EBADF`, indicating an invalid file descriptor, or `EINVAL`, indicating an invalid parameter.

Remarks

The `_futime` routine sets the modification date and the access time on the open file associated with `fd`. `_futime` is identical to `_utime`, except that its argument is the file descriptor of an open file, rather than the name of a file or a path to a file. The `_utimbuf` structure contains fields for the new modification date and access time. Both fields must contain valid values. `_utimbuf32` and `_utimbuf64` are identical to `_utimbuf` except for the use of the 32-bit and 64-bit time types, respectively. `_futime` and `_utimbuf` use a 64-bit time type and `_futime` is identical in behavior to `_futime64`. If you need to force the old behavior, define `_USE_32BIT_TIME_T`. Doing this causes `_futime` to be identical in behavior to `_futime32` and causes the `_utimbuf` structure to use the 32-bit time type, making it equivalent to `_utimbuf32`.

`_futime64`, which uses the `_utimbuf64` structure, can read and modify file dates through 23:59:59, December 31, 3000, UTC; whereas a call to `_futime32` fails if the date on the file is later than 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for these functions.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_futime</code>	<code><sys/utime.h></code>	<code><errno.h></code>
<code>_futime32</code>	<code><sys/utime.h></code>	<code><errno.h></code>
<code>_futime64</code>	<code><sys/utime.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_futime.c
// This program uses _futime to set the
// file-modification time to the current time.

#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <io.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <sys/utime.h>
#include <share.h>

int main( void )
{
    int hFile;

    // Show file time before and after.
    system( "dir crt_futime.c_input" );

    _sopen_s( &hFile, "crt_futime.c_input", _O_RDWR, _SH_DENYNO, 0 );
    if( _futime( hFile, NULL ) == -1 )
        perror( "_futime failed\n" );
    else
        printf( "File time modified\n" );
    _close (hFile);

    system( "dir crt_futime.c_input" );
}
```

Input: crt_futime.c_input

Arbitrary file contents.

Sample output

```
Volume in drive Z has no label.  
Volume Serial Number is 5C68-57C1
```

```
Directory of Z:\crt
```

```
03/25/2004 10:40 AM           24 crt_futime.c_input  
      1 File(s)           24 bytes  
      0 Dir(s) 24,268,476,416 bytes free
```

```
Volume in drive Z has no label.  
Volume Serial Number is 5C68-57C1
```

```
Directory of Z:\crt
```

```
03/25/2004 10:41 AM           24 crt_futime.c_input  
      1 File(s)           24 bytes  
      0 Dir(s) 24,268,476,416 bytes free
```

```
File time modified
```

See also

[Time management](#)

Unimplemented.

Syntax

```
int fwide(
    FILE *stream,
    int mode;
);
```

Parameters

`stream`

Pointer to `FILE` structure (ignored).

`mode`

The new width of the stream: positive for wide character, negative for byte, zero to leave unchanged. (This value is ignored.)

Return value

This function currently just returns `mode`.

Remarks

The current version of this function doesn't conform to the C Standard.

Requirements

FUNCTION	REQUIRED HEADER
<code>fwide</code>	<wchar.h>

For more information, see [Compatibility](#).

fwrite

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes data to a stream.

Syntax

```
size_t fwrite(
    const void *buffer,
    size_t size,
    size_t count,
    FILE *stream
);
```

Parameters

`buffer`

Pointer to data to be written.

`size`

Item size, in bytes.

`count`

Maximum number of items to be written.

`stream`

Pointer to `FILE` structure.

Return value

`fwrite` returns the number of full items the function writes, which may be less than `count` if an error occurs. Also, if an error occurs, the file-position indicator can't be determined. If either `stream` or `buffer` is a null pointer, or if an odd number of bytes to be written is specified in Unicode mode, the function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns 0.

Remarks

The `fwrite` function writes up to `count` items, of `size` length each, from `buffer` to the output `stream`. The file pointer associated with `stream` (if there's one) is incremented by the number of bytes `fwrite` writes. If `stream` is opened in text mode, each line feed is replaced with a carriage return-line feed pair. The replacement has no effect on the return value.

When `stream` is opened in Unicode translation mode—for example, if `stream` is opened by calling `fopen` and using a mode parameter that includes `ccs=UNICODE`, `ccs=UTF-16LE`, or `ccs=UTF-8`, or if the mode is changed to a Unicode translation mode by using `_setmode` and a mode parameter that includes `_o_WTEXT`, `_o_U16TEXT`, or `_o_U8TEXT`—`buffer` is interpreted as a pointer to an array of `wchar_t` that contains UTF-16 data. An attempt to write an odd number of bytes in this mode causes a parameter validation error.

Because this function locks the calling thread, it's thread-safe. For a non-locking version, see `_fwrite_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the](#)

Requirements

FUNCTION	REQUIRED HEADER
<code>fwrite</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`fread`](#).

See also

Stream I/O

<code>_setmode</code>
<code>fread</code>
<code>_fwrite_nolock</code>
<code>_write</code>

_fwrite_nolock

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes data to a stream, without locking the thread.

Syntax

```
size_t _fwrite_nolock(
    const void *buffer,
    size_t size,
    size_t count,
    FILE *stream
);
```

Parameters

`buffer`

Pointer to the data to be written.

`size`

Item size in bytes.

`count`

Maximum number of items to be written.

`stream`

Pointer to the `FILE` structure.

Return value

Same as [fwrite](#).

Remarks

This function is a non-locking version of `fwrite`. It's identical to `fwrite` except that it isn't protected from interference by other threads. It might be faster because it doesn't incur the overhead of locking out other threads. Use this function only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_fwrite_nolock</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for [fread](#).

See also

Stream I/O

[fread](#)

[_write](#)



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The Microsoft-specific function name `gcvt` is a deprecated alias for the `_gcvt` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_gcvt` or the security-enhanced `_gcvt_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

Converts a floating-point value to a string, which it stores in a buffer. A more secure version of this function is available; see [_gcvt_s](#).

Syntax

```
char *_gcvt(
    double value,
    int digits,
    char *buffer
);
```

Parameters

`value`

Value to be converted.

`digits`

Number of significant digits stored.

`buffer`

Storage location for the result.

Return value

`_gcvt` returns a pointer to the string of digits.

Remarks

The `_gcvt` function converts a floating-point `value` to a character string (which includes a decimal point and a possible sign byte) and stores the string in `buffer`. The `buffer` should be large enough to accommodate the converted value plus a terminating null character, which is appended automatically. If a buffer size of `digits` + 1 is used, the function overwrites the end of the buffer. The overwrite happens because the converted string includes a decimal point and can also contain sign and exponent information. The function doesn't account for the overflow. `_gcvt` attempts to produce `digits` digits in decimal format. If it can't, it produces `digits` digits in exponential format. Trailing zeros might be suppressed in the conversion.

A `buffer` of length `_CVTBUFSIZE` is sufficient for any floating point value.

This function validates its parameters. If `buffer` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `NULL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_gcvt</code>	<stdlib.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_gcvt.c
// compile with: /W3
#include <stdlib.h>
#include <stdio.h>
#include <string.h>

int main( void )
{
    char buffer[_CVTBUFSIZE];
    double value = -1234567890.123;
    printf( "The following numbers were converted by _gcvt(value,12,buffer):\n" );
    _gcvt( value, 12, buffer ); // C4996
    // Note: _gcvt is deprecated; consider using _gcvts instead
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
    value *= 10;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
    value *= 10;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
    value *= 10;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );

    printf( "\n" );
    value = -12.34567890123;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
    value /= 10;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
    value /= 10;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
    value /= 10;
    _gcvt( value, 12, buffer ); // C4996
    printf( "buffer: '%s' (%d chars)\n", buffer, strlen(buffer) );
}
```

```
The following numbers were converted by _gcvt(value,12,buffer):  
buffer: '-1234567890.12' (14 chars)  
buffer: '-12345678901.2' (14 chars)  
buffer: '-123456789012' (13 chars)  
buffer: '-1.23456789012e+012' (19 chars)  
  
buffer: '-12.3456789012' (14 chars)  
buffer: '-1.23456789012' (14 chars)  
buffer: '-0.123456789012' (15 chars)  
buffer: '-1.23456789012e-002' (19 chars)
```

See also

Data conversion

Math and floating-point support

[atof](#), [_atof_l](#), [_wtof](#), [_wtof_l](#)

[_ecvt](#)

[_fcvt](#)

Converts a floating-point value to a string. This function is a version of `_gcvt` with security enhancements, as described in [Security features in the CRT](#).

Syntax

```
errno_t _gcvt_s(
    char *buffer,
    size_t sizeInBytes,
    double value,
    int digits
);
template <size_t cchStr>
errno_t _gcvt_s(
    char (&buffer)[cchStr],
    double value,
    int digits
); // C++ only
```

Parameters

`buffer`

Buffer to store the result of the conversion.

`sizeInBytes`

Size of the buffer.

`value`

Value to be converted.

`digits`

Number of significant digits stored.

Return value

Zero if successful. If a failure occurs due to an invalid parameter (see the following table for invalid values), the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, an error code is returned. Error codes are defined in Errno.h. For a listing of these errors, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Error conditions

<code>BUFFER</code>	<code>SIZEINBYTES</code>	<code>VALUE</code>	<code>DIGITS</code>	RETURN	VALUE IN <code>BUFFER</code>
<code>NULL</code>	any	any	any	<code>EINVAL</code>	Not modified.
Not <code>NULL</code> (points to valid memory)	zero	any	any	<code>EINVAL</code>	Not modified.

BUFFER	SIZEINBYTES	VALUE	DIGITS	RETURN	VALUE IN BUFFER
Not <code>NULL</code> (points to valid memory)	any	any	$\geq sizeInBytes$	<code>EINVAL</code>	Not modified.

Security Issues

`_gcvt_s` can generate an access violation if `buffer` doesn't point to valid memory and isn't `NULL`.

Remarks

The `_gcvt_s` function converts a floating-point `value` to a character string (which includes a decimal point and a possible sign byte) and stores the string in `buffer`. `buffer` should be large enough to accommodate the converted value plus a terminating null character, which is appended automatically. A buffer of length `_CVTBUFSIZE` is sufficient for any floating point value. If a buffer size of `digits` + 1 is used, the function won't overwrite the end of the buffer, so be sure to supply a sufficient buffer for this operation. `_gcvt_s` attempts to produce `digits` digits in decimal format. If it can't, it produces `digits` digits in exponential format. Trailing zeros can be suppressed in the conversion.

In C++, using this function is simplified by a template overload; the overload can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug version of this function first fills the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_gcvt_s</code>	<code><stdlib.h></code>	<code><error.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_gcvts.c
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main()
{
    char buf[_CVTBUFSIZE];
    int decimal;
    int sign;
    int err;

    err = _gcvts(buf, _CVTBUFSIZE, 1.2, 5);

    if (err != 0)
    {
        printf("_gcvts failed with error code %d\n", err);
        exit(1);
    }

    printf("Converted value: %s\n");
}
```

```
Converted value: 1.2
```

See also

[Data conversion](#)

[Math and floating-point support](#)

[atof](#) , [_atof_l](#) , [_wtof](#) , [_wtof_l](#)
[_ecvt_s](#)
[_fcvt_s](#)
[_gcvt](#)

`_get_current_locale`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a locale object representing the current locale.

Syntax

```
_locale_t _get_current_locale(void);
```

Return value

A locale object representing the current locale.

Remarks

The `_get_current_locale` function gets the currently set locale for the thread and returns a locale object representing that locale.

The previous name of this function, `__get_current_locale` (with two leading underscores) has been deprecated.

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_current_locale</code>	<locale.h>

For more compatibility information, see [Compatibility](#).

See also

[`setlocale`](#) , [`_wsetlocale`](#)
[`_create_locale`](#) , [`_wcreate_locale`](#)
[`_free_locale`](#)

_get_daylight

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the daylight saving time offset in hours.

Syntax

```
error_t _get_daylight( int* hours );
```

Parameters

hours

The offset in hours of daylight saving time.

Return value

Zero if successful or an `errno` value if an error occurs.

Remarks

The `_get_daylight` function retrieves the number of hours in daylight saving time as an integer. If daylight saving time is in effect, the default offset is one hour (although a few regions do observe a two-hour offset).

If `hours` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

We recommend you use this function instead of the macro `_daylight` or the deprecated function `__daylight`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_daylight</code>	<code><time.h></code>

For more information, see [Compatibility](#).

See also

Time management

`errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`
`_get_dstbias`
`_get_timezone`
`_get_tzname`

_get_doserrno

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the error value returned by the operating system before it's translated into an `errno` value.

Syntax

```
errno_t _get_doserrno(  
    int * pValue  
)
```

Parameters

`pValue`

A pointer to an integer to be filled with the current value of the `_doserrno` global macro.

Return value

If `_get_doserrno` succeeds, it returns zero; if it fails, it returns an error code. If `pValue` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

Remarks

The `_doserrno` global macro is set to zero during CRT initialization, before process execution begins. It's set to the operating-system error value returned by any system-level function call that returns an operating-system error, and it's never reset to zero during execution. When you write code to check the error value returned by a function, always clear `_doserrno` by using `_set_doserrno` before the function call. Because another function call may overwrite `_doserrno`, check the value by using `_get_doserrno` immediately after the function call.

We recommend `_get_errno` instead of `_get_doserrno` for portable error codes.

Possible values of `_doserrno` are defined in `<errno.h>`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_get_doserrno</code>	<code><stdlib.h>, <cstdlib> (C++)</code>	<code><errno.h>, <cerrno> (C++)</code>

`_get_doserrno` is a Microsoft extension. For more compatibility information, see [Compatibility](#).

See also

[_set_doserrno](#)

[errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#)

_get_dstbias

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the daylight saving time offset in seconds.

Syntax

```
error_t _get_dstbias( long* seconds );
```

Parameters

`seconds`

The offset in seconds of daylight saving time.

Return value

Zero if successful or an `errno` value if an error occurs.

Remarks

The `_get_dstbias` function retrieves the number of seconds in daylight saving time as an integer. If daylight saving time is in effect, the default offset is 3600 seconds, which is the number of seconds in one hour (though a few regions do observe a two-hour offset).

If `seconds` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

We recommend you use this function instead of the macro `_dstbias` or the deprecated function `_dstbias`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_dstbias</code>	<code><time.h></code>

For more information, see [Compatibility](#).

See also

Time management

`errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`
`_get_daylight`
`_get_timezone`
`_get_tzname`

_get_errno

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current value of the `errno` global variable.

Syntax

```
errno_t _get_errno(  
    int * pValue  
)
```

Parameters

`pValue`

A pointer to an integer to be filled with the current value of the `errno` variable.

Return value

Returns zero if successful; an error code on failure. If `pValue` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

Remarks

Possible values of `errno` are defined in Errno.h. Also, see [errno constants](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Example

```
// crt_get_errno.c  
#include <errno.h>  
#include <fcntl.h>  
#include <io.h>  
#include <stdio.h>  
#include <sys/stat.h>  
  
int main()  
{  
    errno_t err;  
    int pfh;  
    _open_s(&pfh, "nonexistent.file", _O_WRONLY, _SH_DENYNO, _S_IWRITE);  
    _get_errno(&err);  
    printf("errno = %d\n", err);  
    printf("fyi, ENOENT = %d\n", ENOENT);  
}
```

```
errno = 2  
fyi, ENOENT = 2
```

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_get_errno</code>	<code><stdlib.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

See also

[`_set_errno`](#)
[`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#)

`_get_FMA3_enable`, `_set_FMA3_enable`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets or sets a flag that specifies whether the transcendental math floating-point library functions use FMA3 instructions in code compiled for X64 platforms.

Syntax

```
int _set_FMA3_enable(int flag);
int _get_FMA3_enable();
```

Parameters

`flag`

Set to 1 to enable the FMA3 implementations of the transcendental math floating-point library functions on X64 platforms, or to 0 to use the implementations that don't use FMA3 instructions.

Return value

A non-zero value if the FMA3 implementations of the transcendental math floating-point library functions are enabled. Otherwise, zero.

Remarks

Use the `_set_FMA3_enable` function to enable or disable the use of FMA3 instructions in the transcendental math floating-point functions in the CRT library. The return value reflects the implementation in use after the change. If the CPU doesn't support FMA3 instructions, this function can't enable them in the library, and the return value is zero. Use `_get_FMA3_enable` to get the current state of the library. By default, on X64 platforms, the CRT startup code detects whether the CPU supports FMA3 instructions, and enables or disables the FMA3 implementations in the library.

The FMA3 implementations use different algorithms. Slight differences in the result of computations may be observable when the FMA3 implementations are enabled or disabled. Differences may also be observable between computers that do or don't support FMA3. For more information, see [Floating-point migration issues](#).

Requirements

The `_set_FMA3_enable` and `_get_FMA3_enable` functions are only available in the X64 versions of the CRT.

ROUTINE	REQUIRED HEADER
<code>_set_FMA3_enable</code> , <code>_get_FMA3_enable</code>	C: <math.h> C++: <cmath> or <math.h>

The `_set_FMA3_enable` and `_get_FMA3_enable` functions are Microsoft-specific. For compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

Floating-point migration issues

_get_fmode

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the default file translation mode for file I/O operations.

Syntax

```
errno_t _get_fmode(  
    int * pmode  
)
```

Parameters

pmode

A pointer to an integer to be filled with the current default mode: `_O_TEXT` or `_O_BINARY`.

Return value

Returns zero if successful; an error code on failure. If `pmode` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `EINVAL`.

Remarks

The function gets the value of the `_fmode` global variable. This variable specifies the default file translation mode for both low-level and stream file I/O operations, such as `_open`, `_pipe`, `fopen`, and `freopen`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_get_fmode</code>	<code><stdlib.h></code>	<code><fcntl.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [_set_fmode](#).

See also

`_fmode`
`_set_fmode`
`_setmode`

[Text and binary mode file I/O](#)

_get_heap_handle

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the handle of the heap that's used by the C run-time system.

Syntax

```
intptr_t _get_heap_handle( void );
```

Return value

Returns the handle to the Win32 heap used by the C run-time system.

Remarks

Use this function if you want to call [HeapSetInformation](#) and enable the Low Fragmentation Heap on the CRT heap.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
_get_heap_handle	<malloc.h>

For more compatibility information, see [Compatibility](#).

Sample

```
// crt_get_heap_handle.cpp
// compile with: /MT
#include <windows.h>
#include <malloc.h>
#include <stdio.h>

int main(void)
{
    intptr_t hCrtHeap = _get_heap_handle();
    ULONG ulEnableLFH = 2;
    if (HeapSetInformation((PVOID)hCrtHeap,
                          HeapCompatibilityInformation,
                          &ulEnableLFH, sizeof(ulEnableLFH)))
        puts("Enabling Low Fragmentation Heap succeeded");
    else
        puts("Enabling Low Fragmentation Heap failed");
    return 0;
}
```

See also

[Memory allocation](#)

[_get_invalid_parameter_handler](#),

[_get_thread_local_invalid_parameter_handler](#)

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the function that is called when the CRT detects an invalid argument.

Syntax

```
_invalid_parameter_handler _get_invalid_parameter_handler(void);  
_invalid_parameter_handler _get_thread_local_invalid_parameter_handler(void);
```

Return value

A pointer to the currently set invalid parameter handler function, or a null pointer if none has been set.

Remarks

The `_get_invalid_parameter_handler` function gets the currently set global invalid parameter handler. It returns a null pointer if no global invalid parameter handler was set. Similarly, the

`_get_thread_local_invalid_parameter_handler` gets the current thread-local invalid parameter handler of the thread it's called on, or a null pointer if no handler was set. For information about how to set global and thread-local invalid parameter handlers, see [_set_invalid_parameter_handler](#), [_set_thread_local_invalid_parameter_handler](#).

The returned invalid parameter handler function pointer has the following type:

```
typedef void (__cdecl* _invalid_parameter_handler)(  
    wchar_t const*,  
    wchar_t const*,  
    wchar_t const*,  
    unsigned int,  
    uintptr_t  
>;
```

For details on the invalid parameter handler, see the prototype in [_set_invalid_parameter_handler](#), [_set_thread_local_invalid_parameter_handler](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_invalid_parameter_handler</code> , <code>_get_thread_local_invalid_parameter_handler</code>	C: <stdlib.h> C++: <cstdlib> or <stdlib.h>

The `_get_invalid_parameter_handler` and `_get_thread_local_invalid_parameter_handler` functions are Microsoft-

specific. For compatibility information, see [Compatibility](#).

See also

[`_set_invalid_parameter_handler`](#), [`_set_thread_local_invalid_parameter_handler`](#)

Security-enhanced versions of CRT functions

_get_osfhandle

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the operating-system file handle that is associated with the specified file descriptor.

Syntax

```
intptr_t _get_osfhandle(  
    int fd  
);
```

Parameters

`fd`

An existing file descriptor.

Return value

Returns an operating-system file handle if `fd` is valid. Otherwise, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, it returns `INVALID_HANDLE_VALUE` (-1). It also sets `errno` to `EBADF`, indicating an invalid file handle. To avoid a warning when the result is used as a Win32 file handle, cast it to a `HANDLE` type.

NOTE

When `stdin`, `stdout`, and `stderr` aren't associated with a stream (for example, in a Windows application without a console window), the file descriptor values for these streams are returned from `_fileno` as the special value -2. Similarly, if you use a 0, 1, or 2 as the file descriptor parameter instead of the result of a call to `_fileno`, `_get_osfhandle` also returns the special value -2 when the file descriptor is not associated with a stream, and does not set `errno`. However, this is not a valid file handle value, and subsequent calls that attempt to use it are likely to fail.

For more information about `EBADF` and other error codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

To close a file whose operating system (OS) file handle is obtained by `_get_osfhandle`, call `_close` on the file descriptor `fd`. Never call `CloseHandle` on the return value of this function. The underlying OS file handle is owned by the `fd` file descriptor, and is closed when `_close` is called on `fd`. If the file descriptor is owned by a `FILE *` stream, then calling `fclose` on that `FILE *` stream closes both the file descriptor and the underlying OS file handle. In this case, don't call `_close` on the file descriptor.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_osfhandle</code>	<code><io.h></code>

For more compatibility information, see [Compatibility](#).

See also

File handling

[`_close`](#)
[`_creat`](#), [`_wcreat`](#)
[`_dup`](#), [`_dup2`](#)
[`_open`](#), [`_wopen`](#)
[`_open_osfhandle`](#)

_get_pgmptr

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current value of the `_pgmptr` global variable.

Syntax

```
errno_t _get_pgmptr(  
    char **pValue  
)
```

Parameters

`pValue`

A pointer to a string to be filled with the current value of the `_pgmptr` variable.

Return value

Returns zero if successful; an error code on failure. If `pValue` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

Remarks

Only call `_get_pgmptr` if your program has a narrow entry point, like `main()` or `WinMain()`. The `_pgmptr` global variable contains the full path to the executable associated with the process. For more information, see [_pgmptr](#), [_wpgmptr](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_pgmptr</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

See also

[_get_wpgmptr](#)

_get_printf_count_output

11/2/2022 • 2 minutes to read • [Edit Online](#)

Indicates whether `printf`, `_printf_l`, `wprintf`, `_wprintf_l`-family functions support the `%n` format.

Syntax

```
int _get_printf_count_output();
```

Return value

Non-zero if `%n` is supported; 0 if `%n` isn't supported.

Remarks

If `%n` isn't supported (the default), any `%n` found in the format string of one of the `printf` functions invokes the invalid parameter handler, as described in [Parameter validation](#). If `%n` support is enabled (see `_set_printf_count_output`), then `%n` behaves as described in [Format specification syntax: printf and wprintf functions](#).

IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fegetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_printf_count_output</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for `_set_printf_count_output`.

See also

[_set_printf_count_output](#)

`_get_purecall_handler`, `_set_purecall_handler`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets or sets the error handler for a pure virtual function call.

Syntax

```
typedef void (_cdecl* _purecall_handler)(void);
_purecall_handler __cdecl _get_purecall_handler(void);
_purecall_handler __cdecl _set_purecall_handler(
    _purecall_handler function
);
```

Parameters

`function`

The function to be called when a pure virtual function is called. A `_purecall_handler` function must have a void return type.

Return value

The previous `_purecall_handler`. Returns `nullptr` if there was no previous handler.

Remarks

The `_get_purecall_handler` and `_set_purecall_handler` functions are Microsoft-specific and apply only to C++ code.

A call to a pure virtual function is an error because it has no implementation. By default, the compiler generates code to invoke an error handler function when a pure virtual function is called, which terminates the program. You can install your own error handler function for pure virtual function calls, to catch them for debugging or reporting purposes. To use your own error handler, create a function that has the `_purecall_handler` signature, then use `_set_purecall_handler` to make it the current handler.

Because there's only one `_purecall_handler` for each process, when you call `_set_purecall_handler` it immediately impacts all threads. The last caller on any thread sets the handler.

To restore the default behavior, call `_set_purecall_handler` by using a `nullptr` argument.

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_purecall_handler</code> , <code>_set_purecall_handler</code>	<code><cstdlib></code> or <code><stdlib.h></code>

For compatibility information, see [Compatibility](#).

Example

```
// _set_purecall_handler.cpp
// compile with: /W1
#include <tchar.h>
#include <stdio.h>
#include <stdlib.h>

class CDerived;
class CBase
{
public:
    CBase(CDerived *derived) : m_pDerived(derived) {}
    ~CBase();
    virtual void function(void) = 0;

    CDerived * m_pDerived;
};

class CDerived : public CBase
{
public:
    CDerived() : CBase(this) {} // C4355
    virtual void function(void) {};
};

CBase::~CBase()
{
    m_pDerived -> function();
}

void myPurecallHandler(void)
{
    printf("In _purecall_handler.");
    exit(0);
}

int _tmain(int argc, _TCHAR* argv[])
{
    _set_purecall_handler(myPurecallHandler);
    CDerived myDerived;
}
```

```
In _purecall_handler.
```

See also

[Error handling](#)

[_purecall](#)

_get_terminate

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the termination routine to be called by `terminate`.

Syntax

```
terminate_function _get_terminate( void );
```

Return value

Returns a pointer to the function registered by `set_terminate`. If no function has been set, the return value may be used to restore the default behavior; this value may be `NULL`.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_terminate</code>	<eh.h>

For more compatibility information, see [Compatibility](#).

See also

[Exception handling routines](#)

`abort`
`set_unexpected`
`terminate`
`unexpected`

_get_timezone

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the difference in seconds between coordinated universal time (UTC) and local time.

Syntax

```
error_t _get_timezone(  
    long* seconds  
)
```

Parameters

`seconds`

The difference in seconds between UTC and local time.

Return value

Zero if successful or an `errno` value if an error occurs.

Remarks

The `_get_timezone` function retrieves the difference in seconds between UTC and local time as an integer. The default value is 28,800 seconds, for Pacific Standard Time (eight hours behind UTC).

If `seconds` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_timezone</code>	<code><time.h></code>

For more information, see [Compatibility](#).

See also

Time management

`errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`
`_get_daylight`
`_get_dstbias`
`_get_tzname`

_get_tzname

11/2/2022 • 4 minutes to read • [Edit Online](#)

Retrieves the character string representation of the time zone name or the daylight standard time (DST) zone name.

Syntax

```
errno_t _get_tzname(  
    size_t* pReturnValue,  
    char* timeZoneName,  
    size_t sizeInBytes,  
    int index  
)
```

Parameters

`pReturnValue`

The string length of `timeZoneName` including a `NULL` terminator.

`timeZoneName`

The address of a character string for the representation of the time zone name or the daylight standard time zone name (DST), depending on `index`.

`sizeInBytes`

The size of the `timeZoneName` character string in bytes.

`index`

The `index` of one of the two time zone names to retrieve.

INDEX	CONTENTS OF <code>TIMEZONE NAME</code>	<code>TIMEZONE NAME</code> DEFAULT VALUE
0	Time zone name	"PST"
1	Daylight standard time zone name	"PDT"
> 1 or < 0	<code>errno</code> set to <code>EINVAL</code>	not modified

Unless explicitly updated during runtime, "PST" is returned for the standard time zone and "PDT" for the daylight standard time zone. For more information, see the [Remarks](#).

The time zone string isn't guaranteed to be the same between OS releases. Official time zone names can and do change.

Return value

Zero if successful, otherwise an `errno` type value.

If either `timeZoneName` is `NULL`, or `sizeInBytes` is zero or less than zero (but not both), an invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

Error conditions

<code>PRETURNVALUE</code>	<code>TIMEZONENAME</code>	<code>SIZEINBYTES</code>	<code>INDEX</code>	<code>RETURN VALUE</code>	<code>CONTENTS OF TIMEZONENAME</code>
size of TZ name	<code>NULL</code>	0	0 or 1	0	not modified
size of TZ name	any	> 0	0 or 1	0	TZ name
not modified	<code>NULL</code>	> 0	any	<code>EINVAL</code>	not modified
not modified	any	zero	any	<code>EINVAL</code>	not modified
not modified	any	> 0	> 1	<code>EINVAL</code>	not modified

Remarks

The `_get_tzname` function retrieves the character string representation of the current time zone name or the daylight standard time zone name (DST) into the address of `timeZoneName` depending on the `index` value, along with the size of the string in `pReturnValue`. If `timeZoneName` is `NULL` and `sizeInBytes` is zero, the size of the string in bytes required to hold both the specified time zone, and a terminating `NULL`, is returned in `pReturnValue`.

The `index` values must be either 0 for standard time zone or 1 for daylight standard time zone; any other values have undetermined results.

By default, `"PST"` is returned for the standard time zone and `"PDT"` for the daylight standard time zone. The true time zone name is updated the first time it's needed by a function that requires time zone information, such as `strftime`, `ftime`, `ftime_s`, `mktime`, `localtime`, and others. If a function that doesn't require time zone information isn't called prior to calling `_get_tzname`, the default values are returned unless you first explicitly update them using one of the functions mentioned, or by a call to `tzset`. Also, if the `TZ` environment variable is set, it takes precedence over the time zone name reported by the OS. Even in this case, one of the functions mentioned above must be called before `_get_tzname` is called or the default time zone value will be returned. For more information about the `TZ` environment variable and the CRT, see [_tzset](#).

WARNING

The time zone string is not guaranteed to be the same between OS releases. Official time zone names can and do change.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Example

This sample calls `_get_tzname` to get the required buffer size to display the current Daylight standard time zone name, allocates a buffer of that size, calls `_get_tzname` again to load the name in the buffer, and prints it to the console.

It also calls `_tzset()` to cause the OS to update the time zone information before calling `_get_tzname()`. Otherwise, the default values are used.

```

// crt_get_tzname.c
// Compile by using: cl /W4 crt_get_tzname.c
#include <stdio.h>
#include <time.h>
#include <malloc.h>

enum TZindex {
    STD,
    DST
};

int main()
{
    size_t tznameSize = 0;
    char * tznameBuffer = NULL;

    _tzset(); // Update the time zone information

    // Get the size of buffer required to hold DST time zone name
    if (_get_tzname(&tznameSize, NULL, 0, DST))
    {
        return 1; // Return an error value if it failed
    }

    // Allocate a buffer for the name
    if (NULL == (tznameBuffer = (char *)malloc(tznameSize)))
    {
        return 2; // Return an error value if it failed
    }

    // Load the name in the buffer
    if (_get_tzname(&tznameSize, tznameBuffer, tznameSize, DST))
    {
        return 3; // Return an error value if it failed
    }

    printf_s("The current Daylight standard time zone name is %s.\n", tznameBuffer);
    return 0;
}

```

Output

The current Daylight standard time zone name is Pacific Daylight Time.

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_tzname</code>	<code><time.h></code>

For more information, see [Compatibility](#).

See also

Time management

<code>errno</code>	<code>_doserrno</code>	<code>_sys_errlist</code>	<code>_sys_nerr</code>
<code>_get_daylight</code>			
<code>_get_dstbias</code>			
<code>_get_timezone</code>			

_get_unexpected

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the termination routine to be called by `unexpected`.

Syntax

```
unexpected_function _get_unexpected( void );
```

Return value

Returns a pointer to the function registered by `set_unexpected`. If no function has been set, the return value may be used to restore the default behavior; this value may be `NULL`.

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_unexpected</code>	<code><eh.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Exception handling routines](#)

- [abort](#)
- [set_terminate](#)
- [terminate](#)
- [unexpected](#)

`_get_wpgmpt`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current value of the `_wpgmpt` global variable.

Syntax

```
errno_t _get_wpgmpt(
    wchar_t **pValue
);
```

Parameters

`pValue`

A pointer to a string to be filled with the current value of the `_wpgmpt` variable.

Return value

Returns zero if successful; an error code on failure. If `pValue` is `NULL`, the invalid parameter handler is invoked as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

Remarks

Only call `_get_wpgmpt` if your program has a wide entry point, like `wmain()` or `wWinMain()`. The `_wpgmpt` global variable contains the full path to the executable associated with the process as a wide-character string. For more information, see [`_pgmpt`](#), [`_wpgmpt`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_get_wpgmpt</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

See also

[`_get_pgmpt`](#)

getc, getwc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Read a character from a stream.

Syntax

```
int getc(  
    FILE *stream  
>;  
wint_t getwc(  
    FILE *stream  
>;
```

Parameters

`stream`

Input stream.

Return value

Returns the character read. To indicate a read error or end-of-file condition, `getc` returns `EOF`, and `getwc` returns `WEOF`. For `getc`, use `ferror` or `feof` to check for an error or for end of file. If `stream` is `NULL`, `getc` and `getwc` invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` (or `WEOF` for `getwc`), and set `errno` to `EINVAL`.

For more information about return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Each routine reads a single character from a file at the current position and increments the associated file pointer (if defined) to point to the next character. The file is associated with `stream`.

These functions lock the calling thread and are therefore thread-safe. For a non-locking version, see

[_getc_nolock](#), [_getwc_nolock](#).

Routine-specific remarks follow.

ROUTINE	REMARKS
<code>getc</code>	Same as <code>fgetc</code> , but implemented as a function and as a macro.
<code>getwc</code>	Wide-character version of <code>getc</code> . Reads a multibyte character or a wide character according to whether <code>stream</code> is opened in text mode or binary mode.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettc</code>	<code>getc</code>	<code>getc</code>	<code>getwc</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>getc</code>	<code><stdio.h></code>
<code>getwc</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getc.c
// Use getc to read a line from a file.

#include <stdio.h>

int main()
{
    char buffer[81];
    int i, ch;
    FILE* fp;

    // Read a single line from the file "crt_getc.txt".

    fopen_s(&fp, "crt_getc.txt", "r");
    if (!fp)
    {
        printf("Failed to open file crt_getc.txt.\n");
        exit(1);
    }

    for (i = 0; (i < 80) && ((ch = getc(fp)) != EOF)
        && (ch != '\n'); i++)
    {
        buffer[i] = (char) ch;
    }

    // Terminate string with a null character
    buffer[i] = '\0';
    printf( "Input was: %s\n", buffer);

    fclose(fp);
}
```

Input: crt_getc.txt

```
Line one.
Line two.
```

Output

Input was: Line one.

See also

Stream I/O

[fgetc](#) , [fgetwc](#)

[_getch](#) , [_getwch](#)

[putc](#) , [putwc](#)

[ungetc](#) , [ungetwc](#)

`_getc_nolock`, `_getwc_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads a character from a stream.

Syntax

```
int _getc_nolock(
    FILE *stream
);
wint_t _getwc_nolock(
    FILE *stream
);
```

Parameters

`stream`

Input stream.

Return value

See [getc](#), [getwc](#).

Remarks

These functions are identical to `getc` and `getwc` except that they don't lock the calling thread. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettc_nolock</code>	<code>getc_nolock</code>	<code>getc_nolock</code>	<code>getwc_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>getc_nolock</code>	<code><stdio.h></code>
<code>getwc_nolock</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getc_nolock.c
// Use getc to read a line from a file.

#include <stdio.h>

int main()
{
    char buffer[81];
    int i, ch;
    FILE* fp;

    // Read a single line from the file "crt_getc_nolock.txt".
    fopen_s(&fp, "crt_getc_nolock.txt", "r");
    if (!fp)
    {
        printf("Failed to open file crt_getc_nolock.txt.\n");
        exit(1);
    }

    for (i = 0; (i < 80) && ((ch = getc(fp)) != EOF)
        && (ch != '\n'); i++)
    {
        buffer[i] = (char) ch;
    }

    // Terminate string with a null character
    buffer[i] = '\0';
    printf( "Input was: %s\n", buffer);

    fclose(fp);
}
```

Input: crt_getc_nolock.txt

```
Line the first.  
Line the second.
```

Output

```
Input was: Line the first.
```

See also

Stream I/O

[fgetc](#) , [fgetwc](#)
[_getch](#) , [_getwch](#)
[putc](#) , [putwc](#)
[ungetc](#) , [ungetwc](#)

getch

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `getch` is a deprecated alias for the `_getch` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_getch` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_getch`, `_getwch`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a character from the console without echo.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _getch( void );
wint_t _getwch( void );
```

Return value

Returns the character read. There's no error return.

Remarks

The `_getch` and `_getwch` functions read a single character from the console without echoing the character.

None of these functions can be used to read CTRL+C. To read a function key or arrow key, each function must be called twice. The first call returns `0` or `0xE0`. The second call returns the [key scan code](#).

These functions lock the calling thread and so are thread-safe. For non-locking versions, see [`_getch_nolock`](#), [`_getwch_nolock`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettch</code>	<code>_getch</code>	<code>_getch</code>	<code>_getwch</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getch</code>	<code><conio.h></code>
<code>_getwch</code>	<code><conio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getch.c
// compile with: /c
// This program reads characters from
// the keyboard until it receives a 'Y' or 'y'.

#include <conio.h>
#include <ctype.h>

int main( void )
{
    int ch;

    _cputs( "Type 'Y' when finished typing keys: " );
    do
    {
        ch = _getch();
        ch = toupper( ch );
    } while( ch != 'Y' );

    _putch( ch );
    _putch( '\r' );      // Carriage return
    _putch( '\n' );      // Line feed
}
```

```
abcdefy
```

```
Type 'Y' when finished typing keys: Y
```

See also

Console and port I/O

[_getche](#) , [_getwche](#)
[_cgets](#) , [_cgetws](#)
[getc](#) , [getwc](#)
[_ungetch](#) , [_ungetwch](#) , [_ungetch_nolock](#) , [_ungetwch_nolock](#)

`_getch_nolock`, `_getwch_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a character from the console without echo and without locking the thread.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _getch_nolock( void );
wint_t _getwch_nolock( void );
```

Return value

Returns the character read. There's no error return.

Remarks

`_getch_nolock` and `_getwch_nolock` are identical to `_getch` and `_getchw` except that they are not protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettch_nolock</code>	<code>_getch_nolock</code>	<code>_getch_nolock</code>	<code>_getwch_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getch_nolock</code>	<code><conio.h></code>
<code>_getwch_nolock</code>	<code><conio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getch_nolock.c
// compile with: /c
// This program reads characters from
// the keyboard until it receives a 'Y' or 'y'.

#include <conio.h>
#include <ctype.h>

int main( void )
{
    int ch;

    _cputs( "Type 'Y' when finished typing keys: " );
    do
    {
        ch = _getch_nolock();
        ch = toupper( ch );
    } while( ch != 'Y' );

    _putch_nolock( ch );
    _putch_nolock( '\r' );      // Carriage return
    _putch_nolock( '\n' );      // Line feed
}
```

abcdefy

Type 'Y' when finished typing keys: Y

See also

Console and port I/O

[_getche](#) , [_getwche](#)
[_cgets](#) , [_cgetws](#)
[getc](#) , [getwc](#)
[_ungetch](#) , [_ungetwch](#) , [_ungetch_nolock](#) , [_ungetwch_nolock](#)

getchar , getwchar

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads a character from standard input.

Syntax

```
int getchar();
wint_t getwchar();
```

Return value

Returns the character read. These functions wait for input and don't return until input is available.

To indicate a read error or end-of-file condition, `getchar` returns `EOF`, and `getwchar` returns `WEOF`. For `getchar`, use `ferror` or `feof` to check for an error or for end of file.

Remarks

Each routine reads a single character from `stdin` and increments the associated file pointer to point to the next character. `getchar` is the same as `_fgetchar`, but it's implemented as a function and as a macro.

These functions also lock the calling thread and are thread-safe. For a non-locking version, see [_getchar_nolock](#), [_getwchar_nolock](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_gettchar</code>	<code>getchar</code>	<code>getchar</code>	<code>getwchar</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>getchar</code>	<code><stdio.h></code>
<code>getwchar</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_getchar.c
// Use getchar to read a line from stdin.

#include <stdio.h>

int main()
{
    char buffer[81];
    int i, ch;

    for (i = 0; (i < 80) && ((ch = getchar()) != EOF)
          && (ch != '\n'); i++)
    {
        buffer[i] = (char) ch;
    }

    // Terminate string with a null character
    buffer[i] = '\0';
    printf( "Input was: %s\n", buffer);
}
```

This textInput was: This text

See also

Stream I/O

[getc](#) , [getwc](#)
[fgetc](#) , [fgetwc](#)
[_getch](#) , [_getwch](#)
[putc](#) , [putwc](#)
[ungetc](#) , [ungetwc](#)

`_getchar_nolock`, `_getwchar_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads a character from standard input.

Syntax

```
int _getchar_nolock( void );
wint_t _getwchar_nolock( void );
```

Return value

See [getchar](#), [getwchar](#).

Remarks

`_getchar_nolock` and `_getwchar_nolock` are identical to `getchar` and `getwchar` except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettchar_nolock</code>	<code>_getchar_nolock</code>	<code>_getchar_nolock</code>	<code>_getwchar_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getchar_nolock</code>	<code><stdio.h></code>
<code>_getwchar_nolock</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_getchar_nolock.c
// Use _getchar_nolock to read a line from stdin.

#include <stdio.h>

int main()
{
    char buffer[81];
    int i, ch;

    for (i = 0; (i < 80) && ((ch = _getchar_nolock()) != EOF)
        && (ch != '\n'); i++)
    {
        buffer[i] = (char) ch;
    }

    // Terminate string with a null character

    buffer[i] = '\0';
    printf( "Input was: %s\n", buffer);
}
```

```
This textInput was: This text
```

See also

Stream I/O

[getc](#) , [getwc](#)
[fgetc](#) , [fgetwc](#)
[_getch](#) , [_getwch](#)
[putc](#) , [putwc](#)
[ungetc](#) , [ungetwc](#)

getche

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `getche` is a deprecated alias for the `_getche` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_getche` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_getche`, `_getwche`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a character from the console with echo.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _getche( void );
wint_t _getwche( void );
```

Return value

Returns the character read. There's no error return.

Remarks

The `_getche` and `_getwche` functions read a single character from the console with echo, meaning that the character is displayed at the console. None of these functions can be used to read CTRL+C. When `_getche` or `_getwche` reads a function key or an arrow key, the function must be called twice; the first call returns 0 or 0xE0, and the second call returns the actual key code.

These functions lock the calling thread and are therefore thread-safe. For non-locking versions, see

[`_getche_nolock`](#), [`_getwche_nolock`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettche</code>	<code>_getche</code>	<code>_getche</code>	<code>_getwche</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getche</code>	<code><conio.h></code>
<code>_getwche</code>	<code><conio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getche.c
// compile with: /c
// This program reads characters from
// the keyboard until it receives a 'Y' or 'y'.

#include <conio.h>
#include <ctype.h>

int main( void )
{
    int ch;

    _cputs( "Type 'Y' when finished typing keys: " );
    do
    {
        ch = _getche();
        ch = toupper( ch );
    } while( ch != 'Y' );

    _putch( ch );
    _putch( '\r' );      // Carriage return
    _putch( '\n' );      // Line feed
}
```

```
abcdefy
```

```
Type 'Y' when finished typing keys: abcdefyY
```

See also

Console and port I/O

[_cgets](#) , [_cgetws](#)
[getc](#) , [getwc](#)
[_ungetch](#) , [_ungetwch](#) , [_ungetch_nolock](#) , [_ungetwch_nolock](#)

`_getche_nolock`, `_getwche_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a character from the console, with echo and without locking the thread.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _getche_nolock( void );
wint_t _getwche_nolock( void );
```

Return value

Returns the character read. There's no error return.

Remarks

`_getche_nolock` and `_getwche_nolock` are identical to `_getche` and `_getwche` except that they are not protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_gettche_nolock</code>	<code>_getche_nolock</code>	<code>_getch_nolock</code>	<code>_getwche_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getche_nolock</code>	<code><conio.h></code>
<code>_getwche_nolock</code>	<code><conio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getche_nolock.c
// compile with: /c
// This program reads characters from
// the keyboard until it receives a 'Y' or 'y'.

#include <conio.h>
#include <ctype.h>

int main( void )
{
    int ch;

    _cputs( "Type 'Y' when finished typing keys: " );
    do
    {
        ch = _getche_nolock();
        ch = toupper( ch );
    } while( ch != 'Y' );

    _putch_nolock( ch );
    _putch_nolock( '\r' );      // Carriage return
    _putch_nolock( '\n' );      // Line feed
}
```

```
abcdefy
```

```
Type 'Y' when finished typing keys: abcdefyY
```

See also

Console and port I/O

[_cgets](#) , [_cgetws](#)
[getc](#) , [getwc](#)
[_ungetch](#) , [_ungetwch](#) , [_ungetch_nolock](#) , [_ungetwch_nolock](#)

getcwd

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `getcwd` is a deprecated alias for the `_getcwd` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_getcwd` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_getcwd`, `_wgetcwd`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current working directory.

Syntax

```
char *_getcwd(
    char *buffer,
    int maxlen
);
wchar_t *_wgetcwd(
    wchar_t *buffer,
    int maxlen
);
```

Parameters

`buffer`

Storage location for the path.

`maxLen`

Maximum length of the path in characters: `char` for `_getcwd` and `wchar_t` for `_wgetcwd`.

Return value

Returns a pointer to `buffer`. A `NULL` return value indicates an error, and `errno` is set either to `ENOMEM`, indicating that there's insufficient memory to allocate `maxLen` bytes (when a `NULL` argument is given as `buffer`), or to `ERANGE`, indicating that the path is longer than `maxLen` characters. If `maxLen` is less than or equal to zero, this function invokes an invalid parameter handler, as described in [Parameter validation](#).

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_getcwd` function gets the full path of the current working directory for the default drive and stores it at `buffer`. The integer argument `maxLen` specifies the maximum length for the path. An error occurs if the length of the path (including the terminating null character) exceeds `maxLen`. The `buffer` argument can be `NULL`; a buffer of at least size `maxLen` (more only if necessary) is automatically allocated, using `malloc`, to store the path. This buffer can later be freed by calling `free` and passing it the `_getcwd` return value (a pointer to the allocated buffer).

`_getcwd` returns a string that represents the path of the current working directory. If the current working directory is the root, the string ends with a backslash (`\`). If the current working directory is a directory other than the root, the string ends with the directory name and not with a backslash.

`_wgetcwd` is a wide-character version of `_getcwd`; the `buffer` argument and return value of `_wgetcwd` are wide-character strings. `_wgetcwd` and `_getcwd` behave identically otherwise.

When `_DEBUG` and `_CRTDBG_MAP_ALLOC` are defined, calls to `_getcwd` and `_wgetcwd` are replaced by calls to `_getcwd_dbg` and `_wgetcwd_dbg`, to allow you to debug memory allocations. For more information, see

`_getcwd_dbg` , `_wgetcwd_dbg` .

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tgetcwd</code>	<code>_getcwd</code>	<code>_getcwd</code>	<code>_wgetcwd</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getcwd</code>	<code><direct.h></code>
<code>_wgetcwd</code>	<code><direct.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getcwd.c
// Compile with: cl /W4 crt_getcwd.c
// This program places the name of the current directory in the
// buffer array, then displays the name of the current directory
// on the screen. Passing NULL as the buffer forces getcwd to allocate
// memory for the path, which allows the code to support file paths
// longer than _MAX_PATH, which are supported by NTFS.

#include <direct.h> // _getcwd
#include <stdlib.h> // free, perror
#include <stdio.h> // printf
#include <string.h> // strlen

int main( void )
{
    char* buffer;

    // Get the current working directory:
    if ( (buffer = _getcwd( NULL, 0 )) == NULL )
        perror( "_getcwd error" );
    else
    {
        printf( "%s \nLength: %zu\n", buffer, strlen(buffer) );
        free(buffer);
    }
}
```

C:\Code

See also

Directory control

`_chdir` , `_wchdir`

`_mkdir`, `_wmkdir`

`_rmdir`, `_wrmdir`

`_getcwd_dbg`, `_wgetcwd_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Debug versions of the `_getcwd`, `_wgetcwd` functions (only available during debug).

Syntax

```
char *_getcwd_dbg(
    char *buffer,
    int maxlen,
    int blockType,
    const char *filename,
    int linenumber
);
wchar_t *_wgetcwd_dbg(
    wchar_t *buffer,
    int maxlen,
    int blockType,
    const char *filename,
    int linenumber
);
```

Parameters

`buffer`

Storage location for the path.

`maxLen`

Maximum length of the path in characters: `char` for `_getcwd_dbg` and `wchar_t` for `_wgetcwd_dbg`.

`blockType`

Requested type of the memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file that requested the allocation operation or `NULL`.

`linenumber`

Line number in the source file where the allocation operation was requested or `NULL`.

Return value

Returns a pointer to `buffer`. A `NULL` return value indicates an error, and `errno` is set either to `ENOMEM`, indicating that there's insufficient memory to allocate `maxLen` bytes (when a `NULL` argument is given as `buffer`), or to `ERANGE`, indicating that the path is longer than `maxLen` characters.

For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_getcwd_dbg` and `_wgetcwd_dbg` functions are identical to `_getcwd` and `_wgetcwd` except that, when `_DEBUG` is defined, these functions use the debug version of `malloc` and `_malloc_dbg` to allocate memory if `NULL` is passed as the first parameter. For more information, see `_malloc_dbg`.

You don't need to call these functions explicitly in most cases. Instead, you can define the `_CRTDBG_MAP_ALLOC`

flag. When `_CRTDBG_MAP_ALLOC` is defined, calls to `_getcwd` and `_wgetcwd` are remapped to `_getcwd_dbg` and `_wgetcwd_dbg`, respectively, with the `blockType` set to `_NORMAL_BLOCK`. Thus, you don't need to call these functions explicitly unless you want to mark the heap blocks as `_CLIENT_BLOCK`. For more information, see [Types of blocks on the debug heap](#).

Generic-text routine mapping

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tgetcwd_dbg</code>	<code>_getcwd_dbg</code>	<code>_getcwd_dbg</code>	<code>_wgetcwd_dbg</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getcwd_dbg</code>	<crtdbg.h>
<code>_wgetcwd_dbg</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

See also

[`_getcwd`](#) , [`_wgetcwd`](#)

[Directory control](#)

[Debug versions of heap allocation functions](#)

`_getdcwd`, `_wgetdcwd`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the full path of the current working directory on the specified drive.

Syntax

```
char *_getdcwd(
    int drive,
    char *buffer,
    int maxlen
);
wchar_t *_wgetdcwd(
    int drive,
    wchar_t *buffer,
    int maxlen
);
```

Parameters

`drive`

A non-negative integer that specifies the drive (0 = default drive, 1 = A, 2 = B, and so on).

If the specified drive isn't available, the invalid parameter handler is invoked. It's also invoked when the kind of drive (for example, removable, fixed, CD-ROM, RAM disk, or network drive) can't be determined. For more information, see [Parameter validation](#).

`buffer`

Storage location for the path, or `NULL`.

If `NULL` is specified, this function allocates a buffer of at least `maxLen` size by using `malloc`, and the return value of `_getdcwd` is a pointer to the allocated buffer. The buffer can be freed by calling `free` and passing it the pointer.

`maxLen`

A nonzero positive integer that specifies the maximum length of the path, in characters: `char` for `_getdcwd` and `wchar_t` for `_wgetdcwd`.

If `maxLen` is less than or equal to zero, the invalid-parameter handler is invoked. For more information, see [Parameter validation](#).

Return value

Pointer to a string that represents the full path of the current working directory on the specified drive, or `NULL`, which indicates an error.

If `buffer` is specified as `NULL` and there's insufficient memory to allocate `maxLen` characters, an error occurs and `errno` is set to `ENOMEM`. If the length of the path including the terminating null character exceeds `maxLen`, an error occurs, and `errno` is set to `ERANGE`. For more information about these error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_getdcwd` function gets the full path of the current working directory on the specified drive and stores it at `buffer`. If the current working directory is set to the root, the string ends with a backslash (\). If the current working directory is set to a directory other than the root, the string ends with the name of the directory and not with a backslash.

`_wgetdcwd` is a wide-character version of `_getdcwd`, and its `buffer` parameter and return value are wide-character strings. Otherwise, `_wgetdcwd` and `_getdcwd` behave identically.

This function is thread-safe even though it depends on `GetFullPathName`, which is itself not thread-safe. However, you can violate thread safety if your multithreaded application calls both this function and `GetFullPathName`.

The version of this function that has the `_nolock` suffix behaves identically to this function except that it isn't thread-safe and isn't protected from interference by other threads. For more information, see `_getdcwd_nolock`, `_wgetdcwd_nolock`.

When `_DEBUG` and `_CRTDBG_MAP_ALLOC` are defined, calls to `_getdcwd` and `_wgetdcwd` are replaced by calls to `_getdcwd_dbg` and `_wgetdcwd_dbg`, so that you can debug memory allocations. For more information, see `_getdcwd_dbg`, `_wgetdcwd_dbg`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tgetdcwd</code>	<code>_getdcwd</code>	<code>_getdcwd</code>	<code>_wgetdcwd</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getdcwd</code>	<code><direct.h></code>
<code>_wgetdcwd</code>	<code><direct.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example in [`_getdrive`](#).

See also

Directory control

<code>_chdir</code>	<code>_wchdir</code>
<code>_getcwd</code>	<code>_wgetcwd</code>
<code>_getdrive</code>	
<code>_mkdir</code>	<code>_wmkdir</code>
<code>_rmdir</code>	<code>_wrmdir</code>

`_getdcwd_dbg`, `_wgetdcwd_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Debug versions of the `_getdcwd`, `_wgetdcwd` functions (only available during debug).

Syntax

```
char *_getdcwd_dbg(
    int drive,
    char *buffer,
    int maxlen,
    int blockType,
    const char *filename,
    int linenumber
);
wchar_t *_wgetdcwd_dbg(
    int drive,
    wchar_t *buffer,
    int maxlen,
    int blockType,
    const char *filename,
    int linenumber
);
```

Parameters

`drive`

Name of the disk drive.

`buffer`

Storage location for the path.

`maxLen`

Maximum length of the path in characters: `char` for `_getdcwd_dbg` and `wchar_t` for `_wgetdcwd_dbg`.

`blockType`

Requested type of the memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file that requested the allocation operation or `NULL`.

`linenumber`

Line number in the source file where the allocation operation was requested or `NULL`.

Return value

Returns a pointer to `buffer`. A `NULL` return value indicates an error, and `errno` is set either to `ENOMEM`, indicating that there's insufficient memory to allocate `maxLen` bytes (when a `NULL` argument is given as `buffer`), or to `ERANGE`, indicating that the path is longer than `maxLen` characters. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_getdcwd_dbg` and `_wgetdcwd_dbg` functions are identical to `_getdcwd` and `_wgetdcwd` except that, when

`_DEBUG` is defined, these functions use the debug version of `malloc` and `_malloc_dbg` to allocate memory if `NULL` is passed as the `buffer` parameter. For more information, see [_malloc_dbg](#).

You don't need to call these functions explicitly in most cases. Instead, you can define the `_CRTDBG_MAP_ALLOC` flag. When `_CRTDBG_MAP_ALLOC` is defined, calls to `_getdcwd` and `_wgetdcwd` are remapped to `_getdcwd_dbg` and `_wgetdcwd_dbg`, respectively, with the `blockType` set to `_NORMAL_BLOCK`. Thus, you don't need to call these functions explicitly unless you want to mark the heap blocks as `_CLIENT_BLOCK`. For more information, see [Types of blocks on the debug heap](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tgetdcwd_dbg</code>	<code>_getdcwd_dbg</code>	<code>_getdcwd_dbg</code>	<code>_wgetdcwd_dbg</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getdcwd_dbg</code>	<crtdbg.h>
<code>_wgetdcwd_dbg</code>	<crtdbg.h>

For more compatibility information, see [Compatibility](#).

See also

[_getdcwd](#) , [_wgetdcwd](#)

[Directory control](#)

[Debug versions of heap allocation functions](#)

`_getdcwd_nolock`, `_wgetdcwd_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the full path of the current working directory on the specified drive.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
char *_getdcwd_nolock(
    int drive,
    char *buffer,
    int maxlen
);
wchar_t *_wgetdcwd_nolock(
    int drive,
    wchar_t *buffer,
    int maxlen
);
```

Parameters

`drive`

Disk drive.

`buffer`

Storage location for the path.

`maxLen`

Maximum length of path in characters: `char` for `_getdcwd_nolock` and `wchar_t` for `_wgetdcwd_nolock`.

Return value

See [_getdcwd](#), [_wgetdcwd](#).

Remarks

`_getdcwd_nolock` and `_wgetdcwd_nolock` are identical to `_getdcwd` and `_wgetdcwd`, respectively, except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tgetdcwd_nolock</code>	<code>_getdcwd_nolock</code>	<code>_getdcwd_nolock</code>	<code>_wgetdcwd_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_getdcwd_nolock</code>	<code><direct.h></code>
<code>_wgetdcwd_nolock</code>	<code><direct.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

Directory control

<code>_chdir</code>	<code>_wchdir</code>
<code>_getcwd</code>	<code>_wgetcwd</code>
<code>_getdrive</code>	
<code>_mkdir</code>	<code>_wmkdir</code>
<code>_rmdir</code>	<code>_wrmdir</code>

_getdiskfree

11/2/2022 • 2 minutes to read • [Edit Online](#)

Get information about a disk drive such as total clusters, available clusters, sectors per cluster, and bytes per sector.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned _getdiskfree(
    unsigned drive,
    struct _diskfree_t * driveinfo
);
```

Parameters

`drive`

The disk drive for which you want information.

`driveinfo`

A `_diskfree_t` structure that will be populated with information about the drive.

Return value

If the function succeeds, the return value is zero. If the function fails, the return value is the error code. The value `errno` is set for any errors that are returned by the operating system. For more information about error conditions that are indicated by `errno`, see [errno constants](#).

Remarks

The `_diskfree_t` structure is defined in Direct.h.

```
struct _diskfree_t {
    unsigned total_clusters;      // The total number of clusters, both used and available, on the disk.
    unsigned avail_clusters;      // The number of unused clusters on the disk.
    unsigned sectors_per_cluster; // The number of sectors in each cluster.
    unsigned bytes_per_sector;   // The size of each sector in bytes.
};
```

This function validates its parameters. If the `driveinfo` pointer is `NULL` or `drive` specifies an invalid drive, this function invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns `EINVAL` and sets `errno` to `EINVAL`. Valid drives range from 0 to 26. A `drive` value of 0 specifies the current drive; thereafter, numbers map to letters of the English alphabet such that 1 indicates drive A, 3 indicates drive C, and so on.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the](#)

Requirements

ROUTINE	REQUIRED HEADER
_getdiskfree	<direct.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getdiskfree.c
// compile with: /c
#include <windows.h>
#include <direct.h>
#include <stdio.h>

int main(int argc, char* argv[])
{
    ULONG uDriveMask = _getdrives();

    for (unsigned uDrive = 1; uDrive <= 26; ++uDrive)
    {
        if (uDriveMask & 1)
        {
            struct _diskfree_t df = { 0 };
            unsigned uErr = _getdiskfree(uDrive, &df);
            printf("\nDrive: %c\n", uDrive + 'A' - 1);

            if (uErr == 0)
            {
                printf("\tTotal clusters:      %11u\n", df.total_clusters);
                printf("\tAvailable clusters:  %11u\n", df.avail_clusters);
                printf("\tSectors per cluster: %11u\n", df.sectors_per_cluster);
                printf("\tBytes per sector:    %11u\n", df.bytes_per_sector);
            }
            else
            {
                WCHAR errMsg[80];
                unsigned uLen = FormatMessage(FORMAT_MESSAGE_FROM_SYSTEM, NULL,
                                              uErr, 0, errMsg, sizeof(errMsg), NULL);
                printf("%S\n", errMsg);
            }
        }
        uDriveMask >>= 1;
    }
}
```

```
Drive: C
    Total clusters:      249754111
    Available clusters: 160184686
    Sectors per cluster:     8
    Bytes per sector:      512
```

See also

[Directory control](#)

_getdrive

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the current disk drive.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _getdrive( void );
```

Return value

Returns the current (default) drive (1=A, 2=B, and so on). A return value of zero means that the current path doesn't start with a letter drive name, such as a UNC path. Or, it means that an internal buffer allocation failed. If an internal allocation fails, `errno` is set to ENOMEM.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_getdrive</code>	<code><direct.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_getdrive.c
// compile with: /c
// Illustrates drive functions including:
//     _getdrive      _chdrive      _getdcwd
//


#include <stdio.h>
#include <direct.h>
#include <stdlib.h>
#include <ctype.h>

int main( void )
{
    int ch, drive, curdrive;
    static char path[_MAX_PATH];

    // Save current drive.
    curdrive = _getdrive();

    printf( "Available drives are:\n" );

    // If we can switch to the drive, it exists.
    for( drive = 1; drive <= 26; drive++ )
    {
        if( !_chdrive( drive ) )
        {
            printf( "%c:", drive + 'A' - 1 );
            if( _getdcwd( drive, path, _MAX_PATH ) != NULL )
                printf( " (Current directory is %s)", path );
            putchar( '\n' );
        }
    }

    // Restore original drive.
    _chdrive( curdrive );
}

```

```

Available drives are:
A: (Current directory is A:\\)
C: (Current directory is C:\\)
E: (Current directory is E:\\testdir\\bin)
F: (Current directory is F:\\)
G: (Current directory is G:\\)

```

See also

[Directory control](#)

_chdrive
_getcwd , _wgetcwd
_getdcwd , _wgetdcwd

_getdrives

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns a bitmask that represents the currently available disk drives.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned long _getdrives( void );
```

Return value

If the function succeeds, the return value is a bitmask that represents the currently available disk drives. Bit position 0 (the least-significant bit) represents drive A. Similarly, bit position 1 represents drive B, bit position 2 represents drive C, and so on. If the function fails, the return value is zero. To get extended error information, call [GetLastError](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
_getdrives	<direct.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getdrives.c
// This program retrieves and lists out
// all the logical drives that are
// currently mounted on the machine.

#include <windows.h>
#include <direct.h>
#include <stdio.h>
#include <tchar.h>

TCHAR g_szDrvMsg[] = _T("A:\n");

int main(int argc, char* argv[])
{
    ULONG uDriveMask = _getdrives();

    if (uDriveMask == 0)
    {
        printf( "_getdrives() failed with failure code: %d\n",
            GetLastError());
    }
    else
    {
        printf("The following logical drives are being used:\n");

        while (uDriveMask) {
            if (uDriveMask & 1)
                printf(g_szDrvMsg);

            ++g_szDrvMsg[0];
            uDriveMask >>= 1;
        }
    }
}
```

```
The following logical drives are being used:
A:
C:
D:
E:
```

See also

[Directory control](#)

`getenv`, `_wgetenv`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Gets a value from the current environment. More secure versions of these functions are available; see [`getenv_s`](#), [`_wgetenv_s`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
char *getenv(
    const char *varname
);
wchar_t *_wgetenv(
    const wchar_t *varname
);
```

Parameters

`varname`

Environment variable name.

Return value

Returns a pointer to the environment table entry containing `varname`. It isn't safe to modify the value of the environment variable using the returned pointer. Use the [`_putenv`](#) function to modify the value of an environment variable. The return value is `NULL` if `varname` isn't found in the environment table.

Remarks

The `getenv` function searches the list of environment variables for `varname`. `getenv` isn't case sensitive in the Windows operating system. `getenv` and `_putenv` use the copy of the environment pointed to by the global variable `_environ` to access the environment. `getenv` operates only on the data structures accessible to the run-time library and not on the environment "segment" created for the process by the operating system. Therefore, programs that use the `envp` argument to `main` or `wmain` may retrieve invalid information.

If `varname` is `NULL`, this function invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `NULL`.

`_wgetenv` is a wide-character version of `getenv`; the argument and return value of `_wgetenv` are wide-character strings. The `_wenviron` global variable is a wide-character version of `_environ`.

In an MBCS program (for example, in an SBCS ASCII program), `_wenviron` is initially `NULL` because the environment is composed of multibyte-character strings. Then, on the first call to `_wpopenv`, or on the first call to `_wgetenv` if an (MBCS) environment already exists, a corresponding wide-character string environment is created and is then pointed to by `_wenviron`.

Similarly in a Unicode (`_wmain`) program, `_environ` is initially `NULL` because the environment is composed of wide-character strings. Then, on the first call to `_putenv`, or on the first call to `getenv` if a (Unicode) environment already exists, a corresponding MBCS environment is created and is then pointed to by `_environ`.

When two copies of the environment (MBCS and Unicode) exist simultaneously in a program, the run-time system must maintain both copies, resulting in slower execution time. For example, whenever you call `_putenv`, a call to `_wputenv` is also executed automatically, so that the two environment strings correspond.

Caution

In rare instances, when the run-time system is maintaining both a Unicode version and a multibyte version of the environment, these two environment versions may not correspond exactly. This is because, although any unique multibyte-character string maps to a unique Unicode string, the mapping from a unique Unicode string to a multibyte-character string is not necessarily unique. For more information, see `_environ`, `_wenviron`.

NOTE

The `_putenv` and `_getenv` families of functions are not thread-safe. `_getenv` could return a string pointer while `_putenv` is modifying the string, causing random failures. Make sure that calls to these functions are synchronized.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tgetenv</code>	<code>getenv</code>	<code>getenv</code>	<code>_wgetenv</code>

To check or change the value of the `TZ` environment variable, use `getenv`, `_putenv` and `_tzset` as necessary. For more information about `TZ`, see `_tzset` and `_daylight`, `timezone`, and `_tzname`.

Requirements

ROUTINE	REQUIRED HEADER
<code>getenv</code>	<code><stdlib.h></code>
<code>_wgetenv</code>	<code><stdlib.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getenv.c
// compile with: /W3
// This program uses getenv to retrieve
// the LIB environment variable and then uses
// _putenv to change it to a new value.

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    char *libvar;

    // Get the value of the LIB environment variable.
    libvar = getenv( "LIB" ); // C4996
    // Note: getenv is deprecated; consider using getenv_s instead

    if( libvar != NULL )
        printf( "Original LIB variable is: %s\n", libvar );

    // Attempt to change path. Note that this only affects the environment
    // variable of the current process. The command processor's
    // environment is not changed.
    _putenv( "LIB=c:\\mylib;c:\\yourlib" ); // C4996
    // Note: _putenv is deprecated; consider using putenv_s instead

    // Get new value.
    libvar = getenv( "LIB" ); // C4996

    if( libvar != NULL )
        printf( "New LIB variable is: %s\n", libvar );
}
```

```
Original LIB variable is: C:\\progra~1\\devstu~1\\vc\\lib
New LIB variable is: c:\\mylib;c:\\yourlib
```

See also

[Process and environment control](#)

[_putenv](#) , [_wputenv](#)

[Environmental constants](#)

`getenv_s`, `_wgetenv_s`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Gets a value from the current environment. These versions of `getenv`, `_wgetenv` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t getenv_s(
    size_t *pReturnValue,
    char* buffer,
    size_t numberOfElements,
    const char *varname
);
errno_t _wgetenv_s(
    size_t *pReturnValue,
    wchar_t *buffer,
    size_t numberOfElements,
    const wchar_t *varname
);
template <size_t size>
errno_t getenv_s(
    size_t *pReturnValue,
    char (&buffer)[size],
    const char *varname
); // C++ only
template <size_t size>
errno_t _wgetenv_s(
    size_t *pReturnValue,
    wchar_t (&buffer)[size],
    const wchar_t *varname
); // C++ only
```

Parameters

`pReturnValue`

The buffer size that's required, or 0 if the variable isn't found.

`buffer`

Buffer to store the value of the environment variable.

`numberOfElements`

Size of `buffer`.

`varname`

Environment variable name.

Return value

Zero if successful; otherwise, an error code on failure.

Error conditions

PRERETURNVALUE	BUFFER	NUMBEROFELEMENTS	VARNAME	RETURN VALUE
NULL	any	any	any	EINVAL
any	NULL	>0	any	EINVAL
any	any	any	NULL	EINVAL

Any of these error conditions invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the functions set `errno` to `EINVAL` and return `EINVAL`.

Also, if the buffer is too small, these functions return `ERANGE`. They don't invoke an invalid parameter handler. They write out the required buffer size in `pReturnValue`, and thereby enable programs to call the function again with a larger buffer.

Remarks

The `getenv_s` function searches the list of environment variables for `varname`. `getenv_s` isn't case sensitive in the Windows operating system. `getenv_s` and `_putenv_s` use the copy of the environment that's pointed to by the global variable `_environ` to access the environment. `getenv_s` operates only on the data structures that are accessible to the run-time library and not on the environment "segment" that's created for the process by the operating system. Therefore, programs that use the `envp` argument to `main` or `wmain` might retrieve invalid information.

`_wgetenv_s` is a wide-character version of `getenv_s`; the argument and return value of `_wgetenv_s` are wide-character strings. The `_wenviron` global variable is a wide-character version of `_environ`.

In an MBCS program (for example, in an SBCS ASCII program), `_wenviron` is initially `NULL` because the environment is composed of multibyte-character strings. Then, on the first call to `_wputenv`, or on the first call to `_wgetenv_s`, if an (MBCS) environment already exists, a corresponding wide-character string environment is created and is then pointed to by `_wenviron`.

Similarly in a Unicode (`_wmain`) program, `_environ` is initially `NULL` because the environment is composed of wide-character strings. Then, on the first call to `_putenv`, or on the first call to `getenv_s` if a (Unicode) environment already exists, a corresponding MBCS environment is created and is then pointed to by `_environ`.

When two copies of the environment (MBCS and Unicode) exist simultaneously in a program, execution can take longer, because the run-time system must maintain both copies. For example, when you call `_putenv`, a call to `_wputenv` is also executed automatically so that the two environment strings correspond.

Caution

In rare instances, when the run-time system is maintaining both a Unicode version and a multibyte version of the environment, the two environment versions may not correspond exactly. This happens because, although any unique multibyte-character string maps to a unique Unicode string, the mapping from a unique Unicode string to a multibyte-character string is not necessarily unique. For more information, see `_environ`, `_wenviron`.

NOTE

The `_putenv_s` and `_getenv_s` families of functions are not thread-safe. `_getenv_s` could return a string pointer while `_putenv_s` is modifying the string and thereby cause random failures. Make sure that calls to these functions are synchronized.

In C++, use of these functions is simplified by template overloads; the overloads can infer buffer length

automatically and thereby eliminate the need to specify a size argument. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tgetenv_s</code>	<code>getenv_s</code>	<code>getenv_s</code>	<code>_wgetenv_s</code>

To check or change the value of the `TZ` environment variable, use `getenv_s`, `_putenv`, and `_tzset`, as required. For more information about `TZ`, see [_tzset](#) and [_daylight](#), [_dstbias](#), [_timezone](#), and [_tzname](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>getenv_s</code>	<code><stdlib.h></code>
<code>_wgetenv_s</code>	<code><stdlib.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_getenv_s.c
// This program uses getenv_s to retrieve
// the LIB environment variable and then uses
// _putenv to change it to a new value.

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    char* libvar;
    size_t requiredSize;

    getenv_s( &requiredSize, NULL, 0, "LIB");
    if (requiredSize == 0)
    {
        printf("LIB doesn't exist!\n");
        exit(1);
    }

    libvar = (char*) malloc(requiredSize * sizeof(char));
    if (!libvar)
    {
        printf("Failed to allocate memory!\n");
        exit(1);
    }

    // Get the value of the LIB environment variable.
    getenv_s( &requiredSize, libvar, requiredSize, "LIB" );

    printf( "Original LIB variable is: %s\n", libvar );

    // Attempt to change path. Note that this only affects
    // the environment variable of the current process. The command
    // processor's environment is not changed.
    _putenv_s( "LIB", "c:\\mylib;c:\\yourlib" );

    getenv_s( &requiredSize, NULL, 0, "LIB");

    libvar = (char*) realloc(libvar, requiredSize * sizeof(char));
    if (!libvar)
    {
        printf("Failed to allocate memory!\n");
        exit(1);
    }

    // Get the new value of the LIB environment variable.
    getenv_s( &requiredSize, libvar, requiredSize, "LIB" );

    printf( "New LIB variable is: %s\n", libvar );

    free(libvar);
}

```

```

Original LIB variable is: c:\\vctools\\lib;c:\\vctools\\atlmfc\\lib;c:\\vctools\\PlatformSDK\\lib;c:\\vctools\\Visual
Studio SDKs\\DIA Sdk\\lib;c:\\vctools\\Visual Studio SDKs\\BSC Sdk\\lib
New LIB variable is: c:\\mylib;c:\\yourlib

```

See also

[Process and environment control](#)

[Environmental constants](#)

[_putenv](#) , [_wputenv](#)

`_dupenv_s` , `_wdupenv_s`

_getmaxstdio

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the number of simultaneously open files permitted at the stream I/O level.

Syntax

```
int _getmaxstdio( void );
```

Return value

Returns a number that represents the number of simultaneously open files currently permitted at the `stdio` level.

Remarks

Use `_setmaxstdio` to configure the number of simultaneously open files permitted at the `stdio` level.

Requirements

ROUTINE	REQUIRED HEADER
<code>_getmaxstdio</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_setmaxstdio.c
// The program retrieves the maximum number
// of open files and prints the results
// to the console.

#include <stdio.h>

int main()
{
    printf( "%d\n", _getmaxstdio());

    _setmaxstdio(2048);

    printf( "%d\n", _getmaxstdio());
}
```

512
2048

See also

Stream I/O

_getmbcp

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the current code page.

Syntax

```
int _getmbcp( void );
```

Return value

Returns the current multibyte code page. A return value of 0 indicates that a single byte code page is in use.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_getmbcp</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[_setmbcp](#)

getpid

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `getpid` is a deprecated alias for the `_getpid` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_getpid` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_getpid

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the process identification.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _getpid( void );
```

Return value

Returns the process ID obtained from the system. There's no error return.

Remarks

The `_getpid` function obtains the process ID from the system. The process ID uniquely identifies the calling process.

Requirements

ROUTINE	REQUIRED HEADER
<code>_getpid</code>	<code><process.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getpid.c
// This program uses _getpid to obtain
// the process ID and then prints the ID.

#include <stdio.h>
#include <process.h>

int main( void )
{
    // If run from command line, shows different ID for
    // command line than for operating system shell.

    printf( "Process id: %d\n", _getpid() );
}
```

Process id: 3584

See also

[Process and environment control](#)

[_mktemp](#) , [_wmktemp](#)

`gets_s`, `_getws_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets a line from the `stdin` stream. These versions of `gets`, `_getws` have security enhancements, as described in [Security features in the CRT](#).

Syntax

```
char *gets_s(
    char *buffer,
    size_t sizeInCharacters
);
wchar_t *_getws_s(
    wchar_t *buffer,
    size_t sizeInCharacters
);
```

```
template <size_t size>
char *gets_s( char (&buffer)[size] ); // C++ only

template <size_t size>
wchar_t *_getws_s( wchar_t (&buffer)[size] ); // C++ only
```

Parameters

`buffer`

Storage location for input string.

`sizeInCharacters`

The size of the buffer.

Return value

Returns `buffer` if successful. A `NULL` pointer indicates an error or end-of-file condition. Use `ferror` or `feof` to determine which one has occurred.

Remarks

The `gets_s` function reads a line from the standard input stream `stdin` and stores it in `buffer`. The line consists of all characters up to and including the first newline character ('`\n`'). `gets_s` then replaces the newline character with a null character ('`\0`') before returning the line. In contrast, the `fgets_s` function retains the newline character.

If the first character read is the end-of-file character, a null character is stored at the beginning of `buffer`, and `NULL` is returned.

`_getws_s` is a wide-character version of `gets_s`; its argument and return value are wide-character strings.

If `buffer` is `NULL` or `sizeInCharacters` is less than or equal to zero, or if the buffer is too small to contain the input line and null terminator, these functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `NULL` and set `errno` to `ERANGE`.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
_getts_s	gets_s	gets_s	_getws_s

Requirements

ROUTINE	REQUIRED HEADER
gets_s	<stdio.h>
_getws_s	<stdio.h> or <wchar.h>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_gets_s.c
// This program retrieves a string from the stdin and
// prints the same string to the console.

#include <stdio.h>

int main( void )
{
    char line[21]; // room for 20 chars + '\0'
    gets_s( line, 20 );
    printf( "The line entered was: %s\n", line );
}
```

Hello there!

The line entered was: Hello there!

See also

Stream I/O

`gets`, `_getws`
`fgets`, `fgetws`
`fputs`, `fputws`
`puts`, `_putws`

getw

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `getw` is a deprecated alias for the `_getw` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_getw` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_getw

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets an integer from a stream.

Syntax

```
int _getw(  
    FILE *stream  
)
```

Parameters

`stream`

Pointer to the `FILE` structure.

Return value

`_getw` returns the integer value read. A return value of `EOF` indicates either an error or end of file. However, because the `EOF` value is also a legitimate integer value, use `feof` or `ferror` to verify an end-of-file or error condition. If `stream` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `EOF`.

Remarks

The `_getw` function reads the next binary value of type `int` from the file associated with `stream` and increments the associated file pointer (if one exists) to point to the next unread character. `_getw` doesn't assume any special alignment of items in the stream. Problems with porting can occur with `_getw` because the size of the `int` type and the ordering of bytes within the `int` type differ across systems.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_getw</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_getw.c
// This program uses _getw to read a word
// from a stream, then performs an error check.

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    FILE *stream;
    int i;

    if( fopen_s( &stream, "crt_getw.txt", "rb" ) )
        printf( "Couldn't open file\n" );
    else
    {
        // Read a word from the stream:
        i = _getw( stream );

        // If there is an error...
        if( ferror( stream ) )
        {
            printf( "_getw failed\n" );
            clearerr_s( stream );
        }
        else
            printf( "First data word in file: 0x%.4x\n", i );
        fclose( stream );
    }
}
```

Input: crt_getw.txt

```
Line one.
Line two.
```

Output

```
First data word in file: 0x656e694c
```

See also

[Stream I/O](#)

[_putw](#)

`gmtime`, `_gmtime32`, `_gmtime64`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a `time_t` time value to a `tm` structure. More secure versions of these functions are available; see `gmtime_s`, `_gmtime32_s`, `_gmtime64_s`.

Syntax

```
struct tm *gmtime( const time_t *sourceTime );
struct tm *_gmtime32( const __time32_t *sourceTime );
struct tm *_gmtime64( const __time64_t *sourceTime );
```

Parameters

`sourceTime`

Pointer to the stored time. The time is represented as seconds elapsed since midnight (00:00:00), January 1, 1970, coordinated universal time (UTC).

Return value

A pointer to a structure of type `tm`. The fields of the returned structure hold the evaluated value of the `sourceTime` argument in UTC rather than in local time. Each of the structure fields is of type `int`, as follows:

FIELD	DESCRIPTION
<code>tm_sec</code>	Seconds after minute (0 - 59).
<code>tm_min</code>	Minutes after hour (0 - 59).
<code>tm_hour</code>	Hours since midnight (0 - 23).
<code>tm_mday</code>	Day of month (1 - 31).
<code>tm_mon</code>	Month (0 - 11; January = 0).
<code>tm_year</code>	Year (current year minus 1900).
<code>tm_wday</code>	Day of week (0 - 6; Sunday = 0).
<code>tm_yday</code>	Day of year (0 - 365; January 1 = 0).
<code>tm_isdst</code>	Always 0 for <code>gmtime</code> .

Both the 32-bit and 64-bit versions of `gmtime`, `mktme`, `mkgmtime`, and `localtime` all use one common `tm` structure per thread for the conversion. Each call to one of these functions destroys the result of any previous call. If `sourceTime` represents a date before midnight, January 1, 1970, `gmtime` returns `NULL`. There's no error return.

`_gmtime64`, which uses the `__time64_t` structure, enables dates to be expressed up through 23:59:59, December

31, 3000, UTC. `_gmtime32` only represent dates through 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for both functions.

`gmtime` is an inline function that evaluates to `_gmtime64`, and `time_t` is equivalent to `_time64_t` unless `_USE_32BIT_TIME_T` is defined. If you must force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`, but doing so causes `gmtime` to be in-lined to `_gmtime32` and `time_t` to be defined as `_time32_t`. We don't recommend use of `_USE_32BIT_TIME_T`, because it isn't allowed on 64-bit platforms. In any case, your application may fail after January 18, 2038.

These functions validate their parameters. If `sourceTime` is a `NULL` pointer, or if the `sourceTime` value is negative, these functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `NULL` and set `errno` to `EINVAL`.

Remarks

The `_gmtime32` function breaks down the `sourceTime` value and stores it in a statically allocated structure of type `tm`, defined in `TIME.H`. The value of `sourceTime` is typically obtained from a call to the `time` function.

NOTE

In most cases, the target environment tries to determine whether daylight savings time is in effect. The C run-time library assumes that the United States rules for implementing the calculation of Daylight Saving Time (DST) are used.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>gmtime</code> , <code>_gmtime32</code> , <code>_gmtime64</code>	<code><time.h></code>	<code><cctime></code> or <code><time.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_gmtime.c
// compile with: /W3
// This program uses _gmtime64 to convert a long-
// integer representation of coordinated universal time
// to a structure named newtime, then uses asctime to
// convert this structure to an output string.

#include <time.h>
#include <stdio.h>

int main(void)
{
    struct tm *newtime;
    __int64 ltime;
    char buff[80];

    _time64( &ltime );

    // Obtain coordinated universal time:
    newtime = _gmtime64( &ltime ); // C4996
    // Note: _gmtime64 is deprecated; consider using _gmtime64_s
    asctime_s( buff, sizeof(buff), newtime );
    printf( "Coordinated universal time is %s\n", buff );
}

```

Coordinated universal time is Tue Feb 12 23:11:31 2002

See also

Time management

[asctime](#), [_wasctime](#)
[ctime](#), [_ctime32](#), [_ctime64](#), [_wctime](#), [_wctime32](#), [_wctime64](#)
[_ftime](#), [_ftime32](#), [_ftime64](#)
[gmtime_s](#), [_gmtime32_s](#), [_gmtime64_s](#)
[localtime](#), [_localtime32](#), [_localtime64](#)
[_mkgmtime](#), [_mkgmtime32](#), [_mkgmtime64](#)
[mktime](#), [_mktime32](#), [_mktime64](#)
[time](#), [_time32](#), [_time64](#)

`gmtime_s`, `_gmtime32_s`, `_gmtime64_s`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a time value to a `tm` structure. These functions are versions of `_gmtime32`, `_gmtime64` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t gmtime_s(
    struct tm* tmDest,
    const __time_t* sourceTime
);
errno_t _gmtime32_s(
    struct tm* tmDest,
    const __time32_t* sourceTime
);
errno_t _gmtime64_s(
    struct tm* tmDest,
    const __time64_t* sourceTime
);
```

Parameters

`tmDest`

Pointer to a `tm` structure. The fields of the returned structure hold the evaluated value of the `timer` argument in UTC rather than in local time.

`sourceTime`

Pointer to stored time. The time is represented as seconds elapsed since midnight (00:00:00), January 1, 1970, coordinated universal time (UTC).

Return value

Zero if successful. The return value is an error code if there's a failure. Error codes are defined in `Errno.h`; for a listing of these errors, see [errno](#).

Error conditions

<code>TMDEST</code>	<code>SOURCETIME</code>	RETURN	VALUE IN <code>TMDEST</code>
<code>NULL</code>	any	<code>EINVAL</code>	Not modified.
Not <code>NULL</code> (points to valid memory)	<code>NULL</code>	<code>EINVAL</code>	All fields set to -1.
Not <code>NULL</code>	< 0	<code>EINVAL</code>	All fields set to -1.

The first two error conditions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

Remarks

The `_gmtime32_s` function breaks down the `sourceTime` value and stores it in a structure of type `tm`, defined in `Time.h`. The address of the structure is passed in `tmDest`. The value of `sourceTime` is often obtained from a call to the `time` function.

NOTE

The target environment should try to determine whether daylight savings time is in effect. The C run-time library assumes the United States rules for implementing the calculation of daylight saving time .

Each of the structure fields is of type `int`, as shown in the following table.

FIELD	DESCRIPTION
<code>tm_sec</code>	Seconds after minute (0 - 59).
<code>tm_min</code>	Minutes after hour (0 - 59).
<code>tm_hour</code>	Hours since midnight (0 - 23).
<code>tm_mday</code>	Day of month (1 - 31).
<code>tm_mon</code>	Month (0 - 11; January = 0).
<code>tm_year</code>	Year (current year minus 1900).
<code>tm_wday</code>	Day of week (0 - 6; Sunday = 0).
<code>tm_yday</code>	Day of year (0 - 365; January 1 = 0).
<code>tm_isdst</code>	Always 0 for <code>gmtime_s</code> .

`_gmtime64_s`, which uses the `_time64_t` structure, allows dates to be expressed up through 23:59:59, December 31, 3000, UTC; whereas `gmtime32_s` only represent dates through 23:59:59 January 18, 2038, UTC. Midnight, January 1, 1970, is the lower bound of the date range for both these functions.

`gmtime_s` is an inline function that evaluates to `_gmtime64_s` and `time_t` is equivalent to `_time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`. `_USE_32BIT_TIME_T` causes `gmtime_s` to be inlined as `_gmtime32_s`. We don't recommend `_USE_32BIT_TIME_T`, because your application may fail after January 18, 2038, and because it isn't allowed on 64-bit platforms.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>gmtime_s</code> , <code>_gmtime32_s</code> , <code>_gmtime64_s</code>	<code><time.h></code>	<code><cctime></code> or <code><time.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_gmtime64_s.c
// This program uses _gmtime64_s to convert a 64-bit
// integer representation of coordinated universal time
// to a structure named newtime, then uses asctime_s to
// convert this structure to an output string.

#include <time.h>
#include <stdio.h>

int main( void )
{
    struct tm newtime;
    __int64 ltime;
    char buf[26];
    errno_t err;

    _time64( &ltime );

    // Obtain coordinated universal time:
    err = _gmtime64_s( &newtime, &ltime );
    if (err)
    {
        printf("Invalid Argument to _gmtime64_s.");
    }

    // Convert to an ASCII representation
    err = asctime_s(buf, 26, &newtime);
    if (err)
    {
        printf("Invalid Argument to asctime_s.");
    }

    printf( "Coordinated universal time is %s\n",
           buf );
}
```

```
Coordinated universal time is Fri Apr 25 20:12:33 2003
```

See also

Time management

[asctime_s](#), [_wasctime_s](#)
[ctime](#), [_ctime32](#), [_ctime64](#), [_wctime](#), [_wctime32](#), [_wctime64](#)
[_ftime](#), [_ftime32](#), [_ftime64](#)
[gmtime](#), [_gmtime32](#), [_gmtime64](#)
[localtime_s](#), [_localtime32_s](#), [_localtime64_s](#)
[_mkgmtime](#), [_mkgmtime32](#), [_mkgmtime64](#)
[mktime](#), [_mktime32](#), [_mktime64](#)
[time](#), [_time32](#), [_time64](#)

_heapchk

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Runs consistency checks on the heap.

Syntax

```
int _heapchk( void );
```

Return value

`_heapchk` returns one of the following integer manifest constants defined in `Malloc.h`.

RETURN VALUE	CONDITION
<code>_HEAPBADBEGIN</code>	Initial header information is bad or can't be found.
<code>_HEAPBADNODE</code>	Bad node has been found or heap is damaged.
<code>_HEAPBADPTR</code>	Pointer into heap isn't valid.
<code>_HEAPEMPTY</code>	Heap hasn't been initialized.
<code>_HEAPOK</code>	Heap appears to be consistent.

In addition, if an error occurs, `_heapchk` sets `errno` to `ENOSYS`.

Remarks

The `_heapchk` function helps debug heap-related problems by checking for minimal consistency of the heap. If the operating system doesn't support `_heapchk` (for example, Windows 98), the function returns `_HEAPOK` and sets `errno` to `ENOSYS`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_heapchk</code>	<code><malloc.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_heapchk.c
// This program checks the heap for
// consistency and prints an appropriate message.

#include <malloc.h>
#include <stdio.h>

int main( void )
{
    int heapstatus;
    char *buffer;

    // Allocate and deallocate some memory
    if( (buffer = (char *)malloc( 100 )) != NULL )
        free( buffer );

    // Check heap status
    heapstatus = _heapchk();
    switch( heapstatus )
    {
        case _HEAPOK:
            printf(" OK - heap is fine\n" );
            break;
        case _HEAPEMPTY:
            printf(" OK - heap is empty\n" );
            break;
        case _HEAPBADBEGIN:
            printf( "ERROR - bad start of heap\n" );
            break;
        case _HEAPBADNODE:
            printf( "ERROR - bad node in heap\n" );
            break;
    }
}
```

```
OK - heap is fine
```

See also

[Memory allocation](#)

[_heapadd](#)
[_heapmin](#)
[_heapset](#)
[_heapwalk](#)

_heapmin

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Releases unused heap memory to the operating system.

Syntax

```
int _heapmin( void );
```

Return value

If successful, `_heapmin` returns 0; otherwise, the function returns -1 and sets `errno` to `ENOSYS`.

For more information about this and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_heapmin` function minimizes the heap by releasing unused heap memory to the operating system. If the operating system doesn't support `_heapmin` (for example, Windows 98), the function returns -1 and sets `errno` to `ENOSYS`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_heapmin</code>	<malloc.h>	<errno.h>

For more compatibility information, see [Compatibility](#).

See also

Memory allocation

`free`
`_heapadd`
`_heapchk`
`_heapset`
`_heapwalk`
`malloc`

_heapwalk

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Traverses the heap and returns information about the next entry.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime except in Debug builds. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _heapwalk( _HEAPINFO *entryinfo );
```

Parameters

`entryinfo`

Buffer to contain heap information.

Return value

`_heapwalk` returns one of the following integer manifest constants defined in Malloc.h.

RETURN VALUE	MEANING
<code>_HEAPBADBEGIN</code>	Initial header information invalid or not found.
<code>_HEAPBADNODE</code>	Heap damaged or bad node found.
<code>_HEAPBADPTR</code>	The <code>_pentry</code> field of the <code>_HEAPINFO</code> structure doesn't contain a valid pointer into the heap or <code>entryinfo</code> is a null pointer.
<code>_HEAPEND</code>	End of the heap reached successfully.
<code>_HEAPEMPTY</code>	Heap not initialized.
<code>_HEAPOK</code>	No errors so far; <code>entryinfo</code> is updated with information about the next heap entry.

In addition, if an error occurs, `_heapwalk` sets `errno` to `ENOSYS`.

Remarks

The `_heapwalk` function helps debug heap-related problems in programs. The function walks through the heap, traversing one entry per call, and returns a pointer to a structure of type `_HEAPINFO` that contains information about the next heap entry. The `_HEAPINFO` type, defined in Malloc.h, contains the following elements.

FIELD	MEANING
<code>int *_pentry</code>	Heap entry pointer.
<code>size_t _size</code>	Size of the heap entry.
<code>int _useflag</code>	Flag that indicates whether the heap entry is in use.

A call to `_heapwalk` that returns `_HEAPOK` stores the size of the entry in the `_size` field and sets the `_useflag` field to either `_FREEENTRY` or `_USEDENTRY` (both are constants defined in `Malloc.h`). To obtain this information about the first entry in the heap, pass `_heapwalk` a pointer to a `_HEAPINFO` structure whose `_pentry` member is `NULL`. If the operating system doesn't support `_heapwalk`, the function returns `_HEAPEND` and sets `errno` to `ENOSYS`.

This function validates its parameter. If `entryinfo` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `_HEAPBADPTR`.

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_heapwalk</code>	<code><malloc.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_heapwalk.c

// This program "walks" the heap, starting
// at the beginning (_pentry = NULL). It prints out each
// heap entry's use, location, and size. It also prints
// out information about the overall state of the heap as
// soon as _heapwalk returns a value other than _HEAPOK
// or if the loop has iterated 100 times.

#include <stdio.h>
#include <malloc.h>

void heapdump(void);

int main(void)
{
    char *buffer;

    heapdump();
    if((buffer = (char *)malloc(59)) != NULL)
    {
        heapdump();
        free(buffer);
    }
    heapdump();
}

void heapdump(void)
{
    _HEAPINFO hinfo;
    int heapstatus;
    int numLoops;
    hinfo._pentry = NULL;
    numLoops = 0;
    while((heapstatus = _heapwalk(&hinfo)) == _HEAPOK &&
          numLoops < 100)
    {
        printf("%8s block at %Fp of size %4.4X\n",
               (hinfo._useflag == _USEDENTRY ? "USED" : "FREE"),
               hinfo._pentry, hinfo._size);
        numLoops++;
    }

    switch(heapstatus)
    {
    case _HEAPEMPTY:
        printf("OK - empty heap\n");
        break;
    case _HEAPEND:
        printf("OK - end of heap\n");
        break;
    case _HEAPBADPTR:
        printf("ERROR - bad pointer to heap\n");
        break;
    case _HEAPBADBEGIN:
        printf("ERROR - bad start of heap\n");
        break;
    case _HEAPBADNODE:
        printf("ERROR - bad node in heap\n");
        break;
    }
}

```

```
USED block at 00310650 of size 0100
USED block at 00310758 of size 0800
USED block at 00310F60 of size 0080
FREE block at 00310FF0 of size 0398
USED block at 00311390 of size 000D
USED block at 003113A8 of size 00B4
USED block at 00311468 of size 0034
USED block at 003114A8 of size 0039
...
USED block at 00312228 of size 0010
USED block at 00312240 of size 1000
FREE block at 00313250 of size 1DB0
OK - end of heap
```

See also

Memory allocation

[_heapadd](#)
[_heapchk](#)
[_heapmin](#)
[_heapset](#)

`hypot`, `hypotf`, `hypotl`, `_hypot`, `_hypotf`,
`_hypotl`

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Calculates the hypotenuse.

Syntax

```
double hypot(
    double x,
    double y
);
float hypotf(
    float x,
    float y
);
long double hypotl(
    long double x,
    long double y
);
double _hypot(
    double x,
    double y
);
float _hypotf(
    float x,
    float y
);
long double _hypotl(
    long double x,
    long double y
);
#define hypotf(X, Y) // Requires C11 or higher
```

Parameters

`x`, `y`

Floating-point values.

Return value

If successful, `hypot` returns the length of the hypotenuse; on overflow, `hypot` returns INF (infinity) and the `errno` variable is set to `ERANGE`. You can use `_matherr` to modify error handling.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `hypot` functions calculate the length of the hypotenuse of a right triangle, given the length of the two sides `x` and `y` (in other words, the square root of $x^2 + y^2$).

The versions of the functions that have leading underscores are provided for compatibility with earlier standards. Their behavior is identical to the versions that don't have leading underscores. We recommend using the versions without leading underscores for new code.

If you use the `<tgmath.h>` `hypot()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>hypot</code> , <code>hypotf</code> , <code>hypotl</code> , <code>_hypot</code> , <code>_hypotf</code> , <code>_hypotl</code>	<code><math.h></code>
<code>hypot</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_hypot.c
// This program prints the hypotenuse of a right triangle.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 3.0, y = 4.0;

    printf( "If a right triangle has sides %2.1f and %2.1f, "
            "its hypotenuse is %2.1f\n", x, y, _hypot( x, y ) );
}
```

```
If a right triangle has sides 3.0 and 4.0, its hypotenuse is 5.0
```

See also

[Math and floating-point support](#)

[`_cabs`](#)

[`_matherr`](#)

ilogb, ilogbf, ilogbl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves an integer that represents the unbiased base-2 exponent of the specified value.

Syntax

```
int ilogb(
    double x
);

int ilogb(
    float x
); //C++ only

int ilogb(
    long double x
); //C++ only

int ilogbf(
    float x
);

int ilogbl(
    long double x
);

#define ilogbl(X) // Requires C11 or higher
```

Parameters

x

The specified value.

Return value

If successful, these functions return the base-2 exponent of x as a signed int value.

Otherwise, the functions return one of the following values, defined in <math.h>:

INPUT	RESULT
± 0	FP_ILOGB0
$\pm \text{INF}$, $\pm \text{NAN}$, IND	FP_ILOGBNAN

Errors are reported as specified in [_matherr](#).

Remarks

Because C++ allows overloading, you can call overloads of `ilogb` that take and return `float` and `long double` types. In a C program, unless you're using the <tgmath.h> macro to call this function, `ilogb` always takes and returns a `double`.

If you use the `<tgmath.h>` `ilogb()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Calling this function is similar to calling the equivalent `logb` function, then casting the return value to `int`.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>ilogb</code> , <code>ilogbf</code> , <code>ilogbl</code>	<code><math.h></code>	<code><cmath></code>
<code>ilogb</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`frexp`
`logb`, `logbf`, `logbl`, `_logb`, `_logbf`

imaxabs

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Calculates the absolute value of an integer of any size.

Syntax

```
intmax_t imaxabs(  
    intmax_t n  
)
```

Parameters

`n`

Integer value.

Return value

The `imaxabs` function returns the absolute value of the argument. There's no error return.

NOTE

Because the range of negative integers that can be represented by using `intmax_t` is larger than the range of positive integers that can be represented, it's possible to supply an argument to `imaxabs` that can't be converted. If the absolute value of the argument cannot be represented by the return type, the behavior of `imaxabs` is undefined.

Requirements

ROUTINE	REQUIRED HEADER
<code>imaxabs</code>	<code><inttypes.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the C run-time libraries.

Example

```
// crt_imaxabs.c
// Build using: cl /W3 /Tc crt_imaxabs.c
// This example calls imaxabs to compute an
// absolute value, then displays the results.

#include <stdio.h>
#include <stdlib.h>
#include <inttypes.h>

int main(int argc, char *argv[])
{
    intmax_t x = LLONG_MIN + 2;

    printf("The absolute value of %lld is %lld\n", x, imaxabs(x));
}
```

```
The absolute value of -9223372036854775806 is 9223372036854775806
```

See also

[Data conversion](#)

[Math and floating-point support](#)

[abs](#) , [labs](#) , [llabs](#) , [_abs64](#)
[_cabs](#)
[fabs](#) , [fabsf](#) , [fabsl](#)

imaxdiv

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Computes the quotient and the remainder of two integer values of any size as a single operation.

Syntax

```
imaxdiv_t imaxdiv(  
    intmax_t numer,  
    intmax_t denom  
)
```

Parameters

numer

The numerator.

denom

The denominator.

Return value

`imaxdiv`, called with arguments of type `intmax_t`, returns a structure of type `imaxdiv_t` that comprises the quotient and the remainder.

Remarks

The `imaxdiv` function divides `numer` by `denom` and thereby computes the quotient and the remainder. The `imaxdiv_t` structure contains the quotient, `intmax_t quot`, and the remainder, `intmax_t rem`. The sign of the quotient is the same as the sign of the mathematical quotient. Its absolute value is the largest integer that's less than the absolute value of the mathematical quotient. If the denominator is 0, the program terminates with an error message.

Requirements

ROUTINE	REQUIRED HEADER
<code>imaxdiv</code>	<code><inttypes.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_imaxdiv.c
// Build using: cl /W3 /Tc crt_imaxdiv.c
// This example takes two integers as command-line
// arguments and calls imaxdiv to divide the first
// argument by the second, then displays the results.

#include <stdio.h>
#include <stdlib.h>
#include <inttypes.h>

int main(int argc, char *argv[])
{
    intmax_t x,y;
    imaxdiv_t div_result;

    x = atol(argv[1]);
    y = atol(argv[2]);

    printf("The call to imaxdiv(%lld, %lld)\n", x, y);
    div_result = imaxdiv(x, y);
    printf("results in a quotient of %lld, and a remainder of %lld\n\n",
           div_result.quot, div_result.rem);
}

```

When built and then called with command line parameters of `9460730470000000 8766`, the code generates this output:

```

The call to imaxdiv(9460730470000000, 8766)
results in a quotient of 1079252848505, and a remainder of 5170

```

See also

[Math and floating-point support](#)

[div](#)

[ldiv](#) , [lldiv](#)

`_initterm`, `_initterm_e`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Internal methods that walk a table of function pointers and initialize them.

The first pointer is the starting location in the table and the second pointer is the ending location.

Syntax

```
void __cdecl _initterm(
    PVFV *,
    PVFV *
);

int __cdecl _initterm_e(
    PVFV *,
    PVFV *
);
```

Return value

A non-zero error code if an initialization fails and throws an error; 0 if no error occurs.

Remarks

These methods are only called internally during the initialization of a C++ program. Don't call these methods in a program.

When these methods walk a table of function entries, they skip `NULL` entries and continue.

See also

[Alphabetical function reference](#)

```
_invalid_parameter, _invalid_parameter_noinfo,  
_invalid_parameter_noinfo_noreturn,  
_invoke_watson
```

11/2/2022 • 2 minutes to read • [Edit Online](#)

These functions are used by the C Runtime Library to handle non-valid parameters passed to CRT Library functions. Your code may also use these functions to support default or customizable handling of non-valid parameters.

Syntax

```
extern "C" void __cdecl  
_invalid_parameter(  
    wchar_t const* const expression,  
    wchar_t const* const function_name,  
    wchar_t const* const file_name,  
    unsigned int    const line_number,  
    uintptr_t      const reserved);  
  
extern "C" void __cdecl  
_invalid_parameter_noinfo(void);  
  
extern "C" __declspec(noreturn) void __cdecl  
_invalid_parameter_noinfo_noreturn(void);  
  
extern "C" __declspec(noreturn) void __cdecl  
_invoke_watson(  
    wchar_t const* const expression,  
    wchar_t const* const function_name,  
    wchar_t const* const file_name,  
    unsigned int    const line_number,  
    uintptr_t      const reserved);
```

Parameters

expression

A string representing the source code parameter expression that isn't valid.

function_name

The name of the function that called the handler.

file_name

The source code file where the handler was called.

Line_number

The line number in the source code where the handler was called.

reserved

Unused.

Return value

These functions don't return a value. The `_invalid_parameter_noinfo_noreturn` and `_invoke_watson` functions don't return to the caller, and in some cases, `_invalid_parameter` and `_invalid_parameter_noinfo` may not return to the caller.

Remarks

When C runtime library functions are passed non-valid parameters, the library functions call an *invalid parameter handler*, a function that may be specified by the programmer to do any of several things. For example, it may report the issue to the user, write to a log, break in a debugger, terminate the program, or do nothing at all. If no function is specified by the programmer, a default handler, `_invoke_watson`, is called.

By default, when a non-valid parameter is identified in debug code, CRT library functions call the function `_invalid_parameter` using verbose parameters. In non-debug code, the `_invalid_parameter_noinfo` function is called, which calls the `_invalid_parameter` function using empty parameters. If the non-debug CRT library function requires program termination, the `_invalid_parameter_noinfo_noreturn` function is called, which calls the `_invalid_parameter` function using empty parameters, followed by a call to the `_invoke_watson` function to force program termination.

The `_invalid_parameter` function checks whether a user-defined invalid parameter handler was set, and if so, calls it. For example, if a user-defined thread-local handler was set by a call to

`set_thread_local_invalid_parameter_handler` in the current thread, it's called, then the function returns.

Otherwise, if a user-defined global invalid parameter handler was set by a call to `set_invalid_parameter_handler`, it's called, then the function returns. Otherwise, the default handler `_invoke_watson` is called. The default behavior of `_invoke_watson` is to terminate the program. User-defined handlers may terminate or return. We recommend that user-defined handlers terminate the program unless recovery is certain.

When the default handler `_invoke_watson` is called, if the processor supports a `__fastfail` operation, it's invoked using a parameter of `FAST_FAIL_INVALID_ARG` and the process terminates. Otherwise, a fast fail exception is raised, which can be caught by an attached debugger. If the process is allowed to continue, it's terminated by a call to the Windows `TerminateProcess` function using an exception code status of `STATUS_INVALID_CRUNTIME_PARAMETER`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	REQUIRED HEADER
<code>_invalid_parameter</code> , <code>_invalid_parameter_noinfo</code> , <code>_invalid_parameter_noinfo_noreturn</code> , <code>_invoke_watson</code>	<code><corecrt.h></code>

For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

[`_get_invalid_parameter_handler`](#) , [`_get_thread_local_invalid_parameter_handler`](#)
[`_set_invalid_parameter_handler`](#) , [`_set_thread_local_invalid_parameter_handler`](#)

[Parameter validation](#)

`isalnum`, `iswalnum`, `_isalnum_l`, `_iswalnum_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents an alphanumeric character.

Syntax

```
int isalnum( int c );
int iswalnum( wint_t c );
int _isalnum_l( int c, _locale_t locale );
int _iswalnum_l( wint_t c, _locale_t locale );
```

Parameters

`c`

Integer to test.

`Locale`

The locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of an alphanumeric character.

`isalnum` returns a nonzero value if either `isalpha` or `isdigit` is nonzero for `c`, that is, if `c` is within the ranges A - Z, a - z, or 0 - 9. `iswalnum` returns a nonzero value if either `iswalpha` or `iswdigit` is nonzero for `c`. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale parameter that's passed in instead of the current locale. For more information, see [Locale](#).

The behavior of `isalnum` and `_isalnum_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istalnum</code>	<code>isalnum</code>	<code>_ismbcalnum</code>	<code>iswalnum</code>
<code>_istalnum_l</code>	<code>_isalnum_l</code>	<code>_ismbcalnum_l</code>	<code>_iswalnum_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isalnum</code>	<code><ctype.h></code>
<code>iswalnum</code>	<code><ctype.h> or <wchar.h></code>
<code>_isalnum_l</code>	<code><ctype.h></code>
<code>_iswalnum_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

[is , isw routines](#)

`isalpha`, `iswalpha`, `_isalpha_l`, `_iswalpha_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents an alphabetic character.

Syntax

```
int isalpha(
    int c
);
int iswalpha(
    wint_t c
);
int _isalpha_l(
    int c,
    _locale_t locale
);
int _iswalpha_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

The locale to use instead of the current locale.

Return value

Each of these routines returns nonzero if `c` is a particular representation of an alphabetic character. `isalpha` returns a nonzero value if `c` is within the ranges A - Z or a - z. `iswalpha` returns a nonzero value only for wide characters for which `iswupper` or `iswlower` is nonzero; that is, for any wide character that is one of an implementation-defined set for which none of `iswcntrl`, `iswdigit`, `iswpunct`, or `iswspace` is nonzero. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale parameter that's passed in instead of the current locale. For more information, see [Locale](#).

The behavior of `isalpha` and `_isalpha_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istalpha</code>	<code>isalpha</code>	<code>_ismbcalpha</code>	<code>iswalpha</code>
<code>_istalpha_l</code>	<code>_isalpha_l</code>	<code>_ismbcalpha_l</code>	<code>_iswalpha_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isalpha</code>	<code><ctype.h></code>
<code>iswalpha</code>	<code><ctype.h> or <wchar.h></code>
<code>_isalpha_l</code>	<code><ctype.h></code>
<code>_iswalpha_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`isascii`, `_isascii`, `iswascii`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a particular character is an ASCII character.

Syntax

```
int __isascii(
    int c
);
int iswascii(
    wint_t c
);

#define isascii __isascii
```

Parameters

`c`

Integer to test.

Return value

Each of these routines returns nonzero if `c` is a particular representation of an ASCII character. `__isascii` returns a nonzero value if `c` is an ASCII character (in the range 0x00 - 0x7F). `iswascii` returns a nonzero value if `c` is a wide-character representation of an ASCII character. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

Remarks

Both `__isascii` and `iswascii` are implemented as macros unless the preprocessor macro `_CTYPE_DISABLE_MACROS` is defined.

For backward compatibility, `isascii` is implemented as a macro only if `_STDC_` isn't defined or is defined as 0; otherwise it's undefined.

By default, this function's global state is scoped to the application. To change this scope, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istascii</code>	<code>__isascii</code>	<code>__isascii</code>	<code>iswascii</code>

Requirements

ROUTINE	REQUIRED HEADER
---------	-----------------

ROUTINE	REQUIRED HEADER
<code>isascii</code> , <code>__isascii</code>	C: <ctype.h> C++: <cctype> or <ctype.h>
<code>iswascii</code>	C: <wctype.h>, <ctype.h>, or <wchar.h> C++: <cwctype>, <cctype>, <wctype.h>, <ctype.h>, or <wchar.h>

The `isascii`, `__isascii`, and `iswascii` functions are Microsoft-specific. For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

[is](#), [isw](#) routines

isatty

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The Microsoft-implemented POSIX function name `isatty` is a deprecated alias for the `_isatty` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_isatty` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_isatty

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a file descriptor is associated with a character device.

Syntax

```
int _isatty( int fd );
```

Parameters

`fd`

File descriptor that refers to the device to be tested.

Return value

`_isatty` returns a nonzero value if the descriptor is associated with a character device. Otherwise, `_isatty` returns 0.

Remarks

The `_isatty` function determines whether `fd` is associated with a character device (a terminal, console, printer, or serial port).

This function validates the `fd` parameter. If `fd` is a bad file pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns 0 and sets `errno` to `EBADF`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_isatty</code>	<code><io.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_isatty.c
/* This program checks to see whether
* stdout has been redirected to a file.
*/
#include <stdio.h>
#include <io.h>

int main( void )
{
    if( _isatty( _fileno( stdout ) ) )
        printf( "stdout has not been redirected to a file\n" );
    else
        printf( "stdout has been redirected to a file\n" );
}
```

Sample output

```
stdout has not been redirected to a file
```

See also

[File handling](#)

`isblank`, `iswblank`, `_isblank_l`, `_iswblank_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents a blank character.

Syntax

```
int isblank(
    int c
);
int iswblank(
    wint_t c
);
int _isblank_l(
    int c,
    _locale_t locale
);
int _iswblank_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

Locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a space or horizontal tab character, or is one of a locale-specific set of characters that are used to separate words within a line of text. `isblank` returns a nonzero value if `c` is a space character (0x20) or horizontal tab character (0x09). The result of the test condition for the `isblank` functions depends on the `LC_CTYPE` category setting of the locale; for more information, see [setlocale](#), [_wsetlocale](#). The versions of these functions that don't have the `_l` suffix use the current locale for any locale-dependent behavior; the versions that do have the `_l` suffix are identical except that they use the locale that's passed in instead. For more information, see [Locale](#).

`iswblank` returns a nonzero value if `c` is a wide character that corresponds to a standard space or horizontal tab character.

The behavior of `isblank` and `_isblank_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istblank</code>	<code>isblank</code>	<code>_ismbcblank</code>	<code>iswblank</code>

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istblank_l</code>	<code>_isblank_l</code>	<code>_ismbcblank_l</code>	<code>_iswblank_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isblank</code>	<code><ctype.h></code>
<code>iswblank</code>	<code><ctype.h> or <wchar.h></code>
<code>_isblank_l</code>	<code><ctype.h></code>
<code>_iswblank_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is`, `isw` routines

`iscntrl`, `iswcntrl`, `_iscntrl_l`, `_iswcntrl_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents a control character.

Syntax

```
int iscntrl(
    int c
);
int iswcntrl(
    wint_t c
);
int _iscntrl_l(
    int c,
    _locale_t locale
);
int _iswcntrl_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test

`Locale`

The locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a control character. `iscntrl` returns a nonzero value if `c` is a control character (0x00 - 0x1F or 0x7F). `iswcntrl` returns a nonzero value if `c` is a control wide character. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale parameter that's passed in instead of the current locale. For more information, see [Locale](#).

The behavior of `iscntrl` and `_iscntrl_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istcntrl</code>	<code>iscntrl</code>	<code>iscntrl</code>	<code>iswcntrl</code>
<code>_istcntrl_l</code>	<code>_iscntrl_l</code>	<code>_iscntrl_l</code>	<code>_iswcntrl_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>iscntrl</code>	<code><ctype.h></code>
<code>iswcntrl</code>	<code><ctype.h> or <wchar.h></code>
<code>_iscntrl_l</code>	<code><ctype.h></code>
<code>_iswcntrl_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`_isctype`, `_iswctype`, `_isctype_l`, `_iswctype_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tests `c` for the `ctype` property specified by the `desc` argument. For each valid value of `desc`, there's an equivalent wide-character classification routine.

Syntax

```
int _isctype(
    int c,
    _ctype_t desc
);
int _isctype_l(
    int c,
    _ctype_t desc,
    _locale_t locale
);
int iswctype(
    wint_t c,
    wctype_t desc
);
int _iswctype_l(
    wint_t c,
    wctype_t desc,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`desc`

Property to test for. The property is normally retrieved using `ctype` or `wctype`.

`Locale`

The locale to use for any locale-dependent tests.

Return value

`_isctype` and `_iswctype` return a nonzero value if `c` has the property specified by `desc` in the current locale. Otherwise, they return 0. The versions of these functions with the `_l` suffix are identical except that they use the locale passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

The behavior of `_isctype` and `_isctype_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
n/a	<code>_isctype</code>	n/a	<code>_iswctype</code>

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
n/a	<code>_isctype_1</code>	n/a	<code>_iswctype_1</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_isctype</code>	<code><ctype.h></code>
<code>iswctype</code>	<code><ctype.h> or <wchar.h></code>
<code>_isctype_1</code>	<code><ctype.h></code>
<code>_iswctype_1</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Character classification](#)

[Locale](#)

[`is`, `isw` routines](#)

```
iscsym, iscsmf, __iscsym, __iswcsym,
iscsymf, iswcsymf, __iscsym_l, __iswcsym_l,
iscsym_l, iswcsym_l
```

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determine if an integer represents a character that may be used in an identifier.

Syntax

```
int __iscsym(
    int c
);
int __iswcsym(
    wint_t c
);
int __iscsymf(
    int c
);
int __iswcsymf(
    wint_t c
);
int __iscsym_l(
    int c,
    _locale_t locale
);
int __iswcsym_l(
    wint_t c,
    _locale_t locale
);
int __iscsymf_l(
    int c,
    _locale_t locale
);
int __iswcsymf_l(
    wint_t c,
    _locale_t locale
);
#define iscsym __iscsym
#define iscsmf __iscsymf
```

Parameters

`c`

Integer to test. `c` should be in the range of 0-255 for the narrow character version of the function.

`Locale`

The locale to use.

Return value

Both `__iscsym` and `__iswcsym` return a nonzero value if `c` is a letter, underscore, or digit. Both `__iscsymf` and `__iswcsymf` return a nonzero value if `c` is a letter or an underscore. Each of these routines returns 0 if `c` doesn't satisfy the test condition. The versions of these functions with the `_l` suffix are identical except that they use the `Locale` passed in instead of the current locale for their locale-dependent behavior. For more

information, see [Locale](#).

Remarks

These routines are defined as macros unless the preprocessor macro `_CTYPE_DISABLE_MACROS` is defined. When you use the macro versions of these routines, the arguments can be evaluated more than once. Be careful when you use expressions that have side effects within the argument list.

For backward compatibility, `iscsym` and `iscsymf` are defined as macros only when `__STDC__` isn't defined or is defined as 0; otherwise they're undefined.

Requirements

ROUTINE	REQUIRED HEADER
<code>iscsym</code> , <code>iscsymf</code> , <code>__iscsym</code> , <code>__iswcsym</code> , <code>__iscsymf</code> , <code>__iswcsymf</code> , <code>_iscsym_1</code> , <code>_iswcsym_1</code> , <code>_iscsymf_1</code> , <code>_iswcsymf_1</code>	C: <code><ctype.h></code> C++: <code><cctype></code> or <code><ctype.h></code>

The `iscsym`, `iscsymf`, `__iscsym`, `__iswcsym`, `__iscsymf`, `__iswcsymf`, `_iscsym_1`, `_iswcsym_1`, `_iscsymf_1`, and `_iswcsymf_1` routines are Microsoft-specific. For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is`, `isw` routines

`isdigit`, `iswdigit`, `_isdigit_l`, `_iswdigit_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents a decimal-digit character.

Syntax

```
int isdigit(
    int c
);
int iswdigit(
    wint_t c
);
int _isdigit_l(
    int c,
    _locale_t locale
);
int _iswdigit_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

The locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a decimal-digit character. `isdigit` returns a nonzero value if `c` is a decimal digit (0 - 9). `iswdigit` returns a nonzero value if `c` is a wide character that corresponds to a decimal-digit character. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale that's passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

The behavior of `isdigit` and `_isdigit_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istdigit</code>	<code>isdigit</code>	<code>_ismbcdigit</code>	<code>iswdigit</code>
<code>_istdigit_l</code>	<code>_isdigit_l</code>	<code>_ismbcdigit_l</code>	<code>_iswdigit_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isdigit</code>	<code><ctype.h></code>
<code>iswdigit</code>	<code><ctype.h> or <wchar.h></code>
<code>_isdigit_l</code>	<code><ctype.h></code>
<code>_iswdigit_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`isfinite`, `_finite`, `_finitef`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a floating-point value is finite.

Syntax

```
int isfinite(
    /* floating-point */ x
); /* C-only macro */

template <class FloatingType>
inline bool isfinite(
    FloatingType x
) throw(); /* C++-only template function */

int _finite(
    double x
);

int _finitef(
    float x
); /* x64 and ARM/ARM64 only */
```

Parameters

`x`

The floating-point value to test.

Return value

The `isfinite` macro and the `_finite` and `_finitef` functions return a non-zero value if `x` is either a normal or subnormal finite value. They return 0 if the argument is infinite or a NaN. The C++ inline template function `isfinite` behaves the same way, but returns `true` or `false`.

Remarks

`isfinite` is a macro when compiled as C, and an inline template function when compiled as C++. The `_finite` and `_finitef` functions are Microsoft-specific. The `_finitef` function is only available when compiled for x86, ARM, or ARM64 platforms.

Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>_finite</code>	<code><float.h></code> or <code><math.h></code>	<code><float.h>, <math.h>, <cfloat>, or <cmath></code>
<code>isfinite</code> , <code>_finitef</code>	<code><math.h></code>	<code><math.h> or <cmath></code>

For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

[fpclassify](#)
[_fpclass](#), [_fpclassf](#)
[isinf](#)
[isnan](#), [_isnan](#), [_isnanf](#)
[isnormal](#)

`isgraph`, `iswgraph`, `_isgraph_l`, `_iswgraph_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents a graphical character.

Syntax

```
int isgraph(
    int c
);
int iswgraph(
    wint_t c
);
int _isgraph_l(
    int c,
    _locale_t locale
);
int _iswgraph_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a printable character other than a space. `isgraph` returns a nonzero value if `c` is a printable character other than a space. `iswgraph` returns a nonzero value if `c` is a printable wide character other than a wide character space. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale that's passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

The behavior of `isgraph` and `_isgraph_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istgraph</code>	<code>isgraph</code>	<code>_ismbcgraph</code>	<code>iswgraph</code>
<code>_istgraph_l</code>	<code>_isgraph_l</code>	<code>_ismbcgraph_l</code>	<code>_iswgraph_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isgraph</code>	<code><ctype.h></code>
<code>iswgraph</code>	<code><ctype.h> or <wchar.h></code>
<code>_isgraph_l</code>	<code><ctype.h></code>
<code>_iswgraph_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

[`is`, `isw` routines](#)

`isgreater`, `isgreaterequal`, `isless`, `islessequal`,
`islessgreater`, `isunordered`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines the ordering relationship between two floating-point values.

Syntax

```
int isgreater(
    /* floating-point */ x,
    /* floating-point */ y
); /* C-only macro */

int isgreaterequal(
    /* floating-point */ x,
    /* floating-point */ y
); /* C-only macro */

int isless(
    /* floating-point */ x,
    /* floating-point */ y
); /* C-only macro */

int islessequal(
    /* floating-point */ x,
    /* floating-point */ y
); /* C-only macro */

int islessgreater(
    /* floating-point */ x,
    /* floating-point */ y
); /* C-only macro */

int isunordered(
    /* floating-point */ x,
    /* floating-point */ y
); /* C-only macro */
```

```

template <class FloatingType1, class FloatingType2>
inline bool isgreater(
    FloatingType1 x,
    FloatingType2 y
) throw(); /* C++-only template function */

template <class FloatingType1, class FloatingType2>
inline bool isgreaterequal(
    FloatingType1 x,
    FloatingType2 y
) throw(); /* C++-only template function */

template <class FloatingType1, class FloatingType2>
inline bool isless(
    FloatingType1 x,
    FloatingType2 y
) throw(); /* C++-only template function */

template <class FloatingType1, class FloatingType2>
inline bool islessequal(
    FloatingType1 x,
    FloatingType2 y
) throw(); /* C++-only template function */

template <class FloatingType1, class FloatingType2>
inline bool islessgreater(
    FloatingType1 x,
    FloatingType2 y
) throw(); /* C++-only template function */

template <class FloatingType1, class FloatingType2>
inline bool isunordered(
    FloatingType1 x,
    FloatingType2 y
) throw(); /* C++-only template function */

```

Parameters

`x`, `y`

The floating-point values to compare.

Return value

In all comparisons, infinities of the same sign compare as equal. Negative infinity is less than any finite value or positive infinity. Positive infinity is greater than any finite value or negative infinity. Zeroes are equal regardless of sign. NaNs aren't less than, equal to, or greater than any value, including another NaN.

When neither argument is a NaN, the ordering macros `isgreater`, `isgreaterequal`, `isless`, and `islessequal` return a non-zero value if the specified ordering relation between `x` and `y` holds true. These macros return 0 if either or both arguments are NaNs or if the ordering relationship is false. The function forms behave the same way, but return `true` or `false`.

The `islessgreater` macro returns a non-zero value if both `x` and `y` aren't NaNs, and `x` is either less than or greater than `y`. It returns 0 if either or both arguments are NaNs, or if the values are equal. The function form behaves the same way, but returns `true` or `false`.

The `isunordered` macro returns a non-zero value if either `x`, `y`, or both are NaNs. Otherwise, it returns 0. The function form behaves the same way, but returns `true` or `false`.

Remarks

These comparison operations are implemented as macros when compiled as C, and as inline template functions when compiled as C++.

Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>isgreater</code> , <code>isgreaterequal</code> , <code>isless</code> , <code>islessequal</code> , <code>islessgreater</code> , <code>isunordered</code>	<code><math.h></code>	<code><math.h> or <cmath></code>

For more compatibility information, see [Compatibility](#).

See also

Math and floating-point support

<code>isfinite</code> , <code>_finite</code> , <code>_finitef</code>
<code>isinf</code>
<code>isnan</code> , <code>_isnan</code> , <code>_isnanf</code>
<code>_fpclass</code> , <code>_fpclassf</code>

isinf

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a floating-point value is an infinity.

Syntax

```
int isinf(  
    /* floating-point */ x  
); /* C-only macro */  
  
template <class FloatingType>  
inline bool isinf(  
    FloatingType x  
) throw(); /* C++-only template function */
```

Parameters

x

The floating-point value to test.

Return value

`isinf` returns a nonzero value (`true` in C++ code) if the argument `x` is a positive or negative infinity. `isinf` returns 0 (`false` in C++ code) if the argument is finite or a NAN. Both normal and subnormal floating-point values are considered finite.

Remarks

`isinf` is a macro when compiled as C, and an inline template function when compiled as C++.

Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>isinf</code>	<code><math.h></code>	<code><math.h> or <cmath></code>

For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

`fpclassify`
`_fpclass`, `_fpclassf`
`isfinite`, `_finite`, `_finitef`
`isnan`, `_isnan`, `_isnanf`
`isnormal`

`isleadbyte`, `_isleadbyte_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a character is the lead byte of a multibyte character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int isleadbyte( int c );
int _isleadbyte_l( int c );
```

Parameters

`c`

Integer to test.

Return value

`isleadbyte` returns a nonzero value if the argument satisfies the test condition. Otherwise, it returns 0. In the "C" locale and in single-byte character set (SBCS) locales, `isleadbyte` always returns 0.

Remarks

The `isleadbyte` macro returns a nonzero value if its argument is the first byte of a multibyte character.

`isleadbyte` produces a meaningful result for any integer argument from -1 (`EOF`) to `UCHAR_MAX` (0xFF), inclusive.

The expected argument type of `isleadbyte` is `int`; if a signed character is passed, the compiler may convert it to an integer by sign extension, yielding unpredictable results.

The version of this function with the `_l` suffix is identical except that it uses the locale passed in instead of the current locale for its locale-dependent behavior.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istleadbyte</code>	Always returns false	<code>_isleadbyte</code>	Always returns false

Requirements

ROUTINE	REQUIRED HEADER
<code>isleadbyte</code>	<code><ctype.h></code>
<code>_isleadbyte_1</code>	<code><ctype.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

[Locale](#)

[`_ismbb` routines](#)

`islower`, `iswlower`, `_islower_l`, `_iswlower_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether an integer represents a lowercase character.

Syntax

```
int islower(
    int c
);
int iswlower(
    wint_t c
);
int islower_l(
    int c,
    _locale_t locale
);
int _iswlower_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

Locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a lowercase character. `islower` returns a nonzero value if `c` is a lowercase character (a - z). `iswlower` returns a nonzero value if `c` is a wide character that corresponds to a lowercase letter, or if `c` is one of an implementation-defined set of wide characters for which none of `iswcntrl`, `iswdigit`, `iswpunct`, or `iswspace` is nonzero. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale that's passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

The behavior of `islower` and `_islower_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istlower</code>	<code>islower</code>	<code>_ismbclower</code>	<code>iswlower</code>
<code>_istlower_l</code>	<code>_islower_l</code>	<code>_ismbclower_l</code>	<code>_liswlower_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>islower</code>	<code><ctype.h></code>
<code>iswlower</code>	<code><ctype.h> or <wchar.h></code>
<code>_islower_l</code>	<code><ctype.h></code>
<code>_swlower_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`_ismbbalnum`, `_ismbbalnum_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a specified multibyte character is alpha or numeric.

Syntax

```
int _ismbbalnum(
    unsigned int c
);
int _ismbbalnum_1(
    unsigned int c
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbalnum` returns a nonzero value when the expression:

`isalnum(c) || _ismbbkalnum(c)`

is nonzero for `c`, or 0 when the expression is zero.

The version of this function with the `_1` suffix is identical except that it uses the locale passed in instead of the current locale for its locale-dependent behavior.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbalnum</code>	<code><mbctype.h></code>
<code>_ismbbalnum_1</code>	<code><mbctype.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Byte classification](#)

[`_ismbb` routines](#)

`_ismbbalpha`, `_ismbbalpha_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a specified multibyte character is alpha.

Syntax

```
int _ismbbalpha(
    unsigned int c
);
int _ismbbalpha_1(
    unsigned int c
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbalpha` returns a nonzero value when the expression:

```
isalpha(c) || _ismbbkalnum(c)
```

is nonzero for `c`, or 0 when the expression is zero. `_ismbbalpha` uses the current locale for any locale-dependent character settings. `_ismbbalpha_1` is identical except that it uses the locale passed in.

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbalpha</code>	<mbctype.h>
<code>_ismbbalpha_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

Byte classification

`_ismbb` routines

`_ismbbblank`, `_ismbbblank_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a specified multibyte character is a blank character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbbblank(
    unsigned int c
);
int _ismbbblank_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbblank` returns a nonzero value if `c` represents a space (0x20) character, a horizontal tab (0x09) character, or a locale-specific character that's used to separate words within a line of text for which `isspace` is true; otherwise, returns 0. `_ismbbblank` uses the current locale for any locale-dependent behavior. `_ismbbblank_1` is identical except that it instead uses the locale that's passed in. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbblank</code>	<code><mbctype.h></code>
<code>_ismbbblank_1</code>	<code><mbctype.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

[`_ismbb` routines](#)

`_ismbbgraph`, `_ismbbgraph_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a particular multibyte character is a graphical character.

Syntax

```
int _ismbbgraph (
    unsigned int c
);
int _ismbbgraph_1 (
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

Returns a nonzero value when the expression:

```
isctype(c, ( _PUNCT | _UPPER | _LOWER | _DIGIT )) || _ismbbkprint(c)
```

is nonzero for `c`, or 0 when it's zero. `_ismbbgraph` uses the current locale for any locale-dependent behavior.

`_ismbbgraph_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbgraph</code>	<mbctype.h>
<code>_ismbbgraph_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Byte classification](#)

[`_ismbb` routines](#)

`_ismbbkalnum`, `_ismbbkalnum_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a particular multibyte character is a non-ASCII text symbol.

Syntax

```
int _ismbbkalnum(
    unsigned int c
);
int _ismbbkalnum_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbkalnum` returns a nonzero value if the integer `c` is a non-ASCII text symbol other than punctuation.

Otherwise, it returns 0. `_ismbbkalnum` uses the current locale for locale-dependent character information.

`_ismbbkalnum_1` is identical to `_ismbbkalnum` except that it takes the locale as a parameter. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbkalnum</code>	<mbctype.h>
<code>_ismbbkalnum_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_ismbb` routines

`_ismbbkana`, `_ismbbkana_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tests for a katakana symbol and is specific to code page 932.

Syntax

```
int _ismbbkana(
    unsigned int c
);
int _ismbbkana_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbkana` returns a nonzero value if the integer `c` is a katakana symbol. Otherwise, it returns 0. `_ismbbkana` uses the current locale for locale-dependent character information. `_ismbbkana_1` is identical except that it uses the locale object passed in. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbkana</code>	<mbctype.h>
<code>_ismbbkana_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_ismbb` routines

`_ismbbkprint`, `_ismbbkprint_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a particular multibyte character is a punctuation symbol.

Syntax

```
int _ismbbkprint(
    unsigned int c
);
int _ismbbkprint_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbkprint` returns a nonzero value if the integer `c` is a non-ASCII text or non-ASCII punctuation symbol. Otherwise, it returns 0. For example, in code page 932 only, `_ismbbkprint` tests for katakana alphanumeric or katakana punctuation (range: 0xA1 - 0xDF). `_ismbbkprint` uses the current locale for locale-dependent character settings. `_ismbbkprint_l` is identical except that it uses the locale passed in. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbkprint</code>	<mbctype.h>
<code>_ismbbkprint_l</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_ismbb` routines

`_ismbbkpunct`, `_ismbbkpunct_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Checks whether a multibyte character is a punctuation character.

Syntax

```
int _ismbbkpunct(
    unsigned int c
);
int _ismbbkpunct_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbkpunct` returns a nonzero value if the integer `c` is a non-ASCII punctuation symbol. Otherwise, it returns 0. For example, in code page 932 only, `_ismbbkpunct` tests for katakana punctuation. `_ismbbkpunct` uses the current locale for any locale-dependent character settings. `_ismbbkpunct_1` is identical except that it uses the locale that's passed in. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbkpunct</code>	<mbctype.h>
<code>_ismbbkpunct_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_ismbb` routines

`_ismbblead`, `_ismbblead_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tests a character to determine whether it's a lead byte of a multibyte character.

Syntax

```
int _ismbblead(
    unsigned int c
);
int _ismbblead_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

Returns a nonzero value if the integer `c` is the first byte of a multibyte character.

Remarks

Multibyte characters consist of a lead byte followed by a trailing byte. Lead bytes are distinguished by being in a particular range for a given character set. For example, in code page 932 only, lead bytes range from 0x81 - 0x9F and 0xE0 - 0xFC.

`_ismbblead` uses the current locale for locale-dependent behavior. `_ismbblead_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

When the locale is UTF-8, `_ismbblead` and `_ismbblead_1` always return 0 (false), whether `c` is a lead byte or not.

`_ismbblead` and `_ismbblead_1` are Microsoft-specific, not part of the Standard C library. We don't recommend you use them where you want portable code. For Standard C compatibility, use `mbrlen` instead.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istlead</code>	Always returns false	<code>_ismbblead</code>	Always returns false

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_ismbblead</code>	<mbctype.h> or <mbstring.h>	<ctype.h>,* <limits.h>, <stdlib.h>
<code>_ismbblead_l</code>	<mbctype.h> or <mbstring.h>	<ctype.h>,* <limits.h>, <stdlib.h>

* For manifest constants for the test conditions.

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

[`_ismbb` routines](#)

[`mbrlen`](#)

`_ismbbprint`, `_ismbbprint_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a specified multibyte character is a print character.

Syntax

```
int _ismbbprint(
    unsigned int c
);
int _ismbbprint_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbprint` returns a nonzero value when the expression:

```
isprint(c) || _ismbbkprint(c)
```

is nonzero for `c`, or 0 when it isn't. `_ismbbprint` uses the current locale for any locale-dependent behavior.

`_ismbbprint_l` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbprint</code>	<mbctype.h>
<code>_ismbbprint_l</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_ismbb` routines

`_ismbbpunct`, `_ismbbpunct_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a particular character is a punctuation character.

Syntax

```
int _ismbbpunct(
    unsigned int c
);
int _ismbbpunct_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Integer to be tested.

`Locale`

Locale to use.

Return value

`_ismbbpunct` returns a nonzero value if the integer `c` is a non-ASCII punctuation symbol. `_ismbbpunct` uses the current locale for any locale-dependent character settings. `_ismbbpunct_1` is identical except that it uses the locale that's passed in. For more information, see [Locale](#).

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbbpunct</code>	<mbctype.h>
<code>_ismbbpunct_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_ismbb` routines

`_ismbbtrail`, `_ismbbtrail_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines whether a byte is a trailing byte of a multibyte character.

Syntax

```
int _ismbbtrail(
    unsigned int c
);
int _ismbbtrail_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

The integer to be tested.

`Locale`

The locale to use.

Return value

`_ismbbtrail` returns a nonzero value if the integer `c` is the second byte of a multibyte character. For example, in code page 932 only, valid ranges are 0x40 to 0x7E and 0x80 to 0xFC.

Remarks

`_ismbbtrail` uses the current locale for locale-dependent behavior. `_ismbbtrail_1` is identical except that it uses the locale that's passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_ismbbtrail</code>	<code><mbctype.h></code> or <code><mbstring.h></code>	<code><ctype.h></code> ,*, <code><limits.h></code> , <code><stdlib.h></code>
<code>_ismbbtrail_1</code>	<code><mbctype.h></code> or <code><mbstring.h></code>	<code><ctype.h></code> ,*, <code><limits.h></code> , <code><stdlib.h></code>

* For manifest constants for the test conditions.

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

[_ismbb](#) routines

`_ismbcalnum`, `_ismbcalnum_l`, `_ismbcalpha`,
`_ismbcalpha_l`, `_ismbcdigit`, `_ismbcdigit_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Checks whether a multibyte character is an alphanumeric, alpha, or digit character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbcalnum
(
    unsigned int c
);
int _ismbcalnum_l
(
    unsigned int c,
    _locale_t locale
);
int _ismbcalpha
(
    unsigned int c
);
int _ismbcalpha_l
(
    unsigned int c,
    _locale_t locale
);
int _ismbcdigit
(
    unsigned int c
);
int _ismbcdigit_l
(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to be tested.

`Locale`

Locale to use.

Return value

Each of these routines returns a nonzero value if the character satisfies the test condition. Otherwise, they return 0. If `c` <= 255 and there's a corresponding `_ismbb` routine (for example, `_ismbcalnum` corresponds to `_ismbbalnum`), the result is the return value of the corresponding `_ismbb` routine.

Remarks

Each of these routines tests a given multibyte character for a given condition.

The versions of these functions with the `_1` suffix are identical except that they use the locale passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

ROUTINE	TEST CONDITION	CODE PAGE 932 EXAMPLE
<code>_ismbcalnum</code> , <code>_ismbcalnum_1</code>	Alphanumeric	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII English letter: See examples for <code>_ismbcdigit</code> and <code>_ismbcalpha</code> .
<code>_ismbcalpha</code> , <code>_ismbcalpha_1</code>	Alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII English letter: $0x41 \leq c \leq 0x5A$ or $0x61 \leq c \leq 0x7A$; or a katakana letter: $0xA6 \leq c \leq 0xDF$.
<code>_ismbcdigit</code> , <code>_ismbcdigit_1</code>	Digit	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII digit: $0x30 \leq c \leq 0x39$.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbcalnum</code> , <code>_ismbcalnum_1</code>	<code><mbstring.h></code>
<code>_ismbcalpha</code> , <code>_ismbcalpha_1</code>	<code><mbstring.h></code>
<code>_ismbcdigit</code> , <code>_ismbcdigit_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

Character classification

`_ismbc` routines
`is`, `isw` routines
`_ismbb` routines



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Determines whether character is a graphical character, a display character, a punctuation character, or a space character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbcgraph(
    unsigned int c
);
int _ismbcgraph_l(
    unsigned int c,
    _locale_t locale
);
int _ismbcprint(
    unsigned int c
);
int _ismbcprint_l(
    unsigned int c,
    _locale_t locale
);
int _ismbcpunct(
    unsigned int c
);
int _ismbcpunct_l(
    unsigned int c,
    _locale_t locale
);
int _ismbcblank(
    unsigned int c
);
int _ismbcblank_l(
    unsigned int c,
    _locale_t locale
);
int _ismbcspace(
    unsigned int c
);
int _ismbcspace_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to be determined.

`Locale`

Locale to use.

Return value

Each of these routines returns a nonzero value if the character satisfies the test condition. Otherwise, they return 0. If `c` <= 255 and there's a corresponding `_ismbb` routine (for example, `_ismbcalnum` corresponds to `_ismbalnum`), the result is the return value of the corresponding `_ismbb` routine.

The versions of these functions are identical, except that the ones that have the `_1` suffix use the locale that's passed in for their locale-dependent behavior, instead of the current locale. For more information, see [Locale](#).

Remarks

Each of these functions tests a given multibyte character for a given condition.

ROUTINE	TEST CONDITION	CODE PAGE 932 EXAMPLE
<code>_ismbcgraph</code>	Graphic	Returns nonzero if and only if <code>c</code> is a single-byte representation of any ASCII or katakana printable character except a white space.
<code>_ismbcprint</code>	Printable	Returns nonzero if and only if <code>c</code> is a single-byte representation of any ASCII or katakana printable character including a white space.
<code>_ismbcpunct</code>	Punctuation	Returns nonzero if and only if <code>c</code> is a single-byte representation of any ASCII or katakana punctuation character.
<code>_ismbcblank</code>	Space or horizontal tab	Returns nonzero if and only if <code>c</code> is a space or horizontal tab character: <code>c</code> =0x20 or <code>c</code> =0x09.
<code>_ismbcspace</code>	White space	Returns nonzero if and only if <code>c</code> is a white-space character: <code>c</code> =0x20 or <code>0x09 <= c <= 0xD</code> .

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbcgraph</code>	<code><mbstring.h></code>

ROUTINE	REQUIRED HEADER
<code>_ismbcgraph_1</code>	<mbstring.h>
<code>_ismbcprint</code>	<mbstring.h>
<code>_ismbcprint_1</code>	<mbstring.h>
<code>_ismbcpunct</code>	<mbstring.h>
<code>_ismbcpunct_1</code>	<mbstring.h>
<code>_ismbcblank</code>	<mbstring.h>
<code>_ismbcblank_1</code>	<mbstring.h>
<code>_ismbcspace</code>	<mbstring.h>
<code>_ismbcspace_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Character classification](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[_ismbc routines](#)

[is , isw routines](#)

[_ismbb routines](#)

`_ismbchira`, `_ismbchira_l`, `_ismbckata`,
`_ismbckata_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Code Page 932 Specific functions

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbchira(
    unsigned int c
);
int _ismbchira_l(
    unsigned int c,
    _locale_t locale
);
int _ismbckata(
    unsigned int c
);
int _ismbckata_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to be tested.

`Locale`

Locale to use.

Return value

Each of these routines returns a nonzero value if the character satisfies the test condition. Otherwise, they return 0. If `c` <= 255 and there's a corresponding `_ismbb` routine (for example, `_ismbcalnum` corresponds to `_ismbbalnum`), the result is the return value of the corresponding `_ismbb` routine.

Remarks

Each of these functions tests a given multibyte character for a given condition.

The versions of these functions with the `_l` suffix are identical except that they use the locale passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

ROUTINE	TEST CONDITION (CODE PAGE 932 ONLY)
<code>_ismbchira</code>	Double-byte Hiragana: 0x829F <= <code>c</code> <= 0x82F1.
<code>_ismbchira_l</code>	Double-byte Hiragana: 0x829F <= <code>c</code> <= 0x82F1.
<code>_ismbckata</code>	Double-byte katakana: 0x8340 <= <code>c</code> <= 0x8396.
<code>_ismbckata_l</code>	Double-byte katakana: 0x8340 <= <code>c</code> <= 0x8396.

End Code Page 932 Specific

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbchira</code>	<code><mbstring.h></code>
<code>_ismbchira_l</code>	<code><mbstring.h></code>
<code>_ismbckata</code>	<code><mbstring.h></code>
<code>_ismbckata_l</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

`_ismbc` routines

`is` , `isw` routines

Locale

[Interpretation of multibyte-character sequences](#)

`_ismbc10`, `_ismbc10_l`, `_ismbc11`, `_ismbc11_l`,
`_ismbc12`, `_ismbc12_l`

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Code Page 932 Specific functions, using the current locale or a specified LC_CTYPE conversion state category.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbc10(
    unsigned int c
);
int _ismbc10_l(
    unsigned int c,
    _locale_t locale
);
int _ismbc11(
    unsigned int c
);
int _ismbc11_l(
    unsigned int c ,
    _locale_t locale
);
int _ismbc12(
    unsigned int c
);
int _ismbc12_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to be tested.

`Locale`

Locale to use.

Return value

Each of these routines returns a nonzero value if the character satisfies the test condition. Otherwise, they return 0. If `c` <= 255 and there's a corresponding `_ismbb` routine (for example, `_ismbcalnum` corresponds to `_ismbbalnum`), the result is the return value of the corresponding `_ismbb` routine.

Remarks

Each of these functions tests a given multibyte character for a given condition.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

ROUTINE	TEST CONDITION (CODE PAGE 932 ONLY)
<code>_ismbc10</code>	JIS non-Kanji: $0x8140 \leq c \leq 0x889E$.
<code>_ismbc10_1</code>	JIS non-Kanji: $0x8140 \leq c \leq 0x889E$.
<code>_ismbc11</code>	JIS level-1: $0x889F \leq c \leq 0x9872$.
<code>_ismbc11_1</code>	JIS level-1: $0x889F \leq c \leq 0x9872$.
<code>_ismbc12</code>	JIS level-2: $0x989F \leq c \leq 0xEAA4$.
<code>_ismbc12_1</code>	JIS level-2: $0x989F \leq c \leq 0xEAA4$.

The functions check that the specified value `c` matches the test conditions described above, but don't check that `c` is a valid multibyte character. If the lower byte is in the ranges `0x00 - 0x3F`, `0x7F`, or `0xFD - 0xFF`, these functions return a nonzero value, indicating that the character satisfies the test condition. Use [`_ismbbtrail`](#) to test whether the multibyte character is defined.

End Code Page 932 Specific

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbc10</code>	<code><mbstring.h></code>
<code>_ismbc10_1</code>	<code><mbstring.h></code>
<code>_ismbc11</code>	<code><mbstring.h></code>
<code>_ismbc11_1</code>	<code><mbstring.h></code>
<code>_ismbc12</code>	<code><mbstring.h></code>
<code>_ismbc12_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[`_ismbc` routines](#)

`is`, `isw` routines

`_ismbclegal`, `_ismbclegal_l`, `_ismbcsymbol`,
`_ismbcsymbol_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Checks whether a multibyte character is a legal or symbol character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbclegal(
    unsigned int c
);
int _ismbclegal_l(
    unsigned int c,
    _locale_t locale
);
int _ismbcsymbol(
    unsigned int c
);
int _ismbcsymbol_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to be tested.

`Locale`

Locale to use.

Return value

Each of these routines returns a nonzero value if the character satisfies the test condition. Otherwise, they return 0. If `c` <= 255 and there's a corresponding `_ismbb` routine (for example, `_ismbcalnum` corresponds to `_ismbbalnum`), the result is the return value of the corresponding `_ismbb` routine.

Remarks

Each of these functions tests a given multibyte character for a given condition.

The versions of these functions with the `_l` suffix are identical except that they use the locale passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

ROUTINE	TEST CONDITION	CODE PAGE 932 EXAMPLE
<code>_ismbclegal</code>	Valid multibyte	Returns nonzero if and only if the first byte of <code>c</code> is within ranges 0x81 - 0x9F or 0xE0 - 0xFC, while the second byte is within ranges 0x40 - 0x7E or 0x80 - FC.
<code>_ismbcsymbol</code>	Multibyte symbol	Returns nonzero if and only if $0x8141 \leq c \leq 0x81AC$.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istlegal</code>	Always returns false	<code>_ismbclegal</code>	Always returns false.
<code>_istlegal_1</code>	Always returns false	<code>_ismbclegal_1</code>	Always returns false.

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbclegal</code> , <code>_ismbclegal_1</code>	<code><mbstring.h></code>
<code>_ismbcsymbol</code> , <code>_ismbcsymbol_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

Character classification

[`_ismbc` routines](#)
[`is`, `isw` routines](#)
[`_ismbb` routines](#)

`_ismbclower`, `_ismbclower_l`, `_ismbcupper`,
`_ismbcupper_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Checks whether a multibyte character is lowercase or uppercase.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbclower(
    unsigned int c
);
int _ismbclower_l(
    unsigned int c,
    _locale_t locale
);
int _ismbcupper(
    unsigned int c
);
int _ismbcupper_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to be tested.

`Locale`

Locale to use.

Return value

Each of these routines returns a nonzero value if the character satisfies the test condition. Otherwise, they return 0. If `c` <= 255 and there's a corresponding `_ismbb` routine (for example, `_ismbcalnum` corresponds to `_ismbbalnum`), the result is the return value of the corresponding `_ismbb` routine.

Remarks

Each of these functions tests a given multibyte character for a given condition.

The versions of these functions with the `_l` suffix are identical except that they use the locale passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

ROUTINE	TEST CONDITION	CODE PAGE 932 EXAMPLE
<code>_ismbclower</code>	Lowercase alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII lowercase English letter: $0x61 \leq c \leq 0x7A$.
<code>_ismbclower_1</code>	Lowercase alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII lowercase English letter: $0x61 \leq c \leq 0x7A$.
<code>_ismbcupper</code>	Uppercase alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII uppercase English letter: $0x41 \leq c \leq 0x5A$.
<code>_ismbcupper_1</code>	Uppercase alphabetic	Returns nonzero if and only if <code>c</code> is a single-byte representation of an ASCII uppercase English letter: $0x41 \leq c \leq 0x5A$.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_ismbclower</code>	<code><mbstring.h></code>
<code>_ismbclower_1</code>	<code><mbstring.h></code>
<code>_ismbcupper</code>	<code><mbstring.h></code>
<code>_ismbcupper_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

`_ismbc` routines

Locale

[Interpretation of multibyte-character sequences](#)

`is`, `isw` routines

`_ismbb` routines

`_ismbstrail`, `_ismbstrail_l`, `_ismbstrail_l1`,

`_ismbstrail_l1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs context-sensitive tests for multibyte-character-string lead bytes and trail bytes and determines whether a given substring pointer points to a lead byte or a trail byte.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _ismbstrail(
    const unsigned char *str,
    const unsigned char *current
);
int _ismbstrail_l(
    const unsigned char *str,
    const unsigned char *current
);
int _ismbstrail_l1(
    const unsigned char *str,
    const unsigned char *current,
    _locale_t locale
);
int _ismbstrail_l1(
    const unsigned char *str,
    const unsigned char *current,
    _locale_t locale
);
```

Parameters

`str`

Pointer to the start of the string or the previous known lead byte.

`current`

Pointer to the position in the string to be tested.

`Locale`

The locale to use.

Return value

`_ismbstrail` returns -1 if the character is a lead byte and `_ismbstrail_l` returns -1 if the character is a trail byte. If the input strings are valid but aren't a lead byte or trail byte, these functions return zero. If either argument is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `NULL` and set `errno` to `EINVAL`.

Remarks

`_ismbsslead` and `_ismbstrail` are slower than the `_ismbblead` and `_ismbbtrail` versions because they take the string context into account.

The versions of these functions that have the `_1` suffix are identical except that for their locale-dependent behavior they use the locale that's passed in instead of the current locale. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_ismbsslead</code>	<code><mbctype.h></code> or <code><mbstring.h></code>	<code><ctype.h>, * <limits.h>, <stdlib.h></code>
<code>_ismbstrail</code>	<code><mbctype.h></code> or <code><mbstring.h></code>	<code><ctype.h>, * <limits.h>, <stdlib.h></code>
<code>_ismbsslead_1</code>	<code><mbctype.h></code> or <code><mbstring.h></code>	<code><ctype.h>, * <limits.h>, <stdlib.h></code>
<code>_ismbstrail_1</code>	<code><mbctype.h></code> or <code><mbstring.h></code>	<code><ctype.h>, * <limits.h>, <stdlib.h></code>

* For manifest constants for the test conditions.

For more compatibility information, see [Compatibility](#).

See also

Character classification

`_ismbc` routines
`is`, `isw` routines
`_ismbb` routines

`isnan`, `_isnan`, `_isnanf`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tests if a floating-point value is a NaN ("Not a Number").

Syntax

```
int isnan(
    /* floating-point */ x
); /* C-only macro */

int _isnan(
    double x
);

int _isnanf(
    float x
); /* x64 only */

template <class T>
bool isnan(
    T x
) throw(); /* C++ only */
```

Parameters

`x`

The floating-point value to test.

Return value

In C, the `isnan` macro and the `_isnan` and `_isnanf` functions return a non-zero value if the argument `x` is a NaN; otherwise they return 0.

In C++, the `isnan` template function returns `true` if the argument `x` is a NaN; otherwise it returns `false`.

Remarks

Because a NaN value doesn't compare as equal to itself or to any other NaN value, to detect one, you must use one of these functions or macros. A NaN is generated when the result of a floating-point operation can't be represented in IEEE-754 floating-point format for the specified type. For information about how a NaN is represented for output, see [printf](#).

When compiled as C++, the `isnan` macro isn't defined, and an `isnan` template function is defined instead. It behaves the same way as the macro, but returns a value of type `bool` instead of an integer.

The `_isnan` and `_isnanf` functions are Microsoft-specific. The `_isnanf` function is only available when compiled for x64.

Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>isnan</code> , <code>_isnanf</code>	<code><math.h></code>	<code><math.h> or <cmath></code>
<code>_isnan</code>	<code><float.h></code>	<code><float.h> or <cfloat></code>

For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

[`fpclassify`](#)

[`_fpclass` , `_fpclassf`](#)

[`isfinite` , `_finite` , `_finitef`](#)

[`isinf`](#)

[`isnormal`](#)

isnormal

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Determines whether a floating-point value is a normal value.

Syntax

```
int isnormal(
    /* floating-point */ x
); /* C-only macro */

template <class FloatingType>
inline bool isnormal(
    FloatingType x
) throw(); /* C++-only function template */
```

Parameters

x

The floating-point value to test.

Return value

`isnormal` returns a nonzero value (`true` in C++ code) if the argument `x` isn't zero, subnormal, infinite, or a NaN. Otherwise, `isnormal` returns 0 (`false` in C++ code).

Remarks

`isnormal` is a macro when compiled as C, and an inline function template when compiled as C++.

Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>isnormal</code>	<code><math.h></code>	<code><math.h> or <cmath></code>

For more compatibility information, see [Compatibility](#).

See also

Math and floating-point support

`isfinite`, `_finite`, `_finitef`
`isinf`
`isnan`, `_isnan`, `_isnanf`
`_fpclass`, `_fpclassf`

`ispunct`, `iswpunct`, `_ispunct_l`, `_iswpunct_l`

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Determines whether an integer represents a punctuation character.

Syntax

```
int ispunct(
    int c
);
int iswpunct(
    wint_t c
);
int _ispunct_l(
    int c,
    _locale_t locale
);
int _iswpunct_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

The locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a punctuation character. `ispunct` returns a nonzero value for any printable character that isn't a space character or a character for which `isalnum` is nonzero. `iswpunct` returns a nonzero value for any printable wide character that isn't the space wide character or a wide character for which `iswalnum` is nonzero. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The result of the test condition for the `ispunct` function depends on the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#), [_wsetlocale](#). The versions of these functions that don't have the `_l` suffix use the current locale for any locale-dependent behavior; the versions that do have the `_l` suffix are identical except that they use the locale that's passed in instead. For more information, see [Locale](#).

The behavior of `ispunct` and `_ispunct_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istpunct</code>	<code>ispunct</code>	<code>_ismbcpunct</code>	<code>iswpunct</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>ispunct</code>	<code><ctype.h></code>
<code>iswpunct</code>	<code><ctype.h> or <wchar.h></code>
<code>_ispunct_l</code>	<code><ctype.h></code>
<code>_iswpunct_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`isprint`, `iswprint`, `_isprint_l`, `_iswprint_l`

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Determines whether an integer represents a printable character.

Syntax

```
int isprint(
    int c
);
int iswprint(
    wint_t c
);
int _isprint_l(
    int c,
    _locale_t locale
);
int _iswprint_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

The locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a printable character. `isprint` returns a nonzero value if `c` is a printable character (0x20 - 0x7E), including the space character. `iswprint` returns a nonzero value if `c` is a printable wide character, including the space wide character. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The result of the test condition for these functions depends on the `LC_CTYPE` category setting of the locale. For more information, see `setlocale`, `wsetlocale`. The versions of these functions that don't have the `_l` suffix use the current locale for any locale-dependent behavior; the versions that do have the `_l` suffix are identical except that they use the locale that's passed in instead. For more information, see [Locale](#).

The behavior of `isprint` and `_isprint_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istprint</code>	<code>isprint</code>	<code>_ismbcprint</code>	<code>iswprint</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isprint</code>	<code><ctype.h></code>
<code>iswprint</code>	<code><ctype.h> or <wchar.h></code>
<code>_isprint_l</code>	<code><ctype.h></code>
<code>_iswprint_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`isspace`, `iswspace`, `_isspace_l`, `_iswspace_l`

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Determines whether an integer represents a space character.

Syntax

```
int isspace(
    int c
);
int iswspace(
    wint_t c
);
int _isspace_l(
    int c,
    _locale_t locale
);
int _iswspace_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

Locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a space character. `isspace` returns a nonzero value if `c` is a white-space character (0x09 - 0x0D or 0x20). The result of the test condition for the `isspace` function depends on the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#), [_wsetlocale](#). The versions of these functions that don't have the `_l` suffix use the current locale for any locale-dependent behavior; the versions that do have the `_l` suffix are identical except that they use the locale that's passed in instead. For more information, see [Locale](#).

`iswspace` returns a nonzero value if `c` is a wide character that corresponds to a standard white-space character.

The behavior of `isspace` and `_isspace_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istospace</code>	<code>isspace</code>	<code>_ismbcspace</code>	<code>iswspace</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isspace</code>	<code><ctype.h></code>
<code>iswspace</code>	<code><ctype.h> or <wchar.h></code>
<code>_isspace_l</code>	<code><ctype.h></code>
<code>_iswspace_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

`isupper`, `_isupper_l`, `iswupper`, `_iswupper_l`

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Determines whether an integer represents an uppercase character.

Syntax

```
int isupper(
    int c
);
int _isupper_l (
    int c,
    _locale_t locale
);
int iswupper(
    wint_t c
);
int _iswupper_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

Locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of an uppercase letter. `isupper` returns a nonzero value if `c` is an uppercase character (A - Z). `iswupper` returns a nonzero value if `c` is a wide character that corresponds to an uppercase letter, or if `c` is one of an implementation-defined set of wide characters for which none of `iswcntrl`, `iswdigit`, `iswpunct`, or `iswspace` is nonzero. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

The versions of these functions that have the `_l` suffix use the locale that's passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

The behavior of `isupper` and `_isupper_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istupper</code>	<code>isupper</code>	<code>_ismbcupper</code>	<code>iswupper</code>

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istupper_l</code>	<code>_isupper_l</code>	<code>_ismbclower</code> , <code>_ismbclower_l</code> , <code>_ismbcupper</code> , <code>_ismbcupper_l</code>	<code>_iswupper_l</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isupper</code>	<code><ctype.h></code>
<code>_isupper_l</code>	<code><ctype.h></code>
<code>iswupper</code>	<code><ctype.h></code> or <code><wchar.h></code>
<code>_iswupper_l</code>	<code><ctype.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is`, `isw` routines

`isxdigit`, `iswxdigit`, `_isxdigit_l`, `_iswxdigit_l`

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Determines whether an integer represents a character that is a hexadecimal digit.

Syntax

```
int isxdigit(
    int c
);
int iswxdigit(
    wint_t c
);
int _isxdigit_l(
    int c,
    _locale_t locale
);
int _iswxdigit_l(
    wint_t c,
    _locale_t locale
);
```

Parameters

`c`

Integer to test.

`Locale`

Locale to use.

Return value

Each of these routines returns nonzero if `c` is a particular representation of a hexadecimal digit. `isxdigit` returns a nonzero value if `c` is a hexadecimal digit (A - F, a - f, or 0 - 9). `iswxdigit` returns a nonzero value if `c` is a wide character that corresponds to a hexadecimal digit character. Each of these routines returns 0 if `c` doesn't satisfy the test condition.

For the "C" locale, the `iswxdigit` function doesn't support Unicode full-width hexadecimal characters.

The versions of these functions that have the `_l` suffix use the locale that's passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

The behavior of `isxdigit` and `_isxdigit_l` is undefined if `c` isn't EOF or in the range 0 through 0xFF, inclusive. When a debug CRT library is used and `c` isn't one of these values, the functions raise an assertion.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_istxdigit</code>	<code>isxdigit</code>	<code>isxdigit</code>	<code>iswxdigit</code>

Remarks

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>isxdigit</code>	<code><ctype.h></code>
<code>iswxdigit</code>	<code><ctype.h> or <wchar.h></code>
<code>_isxdigit_l</code>	<code><ctype.h></code>
<code>_iswxdigit_l</code>	<code><ctype.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Character classification](#)

[Locale](#)

`is` , `isw` routines

<code>itoa</code>	<code>_itoa</code>	<code>ltoa</code>	<code>_ltoa</code>	<code>ultoa</code>	<code>_ultoa</code>
<code>_i64toa</code>	<code>_ui64toa</code>	<code>_itow</code>	<code>_ltow</code>	<code>_ultow</code>	
<code>_i64tow</code>	<code>_ui64tow</code>				

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Converts an integer to a string. More secure versions of these functions are available, see [`_itoa_s`](#), [`_itow_s`](#) functions.

Syntax

```

char * _itoa( int value, char *buffer, int radix );
char * _ltoa( long value, char *buffer, int radix );
char * _ultoa( unsigned long value, char *buffer, int radix );
char * _i64toa( long long value, char *buffer, int radix );
char * _ui64toa( unsigned long long value, char *buffer, int radix );

wchar_t * _itow( int value, wchar_t *buffer, int radix );
wchar_t * _ltow( long value, wchar_t *buffer, int radix );
wchar_t * _ultow( unsigned long value, wchar_t *buffer, int radix );
wchar_t * _i64tow( long long value, wchar_t *buffer, int radix );
wchar_t * _ui64tow( unsigned long long value, wchar_t *buffer, int radix );

// These POSIX versions of the functions have deprecated names:
char * itoa( int value, char *buffer, int radix );
char * ltoa( long value, char *buffer, int radix );
char * ultoa( unsigned long value, char *buffer, int radix );

// The following template functions are C++ only:
template <size_t size>
char *_itoa( int value, char (&buffer)[size], int radix );

template <size_t size>
char *_itoa( long value, char (&buffer)[size], int radix );

template <size_t size>
char *_itoa( unsigned long value, char (&buffer)[size], int radix );

template <size_t size>
char *_i64toa( long long value, char (&buffer)[size], int radix );

template <size_t size>
char *_ui64toa( unsigned long long value, char (&buffer)[size], int radix );

template <size_t size>
wchar_t *_itow( int value, wchar_t (&buffer)[size], int radix );

template <size_t size>
wchar_t *_ltow( long value, wchar_t (&buffer)[size], int radix );

template <size_t size>
wchar_t *_ultow( unsigned long value, wchar_t (&buffer)[size], int radix );

template <size_t size>
wchar_t *_i64tow( long long value, wchar_t (&buffer)[size], int radix );

template <size_t size>
wchar_t *_ui64tow( unsigned long long value, wchar_t (&buffer)[size],
    int radix );

```

Parameters

`value`

Number to be converted.

`buffer`

Buffer that holds the result of the conversion.

`radix`

The base to use for the conversion of `value`, which must be in the range 2-36.

`size`

Length of the buffer in units of the character type. This parameter is inferred from the `buffer` argument in C++.

Return value

Each of these functions returns a pointer to `buffer`. There's no error return.

Remarks

The `_itoa`, `_ltoa`, `_ultoa`, `_i64toa`, and `_ui64toa` functions convert the digits of the given `value` argument to a null-terminated character string and store the result (up to 33 characters for `_itoa`, `_ltoa`, and `_ultoa`, and 65 for `_i64toa` and `_ui64toa`) in `buffer`. If `radix` equals 10 and `value` is negative, the first character of the stored string is the minus sign (-). The `_itow`, `_ltow`, `_ultow`, `_i64tow`, and `_ui64tow` functions are wide-character versions of `_itoa`, `_ltoa`, `_ultoa`, `_i64toa`, and `_ui64toa`, respectively.

IMPORTANT

These functions can write past the end of a buffer that is too small. To prevent buffer overruns, ensure that `buffer` is large enough to hold the converted digits plus the trailing null-character and a sign character. Misuse of these functions can cause serious security issues in your code.

Because of their potential for security issues, by default, these functions cause deprecation warning [C4996: This function or variable may be unsafe. Consider using `safe_function` instead. To disable deprecation, use `_CRT_SECURE_NO_WARNINGS`](#). We recommend you change your source code to use the `safe_function` suggested by the warning message. The more secure functions don't write more characters than the specified buffer size. For more information, see [`_itoa_s`, `_itow_s` functions](#).

To use these functions without the deprecation warning, define the `_CRT_SECURE_NO_WARNINGS` preprocessor macro before including any CRT headers. You can define it by adding the `/D_CRT_SECURE_NO_WARNINGS` compiler option to the `c1` command. Otherwise, define the macro in your source files. If you use precompiled headers, define the macro at the top of the precompiled header include file, `pch.h` (`stdafx.h` in Visual Studio 2017 and earlier). To define the macro in your source code, use a `#define` directive before you include any CRT header, as in this example:

```
#define _CRT_SECURE_NO_WARNINGS 1
#include <stdlib.h>
```

In C++, these functions have template overloads that invoke their safer counterparts. For more information, see [Secure template overloads](#).

By default, these functions' global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

The POSIX names `itoa`, `ltoa`, and `ultoa` exist as aliases for the `_itoa`, `_ltoa`, and `_ultoa` functions. The POSIX names are deprecated because they don't follow the implementation-specific global function name conventions of ISO C. By default, these functions cause deprecation warning [C4996: The POSIX name for this item is deprecated. Instead, use the ISO C and C++ conformant name: `new_name`](#). We recommend you change your source code to use the safer versions of these functions, `_itoa_s`, `_ltoa_s`, or `_ultoa_s`. For more information, see [`_itoa_s`, `_itow_s` functions](#).

For source code portability, you may prefer to retain the POSIX names in your code. To use these functions without the deprecation warning, define both the `_CRT_NONSTDC_NO_WARNINGS` and `_CRT_SECURE_NO_WARNINGS` preprocessor macros before including any CRT headers. You can define them by adding the `/D_CRT_SECURE_NO_WARNINGS` and `/D_CRT_NONSTDC_NO_WARNINGS` compiler options to the `c1` command. Otherwise, define the macros in your source files. If you use precompiled headers, define the macros at the top of the precompiled header include file. To define the macros in your source code, use `#define` directives before you include any CRT header, as in this example:

```
#define _CRT_NONSTDC_NO_WARNINGS 1
#define _CRT_SECURE_NO_WARNINGS 1
#include <stdlib.h>
```

Maximum conversion count macros

To help you create secure buffers for conversions, the CRT includes some convenient macros. These macros define the size of the buffer required to convert the longest possible value of each integer type, including the null terminator and sign character, for several common bases. To ensure that your conversion buffer is large enough to receive any conversion in the base specified by *radix*, use one of these defined macros when you allocate the buffer. The macros help you prevent buffer overrun errors when you convert integral types to strings. These macros are defined when you include either stdlib.h or wchar.h in your source.

To use one of these macros in a string conversion function, declare your conversion buffer of the appropriate character type and use the macro value for the integer type and base as the buffer dimension. This table lists the macros that are appropriate for each function for the listed bases:

FUNCTIONS	RADIX	MACROS
<code>_itoa</code> , <code>_itow</code>	16 10 8 2	<code>_MAX_ITOSTR_BASE16_COUNT</code> <code>_MAX_ITOSTR_BASE10_COUNT</code> <code>_MAX_ITOSTR_BASE8_COUNT</code> <code>_MAX_ITOSTR_BASE2_COUNT</code>
<code>_ltoa</code> , <code>_ltow</code>	16 10 8 2	<code>_MAX_LTOSTR_BASE16_COUNT</code> <code>_MAX_LTOSTR_BASE10_COUNT</code> <code>_MAX_LTOSTR_BASE8_COUNT</code> <code>_MAX_LTOSTR_BASE2_COUNT</code>
<code>_ultoa</code> , <code>_ultow</code>	16 10 8 2	<code>_MAX_ULTOSTR_BASE16_COUNT</code> <code>_MAX_ULTOSTR_BASE10_COUNT</code> <code>_MAX_ULTOSTR_BASE8_COUNT</code> <code>_MAX_ULTOSTR_BASE2_COUNT</code>
<code>_i64toa</code> , <code>_i64tow</code>	16 10 8 2	<code>_MAX_I64TOSTR_BASE16_COUNT</code> <code>_MAX_I64TOSTR_BASE10_COUNT</code> <code>_MAX_I64TOSTR_BASE8_COUNT</code> <code>_MAX_I64TOSTR_BASE2_COUNT</code>
<code>_ui64toa</code> , <code>_ui64tow</code>	16 10 8 2	<code>_MAX_U64TOSTR_BASE16_COUNT</code> <code>_MAX_U64TOSTR_BASE10_COUNT</code> <code>_MAX_U64TOSTR_BASE8_COUNT</code> <code>_MAX_U64TOSTR_BASE2_COUNT</code>

This example uses a conversion count macro to define a buffer large enough to contain an `unsigned long long` in base 2:

```
#include <wchar.h>
#include <iostream>
int main()
{
    wchar_t buffer[_MAX_U64TOSTR_BASE2_COUNT];
    std::wcout << _ui64tow(0xFFFFFFFFFFFFFFFull, buffer, 2) << std::endl;
}
```

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
_itot	_itoa	_itoa	_itow
_ltot	_ltoa	_ltoa	_ltow
_ultot	_ultoa	_ultoa	_ultow
_i64tot	_i64toa	_i64toa	_i64tow
_ui64tot	_ui64toa	_ui64toa	_ui64tow

Requirements

ROUTINE	REQUIRED HEADER
itoa, ltoa, ultoa	<stdlib.h>
_itoa, _ltoa, _ultoa, _i64toa, _ui64toa	<stdlib.h>
_itow, _ltow, _ultow, _i64tow, _ui64tow	<stdlib.h> or <wchar.h>

These functions and macros are Microsoft-specific. For more compatibility information, see [Compatibility](#).

Example

This sample demonstrates the use of some of the integer conversion functions. Note the use of the `_CRT_SECURE_NO_WARNINGS` macro to silence warning C4996.

```
// crt_itoa.c
// Compile by using: cl /W4 crt_itoa.c
// This program makes use of the _itoa functions
// in various examples.

#define _CRT_SECURE_NO_WARNINGS 1
#include <stdio.h>      // for printf
#include <string.h>      // for strlen
#include <stdlib.h>      // for _countof, _itoa fns, _MAX_COUNT macros

int main(void)
{
    char buffer[_MAX_U64TOSTR_BASE2_COUNT];
    int r;

    for (r = 10; r >= 2; --r)
    {
        _itoa(-1, buffer, r);
        printf("base %d: %s (%d chars)\n", r, buffer,
               strlen(buffer, _countof(buffer)));
    }
    printf("\n");

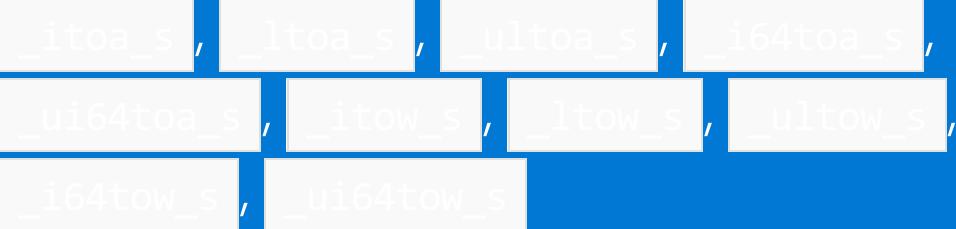
    for (r = 10; r >= 2; --r)
    {
        _i64toa(-1LL, buffer, r);
        printf("base %d: %s (%d chars)\n", r, buffer,
               strlen(buffer, _countof(buffer)));
    }
    printf("\n");

    for (r = 10; r >= 2; --r)
    {
        _ui64toa(0xffffffffffffffffULL, buffer, r);
        printf("base %d: %s (%d chars)\n", r, buffer,
               strlen(buffer, _countof(buffer)));
    }
}
```

See also

Data conversion

`_itoa_s` , `_itow_s` functions



11/2/2022 • 4 minutes to read • [Edit Online](#)

Converts an integer to a string. These functions are versions of the [_itoa](#), [_itow](#) functions with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _itoa_s( int value, char * buffer, size_t size, int radix );
errno_t _ltoa_s( long value, char * buffer, size_t size, int radix );
errno_t _ultoa_s( unsigned long value, char * buffer, size_t size, int radix );
errno_t _i64toa_s( long long value, char *buffer,
    size_t size, int radix );
errno_t _ui64toa_s( unsigned long long value, char *buffer,
    size_t size, int radix );

errno_t _itow_s( int value, wchar_t *buffer,
    size_t size, int radix );
errno_t _ltow_s( long value, wchar_t *buffer,
    size_t size, int radix );
errno_t _ultow_s( unsigned long value, wchar_t *buffer,
    size_t size, int radix );
errno_t _i64tow_s( long long value, wchar_t *buffer,
    size_t size, int radix );
errno_t _ui64tow_s( unsigned long long value, wchar_t *buffer,
    size_t size, int radix
);

// These template functions are C++ only:
template <size_t size>
errno_t _itoa_s( int value, char (&buffer)[size], int radix );

template <size_t size>
errno_t _ltoa_s( long value, char (&buffer)[size], int radix );

template <size_t size>
errno_t _ultoa_s( unsigned long value, char (&buffer)[size], int radix );

template <size_t size>
errno_t _itow_s( int value, wchar_t (&buffer)[size], int radix );

template <size_t size>
errno_t _ltow_s( long value, wchar_t (&buffer)[size], int radix );

template <size_t size>
errno_t _ultow_s( unsigned long value, wchar_t (&buffer)[size], int radix );
```

Parameters

value

Number to be converted.

buffer

Output buffer that holds the result of the conversion.

`size`

Size of `buffer` in characters or wide characters.

`radix`

The radix or numeric base to use to convert `value`, which must be in the range 2-36.

Return value

Zero if successful; an error code on failure. If any of the following conditions applies, the function invokes an invalid parameter handler, as described in [Parameter validation](#).

Error conditions

VALUE	BUFFER	SIZE	RADIX	RETURN
any	<code>NULL</code>	any	any	<code>EINVAL</code>
any	any	<=0	any	<code>EINVAL</code>
any	any	<= length of the result string required	any	<code>EINVAL</code>
any	any	any	<code>radix</code> < 2 or <code>radix</code> > 36	<code>EINVAL</code>

Security issues

These functions can generate an access violation if `buffer` doesn't point to valid memory and isn't `NULL`, or if the length of the buffer isn't long enough to hold the result string.

Remarks

Except for the parameters and return value, the `_itoa_s` and `_itow_s` function families have the same behavior as the corresponding less secure `_itoa` and `_itow` versions.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

The CRT includes convenient macros to define the size of the buffer required to convert the longest possible value of each integer type, including the null terminator and sign character, for several common bases. For information, see [Maximum conversion count macros](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_itot_s</code>	<code>_itoa_s</code>	<code>_itoa_s</code>	<code>_itow_s</code>

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ltoi_s</code>	<code>_ltoa_s</code>	<code>_ltoa_s</code>	<code>_ltow_s</code>
<code>_ultoi_s</code>	<code>_ultoa_s</code>	<code>_ultoa_s</code>	<code>_ultow_s</code>
<code>_i64toi_s</code>	<code>_i64toa_s</code>	<code>_i64toa_s</code>	<code>_i64tow_s</code>
<code>_ui64toi_s</code>	<code>_ui64toa_s</code>	<code>_ui64toa_s</code>	<code>_ui64tow_s</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_itoa_s</code> , <code>_ltoa_s</code> , <code>_ultoa_s</code> , <code>_i64toa_s</code> , <code>_ui64toa_s</code>	<code><stdlib.h></code>
<code>_itow_s</code> , <code>_ltow_s</code> , <code>_ultow_s</code> , <code>_i64tow_s</code> , <code>_ui64tow_s</code>	<code><stdlib.h></code> or <code><wchar.h></code>

These functions are Microsoft-specific. For more compatibility information, see [Compatibility](#).

Example

This sample demonstrates the use of a few of the integer conversion functions. The `_countof` macro only works to determine buffer size when the array declaration is visible to the compiler, and not for parameters that have decayed to pointers.

```
// crt_itoa_s.c
// Compile by using: cl /W4 crt_itoa_s.c
#include <stdlib.h>      // for _itoa_s functions, _countof, count macro
#include <stdio.h>        // for printf
#include <string.h>        // for strlen

int main( void )
{
    char buffer[_MAX_U64TOSTR_BASE2_COUNT];
    int r;
    for ( r = 10; r >= 2; --r )
    {
        _itoa_s( -1, buffer, _countof(buffer), r );
        printf( "base %d: %s (%d chars)\n",
                r, buffer, strlen(buffer), _countof(buffer) );
    }
    printf( "\n" );
    for ( r = 10; r >= 2; --r )
    {
        _i64toa_s( -1LL, buffer, _countof(buffer), r );
        printf( "base %d: %s (%d chars)\n",
                r, buffer, strlen(buffer), _countof(buffer) );
    }
    printf( "\n" );
    for ( r = 10; r >= 2; --r )
    {
        _ui64toa_s( 0xffffffffffffffffULL, buffer, _countof(buffer), r );
        printf( "base %d: %s (%d chars)\n",
                r, buffer, strlen(buffer), _countof(buffer) );
    }
}
```

See also

Data conversion

`_itoa`, `_itow` functions

`j0`, `j1`, `jn`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function names `j0`, `j1`, and `jn` are deprecated aliases for the `_j0`, `_j1`, and `_jn` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_j0`, `_j1`, and `_jn` instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

The Microsoft-specific function name `kbhit` is a deprecated alias for the `_kbhit` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_kbhit` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

_kbhit

11/2/2022 • 2 minutes to read • [Edit Online](#)

Checks the console for keyboard input.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _kbhit( void );
```

Return value

`_kbhit` returns a nonzero value if a key has been pressed. Otherwise, it returns 0.

Remarks

The `_kbhit` function checks the console for a recent keystroke. If the function returns a nonzero value, a keystroke is waiting in the buffer. The program can then call `_getch` or `_getche` to get the keystroke.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_kbhit</code>	<code><conio.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_kbhit.c
// compile with: /c
/* This program loops until the user
* presses a key. If _kbhit returns nonzero, a
* keystroke is waiting in the buffer. The program
* can call _getch or _getche to get the keystroke.
*/
#include <conio.h>
#include <stdio.h>

int main( void )
{
    /* Display message until key is pressed. */
    while( !_kbhit() )
        _cputs( "Hit me!! " );

    /* Use _getch to throw key away. */
    printf( "\nKey struck was '%c'\n", _getch() );
}
```

Sample output

```
Hit me!! Hit me!! Hit me!! Hit me!! Hit me!! Hit me!!
Key struck was 'q'
```

See also

[Console and port I/O](#)

`ldexp`, `ldexpf`, `ldexpl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Multiples a floating-point number by an integral power of two.

Syntax

```
double ldexp(
    double x,
    int exp
);
float ldexpf(
    float x,
    int exp
);
long double ldexpl(
    long double x,
    int exp
);
#define ldexp(X, INT) // Requires C11 or higher

float ldexp(
    float x,
    int exp
); // C++ only
long double ldexp(
    long double x,
    int exp
); // C++ only
```

Parameters

`x`

Floating-point value.

`exp`

Integer exponent.

Return value

The `ldexp` functions return the value of $x * 2^{\text{exp}}$ if successful. On overflow, and depending on the sign of `x`, `ldexp` returns $+\text{-} \text{HUGE_VAL}$; the `errno` value is set to `ERANGE`.

For more information about `errno` and possible error return values, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

Because C++ allows overloading, you can call overloads of `ldexp` that take `float` or `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `ldexp` always takes a `double` and an `int` and returns a `double`.

If you use the `<tgmath.h>` `ldexp()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>ldexp</code> , <code>ldexpf</code> , <code>ldexpl</code>	<code><math.h></code>	<code><cmath></code>
<code>ldexp</code> macro	<code><tgmath.h></code>	

For compatibility information, see [Compatibility](#).

Example

```
// crt_ldexp.c

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 4.0, y;
    int p = 3;

    y = ldexp( x, p );
    printf( "%2.1f times two to the power of %d is %2.1f\n", x, p, y );
}
```

Output

```
4.0 times two to the power of 3 is 32.0
```

See also

[Math and floating-point support](#)

`frexp`
`modf`, `modff`, `modfl`

`div`, `ldiv`, `lldiv`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the quotient and the remainder of two integer values.

Syntax

```
div_t div(
    int numer,
    int denom
);
ldiv_t ldiv(
    long numer,
    long denom
);
lldiv_t lldiv(
    long long numer,
    long long denom
);
```

```
ldiv_t div(
    long numer,
    long denom
); /* C++ only */
lldiv_t div(
    long long numer,
    long long denom
); /* C++ only */
```

Parameters

`numer`

The numerator.

`denom`

The denominator.

Return value

`div` called by using arguments of type `int` returns a structure of type `div_t`, which contains the quotient and the remainder. The return value with arguments of type `long` is `ldiv_t`, and the return value with arguments of type `long long` is `lldiv_t`. The `div_t`, `ldiv_t`, and `lldiv_t` types are defined in `<stdlib.h>`.

Remarks

The `div` function divides `numer` by `denom` and computes the quotient and the remainder. The `div_t` structure contains the quotient, `quot`, and the remainder, `rem`. The sign of the quotient is the same as the sign of the mathematical quotient. Its absolute value is the largest integer that's less than the absolute value of the mathematical quotient. If the denominator is 0, the program terminates with an error message.

The overloads of `div` that take arguments of type `long` or `long long` are only available to C++ code. The return types `ldiv_t` and `lldiv_t` contain members `quot` and `rem`, which have the same meanings as the members of `div_t`.

Requirements

ROUTINE	REQUIRED HEADER
<code>div</code> , <code>ldiv</code> , <code>lldiv</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_div.c
// arguments: 876 13

// This example takes two integers as command-line
// arguments and displays the results of the integer
// division. This program accepts two arguments on the
// command line following the program name, then calls
// div to divide the first argument by the second.
// Finally, it prints the structure members quot and rem.
//

#include <stdlib.h>
#include <stdio.h>
#include <math.h>

int main( int argc, char *argv[] )
{
    int x,y;
    div_t div_result;

    x = atoi( argv[1] );
    y = atoi( argv[2] );

    printf( "x is %d, y is %d\n", x, y );
    div_result = div( x, y );
    printf( "The quotient is %d, and the remainder is %d\n",
           div_result.quot, div_result.rem );
}
```

```
x is 876, y is 13
The quotient is 67, and the remainder is 5
```

See also

[Math and floating-point support](#)

[imaxdiv](#)

The Microsoft-implemented POSIX function name `lfind` is a deprecated alias for the `_lfind` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_lfind` or security-enhanced `_lfind_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_lfind

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs a linear search for the specified key. A more secure version of this function is available; see [_lfind_s](#).

Syntax

```
void *_lfind(
    const void *key,
    const void *base,
    unsigned int *num,
    unsigned int width,
    int (__cdecl *compare)(const void *, const void *)
);
```

Parameters

`key`

Object to search for.

`base`

Pointer to the base of search data.

`number`

Number of array elements.

`width`

Width of array elements.

`compare`

Pointer to comparison routine. The first parameter is a pointer to key for search. The second parameter is a pointer to array element to be compared with key.

Return value

If the key is found, `_lfind` returns a pointer to the element of the array at `base` that matches `key`. If the key isn't found, `_lfind` returns `NULL`.

Remarks

The `_lfind` function performs a linear search for the value `key` in an array of `number` elements, each of `width` bytes. Unlike `bsearch`, `_lfind` doesn't require the array to be sorted. The `base` argument is a pointer to the base of the array to be searched. The `compare` argument is a pointer to a user-supplied routine that compares two array elements and then returns a value specifying their relationship. `_lfind` calls the `compare` routine one or more times during the search, passing pointers to two array elements on each call. The `compare` routine must compare the elements and then return nonzero (meaning the elements are different) or 0 (meaning the elements are identical).

This function validates its parameters. If `compare`, `key` or `number` is `NULL`, or if `base` is `NULL` and `number` is nonzero, or if `width` is less than zero, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
_lfind	<search.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_lfind.c
// This program uses _lfind to search a string array
// for an occurrence of "hello".

#include <search.h>
#include <string.h>
#include <stdio.h>

int compare(const void *arg1, const void *arg2 )
{
    return( _stricmp( * (char**)arg1, * (char**)arg2 ) );
}

int main( )
{
    char *arr[] = {"Hi", "Hello", "Bye"};
    int n = sizeof(arr) / sizeof(char*);
    char **result;
    char *key = "hello";

    result = (char **)_lfind( &key, arr,
                             &n, sizeof(char *), compare );

    if( result )
        printf( "%s found\n", *result );
    else
        printf( "hello not found!\n" );
}
```

```
Hello found
```

See also

[Searching and sorting](#)

[_lfind_s](#)
[bsearch](#)
[_lsearch](#)
[qsort](#)

_lfind_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Performs a linear search for the specified key. A version of [_lfind](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
void *_lfind_s(
    const void *key,
    const void *base,
    unsigned int *num,
    size_t size,
    int (_cdecl *compare)(void *, const void *, const void *),
    void * context
);
```

Parameters

`key`

Object to search for.

`base`

Pointer to the base of search data.

`number`

Number of array elements.

`size`

Size of array elements in bytes.

`compare`

Pointer to comparison routine. The first parameter is the `context` pointer. The second parameter is a pointer to key for search. The third parameter is a pointer to array element to be compared with key.

`context`

A pointer to an object that might be accessed in the comparison function.

Return value

If the key is found, `_lfind_s` returns a pointer to the element of the array at `base` that matches `key`. If the key isn't found, `_lfind_s` returns `NULL`.

If invalid parameters are passed to the function, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`.

Error conditions

KEY	BASE	COMPARE	NUMBER	SIZE	ERRNO
<code>NULL</code>	any	any	any	any	<code>EINVAL</code>

KEY	BASE	COMPARE	NUMBER	SIZE	ERRNO
any	NULL	any	!= 0	any	EINVAL
any	any	any	any	zero	EINVAL
any	any	NULL	an	any	EINVAL

Remarks

The `_lfind_s` function performs a linear search for the value `key` in an array of `number` elements, each of `size` bytes. Unlike `bsearch_s`, `_lfind_s` doesn't require the array to be sorted. The `base` argument is a pointer to the base of the array to be searched. The `compare` argument is a pointer to a user-supplied routine that compares two array elements and then returns a value specifying their relationship. `_lfind_s` calls the `compare` routine one or more times during the search, passing the `context` pointer and pointers to two array elements on each call. The `compare` routine must compare the elements then return nonzero (meaning that the elements are different) or 0 (meaning that the elements are identical).

`_lfind_s` is similar to `_lfind` except for the addition of the `context` pointer to the arguments of the comparison function and the parameter list of the function. The `context` pointer can be useful if the searched data structure is part of an object and the `compare` function needs to access members of the object. The `compare` function can cast the void pointer into the appropriate object type and access members of that object. The addition of the `context` parameter makes `_lfind_s` more secure because extra context can be used to avoid reentrancy bugs associated with using static variables to make data available to the `compare` function.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_lfind_s</code>	<search.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_lfind_s.cpp
// This program uses _lfind_s to search a string array,
// passing a locale as the context.
// compile with: /EHsc
#include <stdlib.h>
#include <stdio.h>
#include <search.h>
#include <process.h>
#include <locale.h>
#include <locale>
#include <windows.h>
using namespace std;

// The sort order is dependent on the code page. Use 'chcp' at the
// command line to change the codepage. When executing this application,
// the command prompt codepage must match the codepage used here:

#define CODEPAGE 850
```

```

#ifndef CODEPAGE_850
// Codepage 850 is the OEM codepage used by the command line,
// so \x00e1 is the German Sharp S

char *array1[] = { "wei\x00e1", "weis", "annehmen", "weizen", "Zeit",
                  "weit" };

#define GERMAN_LOCALE "German_Germany.850"

#endif

#ifndef CODEPAGE_1252
// If using codepage 1252 (ISO 8859-1, Latin-1), use \x00df
// for the German Sharp S
char *array1[] = { "wei\x00df", "weis", "annehmen", "weizen", "Zeit",
                  "weit" };

#define GERMAN_LOCALE "German_Germany.1252"

#endif

// The context parameter lets you create a more generic compare.
// Without this parameter, you would have stored the locale in a
// static variable, thus making it vulnerable to thread conflicts
// (if this were a multithreaded program).

int compare( void *pvlocale, const void *str1, const void *str2)
{
    char *s1 = *(char**)str1;
    char *s2 = *(char**)str2;

    locale& loc = *( reinterpret_cast< locale * > ( pvlocale));

    return use_facet< collate<char> >(loc).compare(
        s1, s1+strlen(s1),
        s2, s2+strlen(s2) );
}

void find_it( char *key, char *array[], unsigned int num, locale &loc )
{
    char **result = (char **)lfind_s( &key, array,
                                    &num, sizeof(char *), compare, &loc );
    if( result )
        printf( "%s found\n", *result );
    else
        printf( "%s not found\n", key );
}

int main( )
{
    find_it( "weit", array1, sizeof(array1)/sizeof(char*), locale(GERMAN_LOCALE) );
}

```

weit found

See also

[Searching and sorting](#)

[bsearch_s](#)

[_lsearch_s](#)

[qsort_s](#)

[_lfind](#)

Igamma , Igammaf , Igammal

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines the natural logarithm of the absolute value of the gamma function of the specified value.

Syntax

```
double lgamma( double x );
float lgammaf( float x );
long double lgammal( long double x );
#define lgammal(X) // Requires C11 or higher

float lgamma( float x ); //C++ only
long double lgamma( long double x ); //C++ only
```

Parameters

x

The value to compute.

Return value

If successful, return the natural logarithm of the absolute value of the gamma function of x.

ISSUE	RETURN
x = NaN	NaN
x = ±0	+INFINITY
x = negative integer	+INFINITY
±INFINITY	+INFINITY
pole error	+ HUGE_VAL , + HUGE_VALF , or + HUGE_VALL
overflow range error	± HUGE_VAL , ± HUGE_VALF , or ± HUGE_VALL

Errors are reported as specified in [_matherr](#).

Remarks

Because C++ allows overloading, you can call overloads of lgamma that take and return float and long double types. In a C program, unless you're using the <tgmath.h> macro to call this function, lgamma always takes and returns a double.

If you use the <tgmath.h> lgamma() macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

If x is a rational number, this function returns the logarithm of the factorial of (x - 1).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>lgamma</code> , <code>lgammaf</code> , <code>lgammal</code>	<code><math.h></code>	<code><cmath></code>
<code>lgamma</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[`tgamma`](#), [`tgammaf`](#), [`tgammal`](#)

Localeconv

11/2/2022 • 4 minutes to read • [Edit Online](#)

Gets detailed information on locale settings.

Syntax

```
struct lconv *localeconv( void );
```

Return value

`localeconv` returns a pointer to a filled-in object of type `struct lconv`. The values contained in the object are copied from the locale settings in thread-local storage, and can be overwritten by subsequent calls to `localeconv`. Changes made to the values in this object don't modify the locale settings. Calls to `setlocale` with `category` values of `LC_ALL`, `LC_MONETARY`, or `LC_NUMERIC` overwrite the contents of the structure.

Remarks

The `localeconv` function gets detailed information about numeric formatting for the current locale. This information is stored in a structure of type `lconv`. The `lconv` structure, defined in LOCALE.H, contains the following members:

FIELD	MEANING
<code>decimal_point</code> , <code>_W_decimal_point</code>	Pointer to decimal-point character for nonmonetary quantities.
<code>thousands_sep</code> , <code>_W_thousands_sep</code>	Pointer to character that separates groups of digits to left of decimal point for nonmonetary quantities.
<code>grouping</code>	Pointer to a <code>char</code> -sized integer that contains the size of each group of digits in nonmonetary quantities.
<code>int_curr_symbol</code> , <code>_W_int_curr_symbol</code>	Pointer to international currency symbol for current locale. First three characters specify alphabetic international currency symbol as defined in the <i>ISO 4217 Codes for the Representation of Currency and Funds</i> standard. Fourth character (immediately preceding null character) separates international currency symbol from monetary quantity.
<code>currency_symbol</code> , <code>_W_currency_symbol</code>	Pointer to local currency symbol for current locale.
<code>mon_decimal_point</code> , <code>_W_mon_decimal_point</code>	Pointer to decimal-point character for monetary quantities.
<code>mon_thousands_sep</code> , <code>_W_mon_thousands_sep</code>	Pointer to separator for groups of digits to left of decimal place in monetary quantities.

FIELD	MEANING
<code>mon_grouping</code>	Pointer to a <code>char</code> -sized integer that contains the size of each group of digits in monetary quantities.
<code>positive_sign</code> , <code>_W_positive_sign</code>	String denoting sign for nonnegative monetary quantities.
<code>negative_sign</code> , <code>_W_negative_sign</code>	String denoting sign for negative monetary quantities.
<code>int_frac_digits</code>	Number of digits to right of decimal point in internationally formatted monetary quantities.
<code>frac_digits</code>	Number of digits to right of decimal point in formatted monetary quantities.
<code>p_cs_precedes</code>	Set to 1 if currency symbol precedes value for nonnegative formatted monetary quantity. Set to 0 if symbol follows value.
<code>p_sep_by_space</code>	Set to 1 if currency symbol is separated by space from value for nonnegative formatted monetary quantity. Set to 0 if there's no space separation.
<code>n_cs_precedes</code>	Set to 1 if currency symbol precedes value for negative formatted monetary quantity. Set to 0 if symbol succeeds value.
<code>n_sep_by_space</code>	Set to 1 if currency symbol is separated by space from value for negative formatted monetary quantity. Set to 0 if there's no space separation.
<code>p_sign_posn</code>	In nonnegative formatted monetary quantities, position of the positive sign.
<code>n_sign_posn</code>	In negative formatted monetary quantities, position of the positive sign.

Except as specified, members of the `lconv` structure that have `char *` and `wchar_t *` versions are pointers to strings. Any member that equals `""` (or `L""` for `wchar_t *`) is either of zero length, or not supported in the current locale. Both `decimal_point` and `_W_decimal_point` are always supported and have a nonzero length.

The `char` members of the structure are small non-negative numbers, not characters. Any member that equals `CHAR_MAX` isn't supported in the current locale.

The values of `grouping` and `mon_grouping` are interpreted according to the following rules:

- `CHAR_MAX` - Don't perform any further grouping.
- 0 - Use previous element for each of remaining digits.
- `n` - Number of digits that make up current group. Next element is examined to determine size of next group of digits before current group.

The values for `int_curr_symbol` are interpreted according to the following rules:

- The first three characters specify the alphabetic international currency symbol as defined in the *ISO 4217 Codes for the Representation of Currency and Funds* standard.
- The fourth character (immediately preceding the null character) separates the international currency symbol from the monetary quantity.

The values for `p_cs_precedes` and `n_cs_precedes` are interpreted according to the following rules (the `n_sep_by_space` rule is in parentheses):

- 0 - Currency symbol follows value for nonnegative (negative) formatted monetary value.
- 1 - Currency symbol precedes value for nonnegative (negative) formatted monetary value.

The values for `p_sep_by_space` and `n_sep_by_space` are interpreted according to the following rules (the `n_sep_by_space` rule is in parentheses):

- 0 - Currency symbol is separated from value by space for nonnegative (negative) formatted monetary value.
- 1 - There's no space separation between currency symbol and value for nonnegative (negative) formatted monetary value.

The values for `p_sign_posn` and `n_sign_posn` are interpreted according to the following rules:

- 0 - Parentheses surround quantity and currency symbol.
- 1 - Sign string precedes quantity and currency symbol.
- 2 - Sign string follows quantity and currency symbol.
- 3 - Sign string immediately precedes currency symbol.
- 4 - Sign string immediately follows currency symbol.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>localeconv</code>	<code><locale.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

Locale

`setlocale`
`strcoll` functions
`strftime`, `wcsftime`, `_strftime_1`, `_wcsftime_1`
`strxfrm`, `wcsxfrm`, `_strxfrm_1`, `_wcsxfrm_1`

`_localtime`, `_localtime32`, `_localtime64`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a time value and corrects for the local time zone. More secure versions of these functions are available; see [`_localtime_s`](#), [`_localtime32_s`](#), [`_localtime64_s`](#).

Syntax

```
struct tm *localtime( const time_t *sourceTime );
struct tm *_localtime32( const __time32_t *sourceTime );
struct tm *_localtime64( const __time64_t *sourceTime );
```

Parameters

`sourceTime`

Pointer to stored time.

Return value

Return a pointer to the structure result, or `NULL` if the date passed to the function is:

- Before midnight, January 1, 1970.
- After 03:14:07, January 19, 2038, UTC (using `_time32` and `time32_t`).
- After 23:59:59, December 31, 3000, UTC (using `_time64` and `__time64_t`).

`_localtime64`, which uses the `__time64_t` structure, allows dates to be expressed up through 23:59:59, December 31, 3000, coordinated universal time (UTC), whereas `_localtime32` represents dates through 23:59:59 January 18, 2038, UTC.

`localtime` is an inline function that evaluates to `_localtime64`, and `time_t` is equivalent to `__time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`. `_USE_32BIT_TIME_T` causes `localtime` to evaluate to `_localtime32`. We don't recommend `_USE_32BIT_TIME_T`, because your application may fail after January 18, 2038, and it isn't allowed on 64-bit platforms.

The fields of the structure type `tm` store the following values, each of which is an `int`:

FIELD	DESCRIPTION
<code>tm_sec</code>	Seconds after minute (0 - 59).
<code>tm_min</code>	Minutes after hour (0 - 59).
<code>tm_hour</code>	Hours since midnight (0 - 23).
<code>tm_mday</code>	Day of month (1 - 31).
<code>tm_mon</code>	Month (0 - 11; January = 0).

FIELD	DESCRIPTION
<code>tm_year</code>	Year (current year minus 1900).
<code>tm_wday</code>	Day of week (0 - 6; Sunday = 0).
<code>tm_yday</code>	Day of year (0 - 365; January 1 = 0).
<code>tm_isdst</code>	Positive value if daylight saving time is in effect; 0 if daylight saving time isn't in effect; negative value if status of daylight saving time is unknown.

If the `TZ` environment variable is set, the C run-time library assumes rules appropriate to the United States for implementing the calculation of daylight-saving time (DST).

Remarks

The `localtime` function converts a time stored as a `time_t` value and stores the result in a structure of type `tm`. The `long` value `sourceTime` represents the seconds elapsed since midnight (00:00:00), January 1, 1970, UTC. This value is often obtained from the `time` function.

Both the 32-bit and 64-bit versions of `gmtime`, `mktme`, `mkgmtime`, and `localtime` all use a single `tm` structure per thread for the conversion. Each call to one of these routines destroys the result of the previous call.

`localtime` corrects for the local time zone if the user first sets the global environment variable `TZ`. When `TZ` is set, three other environment variables (`_timezone`, `_daylight`, and `_tzname`) are automatically set as well. If the `TZ` variable isn't set, `localtime` attempts to use the time zone information specified in the Date/Time application in Control Panel. If this information can't be obtained, PST8PDT, which signifies the Pacific Time Zone, is used by default. See `_tzset` for a description of these variables. `TZ` is a Microsoft extension and not part of the ANSI standard definition of `localtime`.

NOTE

The target environment should try to determine whether daylight saving time is in effect.

These functions validate their parameters. If `sourceTime` is a null pointer, or if the `sourceTime` value is negative, these functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `NULL` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>localtime</code> , <code>_localtime32</code> , <code>_localtime64</code>	<code><time.h></code>	<code><cctime></code> or <code><time.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_localtime.cpp
// compile with: /W3
// This program uses _time64 to get the current time
// and then uses localtime64() to convert this time to a structure
// representing the local time. The program converts the result
// from a 24-hour clock to a 12-hour clock and determines the
// proper extension (AM or PM).

#include <stdio.h>
#include <string.h>
#include <time.h>

int main( void )
{
    struct tm *newtime;
    char am_pm[] = "AM";
    __time64_t long_time;

    _time64( &long_time );           // Get time as 64-bit integer.
                                    // Convert to local time.
    newtime = _localtime64( &long_time ); // C4996
    // Note: _localtime64 deprecated; consider _localetime64_s

    if( newtime->tm_hour > 12 )      // Set up extension.
        strcpy_s( am_pm, sizeof(am_pm), "PM" );
    if( newtime->tm_hour > 12 )      // Convert from 24-hour
        newtime->tm_hour -= 12;       // to 12-hour clock.
    if( newtime->tm_hour == 0 )       // Set hour to 12 if midnight.
        newtime->tm_hour = 12;

    char buff[30];
    asctime_s( buff, sizeof(buff), newtime );
    printf( "%.19s %s\n", buff, am_pm );
}

```

Tue Feb 12 10:05:58 AM

See also

Time management

asctime	_wasctime				
ctime	_ctime32	_ctime64	_wctime	_wctime32	_wctime64
_ftime	_ftime32	_ftime64			
gmtime	_gmtime32	_gmtime64			
localtime_s	_localtime32_s	_localtime64_s			
time	_time32	_time64			
_tzset					

`_localtime_s`, `_localtime32_s`, `_localtime64_s`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Converts a `time_t` time value to a `tm` structure, and corrects for the local time zone. These functions are versions of `localtime`, `_localtime32`, `_localtime64` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t localtime_s(
    struct tm* const tmDest,
    time_t const* const sourceTime
);
errno_t _localtime32_s(
    struct tm* tmDest,
    __time32_t const* sourceTime
);
errno_t _localtime64_s(
    struct tm* tmDest,
    __time64_t const* sourceTime
);
```

Parameters

`tmDest`

Pointer to the time structure to be filled in.

`sourceTime`

Pointer to the stored time.

Return value

Zero if successful. The return value is an error code if there's a failure. Error codes are defined in `Errno.h`. For a listing of these errors, see [errno](#).

Error conditions

<code>TMDEST</code>	<code>SOURCETIME</code>	RETURN VALUE	VALUE IN <code>TMDEST</code>	INVOKES INVALID PARAMETER HANDLER
<code>NULL</code>	any	<code>EINVAL</code>	Not modified	Yes
Not <code>NULL</code> (points to valid memory)	<code>NULL</code>	<code>EINVAL</code>	All fields set to -1	Yes
Not <code>NULL</code> (points to valid memory)	less than 0 or greater than <code>_MAX__TIME64_T</code>	<code>EINVAL</code>	All fields set to -1	No

The first two error conditions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

Remarks

The `localtime_s` function converts a time stored as a `time_t` value and stores the result in a structure of type `tm`. The `time_t` value `sourceTime` represents the seconds elapsed since midnight (00:00:00), January 1, 1970, UTC. This value is often obtained from the `time` function.

`localtime_s` corrects for the local time zone if the user first sets the global environment variable `TZ`. When `TZ` is set, three other environment variables (`_timezone`, `_daylight`, and `_tzname`) are automatically set as well. If the `TZ` variable isn't set, `localtime_s` attempts to use the time zone information specified in the Date/Time application in Control Panel. If this information can't be obtained, PST8PDT, which signifies the Pacific time zone, is used by default. See `_tzset` for a description of these variables. `TZ` is a Microsoft extension and not part of the ANSI standard definition of `localtime`.

NOTE

The target environment should try to determine whether daylight saving time is in effect.

`localtime64_s`, which uses the `_time64_t` structure, allows dates to be expressed up through 23:59:59, January 18, 3001, coordinated universal time (UTC), whereas `localtime32_s` represents dates through 23:59:59 January 18, 2038, UTC.

`localtime_s` is an inline function that evaluates to `localtime64_s`, and `time_t` is equivalent to `_time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`, which causes `localtime_s` to evaluate to `localtime32_s`. We don't recommend `_USE_32BIT_TIME_T`, because your application may fail after January 18, 2038, and it isn't allowed on 64-bit platforms.

The fields of the structure type `tm` store the following values, each of which is an `int`.

FIELD	DESCRIPTION
<code>tm_sec</code>	Seconds after minute (0 - 59).
<code>tm_min</code>	Minutes after hour (0 - 59).
<code>tm_hour</code>	Hours since midnight (0 - 23).
<code>tm_mday</code>	Day of month (1 - 31).
<code>tm_mon</code>	Month (0 - 11; January = 0).
<code>tm_year</code>	Year (current year minus 1900).
<code>tm_wday</code>	Day of week (0 - 6; Sunday = 0).
<code>tm_yday</code>	Day of year (0 - 365; January 1 = 0).
<code>tm_isdst</code>	Positive value if daylight saving time is in effect; 0 if daylight saving time isn't in effect; negative value if status of daylight saving time is unknown.

If the `TZ` environment variable is set, the C run-time library assumes rules appropriate to the United States for implementing the calculation of daylight saving time (DST).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>localtime_s</code> , <code>_localtime32_s</code> , <code>_localtime64_s</code>	<code><time.h></code>	<code><ctime></code> or <code><time.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_localtime_s.c
// This program uses _time64 to get the current time
// and then uses _localtime64_s() to convert this time to a structure
// representing the local time. The program converts the result
// from a 24-hour clock to a 12-hour clock and determines the
// proper extension (AM or PM).

#include <stdio.h>
#include <string.h>
#include <time.h>

int main( void )
{
    struct tm newtime;
    char am_pm[] = "AM";
    __time64_t long_time;
    char timebuf[26];
    errno_t err;

    // Get time as 64-bit integer.
    _time64( &long_time );
    // Convert to local time.
    err = _localtime64_s( &newtime, &long_time );
    if (err)
    {
        printf("Invalid argument to _localtime64_s.");
        exit(1);
    }
    if( newtime.tm_hour > 12 )          // Set up extension.
        strcpy_s( am_pm, sizeof(am_pm), "PM" );
    if( newtime.tm_hour > 12 )          // Convert from 24-hour
        newtime.tm_hour -= 12;           // to 12-hour clock.
    if( newtime.tm_hour == 0 )           // Set hour to 12 if midnight.
        newtime.tm_hour = 12;

    // Convert to an ASCII representation.
    err = asctime_s(timebuf, 26, &newtime);
    if (err)
    {
        printf("Invalid argument to asctime_s.");
        exit(1);
    }
    printf( "%.19s %s\n", timebuf, am_pm );
}
```

See also

Time management

`asctime_s`, `_wasctime_s`
`ctime`, `_ctime32`, `_ctime64`, `_wctime`, `_wctime32`, `_wctime64`
`_ftime`, `_ftime32`, `_ftime64`
`gmtime_s`, `_gmtime32_s`, `_gmtime64_s`
`localtime`, `_localtime32`, `_localtime64`
`time`, `_time32`, `_time64`
`_tzset`

_lock_file

11/2/2022 • 2 minutes to read • [Edit Online](#)

Locks a `FILE` object to ensure consistency for threads accessing the `FILE` object concurrently.

Syntax

```
void _lock_file( FILE* file );
```

Parameters

`file`

File handle.

Remarks

The `_lock_file` function locks the `FILE` object specified by `file`. The underlying file isn't locked by `_lock_file`. Use `_unlock_file` to release the lock on the file. Calls to `_lock_file` and `_unlock_file` must be matched in a thread.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_lock_file</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_lock_file.c
// This example creates multiple threads that write to standard output
// concurrently, first with _file_lock, then without.

#include <stdio.h>
#include <process.h> // _beginthread
#include <windows.h> // HANDLE

void Task_locked( void* str )
{
    for( int i=0; i<1000; ++i )
    {
        _lock_file( stdout );
        for( char* cp = (char*)str; *cp; ++cp )
        {
            _fputc_nolock( *cp, stdout );
        }
        _unlock_file( stdout );
    }
}

void Task_unlocked( void* str )
{
    for( int i=0; i<1000; ++i )
    {
        for( char* cp = (char*)str; *cp; ++cp )
        {
            fputc( *cp, stdout );
        }
    }
}

int main()
{
    HANDLE h[3];
    h[0] = (HANDLE)_beginthread( &Task_locked, 0, "First\n" );
    h[1] = (HANDLE)_beginthread( &Task_locked, 0, "Second\n" );
    h[2] = (HANDLE)_beginthread( &Task_locked, 0, "Third\n" );

    WaitForMultipleObjects( 3, h, true, INFINITE );

    h[0] = (HANDLE)_beginthread( &Task_unlocked, 0, "First\n" );
    h[1] = (HANDLE)_beginthread( &Task_unlocked, 0, "Second\n" );
    h[2] = (HANDLE)_beginthread( &Task_unlocked, 0, "Third\n" );

    WaitForMultipleObjects( 3, h, true, INFINITE );
}

```

```
...
First
Second
First
Second
Third
Second
Third
Second
...
FSiercsotn
dF
iSrescto
nFdi
rSsetc
oFnidr
sSte
cFoinrds
tS
eFciorndsdt
```

See also

File handling

[_creat](#) , [_wcreat](#)
[_open](#) , [_wopen](#)
[_unlock_file](#)

Locking

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `locking` is a deprecated alias for the `_locking` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_locking` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_locking

11/2/2022 • 2 minutes to read • [Edit Online](#)

Locks or unlocks bytes of a file.

Syntax

```
int _locking(
    int fd,
    int mode,
    long nbytes
);
```

Parameters

`fd`

File descriptor.

`mode`

Locking action to perform.

`nbytes`

Number of bytes to lock.

Return value

`_locking` returns 0 if successful. A return value of -1 indicates failure, in which case `errno` is set to one of the following values.

<code>errno</code> value	Condition
<code>EACCES</code>	Locking violation (file already locked or unlocked).
<code>EBADF</code>	Invalid file descriptor.
<code>EDEADLOCK</code>	Locking violation. Returned when the <code>_LK_LOCK</code> or <code>_LK_RLCK</code> flag is specified and the file can't be locked after 10 attempts.
<code>EINVAL</code>	An invalid argument was given to <code>_locking</code> .

If the failure is due to a bad parameter, such as an invalid file descriptor, the invalid parameter handler is invoked, as described in [Parameter validation](#).

Remarks

The `_locking` function locks or unlocks `nbytes` bytes of the file specified by `fd`. Locking bytes in a file prevents access to those bytes by other processes. All locking or unlocking begins at the current position of the file pointer and proceeds for the next `nbytes` bytes. It's possible to lock bytes past end of file.

`mode` must be one of the following manifest constants, which are defined in `Locking.h`.

MODE VALUE	EFFECT
<code>_LK_LOCK</code>	Locks the specified bytes. If the bytes can't be locked, the program immediately tries again after 1 second. If the bytes can't be locked after 10 attempts, the constant returns an error.
<code>_LK_NBLOCK</code>	Locks the specified bytes. If the bytes can't be locked, the constant returns an error.
<code>_LK_NBRLCK</code>	Same as <code>_LK_NBLOCK</code> .
<code>_LK_RLCK</code>	Same as <code>_LK_LOCK</code> .
<code>_LK_UNLCK</code>	Unlocks the specified bytes, which must have been previously locked.

Multiple regions of a file that don't overlap can be locked. A region being unlocked must have been previously locked. `_locking` doesn't merge adjacent regions; if two locked regions are adjacent, each region must be unlocked separately. Regions should be locked only briefly and should be unlocked before closing a file or exiting the program.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_locking</code>	<code><io.h></code> and <code><sys/locking.h></code>	<code><errno.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_locking.c
/* This program opens a file with sharing. It locks
 * some bytes before reading them, then unlocks them. Note that the
 * program works correctly only if the file exists.
 */

#include <sys/types.h>
#include <sys/stat.h>
#include <sys/locking.h>
#include <share.h>
#include <fcntl.h>
#include <stdio.h>
#include <stdlib.h>
#include <io.h>

int main( void )
{
    int fh, numread;
    char buffer[40];

    /* Quit if can't open file or system doesn't
     * support sharing.
     */
    errno_t err = _sopen_s( &fh, "crt_locking.txt", _O_RDONLY, _SH_DENYNO,
                           _S_IREAD | _S_IWRITE );
    printf( "%d %d\n", err, fh );
    if( err != 0 )
        exit( 1 );

    /* Lock some bytes and read them. Then unlock. */
    if( _locking( fh, LK_NBLCK, 30L ) != -1 )
    {
        long lseek_ret;
        printf( "No one can change these bytes while I'm reading them\n" );
        numread = _read( fh, buffer, 30 );
        buffer[30] = '\0';
        printf( "%d bytes read: %.30s\n", numread, buffer );
        lseek_ret = _lseek( fh, 0L, SEEK_SET );
        _locking( fh, LK_UNLCK, 30L );
        printf( "Now I'm done. Do what you will with them\n" );
    }
    else
        perror( "Locking failed\n" );

    _close( fh );
}

```

Input: crt_locking.txt

The first thirty bytes of this file will be locked.

Sample output

No one can change these bytes while I'm reading them
30 bytes read: The first thirty bytes of this
Now I'm done. Do what you will with them

See also

[File handling](#)

[_creat](#) , [_wcreat](#)

[_open](#) , [_wopen](#)

`log`, `logf`, `logl`, `log10`, `log10f`, `log10l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates logarithms.

Syntax

```
double log(double x);
float logf(float x);
long double logl(double x);
double log10(double x);
float log10f (float x);
long double log10l(double x);
#define log(X) // Requires C11 or higher
#define log10(X) // Requires C11 or higher

float log(float x); // C++ only
long double log(long double x); // C++ only
float log10(float x); // C++ only
long double log10(long double x); // C++ only
```

Parameters

`x`

Value whose logarithm is to be found.

Return value

The `log` functions return the natural logarithm (base e) of `x` if successful. The `log10` functions return the base-10 logarithm. If `x` is negative, these functions return an indefinite (`IND`), by default. If `x` is 0, they return infinity (`INF`).

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>
± 0	<code>ZERODIVIDE</code>	<code>_SING</code>
$x < 0$	<code>INVALID</code>	<code>_DOMAIN</code>

`log` and `log10` have an implementation that uses Streaming SIMD Extensions 2 (SSE2). See [_set_SSE2_enable](#) for information and restrictions on using the SSE2 implementation.

Remarks

C++ allows overloading, so you can call overloads of `log` and `log10` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `log` and `log10` always take and return a `double`.

If you use the `<tgmath.h> log()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>log</code> , <code>logf</code> , <code>logl</code> , <code>log10</code> , <code>log10f</code> , <code>log10l</code>	<code><math.h></code>
<code>log</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_log.c
/* This program uses log and log10
 * to calculate the natural logarithm and
 * the base-10 logarithm of 9,000.
 */

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 9000.0;
    double y;

    y = log( x );
    printf( "log( %.2f ) = %f\n", x, y );
    y = log10( x );
    printf( "log10( %.2f ) = %f\n", x, y );
}
```

```
log( 9000.00 ) = 9.104980
log10( 9000.00 ) = 3.954243
```

To generate logarithms for other bases, use the mathematical relation: $\log \text{ base } b \text{ of } a = \frac{\text{natural log}(a)}{\text{natural log}(b)}$.

```
// logbase.cpp
#include <math.h>
#include <stdio.h>

double logbase(double a, double base)
{
    return log(a) / log(base);
}

int main()
{
    double x = 65536;
    double result;

    result = logbase(x, 2);
    printf("Log base 2 of %lf is %lf\n", x, result);
}
```

```
Log base 2 of 65536.000000 is 16.000000
```

See also

[Math and floating-point support](#)

[exp](#) , [expf](#) , [expl](#)

[_matherr](#)

[pow](#) , [powf](#) , [powl](#)

[_CIlog](#)

[_CIlog10](#) \

log1p, log1pf, log1pl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the natural logarithm of 1 plus the specified value.

Syntax

```
double log1p(  
    double x  
);  
float log1pf(  
    float x  
);  
long double log1pl(  
    long double x  
);  
  
#define log1p(X) // Requires C11 or higher  
  
float log1p(  
    float x  
); //C++ only  
  
long double log1p(  
    long double x  
); //C++ only
```

Parameters

x

The floating-point argument.

Return value

If successful, returns the natural (base-e) log of ($x + 1$).

Otherwise, may return one of the following values:

INPUT	RESULT	SEH EXCEPTION	ERRNO
+INF	+INF		
Denormals	Same as input	UNDERFLOW	
± 0	Same as input		
-1	-INF	DIVBYZERO	ERANGE
< -1	NaN	INVALID	EDOM
-INF	NaN	INVALID	EDOM
$\pm \text{SNaN}$	Same as input	INVALID	

INPUT	RESULT	SEH EXCEPTION	ERRNO
$\pm\text{QNaN}$, indefinite	Same as input		

The `errno` value is set to ERANGE if $x = -1$. The `errno` value is set to EDOM if $x < -1$.

Remarks

The `log1p` functions may be more accurate than using `log(x + 1)` when x is near 0.

Because C++ allows overloading, you can call overloads of `log1p` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `log1p` always takes and returns a `double`.

If you use the `<tgmath.h>` `log1p()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

If x is a natural number, this function returns the logarithm of the factorial of ($x - 1$).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>log1p</code> , <code>log1pf</code> , <code>log1pl</code>	<code><math.h></code>	<code><cmath></code>
<code>log1p</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`log2`, `log2f`, `log2l`
`log`, `logf`, `log10`, `log10f`

`log2`, `log2f`, `log2l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines the binary (base-2) logarithm of the specified value.

Syntax

```
double log2(
    double x
);

float log2(
    float x
); //C++ only

long double log2(
    long double x
); //C++ only

float log2f(
    float x
);

long double log2l(
    long double x
);

#define log2(X) // Requires C11 or higher
```

Parameters

`x`

The value to determine the base-2 logarithm of.

Return value

On success, the functions return the base-2 log of `x`.

Otherwise, the functions may return one of the following values:

ISSUE	RETURN
<code>x < 0</code>	NaN
<code>x = ±0</code>	-INFINITY
<code>x = 1</code>	+0
+INFINITY	+INFINITY
NaN	NaN
domain error	NaN

ISSUE	RETURN
pole error	- <code>HUGE_VAL</code> , - <code>HUGE_VALF</code> , or - <code>HUGE_VALL</code>

Errors are reported as specified in [_matherr](#).

Remarks

If x is an integer, this function essentially returns the zero-based index of the most significant 1 bit of x .

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>log2</code> , <code>log2f</code> , <code>log2l</code>	<code><math.h></code>	<code><cmath></code>
<code>log2</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

<code>exp2</code> , <code>exp2f</code> , <code>exp2l</code>
<code>log</code> , <code>logf</code> , <code>log10</code> , <code>log10f</code>

`logb`, `logbf`, `logbl`, `_logb`, `_logbf`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Extracts the exponent value of a floating-point argument.

Syntax

```
double logb(
    double x
);
float logb(
    float x
); // C++ only
long double logb(
    long double x
); // C++ only
float logbf(
    float x
);
long double logbl(
    long double x
);
double _logb(
    double x
);
float _logbf(
    float x
);
#define logb(X) // Requires C11 or higher
```

Parameters

`x`

A floating-point value.

Return value

`logb` returns the unbiased exponent value of `x` as a signed integer represented as a floating-point value.

Remarks

The `logb` functions extract the exponential value of the floating-point argument `x`, as though `x` were represented with infinite range. If the argument `x` is denormalized, it's treated as if it were normalized.

Because C++ allows overloading, you can call overloads of `logb` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `logb` always takes and returns a `double`.

If you use the `logb` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	None	<code>_DOMAIN</code>

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
± 0	ZERODIVIDE	_SING

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
_logb	<float.h>
logb, logbf, logbl, _logbf	<math.h>
logb macro	<tgmath.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Math and floating-point support](#)

[frexp](#)

Restores the stack environment and execution locale set by a `setjmp` call.

Syntax

```
void longjmp(
    jmp_buf env,
    int value
);
```

Parameters

`env`

Variable in which environment is stored.

`value`

Value to be returned to `setjmp` call.

Remarks

The `longjmp` function restores a stack environment and execution locale previously saved in `env` by `setjmp`. `setjmp` and `longjmp` provide a way to execute a nonlocal `goto`; they're typically used to pass execution control to error-handling or recovery code in a previously called routine without using the normal call and return conventions.

A call to `setjmp` causes the current stack environment to be saved in `env`. A subsequent call to `longjmp` restores the saved environment and returns control to the point immediately following the corresponding `setjmp` call. Execution resumes as if `value` had been returned by the `setjmp` call. The values of all variables (except register variables) that are accessible to the routine receiving control contain the values they had when `longjmp` was called. The values of register variables are unpredictable. The value returned by `setjmp` must be nonzero. If `value` is passed as 0, the value 1 is substituted in the actual return.

Microsoft Specific

In Microsoft C++ code on Windows, `longjmp` uses the same stack-unwinding semantics as exception-handling code. It's safe to use in the same places that C++ exceptions can be raised. However, this usage isn't portable, and comes with some important caveats.

Only call `longjmp` before the function that called `setjmp` returns; otherwise the results are unpredictable.

Observe the following restrictions when using `longjmp`:

- Don't assume that the values of the register variables will remain the same. The values of register variables in the routine calling `setjmp` may not be restored to the proper values after `longjmp` is executed.
- Don't use `longjmp` to transfer control out of an interrupt-handling routine unless the interrupt is caused by a floating-point exception. In this case, a program may return from an interrupt handler via `longjmp` if it first reinitializes the floating-point math package by calling `_fpreset`.

- Don't use `longjmp` to transfer control from a callback routine invoked directly or indirectly by Windows code.
- If the code is compiled by using `/EHs` or `/EHsc`, and the function that contains the `longjmp` call is `noexcept`, then local objects in that function may not be destructed during the stack unwind.

END Microsoft Specific

NOTE

In portable C++ code, you can't assume `setjmp` and `longjmp` support C++ object semantics. Specifically, a `setjmp` / `longjmp` call pair has undefined behavior if replacing the `setjmp` and `longjmp` by `catch` and `throw` would invoke any non-trivial destructors for any automatic objects. In C++ programs, we recommend you use the C++ exception-handling mechanism.

For more information, see [Using setjmp and longjmp](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>longjmp</code>	<code><setjmp.h></code>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`_fpreset`](#).

See also

[Process and environment control](#) `setjmp`

lrint, lrintf, lrintl, llrint, llrintf,
llrintl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rounds the specified floating-point value to the nearest integral value, by using the current rounding mode and direction.

Syntax

```
long int lrint(
    double x
);

long int lrint(
    float x
); //C++ only

long int lrint(
    long double x
); //C++ only

long int lrintf(
    float x
);

long int llrintl(
    long double x
);

long long int llrint(
    double x
);

long long int llrint(
    float x
); //C++ only

long long int llrint(
    long double x
); //C++ only

long long int llrintf(
    float x
);

long long int llrintl(
    long double x
);

#define lrint(X) // Requires C11 or higher
```

Parameters

x

The value to round.

Return value

If successful, returns the rounded integral value of x .

ISSUE	RETURN
x is outside the range of the return type	Raises <code>FE_INVALID</code> and returns zero (0).
$x = \pm\text{INF}$	
$x = \text{NaN}$	

Remarks

Because C++ allows overloading, you can call overloads of `lrint` and `llrint` that take `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `lrint` and `llrint` always take a `double`.

If you use the `<tgmath.h> llrint()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

If x doesn't represent the floating-point equivalent of an integral value, these functions raise `FE_INEXACT`.

Microsoft-specific: When the result is outside the range of the return type, or when the parameter is a NaN or infinity, the return value is implementation defined. The Microsoft compiler returns a zero (0) value.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>lrint</code> , <code>lrintf</code> , <code>lrintl</code> , <code>llrint</code> , <code>llrintf</code> , <code>llrintl</code>	<code><math.h></code>	<code><cmath></code>
<code>lrint</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

`lround`, `lroundf`, `lroundl`, `llround`, `llroundf`,
`llroundl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rounds a floating-point value to the nearest integer.

Syntax

```
long lround(
    double x
);
long lround(
    float x
); // C++ only
long lround(
    long double x
); // C++ only
long lroundf(
    float x
);
long lroundl(
    long double x
);
long long llround(
    double x
);
long long llround(
    float x
); // C++ only
long long llround(
    long double x
); // C++ only
long long llroundf(
    float x
);
long long llroundl(
    long double x
);
#define lround(X) // Requires C11 or higher
```

Parameters

`x`

The floating-point value to round.

Return value

The `lround` and `llround` functions return the nearest `long` or `long long` integer to `x`. Halfway values are rounded away from zero, regardless of the setting of the floating-point rounding mode. There's no error return.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

Remarks

Because C++ allows overloading, you can call `lround` or `llround` overloads that take and return `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `lround` and `llround` always take and return a `double`.

If you use the `<tgmath.h>` `lround()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>lround</code> , <code>lroundf</code> , <code>lroundl</code> , <code>llround</code> , <code>llroundf</code> , <code>llroundl</code>	<code><math.h></code>
<code>lround</code> macro	<code><tgmath.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_lround.c
// Build with: cl /W4 /Tc crt_lround.c
// This example displays the rounded results of
// the floating-point values 2.499999, -2.499999,
// 2.8, -2.8, 3.5 and -3.5.

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 2.499999;
    float y = 2.8f;
    long double z = 3.5L;

    printf("lround(%f) is %d\n", x, lround(x));
    printf("lround(%f) is %d\n", -x, lround(-x));
    printf("lroundf(%f) is %d\n", y, lroundf(y));
    printf("lroundf(%f) is %d\n", -y, lroundf(-y));
    printf("lroundl(%Lf) is %d\n", z, lroundl(z));
    printf("lroundl(%Lf) is %d\n", -z, lroundl(-z));
}
```

```
lround(2.499999) is 2
lround(-2.499999) is -2
lroundf(2.800000) is 3
lroundf(-2.800000) is -3
lroundl(3.500000) is 4
lroundl(-3.500000) is -4
```

See also

Math and floating-point support

```
ceil , ceilf , ceill  
floor , floorf , floorl  
fmod , fmodf  
lrint , lrintf , lrintl , llrint , llrintf , llrintl  
round , roundf , roundl  
nearbyint , nearbyintf , nearbyintl  
rint , rintf , rintl
```

`_lrotl`, `_lrotr`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rotates bits to the left (`_lrotl`) or right (`_lrotr`).

Syntax

```
unsigned long _lrotl( unsigned long value, int shift );
unsigned long _lrotr( unsigned long value, int shift );
```

Parameters

`value`

Value to be rotated.

`shift`

Number of bits to shift `value`.

Return value

Both functions return the rotated value. There's no error return.

Remarks

The `_lrotl` and `_lrotr` functions rotate `value` by `shift` bits. `_lrotl` rotates the value left, toward more significant bits. `_lrotr` rotates the value right, toward less significant bits. Both functions wrap bits rotated off one end of `value` to the other end.

Requirements

ROUTINE	REQUIRED HEADER
<code>_lrotl</code> , <code>_lrotr</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_lrot.c

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    unsigned long val = 0x0fac35791;

    printf( "0x%8.8lx rotated left eight bits is 0x%8.8lx\n",
            val, _lrotl( val, 8 ) );
    printf( "0x%8.8lx rotated right four bits is 0x%8.8lx\n",
            val, _lrotr( val, 4 ) );
}
```

```
0xfac35791 rotated left eight bits is 0xc35791fa
0xfac35791 rotated right four bits is 0x1fac3579
```

See also

[Math and floating-point support](#)

[_rotl](#) , [_rotl64](#) , [_rotr](#) , [_rotr64](#)

`lsearch`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `lsearch` is a deprecated alias for the `_lsearch` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_lsearch` or security-enhanced `_lsearch_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_lsearch

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs a linear search for a value; adds to end of list if not found. A more secure version of this function is available; see [_lsearch_s](#).

Syntax

```
void *_lsearch(
    const void *key,
    void *base,
    unsigned int *num,
    unsigned int width,
    int (__cdecl *compare)(const void *, const void *)
);
```

Parameters

`key`

Object to search for.

`base`

Pointer to the base of array to be searched.

`number`

Number of elements.

`width`

Width of each array element.

`compare`

Pointer to the comparison routine. The first parameter is a pointer to the key for search. The second parameter is a pointer to an array element to be compared with the key.

Return value

If the key is found, `_lsearch` returns a pointer to the element of the array at `base` that matches `key`. If the key isn't found, `_lsearch` returns a pointer to the newly added item at the end of the array.

Remarks

The `_lsearch` function performs a linear search for the value `key` in an array of `number` elements, each of `width` bytes. Unlike `bsearch`, `_lsearch` doesn't require the array to be sorted. If `key` isn't found, `_lsearch` adds it to the end of the array and increments `number`.

The `compare` argument is a pointer to a user-supplied routine that compares two array elements and returns a value specifying their relationship. `_lsearch` calls the `compare` routine one or more times during the search, passing pointers to two array elements on each call. `compare` must compare the elements and return either nonzero (meaning the elements are different) or 0 (meaning the elements are identical).

This function validates its parameters. If `compare`, `key` or `number` is `NULL`, or if `base` is `NULL` and `number` is nonzero, or if `width` is less than zero, the invalid parameter handler is invoked, as described in [Parameter](#)

[validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_lsearch</code>	<code><search.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_lsearch.c
#include <search.h>
#include <string.h>
#include <stdio.h>

int compare( const void *arg1, const void *arg2 );

int main(void)
{
    char * wordlist[4] = { "hello", "thanks", "bye" };
                           // leave room to grow...
    int n = 3;
    char **result;
    char *key = "extra";
    int i;

    printf( "wordlist before _lsearch:" );
    for( i=0; i<n; ++i ) printf( " %s", wordlist[i] );
    printf( "\n" );

    result = (char **)_lsearch( &key, wordlist,
                               &n, sizeof(char *), compare );

    printf( "wordlist after _lsearch:" );
    for( i=0; i<n; ++i ) printf( " %s", wordlist[i] );
    printf( "\n" );
}

int compare(const void *arg1, const void *arg2 )
{
    return( _stricmp( * (char**)arg1, * (char**)arg2 ) );
}
```

```
wordlist before _lsearch: hello thanks bye
wordlist after _lsearch: hello thanks bye extra
```

See also

[Searching and sorting](#)

`bsearch`
`_lfind`
`_lsearch_s`

_lsearch_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Performs a linear search for a value. A version of [_lsearch](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
void *_lsearch_s(
    const void *key,
    void *base,
    unsigned int *num,
    size_t size,
    int (_cdecl *compare)(void *, const void *, const void *),
    void * context
);
```

Parameters

`key`

Object to search for.

`base`

Pointer to the base of array to be searched.

`number`

Number of elements.

`size`

Size of each array element in bytes.

`compare`

Pointer to the comparison routine. The second parameter is a pointer to the key for search. The third parameter is a pointer to an array element to be compared with the key.

`context`

A pointer to an object that might be accessed in the comparison function.

Return value

If `key` is found, `_lsearch_s` returns a pointer to the element of the array at `base` that matches `key`. If `key` isn't found, `_lsearch_s` returns a pointer to the newly added item at the end of the array.

If invalid parameters are passed to the function, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, then `errno` is set to `EINVAL` and the function returns `NULL`. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Error conditions

KEY	BASE	COMPARE	NUMBER	SIZE	ERRNO
<code>NULL</code>	any	any	any	any	<code>EINVAL</code>

KEY	BASE	COMPARE	NUMBER	SIZE	ERRNO
any	NULL	any	!= 0	any	EINVAL
any	any	any	any	zero	EINVAL
any	any	NULL	an	any	EINVAL

Remarks

The `_lsearch_s` function performs a linear search for the value `key` in an array of `number` elements, each of `size` bytes. Unlike `bsearch_s`, `_lsearch_s` doesn't require the array to be sorted. If `key` isn't found, then `_lsearch_s` adds it to the end of the array and increments `number`.

The `compare` function is a pointer to a user-supplied routine that compares two array elements and returns a value specifying their relationship. The `compare` function also takes the pointer to the context as the first argument. `_lsearch_s` calls `compare` one or more times during the search, passing pointers to two array elements on each call. `compare` must compare the elements and then return either nonzero (meaning the elements are different) or 0 (meaning the elements are identical).

The `context` pointer can be useful if the searched data structure is part of an object and the `compare` function needs to access members of the object. For example, code in the `compare` function can cast the void pointer into the appropriate object type and access members of that object. The addition of the `context` pointer makes `_lsearch_s` more secure because extra context can be used to avoid reentrancy bugs associated with using static variables to make data available to the `compare` function.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_lsearch_s</code>	<search.h>

For more compatibility information, see [Compatibility](#).

See also

Searching and sorting

`bsearch_s`
`_lfind_s`
`_lsearch`

The Microsoft-implemented POSIX function name `lseek` is a deprecated alias for the `_lseek` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_lseek` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_lseek`, `_lseeki64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Moves a file pointer to the specified location.

Syntax

```
long _lseek(
    int fd,
    long offset,
    int origin
);
__int64 _lseeki64(
    int fd,
    __int64 offset,
    int origin
);
```

Parameters

`fd`

File descriptor referring to an open file.

`offset`

Number of bytes from `origin`.

`origin`

Initial position.

Return value

`_lseek` returns the offset, in bytes, of the new position from the beginning of the file. `_lseeki64` returns the offset in a 64-bit integer. The function returns -1L to indicate an error. If passed an invalid parameter, such as a bad file descriptor, or the value for `origin` is invalid or the position specified by `offset` is before the beginning of the file, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EBADF` and return -1L. On devices incapable of seeking (such as terminals and printers), the return value is undefined.

For more information about these and other error codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

The `_lseek` function moves the file pointer associated with `fd` to a new location that is `offset` bytes from `origin`. The next operation on the file occurs at the new location. The `origin` argument must be one of the following constants, which are defined in Stdio.h.

<code>ORIGIN</code> VALUE	DESCRIPTION
<code>SEEK_SET</code>	Beginning of the file.
<code>SEEK_CUR</code>	Current position of the file pointer.

ORIGIN	VALUE	DESCRIPTION
	SEEK_END	End of file.

You can use `_lseek` to reposition the pointer anywhere in a file or beyond the end of the file.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_lseek</code>	<code><io.h></code>
<code>_lseeki64</code>	<code><io.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_lseek.c
/* This program first opens a file named lseek.txt.
* It then uses _lseek to find the beginning of the file,
* to find the current position in the file, and to find
* the end of the file.
*/
#include <io.h>
#include <fcntl.h>
#include <stdlib.h>
#include <stdio.h>
#include <share.h>

int main( void )
{
    int fh;
    long pos;           /* Position of file pointer */
    char buffer[10];

    _sopen_s( &fh, "crt_lseek.c_input", _O_RDONLY, _SH_DENYNO, 0 );

    /* Seek the beginning of the file: */
    pos = _lseek( fh, 0L, SEEK_SET );
    if( pos == -1L )
        perror( "_lseek to beginning failed" );
    else
        printf( "Position for beginning of file seek = %ld\n", pos );

    /* Move file pointer a little */
    _read( fh, buffer, 10 );

    /* Find current position: */
    pos = _lseek( fh, 0L, SEEK_CUR );
    if( pos == -1L )
        perror( "_lseek to current position failed" );
    else
        printf( "Position for current position seek = %ld\n", pos );

    /* Set the end of the file: */
    pos = _lseek( fh, 0L, SEEK_END );
    if( pos == -1L )
        perror( "_lseek to end failed" );
    else
        printf( "Position for end of file seek = %ld\n", pos );

    _close( fh );
}

```

Input: crt_lseek.c_input

```

Line one.
Line two.
Line three.
Line four.
Line five.

```

Output

```

Position for beginning of file seek = 0
Position for current position seek = 10
Position for end of file seek = 57

```

See also

Low-level I/O

fseek	_fseeki64
_tell	_telli64

`_makepath`, `_wmakepath`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Create a path name from components. More secure versions of these functions are available; see [`_makepath_s`](#), [`_wmakepath_s`](#).

Syntax

```
void _makepath(
    char *path,
    const char *drive,
    const char *dir,
    const char *fname,
    const char *ext
);
void _wmakepath(
    wchar_t *path,
    const wchar_t *drive,
    const wchar_t *dir,
    const wchar_t *fname,
    const wchar_t *ext
);
```

Parameters

`path`

Full path buffer.

`drive`

Contains a letter (A, B, and so on) corresponding to the desired drive and an optional trailing colon. `_makepath` inserts the colon automatically in the composite path if it's missing. If `drive` is `NULL` or points to an empty string, no drive letter appears in the composite `path` string.

`dir`

Contains the path of directories, not including the drive designator or the actual file name. The trailing slash is optional, and either a forward slash (`/`) or a backslash (`\`) or both might be used in a single `dir` argument. If no trailing slash (`/` or `\`) is specified, it's inserted automatically. If `dir` is `NULL` or points to an empty string, no directory path is inserted in the composite `path` string.

`fname`

Contains the base file name without any file name extensions. If `fname` is `NULL` or points to an empty string, no filename is inserted in the composite `path` string.

`ext`

Contains the actual file name extension, with or without a leading period (`.`). `_makepath` inserts the period automatically if it doesn't appear in `ext`. If `ext` is `NULL` or points to an empty string, no extension is inserted in the composite `path` string.

Remarks

The `_makepath` function creates a composite path string from individual components, storing the result in `path`. The `path` might include a drive letter, directory path, filename, and filename extension. `_wmakepath` is a wide-

character version of `_makepath`; the arguments to `_wmakepath` are wide-character strings. `_wmakepath` and `_makepath` behave identically otherwise.

Security Note Use a null-terminated string. To avoid buffer overrun, the null-terminated string must not exceed the size of the `path` buffer. `_makepath` doesn't ensure that the length of the composite path string doesn't exceed `_MAX_PATH`. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tmakepath</code>	<code>_makepath</code>	<code>_makepath</code>	<code>_wmakepath</code>

The `path` argument must point to an empty buffer large enough to hold the complete path. The composite `path` must be no larger than the `_MAX_PATH` constant, defined in `Stdlib.h`.

If `path` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). In addition, `errno` is set to `EINVAL`. `NULL` values are allowed for all other parameters.

Requirements

ROUTINE	REQUIRED HEADER
<code>_makepath</code>	<code><stdlib.h></code>
<code>_wmakepath</code>	<code><stdlib.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_makepath.c
#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    char path_buffer[_MAX_PATH];
    char drive[_MAX_DRIVE];
    char dir[_MAX_DIR];
    char fname[_MAX_FNAME];
    char ext[_MAX_EXT];

    _makepath( path_buffer, "c", "\\sample\\crt\\", "makepath", "c" ); // C4996
    // Note: _makepath is deprecated; consider using _makepath_s instead
    printf( "Path created with _makepath: %s\n\n", path_buffer );
    _splitpath( path_buffer, drive, dir, fname, ext ); // C4996
    // Note: _splitpath is deprecated; consider using _splitpath_s instead
    printf( "Path extracted with _splitpath:\n" );
    printf( "    Drive: %s\n", drive );
    printf( "    Dir: %s\n", dir );
    printf( "    Filename: %s\n", fname );
    printf( "    Ext: %s\n", ext );
}
```

```
Path created with _makepath: c:\sample\crt\makepath.c
```

```
Path extracted with _splitpath:
```

```
Drive: c:  
Dir: \sample\crt\  
Filename: makepath  
Ext: .c
```

See also

File handling

[_fullpath](#), [_wfullpath](#)

[_splitpath](#), [_wsplitpath](#)

[_makepath_s](#), [_wmakepath_s](#)

`_makepath_s`, `_wmakepath_s`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Creates a path name from components. These functions are versions of `_makepath`, `_wmakepath` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _makepath_s(
    char *path,
    size_t sizeInBytes,
    const char *drive,
    const char *dir,
    const char *fname,
    const char *ext
);
errno_t _wmakepath_s(
    wchar_t *path,
    size_t sizeInWords,
    const wchar_t *drive,
    const wchar_t *dir,
    const wchar_t *fname,
    const wchar_t *ext
);
template <size_t size>
errno_t _makepath_s(
    char (&path)[size],
    const char *drive,
    const char *dir,
    const char *fname,
    const char *ext
); // C++ only
template <size_t size>
errno_t _wmakepath_s(
    wchar_t (&path)[size],
    const wchar_t *drive,
    const wchar_t *dir,
    const wchar_t *fname,
    const wchar_t *ext
); // C++ only
```

Parameters

`path`

Full path buffer.

`sizeInWords`

Size of the buffer in words.

`sizeInBytes`

Size of the buffer in bytes.

`drive`

Contains a letter (A, B, and so on) corresponding to the desired drive and an optional trailing colon. `_makepath_s` inserts the colon automatically in the composite path if it's missing. If `drive` is `NULL` or points to an empty string, no drive letter appears in the composite `path` string.

`dir`

Contains the path of directories, not including the drive designator or the actual file name. The trailing slash is optional, and either a forward slash (/) or a backslash (\) or both might be used in a single `dir` argument. If no trailing slash (/ or \) is specified, it's inserted automatically. If `dir` is `NULL` or points to an empty string, no directory path is inserted in the composite `path` string.

`fname`

Contains the base file name without any file name extensions. If `fname` is `NULL` or points to an empty string, no filename is inserted in the composite `path` string.

`ext`

Contains the actual file name extension, with or without a leading period (.). `_makepath_s` inserts the period automatically if it doesn't appear in `ext`. If `ext` is `NULL` or points to an empty string, no extension is inserted in the composite `path` string.

Return value

Zero if successful; an error code on failure.

Error conditions

PATH	SIZEINWORDS / SIZEINBYTES	RETURN	CONTENTS OF PATH
<code>NULL</code>	any	<code>EINVAL</code>	not modified
any	<code><= 0</code>	<code>EINVAL</code>	not modified

If any of the above error conditions occurs, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the functions returns `EINVAL`. `NULL` is allowed for the parameters `drive`, `fname`, and `ext`. For information about the behavior when these parameters are null pointers or empty strings, see the Remarks section.

Remarks

The `_makepath_s` function creates a composite path string from individual components, storing the result in `path`. The `path` might include a drive letter, directory path, file name, and file name extension. `_wmakepath_s` is a wide-character version of `_makepath_s`; the arguments to `_wmakepath_s` are wide-character strings. `_wmakepath_s` and `_makepath_s` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tmakepath_s</code>	<code>_makepath_s</code>	<code>_makepath_s</code>	<code>_wmakepath_s</code>

The `path` argument must point to an empty buffer large enough to hold the complete path. The composite `path` must be no larger than the `_MAX_PATH` constant, defined in `Stdlib.h`.

If `path` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). In addition, `errno` is set to `EINVAL`. `NULL` values are allowed for all other parameters.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length

automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [`_CrtSetDebugFillThreshold`](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_makepath_s</code>	<code><stdlib.h></code>
<code>_wmakepath_s</code>	<code><stdlib.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_makepath_s.c

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    char path_buffer[_MAX_PATH];
    char drive[_MAX_DRIVE];
    char dir[_MAX_DIR];
    char fname[_MAX_FNAME];
    char ext[_MAX_EXT];
    errno_t err;

    err = _makepath_s( path_buffer, _MAX_PATH, "c", "\\sample\\crt\\",
                      "crt_makepath_s", "c" );
    if (err != 0)
    {
        printf("Error creating path. Error code %d.\n", err);
        exit(1);
    }
    printf( "Path created with _makepath_s: %s\n\n", path_buffer );
    err = _splitpath_s( path_buffer, drive, _MAX_DRIVE, dir, _MAX_DIR,
                       fname, _MAX_FNAME, ext, _MAX_EXT );
    if (err != 0)
    {
        printf("Error splitting the path. Error code %d.\n", err);
        exit(1);
    }
    printf( "Path extracted with _splitpath_s:\n" );
    printf( "    Drive: %s\n", drive );
    printf( "    Dir: %s\n", dir );
    printf( "    Filename: %s\n", fname );
    printf( "    Ext: %s\n", ext );
}
```

```
Path created with _makepath_s: c:\sample\crt\crt_makepath_s.c
```

```
Path extracted with _splitpath_s:
```

```
Drive: c:  
Dir: \sample\crt\  
Filename: crt_makepath_s  
Ext: .c
```

See also

File handling

[_fullpath](#) , [_wfullpath](#)

[_splitpath_s](#) , [_wsplitpath_s](#)

[_makepath](#) , [_wmakepath](#)

malloc

11/2/2022 • 3 minutes to read • [Edit Online](#)

Allocates memory blocks.

Syntax

```
void *malloc(  
    size_t size  
)
```

Parameters

`size`

Bytes to allocate.

Return value

`malloc` returns a void pointer to the allocated space, or `NULL` if there's insufficient memory available. To return a pointer to a type other than `void`, use a type cast on the return value. The storage space pointed to by the return value is suitably aligned for storage of any type of object that has an alignment requirement less than or equal to that of the fundamental alignment. (In Visual C++, the fundamental alignment is the alignment that's required for a `double`, or 8 bytes. In code that targets 64-bit platforms, it's 16 bytes.) Use `_aligned_malloc` to allocate storage for objects that have a larger alignment requirement—for example, the SSE types `_m128` and `_m256`, and types that are declared by using `__declspec(align(n))` where `n` is greater than 8. If `size` is 0, `malloc` allocates a zero-length item in the heap and returns a valid pointer to that item. Always check the return from `malloc`, even if the amount of memory requested is small.

Remarks

The `malloc` function allocates a memory block of at least `size` bytes. The block may be larger than `size` bytes because of the space that's required for alignment and maintenance information.

`malloc` sets `errno` to `ENOMEM` if a memory allocation fails or if the amount of memory requested exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

The startup code uses `malloc` to allocate storage for the `_environ`, `envp`, and `argv` variables. The following functions and their wide-character counterparts also call `malloc`.

`calloc`
`_exec` functions
`fgetc`
`_fgetchar`
`fgets`
`fprintf`
`fputc`
`_fputchar`
`fputs`

`fread`

`fscanf`

`fseek`

`fsetpos`

`_fullpath`

`fwrite`

`getc`

`getchar`

`_getcwd`

`_getdcwd`

`gets`

`_getw`

`_popen`

`printf`

`putc`

`putchar`

`_putenv`

`puts`

`_putw`

`scanf`

`_searchenv`

`setvbuf`

`_spawn` functions

`_strup`

`system`

`_tempnam`

`ungetc`

`vfprintf`

`vprintf`

The C++ `_set_new_mode` function sets the new handler mode for `malloc`. The new handler mode indicates whether, on failure, `malloc` is to call the new handler routine as set by `_set_new_handler`. By default, `malloc` doesn't call the new handler routine on failure to allocate memory. You can override this default behavior so that, when `malloc` fails to allocate memory, `malloc` calls the new handler routine in the same way that the `new` operator does when it fails for the same reason. To override the default, call `_set_new_mode(1)` early in your program, or link with `NEWMODE.OBJ` (see [Link options](#)).

When the application is linked with a debug version of the C run-time libraries, `malloc` resolves to `_malloc_dbg`. For more information about how the heap is managed during the debugging process, see [CRT debug heap details](#).

`malloc` is marked `__declspec(noalias)` and `__declspec(restrict)`. These attributes mean that the function is guaranteed not to modify global variables, and that the pointer returned isn't aliased. For more information, see `noalias` and `restrict`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>malloc</code>	<code><stdlib.h></code> and <code><malloc.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_malloc.c
// This program allocates memory with
// malloc, then frees the memory with free.

#include <stdlib.h> // For _MAX_PATH definition
#include <stdio.h>
#include <malloc.h>

int main( void )
{
    char *string;

    // Allocate space for a path name
    string = malloc( _MAX_PATH );

    // In a C++ file, explicitly cast malloc's return. For example,
    // string = (char *)malloc( _MAX_PATH );

    if( string == NULL )
        printf( "Insufficient memory available\n" );
    else
    {
        printf( "Memory space allocated for path name\n" );
        free( string );
        printf( "Memory freed\n" );
    }
}
```

```
Memory space allocated for path name
Memory freed
```

See also

[Memory allocation](#)

<code>calloc</code>
<code>free</code>
<code>realloc</code>
<code>_aligned_malloc</code>

_malloc_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Allocates a block of memory in the heap with extra space for a debugging header and overwrite buffers (debug version only).

Syntax

```
void *_malloc_dbg(
    size_t size,
    int blockType,
    const char *filename,
    int linenumber
);
```

Parameters

`size`

Requested size of the memory block (in bytes).

`blockType`

Requested type of the memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file that requested the allocation operation or `NULL`.

`linenumber`

Line number in the source file where the allocation operation was requested or `NULL`.

The `filename` and `linenumber` parameters are only available when `_malloc_dbg` has been called explicitly or the `_CRTDBG_MAP_ALLOC` preprocessor constant has been defined.

Return value

On successful completion, this function returns a pointer to the user portion of the allocated memory block, calls the new handler function, or returns `NULL`. For a complete description of the return behavior, see the following Remarks section. For more information about how the new handler function is used, see the `malloc` function.

Remarks

`_malloc_dbg` is a debug version of the `malloc` function. When `_DEBUG` isn't defined, each call to `_malloc_dbg` is reduced to a call to `malloc`. Both `malloc` and `_malloc_dbg` allocate a block of memory in the base heap, but `_malloc_dbg` offers several debugging features: buffers on either side of the user portion of the block to test for leaks, a block type parameter to track specific allocation types, and `filename` / `linenumber` information to determine the origin of allocation requests.

`_malloc_dbg` allocates the memory block with slightly more space than the requested `size`. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. When the block is allocated, the user portion of the block is filled with the value 0xCD, and each of the overwrite buffers are filled with 0xFD.

`_malloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails or if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and debug versions, see [Debug versions of heap allocation functions](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_malloc_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

For a sample of how to use `_malloc_dbg`, see [crt_dbg1](#).

See also

Debug routines

`malloc`
`_calloc_dbg`

_malloca

11/2/2022 • 3 minutes to read • [Edit Online](#)

Allocates memory on the stack. This function is a version of [_alloca](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
void *_malloca(  
    size_t size  
)
```

Parameters

`size`

Bytes to be allocated from the stack.

Return value

The `_malloca` routine returns a `void` pointer to the allocated space, which is suitably aligned for storage of any type of object. If `size` is 0, `_malloca` allocates a zero-length item and returns a valid pointer to that item.

If `size` is greater than `_ALLOCA_S_THRESHOLD`, then `_malloca` attempts to allocate on the heap, and returns a null pointer if the space can't be allocated. If `size` is less than or equal to `_ALLOCA_S_THRESHOLD`, then `_malloca` attempts to allocate on the stack, and a stack overflow exception is generated if the space can't be allocated. The stack overflow exception isn't a C++ exception; it's a structured exception. Instead of using C++ exception handling, you must use [Structured exception handling](#) (SEH) to catch this exception.

Remarks

`_malloca` allocates `size` bytes from the program stack or the heap if the request exceeds a certain size in bytes given by `_ALLOCA_S_THRESHOLD`. The difference between `_malloca` and `_alloca` is that `_alloca` always allocates on the stack, regardless of the size. Unlike `_alloca`, which doesn't require or permit a call to `free` to free the memory so allocated, `_malloca` requires the use of `_freea` to free memory. In debug mode, `_malloca` always allocates memory from the heap.

There are restrictions to explicitly calling `_malloca` in an exception handler (EH). EH routines that run on x86-class processors operate in their own memory frame: They perform their tasks in memory space that isn't based on the current location of the stack pointer of the enclosing function. The most common implementations include Windows NT structured exception handling (SEH) and C++ catch clause expressions. Therefore, explicitly calling `_malloca` in any of the following scenarios results in program failure during the return to the calling EH routine:

- Windows SEH exception filter expression: `_except (_malloca ())`
- Windows SEH final exception handler: `_finally { _malloca () }`
- C++ EH catch clause expression

However, `_malloca` can be called directly from within an EH routine or from an application-supplied callback that gets invoked by one of the EH scenarios previously listed.

IMPORTANT

In Windows, if `_malloca` is called inside a `try/catch` block, you must call `_resetstkoflw` in the catch block.

In addition to the above restrictions, when using the `/clr` (Common Language Runtime Compilation) option, `_malloca` can't be used in `__except` blocks. For more information, see `/clr` Restrictions.

Requirements

ROUTINE	REQUIRED HEADER
<code>_malloca</code>	<code><malloc.h></code>

Example: `_malloca`

```
// crt_malloca_simple.c
#include <stdio.h>
#include <malloc.h>

void Fn()
{
    char * buf = (char *)_malloca( 100 );
    // do something with buf
    _freea( buf );
}

int main()
{
    Fn();
}
```

Example: `_malloca` exception

```

// crt_malloc_exception.c
// This program demonstrates the use of
// _malloc and trapping any exceptions
// that may occur.

#include <windows.h>
#include <stdio.h>
#include <malloc.h>

int main()
{
    int      size;
    int      numberRead = 0;
    int      errcode = 0;
    void    *p = NULL;
    void    *pMarker = NULL;

    while (numberRead == 0)
    {
        printf_s("Enter the number of bytes to allocate "
                "using _malloc: ");
        numberRead = scanf_s("%d", &size);
    }

    // Do not use try/catch for _malloc,
    // use __try/__except, since _malloc throws
    // Structured Exceptions, not C++ exceptions.

    __try
    {
        if (size > 0)
        {
            p = _malloc( size );
        }
        else
        {
            printf_s("Size must be a positive number.");
        }
        _freea( p );
    }

    // Catch any exceptions that may occur.
    __except( GetExceptionCode() == STATUS_STACK_OVERFLOW )
    {
        printf_s("_malloc failed!\n");

        // If the stack overflows, use this function to restore.
        errcode = _resetstkoflw();
        if (errcode)
        {
            printf("Could not reset the stack!");
            _exit(1);
        }
    };
}

```

Input

1000

Sample output

Enter the number of bytes to allocate using _malloc: 1000

See also

[Memory allocation](#)

[calloc](#)

[malloc](#)

[realloc](#)

[_resetstkoflw](#)

_matherr

11/2/2022 • 3 minutes to read • [Edit Online](#)

Handles math errors.

Syntax

```
int _matherr(struct _exception *except);
```

Parameters

`except`

Pointer to the structure containing error information.

Return value

`_matherr` returns 0 to indicate an error, or a nonzero value to indicate success:

- If `_matherr` returns 0, an error message can be displayed and `errno` is set to an appropriate error value.
- If `_matherr` returns a nonzero value, no error message is displayed, and `errno` remains unchanged.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_matherr` function processes errors generated by the floating-point functions of the math library. These functions call `_matherr` when an error is detected. This interaction isn't impacted by the [floating-point mode of the compiler](#) or the [floating point control word](#). Since `_matherr` is a library function, math [intrinsic functions](#) won't call it.

For special error handling, you can provide a different definition of `_matherr`. If you use the dynamically linked version of the C run-time library (CRT), you can replace the default `_matherr` routine in a client executable with a user-defined version. However, you can't replace the default `_matherr` routine in a DLL client of the CRT DLL.

When an error occurs in a math routine, `_matherr` is called with a pointer to an `_exception` type structure (defined in `<math.h>`) as an argument. The `_exception` structure contains the following elements.

```
struct _exception
{
    int     type;    // exception type - see below
    char*   name;   // name of function where error occurred
    double  arg1;   // first argument to function
    double  arg2;   // second argument (if any) to function
    double  retval; // value to be returned by function
};
```

The `type` member specifies the type of math error. It's one of the following values, defined in `<math.h>`:

MACRO	DESCRIPTION
<code>_DOMAIN</code>	Argument domain error

MACRO	DESCRIPTION
_SING	Argument singularity
_OVERFLOW	Overflow range error
_PLOSS	Partial loss of significance
_TLOSS	Total loss of significance
_UNDERFLOW	The result is too small to be represented. (This condition isn't currently supported.)

The structure member `name` is a pointer to a null-terminated string containing the name of the function that caused the error. The structure members `arg1` and `arg2` specify the values that caused the error. If only one argument is given, it's stored in `arg1`.

The default return value for the given error is `retval`. If you change the return value, it must specify whether an error actually occurred.

Requirements

ROUTINE	REQUIRED HEADER
<code>_matherr</code>	<code><math.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

/* crt_matherr.c
 * Illustrates writing an error routine for math
 * functions.
 * The error handling function must be named _matherr
 */

#include <math.h>
#include <string.h>
#include <stdio.h>

int main()
{
    /* Do several math operations that cause errors. The _matherr
     * routine handles _DOMAIN errors, but lets the system handle
     * other errors normally.
     */
    printf( "log( -2.0 ) = %e\n", log( -2.0 ) );
    printf( "log10( -5.0 ) = %e\n", log10( -5.0 ) );
    printf( "log( 0.0 ) = %e\n", log( 0.0 ) );
}

/* Handle several math errors caused by passing a negative argument
 * to log or log10 (_DOMAIN errors). When this happens, _matherr
 * returns the natural or base-10 logarithm of the absolute value
 * of the argument and suppresses the usual error message.
 */
int _matherr(struct _exception *except)
{
    /* Handle _DOMAIN errors for log or log10. */
    if (except->type == _DOMAIN)
    {
        if (strcmp(except->name, "log") == 0)
        {
            except->retval = log(-(except->arg1));
            printf("Special: using absolute value: %s: _DOMAIN "
                   "error\n", except->name);
            return 1;
        }
        else if (strcmp(except->name, "log10") == 0)
        {
            except->retval = log10(-(except->arg1));
            printf("Special: using absolute value: %s: _DOMAIN "
                   "error\n", except->name);
            return 1;
        }
    }
    printf("Normal: ");
    return 0;      /* Else use the default actions */
}

```

```

Special: using absolute value: log: _DOMAIN error
log( -2.0 ) = 6.931472e-01
Special: using absolute value: log10: _DOMAIN error
log10( -5.0 ) = 6.989700e-01
Normal: log( 0.0 ) = -inf

```

See also

[Math and floating-point support](#)



11/2/2022 • 2 minutes to read • [Edit Online](#)

A preprocessor macro that returns the larger of two values.

Syntax

```
#define __max(a,b) (((a) > (b)) ? (a) : (b))
```

Parameters

`a`, `b`

Values of any numeric type to be compared.

Return value

`__max` returns the larger of its arguments.

Remarks

The `__max` macro compares two values and returns the value of the larger one. The arguments can be of any numeric data type, signed or unsigned. Both arguments and the return value must be of the same data type.

The argument returned is evaluated twice by the macro. Double evaluation can lead to unexpected results if the argument is an expression that alters its value when it's evaluated, such as `*p++`.

Requirements

MACRO	REQUIRED HEADER
<code>__max</code>	<code><stdlib.h></code>

Example

For more information, see the example for [`__min`](#).

See also

[Math and floating-point support](#)

[`__min`](#)

`_mbbtombc`, `_mbbtombc_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a single-byte multibyte character to a corresponding double-byte multibyte character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned int _mbbtombc(
    unsigned int c
);
unsigned int _mbbtombc_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Single-byte character to convert.

`Locale`

Locale to use.

Return value

If `_mbbtombc` successfully converts `c`, it returns a multibyte character; otherwise, it returns `c`.

Remarks

The `_mbbtombc` function converts a given single-byte multibyte character to a corresponding double-byte multibyte character. Characters must be within the range 0x20 - 0x7E or 0xA1 - 0xDF to be converted.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see `setlocale`, `wsetlocale`. The versions of this function are identical, except that `_mbbtombc` uses the current locale for this locale-dependent behavior and `_mbbtombc_1` instead uses the locale parameter that's passed in. For more information, see [Locale](#).

In earlier versions, `_mbbtombc` was named `hantozem`. For new code, use `_mbbtombc`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbbtombc</code>	<mbstring.h>
<code>_mbbtombc_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

[Data conversion](#)

`_mbctombb` , `_mbctombb_1`

`_mbbtype`, `_mbbtype_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the byte type, based on the previous byte.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _mbbtype(
    unsigned char c,
    int type
);
int _mbbtype_l(
    unsigned char c,
    int type,
    _locale_t locale
);
```

Parameters

`c`

The character to test.

`type`

The type of byte to test for.

`Locale`

The locale to use.

Return value

`_mbbtype` returns the type of byte in a string. This decision is context-sensitive, as specified by the value of `type`, which provides the control test condition. `type` is the type of the previous byte in the string. The manifest constants in the following table are defined in Mbctype.h.

VALUE OF <code>TYPE</code>	<code>_MBBTYPEx</code> TESTS FOR	RETURN VALUE	<code>c</code>
Any value except 1	Valid single byte or lead byte	<code>_MBC_SINGLE</code> (0)	Single byte (0x20 - 0x7E, 0xA1 - 0xDF)
Any value except 1	Valid single byte or lead byte	<code>_MBC_LEAD</code> (1)	Lead byte of multibyte character (0x81 - 0x9F, 0xE0 - 0xFC)
Any value except 1	Valid single-byte or lead byte	<code>_MBC_ILLEGAL</code> (-1)	Invalid character (any value except 0x20 - 0x7E, 0xA1 - 0xDF, 0x81 - 0x9F, 0xE0 - 0xFC)

VALUE OF <code>TYPE</code>	<code>_MBBTYPED</code> TESTS FOR	RETURN VALUE	C
1	Valid trail byte	<code>_MBC_TRAIL</code> (2)	Trailing byte of multibyte character (0x40 - 0x7E, 0x80 - 0xFC)
1	Valid trail byte	<code>_MBC_ILLEGAL</code> (-1)	Invalid character (any value except 0x20 - 0x7E, 0xA1 - 0xDF, 0x81 - 0x9F, 0xE0 - 0xFC)

Remarks

The `_mbbtype` function determines the type of a byte in a multibyte character. If the value of `type` is any value except 1, `_mbbtype` tests for a valid single-byte or lead byte of a multibyte character. If the value of `type` is 1, `_mbbtype` tests for a valid trail byte of a multibyte character.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see `setlocale`, `wsetlocale`. The `_mbbtype` version of this function uses the current locale for this locale-dependent behavior; the `_mbbtype_1` version is identical except that it uses the locale parameter that's passed in instead. For more information, see [Locale](#).

In earlier versions, `_mbbtype` was named `chkctype`. For new code, use `_mbbtype` instead.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_mbbtype</code>	<code><mbstring.h></code>	<code><mbctype.h></code> *
<code>_mbbtype_1</code>	<code><mbstring.h></code>	<code><mbctype.h></code> *

* For definitions of manifest constants that are used as return values.

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

`_mbccpy`, `_mbccpy_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copies a multibyte character from one string to another string. More secure versions of these functions are available; see [`_mbccpy_s`](#), [`_mbccpy_s_1`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
void _mbccpy(
    unsigned char *dest,
    const unsigned char *src
);
void _mbccpy_1(
    unsigned char *dest,
    const unsigned char *src,
    _locale_t locale
);
```

Parameters

`dest`

Copy destination.

`src`

Multibyte character to copy.

`Locale`

Locale to use.

Remarks

The `_mbccpy` function copies one multibyte character from `src` to `dest`.

This function validates its parameters. If `_mbccpy` is passed a null pointer for `dest` or `src`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`.

`_mbccpy` uses the current locale for any locale-dependent behavior. `_mbccpy_1` is identical to `_mbccpy` except that `_mbccpy_1` uses the locale passed in for any locale-dependent behavior. For more information, see [Locale](#).

Security Note Use a null-terminated string. The null-terminated string must not exceed the size of the destination buffer. For more information, see [Avoiding buffer overruns](#). Buffer overrun problems are a frequent method of system attack, resulting in an unwarranted elevation of privilege.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tccpy</code>	Maps to macro or inline function	<code>_mbccpy</code>	Maps to macro or inline function
<code>_tccpy_1</code>	n/a	<code>_mbccpy_1</code>	n/a

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbccpy</code>	<mbctype.h>
<code>_mbccpy_1</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

See also

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`_mbclen` , `mblen` , `_mblen_1`

`_mbccpy_s`, `_mbccpy_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copies one multibyte character from a string to another string. These versions of `_mbccpy`, `_mbccpy_1` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _mbccpy_s(
    unsigned char *dest,
    size_t bufferSizeInBytes,
    int * pCopied,
    const unsigned char *src
);
errno_t _mbccpy_s_l(
    unsigned char *dest,
    size_t bufferSizeInBytes,
    int * pCopied,
    const unsigned char *src,
    _locale_t locale
);
template <size_t size>
errno_t _mbccpy_s(
    unsigned char (&dest)[size],
    int * pCopied,
    const unsigned char *src
); // C++ only
template <size_t size>
errno_t _mbccpy_s_l(
    unsigned char (&dest)[size],
    int * pCopied,
    const unsigned char *src,
    _locale_t locale
); // C++ only
```

Parameters

`dest`

Copy destination.

`bufferSizeInBytes`

Size of the destination buffer.

`pCopied`

Filled with the number of bytes copied (1 or 2 if successful). Pass `NULL` if you don't care about the number.

`src`

Multibyte character to copy.

`Locale`

Locale to use.

Return value

Zero if successful; an error code on failure. If `src` or `dest` is `NULL`, or if more than `buffSizeInBytes` bytes would be copied to `dest`, then the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `EINVAL`, and `errno` is set to `EINVAL`.

Remarks

The `_mbccpy_s` function copies one multibyte character from `src` to `dest`. If `src` doesn't point to the lead byte of a multibyte character as determined by an implicit call to `_ismbblead`, then the single byte that `src` points to is copied. If `src` points to a lead byte, but the following byte is 0 and thus invalid, then 0 is copied to `dest`, `errno` is set to `EILSEQ`, and the function returns `EILSEQ`.

`_mbccpy_s` doesn't append a null terminator; however, if `src` points to a null character, then that null is copied to `dest` (as a regular single-byte copy).

The value in `pCopied` is filled with the number of bytes copied. Possible values are 1 and 2 if the operation is successful. If `NULL` is passed in, this parameter is ignored.

<code>SRC</code>	<code>COPIED TO DEST</code>	<code>PCOPIED</code>	<code>RETURN VALUE</code>
non-lead-byte	non-lead-byte	1	0
0	0	1	0
lead-byte followed by non-0	lead-byte followed by non-0	2	0
lead-byte followed by 0	0	1	<code>EILSEQ</code>

The second row is just a special case of the first row. The table assumes `buffSizeInBytes` \geq `pCopied`.

`_mbccpy_s` uses the current locale for any locale-dependent behavior. `_mbccpy_s_1` is identical to `_mbccpy_s` except that `_mbccpy_s_1` uses the locale passed in for any locale-dependent behavior.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tccpy_s</code>	Maps to macro or inline function.	<code>_mbccpy_s</code>	Maps to macro or inline function.

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbccpy_s</code>	<mbstring.h>
<code>_mbccpy_s_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[`_mbclen`](#) , [`mblen`](#) , [`_mblen_1`](#)

`_mbcjistojms`, `_mbcjistojms_l`, `_mbcjmstojis`,

`_mbcjmstojis_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts between Japan Industry Standard (JIS) and Japan Microsoft (JMS) characters.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned int _mbcjistojms(
    unsigned int c
);
unsigned int _mbcjistojms_l(
    unsigned int c,
    _locale_t locale
);
unsigned int _mbcjmstojis(
    unsigned int c
);
unsigned int _mbcjmstojis_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Character to convert.

`Locale`

Locale to use.

Return value

On Japanese locale, these functions return a converted character or return 0 if no conversion is possible. On a non-Japanese locale, these functions return the character passed in.

Remarks

The `_mbcjistojms` function converts a Japan Industry Standard (JIS) character to a Microsoft Kanji (Shift JIS) character. The character is converted only if the lead and trail bytes are in the range 0x21 - 0x7E. If the lead or trail byte is outside this range, `errno` is set to `EILSEQ`. For more information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

The `_mbcjmstojis` function converts a Shift JIS character to a JIS character. The character is converted only if the lead byte is in the range 0x81 - 0x9F or 0xE0 - 0xFC and the trail byte is in the range 0x40 - 0x7E or 0x80 - 0xFC. Some code points in that range don't have a character assigned, and so can't be converted.

The value `c` should be a 16-bit value whose upper 8 bits represent the lead byte of the character to convert and whose lower 8 bits represent the trail byte.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

In earlier versions, `_mbcjistojms` and `_mbcjmstojis` were called `jistojms` and `jmstojis`, respectively.

`_mbcjistojms`, `_mbcjistojms_1`, `_mbcjmstojis` and `_mbcjmstojis_1` should be used instead.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbcjistojms</code>	<mbstring.h>
<code>_mbcjistojms_1</code>	<mbstring.h>
<code>_mbcjmstojis</code>	<mbstring.h>
<code>_mbcjmstojis_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

[Data conversion](#)

[`_ismbb` routines](#)

`_mbclen`, `mblen`, `_mblen_l`, `_mbclen_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the length and determines the validity of a multibyte character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
size_t _mbclen(
    const unsigned char *c
);
size_t _mbclen_l(
    unsigned char const* c,
    _locale_t locale
);
int mblen(
    const char *mbstr,
    size_t count
);
int _mblen_l(
    const char *mbstr,
    size_t count,
    _locale_t locale
);
```

Parameters

`c`

Multibyte character.

`mbstr`

Address of a multibyte-character byte sequence.

`count`

Number of bytes to check.

`Locale`

Locale to use.

Return value

`_mbclen` and `_mbclen_l` return 1 or 2, according to the length of the multibyte character `c`. The functions always return 1 for UTF-8, whether `c` is multibyte or not. There's no error return for `_mbclen`.

If `mbstr` isn't `NULL`, `mblen` and `_mblen_l` return the length, in bytes, of the multibyte character. The `mblen` and `_mblen_l` functions work correctly on UTF-8, and may return a value between 1 and 3. When `mbstr` is `NULL` (or it points to the wide-character null character), `mblen` and `_mblen_l` return 0. The object that `mbstr` points to must form a valid multibyte character within the first `count` characters, or `mblen` and `_mblen_l` return -1.

Remarks

The `_mbclen` function returns the length, in bytes, of the multibyte character `c`. If `c` doesn't point to the lead byte of a multibyte character (as determined by an implicit call to `ismbblead`), the result of `_mbclen` is unpredictable.

`mblen` returns the length in bytes of `mbstr` if it's a valid multibyte character. It also determines multibyte-character validity associated with the code page. `mblen` examines `count` or fewer bytes contained in `mbstr`, but not more than `MB_CUR_MAX` bytes.

The output value is affected by the `LC_CTYPE` category setting of the locale. The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior. The `_1` suffixed versions behave the same, but they use the locale parameter passed in instead. For more information, see [setlocale](#) and [Locale](#).

`_mbclen`, `_mblen_1`, and `_mbclen_1` are Microsoft-specific, not part of the Standard C library. We don't recommend you use them where you want portable code. For Standard C compatibility, use `mblen` or `mbrlen` instead.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcrlen</code>	Maps to macro or inline function	<code>_mbclen</code>	Maps to macro or inline function

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbclen</code>	<mbstring.h>
<code>mblen</code>	<stdlib.h>
<code>_mblen_1</code>	<stdlib.h>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_mblen.c
/* illustrates the behavior of the mbolen function
*/
#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    int      i;
    char    *pmbc = (char *)malloc( sizeof( char ) );
    wchar_t  wc   = L'a';

    printf( "Convert wide character to multibyte character:\n" );
    wctomb_s( &i, pmbc, sizeof(char), wc );
    printf( "    Characters converted: %u\n", i );
    printf( "    Multibyte character: %x\n\n", *pmbc );

    i = mbolen( pmbc, MB_CUR_MAX );
    printf( "Length in bytes of multibyte character %x: %u\n", *pmbc, i );

    pmbc = NULL;
    i = mbolen( pmbc, MB_CUR_MAX );
    printf( "Length in bytes of NULL multibyte character %x: %u\n", pmbc, i );
}

```

Convert wide character to multibyte character:
 Characters converted: 1
 Multibyte character: 61

Length in bytes of multibyte character 61: 1
 Length in bytes of NULL multibyte character 0: 0

See also

[Character classification](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[_mbccpy](#) , [_mbccpy_1](#)

[mbrlen](#)

[strlen](#) , [wcslen](#) , [_mbslen](#) , [_mbslen_1](#) , [_mbstrlen](#) , [_mbstrlen_1](#)

`_mbctohira`, `_mbctohira_l`, `_mbctokata`,
`_mbctokata_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts between hiragana and katakana characters.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned int _mbctohira(
    unsigned int c
);
unsigned int _mbctohira_l(
    unsigned int c,
    _locale_t locale
);
unsigned int _mbctokata(
    unsigned int c
);
unsigned int _mbctokata_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Multibyte character to convert.

`Locale`

Locale to use.

Return value

Each of these functions returns the converted character `c`, if possible. Otherwise it returns the character `c` unchanged.

Remarks

The `_mbctohira` and `_mbctokata` functions test a character `c` and, if possible, apply one of the following conversions.

ROUTINES	CONVERTS
<code>_mbctohira</code> , <code>_mbctohira_l</code>	Multibyte katakana to multibyte hiragana.

ROUTINES	CONVERTS
<code>_mbctokata</code> , <code>_mbctokata_1</code>	Multibyte hiragana to multibyte katakana.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions are identical, except that the ones that don't have the `_1` suffix use the current locale for this locale-dependent behavior and the ones that do have the `_1` suffix instead use the locale parameter that's passed in. For more information, see [Locale](#).

In earlier versions, `_mbctohira` was named `jtohira` and `_mbctokata` was named `jtokata`. For new code, use the new names.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbctohira</code>	<code><mbstring.h></code>
<code>_mbctohira_1</code>	<code><mbstring.h></code>
<code>_mbctokata</code>	<code><mbstring.h></code>
<code>_mbctokata_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

Data conversion

<code>_mbcjistojms</code>	<code>_mbcjistojms_1</code>	<code>_mbcjmstojis</code>	<code>_mbcjmstojis_1</code>
<code>_mbctolower</code>	<code>_mbctolower_1</code>	<code>_mbctoupper</code>	<code>_mbctoupper_1</code>
<code>_mbctombb</code>			<code>_mbctombb_1</code>

`_mbctolower`, `_mbctolower_l`, `_mbctoupper`,
`_mbctoupper_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tests and converts the case of a multibyte character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned int _mbctolower(
    unsigned int c
);
unsigned int _mbctolower_l(
    unsigned int c,
    _locale_t locale
);
unsigned int _mbctoupper(
    unsigned int c
);
unsigned int _mbctoupper_l(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Multibyte character to convert.

`Locale`

Locale to use.

Return value

Each of these functions returns the converted character `c`, if possible. Otherwise it returns the character `c` unchanged.

Remarks

The functions test a character `c` and, if possible, apply one of the following conversions.

ROUTINES	CONVERTS
<code>_mbctolower</code> , <code>_mbctolower_l</code>	Uppercase character to lowercase character.
<code>_mbctoupper</code> , <code>_mbctoupper_l</code>	Lowercase character to uppercase character.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The version of this function without the `_1` suffix uses the current locale for this locale-dependent behavior; the version with the `_1` suffix is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

In previous versions, `_mbctolower` was called `jtolower`, and `_mbctoupper` was called `jtoupper`. For new code, use the new names instead.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_totlower</code>	<code>tolower</code>	<code>_mbctolower</code>	<code>towlower</code>
<code>_totlower_1</code>	<code>_tolower_1</code>	<code>_mbctolower_1</code>	<code>_towlower_t</code>
<code>_totupper</code>	<code>toupper</code>	<code>_mbctoupper</code>	<code>towupper</code>
<code>_totupper_1</code>	<code>toupper_1</code>	<code>_mbctoupper_1</code>	<code>_towupper_1</code>

Requirements

ROUTINES	REQUIRED HEADER
<code>_mbctolower</code> , <code>_mbctolower_1</code>	<code><mbstring.h></code>
<code>_mbctoupper</code> , <code>_mbctoupper_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

Data conversion

<code>_mbbtombc</code> , <code>_mbbtombc_1</code>
<code>_mbcjistojms</code> , <code>_mbcjistojms_1</code> , <code>_mbcjmstojis</code> , <code>_mbcjmstojis_1</code>
<code>_mbctohira</code> , <code>_mbctohira_1</code> , <code>_mbctokata</code> , <code>_mbctokata_1</code>
<code>_mbctombb</code> , <code>_mbctombb_1</code>

`_mbctombb`, `_mbctombb_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a double-byte multibyte character to a corresponding single-byte multibyte character.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned int _mbctombb(
    unsigned int c
);
unsigned int _mbctombb_1(
    unsigned int c,
    _locale_t locale
);
```

Parameters

`c`

Multibyte character to convert.

`Locale`

Locale to use.

Return value

If successful, `_mbctombb` and `_mbctombb_1` returns the single-byte character that corresponds to `c`; otherwise it returns `c`.

Remarks

The `_mbctombb` and `_mbctombb_1` functions convert a given multibyte character to a corresponding single-byte multibyte character. Characters must correspond to single-byte characters within the range 0x20 - 0x7E or 0xA1 - 0xDF to be converted.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The version of this function without the `_1` suffix uses the current locale for this locale-dependent behavior; the version with the `_1` suffix is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

In previous versions, `_mbctombb` was called `zentoahan`. Use `_mbctombb` instead.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbctombb</code>	<mbstring.h>
<code>_mbctombb_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

Data conversion

[`_mbbtombc`](#), [`_mbbtombc_1`](#)
[`_mbcjistojms`](#), [`_mbcjistojms_1`](#), [`_mbcjmstojis`](#), [`_mbcjmstojis_1`](#)
[`_mbctohira`](#), [`_mbctohira_1`](#), [`_mbctokata`](#), [`_mbctokata_1`](#)
[`_mbctolower`](#), [`_mbctolower_1`](#), [`_mbctoupper`](#), [`_mbctoupper_1`](#)

mbrlen

11/2/2022 • 3 minutes to read • [Edit Online](#)

Determine the number of bytes that are required to complete a multibyte character in the current locale, with the capability of restarting in the middle of a multibyte character.

Syntax

```
size_t mbrlen(
    const char * str,
    size_t count,
    mbstate_t * mbstate
);
```

Parameters

`str`

Pointer to the next byte to inspect in a multibyte character string.

`count`

The maximum number of bytes to inspect.

`mbstate`

Pointer to the current shift state of the initial byte of `str`.

Return value

One of the following values:

VALUE	DESCRIPTION
0	The next <code>count</code> or fewer bytes complete the multibyte character that represents the wide null character.
1 to <code>count</code> , inclusive	The next <code>count</code> or fewer bytes complete a valid multibyte character. The value returned is the number of bytes that complete the multibyte character.
(<code>size_t</code>)(-2)	The next <code>count</code> bytes contribute to an incomplete but potentially valid multibyte character and all <code>count</code> bytes have been processed.
(<code>size_t</code>)(-1)	An encoding error occurred. The next <code>count</code> or fewer bytes don't contribute to a complete and valid multibyte character. In this case, <code>errno</code> is set to EILSEQ and the conversion state in <code>mbstate</code> is unspecified.

Remarks

The `mbrlen` function inspects at most `count` bytes starting with the byte pointed to by `str` to determine the number of bytes that are required to complete the next multibyte character, including any shift sequences. It's

equivalent to the call `mbrtowc(NULL, str, count, &mbstate)` where `mbstate` is either a user-provided `mbstate_t` object, or a static internal object provided by the library.

The `mbrlen` function saves and uses the shift state of an incomplete multibyte character in the `mbstate` parameter. It's why `**mbrlen**` can restart in the middle of a multibyte character, if needed, and examine at most `count` bytes. If `mbstate` is a null pointer, `mbrlen` uses an internal, static `mbstate_t` object to store the shift state. Because the internal `mbstate_t` object isn't thread-safe, we recommend that you always allocate and pass your own `mbstate` parameter.

The `mbrlen` function differs from `_mbclen`, `mblen`, `_mblen_1` by its restartability. The shift state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application should use `wcsrlen` instead of `wcslen` if a subsequent call to `wcsrtombs` is used instead of `wcstombs`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
not applicable	not applicable	<code>mbrlen</code>	not applicable

Requirements

ROUTINE	REQUIRED HEADER
<code>mbrlen</code>	<code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

This example shows how the interpretation of multibyte characters depends on the current code page, and demonstrates the resuming capability of `mbrlen`.

```

// crt_mbrlen.c
// Compile by using: cl crt_mbrlen.c
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <locale.h>
#include <wchar.h>

size_t Example(const char * pStr)
{
    size_t      charLen = 0;
    size_t      charCount = 0;
    mbstate_t   mbState = {0};

    while ((charLen = mbrlen(pStr++, 1, &mbState)) != 0 &&
           charLen != (size_t)-1)
    {
        if (charLen != (size_t)-2) // if complete mbcs char,
        {
            charCount++;
        }
    }
    return (charCount);
}

int main( void )
{
    int      cp;
    size_t   charCount = 0;
    const char *pSample =
        "\x82\xD0\x82\xE7\x82\xAA\x82\xC8: Shift-jis hiragana.";

    cp = _getmbcp();
    charCount = Example(pSample);
    printf("\nCode page: %d\n%s\nCharacter count: %d\n",
          cp, pSample, charCount);

    setlocale(LC_ALL, "ja-JP"); // Set Japanese locale
    _setmbcp(932); // and Japanese multibyte code page
    cp = _getmbcp();
    charCount = Example(pSample);
    printf("\nCode page: %d\n%s\nCharacter count: %d\n",
          cp, pSample, charCount);
}

```

Code page: 932
????: Shift-jis hiragana.
Character count: 25

See also

String manipulation

Locale

mbrtoc16 , mbrtoc32

11/2/2022 • 3 minutes to read • [Edit Online](#)

Translates the first UTF-8 multibyte character in a string into the equivalent UTF-16 or UTF-32 character.

Syntax

```
size_t mbrtoc16(
    char16_t* destination,
    const char* source,
    size_t max_bytes,
    mbstate_t* state
);

size_t mbrtoc32(
    char32_t* destination,
    const char* source,
    size_t max_bytes,
    mbstate_t* state
);
```

Parameters

destination

Pointer to the `char16_t` or `char32_t` equivalent of the UTF-8 multibyte character to convert. If null, the function doesn't store a value.

source

Pointer to the UTF-8 multibyte character string to convert.

max_bytes

The maximum number of bytes in `source` to examine for a character to convert. This argument should be a value between one and the number of bytes, including any null terminator, remaining in `source`.

state

Pointer to a `mbstate_t` conversion state object used to interpret the UTF-8 multibyte string to one or more output characters.

Return value

On success, returns the value of the first of these conditions that applies, given the current `state` value:

VALUE	CONDITION
0	The next <code>max_bytes</code> or fewer characters converted from <code>source</code> correspond to the null wide character, which is the value stored if <code>destination</code> isn't null. <code>state</code> contains the initial shift state.
Between 1 and <code>max_bytes</code> , inclusive	The value returned is the number of bytes of <code>source</code> that complete a valid multibyte character. The converted wide character is stored if <code>destination</code> isn't null.

VALUE	CONDITION
-3	The next wide character resulting from a previous call to the function has been stored in <code>destination</code> if <code>destination</code> isn't null. No bytes from <code>source</code> are consumed by this call to the function. When <code>source</code> points to a UTF-8 multibyte character that requires more than one wide character to represent (for example, a surrogate pair), then the <code>state</code> value is updated so that the next function call writes out the extra character.
-2	The next <code>max_bytes</code> bytes represent an incomplete, but potentially valid, UTF-8 multibyte character. No value is stored in <code>destination</code> . This result can occur if <code>max_bytes</code> is zero.
-1	An encoding error has occurred. The next <code>max_bytes</code> or fewer bytes don't contribute to a complete and valid UTF-8 multibyte character. No value is stored in <code>destination</code> . <code>EILSEQ</code> is stored in <code>errno</code> and the conversion state value <code>state</code> is unspecified.

Remarks

The `mbrtoc16` function reads up to `max_bytes` bytes from `source` to find the first complete, valid UTF-8 multibyte character, and then stores the equivalent UTF-16 character in `destination`. If the character requires more than one UTF-16 output character, such as a surrogate pair, then the `state` value is set to store the next UTF-16 character in `destination` on the next call to `mbrtoc16`. The `mbrtoc32` function is identical, but output is stored as a UTF-32 character.

If `source` is null, these functions return the equivalent of a call made using arguments of `NULL` for `destination`, `""` (an empty, null-terminated string) for `source`, and 1 for `max_bytes`. The passed values of `destination` and `max_bytes` are ignored.

If `source` isn't null, the function starts at the beginning of the string and inspects up to `max_bytes` bytes to determine the number of bytes required to complete the next UTF-8 multibyte character, including any shift sequences. If the examined bytes contain a valid and complete UTF-8 multibyte character, the function converts the character into the equivalent 16-bit or 32-bit wide character or characters. If `destination` isn't null, the function stores the first (and possibly only) result character in destination. If extra output characters are required, a value is set in `state`, so that subsequent calls to the function output the extra characters and return the value -3. If no more output characters are required, then `state` is set to the initial shift state.

To convert non-UTF-8 multibyte characters to UTF-16 LE characters, use the `mbrtowc`, `mbtowc`, or `_mbtowc_l` functions.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
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FUNCTION	C HEADER	C++ HEADER
<code>mbrtoc16</code> , <code>mbrtoc32</code>	<uchar.h>	<cuchar>

For more compatibility information, see [Compatibility](#).

See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`c16rtomb` , `c32rtomb`

`mbrtowc`

`mbsrtowcs`

`mbsrtowcs_s`

Convert a multibyte character in the current locale into the equivalent wide character, with the capability of restarting in the middle of a multibyte character.

Syntax

```
size_t mbrtowc(  
    wchar_t *wchar,  
    const char *mbchar,  
    size_t count,  
    mbstate_t *mbstate  
)
```

Parameters

`wchar`

Address of a wide character to receive the converted wide character string (type `wchar_t`). This value can be a null pointer if no return wide character is required.

`mbchar`

Address of a sequence of bytes (a multibyte character).

`count`

Number of bytes to check.

`mbstate`

Pointer to conversion state object. If this value is a null pointer, the function uses a static internal conversion state object. Because the internal `mbstate_t` object isn't thread-safe, we recommend that you always pass your own `mbstate` argument.

Return value

One of the following values:

0 The next `count` or fewer bytes complete the multibyte character that represents the null wide character, which is stored in `wchar`, if `wchar` isn't a null pointer.

1 to `count`, inclusive The next `count` or fewer bytes complete a valid multibyte character. The value returned is the number of bytes that complete the multibyte character. The wide character equivalent is stored in `wchar`, if `wchar` isn't a null pointer.

(`size_t`)(-1) An encoding error occurred. The next `count` or fewer bytes don't contribute to a complete and valid multibyte character. In this case, `errno` is set to EILSEQ and the conversion shift state in `mbstate` is unspecified.

(`size_t`)(-2) The next `count` bytes contribute to an incomplete but potentially valid multibyte character, and all `count` bytes have been processed. No value is stored in `wchar`, but `mbstate` is updated to restart the function.

Remarks

If `mbchar` is a null pointer, the function is equivalent to the call:

```
mbrtowc(NULL, "", 1, &mbstate)
```

In this case, the values of the `wchar` and `count` arguments are ignored.

If `mbchar` isn't a null pointer, the function examines `count` bytes from `mbchar` to determine the required number of bytes that are required to complete the next multibyte character. If the next character is valid, the corresponding multibyte character is stored in `wchar` if it isn't a null pointer. If the character is the corresponding wide null character, the resulting state of `mbstate` is the initial conversion state.

The `mbrtowc` function differs from `mbtowc`, `_mbtowc_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application should use `wcsrlen` instead of `wcslen` if a subsequent call to `wcsrtombs` is used instead of `wcstombs`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Example

Converts a multibyte character to its wide character equivalent.

```
// crt_mbrtowc.cpp

#include <stdio.h>
#include <mbctype.h>
#include <string.h>
#include <locale.h>
#include <wchar.h>

#define BUF_SIZE 100

int Sample(char* szIn, wchar_t* wcOut, int nMax)
{
    mbstate_t state = {0}; // Initial state
    size_t nConvResult,
           nmbLen = 0,
           nwclen = 0;
    wchar_t* wcCur = wcOut;
    wchar_t* wcEnd = wcCur + nMax;
    const char* mbCur = szIn;
    const char* mbEnd = mbCur + strlen(mbCur) + 1;
    char* szLocal;

    // Sets all locale to French_Canada.1252
    szLocal = setlocale(LC_ALL, "French_Canada.1252");
    if (!szLocal)
    {
        printf("The function setlocale(LC_ALL, \"French_Canada.1252\") failed!\n");
        return 1;
    }

    printf("Locale set to: \"%s\"\n", szLocal);

    // Sets the code page associated current locale's code page
    // from a previous call to setlocale.
    if (_setmbcp(_MB_CP_SBCS) == -1)
    {
        printf("The function _setmbcp(_MB_CP_SBCS) failed!");
        return 1;
    }

    while ((mbCur < mbEnd) && (wcCur < wcEnd))
    {
        //
```

```

nConvResult = mbrtowc(wcCur, mbCur, 1, &state);
switch (nConvResult)
{
    case 0:
        { // done
            printf("Conversion succeeded!\nMultibyte String: ");
            printf(szIn);
            printf("\nWC String: ");
            wprintf(wcOut);
            printf("\n");
            mbCur = mbEnd;
            break;
        }

    case -1:
        { // encoding error
            printf("The call to mbrtowc has detected an encoding error.\n");
            mbCur = mbEnd;
            break;
        }

    case -2:
        { // incomplete character
            if (!mbsinit(&state))
            {
                printf("Currently in middle of mb conversion, state = %x\n", state);
                // state will contain data regarding lead byte of mb character
            }

            ++nmbLen;
            ++mbCur;
            break;
        }

    default:
        {
            if (nConvResult > 2) // The multibyte should never be larger than 2
            {
                printf("Error: The size of the converted multibyte is %d.\n", nConvResult);
            }

            ++nmbLen;
            ++nwcLen;
            ++wcCur;
            ++mbCur;
            break;
        }
    }
}

return 0;
}

int main(int argc, char* argv[])
{
    char    mbBuf[BUF_SIZE] = "AaBbCc\x9A\x8B\xE0\xEF\xF0\xYyZz";
    wchar_t wcBuf[BUF_SIZE] = {L''};

    return Sample(mbBuf, wcBuf, BUF_SIZE);
}

```

Sample output

```
Locale set to: "French_Canada.1252"
Conversion succeeded!
Multibyte String: AaBbCcÜïæn=xXyYzz
WC String: AaBbCcÜïæn=xXyYzz
```

Requirements

ROUTINE	REQUIRED HEADER
<code>mbrtowc</code>	<wchar.h>

See also

[Data conversion](#)
[Locale](#)
[Interpretation of multibyte-character sequences](#)

`_mbsctype`, `_mbsctype_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the type of byte within a string.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _mbsctype(
    const unsigned char *mbstr,
    size_t count
);
int _mbsctype_1(
    const unsigned char *mbstr,
    size_t count,
    _locale_t locale
);
```

Parameters

`mbstr`

Address of a sequence of multibyte characters.

`count`

Byte offset from head of string.

`Locale`

Locale to use.

Return value

`_mbsctype` and `_mbsctype_1` returns an integer value indicating the result of the test on the specified byte. The manifest constants in the following table are defined in Mbctype.h.

RETURN VALUE	BYTE TYPE
<code>_MBC_SINGLE</code> (0)	Single-byte character. For example, in code page 932, <code>_mbsctype</code> returns 0 if the specified byte is within the range 0x20 - 0x7E or 0xA1 - 0xDF.
<code>_MBC_LEAD</code> (1)	Lead byte of multibyte character. For example, in code page 932, <code>_mbsctype</code> returns 1 if the specified byte is within the range 0x81 - 0x9F or 0xE0 - 0xFC.
<code>_MBC_TRAIL</code> (2)	Trailing byte of multibyte character. For example, in code page 932, <code>_mbsctype</code> returns 2 if the specified byte is within the range 0x40 - 0x7E or 0x80 - 0xFC.

RETURN VALUE	BYTE TYPE
<code>_MBC_ILLEGAL</code> (-1)	<code>NULL</code> string, invalid character, or null byte found before the byte at offset <code>count</code> in <code>mbstr</code> .

Remarks

The `_mbsctype` function determines the type of a byte in a multibyte character string. The function examines only the byte at offset `count` in `mbstr`, ignoring invalid characters before the specified byte.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The version of this function without the `_1` suffix uses the current locale for this locale-dependent behavior; the version with the `_1` suffix is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

If the input string is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `_MBC_ILLEGAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_mbsctype</code>	<code><mbstring.h></code>	<code><mbctype.h></code> *
<code>_mbsctype_1</code>	<code><mbstring.h></code>	<code><mbctype.h></code> *

* For manifest constants used as return values.

For more compatibility information, see [Compatibility](#).

See also

[Byte classification](#)

mbsinit

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tracks the state of a multibyte character conversion.

Syntax

```
int mbsinit(
    const mbstate_t* ps
);
```

Parameters

`ps`

A pointer to an `mbstate_t` variable.

Return value

Nonzero if `ps` is `NULL` or if not in the middle of a conversion.

Remarks

When using one of the ANSI functions that takes an `mbstate_t` pointer, passing the address of your `mbstate_t` will return information about whether the last byte in the buffer was converted.

The appropriate code page needs to be installed to support your multibyte characters.

Example

```
// crt_mbsinit.cpp
#include <stdio.h>
#include <mbctype.h>
#include <string.h>
#include <locale.h>
#include <cwchar.h>
#include <xlocinfo.h>

#define BUF_SIZE 0x40

wchar_t g_wcBuf[BUF_SIZE] = L"This a wc buffer that will be over written...";
char g_mbBuf[BUF_SIZE] = "AaBbCc\x9A\x8B\xE0\xEF\xF0\xYy\xZ\xZ";
int g_nInit = strlen(g_mbBuf);

int MbsinitSample(char* szIn, wchar_t* wcOut, int nMax)
{
    mbstate_t state = {0};
    size_t nConvResult, nmbLen = 0, nwcLen = 0;
    wchar_t* wcCur = wcOut;
    wchar_t* wcEnd = wcCur + nMax;
    const char* mbCur = szIn;
    const char* mbEnd = mbCur + strlen(mbCur) + 1;
    char* szLocal = setlocale(LC_ALL, "japanese");

    printf("Locale set to: \"%s\"\n", szLocal);

    if (setmhcnp(MB_CPLocale) != -1)
```

```

    {
        while ((mbCur < mbEnd) && (wcCur < wcEnd))
        {
            nConvResult = mbrtowc(wcCur, mbCur, 1, &state);

            switch (nConvResult)
            {
                case 0:
                {   // done
                    printf("Conversion succeeded!\nMB String: ");
                    printf(szIn);
                    printf("\nWC String: ");
                    wprintf(wcOut);
                    printf("\n");
                    mbCur = mbEnd;
                    break;
                }

                case -1:
                {   // encoding error
                    printf("ERROR: The call to mbrtowc has detected an encoding error.\n");
                    mbCur = mbEnd;
                    break;
                }

                case -2:
                {   // incomplete character
                    if (!mbsinit(&state))
                    {
                        printf("Currently in middle of mb conversion, state = %x\n", state);
                        // state will contain data regarding lead byte of mb character
                    }

                    ++nmbLen;
                    ++mbCur;
                    break;
                }

                default:
                {
                    if (nConvResult > 2) // Microsoft mb should never be larger than 2
                        printf("ERROR: nConvResult = %d\n", nConvResult);

                    ++nmbLen;
                    ++nwclen;
                    ++wcCur;
                    ++mbCur;
                    break;
                }
            }
        }
    }

    else
        printf("ERROR: _setmbcp(932) failed!");

    return 0;
}

int main(int argc, char* argv[])
{
    return MbsinitSample(g_mbBuf, g_wcBuf, BUF_SIZE);
}

```

Sample output

```
Locale set to: "Japanese_Japan.932"
Currently in middle of mb conversion, state = 9a
Currently in middle of mb conversion, state = e0
Currently in middle of mb conversion, state = f0
Conversion succeeded!
MB String: AaBbCcXyYzZ
WC String: AaBbCcXyYzZ
```

See also

[Byte classification](#)

`_mbsnbcat`, `_mbsnbcat_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Appends, at most, the first `n` bytes of one multibyte-character string to another. More secure versions of these functions are available; see [`_mbsnbcat_s`](#), [`_mbsnbcat_s_l`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned char *_mbsnbcat(
    unsigned char *dest,
    const unsigned char *src,
    size_t count
);
unsigned char *_mbsnbcat_l(
    unsigned char *dest,
    const unsigned char *src,
    size_t count,
    _locale_t locale
);
template <size_t size>
unsigned char *_mbsnbcat(
    unsigned char (&dest)[size],
    const unsigned char *src,
    size_t count
); // C++ only
template <size_t size>
unsigned char *_mbsnbcat_l(
    unsigned char (&dest)[size],
    const unsigned char *src,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`dest`

Null-terminated multibyte-character destination string.

`src`

Null-terminated multibyte-character source string.

`count`

Number of bytes from `src` to append to `dest`.

`Locale`

Locale to use.

Return value

`_mbsnbcat` returns a pointer to the destination string. No return value is reserved to indicate an error.

Remarks

The `_mbsnbcat` function appends, at most, the first `count` bytes of `src` to `dest`. If the byte immediately preceding the null character in `dest` is a lead byte, the initial byte of `src` overwrites this lead byte. Otherwise, the initial byte of `src` overwrites the terminating null character of `dest`. If a null byte appears in `src` before `count` bytes are appended, `_mbsnbcat` appends all bytes from `src`, up to the null character. If `count` is greater than the length of `src`, the length of `src` is used in place of `count`. The resulting string is terminated with a null character. If copying takes place between strings that overlap, the behavior is undefined.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The `_mbsnbcat` version of the function uses the current locale for this locale-dependent behavior; the `_mbsnbcat_1` version is identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

Security Note Use a null-terminated string. The null-terminated string must not exceed the size of the destination buffer. For more information, see [Avoiding buffer overruns](#).

If `dest` or `src` is `NULL`, the function will generate an invalid parameter error, as described in [Parameter validation](#). If the error is handled, the function returns `EINVAL` and sets `errno` to `EINVAL`.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncat</code>	<code>strncat</code>	<code>_mbsnbcat</code>	<code>wcsncat</code>
<code>_tcsncat_1</code>	<code>_strncat_1</code>	<code>_mbsnbcat_1</code>	<code>_wcsncat_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbcat</code>	<mbstring.h>
<code>_mbsnbcat_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

String manipulation

`_mbsnbcmp`, `_mbsnbcmp_1`
`_strncnt`, `_wcsncnt`, `_mbsncnt`, `_mbsncnt_1`, `_mbsnccnt`, `_mbsnccnt_1`
`_mbsnbcpy`, `_mbsnbcpy_1`
`_mbsnbicmp`, `_mbsnbicmp_1`
`_mbsnbset`, `_mbsnbset_1`
`strncat`, `_strncat_1`, `wcsncat`, `_wcsncat_1`, `_mbsncat`, `_mbsncat_1`

[_mbsnbcat_s](#) , [_mbsnbcat_s_l](#)

`_mbsnbcat_s`, `_mbsnbcat_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Appends to a multibyte character string, at most, the first **n** bytes of another multibyte-character string. These functions are versions of `_mbsnbcat`, `_mbsnbcat_l` that have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _mbsnbcat_s(
    unsigned char *dest,
    size_t sizeInBytes,
    const unsigned char *src,
    size_t count
);
errno_t _mbsnbcat_s_l(
    unsigned char *dest,
    size_t sizeInBytes,
    const unsigned char *src,
    size_t count,
    _locale_t locale
);
template <size_t size>
errno_t _mbsnbcat_s(
    unsigned char (&dest)[size],
    const unsigned char *src,
    size_t count
); // C++ only
template <size_t size>
errno_t _mbsnbcat_s_l(
    unsigned char (&dest)[size],
    const unsigned char *src,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`dest`

Null-terminated multibyte-character destination string.

`sizeInBytes`

Size of the `dest` buffer in bytes.

`src`

Null-terminated multibyte-character source string.

`count`

Number of bytes from `src` to append to `dest`.

Locale

Locale to use.

Return value

Zero if successful; otherwise, an error code.

Error conditions

DEST	SIZEINBYTES	SRC	RETURN VALUE
NULL	any	any	EINVAL
Any	<= 0	any	EINVAL
Any	any	NULL	EINVAL

If any of the error conditions occurs, the function generates an invalid parameter error, as described in [Parameter validation](#). If the error is handled, the function returns `EINVAL` and sets `errno` to `EINVAL`.

Remarks

The `_mbsnbcat_s` function appends to `dest`, at most, the first `count` bytes of `src`. If the byte that immediately precedes the null character in `dest` is a lead byte, it's overwritten by the initial byte of `src`. Otherwise, the initial byte of `src` overwrites the terminating null character of `dest`. If a null byte appears in `src` before `count` bytes are appended, `_mbsnbcat_s` appends all bytes from `src`, up to the null character. If `count` is greater than the length of `src`, the length of `src` is used in place of `count`. The resulting string is terminated by a null character. If copying takes place between strings that overlap, the behavior is undefined.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions are identical, except that the ones that don't have the `_1` suffix use the current locale and the ones that do have the `_1` suffix instead use the locale parameter that's passed in. For more information, see [Locale](#).

In C++, the use of these functions is simplified by template overloads. The overloads can infer buffer length automatically, which eliminates the need to specify a size argument, and they can automatically use the newer, more secure functions to replace older, less-secure functions. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [_CrtSetDebugFillThreshold](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcsncat_s</code>	<code>strncat_s</code>	<code>_mbsnbcat_s</code>	<code>wcsncat_s</code>
<code>_tcsncat_s_1</code>	<code>_strncat_s_1</code>	<code>_mbsnbcat_s_1</code>	<code>_wcsncat_s_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbcat_s</code>	<mbstring.h>
<code>_mbsnbcat_s_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

String manipulation

<code>_mbsnbcmp</code>	<code>, _mbsnbcmp_1</code>
<code>_strncnt</code>	<code>, _wcscnt, _mbsnbcnt, _mbsnbcnt_1, _mbsnccnt, _mbsnccnt_1</code>
<code>_mbsnbcpy</code>	<code>, _mbsnbcpy_1</code>
<code>_mbsnbcpy_s</code>	<code>, _mbsnbcpy_s_1</code>
<code>_mbsnbset</code>	<code>, _mbsnbset_1</code>
<code>strncat</code>	<code>, _strncat_1, wcsncat, _wcsncat_1, _mbsncat, _mbsncat_1</code>
<code>strncat_s</code>	<code>, _strncat_s_1, wcsncat_s, _wcsncat_s_1, _mbsncat_s, _mbsncat_s_1</code>

`_mbsnbcmp`, `_mbsnbcmp_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Compares the first *n* bytes of two multibyte-character strings.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _mbsnbcmp(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count
);
int _mbsnbcmp_l(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count,
    _locale_t locale
);
```

Parameters

`string1`, `string2`

The strings to compare.

`count`

The number of bytes to compare.

`Locale`

The locale to use.

Return value

The return value indicates the ordinal relationship between the substrings of `string1` and `string2`.

RETURN VALUE	DESCRIPTION
< 0	<code>string1</code> substring is less than <code>string2</code> substring.
0	<code>string1</code> substring is identical to <code>string2</code> substring.
> 0	<code>string1</code> substring is greater than <code>string2</code> substring.

On a parameter validation error, `_mbsnbcmp` and `_mbsnbcmp_l` return `_NLSCMPERROR`, which is defined in `<string.h>` and `<mbstring.h>`.

Remarks

The `_mbsnbcmp` functions compare at most the first `count` bytes in `string1` and `string2` and return a value that indicates the relationship between the substrings. `_mbsnbcmp` is a case-sensitive version of `_mbsnbicmp`. Unlike `_mbsnbcoll`, `_mbsnbcmp` isn't affected by the collation order of the locale. `_mbsnbcmp` recognizes multibyte-character sequences according to the current multibyte [code page](#).

`_mbsnbcmp` resembles `_mbsncmp`, except that `_mbsncmp` compares strings by characters rather than by bytes.

The output value is affected by the `LC_CTYPE` category setting of the locale, which specifies the lead bytes and trailing bytes of multibyte characters. For more information, see [setlocale](#). The `_mbsnbcmp` function uses the current locale for this locale-dependent behavior. The `_mbsnbcmp_1` function is identical except that it uses the `Locale` parameter instead. For more information, see [Locale](#).

If either `string1` or `string2` is a null pointer, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `NLSCMPERROR`, and `errno` is set to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncmp</code>	<code>strcmp</code>	<code>_mbsnbcmp</code>	<code>wcsncmp</code>
<code>_tcsncmp_1</code>	<code>strcmp</code>	<code>_mbsnbcml</code>	<code>wcsncmp</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbcmp</code>	<code><mbstring.h></code>
<code>_mbsnbcmp_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

Example

```

// crt_mbsnbcmp.c
#include <mbstring.h>
#include <stdio.h>

char string1[] = "The quick brown dog jumps over the lazy fox";
char string2[] = "The QUICK brown fox jumps over the lazy dog";

int main( void )
{
    char tmp[20];
    int result;
    printf( "Compare strings:\n      %s\n", string1 );
    printf( "      %s\n\n", string2 );
    printf( "Function: _mbsnbcmp (first 10 characters only)\n" );
    result = _mbsncmp( string1, string2 , 10 );
    if( result > 0 )
        _mbscopy_s( tmp, sizeof(tmp), "greater than" );
    else if( result < 0 )
        _mbscopy_s( tmp, sizeof(tmp), "less than" );
    else
        _mbscopy_s( tmp, sizeof(tmp), "equal to" );
    printf( "Result:   String 1 is %s string 2\n\n", tmp );
    printf( "Function: _mbsnicmp _mbsnicmp (first 10 characters only)\n" );
    result = _mbsnicmp( string1, string2, 10 );
    if( result > 0 )
        _mbscopy_s( tmp, sizeof(tmp), "greater than" );
    else if( result < 0 )
        _mbscopy_s( tmp, sizeof(tmp), "less than" );
    else
        _mbscopy_s( tmp, sizeof(tmp), "equal to" );
    printf( "Result:   String 1 is %s string 2\n\n", tmp );
}

```

Output

```

Compare strings:
      The quick brown dog jumps over the lazy fox
      The QUICK brown fox jumps over the lazy dog

Function: _mbsnbcmp (first 10 characters only)
Result:   String 1 is greater than string 2

Function: _mbsnicmp _mbsnicmp (first 10 characters only)
Result:   String 1 is equal to string 2

```

See also

[String manipulation](#)

[_mbsnbcat](#) , [_mbsnbcat_1](#)
[_mbsnbicmp](#) , [_mbsnbicmp_1](#)
[strncmp](#) , [wcsncmp](#) , [_mbsncmp](#) , [_mbsncmp_1](#)
[_strnicmp](#) , [_wcsnicmp](#) , [_mbsnicmp](#) , [_strnicmp_1](#) , [_wcsnicmp_1](#) , [_mbsnicmp_1](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`_mbsnbcoll`, `_mbsnbcoll_l`, `_mbsnbicoll`,
`_mbsnbicoll_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Compares `n` bytes of two multibyte-character strings by using multibyte code-page information.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _mbsnbcoll(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count
);
int _mbsnbcoll_l(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count,
    _locale_t locale
);
int _mbsnbicoll(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count
);
int _mbsnbicoll_l(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count,
    _locale_t locale
);
```

Parameters

`string1`, `string2`

Strings to compare.

`count`

Number of bytes to compare.

`Locale`

Locale to use.

Return value

The return value indicates the relation of the substrings of `string1` and `string2`.

RETURN VALUE	DESCRIPTION
< 0	<code>string1</code> substring less than <code>string2</code> substring.
0	<code>string1</code> substring identical to <code>string2</code> substring.
> 0	<code>string1</code> substring greater than <code>string2</code> substring.

If `string1` or `string2` is `NULL` or `count` is greater than `INT_MAX`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`. To use `_NLSCMPERROR`, include either `String.h` or `Mbstring.h`.

Remarks

Each of these functions collates, at most, the first `count` bytes in `string1` and `string2` and returns a value indicating the relationship between the resulting substrings of `string1` and `string2`. If the final byte in the substring of `string1` or `string2` is a lead byte, it isn't included in the comparison; these functions compare only complete characters in the substrings. `_mbsnbcoll` is a case-insensitive version of `_mbsnbcoll`. Like `_mbsnbcmp` and `_mbsnbicmp`, `_mbsnbcoll` and `_mbsnbcoll` collate the two multibyte-character strings according to the lexicographic order specified by the multibyte [code page](#) currently in use.

For some code pages and corresponding character sets, the order of characters in the character set might differ from the lexicographic character order. In the "C" locale, the order of characters in the ASCII character set is the same as the lexicographic order of the characters. However, in certain European code pages, for example, the character 'a' (value 0x61) precedes the character 'ä' (value 0xE4) in the character set, but the character 'ä' precedes the character 'a' lexicographically. To perform a lexicographic comparison of strings by bytes in such an instance, use `_mbsnbcoll` rather than `_mbsnbcmp`; to check only for string equality, use `_mbsnbcmp`.

Because the `coll` functions collate strings lexicographically for comparison, whereas the `cmp` functions simply test for string equality, the `coll` functions are much slower than the corresponding `cmp` versions. Therefore, the `coll` functions should be used only when there's a difference between the character set order and the lexicographic character order in the current code page and this difference is of interest for the comparison.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncoll</code>	<code>_strncoll</code>	<code>_mbsnbcoll</code>	<code>_wcsncoll</code>
<code>_tcsncoll_1</code>	<code>_strncoll</code> , <code>_wcsncoll</code> , <code>_mbsnccoll</code> , <code>_strncoll_1</code> , , <code>_wcsncoll_1</code> , <code>_mbsnccoll_1</code>	<code>_mbsnbcoll_1</code>	<code>_wcsncoll_1</code>
<code>_tcsnicoll</code>	<code>_strnicoll</code>	<code>_mbsnbcoll</code>	<code>_wcsnicoll</code>

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnicoll_l</code>	<code>_strnicoll_l</code>	<code>_mbsnbicoll_l</code>	<code>_wcsnicoll_l</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbcoll</code>	<code><mbstring.h></code>
<code>_mbsnbcoll_l</code>	<code><mbstring.h></code>
<code>_mbsnbicoll</code>	<code><mbstring.h></code>
<code>_mbsnbicoll_l</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

String manipulation

<code>_mbsnbcat</code>	<code>, _mbsnbcat_l</code>
<code>_mbsnbcmp</code>	<code>, _mbsnbcmp_l</code>
<code>_mbsnbicmp</code>	<code>, _mbsnbicmp_l</code>
<code>strcoll</code> functions	
<code>strncpy</code> , <code>wcsncmp</code> , <code>_mbsncmp</code> , <code>_mbsncmp_l</code>	
<code>_strnicmp</code> , <code>_wcsnicmp</code> , <code>_mbsnicmp</code> , <code>_strnicmp_l</code> , <code>_wcsnicmp_l</code> , <code>_mbsnicmp_l</code>	

`_mbsnbcpy`, `_mbsnbcpy_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copies **n** bytes of a string to a destination string. More secure versions of these functions are available—see [_mbsnbcpy_s](#), [_mbsnbcpy_s_l](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned char * _mbsnbcpy(
    unsigned char * strDest,
    const unsigned char * strSource,
    size_t count
);
unsigned char * _mbsnbcpy_l(
    unsigned char * strDest,
    const unsigned char * strSource,
    size_t count,
    _locale_t locale
);
template <size_t size>
unsigned char * _mbsnbcpy(
    unsigned char (&strDest)[size],
    const unsigned char * strSource,
    size_t count
); // C++ only
template <size_t size>
unsigned char * _mbsnbcpy_l(
    unsigned char (&strDest)[size],
    const unsigned char * strSource,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`strDest`

Destination for the character string to be copied.

`strSource`

Character string to be copied.

`count`

Number of bytes to be copied.

`Locale`

Locale to use.

Return value

`_mbsnbcpy` returns a pointer to the destination character string. No return value is reserved to indicate an error.

Remarks

The `_mbsncpy` function copies `count` bytes from `strSource` to `strDest`. If `count` exceeds the size of `strDest` or the source and destination strings overlap, the behavior of `_mbsncpy` is undefined.

If `strSource` or `strDest` is a null pointer, this function invokes the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, the function returns `NULL` and sets `errno` to `EINVAL`.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions are identical, except that the ones that don't have the `_1` suffix use the current locale and the versions that do have the `_1` suffix instead use the locale parameter that's passed in. For more information, see [Locale](#).

IMPORTANT

These functions might be vulnerable to buffer overrun threats. Buffer overruns can be used to execute arbitrary attacker code, which can cause an unwarranted elevation of privilege and compromise the system. For more information, see [Avoiding buffer overruns](#).

In C++, these functions have template overloads that invoke the newer, more secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncpy</code>	<code>strncpy</code>	<code>_mbsncpy</code>	<code>wcsncpy</code>
<code>_tcsncpy_1</code>	<code>_strncpy_1</code>	<code>_mbsncpy_1</code>	<code>_wcsncpy_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsncpy</code>	<mbstring.h>
<code>_mbsncpy_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

See also

String manipulation

<code>_mbsnbcat</code>	<code>_mbsnbcat_1</code>
<code>_mbsnbcmp</code>	<code>_mbsnbcmp_1</code>
<code>_strncnt</code>	<code>_wcsncnt</code>
<code>_mbsnbcnt</code>	<code>_mbsnbcnt_1</code>
<code>_mbsnccnt</code>	<code>_mbsnccnt_1</code>
<code>_mbsnbset</code>	<code>_mbsnbset_1</code>
<code>strncpy</code>	<code>_strncpy_1</code>
<code>wcsncpy</code>	<code>_wcsncpy_1</code>
<code>_mbsncpy</code>	<code>_mbsncpy_1</code>

`_mbsncpy_s`, `_mbsncpy_s_l`

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Copies **n** bytes of a string to a destination string. These versions of `_mbsncpy`, `_mbsncpy_l` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _mbsncpy_s(
    unsigned char * strDest,
    size_t sizeInBytes,
    const unsigned char * strSource,
    size_t count
);
errno_t _mbsncpy_s_l(
    unsigned char * strDest,
    size_t sizeInBytes,
    const unsigned char * strSource,
    size_t count,
    _locale_t locale
);
template <size_t size>
errno_t _mbsncpy_s(
    unsigned char (&strDest)[size],
    const unsigned char * strSource,
    size_t count
); // C++ only
template <size_t size>
errno_t _mbsncpy_s_l(
    unsigned char (&strDest)[size],
    const unsigned char * strSource,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`strDest`

Destination for character string to be copied.

`sizeInBytes`

Destination buffer size.

`strSource`

Character string to be copied.

`count`

Number of bytes to be copied.

`Locale`

Locale to use.

Return value

Zero if successful; `EINVAL` if a bad parameter was passed in.

Remarks

The `_mbsncpy_s` function copies `count` bytes from `strSource` to `strDest`. If `count` exceeds the size of `strDest`, either of the input strings is a null pointer, or `sizeInBytes` or `count` is 0, the function invokes the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, the function returns `EINVAL`. If the source and destination strings overlap, the behavior of `_mbsncpy_s` is undefined.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

NOTE

Unlike the non-secure version of this function, `_mbsncpy_s` does not do any null padding and always null terminates the string.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncpy_s</code>	<code>_strncpy_s</code>	<code>_mbsncpy_s</code>	<code>_wcsncpy_s</code>
<code>_tcsncpy_s_1</code>	<code>_strncpy_s_1</code>	<code>_mbsncpy_s_1</code>	<code>_wcsncpy_s_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsncpy_s</code>	<code><mbstring.h></code>
<code>_mbsncpy_s_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

See also

String manipulation

`_mbsnbcat`, `_mbsnbcat_1`
`_mbsnbcmp`, `_mbsnbcmp_1`
`_strncnt`, `_wcsncnt`, `_mbsnbcnt`, `_mbsnbcnt_1`, `_mbsnccnt`, `_mbsnccnt_1`
`_mbsnbicmp`, `_mbsnbicmp_1`
`_mbsnbset`, `_mbsnbset_1`
`strncpy`, `_strncpy_1`, `wcsncpy`, `_wcsncpy_1`, `_mbsncpy`, `_mbsncpy_1`

`_mbsnbicmp`, `_mbsnbicmp_l`

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Compares `n` bytes of two multibyte-character strings, and ignores case.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _mbsnbicmp(
    const unsigned char *string1,
    const unsigned char *string2,
    size_t count
);
```

Parameters

`string1`, `string2`

Null-terminated strings to compare.

`count`

Number of bytes to compare.

Return value

The return value indicates the relationship between the substrings.

RETURN VALUE	DESCRIPTION
<code>< 0</code>	<code>string1</code> substring less than <code>string2</code> substring.
<code>0</code>	<code>string1</code> substring identical to <code>string2</code> substring.
<code>> 0</code>	<code>string1</code> substring greater than <code>string2</code> substring.

On an error, `_mbsnbicmp` returns `_NLSCMPERROR`, which is defined in String.h and Mbstring.h.

Remarks

The `_mbsnbicmp` function performs an ordinal comparison of at most the first `count` bytes of `string1` and `string2`. The comparison is performed by converting each character to lowercase; `_mbsnbicmp` is a case-sensitive version of `_mbsnbicmp`. The comparison ends if a terminating null character is reached in either string before `count` characters are compared. If the strings are equal when a terminating null character is reached in either string before `count` characters are compared, the shorter string is lesser.

`_mbsnbicmp` is similar to `_mbsnbcmp`, except that it compares strings up to `count` bytes instead of by characters.

Two strings containing characters located between 'Z' and 'a' in the ASCII table ('[', '\', ']', '^', '_', and ``') compare differently, depending on their case. For example, the two strings "ABCDE" and "ABCD^" compare one way if the comparison is lowercase ("abcde" > "abcd^") and the other way ("ABCDE" < "ABCD^") if it's uppercase.

`_mbsnbicmp` recognizes multibyte-character sequences according to the [multibyte code page](#) currently in use. It isn't affected by the current locale setting.

If either `string1` or `string2` is a null pointer, `_mbsnbicmp` invokes the invalid parameter handler as described in [Parameter validation](#). If execution is allowed to continue, the function returns `_NLSCMPERROR` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnicmp</code>	<code>_strnicmp</code>	<code>_mbsnbicmp</code>	<code>_wcsnicmp</code>
<code>_tcsnicmp_l</code>	<code>_strnicmp_l</code>	<code>_mbsnbicmp_l</code>	<code>_wcsnicmp_l</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbicmp</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

Example

See the example for [`_mbsnbcmp`](#), [`_mbsnbcmp_l`](#).

See also

String manipulation

[`_mbsnbcat`](#), [`_mbsnbcat_l`](#)
[`_mbsnbcmp`](#), [`_mbsnbcmp_l`](#)
[`_stricmp`](#), [`_wcsicmp`](#), [`_mbsicmp`](#), [`_stricmp_l`](#), [`_wcsicmp_l`](#), [`_mbsicmp_l`](#)

`_mbsnbset`, `_mbsnbset_1`

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Sets the first `n` bytes of a multibyte-character string to a specified character. More secure versions of these functions are available; see [`_mbsnbset_s`](#), [`_mbsnbset_s_1`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
unsigned char *_mbsnbset(
    unsigned char *str,
    unsigned int c,
    size_t count
);
unsigned char *_mbsnbset_1(
    unsigned char *str,
    unsigned int c,
    size_t count,
    _locale_t locale
);
```

Parameters

`str`

String to be altered.

`c`

Single-byte or multibyte-character setting.

`count`

Number of bytes to be set.

`Locale`

Locale to use.

Return value

`_mbsnbset` returns a pointer to the altered string.

Remarks

The `_mbsnbset` and `_mbsnbset_1` functions set, at most, the first `count` bytes of `str` to `c`. If `count` is greater than the length of `str`, the length of `str` is used instead of `count`. If `c` is a multibyte character and can't be set entirely into the last byte specified by `count`, the last byte is padded with a blank character. `_mbsnbset` and `_mbsnbset_1` doesn't place a terminating null at the end of `str`.

`_mbsnbset` and `_mbsnbset_1` is similar to `_mbsnset`, except that it sets `count` bytes rather than `count` characters of `c`.

If `str` is `NULL` or `count` is zero, this function generates an invalid parameter exception as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`. Also, if `c` isn't a valid multibyte character, `errno` is set to `EINVAL` and a space is used instead.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The `_mbsnset` version of this function uses the current locale for this locale-dependent behavior; the `_mbsnset_l` version is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

Security Note This API incurs a potential threat brought about by a buffer overrun problem. Buffer overrun problems are a frequent method of system attack, resulting in an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnset</code>	<code>_strnset</code>	<code>_mbsnset</code>	<code>_wcsnset</code>
<code>_tcsnset_l</code>	<code>_strnset_l</code>	<code>_mbsnset_l</code>	<code>_wcsnset_l</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnset</code>	<code><mbstring.h></code>
<code>_mbsnset_l</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_mbsnset.c
// compile with: /W3
#include <mbstring.h>
#include <stdio.h>

int main( void )
{
    char string[15] = "This is a test";
    /* Set not more than 4 bytes of string to be '*'s */
    printf( "Before: %s\n", string );
    _mbsnset( string, '*', 4 ); // C4996
    // Note: _mbsnset is deprecated; consider _mbsnset_s
    printf( "After:  %s\n", string );
}
```

Output

```
Before: This is a test  
After: **** is a test
```

See also

String manipulation

[_mbsnbcat](#), [_mbsnbcat_1](#)
[_strnset](#), [_strnset_1](#), [_wcsnset](#), [_wcsnset_1](#), [_mbsnset](#), [_mbsnset_1](#)
[_strset](#), [_strset_1](#), [_wcsset](#), [_wcsset_1](#), [_mbsset](#), [_mbsset_1](#)

`_mbsnbset_s`, `_mbsnbset_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the first *n* bytes of a multibyte-character string to a specified character. These versions of `_mbsnbset`, `_mbsnbset_l` have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _mbsnbset_s(
    unsigned char *str,
    size_t size,
    unsigned int c,
    size_t count
);
errno_t _mbsnbset_s_l(
    unsigned char *str,
    size_t size,
    unsigned int c,
    size_t count,
    _locale_t locale
);
template <size_t size>
errno_t _mbsnbset_s(
    unsigned char (&str)[size],
    unsigned int c,
    size_t count
); // C++ only
template <size_t size>
errno_t _mbsnbset_s_l(
    unsigned char (&str)[size],
    unsigned int c,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`str`

String to be altered.

`size`

The size of the string buffer.

`c`

Single-byte or multibyte-character setting.

`count`

Number of bytes to be set.

`Locale`

Locale to use.

Return value

Zero if successful; otherwise, an error code.

Remarks

The `_mbsnbset_s` and `_mbsnbset_s_1` functions set, at most, the first `count` bytes of `str` to `c`. If `count` is greater than the length of `str`, the length of `str` is used instead of `count`. If `c` is a multibyte character and can't be set entirely into the last byte that's specified by `count`, the last byte is padded with a blank character. `_mbsnbset_s` and `_mbsnbset_s_1` don't place a terminating null at the end of `str`.

`_mbsnbset_s` and `_mbsnbset_s_1` resemble `_mbsnset`, except that they set `count` bytes rather than `count` characters of `c`.

If `str` is `NULL` or `count` is zero, this function generates an invalid parameter exception, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `NULL`. Also, if `c` isn't a valid multibyte character, `errno` is set to `EINVAL` and a space is used instead.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The `_mbsnbset_s` version of this function uses the current locale for this locale-dependent behavior; the `_mbsnbset_s_1` version is identical except that it instead uses the locale parameter that's passed in. For more information, see [Locale](#).

In C++, use of these functions is simplified by template overloads; the overloads can infer buffer length automatically and thereby eliminate the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with `0xFE`. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnset_s</code>	<code>_strnset_s</code>	<code>_mbsnbset_s</code>	<code>_wcsnset_s</code>
<code>_tcsnset_s_1</code>	<code>_strnset_s_1</code>	<code>_mbsnbset_s_1</code>	<code>_wcsnset_s_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbset_s</code>	<code><mbstring.h></code>
<code>_mbsnbset_s_1</code>	<code><mbstring.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_mbsnbset_s.c
#include <mbstring.h>
#include <stdio.h>

int main( void )
{
    char string[15] = "This is a test";
    /* Set not more than 4 bytes of string to be '*'s */
    printf( "Before: %s\n", string );
    _mbsnbset_s( string, sizeof(string), '*', 4 );
    printf( "After:  %s\n", string );
}
```

Output

```
Before: This is a test
After:  **** is a test
```

See also

String manipulation

[_mbsnbcat](#), [_mbsnbcat_1](#)
[_strnset](#), [_strnset_1](#), [_wcsnset](#), [_wcsnset_1](#), [_mbsnset](#), [_mbsnset_1](#)
[_strset](#), [_strset_1](#), [_wcsset](#), [_wcsset_1](#), [_mbsset](#), [_mbsset_1](#)

Converts a multibyte character string in the current locale to a corresponding wide character string, with the capability of restarting in the middle of a multibyte character. A more secure version of this function is available; see [mbsrtowcs_s](#).

Syntax

```
size_t mbsrtowcs(
    wchar_t *wcstr,
    const char **mbstr,
    sizeof count,
    mbstate_t *mbstate
);
template <size_t size>
size_t mbsrtowcs(
    wchar_t (&wcstr)[size],
    const char **mbstr,
    sizeof count,
    mbstate_t *mbstate
); // C++ only
```

Parameters

`wcstr`

Address to store the resulting converted wide character string.

`mbstr`

Indirect pointer to the location of the multibyte character string to convert.

`count`

The maximum number of characters (not bytes) to convert and store in `wcstr`.

`mbstate`

A pointer to an `mbstate_t` conversion state object. If this value is a null pointer, a static internal conversion state object is used. Because the internal `mbstate_t` object isn't thread-safe, we recommend that you always pass your own `mbstate` parameter.

Return value

Returns the number of characters successfully converted, not including the terminating null character, if any.

Returns `(size_t)(-1)` if an error occurred, and sets `errno` to `EILSEQ`.

Remarks

The `mbsrtowcs` function converts a string of multibyte characters indirectly pointed to by `mbstr`, into wide characters stored in the buffer pointed to by `wcstr`, by using the conversion state contained in `mbstate`. The conversion continues for each character until either a terminating null multibyte character is encountered, a multibyte sequence that doesn't correspond to a valid character in the current locale is encountered, or until `count` characters have been converted. If `mbsrtowcs` encounters the multibyte null character ('\0') either before or when `count` occurs, it converts it to a 16-bit terminating null character and stops.

Thus, the wide character string at `wcstr` is null-terminated only if `mbsrtowcs` encounters a multibyte null character during conversion. If the sequences pointed to by `mbstr` and `wcstr` overlap, the behavior of `mbsrtowcs` is undefined. `mbsrtowcs` is affected by the `LC_TYPE` category of the current locale.

The `mbsrtowcs` function differs from `mbstowcs`, `_mbstowcs_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application should use `mbsrlen` instead of `mbslen`, if a subsequent call to `mbsrtowcs` is used instead of `mbstowcs`.

If `wcstr` isn't a null pointer, the pointer object pointed to by `mbstr` is assigned a null pointer if conversion stopped because a terminating null character was reached. Otherwise, it's assigned the address just past the last multibyte character converted, if any. It allows a subsequent function call to restart conversion where this call stopped.

If the `wcstr` argument is a null pointer, the `count` argument is ignored, and `mbsrtowcs` returns the required size in wide characters for the destination string. If `mbstate` is a null pointer, the function uses a non-thread-safe static internal `mbstate_t` conversion state object. If the character sequence `mbstr` doesn't have a corresponding multibyte character representation, a -1 is returned, and `errno` is set to `EILSEQ`.

If `mbstr` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns -1.

In C++, this function has a template overload that invokes the newer, secure counterpart of this function. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Exceptions

The `mbsrtowcs` function is multithread safe as long as no function in the current thread calls `setlocale` as long as this function is executing and the `mbstate` argument isn't a null pointer.

Requirements

ROUTINE	REQUIRED HEADER
<code>mbsrtowcs</code>	<wchar.h>

See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`mbrtowc`
`mbtowc`, `_mbtowc_1`
`mbstowcs`, `_mbstowcs_1`
`mbsinit`

mbsrtowcs_s

11/2/2022 • 4 minutes to read • [Edit Online](#)

Convert a multibyte character string in the current locale to its wide character string representation. A version of [mbsrtowcs](#) with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t mbsrtowcs_s(
    size_t * pReturnValue,
    wchar_t * wcstr,
    size_t sizeInWords,
    const char ** mbstr,
    size_t count,
    mbstate_t * mbstate
);
template <size_t size>
errno_t mbsrtowcs_s(
    size_t * pReturnValue,
    wchar_t (&wcstr)[size],
    const char ** mbstr,
    size_t count,
    mbstate_t * mbstate
); // C++ only
```

Parameters

`pReturnValue`

The number of characters converted.

`wcstr`

Address of buffer to store the resulting converted wide character string.

`sizeInWords`

The size of `wcstr` in words (wide characters).

`mbstr`

Indirect pointer to the location of the multibyte character string to be converted.

`count`

The maximum number of wide characters to store in the `wcstr` buffer, not including the terminating null, or [_TRUNCATE](#).

`mbstate`

A pointer to an `mbstate_t` conversion state object. If this value is a null pointer, a static internal conversion state object is used. Because the internal `mbstate_t` object isn't thread-safe, we recommend that you always pass your own `mbstate` parameter.

Return value

Zero if conversion is successful, or an error code on failure.

ERROR CONDITION	RETURN VALUE AND <code>errno</code>
<code>wcstr</code> is a null pointer and <code>sizeInWords</code> > 0	<code>EINVAL</code>
<code>mbstr</code> is a null pointer	<code>EINVAL</code>
The string indirectly pointed to by <code>mbstr</code> contains a multibyte sequence that isn't valid for the current locale.	<code>EILSEQ</code>
The destination buffer is too small to contain the converted string (unless <code>count</code> is <code>_TRUNCATE</code> ; for more information, see Remarks)	<code>ERANGE</code>

If any one of these conditions occurs, the invalid parameter exception is invoked as described in [Parameter validation](#). If execution is allowed to continue, the function returns an error code and sets `errno` as indicated in the table.

Remarks

The `mbsrtowcs_s` function converts a string of multibyte characters indirectly pointed to by `mbstr` into wide characters stored in the buffer pointed to by `wcstr`, by using the conversion state contained in `mbstate`. The conversion will continue for each character until one of these conditions is met:

- A multibyte null character is encountered
- An invalid multibyte character is encountered
- The number of wide characters stored in the `wcstr` buffer equals `count`.

The destination string `wcstr` is always null-terminated, even when there's an error, unless `wcstr` is a null pointer.

If `count` is the special value `_TRUNCATE`, `mbsrtowcs_s` converts as much of the string as will fit into the destination buffer, while still leaving room for a null terminator.

If `mbsrtowcs_s` successfully converts the source string, it puts the size in wide characters of the converted string and the null terminator into `*pReturnValue`, provided `pReturnValue` isn't a null pointer. The size is calculated even if the `wcstr` argument is a null pointer, which lets you determine the required buffer size. If `wcstr` is a null pointer, `count` is ignored.

If `wcstr` isn't a null pointer, the pointer object pointed to by `mbstr` is assigned a null pointer if conversion stopped because a terminating null character was reached. Otherwise, it's assigned the address just past the last multibyte character converted, if any. It allows a subsequent function call to restart conversion where this call stopped.

If `mbstate` is a null pointer, the library internal `mbstate_t` conversion state static object is used. Because this internal static object isn't thread-safe, we recommend that you pass your own `mbstate` value.

If `mbsrtowcs_s` encounters a multibyte character that isn't valid in the current locale, it puts -1 in `*pReturnValue`, sets the destination buffer `wcstr` to an empty string, sets `errno` to `EILSEQ`, and returns `EILSEQ`.

If the sequences pointed to by `mbstr` and `wcstr` overlap, the behavior of `mbsrtowcs_s` is undefined. `mbsrtowcs_s` is affected by the `LC_TYPE` category of the current locale.

IMPORTANT

Ensure that `wcstr` and `mbstr` do not overlap, and that `count` correctly reflects the number of multibyte characters to convert.

The `mbsrtowcs_s` function differs from `mbstowcs_s`, `_mbstowcs_s_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application should use `mbsrlen` instead of `mbslen`, if a subsequent call to `mbsrtowcs_s` is used instead of `mbstowcs_s`.

In C++, using this function is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the requirement to specify a size argument) and they can automatically replace older, non-secure functions by using the newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Exceptions

The `mbsrtowcs_s` function is multithread safe if no function in the current thread calls `setlocale` as long as this function is executing and the `mbstate` argument isn't a null pointer.

Requirements

ROUTINE	REQUIRED HEADER
<code>mbsrtowcs_s</code>	<wchar.h>

See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`mbtowc`
`mbtowc`, `_mbtowc_1`
`mbstowcs_s`, `_mbstowcs_s_1`
`mbsinit`

`mbstowcs`, `_mbstowcs_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Converts a sequence of multibyte characters to a corresponding sequence of wide characters. More secure versions of these functions are available; see `mbstowcs_s`, `_mbstowcs_s_l`.

Syntax

```
size_t mbstowcs(
    wchar_t *wcstr,
    const char *mbstr,
    size_t count
);
size_t _mbstowcs_l(
    wchar_t *wcstr,
    const char *mbstr,
    size_t count,
    _locale_t locale
);
template <size_t size>
size_t mbstowcs(
    wchar_t (&wcstr)[size],
    const char *mbstr,
    size_t count
); // C++ only
template <size_t size>
size_t _mbstowcs_l(
    wchar_t (&wcstr)[size],
    const char *mbstr,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`wcstr`

The address of a sequence of wide characters.

`mbstr`

The address of a sequence of null terminated multibyte characters.

`count`

The maximum number of multibyte characters to convert.

`Locale`

The locale to use.

Return value

If `mbstowcs` successfully converts the source string, it returns the number of converted multibyte characters. If the `wcstr` argument is `NULL`, the function returns the required size (in wide characters) of the destination string. If `mbstowcs` encounters an invalid multibyte character, it returns -1. If the return value is `count`, the wide-character string isn't null-terminated.

IMPORTANT

Ensure that `wcstr` and `mbstr` do not overlap, and that `count` correctly reflects the number of multibyte characters to convert.

Remarks

The `mbstowcs` function converts up to a maximum number of `count` multibyte characters pointed to by `mbstr` to a string of corresponding wide characters that are determined by the current locale. It stores the resulting wide-character string at the address represented by `wcstr`. The result is similar to a series of calls to `mbtowc`. If `mbstowcs` encounters the single-byte null character ('0') either before or when `count` occurs, it converts the null character to a wide-character null character (L'\0') and stops. Thus the wide-character string at `wcstr` is null-terminated only if a null character is encountered during conversion. If the sequences pointed to by `wcstr` and `mbstr` overlap, the behavior is undefined.

If the `wcstr` argument is `NULL`, `mbstowcs` returns the number of wide characters that would result from conversion, not including a null terminator. The source string must be null-terminated for the correct value to be returned. If you need the resulting wide character string to be null-terminated, add one to the returned value.

If the `mbstr` argument is `NULL`, or if `count` is > `INT_MAX`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns -1.

`mbstowcs` uses the current locale for any locale-dependent behavior; `_mbstowcs_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>mbstowcs</code>	<code><stdlib.h></code>
<code>_mbstowcs_1</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_mbstowcs.c
// compile with: /W3
// illustrates the behavior of the mbstowcs function

#include <stdlib.h>
#include <stdio.h>
#include <locale.h>

int main( void )
{
    size_t size;
    int nchar = 2; // number of characters to convert
```

```

int nchar = 2; // Number of characters to convert
int requiredSize;

unsigned char *pmbnull = NULL;
unsigned char *pmbhello = NULL;
char* localeInfo;

wchar_t *pwchello = L"\x3042\x3043"; // 2 Hiragana characters
wchar_t *pwc;

/* Enable the Japanese locale and codepage */
localeInfo = setlocale(LC_ALL, "Japanese_Japan.932");
printf("Locale information set to %s\n", localeInfo);

printf( "Convert to multibyte string:\n" );

requiredSize = wcstombs( NULL, pwchello, 0); // C4996
// Note: wcstombs is deprecated; consider using wcstombs_s
printf(" Required Size: %d\n", requiredSize);

/* Add one to leave room for the null terminator. */
pmbhello = (unsigned char *)malloc( requiredSize + 1);
if (! pmbhello)
{
    printf("Memory allocation failure.\n");
    return 1;
}
size = wcstombs( pmbhello, pwchello, requiredSize + 1); // C4996
// Note: wcstombs is deprecated; consider using wcstombs_s
if (size == (size_t) (-1))
{
    printf("Couldn't convert string. Code page 932 may"
          " not be available.\n");
    return 1;
}
printf( " Number of bytes written to multibyte string: %u\n",
       (unsigned int) size );
printf( " Hex values of the" );
printf( " multibyte characters: %#.2x %#.2x %#.2x %#.2x\n",
       pmbhello[0], pmbhello[1], pmbhello[2], pmbhello[3] );
printf( " Codepage 932 uses 0x81 to 0x9f as lead bytes.\n\n" );

printf( "Convert back to wide-character string:\n" );

/* Assume we don't know the length of the multibyte string.
   Get the required size in characters, and allocate enough space. */

requiredSize = mbstowcs(NULL, pmbhello, 0); // C4996
/* Add one to leave room for the null terminator */
pwc = (wchar_t *)malloc( (requiredSize + 1) * sizeof( wchar_t ) );
if (! pwc)
{
    printf("Memory allocation failure.\n");
    return 1;
}
size = mbstowcs( pwc, pmbhello, requiredSize + 1); // C4996
if (size == (size_t) (-1))
{
    printf("Couldn't convert string--invalid multibyte character.\n");
}
printf( " Characters converted: %u\n", (unsigned int) size );
printf( " Hex value of first 2" );
printf( " wide characters: %#.4x %#.4x\n\n", pwc[0], pwc[1] );
free(pwc);
free(pmbhello);
}
}

```

```
Locale information set to Japanese_Japan.932
Convert to multibyte string:
Required Size: 4
Number of bytes written to multibyte string: 4
Hex values of the multibyte characters: 0x82 0xa0 0x82 0xa1
Codepage 932 uses 0x81 to 0x9f as lead bytes.

Convert back to wide-character string:
Characters converted: 2
Hex value of first 2 wide characters: 0x3042 0x3043
```

See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[_mbclen](#), [_mblen](#), [_mblen_l](#)
[mbtowc](#), [_mbtowc_l](#)
[wcstombs](#), [_wcstombs_l](#)
[wctomb](#), [_wctomb_l](#)
[MultiByteToWideChar](#)

`mbstowcs_s`, `_mbstowcs_s_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a sequence of multibyte characters to a corresponding sequence of wide characters. Versions of `mbstowcs`, `_mbstowcs_l` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t mbstowcs_s(
    size_t *pReturnValue,
    wchar_t *wcstr,
    size_t sizeInWords,
    const char *mbstr,
    size_t count
);
errno_t _mbstowcs_s_l(
    size_t *pReturnValue,
    wchar_t *wcstr,
    size_t sizeInWords,
    const char *mbstr,
    size_t count,
    _locale_t locale
);
template <size_t size>
errno_t mbstowcs_s(
    size_t *pReturnValue,
    wchar_t (&wcstr)[size],
    const char *mbstr,
    size_t count
); // C++ only
template <size_t size>
errno_t _mbstowcs_s_l(
    size_t *pReturnValue,
    wchar_t (&wcstr)[size],
    const char *mbstr,
    size_t count,
    _locale_t locale
); // C++ only
```

Parameters

`pReturnValue`

The number of characters converted.

`wcstr`

Address of buffer for the resulting converted wide character string.

`sizeInWords`

The size of the `wcstr` buffer in words.

`mbstr`

The address of a sequence of null terminated multibyte characters.

`count`

The maximum number of wide characters to store in the `wcstr` buffer, not including the terminating null, or [`_TRUNCATE`](#).

Locale

The locale to use.

Return value

Zero if successful, an error code on failure.

ERROR CONDITION	RETURN VALUE AND <code>errno</code>
<code>wcstr</code> is <code>NULL</code> and <code>sizeInWords</code> > 0	<code>EINVAL</code>
<code>mbstr</code> is <code>NULL</code>	<code>EINVAL</code>
The destination buffer is too small to contain the converted string (unless <code>count</code> is <code>_TRUNCATE</code> ; see Remarks below)	<code>ERANGE</code>
<code>wcstr</code> isn't <code>NULL</code> and <code>sizeInWords</code> == 0	<code>EINVAL</code>

If any of these conditions occurs, the invalid parameter exception is invoked as described in [Parameter validation](#). If execution is allowed to continue, the function returns an error code and sets `errno` as indicated in the table.

Remarks

The `mbstowcs_s` function converts a string of multibyte characters pointed to by `mbstr` into wide characters stored in the buffer pointed to by `wcstr`. The conversion will continue for each character until one of these conditions is met:

- A multibyte null character is encountered
- An invalid multibyte character is encountered
- The number of wide characters stored in the `wcstr` buffer equals `count`.

The destination string is always null-terminated (even if there's an error).

If `count` is the special value `_TRUNCATE`, then `mbstowcs_s` converts as much of the string as will fit into the destination buffer, while still leaving room for a null terminator.

If `mbstowcs_s` successfully converts the source string, it puts the size in wide characters of the converted string, including the null terminator, into `*pReturnValue` (provided `pReturnValue` isn't `NULL`). The size is calculated even if the `wcstr` argument is `NULL`, and provides a way to determine the required buffer size. If `wcstr` is `NULL`, `count` is ignored, and `sizeInWords` must be 0.

If `mbstowcs_s` encounters an invalid multibyte character, it puts 0 in `*pReturnValue`, sets the destination buffer to an empty string, sets `errno` to `EILSEQ`, and returns `EILSEQ`.

If the sequences pointed to by `mbstr` and `wcstr` overlap, the behavior of `mbstowcs_s` is undefined.

IMPORTANT

Ensure that `wcstr` and `mbstr` do not overlap, and that `count` correctly reflects the number of multibyte characters to convert.

`mbstowcs_s` uses the current locale for any locale-dependent behavior; `_mbstowcs_s_1` is identical except that it

uses the locale passed in instead. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>mbstowcs_s</code>	<code><stdlib.h></code>
<code>_mbstowcs_s_l</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Data conversion](#)

[Locale](#)

[MultiByteToWideChar](#)

[Interpretation of multibyte-character sequences](#)

[_mbclen](#), [_mblen](#), [_mblen_l](#)

[mbtowc](#), [_mbtowc_l](#)

[wcstombs](#), [_wcstombs_l](#)

[wctomb](#), [_wctomb_l](#)

`mbtowc`, `_mbtowc_1`

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Convert a multibyte character to a corresponding wide character.

Syntax

```
int mbtowc(
    wchar_t *wchar,
    const char *mbchar,
    size_t count
);
int _mbtowc_1(
    wchar_t *wchar,
    const char *mbchar,
    size_t count,
    _locale_t locale
);
```

Parameters

`wchar`

Address of a wide character (type `wchar_t`).

`mbchar`

Address of a sequence of bytes (a multibyte character).

`count`

Number of bytes to check.

`Locale`

The locale to use.

Return value

If `mbchar` isn't `NULL`, and if `mbchar` points to a valid multibyte character, `mbtowc` returns the length in bytes of the multibyte character. If `mbchar` is `NULL` or points to a wide-character null character (`L'\0'`), the function returns 0. If the object that `mbchar` points to doesn't form a valid multibyte character within the first `count` characters, it returns -1.

Remarks

The `mbtowc` function converts `count` or fewer bytes pointed to by `mbchar`, if `mbchar` isn't `NULL`, to a corresponding wide character. `mbtowc` stores the resulting wide character at `wchar`; if `wchar` isn't `NULL`. `mbtowc` doesn't examine more than `MB_CUR_MAX` bytes. `mbtowc` uses the current locale for locale-dependent behavior; `_mbtowc_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>mbtowc</code>	<code><stdlib.h></code>
<code>_mbtowc_l</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_mbtowc.c
// Illustrates the behavior of the mbtowc function

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    int      i;
    char    *pmbc    = (char *)malloc( sizeof( char ) );
    wchar_t  wc      = L'a';
    wchar_t *pwcnull = NULL;
    wchar_t *pwc     = (wchar_t *)malloc( sizeof( wchar_t ) );
    printf( "Convert a wide character to multibyte character:\n" );
    wctomb_s( &i, pmbc, sizeof(char), wc );
    printf( "    Characters converted: %u\n", i );
    printf( "    Multibyte character: %x\n\n", *pmbc );

    printf( "Convert multibyte character back to a wide "
           "character:\n" );
    i = mbtowc( pwc, pmbc, MB_CUR_MAX );
    printf( "    Bytes converted: %u\n", i );
    printf( "    Wide character: %x\n\n", *pwc );
    printf( "Attempt to convert when target is NULL\n" );
    printf( "    returns the length of the multibyte character:\n" );
    i = mbtowc( pwcnull, pmbc, MB_CUR_MAX );
    printf( "    Length of multibyte character: %u\n\n", i );

    printf( "Attempt to convert a NULL pointer to a" );
    printf( "    wide character:\n" );
    pmbc = NULL;
    i = mbtowc( pwc, pmbc, MB_CUR_MAX );
    printf( "    Bytes converted: %u\n", i );
}
```

```
Convert a wide character to multibyte character:  
Characters converted: 1  
Multibyte character: 61  
  
Convert multibyte character back to a wide character:  
Bytes converted: 1  
Wide character: 61  
  
Attempt to convert when target is NULL  
returns the length of the multibyte character:  
Length of multibyte character: 1  
  
Attempt to convert a NULL pointer to a wide character:  
Bytes converted: 0
```

See also

[Data conversion](#)

[MultiByteToWideChar](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[_mbclen](#) , [mblen](#) , [_mblen_l](#)
[wcstombs](#) , [_wcstombs_l](#)
[wctomb](#) , [_wctomb_l](#)

memccpy

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The Microsoft-implemented POSIX function name `memccpy` is a deprecated alias for the `_memccpy` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_memccpy` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_memccpy

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Copies characters from a buffer.

Syntax

```
void *_memccpy(
    void *dest,
    const void *src,
    int c,
    size_t count
);
```

Parameters

`dest`

Pointer to the destination.

`src`

Pointer to the source.

`c`

Last character to copy.

`count`

Number of characters.

Return value

If the character `c` is copied, `_memccpy` returns a pointer to the char in `dest` that immediately follows the character. If `c` isn't copied, it returns `NULL`.

Remarks

The `_memccpy` function copies zero or more characters of `src` to `dest`, halting when the character `c` has been copied or when `count` characters have been copied, whichever comes first.

Security Note Make sure that the destination buffer is the same size or larger than the source buffer. For more information, see [Avoiding buffer overruns](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_memccpy</code>	<code><memory.h></code> or <code><string.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Example

```
// crt_memccpy.c

#include <memory.h>
#include <stdio.h>
#include <string.h>

char string1[60] = "The quick brown dog jumps over the lazy fox";

int main( void )
{
    char buffer[61];
    char *pdest;

    printf( "Function: _memccpy 60 characters or to character 's'\n" );
    printf( "Source: %s\n", string1 );
    pdest = _memccpy( buffer, string1, 's', 60 );
    *pdest = '\0';
    printf( "Result: %s\n", buffer );
    printf( "Length: %d characters\n", strlen( buffer ) );
}
```

Output

```
Function: _memccpy 60 characters or to character 's'
Source: The quick brown dog jumps over the lazy fox
Result: The quick brown dog jumps
Length: 25 characters
```

See also

Buffer manipulation

memchr	wmemchr
memcmp	wmemcmp
memcpy	wmemcpy
memset	wmemset

`memchr`, `wmemchr`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Find characters in a buffer.

Syntax

```
void *memchr(
    const void *buffer,
    int c,
    size_t count
); // C only
void *memchr(
    void *buffer,
    int c,
    size_t count
); // C++ only
const void *memchr(
    const void *buffer,
    int c,
    size_t count
); // C++ only
wchar_t *wmemchr(
    const wchar_t * buffer,
    wchar_t c,
    size_t count
); // C only
wchar_t *wmemchr(
    wchar_t * buffer,
    wchar_t c,
    size_t count
); // C++ only
const wchar_t *wmemchr(
    const wchar_t * buffer,
    wchar_t c,
    size_t count
); // C++ only
```

Parameters

`buffer`

Pointer to buffer.

`c`

Character to look for.

`count`

Number of characters to check.

Return value

If successful, returns a pointer to the first location of `c` in `buffer`. Otherwise it returns NULL.

Remarks

`memchr` and `wmemchr` look for the first occurrence of `c` in the first `count` characters of `buffer`. It stops when it

finds `c` or when it has checked the first `count` characters.

In C, these functions take a `const` pointer for the first argument. In C++, two overloads are available. The overload taking a pointer to `const` returns a pointer to `const`; the version that takes a pointer to non-`const` returns a pointer to non-`const`. The macro `_CRT_CONST_CORRECT_OVERLOADS` is defined if both the `const` and non-`const` versions of these functions are available. If you require the non-`const` behavior for both C++ overloads in C++, define the symbol `_CONST_RETURN`.

Requirements

ROUTINE	REQUIRED HEADER
<code>memchr</code>	<code><memory.h></code> or <code><string.h></code>
<code>wmemchr</code>	<code><wchar.h></code>

For more information about compatibility, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_memchr.c

#include <memory.h>
#include <stdio.h>

int ch = 'r';
char str[] = "lazy";
char string[] = "The quick brown dog jumps over the lazy fox";
char fmt1[] = "1234567890123456789012345678901234567890";
char fmt2[] = "12345678901234567890123456789012345678901234567890";

int main( void )
{
    char *pdest;
    int result;
    printf( "String to be searched:\n%s\n", string );
    printf( "%s\n", fmt1, fmt2 );

    printf( "Search char: %c\n", ch );
    pdest = memchr( string, ch, sizeof( string ) );
    result = (int)(pdest - string + 1);
    if ( pdest != NULL )
        printf( "Result: %c found at position %d\n", ch, result );
    else
        printf( "Result: %c not found\n" );
}
```

Output

```
String to be searched:  
The quick brown dog jumps over the lazy fox  
1 2 3 4 5  
12345678901234567890123456789012345678901234567890  
  
Search char: r  
Result: r found at position 12
```

See also

Buffer manipulation

[_memccpy](#)
[memcmp](#), [wmemcmp](#)
[memcpy](#), [wmemcpy](#)
[memset](#), [wmemset](#)
[strchr](#), [wcschr](#), [_mbschr](#), [_mbschr_1](#)

Compares characters in two buffers.

Syntax

```
int memcmp(
    const void *buffer1,
    const void *buffer2,
    size_t count
);
int wmemcmp(
    const wchar_t * buffer1,
    const wchar_t * buffer2,
    size_t count
);
```

Parameters

`buffer1`

First buffer.

`buffer2`

Second buffer.

`count`

Number of characters to compare. (Compares bytes for `memcmp`, wide characters for `wmemcmp`).

Return value

The return value indicates the relationship between the buffers.

RETURN VALUE	RELATIONSHIP OF FIRST <code>COUNT</code> CHARACTERS OF <code>BUF1</code> AND <code>BUF2</code>
<code>< 0</code>	<code>buffer1</code> less than <code>buffer2</code>
<code>0</code>	<code>buffer1</code> identical to <code>buffer2</code>
<code>> 0</code>	<code>buffer1</code> greater than <code>buffer2</code>

Remarks

Compares the first `count` characters of `buffer1` and `buffer2` and returns a value that indicates their relationship. The sign of a non-zero return value is the sign of the difference between the first differing pair of values in the buffers. The values are interpreted as `unsigned char` for `memcmp`, and as `wchar_t` for `wmemcmp`.

Requirements

ROUTINE	REQUIRED HEADER
memcmp	<memory.h> or <string.h>
wmemcmp	<wchar.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time library](#).

Example

```
// crt_memcmp.c
/* This program uses memcmp to compare
 * the strings named first and second. If the first
 * 19 bytes of the strings are equal, the program
 * considers the strings to be equal.
 */

#include <string.h>
#include <stdio.h>

int main( void )
{
    char first[] = "12345678901234567890";
    char second[] = "12345678901234567891";
    int int_arr1[] = {1,2,3,4};
    int int_arr2[] = {1,2,3,4};
    int result;

    printf( "Compare '%.19s' to '%.19s':\n", first, second );
    result = memcmp( first, second, 19 );
    if( result < 0 )
        printf( "First is less than second.\n" );
    else if( result == 0 )
        printf( "First is equal to second.\n" );
    else
        printf( "First is greater than second.\n" );

    printf( "Compare '%d,%d' to '%d,%d':\n", int_arr1[0], int_arr1[1], int_arr2[0], int_arr2[1] );
    result = memcmp( int_arr1, int_arr2, sizeof(int) * 2 );
    if( result < 0 )
        printf( "int_arr1 is less than int_arr2.\n" );
    else if( result == 0 )
        printf( "int_arr1 is equal to int_arr2.\n" );
    else
        printf( "int_arr1 is greater than int_arr2.\n" );
}
```

```
Compare '1234567890123456789' to '1234567890123456789':
First is equal to second.
Compare '1,2' to '1,2':
int_arr1 is equal to int_arr2.
```

See also

[Buffer manipulation](#)

_memccpy

memchr , wmemchr	
memcpy , wmemcpy	
memset , wmemset	
strcmp , wcsncmp , _mbscmp	
strncmp , wcsncmp , _mbsncmp , _mbsncmp_1	

`memcpy`, `wmemcpy`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copies bytes between buffers. More secure versions of these functions are available; see [`memcpy_s`](#), [`wmemcpy_s`](#).

Syntax

```
void *memcpy(
    void *dest,
    const void *src,
    size_t count
);
wchar_t *wmemcpy(
    wchar_t *dest,
    const wchar_t *src,
    size_t count
);
```

Parameters

`dest`

New buffer.

`src`

Buffer to copy from.

`count`

Number of characters to copy.

Return value

The value of `dest`.

Remarks

`memcpy` copies `count` bytes from `src` to `dest`; `wmemcpy` copies `count` wide characters. If the source and destination regions overlap, the behavior of `memcpy` is undefined. Use `memmove` to handle overlapping regions.

IMPORTANT

Make sure that the destination buffer is the same size or larger than the source buffer. For more information, see [Avoiding buffer overruns](#).

IMPORTANT

Because so many buffer overruns, and thus potential security exploits, have been traced to improper usage of `memcpy`, this function is listed among the "banned" functions by the Security Development Lifecycle (SDL). You may observe that some VC++ library classes continue to use `memcpy`. Furthermore, you may observe that the VC++ compiler optimizer sometimes emits calls to `memcpy`. The Visual C++ product is developed in accordance with the SDL process, and thus usage of this banned function has been closely evaluated. In the case of library use of it, the calls have been carefully scrutinized to ensure that buffer overruns will not be allowed through these calls. In the case of the compiler, sometimes certain code patterns are recognized as identical to the pattern of `memcpy`, and are thus replaced with a call to the function. In such cases, the use of `memcpy` is no more unsafe than the original instructions would have been; they have simply been optimized to a call to the performance-tuned `memcpy` function. Just as the use of "safe" CRT functions doesn't guarantee safety (they just make it harder to be unsafe), the use of "banned" functions doesn't guarantee danger (they just require greater scrutiny to ensure safety).

Because `memcpy` usage by the VC++ compiler and libraries has been so carefully scrutinized, these calls are permitted within code that otherwise conforms with the SDL. `memcpy` calls introduced in application source code only conform with the SDL when that use has been reviewed by security experts.

The `memcpy` and `wmemcpy` functions are only deprecated if the constant `_CRT_SECURE_DEPRECATE_MEMORY` is defined before the include statement, as in the example below:

```
#define _CRT_SECURE_DEPRECATE_MEMORY  
#include <memory.h>
```

or

```
#define _CRT_SECURE_DEPRECATE_MEMORY  
#include <wchar.h>
```

Requirements

ROUTINE	REQUIRED HEADER
<code>memcpy</code>	<code><memory.h></code> or <code><string.h></code>
<code>wmemcpy</code>	<code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

See `memmove` for a sample of how to use `memcpy`.

See also

Buffer manipulation

<code>_memccpy</code>
<code>memchr</code> , <code>wmemchr</code>
<code>memcmp</code> , <code>wmemcmp</code>
<code>memmove</code> , <code>wmemmove</code>
<code>memset</code> , <code>wmemset</code>
<code>strcpy_s</code> , <code>wcsncpy_s</code> , <code>_mbscopy_s</code>

`strncpy_s` , `_strncpy_s_1` , `wcsncpy_s` , `_wcsncpy_s_1` , `_mbsncpy_s` , `_mbsncpy_s_1` \

`memcpy_s`, `wmemcpy_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copies bytes between buffers. These functions are versions of `memcpy`, `wmemcpy` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t memcpy_s(
    void *dest,
    size_t destSize,
    const void *src,
    size_t count
);
errno_t wmemcpy_s(
    wchar_t *dest,
    size_t destSize,
    const wchar_t *src,
    size_t count
);
```

Parameters

`dest`

New buffer.

`destSize`

Size of the destination buffer, in bytes for `memcpy_s` and wide characters (`wchar_t`) for `wmemcpy_s`.

`src`

Buffer to copy from.

`count`

Number of characters to copy.

Return value

Zero if successful; an error code on failure.

Error conditions

<code>DEST</code>	<code>DETSIZE</code>	<code>SRC</code>	<code>COUNT</code>	RETURN VALUE	CONTENTS OF <code>DEST</code>
any	any	any	0	0	Not modified
<code>NULL</code>	any	any	non-zero	<code>EINVAL</code>	Not modified
any	any	<code>NULL</code>	non-zero	<code>EINVAL</code>	<code>dest</code> is zeroed out
any	< <code>count</code>	any	non-zero	<code>ERANGE</code>	<code>dest</code> is zeroed out

Remarks

`memcpy_s` copies `count` bytes from `src` to `dest`; `wmemcpy_s` copies `count` wide characters. If the source and destination regions overlap, the behavior of `memcpy_s` is undefined. Use `memmove_s` to handle overlapping regions.

These functions validate their parameters. If `count` is non-zero and `dest` or `src` is a null pointer, or `destSize` is smaller than `count`, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EINVAL` or `ERANGE`, and set `errno` to the return value.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>memcpy_s</code>	<code><memory.h></code> or <code><string.h></code>
<code>wmemcpy_s</code>	<code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_memcpy_s.c
// Copy memory in a more secure way.

#include <memory.h>
#include <stdio.h>

int main()
{
    int a1[10], a2[100], i;
    errno_t err;

    // Populate a2 with squares of integers
    for (i = 0; i < 100; i++)
    {
        a2[i] = i*i;
    }

    // Tell memcpy_s to copy 10 ints (40 bytes), giving
    // the size of the a1 array (also 40 bytes).
    err = memcpy_s(a1, sizeof(a1), a2, 10 * sizeof (int) );
    if (err)
    {
        printf("Error executing memcpy_s.\n");
    }
    else
    {
        for (i = 0; i < 10; i++)
            printf("%d ", a1[i]);
    }
    printf("\n");
}
```

0 1 4 9 16 25 36 49 64 81

See also

Buffer manipulation

[_memccpy](#)
[memchr](#), [wmemchr](#)
[memcmp](#), [wmemcmp](#)
[memmove](#), [wmemmove](#)
[memset](#), [wmemset](#)
[strcpy](#), [wcscpy](#), [_mbscopy](#)
[strncpy](#), [_strncpy_l](#), [wcsncpy](#), [_wcsncpy_l](#), [_mbsncpy](#), [_mbsncpy_l](#)
[strncpy_s](#), [_strncpy_s_l](#), [wcsncpy_s](#), [_wcsncpy_s_l](#), [_mbsncpy_s](#), [_mbsncpy_s_l](#)

memicmp

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The Microsoft-specific function name `memicmp` is a deprecated alias for the `_memicmp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_memicmp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_memicmp`, `_memicmp_l`

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Compares characters in two buffers (case-insensitive).

Syntax

```
int _memicmp(
    const void *buffer1,
    const void *buffer2,
    size_t count
);
int _memicmp_l(
    const void *buffer1,
    const void *buffer2,
    size_t count,
    _locale_t locale
);
```

Parameters

`buffer1`

First buffer.

`buffer2`

Second buffer.

`count`

Number of characters.

`Locale`

Locale to use.

Return value

The return value indicates the relationship between the buffers.

RETURN VALUE	RELATIONSHIP OF FIRST COUNT BYTES OF BUF1 AND BUF2
< 0	<code>buffer1</code> less than <code>buffer2</code> .
0	<code>buffer1</code> identical to <code>buffer2</code> .
> 0	<code>buffer1</code> greater than <code>buffer2</code> .
<code>_NLSCMPERROR</code>	An error occurred.

Remarks

The `_memicmp` function compares the first `count` characters of the two buffers `buffer1` and `buffer2` byte by byte. The comparison isn't case-sensitive.

If either `buffer1` or `buffer2` is a null pointer, this function invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns `_NLSCMPERROR` and sets `errno` to `EINVAL`.

`_memicmp` uses the current locale for locale-dependent behavior; `_memicmp_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_memicmp</code>	<code><memory.h></code> or <code><string.h></code>
<code>_memicmp_1</code>	<code><memory.h></code> or <code><string.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_memicmp.c
// This program uses _memicmp to compare
// the first 29 letters of the strings named first and
// second without regard to the case of the letters.

#include <memory.h>
#include <stdio.h>
#include <string.h>

int main( void )
{
    int result;
    char first[] = "Those Who Will Not Learn from History";
    char second[] = "THOSE WHO WILL NOT LEARN FROM their mistakes";
    // Note that the 29th character is right here ^

    printf( "Compare '%.29s' to '%.29s'\n", first, second );
    result = _memicmp( first, second, 29 );
    if( result < 0 )
        printf( "First is less than second.\n" );
    else if( result == 0 )
        printf( "First is equal to second.\n" );
    else if( result > 0 )
        printf( "First is greater than second.\n" );
}
```

```
Compare 'Those Who Will Not Learn from' to 'THOSE WHO WILL NOT LEARN FROM'
First is equal to second.
```

See also

[Buffer manipulation](#)

`_memccpy`
`memchr`, `wmemchr`
`memcmp`, `wmemcmp`

<code>memcpy</code>	<code>wmemcpy</code>				
<code>memset</code>	<code>wmemset</code>				
<code>_stricmp</code>	<code>_wcsicmp</code>	<code>_mbsicmp</code>	<code>_stricmp_l</code>	<code>_wcsicmp_l</code>	<code>_mbsicmp_l</code>
<code>_strnicmp</code>	<code>_wcstrnicmp</code>	<code>_mbsnicmp</code>	<code>_strnicmp_l</code>	<code>_wcstrnicmp_l</code>	<code>_mbsnicmp_l</code>

`memmove`, `wmemmove`

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Moves one buffer to another. More secure versions of these functions are available; see [`memmove_s`](#), [`wmemmove_s`](#).

Syntax

```
void *memmove(
    void *dest,
    const void *src,
    size_t count
);
wchar_t *wmemmove(
    wchar_t *dest,
    const wchar_t *src,
    size_t count
);
```

Parameters

`dest`

Destination object.

`src`

Source object.

`count`

Number of bytes (`memmove`) or characters (`wmemmove`) to copy.

Return value

The value of `dest`.

Remarks

Copies `count` bytes (`memmove`) or characters (`wmemmove`) from `src` to `dest`. If some portions of the source and the destination regions overlap, both functions ensure that the original source bytes in the overlapping region are copied before being overwritten.

Security Note Make sure that the destination buffer is the same size or larger than the source buffer. For more information, see [Avoiding buffer overruns](#).

The `memmove` and `wmemmove` functions will only be deprecated if the constant `_CRT_SECURE_DEPRECATE_MEMORY` is defined before the inclusion statement in order for the functions to be deprecated, such as in the example below:

```
#define _CRT_SECURE_DEPRECATE_MEMORY
#include <string.h>
```

or

```
#define _CRT_SECURE_DEPRECATE_MEMORY
#include <wchar.h>
```

Requirements

ROUTINE	REQUIRED HEADER
memmove	<string.h>
wmemmove	<wchar.h>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_memcpy.c
// Illustrate overlapping copy: memmove
// always handles it correctly; memcpy may handle
// it correctly.
//

#include <memory.h>
#include <string.h>
#include <stdio.h>

char str1[7] = "aabbcc";

int main( void )
{
    printf( "The string: %s\n", str1 );
    memcpy( str1 + 2, str1, 4 );
    printf( "New string: %s\n", str1 );

    strcpy_s( str1, sizeof(str1), "aabbcc" ); // reset string

    printf( "The string: %s\n", str1 );
    memmove( str1 + 2, str1, 4 );
    printf( "New string: %s\n", str1 );
}
```

```
The string: aabbcc
New string: aaaabb
The string: aabbcc
New string: aaaabb
```

See also

Buffer manipulation

[_memccpy](#)
[memcpy](#), [wmemcpy](#)
[strcpy](#), [wcscpy](#), [_mbscopy](#)
[strncpy](#), [_strncpy_1](#), [wcsncpy](#), [_wcsncpy_1](#), [_mbsncpy](#), [_mbsncpy_1](#)

`memmove_s`, `wmemmove_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Moves one buffer to another. These functions are versions of `memmove`, `wmemmove` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t memmove_s(  
    void *dest,  
    size_t numberOfElements,  
    const void *src,  
    size_t count  
);  
errno_t wmemmove_s(  
    wchar_t *dest,  
    size_t numberOfElements,  
    const wchar_t *src,  
    size_t count  
);
```

Parameters

`dest`

Destination object.

`numberOfElements`

Size of the destination buffer.

`src`

Source object.

`count`

Number of bytes (`memmove_s`) or characters (`wmemmove_s`) to copy.

Return value

Zero if successful; an error code on failure

Error conditions

<code>DEST</code>	<code>NUMBEROFELEMENTS</code>	<code>SRC</code>	<code>RETURN VALUE</code>	<code>CONTENTS OF DEST</code>
<code>NULL</code>	any	any	<code>EINVAL</code>	not modified
any	any	<code>NULL</code>	<code>EINVAL</code>	not modified
any	< <code>count</code>	any	<code>ERANGE</code>	not modified

Remarks

Copies `count` bytes of characters from `src` to `dest`. If some portions of the source and the destination

regions overlap, `memmove_s` ensures that the original source bytes in the overlapping region are copied before being overwritten.

If `dest` or if `src` is a null pointer, or if the destination string is too small, these functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EINVAL` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>memmove_s</code>	<code><string.h></code>
<code>wmemmove_s</code>	<code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_memmove_s.c
//
// The program demonstrates the
// memmove_s function which works as expected
// for moving overlapping regions.

#include <stdio.h>
#include <string.h>

int main()
{
    char str[] = "0123456789";

    printf("Before: %s\n", str);

    // Move six bytes from the start of the string
    // to a new position shifted by one byte. To protect against
    // buffer overrun, the secure version of memmove requires the
    // the length of the destination string to be specified.

    memmove_s((str + 1), strlen(str + 1, 10), str, 6);

    printf_s(" After: %s\n", str);
}
```

Output

```
Before: 0123456789
After: 0012345789
```

See also

Buffer manipulation

`_memccpy`
`memcpy` , `wmemcpy`

`strncpy_s`, `wcscpy_s`, `_mbscopy_s`

`strcpy`, `wcscpy`, `_mbscopy`

`strncpy_s`, `_strncpy_s_1`, `wcsncpy_s`, `_wcsncpy_s_1`, `_mbsncpy_s`, `_mbsncpy_s_1`

`strncpy`, `_strncpy_1`, `wcsncpy`, `_wcsncpy_1`, `_mbsncpy`, `_mbsncpy_1`

memset, wmemset

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a buffer to a specified character.

Syntax

```
void *memset(
    void *dest,
    int c,
    size_t count
);
wchar_t *wmemset(
    wchar_t *dest,
    wchar_t c,
    size_t count
);
```

Parameters

`dest`

Pointer to destination.

`c`

Character to set.

`count`

Number of characters.

Return value

The value of `dest`.

Remarks

Sets the first `count` characters of `dest` to the character `c`.

Security Note Make sure that the destination buffer has enough room for at least `count` characters. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>memset</code>	<code><memory.h></code> or <code><string.h></code>
<code>wmemset</code>	<code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_memset.c
/* This program uses memset to
 * set the first four chars of buffer to "*".
 */
#include <memory.h>
#include <stdio.h>

int main( void )
{
    char buffer[] = "This is a test of the memset function";

    printf( "Before: %s\n", buffer );
    memset( buffer, '*', 4 );
    printf( "After:  %s\n", buffer );
}
```

The example produces this output:

```
Before: This is a test of the memset function
After:  **** is a test of the memset function
```

Here's an example of the use of `wmemset`:

```
// crt_wmemset.c
/* This program uses memset to
 * set the first four chars of buffer to "*".
 */
#include <wchar.h>
#include <stdio.h>

int main( void )
{
    wchar_t buffer[] = L"This is a test of the wmemset function";

    wprintf( L"Before: %s\n", buffer );
    wmemset( buffer, L'*', 4 );
    wprintf( L"After:  %s\n", buffer );
}
```

The example produces this output:

```
Before: This is a test of the wmemset function
After:  **** is a test of the wmemset function
```

See also

[Buffer manipulation](#)

[_memccpy](#)

[memchr](#), [wmemchr](#)

`memcmp`, `wmemcmp`

`memcpy`, `wmemcpy`

`_strnset`, `_strnset_1`, `_wcsnset`, `_wcsnset_1`, `_mbsnset`, `_mbsnset_1`

A preprocessor macro that returns the smaller of two values.

Syntax

```
#define __min(a,b) (((a) < (b)) ? (a) : (b))
```

Parameters

`a`, `b`

Values of any type that the `<` operator works on.

Return value

The smaller of the two arguments.

Remarks

The `_min` macro compares two values and returns the value of the smaller one. The arguments can be of any numeric data type, signed or unsigned. Both arguments and the return value must be of the same data type.

The argument returned is evaluated twice by the macro. Double evaluation can lead to unexpected results if the argument is an expression that alters its value when it's evaluated, such as `*p++`.

Requirements

ROUTINE	REQUIRED HEADER
<code>_min</code>	<code><stdlib.h></code>

Example

```
// crt_minmax.c

#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    int a = 10;
    int b = 21;

    printf( "The larger of %d and %d is %d\n", a, b, __max( a, b ) );
    printf( "The smaller of %d and %d is %d\n", a, b, __min( a, b ) );
}
```

The larger of 10 and 21 is 21
The smaller of 10 and 21 is 10

See also

[Math and floating-point support](#)

[__max](#)

`mkdir`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `mkdir` is a deprecated alias for the `_mkdir` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_mkdir` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_mkdir`, `_wmkdir`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates a new directory.

Syntax

```
int _mkdir(
    const char *dirname
);
int _wmkdir(
    const wchar_t *dirname
);
```

Parameters

`dirname`

Path for a new directory.

Return value

Each of these functions returns the value 0 if the new directory was created. On an error, the function returns -1 and sets `errno` as follows.

`EEXIST` Directory wasn't created because `dirname` is the name of an existing file, directory, or device.

`ENOENT` Path wasn't found.

For more information about these and other return codes, see [errno](#), [_doserrno](#), [_sys_errlist](#), and [_sys_nerr](#).

Remarks

The `_mkdir` function creates a new directory with the specified `dirname`. `_mkdir` can create only one new directory per call, so only the last component of `dirname` can name a new directory. `_mkdir` doesn't translate path delimiters. In Windows NT, both the backslash (`\`) and the forward slash (`/`) are valid path delimiters in character strings in run-time routines.

`_wmkdir` is a wide-character version of `_mkdir`; the `dirname` argument to `_wmkdir` is a wide-character string. `_wmkdir` and `_mkdir` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tmkdir</code>	<code>_mkdir</code>	<code>_mkdir</code>	<code>_wmkdir</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_mkdir</code>	<code><direct.h></code>
<code>_wmkdir</code>	<code><direct.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_makedir.c

#include <direct.h>
#include <stdlib.h>
#include <stdio.h>

int main( void )
{
    if( _mkdir( "\\\testtmp" ) == 0 )
    {
        printf( "Directory '\\testtmp' was successfully created\n" );
        system( "dir \\\testtmp" );
        if( _rmdir( "\\\testtmp" ) == 0 )
            printf( "Directory '\\testtmp' was successfully removed\n" );
        else
            printf( "Problem removing directory '\\testtmp'\n" );
    }
    else
        printf( "Problem creating directory '\\testtmp'\n" );
}
```

Sample output

```
Directory '\\testtmp' was successfully created
Volume in drive C has no label.
Volume Serial Number is E078-087A

Directory of C:\\testtmp

02/12/2002  09:56a      <DIR>      .
02/12/2002  09:56a      <DIR>      ..
              0 File(s)           0 bytes
              2 Dir(s)  15,498,690,560 bytes free
Directory '\\testtmp' was successfully removed
```

See also

Directory control

<code>_chdir</code>	<code>_wchdir</code>
<code>_rmdir</code>	<code>_wrmdir</code>

`_mkgmtime`, `_mkgmtime32`, `_mkgmtime64`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a UTC time represented by a `struct tm` to a UTC time represented by a `time_t` type.

Syntax

```
time_t _mkgmtime(
    struct tm* timeptr
);
__time32_t _mkgmtime32(
    struct tm* timeptr
);
__time64_t _mkgmtime64(
    struct tm* timeptr
);
```

Parameters

`timeptr`

A pointer to the UTC time as a `struct tm` to convert.

Return value

A quantity of type `__time32_t` or `__time64_t` representing the number of seconds elapsed since midnight, January 1, 1970, in Coordinated Universal Time (UTC). If the date is out of range (see the Remarks section) or the input can't be interpreted as a valid time, the return value is -1.

Remarks

The `_mkgmtime32` and `_mkgmtime64` functions convert a UTC time to a `__time32_t` or `__time64_t` type representing the time in UTC. To convert a local time to UTC time, use `mktimes`, `_mktimes32`, and `_mktimes64` instead.

`_mkgmtime` is an inline function that evaluates to `_mkgmtime64`, and `time_t` is equivalent to `__time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`. We don't recommend it, because your application might fail after January 18, 2038, the maximum range of a 32-bit `time_t`. It's not allowed at all on 64-bit platforms.

The time structure passed in is changed as follows, in the same way as it's changed by the `_mktimes` functions: the `tm_wday` and `tm_yday` fields are set to new values based on the values of `tm_mday` and `tm_year`. Because the time is assumed to be UTC, the `tm_isdst` field is ignored.

The range of the `_mkgmtime32` function is from midnight, January 1, 1970, UTC to 23:59:59 January 18, 2038, UTC. The range of `_mkgmtime64` is from midnight, January 1, 1970, UTC to 23:59:59, December 31, 3000, UTC. An out-of-range date results in a return value of -1. The range of `_mkgmtime` depends on whether `_USE_32BIT_TIME_T` is defined. When it's not defined, which is the default, the range is the same as `_mkgmtime64`. Otherwise, the range is limited to the 32-bit range of `_mkgmtime32`.

Both `gmtime` and `localtime` use a common static buffer for the conversion. If you supply this buffer to `_mkgmtime`, the previous contents are destroyed.

Examples

```
// crt_mkgmtime.c
#include <stdio.h>
#include <time.h>

int main()
{
    struct tm t1, t2;
    time_t now, mytime, gmtime;
    char buff[30];

    time( & now );

    _localtime64_s( &t1, &now );
    _gmtime64_s( &t2, &now );

    mytime = mktime(&t1);
    gmtime = _mkgmtime(&t2);

    printf("Seconds since midnight, January 1, 1970\n");
    printf("My time: %I64d\nGM time (UTC): %I64d\n\n", mytime, gmtime);

    /* Use asctime_s to display these times. */

    _localtime64_s( &t1, &mytime );
    asctime_s( buff, sizeof(buff), &t1 );
    printf( "Local Time: %s\n", buff );

    _gmtime64_s( &t2, &gmtime );
    asctime_s( buff, sizeof(buff), &t2 );
    printf( "Greenwich Mean Time: %s\n", buff );

}
```

```
Seconds since midnight, January 1, 1970
My time: 1171588492
GM time (UTC): 1171588492

Local Time: Thu Feb 15 17:14:52 2007

Greenwich Mean Time: Fri Feb 16 01:14:52 2007
```

The following example shows how the incomplete structure is filled out by `_mkgmtime`. It computes values for both the day of the week and of the year.

```

// crt_mkgmtime2.c
#include <stdio.h>
#include <time.h>
#include <memory.h>

int main()
{
    struct tm t1, t2;
    time_t gmtime;
    char buff[30];

    memset(&t1, 0, sizeof(struct tm));
    memset(&t2, 0, sizeof(struct tm));

    t1.tm_mon = 1;
    t1.tm_isdst = 0;
    t1.tm_year = 103;
    t1.tm_mday = 12;

    // The day of the week and year will be incorrect in the output here.
    asctime_s( buff, sizeof(buff), &t1 );
    printf("Before calling _mkgmtime, t1 = %s t.tm_yday = %d\n",
           buff, t1.tm_yday );

    gmtime = _mkgmtime(&t1);

    // The correct day of the week and year were determined.
    asctime_s( buff, sizeof(buff), &t1 );
    printf("After calling _mkgmtime, t1 = %s t.tm_yday = %d\n",
           buff, t1.tm_yday );

}

```

```

Before calling _mkgmtime, t1 = Sun Feb 12 00:00:00 2003
t.tm_yday = 0
After calling _mkgmtime, t1 = Wed Feb 12 00:00:00 2003
t.tm_yday = 42

```

See also

Time management

[asctime](#) , [_wasctime](#)
[asctime_s](#) , [_wasctime_s](#)
[gmtime](#) , [_gmtime32](#) , [_gmtime64](#)
[gmtime_s](#) , [_gmtime32_s](#) , [_gmtime64_s](#)
[localtime_s](#) , [_localtime32_s](#) , [_localtime64_s](#)
[mktime](#) , [_mktime32](#) , [_mktime64](#)
[time](#) , [_time32](#) , [_time64](#)

`mktemp`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `mktemp` is a deprecated alias for the `_mktemp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_mktemp` or the security-enhanced `_mktemp_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_mktemp`, `_wmktemp`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Creates a unique file name. More secure versions of these functions are available; see `_mktemp_s`, `_wmktemp_s`.

Syntax

```
char *_mktemp(
    char *nameTemplate
);
wchar_t *_wmktemp(
    wchar_t *nameTemplate
);
template <size_t size>
char *_mktemp(
    char (&nameTemplate)[size]
); // C++ only
template <size_t size>
wchar_t *_wmktemp(
    wchar_t (&nameTemplate)[size]
); // C++ only
```

Parameters

`nameTemplate`

File name pattern.

Return value

Each of these functions returns a pointer to the modified `nameTemplate`. The function returns `NULL` if `nameTemplate` is badly formed or no more unique names can be created from the given `nameTemplate`.

Remarks

The `_mktemp` function creates a unique file name by modifying the `nameTemplate` argument. `_mktemp` automatically handles multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use by the run-time system. `_wmktemp` is a wide-character version of `_mktemp`; the argument and return value of `_wmktemp` are wide-character strings. `_wmktemp` and `_mktemp` behave identically otherwise, except that `_wmktemp` doesn't handle multibyte-character strings.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tmktemp</code>	<code>_mktemp</code>	<code>_mktemp</code>	<code>_wmktemp</code>

The `nameTemplate` argument has the form `baseXXXXXX`, where `base` is the part of the new file name that you supply and each X is a placeholder for a character supplied by `_mktemp`. Each placeholder character in `nameTemplate` must be an uppercase X. `_mktemp` preserves `base` and replaces the first trailing X with an

alphabetic character. `_mktemp` replaces the trailing X characters with a five-digit value. This value is a unique number that identifies the calling process, or in multithreaded programs, the calling thread.

Each successful call to `_mktemp` modifies `nameTemplate`. In each subsequent call from the same process or thread with the same `nameTemplate` argument, `_mktemp` checks for file names that match names returned by `_mktemp` in previous calls. If no file exists for a given name, `_mktemp` returns that name. If files exist for all previously returned names, `_mktemp` creates a new name by replacing the alphabetic character it used in the previously returned name with the next available lowercase letter, in order, from 'a' through 'z'. For example, if `base` is:

```
fn
```

and the five-digit value supplied by `_mktemp` is 12345, the first name returned is:

```
fna12345
```

If this name is used to create file FNA12345 and this file still exists, the next name returned on a call from the same process or thread with the same `base` for `nameTemplate` is:

```
fnb12345
```

If FNA12345 doesn't exist, the next name returned is again:

```
fna12345
```

`_mktemp` can create a maximum of 26 unique file names for any given combination of `base` and `nameTemplate` values. Therefore, FNZ12345 is the last unique file name `_mktemp` can create for the `base` and `nameTemplate` values used in this example.

On failure, `errno` is set. If `nameTemplate` has an invalid format (for example, fewer than six X characters), `errno` is set to `EINVAL`. If `_mktemp` is unable to create a unique name because all 26 possible file names already exist, `_mktemp` sets `nameTemplate` to an empty string and returns `EEXIST`.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_mktemp</code>	<code><io.h></code>
<code>_wmktemp</code>	<code><io.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_mktemp.c
// compile with: /W3
/* The program uses _mktemp to create
* unique filenames. It opens each filename
* to ensure that the next name is unique.
*/
#include <io.h>
#include <string.h>
#include <stdio.h>
#include <errno.h>

char *template = "fnXXXXXX";
char *result;
char names[27][9];

int main( void )
{
    int i;
    FILE *fp;

    for( i = 0; i < 27; i++ )
    {
        strcpy_s( names[i], sizeof( names[i] ), template );
        /* Attempt to find a unique filename: */
        result = _mktemp( names[i] ); // C4996
        // Note: _mktemp is deprecated; consider using _mktemp_s instead
        if( result == NULL )
        {
            printf( "Problem creating the template\n" );
            if (errno == EINVAL)
            {
                printf( "Bad parameter\n" );
            }
            else if (errno == EEXIST)
            {
                printf( "Out of unique filenames\n" );
            }
        }
        else
        {
            fopen_s( &fp, result, "w" );
            if( fp != NULL )
                printf( "Unique filename is %s\n", result );
            else
                printf( "Cannot open %s\n", result );
            fclose( fp );
        }
    }
}
```

```
Unique filename is fna03912
Unique filename is fnb03912
Unique filename is fnc03912
Unique filename is fnd03912
Unique filename is fne03912
Unique filename is fnf03912
Unique filename is fng03912
Unique filename is fnh03912
Unique filename is fni03912
Unique filename is fnj03912
Unique filename is fnk03912
Unique filename is fnl03912
Unique filename is fnm03912
Unique filename is fnn03912
Unique filename is fno03912
Unique filename is fnp03912
Unique filename is fnq03912
Unique filename is fnr03912
Unique filename is fns03912
Unique filename is fnt03912
Unique filename is fnu03912
Unique filename is fnv03912
Unique filename is fnw03912
Unique filename is fnx03912
Unique filename is fny03912
Unique filename is fnz03912
Problem creating the template.
Out of unique filenames.
```

See also

File handling

[fopen](#) , [_wfopen](#)
[_getmbcp](#)
[_getpid](#)
[_open](#) , [_wopen](#)
[_setmbcp](#)
[_tempnam](#) , [_wtempnam](#) , [tmpnam](#) , [_wtmpnam](#)
[tmpfile](#)

`_mktemp_s`, `_wmktemp_s`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Creates a unique file name. These functions are versions of `_mktemp`, `_wmktemp` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
errno_t _mktemp_s(
    char *nameTemplate,
    size_t sizeInChars
);
errno_t _wmktemp_s(
    wchar_t *nameTemplate,
    size_t sizeInChars
);
template <size_t size>
errno_t _mktemp_s(
    char (&nameTemplate)[size]
); // C++ only
template <size_t size>
errno_t _wmktemp_s(
    wchar_t (&nameTemplate)[size]
); // C++ only
```

Parameters

`nameTemplate`

File name pattern.

`sizeInChars`

Size of the buffer in single-byte characters in `_mktemp_s`; wide characters in `_wmktemp_s`, including the null terminator.

Return value

Both of these functions return zero on success; an error code on failure.

Error conditions

<code>NAMETEMPLATE</code>	<code>SIZEINCHARS</code>	<code>RETURN VALUE</code>	<code>NEW VALUE IN NAMETEMPLATE</code>
<code>NULL</code>	any	<code>EINVAL</code>	<code>NULL</code>
Incorrect format (see Remarks section for correct format)	any	<code>EINVAL</code>	empty string
any	<= number of X characters	<code>EINVAL</code>	empty string

If any of the above error conditions occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the functions returns `EINVAL`.

Remarks

The `_mktemp_s` function creates a unique file name by modifying the `nameTemplate` argument, so that after the call, the `nameTemplate` pointer points to a string containing the new file name. `_mktemp_s` automatically handles multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use by the run-time system. `_wmktemp_s` is a wide-character version of `_mktemp_s`; the argument of `_wmktemp_s` is a wide-character string. `_wmktemp_s` and `_mktemp_s` behave identically otherwise, except that `_wmktemp_s` doesn't handle multibyte-character strings.

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tmktemp_s</code>	<code>_mktemp_s</code>	<code>_mktemp_s</code>	<code>_wmktemp_s</code>

The `nameTemplate` argument has the form `baseXXXXXX`, where `base` is the part of the new file name that you supply and each X is a placeholder for a character supplied by `_mktemp_s`. Each placeholder character in `nameTemplate` must be an uppercase X. `_mktemp_s` preserves `base` and replaces the first trailing X with an alphabetic character. `_mktemp_s` replaces the X characters that follow with a five-digit value. This value is a unique number that identifies the calling process, or in multithreaded programs, the calling thread.

Each successful call to `_mktemp_s` modifies `nameTemplate`. In each subsequent call from the same process or thread with the same `nameTemplate` argument, `_mktemp_s` checks for file names that match names returned by `_mktemp_s` in previous calls. If no file exists for a given name, `_mktemp_s` returns that name. If files exist for all previously returned names, `_mktemp_s` creates a new name by replacing the alphabetic character it used in the previously returned name with the next available lowercase letter, in order, from 'a' through 'z'. For example, if `base` is:

```
fn
```

and the five-digit value supplied by `_mktemp_s` is 12345, the first name returned is:

```
fna12345
```

If this name is used to create file FNA12345 and this file still exists, the next name returned on a call from the same process or thread with the same `base` for `nameTemplate` is:

```
fnb12345
```

If FNA12345 doesn't exist, the next name returned is again:

```
fna12345
```

`_mktemp_s` can create a maximum of 26 unique file names for any given combination of `base` and `nameTemplate` values. Therefore, FNZ12345 is the last unique file name `_mktemp_s` can create for the `base` and `nameTemplate` values used in this example.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_mktemp_s</code>	<code><iostream.h></code>
<code>_wmktemp_s</code>	<code><iostream.h> or <wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_mktemp_s.cpp
/* The program uses _mktemp to create
 * five unique filenames. It opens each filename
 * to ensure that the next name is unique.
 */

#include <iostream.h>
#include <string.h>
#include <stdio.h>

char *fnTemplate = "fnXXXXXX";
char names[5][9];

int main()
{
    int i, err, sizeInChars;
    FILE *fp;

    for( i = 0; i < 5; i++ )
    {
        strcpy_s( names[i], sizeof(names[i]), fnTemplate );
        /* Get the size of the string and add one for the null terminator.*/
        sizeInChars = strlen(names[i], 9) + 1;
        /* Attempt to find a unique filename: */
        err = _mktemp_s( names[i], sizeInChars );
        if( err != 0 )
            printf( "Problem creating the template" );
        else
        {
            if( fopen_s( &fp, names[i], "w" ) == 0 )
                printf( "Unique filename is %s\n", names[i] );
            else
                printf( "Cannot open %s\n", names[i] );
            fclose( fp );
        }
    }

    return 0;
}
```

Sample output

```
Unique filename is fna03188
Unique filename is fnb03188
Unique filename is fnc03188
Unique filename is fnd03188
Unique filename is fne03188
```

See also

[File handling](#)

[fopen](#) , [_wfopen](#)
[_getmbcp](#)
[_getpid](#)
[_open](#) , [_wopen](#)
[_setmbcp](#)
[_tempnam](#) , [_wtempnam](#) , [tmpnam](#) , [_wtmpnam](#)
[tmpfile_s](#)

`mktimed`, `_mktimed32`, `_mktimed64`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Convert the local time to a calendar value.

Syntax

```
time_t mktimed(
    struct tm *timeptr
);
__time32_t _mktimed32(
    struct tm *timeptr
);
__time64_t _mktimed64(
    struct tm *timeptr
);
```

Parameters

`timeptr`

Pointer to time structure; see [asctime](#).

Return value

`_mktimed32` returns the specified calendar time encoded as a value of type `time_t`. If `timeptr` references a date before midnight, January 1, 1970, or if the calendar time can't be represented, `_mktimed32` returns -1 cast to type `time_t`. When using `_mktimed32` and if `timeptr` references a date after 23:59:59 January 18, 2038, Coordinated Universal Time (UTC), it will return -1 cast to type `time_t`.

`_mktimed64` will return -1 cast to type `__time64_t` if `timeptr` references a date after 23:59:59, December 31, 3000, UTC.

Remarks

The `mktimed`, `_mktimed32` and `_mktimed64` functions convert the supplied time structure (possibly incomplete) pointed to by `timeptr` into a fully defined structure with normalized values and then converts it to a `time_t` calendar time value. The converted time has the same encoding as the values returned by the `time` function. The original values of the `tm_wday` and `tm_yday` components of the `timeptr` structure are ignored, and the original values of the other components aren't restricted to their normal ranges.

`mktimed` is an inline function that is equivalent to `_mktimed64`, unless `_USE_32BIT_TIME_T` is defined, in which case it's equivalent to `_mktimed32`.

After an adjustment to UTC, `_mktimed32` handles dates from midnight, January 1, 1970, to 23:59:59 January 18, 2038, UTC. `_mktimed64` handles dates from midnight, January 1, 1970 to 23:59:59, December 31, 3000. This adjustment may cause these functions to return -1 (cast to `time_t`, `__time32_t` or `__time64_t`) even though the date you specify is within range. For example, if you are in Cairo, Egypt, which is two hours ahead of UTC, two hours will first be subtracted from the date you specify in `timeptr`; the subtraction may now put your date out of range.

These functions may be used to validate and fill in a `tm` structure. If successful, these functions set the values of `tm_wday` and `tm_yday` as appropriate and set the other components to represent the specified calendar time,

but with their values forced to the normal ranges. The final value of `tm_mday` isn't set until `tm_mon` and `tm_year` are determined. When specifying a `tm` structure time, set the `tm_isdst` field to:

- Zero (0) to indicate that standard time is in effect.
- A value greater than 0 to indicate that daylight saving time is in effect.
- A value less than zero to have the C run-time library code compute whether standard time or daylight saving time is in effect.

The C run-time library will determine the daylight savings time behavior from the `TZ` environment variable. If `TZ` isn't set, the Win32 API call `GetTimeZoneInformation` is used to get the daylight savings time information from the operating system. If the call fails, the library assumes the United States' rules for implementing the calculation of daylight saving time are used. `tm_isdst` is a required field. If not set, its value is undefined and the return value from these functions is unpredictable. If `timeptr` points to a `tm` structure returned by a previous call to `asctime`, `gmtime`, or `localtime` (or variants of these functions), the `tm_isdst` field contains the correct value.

The `gmtime` and `localtime` (and `_gmtime32`, `_gmtime64`, `_localtime32`, and `_localtime64`) functions use a single buffer per thread for the conversion. If you supply this buffer to `mktme`, `_mktme32` or `_mktme64`, the previous contents are destroyed.

These functions validate their parameter. If `timeptr` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>mktme</code>	<code><time.h></code>
<code>_mktme32</code>	<code><time.h></code>
<code>_mktme64</code>	<code><time.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_mktme.c
/* The example takes a number of days
 * as input and returns the time, the current
 * date, and the specified number of days.
 */
#include <time.h>
#include <stdio.h>

int main( void )
{
    struct tm  when;
    __time64_t now, result;
    int        days;
    char       buff[80];

    time( &now );
    _localtime64_s( &when, &now );
    asctime_s( buff, sizeof(buff), &when );
    printf( "Current time is %s\n", buff );
    days = 20;
    when.tm_mday = when.tm_mday + days;
    if( (result = mktme( &when )) != (time_t)-1 ) {
        asctime_s( buff, sizeof(buff), &when );
        printf( "In %d days the time will be %s\n", days, buff );
    } else
        perror( "mktme failed" );
}

```

Sample output

```

Current time is Fri Apr 25 13:34:07 2003

In 20 days the time will be Thu May 15 13:34:07 2003

```

See also

Time management

[asctime](#) , [_wasctime](#)
[gmtime](#) , [_gmtime32](#) , [_gmtime64](#)
[localtime](#) , [_localtime32](#) , [_localtime64](#)
[_mkgmtme](#) , [_mkgmtme32](#) , [_mkgmtme64](#)
[time](#) , [_time32](#) , [_time64](#)

`modf`, `modff`, `modfl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Splits a floating-point value into fractional and integer parts.

Syntax

```
double modf( double x, double * intptr );
float modff( float x, float * intptr );
long double modfl( long double x, long double * intptr );
```

```
float modf( float x, float * intptr ); // C++ only
long double modf( long double x, long double * intptr ); // C++ only
```

Parameters

`x`

Floating-point value.

`intptr`

Pointer to stored integer portion.

Return value

This function returns the signed fractional portion of `x`. There's no error return.

Remarks

The `modf` functions break down the floating-point value `x` into fractional and integer parts, each of which has the same sign as `x`. The signed fractional portion of `x` is returned. The integer portion is stored as a floating-point value at `intptr`.

`modf` has an implementation that uses Streaming SIMD Extensions 2 (SSE2). See [_set_SSE2_enable](#) for information and restrictions on using the SSE2 implementation.

C++ allows overloading, so you can call overloads of `modf` that take and return `float` or `long double` parameters. In a C program, `modf` always takes two double values and returns a double value.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>modf</code> , <code>modff</code> , <code>modfl</code>	C: <code><math.h></code> C++: <code><cmath></code> or <code><math.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_modf.c

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x, y, n;

    x = -14.87654321;      /* Divide x into its fractional */
    y = modf( x, &n );      /* and integer parts          */

    printf( "For %f, the fraction is %f and the integer is %.f\n",
            x, y, n );
}
```

```
For -14.876543, the fraction is -0.876543 and the integer is -14
```

See also

[Math and floating-point support](#)

[frexp](#)

[ldexp](#)

_msize

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the size of a memory block allocated in the heap.

Syntax

```
size_t _msize(  
    void *memblock  
)
```

Parameters

`memblock`

Pointer to the memory block.

Return value

`_msize` returns the size (in bytes) as an unsigned integer.

Remarks

The `_msize` function returns the size, in bytes, of the memory block allocated by a call to `calloc`, `malloc`, or `realloc`.

When the application is linked with a debug version of the C run-time libraries, `_msize` resolves to `_msize_dbg`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

This function validates its parameter. If `memblock` is a `NULL` pointer, `_msize` invokes an invalid parameter handler, as described in [Parameter validation](#). If the error is handled, the function sets `errno` to `EINVAL` and returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_msize</code>	<code><malloc.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

See the example for `realloc`.

See also

[Memory allocation](#)

[calloc](#)

[_expand](#)

[malloc](#)

[realloc](#)

_msize_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the size of a block of memory in the heap (debug version only).

Syntax

```
size_t _msize_dbg(  
    void *userData,  
    int blockType  
)
```

Parameters

`userData`

Pointer to the memory block for which to determine the size.

`blockType`

Type of the specified memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

Return value

On successful completion, `_msize_dbg` returns the size (in bytes) of the specified memory block; otherwise it returns `NULL`.

Remarks

`_msize_dbg` is a debug version of the `_msize` function. When `_DEBUG` isn't defined, each call to `_msize_dbg` is reduced to a call to `_msize`. Both `_msize` and `_msize_dbg` calculate the size of a memory block in the base heap, but `_msize_dbg` adds two debugging features: It includes the buffers on either side of the user portion of the memory block in the returned size and it allows size calculations for specific block types.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and the debug versions, see [Debug versions of heap allocation functions](#).

This function validates its parameter. If `membLock` is a null pointer, `_msize_dbg` invokes an invalid parameter handler, as described in [Parameter validation](#). If the error is handled, the function sets `errno` to `EINVAL` and returns -1.

Requirements

ROUTINE	REQUIRED HEADER
<code>_msize_dbg</code>	<code><crtdbg.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

Debug versions of [C run-time libraries](#) only.

Example

```
// crt_mszie_dbg.c
// compile with: /MTd
/*
* This program allocates a block of memory using _malloc_dbg
* and then calls _msize_dbg to display the size of that block.
* Next, it uses _realloc_dbg to expand the amount of
* memory used by the buffer and then calls _msize_dbg again to
* display the new amount of memory allocated to the buffer.
*/
#include <stdio.h>
#include <malloc.h>
#include <stdlib.h>
#include <crtdbg.h>

int main( void )
{
    long *buffer, *newbuffer;
    size_t size;

    /*
     * Call _malloc_dbg to include the filename and line number
     * of our allocation request in the header
     */
    buffer = (long *)_malloc_dbg( 40 * sizeof(long), _NORMAL_BLOCK, __FILE__, __LINE__ );
    if( buffer == NULL )
        exit( 1 );

    /*
     * Get the size of the buffer by calling _msize_dbg
     */
    size = _msize_dbg( buffer, _NORMAL_BLOCK );
    printf( "Size of block after _malloc_dbg of 40 longs: %u\n", size );

    /*
     * Reallocate the buffer using _realloc_dbg and show the new size
     */
    newbuffer = _realloc_dbg( buffer, size + (40 * sizeof(long)), _NORMAL_BLOCK, __FILE__, __LINE__ );
    if( newbuffer == NULL )
        exit( 1 );
    buffer = newbuffer;
    size = _msize_dbg( buffer, _NORMAL_BLOCK );
    printf( "Size of block after _realloc_dbg of 40 more longs: %u\n", size );

    free( buffer );
    exit( 0 );
}
```

Output

```
Size of block after _malloc_dbg of 40 longs: 160
Size of block after _realloc_dbg of 40 more longs: 320
```

See also

[Debug routines](#)

[_malloc_dbg](#)

`nan`, `nanf`, `nanl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns a quiet NaN value.

Syntax

```
double nan( const char* input );
float nanf( const char* input );
long double nanl( const char* input );
```

Parameters

`input`

A string value.

Return value

The `nan` functions return a quiet NaN value.

Remarks

The `nan` functions return a floating-point value that corresponds to a quiet (non-signalling) NaN. The `input` value is ignored. For information about how a NaN is represented for output, see [printf](#), [_printf_l](#), [wprintf](#), [_wprintf_l](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>nan</code> , <code>nanf</code> , <code>nanl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>

See also

[Math and floating-point support](#)

[fpclassify](#)

[_fpclass](#), [_fpclassf](#)

[isfinite](#), [_finite](#), [_finitef](#)

[isinf](#)

[isnan](#), [_isnan](#), [_isnanf](#)

[isnormal](#)

`nearbyint`, `nearbyintf`, `nearbyintl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rounds the specified floating-point value to an integer, and returns that value in a floating-point format.

Syntax

```
double nearbyint( double x );
float nearbyintf( float x );
long double nearbyintl( long double x );
#define nearbyint( X ) // Requires C11 or higher

float nearbyint( float x ); //C++ only
long double nearbyint( long double x ); //C++ only
```

Parameters

`x`

The value to round.

Return value

If successful, returns `x`, rounded to the nearest integer, using the current rounding format as reported by `fegetround`. Otherwise, the function may return one of the following values:

ISSUE	RETURN
<code>x</code> = ±INFINITY	±INFINITY, unmodified
<code>x</code> = ±0	±0, unmodified
<code>x</code> = NaN	NaN

Errors aren't reported through `_matherr`; specifically, this function doesn't report any `FE_INEXACT` exceptions.

Remarks

The primary difference between this function and `rint` is that this function doesn't raise the inexact floating point exception.

Because the maximum floating-point values are exact integers, this function will never overflow by itself; rather, the output may overflow the return value, depending on which version of the function you use.

C++ allows overloading, so you can call overloads of `nearbyint` that take and return `float` or `long double` parameters. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `nearbyint` always takes two double values and returns a double value.

If you use the `<tgmath.h>` `nearbyint()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

FUNCTION	C HEADER	C++ HEADER
<code>nearbyint</code> , <code>nearbyintf</code> , <code>nearbyintl</code>	<code><math.h></code>	<code><cmath></code> or <code><math.h></code>
<code>nearbyint</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Alphabetical function reference](#)

[Math and floating-point support](#)

`nextafter`, `nextafterf`, `nextafterl`, `_nextafter`,
`_nextafterf`, `nexttoward`, `nexttowardf`,
`nexttowardl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the next representable floating-point value.

Syntax

```
double nextafter( double x, double y );
float nextafterf( float x, float y );
long double nextafterl( long double x, long double y );

double _nextafter( double x, double y );
float _nextafterf( float x, float y ); /* x64 only */

#define nextafter(X, Y) // Requires C11 or higher

double nexttoward( double x, long double y );
float nexttowardf( float x, long double y );
long double nexttowardl( long double x, long double y );

#define nexttoward(X, Y) // Requires C11 or higher

float nextafter( float x, float y ); /* C++ only, requires <cmath> */
long double nextafter( long double x, long double y ); /* C++ only, requires <cmath> */

float nexttoward( float x, long double y ); /* C++ only, requires <cmath> */
long double nexttoward( long double x, long double y ); /* C++ only, requires <cmath> */
```

Parameters

`x`

The floating-point value to start from.

`y`

The floating-point value to go towards.

Return value

Returns the next representable floating-point value of the return type after `x` in the direction of `y`. If `x` and `y` are equal, the function returns `y`, converted to the return type, with no exception triggered. If `x` isn't equal to `y`, and the result is a denormal or zero, the `FE_UNDERFLOW` and `FE_INEXACT` floating-point exception states are set, and the correct result is returned. If either `x` or `y` is a NAN, then the return value is one of the input NaNs. If `x` is finite and the result is infinite or not representable in the type, a correctly signed infinity or NAN is returned, the `FE_OVERFLOW` and `FE_INEXACT` floating-point exception states are set, and `errno` is set to `ERANGE`.

Remarks

The `nextafter` and `nexttoward` function families are equivalent, except for the parameter type of `y`. If `x` and `y` are equal, the value returned is `y` converted to the return type.

Because C++ allows overloading, if you include `<cmath>` you can call overloads of `nextafter` and `nexttoward` that return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `nextafter` and `nexttoward` always return `double`.

If you use the `nextafter` or `nexttoward` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

The `_nextafter` and `_nextafterf` functions are Microsoft-specific. The `_nextafterf` function is only available when compiling for x64.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>nextafter</code> , <code>nextafterf</code> , <code>nextafterl</code> , <code>_nextafterf</code> , <code>nexttoward</code> , <code>nexttowardf</code> , <code>nexttowardl</code>	<code><math.h></code>	<code><math.h></code> or <code><cmath></code>
<code>_nextafter</code>	<code><float.h></code>	<code><float.h></code> or <code><cfloat></code>
<code>nextafter</code> macro, <code>nexttoward</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

See also

[Math and floating-point support](#)

`isnan` , `_isnan` , `_isnanf`

`norm`, `normf`, `norml`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the squared magnitude of a complex number.

Syntax

```
double norm( _Dcomplex z );
float normf( _Fcomplex z );
long double norml( _Lcomplex z );
```

```
float norm( _Fcomplex z ); // C++ only
long double norm( _Lcomplex z ); // C++ only
```

Parameters

`z`

A complex number.

Return value

The squared magnitude of `z`.

Remarks

Because C++ allows overloading, you can call overloads of `norm` that take `_Fcomplex` or `_Lcomplex` values, and return `float` or `long double` values. In a C program, `norm` always takes a `_Dcomplex` value and returns a `double` value.

Requirements

ROUTINE	C HEADER	C++ HEADER
<code>norm</code> , <code>normf</code> , <code>norml</code>	<code><complex.h></code>	<code><complex.h></code>

The `_Fcomplex`, `_Dcomplex`, and `_Lcomplex` types are Microsoft-specific equivalents of the unimplemented native C99 types `float _Complex`, `double _Complex`, and `long double _Complex`, respectively. For more compatibility information, see [Compatibility](#).

See also

Alphabetical function reference

`creal`, `crealf`, `creall`
`cproj`, `cprojf`, `cprojl`
`conj`, `conjf`, `conjl`
`cimag`, `cimags`, `cimagsl`
`carg`, `cargf`, `cargl`
`cabs`, `cabsf`, `cabsl`

not

11/2/2022 • 2 minutes to read • [Edit Online](#)

An alternative to the `!` operator.

Syntax

```
#define not !
```

Remarks

The macro yields the operator `!`.

Example

```
// iso646_not.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 0;

    if (!a)
        cout << "a is zero" << endl;

    if (not(a))
        cout << "a is zero" << endl;
}
```

```
a is zero
a is zero
```

Requirements

Header: `<iso646.h>`

not_eq

11/2/2022 • 2 minutes to read • [Edit Online](#)

An alternative to the `!=` operator.

Syntax

```
#define not_eq !=
```

Remarks

The macro yields the operator `!=`.

Example

```
// iso646_not_eq.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 0, b = 1;

    if (a != b)
        cout << "a is not equal to b" << endl;

    if (a not_eq b)
        cout << "a is not equal to b" << endl;
}
```

```
a is not equal to b
a is not equal to b
```

Requirements

Header: `<iso646.h>`

offsetof Macro

11/2/2022 • 2 minutes to read • [Edit Online](#)

Retrieves the offset of a member from the beginning of its parent structure.

Syntax

```
size_t offsetof(  
    structName,  
    memberName  
)
```

Parameters

`structName`

Name of the parent data structure.

`memberName`

Name of the member in the parent data structure for which to determine the offset.

Return value

`offsetof` returns the offset in bytes of the specified member from the beginning of its parent data structure. It's undefined for bit fields.

Remarks

The `offsetof` macro returns the offset in bytes of `memberName` from the beginning of the structure specified by `structName` as a value of type `size_t`. You can specify types with the `struct` keyword.

NOTE

`offsetof` is not a function and cannot be described using a C prototype.

Requirements

ROUTINE	REQUIRED HEADER
<code>offsetof</code>	<code><stddefh></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

[Memory allocation](#)

`_onexit`, `_onexit_m`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Registers a routine to be called at exit time.

Syntax

```
_onexit_t _onexit(
    _onexit_t function
);
_onexit_t_m _onexit_m(
    _onexit_t_m function
);
```

Parameters

`function`

Pointer to a function to be called at exit.

Return value

`_onexit` returns a pointer to the function if successful or `NULL` if there's no space to store the function pointer.

Remarks

The `_onexit` function is passed the address of a function (`function`) to be called when the program terminates normally. Successive calls to `_onexit` create a register of functions that are executed in LIFO (last-in-first-out) order. The functions passed to `_onexit` can't take parameters.

In the case when `_onexit` is called from within a DLL, routines registered with `_onexit` run when the DLL is unloaded, after `DllMain` is called with `DLL_PROCESS_DETACH`.

`_onexit` is a Microsoft extension. For ANSI portability, use `atexit`. The `_onexit_m` version of the function is for mixed mode use.

Requirements

ROUTINE	REQUIRED HEADER
<code>_onexit</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_onexit.c

#include <stdlib.h>
#include <stdio.h>

/* Prototypes */
int fn1(void), fn2(void), fn3(void), fn4 (void);

int main( void )
{
    _onexit( fn1 );
    _onexit( fn2 );
    _onexit( fn3 );
    _onexit( fn4 );
    printf( "This is executed first.\n" );
}

int fn1()
{
    printf( "next.\n" );
    return 0;
}

int fn2()
{
    printf( "executed " );
    return 0;
}

int fn3()
{
    printf( "is " );
    return 0;
}

int fn4()
{
    printf( "This " );
    return 0;
}
```

Output

```
This is executed first.
This is executed next.
```

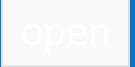
See also

[Process and environment control](#)

[atexit](#)

[exit](#), [_Exit](#), [_exit](#)

[__dлонexit](#)

 open11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `open` is a deprecated alias for the `_open` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_open` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_open`, `_wopen`

11/2/2022 • 6 minutes to read • [Edit Online](#)

Opens a file. These functions are deprecated because more-secure versions are available; see [`_sopen_s`](#), [`_wsopen_s`](#).

Syntax

```
int _open(
    const char *filename,
    int oflag [, 
    int pmode]
);
int _wopen(
    const wchar_t *filename,
    int oflag [, 
    int pmode]
);
```

Parameters

`filename`

File name.

`oflag`

The kind of operations allowed.

`pmode`

Permission mode.

Return value

Each of these functions returns a file descriptor for the opened file. A return value of -1 indicates an error; in that case `errno` is set to one of the following values.

ERRNO	VALUE	CONDITION
<code>EACCES</code>		Tried to open a read-only file for writing, file's sharing mode doesn't allow the specified operations, or the given path is a directory.
<code>EEXIST</code>		<code>_O_CREAT</code> and <code>_O_EXCL</code> flags specified, but <code>filename</code> already exists.
<code>EINVAL</code>		Invalid <code>oflag</code> or <code>pmode</code> argument.
<code>EMFILE</code>		No more file descriptors are available (too many files are open).
<code>ENOENT</code>		File or path not found.

For more information about these and other return codes, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#)

Remarks

The `_open` function opens the file specified by `filename` and prepares it for reading or writing, as specified by `oflag`. `_wopen` is a wide-character version of `_open`; the `filename` argument to `_wopen` is a wide-character string. `_wopen` and `_open` behave identically otherwise.

Generic-text routine mappings

<code><TCHAR.H></code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_topen</code>	<code>_open</code>	<code>_open</code>	<code>_wopen</code>

`oflag` is an integer expression formed from one or more of the following manifest constants or constant combinations, which are defined in `<fcntl.h>`.

<code>OFLAG</code> CONSTANT	BEHAVIOR
<code>_O_APPEND</code>	Moves the file pointer to the end of the file before every write operation.
<code>_O_BINARY</code>	Opens the file in binary (untranslated) mode. (See <code>fopen</code> for a description of binary mode.)
<code>_O_CREAT</code>	Creates a file and opens it for writing. Has no effect if the file specified by <code>filename</code> exists. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified.
<code>_O_CREAT _O_SHORT_LIVED</code>	Creates a file as temporary and if possible doesn't flush to disk. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified.
<code>_O_CREAT _O_TEMPORARY</code>	Creates a file as temporary; the file is deleted when the last file descriptor is closed. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified. To preserve legacy behavior for app-compatibility, other processes aren't prevented from deleting this file.
<code>_O_CREAT _O_EXCL</code>	Returns an error value if a file specified by <code>filename</code> exists. Applies only when used with <code>_O_CREAT</code> .
<code>_O_NOINHERIT</code>	Prevents creation of a shared file descriptor.
<code>_O_RANDOM</code>	Specifies that caching is optimized for, but not restricted to, random access from disk.
<code>_O_RDONLY</code>	Opens a file for reading only. Can't be specified with <code>_O_RDWR</code> or <code>_O_WRONLY</code> .
<code>_O_RDWR</code>	Opens a file for both reading and writing. Can't be specified with <code>_O_RDONLY</code> or <code>_O_WRONLY</code> .

<code>OFLAG</code> CONSTANT	BEHAVIOR
<code>_O_SEQUENTIAL</code>	Specifies that caching is optimized for, but not restricted to, sequential access from disk.
<code>_O_TEXT</code>	Opens a file in text (translated) mode. (For more information, see Text and binary mode file I/O and <code>fopen</code> .)
<code>_O_TRUNC</code>	Opens a file and truncates it to zero length; the file must have write permission. Can't be specified with <code>_O_RDONLY</code> . <code>_O_TRUNC</code> used with <code>_O_CREAT</code> opens an existing file or creates a file. Note: The <code>_O_TRUNC</code> flag destroys the contents of the specified file.
<code>_O_WRONLY</code>	Opens a file for writing only. Can't be specified with <code>_O_RDONLY</code> or <code>_O_RDWR</code> .
<code>_O_U16TEXT</code>	Opens a file in Unicode UTF-16 mode.
<code>_O_U8TEXT</code>	Opens a file in Unicode UTF-8 mode.
<code>_O_WTEXT</code>	Opens a file in Unicode mode.

To specify the file access mode, you must specify either `_O_RDONLY`, `_O_RDWR`, or `_O_WRONLY`. There's no default value for the access mode.

If `_O_WTEXT` is used to open a file for reading, `_open` reads the beginning of the file and checks for a byte order mark (BOM). If there's a BOM, the file is treated as UTF-8 or UTF-16LE, depending on the BOM. If no BOM is present, the file is treated as ANSI. When a file is opened for writing by using `_O_WTEXT`, UTF-16 is used.

Regardless of any previous setting or byte order mark, if `_O_U8TEXT` is used, the file is always opened as UTF-8; if `_O_U16TEXT` is used, the file is always opened as UTF-16.

When a file is opened in Unicode mode by using `_O_WTEXT`, `_O_U8TEXT`, or `_O_U16TEXT`, input functions translate the data that's read from the file into UTF-16 data stored as type `wchar_t`. Functions that write to a file opened in Unicode mode expect buffers that contain UTF-16 data stored as type `wchar_t`. If the file is encoded as UTF-8, then UTF-16 data is translated into UTF-8 when it's written. The file's UTF-8-encoded content is translated into UTF-16 when it's read. An attempt to read or write an odd number of bytes in Unicode mode causes a parameter validation error. To read or write data that's stored in your program as UTF-8, use a text or binary file mode instead of a Unicode mode. You're responsible for any required encoding translation.

If `_open` is called with `_O_WRONLY | _O_APPEND` (append mode) and `_O_WTEXT`, `_O_U16TEXT`, or `_O_U8TEXT`, it first tries to open the file for reading and writing, read the BOM, then reopen it for writing only. If opening the file for reading and writing fails, it opens the file for writing only and uses the default value for the Unicode mode setting.

When two or more manifest constants are used to form the `oflag` argument, the constants are combined with the bitwise-OR operator (`|`). For a discussion of binary and text modes, see [Text and binary mode file I/O](#).

The `pmode` argument is required only when `_O_CREAT` is specified. If the file already exists, `pmode` is ignored. Otherwise, `pmode` specifies the file permission settings, which are set when the new file is closed the first time. `_open` applies the current file-permission mask to `pmode` before the permissions are set. (For more information, see [`_umask`](#).) `pmode` is an integer expression that contains one or both of the following manifest constants, which are defined in `<sys\stat.h>`.

<code>pMode</code>	MEANING
<code>_S_IREAD</code>	Only reading permitted.
<code>_S_IWRITE</code>	Writing permitted. (In effect, permits reading and writing.)
<code>_S_IREAD _S_IWRITE</code>	Reading and writing permitted.

When both constants are given, they're joined with the bitwise-OR operator (`|`). In Windows, all files are readable; write-only permission isn't available. Therefore, the modes `_S_IWRITE` and `_S_IREAD | _S_IWRITE` are equivalent.

If a value other than some combination of `_S_IREAD` and `_S_IWRITE` is specified for `pmode`—even if it would specify a valid `pmode` in another operating system—or if any value other than the allowed `oflag` values is specified, the function generates an assertion in Debug mode and invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EINVAL`.

Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_open</code>	<code><iostream.h></code>	<code><fcntl.h></code> , <code><sys\types.h></code> , <code><sys\stat.h></code>
<code>_wopen</code>	<code><iostream.h></code> or <code><wchar.h></code>	<code><fcntl.h></code> , <code><sys\types.h></code> , <code><sys\stat.h></code>

`_open` and `_wopen` are Microsoft extensions. For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_open.c
// compile with: /W3
/* This program uses _open to open a file
 * named CRT_OPEN.C for input and a file named CRT_OPEN.OUT
 * for output. The files are then closed.
 */
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <io.h>
#include <stdio.h>

int main( void )
{
    int fh1, fh2;

    fh1 = _open( "CRT_OPEN.C", _O_RDONLY ); // C4996
    // Note: _open is deprecated; consider using _sopen_s instead
    if( fh1 == -1 )
        perror( "Open failed on input file" );
    else
    {
        printf( "Open succeeded on input file\n" );
        _close( fh1 );
    }

    fh2 = _open( "CRT_OPEN.OUT",
                _O_WRONLY | _O_CREAT,
                _S_IREAD | _S_IWRITE ); // C4996
    if( fh2 == -1 )
        perror( "Open failed on output file" );
    else
    {
        printf( "Open succeeded on output file\n" );
        _close( fh2 );
    }
}

```

Output

```

Open succeeded on input file
Open succeeded on output file

```

See also

Low-level I/O

_chmod	_wchmod
_close	
_creat	_wcreat
_dup	_dup2
_fopen	_wfopen
_sopen	_wsopen

_open_osfhandle

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Associates a C run-time file descriptor with an existing operating system file handle.

Syntax

```
int _open_osfhandle (
    intptr_t osfhandle,
    int flags
);
```

Parameters

`osfhandle`

Operating system file handle.

`flags`

Types of operations allowed.

Return value

If successful, `_open_osfhandle` returns a C run-time file descriptor. Otherwise, it returns -1.

Remarks

The `_open_osfhandle` function allocates a C run-time file descriptor. It associates this file descriptor with the operating system file handle specified by `osfhandle`. To avoid a compiler warning, cast the `osfhandle` argument from `HANDLE` to `intptr_t`. The `flags` argument is an integer expression formed from one or more of the manifest constants defined in `<fcntl.h>`. You can use the bitwise "or" (`|`) operator to combine two or more manifest constants to form the `flags` argument.

These manifest constants are defined in `<fcntl.h>`:

CONSTANT	DESCRIPTION
<code>_O_APPEND</code>	Positions a file pointer to the end of the file before every write operation.
<code>_O_RDONLY</code>	Opens the file for reading only.
<code>_O_TEXT</code>	Opens the file in text (translated) mode.
<code>_O_WTEXT</code>	Opens the file in Unicode (translated UTF-16) mode.

The `_open_osfhandle` call transfers ownership of the Win32 file handle to the file descriptor. To close a file opened by using `_open_osfhandle`, call `_close`. The underlying OS file handle is also closed by a call to `_close`. Don't call the Win32 function `CloseHandle` on the original handle. If the file descriptor is owned by a `FILE *` stream, then a call to `fclose` closes both the file descriptor and the underlying handle. In this case, don't call `_close` on the file descriptor or `CloseHandle` on the original handle.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_open_osfhandle</code>	<code><io.h></code>

For more compatibility information, see [Compatibility](#).

See also

File handling

[`_get_osfhandle`](#)

or_eq

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An alternative to the `|=` operator.

Syntax

```
#define or_eq |=
```

Remarks

The macro yields the operator `|=`.

Example

```
// iso646_oreq.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    int a = 3, b = 2, result;

    result= a |= b;
    cout << result << endl;

    result= a or_eq b;
    cout << result << endl;
}
```

```
3
3
```

Requirements

Header: `<iso646.h>`



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An alternative to the `||` operator.

Syntax

```
#define or ||
```

Remarks

The macro yields the operator `||`.

Example

```
// iso646_or.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main( )
{
    using namespace std;
    bool a = true, b = false, result;

    boolalpha(cout);

    result= a || b;
    cout << result << endl;

    result= a or b;
    cout << result << endl;
}
```

```
true
true
```

Requirements

Header: <iso646.h>

_pclose

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Waits for a new command processor and closes the stream on the associated pipe.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _pclose(  
FILE *stream  
)
```

Parameters

`stream`

Return value from the previous call to `_popen`.

Return value

Returns the exit status of the terminating command processor, or -1 if an error occurs. The format of the return value is the same as for `_cwait`, except the low-order and high-order bytes are swapped. If `stream` is `NULL`, `_pclose` sets `errno` to `EINVAL` and returns -1.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_pclose` function looks up the process ID of the command processor (Cmd.exe) started by the associated `_popen` call, executes a `_cwait` call on the new command processor, and closes the stream on the associated pipe.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_pclose</code>	<code><stdio.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

Process and environment control

[_pipe](#)

[_popen](#) , [_wpopen](#)

`perror`, `_wperror`

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Print an error message.

Syntax

```
void perror(
    const char *message
);
void _wperror(
    const wchar_t *message
);
```

Parameters

`message`

String message to print.

Remarks

The `perror` function prints an error message to `stderr`. `_wperror` is a wide-character version of `_perror`; the `message` argument to `_wperror` is a wide-character string. `_wperror` and `_perror` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tperror</code>	<code>perror</code>	<code>perror</code>	<code>_wperror</code>

`message` is printed first, followed by a colon, then by the system error message for the last library call that produced the error, and finally by a newline character. If `message` is a null pointer or a pointer to a null string, `perror` prints only the system error message.

The error number is stored in the variable `errno` (defined in `ERRNO.H`). The system error messages are accessed through the variable `_sys_errlist`, which is an array of messages ordered by error number. `perror` prints the appropriate error message using the `errno` value as an index to `_sys_errlist`. The value of the variable `_sys_nerr` is defined as the maximum number of elements in the `_sys_errlist` array.

For accurate results, call `perror` immediately after a library routine returns an error. Otherwise, subsequent calls can overwrite the `errno` value.

In the Windows operating system, some `errno` values listed in `ERRNO.H` are unused. These values are reserved for use by the UNIX operating system. See `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr` for a listing of `errno` values used by the Windows operating system. `perror` prints an empty string for any `errno` value not used by these platforms.

Requirements

ROUTINE	REQUIRED HEADER
<code>perror</code>	<code><stdio.h></code> or <code><stdlib.h></code>
<code>_w perror</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_perror.c
// compile with: /W3
/* This program attempts to open a file named
* NOSUCHFILE. Because this file probably doesn't exist,
* an error message is displayed. The same message is
* created using perror, strerror, and _strerror.
*/
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <io.h>
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <share.h>

int main( void )
{
    int fh;

    if( _sopen_s( &fh, "NOSUCHFILE", _O_RDONLY, _SH_DENYNO, 0 ) != 0 )
    {
        /* Three ways to create error message: */
        perror( "perror says open failed" );
        printf( "strerror says open failed: %s\n",
            strerror( errno ) ); // C4996
        printf( _strerror( "_strerror says open failed" ) ); // C4996
        // Note: strerror and _strerror are deprecated; consider
        // using strerror_s and _strerror_s instead.
    }
    else
    {
        printf( "open succeeded on input file\n" );
        _close( fh );
    }
}
```

```
perror says open failed: No such file or directory
strerror says open failed: No such file or directory
_strerror says open failed: No such file or directory
```

See also

Process and environment control

[clearerr](#)

[ferror](#)

[strerror](#) , [_strerror](#) , [_wcstrlen](#) , [__wcstrlen](#)

Creates a pipe for reading and writing.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _pipe(  
    int *pfds,  
    unsigned int psize,  
    int textmode  
) ;
```

Parameters

`pfds`

Pointer to an array of two `int` to hold read and write file descriptors.

`psize`

Amount of memory to reserve.

`textmode`

File mode.

Return value

Returns 0 if successful. Returns -1 to indicate an error. On error, `errno` is set to one of these values:

- `EMFILE`, which indicates that no more file descriptors are available.
- `ENFILE`, which indicates a system-file-table overflow.
- `EINVAL`, which indicates that either the array `pfds` is a null pointer or that an invalid value for `textmode` was passed in.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`

Remarks

The `_pipe` function creates a *pipe*, which is an artificial I/O channel that a program uses to pass information to other programs. A pipe resembles a file, because it has a file pointer, a file descriptor, or both. And, it can be read from or written to by using the Standard Library input and output functions. However, a pipe doesn't represent a specific file or device. Instead, it represents temporary storage in memory that is independent of the program's own memory and is controlled entirely by the operating system.

`_pipe` resembles `_open` but opens the pipe for reading and writing and returns two file descriptors instead of

one. The program can use both sides of the pipe or close the one that it doesn't need. For example, the command processor in Windows creates a pipe when it executes a command such as `PROGRAM1 | PROGRAM2`.

The standard output descriptor of `PROGRAM1` is attached to the pipe's write descriptor. The standard input descriptor of `PROGRAM2` is attached to the pipe's read descriptor. This attachment eliminates the need to create temporary files to pass information to other programs.

The `_pipe` function returns two file descriptors to the pipe in the `pfds` argument. The element `pfds[0]` contains the read descriptor, and the element `pfds[1]` contains the write descriptor. Pipe file descriptors are used in the same way as other file descriptors. (The low-level input and output functions `_read` and `_write` can read from and write to a pipe.) To detect the end-of-pipe condition, check for a `_read` request that returns 0 as the number of bytes read.

The `psize` argument specifies the amount of memory, in bytes, to reserve for the pipe. The `textmode` argument specifies the translation mode for the pipe. The manifest constant `_O_TEXT` specifies a text translation, and the constant `_O_BINARY` specifies binary translation. (See `fopen`, `wfopen` for a description of text and binary modes.) If the `textmode` argument is 0, `_pipe` uses the default translation mode that's specified by the default-mode variable `_fmode`.

In multithreaded programs, no locking is performed. The file descriptors that are returned are newly opened and shouldn't be referenced by any thread until after the `_pipe` call is complete.

To use the `_pipe` function to communicate between a parent process and a child process, each process must have only one descriptor open on the pipe. The descriptors must be opposites: if the parent has a read descriptor open, then the child must have a write descriptor open. It's easiest to use a bitwise "or" (`|`) on the `_O_NOINHERIT` flag with `textmode`. Then, use `_dup` or `_dup2` to create an inheritable copy of the pipe descriptor that you want to pass to the child. Close the original descriptor, and then spawn the child process. On returning from the spawn call, close the duplicate descriptor in the parent process. For more information, see example 2 later in this article.

In the Windows operating system, a pipe is destroyed when all of its descriptors have been closed. (If all read descriptors on the pipe have been closed, then writing to the pipe causes an error.) All read and write operations on the pipe wait until there's enough data or enough buffer space to complete the I/O request.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_pipe</code>	<code><io.h></code>	<code><fcntl.h></code> ¹ , <code><errno.h></code> ²

¹ For `_O_BINARY` and `_O_TEXT` definitions.

² `errno` definitions.

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example 1

```

// crt_pipe.c
/* This program uses the _pipe function to pass streams of
 * text to spawned processes.
*/
#include <stdlib.h>
#include <stdio.h>
#include <io.h>
#include <fcntl.h>
#include <process.h>
#include <math.h>

enum PIPES { READ, WRITE }; /* Constants 0 and 1 for READ and WRITE */
#define NUMPROBLEM 8

int main( int argc, char *argv[] )
{
    int fdpipe[2];
    char hstr[20];
    int pid, problem, c;
    int termstat;

    /* If no arguments, this is the spawning process */
    if( argc == 1 )
    {
        setvbuf( stdout, NULL, _IONBF, 0 );

        /* Open a set of pipes */
        if( _pipe( fdpipe, 256, 0_BINARY ) == -1 )
            exit( 1 );

        /* Convert pipe read descriptor to string and pass as argument
         * to spawned program. Program spawns itself (argv[0]). */
        /* */
        _itoa_s( fdpipe[READ], hstr, sizeof(hstr), 10 );
        if( ( pid = _spawnl( P_NOWAIT, argv[0], argv[0],
            hstr, NULL ) ) == -1 )
            printf( "Spawn failed" );

        /* Put problem in write pipe. Since spawned program is
         * running simultaneously, first solutions may be done
         * before last problem is given.
        */
        for( problem = 1000; problem <= NUMPROBLEM * 1000; problem += 1000 )
        {
            printf( "Son, what is the square root of %d?\n", problem );
            _write( fdpipe[WRITE], (char *)&problem, sizeof( int ) );
        }

        /* Wait until spawned program is done processing. */
        _cwait( &termstat, pid, WAIT_CHILD );
        if( termstat & 0x0 )
            printf( "Child failed\n" );

        _close( fdpipe[READ] );
        _close( fdpipe[WRITE] );
    }

    /* If there is an argument, this must be the spawned process. */
    else
    {
        /* Convert passed string descriptor to integer descriptor. */
        fdpipe[READ] = atoi( argv[1] );
    }
}

```

```

/* Read problem from pipe and calculate solution. */
for( c = 0; c < NUMPROBLEM; c++ )
{
    _read( fdpipe[READ], (char *)&problem, sizeof( int ) );
    printf( "Dad, the square root of %d is %3.2f.\n",
            problem, sqrt( ( double )problem ) );
}

}
}

```

```

Son, what is the square root of 1000?
Son, what is the square root of 2000?
Son, what is the square root of 1000 is 31.62.
Dad, the square root of 2000 is 44.72.
Son, what is the square root of 3000?
Dad, the square root of 3000 is 54.77.
Son, what is the square root of 4000?
Dad, the square root of 4000 is 63.25.
Son, what is the square root of 5000?
Dad, the square root of 5000 is 70.71.
Son, what is the square root of 6000?
SonDad, the square root of 6000 is 77.46.
, what is the square root of 7000?
Dad, the square root of 7000 is 83.67.
Son, what is the square root of 8000?
Dad, the square root of 8000 is 89.44.

```

Example 2

The sample code is a basic filter application. It spawns the application `crt_pipe_beeper` after it creates a pipe that directs the spawned application's `stdout` to the filter. The filter removes ASCII 7 (beep) characters.

```

// crt_pipe_beeper.c

#include <stdio.h>
#include <string.h>

int main()
{
    int i;
    for(i=0;i<10;++i)
    {
        printf("This is speaker beep number %d...\n\b", i+1);
    }
    return 0;
}

```

The actual filter application:

```

// crt_pipe_BeepFilter.C
// arguments: crt_pipe_beeper.exe

#include <windows.h>
#include <process.h>
#include <memory.h>
#include <string.h>
#include <stdio.h>
#include <fcntl.h>
#include <io.h>

```

```

#define OUT_BUFF_SIZE 512
#define READ_FD 0
#define WRITE_FD 1
#define BEEP_CHAR 7

char szBuffer[OUT_BUFF_SIZE];

int Filter(char* szBuff, ULONG nSize, int nChar)
{
    char* szPos = szBuff + nSize -1;
    char* szEnd = szPos;
    int nRet = nSize;

    while (szPos > szBuff)
    {
        if (*szPos == nChar)
        {
            memmove(szPos, szPos+1, szEnd - szPos);
            --nRet;
        }
        --szPos;
    }
    return nRet;
}

int main(int argc, char** argv)
{
    int nExitCode = STILL_ACTIVE;
    if (argc >= 2)
    {
        HANDLE hProcess;
        int fdStdOut;
        int fdStdOutPipe[2];

        // Create the pipe
        if(_pipe(fdStdOutPipe, 512, _O_NOINHERIT) == -1)
            return 1;

        // Duplicate stdout file descriptor (next line will close original)
        fdStdOut = _dup(_fileno(stdout));

        // Duplicate write end of pipe to stdout file descriptor
        if(_dup2(fdStdOutPipe[WRITE_FD], _fileno(stdout)) != 0)
            return 2;

        // Close original write end of pipe
        _close(fdStdOutPipe[WRITE_FD]);

        // Spawn process
        hProcess = (HANDLE)_spawnvp(P_NOWAIT, argv[1],
                                     (const char* const*)&argv[1]);

        // Duplicate copy of original stdout back into stdout
        if(_dup2(fdStdOut, _fileno(stdout)) != 0)
            return 3;

        // Close duplicate copy of original stdout
        _close(fdStdOut);

        if(hProcess)
        {
            int nOutRead;
            while  (nExitCode == STILL_ACTIVE)
            {
                nOutRead = _read(fdStdOutPipe[READ_FD],
                                szBuffer, OUT_BUFF_SIZE);
                if(nOutRead)
                {

```

```
    nOutRead = Filter(szBuffer, nOutRead, BEEP_CHAR);
    fwrite(szBuffer, 1, nOutRead, stdout);
}

if(!GetExitCodeProcess(hProcess,(unsigned long*)&nExitCode))
    return 4;
}
}

return nExitCode;
}
```

```
This is speaker beep number 1...
This is speaker beep number 2...
This is speaker beep number 3...
This is speaker beep number 4...
This is speaker beep number 5...
This is speaker beep number 6...
This is speaker beep number 7...
This is speaker beep number 8...
This is speaker beep number 9...
This is speaker beep number 10...
```

See also

[Process and environment control](#)

[_open](#) , [_wopen](#)

`_popen`, `_wpopen`

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Creates a pipe and executes a command.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
FILE *_popen(
    const char *command,
    const char *mode
);
FILE *_wpopen(
    const wchar_t *command,
    const wchar_t *mode
);
```

Parameters

`command`

Command to be executed.

`mode`

Mode of the returned stream.

Return value

Returns a stream associated with one end of the created pipe. The other end of the pipe is associated with the spawned command's standard input or standard output. The functions return `NULL` on an error. If the error is caused by an invalid parameter, `errno` is set to `EINVAL`. See the Remarks section for valid modes.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_popen` function creates a pipe. It then asynchronously executes a spawned copy of the command processor, and uses `command` as the command line. The character string `mode` specifies the type of access requested, as follows.

ACCESS MODE	DESCRIPTION
" <code>r</code> "	The calling process can read the spawned command's standard output using the returned stream.
" <code>w</code> "	The calling process can write to the spawned command's standard input using the returned stream.

ACCESS MODE	DESCRIPTION
" <code>b</code> "	Open in binary mode.
" <code>t</code> "	Open in text mode.

NOTE

If used in a Windows program, the `_popen` function returns an invalid file pointer that causes the program to stop responding indefinitely. `_popen` works properly in a console application. To create a Windows application that redirects input and output, see [Creating a child process with redirected input and output](#) in the Windows SDK.

`_wpopen` is a wide-character version of `_popen`; the `path` argument to `_wpopen` is a wide-character string. `_wpopen` and `_popen` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tpopen</code>	<code>_popen</code>	<code>_popen</code>	<code>_wpopen</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_popen</code>	<code><stdio.h></code>
<code>_wpopen</code>	<code><stdio.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```

// crt_popen.c
/* This program uses _popen and _pclose to receive a
 * stream of text from a system process.
 */
#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    char    psBuffer[128];
    FILE   *pPipe;

    /* Run DIR so that it writes its output to a pipe. Open this
     * pipe with read text attribute so that we can read it
     * like a text file.
    */

    if( (pPipe = _popen( "dir *.c /on /p", "rt" )) == NULL )
        exit( 1 );

    /* Read pipe until end of file, or an error occurs. */

    while(fgets(psBuffer, 128, pPipe))
    {
        puts(psBuffer);
    }

    /* Close pipe and print return value of pPipe. */
    if (feof( pPipe))
    {
        printf( "\nProcess returned %d\n", _pclose( pPipe ) );
    }
    else
    {
        printf( "Error: Failed to read the pipe to the end.\n");
    }
}

```

This output assumes there's only one file in the current directory that has a `.c` file name extension.

```

Volume in drive C is CDRIVE
Volume Serial Number is 0E17-1702

Directory of D:\proj\console\test1

07/17/98  07:26p          780  popen.c
               1 File(s)      780 bytes
                           86,597,632 bytes free

Process returned 0

```

See also

[Process and environment control](#)

[`_pclose`](#)

[`_pipe`](#)

`pow`, `powf`, `powl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates x raised to the power of y .

Syntax

```
double pow( double x, double y );
float powf( float x, float y );
long double powl( long double x, long double y );
#define pow(X, Y) // Requires C11 or higher

double pow( double x, int y ); // C++ only
float pow( float x, float y ); // C++ only
float pow( float x, int y ); // C++ only
long double pow( long double x, long double y ); // C++ only
long double pow( long double x, int y ); // C++ only
```

Parameters

x

Base.

y

Exponent.

Return value

Returns the value of x^y . No error message is printed on overflow or underflow.

VALUES OF x AND y	RETURN VALUE OF <code>pow</code>
$x \neq 0.0$ and $y == 0.0$	1
$x == 0.0$ and $y == 0.0$	1
$x == 0.0$ and $y < 0$	INF

Remarks

`pow` doesn't recognize integral floating-point values greater than 2^{64} (for example, 1.0E100).

`pow` has an implementation that uses Streaming SIMD Extensions 2 (SSE2). For information and restrictions about using the SSE2 implementation, see [_set_SSE2_enable](#).

Because C++ allows overloading, you can call any of the various overloads of `pow`. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `pow` always takes two `double` values and returns a `double` value.

If you use the `pow` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

The `pow(int, int)` overload is no longer available. If you use this overload, the compiler may emit [C2668](#). To avoid this problem, cast the first parameter to `double`, `float`, or `long double`.

Originally, the `pow(T, int)` overloads unrolled the `pow` call into a sequence of inline multiplication operations. While it was faster, it was also much less accurate. This implementation was removed in Visual Studio 2015 Update 1. For more information, see [Conformance improvements in Visual Studio 2015 Update 1](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>pow</code> , <code>powf</code> , <code>powl</code>	<code><math.h></code>	<code><math.h></code> or <code><cmath></code>
<code>pow</code> macro	<code><tgmath.h></code>	

For more compatibility information, see [Compatibility](#).

Example

```
// crt_pow.c

#include <math.h>
#include <stdio.h>

int main( void )
{
    double x = 2.0, y = 3.0, z;

    z = pow( x, y );
    printf( "%.1f to the power of %.1f is %.1f\n", x, y, z );
}
```

```
2.0 to the power of 3.0 is 8.0
```

See also

[Math and floating-point support](#)

`exp`, `expf`, `expl`
`log`, `logf`, `log10`, `log10f`
`sqrt`, `sqrtf`, `sqrtn`
`_CIpow`

`printf`, `_printf_l`, `wprintf`, `_wprintf_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Prints formatted output to the standard output stream. More secure versions of these functions are available; see `printf_s`, `_printf_s_l`, `wprintf_s`, `_wprintf_s_l`.

Syntax

```
int printf(
    const char *format [,,
    argument]...
);
int _printf_l(
    const char *format,
    _locale_t locale [,,
    argument]...
);
int wprintf(
    const wchar_t *format [,,
    argument]...
);
int _wprintf_l(
    const wchar_t *format,
    _locale_t locale [,,
    argument]...
);
```

Parameters

`format`

Format control.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

Returns the number of characters printed, or a negative value if an error occurs. If `format` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EINVAL`. If `EOF` (0xFFFF) is encountered in `argument`, the function returns -1.

For information on `errno` and error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `printf` function formats and prints a series of characters and values to the standard output stream, `stdout`. If arguments follow the `format` string, the `format` string must contain specifications that determine the output format for the arguments. `printf` and `fprintf` behave identically except that `printf` writes output to `stdout` rather than to a destination of type `FILE`.

`wprintf` is a wide-character version of `printf`; `format` is a wide-character string. `wprintf` and `printf` behave identically if the stream is opened in ANSI mode. `printf` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

The `format` argument consists of ordinary characters, escape sequences, and (if arguments follow `format`) format specifications. The ordinary characters and escape sequences are copied to `stdout` in order of their appearance. For example, the line:

```
printf("Line one\n\t\tLine two\n");
```

produces the output:

```
Line one
    Line two
```

Format specifications always begin with a percent sign (%) and are read left to right. When `printf` encounters the first format specification (if any), it converts the value of the first argument after `format` and outputs it accordingly. The second format specification causes the second argument to be converted and output, and so on. If there are more arguments than there are format specifications, the extra arguments are ignored. The results are undefined if there aren't enough arguments for all the format specifications.

IMPORTANT

Ensure that `format` is not a user-defined string.

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tprintf</code>	<code>printf</code>	<code>printf</code>	<code>wprintf</code>
<code>_tprintf_1</code>	<code>_printf_1</code>	<code>_printf_1</code>	<code>_wprintf_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>printf</code> , <code>_printf_1</code>	<code><stdio.h></code>
<code>wprintf</code> , <code>_wprintf_1</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

Example

```

// crt_printf.c
// This program uses the printf and wprintf functions
// to produce formatted output.

#include <stdio.h>

int main( void )
{
    char      ch = 'h',
              *string = "computer";
    wchar_t   wch = L'w',
              *wstring = L"Unicode";
    int       count = -9234;
    double    fp = 251.7366;

    // Display integers
    printf( "Integer formats:\n"
            "    Decimal: %d  Justified: %.6d  "
            "Unsigned: %u\n",
            count, count, count, count );

    // Display decimals
    printf( "Decimal %d as:\n    Hex: %xh  "
            "C hex: 0x%x  Octal: %o\n",
            count, count, count, count );

    // Display in different radices
    printf( "Digits 10 equal:\n    Hex: %i  "
            "Octal: %i  Decimal: %i\n",
            0x10, 010, 10 );

    // Display characters
    printf("Characters in field (1):\n"
          "%10c%5hc%5C%5lc\n",
          ch, ch, wch, wch);
    wprintf(L"Characters in field (2):\n"
           L"%10C%5hc%5c%5lc\n",
           ch, ch, wch, wch);

    // Display strings
    printf("Strings in field (1):\n%25s\n"
          "%25.4hs\n    %S%25.3ls\n",
          string, string, wstring, wstring);
    wprintf(L"Strings in field (2):\n%25S\n"
           L"%25.4hs\n    %s%25.3ls\n",
           string, string, wstring, wstring);

    // Display real numbers
    printf("Real numbers:\n    %f %.2f %e %E\n",
           fp, fp, fp, fp );

    // Display pointer
    printf( "\nAddress as:  %p\n", &count);
}

```

Sample output

```
Integer formats:  
    Decimal: -9234  Justified: -009234  Unsigned: 4294958062  
Decimal -9234 as:  
    Hex: FFFFDBEEh  C hex: 0xffffdbee  Octal: 37777755756  
Digits 10 equal:  
    Hex: 16  Octal: 8  Decimal: 10  
Characters in field (1):  
    h     h     w     w  
Characters in field (2):  
    h     h     w     w  
Strings in field (1):  
    computer  
    comp  
    Unicode          Uni  
Strings in field (2):  
    computer  
    comp  
    Unicode          Uni  
Real numbers:  
    251.736600 251.74 2.517366e+002 2.517366E+002  
Address as: 0012FF3C
```

See also

Format specification syntax: [printf](#) and [wprintf](#) functions

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

[_fopen](#), [_wfopen](#)
[_fprintf_p](#), [_fprintf_p_l](#), [_fwprintf_p](#), [_fwprintf_p_l](#)
[scanf](#), [_scanf_l](#), [wscanf](#), [_wscanf_l](#)
[sprintf](#), [_sprintf_l](#), [swprintf](#), [_swprintf_l](#), [__swprintf_l](#)
[vprintf](#) functions
[_set_output_format](#)

`_printf_p`, `_printf_p_l`, `_wprintf_p`,
`_wprintf_p_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Prints formatted output to the standard output stream, and enables specification of the order in which parameters are used in the format string.

Syntax

```
int _printf_p(
    const char *format [,,
    argument]...
);
int _printf_p_l(
    const char *format,
    _locale_t locale [,,
    argument]...
);
int _wprintf_p(
    const wchar_t *format [,,
    argument]...
);
int _wprintf_p_l(
    const wchar_t *format,
    _locale_t locale [,,
    argument]...
);
```

Parameters

`format`

Format control.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

Returns the number of characters printed or a negative value if an error occurs.

Remarks

The `_printf_p` function formats and prints a series of characters and values to the standard output stream, `stdout`. If arguments follow the `format` string, the `format` string must contain specifications that determine the output format for the arguments (see [printf_p Positional Parameters](#)).

The difference between `_printf_p` and `printf_s` is that `_printf_p` supports positional parameters, which allows specifying the order in which the arguments are used in the format string. For more information, see [printf_p Positional Parameters](#).

`_wprintf_p` is the wide-character version of `_printf_p`; they behave identically if the stream is opened in ANSI mode. `_printf_p` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

IMPORTANT

Ensure that `format` is not a user-defined string.

If `format` or `argument` are `NULL`, or of the format string contains invalid formatting characters, `_printf_p` and `_wprintf_p` functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EINVAL`.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tprintf_p</code>	<code>_printf_p</code>	<code>_printf_p</code>	<code>_wprintf_p</code>
<code>_tprintf_p_1</code>	<code>_printf_p_1</code>	<code>_printf_p_1</code>	<code>_wprintf_p_1</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_printf_p</code> , <code>_printf_p_1</code>	<code><stdio.h></code>
<code>_wprintf_p</code> , <code>_wprintf_p_1</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

Example

```
// crt_printf_p.c
// This program uses the _printf_p and _wprintf_p
// functions to choose the order in which parameters
// are used.

#include <stdio.h>

int main( void )
{
    // Positional arguments
    _printf_p( "Specifying the order: %2$s %3$s %1$s %4$s %5$s.\n",
               "little", "I'm", "a", "tea", "pot");

    // Resuse arguments
    _wprintf_p( L"Reusing arguments: %1$d %1$d %1$d %1$d\n", 10);

    // Width argument
    _printf_p("Width specifiers: %1$*2$s", "Hello\n", 10);
}
```

```
Specifying the order: I'm a little tea pot.
Reusing arguments: 10 10 10 10
Width specifiers: Hello
```

See also

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

[fopen](#) , [_wfopen](#)
[_fprintf_p](#) , [_fprintf_p_l](#) , [_fwprintf_p](#) , [_fwprintf_p_l](#)
[fprintf](#) , [_fprintf_l](#) , [fwprintf](#) , [_fwprintf_l](#)
[fprintf_s](#) , [_fprintf_s_l](#) , [fwprintf_s](#) , [_fwprintf_s_l](#)
[scanf](#) , [_scanf_l](#) , [wscanf](#) , [_wscanf_l](#)
[scanf_s](#) , [_scanf_s_l](#) , [wscanf_s](#) , [_wscanf_s_l](#)
[_sprintf_p](#) , [_sprintf_p_l](#) , [_swprintf_p](#) , [_swprintf_p_l](#)
[sprintf](#) , [_sprintf_l](#) , [swprintf](#) , [_swprintf_l](#) , [_swprintf_l](#)
[sprintf_s](#) , [_sprintf_s_l](#) , [swprintf_s](#) , [_swprintf_s_l](#)
[vprintf](#) functions

`printf_s`, `_printf_s_l`, `wprintf_s`, `_wprintf_s_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Prints formatted output to the standard output stream. These versions of `printf`, `_printf_l`, `wprintf`, `_wprintf_l` have security enhancements, as described in [Security features in the CRT](#).

Syntax

```
int printf_s(
    const char *format [,,
    argument]...
);
int _printf_s_l(
    const char *format,
    _locale_t locale [,,
    argument]...
);
int wprintf_s(
    const wchar_t *format [,,
    argument]...
);
int _wprintf_s_l(
    const wchar_t *format,
    _locale_t locale [,,
    argument]...
);
```

Parameters

`format`

Format control.

`argument`

Optional arguments.

`Locale`

The locale to use.

Return value

Returns the number of characters printed, or a negative value if an error occurs.

Remarks

The `printf_s` function formats and prints a series of characters and values to the standard output stream, `stdout`. If arguments follow the `format` string, the `format` string must contain specifications that determine the output format for the arguments.

The main difference between `printf_s` and `printf` is that `printf_s` checks the format string for valid formatting characters, whereas `printf` only checks if the format string is a null pointer. If either check fails, an invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EINVAL`.

For information on `errno` and error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

`printf_s` and `fprintf_s` behave identically except that `printf_s` writes output to `stdout` rather than to a destination of type `FILE`. For more information, see [fprintf_s](#), [_fprintf_s_l](#), [fwprintf_s](#), [_fwprintf_s_l](#).

`wprintf_s` is a wide-character version of `printf_s`; `format` is a wide-character string. `wprintf_s` and `printf_s` behave identically if the stream is opened in ANSI mode. `printf_s` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_l` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tprintf_s</code>	<code>printf_s</code>	<code>printf_s</code>	<code>wprintf_s</code>
<code>_tprintf_s_l</code>	<code>_printf_s_l</code>	<code>_printf_s_l</code>	<code>_wprintf_s_l</code>

The `format` argument consists of ordinary characters, escape sequences, and (if arguments follow `format`) format specifications. The ordinary characters and escape sequences are copied to `stdout` in order of their appearance. For example, the line

```
printf_s("Line one\n\t\tLine two\n");
```

produces the output

```
Line one
    Line two
```

Format specifications always begin with a percent sign (`%`) and are read left to right. When `printf_s` encounters the first format specification (if any), it converts the value of the first argument after `format` and outputs it accordingly. The second format specification causes the second argument to be converted and output, and so on. If there are more arguments than there are format specifications, the extra arguments are ignored. The results are undefined if there aren't enough arguments for all the format specifications.

IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fegetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

Requirements

ROUTINE	REQUIRED HEADER
<code>printf_s</code> , <code>_printf_s_l</code>	<code><stdio.h></code>
<code>wprintf_s</code> , <code>_wprintf_s_l</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Example

```
// crt_printf_s.c
/* This program uses the printf_s and wprintf_s functions
* to produce formatted output.
*/
#include <stdio.h>

int main( void )
{
    char    ch = 'h', *string = "computer";
    int     count = -9234;
    double fp = 251.7366;
    wchar_t wch = L'w', *wstring = L"Unicode";

    /* Display integers. */
    printf_s( "Integer formats:\n"
              "    Decimal: %d Justified: %.6d Unsigned: %u\n",
              count, count, count );

    printf_s( "Decimal %d as:\n    Hex: %Xh C hex: 0x%hx Octal: %o\n",
              count, count, count, count );

    /* Display in different radixes. */
    printf_s( "Digits 10 equal:\n    Hex: %i Octal: %i Decimal: %i\n",
              0x10, 010, 10 );

    /* Display characters. */

    printf_s("Characters in field (1):\n%10c%5hc%5C%1lc\n", ch, ch, wch, wch);
    wprintf_s(L"Characters in field (2):\n%10C%5hc%5c%5lc\n", ch, ch, wch, wch);

    /* Display strings. */

    printf_s("Strings in field (1):\n%25s\n%25.4hs\n    %S%25.3ls\n",
            string, string, wstring, wstring);
    wprintf_s(L"Strings in field (2):\n%25S\n%25.4hs\n    %s%25.3ls\n",
            string, string, wstring, wstring);

    /* Display real numbers. */
    printf_s( "Real numbers:\n    %f %.2f %e %E\n", fp, fp, fp, fp );

    /* Display pointer. */
    printf_s( "\nAddress as:    %p\n", &count);

}
```

Sample output

```
Integer formats:  
    Decimal: -9234  Justified: -009234  Unsigned: 4294958062  
Decimal -9234 as:  
    Hex: FFFFDBEEh  C hex: 0xffffdbee  Octal: 37777755756  
Digits 10 equal:  
    Hex: 16  Octal: 8  Decimal: 10  
Characters in field (1):  
    h   h   w   w  
Characters in field (2):  
    h   h   w   w  
Strings in field (1):  
    computer  
    comp  
    Unicode          Uni  
Strings in field (2):  
    computer  
    comp  
    Unicode          Uni  
Real numbers:  
    251.736600 251.74 2.517366e+002 2.517366E+002  
Address as: 0012FF78
```

See also

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

[fopen](#), [_wfopen](#)
[fprintf](#), [_fprintf_l](#), [fwprintf](#), [_fwprintf_l](#)
[scanf](#), [_scanf_l](#), [wscanf](#), [_wscanf_l](#)
[sprintf](#), [_sprintf_l](#), [swprintf](#), [_swprintf_l](#), [__swprintf_l](#)
[vprintf](#) functions

_purecall

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The default pure virtual function call error handler. The compiler generates code to call this function when a pure virtual member function is called.

Syntax

```
extern "C" int __cdecl _purecall();
```

Remarks

The `_purecall` function is a Microsoft-specific implementation detail of the Microsoft C++ compiler. This function isn't intended to be called by your code directly, and it has no public header declaration. It's documented here because it's a public export of the C Runtime Library.

A call to a pure virtual function is an error because it has no implementation. The compiler generates code to invoke the `_purecall` error handler function when a pure virtual function is called. By default, `_purecall` terminates the program. Before the `_purecall` function terminates, it invokes a `_purecall_handler` function, if one has been set for the process. You can install your own error handler function for pure virtual function calls, to catch them for debugging or reporting purposes. To use your own error handler, create a function that has the `_purecall_handler` signature, then use `_set_purecall_handler` to make it the current handler.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

The `_purecall` function doesn't have a header declaration. The `_purecall_handler` typedef is defined in `<stdlib.h>`.

See also

[Alphabetical function reference](#)

`_get_purecall_handler`, `_set_purecall_handler`

putc, putwc

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to a stream.

Syntax

```
int putc(
    int c,
    FILE *stream
);
wint_t putwc(
    wchar_t c,
    FILE *stream
);
```

Parameters

c

Character to be written.

stream

Pointer to `FILE` structure.

Return value

Returns the character written. To indicate an error or end-of-file condition, `putc` and `putchar` return `EOF`; `putwc` and `putwchar` return `WEOF`. For all four routines, use `ferror` or `feof` to check for an error or end of file. If passed a null pointer for `stream`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` or `WEOF`, and set `errno` to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `putc` routine writes the single character `c` to the output `stream` at the current position. Any integer can be passed to `putc`, but only the lower 8 bits are written. The `putchar` routine is identical to `putc(c, stdout)`. For each routine, if a read error occurs, the error indicator for the stream is set. `putc` and `putchar` are similar to `fputc` and `_fputchar`, respectively, but are implemented both as functions and as macros (see [Recommendations for choosing between functions and macros](#)). `putwc` and `putwchar` are wide-character versions of `putc` and `putchar`, respectively. `putwc` and `putc` behave identically if the stream is opened in ANSI mode. `putc` doesn't currently support output into a UNICODE stream.

The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads. For more information, see `_putc_nolock`, `_putwc_nolock`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_puttc</code>	<code>putc</code>	<code>putc</code>	<code>putwc</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>putc</code>	<code><stdio.h></code>
<code>putwc</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_putc.c
/* This program uses putc to write buffer
 * to a stream. If an error occurs, the program
 * stops before writing the entire buffer.
 */

#include <stdio.h>

int main( void )
{
    FILE *stream;
    char *p, buffer[] = "This is the line of output\n";
    int ch;

    ch = 0;
    /* Make standard out the stream and write to it. */
    stream = stdout;
    for( p = buffer; (ch != EOF) && (*p != '\0'); p++ )
        ch = putc( *p, stream );
}
```

Output

```
This is the line of output
```

See also

Stream I/O

`fputc`, `fputwc`
`getc`, `getwc`

`_putc_nolock`, `_putwc_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to a stream without locking the thread.

Syntax

```
int _putc_nolock(
    int c,
    FILE *stream
);
wint_t _putwc_nolock(
    wchar_t c,
    FILE *stream
);
```

Parameters

`c`

Character to be written.

`stream`

Pointer to the `FILE` structure.

Return value

See `putc`, `putwc`.

Remarks

`_putc_nolock` and `_putwc_nolock` are identical to the versions without the `_nolock` suffix except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

`_putwc_nolock` is the wide-character version of `_putc_nolock`; the two functions behave identically if the stream is opened in ANSI mode. `_putc_nolock` doesn't currently support output into a UNICODE stream.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_puttc_nolock</code>	<code>_putc_nolock</code>	<code>_putc_nolock</code>	<code>_putwc_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
_putc_nolock	<stdio.h>
_putwc_nolock	<stdio.h> or <wchar.h>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_putc_nolock.c
/* This program uses putc to write buffer
 * to a stream. If an error occurs, the program
 * stops before writing the entire buffer.
 */

#include <stdio.h>

int main( void )
{
    FILE *stream;
    char *p, buffer[] = "This is the line of output\n";
    int ch;

    ch = 0;
    /* Make standard out the stream and write to it. */
    stream = stdout;
    for( p = buffer; (ch != EOF) && (*p != '\0'); p++ )
        ch = _putc_nolock( *p, stream );
}
```

Output

```
This is the line of output
```

See also

Stream I/O

`fputc` , `fputwc`
`getc` , `getwc`

The Microsoft-specific function name `putch` is a deprecated alias for the `_putch` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_putch` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_putch`, `_putwch`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to the console.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _putch(
    int c
);

wint_t _putwch(
    wchar_t c
);
```

Parameters

`c`

Character to be output.

Return value

Returns `c` if successful. If `_putch` fails, it returns `EOF`; if `_putwch` fails, it returns `WEOF`.

Remarks

These functions write the character `c` directly, without buffering, to the console. In Windows NT, `_putwch` writes Unicode characters using the current console locale setting.

The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads. For more information, see [`_putch_nolock`](#), [`_putwch_nolock`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_puttch</code>	<code>_putch</code>	<code>_putch</code>	<code>_putwch</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_putch</code>	<conio.h>
<code>_putwch</code>	<conio.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

See the example for [`_getch`](#).

See also

Console and port I/O

[`_cprintf`](#), [`_cprintf_l`](#), [`_cwprintf`](#), [`_cwprintf_l`](#)
[`_getch`](#), [`_getwch`](#)

`_putch_nolock`, `_putwch_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to the console without locking the thread.

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _putch_nolock(  
    int c  
);  
wint_t _putwch_nolock(  
    wchar_t c  
);
```

Parameters

`c`

Character to be output.

Return value

Returns `c` if successful. If `_putch_nolock` fails, it returns `EOF`; if `_putwch_nolock` fails, it returns `WEOF`.

Remarks

`_putch_nolock` and `_putwch_nolock` are identical to `_putch` and `_putwch`, respectively, except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_puttch_nolock</code>	<code>_putch_nolock</code>	<code>_putch_nolock</code>	<code>_putwch_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_putch_nolock</code>	<code><conio.h></code>

ROUTINE	REQUIRED HEADER
<code>_putwch_nolock</code>	<conio.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

Console and port I/O

[`_cprintf`](#), [`_cprintf_l`](#), [`_cwprintf`](#), [`_cwprintf_l`](#)
[`_getch`](#), [`_getwch`](#)

`putchar`, `putwchar`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to `stdout`.

Syntax

```
int putchar(  
    int c  
);  
wint_t putwchar(  
    wchar_t c  
);
```

Parameters

`c`

Character to be written.

Return value

Returns the character written. To indicate an error or end-of-file condition, `putc` and `putchar` return `EOF`; `putwc` and `putwchar` return `WEOF`. For all four routines, use `ferror` or `feof` to check for an error or end of file. If passed a null pointer for `stream`, these functions generate an invalid parameter exception, as described in [Parameter validation](#). If execution is allowed to continue, they return `EOF` or `WEOF`, and set `errno` to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `putc` routine writes the single character `c` to the output `stream` at the current position. Any integer can be passed to `putc`, but only the lower 8 bits are written. The `putchar` routine is identical to `putc(c, stdout)`. For each routine, if a read error occurs, the error indicator for the stream is set. `putc` and `putchar` are similar to `fputc` and `_fputchar`, respectively, but are implemented both as functions and as macros (see [Recommendations for choosing between functions and macros](#)). `putwc` and `putwchar` are wide-character versions of `putc` and `putchar`, respectively.

The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads. They may be faster since they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_puttchar</code>	<code>putchar</code>	<code>putchar</code>	<code>putwchar</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>putchar</code>	<code><stdio.h></code>
<code>putwchar</code>	<code><stdio.h> or <wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_putchar.c
/* This program uses putc to write buffer
 * to a stream. If an error occurs, the program
 * stops before writing the entire buffer.
*/
#include <stdio.h>

int main( void )
{
    FILE *stream;
    char *p, buffer[] = "This is the line of output\n";
    int ch;

    ch = 0;

    for( p = buffer; (ch != EOF) && (*p != '\0'); p++ )
        ch = putchar( *p );
}
```

Output

```
This is the line of output
```

See also

Stream I/O

`fputc`, `fputwc`
`getc`, `getwc`

`_putchar_nolock`, `_putwchar_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a character to `stdout` without locking the thread.

Syntax

```
int _putchar_nolock(
    int c
);
wint_t _putwchar_nolock(
    wchar_t c
);
```

Parameters

`c`

Character to be written.

Return value

See `putchar`, `putwchar`.

Remarks

`putchar_nolock` and `_putwchar_nolock` are identical to the versions without the `_nolock` suffix except that they aren't protected from interference by other threads. They might be faster because they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_puttchar_nolock</code>	<code>_putchar_nolock</code>	<code>_putchar_nolock</code>	<code>_putwchar_nolock</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>_putchar_nolock</code>	<code><stdio.h></code>
<code>_putwchar_nolock</code>	<code><stdio.h></code> or <code><wchar.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Libraries

Example

```
// crt_putchar_nolock.c
/* This program uses putchar to write buffer
 * to stdout. If an error occurs, the program
 * stops before writing the entire buffer.
*/
#include <stdio.h>

int main( void )
{
    FILE *stream;
    char *p, buffer[] = "This is the line of output\n";
    int ch;

    ch = 0;

    for( p = buffer; (ch != EOF) && (*p != '\0'); p++ )
        ch = _putchar_nolock( *p );
}
```

Output

```
This is the line of output
```

See also

Stream I/O

[fputc](#) , [fputwc](#)
[fgetc](#) , [fgetwc](#)

putenv

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `putenv` is a deprecated alias for the `_putenv` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_putenv` or security-enhanced `_putenv_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_putenv`, `_wputenv`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates, modifies, or removes environment variables. More secure versions of these functions are available; see

[`_putenv_s`](#), [`_wputenv_s`](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
int _putenv(
    const char *envstring
);
int _wputenv(
    const wchar_t *envstring
);
```

Parameters

`envstring`

Environment-string definition.

Return value

The functions return 0 if successful, or -1 if there's an error.

Remarks

The `_putenv` function adds new environment variables or modifies the values of existing environment variables. Environment variables define the environment in which a process executes (for example, the default search path for libraries to be linked with a program). `_wputenv` is a wide-character version of `_putenv`; the `envstring` argument to `_wputenv` is a wide-character string.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE AND _MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tputenv</code>	<code>_putenv</code>	<code>_putenv</code>	<code>_wputenv</code>

The `envstring` argument must be a pointer to a string of the form `varname=value_string`, where `varname` is the name of the environment variable to be added or modified and `value_string` is the variable's value. If `varname` is already part of the environment, its value is replaced by `value_string`; otherwise, the new `varname` variable and its `value_string` value are added to the environment. You can remove a variable from the environment by specifying an empty `value_string`, or in other words, by specifying only `varname =`.

`_putenv` and `_wputenv` affect only the environment that is local to the current process; you can't use them to modify the command-level environment. That is, these functions operate only on data structures accessible to the run-time library. They don't operate on the environment segment created for a process by the operating system. When the current process terminates, the environment reverts to the level of the calling process (in most cases, the operating-system level). However, the modified environment can be passed to any new processes created by `_spawn`, `_exec`, or `system`, and these new processes get any new items added by `_putenv` and `_wputenv`.

Don't change an environment entry directly: instead, use `_putenv` or `_wputenv` to change it. In particular, direct freeing elements of the `_environ[]` global array might lead to invalid memory being addressed.

`_getenv` and `_putenv` use the global variable `_environ` to access the environment table; `_wgetenv` and `_wputenv` use `_wenviron`. `_putenv` and `_wputenv` might change the value of `_environ` and `_wenviron`, thus invalidating the `_envp` argument to `main` and the `_wenvp` argument to `wmain`. Therefore, it's safer to use `_environ` or `_wenviron` to access the environment information. For more information about the relation of `_putenv` and `_wputenv` to global variables, see [_environ](#), [_wenviron](#).

NOTE

The `_putenv` and `_getenv` families of functions are not thread-safe. `_getenv` could return a string pointer while `_putenv` is modifying the string, causing random failures. Make sure that calls to these functions are synchronized.

Requirements

ROUTINE	REQUIRED HEADER
<code>_putenv</code>	<code><stdlib.h></code>
<code>_wputenv</code>	<code><stdlib.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

For a sample of how to use `_putenv`, see [getenv](#), [_wgetenv](#).

See also

Process and environment control

[getenv](#), [_wgetenv](#)
[_searchenv](#), [_wsearchenv](#)

`_putenv_s`, `_wputenv_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates, modifies, or removes environment variables. These functions are versions of `_putenv`, `_wputenv` that have security enhancements, as described in [Security features in the CRT](#).

IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

Syntax

```
errno_t _putenv_s(
    const char *varname,
    const char *value_string
);
errno_t _wputenv_s(
    const wchar_t *varname,
    const wchar_t *value_string
);
```

Parameters

`varname`

The environment variable name.

`value_string`

The value to set the environment variable to.

Return value

Returns 0 if successful, or an error code.

Error conditions

VARNAME	VALUE_STRING	RETURN VALUE
NULL	any	EINVAL
any	NULL	EINVAL

If one of the error conditions occurs, these functions invoke an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EINVAL` and set `errno` to `EINVAL`.

Remarks

The `_putenv_s` function adds new environment variables or modifies the values of existing environment variables. Environment variables define the environment in which a process executes (for example, the default search path for libraries to be linked with a program). `_wputenv_s` is a wide-character version of `_putenv_s`; the

`envstring` argument to `_wputenv_s` is a wide-character string.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tputenv_s</code>	<code>_putenv_s</code>	<code>_putenv_s</code>	<code>_wputenv_s</code>

`varname` is the name of the environment variable to be added or modified and `value_string` is the variable's value. If `varname` is already part of the environment, its value is replaced by `value_string`; otherwise, the new `varname` variable and its `value_string` are added to the environment. You can remove a variable from the environment by specifying an empty string (that is, `""`) for `value_string`.

`_putenv_s` and `_wputenv_s` affect only the environment that is local to the current process; you can't use them to modify the command-level environment. These functions operate only on data structures that are accessible to the run-time library and not on the environment "segment" that the operating system creates for a process. When the current process terminates, the environment reverts to the level of the calling process, which in most cases is the operating-system level. However, the modified environment can be passed to any new processes that are created by `_spawn`, `_exec`, or `system`, and these new processes get any new items that are added by `_putenv_s` and `_wputenv_s`.

Don't change an environment entry directly; instead, use `_putenv_s` or `_wputenv_s` to change it. In particular, directly freeing elements of the `_environ[]` global array might cause invalid memory to be addressed.

`getenv` and `_putenv_s` use the global variable `_environ` to access the environment table; `_wgetenv` and `_wputenv_s` use `_wenviron`. `_putenv_s` and `_wputenv_s` may change the value of `_environ` and `_wenviron`, and thereby invalidate the `envp` argument to `main` and the `_wenvp` argument to `wmain`. Therefore, it's safer to use `_environ` or `_wenviron` to access the environment information. For more information about the relationship of `_putenv_s` and `_wputenv_s` to global variables, see [_environ](#), [_wenviron](#).

NOTE

The `_putenv_s` and `_getenv_s` families of functions are not thread-safe. `_getenv_s` could return a string pointer while `_putenv_s` is modifying the string, and thereby cause random failures. Make sure that calls to these functions are synchronized.

Requirements

ROUTINE	REQUIRED HEADER
<code>_putenv_s</code>	<code><stdlib.h></code>
<code>_wputenv_s</code>	<code><stdlib.h></code> or <code><wchar.h></code>

For more compatibility information, see [Compatibility](#).

Example

For a sample that shows how to use `_putenv_s`, see [getenv_s](#), [_wgetenv_s](#).

See also

Process and environment control

[getenv](#) , [_wgetenv](#)
[_searchenv](#) , [_wsearchenv](#)

`puts`, `_putws`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes a string to `stdout`.

Syntax

```
int puts(
    const char *str
);
int _putws(
    const wchar_t *str
);
```

Parameters

`str`

Output string.

Return value

Returns a nonnegative value if successful. If `puts` fails, it returns `EOF`; if `_putws` fails, it returns `WEOF`. If `str` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions set `errno` to `EINVAL` and return `EOF` or `WEOF`.

For information on these and other error codes, see [`errno`](#), [`_doserrno`](#), [`_sys_errlist`](#), and [`_sys_nerr`](#).

Remarks

The `puts` function writes `str` to the standard output stream `stdout`, replacing the string's terminating null character ('\0') with a newline character ('\n') in the output stream.

`_putws` is the wide-character version of `puts`; the two functions behave identically if the stream is opened in ANSI mode. `puts` doesn't currently support output into a UNICODE stream.

`_putwch` writes Unicode characters using the current CONSOLE LOCALE setting.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_putts</code>	<code>puts</code>	<code>puts</code>	<code>_putws</code>

Requirements

ROUTINE	REQUIRED HEADER
<code>puts</code>	<code><stdio.h></code>
<code>_putws</code>	<code><stdio.h></code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_puts.c
// This program uses puts to write a string to stdout.

#include <stdio.h>

int main( void )
{
    puts( "Hello world from puts!" );
}
```

Output

```
Hello world from puts!
```

See also

Stream I/O

<code>fputs</code>	<code>fputws</code>
<code>fgets</code>	<code>fgetws</code>

putw

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The Microsoft-specific function name `putw` is a deprecated alias for the `_putw` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_putw` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

_putw

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Writes an integer to a stream.

Syntax

```
int _putw(
    int binint,
    FILE *stream
);
```

Parameters

`binint`

Binary integer to be output.

`stream`

Pointer to the `FILE` structure.

Return value

Returns the value written. A return value of `EOF` might indicate an error. Because `EOF` is also a legitimate integer value, use `errno` to verify an error. If `stream` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EOF`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

Remarks

The `_putw` function writes a binary value of type `int` to the current position of `stream`. `_putw` doesn't affect the alignment of items in the stream nor does it assume any special alignment. `_putw` is primarily for compatibility with previous libraries. Portability problems might occur with `_putw` because the size of an `int` and the ordering of bytes within an `int` differ across systems.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>_putw</code>	<stdio.h>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

Example

```
// crt_putw.c
/* This program uses _putw to write a
 * word to a stream, then performs an error check.
 */

#include <stdio.h>
#include <stdlib.h>

int main( void )
{
    FILE *stream;
    unsigned u;
    if( fopen_s( &stream, "data.out", "wb" ) )
        exit( 1 );
    for( u = 0; u < 10; u++ )
    {
        _putw( u + 0x2132, stream ); /* Write word to stream. */
        if( ferror( stream ) )      /* Make error check. */
        {
            printf( "_putw failed" );
            clearerr_s( stream );
            exit( 1 );
        }
    }
    printf( "Wrote ten words\n" );
    fclose( stream );
}
```

Output

```
Wrote ten words
```

See also

[Stream I/O](#)

[_getw](#)

`_query_new_handler`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the address of the current `new` handler routine.

Syntax

```
_PNH _query_new_handler(  
    void  
)
```

Return value

Returns the address of the current `new` handler routine as set by `_set_new_handler`.

Remarks

The C++ `_query_new_handler` function returns the address of the current exception-handling function set by the C++ `_set_new_handler` function. `_set_new_handler` is used to specify an exception-handling function that is to gain control if the `new` operator fails to allocate memory. For more information, see the discussion of the `new` and `delete` operators in the C++ Language Reference.

Requirements

ROUTINE	REQUIRED HEADER
<code>_query_new_handler</code>	<code><new.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the C run-time libraries.

See also

[Memory allocation](#)

`free`

_query_new_mode

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Returns an integer indicating the `new` handler mode set by `_set_new_mode` for `malloc`.

Syntax

```
int _query_new_mode(  
    void  
)
```

Return value

Returns the current `new` handler mode, namely 0 or 1, for `malloc`. A return value of 1 indicates that, on failure to allocate memory, `malloc` calls the `new` handler routine; a return value of 0 indicates that it doesn't.

Remarks

The C++ `_query_new_mode` function returns an integer that indicates the `new` handler mode that is set by the C++ `_set_new_mode` function for `malloc`. The `new` handler mode indicates whether, on failure to allocate memory, `malloc` is to call the `new` handler routine as set by `_set_new_handler`. By default, `malloc` doesn't call the `new` handler routine on failure. You can use `_set_new_mode` to override this behavior so that on failure `malloc` calls the `new` handler routine in the same way that the `new` operator does when it fails to allocate memory. For more information, see the discussion of the [new and delete operators](#) in the C++ Language Reference.

Requirements

ROUTINE	REQUIRED HEADER
<code>_query_new_mode</code>	<code><new.h></code>

For more compatibility information, see [Compatibility](#).

Libraries

All versions of the [C run-time libraries](#).

See also

Memory allocation

`calloc`
`free`
`realloc`
`_query_new_handler`

quick_exit

11/2/2022 • 2 minutes to read • [Edit Online](#)

Causes normal program termination to occur.

Syntax

```
__declspec(noreturn) void quick_exit(  
    int status  
)
```

Parameters

`status`

The status code to return to the host environment.

Return value

The `quick_exit` function can't return to its caller.

Remarks

The `quick_exit` function causes normal program termination. It calls no functions registered by `atexit`, `_onexit` or signal handlers registered by the `signal` function. Behavior is undefined if `quick_exit` is called more than once, or if the `exit` function is also called.

The `quick_exit` function calls, in last-in, first-out (LIFO) order, the functions registered by `at_quick_exit`, except for those functions already called when the function was registered. Behavior is undefined if a `longjmp` call is made during a call to a registered function that would terminate the call to the function.

After the registered functions have been called, `quick_exit` invokes `_Exit` by using the `status` value to return control to the host environment.

Requirements

ROUTINE	REQUIRED HEADER
<code>quick_exit</code>	<process.h> or <stdlib.h>

For more information about compatibility, see [Compatibility](#).

See also

[Process and environment control](#)

`abort`
`atexit`
`_exec`, `_wexec` functions
`exit`, `_Exit`, `_exit`
`_onexit`, `_onexit_m`
`_spawn`, `_wspawn` functions

`system` , `_wsystem`

Performs a quick sort. A more secure version of this function is available; see [qsort_s](#).

Syntax

```
void qsort(
    void *base,
    size_t number,
    size_t width,
    int (__cdecl *compare )(const void *, const void *)
);
```

Parameters

`base`

Start of target array.

`number`

Array size in elements.

`width`

Element size in bytes.

`compare`

Pointer to a user-supplied routine that compares two array elements and returns a value that specifies their relationship.

Remarks

The `qsort` function implements a quick-sort algorithm to sort an array of `number` elements, each of `width` bytes. The argument `base` is a pointer to the base of the array to be sorted. `qsort` overwrites this array by using the sorted elements.

`qsort` calls the `compare` routine one or more times during the sort, and passes pointers to two array elements on each call. If `compare` indicates two elements are the same, their order in the resulting sorted array is unspecified.

```
compare( (void *) & elem1, (void *) & elem2 );
```

The routine compares the elements and returns one of the following values.

COMPARE FUNCTION RETURN VALUE	DESCRIPTION
< 0	<code>elem1</code> less than <code>elem2</code>
0	<code>elem1</code> equivalent to <code>elem2</code>
> 0	<code>elem1</code> greater than <code>elem2</code>

The array is sorted in increasing order, as defined by the comparison function. To sort an array in decreasing order, reverse the sense of "greater than" and "less than" in the comparison function.

This function validates its parameters. If `compare` or `number` is `NULL`, or if `base` is `NULL` and `number` is nonzero, or if `width` is less than zero, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns, and `errno` is set to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>qsort</code>	<code><stdlib.h></code> and <code><search.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_qsort.c
// arguments: every good boy deserves favor

/* This program reads the command-line
 * parameters and uses qsort to sort them. It
 * then displays the sorted arguments.
 */

#include <stdlib.h>
#include <string.h>
#include <stdio.h>

int compare( const void *arg1, const void *arg2 );

int main( int argc, char **argv )
{
    int i;
    /* Eliminate argv[0] from sort: */
    argv++;
    argc--;

    /* Sort remaining args using Quicksort algorithm: */
    qsort( (void *)argv, (size_t)argc, sizeof( char * ), compare );

    /* Output sorted list: */
    for( i = 0; i < argc; ++i )
        printf( " %s", argv[i] );
    printf( "\n" );
}

int compare( const void *arg1, const void *arg2 )
{
    /* Compare all of both strings: */
    return _stricmp( * ( char** ) arg1, * ( char** ) arg2 );
}
```

```
boy deserves every favor good
```

See also

[Searching and sorting](#)

[bsearch](#)

[lsearch](#)

qsort_s

11/2/2022 • 4 minutes to read • [Edit Online](#)

Performs a quick sort. A version of `qsort` with security enhancements as described in [Security features in the CRT](#).

Syntax

```
void qsort_s(
    void *base,
    size_t num,
    size_t width,
    int (__cdecl *compare )(void *, const void *, const void *),
    void * context
);
```

Parameters

`base`

Start of target array.

`number`

Array size in elements.

`width`

Element size in bytes.

`compare`

Comparison function. The first argument is the `context` pointer. The second argument is a pointer to the `key` for the search. The third argument is a pointer to the array element to be compared with `key`.

`context`

A pointer to a context, which can be any object that the `compare` routine needs to access.

Remarks

The `qsort_s` function implements a quick-sort algorithm to sort an array of `number` elements, each of `width` bytes. The argument `base` is a pointer to the base of the array to be sorted. `qsort_s` overwrites this array with the sorted elements. The argument `compare` is a pointer to a user-supplied routine that compares two array elements and returns a value specifying their relationship. `qsort_s` calls the `compare` routine one or more times during the sort, passing pointers to two array elements on each call:

```
compare( context, (void *) & elem1, (void *) & elem2 );
```

The routine must compare the elements and then return one of the following values:

RETURN VALUE	DESCRIPTION
< 0	<code>element 1 less than element 2</code>

RETURN VALUE	DESCRIPTION
0	<i>element 1</i> equivalent to <i>element 2</i>
> 0	<i>element 1</i> greater than <i>element 2</i>

The array is sorted in increasing order, as defined by the comparison function. To sort an array in decreasing order, reverse the sense of "greater than" and "less than" in the comparison function.

If invalid parameters are passed to the function, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, then the function returns, and `errno` is set to `EINVAL`. For more information, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Error conditions

KEY	BASE	COMPARE	NUM	WIDTH	ERRNO
<code>NULL</code>	any	any	any	any	<code>EINVAL</code>
any	<code>NULL</code>	any	<code>!= 0</code>	any	<code>EINVAL</code>
any	any	any	any	<code><= 0</code>	<code>EINVAL</code>
any	any	<code>NULL</code>	any	any	<code>EINVAL</code>

`qsort_s` has the same behavior as `qsort` but has the `context` parameter and sets `errno`. The `context` parameter allows comparison functions to use an object pointer to access object functionality or other information not accessible through an element pointer. The addition of the `context` parameter makes `qsort_s` more secure because `context` can be used to avoid reentrancy bugs introduced by using static variables to make shared information available to the `compare` function.

Requirements

ROUTINE	REQUIRED HEADER
<code>qsort_s</code>	<code><stdlib.h></code> and <code><search.h></code>

For more compatibility information, see [Compatibility](#).

Libraries: All versions of the [C runtime libraries](#).

Example

The following example demonstrates how to use the `context` parameter in the `qsort_s` function. The `context` parameter makes it easier to perform thread-safe sorts. Instead of using static variables that must be synchronized to ensure thread safety, pass a different `context` parameter in each sort. In this example, a locale object is used as the `context` parameter.

```
// crt_qsort_s.cpp
// compile with: /EHsc /MT
#include <stdlib.h>
#include <search.h>
```

```

#include <stdio.h>
#include <search.h>
#include <process.h>
#include <locale.h>
#include <locale>
#include <windows.h>
using namespace std;

// The sort order is dependent on the code page. Use 'chcp' at the
// command line to change the codepage. When executing this application,
// the command prompt codepage must match the codepage used here:

#define CODEPAGE_850

#ifndef CODEPAGE_850
// Codepage 850 is the OEM codepage used by the command line,
// so \x00e1 is the German Sharp S in that codepage and \x00a4
// is the n tilde.

char *array1[] = { "wei\x00e1", "weis", "annehmen", "weizen", "Zeit",
                  "weit" };
char *array2[] = { "Espa\x00a4ol", "Espa\x00a4" "a", "espantado" };
char *array3[] = { "table", "tableux", "tablet" };

#define GERMAN_LOCALE "German_Germany.850"
#define SPANISH_LOCALE "Spanish_Spain.850"
#define ENGLISH_LOCALE "English_US.850"

#endif

#define CODEPAGE_1252
// If using codepage 1252 (ISO 8859-1, Latin-1), use \x00df
// for the German Sharp S and \x00f1 for the n tilde.
char *array1[] = { "wei\x00df", "weis", "annehmen", "weizen", "Zeit",
                  "weit" };
char *array2[] = { "Espa\x00f1ol", "Espa\x00f1" "a", "espantado" };
char *array3[] = { "table", "tableux", "tablet" };

#define GERMAN_LOCALE "German_Germany.1252"
#define SPANISH_LOCALE "Spanish_Spain.1252"
#define ENGLISH_LOCALE "English_US.1252"

#endif

// The context parameter lets you create a more generic compare.
// Without this parameter, you would have stored the locale in a
// static variable, thus making sort_array vulnerable to thread
// conflicts.

int compare( void *pvlocale, const void *str1, const void *str2)
{
    char s1[256];
    char s2[256];
    strcpy_s(s1, 256, *(char**)str1);
    strcpy_s(s2, 256, *(char**)str2);
    _strlwr_s( s1, sizeof(s1) );
    _strlwr_s( s2, sizeof(s2) );

    locale& loc = *( reinterpret_cast< locale * > ( pvlocale));

    return use_facet< collate<char> >(loc).compare(s1,
        &s1[strlen(s1)], s2, &s2[strlen(s2)]);

}

void sort_array(char *array[], int num, locale &loc)
{
    qsort_s(array, num, sizeof(char*), compare, &loc);
}

```

```

void print_array(char *a[], int c)
{
    for (int i = 0; i < c; i++)
        printf("%s ", a[i]);
    printf("\n");
}

void sort_german(void * Dummy)
{
    sort_array(array1, 6, locale(GERMAN_LOCALE));
}

void sort_spanish(void * Dummy)
{
    sort_array(array2, 3, locale(SPANISH_LOCALE));
}

void sort_english(void * Dummy)
{
    sort_array(array3, 3, locale(ENGLISH_LOCALE));
}

int main( )
{
    int i;
    HANDLE threads[3];

    printf("Unsorted input:\n");
    print_array(array1, 6);
    print_array(array2, 3);
    print_array(array3, 3);

    // Create several threads that perform sorts in different
    // languages at the same time.

    threads[0] = reinterpret_cast<HANDLE>(
        _beginthread( sort_german , 0, NULL));
    threads[1] = reinterpret_cast<HANDLE>(
        _beginthread( sort_spanish, 0, NULL));
    threads[2] = reinterpret_cast<HANDLE>(
        _beginthread( sort_english, 0, NULL));

    for (i = 0; i < 3; i++)
    {
        if (threads[i] == reinterpret_cast<HANDLE>(-1))
        {
            printf("Error creating threads.\n");
            exit(1);
        }
    }

    // Wait until all threads have terminated.
    WaitForMultipleObjects(3, threads, true, INFINITE);

    printf("Sorted output: \n");

    print_array(array1, 6);
    print_array(array2, 3);
    print_array(array3, 3);
}

```

Sample output

```
Unsorted input:  
weiß weisannehmen weizen Zeit weit  
Español España espantado  
table tableux tablet  
Sorted output:  
annehmen weiß weis weit weizen Zeit  
España Español espantado  
table tablet tableaux
```

See also

[Searching and sorting](#)

[bsearch_s](#)

[lsearch_s](#)

[qsort](#)

raise

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Sends a signal to the executing program.

NOTE

Do not use this method to shut down a Microsoft Store app, except in testing or debugging scenarios. Programmatic or UI ways to close a Store app are not permitted according to the [Microsoft Store policies](#). For more information, see [UWP app lifecycle](#).

Syntax

```
int raise(  
    int sig  
)
```

Parameters

`sig`

Signal to be raised.

Return value

If successful, `raise` returns 0. Otherwise, it returns a nonzero value.

Remarks

The `raise` function sends `sig` to the executing program. If a previous call to `signal` has installed a signal-handling function for `sig`, `raise` executes that function. If no handler function has been installed, the default action associated with the signal value `sig` is taken, as follows.

SIGNAL	DESCRIPTION	DEFAULT BEHAVIOR
<code>SIGABRT</code>	Abnormal termination	Terminates the calling program with exit code 3
<code>SIGFPE</code>	Floating-point error	Terminates the calling program
<code>SIGILL</code>	Illegal instruction	Terminates the calling program
<code>SIGINT</code>	CTRL+C interrupt	Terminates the calling program
<code>SIGSEGV</code>	Illegal storage access	Terminates the calling program
<code>SIGTERM</code>	Termination request sent to the program	Ignores the signal

If the argument isn't a valid signal as specified above, the invalid parameter handler is invoked, as described in

Parameter validation. If not handled, the function sets `errno` to `EINVAL` and returns a nonzero value.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>raise</code>	<code><signal.h></code>

For more compatibility information, see [Compatibility](#).

See also

[Process and environment control](#)

`abort`
`signal`

rand

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Generates a pseudorandom number. A more programmatically secure version of this function is available; see [rand_s](#). Numbers generated by `rand` aren't cryptographically secure. For more cryptographically secure random number generation, use [rand_s](#) or the functions declared in the C++ Standard Library in [<random>](#).

Syntax

```
int rand(void);
```

Return value

`rand` returns a pseudorandom number, as described above. There's no error return.

Remarks

The `rand` function returns a pseudorandom integer in the range 0 to `RAND_MAX` (32767). Use the [srand](#) function to seed the pseudorandom-number generator before calling `rand`.

The `rand` function generates a well-known sequence and isn't appropriate for use as a cryptographic function. For more cryptographically secure random number generation, use [rand_s](#) or the functions declared in the C++ Standard Library in [<random>](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

Requirements

ROUTINE	REQUIRED HEADER
<code>rand</code>	<code><stdlib.h></code>

For more compatibility information, see [Compatibility](#).

Example

```
// crt_rand.c
// This program seeds the random-number generator
// with a fixed seed, then exercises the rand function
// to demonstrate generating random numbers, and
// random numbers in a specified range.

#include <stdlib.h> // rand(), srand()
#include <stdio.h> // printf()

void SimpleRandDemo(int n)
{
    // Print n random numbers.
    for (int i = 0; i < n; i++)
    {
```

```

        printf(" %6d\n", rand());
    }

void RangedRandDemo(int range_min, int range_max, int n)
{
    // Generate random numbers in the interval [range_min, range_max], inclusive.

    for (int i = 0; i < n; i++)
    {
        // Note: This method of generating random numbers in a range isn't suitable for
        // applications that require high quality random numbers.
        // rand() has a small output range [0,32767], making it unsuitable for
        // generating random numbers across a large range using the method below.
        // The approach below also may result in a non-uniform distribution.
        // More robust random number functionality is available in the C++ <random> header.
        // See https://learn.microsoft.com/cpp/standard-library/random
        int r = ((double)rand() / RAND_MAX) * (range_max - range_min) + range_min;
        printf(" %6d\n", r);
    }
}

int main(void)
{
    // Seed the random-number generator with a fixed seed so that
    // the numbers will be the same every time we run.
    srand(1792);

    printf("Simple random number demo =====\n\n");
    SimpleRandDemo(10);
    printf("\nRandom number in a range demo =====\n\n");
    RangedRandDemo(-100, 100, 100000);
}
```
```
```Output
Simple random number demo =====

5890
1279
19497
1207
11420
3377
15317
29489
9716
23323

Random number in a range demo =====

-82
-46
50
77
-47
32
76
-13
-58
90

```

## See also

[Math and floating-point support](#)

[srand](#)

[rand\\_s](#)

C++ `<random>` library

# rand\_s

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Generates a pseudorandom number. This function is a more secure version of the function `rand`, with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t rand_s(unsigned int* randomValue);
```

### Parameters

`randomValue`

A pointer to an integer to hold the generated value.

## Return value

Zero if successful, otherwise, an error code. If the input pointer `_randomValue_` is a `NULL` pointer, the function invokes an invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns `EINVAL` and sets `errno` to `EINVAL`. If the function fails for any other reason, `*_randomValue_` is set to 0.

## Remarks

The `rand_s` function writes a pseudorandom integer in the range 0 to `UINT_MAX` to the input pointer. The `rand_s` function uses the operating system to generate cryptographically secure random numbers. It doesn't use the seed generated by the `srand` function, nor does it affect the random number sequence used by `rand`.

The `_CRT_RAND_S` constant must be defined before the `stdlib.h` header for the `rand_s` function is included, as shown in the following example:

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

```
#define _CRT_RAND_S
#include <stdlib.h>
```

`rand_s` depends on the `RtlGenRandom` API, which is only available in Windows XP and later.

## Requirements

ROUTINE	REQUIRED HEADER
<code>rand_s</code>	<code>&lt;stdlib.h&gt;</code>

For more information, see [Compatibility](#).

## Example

```

// crt_rand_s.c
// This program illustrates how to generate random
// integer or floating point numbers in a specified range.

// Remember to define _CRT_RAND_S before you include
// stdlib.h.
#define _CRT_RAND_S

#include <stdlib.h>
#include <stdio.h>
#include <limits.h>

int main(void)
{
 int i;
 unsigned int number;
 double max = 100.0;
 errno_t err;

 // Display 10 random integers in the range [1,10].
 for(i = 0; i < 10;i++)
 {
 err = rand_s(&number);
 if (err != 0)
 {
 printf_s("The rand_s function failed!\n");
 }
 printf_s(" %u\n", (unsigned int) ((double)number /
 ((double) UINT_MAX + 1) * 10.0) + 1);
 }

 printf_s("\n");

 // Display 10 random doubles in [0, max].
 for (i = 0; i < 10;i++)
 {
 err = rand_s(&number);
 if (err != 0)
 {
 printf_s("The rand_s function failed!\n");
 }
 printf_s(" %g\n", (double) number /
 ((double) UINT_MAX + 1) * max);
 }
}

```

### Sample output

**10**

**4**

**5**

**2**

**8**

**2**

**5**

**6**

**1**

**1**

**32.6617**

**29.4471**

**11.5413**

**6.41924**

**20.711**

**60.2878**

**61.0094**

**20.1222**

**80.9192**

**65.0712**

## See also

[Math and floating-point support](#)

[rand](#)

[srand](#)

read

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `read` is a deprecated alias for the `_read` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_read` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# \_read

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads data from a file.

## Syntax

```
int _read(
 int const fd,
 void * const buffer,
 unsigned const buffer_size
);
```

### Parameters

`fd`

File descriptor referring to the open file.

`buffer`

Storage location for data.

`buffer_size`

Maximum number of bytes to read.

## Return value

`_read` returns the number of bytes read, which might be less than `buffer_size` if there are fewer than `buffer_size` bytes left in the file, or if the file was opened in text mode. In text mode, each carriage return-line feed pair `\r\n` is replaced with a single line feed character `\n`. Only the single line feed character is counted in the return value. The replacement doesn't affect the file pointer.

If the function tries to read at end of file, it returns 0. If `fd` isn't valid, the file isn't open for reading, or the file is locked, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EBADF`.

If `buffer` is `NULL`, or if `buffer_size > INT_MAX`, the invalid parameter handler is invoked. If execution is allowed to continue, the function returns -1 and `errno` is set to `EINVAL`.

For more information about this and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_read` function reads a maximum of `buffer_size` bytes into `buffer` from the file associated with `fd`. The read operation begins at the current position of the file pointer associated with the given file. After the read operation, the file pointer points to the next unread character.

If the file was opened in text mode, the read terminates when `_read` encounters a CTRL+Z character, which is treated as an end-of-file indicator. Use `_lseek` to clear the end-of-file indicator.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

# Requirements

ROUTINE	REQUIRED HEADER
_read	<io.h>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

```
// crt_read.c
/* This program opens a file named crt_read.txt
 * and tries to read 60,000 bytes from
 * that file using _read. It then displays the
 * actual number of bytes read.
 */

#include <fcntl.h> /* Needed only for _O_RDWR definition */
#include <io.h>
#include <stdlib.h>
#include <stdio.h>
#include <share.h>

char buffer[60000];

int main(void)
{
 int fh, bytesread;
 unsigned int nbytes = 60000;

 /* Open file for input: */
 if (_open(&fh, "crt_read.txt", _O_RDONLY, _SH_DENYNO, 0))
 {
 perror("open failed on input file");
 exit(1);
 }

 /* Read in input: */
 if ((bytesread = _read(fh, buffer, nbytes)) <= 0)
 perror("Problem reading file");
 else
 printf("Read %u bytes from file\n", bytesread);

 _close(fh);
}
```

### Input: crt\_read.txt

```
Line one.
Line two.
```

### Output

```
Read 19 bytes from file
```

## See also

Low-level I/O

[\\_creat](#) , [\\_wcreat](#)  
[fread](#)  
[\\_open](#) , [\\_wopen](#)  
[\\_write](#) \

# realloc

11/2/2022 • 3 minutes to read • [Edit Online](#)

Reallocate memory blocks.

## Syntax

```
void *realloc(
 void *memblock,
 size_t size
)
```

### Parameters

`memblock`

Pointer to previously allocated memory block.

`size`

New size in bytes.

## Return value

`realloc` returns a `void` pointer to the reallocated (and possibly moved) memory block.

If there isn't enough available memory to expand the block to the given size, the original block is left unchanged, and `NULL` is returned.

If `size` is zero, then the block pointed to by `memblock` is freed; the return value is `NULL`, and `memblock` is left pointing at a freed block.

The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than `void`, use a type cast on the return value.

## Remarks

### NOTE

`realloc` hasn't been updated to implement C17 behavior because the new behavior isn't compatible with the Windows operating system.

The `realloc` function changes the size of an allocated memory block. The `memblock` argument points to the beginning of the memory block. If `memblock` is `NULL`, `realloc` behaves the same way as `malloc` and allocates a new block of `size` bytes. If `memblock` isn't `NULL`, it should be a pointer returned by a previous call to `calloc`, `malloc`, or `realloc`.

The `size` argument gives the new size of the block, in bytes. The contents of the block are unchanged up to the shorter of the new and old sizes, although the new block can be in a different location. Because the new block can be in a new memory location, the pointer returned by `realloc` isn't guaranteed to be the pointer passed through the `memblock` argument. `realloc` doesn't zero newly allocated memory if there's buffer growth.

`realloc` sets `errno` to `ENOMEM` if the memory allocation fails or if the amount of memory requested exceeds

`_HEAP_MAXREQ`. For information on this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

`realloc` calls `malloc` in order to use the C++ `_set_new_mode` function to set the new handler mode. The new handler mode indicates whether, on failure, `malloc` is to call the new handler routine as set by `_set_new_handler`. By default, `malloc` doesn't call the new handler routine on failure to allocate memory. You can override this default behavior so that, when `realloc` fails to allocate memory, `malloc` calls the new handler routine in the same way that the `new` operator does when it fails for the same reason. To override the default, call

```
_set_new_mode(1);
```

early in ones program, or link with NEWMODE.OBJ (see [Link options](#)).

When the application is linked with a debug version of the C run-time libraries, `realloc` resolves to `_realloc_dbg`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

`realloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables, and that the pointer returned isn't aliased. For more information, see `noalias` and `restrict`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>realloc</code>	<code>&lt;stdlib.h&gt;</code> and <code>&lt;malloc.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_realloc.c
// This program allocates a block of memory for
// buffer and then uses _msize to display the size of that
// block. Next, it uses realloc to expand the amount of
// memory used by buffer and then calls _msize again to
// display the new amount of memory allocated to buffer.

#include <stdio.h>
#include <malloc.h>
#include <stdlib.h>

int main(void)
{
 long *buffer, *oldbuffer;
 size_t size;

 if((buffer = (long *)malloc(1000 * sizeof(long))) == NULL)
 exit(1);

 size = _msize(buffer);
 printf_s("Size of block after malloc of 1000 longs: %u\n", size);

 // Reallocate and show new size:
 oldbuffer = buffer; // save pointer in case realloc fails
 if((buffer = realloc(buffer, size + (1000 * sizeof(long)))) ==
 == NULL)
 {
 free(oldbuffer); // free original block
 exit(1);
 }
 size = _msize(buffer);
 printf_s("Size of block after realloc of 1000 more longs: %u\n",
 size);

 free(buffer);
 exit(0);
}

```

```

Size of block after malloc of 1000 longs: 4000
Size of block after realloc of 1000 more longs: 8000

```

## See also

### [Memory allocation](#)

[calloc](#)  
[free](#)  
[malloc](#)

# \_realloc\_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reallocates a specified block of memory in the heap by moving and/or resizing the block (debug version only).

## Syntax

```
void *_realloc_dbg(
 void *userData,
 size_t newSize,
 int blockType,
 const char *filename,
 int linenumber
);
```

### Parameters

`userData`

Pointer to the previously allocated memory block.

`newSize`

Requested size for the reallocated block (bytes).

`blockType`

Requested type for the reallocated block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to the name of the source file that requested the `realloc` operation or `NULL`.

`linenumber`

Line number in the source file where the `realloc` operation was requested or `NULL`.

The `filename` and `linenumber` parameters are only available when `_realloc_dbg` has been called explicitly or the `_CRTDBG_MAP_ALLOC` preprocessor constant has been defined.

## Return value

On successful completion, this function either returns a pointer to the user portion of the reallocated memory block, calls the new handler function, or returns `NULL`. For a complete description of the return behavior, see the following Remarks section. For more information about how the new handler function is used, see the `realloc` function.

## Remarks

`_realloc_dbg` is a debug version of the `realloc` function. When `_DEBUG` isn't defined, each call to `_realloc_dbg` is reduced to a call to `realloc`. Both `realloc` and `_realloc_dbg` reallocate a memory block in the base heap, but `_realloc_dbg` accommodates several debugging features: buffers on either side of the user portion of the block to test for leaks, a block type parameter to track specific allocation types, and `filename` / `linenumber` information to determine the origin of allocation requests.

`_realloc_dbg` reallocates the specified memory block with slightly more space than the requested `newSize`.

`newSize` might be greater or less than the size of the originally allocated memory block. The extra space is used

by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The reallocation might result in both moving the original memory block to a different location in the heap, and changing the size of the memory block. If the memory block is moved, the contents of the original block are overwritten.

`_realloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails or if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#). For information about the differences between standard heap functions and debug versions, see [Debug versions of heap allocation functions](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_realloc_dbg</code>	<code>&lt;crtdbg.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

Debug versions of [C run-time libraries](#) only.

## Example

See the example in the [`\_msize\_dbg`](#) article.

## See also

[Debug routines](#)

[`\_malloc\_dbg`](#)

# \_realloc

11/2/2022 • 2 minutes to read • [Edit Online](#)

A combination of `realloc` and `calloc`. Rellocates an array in memory and initializes its elements to 0.

## Syntax

```
void *_realloc(
 void *memblock
 size_t num,
 size_t size
);
```

### Parameters

`memblock`

Pointer to previously allocated memory block.

`number`

Number of elements.

`size`

Length in bytes of each element.

## Return value

`_realloc` returns a `void` pointer to the reallocated (and possibly moved) memory block.

If there isn't enough available memory to expand the block to the given size, the original block is left unchanged, and `NULL` is returned.

If the requested size is zero, then the block pointed to by `memblock` is freed; the return value is `NULL`, and `memblock` is left pointing at a freed block.

The return value points to a storage space that is suitably aligned for storage of any type of object. To get a pointer to a type other than `void`, use a type cast on the return value.

## Remarks

The `_realloc` function changes the size of an allocated memory block. The `memblock` argument points to the beginning of the memory block. If `memblock` is `NULL`, `_realloc` behaves the same way as `calloc` and allocates a new block of `number * size` bytes. Each element is initialized to 0. If `memblock` isn't `NULL`, it should be a pointer returned by a previous call to `calloc`, `malloc`, or `realloc`.

Because the new block can be in a new memory location, the pointer returned by `_realloc` isn't guaranteed to be the pointer passed through the `memblock` argument.

`_realloc` sets `errno` to `ENOMEM` if the memory allocation fails or if the amount of memory requested exceeds `_HEAP_MAXREQ`. For information on this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

`realloc` calls `realloc` in order to use the C++ `_set_new_mode` function to set the new handler mode. The new

handler mode indicates whether, on failure, `realloc` is to call the new handler routine as set by `_set_new_handler`. By default, `realloc` doesn't call the new handler routine on failure to allocate memory. You can override this default behavior so that, when `_recalloc` fails to allocate memory, `realloc` calls the new handler routine in the same way that the `new` operator does when it fails for the same reason. To override the default, call

```
_set_new_mode(1);
```

early in the program, or link with NEWMODE.OBJ.

When the application is linked with a debug version of the C run-time libraries, `_recalloc` resolves to `_recalloc_dbg`. For more information about how the heap is managed during the debugging process, see [The CRT debug heap](#).

`_recalloc` is marked `__declspec(noalias)` and `__declspec(restrict)`, meaning that the function is guaranteed not to modify global variables, and that the pointer returned isn't aliased. For more information, see [noalias](#) and [restrict](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_recalloc</code>	<stdlib.h> and <malloc.h>

For more compatibility information, see [Compatibility](#).

## See also

[Memory allocation](#)

`_recalloc_dbg`  
`_aligned_realloc`  
`_aligned_offset_realloc`  
`free`

[Link options](#)

# \_realloc\_dbg

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reallocates an array and initializes its elements to 0 (debug version only).

## Syntax

```
void *_realloc_dbg(
 void *userData,
 size_t num,
 size_t size,
 int blockType,
 const char *filename,
 int linenumber
);
```

### Parameters

`userData`

Pointer to the previously allocated memory block.

`number`

Requested number of memory blocks.

`size`

Requested size of each memory block (bytes).

`blockType`

Requested type of memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

For information about the allocation block types and how they're used, see [Types of blocks on the debug heap](#).

`filename`

Pointer to name of the source file that requested allocation operation or `NULL`.

`linenumber`

Line number in the source file where allocation operation was requested or `NULL`.

The `filename` and `linenumber` parameters are only available when `_realloc_dbg` has been called explicitly or the `_CRTDBG_MAP_ALLOC` preprocessor constant has been defined.

## Return value

On successful completion, this function either returns a pointer to the user portion of the reallocated memory block, calls the new handler function, or returns `NULL`. For a complete description of the return behavior, see the following Remarks section. For more information about how the new handler function is used, see the `_realloc` function.

## Remarks

`_realloc_dbg` is a debug version of the `_realloc` function. When `_DEBUG` isn't defined, each call to `_realloc_dbg` is reduced to a call to `_realloc`. Both `_realloc` and `_realloc_dbg` reallocate a memory block in the base heap, but `_realloc_dbg` accommodates several debugging features: buffers on either side of the

user portion of the block to test for leaks, a block type parameter to track specific allocation types, and `filename` / `linenumber` information to determine the origin of allocation requests.

`_recalloc_dbg` reallocates the specified memory block with slightly more space than the requested size (`number * size`) which might be greater or less than the size of the originally allocated memory block. The extra space is used by the debug heap manager to link the debug memory blocks and to provide the application with debug header information and overwrite buffers. The reallocation might result in both moving the original memory block to a different location in the heap, and changing the size of the memory block. The user portion of the block is filled with the value 0xCD and each of the overwrite buffers are filled with 0xFD.

`_recalloc_dbg` sets `errno` to `ENOMEM` if a memory allocation fails; `EINVAL` is returned if the amount of memory needed (including the overhead mentioned previously) exceeds `_HEAP_MAXREQ`. For information about this and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

For information about how memory blocks are allocated, initialized, and managed in the debug version of the base heap, see [CRT debug heap details](#). For information about the differences between standard heap functions and debug versions, see [Debug versions of heap allocation functions](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_recalloc_dbg</code>	<code>&lt;crtdbg.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

Debug versions of [C run-time libraries](#) only.

## See also

[Debug routines](#)

# remainder, remainderf, remainderl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the remainder of the quotient of two floating-point values, rounded to the nearest integral value.

## Syntax

```
double remainder(double x, double y);
float remainderf(float x, float y);
long double remainderl(long double x, long double y);
#define remainder(X, Y) // Requires C11 or higher

float remainder(float x, float y); /* C++ only */
long double remainder(long double x, long double y); /* C++ only */
```

## Parameters

x

The numerator.

y

The denominator.

## Return value

The floating-point remainder of  $x / y$ . If the value of  $y$  is 0.0, `remainder` returns a quiet NaN. For information about the representation of a quiet NaN by the `printf` family, see [printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#).

## Remarks

The `remainder` functions calculate the floating-point remainder  $r$  of  $x / y$  such that  $x = n * y + r$ , where  $n$  is the integer nearest in value to  $x / y$  and  $n$  is even whenever  $|n - x / y| = 1/2$ . When  $r = 0$ ,  $r$  has the same sign as  $x$ .

Because C++ allows overloading, you can call overloads of `remainder` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `remainder` always takes two `double` arguments and returns a `double`.

If you use the `<tgmath.h>` `remainder()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>remainder</code> , <code>remainderf</code> , <code>remainderl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code> or <code>&lt;math.h&gt;</code>

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>remainder</code> macro	<code>&lt;tgmath.h&gt;</code>	

For compatibility information, see [Compatibility](#).

## Example

```
// crt_remainder.c
// This program displays a floating-point remainder.

#include <math.h>
#include <stdio.h>

int main(void)
{
 double w = -10.0, x = 3.0, z;

 z = remainder(w, x);
 printf("The remainder of %.2f / %.2f is %f\n", w, x, z);
}
```

```
The remainder of -10.00 / 3.00 is -1.000000
```

## See also

[Math and floating-point support](#)

[ldiv](#), [lldiv](#)  
[imaxdiv](#)  
[fmod](#), [fmodf](#)  
[remquo](#), [remquof](#), [remquol](#)

# `remove`, `_wremove`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Delete a file.

## Syntax

```
int remove(
 const char *path
);
int _wremove(
 const wchar_t *path
);
```

### Parameters

`path`

Path of file to be removed.

## Return value

Each of these functions returns 0 if the file is successfully deleted. Otherwise, it returns -1 and sets `errno` either to `EACCES` to indicate that the path specifies a read-only file, specifies a directory, or the file is open, or to `ENOENT` to indicate that the filename or path wasn't found.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `remove` function deletes the file specified by `path`. `_wremove` is a wide-character version of `_remove`; the `path` argument to `_wremove` is a wide-character string. `_wremove` and `_remove` behave identically otherwise. All handles to a file must be closed before it can be deleted.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tremove</code>	<code>remove</code>	<code>remove</code>	<code>_wremove</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>remove</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;iostream.h&gt;</code>
<code>_wremove</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

```
// crt_remove.c
/* This program uses remove to delete crt_remove.txt */

#include <stdio.h>

int main(void)
{
 if(remove("crt_remove.txt") == -1)
 perror("Could not delete 'CRT_REMOVE.TXT'");
 else
 printf("Deleted 'CRT_REMOVE.TXT'\n");
}
```

**Input:** crt\_remove.txt

This file will be deleted.

## Sample output

Deleted 'CRT\_REMOVE.TXT'

## See also

[File handling](#)

[\\_unlink](#) , [\\_wunlink](#)

# `remquo`, `remquof`, `remquol`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Computes the remainder of two integer values, and stores an integer value with the sign and approximate magnitude of the quotient in a parameter.

## Syntax

```
double remquo(double numer, double denom, int* quo);
float remquof(float numer, float denom, int* quo);
long double remquol(long double numer, long double denom, int* quo);
#define remquo(X, Y, INT_PTR) // Requires C11 or higher

float remquo(float numer, float denom, int* quo); /* C++ only */
long double remquo(long double numer, long double denom, int* quo); /* C++ only */
```

### Parameters

`numer`

The numerator.

`denom`

The denominator.

`quo`

A pointer to an integer to store a value that has the sign and approximate magnitude of the quotient.

## Return value

`remquo` returns the floating-point remainder of  $x / y$ . If the value of  $y$  is 0.0, `remquo` returns a quiet NaN. For information about the representation of a quiet NaN by the `printf` family, see [printf](#), [\\_printf\\_1](#), [wprintf](#), [\\_wprintf\\_1](#).

## Remarks

The `remquo` function calculates the floating-point remainder  $f$  of  $x / y$  such that  $x = n * y + f$ , where  $n$  is an integer,  $f$  has the same sign as  $x$ , and the absolute value of  $f$  is less than the absolute value of  $y$ .

C++ allows overloading, so you can call overloads of `remquo` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `remquo` always takes two `double` arguments and returns a `double`.

If you use the `<tgmath.h>` `remquo()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>remquo</code> , <code>remquof</code> , <code>remquol</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code> or <code>&lt;math.h&gt;</code>
<code>remquo</code> macro	<code>&lt;tgmath.h&gt;</code>	

For compatibility information, see [Compatibility](#).

## Example

```
// crt_remquo.c
// This program displays a floating-point remainder.

#include <math.h>
#include <stdio.h>

int main(void)
{
 double w = -10.0, x = 3.0, z;
 int quo = 0;

 z = remquo(w, x, &quo);
 printf("The remainder of %.2f / %.2f is %f\n", w, x, z);
 printf("Approximate signed quotient is %d\n");
}
```

```
The remainder of -10.00 / 3.00 is -1.000000
Approximate signed quotient is -3
```

## See also

### Math and floating-point support

<code>ldiv</code> , <code>lldiv</code>
<code>imaxdiv</code>
<code>fmod</code> , <code>fmodf</code>
<code>remainder</code> , <code>remainderf</code> , <code>remainderl</code>

# rename , \_wrename

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rename a file or directory.

## Syntax

```
int rename(
 const char *oldname,
 const char *newname
);
int _wrename(
 const wchar_t *oldname,
 const wchar_t *newname
);
```

### Parameters

`oldname`

Pointer to old name.

`newname`

Pointer to new name.

## Return value

Each of these functions returns 0 if it's successful. On an error, the function returns a nonzero value and sets `errno` to one of the following values:

ERRNO	VALUE	CONDITION
<code>EACCES</code>		File or directory specified by <code>newname</code> already exists or couldn't be created (invalid path); or <code>oldname</code> is a directory and <code>newname</code> specifies a different path.
<code>ENOENT</code>		File or path specified by <code>oldname</code> not found.
<code>EINVAL</code>		Name contains invalid characters.

For other possible return values, see [\\_doserrno](#), [\\_errno](#), [syserrlist](#), and [\\_sys\\_nerr](#).

## Remarks

The `rename` function renames the file or directory specified by `oldname` to the name given by `newname`. The old name must be the path of an existing file or directory. The new name must not be the name of an existing file or directory. You can use `rename` to move a file from one directory or device to another by giving a different path in the `newname` argument. However, you can't use `rename` to move a directory. Directories can be renamed, but not moved.

`_wrename` is a wide-character version of `_rename`; the arguments to `_wrename` are wide-character strings. `_wrename` and `_rename` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_trename</code>	<code>rename</code>	<code>rename</code>	<code>_wrename</code>

## Requirements

<code>ROUTINE</code>	<code>REQUIRED HEADER</code>
<code>rename</code>	<code>&lt;io.h&gt; or &lt;stdio.h&gt;</code>
<code>_wrename</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

```
// crt_renamer.c
/* This program attempts to rename a file named
 * CRT_RENAMER.OBJ to CRT_RENAMER.JBO. For this operation
 * to succeed, a file named CRT_RENAMER.OBJ must exist and
 * a file named CRT_RENAMER.JBO must not exist.
 */
#include <stdio.h>

int main(void)
{
 int result;
 char old[] = "CRT_RENAMER.OBJ", new[] = "CRT_RENAMER.JBO";

 /* Attempt to rename file: */
 result = rename(old, new);
 if(result != 0)
 printf("Could not rename '%s'\n", old);
 else
 printf("File '%s' renamed to '%s'\n", old, new);
}
```

## Output

```
File 'CRT_RENAMER.OBJ' renamed to 'CRT_RENAMER.JBO'
```

## See also

[File handling](#)

# \_resetstkoflw

11/2/2022 • 7 minutes to read • [Edit Online](#)

Recovers from stack overflow.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _resetstkoflw(void);
```

## Return value

Nonzero if the function succeeds, zero if it fails.

## Remarks

The `_resetstkoflw` function recovers from a stack overflow condition, allowing a program to continue instead of failing with a fatal exception error. If the `_resetstkoflw` function isn't called, there are no guard pages after the previous exception. The next time that there's a stack overflow, there are no exceptions at all and the process terminates without warning.

If a thread in an application causes an `EXCEPTION_STACK_OVERFLOW` exception, the thread has left its stack in a damaged state. This exception is different from other exceptions such as `EXCEPTION_ACCESS_VIOLATION` or `EXCEPTION_INT_DIVIDE_BY_ZERO`, where the stack isn't damaged. The stack is set to an arbitrarily small value when the program is first loaded. The stack then grows on demand to meet the needs of the thread. On-demand growth is implemented by placing a page with `PAGE_GUARD` access at the end of the current stack. For more information, see [Creating guard pages](#).

When the code causes the stack pointer to point to an address on this page, an exception occurs and the system does the following three things:

- Removes the `PAGE_GUARD` protection on the guard page so that the thread can read and write data to the memory.
- Allocates a new guard page that is located one page below the last one.
- Reruns the instruction that raised the exception.

In this way, the system can increase the size of the stack for the thread automatically. Each thread in a process has a maximum stack size. The stack size is set at compile time by the `/STACK` ([Stack Allocations](#)) option, or by the `STACKSIZE` statement in the `.def` file for the project.

When this maximum stack size is exceeded, the system does the following three things:

- Removes the `PAGE_GUARD` protection on the guard page, as previously described.
- Tries to allocate a new guard page below the last one. However, the allocation fails because the maximum

stack size has been exceeded.

- Raises an exception so that the thread can handle it in the exception block.

At that point, the stack no longer has a guard page. The next time the program grows the stack to where it writes beyond the end of the stack, it causes an access violation.

Call `_resetstkoflw` to restore the guard page whenever recovery is done after a stack overflow exception. This function can be called from inside the main body of an `__except` block or outside an `__except` block. However, there are some restrictions on when it should be used. `_resetstkoflw` shouldn't be called from:

- A filter expression.
- A filter function.
- A function called from a filter function.
- A `catch` block.
- A `__finally` block.

At these points, the stack isn't yet sufficiently unwound.

Stack overflow exceptions are generated as structured exceptions, not C++ exceptions, so `_resetstkoflw` isn't useful in an ordinary `catch` block because it won't catch a stack overflow exception. However, if `_set_se_translator` is used to implement a structured exception translator that throws C++ exceptions (as in the second example), a stack overflow exception results in a C++ exception that can be handled by a C++ catch block.

It isn't safe to call `_resetstkoflw` in a C++ catch block that is reached from an exception thrown by the structured exception translator function. In this case, the stack space isn't freed and the stack pointer isn't reset until outside the catch block, even though destructors have been called for any destructible objects before the catch block. This function shouldn't be called until the stack space is freed and the stack pointer has been reset. Therefore, it should be called only after exiting the catch block. As little stack space as possible should be used in the catch block. A stack overflow that occurs in the catch block that is itself attempting to recover from a previous stack overflow isn't recoverable. It can cause the program to stop responding, as the overflow in the catch block triggers an exception that itself is handled by the same catch block.

There are situations where `_resetstkoflw` can fail even if used in a correct location, such as within an `__except` block. There may not be enough stack space left to execute `_resetstkoflw` without writing into the last page of the stack, even after unwinding the stack. Then, `_resetstkoflw` fails to reset the last page of the stack as the guard page, and returns 0, indicating failure. Safe usage of this function should include checking the return value instead of assuming that the stack is safe to use.

Structured exception handling won't catch a `STATUS_STACK_OVERFLOW` exception when the application is compiled with `/clr` (see [/clr \(Common Language Runtime Compilation\)](#)).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_resetstkoflw</code>	<code>&lt;malloc.h&gt;</code>

For more compatibility information, see [Compatibility](#).

**Libraries:** All versions of the [CRT library features](#).

## Example

The following example shows the recommended usage of the `_resetstkoflw` function.

```

// crt_resetstkoflw.c
// Launch program with and without arguments to observe
// the difference made by calling _resetstkoflw.

#include <malloc.h>
#include <stdio.h>
#include <windows.h>

void recursive(int recurse)
{
 _alloca(2000);
 if (recurse)
 recursive(recurse);
}

// Filter for the stack overflow exception.
// This function traps the stack overflow exception, but passes
// all other exceptions through.
int stack_overflow_exception_filter(int exception_code)
{
 if (exception_code == EXCEPTION_STACK_OVERFLOW)
 {
 // Do not call _resetstkoflw here, because
 // at this point, the stack isn't yet unwound.
 // Instead, signal that the handler (the __except block)
 // is to be executed.
 return EXCEPTION_EXECUTE_HANDLER;
 }
 else
 return EXCEPTION_CONTINUE_SEARCH;
}

int main(int ac)
{
 int i = 0;
 int recurse = 1, result = 0;

 for (i = 0 ; i < 10 ; i++)
 {
 printf("loop #%d\n", i + 1);
 __try
 {
 recursive(recurse);

 }

 __except(stack_overflow_exception_filter(GetExceptionCode()))
 {
 // Here, it is safe to reset the stack.

 if (ac >= 2)
 {
 puts("resetting stack overflow");
 result = _resetstkoflw();
 }
 }

 // Terminate if _resetstkoflw failed (returned 0)
 if (!result)
 return 3;
 }

 return 0;
}

```

Sample output with no program arguments:

```
loop #1
```

The program stops responding without executing further iterations.

With program arguments:

```
loop #1
resetting stack overflow
loop #2
resetting stack overflow
loop #3
resetting stack overflow
loop #4
resetting stack overflow
loop #5
resetting stack overflow
loop #6
resetting stack overflow
loop #7
resetting stack overflow
loop #8
resetting stack overflow
loop #9
resetting stack overflow
loop #10
resetting stack overflow
```

## Description

The following example shows the recommended use of `_resetstkoflw` in a program where structured exceptions are converted to C++ exceptions.

## Code

```
// crt_resetstkoflw2.cpp
// compile with: /EHs
// _set_se_translator requires the use of /EHs
#include <malloc.h>
#include <stdio.h>
#include <windows.h>
#include <eh.h>

class Exception { };

class StackOverflowException : Exception { };

// Because the overflow is deliberate, disable the warning that
// this function will cause a stack overflow.
#pragma warning (disable: 4717)
void CauseStackOverflow (int i)
{
 // Overflow the stack by allocating a large stack-based array
 // in a recursive function.
 int a[10000];
 printf("%d ", i);
 CauseStackOverflow (i + 1);
}

void __cdecl SEHTranslator (unsigned int code, _EXCEPTION_POINTERS*)
{
 // For stack overflow exceptions, throw our own C++
 // exception object.
 // For all other exceptions, throw a generic exception object.
 // Use minimal stack space in this function.
}
```

```

// Do not call _resetstkoflw in this function.

if (code == EXCEPTION_STACK_OVERFLOW)
 throw StackOverflowException();
else
 throw Exception();
}

int main()
{
 bool stack_reset = false;
 bool result = false;

 // Set up a function to handle all structured exceptions,
 // including stack overflow exceptions.
 _set_se_translator (SEHTranslator);

 try
 {
 CauseStackOverflow (0);
 }
 catch (StackOverflowException except)
 {
 // Use minimal stack space here.
 // Do not call _resetstkoflw here.
 printf("\nStack overflow!\n");
 stack_reset = true;
 }
 catch (Exception except)
 {
 // Do not call _resetstkoflw here.
 printf("\nUnknown Exception!\n");
 }
 if (stack_reset)
 {
 result = _resetstkoflw();
 // If stack reset failed, terminate the application.
 if (result == 0)
 exit(1);
 }

 void* pv = _alloca(100000);
 printf("Recovered from stack overflow and allocated 100,000 bytes"
 " using _alloca.");
}

return 0;
}

```

```

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Stack overflow!
Recovered from stack overflow and allocated 100,000 bytes using _alloca.

```

## See also

[\\_alloca](#)

# rewind

11/2/2022 • 2 minutes to read • [Edit Online](#)

Repositions the file pointer to the beginning of a file.

## Syntax

```
void rewind(
 FILE *stream
)
```

### Parameters

`stream`

Pointer to `FILE` structure.

## Remarks

The `rewind` function repositions the file pointer associated with `stream` to the beginning of the file. A call to `rewind` is similar to

```
(void) fseek(stream, 0L, SEEK_SET);
```

However, unlike `fseek`, `rewind` clears both the error indicators for the stream and the end-of-file indicator. Also, unlike `fseek`, `rewind` doesn't return a value to indicate whether the pointer was successfully moved.

To clear the keyboard buffer, use `rewind` with the stream `stdin`, which is associated with the keyboard by default.

If `stream` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function returns, and `errno` is set to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>rewind</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the C run-time libraries.

## Example

```
// crt_rewind.c
/* This program first opens a file named
* crt_rewind.out for input and output and writes two
* integers to the file. Next, it uses rewind to
* reposition the file pointer to the beginning of
* the file and reads the data back in.
*/
#include <stdio.h>

int main(void)
{
 FILE *stream;
 int data1, data2;

 data1 = 1;
 data2 = -37;

 fopen_s(&stream, "crt_rewind.out", "w+");
 if(stream != NULL)
 {
 fprintf(stream, "%d %d", data1, data2);
 printf("The values written are: %d and %d\n", data1, data2);
 rewind(stream);
 fscanf_s(stream, "%d %d", &data1, &data2);
 printf("The values read are: %d and %d\n", data1, data2);
 fclose(stream);
 }
}
```

## Output

```
The values written are: 1 and -37
The values read are: 1 and -37
```

## See also

[Stream I/O](#)

`rint`, `rintf`, `rintl`

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Rounds a floating-point value to the nearest integer in floating-point format.

## Syntax

```
double rint(double x);
float rintf(float x);
long double rintl(long double x);
#define rint(X) // Requires C11 or higher

float rint(float x); // C++ only
long double rint(long double x); // C++ only
```

### Parameters

`x`

The floating-point value to round.

## Return value

The `rint` functions return a floating-point value that represents the nearest integer to `x`. Halfway values are rounded according to the current setting of the floating-point rounding mode, the same as the `nearbyint` functions. Unlike the `nearbyint` functions, the `rint` functions may raise the `FE_INEXACT` floating-point exception if the result differs in value from the argument. There's no error return.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{INF}$ , QNaN, IND	none	none
Denormals	<code>EXCEPTION_FLT_UNDERFLOW</code>	none

## Remarks

Because C++ allows overloading, you can call overloads of `rint` that take and return `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `rint` always takes and returns a `double`.

If you use the `<tgmath.h>` `rint()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

FUNCTION	C HEADER	C++ HEADER
<code>rint</code> , <code>rintf</code> , <code>rintl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code>

FUNCTION	C HEADER	C++ HEADER
<code>rint</code> macro	<tgmath.h>	

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_rint.c
// Build with: cl /W3 /Tc crt_rint.c
// This example displays the rounded results of
// the floating-point values 2.499999, -2.499999,
// 2.8, -2.8, 2.5 and -2.5.

#include <math.h>
#include <stdio.h>

int main(void)
{
 double x = 2.499999;
 float y = 2.8f;
 long double z = 2.5;

 printf("rint(%f) is %.0f\n", x, rint (x));
 printf("rint(%f) is %.0f\n", -x, rint (-x));
 printf("rintf(%f) is %.0f\n", y, rintf(y));
 printf("rintf(%f) is %.0f\n", -y, rintf(-y));
 printf("rintl(%Lf) is %.0Lf\n", z, rintl(z));
 printf("rintl(%Lf) is %.0Lf\n", -z, rintl(-z));
}
```

```
rint(2.499999) is 2
rint(-2.499999) is -2
rintf(2.800000) is 3
rintf(-2.800000) is -3
rintl(2.500000) is 3
rintl(-2.500000) is -3
```

## See also

[Math and floating-point support](#)

[ceil](#), [ceilf](#), [ceill](#)  
[floor](#), [floorf](#), [floorl](#)  
[fmod](#), [fmodf](#)  
[lrint](#), [lrintf](#), [lrintl](#), [llrint](#), [llrintf](#), [llrintl](#)  
[lround](#), [lroundf](#), [lroundl](#), [llround](#), [llroundf](#), [llroundl](#)  
[nearbyint](#), [nearbyintf](#), [nearbyintl](#)  
[rint](#)

rmdir

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The Microsoft-implemented POSIX function name `rmdir` is a deprecated alias for the `_rmdir` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_rmdir` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# `_rmdir`, `_wrmdir`

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Deletes a directory.

## Syntax

```
int _rmdir(
 const char *dirname
);
int _wrmdir(
 const wchar_t *dirname
);
```

### Parameters

`dirname`

Path of the directory to be removed.

## Return value

Each of these functions returns 0 if the directory is successfully deleted. A return value of -1 indicates an error and `errno` is set to one of the following values:

ERRNO	VALUE	CONDITION
	<code>ENOTEMPTY</code>	Given path isn't a directory, the directory isn't empty, or the directory is either the current working directory or the root directory.
	<code>ENOENT</code>	Path is invalid.
	<code>EACCES</code>	A program has an open handle to the directory.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_rmdir` function deletes the directory specified by `dirname`. The directory must be empty, and it must not be the current working directory or the root directory.

`_wrmdir` is a wide-character version of `_rmdir`; the `dirname` argument to `_wrmdir` is a wide-character string. `_wrmdir` and `_rmdir` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_trmdir</code>	<code>_rmdir</code>	<code>_rmdir</code>	<code>_wrmdir</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_rmdir</code>	<code>&lt;direct.h&gt;</code>
<code>_wrmdir</code>	<code>&lt;direct.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

See the example for [`\_mkdir`](#).

## See also

### Directory control

<a href="#"><code>_chdir</code></a>	<a href="#"><code>_wchdir</code></a>
<a href="#"><code>_mkdir</code></a>	<a href="#"><code>_wmkdir</code></a>

# rmtmp

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The Microsoft-specific function name `rmtmp` is a deprecated alias for the `_rmtmp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_rmtmp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# \_rmtmp

11/2/2022 • 2 minutes to read • [Edit Online](#)

Removes temporary files.

## Syntax

```
int _rmtmp(void);
```

## Return value

`_rmtmp` returns the number of temporary files closed and deleted.

## Remarks

The `_rmtmp` function cleans up all temporary files in the current directory. The function removes only those files created by `tmpfile`; use it only in the same directory in which the temporary files were created.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_rmtmp</code>	<stdio.h>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

See the example for `tmpfile`.

## See also

### Stream I/O

`_flushall`  
`tmpfile`  
`_tempnam`, `_wtempnam`, `tmpnam`, `_wtmpnam`

`_rotl`, `_rotl64`, `_rotr`, `_rotr64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rotates bits to the left (`_rotl`) or right (`_rotr`).

## Syntax

```
unsigned int _rotl(
 unsigned int value,
 int shift
);
unsigned __int64 _rotl64(
 unsigned __int64 value,
 int shift
);
unsigned int _rotr(
 unsigned int value,
 int shift
);
unsigned __int64 _rotr64(
 unsigned __int64 value,
 int shift
);
```

### Parameters

`value`

Value to be rotated.

`shift`

Number of bits to shift.

## Return value

The rotated value. There's no error return.

## Remarks

The `_rotl` and `_rotr` functions rotate the unsigned `value` by `shift` bits. `_rotl` rotates the value left. `_rotr` rotates the value right. Both functions wrap bits rotated off one end of `value` to the other end.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_rotl</code> , <code>_rotl64</code>	<code>&lt;stdlib.h&gt;</code>
<code>_rotr</code> , <code>_rotr64</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

# Libraries

All versions of the [C run-time libraries](#).

## Example

```
// crt_rot.c
/* This program shifts values to rotate an integer.
*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 unsigned val = 0x0fd93;
 __int64 val2 = 0x0101010101010101;

 printf("0x%4.4x rotated left three times is 0x%4.4x\n",
 val, _rotl(val, 3));
 printf("0x%4.4x rotated right four times is 0x%4.4x\n",
 val, _rotr(val, 4));

 printf("%I64x rotated left three times is %I64x\n",
 val2, _rotl64(val2, 3));
 printf("%I64x rotated right four times is %I64x\n",
 val2, _rotr64(val2, 4));
}
```

## Output

```
0xfd93 rotated left three times is 0x7ec98
0xfd93 rotated right four times is 0x30000fd9
101010101010101 rotated left three times is 808080808080808
101010101010101 rotated right four times is 1010101010101010
```

## See also

[Math and floating-point support](#)

[\\_lrotl](#) , [\\_lrotr](#)

# round, roundf, roundl

11/2/2022 • 2 minutes to read • [Edit Online](#)

Rounds a floating-point value to the nearest integer value.

## Syntax

```
double round(
 double x
);
float round(
 float x
); // C++ only
long double round(
 long double x
); // C++ only
float roundf(
 float x
);
long double roundl(
 long double x
);
#define round(X) // Requires C11 or higher
```

## Parameters

x

The floating-point value to round.

## Return value

The `round` functions return a floating-point value that represents the nearest integer to `x`. Halfway values are rounded away from zero, regardless of the setting of the floating-point rounding mode. There's no error return.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

## Remarks

Because C++ allows overloading, you can call overloads of `round` that take and return `float` and `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `round` always takes and returns a `double`.

If you use the `round` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
round , roundf , roundl	<math.h>
round macro	<tgmath.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// Build with: cl /W3 /Tc
// This example displays the rounded
// results of floating-point values

#include <math.h>
#include <stdio.h>

int main()
{
 printf("===== Round a float\n\n");
 float floatValue = 2.4999999f; // float stores a value close to, but not exactly equal to, the
 // initializer below. floatValue will contain 2.5 because it is the closest single precision value
 printf("roundf(.1000g) is %.1000g\n", floatValue, roundf(floatValue));
 printf("roundf(.1000g) is %.1000g\n", -floatValue, roundf(-floatValue));

 // double stores a value close to, but not exactly equal to, the initializer below. The closest double
 // value is just slightly larger.
 double doubleValue = 2.4999999;
 printf("\n===== Round a double\n\n");
 printf("round(%1.1000g) is %.1000g\n", doubleValue, round(doubleValue));
 printf("round(%1.1000g) is %.1000g\n", -doubleValue, round(-doubleValue));

 // long double stores a value close to, but not exactly equal to, the initializer below. The closest
 // long double value is just slightly larger.
 long double longDoubleValue = 2.4999999L;
 printf("\n===== Round a long double\n\n");
 printf("roundl(%1.1000g) is %.1000g\n", longDoubleValue, roundl(longDoubleValue));
 printf("roundl(%1.1000g) is %.1000g\n", -longDoubleValue, roundl(-longDoubleValue));

 return 0;
}
```

```
===== Round a float

roundf(2.5) is 3
roundf(-2.5) is -3

===== Round a double

round(2.499999900000000163657887242152355611324310302734375) is 2
round(-2.499999900000000163657887242152355611324310302734375) is -2

===== Round a long double

roundl(2.499999900000000163657887242152355611324310302734375) is 2
roundl(-2.499999900000000163657887242152355611324310302734375) is -2
```

## See also

[Math and floating-point support](#)

```
ceil, ceilf, ceill
floor, floorf, floorl
fmod, fmodf
lrint, lrintf, lrintl, llrint, llrintf, llrintl
lround, lroundf, lroundl, llround, llroundf, llroundl
nearbyint, nearbyintf, nearbyintl
rint, rintf, rintl
```

# `_RPT`, `_RPTF`, `_RPTW`, `_RPTFW` Macros

11/2/2022 • 2 minutes to read • [Edit Online](#)

Tracks an application's progress by generating a debug report (debug version only). The `n` suffix specifies the number of arguments in `args`, and can be 0, 1, 2, 3, 4, or 5.

## Syntax

```
_RPTn(
 reportType,
 format,
 ...[args]
);
_RPTFn(
 reportType,
 format,
 [args]
);
_RPTWn(
 reportType,
 format
 [args]
);
_RPTFWn(
 reportType,
 format
 [args]
);
```

### Parameters

`reportType`

Report type: `_CRT_WARN`, `_CRT_ERROR`, or `_CRT_ASSERT`.

`format`

Format-control string used to create the user message.

`args`

Substitution arguments used by `format`.

## Remarks

All these macros take the `reportType` and `format` parameters. In addition, they might also take up to four more arguments, signified by the number appended to the macro name. For example, `_RPT0` and `_RPTF0` take no more arguments, `_RPT1` and `_RPTF1` take `arg1`, `_RPT2` and `_RPTF2` take `arg1` and `arg2`, and so on.

The `_RPT` and `_RPTF` macros are similar to the `printf` function, because they can be used to track an application's progress during the debugging process. However, these macros are more flexible than `printf` because they don't need to be enclosed in `#ifdef` statements to prevent them from being called in a retail build of an application. This flexibility is achieved by using the `_DEBUG` macro; the `_RPT` and `_RPTF` macros are only available when the `_DEBUG` flag is defined. When `_DEBUG` isn't defined, calls to these macros are removed during preprocessing.

The `_RPTW` and `_RPTFW` macros are wide-character versions of these macros. They are like `wprintf` and take

wide-character strings as arguments.

The `_RPT` macros call the `_CrtDbgReport` function to generate a debug report with a user message. The `_RPTW` macros call the `_CrtDbgReportW` function to generate the same report with wide characters. The `_RPTF` and `_RPTFW` macros create a debug report with the source file and line number where the report macro was called, in addition to the user message. The user message is created by substituting the `arg[n]` arguments into the `format` string, using the same rules defined by the `printf` function.

`_CrtDbgReport` or `_CrtDbgReportW` generates the debug report and determines its destinations based on the current report modes and file defined for `reportType`. The `_CrtSetReportMode` and `_CrtSetReportFile` functions are used to define the destinations for each report type.

If an `_RPT` macro is called, and `_CrtSetReportMode` and `_CrtSetReportFile` haven't been called, messages are displayed as follows:

REPORT TYPE	OUTPUT DESTINATION
<code>_CRT_WARN</code>	Warning text isn't displayed.
<code>_CRT_ERROR</code>	A pop-up window. Same as if <code>_CrtSetReportMode(_CRT_ERROR, _CRTDBG_MODE_WNDW);</code> had been specified.
<code>_CRT_ASSERT</code>	Same as <code>_CRT_ERROR</code> .

When the destination is a debug message window and the user chooses the **Retry** button, `_CrtDbgReport` or `_CrtDbgReportW` returns 1. This return value causes these macros to start the debugger, if just-in-time (JIT) debugging is enabled. For more information about using these macros as a debugging error handling mechanism, see [Using macros for verification and reporting](#).

Two other macros exist that generate a debug report. The `_ASSERT` macro generates a report, but only when its expression argument evaluates to `FALSE`. `_ASERTE` is exactly like `_ASSERT`, but includes the failed expression in the generated report.

## Requirements

MACRO	REQUIRED HEADER
<code>_RPT</code> macros	<code>&lt;crtdbg.h&gt;</code>
<code>_RPTF</code> macros	<code>&lt;crtdbg.h&gt;</code>
<code>_RPTW</code> macros	<code>&lt;crtdbg.h&gt;</code>
<code>_RPTFW</code> macros	<code>&lt;crtdbg.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

Debug versions of [C run-time libraries](#) only.

Although these macros are available when you include `crtdbg.h`, to run, the application must link with one of the debug libraries, because these macros call other run-time functions.

## Example

See the example in the [\\_ASSERT](#) article.

## See also

[Debug routines](#)

## `_RTC_GetErrDesc`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns a brief description of a run-time error check (RTC) type.

## Syntax

```
const char * _RTC_GetErrDesc(
 _RTC_ErrorNumber errnum
)
```

### Parameters

`errnum`

A number between zero and one less than the value returned by `_RTC_NumErrors`.

## Return value

A character string that contains a short description of one of the error types detected by the run-time error check system. If error is less than zero or greater than or equal to the value returned by `_RTC_NumErrors`, `_RTC_GetErrDesc` returns `NULL`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_RTC_GetErrDesc</code>	<code>&lt;rtcapi.h&gt;</code>

For more information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## See also

[`\_RTC\_NumErrors`](#)

[Runtime error checking](#)

## \_RTC\_NumErrors

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the total number of errors that can be detected by run-time error checks (RTC). You can use this number as the control in a `for` loop, where each value in the loop is passed to [\\_RTC\\_GetErrDesc](#).

## Syntax

```
int _RTC_NumErrors(void);
```

## Return value

An integer whose value represents the total number of errors that can be detected by the Visual C++ run-time error checks.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_RTC_NumErrors</code>	<code>&lt;rtcapi.h&gt;</code>

For more information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## See also

[\\_RTC\\_GetErrDesc](#)

[Runtime error checking](#)

# `_RTC_SetErrorFunc`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Designates a function as the handler for reporting run-time error checks (RTCs). This function is deprecated; use `_RTC_SetErrorFuncW` instead.

## Syntax

```
_RTC_error_fn _RTC_SetErrorFunc(
 _RTC_error_fn function
)
```

### Parameters

`function`

The address of the function that will handle run-time error checks.

## Return value

The previously defined error function. If there's no previously defined function, returns `NULL`.

## Remarks

Don't use this function; instead, use `_RTC_SetErrorFuncW`. It's retained only for backward compatibility.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_RTC_SetErrorFunc</code>	<code>&lt;rtcapi.h&gt;</code>

For more information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## See also

[`\_CrtDbgReport`](#) , [`\_CrtDbgReportW`](#)

[Runtime error checking](#)

## `_RTC_SetErrorFuncW`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Designates a function as the handler for the reporting of run-time error checks (RTCs).

## Syntax

```
_RTC_error_fnW _RTC_SetErrorFuncW(
 _RTC_error_fnW function
)
```

### Parameters

`function`

The address of the function that will handle run-time error checks.

## Return value

The previously defined error function; or `NULL` if there's no previously defined function.

## Remarks

In new code, use only `_RTC_SetErrorFuncW`. `_RTC_SetErrorFunc` is only included in the library for backward compatibility.

The `_RTC_SetErrorFuncW` callback applies only to the component that it was linked in, but not globally.

Make sure that the address that you pass to `_RTC_SetErrorFuncW` is that of a valid error handling function.

If an error has been assigned a type of -1 by using `_RTC_SetErrorType`, the error handling function isn't called.

Before you can call this function, you must first call one of the run-time error-check initialization functions. For more information, see [Using runtime checks without the C runtime library](#).

`_RTC_error_fnW` is defined as follows:

```
typedef int (__cdecl * _RTC_error_fnW)(
 int errorType,
 const wchar_t * filename,
 int linenumber,
 const wchar_t * moduleName,
 const wchar_t * format,
 ...);
```

where:

`errorType`

The type of error that's specified by `_RTC_SetErrorType`.

`filename`

The source file where the failure occurred, or null if no debug information is available.

`Linenumber`

The line in `filename` where the failure occurred, or 0 if no debug information is available.

`moduleName`

The DLL or executable name where the failure occurred.

`format`

printf style string to display an error message, using the remaining parameters. The first argument of the `VA_ARGLIST` is the RTC Error number that occurred.

For an example that shows how to use `_RTC_error_fnW`, see [Native runtime checks customization](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_RTC_SetErrorFuncW</code>	<code>&lt;rtcapi.h&gt;</code>

For more information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## See also

[`\_CrtDbgReport`](#) , [`\_CrtDbgReportW`](#)

[Runtime error checking](#)

## `_RTC_SetErrorType`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Associates an error that is detected by run-time error checks (RTCs) with a type. Your error handler processes how to output errors of the specified type.

## Syntax

```
int _RTC_SetErrorType(
 _RTC_ErrorNumber errnum,
 int ErrType
);
```

### Parameters

`errnum`

A number between zero and one less than the value returned by [`\_RTC\_NumErrors`](#).

`ErrType`

A value to assign to this `errnum`. For example, you might use `_CRT_ERROR`. If you're using `_CrtDbgReport` as your error handler, `ErrType` can only be one of the symbols defined in [`\_CrtSetReportMode`](#). If you have your own error handler ([`\_RTC\_SetErrorFunc`](#)), you can have as many `ErrType` values as there are `errnum` values.

An `ErrType` of `_RTC_ERRTYPE_IGNORE` has special meaning to `_CrtSetReportMode`; the error is ignored.

## Return value

The previous value for the error type replaced by `ErrType`.

## Remarks

By default, all errors are set to `ErrType` = 1, which corresponds to `_CRT_ERROR`. For more information about the default error types such as `_CRT_ERROR`, see [`\_CrtDbgReport`](#).

Before you can call this function, you must first call one of the run-time error check initialization functions; see [Using runtime checks without the C runtime library](#)

## Requirements

ROUTINE	REQUIRED HEADER
<code>_RTC_SetErrorType</code>	<code>&lt;rtcapi.h&gt;</code>

For more information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## See also

`_RTC_GetErrDesc`

Runtime error checking

# `_scalb`, `_scalbf`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Scales argument by a power of 2.

## Syntax

```
double _scalb(
 double x,
 long exp
);
float _scalbf(
 float x,
 long exp
); /* x64 only */
```

## Parameters

`x`

Double-precision, floating-point value.

`exp`

Long integer exponent.

## Return value

Returns an exponential value if successful. On overflow (depending on the sign of `x`), `_scalb` returns  $+\text{-}\infty$ ; the `errno` variable is set to `ERANGE`.

For more information about this and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

The `_scalb` function calculates the value of  $x * 2^{\text{exp}}$ .

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_scalb</code> , <code>_scalbf</code>	<code>&lt;float.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

[Math and floating-point support](#)

[ldexp](#)

`scalbn`, `scalbnf`, `scalbnl`, `scalbln`, `scalblnf`,  
`scalblnl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Multiples a floating-point number by an integral power of `FLT_RADIX`.

## Syntax

```
double scalbn(
 double x,
 int exp
);
float scalbn(
 float x,
 int exp
); // C++ only
long double scalbn(
 long double x,
 int exp
); // C++ only
float scalbnf(
 float x,
 int exp
);
long double scalbln(
 long double x,
 int exp
);

#define scalbn(X, INT) // Requires C11 or higher

double scalbln(
 double x,
 long exp
);

float scalblnf(
 float x,
 long exp
);
long double scalblnl(
 long double x,
 long exp
);

#define scalbln(X, LONG) // Requires C11 or higher

float scalbln(
 float x,
 long exp
); // C++ only
long double scalbln(
 long double x,
 long exp
); // C++ only
```

## Parameters

x

Floating-point value.

exp

Integer exponent.

## Return value

The `scalbn` functions return the value of  $x * \text{FLT\_RADIX}^{\text{exp}}$  when successful. On overflow (depending on the sign of `x`), `scalbn` returns  $+\text{-HUGE\_VAL}$ ; the `errno` value is set to `ERANGE`.

For more information about `errno` and possible error return values, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

`FLT_RADIX` is defined in `<float.h>` as the native floating-point radix; on binary systems, it has a value of 2, and `scalbn` is equivalent to `ldexp`.

Because C++ allows overloading, you can call `scalbn` and `scalbln` overloads that take and return `float` or `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `scalbn` always takes a `double` and an `int` and returns a `double`, and `scalbln` always takes a `double` and a `long` and returns a `double`.

If you use the `<tgmath.h>` `scalbn()` or `scalbln` macros, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

FUNCTION	C HEADER	C++ HEADER
<code>scalbn</code> , <code>scalbnf</code> , <code>scalbnl</code> , <code>scalbln</code> , <code>scalblnf</code> , <code>scalblnl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code>
<code>scalbn</code> or <code>scalbln</code> macro	<code>&lt;tgmath.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_scalbn.c
// Compile using: cl /W4 crt_scalbn.c
#include <math.h>
#include <stdio.h>

int main(void)
{
 double x = 6.4, y;
 int p = 3;

 y = scalbn(x, p);
 printf("%2.1f times FLT_RADIX to the power of %d is %2.1f\n", x, p, y);
}
```

## Output

```
6.4 times FLT_RADIX to the power of 3 is 51.2
```

## See also

Math and floating-point support

[frexp](#)

[ldexp](#)

[modf](#) , [modff](#) , [modfl](#)

`scanf`, `_scanf_l`, `wscanf`, `_wscanf_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Reads formatted data from the standard input stream. More secure versions of these functions are available; see

`scanf_s`, `_scanf_s_l`, `wscanf_s`, `_wscanf_s_l`.

#### NOTE

In Visual Studio 2015 The `printf` and `scanf` family of functions were declared as `inline` and moved to the `<stdio.h>` and `<conio.h>` headers. If you are migrating older code you might see Linker Error LNK2019 in connection with these functions. For more information, see [Visual C++ change history 2003 - 2015](#).

## Syntax

```
int scanf(
 const char *format [,,
 argument]...
);
int _scanf_l(
 const char *format,
 _locale_t locale [,,
 argument]...
);
int wscanf(
 const wchar_t *format [,,
 argument]...
);
int _wscanf_l(
 const wchar_t *format,
 _locale_t locale [,,
 argument]...
);
```

### Parameters

`format`

Format control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

## Return value

Returns the number of fields successfully converted and assigned; the return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned.

If `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `scanf` function reads data from the standard input stream `stdin` and writes the data into the location given by `argument`. Each `argument` must be a pointer to a variable of a type that corresponds to a type specifier in `format`. If copying takes place between strings that overlap, the behavior is undefined.

### IMPORTANT

When reading a string with `scanf`, always specify a width for the `%s` format (for example, `%32s` instead of `%s`); otherwise, improperly formatted input can easily cause a buffer overrun. Alternately, consider using `scanf_s`, `_scanf_s_1`, `wscanf_s`, `_wscanf_s_1` or `fgets`.

`wscanf` is a wide-character version of `scanf`; the `format` argument to `wscanf` is a wide-character string. `wscanf` and `scanf` behave identically if the stream is opened in ANSI mode. `scanf` doesn't currently support input from a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tscanf</code>	<code>scanf</code>	<code>scanf</code>	<code>wscanf</code>
<code>_tscanf_1</code>	<code>_scanf_1</code>	<code>_scanf_1</code>	<code>_wscanf_1</code>

For more information, see [Format specification fields: `scanf` and `wscanf` functions](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>scanf</code> , <code>_scanf_1</code>	<code>&lt;stdio.h&gt;</code>
<code>wscanf</code> , <code>_wscanf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## Example

```

// crt_scanf.c
// compile with: /W3
// This program uses the scanf and wscanf functions
// to read formatted input.

#include <stdio.h>

int main(void)
{
 int i, result;
 float fp;
 char c, s[81];
 wchar_t wc, ws[81];
 result = scanf("%d %f %c %C %80s %80S", &i, &fp, &c, &wc, s, ws); // C4996
 // Note: scanf and wscanf are deprecated; consider using scanf_s and wscanf_s
 printf("The number of fields input is %d\n", result);
 printf("The contents are: %d %f %c %C %s %S\n", i, fp, c, wc, s, ws);
 result = wscanf(L"%d %f %hc %lc %80S %80ls", &i, &fp, &c, &wc, s, ws); // C4996
 wprintf(L"The number of fields input is %d\n", result);
 wprintf(L"The contents are: %d %f %C %c %hs %s\n", i, fp, c, wc, s, ws);
}

```

71 98.6 h z Byte characters  
 36 92.3 y n Wide characters

The number of fields input is 6  
 The contents are: 71 98.599998 h z Byte characters  
 The number of fields input is 6  
 The contents are: 36 92.300003 y n Wide characters

## See also

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

<a href="#">fscanf</a>	<a href="#">_fscanf_l</a>	<a href="#">fwscanf</a>	<a href="#">_fwscanf_l</a>
<a href="#">printf</a>	<a href="#">_printf_l</a>	<a href="#">wprintf</a>	<a href="#">_wprintf_l</a>
<a href="#">sprintf</a>	<a href="#">_sprintf_l</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_l</a>
<a href="#">sscanf</a>	<a href="#">_sscanf_l</a>	<a href="#">wscanf</a>	<a href="#">_wscanf_l</a>

`scanf_s`, `_scanf_s_l`, `wscanf_s`, `_wscanf_s_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Reads formatted data from the standard input stream. These versions of `scanf`, `_scanf_l`, `wscanf`, `_wscanf_l` have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
int scanf_s(
 const char *format [,,
 argument]...
);
int _scanf_s_l(
 const char *format,
 _locale_t locale [,,
 argument]...
);
int wscanf_s(
 const wchar_t *format [,,
 argument]...
);
int _wscanf_s_l(
 const wchar_t *format,
 _locale_t locale [,,
 argument]...
);
```

### Parameters

`format`

Format control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

## Return value

Returns the number of fields successfully converted and assigned. The return value doesn't include fields that were read but not assigned. A return value of 0 indicates no fields were assigned. The return value is `EOF` for an error, or if the end-of-file character or the end-of-string character is found in the first attempt to read a character. If `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `scanf_s` and `wscanf_s` return `EOF` and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `scanf_s` function reads data from the standard input stream, `stdin`, and writes it into `argument`. Each `argument` must be a pointer to a variable type that corresponds to the type specifier in `format`. If copying occurs between strings that overlap, the behavior is undefined.

`wscanf_s` is a wide-character version of `scanf_s`; the `format` argument to `wscanf_s` is a wide-character string. `wscanf_s` and `scanf_s` behave identically if the stream is opened in ANSI mode. `scanf_s` doesn't currently support input from a UNICODE stream.

The versions of these functions that have the `_1` suffix are identical, except they use the `Locale` parameter instead of the current thread locale.

Unlike `scanf` and `wscanf`, `scanf_s` and `wscanf_s` require you to specify buffer sizes for some parameters. Specify the sizes for all `c`, `C`, `s`, `S`, or string control set `[]` parameters. The buffer size in characters is passed as another parameter. It immediately follows the pointer to the buffer or variable. For example, if you're reading a string, the buffer size for that string is passed as follows:

```
char s[10];
scanf_s("%9s", s, (unsigned)_countof(s)); // buffer size is 10, width specification is 9
```

The buffer size includes the terminal null. You can use a width specification field to ensure the token that's read in fits into the buffer. When a token is too large to fit, nothing is written to the buffer unless there's a width specification.

#### NOTE

The size parameter is of type `unsigned`, not `size_t`. Use a static cast to convert a `size_t` value to `unsigned` for 64-bit build configurations.

The buffer size parameter describes the maximum number of characters, not bytes. In this example, the width of the buffer type doesn't match the width of the format specifier.

```
wchar_t ws[10];
wscanf_s(L"%9S", ws, (unsigned)_countof(ws));
```

The `s` format specifier means use the character width that's "opposite" the default width supported by the function. The character width is single byte, but the function supports double-byte characters. This example reads in a string of up to nine single-byte-wide characters and puts them in a double-byte-wide character buffer. The characters are treated as single-byte values; the first two characters are stored in `ws[0]`, the second two are stored in `ws[1]`, and so on.

This example reads a single character:

```
char c;
scanf_s("%c", &c, 1);
```

When multiple characters for non-null-terminated strings are read, integers are used for both the width specification and the buffer size.

```
char c[4];
scanf_s("%4c", c, (unsigned)_countof(c)); // not null terminated
```

For more information, see [scanf Width Specification](#).

#### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tscanf_s</code>	<code>scanf_s</code>	<code>scanf_s</code>	<code>wscanf_s</code>
<code>_tscanf_s_l</code>	<code>_scanf_s_l</code>	<code>_scanf_s_l</code>	<code>_wscanf_s_l</code>

For more information, see [Format specification fields: `scanf` and `wscanf` functions](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>scanf_s</code> , <code>_scanf_s_l</code>	<code>&lt;stdio.h&gt;</code>
<code>wscanf_s</code> , <code>_wscanf_s_l</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles `stdin`, `stdout`, and `stderr` must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## Example

```
// crt_scanf_s.c
// This program uses the scanf_s and wscanf_s functions
// to read formatted input.

#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 int i,
 result;
 float fp;
 char c,
 s[80];
 wchar_t wc,
 ws[80];

 result = scanf_s("%d %f %c %C %s %S", &i, &fp, &c, 1,
 &wc, 1, s, (unsigned)_countof(s), ws, (unsigned)_countof(ws));
 printf("The number of fields input is %d\n", result);
 printf("The contents are: %d %f %c %C %s %S\n", i, fp, c,
 wc, s, ws);
 result = wscanf_s(L"%d %f %hc %lc %S %ls", &i, &fp, &c, 2,
 &wc, 1, s, (unsigned)_countof(s), ws, (unsigned)_countof(ws));
 wprintf(L"The number of fields input is %d\n", result);
 wprintf(L"The contents are: %d %f %C %c %hs %s\n", i, fp,
 c, wc, s, ws);
}
```

This program produces the following output when given this input:

```
71 98.6 h z Byte characters
36 92.3 y n Wide characters
```

```
The number of fields input is 6
The contents are: 71 98.599998 h z Byte characters
The number of fields input is 6
The contents are: 36 92.300003 y n Wide characters
```

## See also

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

[fscanf](#), [\\_fscanf\\_l](#), [fwscanf](#), [\\_fwscanf\\_l](#)  
[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)  
[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)  
[sscanf](#), [\\_sscanf\\_l](#), [swscanf](#), [\\_swscanf\\_l](#)

`_scprintf`, `_scprintf_l`, `_scwprintf`,  
`_scwprintf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the number of characters in the formatted string.

## Syntax

```
int _scprintf(
 const char *format [,,
 argument] ...
);
int _scprintf_l(
 const char *format,
 _locale_t locale [,,
 argument] ...
);
int _scwprintf(
 const wchar_t *format [,,
 argument] ...
);
int _scwprintf_l(
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);
```

### Parameters

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

Returns the number of characters that would be generated if the string were to be printed or sent to a file or buffer using the specified formatting codes. The value returned doesn't include the terminating null character. `_scwprintf` performs the same function for wide characters.

If `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each `argument` (if any) is converted according to the corresponding format specification in `format`. The format

consists of ordinary characters and has the same form and function as the `format` argument for `printf`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

#### IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_sctprintf</code>	<code>_scprintf</code>	<code>_scprintf</code>	<code>_scwprintf</code>
<code>_sctprintf_1</code>	<code>_scprintf_1</code>	<code>_scprintf_1</code>	<code>_scwprintf_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_scprintf</code> , <code>_scprintf_1</code>	<code>&lt;stdio.h&gt;</code>
<code>_scwprintf</code> , <code>_scwprintf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_scprintf.c

#define _USE_MATH_DEFINES

#include <stdio.h>
#include <math.h>
#include <malloc.h>

int main(void)
{
 int count;
 int size;
 char *s = NULL;

 count = _scprintf("The value of Pi is calculated to be %f.\n",
 M_PI);

 size = count + 1; // the string will need one more char for the null terminator
 s = malloc(sizeof(char) * size);
 sprintf_s(s, size, "The value of Pi is calculated to be %f.\n",
 M_PI);
 printf("The length of the following string will be %i.\n", count);
 printf("%s", s);
 free(s);
}
```

```
The length of the following string will be 46.
The value of Pi is calculated to be 3.141593.
```

## See also

### Stream I/O

[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)  
[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)  
[scanf](#), [\\_scanf\\_l](#), [wscanf](#), [\\_wscanf\\_l](#)  
[sscanf](#), [\\_sscanf\\_l](#), [swscanf](#), [\\_swscanf\\_l](#)  
[vprintf](#) functions

`_scprintf_p`, `_scprintf_p_l`, `_scwprintf_p`,  
`_scwprintf_p_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the number of characters in the formatted string, with the ability to specify the order in which parameters are used in the format string.

## Syntax

```
int _scprintf_p(
 const char *format [,,
 argument] ...
);
int _scprintf_p_l(
 const char *format,
 _locale_t locale [,,
 argument] ...
);
int _scwprintf_p (
 const wchar_t *format [,,
 argument] ...
);
int _scwprintf_p_l(
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);
```

## Parameters

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

## Return value

Returns the number of characters that would be generated if the string were to be printed or sent to a file or buffer using the specified formatting codes. The value returned doesn't include the terminating null character.

`_scwprintf_p` performs the same function for wide characters.

The difference between `_scprintf_p` and `_scprintf` is that `_scprintf_p` supports positional parameters, which allows specifying the order in which the arguments are used in the format string. For more information, see [printf\\_p Positional Parameters](#).

If `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each `argument` (if any) is converted according to the corresponding format specification in `format`. The format consists of ordinary characters and has the same form and function as the `format` argument for `printf`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with '`legacy_stdio_float_rounding.obj`'.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_sctprintf_p</code>	<code>_scprintf_p</code>	<code>_scprintf_p</code>	<code>_scwprintf_p</code>
<code>_sctprintf_p_1</code>	<code>_scprintf_p_1</code>	<code>_scprintf_p_1</code>	<code>_scwprintf_p_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_scprintf_p</code> , <code>_scprintf_p_1</code>	<code>&lt;stdio.h&gt;</code>
<code>_scwprintf_p</code> , <code>_scwprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

`_scprintf`, `_scprintf_l`, `_scwprintf`, `_scwprintf_l`  
`_printf_p`, `_printf_p_1`, `_wprintf_p`, `_wprintf_p_1`

# `_searchenv`, `_wsearchenv`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Uses environment paths to search for a file. More secure versions of these functions are available; see [`\_searchenv\_s`](#), [`\_wsearchenv\_s`](#).

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
void _searchenv(
 const char *filename,
 const char *varname,
 char *pathname
);
void _wsearchenv(
 const wchar_t *filename,
 const wchar_t *varname,
 wchar_t *pathname
);
template <size_t size>
void _searchenv(
 const char *filename,
 const char *varname,
 char (&pathname)[size]
); // C++ only
template <size_t size>
void _wsearchenv(
 const wchar_t *filename,
 const wchar_t *varname,
 wchar_t (&pathname)[size]
); // C++ only
```

## Parameters

`filename`

Name of the file to search for.

`varname`

Environment to search.

`pathname`

Buffer to store the complete path.

## Remarks

The `_searchenv` routine searches for the target file in the specified domain. The `varname` variable can be any environment or user-defined variable—for example, `PATH`, `LIB`, or `INCLUDE`—that specifies a list of directory paths. Because `_searchenv` is case-sensitive, `varname` should match the case of the environment variable.

The routine first searches for the file in the current working directory. If it doesn't find the file, it looks through

the directories that are specified by the environment variable. If the target file is in one of those directories, the newly created path is copied into `pathname`. If the `filename` file isn't found, `pathname` contains an empty null-terminated string.

The `pathname` buffer should be at least `_MAX_PATH` characters long to accommodate the full length of the constructed path name. Otherwise, `_searchenv` might overrun the `pathname` buffer and cause unexpected behavior.

`_wsearchenv` is a wide-character version of `_searchenv`, and the arguments to `_wsearchenv` are wide-character strings. `_wsearchenv` and `_searchenv` behave identically otherwise.

If `filename` is an empty string, these functions return `ENOENT`.

If `filename` or `pathname` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For more information about `errno` and error codes, see [errno constants](#).

In C++, these functions have template overloads that invoke the newer, more secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tsearchenv</code>	<code>_searchenv</code>	<code>_searchenv</code>	<code>_wsearchenv</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_searchenv</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wsearchenv</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_searchenv.c
// compile with: /W3
// This program searches for a file in
// a directory that's specified by an environment variable.

#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 char pathbuffer[_MAX_PATH];
 char searchfile[] = "CL.EXE";
 char envvar[] = "PATH";

 // Search for file in PATH environment variable:
 _searchenv(searchfile, envvar, pathbuffer); // C4996
 // Note: _searchenv is deprecated; consider using _searchenv_s
 if(*pathbuffer != '\0')
 printf("Path for %s:\n%s\n", searchfile, pathbuffer);
 else
 printf("%s not found\n", searchfile);
}
```

```
Path for CL.EXE:
C:\Program Files\Microsoft Visual Studio 8\VC\BIN\CL.EXE
```

## See also

### Directory control

[getenv](#) , [\\_wgetenv](#)

[\\_putenv](#) , [\\_wputenv](#)

[\\_searchenv\\_s](#) , [\\_wsearchenv\\_s](#)

## `_searchenv_s`, `_wsearchenv_s`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Searches for a file by using environment paths. These versions of `_searchenv`, `_wsearchenv` have security enhancements, as described in [Security features in the CRT](#).

### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t _searchenv_s(
 const char *filename,
 const char *varname,
 char *pathname,
 size_t numberOfElements
);
errno_t _wsearchenv_s(
 const wchar_t *filename,
 const wchar_t *varname,
 wchar_t *pathname,
 size_t numberOfElements
);
template <size_t size>
errno_t _searchenv_s(
 const char *filename,
 const char *varname,
 char (&pathname)[size]
); // C++ only
template <size_t size>
errno_t _wsearchenv_s(
 const wchar_t *filename,
 const wchar_t *varname,
 wchar_t (&pathname)[size]
); // C++ only
```

### Parameters

`filename`

Name of the file to search for.

`varname`

Environment to search.

`pathname`

Buffer to store the complete path.

`numberOfElements`

Size of the `pathname` buffer.

## Return value

Zero if successful; an error code on failure.

If `filename` is an empty string, the return value is `ENOENT`.

## Error conditions

<code>FILENAME</code>	<code>VARNAME</code>	<code>PATHNAME</code>	<code>NUMBEROFELEMENTS</code>	<code>RETURN VALUE</code>	<code>CONTENTS OF PATHNAME</code>
any	any	<code>NULL</code>	any	<code>EINVAL</code>	n/a
<code>NULL</code>	any	any	any	<code>EINVAL</code>	not changed
any	any	any	<= 0	<code>EINVAL</code>	not changed

If any of these error conditions occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

## Remarks

The `_searchenv_s` routine searches for the target file in the specified domain. The `varname` variable can be any environment or user-defined variable that specifies a list of directory paths, such as `PATH`, `LIB`, and `INCLUDE`. Because `_searchenv_s` is case-sensitive, `varname` should match the case of the environment variable. If `varname` doesn't match the name of an environment variable defined in the process's environment, the function returns zero, and the `pathname` variable is unchanged.

The routine searches first for the file in the current working directory. If it doesn't find the file, it looks next through the directories specified by the environment variable. If the target file is in one of those directories, the newly created path is copied into `pathname`. If the `filename` file isn't found, `pathname` contains an empty null-terminated string.

The `pathname` buffer should be at least `_MAX_PATH` characters long to accommodate the full length of the constructed path name. Otherwise, `_searchenv_s` might overrun the `pathname` buffer resulting in unexpected behavior.

`_wsearchenv_s` is a wide-character version of `_searchenv_s`; the arguments to `_wsearchenv_s` are wide-character strings. `_wsearchenv_s` and `_searchenv_s` behave identically otherwise.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tsearchenv_s</code>	<code>_searchenv_s</code>	<code>_searchenv_s</code>	<code>_wsearchenv_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_searchenv_s</code>	<code>&lt;stdlib.h&gt;</code>

ROUTINE	REQUIRED HEADER
_wsearchenv_s	<stdlib.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_searchenv_s.c
/* This program searches for a file in
 * a directory specified by an environment variable.
 */

#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 char pathbuffer[_MAX_PATH];
 char searchfile[] = "CL.EXE";
 char envvar[] = "PATH";
 errno_t err;

 /* Search for file in PATH environment variable: */
 err = _searchenv_s(searchfile, envvar, pathbuffer, _MAX_PATH);
 if (err != 0)
 {
 printf("Error searching the path. Error code: %d\n", err);
 }
 if(*pathbuffer != '\0')
 printf("Path for %s:\n%s\n", searchfile, pathbuffer);
 else
 printf("%s not found\n", searchfile);
}
```

```
Path for CL.EXE:
C:\Program Files\Microsoft Visual Studio 2010\VC\BIN\CL.EXE
```

## See also

### Directory control

<a href="#">_searchenv</a>	<a href="#">_wsearchenv</a>
<a href="#"> getenv</a>	<a href="#"> _wgetenv</a>
<a href="#"> _putenv</a>	<a href="#"> _wputenv</a>

# `_security_init_cookie`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Initializes the global security cookie.

## Syntax

```
void __security_init_cookie(void);
```

## Remarks

The global security cookie is used for buffer overrun protection in code compiled with [/GS \(Buffer Security Check\)](#) and in code that uses exception handling. On entry to an overrun-protected function, the cookie is put on the stack, and on exit, the value on the stack is compared with the global cookie. Any difference between them indicates that a buffer overrun has occurred and causes immediate termination of the program.

Normally, `__security_init_cookie` is called by the CRT when it's initialized. If you bypass CRT initialization—for example, if you use `/ENTRY` to specify an entry-point—then you must call `__security_init_cookie` yourself. If `__security_init_cookie` isn't called, the global security cookie is set to a default value, and buffer overrun protection is compromised. Because an attacker can exploit this default cookie value to defeat the buffer overrun checks, we recommend that you always call `__security_init_cookie` when you define your own entry point.

The call to `__security_init_cookie` must be made before any overrun-protected function is entered; otherwise a spurious buffer overrun will be detected. For more information, see [C Runtime Error R6035](#).

## Example

See the examples in [C Runtime Error R6035](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>__security_init_cookie</code>	<code>&lt;process.h&gt;</code>

`__security_init_cookie` is a Microsoft extension to the standard C Runtime Library. For compatibility information, see [Compatibility](#).

## See also

[Microsoft Security Response Center](#)

## `_seh_filter_dll`, `_seh_filter_exe`

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Identifies the exception and the related action to be taken.

## Syntax

```
int __cdecl _seh_filter_dll(
 unsigned long exceptionNum,
 struct _EXCEPTION_POINTERS* exceptionPtr
);
int __cdecl _seh_filter_exe(
 unsigned long exceptionNum,
 struct _EXCEPTION_POINTERS* exceptionPtr
);
```

### Parameters

`exceptionNum`

The identifier for the exception.

`exceptionPtr`

A pointer to the exception information.

## Return value

An integer that indicates the action to be taken, based on the result of exception processing.

## Remarks

These methods are called by the exception-filter expression of the [try-except Statement](#). The method consults a constant internal table to identify the exception and determine the appropriate action, as shown here. The exception numbers are defined in winnt.h and the signal numbers are defined in signal.h.

EXCEPTION NUMBER (UNSIGNED LONG)	SIGNAL NUMBER
<code>STATUS_ACCESS_VIOLATION</code>	<code>SIGSEGV</code>
<code>STATUS_ILLEGAL_INSTRUCTION</code>	<code>SIGILL</code>
<code>STATUS_PRIVILEGED_INSTRUCTION</code>	<code>SIGILL</code>
<code>STATUS_FLOAT_DENORMAL_OPERAND</code>	<code>SIGFPE</code>
<code>STATUS_FLOAT_DIVIDE_BY_ZERO</code>	<code>SIGFPE</code>
<code>STATUS_FLOAT_INEXACT_RESULT</code>	<code>SIGFPE</code>
<code>STATUS_FLOAT_INVALID_OPERATION</code>	<code>SIGFPE</code>

EXCEPTION NUMBER (UNSIGNED LONG)	SIGNAL NUMBER
STATUS_FLOAT_OVERFLOW	SIGFPE
STATUS_FLOAT_STACK_CHECK	SIGFPE
STATUS_FLOAT_UNDERFLOW	SIGFPE

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

**Header:** corecrt\_startup.h

## See also

[Alphabetical function reference](#)

# \_set\_abort\_behavior

11/2/2022 • 2 minutes to read • [Edit Online](#)

Specifies the action to be taken when a program is abnormally terminated.

## NOTE

Do not use the `abort` function to shut down a Microsoft Store app, except in testing or debugging scenarios. Programmatic or UI ways to close a Store app are not permitted according to the [Microsoft Store policies](#). For more information, see [UWP app lifecycle](#).

## Syntax

```
unsigned int _set_abort_behavior(
 unsigned int flags,
 unsigned int mask
) ;
```

### Parameters

`flags`

New value of the `abort` flags.

`mask`

Mask for the `abort` flags bits to set.

## Return value

The old value of the flags.

## Remarks

There are two `abort` flags: `_WRITE_ABORT_MSG` and `_CALL_REPORTFAULT`. `_WRITE_ABORT_MSG` determines whether a helpful text message is printed when a program is abnormally terminated. The message states that the application has called the `abort` function. The default behavior is to print the message. `_CALL_REPORTFAULT`, if set, invokes the Windows Error Reporting Service mechanism (formerly known as Dr. Watson) to report failures to Microsoft when `abort` is called. By default, crash dump reporting is enabled in non-DEBUG builds. If the Windows error reporting handler isn't invoked, then `abort` calls `_exit` to terminate the process with exit code 3 and returns control to the parent process or the operating system. `_exit` doesn't flush stream buffers or do `atexit` / `_onexit` processing.

For Windows compatibility reasons, when `abort` calls `_exit`, it may invoke the Windows `ExitProcess` API, which in turn allows DLL termination routines to run. Destructors aren't run in the executable, but the same may not be true of DLLs loaded in the executable's process space. This behavior doesn't strictly conform to the C++ standard. To immediately terminate a process including any DLLs, use the Windows `TerminateProcess` API. You can also register an abort signal handler that invokes `TerminateProcess` for standard-compliant behavior. Compliant behavior may come at some cost in Windows compatibility.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

# Requirements

ROUTINE	REQUIRED HEADER
_set_abort_behavior	<stdlib.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_set_abort_behavior.c
// compile with: /TC
#include <stdlib.h>

int main()
{
 printf("Suppressing the abort message. If successful, this message"
 " will be the only output.\n");
 // Suppress the abort message
 _set_abort_behavior(0, _WRITE_ABORT_MSG);
 abort();
}
```

```
Suppressing the abort message. If successful, this message will be the only output.
```

## See also

[abort](#)

# setbuf

11/2/2022 • 2 minutes to read • [Edit Online](#)

Controls stream buffering. This function is deprecated; use [setvbuf](#) instead.

## Syntax

```
void setbuf(
 FILE *stream,
 char *buffer
) ;
```

### Parameters

`stream`

Pointer to `FILE` structure.

`buffer`

User-allocated buffer.

## Remarks

The `setbuf` function controls buffering for `stream`. The `stream` argument must refer to an open file that hasn't been read or written. If the `buffer` argument is `NULL`, the stream is unbuffered. If not, the buffer must point to a character array of length `BUFSIZ`, where `BUFSIZ` is the buffer size as defined in `STDIO.H`. The user-specified buffer, instead of the default system-allocated buffer for the given stream, is used for I/O buffering. The `stderr` stream is unbuffered by default, but you can use `setbuf` to assign buffers to `stderr`.

`setbuf` has been replaced by `setvbuf`, which is the preferred routine for new code. Unlike `setvbuf`, `setbuf` has no way of reporting errors. `setvbuf` also lets you control both the buffering mode and the buffer size. `setbuf` exists for compatibility with existing code.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>setbuf</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_setbuf.c
// compile with: /W3
// This program first opens files named DATA1 and
// DATA2. Then it uses setbuf to give DATA1 a user-assigned
// buffer and to change DATA2 so that it has no buffer.

#include <stdio.h>

int main(void)
{
 char buf[BUFSIZ];
 FILE *stream1, *stream2;

 fopen_s(&stream1, "data1", "a");
 fopen_s(&stream2, "data2", "w");

 if((stream1 != NULL) && (stream2 != NULL))
 {
 // "stream1" uses user-assigned buffer:
 setbuf(stream1, buf); // C4996
 // Note: setbuf is deprecated; consider using setvbuf instead
 printf("stream1 set to user-defined buffer at: %Fp\n", buf);

 // "stream2" is unbuffered
 setbuf(stream2, NULL); // C4996
 printf("stream2 buffering disabled\n");
 _fcloseall();
 }
}

```

```

stream1 set to user-defined buffer at: 0012FCDC
stream2 buffering disabled

```

## See also

### Stream I/O

<a href="#">fclose</a>	<a href="#">_fcloseall</a>
<a href="#">fflush</a>	
<a href="#">fopen</a>	<a href="#">_wfopen</a>
<a href="#">setvbuf</a>	

# `_set_controlfp`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the floating-point control word.

## Syntax

```
void __cdecl _set_controlfp(
 unsigned int newControl,
 unsigned int mask
)
```

### Parameters

`newControl`

New control-word bit values.

`mask`

Mask for new control-word bits to set.

## Return value

None.

## Remarks

The `_set_controlfp` function is similar to `_control87`, but it only sets the floating-point control word to `newControl`. The bits in the values indicate the floating-point control state. The floating-point control state allows the program to change the precision, rounding, and infinity modes in the floating-point math package. You can also mask or unmask floating-point exceptions using `_set_controlfp`. For more information, see [\\_control87](#), [\\_controlfp](#), [\\_control87\\_2](#).

This function is deprecated when compiling with [/clr \(Common Language Runtime Compilation\)](#) because the common language runtime only supports the default floating-point precision.

## Requirements

ROUTINE	REQUIRED HEADER	COMPATIBILITY
<code>_set_controlfp</code>	<code>&lt;float.h&gt;</code>	x86 processor only

For more compatibility information, see [Compatibility](#).

## See also

[Math and floating-point support](#)

`_clear87`, `_clearfp`

`_status87`, `_statusfp`, `_statusfp2`

# \_set\_doserrno

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the value of the `_doserrno` global variable.

## Syntax

```
errno_t _set_doserrno(int error_value);
```

### Parameters

`error_value`

The new value of `_doserrno`.

## Return value

Returns zero if successful.

## Remarks

Possible values are defined in Errno.h.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_set_doserrno</code>	<stdlib.h>	<errno.h>

For more compatibility information, see [Compatibility](#).

## See also

`_get_doserrno`

`errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`

## \_set\_errno

11/2/2022 • 2 minutes to read • [Edit Online](#)

Set the value of the `errno` global variable.

## Syntax

```
errno_t _set_errno(int error_value);
```

### Parameters

`error_value`

The new value of `errno`.

## Return value

Returns zero if successful.

## Remarks

Possible values are defined in Errno.h. Also, see [errno constants](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Example

```
// crt_set_errno.c
#include <stdio.h>
#include <errno.h>

int main()
{
 _set_errno(EILSEQ);
 perror("Oops");
}
```

```
Oops: Illegal byte sequence
```

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_set_errno</code>	<code>&lt;stdlib.h&gt;</code>	<code>&lt;errno.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

`_get_errno`

`errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`

# \_set\_error\_mode

11/2/2022 • 2 minutes to read • [Edit Online](#)

Modifies `__error_mode` to determine a non-default location where the C runtime writes an error message for an error that might end the program.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _set_error_mode(
 int mode_val
)
```

### Parameters

`mode_val`

Destination of error messages.

## Return value

Returns the old setting or -1 if an error occurs.

## Remarks

Controls the error output sink by setting the value of `__error_mode`. For example, you can direct output to a standard error or use the `MessageBox` API.

The `mode_val` parameter can be set to one of the following values.

VALUE	DESCRIPTION
<code>_OUT_TO_DEFAULT</code>	Error sink is determined by <code>__app_type</code> .
<code>_OUT_TO_STDERR</code>	Error sink is a standard error.
<code>_OUT_TO_MSGBOX</code>	Error sink is a message box.
<code>_REPORT_ERRMODE</code>	Report the current <code>__error_mode</code> value.

If a value is passed in other than the listed ones, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_set_error_mode` sets `errno` to `EINVAL` and returns -1.

When it's used with an `assert`, `_set_error_mode` displays the statement that failed in the dialog box, and gives you the option of choosing the **Ignore** button, so that you can continue to run the program.

# Requirements

ROUTINE	REQUIRED HEADER
_set_error_mode	<stdlib.h>

## Example

```
// crt_set_error_mode.c
// compile with: /c
#include <stdlib.h>
#include <assert.h>

int main()
{
 _set_error_mode(_OUT_TO_STDERR);
 assert(2+2==5);
}
```

```
Assertion failed: 2+2==5, file crt_set_error_mode.c, line 8
```

```
This application has requested the Runtime to terminate it in an unusual way.
Please contact the application's support team for more information.
```

## See also

[assert Macro](#), [\\_assert](#), [\\_wassert](#)

# \_set\_fmode

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the default file translation mode for file I/O operations.

## Syntax

```
errno_t _set_fmode(
 int mode
)
```

### Parameters

`mode`

The file translation mode desired: `_O_TEXT` or `_O_BINARY`.

## Return value

Returns zero if successful, an error code on failure. If `mode` isn't `_O_TEXT` or `_O_BINARY` or `_O_WTEXT`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `EINVAL`.

## Remarks

The function sets the `_fmode` global variable. This variable specifies the default file translation mode for the file I/O operations `_open` and `_pipe`.

`_O_TEXT` and `_O_BINARY` are defined in `Fcntl.h`. `EINVAL` is defined in `Errno.h`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_set_fmode</code>	<code>&lt;stdlib.h&gt;</code>	<code>&lt;fcntl.h&gt;, &lt;errno.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_set_fmode.c
#include <stdlib.h>
#include <stdio.h>
#include <fcntl.h> /* for _O_TEXT and _O_BINARY */
#include <errno.h> /* for EINVAL */
#include <sys\stat.h> /* for _S_IWRITE */
#include <share.h> /* for _SH_DENYNO */

int main()
{
 int mode, fd, ret;
 errno_t err;
 int buf[12] = { 65, 66, 67, 68, 69, 70, 71, 72, 73, 74,
 75, 76 };
 char * filename = "fmode.out";

 err = _get_fmode(&mode);
 if (err == EINVAL)
 {
 printf("Invalid parameter: mode\n");
 return 1;
 }
 else
 printf("Default Mode is %s\n", mode == _O_TEXT ? "text" :
 "binary");

 err = _set_fmode(_O_BINARY);
 if (err == EINVAL)
 {
 printf("Invalid mode.\n");
 return 1;
 }

 if (_open_s(&fd, filename, _O_RDWR | _O_CREAT, _SH_DENYNO, _S_IWRITE | _S_IREAD) != 0)
 {
 printf("Error opening the file %s\n", filename);
 return 1;
 }

 if (ret = _write(fd, buf, 12*sizeof(int)) < 12*sizeof(int))
 {
 printf("Problem writing to the file %s.\n", filename);
 printf("Number of bytes written: %d\n", ret);
 }

 if (_close(fd) != 0)
 {
 printf("Error closing the file %s. Error code %d.\n",
 filename, errno);
 }

 system("type fmode.out");
}

```

```

Default Mode is binary
A B C D E F G H I J K L

```

## See also

[\\_fmode](#)  
[\\_get\\_fmode](#)  
[\\_setmode](#)

## Text and binary mode file I/O

`_set_invalid_parameter_handler`,

`_set_thread_local_invalid_parameter_handler`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a function to be called when the CRT detects an invalid argument.

## Syntax

```
_invalid_parameter_handler _set_invalid_parameter_handler(
 _invalid_parameter_handler pNew
>;
_invalid_parameter_handler _set_thread_local_invalid_parameter_handler(
 _invalid_parameter_handler pNew
>);
```

### Parameters

`pNew`

The function pointer to the new invalid parameter handler.

## Return value

A pointer to the invalid parameter handler before the call.

## Remarks

Many C runtime functions check the validity of arguments passed to them. If an invalid argument is passed, the function can set the `errno` error number or return an error code. In such cases, the invalid parameter handler is also called. The C runtime supplies a default global invalid parameter handler that terminates the program and displays a runtime error message. You can use the `_set_invalid_parameter_handler` to set your own function as the global invalid parameter handler. The C runtime also supports a thread-local invalid parameter handler. If a thread-local parameter handler is set in a thread by using `_set_thread_local_invalid_parameter_handler`, the C runtime functions called from the thread use that handler instead of the global handler. Only one function can be specified as the global invalid argument handler at a time. Only one function can be specified as the thread-local invalid argument handler per thread, but different threads can have different thread-local handlers. Thread local handlers allow you to change the handler used in one part of your code without affecting the behavior of other threads.

When the runtime calls the invalid parameter function, it usually means that a nonrecoverable error occurred. The invalid parameter handler function you supply should save any data it can and then abort. It shouldn't return control to the main function unless you're confident that the error is recoverable.

The invalid parameter handler function must have the following prototype:

```

void _invalid_parameter(
 const wchar_t * expression,
 const wchar_t * function,
 const wchar_t * file,
 unsigned int line,
 uintptr_t pReserved
);

```

The `expression` argument is a wide string representation of the argument expression that raised the error. The `function` argument is the name of the CRT function that received the invalid argument. The `file` argument is the name of the CRT source file that contains the function. The `line` argument is the line number in that file. The last argument is reserved. The parameters all have the value `NULL` unless a debug version of the CRT library is used.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_set_invalid_parameter_handler</code> , <code>_set_thread_local_invalid_parameter_handler</code>	C: <stdlib.h> C++: <cstdlib> or <stdlib.h>

The `_set_invalid_parameter_handler` and `_set_thread_local_invalid_parameter_handler` functions are Microsoft-specific. For compatibility information, see [Compatibility](#).

## Example

In the following example, an invalid parameter error handler is used to print the function that received the invalid parameter and the file and line in CRT sources. When the debug CRT library is used, invalid parameter errors also raise an assertion, which is disabled in this example using `_CrSetReportMode`.

```

// crt_set_invalid_parameter_handler.c
// compile with: /Zi /MTd
#include <stdio.h>
#include <stdlib.h>
#include <crtdbg.h> // For _CrtSetReportMode

void myInvalidParameterHandler(const wchar_t* expression,
 const wchar_t* function,
 const wchar_t* file,
 unsigned int line,
 uintptr_t pReserved)
{
 wprintf(L"Invalid parameter detected in function %s."
 L" File: %s Line: %d\n", function, file, line);
 wprintf(L"Expression: %s\n", expression);
 abort();
}

int main()
{
 char* formatString;

 _invalid_parameter_handler oldHandler, newHandler;
 newHandler = myInvalidParameterHandler;
 oldHandler = _set_invalid_parameter_handler(newHandler);

 // Disable the message box for assertions.
 _CrtSetReportMode(_CRT_ASSERT, 0);

 // Call printf_s with invalid parameters.

 formatString = NULL;
 printf(formatString);
}

```

Invalid parameter detected in function common\_vfprintf. File:  
minkernel\crt\src\appcrt\stdio\output.cpp Line: 32  
Expression: format != nullptr

## See also

[\\_get\\_invalid\\_parameter\\_handler](#) , [\\_get\\_thread\\_local\\_invalid\\_parameter\\_handler](#)

Security-enhanced versions of CRT functions

[errno](#) , [\\_doserrno](#) , [\\_sys\\_errlist](#) , and [\\_sys\\_nerr](#)

# setjmp

11/2/2022 • 2 minutes to read • [Edit Online](#)

Saves the current state of the program.

## Syntax

```
int setjmp(
 jmp_buf env
);
```

### Parameters

`env`

Variable in which environment is stored.

## Return value

Returns 0 after saving the stack environment. If `setjmp` returns because of a `longjmp` call, it returns the `value` argument of `longjmp`, or if the `value` argument of `longjmp` is 0, `setjmp` returns 1. There's no error return.

## Remarks

The `setjmp` function saves a stack environment, which you can subsequently restore, using `longjmp`. When used together, `setjmp` and `longjmp` provide a way to execute a non-local `goto`. They're typically used to pass execution control to error-handling or recovery code in a previously called routine without using the normal calling or return conventions.

A call to `setjmp` saves the current stack environment in `env`. A subsequent call to `longjmp` restores the saved environment and returns control to the point just after the corresponding `setjmp` call. All variables (except register variables) accessible to the routine receiving control contain the values they had when `longjmp` was called.

It isn't possible to use `setjmp` to jump from native to managed code.

### Microsoft Specific

In Microsoft C++ code on Windows, `longjmp` uses the same stack-unwinding semantics as exception-handling code. It is safe to use in the same places that C++ exceptions can be raised. However, this usage isn't portable, and comes with some important caveats. For details, see [longjmp](#).

### END Microsoft Specific

#### NOTE

In portable C++ code, you can't assume `setjmp` and `longjmp` support C++ object semantics. Specifically, a `setjmp` / `longjmp` call pair has undefined behavior if replacing the `setjmp` and `longjmp` by `catch` and `throw` would invoke any non-trivial destructors for any automatic objects. In C++ programs, we recommend you use the C++ exception-handling mechanism.

For more information, see [Using `setjmp` and `longjmp`](#).

# Requirements

ROUTINE	REQUIRED HEADER
<code>setjmp</code>	<code>&lt;setjmp.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [`\_fpreset`](#).

## See also

[Process and environment control](#)

[`longjmp`](#)

# setlocale, \_wsetlocale

11/2/2022 • 10 minutes to read • [Edit Online](#)

Sets or retrieves the run-time locale.

## Syntax

```
char *setlocale(
 int category,
 const char *locale
);
wchar_t *_wsetlocale(
 int category,
 const wchar_t *locale
);
```

## Parameters

`category`

Category affected by locale.

`Locale`

Locale specifier.

## Return value

If a valid `Locale` and `category` are given, the functions return a pointer to the string associated with the specified `Locale` and `category`.

If the `Locale` or `category` isn't valid, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, each function sets `errno` to `EINVAL`, and returns `NULL`.

The call

```
setlocale(LC_ALL, "en-US");
```

sets all categories, returning only the string

```
en-US
```

You can copy the string returned by `setlocale` to restore that part of the program's locale information. Global or thread local storage is used for the string returned by `setlocale`. Later calls to `setlocale` overwrite the string, which invalidates string pointers returned by earlier calls.

## Remarks

Use the `setlocale` function to set, change, or query some or all of the current program locale information specified by `Locale` and `category`. `Locale` refers to the locality (country/region and language) for which you can customize certain aspects of your program. Some locale-dependent categories include the formatting of dates and the display format for monetary values. If you set `Locale` to the default string for a language that has

multiple forms supported on your computer, you should check the `setlocale` return value to see which language is in effect. For example, if you set `Locale` to "chinese" the return value could be either "chinese-simplified" or "chinese-traditional".

`_wsetlocale` is a wide-character version of `setlocale`; the `Locale` argument and return value of `_wsetlocale` are wide-character strings. `_wsetlocale` and `setlocale` behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tsetlocale</code>	<code>setlocale</code>	<code>setlocale</code>	<code>_wsetlocale</code>

The `category` argument specifies the parts of a program's locale information that are affected. The macros used for `category` and the parts of the program they affect are as follows:

<code>CATEGORY FLAG</code>	<code>AFFECTS</code>
<code>LC_ALL</code>	All categories, as listed below.
<code>LC_COLLATE</code>	The <code>strcoll</code> , <code>_stricoll</code> , <code>wcscoll</code> , <code>_wcsicoll</code> , <code>strxfrm</code> , <code>_strncoll</code> , <code>_strnicoll</code> , <code>_wcsncoll</code> , <code>_wcsnicoll</code> , and <code>wcsxfrm</code> functions.
<code>LC_CTYPE</code>	The character-handling functions (except <code>isdigit</code> , <code>isxdigit</code> , <code>mbstowcs</code> , and <code>mbtowc</code> , which are unaffected).
<code>LC_MONETARY</code>	Monetary-formatting information returned by the <code>localeconv</code> function.
<code>LC_NUMERIC</code>	Decimal-point character for the formatted output routines (such as <code>printf</code> ), for the data-conversion routines, and for the non-monetary formatting information returned by <code>localeconv</code> . In addition to the decimal-point character, <code>LC_NUMERIC</code> sets the thousands separator and the grouping control string returned by <code>localeconv</code> .
<code>LC_TIME</code>	The <code>strftime</code> and <code>wcsftime</code> functions.

This function validates the `category` parameter. If the `category` parameter isn't one of the values given in the previous table, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function sets `errno` to `EINVAL` and returns `NULL`.

The `Locale` argument is a pointer to a string that specifies the locale. For information about the format of the `Locale` argument, see [Locale names, Languages, and Country/Region strings](#). If `Locale` points to an empty string, the locale is the implementation-defined native environment. A value of `c` specifies the minimal ANSI conforming environment for C translation. The `c` locale assumes that all `char` data types are 1 byte and that their value is always less than 256.

At program startup, the equivalent of the following statement is executed:

```
setlocale(LC_ALL, "C");
```

The `Locale` argument can take a locale name, a language string, a language string and country/region code, a code page, or a language string, country/region code, and code page. The available locale names, languages, country/region codes, and code pages include all the ones supported by the Windows NLS API. The set of locale names supported by `setlocale` is described in [Locale names, Languages, and Country/Region strings](#). The set of language and country/region strings supported by `setlocale` are listed in [Language strings](#) and [Country/Region strings](#). We recommend the locale name form for performance and for maintainability of locale strings embedded in code or serialized to storage. The locale name strings are less likely to be changed by an operating system update than the language and country/region name form.

A null pointer that's passed as the `Locale` argument tells `setlocale` to query instead of to set the international environment. If the `Locale` argument is a null pointer, the program's current locale setting isn't changed. Instead, `setlocale` returns a pointer to the string that's associated with the `category` of the thread's current locale. If the `category` argument is `LC_ALL`, the function returns a string that indicates the current setting of each category, separated by semicolons. For example, the sequence of calls

```
// Set all categories and return "en-US"
setlocale(LC_ALL, "en-US");
// Set only the LC_MONETARY category and return "fr-FR"
setlocale(LC_MONETARY, "fr-FR");
printf("%s\n", setlocale(LC_ALL, NULL));
```

returns

```
LC_COLLATE=en-US;LC_CTYPE=en-US;LC_MONETARY=fr-FR;LC_NUMERIC=en-US;LC_TIME=en-US
```

which is the string that's associated with the `LC_ALL` category.

The following examples pertain to the `LC_ALL` category. Either of the strings ".OCP" and ".ACP" can be used instead of a code page number to specify use of the user-default OEM code page and user-default ANSI code page for that locale name, respectively.

- `setlocale( LC_ALL, "" );`

Sets the locale to the default, which is the user-default ANSI code page obtained from the operating system. The locale name is set to the value returned by [GetUserDefaultLocaleName](#). The code page is set to the value returned by [GetACP](#).

- `setlocale( LC_ALL, ".OCP" );`

Sets the locale to the current OEM code page obtained from the operating system. The locale name is set to the value returned by [GetUserDefaultLocaleName](#). The code page is set to the [LOCALE\\_IDEFAULTCODEPAGE](#) value for the user-default locale name by [GetLocaleInfoEx](#).

- `setlocale( LC_ALL, ".ACP" );`

Sets the locale to the ANSI code page obtained from the operating system. The locale name is set to the value returned by [GetUserDefaultLocaleName](#). The code page is set to the [LOCALE\\_IDEFAULTANSICODEPAGE](#) value for the user-default locale name by [GetLocaleInfoEx](#).

- `setlocale( LC_ALL, "<localename>" );`

Sets the locale to the locale name that's indicated by `<Localename>`. The code page is set to the [LOCALE\\_IDEFAULTANSICODEPAGE](#) value for the specified locale name by [GetLocaleInfoEx](#).

- `setlocale( LC_ALL, "<language>_<country>" );`

Sets the locale to the language and country/region indicated by `<Language>` and `<country>`, together with the default code page obtained from the host operating system. The code page is set to the `LOCALE_IDEFAULTANSICODEPAGE` value for the specified locale name by [GetLocaleInfoEx](#).

- `setlocale( LC_ALL, "<language>_<country>.<code_page>" );`

Sets the locale to the language, country/region, and code page indicated by the `<language>`, `<country>`, and `<code_page>` strings. You can use various combinations of language, country/region, and code page. For example, this call sets the locale to French Canada with code page 1252:

```
setlocale(LC_ALL, "French_Canada.1252");
```

This call sets the locale to French Canada with the default ANSI code page:

```
setlocale(LC_ALL, "French_Canada.ACP");
```

This call sets the locale to French Canada with the default OEM code page:

```
setlocale(LC_ALL, "French_Canada.OCP");
```

- `setlocale( LC_ALL, "<language>" );`

Sets the locale to the language that's indicated by `<language>`, and uses the default country/region for the specified language and the user-default ANSI code page for that country/region as obtained from the host operating system. For example, the following calls to `setlocale` are functionally equivalent:

```
setlocale(LC_ALL, "en-US");
```

```
setlocale(LC_ALL, "English");
```

```
setlocale(LC_ALL, "English_United States.1252");
```

We recommend the first form for performance and maintainability.

- `setlocale( LC_ALL, ".<code_page>" );`

Sets the code page to the value indicated by `<code_page>`, together with the default country/region and language (as defined by the host operating system) for the specified code page.

The category must be either `LC_ALL` or `LC_CTYPE` to effect a change of code page. For example, if the default country/region and language of the host operating system are "`United States`" and "`English`", the following two calls to `setlocale` are functionally equivalent:

```
setlocale(LC_ALL, ".1252");
```

```
setlocale(LC_ALL, "English_United States.1252");
```

For more information, see the `setlocale` pragma directive in the [C/C++ Preprocessor Reference](#).

The function `_configthreadlocale` is used to control whether `setlocale` affects the locale of all threads in a program or only the locale of the calling thread.

## UTF-8 support

Starting in Windows 10 version 1803 (10.0.17134.0), the Universal C Runtime supports using a UTF-8 code page. The change means that `char` strings passed to C runtime functions can expect strings in the UTF-8 encoding. To enable UTF-8 mode, use `".UTF8"` as the code page when using `setlocale`. For example, `setlocale(LC_ALL, ".UTF8")` will use the current default Windows ANSI code page (ACP) for the locale and UTF-8 for the code page.

The string to specify UTF-8 mode is:

- case-insensitive
- the hyphen (-) is optional
- It must be in the code page part of the locale name, so must have a leading period (.) as in these examples:  
"en\_US.UTF8" or ".utf8"

The following examples show how to specify the UTF-8 string:

```
".UTF8"
".UTF-8"
".utf8"
".utf-8"
"en_us.utf8"
"ja_JP.Utf-8"
```

After calling `setlocale(LC_ALL, ".UTF8")`, you may pass "𩿵" to `mbtowcs` and it will be properly translated to a `wchar_t` string. Previously, there wasn't a locale setting available to do this translation.

UTF-8 mode is also enabled for functions that have historically translated `char` strings using the default Windows ANSI code page (ACP). For example, calling `_mkdir("𩿵")` while using a UTF-8 code page will correctly produce a directory with that emoji as the folder name, instead of requiring the ACP to be changed to UTF-8 before running your program. Likewise, calling `_getcwd()` in that folder will return a UTF-8 encoded string. For compatibility, the ACP is still used if the C locale code page isn't set to UTF-8.

The following aspects of the C Runtime can't use UTF-8 because they're set during program startup and must use the default Windows ANSI code page (ACP): `_argv`, `_acmdln`, and `_pgmptr`.

Previous to this support, `mbrtoc16`, `mbrtoc32`, `c16rtomb`, and `c32rtomb` existed to translate between UTF-8 narrow strings, UTF-16 (same encoding as `wchar_t` on Windows platforms) and UTF-32. For compatibility reasons, these APIs still only translate to and from UTF-8 and not the code page set via `setlocale`.

To use this feature on an OS prior to Windows 10, you must use [app-local deployment](#) or link statically using version 1803 (10.0.17134.0) of the Windows SDK or later. For Windows 10 operating systems prior to 1803 (10.0.17134.0), only static linking is supported.

## Requirements

ROUTINE	REQUIRED HEADER
<code>setlocale</code>	<code>&lt;locale.h&gt;</code>
<code>_wsetlocale</code>	<code>&lt;locale.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_setlocale.c
//
// This program demonstrates the use of setlocale when
// using two independent threads.

#include <locale.h>
#include <process.h>
```

```

#include <windows.h>
#include <stdio.h>
#include <time.h>

#define BUFF_SIZE 100

// Retrieve the date in the current
// locale's format.
int get_date(unsigned char* str)
{
 _time64_t ltime;
 struct tm thetime;

 // Retrieve the current time
 _time64(<ime);
 _gmtime64_s(&thetime, <ime);

 // Format the current time structure into a string
 // "%#x" is the long date representation in the
 // current locale
 if (!strftime((char *)str, BUFF_SIZE, "%#x",
 (const struct tm *)&thetime))
 {
 printf("strftime failed!\n");
 return -1;
 }
 return 0;
}

// This thread sets its locale to the argument
// and prints the date.
uintptr_t __stdcall SecondThreadFunc(void* pArguments)
{
 unsigned char str[BUFF_SIZE];
 char * locale = (char *)pArguments;

 // Set the thread locale
 printf("The thread locale is now set to %s.\n",
 setlocale(LC_ALL, locale));

 // Retrieve the date string from the helper function
 if (get_date(str) == 0)
 {
 printf("The date in %s locale is: '%s'\n", locale, str);
 }

 _endthreadex(0);
 return 0;
}

// The main thread sets the locale to English
// and then spawns a second thread (above) and prints the date.
int main()
{
 HANDLE hThread;
 unsigned threadID;
 unsigned char str[BUFF_SIZE];

 // Enable per-thread locale causes all subsequent locale
 // setting changes in this thread to only affect this thread.
 _configthreadlocale(_ENABLE_PER_THREAD_LOCALE);

 // Set the locale of the main thread to US English.
 printf("The thread locale is now set to %s.\n",
 setlocale(LC_ALL, "en-US"));

 // Create the second thread with a German locale.
 // Our thread function takes an argument of the locale to use.
 hThread = (HANDLE)_beginthreadex(NULL, 0, &SecondThreadFunc,

```

```
 "de-DE", 0, &threadID);

 if (get_date(str) == 0)
 {
 // Retrieve the date string from the helper function
 printf("The date in en-US locale is: '%s'\n\n", str);
 }

 // Wait for the created thread to finish.
 WaitForSingleObject(hThread, INFINITE);

 // Destroy the thread object.
 CloseHandle(hThread);
}
```

```
The thread locale is now set to en-US.
The time in en-US locale is: 'Wednesday, May 12, 2004'

The thread locale is now set to de-DE.
The time in de-DE locale is: 'Mittwoch, 12. Mai 2004'
```

## See also

[Locale names, Languages, and Country/Region strings](#)

[\\_configthreadlocale](#)

[\\_create\\_locale](#), [\\_wcreate\\_locale](#)

**Locale**

[localeconv](#)

[\\_mbclen](#), [\\_mblen](#), [\\_mblen\\_l](#)

[strlen](#), [wcslen](#), [\\_mbslen](#), [\\_mbslen\\_l](#), [\\_mbstrlen](#), [\\_mbstrlen\\_l](#)

[mbstowcs](#), [\\_mbstowcs\\_l](#)

[mbtowc](#), [\\_mbtowc\\_l](#)

[\\_setmbcp](#)

[strcoll](#) functions

[strftime](#), [wcsftime](#), [\\_strftime\\_l](#), [\\_wcsftime\\_l](#)

[strxfrm](#), [wcsxfrm](#), [\\_strxfrm\\_l](#), [\\_wcsxfrm\\_l](#)

[wcstombs](#), [\\_wcstombs\\_l](#)

[wctomb](#), [\\_wctomb\\_l](#)

# \_setmaxstdio

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a maximum for the number of simultaneously open files at the stream I/O level.

## Syntax

```
int _setmaxstdio(
 int new_max
)
```

### Parameters

`new_max`

New maximum for the number of simultaneously open files at the stream I/O level.

## Return value

Returns `new_max` if successful; -1 otherwise.

If `new_max` is less than `_IOB_ENTRIES`, or greater than the maximum number of handles available in the operating system, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function returns -1 and sets `errno` to `EINVAL`.

For information about these and other error codes, see [`errno`](#), [`\_doserrno`](#), [`\_sys\_errlist`](#), and [`\_sys\_nerr`](#).

## Remarks

The `_setmaxstdio` function changes the maximum value for the number of files that may be open simultaneously at the stream I/O level.

C run-time I/O now supports up to 8,192 files open simultaneously at the [low I/O level](#). This level includes files opened and accessed using the `_open`, `_read`, and `_write` family of I/O functions. By default, up to 512 files can be open simultaneously at the [stream I/O level](#). This level includes files opened and accessed using the `fopen`, `fgetc`, and `fputc` family of functions. The limit of 512 open files at the stream I/O level can be increased to a maximum of 8,192 by use of the `_setmaxstdio` function.

Because stream I/O-level functions, such as `fopen`, are built on top of the low I/O-level functions, the maximum of 8,192 is a hard upper limit for the number of simultaneously open files accessed through the C run-time library.

### NOTE

This upper limit might be beyond what's supported by a particular Win32 platform and configuration.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_setmaxstdio</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See [`\_getmaxstdio`](#) for an example of using `_setmaxstdio`.

## See also

[Stream I/O](#)

# `_setmbcp`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a new multibyte code page.

## Syntax

```
int _setmbcp(
 int codepage
)
```

### Parameters

`codepage`

New code page setting for locale-independent multibyte routines.

## Return value

Returns 0 if the code page is set successfully. If an invalid code page value is supplied for `codepage`, returns -1 and the code page setting is unchanged. Sets `errno` to `EINVAL` if a memory allocation failure occurs.

## Remarks

The `_setmbcp` function specifies a new multibyte code page. By default, the run-time system automatically sets the multibyte code page to the system-default ANSI code page. The multibyte code page setting affects all multibyte routines that aren't locale dependent. However, it's possible to instruct `_setmbcp` to use the code page defined for the current locale (see the following list of manifest constants and associated behavior results). For a list of the multibyte routines that are dependent on the locale code page rather than the multibyte code page, see [Interpretation of multibyte-character sequences](#).

The `codepage` argument can be set to any of the following values:

- `_MB_CP_ANSI` Use ANSI code page obtained from operating system at program startup.
- `_MB_CP_LOCALE` Use the current locale's code page obtained from a previous call to [`setlocale`](#).
- `_MB_CP_OEM` Use OEM code page obtained from operating system at program startup.
- `_MB_CP_SBCS` Use single-byte code page. When the code page is set to `_MB_CP_SBCS`, a routine such as [`ismbbblead`](#) always returns false.
- `_MB_CP_UTF8` Use UTF-8. When the code page is set to `_MB_CP_UTF8`, a routine such as [`ismbbblead`](#) always returns false.
- Any other valid code page value, regardless of whether the value is an ANSI, OEM, or other operating-system-supported code page (except UTF-7, which isn't supported).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_setmbcp</code>	<mbctype.h>

For more compatibility information, see [Compatibility](#).

## See also

[`\_getmbcp`](#)  
[`setlocale`](#) , [`\_wsetlocale`](#)

# setmode

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `setmode` is a deprecated alias for the `_setmode` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_setmode` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# \_setmode

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the file translation mode.

## Syntax

```
int _setmode (
 int fd,
 int mode
);
```

### Parameters

`fd`

File descriptor.

`mode`

New translation mode.

## Return value

If successful, returns the previous translation mode.

If invalid parameters are passed to this function, the invalid-parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function returns -1 and sets `errno` to either `EBADF`, which indicates an invalid file descriptor, or `EINVAL`, which indicates an invalid `mode` argument.

For more information about these and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

The `_setmode` function sets to `mode` the translation mode of the file given by `fd`. Passing `_O_TEXT` as `mode` sets text (that is, translated) mode. Carriage return-line feed (CR-LF) combinations are translated into a single line feed character on input. Line feed characters are translated into CR-LF combinations on output. Passing `_O_BINARY` sets binary (untranslated) mode, in which these translations are suppressed.

You can also pass `_O_U16TEXT`, `_O_U8TEXT`, or `_O_WTEXT` to enable Unicode mode, as demonstrated in the second example later in this document.

#### Caution

Unicode mode is for wide print functions (for example, `wprintf`) and is not supported for narrow print functions. Use of a narrow print function on a Unicode mode stream triggers an assert.

`_setmode` is typically used to modify the default translation mode of `stdin` and `stdout`, but you can use it on any file. If you apply `_setmode` to the file descriptor for a stream, call `_setmode` before you perform any input or output operations on the stream.

#### Caution

If you write data to a file stream, explicitly flush the code by using `fflush` before you use `_setmode` to change the mode. If you do not flush the code, you might get unexpected behavior. If you have not written data to the stream, you do not have to flush the code.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_setmode</code>	<code>&lt;io.h&gt;</code>	<code>&lt;fcntl.h&gt;</code>

For more compatibility information, see [Compatibility](#).

### Example: Use `_setmode` to change stdin

```
// crt_setmode.c
// This program uses _setmode to change
// stdin from text mode to binary mode.

#include <stdio.h>
#include <fcntl.h>
#include <io.h>

int main(void)
{
 int result;

 // Set "stdin" to have binary mode:
 result = _setmode(_fileno(stdin), _O_BINARY);
 if(result == -1)
 perror("Cannot set mode");
 else
 printf("'stdin' successfully changed to binary mode\n");
}
```

```
'stdin' successfully changed to binary mode
```

### Example: Use `_setmode` to change stdout

```
// crt_setmodeunicode.c
// This program uses _setmode to change
// stdout to Unicode. Cyrillic and Ideographic
// characters will appear on the console (if
// your console font supports those character sets).

#include <fcntl.h>
#include <io.h>
#include <stdio.h>

int main(void) {
 _setmode(_fileno(stdout), _O_U16TEXT);
 wprintf(L"\x043a\x043e\x0448\x043a\x0430 \x65e5\x672c\x56fd\n");
 return 0;
}
```

## See also

[File handling](#)

[\\_creat](#) , [\\_wcreat](#)

[fopen](#) , [\\_wfopen](#)

[\\_open](#) , [\\_wopen](#)

[\\_set\\_fmode](#)

# \_set\_new\_handler

11/2/2022 • 3 minutes to read • [Edit Online](#)

Transfers control to your error-handling mechanism if the `new` operator fails to allocate memory. The Microsoft C++ compiler uses this function to implement `std::set_new_handler` in the standard library.

## Syntax

```
_PNH _set_new_handler(_PNH pNewHandler);
```

### Parameters

`pNewHandler`

Pointer to the application-supplied memory handling function. An argument of 0 or `nullptr` causes the new handler to be removed.

## Return value

Returns a pointer to the previous exception handling function registered by `_set_new_handler`, so that the previous function can be restored later. If no previous function has been set, the return value can be used to restore the default behavior. This value can be `nullptr` or 0.

## Remarks

The C++ `_set_new_handler` function specifies an exception-handling function that gains control if the `new` operator fails to allocate memory. If `new` fails, the run-time system automatically calls the exception-handling function that was passed as an argument to `_set_new_handler`. `_PNH`, defined in `<new.h>`, is a pointer to a function that returns type `int` and takes an argument of type `size_t`. Use `size_t` to specify the amount of space to be allocated.

There's no default handler.

`_set_new_handler` is essentially a garbage-collection scheme. The run-time system retries allocation each time your function returns a nonzero value and fails if your function returns 0.

An occurrence of the `_set_new_handler` function in a program registers the exception-handling function specified in the argument list with the run-time system:

```
// _set_new_handler1.cpp
#include <new.h>

int handle_program_memory_depletion(size_t)
{
 // Your code
}

int main(void)
{
 _set_new_handler(handle_program_memory_depletion);
 int *pi = new int[BIG_NUMBER];
}
```

By default, the `_set_new_handler` function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

You can save the function address that was last passed to the `_set_new_handler` function and reinstate it later:

```
_PNH old_handler = _set_new_handler(my_handler);
// Code that requires my_handler
// . .
_set_new_handler(old_handler)
// Code that requires old_handler
// . . .
```

The C++ `_set_new_mode` function sets the new handler mode for `malloc`. The new handler mode indicates whether, on failure, `malloc` is to call the new handler routine as set by `_set_new_handler`. By default, `malloc` doesn't call the new handler routine on failure to allocate memory. You can override this default behavior so that, when `malloc` fails to allocate memory, `malloc` calls the new handler routine in the same way that the `new` operator does when it fails for the same reason. To override the default, call `_set_new_mode(1);` early in your program or link with `newmode.obj`.

If a user-defined `operator new` is provided, the new handler functions aren't automatically called on failure.

For more information, see `new` and `delete` in the *C++ Language Reference*.

There's a single `_set_new_handler` handler for all dynamically linked DLLs or executables in a single process. Even if you call `_set_new_handler`, your handler might be replaced by another. Or, your new handler may replace a handler set by another DLL or executable in your process.

## Requirements

FUNCTION	REQUIRED HEADER
<code>_set_new_handler</code>	<code>&lt;new.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

In this example, when the allocation fails, control is transferred to `MyNewHandler`. The argument passed to `MyNewHandler` is the number of bytes requested. The value returned from `MyNewHandler` is a flag indicating whether allocation should be retried: a nonzero value indicates that allocation should be retried, and a zero value indicates that allocation has failed.

```
// crt_set_new_handler.cpp
// Build for x86.
// WARNING: This code intentionally allocates memory until an allocation fails.
// Running this code can cause your system to become non-responsive.
#include <iostream>
#include <new>
#include <new.h>

static const int Big_number = 0x03FFFFFF;

struct MemoryHog {
 int pork[Big_number];
};

class MemoryReserve {
 MemoryHog* reserved = nullptr;
```

```

public:
 MemoryReserve() {
 reserved = new MemoryHog();
 }
 ~MemoryReserve() noexcept {
 if (reserved != nullptr)
 delete reserved;
 }
 bool free_reserve() noexcept {
 if (reserved != nullptr) {
 delete reserved;
 reserved = nullptr;
 return true; // return true if memory freed
 }
 return false; // reserved memory exhausted.
 }
};

// Global singleton for a MemoryReserve object
static MemoryReserve reserve{};

// Define a function to be called if new fails to allocate memory.
int MyNewHandler(size_t /* unused */)
{
 // Call a function to recover some heap space. Return 1 on success.
 if (reserve.free_reserve()) {
 std::cerr << "MyNewHandler: Released reserved memory.\n";
 return 1;
 }
 std::cerr << "MyNewHandler: Reserved memory exhausted.\n";
 return 0;
}

static const int max_depth = 16; // recursion depth limiter
static int depth = 0;

void RecurseAlloc() {
 MemoryHog* piggy = new MemoryHog{};
 if (++depth < max_depth) // Recurse until memory exhausted or max_depth
 RecurseAlloc();
 depth--;
 delete piggy;
 return;
}

int main()
{
 try {
 _set_new_handler(MyNewHandler); // Set handler for new.
 RecurseAlloc();
 }
 catch (std::bad_alloc& ex) {
 std::cerr << "bad_alloc caught: " << ex.what() << '\n';
 }
}

/* Output:
MyNewHandler: Released reserved memory.
MyNewHandler: Reserved memory exhausted.
bad_alloc caught: bad allocation
*/

```

## See also

[Memory allocation](#)

[calloc](#)

`free`

`realloc`

# \_set\_new\_mode

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets a `new` handler mode for `malloc`.

## Syntax

```
int _set_new_mode(int newhandlermode);
```

### Parameters

`newhandlermode`

`new` handler mode for `malloc`; valid value is 0 or 1.

## Return value

Returns the previous handler mode set for `malloc`. A return value of 1 indicates that, on failure to allocate memory, `malloc` previously called the `new` handler routine; a return value of 0 indicates that it didn't. If the `newhandlermode` argument doesn't equal 0 or 1, returns -1.

## Remarks

The C++ `_set_new_mode` function sets the `new` handler mode for `malloc`. The `new` handler mode indicates whether, on failure, `malloc` is to call the `new` handler routine as set by `_set_new_handler`. By default, `malloc` doesn't call the `new` handler routine on failure to allocate memory. You can override this default behavior so that, when `malloc` fails to allocate memory, `malloc` calls the `new` handler routine in the same way that the `new` operator does when it fails for the same reason. For more information, see the `new` and `delete` operators in the *C++ Language Reference*. To override the default, call:

```
_set_new_mode(1);
```

early in your program or link with Newmode.obj (see [Link options](#)).

This function validates its parameter. If `newhandlermode` is anything other than 0 or 1, the function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `_set_new_mode` returns -1 and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_set_new_mode</code>	<code>&lt;new.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

[Memory allocation](#)

[calloc](#)  
[free](#)  
[realloc](#)  
[\\_query\\_new\\_handler](#)  
[\\_query\\_new\\_mode](#)

# \_set\_printf\_count\_output

11/2/2022 • 2 minutes to read • [Edit Online](#)

Enable or disable support of the %n format in `printf`, `_printf_l`, `wprintf`, `_wprintf_l`-family functions.

## Syntax

```
int _set_printf_count_output(
 int enable
)
```

### Parameters

`enable`

A non-zero value to enable %n support, 0 to disable %n support.

## Property value or return value

The state of %n support before calling this function: non-zero if %n support was enabled, 0 if it was disabled.

## Remarks

Because of security reasons, support for the %n format specifier is disabled by default in `printf` and all its variants. If %n is encountered in a `printf` format specification, the default behavior is to invoke the invalid parameter handler as described in [Parameter validation](#). Calling `_set_printf_count_output` with a non-zero argument will cause `printf`-family functions to interpret %n as described in [Format specification syntax: printf and wprintf functions](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_set_printf_count_output</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_set_printf_count_output.c
#include <stdio.h>

int main()
{
 int e;
 int i;
 e = _set_printf_count_output(1);
 printf("%n support was %sabled.\n",
 e ? "en" : "dis");
 printf("%n support is now %sabled.\n",
 _get_printf_count_output() ? "en" : "dis");
 printf("12345%n6789\n", &i); // %n format should set i to 5
 printf("i = %d\n", i);
}
```

```
%n support was disabled.
%n support is now enabled.
123456789
i = 5
```

## See also

[\\_get\\_printf\\_count\\_output](#)

# `_set_se_translator`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Set a per-thread callback function to translate Win32 exceptions (C structured exceptions) into C++ typed exceptions.

## Syntax

```
_se_translator_function _set_se_translator(
 _se_translator_function seTransFunction
)
```

### Parameters

`seTransFunction`

Pointer to a C structured exception translator function that you write.

## Return value

Returns a pointer to the previous translator function registered by `_set_se_translator`, so that the previous function can be restored later. If no previous function has been set, the return value can be used to restore the default behavior; this value can be `nullptr`.

## Remarks

The `_set_se_translator` function provides a way to handle Win32 exceptions (C structured exceptions) as C++ typed exceptions. To allow each C exception to be handled by a C++ `catch` handler, first define a C exception wrapper class that can be used, or derived from, to attribute a specific class type to a C exception. To use this class, install a custom C exception translator function that is called by the internal exception-handling mechanism each time a C exception is raised. Within your translator function, you can throw any typed exception that can be caught by a matching C++ `catch` handler.

You must use the `/EHs` option when you use `_set_se_translator`.

To specify a custom translation function, call `_set_se_translator` using the name of your translation function as its argument. The translator function that you write is called once for each function invocation on the stack that has `try` blocks. There's no default translator function.

Your translator function should do no more than throw a C++ typed exception. If it does anything in addition to throwing (such as writing to a log file, for example) your program might not behave as expected because the number of invocations of the translator function is platform-dependent.

In a multithreaded environment, translator functions are maintained separately for each thread. Each new thread needs to install its own translator function. Thus, each thread is in charge of its own translation handling.

`_set_se_translator` is specific to one thread--another DLL can install a different translation function.

The `seTransFunction` function that you write must be a native-compiled function (not compiled with `/clr`). It must take an unsigned integer and a pointer to a Win32 `_EXCEPTION_POINTERS` structure as arguments. The arguments are the return values of calls to the Win32 API `GetExceptionCode` and `GetExceptionInformation` functions, respectively.

```
typedef void (__cdecl *_se_translator_function)(unsigned int, struct _EXCEPTION_POINTERS*);
```

For `_set_se_translator`, there are implications when dynamically linking to the CRT; another DLL in the process might call `_set_se_translator` and replace your handler with its own.

When you use `_set_se_translator` from managed code (code compiled with `/clr`) or mixed native and managed code, the translator affects exceptions generated in native code only. Any managed exceptions generated in managed code (such as when raising `System::Exception`) aren't routed through the translator function. Exceptions raised in managed code using the Win32 function `RaiseException` or caused by a system exception like a divide by zero exception are routed through the translator.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_set_se_translator</code>	<code>&lt;eh.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example: Catch `__try` exception error

This sample wraps the calls to set a structured exception translator and to restore the old one in an `RAII` class, `Scoped_SE_Translator`. This class lets you introduce a scope-specific translator as a single declaration. The class destructor restores the original translator when control leaves the scope.

```

// crt_settrans.cpp
// compile with: cl /W4 /EHc crt_settrans.cpp
#include <stdio.h>
#include <windows.h>
#include <eh.h>
#include <exception>

class SE_Exception : public std::exception
{
private:
 const unsigned int nSE;
public:
 SE_Exception() noexcept : SE_Exception{ 0 } {}
 SE_Exception(unsigned int n) noexcept : nSE{ n } {}
 unsigned int getSeNumber() const noexcept { return nSE; }
};

class Scoped_SE_Translator
{
private:
 const _se_translator_function old_SE_translator;
public:
 Scoped_SE_Translator(_se_translator_function new_SE_translator) noexcept
 : old_SE_translator{ _set_se_translator(new_SE_translator) } {}
 ~Scoped_SE_Translator() noexcept { _set_se_translator(old_SE_translator); }
};

void SEFunc()
{
 __try
 {
 printf("In __try, about to force exception\n");
 int x = 5;
 int y = 0;
 int *p = &y;
 *p = x / *p;
 }
 __finally
 {
 printf("In __finally\n");
 }
}

void trans_func(unsigned int u, EXCEPTION_POINTERS*)
{
 throw SE_Exception(u);
}

int main()
{
 Scoped_SE_Translator scoped_se_translator{ trans_func };
 try
 {
 SEFunc();
 }
 catch(const SE_Exception& e)
 {
 printf("Caught a __try exception, error %8.8x.\n", e.getSeNumber());
 }
}

```

```

In __try, about to force exception
In __finally
Caught a __try exception, error c0000094.

```

## Example: Catch `SE_Exception` error

Although the functionality provided by `_set_se_translator` isn't available in managed code, it's possible to use this mapping in native code, even if that native code is in a compilation under the `/clr` switch, as long as the native code is indicated using `#pragma unmanaged`. If a structured exception is being thrown in managed code that is to be mapped, the code that generates and handles the exception must be marked `#pragma unmanaged`. The following code shows a possible use. For more information, see [Pragma directives and the `\_\_pragma` and `\_Pragma` keywords](#).

```

// crt_set_se_translator_clr.cpp
// compile with: cl /W4 /clr crt_set_se_translator_clr.cpp
#include <windows.h>
#include <eh.h>
#include <stdio.h>
#include <exception>

int thrower_func(int i) {
 int y = 0;
 int *p = &y;
 *p = i / *p;
 return 0;
}

class SE_Exception : public std::exception
{
private:
 const unsigned int nSE;
public:
 SE_Exception() noexcept : SE_Exception{ 0 } {}
 SE_Exception(unsigned int n) noexcept : nSE{ n } {}
 unsigned int getSeNumber() const noexcept { return nSE; }
};

class Scoped_SE_Translator
{
private:
 const _se_translator_function old_SE_translator;
public:
 Scoped_SE_Translator(_se_translator_function new_SE_translator) noexcept
 : old_SE_translator{ _set_se_translator(new_SE_translator) } {}
 ~Scoped_SE_Translator() noexcept { _set_se_translator(old_SE_translator); }
};

#pragma unmanaged
void my_trans_func(unsigned int u, PEXCEPTION_POINTERS)
{
 throw SE_Exception(u);
}

void DoTest()
{
 try
 {
 thrower_func(10);
 }
 catch(const SE_Exception& e)
 {
 printf("Caught SE_Exception, error %8.8x\n", e.getSeNumber());
 }
 catch(...)
 {
 printf("Caught unexpected SEH exception.\n");
 }
}
#pragma managed

int main() {
 Scoped_SE_Translator scoped_se_translator{ my_trans_func };

 DoTest();
}

```

Caught SE\_Exception, error c0000094

## See also

Exception handling routines

[set\\_terminate](#)

[set\\_unexpected](#)

[terminate](#)

[unexpected](#)\

# `_set_SSE2_enable`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Enables or disables the use of Streaming SIMD Extensions 2 (SSE2) instructions in CRT math routines. (This function isn't available on x64 architectures because SSE2 is enabled by default.)

## Syntax

```
int _set_SSE2_enable(
 int flag
)
```

### Parameters

`flag`

1 to enable the SSE2 implementation; 0 to disable the SSE2 implementation. By default, SSE2 implementation is enabled on processors that support it.

## Return value

Nonzero if SSE2 implementation is enabled; zero if SSE2 implementation is disabled.

## Remarks

The following functions have SSE2 implementations that can be enabled by using `_set_SSE2_enable`:

- [atan](#)
- [ceil](#)
- [exp](#)
- [floor](#)
- [log](#)
- [log10](#)
- [modf](#)
- [pow](#)

The SSE2 implementations of these functions might give slightly different answers than the default implementations. SSE2 intermediate values are 64-bit floating-point quantities, but the default implementation intermediate values are 80-bit floating-point quantities.

#### NOTE

If you use the [/Oi \(Generate Intrinsic Functions\)](#) compiler option to compile the project, it may appear that `_set_SSE2_enable` has no effect. The `/Oi` compiler option gives the compiler the authority to use intrinsics to replace CRT calls; this behavior overrides the effect of `_set_SSE2_enable`. If you want to guarantee that `/Oi` does not override `_set_SSE2_enable`, use `/Oi-` to compile your project. This might also be good practice when you use other compiler switches that imply `/Oi`.

The SSE2 implementation is only used if all exceptions are masked. Use `_control87`, `_controlfp` to mask exceptions.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_set_SSE2_enable</code>	<code>&lt;math.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_set_SSE2_enable.c
// processor: x86
#include <math.h>
#include <stdio.h>

int main()
{
 int i = _set_SSE2_enable(1);

 if (i)
 printf("SSE2 enabled.\n");
 else
 printf("SSE2 not enabled; processor does not support SSE2.\n");
}
```

```
SSE2 enabled.
```

## See also

[C runtime \(CRT\) and C++ Standard Library \(STL\) .lib files](#)

# set\_terminate (CRT)

11/2/2022 • 2 minutes to read • [Edit Online](#)

Installs your own termination routine to be called by `terminate`.

## Syntax

```
terminate_function set_terminate(terminate_function termFunction);
```

### Parameters

`termFunction`

Pointer to a terminate function that you write.

## Return value

Returns a pointer to the previous function registered by `set_terminate` so that the previous function can be restored later. If no previous function has been set, the return value may be used to restore the default behavior; this value may be `NULL`.

## Remarks

The `set_terminate` function installs `termFunction` as the function called by `terminate`. `set_terminate` is used with C++ exception handling and may be called at any point in your program before the exception is thrown. `terminate` calls `abort` by default. You can change this default by writing your own termination function and calling `set_terminate` with the name of your function as its argument. `terminate` calls the last function given as an argument to `set_terminate`. After it performs any desired cleanup tasks, `termFunction` should exit the program. If it doesn't exit (if it returns to its caller), `abort` is called.

In a multithreaded environment, terminate functions are maintained separately for each thread. Each new thread needs to install its own terminate function. Thus, each thread is in charge of its own termination handling.

The `terminate_function` type is defined in EH.H as a pointer to a user-defined termination function, `termFunction` that returns `void`. Your custom function `termFunction` can take no arguments and shouldn't return to its caller. If it does, `abort` is called. An exception may not be thrown from within `termFunction`.

```
typedef void (*terminate_function)();
```

### NOTE

The `set_terminate` function only works outside the debugger.

There's a single `set_terminate` handler for all dynamically linked DLLs or EXEs; even if you call `set_terminate` your handler may be replaced by another, or you may be replacing a handler set by another DLL or EXE.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

# Requirements

ROUTINE	REQUIRED HEADER
<code>set_terminate</code>	<code>&lt;eh.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [`terminate`](#).

## See also

### Exception handling routines

[`abort`](#)  
[`\_get\_terminate`](#)  
[`set\_unexpected`](#)  
[`terminate`](#)  
[`unexpected`](#)

# `set_unexpected` (CRT)

11/2/2022 • 2 minutes to read • [Edit Online](#)

Installs your own termination function to be called by `unexpected`.

## Syntax

```
unexpected_function set_unexpected(unexpected_function unexpFunction);
```

### Parameters

`unexpFunction`

Pointer to a function that you write to replace the `unexpected` function.

## Return value

Returns a pointer to the previous termination function registered by `_set_unexpected` so that the previous function can be restored later. If no previous function has been set, the return value may be `NULL`.

## Remarks

The `set_unexpected` function installs `unexpFunction` as the function called by `unexpected`. `unexpected` isn't used in the current C++ exception-handling implementation. The `unexpected_function` type is defined in EH.H as a pointer to a user-defined unexpected function, `unexpFunction` that returns `void`. Your custom `unexpFunction` function shouldn't return to its caller.

```
typedef void (*unexpected_function)();
```

By default, `unexpected` calls `terminate`. You can change this default behavior by writing your own termination function and calling `set_unexpected` with the name of your function as its argument. `unexpected` calls the last function given as an argument to `set_unexpected`.

Unlike the custom termination function installed by a call to `set_terminate`, an exception can be thrown from within `unexpFunction`.

In a multithreaded environment, unexpected functions are maintained separately for each thread. Each new thread needs to install its own unexpected function. Thus, each thread is in charge of its own unexpected handling.

In the current Microsoft implementation of C++ exception handling, `unexpected` calls `terminate` by default and is never called by the exception-handling run-time library. There's no particular advantage to calling `unexpected` rather than `terminate`.

There's a single `set_unexpected` handler for all dynamically linked DLLs or EXEs; even if you call `set_unexpected` your handler may be replaced by another or that you're replacing a handler set by another DLL or EXE.

## Requirements

ROUTINE	REQUIRED HEADER
<code>set_unexpected</code>	<code>&lt;eh.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### Exception handling routines

`abort`  
`_get_unexpected`  
`set_terminate`  
`terminate`  
`unexpected`\

# setvbuf

11/2/2022 • 2 minutes to read • [Edit Online](#)

Controls stream buffering and buffer size.

## Syntax

```
int setvbuf(
 FILE *stream,
 char *buffer,
 int mode,
 size_t size
);
```

### Parameters

`stream`

Pointer to `FILE` structure.

`buffer`

User-allocated buffer.

`mode`

Mode of buffering.

`size`

Buffer size in bytes. Allowable range:  $2 \leq \text{size} \leq \text{INT\_MAX}$  (2147483647). Internally, the value supplied for `size` is rounded down to the nearest multiple of 2.

## Return value

Returns 0 if successful.

If `stream` is `NULL`, or if `mode` or `size` isn't within a valid range, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function returns -1 and sets `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `setvbuf` function allows the program to control both buffering and buffer size for `stream`. `stream` must refer to an open file that hasn't undergone an I/O operation since it was opened. The array pointed to by `buffer` is used as the buffer, unless `buffer` is `NULL`, in which case `setvbuf` uses an automatically allocated buffer of length `size /2 * 2` bytes.

The mode must be `_IOFBF`, `_IOLBF`, or `_IONBF`. If `mode` is `_IOFBF` or `_IOLBF`, then `size` is used as the size of the buffer. If `mode` is `_IONBF`, the stream is unbuffered, and both `size` and `buffer` are ignored. Values for `mode` and their meanings are:

MODE	VALUE	MEANING
	<code>_IOFBF</code>	Full buffering; that is, <code>buffer</code> is used as the buffer and <code>size</code> is used as the size of the buffer. If <code>buffer</code> is <code>NULL</code> , this mode uses an automatically allocated buffer that's <code>size</code> bytes long.
	<code>_IOLBF</code>	For some systems, this mode provides line buffering. However, for Win32, the behavior is the same as <code>_IOFBF</code> - Full Buffering.
	<code>_IONBF</code>	No buffer is used, regardless of <code>buffer</code> or <code>size</code> .

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>setvbuf</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

```
// crt_setvbuf.c
// This program opens two streams: stream1
// and stream2. It then uses setvbuf to give stream1 a
// user-defined buffer of 1024 bytes and stream2 no buffer.
//

#include <stdio.h>

int main(void)
{
 char buf[1024];
 FILE *stream1, *stream2;

 if(fopen_s(&stream1, "data1", "a") == 0 &&
 fopen_s(&stream2, "data2", "w") == 0)
 {
 if(setvbuf(stream1, buf, _IOFBF, sizeof(buf)) != 0)
 printf("Incorrect type or size of buffer for stream1\n");
 else
 printf("'stream1' now has a buffer of 1024 bytes\n");
 if(setvbuf(stream2, NULL, _IONBF, 0) != 0)
 printf("Incorrect type or size of buffer for stream2\n");
 else
 printf("'stream2' now has no buffer\n");
 _fcloseall();
 }
}
```

```
'stream1' now has a buffer of 1024 bytes
'stream2' now has no buffer
```

## See also

### Stream I/O

[fclose](#), [\\_fcloseall](#)

[fflush](#)

[fopen](#), [\\_wfopen](#)

[setbuf](#)

Sets interrupt signal handling.

#### IMPORTANT

Do not use this method to shut down a Microsoft Store app, except in testing or debugging scenarios. Programmatic or UI ways to close a Store app are not permitted according to the [Microsoft Store policies](#). For more information, see [UWP app lifecycle](#).

## Syntax

```
void __cdecl *signal(int sig, int (*func)(int, int));
```

#### Parameters

`sig`

Signal value.

`func`

The second parameter is a pointer to the function to be executed. The first parameter is a signal value, and the second parameter is a subcode that can be used when the first parameter is `SIGFPE`.

## Return value

`signal` returns the previous value of `func` that's associated with the given signal. For example, if the previous value of `func` was `SIG_IGN`, the return value is also `SIG_IGN`. A return value of `SIG_ERR` indicates an error; in that case, `errno` is set to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `signal` function enables a process to choose one of several ways to handle an interrupt signal from the operating system. The `sig` argument is the interrupt to which `signal` responds; it must be one of the following manifest constants, which are defined in `SIGNAL.H`.

<code>SIG</code> VALUE	DESCRIPTION
<code>SIGABRT</code>	Abnormal termination
<code>SIGFPE</code>	Floating-point error
<code>SIGILL</code>	Illegal instruction
<code>SIGINT</code>	CTRL+C signal

SIG VALUE	DESCRIPTION
SIGSEGV	Illegal storage access
SIGTERM	Termination request

If `sig` isn't one of the above values, the invalid parameter handler is invoked, as defined in [Parameter validation](#). If execution is allowed to continue, this function sets `errno` to `EINVAL` and returns `SIG_ERR`.

By default, `signal` terminates the calling program with exit code 3, regardless of the value of `sig`.

#### NOTE

`SIGINT` is not supported for any Win32 application. When a CTRL+C interrupt occurs, Win32 operating systems generate a new thread to specifically handle that interrupt. This can cause a single-thread application, such as one in UNIX, to become multithreaded and cause unexpected behavior.

The `func` argument is an address to a signal handler that you write, or to one of the predefined constants `SIG_DFL` or `SIG_IGN`, which are also defined in `SIGNAL.H`. If `func` is a function, it's installed as the signal handler for the given signal. The signal handler's prototype requires one formal argument, `sig`, of type `int`. The operating system provides the actual argument through `sig` when an interrupt occurs; the argument is the signal that generated the interrupt. Therefore, you can use the six manifest constants (listed in the preceding table) in your signal handler to determine which interrupt occurred and take appropriate action. For example, you can call `signal` twice to assign the same handler to two different signals, and then test the `sig` argument in the handler to take different actions based on the signal received.

If you're testing for floating-point exceptions (`SIGFPE`), `func` points to a function that takes an optional second argument that is one of several manifest constants, defined in `FLOAT.H`, of the form `FPE_xxx`. When a `SIGFPE` signal occurs, you can test the value of the second argument to determine the kind of floating-point exception, and then take appropriate action. This argument and its possible values are Microsoft extensions.

For floating-point exceptions, the value of `func` isn't reset when the signal is received. To recover from floating-point exceptions, use try/except clauses to surround the floating point operations. It's also possible to recover by using `setjmp` with `longjmp`. In either case, the calling process resumes execution and leaves the floating-point state of the process undefined.

If the signal handler returns, the calling process resumes execution immediately following the point at which it received the interrupt signal, regardless of the kind of signal or operating mode.

Before the specified function is executed, the value of `func` is set to `SIG_DFL`. The next interrupt signal is treated as described for `SIG_DFL`, unless an intervening call to `signal` specifies otherwise. You can use this feature to reset signals in the called function.

Because signal-handler routines are often called asynchronously when an interrupt occurs, your signal-handler function may get control when a run-time operation is incomplete and in an unknown state. The following list summarizes the restrictions that determine which functions you can use in your signal-handler routine.

- Don't issue low-level or `STDIO.H` I/O routines (for example, `printf` or `fread`).
- Don't call heap routines or any routine that uses the heap routines (for example, `malloc`, `_strdup`, or `_putenv`). For more information, see `malloc`.
- Don't use any function that generates a system call (for example, `_getcwd` or `time`).
- Don't use `longjmp` unless the interrupt is caused by a floating-point exception (that is, `sig` is `SIGFPE`). In

this case, first reinitialize the floating-point package by using a call to `_fpreset`.

- Don't use any overlay routines.

A program must contain floating-point code if it's to trap the `SIGFPE` exception by using the function. If your program doesn't have floating-point code and requires the run-time library's signal-handling code, just declare a volatile double and initialize it to zero:

```
volatile double d = 0.0f;
```

The `SIGILL` and `SIGTERM` signals aren't generated under Windows. They're included for ANSI compatibility. Therefore, you can set signal handlers for these signals by using `signal`, and you can also explicitly generate these signals by calling `raise`.

Signal settings aren't preserved in spawned processes that are created by calls to `_exec` or `_spawn` functions. The signal settings are reset to the default values in the new process.

## Requirements

ROUTINE	REQUIRED HEADER
<code>signal</code>	<code>&lt;signal.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

The following example shows how to use `signal` to add some custom behavior to the `SIGABRT` signal. For more information about abort behavior, see [\\_set\\_abort\\_behavior](#).

```
// crt_signal.c
// compile with: /EHsc /W4
// Use signal to attach a signal handler to the abort routine
#include <stdlib.h>
#include <signal.h>

void SignalHandler(int signal)
{
 if (signal == SIGABRT) {
 // abort signal handler code
 } else {
 // ...
 }
}

int main()
{
 typedef void (*SignalHandlerPointer)(int);

 SignalHandlerPointer previousHandler;
 previousHandler = signal(SIGABRT, SignalHandler);

 abort();
}
```

The output depends on the version of the runtime used, whether the app is a console or Windows app, and on Windows registry settings. For a console app, something like the following message may be sent to stderr:

Debug Error!

Program: c:\Projects\crt\_signal\Debug\crt\_signal.exe

R6010

- abort() has been called

## See also

[Process and environment control](#)

[abort](#)

[\\_exec](#), [\\_wexec](#) functions

[exit](#), [\\_Exit](#), [\\_exit](#)

[\\_fpreset](#)

[\\_spawn](#), [\\_wspawn](#) functions

Determines whether a floating-point value is negative.

## Syntax

```
int signbit(
 /* floating-point */ x
); /* C-only macro */

inline bool signbit(
 float x
) throw(); /* C++-only overloaded function */

inline bool signbit(
 double x
) throw(); /* C++-only overloaded function */

inline bool signbit(
 long double x
) throw(); /* C++-only overloaded function */
```

### Parameters

x

The floating-point value to test.

## Return value

`signbit` returns a non-zero value (`true` in C++) if the argument `x` is negative or negative infinity. It returns 0 (`false` in C++) if the argument is non-negative, positive infinity, or a NAN.

## Remarks

`signbit` is a macro when compiled as C, and an overloaded inline function when compiled as C++.

## Requirements

FUNCTION	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>signbit</code>	<code>&lt;math.h&gt;</code>	<code>&lt;math.h&gt; or &lt;cmath&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### Math and floating-point support

`isfinite`, `_finite`, `_finitef`  
`isinf`  
`isnan`, `_isnan`, `_isnanf`  
`isnormal`

`_fpclass` , `_fpclassf`

`sin`, `sinf`, `sinl`

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Calculates the sine of a floating-point value.

## Syntax

```
double sin(double x);
float sinf(float x);
long double sinl(long double x);
#define sin(x) // Requires C11 or higher
```

```
float sin(float x); // C++ only
long double sin(long double x); // C++ only
```

### Parameters

`x`

Angle in radians.

## Return value

The `sin` functions return the sine of `x`. If `x` is greater than or equal to 263, or less than or equal to -263, a loss of significance in the result occurs.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}$ , IND	None	<code>_DOMAIN</code>
$\pm \text{INF}$ ( <code>sin</code> , <code>sinf</code> , <code>sinl</code> )	<code>INVALID</code>	<code>_DOMAIN</code>

For more information about return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

Because C++ allows overloading, you can call overloads of `sin` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `sin` always takes and returns `double`.

If you use the `<tgmath.h> sin()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>sin</code> , <code>sinf</code> , <code>sinl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code> or <code>&lt;math.h&gt;</code>
<code>sin</code> macro	<code>&lt;tgmath.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_sincos.c
// This program displays the sine and cosine of pi / 2.
// Compile by using: cl /W4 crt_sincos.c

#include <math.h>
#include <stdio.h>

int main(void)
{
 double pi = 3.1415926535;
 double x, y;

 x = pi / 2;
 y = sin(x);
 printf("sin(%f) = %f\n", x, y);
 y = cos(x);
 printf("cos(%f) = %f\n", x, y);
}
```

```
sin(1.570796) = 1.000000
cos(1.570796) = 0.000000
```

## See also

### Math and floating-point support

<code>acos</code>	<code>acosf</code>	<code>acosl</code>
<code>asin</code>	<code>asinf</code>	<code>asinl</code>
<code>atan</code>	<code>atanf</code>	<code>atanl</code>
<code>atan2</code>	<code>atan2f</code>	<code>atan2l</code>
<code>cos</code>	<code>cosf</code>	<code>cosl</code>
<code>tan</code>	<code>tanf</code>	<code>tanl</code>
<code>_CIsin</code>	\	

# `sinh`, `sinhf`, `sinhl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the hyperbolic sine.

## Syntax

```
double sinh(double x);
float sinhf(float x);
long double sinhl(long double x);
#define sinh(x) // Requires C11 or higher

float sinh(float x); // C++ only
long double sinh(long double x); // C++ only
```

## Parameters

`x`

Angle in radians.

## Return value

The `sinh` functions return the hyperbolic sine of `x`. By default, if the result is too large, `sinh` sets `errno` to `ERANGE` and returns  $\pm \text{HUGE\_VAL}$ .

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	None	<code>_DOMAIN</code>
$ x  \geq 7.104760e+002$	<code>OVERFLOW</code> + <code>INEXACT</code>	<code>OVERFLOW</code>

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Because C++ allows overloading, you can call overloads of `sinh` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `sinh` always takes and returns `double`.

If you use the `sinh` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>sinh</code> , <code>sinhf</code> , <code>sinhl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code> or <code>&lt;math.h&gt;</code>

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>sinh</code> macro	<code>&lt;tgmath.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_sinhcosh.c
// This program displays the hyperbolic
// sine and hyperbolic cosine of pi / 2.
// Compile by using: cl /W4 crt_sinhcosh.c

#include <math.h>
#include <stdio.h>

int main(void)
{
 double pi = 3.1415926535;
 double x, y;

 x = pi / 2;
 y = sinh(x);
 printf("sinh(%f) = %f\n", x, y);
 y = cosh(x);
 printf("cosh(%f) = %f\n", x, y);
}
```

```
sinh(1.570796) = 2.301299
cosh(1.570796) = 2.509178
```

## See also

[Math and floating-point support](#)

<a href="#">acosh</a>	<a href="#">acoshf</a>	<a href="#">acoshl</a>
<a href="#">asinh</a>	<a href="#">asinhf</a>	<a href="#">asinhl</a>
<a href="#">atanh</a>	<a href="#">atanhf</a>	<a href="#">atanhl</a>
<a href="#">cosh</a>	<a href="#">coshf</a>	<a href="#">coshl</a>
<a href="#">tanh</a>	<a href="#">tanhf</a>	<a href="#">tanhl</a>

`_snprintf`, `_snprintf_l`, `_snprintf_s`, `_snwprintf`,  
`_snwprintf_l`

11/2/2022 • 6 minutes to read • [Edit Online](#)

Writes formatted data to a string. More secure versions of these functions are available; see `_snprintf_s`, `_snprintf_s_l`, `_snwprintf_s`, `_snwprintf_s_l`.

## Syntax

```
int sprintf(
 char *buffer,
 size_t count,
 const char *format [,,
 argument] ...
);

int _sprintf(
 char *buffer,
 size_t count,
 const char *format [,,
 argument] ...
);

int _sprintf_l(
 char *buffer,
 size_t count,
 const char *format,
 _locale_t locale [,,
 argument] ...
);

int _snprintf(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format [,,
 argument] ...
);

int _snprintf_l(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);

template <size_t size>
int _sprintf(
 char (&buffer)[size],
 size_t count,
 const char *format [,,
 argument] ...
); // C++ only

template <size_t size>
int _sprintf_l(
 char (&buffer)[size],
 size_t count,
 const char *format,
 _locale_t locale [,,
 argument] ...
); // C++ only

template <size_t size>
int _snprintf(
 wchar_t (&buffer)[size],
 size_t count,
 const wchar_t *format [,,
 argument] ...
); // C++ only

template <size_t size>
int _snprintf_l(
 wchar_t (&buffer)[size],
 size_t count,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
); // C++ only
```

## Parameters

*buffer*

Storage location for the output.

`count`

Maximum number of characters to store.

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax: `printf` and `wprintf` functions](#).

## Return value

Let `len` be the length of the formatted data string, not including the terminating null. Both `len` and `count` are the number of characters for `snprintf` and `_snprintf`, and the number of wide characters for `_snwprintf`.

For all functions, if `len` < `count`, `len` characters are stored in `buffer`, a null-terminator is appended, and `len` is returned.

The `snprintf` function truncates the output when `len` is greater than or equal to `count`, by placing a null-terminator at `buffer[count-1]`. The value returned is `len`, the number of characters that would have been output if `count` was large enough. The `snprintf` function returns a negative value if an encoding error occurs.

For all functions other than `snprintf`, if `len` = `count`, `len` characters are stored in `buffer`, no null-terminator is appended, and `len` is returned. If `len` > `count`, `count` characters are stored in `buffer`, no null-terminator is appended, and a negative value is returned.

If `buffer` is a null pointer and `count` is zero, `len` is returned as the count of characters required to format the output, not including the terminating null. To make a successful call with the same `argument` and `Locale` parameters, allocate a buffer holding at least `len` + 1 characters.

If `buffer` is a null pointer and `count` is nonzero, or if `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information about these and other error codes, see [`errno`, `\_doserrno`, `\_sys\_errlist`, and `\_sys\_nerr`](#).

## Remarks

The `snprintf` function and the `_snprintf` family of functions format and store `count` or fewer characters in `buffer`. The `snprintf` function always stores a terminating null character, truncating the output if necessary. The `_snprintf` family of functions only appends a terminating null character if the formatted string length is strictly less than `count` characters. Each `argument` (if any) is converted and is output according to the corresponding format specification in `format`. The format consists of ordinary characters and has the same form and function as the `format` argument for `printf`. If copying occurs between strings that overlap, the behavior is undefined.

## IMPORTANT

Ensure that `format` is not a user-defined string. Because the `_snprintf` functions do not guarantee null termination—in particular, when the return value is `count`—make sure that they are followed by code that adds the null terminator. For more information, see [Avoiding buffer overruns](#).

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

Beginning with the UCRT in Visual Studio 2015 and Windows 10, `snprintf` is no longer identical to `_snprintf`. The `snprintf` function behavior is now C99 standard conformant.

`_snprintf` is a wide-character version of `_snprintf`; the pointer arguments to `_snprintf` are wide-character strings. Detection of encoding errors in `_snprintf` might differ from the detection in `_snprintf`. `_snprintf`, just like `swprintf`, writes output to a string instead of a destination of type `FILE`.

The versions of these functions that have the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

In C++, these functions have template overloads that invoke the newer, more secure counterparts. For more information, see [Secure template overloads](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_snprintf</code>	<code>_snprintf</code>	<code>_snprintf</code>	<code>_snwprintf</code>
<code>_snprintf_1</code>	<code>_snprintf_1</code>	<code>_snprintf_1</code>	<code>_snwprintf_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>snprintf</code> , <code>_snprintf</code> , <code>_snprintf_1</code>	<code>&lt;stdio.h&gt;</code>
<code>_snwprintf</code> , <code>_snwprintf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_snprintf.c
// compile with: /W3
#include <stdio.h>
#include <stdlib.h>
```

```

#ifndef __cplusplus
typedef int bool;
const bool true = 1;
const bool false = 0;
#endif

#define FAIL 0 // change to 1 and see what happens

int main(void)
{
 char buffer[200];
 const static char s[] = "computer"
#if FAIL
"computercomputercomputercomputercomputercomputercomputercomputer"
"computercomputercomputercomputercomputercomputercomputercomputer"
"computercomputercomputercomputercomputercomputercomputercomputer"
"computercomputercomputercomputercomputercomputercomputercomputer"
#endif
;
 const char c = 'l';
 const int i = 35;
#if FAIL
 const double fp = 1e300; // doesn't fit in the buffer
#else
 const double fp = 1.7320534;
#endif
/* !subtract one to prevent "squeezing out" the terminal null! */
const int bufferSize = sizeof(buffer)/sizeof(buffer[0]) - 1;
int bufferUsed = 0;
int bufferLeft = bufferSize - bufferUsed;
bool bSuccess = true;
buffer[0] = 0;

/* Format and print various data: */

if (bufferLeft > 0)
{
 int perElementBufferUsed = _snprintf(&buffer[bufferUsed],
bufferLeft, " String: %s\n", s); // C4996
// Note: _snprintf is deprecated; consider _snprintf_s instead
if (bSuccess = (perElementBufferUsed >= 0))
{
 bufferUsed += perElementBufferUsed;
 bufferLeft -= perElementBufferUsed;
 if (bufferLeft > 0)
 {
 int perElementBufferUsed = _snprintf(&buffer[bufferUsed],
bufferLeft, " Character: %c\n", c); // C4996
 if (bSuccess = (perElementBufferUsed >= 0))
 {
 bufferUsed += perElementBufferUsed;
 bufferLeft -= perElementBufferUsed;
 if (bufferLeft > 0)
 {
 int perElementBufferUsed = _snprintf(&buffer
[bufferUsed], bufferLeft, " Integer: %d\n", i); // C4996
 if (bSuccess = (perElementBufferUsed >= 0))
 {
 bufferUsed += perElementBufferUsed;
 bufferLeft -= perElementBufferUsed;
 if (bufferLeft > 0)
 {
 int perElementBufferUsed = _snprintf(&buffer
[bufferUsed], bufferLeft, " Real: %f\n", fp); // C4996
 if (bSuccess = (perElementBufferUsed >= 0))
 {
 bufferUsed += perElementBufferUsed;
 }
 }
 }
 }
 }
 }
}

```

```

 }
 }
}
}

if (!bSuccess)
{
 printf("%s\n", "failure");
}
else
{
 /* !store null because _snprintf doesn't necessarily (if the string
 * fits without the terminal null, but not with it)!
 * bufferUsed might be as large as bufferSize, which normally is
 * like going one element beyond a buffer, but in this case
 * subtracted one from bufferSize, so we're ok.
 */
 buffer[bufferUsed] = 0;
 printf("Output:\n%s\ncharacter count = %d\n", buffer, bufferUsed);
}
return EXIT_SUCCESS;
}

```

Output:  
String: computer  
Character: 1  
Integer: 35  
Real: 1.732053

character count = 69

## See also

### Stream I/O

<a href="#">sprintf</a>	<a href="#">_sprintf_l</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_l</a>	<a href="#">__swprintf_l</a>
<a href="#">fprintf</a>	<a href="#">_fprintf_l</a>	<a href="#">fwprintf</a>	<a href="#">_fwprintf_l</a>	
<a href="#">printf</a>	<a href="#">_printf_l</a>	<a href="#">wprintf</a>	<a href="#">_wprintf_l</a>	
<a href="#">scanf</a>	<a href="#">_scanf_l</a>	<a href="#">wscanf</a>	<a href="#">_wscanf_l</a>	
<a href="#">sscanf</a>	<a href="#">_sscanf_l</a>	<a href="#">swscanf</a>	<a href="#">_swscanf_l</a>	
<a href="#">vprintf</a>	functions			

`_snprintf_s`, `_snprintf_s_l`, `_snwprintf_s`,  
`_snwprintf_s_l`

11/2/2022 • 5 minutes to read • [Edit Online](#)

Writes formatted data to a string. These functions are versions of `snprintf`, `_snprintf`, `_snprintf_1`, `_snwprintf`, `_snwprintf_1` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
int _snprintf_s(
 char *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const char *format [,,
 argument] ...
);

int _snprintf_s_l(
 char *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const char *format,
 _locale_t locale [,,
 argument] ...
);

int _snwprintf_s(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const wchar_t *format [,,
 argument] ...
);

int _snwprintf_s_l(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);

template <size_t size>
int _snprintf_s(
 char (&buffer)[size],
 size_t count,
 const char *format [,,
 argument] ...
); // C++ only

template <size_t size>
int _snwprintf_s(
 wchar_t (&buffer)[size],
 size_t count,
 const wchar_t *format [,,
 argument] ...
); // C++ only
```

## Parameters

`buffer`

Storage location for the output.

`sizeOfBuffer`

The size of the storage location for output. Size in `bytes` for `_snprintf_s` or size in `words` for `_snwprintf_s`.

`count`

Maximum number of characters to store, or `_TRUNCATE`.

`format`

Format-control string.

`argument`

Optional arguments.

`Locale`

The locale to use.

## Return value

`_snprintf_s` returns the number of characters stored in `buffer`, not counting the terminating null character.

`_snwprintf_s` returns the number of wide characters stored in `buffer`, not counting the terminating null wide character.

If the storage required to store the data and a terminating null exceeds `sizeOfBuffer`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution continues after the invalid parameter handler, these functions set `buffer` to an empty string, set `errno` to `E RANGE`, and return -1.

If `buffer` or `format` is a `NULL` pointer, or if `count` is less than or equal to zero, the invalid parameter handler is invoked. If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_snprintf_s` function formats and stores `count` or fewer characters in `buffer` and appends a terminating null. Each argument (if any) is converted and output according to the corresponding format specification in `format`. The formatting is consistent with the `printf` family of functions; see [Format specification syntax: printf and wprintf functions](#). If copying occurs between strings that overlap, the behavior is undefined.

If `count` is `_TRUNCATE`, then `_snprintf_s` writes as much of the string as will fit in `buffer` while leaving room for a terminating null. If the entire string (with terminating null) fits in `buffer`, then `_snprintf_s` returns the number of characters written (not including the terminating null); otherwise, `_snprintf_s` returns -1 to indicate that truncation occurred.

## IMPORTANT

Ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

`_snwprintf_s` is a wide-character version of `_snprintf_s`; the pointer arguments to `_snwprintf_s` are wide-character strings. Detection of encoding errors in `_snwprintf_s` might differ from the detection in `_snprintf_s`. `_snwprintf_s`, like `swprintf_s`, writes output to a string rather than to a destination of type `FILE`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

## Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_snprintf_s</code>	<code>_snprintf_s</code>	<code>_snprintf_s</code>	<code>_snwprintf_s</code>
<code>_snprintf_s_1</code>	<code>_snprintf_s_1</code>	<code>_snprintf_s_1</code>	<code>_snwprintf_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_snprintf_s</code> , <code>_snprintf_s_1</code>	<code>&lt;stdio.h&gt;</code>
<code>_snwprintf_s</code> , <code>_snwprintf_s_1</code>	<code>&lt;stdio.h&gt;</code> OR <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_snprintf_s.cpp
// compile with: /MTd

// These #defines enable secure template overloads
// (see last part of Examples() below)
#define _CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES 1
#define _CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT 1

#include <stdio.h>
```

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <crtdbg.h> // For _CrtSetReportMode
#include <errno.h>

// This example uses a 10-byte destination buffer.

int sprintf_s_tester(const char * fmt, int x, size_t count)
{
 char dest[10];

 printf("\n");

 if (count == _TRUNCATE)
 printf("%zd-byte buffer; truncation semantics\n",
 _countof(dest));
 else
 printf("count = %zd; %zd-byte buffer\n",
 count, _countof(dest));

 int ret = _snprintf_s(dest, _countof(dest), count, fmt, x);

 printf(" new contents of dest: '%s'\n", dest);

 return ret;
}

void Examples()
{
 // Formatted output string is 9 characters long: "<<<123>>""
 sprintf_s_tester("<<<%d>>", 121, 8);
 sprintf_s_tester("<<<%d>>", 121, 9);
 sprintf_s_tester("<<<%d>>", 121, 10);

 printf("\nDestination buffer too small:\n");

 sprintf_s_tester("<<<%d>>", 1221, 10);

 printf("\nTruncation examples:\n");

 int ret = sprintf_s_tester("<<<%d>>", 1221, _TRUNCATE);
 printf(" truncation %s occur\n", ret == -1 ? "did"
 : "did not");

 ret = sprintf_s_tester("<<<%d>>", 121, _TRUNCATE);
 printf(" truncation %s occur\n", ret == -1 ? "did"
 : "did not");
 printf("\nSecure template overload example:\n");

 char dest[10];
 _snprintf(dest, 10, "<<<%d>>", 12321);
 // With secure template overloads enabled (see #defines
 // at top of file), the preceding line is replaced by
 // _snprintf_s(dest, _countof(dest), 10, "<<<%d>>", 12345);
 // Instead of causing a buffer overrun, _snprintf_s invokes
 // the invalid parameter handler.
 // If secure template overloads were disabled, _snprintf would
 // write 10 characters and overrun the dest buffer.
 printf(" new contents of dest: '%s'\n", dest);
}

void myInvalidParameterHandler(
 const wchar_t* expression,
 const wchar_t* function,
 const wchar_t* file,
 unsigned int line,
 uintptr_t pReserved)
{

```

```
wprintf(L"Invalid parameter handler invoked: %s\n", expression);
}

int main(void)
{
 _invalid_parameter_handler oldHandler, newHandler;

 newHandler = myInvalidParameterHandler;
 oldHandler = _set_invalid_parameter_handler(newHandler);
 // Disable the message box for assertions.
 _CrtSetReportMode(_CRT_ASSERT, 0);

 Examples();
}
```

```
count = 8; 10-byte buffer
new contents of dest: '<<<121>>'

count = 9; 10-byte buffer
new contents of dest: '<<<121>>>'

count = 10; 10-byte buffer
new contents of dest: '<<<121>>>'

Destination buffer too small:

count = 10; 10-byte buffer
Invalid parameter handler invoked: ("Buffer too small", 0)
new contents of dest: ''

Truncation examples:

10-byte buffer; truncation semantics
new contents of dest: '<<<1221>>'
truncation did occur

10-byte buffer; truncation semantics
new contents of dest: '<<<121>>>'
truncation did not occur

Secure template overload example:
Invalid parameter handler invoked: ("Buffer too small", 0)
new contents of dest: ''
```

## See also

### Stream I/O

<a href="#">sprintf</a>	<a href="#">_sprintf_l</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_l</a>	<a href="#">__swprintf_l</a>
<a href="#">fprintf</a>	<a href="#">_fprintf_l</a>	<a href="#">fwprintf</a>	<a href="#">_fwprintf_l</a>	
<a href="#">printf</a>	<a href="#">_printf_l</a>	<a href="#">wprintf</a>	<a href="#">_wprintf_l</a>	
<a href="#">scanf</a>	<a href="#">_scanf_l</a>	<a href="#">wscanf</a>	<a href="#">_wscanf_l</a>	
<a href="#">sscanf</a>	<a href="#">_sscanf_l</a>	<a href="#">swscanf</a>	<a href="#">_swscanf_l</a>	
<a href="#">vprintf</a>				

[functions](#)

`_snsscanf`, `_snsscanf_l`, `_snwscanf`, `_snwscanf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data of a specified length from a string. More secure versions of these functions are available; see [`\_snsscanf\_s`](#), [`\_snsscanf\_s\_l`](#), [`\_snwscanf\_s`](#), [`\_snwscanf\_s\_l`](#).

## Syntax

```
int __cdecl _snsscanf(
 const char * input,
 size_t length,
 const char * format,
 ...
);
int __cdecl _snsscanf_l(
 const char * input,
 size_t length,
 const char * format,
 _locale_t locale,
 ...
);
int __cdecl _snwscanf(
 const wchar_t * input,
 size_t length,
 const wchar_t * format,
 ...
);
int __cdecl _snwscanf_l(
 const wchar_t * input,
 size_t length,
 const wchar_t * format,
 _locale_t locale,
 ...
);
```

## Parameters

`input`

Input string to examine.

`Length`

Number of characters to examine in `input`.

`format`

One or more format specifiers.

`...`

Optional variables that will be used to store the values extracted from the input string by the format specifiers in `format`.

`Locale`

The locale to use.

## Return value

Both of these functions return the number of fields successfully converted and assigned; the return value

doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error or if the end of the string is reached before the first conversion. For more information, see [scanf](#).

If `input` or `format` is a `NULL` pointer, or if `Length` is less than or equal to zero, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

This function is like `sscanf`, except that it lets you specify a fixed number of characters to examine from the input string. For more information, see [scanf](#).

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_snscanf</code>	<code>_snscanf</code>	<code>_snscanf</code>	<code>_snwscanf</code>
<code>_snscanf_1</code>	<code>_snscanf_1</code>	<code>_snscanf_1</code>	<code>_snwscanf_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_snscanf</code> , <code>_snscanf_1</code>	<code>&lt;stdio.h&gt;</code>
<code>_snwscanf</code> , <code>_snwscanf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_snscanf.c
// compile with: /W3

#include <stdio.h>
int main()
{
 char str1[] = "15 12 14...";
 wchar_t str2[] = L"15 12 14...";
 char s1[3];
 wchar_t s2[3];
 int i;
 float fp;

 i = _snscanf(str1, 6, "%s %f", s1, &fp); // C4996
 // Note: _snscanf is deprecated; consider using _snscanf_s instead
 printf("_snscanf converted %d fields: ", i);
 printf("%s and %f\n", s1, fp);

 i = _snwscanf(str2, 6, L"%s %f", s2, &fp); // C4996
 // Note: _snwscanf is deprecated; consider using _snwscanf_s instead
 wprintf(L"_snwscanf converted %d fields: ", i);
 wprintf(L"%s and %f\n", s2, fp);
}
```

```
_snscanf converted 2 fields: 15 and 12.000000
_snwscanf converted 2 fields: 15 and 12.000000
```

## See also

[scanf Width Specification](#)

`_snsprintf_s`, `_snsprintf_s_l`, `_snwprintf_s`,  
`_snwprintf_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data of a specified length from a string. These functions are versions of `_snsprintf`, `_snsprintf_l`, `_snwprintf`, `_snwprintf_l` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
int __cdecl _snsprintf_s(
 const char * input,
 size_t length,
 const char * format [, argument_list]
);
int __cdecl _snsprintf_s_l(
 const char * input,
 size_t length,
 const char * format,
 _locale_t locale [, argument_list]
);
int __cdecl _snwprintf_s(
 const wchar_t * input,
 size_t length,
 const wchar_t * format [, argument_list]
);
int __cdecl _snwprintf_s_l(
 const wchar_t * input,
 size_t length,
 const wchar_t * format,
 _locale_t locale [, argument_list]
);
```

## Parameters

`input`

Input string to examine.

`Length`

Number of characters to examine in `input`.

`format`

One or more format specifiers.

`Locale`

The locale to use.

`argument_List`

Optional arguments to be assigned according to the format string.

## Return value

Both of these functions return the number of fields successfully converted and assigned; the return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error or if the end of the string is reached before the first conversion. For more

information, see `sscanf_s`, `_sscanf_s_1`, `swscanf_s`, `_swscanf_s_1`.

If `input` or `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

This function is like `sscanf_s`, except that it lets you specify a fixed number of characters to examine from the input string. For more information, see `sscanf_s`, `_sscanf_s_1`, `swscanf_s`, `_swscanf_s_1`.

The buffer size parameter is required with the type field characters `c`, `C`, `s`, `S`, and `[`. For more information, see [scanf Type Field Characters](#).

### NOTE

The size parameter is of type `unsigned`, not `size_t`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_snscanf_s</code>	<code>_snsprintf_s</code>	<code>_snsprintf_s</code>	<code>_snwprintf_s</code>
<code>_snscanf_s_1</code>	<code>_snsprintf_s_1</code>	<code>_snsprintf_s_1</code>	<code>_snwprintf_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_snsprintf_s</code> , <code>_snsprintf_s_1</code>	<code>&lt;stdio.h&gt;</code>
<code>_snwprintf_s</code> , <code>_snwprintf_s_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_snscanf_s.c
// This example scans a string of
// numbers, using both the character
// and wide character secure versions
// of the sscanf function.

#include <stdio.h>

int main()
{
 char str1[] = "15 12 14...";
 wchar_t str2[] = L"15 12 14...";
 char s1[3];
 wchar_t s2[3];
 int i;
 float fp;

 i = _snscanf_s(str1, 6, "%s %f", s1, 3, &fp);
 printf_s("_snscanf_s converted %d fields: ", i);
 printf_s("%s and %f\n", s1, fp);

 i = _snwscanf_s(str2, 6, L"%s %f", s2, 3, &fp);
 wprintf_s(L"_snwscanf_s converted %d fields: ", i);
 wprintf_s(L"%s and %f\n", s2, fp);
}
```

```
_snscanf_s converted 2 fields: 15 and 12.000000
_snwscanf_s converted 2 fields: 15 and 12.000000
```

## See also

[scanf Width Specification](#)

# sopen

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The Microsoft-specific function name `sopen` is a deprecated alias for the `_sopen` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_sopen` or the security-enhanced `_sopen_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# `_sopen` , `_wsopen`

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Opens a file for sharing. More secure versions of these functions are available: see [`\_sopen\_s`](#) , [`\_wsopen\_s`](#) .

## Syntax

```
int _sopen(
 const char *filename,
 int oflag,
 int shflag [,,
 int pmode]
);
int _wsopen(
 const wchar_t *filename,
 int oflag,
 int shflag [,,
 int pmode]
);
```

### Parameters

`filename`

File name.

`oflag`

The kind of operations allowed.

`shflag`

The kind of sharing allowed.

`pmode`

Permission setting.

## Return value

Each of these functions returns a file descriptor for the opened file.

If `filename` or `oflag` is a `NULL` pointer, or if `oflag` or `shflag` isn't within a valid range of values, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to one of the following values.

ERRNO	VALUE	CONDITION
<code>EACCES</code>		The given path is a directory, or the file is read-only, but an open-for-writing operation was attempted.
<code>EEXIST</code>		<code>_O_CREAT</code> and <code>_O_EXCL</code> flags were specified, but <code>filename</code> already exists.
<code>EINVAL</code>		Invalid <code>oflag</code> or <code>shflag</code> argument.

ERRNO	VALUE	CONDITION
	<code>EMFILE</code>	No more file descriptors are available.
	<code>ENOENT</code>	File or path isn't found.

For more information about these and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

The `_sopen` function opens the file specified by `filename` and prepares the file for shared reading or writing, as defined by `oflag` and `shflag`. `_wsopen` is a wide-character version of `_sopen`; the `filename` argument to `_wsopen` is a wide-character string. `_wsopen` and `_sopen` behave identically otherwise.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tsopen</code>	<code>_sopen</code>	<code>_sopen</code>	<code>_wsopen</code>

The integer expression `oflag` is formed by combining one or more of the following manifest constants, which are defined in `<fcntl.h>`. When two or more constants form the argument `oflag`, they're combined with the bitwise-OR operator (`|`).

<code>OFLAG</code> CONSTANT	BEHAVIOR
<code>_O_APPEND</code>	Moves the file pointer to the end of the file before every write operation.
<code>_O_BINARY</code>	Opens the file in binary (untranslated) mode. (See <a href="#">fopen</a> for a description of binary mode.)
<code>_O_CREAT</code>	Creates a file and opens it for writing. Has no effect if the file specified by <code>filename</code> exists. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified.
<code>_O_CREAT   _O_SHORT_LIVED</code>	Creates a file as temporary and if possible doesn't flush to disk. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified.
<code>_O_CREAT   _O_TEMPORARY</code>	Creates a file as temporary; the file is deleted when the last file descriptor is closed. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified. To preserve legacy behavior for app-compatibility, other processes aren't prevented from deleting this file.
<code>_O_CREAT   _O_EXCL</code>	Returns an error value if a file specified by <code>filename</code> exists. Applies only when used with <code>_O_CREAT</code> .
<code>_O_NOINHERIT</code>	Prevents creation of a shared file descriptor.

<code>OFLAG</code> CONSTANT	BEHAVIOR
<code>_O_RANDOM</code>	Specifies that caching is optimized for, but not restricted to, random access from disk.
<code>_O_RDONLY</code>	Opens a file for reading only. Can't be specified with <code>_O_RDWR</code> or <code>_O_WRONLY</code> .
<code>_O_RDWR</code>	Opens a file for both reading and writing. Can't be specified with <code>_O_RDONLY</code> or <code>_O_WRONLY</code> .
<code>_O_SEQUENTIAL</code>	Specifies that caching is optimized for, but not restricted to, sequential access from disk.
<code>_O_TEXT</code>	Opens a file in text (translated) mode. (For more information, see <a href="#">Text and binary mode file I/O</a> and <a href="#"><code>fopen</code></a> .)
<code>_O_TRUNC</code>	Opens a file and truncates it to zero length; the file must have write permission. Can't be specified with <code>_O_RDONLY</code> . <code>_O_TRUNC</code> used with <code>_O_CREAT</code> opens an existing file or creates a file. <b>Note:</b> The <code>_O_TRUNC</code> flag destroys the contents of the specified file.
<code>_O_WRONLY</code>	Opens a file for writing only. Can't be specified with <code>_O_RDONLY</code> or <code>_O_RDWR</code> .
<code>_O_U16TEXT</code>	Opens a file in Unicode UTF-16 mode.
<code>_O_U8TEXT</code>	Opens a file in Unicode UTF-8 mode.
<code>_O_WTEXT</code>	Opens a file in Unicode mode.

To specify the file access mode, you must specify either `_O_RDONLY`, `_O_RDWR`, or `_O_WRONLY`. There's no default value for the access mode.

When a file is opened in Unicode mode by using `_O_WTEXT`, `_O_U8TEXT`, or `_O_U16TEXT`, input functions translate the data that's read from the file into UTF-16 data stored as type `wchar_t`. Functions that write to a file opened in Unicode mode expect buffers that contain UTF-16 data stored as type `wchar_t`. If the file is encoded as UTF-8, then UTF-16 data is translated into UTF-8 when it's written. The file's UTF-8-encoded content is translated into UTF-16 when it's read. An attempt to read or write an odd number of bytes in Unicode mode causes a parameter validation error. To read or write data that's stored in your program as UTF-8, use a text or binary file mode instead of a Unicode mode. You're responsible for any required encoding translation.

If `_sopen` is called with `_O_WRONLY` | `_O_APPEND` (append mode) and `_O_WTEXT`, `_O_U16TEXT`, or `_O_U8TEXT`, it first tries to open the file for reading and writing, read the BOM, then reopen it for writing only. If opening the file for reading and writing fails, it opens the file for writing only and uses the default value for the Unicode mode setting.

The argument `shflag` is a constant expression consisting of one of the following manifest constants, which are defined in `<share.h>`.

<code>SHFLAG</code> CONSTANT	BEHAVIOR
<code>_SH_DENYRW</code>	Denies read and write access to a file.

SHFLAG CONSTANT	BEHAVIOR
_SH_DENYWR	Denies write access to a file.
_SH_DENYRD	Denies read access to a file.
_SH_DENYNO	Permits read and write access.

The `pmode` argument is required only when `_O_CREAT` is specified. If the file doesn't exist, `pmode` specifies the file's permission settings, which are set when the new file is closed the first time. Otherwise, `pmode` is ignored. `pmode` is an integer expression that contains one or both of the manifest constants `_S_IWRITE` and `_S_IREAD`, which are defined in `<sys\stat.h>`. When both constants are given, they're combined with the bitwise-OR operator. The meaning of `pmode` is as follows.

P MODE	MEANING
<code>_S_IREAD</code>	Only reading permitted.
<code>_S_IWRITE</code>	Writing permitted. (In effect, permits reading and writing.)
<code>_S_IREAD   _S_IWRITE</code>	Reading and writing permitted.

If write permission isn't given, the file is read-only. In the Windows operating system, all files are readable; it isn't possible to give write-only permission. Therefore, the modes `_S_IWRITE` and `_S_IREAD | _S_IWRITE` are equivalent.

`_sopen` applies the current file-permission mask to `pmode` before the permissions are set. For more information, see [\\_umask](#).

## Requirements

FUNCTION	REQUIRED HEADER	OPTIONAL HEADER
<code>_sopen</code>	<code>&lt;io.h&gt;</code>	<code>&lt;fcntl.h&gt;</code> , <code>&lt;sys\types.h&gt;</code> , <code>&lt;sys\stat.h&gt;</code> , <code>&lt;share.h&gt;</code>
<code>_wsopen</code>	<code>&lt;io.h&gt;</code> or <code>&lt;wchar.h&gt;</code>	<code>&lt;fcntl.h&gt;</code> , <code>&lt;sys\types.h&gt;</code> , <code>&lt;sys\stat.h&gt;</code> , <code>&lt;share.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [\\_locking](#).

## See also

### Low-level I/O

<code>_close</code>
<code>_creat</code> , <code>_wcreat</code>
<code>_fopen</code> , <code>_wfopen</code>
<code>_fsopen</code> , <code>_wfsopen</code>

`_open` , `_wopen`

# `_sopen_s`, `_wsopen_s`

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Opens a file for sharing. These versions of `_sopen` and `_wsopen` have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
errno_t _sopen_s(
 int* pfh,
 const char *filename,
 int oflag,
 int shflag,
 int pmode
);
errno_t _wsopen_s(
 int* pfh,
 const wchar_t *filename,
 int oflag,
 int shflag,
 int pmode,
);
```

### Parameters

`pfh`

The file handle, or -1 if there's an error.

`filename`

File name.

`oflag`

The kind of operations allowed.

`shflag`

The kind of sharing allowed.

`pmode`

Permission setting.

## Return value

A nonzero return value indicates an error; in that case `errno` is set to one of the following values.

ERRNO	VALUE	CONDITION
<code>EACCES</code>		The given path is a directory, or the file is read-only, but an open-for-writing operation was attempted.
<code>EEXIST</code>		<code>_O_CREAT</code> and <code>_O_EXCL</code> flags were specified, but <code>filename</code> already exists.

ERRNO	VALUE	CONDITION
EINVAL		Invalid <code>oflag</code> , <code>shflag</code> , or <code>pmode</code> argument, or <code>pfh</code> or <code>filename</code> was a null pointer.
EMFILE		No more file descriptors available.
ENOENT		File or path not found.

If an invalid argument is passed to the function, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and `EINVAL` is returned.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

If there's an error, -1 is returned through `pfh` (unless `pfh` is a null pointer).

## Remarks

The `_sopen_s` function opens the file specified by `filename` and prepares the file for shared reading or writing, as defined by `oflag` and `shflag`. `_wsopen_s` is a wide-character version of `_sopen_s`; the `filename` argument to `_wsopen_s` is a wide-character string. `_wsopen_s` and `_sopen_s` behave identically otherwise.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tsopen_s</code>	<code>_sopen_s</code>	<code>_sopen_s</code>	<code>_wsopen_s</code>

The integer expression `oflag` is formed by combining one or more manifest constants, which are defined in `<fcntl.h>`. When two or more constants form the argument `oflag`, they're combined with the bitwise-OR operator (`|`).

OFLAG CONSTANT	BEHAVIOR
<code>_O_APPEND</code>	Moves the file pointer to the end of the file before every write operation.
<code>_O_BINARY</code>	Opens the file in binary (untranslated) mode. (See <code>fopen</code> for a description of binary mode.)
<code>_O_CREAT</code>	Creates a file and opens it for writing. Has no effect if the file specified by <code>filename</code> exists. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified.
<code>_O_CREAT   _O_SHORT_LIVED</code>	Creates a file as temporary and if possible doesn't flush to disk. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified.

OFLAG CONSTANT	BEHAVIOR
<code>_O_CREAT   _O_TEMPORARY</code>	Creates a file as temporary; the file is deleted when the last file descriptor is closed. The <code>pmode</code> argument is required when <code>_O_CREAT</code> is specified. To preserve legacy behavior for app-compatibility, other processes aren't prevented from deleting this file.
<code>_O_CREAT   _O_EXCL</code>	Returns an error value if a file specified by <code>filename</code> exists. Applies only when used with <code>_O_CREAT</code> .
<code>_O_NOINHERIT</code>	Prevents creation of a shared file descriptor.
<code>_O_RANDOM</code>	Specifies that caching is optimized for, but not restricted to, random access from disk.
<code>_O_RDONLY</code>	Opens a file for reading only. Can't be specified with <code>_O_RDWR</code> or <code>_O_WRONLY</code> .
<code>_O_RDWR</code>	Opens a file for both reading and writing. Can't be specified with <code>_O_RDONLY</code> or <code>_O_WRONLY</code> .
<code>_O_SEQUENTIAL</code>	Specifies that caching is optimized for, but not restricted to, sequential access from disk.
<code>_O_TEXT</code>	Opens a file in text (translated) mode. (For more information, see <a href="#">Text and binary mode file I/O</a> and <code>fopen</code> .)
<code>_O_TRUNC</code>	Opens a file and truncates it to zero length; the file must have write permission. Can't be specified with <code>_O_RDONLY</code> . <code>_O_TRUNC</code> used with <code>_O_CREAT</code> opens an existing file or creates a file. <b>Note:</b> The <code>_O_TRUNC</code> flag destroys the contents of the specified file.
<code>_O_WRONLY</code>	Opens a file for writing only. Can't be specified with <code>_O_RDONLY</code> or <code>_O_RDWR</code> .
<code>_O_U16TEXT</code>	Opens a file in Unicode UTF-16 mode.
<code>_O_U8TEXT</code>	Opens a file in Unicode UTF-8 mode.
<code>_O_WTEXT</code>	Opens a file in Unicode mode.

To specify the file access mode, you must specify either `_O_RDONLY`, `_O_RDWR`, or `_O_WRONLY`. There's no default value for the access mode.

When a file is opened in Unicode mode by using `_O_WTEXT`, `_O_U8TEXT`, or `_O_U16TEXT`, input functions translate the data that's read from the file into UTF-16 data stored as type `wchar_t`. Functions that write to a file opened in Unicode mode expect buffers that contain UTF-16 data stored as type `wchar_t`. If the file is encoded as UTF-8, then UTF-16 data is translated into UTF-8 when it's written. The file's UTF-8-encoded content is translated into UTF-16 when it's read. An attempt to read or write an odd number of bytes in Unicode mode causes a parameter validation error. To read or write data that's stored in your program as UTF-8, use a text or binary file mode instead of a Unicode mode. You're responsible for any required encoding translation.

If `_sopen_s` is called with `_O_WRONLY | _O_APPEND` (append mode) and `_O_WTEXT`, `_O_U16TEXT`, or `_O_U8TEXT`, it

first tries to open the file for reading and writing, read the BOM, then reopen it for writing only. If opening the file for reading and writing fails, it opens the file for writing only and uses the default value for the Unicode mode setting.

The argument `shFlag` is a constant expression that consists of one of the following manifest constants, which are defined in `<share.h>`.

<code>SHFLAG CONSTANT</code>	<code>BEHAVIOR</code>
<code>_SH_DENYRW</code>	Denies read and write access to a file.
<code>_SH_DENYWR</code>	Denies write access to a file.
<code>_SH_DENYRD</code>	Denies read access to a file.
<code>_SH_DENYNO</code>	Permits read and write access.

The `pmode` argument is always required, unlike in `_open`. When you specify `_O_CREAT`, if the file doesn't exist, `pmode` specifies the file's permission settings, which are set when the new file is closed the first time. Otherwise, `pmode` is ignored. `pmode` is an integer expression that contains one or both of the manifest constants `_S_IWRITE` and `_S_IREAD`, which are defined in `<sys\stat.h>`. When both constants are given, they're combined with the bitwise-OR operator. The meaning of `pmode` is as follows.

<code>PMODE</code>	<code>MEANING</code>
<code>_S_IREAD</code>	Only reading permitted.
<code>_S_IWRITE</code>	Writing permitted. (In effect, permits reading and writing.)
<code>_S_IREAD   _S_IWRITE</code>	Reading and writing permitted.

If write permission isn't given, the file is read-only. In the Windows operating system, all files are readable; it isn't possible to give write-only permission. Therefore, the modes `_S_IWRITE` and `_S_IREAD | _S_IWRITE` are equivalent.

`_open_s` applies the current file-permission mask to `pmode` before the permissions are set. (See [\\_umask](#).)

## Requirements

<code>FUNCTION</code>	<code>REQUIRED HEADER</code>	<code>OPTIONAL HEADER</code>
<code>_open_s</code>	<code>&lt;iostream.h&gt;</code>	<code>&lt;fcntl.h&gt;</code> , <code>&lt;sys/types.h&gt;</code> , <code>&lt;sys\stat.h&gt;</code> , <code>&lt;share.h&gt;</code>
<code>_wsopen_s</code>	<code>&lt;iostream.h&gt;</code> or <code>&lt;wchar.h&gt;</code>	<code>&lt;fcntl.h&gt;</code> , <code>&lt;sys/types.h&gt;</code> , <code>&lt;sys/stat.h&gt;</code> , <code>&lt;share.h&gt;</code>

`_open_s` and `_wsopen_s` are Microsoft extensions. For more compatibility information, see [Compatibility](#).

## Example

See the example for [\\_locking](#).

## See also

Low-level I/O

[\\_close](#)  
[\\_creat](#) , [\\_wcreat](#)  
[fopen](#) , [\\_wfopen](#)  
[\\_fsopen](#) , [\\_wfsopen](#)  
[\\_open](#) , [\\_wopen](#)

# spawnl

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `spawnl` is a deprecated alias for the `_spawnl` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnl` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_spawnl``_wspawnl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates and executes a new process.

#### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnl(
 int mode,
 const char *cmdname,
 const char *arg0,
 const char *arg1,
 ... const char *argn,
 NULL
);
intptr_t _wspawnl(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *arg0,
 const wchar_t *arg1,
 ... const wchar_t *argn,
 NULL
);
```

### Parameters

`mode`

Execution mode for the calling process.

`cmdname`

Path of the file to be executed.

`arg0`, `arg1`, ... `argN`

List of pointers to arguments. The `arg0` argument is usually a pointer to `cmdname`. The arguments `arg1` through `argN` are pointers to the character strings forming the new argument list. Following `argN`, there must be a `NULL` pointer to mark the end of the argument list.

## Return value

The return value from a synchronous `_spawnl` or `_wspawnl` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnl` or `_wspawnl` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically calls the `exit` routine with a nonzero argument. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values.

VALUE	DESCRIPTION
E2BIG	Argument list exceeds 1024 bytes.
EINVAL	<i>mode</i> argument is invalid.
ENOENT	File or path isn't found.
ENOEXEC	Specified file isn't executable or has invalid executable-file format.
ENOMEM	Not enough memory is available to execute the new process.

For more information about these and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

These functions validate their parameters. If either *cmdname* or *arg0* is an empty string or a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set [errno](#) to [EINVAL](#), and return -1. No new process is spawned.

## Remarks

Each of these functions creates and executes a new process, passing each command-line argument as a separate parameter.

## Requirements

ROUTINE	REQUIRED HEADER
<a href="#">_spawnl</a>	<process.h>
<a href="#">_wspawnl</a>	<stdio.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

### Process and environment control

[\\_spawn](#), [\\_wspawn](#) functions  
[abort](#)  
[atexit](#)  
[\\_exec](#), [\\_wexec](#) functions  
[exit](#), [\\_Exit](#), [\\_exit](#)  
[\\_flushall](#)  
[\\_getmbcp](#)  
[\\_onexit](#), [\\_onexit\\_m](#)  
[\\_setmbcp](#)  
[system](#), [\\_wsystem](#)

The Microsoft-specific function name `spawnle` is a deprecated alias for the `_spawnle` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnle` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

**IMPORTANT**

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## `_spawnle`, `_wspawnle`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates and executes a new process.

### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnle(
 int mode,
 const char *cmdname,
 const char *arg0,
 const char *arg1,
 ... const char *argn,
 NULL,
 const char *const *envp
);
intptr_t _wspawnle(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *arg0,
 const wchar_t *arg1,
 ... const wchar_t *argn,
 NULL,
 const wchar_t *const *envp
);
```

### Parameters

`mode`

Execution mode for the calling process.

`cmdname`

Path of the file to be executed.

`arg0`, `arg1`, ... `argN`

List of pointers to arguments. The `arg0` argument is usually a pointer to `cmdname`. The arguments `arg1` through `argN` are pointers to the character strings forming the new argument list. Following `argN`, there must be a `NULL` pointer to mark the end of the argument list.

`envp`

Array of pointers to environment settings.

## Return value

The return value from a synchronous `_spawnle` or `_wspawnle` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnle` or `_wspawnle` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically calls the `exit` routine with a nonzero

argument. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values.

VALUE	DESCRIPTION
<code>E2BIG</code>	Argument list exceeds 1024 bytes.
<code>EINVAL</code>	<code>mode</code> argument is invalid.
<code>ENOENT</code>	File or path isn't found.
<code>ENOEXEC</code>	Specified file isn't executable or has invalid executable-file format.
<code>ENOMEM</code>	Not enough memory is available to execute the new process.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions creates and executes a new process, passing each command-line argument as a separate parameter and also passing an array of pointers to environment settings.

These functions validate their parameters. If either `cmdname` or `arg0` is an empty string or a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL`, and return -1. No new process is spawned.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_spawnl</code>	<code>&lt;process.h&gt;</code>
<code>_wspawnl</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

### Process and environment control

<a href="#">_spawn</a> , <a href="#">_wspawn</a> functions
<a href="#">abort</a>
<a href="#">atexit</a>
<a href="#">_exec</a> , <a href="#">_wexec</a> functions
<a href="#">exit</a> , <a href="#">_Exit</a> , <a href="#">_exit</a>
<a href="#">_flushall</a>
<a href="#">_getmbcp</a>

`_onexit` , `_onexit_m`

`_setmbcp`

`system` , `_wsystem`

The Microsoft-specific function name `spawnlp` is a deprecated alias for the `_spawnlp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnlp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

**IMPORTANT**

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

# `_spawnlp`, `_wspawnlp`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates and executes a new process.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnlp(
 int mode,
 const char *cmdname,
 const char *arg0,
 const char *arg1,
 ... const char *argn,
 NULL
);
intptr_t _wspawnlp(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *arg0,
 const wchar_t *arg1,
 ... const wchar_t *argn,
 NULL
);
```

## Parameters

`mode`

Execution mode for the calling process.

`cmdname`

Path of the file to be executed.

`arg0`, `arg1`, ... `argN`

List of pointers to arguments. The `arg0` argument is usually a pointer to `cmdname`. The arguments `arg1` through `argN` are pointers to the character strings forming the new argument list. Following `argN`, there must be a `NULL` pointer to mark the end of the argument list.

## Return value

The return value from a synchronous `_spawnlp` or `_wspawnlp` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnlp` or `_wspawnlp` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically calls the `exit` routine with a nonzero argument. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values.

VALUE	DESCRIPTION
E2BIG	Argument list exceeds 1024 bytes.
EINVAL	<i>mode</i> argument is invalid.
ENOENT	File or path isn't found.
ENOEXEC	Specified file isn't executable or has invalid executable-file format.
ENOMEM	Not enough memory is available to execute the new process.

For more information about these and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

Each of these functions creates and executes a new process, passing each command-line argument as a separate parameter and using the `PATH` environment variable to find the file to execute.

These functions validate their parameters. If either `cmdname` or `arg0` is an empty string or a null pointer, these functions generate an invalid parameter exception, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL`, and return -1. No new process is spawned.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_spawnl</code>	<code>&lt;process.h&gt;</code>
<code>_wspawnl</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

### Process and environment control

[\\_spawn](#), [\\_wspawn](#) functions  
[abort](#)  
[atexit](#)  
[\\_exec](#), [\\_wexec](#) functions  
[exit](#), [\\_Exit](#), [\\_exit](#)  
[\\_flushall](#)  
[\\_getmbcp](#)  
[\\_onexit](#), [\\_onexit\\_m](#)  
[\\_setmbcp](#)  
[system](#), [\\_wsystem](#)

# spawnlpe

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `spawnlpe` is a deprecated alias for the `_spawnlpe` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnlpe` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## `_spawnlpe`, `_wspawnlpe`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates and executes a new process.

### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnlpe(
 int mode,
 const char *cmdname,
 const char *arg0,
 const char *arg1,
 ... const char *argn,
 NULL,
 const char *const *envp
);
intptr_t _wspawnlpe(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *arg0,
 const wchar_t *arg1,
 ... const wchar_t *argn,
 NULL,
 const wchar_t *const *envp
);
```

### Parameters

`mode`

Execution mode for the calling process.

`cmdname`

Path of the file to be executed.

`arg0`, `arg1`, ... `argN`

List of pointers to arguments. The `arg0` argument is typically a pointer to `cmdname`. The arguments `arg1` through `argN` are pointers to the character strings that form the new argument list. Following `argN`, there must be a `NULL` pointer to mark the end of the argument list.

`envp`

Array of pointers to environment settings.

## Return value

The return value from a synchronous `_spawnlpe` or `_wspawnlpe` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnlpe` or `_wspawnlpe` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically uses a nonzero argument to call the

`exit` routine. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit caused by an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values.

VALUE	DESCRIPTION
<code>E2BIG</code>	Argument list exceeds 1024 bytes.
<code>EINVAL</code>	<code>mode</code> argument is invalid.
<code>ENOENT</code>	File or path isn't found.
<code>ENOEXEC</code>	Specified file isn't executable or has invalid executable-file format.
<code>ENOMEM</code>	Not enough memory is available to execute the new process.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions creates and executes a new process, passes each command-line argument as a separate parameter, and passes an array of pointers to environment settings. These functions use the `PATH` environment variable to find the file to execute.

These functions validate their parameters. If either `cmdname` or `arg0` is an empty string or a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL`, and return -1. No new process is spawned.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_spawnlpe</code>	<code>&lt;process.h&gt;</code>
<code>_wspawnlpe</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

### Process and environment control

[\\_spawn](#), [\\_wspawn](#) functions  
[abort](#)  
[atexit](#)  
[\\_exec](#), [\\_wexec](#) functions  
[exit](#), [\\_Exit](#), [\\_exit](#)  
[\\_flushall](#)

```
_getmbcp
_onexit , _onexit_m
_setmbcp
system , _wsystem
```

The Microsoft-specific function name `spawnv` is a deprecated alias for the `_spawnv` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnv` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

**IMPORTANT**

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

# `_spawnv`, `_wspawnv`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates and executes a new process.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnv(
 int mode,
 const char *cmdname,
 const char *const *argv
);
intptr_t _wspawnv(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *const *argv
);
```

### Parameters

`mode`

Execution mode for the calling process.

`cmdname`

Path of the file to be executed.

`argv`

Array of pointers to arguments. The argument `argv[0]` is usually a pointer to a path in real mode or to the program name in protected mode, and `argv[1]` through `argv[n]` are pointers to the character strings forming the new argument list. The argument `argv[n+1]` must be a `NULL` pointer to mark the end of the argument list.

## Return value

The return value from a synchronous `_spawnv` or `_wspawnv` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnv` or `_wspawnv` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically calls the `exit` routine with a nonzero argument. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values.

VALUE	DESCRIPTION
<code>E2BIG</code>	Argument list exceeds 1024 bytes.

VALUE	DESCRIPTION
EINVAL	<code>mode</code> argument is invalid.
ENOENT	File or path isn't found.
ENOEXEC	Specified file isn't executable or has invalid executable-file format.
ENOMEM	Not enough memory is available to execute the new process.

For more information about these and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

Each of these functions creates and executes a new process, passing an array of pointers to command-line arguments.

These functions validate their parameters. If either `cmdname` or `argv` is a null pointer, or if `argv` points to null pointer, or `argv[0]` is an empty string, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL`, and return -1. No new process is spawned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_spawnv</code>	<stdio.h> or <process.h>
<code>_wspawnv</code>	<stdio.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

[Process and environment control](#)

[\\_spawn](#), [\\_wspawn](#) functions  
[abort](#)  
[atexit](#)  
[\\_exec](#), [\\_wexec](#) functions  
[exit](#), [\\_Exit](#), [\\_exit](#)  
[\\_flushall](#)  
[\\_getmbcp](#)  
[\\_onexit](#), [\\_onexit\\_m](#)  
[\\_setmbcp](#)

`system` , `_wsystem`

The Microsoft-specific function name `spawnve` is a deprecated alias for the `_spawnve` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnve` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

**IMPORTANT**

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

# `_spawnve`, `_wspawnve`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates and executes a new process.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnve(
 int mode,
 const char *cmdname,
 const char *const *argv,
 const char *const *envp
);
intptr_t _wspawnve(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *const *argv,
 const wchar_t *const *envp
);
```

## Parameters

`mode`

Execution mode for a calling process.

`cmdname`

Path of the file to be executed.

`argv`

Array of pointers to arguments. The argument `argv[0]` is usually a pointer to a path in real mode or to the program name in protected mode, and `argv[1]` through `argv[n]` are pointers to the character strings forming the new argument list. The argument `argv[n+1]` must be a `NULL` pointer to mark the end of the argument list.

`envp`

Array of pointers to environment settings.

## Return value

The return value from a synchronous `_spawnve` or `_wspawnve` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnve` or `_wspawnve` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically calls the `exit` routine with a nonzero argument. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values.

VALUE	DESCRIPTION
E2BIG	Argument list exceeds 1024 bytes.
EINVAL	<i>mode</i> argument is invalid.
ENOENT	File or path isn't found.
ENOEXEC	Specified file isn't executable or has invalid executable-file format.
ENOMEM	Not enough memory is available to execute the new process.

For more information about these and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

Each of these functions creates and executes a new process, passing an array of pointers to command-line arguments and an array of pointers to environment settings.

These functions validate their parameters. If either *cmdname* or *argv* is a null pointer, or if *argv* points to null pointer, or *argv[0]* is an empty string, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set *errno* to *EINVAL*, and return -1. No new process is spawned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_spawnve</code>	<stdio.h> or <process.h>
<code>_wspawnve</code>	<stdio.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

### Process and environment control

<a href="#">_spawn</a> , <a href="#">_wspawn</a> functions
<a href="#">abort</a>
<a href="#">atexit</a>
<a href="#">_exec</a> , <a href="#">_wexec</a> functions
<a href="#">exit</a> , <a href="#">_Exit</a> , <a href="#">_exit</a>
<a href="#">_flushall</a>
<a href="#">_getmbcp</a>

`_onexit` , `_onexit_m`

`_setmbcp`

`system` , `_wsystem`

The Microsoft-specific function name `spawnvp` is a deprecated alias for the `_spawnvp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnvp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

**IMPORTANT**

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

# `_spawnvp`, `_wspawnvp`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates a process and executes it.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnvp(
 int mode,
 const char *cmdname,
 const char *const *argv
);
intptr_t _wspawnvp(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *const *argv
);
```

### Parameters

`mode`

Execution mode for calling the process.

`cmdname`

Path of the file to be executed.

`argv`

Array of pointers to arguments. The argument `argv[0]` is usually a pointer to a path in real mode or to the program name in protected mode, and `argv[1]` through `argv[n]` are pointers to the character strings forming the new argument list. The argument `argv[n+1]` must be a `NULL` pointer to mark the end of the argument list.

## Return value

The return value from a synchronous `_spawnvp` or `_wspawnvp` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnvp` or `_wspawnvp` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically uses a nonzero argument to call the `exit` routine. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values:

VALUE	DESCRIPTION
<code>E2BIG</code>	Argument list exceeds 1024 bytes.

VALUE	DESCRIPTION
EINVAL	<i>mode</i> argument is invalid.
ENOENT	File or path isn't found.
ENOEXEC	Specified file isn't executable or has invalid executable-file format.
ENOMEM	Not enough memory is available to execute the new process.

For more information about return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

Each of these functions creates a new process and executes it, and passes an array of pointers to command-line arguments and uses the [PATH](#) environment variable to find the file to execute.

These functions validate their parameters. If either *cmdname* or *argv* is a null pointer, or if *argv* points to null pointer, or *argv[0]* is an empty string, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set [errno](#) to [EINVAL](#), and return -1. No new process is spawned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<a href="#">_spawnvp</a>	<stdio.h> or <process.h>
<a href="#">_wspawnvp</a>	<stdio.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

### Process and environment control

<a href="#">_spawn</a> , <a href="#">_wspawn</a> functions
<a href="#">abort</a>
<a href="#">atexit</a>
<a href="#">_exec</a> , <a href="#">_wexec</a> functions
<a href="#">exit</a> , <a href="#">_Exit</a> , <a href="#">_exit</a>
<a href="#">_flushall</a>
<a href="#">_getmbcp</a>
<a href="#">_onexit</a> , <a href="#">_onexit_m</a>
<a href="#">_setmbcp</a>

`system` , `_wsystem`

# spawnvpe

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The Microsoft-specific function name `spawnvpe` is a deprecated alias for the `_spawnvpe` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_spawnvpe` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

# `_spawnvpe`, `_wspawnvpe`

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Creates and executes a new process.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
intptr_t _spawnvpe(
 int mode,
 const char *cmdname,
 const char *const *argv,
 const char *const *envp
);
intptr_t _wspawnvpe(
 int mode,
 const wchar_t *cmdname,
 const wchar_t *const *argv,
 const wchar_t *const *envp
);
```

## Parameters

`mode`

Execution mode for calling process

`cmdname`

Path of file to be executed

`argv`

Array of pointers to arguments. The argument `argv[0]` is usually a pointer to a path in real mode or to the program name in protected mode, and `argv[1]` through `argv[n]` are pointers to the character strings forming the new argument list. The argument `argv[n+1]` must be a `NULL` pointer to mark the end of the argument list.

`envp`

Array of pointers to environment settings

## Return value

The return value from a synchronous `_spawnvpe` or `_wspawnvpe` (`_P_WAIT` specified for `mode`) is the exit status of the new process. The return value from an asynchronous `_spawnvpe` or `_wspawnvpe` (`_P_NOWAIT` or `_P_NOWAITO` specified for `mode`) is the process handle. The exit status is 0 if the process terminated normally. You can set the exit status to a nonzero value if the spawned process specifically calls the `exit` routine with a nonzero argument. If the new process didn't explicitly set a positive exit status, a positive exit status indicates an abnormal exit with an abort or an interrupt. A return value of -1 indicates an error (the new process isn't started). In this case, `errno` is set to one of the following values:

VALUE	DESCRIPTION
E2BIG	Argument list exceeds 1024 bytes.
EINVAL	<i>mode</i> argument is invalid.
ENOENT	File or path isn't found.
ENOEXEC	Specified file isn't executable or has invalid executable-file format.
ENOMEM	Not enough memory is available to execute the new process.

For more information about return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

Each of these functions creates and executes a new process, passing an array of pointers to command-line arguments and an array of pointers to environment settings. These functions use the [PATH](#) environment variable to find the file to execute.

These functions validate their parameters. If either [cmdname](#) or [argv](#) is a null pointer, or if [argv](#) points to null pointer, or [argv\[0\]](#) is an empty string, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set [errno](#) to [EINVAL](#), and return -1. No new process is spawned.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<a href="#">_spawnvpe</a>	<stdio.h> or <process.h>
<a href="#">_wspawnvpe</a>	<stdio.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [\\_spawn](#), [\\_wspawn](#) functions.

## See also

<a href="#">abort</a>
<a href="#">atexit</a>
<a href="#">_exec</a> , <a href="#">_wexec</a> functions
<a href="#">exit</a> , <a href="#">_Exit</a> , <a href="#">_exit</a>
<a href="#">_flushall</a>
<a href="#">_getmbcp</a>
<a href="#">_onexit</a> , <a href="#">_onexit_m</a>

`_setmbcp`

`system` , `_wsystem`

# `_splitpath`, `_wsplitpath`

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Break a path name into components. More secure versions of these functions are available, see [`\_splitpath\_s`](#), [`\_wsplitpath\_s`](#).

## Syntax

```
void _splitpath(
 const char *path,
 char *drive,
 char *dir,
 char *fname,
 char *ext
);
void _wsplitpath(
 const wchar_t *path,
 wchar_t *drive,
 wchar_t *dir,
 wchar_t *fname,
 wchar_t *ext
);
```

## Parameters

`path`

Full path.

`drive`

Drive letter, followed by a colon (:). You can pass `NULL` for this parameter if you don't need the drive letter.

`dir`

Directory path, including trailing slash. Forward slashes (/), backslashes (\), or both may be used. You can pass `NULL` for this parameter if you don't need the directory path.

`fname`

Base filename (no extension). You can pass `NULL` for this parameter if you don't need the filename.

`ext`

Filename extension, including leading period (.). You can pass `NULL` for this parameter if you don't need the filename extension.

## Remarks

The `_splitpath` function breaks a path into its four components. `_splitpath` automatically handles multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use. `_wsplitpath` is a wide-character version of `_splitpath`; the arguments to `_wsplitpath` are wide-character strings. These functions behave identically otherwise.

**Security Note** These functions incur a potential threat brought about by a buffer overrun problem. Buffer overrun problems are a frequent method of system attack, resulting in an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#). More secure versions of these functions are available; see [`\_splitpath\_s`](#), [`\_wsplitpath\_s`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
_tsplitpath	_splitpath	_splitpath	_wsplitpath

Each component of the full path is stored in a separate buffer; the manifest constants `_MAX_DRIVE`, `_MAX_DIR`, `_MAX_FNAME`, and `_MAX_EXT` (defined in `STDLIB.H`) specify the maximum size for each file component. File components that are larger than the corresponding manifest constants cause heap corruption.

Each buffer must be as large as its corresponding manifest constant to avoid potential buffer overrun.

The following table lists the values of the manifest constants.

NAME	VALUE
<code>_MAX_DRIVE</code>	3
<code>_MAX_DIR</code>	256
<code>_MAX_FNAME</code>	256
<code>_MAX_EXT</code>	256

If the full path doesn't contain a component (for example, a filename), `_splitpath` assigns empty strings to the corresponding buffers.

You can pass `NULL` to `_splitpath` for any parameter other than `path` that you don't need.

If `path` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns `EINVAL`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_splitpath</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wsplitpath</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [\\_makepath](#).

## See also

### File handling

`_fullpath`, `_wfullpath`  
`_getmbcp`

`_makepath` , `_wmakepath`

`_setmbcp`

`_splitpath_s` , `_wsplitpath_s`

## `_splitpath_s`, `_wsplitpath_s`

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Breaks a path name into components. These functions are versions of `_splitpath`, `_wsplitpath` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t _splitpath_s(
 const char * path,
 char * drive,
 size_t driveNumberOfElements,
 char * dir,
 size_t dirNumberOfElements,
 char * fname,
 size_t nameNumberOfElements,
 char * ext,
 size_t extNumberOfElements
);
errno_t _wsplitpath_s(
 const wchar_t * path,
 wchar_t * drive,
 size_t driveNumberOfElements,
 wchar_t *dir,
 size_t dirNumberOfElements,
 wchar_t * fname,
 size_t nameNumberOfElements,
 wchar_t * ext,
 size_t extNumberOfElements
);
template <size_t drivesize, size_t dirszie, size_t fnamesize, size_t extsize>
errno_t _splitpath_s(
 const char *path,
 char (&drive)[drivesize],
 char (&dir)[dirszie],
 char (&fname)[fnamesize],
 char (&ext)[extsize]
); // C++ only
template <size_t drivesize, size_t dirszie, size_t fnamesize, size_t extsize>
errno_t _wsplitpath_s(
 const wchar_t *path,
 wchar_t (&drive)[drivesize],
 wchar_t (&dir)[dirszie],
 wchar_t (&fname)[fnamesize],
 wchar_t (&ext)[extsize]
); // C++ only
```

## Parameters

### `path`

Full path.

### `drive`

Drive letter, followed by a colon ( `:` ). You can pass `NULL` for this parameter if you don't need the drive letter.

### `driveNumberOfElements`

The size of the `drive` buffer in single-byte or wide characters. If `drive` is `NULL`, this value must be 0.

`dir`

Directory path, including trailing slash. Forward slashes (`/`), backslashes (`\`), or both may be used. You can pass `NULL` for this parameter if you don't need the directory path.

`dirNumberOfElements`

The size of the `dir` buffer in single-byte or wide characters. If `dir` is `NULL`, this value must be 0.

`fname`

Base filename (without extension). You can pass `NULL` for this parameter if you don't need the filename.

`nameNumberOfElements`

The size of the `fname` buffer in single-byte or wide characters. If `fname` is `NULL`, this value must be 0.

`ext`

Filename extension, including leading period (`.`). You can pass `NULL` for this parameter if you don't need the filename extension.

`extNumberOfElements`

The size of `ext` buffer in single-byte or wide characters. If `ext` is `NULL`, this value must be 0.

## Return value

Zero if successful; an error code on failure.

### Error conditions

CONDITION	RETURN VALUE
<code>path</code> is <code>NULL</code>	<code>EINVAL</code>
<code>drive</code> is <code>NULL</code> , <code>driveNumberOfElements</code> is non-zero	<code>EINVAL</code>
<code>drive</code> is non- <code>NULL</code> , <code>driveNumberOfElements</code> is zero	<code>EINVAL</code>
<code>dir</code> is <code>NULL</code> , <code>dirNumberOfElements</code> is non-zero	<code>EINVAL</code>
<code>dir</code> is non- <code>NULL</code> , <code>dirNumberOfElements</code> is zero	<code>EINVAL</code>
<code>fname</code> is <code>NULL</code> , <code>nameNumberOfElements</code> is non-zero	<code>EINVAL</code>
<code>fname</code> is non- <code>NULL</code> , <code>nameNumberOfElements</code> is zero	<code>EINVAL</code>
<code>ext</code> is <code>NULL</code> , <code>extNumberOfElements</code> is non-zero	<code>EINVAL</code>
<code>ext</code> is non- <code>NULL</code> , <code>extNumberOfElements</code> is zero	<code>EINVAL</code>

If any of the above conditions occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

If any of the buffers is too short to hold the result, these functions clear all the buffers to empty strings, set `errno` to `ERANGE`, and return `ERANGE`.

## Remarks

The `_splitpath_s` function breaks a path into its four components. `_splitpath_s` automatically handles

multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use. `_wsplitpath_s` is a wide-character version of `_splitpath_s`; the arguments to `_wsplitpath_s` are wide-character strings. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tsplitpath_s</code>	<code>_splitpath_s</code>	<code>_splitpath_s</code>	<code>_wsplitpath_s</code>

Each component of the full path is stored in a separate buffer; the manifest constants `_MAX_DRIVE`, `_MAX_DIR`, `_MAX_FNAME`, and `_MAX_EXT` (defined in `STDLIB.H`) specify the maximum allowable size for each file component. File components larger than the corresponding manifest constants cause heap corruption.

The following table lists the values of the manifest constants.

NAME	VALUE
<code>_MAX_DRIVE</code>	3
<code>_MAX_DIR</code>	256
<code>_MAX_FNAME</code>	256
<code>_MAX_EXT</code>	256

If the full path doesn't contain a component (for example, a filename), `_splitpath_s` assigns an empty string to the corresponding buffer.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_splitpath_s</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wsplitpath_s</code>	<code>&lt;stdlib.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for `_makepath_s`, `_wmakepath_s`.

## See also

### File handling

[\\_splitpath](#) , [\\_wsplitpath](#)  
[\\_fullpath](#) , [\\_wfullpath](#)  
[\\_getmbcp](#)  
[\\_makepath](#) , [\\_wmakepath](#)  
[\\_setmbcp](#)

`sprintf`, `_sprintf_l`, `swprintf`, `_swprintf_l`,  
`_swprintf_l`

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Write formatted data to a string. More secure versions of some of these functions are available; see `sprintf_s`, `_sprintf_s_l`, `swprintf_s`, `_swprintf_s_l`. The secure versions of `swprintf` and `_swprintf_l` take the size of the buffer as a parameter.

## Syntax

```
int sprintf(
 char *buffer,
 const char *format [,,
 argument] ...
);
int _sprintf_l(
 char *buffer,
 const char *format,
 _locale_t locale [,,
 argument] ...
);
int swprintf(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format [,,
 argument]...
);
int _swprintf_l(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);
int __swprintf_l(
 wchar_t *buffer,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);
template <size_t size>
int sprintf(
 char (&buffer)[size],
 const char *format [,,
 argument] ...
);
// C++ only
template <size_t size>
int _sprintf_l(
 char (&buffer)[size],
 const char *format,
 _locale_t locale [,,
 argument] ...
);
// C++ only
```

## Parameters

`buffer`

Storage location for output

`count`

Maximum number of characters to store in the Unicode version of this function.

`format`

Format-control string

`argument`

Optional arguments

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

The number of characters written, or -1 if an error occurred. If `buffer` or `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

`sprintf` returns the number of bytes stored in `buffer`, not counting the terminating null character. `swprintf` returns the number of wide characters stored in `buffer`, not counting the terminating null wide character.

## Remarks

The `sprintf` function formats and stores a series of characters and values in `buffer`. Each `argument` (if any) is converted and output according to the corresponding format specification in `format`. The format consists of ordinary characters and has the same form and function as the `format` argument for `printf`. A null character is appended after the last character written. If copying occurs between strings that overlap, the behavior is undefined.

### IMPORTANT

Using `sprintf`, there is no way to limit the number of characters written, which means that code using `sprintf` is susceptible to buffer overruns. Consider using the related function `_snprintf`, which specifies a maximum number of characters to write to `buffer`, or use `_scprintf` to determine how large a buffer is required. Also, ensure that `format` is not a user-defined string.

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fegetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

`swprintf` is a wide-character version of `sprintf`; the pointer arguments to `swprintf` are wide-character strings. Detection of encoding errors in `swprintf` may differ from `sprintf`. `swprintf` and `fwprintf` behave identically except `swprintf` writes output to a string rather than to a destination of type `FILE`, and `swprintf` requires the `count` parameter to specify the maximum number of characters to write. The versions of these

functions with the `_1` suffix are identical except they use the `locale` parameter passed in instead of the current thread locale.

`swprintf` conforms to the ISO C Standard, which requires the second parameter, `count`, of type `size_t`. To force the old nonstandard behavior, define `_CRT_NON_CONFORMING_SWPRINTFS`. In a future version, the old behavior may be removed, so code should be changed to use the new conformant behavior.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_stprintf</code>	<code>sprintf</code>	<code>sprintf</code>	<code>_swprintf</code>
<code>_stprintf_l</code>	<code>_sprintf_l</code>	<code>_sprintf_l</code>	<code>_swprintf_l</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>sprintf</code> , <code>_sprintf_l</code>	<code>&lt;stdio.h&gt;</code>
<code>swprintf</code> , <code>_swprintf_l</code>	<code>&lt;stdio.h&gt;</code> OR <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

### Example: Use `sprintf` to format data

```
// crt_sprintf.c
// compile with: /W3
// This program uses sprintf to format various
// data and place them in the string named buffer.

#include <stdio.h>

int main(void)
{
 char buffer[200], s[] = "computer", c = 'l';
 int i = 35, j;
 float fp = 1.7320534f;

 // Format and print various data:
 j = sprintf(buffer, " String: %s\n", s); // C4996
 j += sprintf(buffer + j, " Character: %c\n", c); // C4996
 j += sprintf(buffer + j, " Integer: %d\n", i); // C4996
 j += sprintf(buffer + j, " Real: %f\n", fp);// C4996
 // Note: sprintf is deprecated; consider using sprintf_s instead

 printf("Output:\n%s\ncharacter count = %d\n", buffer, j);
}
```

```
Output:
String: computer
Character: 1
Integer: 35
Real: 1.732053

character count = 79
```

## Example: Error code handling

```
// crt_swprintf.c
// wide character example
// also demonstrates swprintf returning error code
#include <stdio.h>

int main(void)
{
 wchar_t buf[100];
 int len = swprintf(buf, 100, L"%s", L"Hello world");
 printf("wrote %d characters\n", len);
 len = swprintf(buf, 100, L"%s", L"Hello\xffff world");
 // swprintf fails because string contains WEOF (\xffff)
 printf("wrote %d characters\n", len);
}
```

```
wrote 11 characters
wrote -1 characters
```

## See also

### Stream I/O

[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)  
[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)  
[scanf](#), [\\_scanf\\_l](#), [wscanf](#), [\\_wscanf\\_l](#)  
[sscanf](#), [\\_sscanf\\_l](#), [swscanf](#), [\\_swscanf\\_l](#)  
[vprintf](#) functions

```
_sprintf_p, _sprintf_p_l, _swprintf_p,
_swprintf_p_l
```

11/2/2022 • 4 minutes to read • [Edit Online](#)

Write formatted data to a string with the ability to specify the order that the parameters are used in the format string.

## Syntax

```
int _sprintf_p(
 char *buffer,
 size_t sizeOfBuffer,
 const char *format [,
 argument_list]
);
int _sprintf_p_l(
 char *buffer,
 size_t sizeOfBuffer,
 const char *format,
 _locale_t locale [,
 argument_list]
);
int _swprintf_p(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 const wchar_t *format [,
 argument_list]
);
int _swprintf_p_l(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 const wchar_t *format,
 _locale_t locale [,
 argument_list]
);
```

## Parameters

*buffer*

Storage location for output

*sizeOfBuffer*

Maximum number of characters to store.

*format*

Format-control string.

*argument\_List*

Optional arguments to the format string.

*Locale*

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

The number of characters written, or -1 if an error occurred.

## Remarks

The `_sprintf_p` function formats and stores a series of characters and values in `buffer`. Each argument in the `argument_list` (if any) is converted and output according to the corresponding format specification in `format`.

The `format` argument uses the [format specification syntax for `printf` and `wprintf` functions](#). A null character is appended after the last character written. If copying occurs between strings that overlap, the behavior is undefined. The difference between `_sprintf_p` and `sprintf_s` is that `_sprintf_p` supports positional parameters, which allows specifying the order in which the arguments are used in the format string. For more information, see [printf\\_p Positional Parameters](#).

`_swprintf_p` is a wide-character version of `_sprintf_p`; the pointer arguments to `_swprintf_p` are wide-character strings. Detection of encoding errors in `_swprintf_p` may differ from the detection in `_sprintf_p`. `_swprintf_p` and `fwprintf_p` behave identically except that `_swprintf_p` writes output to a string rather than to a destination of type `FILE`, and `_swprintf_p` requires the `count` parameter to specify the maximum number of characters to be written. The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

`_sprintf_p` returns the number of bytes stored in `buffer`, not counting the terminating null character. `_swprintf_p` returns the number of wide characters stored in `buffer`, not counting the terminating null wide character. If `buffer` or `format` is a null pointer, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

### IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

<code>TCHAR.h</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_stprintf_p</code>	<code>_sprintf_p</code>	<code>_sprintf_p</code>	<code>_swprintf_p</code>
<code>_stprintf_p_1</code>	<code>_sprintf_p_1</code>	<code>_sprintf_p_1</code>	<code>_swprintf_p_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_sprintf_p</code> , <code>_sprintf_p_l</code>	<code>&lt;stdio.h&gt;</code>
<code>_swprintf_p</code> , <code>_swprintf_p_l</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example: Use `_sprintf_p` to format data

```
// crt sprintf_p.c
// This program uses _sprintf_p to format various
// data and place them in the string named buffer.
//

#include <stdio.h>

int main(void)
{
 char buffer[200],
 s[] = "computer", c = 'l';
 int i = 35,
 j;
 float fp = 1.7320534f;

 // Format and print various data:
 j = _sprintf_p(buffer, 200,
 "String: %s\n", s);
 j += _sprintf_p(buffer + j, 200 - j,
 "Character: %c\n", c);
 j += _sprintf_p(buffer + j, 200 - j,
 "Integer: %d\n", i);
 j += _sprintf_p(buffer + j, 200 - j,
 "Real: %f\n", fp);

 printf("Output:\n%s\ncharacter count = %d\n",
 buffer, j);
}
```

```
Output:
String: computer
Character: l
Integer: 35
Real: 1.732053

character count = 79
```

## Example: Error code handling

```

// crt_swprintf_p.c
// This is the wide character example which
// also demonstrates _swprintf_p returning
// error code.
#include <stdio.h>

#define BUFFER_SIZE 100

int main(void)
{
 wchar_t buffer[BUFFER_SIZE];
 int len;

 len = _swprintf_p(buffer, BUFFER_SIZE, L"%2$s %1$d",
 0, L" marbles in your head.");
 _printf_p("Wrote %d characters\n", len);

 // _swprintf_p fails because string contains WEOF (\xffff)
 len = _swprintf_p(buffer, BUFFER_SIZE, L"%s",
 L"Hello\xffff world");
 _printf_p("Wrote %d characters\n", len);
}

```

Wrote 24 characters  
Wrote -1 characters

## See also

### Stream I/O

[\\_fprintf\\_p](#), [\\_fprintf\\_p\\_l](#), [\\_fwprintf\\_p](#), [\\_fwprintf\\_p\\_l](#)  
[fprintf](#), [\\_fprintf\\_l](#), [fprintf](#), [\\_fprintf\\_l](#)  
[\\_printf\\_p](#), [\\_printf\\_p\\_l](#), [\\_wprintf\\_p](#), [\\_wprintf\\_p\\_l](#)  
[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)  
[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)  
[scanf](#), [\\_scanf\\_l](#), [wscanf](#), [\\_wscanf\\_l](#)  
[sscanf](#), [\\_sscanf\\_l](#), [swscanf](#), [\\_swscanf\\_l](#)  
[sscanf\\_s](#), [\\_sscanf\\_s\\_l](#), [swscanf\\_s](#), [\\_swscanf\\_s\\_l](#)  
[vprintf](#) functions  
[printf\\_p](#) Positional Parameters

`sprintf_s`, `_sprintf_s_l`, `swprintf_s`,  
`_swprintf_s_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Write formatted data to a string. These functions are versions of `sprintf`, `_sprintf_l`, `swprintf`, `_swprintf_l`, `__swprintf_l` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
int sprintf_s(
 char *buffer,
 size_t sizeOfBuffer,
 const char *format,
 ...
);
int _sprintf_s_l(
 char *buffer,
 size_t sizeOfBuffer,
 const char *format,
 _locale_t locale,
 ...
);
int swprintf_s(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 const wchar_t *format,
 ...
);
int _swprintf_s_l(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 const wchar_t *format,
 _locale_t locale,
 ...
);
template <size_t size>
int sprintf_s(
 char (&buffer)[size],
 const char *format,
 ...
); // C++ only
template <size_t size>
int swprintf_s(
 wchar_t (&buffer)[size],
 const wchar_t *format,
 ...
); // C++ only
```

## Parameters

`buffer`

Storage location for output

`sizeOfBuffer`

Maximum number of characters to store.

`format`

Format-control string

...

Optional arguments to be formatted

*Locale*

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

The number of characters written, or -1 if an error occurred. If `buffer` or `format` is a null pointer, `sprintf_s` and `swprintf_s` return -1 and set `errno` to `EINVAL`.

`sprintf_s` returns the number of bytes stored in `buffer`, not counting the terminating null character.

`swprintf_s` returns the number of wide characters stored in `buffer`, not counting the terminating null wide character.

## Remarks

The `sprintf_s` function formats and stores a series of characters and values in `buffer`. Each `argument` (if any) is converted and output according to the corresponding format specification in `format`. The format consists of ordinary characters and has the same form and function as the `format` argument for `printf`. A null character is appended after the last character written. If copying occurs between strings that overlap, the behavior is undefined.

One main difference between `sprintf_s` and `printf` is that `sprintf_s` checks the format string for valid formatting characters, whereas `printf` only checks if the format string or buffer are `NULL` pointers. If either check fails, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and sets `errno` to `EINVAL`.

The other main difference between `sprintf_s` and `printf` is that `sprintf_s` takes a length parameter specifying the size of the output buffer in characters. If the buffer is too small for the formatted text, including the terminating null, then the buffer is set to an empty string by placing a null character at `buffer[0]`, and the invalid parameter handler is invoked. Unlike `_snprintf`, `sprintf_s` guarantees that the buffer will be null-terminated unless the buffer size is zero.

`swprintf_s` is a wide-character version of `sprintf_s`; the pointer arguments to `swprintf_s` are wide-character strings. Detection of encoding errors in `swprintf_s` may differ from the detection in `sprintf_s`. The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

In C++, use of these functions is simplified by template overloads. The overloads can infer buffer length automatically, which eliminates the need to specify a size argument. And, they can automatically replace older, non-secure functions with newer, more secure counterparts. For more information, see [Secure template overloads](#).

There are versions of `sprintf_s` that offer more control over what happens if the buffer is too small. For more information, see `_snprintf_s`, `_snprintf_s_1`, `_snwprintf_s`, `_snwprintf_s_1`.

## IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_stprintf_s</code>	<code>sprintf_s</code>	<code>sprintf_s</code>	<code>swprintf_s</code>
<code>_stprintf_s_l</code>	<code>_sprintf_s_l</code>	<code>_sprintf_s_l</code>	<code>_swprintf_s_l</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>sprintf_s</code> , <code>_sprintf_s_l</code>	C: <code>&lt;stdio.h&gt;</code> C++: <code>&lt;cstdio&gt;</code> or <code>&lt;stdio.h&gt;</code>
<code>swprintf_s</code> , <code>_swprintf_s_l</code>	C: <code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> C++: <code>&lt;cstdio&gt;</code> , <code>&lt;cwchar&gt;</code> , <code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example: Use `sprintf_s` to format data

```

// crt_sprintf_s.c
// This program uses sprintf_s to format various
// data and place them in the string named buffer.
//
#include <stdio.h>

int main(void)
{
 char buffer[200], s[] = "computer", c = 'l';
 int i = 35, j;
 float fp = 1.7320534f;

 // Format and print various data:
 j = sprintf_s(buffer, 200, "String: %s\n", s);
 j += sprintf_s(buffer + j, 200 - j, "Character: %c\n", c);
 j += sprintf_s(buffer + j, 200 - j, "Integer: %d\n", i);
 j += sprintf_s(buffer + j, 200 - j, "Real: %f\n", fp);

 printf_s("Output:\n%s\ncharacter count = %d\n", buffer, j);
}

```

Output:

```

String: computer
Character: 1
Integer: 35
Real: 1.732053

character count = 79

```

## Example: Error code handling

```

// crt_swprintf_s.c
// wide character example
// also demonstrates swprintf_s returning error code
#include <stdio.h>

int main(void)
{
 wchar_t buf[100];
 int len = swprintf_s(buf, 100, L"%s", L"Hello world");
 printf("wrote %d characters\n", len);
 len = swprintf_s(buf, 100, L"%s", L"Hello\xffff world");
 // swprintf_s fails because string contains WEOF (\xffff)
 printf("wrote %d characters\n", len);
}

```

```
wrote 11 characters
wrote -1 characters
```

## See also

### Stream I/O

<a href="#">fprintf</a>	<a href="#">_fprintf_l</a>	<a href="#">fwprintf</a>	<a href="#">_fwprintf_l</a>
<a href="#">printf</a>	<a href="#">_printf_l</a>	<a href="#">wprintf</a>	<a href="#">_wprintf_l</a>
<a href="#">sprintf</a>	<a href="#">_sprintf_l</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_l</a>
<a href="#">scanf</a>	<a href="#">_scanf_l</a>	<a href="#">wscanf</a>	<a href="#">_wscanf_l</a>

`sscanf`, `_sscanf_1`, `swscanf`, `_swscanf_1`

`vprintf` functions

`sqrt`, `sqrtf`, `sqrtl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calculates the square root.

## Syntax

```
double sqrt(
 double x
);
float sqrt(
 float x
); // C++ only
long double sqrt(
 long double x
); // C++ only
float sqrtf(
 float x
);
long double sqrtl(
 long double x
);
#define sqrt(x) // Requires C11 or higher
```

### Parameters

`x`

Non-negative floating-point value

## Remarks

Because C++ allows overloading, you can call overloads of `sqrt` that take `float` or `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `sqrt` always takes and returns `double`.

If you use the `<tgmath.h> sqrt()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Return value

The `sqrt` functions return the square-root of `x`. By default, if `x` is negative, `sqrt` returns an indefinite `Nan`.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
<code>± QNaN, IND</code>	none	<code>_DOMAIN</code>
<code>- INF</code>	none	<code>_DOMAIN</code>
<code>x &lt; 0</code>	none	<code>_DOMAIN</code>

# Requirements

FUNCTION	C HEADER	C++ HEADER
<code>sqrt</code> , <code>sqrtf</code> , <code>sqrtl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code>
<code>sqrt</code> macro	<code>&lt;tgmath.h&gt;</code>	

For compatibility information, see [Compatibility](#).

## Example

```
// crt_sqrt.c
// This program calculates a square root.

#include <math.h>
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 double question = 45.35, answer;
 answer = sqrt(question);
 if(question < 0)
 printf("Error: sqrt returns %f\n", answer);
 else
 printf("The square root of %.2f is %.2f\n", question, answer);
}
```

```
The square root of 45.35 is 6.73
```

## See also

### Math and floating-point support

`exp`, `expf`, `expl`  
`log`, `logf`, `log10`, `log10f`  
`pow`, `powf`, `powl`  
`_CIsqrt`\

Sets the starting seed value for the pseudorandom number generator used by the `rand` function.

## Syntax

```
void srand(
 unsigned int seed
>);
```

### Parameters

`seed`

Seed for pseudorandom number generation

## Remarks

The `srand` function sets the starting point for generating a series of pseudorandom integers in the current thread. To reinitialize the generator to create the same sequence of results, call the `srand` function and use the same `seed` argument again. Any other value for `seed` sets the generator to a different starting point in the pseudorandom sequence. `rand` retrieves the pseudorandom numbers that are generated. Calling `rand` before any call to `srand` generates the same sequence as calling `srand` with `seed` passed as 1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>srand</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for `rand`.

## See also

[Math and floating-point support](#)

`rand`

`sscanf`, `_sscanf_l`, `swscanf`, `_swscanf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Read formatted data from a string. More secure versions of these functions are available; see `sscanf_s`, `_sscanf_s_l`, `swscanf_s`, `_swscanf_s_l`.

## Syntax

```
int sscanf(
 const char *buffer,
 const char *format [,,
 argument] ...
);
int _sscanf_l(
 const char *buffer,
 const char *format,
 _locale_t locale [,,
 argument] ...
);
int swscanf(
 const wchar_t *buffer,
 const wchar_t *format [,,
 argument] ...
);
int _swscanf_l(
 const wchar_t *buffer,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);
```

### Parameters

`buffer`

Stored data

`format`

Format-control string. For more information, see [Format specification syntax](#).

`argument`

Optional arguments

`Locale`

The locale to use

## Return value

Each of these functions returns the number of fields successfully converted and assigned; the return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error or if the end of the string is reached before the first conversion.

If `buffer` or `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `sscanf` function reads data from `buffer` into the location given by each `argument`. Every `argument` must be a pointer to a variable with a type that corresponds to a type specifier in `format`. The `format` argument controls the interpretation of the input fields and has the same form and function as the `format` argument for the `scanf` function. If copying takes place between strings that overlap, the behavior is undefined.

For information about `scanf` type field characters, see [scanf type field characters](#). For information about `scanf` format specification fields, see [Format specification fields](#).

### IMPORTANT

When reading a string with `sscanf`, always specify a width for the `%s` format (for example, "`%32s`" instead of "`%s`"); otherwise, improperly formatted input can easily cause a buffer overrun.

`swscanf` is a wide-character version of `sscanf`; the arguments to `swscanf` are wide-character strings. `sscanf` doesn't handle multibyte hexadecimal characters. `swscanf` doesn't handle Unicode full-width hexadecimal or "compatibility zone" characters. Otherwise, `swscanf` and `sscanf` behave identically.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_stscanf</code>	<code>sscanf</code>	<code>sscanf</code>	<code>swscanf</code>
<code>_stscanf_1</code>	<code>_sscanf_1</code>	<code>_sscanf_1</code>	<code>_swscanf_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>sscanf</code> , <code>_sscanf_1</code>	<code>&lt;stdio.h&gt;</code>
<code>swscanf</code> , <code>_swscanf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_sscanf.c
// compile with: /W3
// This program uses sscanf to read data items
// from a string named tokenstring, then displays them.

#include <stdio.h>

int main(void)
{
 char tokenstring[] = "15 12 14...";
 char s[81];
 char c;
 int i;
 float fp;

 // Input various data from tokenstring:
 // max 80 character string:
 sscanf(tokenstring, "%80s", s); // C4996
 sscanf(tokenstring, "%c", &c); // C4996
 sscanf(tokenstring, "%d", &i); // C4996
 sscanf(tokenstring, "%f", &fp); // C4996
 // Note: sscanf is deprecated; consider using sscanf_s instead

 // Output the data read
 printf("String = %s\n", s);
 printf("Character = %c\n", c);
 printf("Integer: = %d\n", i);
 printf("Real: = %f\n", fp);
}

```

```

String = 15
Character = 1
Integer: = 15
Real: = 15.000000

```

## See also

### Stream I/O

fscanf	_fscanf_l	fwscanf	_fwscanf_l
scanf	_scanf_l	wscanf	_wscanf_l
sprintf	_sprintf_l	swprintf	_swprintf_l
snprintf	_snprintf	_snprintf_l	_snwprintf
			_snwprintf_l

`sscanf_s`, `_sscanf_s_l`, `swscanf_s`, `_swscanf_s_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Reads formatted data from a string. These versions of `sscanf`, `_sscanf_l`, `swscanf`, `_swscanf_l` have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
int sscanf_s(
 const char *buffer,
 const char *format [,,
 argument] ...
);
int _sscanf_s_l(
 const char *buffer,
 const char *format,
 _locale_t locale [,,
 argument] ...
);
int swscanf_s(
 const wchar_t *buffer,
 const wchar_t *format [,,
 argument] ...
);
int _swscanf_s_l(
 const wchar_t *buffer,
 const wchar_t *format,
 _locale_t locale [,,
 argument] ...
);
```

### Parameters

`buffer`

Stored data

`format`

Format-control string. For more information, see [Format specification fields: `scanf` and `wscanf` functions](#).

`argument`

Optional arguments

`Locale`

The locale to use

## Return value

Each of these functions returns the number of fields that are successfully converted and assigned. The return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error or if the end of the string is reached before the first conversion.

If `buffer` or `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `sscanf_s` function reads data from `buffer` into the location that's given by each `argument`. The arguments after the format string specify pointers to variables that have a type that corresponds to a type specifier in `format`. Unlike the less secure version `sscanf`, a buffer size parameter is required when you use the type field characters `c`, `C`, `s`, `S`, or string control sets that are enclosed in `[]`. The buffer size in characters must be supplied as an extra parameter immediately after each buffer parameter that requires it. For example, if you're reading into a string, the buffer size for that string is passed as follows:

```
wchar_t ws[10];
swscanf_s(in_str, L"%9s", ws, (unsigned)_countof(ws)); // buffer size is 10, width specification is 9
```

The buffer size includes the terminating null. A width specification field may be used to ensure that the token that's read in will fit into the buffer. If no width specification field is used, and the token read in is too large to fit in the buffer, nothing is written to that buffer.

A single character may be read as follows:

```
wchar_t wc;
swscanf_s(in_str, L"%c", &wc, 1);
```

This example reads a single character from the input string and then stores it in a wide-character buffer. When you read multiple characters for non-null terminated strings, unsigned integers are used as the width specification and the buffer size.

```
char c[4];
sscanf_s(input, "%4c", &c, (unsigned)_countof(c)); // not null terminated
```

For more information, see [scanf\\_s](#), [\\_scanf\\_s\\_1](#), [wscanf\\_s](#), [\\_wscanf\\_s\\_1](#) and [scanf](#) type field characters.

### NOTE

The size parameter is of type `unsigned`, not `size_t`. When compiling for 64-bit targets, use a static cast to convert `_countof` or `sizeof` results to the correct size.

The `format` argument controls the interpretation of the input fields and has the same form and function as the `format` argument for the `scanf_s` function. If copying occurs between strings that overlap, the behavior is undefined.

`swscanf_s` is a wide-character version of `sscanf_s`; the arguments to `swscanf_s` are wide-character strings. `sscanf_s` doesn't handle multibyte hexadecimal characters. `swscanf_s` doesn't handle Unicode full-width hexadecimal or "compatibility zone" characters. Otherwise, `swscanf_s` and `sscanf_s` behave identically.

The versions of these functions that have the `_1` suffix are identical except that they use the locale parameter that's passed in instead of the current thread locale.

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_stscanf_s</code>	<code>sscanf_s</code>	<code>sscanf_s</code>	<code>swscanf_s</code>

<code>_TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_stscanf_s_l</code>	<code>_sscanf_s_l</code>	<code>_sscanf_s_l</code>	<code>_swscanf_s_l</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>sscanf_s</code> , <code>_sscanf_s_l</code>	<code>&lt;stdio.h&gt;</code>
<code>swscanf_s</code> , <code>_swscanf_s_l</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_ssprintf_s.c
// This program uses sscanf_s to read data items
// from a string named tokenstring, then displays them.

#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 char tokenstring[] = "15 12 14...";
 char s[81];
 char c;
 int i;
 float fp;

 // Input various data from tokenstring:
 // max 80 character string plus null terminator
 sscanf_s(tokenstring, "%s", s, (unsigned)_countof(s));
 sscanf_s(tokenstring, "%c", &c, (unsigned)sizeof(char));
 sscanf_s(tokenstring, "%d", &i);
 sscanf_s(tokenstring, "%f", &fp);

 // Output the data read
 printf_s("String = %s\n", s);
 printf_s("Character = %c\n", c);
 printf_s("Integer: = %d\n", i);
 printf_s("Real: = %f\n", fp);
}
```

```
String = 15
Character = 1
Integer: = 15
Real: = 15.000000
```

## See also

### Stream I/O

<code>fscanf</code>	<code>_fscanf_l</code>	<code>fwscanf</code>	<code>_fwscanf_l</code>
<code>scanf</code>	<code>_scanf_l</code>	<code>wscanf</code>	<code>_wscanf_l</code>
<code>sprintf</code>	<code>_sprintf_l</code>	<code>swprintf</code>	<code>_swprintf_l</code>

`snprintf`, `_snprintf`, `_snprintf_l`, `_snwprintf`, `_snwprintf_l`

```
_stat, _stat32, _stat64, _stati64, _stat32i64
, _stat64i32, _wstat, _wstat32, _wstat64,
_wstati64, _wstat32i64, _wstat64i32
```

11/2/2022 • 5 minutes to read • [Edit Online](#)

Get status information on a file.

## Syntax

```
int _stat(
 const char *path,
 struct _stat *buffer
);
int _stat32(
 const char *path,
 struct __stat32 *buffer
);
int _stat64(
 const char *path,
 struct __stat64 *buffer
);
int _stati64(
 const char *path,
 struct __stati64 *buffer
);
int _stat32i64(
 const char *path,
 struct __stat32i64 *buffer
);
int _stat64i32(
 const char *path,
 struct __stat64i32 *buffer
);
int _wstat(
 const wchar_t *path,
 struct _stat *buffer
);
int _wstat32(
 const wchar_t *path,
 struct __stat32 *buffer
);
int _wstat64(
 const wchar_t *path,
 struct __stat64 *buffer
);
int _wstati64(
 const wchar_t *path,
 struct __stati64 *buffer
);
int _wstat32i64(
 const wchar_t *path,
 struct __stat32i64 *buffer
);
int _wstat64i32(
 const wchar_t *path,
 struct __stat64i32 *buffer
);
```

## Parameters

`path`

Pointer to a string containing the path of existing file or directory.

`buffer`

Pointer to structure that stores results.

## Return value

Each of these functions returns 0 if the file-status information is obtained. A return value of -1 indicates an error, in which case `errno` is set to `ENOENT`, indicating that the filename or path couldn't be found. A return value of `EINVAL` indicates an invalid parameter; `errno` is also set to `EINVAL` in this case.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

The date stamp on a file can be represented if it's later than midnight, January 1, 1970, and before 23:59:59, December 31, 3000, UTC, unless you use `_stat32` or `_wstat32`, or have defined `_USE_32BIT_TIME_T`, in which case the date can be represented only until 23:59:59 January 18, 2038, UTC.

## Remarks

The `_stat` function obtains information about the file or directory specified by `path` and stores it in the structure pointed to by `buffer`. `_stat` automatically handles multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the multibyte code page currently in use.

`_wstat` is a wide-character version of `_stat`; the `path` argument to `_wstat` is a wide-character string. `_wstat` and `_stat` behave identically except that `_wstat` doesn't handle multibyte-character strings.

Variations of these functions support 32-bit or 64-bit time types, and 32-bit or 64-bit file lengths. The first numerical suffix ( `32` or `64` ) indicates the size of the time type used; the second suffix is either `i32` or `i64`, indicating whether the file size is represented as a 32-bit or 64-bit integer.

`_stat` is equivalent to `_stat64i32`, and `struct _stat` contains a 64-bit time, unless `_USE_32BIT_TIME_T` is defined, in which case the old behavior is in effect; `_stat` uses a 32-bit time, and `struct _stat` contains a 32-bit time. The same is true for `_stati64`.

### NOTE

`_wstat` does not work with Windows Vista symbolic links. In these cases, `_wstat` will always report a file size of 0. `_stat` does work correctly with symbolic links.

This function validates its parameters. If either `path` or `buffer` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Time type and file length type variations of `_stat`

FUNCTIONS	<code>_USE_32BIT_TIME_T</code> DEFINED	TIME TYPE	FILE LENGTH TYPE
<code>_stat</code> , <code>_wstat</code>	Not defined	64-bit	32-bit
<code>_stat</code> , <code>_wstat</code>	Defined	32-bit	32-bit
<code>_stat32</code> , <code>_wstat32</code>	Not affected by the macro definition	32-bit	32-bit
<code>_stat64</code> , <code>_wstat64</code>	Not affected by the macro definition	64-bit	64-bit
<code>_stati64</code> , <code>_wstati64</code>	Not defined	64-bit	64-bit
<code>_stati64</code> , <code>_wstati64</code>	Defined	32-bit	64-bit
<code>_stat32i64</code> , <code>_wstat32i64</code>	Not affected by the macro definition	32-bit	64-bit

FUNCTIONS	<code>_USE_32BIT_TIME_T</code> DEFINED	TIME TYPE	FILE LENGTH TYPE
<code>_stat64i32</code> , <code>_wstat64i32</code>	Not affected by the macro definition	64-bit	32-bit

## Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstat</code>	<code>_stat</code>	<code>_stat</code>	<code>_wstat</code>
<code>_tstat64</code>	<code>_stat64</code>	<code>_stat64</code>	<code>_wstat64</code>
<code>_tstati64</code>	<code>_stati64</code>	<code>_stati64</code>	<code>_wstati64</code>
<code>_tstat32i64</code>	<code>_stat32i64</code>	<code>_stat32i64</code>	<code>_wstat32i64</code>
<code>_tstat64i32</code>	<code>_stat64i32</code>	<code>_stat64i32</code>	<code>_wstat64i32</code>

The `_stat` structure, defined in `sys\STAT.H`, includes the following fields.

FIELD	DESCRIPTION
<code>st_gid</code>	Numeric identifier of group that owns the file (UNIX-specific). This field will always be zero on Windows systems. A redirected file is classified as a Windows file.
<code>st_atime</code>	Time of last access of file. Valid on NTFS but not on FAT formatted disk drives.
<code>st_ctime</code>	Time of creation of file. Valid on NTFS but not on FAT formatted disk drives.
<code>st_dev</code>	Drive number of the disk containing the file (same as <code>st_rdev</code> ).
<code>st_ino</code>	Number of the information node (the <code>inode</code> ) for the file (UNIX-specific). On UNIX file systems, the <code>inode</code> describes the file date and time stamps, permissions, and content. When files are hard-linked to one another, they share the same <code>inode</code> . The <code>inode</code> , and therefore <code>st_ino</code> , has no meaning in the FAT, HPFS, or NTFS file systems.
<code>st_mode</code>	Bit mask for file-mode information. The <code>_S_IFDIR</code> bit is set if <code>path</code> specifies a directory; the <code>_S_IFREG</code> bit is set if <code>path</code> specifies an ordinary file or a device. User read/write bits are set according to the file's permission mode; user execute bits are set according to the filename extension.
<code>st_mtime</code>	Time of last modification of file.
<code>st_nlink</code>	Always 1 on non-NTFS file systems.

FIELD	DESCRIPTION
<code>st_rdev</code>	Drive number of the disk containing the file (same as <code>st_dev</code> ).
<code>st_size</code>	Size of the file in bytes; a 64-bit integer for variations with the <code>i64</code> suffix.
<code>st_uid</code>	Numeric identifier of user who owns file (UNIX-specific). This field will always be zero on Windows systems. A redirected file is classified as a Windows file.

If `path` refers to a device, the `st_size`, various time fields, `st_dev`, and `st_rdev` fields in the `_stat` structure are meaningless. Because `STAT.H` uses the `_dev_t` type that is defined in `TYPES.H`, you must include `TYPES.H` before `STAT.H` in your code.

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_stat</code> , <code>_stat32</code> , <code>_stat64</code> , <code>_stati64</code> , <code>_stat32i64</code> , <code>_stat64i32</code>	<code>&lt;sys/types.h&gt;</code> followed by <code>&lt;sys/stat.h&gt;</code>	<code>&lt;errno.h&gt;</code>
<code>_wstat</code> , <code>_wstat32</code> , <code>_wstat64</code> , <code>_wstati64</code> , <code>_wstat32i64</code> , <code>_wstat64i32</code>	<code>&lt;sys/types.h&gt;</code> followed by <code>&lt;sys/stat.h&gt;</code> or <code>&lt;wchar.h&gt;</code>	<code>&lt;errno.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_stat.c
// This program uses the _stat function to
// report information about the file named crt_stat.c.

#include <time.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <stdio.h>
#include <errno.h>

int main(void)
{
 struct _stat buf;
 int result;
 char timebuf[26];
 char* filename = "crt_stat.c";
 errno_t err;

 // Get data associated with "crt_stat.c":
 result = _stat(filename, &buf);

 // Check if statistics are valid:
 if(result != 0)
 {
 perror("Problem getting information");
 switch (errno)
 {
 case ENOENT:
 printf("File %s not found.\n", filename);
 break;
 case EINVAL:
 printf("Invalid parameter to _stat.\n");
 break;
 default:
 /* Should never be reached. */
 printf("Unexpected error in _stat.\n");
 }
 }
 else
 {
 // Output some of the statistics:
 printf("File size : %ld\n", buf.st_size);
 printf("Drive : %c:\n", buf.st_dev + 'A');
 err = ctime_s(timebuf, 26, &buf.st_mtime);
 if (err)
 {
 printf("Invalid arguments to ctime_s.");
 exit(1);
 }
 printf("Time modified : %s", timebuf);
 }
}

```

```

File size : 732
Drive : C:
Time modified : Thu Feb 07 14:39:36 2002

```

## See also

### File handling

<a href="#">_access</a>	<a href="#">_waccess</a>				
<a href="#">_fstat</a>	<a href="#">_fstat32</a>	<a href="#">_fstat64</a>	<a href="#">_fstat164</a>	<a href="#">_fstat32i64</a>	<a href="#">_fstat64i32</a>

[\\_getmbcp](#)

[\\_setmbcp](#)

# \_STATIC\_ASSERT macro

11/2/2022 • 2 minutes to read • [Edit Online](#)

Evaluate an expression at compile time and generate an error when the result is `FALSE`.

## Syntax

```
_STATIC_ASSERT(
 booleanExpression
)
```

### Parameters

`booleanExpression`

Expression (including pointers) that evaluates to nonzero (`TRUE`) or 0 (`FALSE`).

## Remarks

This macro resembles the `_ASSERT` and `_ASSERTE` macros, except that `booleanExpression` is evaluated at compile time instead of at runtime. If `booleanExpression` evaluates to `FALSE` (0), [Compiler Error C2466](#) is generated.

## Example

In this example, we check whether the `sizeof` an `int` is larger than or equal to 2 bytes and whether the `sizeof` a `long` is 1 byte. The program won't compile and it will generate [Compiler Error C2466](#) because a `long` is larger than 1 byte.

```
// crt_static_assert.c

#include <crtdbg.h>
#include <stdio.h>

_STATIC_ASSERT(sizeof(int) >= 2);
_STATIC_ASSERT(sizeof(long) == 1); // C2466

int main()
{
 printf("I am sure that sizeof(int) will be >= 2: %d\n",
 sizeof(int));
 printf("I am not so sure that sizeof(long) == 1: %d\n",
 sizeof(long));
}
```

## Requirements

MACRO	REQUIRED HEADER
<code>_STATIC_ASSERT</code>	<code>&lt;crtdbg.h&gt;</code>

## See also

[Alphabetical function reference](#)

[`\_ASSERT`](#) , [`\_ASERTE`](#) , [`\_ASSERT\_EXPR`](#) macros

`_status87`, `_statusfp`, `_statusfp2`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Gets the floating-point status word.

## Syntax

```
unsigned int _status87(void);
unsigned int _statusfp(void);
void _statusfp2(unsigned int *px86, unsigned int *psse2)
```

### Parameters

`px86`

This address is filled with the status word for the x87 floating-point unit.

`psse2`

This address is filled with the status word for the SSE2 floating-point unit.

## Return value

For `_status87` and `_statusfp`, the bits in the value that's returned indicate the floating-point status. See the FLOAT.H include file for a definition of the bits that are returned by `_statusfp`. Many math library functions modify the floating-point status word, with unpredictable results. Optimization can reorder, combine, and eliminate floating-point operations around calls to `_status87`, `_statusfp`, and related functions. Use the `/Od` (Disable (Debug)) compiler option or the `fenv_access` pragma directive to prevent optimizations that reorder floating-point operations. Return values from `_clearfp` and `_statusfp`, and also the return parameters of `_statusfp2`, are more reliable if fewer floating-point operations are performed between known states of the floating-point status word.

## Remarks

The `_statusfp` function gets the floating-point status word. The status word is a combination of the floating-point processor status and other conditions detected by the floating-point exception handler—for example, floating-point stack overflow and underflow. Unmasked exceptions are checked for before the contents of the status word are returned. In other words, the caller is informed of pending exceptions. On x86 platforms, `_statusfp` returns a combination of the x87 and SSE2 floating-point status. On x64 platforms, the status that's returned is based on the SSE's MXCSR status. On ARM64 platforms, `_statusfp` returns status from the FPSCR register.

`_statusfp` is a platform-independent, portable version of `_status87`. It's identical to `_status87` on Intel (x86) platforms and is also supported by the x64 and ARM64 platforms. To ensure that your floating-point code is portable to all architectures, use `_statusfp`. If you're only targeting x86 platforms, you can use either `_status87` or `_statusfp`.

We recommend `_statusfp2` for chips (such as the Pentium IV) that have both an x87 and an SSE2 floating-point processor. For `_statusfp2`, the addresses are filled by using the floating-point status word for both the x87 or the SSE2 floating-point processor. For a chip that supports x87 and SSE2 floating-point processors, `EM_AMBIGUOUS` is set to 1 if `_statusfp` or `_controlfp` is used and the action was ambiguous because it could refer to the x87 or the SSE2 floating-point status word. The `_statusfp2` function is only supported on x86.

platforms.

These functions aren't useful for [/clr \(Common Language Runtime Compilation\)](#) because the common language runtime (CLR) only supports the default floating-point precision.

## Requirements

ROUTINE	REQUIRED HEADER
<a href="#">_status87</a> , <a href="#">_statusfp</a> , <a href="#">_statusfp2</a>	<float.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_statusfp.c
// Build by using: cl /W4 /Ox /nologo crt_statusfp.c
// This program creates various floating-point errors and
// then uses _statusfp to display messages that indicate these problems.

#include <stdio.h>
#include <float.h>
#pragma fenv_access(on)

double test(void)
{
 double a = 1e-40;
 float b;
 double c;

 printf("Status = 0x%.8x - clear\n", _statusfp());

 // Assignment into b is inexact & underflows:
 b = (float)(a + 1e-40);
 printf("Status = 0x%.8x - inexact, underflow\n", _statusfp());

 // c is denormal:
 c = b / 2.0;
 printf("Status = 0x%.8x - inexact, underflow, denormal\n",
 _statusfp());

 // Clear floating point status:
 _clearfp();
 return c;
}

int main(void)
{
 return (int)test();
}
```

```
Status = 0x00000000 - clear
Status = 0x00000003 - inexact, underflow
Status = 0x00080003 - inexact, underflow, denormal
```

## See also

[Math and floating-point support](#)

[\\_clear87](#) , [\\_clearfp](#)

`_control87`, `_controlfp`, `__control87_2`

# `strcat`, `wcscat`, `_mbscat`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Appends a string. More secure versions of these functions are available; see [`strcat\_s`](#), [`wcscat\_s`](#), [`\_mbscat\_s`](#).

## IMPORTANT

`_mbscat_s` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strcat(
 char *strDestination,
 const char *strSource
);
wchar_t *wcscat(
 wchar_t *strDestination,
 const wchar_t *strSource
);
unsigned char *_mbscat(
 unsigned char *strDestination,
 const unsigned char *strSource
);
template <size_t size>
char *strcat(
 char (&strDestination)[size],
 const char *strSource
); // C++ only
template <size_t size>
wchar_t *wcscat(
 wchar_t (&strDestination)[size],
 const wchar_t *strSource
); // C++ only
template <size_t size>
unsigned char *_mbscat(
 unsigned char (&strDestination)[size],
 const unsigned char *strSource
); // C++ only
```

## Parameters

### `strDestination`

Null-terminated destination string.

### `strSource`

Null-terminated source string.

## Return value

Each of these functions returns the destination string (`strDestination`). No return value is reserved to indicate an error.

## Remarks

The `strcat` function appends `strSource` to `strDestination` and terminates the resulting string with a null character. The initial character of `strSource` overwrites the terminating null character of `strDestination`. The behavior of `strcat` is undefined if the source and destination strings overlap.

#### IMPORTANT

Because `strcat` does not check for sufficient space in `strDestination` before appending `strSource`, it is a potential cause of buffer overruns. Consider using `strncat` instead.

`wcscat` and `_mbscat` are wide-character and multibyte-character versions of `strcat`. The arguments and return value of `wcscat` are wide-character strings. The arguments and return value of `_mbscat` are multibyte-character strings. These three functions behave identically otherwise.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tscat</code>	<code>strcat</code>	<code>_mbscat</code>	<code>wcscat</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcat</code>	<code>&lt;string.h&gt;</code>
<code>wcscat</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbscat</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [strcpy](#).

## See also

### String manipulation

<code>strncat</code>	<code>_strncat_1</code>	<code>wcsncat</code>	<code>_wcsncat_1</code>	<code>_mbsncat</code>	<code>_mbscat_1</code>
<code>strncmp</code>	<code>wcsncmp</code>	<code>_mbsncmp</code>	<code>_mbncmp_1</code>		
<code>strncpy</code>	<code>_strncpy_1</code>	<code>wcsncpy</code>	<code>_wcsncpy_1</code>	<code>_mbsncpy</code>	<code>_mbscopy_1</code>
<code>_strnicmp</code>	<code>_wcsnicmp</code>	<code>_mbsnicmp</code>	<code>_strnicmp_1</code>	<code>_wscnicmp_1</code>	<code>_mbsnicmp_1</code>
<code>strrchr</code>	<code>wcsrchr</code>	<code>_mbsrchr</code>	<code>_mbsrchr_1</code>		
<code>strspn</code>	<code>wcsspn</code>	<code>_mbsspn</code>	<code>_mbsspn_1</code>		

`strcat_s`, `wcscat_s`, `_mbscat_s`, `_mbscat_s_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Appends a string. These versions of `strcat`, `wcscat`, `_mbscat` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

`_mbscat_s` and `_mbscat_s_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t strcat_s(
 char *strDestination,
 size_t numberOfElements,
 const char *strSource
);
errno_t wcscat_s(
 wchar_t *strDestination,
 size_t numberOfElements,
 const wchar_t *strSource
);
errno_t _mbscat_s(
 unsigned char *strDestination,
 size_t numberOfElements,
 const unsigned char *strSource
);
errno_t _mbscat_s_1(
 unsigned char *strDestination,
 size_t numberOfElements,
 const unsigned char *strSource,
 _locale_t locale
);
template <size_t size>
errno_t strcat_s(
 char (&strDestination)[size],
 const char *strSource
); // C++ only
template <size_t size>
errno_t wcscat_s(
 wchar_t (&strDestination)[size],
 const wchar_t *strSource
); // C++ only
template <size_t size>
errno_t _mbscat_s(
 unsigned char (&strDestination)[size],
 const unsigned char *strSource
); // C++ only
template <size_t size>
errno_t _mbscat_s_1(
 unsigned char (&strDestination)[size],
 const unsigned char *strSource,
 _locale_t locale
); // C++ only
```

## Parameters

`strDestination`

Null-terminated destination string buffer.

`numberOfElements`

Size of the destination string buffer.

`strSource`

Null-terminated source string buffer.

`Locale`

Locale to use.

## Return value

Zero if successful; an error code on failure.

### Error conditions

<code>STRDESTINATION</code>	<code>NUMBEROFELEMENTS</code>	<code>STRSOURCE</code>	RETURN VALUE	CONTENTS OF <code>STRDESTINATION</code>
<code>NULL</code> or unterminated	any	any	<code>EINVAL</code>	not modified
any	any	<code>NULL</code>	<code>EINVAL</code>	<code>strDestination[0]</code> set to 0
any	0, or too small	any	<code>ERANGE</code>	<code>strDestination[0]</code> set to 0

## Remarks

The `strcat_s` function appends `strSource` to `strDestination` and terminates the resulting string with a null character. The initial character of `strSource` overwrites the terminating null character of `strDestination`. The behavior of `strcat_s` is undefined if the source and destination strings overlap.

The second parameter is the total size of the buffer, not the remaining size:

```
char buf[16];
strcpy_s(buf, 16, "Start");
strcat_s(buf, 16, " End"); // Correct
strcat_s(buf, 16 - strlen(buf), " End"); // Incorrect
```

`wcscat_s` and `_mbscat_s` are wide-character and multibyte-character versions of `strcat_s`. The arguments and return value of `wcscat_s` are wide-character strings. The arguments and return value of `_mbscat_s` are multibyte-character strings. These three functions behave identically otherwise.

If `strDestination` is a null pointer, or isn't null-terminated, or if `strSource` is a `NULL` pointer, or if the destination string is too small, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EINVAL` and set `errno` to `EINVAL`.

The versions of functions that have the `_1` suffix have the same behavior, but use the locale parameter that's passed in instead of the current locale. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-

secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use

`_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscat_s</code>	<code>strcat_s</code>	<code>_mbscat_s</code>	<code>wcscat_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcat_s</code>	<code>&lt;string.h&gt;</code>
<code>wcscat_s</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbscat_s</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the code example in `strcpy_s`, `wcsncpy_s`, `_mbscopy_s`.

## See also

### String manipulation

<code>strncat</code>	<code>_strncat_1</code>	<code>wcsncat</code>	<code>_wcsncat_1</code>	<code>_mbsncat</code>	<code>_mbsnat_1</code>
<code>strncmp</code>	<code>wcsncmp</code>	<code>_mbsncmp</code>	<code>_mbsnncmp_1</code>		
<code>strncpy</code>	<code>_strncpy_1</code>	<code>wcsncpy</code>	<code>_wcsncpy_1</code>	<code>_mbsncpy</code>	<code>_mbsnncpy_1</code>
<code>_strnicmp</code>	<code>_wcsnicmp</code>	<code>_mbsnicmp</code>	<code>_strnicmp_1</code>	<code>_wcsnicmp_1</code>	<code>_mbsnicmp_1</code>
<code>strrchr</code>	<code>wcsrchr</code>	<code>_mbsrchr</code>	<code>_mbsrchr_1</code>		
<code>strspn</code>	<code>wcsspn</code>	<code>_mbsspn</code>	<code>_mbsspn_1</code>		

`strchr`, `wcschr`, `_mbschr`, `_mbschr_1`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Finds a character in a string, by using the current locale or a specified `LC_CTYPE` conversion-state category.

**IMPORTANT**

`_mbschr` and `_mbschr_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strchr(
 const char *str,
 int c
); // C only
char *strchr(
 char * str,
 int c
); // C++ only
const char *strchr(
 const char * str,
 int c
); // C++ only
wchar_t *wcschr(
 const wchar_t *str,
 wchar_t c
); // C only
wchar_t *wcschr(
 wchar_t *str,
 wchar_t c
); // C++ only
const wchar_t *wcschr(
 const wchar_t *str,
 wchar_t c
); // C++ only
unsigned char *_mbschr(
 const unsigned char *str,
 unsigned int c
); // C only
unsigned char *_mbschr(
 unsigned char *str,
 unsigned int c
); // C++ only
const unsigned char *_mbschr(
 const unsigned char *str,
 unsigned int c
); // C++ only
unsigned char *_mbschr_l(
 const unsigned char *str,
 unsigned int c,
 _locale_t locale
); // C only
unsigned char *_mbschr_l(
 unsigned char *str,
 unsigned int c,
 _locale_t locale
); // C++ only
const unsigned char *_mbschr_l(
 const unsigned char *str,
 unsigned int c,
 _locale_t locale
); // C++ only
```

## Parameters

`str`

Null-terminated source string.

`c`

Character to be located.

`Locale`

Locale to use.

## Return value

Each of these functions returns a pointer to the first occurrence of `c` in `str`, or `NULL` if `c` isn't found.

## Remarks

The `strchr` function finds the first occurrence of `c` in `str`, or it returns `NULL` if `c` isn't found. The null terminating character is included in the search.

`wcschr`, `_mbschr` and `_mbschr_1` are wide-character and multibyte-character versions of `strchr`. The arguments and return value of `wcschr` are wide-character strings. The arguments and return value of `_mbschr` are multibyte-character strings. `_mbschr` recognizes multibyte-character sequences. Also, if the string is a null pointer, `_mbschr` invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `_mbschr` returns `NULL` and sets `errno` to `EINVAL`. `strchr` and `wcschr` don't validate their parameters. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale; for more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

In C, these functions take a `const` pointer for the first argument. In C++, two overloads are available. The overload taking a pointer to `const` returns a pointer to `const`; the version that takes a pointer to non-`const` returns a pointer to non-`const`. The macro `_CRT_CONST_CORRECT_OVERLOADS` is defined if both the `const` and non-`const` versions of these functions are available. If you require the non-`const` behavior for both C++ overloads, define the symbol `_CONST_RETURN`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcschr</code>	<code>strchr</code>	<code>_mbschr</code>	<code>wcschr</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strchr</code>	<code>&lt;string.h&gt;</code>
<code>wcschr</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbschr</code> , <code>_mbschr_1</code>	<code>&lt;mbstring.h&gt;</code>

For more information about compatibility, see [Compatibility](#).

## Example

```

// crt_strchr.c
//
// This program illustrates searching for a character
// with strchr (search forward) or strrchr (search backward).
//

#include <string.h>
#include <stdio.h>

int ch = 'r';

char string[] = "The quick brown dog jumps over the lazy fox";
char fmt1[] = " 1 2 3 4 5";
char fmt2[] = "12345678901234567890123456789012345678901234567890";

int main(void)
{
 char *pdest;
 int result;

 printf_s("String to be searched:\n %s\n", string);
 printf_s(" %s\n %s\n", fmt1, fmt2);
 printf_s("Search char: %c\n", ch);

 // Search forward.
 pdest = strchr(string, ch);
 result = (int)(pdest - string + 1);
 if (pdest != NULL)
 printf_s("Result: first %c found at position %d\n",
 ch, result);
 else
 printf_s("Result: %c not found\n", ch);

 // Search backward.
 pdest = strrchr(string, ch);
 result = (int)(pdest - string + 1);
 if (pdest != NULL)
 printf_s("Result: last %c found at position %d\n", ch, result);
 else
 printf_s("Result: %c not found\n", ch);
}

```

```
String to be searched:
The quick brown dog jumps over the lazy fox
 1 2 3 4 5
12345678901234567890123456789012345678901234567890

Search char: r
Result: first r found at position 12
Result: last r found at position 30
```

See also

## String manipulation

## Locale

## Interpretation of multibyte-character sequences

```
strcspn , wcsncpy , _mbscspn , _mbscspn_1
strncat , _strncat_1 , wcsncat , _wcsncat_1 , _mbscopy , _
strcmp , wcsncmp , _mbsnncmp , _mbsnncmp_1
strncpy , _strncpy_1 , wcsncpy , _wcsncpy_1 , _mbscopy , _
strnicmp , wcsnicmp , _mbsnicmp , strnicmp_1 , wcsnicmp
```

`struprbrk`, `wcspbrk`, `_mbspbrk`, `_mbspbrk_1`

`strrchr`, `wcsrchr`, `_mbsrchr`, `_mbsrchr_1`

`strstr`, `wcsstr`, `_mbsstr`, `_mbsstr_1`

`strcmp`, `wcsncmp`, `_mbscmp`, `_mbscmp_l`

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Compare strings.

#### IMPORTANT

`_mbscmp` and `_mbscmp_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int strcmp(
 const char *string1,
 const char *string2
);
int wcsncmp(
 const wchar_t *string1,
 const wchar_t *string2
);
int _mbscmp(
 const unsigned char *string1,
 const unsigned char *string2
);
int _mbscmp_l(
 const unsigned char *string1,
 const unsigned char *string2,
 _locale_t locale
);
```

#### Parameters

`string1`, `string2`

Null-terminated strings to compare.

`Locale`

Locale to use.

## Return value

The return value for each of these functions indicates the ordinal relation of `string1` to `string2`.

VALUE	RELATIONSHIP OF <code>STRING1</code> TO <code>STRING2</code>
< 0	<code>string1</code> is less than <code>string2</code>
0	<code>string1</code> is identical to <code>string2</code>
> 0	<code>string1</code> is greater than <code>string2</code>

On a parameter validation error, `_mbscmp` and `_mbscmp_l` return `_NLSCMPERROR`, which is defined in `<string.h>` and `<mbstring.h>`.

## Remarks

The `strcmp` function performs an ordinal comparison of `string1` and `string2` and returns a value that indicates their relationship. `wcsncmp` and `_mbscmp` are, respectively, wide-character and multibyte-character versions of `strcmp`. `_mbscmp` recognizes multibyte-character sequences according to the current multibyte code page and returns `_NLSCMPERROR` on an error. `_mbscmp_1` has the same behavior, but uses the locale parameter that's passed in instead of the current locale. For more information, see [Code pages](#). Also, if `string1` or `string2` is a null pointer, `_mbscmp` invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, `_mbscmp` and `_mbscmp_1` return `_NLSCMPERROR` and set `errno` to `EINVAL`. `strcmp` and `wcsncmp` don't validate their parameters. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcsncmp</code>	<code>strcmp</code>	<code>_mbscmp</code>	<code>wcsncmp</code>

The `strcmp` functions differ from the `strcoll` functions in that `strcmp` comparisons are ordinal, and aren't affected by locale. `strcoll` compares strings lexicographically by using the `LC_COLLATE` category of the current locale. For more information about the `LC_COLLATE` category, see [setlocale](#), [\\_wsetlocale](#).

In the "C" locale, the order of characters in the character set (ASCII character set) is the same as the lexicographic character order. However, in other locales, the order of characters in the character set may differ from the lexicographic order. For example, in certain European locales, the character '`'a'`' (value 0x61) comes before the character '`'ä'`' (value 0xE4) in the character set, but the character '`'ä'`' comes in front of the character '`'a'`' lexicographically.

In locales for which the character set and the lexicographic character order differ, you can use `strcoll` instead of `strcmp` for lexicographic comparison of strings. Alternatively, you can use `strxfrm` on the original strings, and then use `strcmp` on the resulting strings.

The `strcmp` functions are case-sensitive. `_stricmp`, `_wcscicmp`, and `_mbscicmp` compare strings by first converting them to their lowercase forms. Two strings that contain characters that are located between 'Z' and 'a' in the ASCII table ('`[`', '`\`', '`]`', '`^`', '`_`', and '```') compare differently, depending on their case. For example, the two strings "`ABCDE`" and "`ABCD^`" compare one way if the comparison is lowercase ("`abcde`" > "`abcd^`") and the other way ("`ABCDE`" < "`ABCD ^`") if the comparison is uppercase.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcmp</code>	<code>&lt;string.h&gt;</code>
<code>wcsncmp</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbscmp</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

## Example

```
// crt_strcmp.c

#include <string.h>
#include <stdio.h>
#include <stdlib.h>

char string1[] = "The quick brown dog jumps over the lazy fox";
char string2[] = "The QUICK brown dog jumps over the lazy fox";

int main(void)
{
 char tmp[20];
 int result;

 // Case sensitive
 printf("Compare strings:\n %s\n %s\n\n", string1, string2);
 result = strcmp(string1, string2);
 if(result > 0)
 strcpy_s(tmp, _countof(tmp), "greater than");
 else if(result < 0)
 strcpy_s(tmp, _countof (tmp), "less than");
 else
 strcpy_s(tmp, _countof (tmp), "equal to");
 printf(" strcmp: String 1 is %s string 2\n", tmp);

 // Case insensitive (could use equivalent _stricmp)
 result = _stricmp(string1, string2);
 if(result > 0)
 strcpy_s(tmp, _countof (tmp), "greater than");
 else if(result < 0)
 strcpy_s(tmp, _countof (tmp), "less than");
 else
 strcpy_s(tmp, _countof (tmp), "equal to");
 printf(" _stricmp: String 1 is %s string 2\n", tmp);
}
```

```
Compare strings:
The quick brown dog jumps over the lazy fox
The QUICK brown dog jumps over the lazy fox

strcmp: String 1 is greater than string 2
_stricmp: String 1 is equal to string 2
```

## See also

### String manipulation

[memcmp](#), [wmemcmp](#)  
[\\_memicmp](#), [\\_memicmp\\_l](#)  
[strcoll](#) functions  
[\\_stricmp](#), [\\_wcsicmp](#), [\\_mbsicmp](#), [\\_stricmp\\_l](#), [\\_wcsicmp\\_l](#), [\\_mbsicmp\\_l](#)  
[strncmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_l](#)  
[\\_strnicmp](#), [\\_wcsmicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_l](#), [\\_wcsmicmp\\_l](#), [\\_mbsnicmp\\_l](#)  
[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_l](#)  
[strspn](#), [wcspn](#), [\\_mbsspn](#), [\\_mbsspn\\_l](#)  
[strxfrm](#), [wcsxfrm](#), [\\_strxfrm\\_l](#), [\\_wcsxfrm\\_l](#)

# strcmpl

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The Microsoft-specific function name `strcmpl` is a deprecated alias for the `_stricmp` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_stricmp` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

```
strcoll, wcscoll, _mbscoll, _strcoll_l,
_wcscoll_l, _mbscoll_l
```

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Compares strings by using the current locale or a specified `LC_COLLATE` conversion-state category.

#### IMPORTANT

`_mbscoll` and `_mbscoll_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int strcoll(
 const char *string1,
 const char *string2
);
int wcscoll(
 const wchar_t *string1,
 const wchar_t *string2
);
int _mbscoll(
 const unsigned char *string1,
 const unsigned char *string2
);
int _strcoll_l(
 const char *string1,
 const char *string2,
 _locale_t locale
);
int _wcscoll_l(
 const wchar_t *string1,
 const wchar_t *string2,
 _locale_t locale
);
int _mbscoll_l(
 const unsigned char *string1,
 const unsigned char *string2,
 _locale_t locale
);
```

### Parameters

`string1`, `string2`

Null-terminated strings to compare.

`Locale`

Locale to use.

## Return value

Each of these functions returns a value indicating the relationship of `string1` to `string2`, as follows.

RETURN VALUE	RELATIONSHIP OF <code>STRING1</code> TO <code>STRING2</code>
< 0	<code>string1</code> less than <code>string2</code>
0	<code>string1</code> identical to <code>string2</code>
> 0	<code>string1</code> greater than <code>string2</code>

Each of these functions returns `_NLSCMPERROR` on an error. To use `_NLSCMPERROR`, include either STRING.H or MBSTRING.H. `wcscoll` can fail if either `string1` or `string2` is `NULL` or contains wide-character codes outside the domain of the collating sequence. When an error occurs, `wcscoll` may set `errno` to `EINVAL`. To check for an error on a call to `wcscoll`, set `errno` to 0 and then check `errno` after calling `wcscoll`.

## Remarks

Each of these functions performs a case-sensitive comparison of `string1` and `string2` according to the code page currently in use. These functions should be used only when there's a difference between the character set order and the lexicographic character order in the current code page and this difference is of interest for the string comparison.

All of these functions validate their parameters. If either `string1` or `string2` is a null pointer, or if `count` is greater than `INT_MAX`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`.

The comparison of the two strings is a locale-dependent operation since each locale has different rules for ordering characters. The versions of these functions without the `_1` suffix use the current thread's locale for this locale-dependent behavior; the versions with the `_1` suffix are identical to the corresponding function without the suffix except that they use the locale passed in as a parameter instead of the current locale. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscoll</code>	<code>strcoll</code>	<code>_mbscoll</code>	<code>wcscoll</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcoll</code>	<code>&lt;string.h&gt;</code>
<code>wcscoll</code>	<code>&lt;wchar.h&gt;, &lt;string.h&gt;</code>
<code>_mbscoll</code> , <code>_mbscoll_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_strcoll_1</code>	<code>&lt;string.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_wcscoll_1</code>	<wchar.h>, <string.h>

For more compatibility information, see [Compatibility](#).

## See also

[Locale](#)

[String manipulation](#)

`strcoll` functions

`localeconv`

`_mbsnbcoll`, `_mbsnbcoll_1`, `_mbsnbicoll`, `_mbsnbicoll_1`

`setlocale`, `_wsetlocale`

`strcmp`, `wcsncmp`, `_mbscmp`

`_stricmp`, `_wcsicmp`, `_mbsicmp`, `_stricmp_1`, `_wcsicmp_1`, `_mbsicmp_1`

`strncmp`, `wcsncmp`, `_mbsncmp`, `_mbsncmp_1`

`_strnicmp`, `_wcnicmp`, `_mbsnicmp`, `_strnicmp_1`, `_wcnicmp_1`, `_mbsnicmp_1`

`strxfrm`, `wcsxfrm`, `_strxfrm_1`, `_wcsxfrm_1`

`strcpy`, `wcscpy`, `_mbscopy`

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Copies a string. More secure versions of these functions are available; see [`strcpy\_s`](#), [`wcscpy\_s`](#), [`\_mbscopy\_s`](#).

#### IMPORTANT

`_mbscopy` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strcpy(
 char *strDestination,
 const char *strSource
);
wchar_t *wcscpy(
 wchar_t *strDestination,
 const wchar_t *strSource
);
unsigned char *_mbscopy(
 unsigned char *strDestination,
 const unsigned char *strSource
);
template <size_t size>
char *strcpy(
 char (&strDestination)[size],
 const char *strSource
); // C++ only
template <size_t size>
wchar_t *wcscpy(
 wchar_t (&strDestination)[size],
 const wchar_t *strSource
); // C++ only
template <size_t size>
unsigned char *_mbscopy(
 unsigned char (&strDestination)[size],
 const unsigned char *strSource
); // C++ only
```

#### Parameters

`strDestination`

Destination string.

`strSource`

Null-terminated source string.

## Return value

Each of these functions returns the destination string. No return value is reserved to indicate an error.

## Remarks

The `strcpy` function copies `strSource`, including the terminating null character, to the location that's specified

by `strDestination`. The behavior of `strcpy` is undefined if the source and destination strings overlap.

#### IMPORTANT

Because `strcpy` does not check for sufficient space in `strDestination` before it copies `strSource`, it is a potential cause of buffer overruns. Therefore, we recommend that you use `strcpy_s` instead.

`wcscpy` and `_mbscopy` are, respectively, wide-character and multibyte-character versions of `strcpy`. The arguments and return value of `wcscpy` are wide-character strings. The arguments and return value of `_mbscopy` are multibyte-character strings. These three functions behave identically otherwise.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscopy</code>	<code>strcpy</code>	<code>_mbscopy</code>	<code>wcscopy</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcpy</code>	<code>&lt;string.h&gt;</code>
<code>wcscopy</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbscopy</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_strcpy.c
// compile with: /W3
// This program uses strcpy
// and strcat to build a phrase.

#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[80];

 // If you change the previous line to
 // char string[20];
 // strcpy and strcat will happily overrun the string
 // buffer. See the examples for strncpy and strncat
 // for safer string handling.

 strcpy(string, "Hello world from "); // C4996
 // Note: strcpy is deprecated; use strcpy_s instead
 strcat(string, "strcpy"); // C4996
 // Note: strcat is deprecated; use strcat_s instead
 strcat(string, "and"); // C4996
 strcat(string, "strcat!"); // C4996
 printf("String = %s\n", string);
}

```

String = Hello world from strcpy and strcat!

## See also

### String manipulation

<a href="#">strcat</a>	<a href="#">wcscat</a>	<a href="#">_mbscat</a>			
<a href="#">strcmp</a>	<a href="#">wcscmp</a>	<a href="#">_mbscmp</a>			
<a href="#">strncat</a>	<a href="#">_strncat_1</a>	<a href="#">wcsncat</a>	<a href="#">_wcsncat_1</a>	<a href="#">_mbsncat</a>	<a href="#">_mbssncat_1</a>
<a href="#">strncmp</a>	<a href="#">wcsncmp</a>	<a href="#">_mbsncmp</a>	<a href="#">_mbssncmp_1</a>		
<a href="#">strncpy</a>	<a href="#">_strncpy_1</a>	<a href="#">wcsncpy</a>	<a href="#">_wcsncpy_1</a>	<a href="#">_mbsncpy</a>	<a href="#">_mbssncpy_1</a>
<a href="#">_strnicmp</a>	<a href="#">_wcsnicmp</a>	<a href="#">_mbsnicmp</a>	<a href="#">_strnicmp_1</a>	<a href="#">_wcsnicmp_1</a>	<a href="#">_mbssnicmp_1</a>
<a href="#">strrchr</a>	<a href="#">wcsrchr</a>	<a href="#">_mbsrchr</a>	<a href="#">_mbssrchr_1</a>		
<a href="#">strspn</a>	<a href="#">wcspn</a>	<a href="#">_mbsspn</a>	<a href="#">_mbsspn_1</a>		

`strcpy_s`, `wcscpy_s`, `_mbscopy_s`, `_mbscopy_s_1`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Copies a string. These versions of `strcpy`, `wcscpy`, `_mbscopy` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

`_mbscopy_s` and `_mbscopy_s_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t strcpy_s(
 char *dest,
 rsize_t dest_size,
 const char *src
);
errno_t wcscpy_s(
 wchar_t *dest,
 rsize_t dest_size,
 const wchar_t *src
);
errno_t _mbscopy_s(
 unsigned char *dest,
 rsize_t dest_size,
 const unsigned char *src
);
errno_t _mbscopy_s_1(
 unsigned char *dest,
 rsize_t dest_size,
 const unsigned char *src,
 _locale_t locale
);
```

```

// Template functions are C++ only:
template <size_t size>
errno_t strcpy_s(
 char (&dest)[size],
 const char *src
); // C++ only
template <size_t size>
errno_t wcscpy_s(
 wchar_t (&dest)[size],
 const wchar_t *src
); // C++ only
template <size_t size>
errno_t _mbscopy_s(
 unsigned char (&dest)[size],
 const unsigned char *src
); // C++ only
template <size_t size>
errno_t _mbscopy_s_l(
 unsigned char (&dest)[size],
 const unsigned char *src,
 _locale_t locale
); // C++ only

```

## Parameters

`dest`

Location of the destination string buffer.

`dest_size`

Size of the destination string buffer in `char` units for narrow and multi-byte functions, and `wchar_t` units for wide functions. This value must be greater than zero and not greater than `RSIZE_MAX`. Ensure that this size accounts for the terminating `NULL` following the string.

`src`

Null-terminated source string buffer.

`Locale`

Locale to use.

## Return value

Zero if successful; otherwise, an error.

### Error conditions

<code>DEST</code>	<code>DEST_SIZE</code>	<code>SRC</code>	RETURN VALUE	CONTENTS OF <code>DEST</code>
<code>NULL</code>	any	any	<code>EINVAL</code>	not modified
any	any	<code>NULL</code>	<code>EINVAL</code>	<code>dest[0]</code> set to 0
any	0, or too small	any	<code>ERANGE</code>	<code>dest[0]</code> set to 0

## Remarks

The `strcpy_s` function copies the contents in the address of `src`, including the terminating null character, to the location that's specified by `dest`. The destination string must be large enough to hold the source string and its terminating null character. The behavior of `strcpy_s` is undefined if the source and destination strings

overlap.

`wcscpy_s` is the wide-character version of `strcpy_s`, and `_mbscopy_s` is the multibyte-character version. The arguments of `wcscpy_s` are wide-character strings. The arguments of `_mbscopy_s` and `_mbscopy_s_1` are multibyte-character strings. These functions behave identically otherwise. `_mbscopy_s_1` is identical to `_mbscopy_s` except that it uses the locale parameter passed in instead of the current locale. For more information, see [locale](#).

If `dest` or `src` is a null pointer, or if the destination string size `dest_size` is too small, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EINVAL` and set `errno` to `EINVAL` when `dest` or `src` is a null pointer, and they return `ERANGE` and set `errno` to `ERANGE` when the destination string is too small.

Upon successful execution, the destination string is always null-terminated.

In C++, use of these functions is simplified by template overloads that can infer buffer length automatically, so that you don't have to specify a size argument. And, they can automatically replace older, less-secure functions with newer, more secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [`\_CrtSetDebugFillThreshold`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscopy_s</code>	<code>strcpy_s</code>	<code>_mbscopy_s</code>	<code>wcscopy_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcpy_s</code>	<code>&lt;string.h&gt;</code>
<code>wcscopy_s</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbscopy_s</code>	<code>&lt;mbstring.h&gt;</code>

These functions are Microsoft-specific. For more compatibility information, see [Compatibility](#).

## Example

Unlike production quality code, this sample calls the secure string functions without checking for errors:

```

// crt_strcpy_s.c
// Compile by using: cl /W4 crt_strcpy_s.c
// This program uses strcpy_s and strcat_s
// to build a phrase.

#include <string.h> // for strcpy_s, strcat_s
#include <stdlib.h> // for _countof
#include <stdio.h> // for printf
#include <errno.h> // for return values

int main(void)
{
 char stringBuffer[80];

 strcpy_s(stringBuffer, _countof(stringBuffer), "Hello world from ");
 strcat_s(stringBuffer, _countof(stringBuffer), "strcpy_s ");
 strcat_s(stringBuffer, _countof(stringBuffer), "and ");
 strcat_s(stringBuffer, _countof(stringBuffer), "strcat_s!");

 printf("stringBuffer = %s\n", stringBuffer);
}

```

```
stringBuffer = Hello world from strcpy_s and strcat_s!
```

When you're building C++ code, the template versions may be easier to use.

```

// crt_wcscpy_s.cpp
// Compile by using: cl /EHsc /W4 crt_wcscpy_s.cpp
// This program uses wcscpy_s and wcscat_s
// to build a phrase.

#include <cstring> // for wcscpy_s, wcscat_s
#include <cstdlib> // for _countof
#include <iostream> // for cout, includes <cstdlib>, <cstring>
#include <errno.h> // for return values

int main(void)
{
 wchar_t stringBuffer[80];
 // using template versions of wcscpy_s and wcscat_s:
 wcscpy_s(stringBuffer, L"Hello world from ");
 wcscat_s(stringBuffer, L"wcscpy_s ");
 wcscat_s(stringBuffer, L"and ");
 // of course we can supply the size explicitly if we want to:
 wcscat_s(stringBuffer, _countof(stringBuffer), L"wcscat_s!");

 std::wcout << L"stringBuffer = " << stringBuffer << std::endl;
}

```

```
stringBuffer = Hello world from wcscpy_s and wcscat_s!
```

## See also

### [String manipulation](#)

<a href="#">strcat</a>	<a href="#">wcscat</a>	<a href="#">_mbscat</a>	<a href="#">_mbscat_1</a>
<a href="#">strcmp</a>	<a href="#">wcscmp</a>	<a href="#">_mbscmp</a>	<a href="#">_mbscmp_1</a>
<a href="#">strncat_s</a>	<a href="#">_strncat_s_1</a>	<a href="#">wcsncat_s</a>	<a href="#">_wcsncat_s_1</a>
<a href="#">_mbsncat_s</a>		<a href="#">_mbsncat_s_1</a>	

`strncpy_s`, `_strncpy_s_l`, `wcsncpy_s`, `_wcsncpy_s_l`, `_mbsncpy_s`, `_mbsncpy_s_l`  
`_strnicmp`, `_wcsnicmp`, `_mbsnicmp`, `_strnicmp_l`, `_wcsnicmp_l`, `_mbsnicmp_l`  
`strrchr`, `wcsrchr`, `_mbsrchr`, `_mbsrchr_l`  
`strspn`, `wcsspn`, `_mbsspn`, `_mbsspn_l`

`strcspn`, `wcscspn`, `_mbscspn`, `_mbscspn_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the index of the first occurrence in a string, of a character that belongs to a set of characters.

#### IMPORTANT

`_mbschr` and `_mbschr_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
size_t strcspn(
 const char *str,
 const char *strCharSet
);
size_t wcscspn(
 const wchar_t *str,
 const wchar_t *strCharSet
);
size_t _mbscspn(
 const unsigned char *str,
 const unsigned char *strCharSet
);
size_t _mbscspn_l(
 const unsigned char *str,
 const unsigned char *strCharSet,
 _locale_t locale
);
```

### Parameters

`str`

Null-terminated searched string.

`strCharSet`

Null-terminated character set.

`Locale`

Locale to use.

## Return value

These functions return the index of the first character in `str` that is in `strCharSet`. If none of the characters in `str` is in `strCharSet`, then the return value is the length of `str`.

No return value is reserved to indicate an error.

## Remarks

`wcscspn` and `_mbscspn` are wide-character and multibyte-character versions of `strcspn`. The arguments of `wcscspn` are wide-character strings. The arguments and return value of `_mbscspn` are multibyte-character strings.

`_mbscspn` validates its parameters. If either `str` or `strCharSet` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns 0 and sets `errno` to `EINVAL`. `strcspn` and `wcsncpy` don't validate their parameters. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscspn</code>	<code>strcspn</code>	<code>_mbscspn</code>	<code>wcsncpy</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcspn</code>	<code>&lt;string.h&gt;</code>
<code>wcsncpy</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_mbscspn</code> , <code>_mbscspn_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strcspn.c

#include <string.h>
#include <stdio.h>

void test(const char * str, const char * strCharSet)
{
 int pos = strcspn(str, strCharSet);
 printf("strcspn(\"%s\", \"%s\") = %d\n", str, strCharSet, pos);
}

int main(void)
{
 test("xyzbxz", "abc");
 test("xyzbxz", "xyz");
 test("xyzbxz", "no match");
 test("xyzbxz", "");
 test("", "abc");
 test("", "");
}
```

```
strcspn("xyzbxz", "abc") = 3
strcspn("xyzbxz", "xyz") = 0
strcspn("xyzbxz", "no match") = 6
strcspn("xyzbxz", "") = 6
strcspn("", "abc") = 0
strcspn("", "") = 0
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_strncat](#), [\\_strncat\\_l](#), [wcsncat](#), [\\_wcsncat\\_l](#), [\\_mbsncat](#), [\\_mbsncat\\_l](#)  
[strncmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_l](#)  
[strncpy](#), [\\_strncpy\\_l](#), [wcsncpy](#), [\\_wcsncpy\\_l](#), [\\_mbsncpy](#), [\\_mbsncpy\\_l](#)  
[\\_strnicmp](#), [\\_wcsnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_l](#), [\\_wcsnicmp\\_l](#), [\\_mbsnicmp\\_l](#)  
[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_l](#)  
[strspn](#), [wcspn](#), [\\_mbsspn](#), [\\_mbsspn\\_l](#)

## `_strdate`, `_wstrdate`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copy current system date to a buffer. More secure versions of these functions are available; see [`\_strdate\_s`](#), [`\_wstrdate\_s`](#).

## Syntax

```
char *_strdate(
 char *datestr
);
wchar_t *_wstrdate(
 wchar_t *datestr
);
template <size_t size>
char *_strdate(
 char (&datestr)[size]
); // C++ only
template <size_t size>
wchar_t *_wstrdate(
 wchar_t (&datestr)[size]
); // C++ only
```

## Parameters

`datestr`

A pointer to a buffer containing the formatted date string.

## Return value

Each of these functions returns a pointer to the resulting character string `datestr`.

## Remarks

More secure versions of these functions are available; see [`\_strdate\_s`](#), [`\_wstrdate\_s`](#). It's recommended that the more secure functions be used wherever possible.

The `_strdate` function copies the current system date to the buffer pointed to by `datestr`, formatted *mm/dd/yy*, where *mm* is two digits representing the month, *dd* is two digits representing the day, and *yy* is the last two digits of the year. For example, the string `12/05/99` represents December 5, 1999. The buffer must be at least 9 bytes long.

If `datestr` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

`_wstrdate` is a wide-character version of `_strdate`; the argument and return value of `_wstrdate` are wide-character strings. These functions behave identically otherwise.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tstrdate</code>	<code>_strdate</code>	<code>_strdate</code>	<code>_wstrdate</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strdate</code>	<code>&lt;time.h&gt;</code>
<code>_wstrdate</code>	<code>&lt;time.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// strdate.c
// compile with: /W3
#include <time.h>
#include <stdio.h>
int main()
{
 char tmpbuf[9];

 // Set time zone from TZ environment variable. If TZ is not set,
 // the operating system is queried to obtain the default value
 // for the variable.
 //
 _tzset();

 printf("OS date: %s\n", _strdate(tmpbuf)); // C4996
 // Note: _strdate is deprecated; consider using _strdate_s instead
}
```

```
OS date: 04/25/03
```

## See also

### Time management

<code>asctime</code>	<code>_wasctime</code>
<code>ctime</code>	<code>_ctime32</code>
	<code>_ctime64</code>
<code>_wctime</code>	<code>_wctime32</code>
	<code>_wctime64</code>
<code>gmtime</code>	<code>_gmtime32</code>
	<code>_gmtime64</code>
<code>localtime</code>	<code>_localtime32</code>
	<code>_localtime64</code>
<code>mktime</code>	<code>_mktime32</code>
	<code>_mktime64</code>
<code>time</code>	<code>_time32</code>
	<code>_time64</code>
<code>_tzset</code>	

# `_strdate_s`, `_wstrdate_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copy the current system date to a buffer. These functions are versions of `_strdate`, `_wstrdate` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t _strdate_s(
 char *buffer,
 size_t size
);
errno_t _wstrdate_s(
 wchar_t *buffer,
 size_t size
);
template <size_t size>
errno_t _strdate_s(
 char (&buffer)[size]
); // C++ only
template <size_t size>
errno_t _wstrdate_s(
 wchar_t (&buffer)[size]
); // C++ only
```

## Parameters

`buffer`

A pointer to a buffer to put the formatted date string.

`size`

Size of the buffer in character units.

## Return value

Zero if successful. The return value is an error code if there's a failure. Error codes are defined in ERRNO.H; see table below for the exact errors generated by this function. For more information on error codes, see [errno](#).

## Error conditions

BUFFER	SIZE	RETURN	CONTENTS OF BUFFER
NULL	(any)	EINVAL	Not modified
Not NULL (pointing to valid buffer)	0	EINVAL	Not modified
Not NULL (pointing to valid buffer)	$0 < \text{size} < 9$	EINVAL	Empty string
Not NULL (pointing to valid buffer)	$\text{size} \geq 9$	0	Current date formatted as specified in the remarks

# Security issues

If you pass in an invalid, non-NULL value for `buffer`, it results in an access violation if the `size` parameter is greater than nine.

Passing a value for `size` greater than the actual size of `buffer` results in a buffer overrun.

## Remarks

These functions provide more secure versions of `_strdate` and `_wstrdate`. The `_strdate_s` function copies the current system date to the buffer pointed to by `buffer`. It's formatted `mm/dd/yy`, where `mm` is the two-digit month, `dd` is the two-digit day, and `yy` is the last two digits of the year. For example, the string `12/05/99` represents December 5, 1999. The buffer must be at least nine characters long.

`_wstrdate_s` is a wide-character version of `_strdate_s`; the argument and return value of `_wstrdate_s` are wide-character strings. These functions behave identically otherwise.

When `buffer` is a `NULL` pointer, or `size` is fewer than nine characters, the invalid parameter handler is invoked. It's described in [Parameter validation](#). If execution is allowed to continue, these functions return -1. They set `errno` to `EINVAL` if the buffer is `NULL` or if `size` is less than or equal to 0. Or, they set `errno` to `ERANGE` if `size` is less than 9.

In C++, use of these functions is simplified by template overloads. The overloads can infer buffer length automatically, which eliminates the need to specify a `size` argument. And, they can automatically replace non-secure functions with their newer, more secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [`\_CrtSetDebugFillThreshold`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mapping:

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstrdate_s</code>	<code>_strdate_s</code>	<code>_strdate_s</code>	<code>_wstrdate_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strdate</code>	<code>&lt;time.h&gt;</code>
<code>_wstrdate</code>	<code>&lt;time.h&gt; or &lt;wchar.h&gt;</code>
<code>_strdate_s</code>	<code>&lt;time.h&gt;</code>

## Example

See the example for [`time`](#).

## See also

### Time management

`asctime_s`, `_wasctime_s`  
`ctime_s`, `_ctime32_s`, `_ctime64_s`, `_wctime_s`, `_wctime32_s`, `_wctime64_s`  
`gmtime_s`, `_gmtime32_s`, `_gmtime64_s`  
`localtime_s`, `_localtime32_s`, `_localtime64_s`  
`mktime`, `_mktime32`, `_mktime64`  
`time`, `_time32`, `_time64`  
`_tzset`

`_strdec`, `_wcsdec`, `_mbsdec`, `_mbsdec_1`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Moves a string pointer back one character.

#### IMPORTANT

`mbsdec` and `mbsdec_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
unsigned char *_strdec(
 const unsigned char *start,
 const unsigned char *current
);
unsigned wchar_t *_wcsdec(
 const unsigned wchar_t *start,
 const unsigned wchar_t *current
);
unsigned char *_mbsdec(
 const unsigned char *start,
 const unsigned char *current
);
unsigned char *_mbsdec_1(
 const unsigned char *start,
 const unsigned char *current,
 _locale_t locale
);
```

### Parameters

`start`

Pointer to any character (or for `_mbsdec` and `_mbsdec_1`, the first byte of any multibyte character) in the source string; `start` must precede `current` in the source string.

`current`

Pointer to any character (or for `_mbsdec` and `_mbsdec_1`, the first byte of any multibyte character) in the source string; `current` must follow `start` in the source string.

`locale`

Locale to use.

## Return value

`_mbsdec`, `_mbsdec_1`, `_strdec`, and `_wcsdec` each return a pointer to the character that immediately precedes `current`; `_mbsdec` returns `NULL` if the value of `start` is greater than or equal to that of `current`. `_tcsdec` maps to one of these functions and its return value depends on the mapping.

## Remarks

The `_mbsdec` and `_mbsdec_1` functions return a pointer to the first byte of the multibyte character that

immediately precedes `current` in the string that contains `start`.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#), [\\_wsetlocale](#). `_mbsdec` recognizes multibyte-character sequences according to the locale that's currently in use, while `_mbsdec_1` is identical except that it instead uses the locale parameter that's passed in. For more information, see [Locale](#).

If `start` or `current` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `EINVAL` and sets `errno` to `EINVAL`.

#### IMPORTANT

These functions might be vulnerable to buffer overrun threats. Buffer overruns can be used for system attacks because they can cause an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsdec</code>	<code>_strdec</code>	<code>_mbsdec</code>	<code>_wcsdec</code>

`_strdec` and `_wcsdec` are single-byte-character and wide-character versions of `_mbsdec` and `_mbsdec_1`. `_strdec` and `_wcsdec` are provided only for this mapping and shouldn't be used otherwise.

For more information, see [Using generic-text mappings](#) and [Generic-text mappings](#).

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADER
<code>_mbsdec</code>	<code>&lt;mbstring.h&gt;</code>	<code>&lt;mbctype.h&gt;</code>
<code>_mbsdec_1</code>	<code>&lt;mbstring.h&gt;</code>	<code>&lt;mbctype.h&gt;</code>
<code>_strdec</code>	<code>&lt;tchar.h&gt;</code>	
<code>_wcsdec</code>	<code>&lt;tchar.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## Example

The following example shows a use of `_tcsdec`.

```

// crt_tcsdec.cpp
// Compile by using: cl /EHsc crt_tcsdec.cpp
#include <iostream>
#include <tchar.h>
using namespace std;

int main()
{
 const TCHAR *str = _T("12345");
 cout << "str: " << str << endl;

 const TCHAR *str2;
 str2 = str + 2;
 cout << "str2: " << str2 << endl;

 TCHAR *answer;
 answer = _tcsdec(str, str2);
 cout << "answer: " << answer << endl;

 return (0);
}

```

The following example shows a use of `_mbsdec`.

```

// crt_mbsdec.cpp
// Compile by using: cl /EHsc crt_mbsdec.c
#include <iostream>
#include <mbstring.h>
using namespace std;

int main()
{
 char *str = "12345";
 cout << "str: " << str << endl;

 char *str2;
 str2 = str + 2;
 cout << "str2: " << str2 << endl;

 unsigned char *answer;
 answer = _mbsdec(reinterpret_cast<unsigned char *>(str), reinterpret_cast<unsigned char *>(str2));

 cout << "answer: " << answer << endl;

 return (0);
}

```

## See also

### String manipulation

<code>_strinc</code>	<code>_wcsinc</code>	<code>_mbsinc</code>	<code>_mbsinc_l</code>
<code>_strnnextc</code>	<code>_wcsnnextc</code>	<code>_mbsnnextc</code>	<code>_mbsnnextc_l</code>
<code>_strninc</code>	<code>_wcsninc</code>	<code>_mbsninc</code>	<code>_mbsninc_l</code>

# `strup`, `wcsdup`

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The Microsoft-implemented POSIX function names `strup` and `wcsdup` are deprecated aliases for the [`\_strup`](#) and [`\_wcsdup`](#) functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use [`\_strup`](#) and [`\_wcsdup`](#) instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# `_strup`, `_wcsdup`, `_mbsdup`

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Duplicates strings.

## IMPORTANT

`_mbsdup` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strup(
 const char *strSource
);
wchar_t *_wcsdup(
 const wchar_t *strSource
);
unsigned char *_mbsdup(
 const unsigned char *strSource
);
```

## Parameters

`strSource`

Null-terminated source string.

## Return value

Each of these functions returns a pointer to the storage location for the copied string or `NULL` if storage can't be allocated.

## Remarks

The `_strup` function calls `malloc` to allocate storage space for a copy of `strSource` and then copies `strSource` to the allocated space.

`_wcsdup` and `_mbsdup` are wide-character and multibyte-character versions of `_strup`. The arguments and return value of `_wcsdup` are wide-character strings. The arguments and return value of `_mbsdup` are multibyte-character strings. These three functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsdup</code>	<code>_strup</code>	<code>_mbsdup</code>	<code>_wcsdup</code>

Because `_strup` calls `malloc` to allocate storage space for the copy of `strsource`, it's good practice always to

release this memory by calling the `free` routine on the pointer that's returned by the call to `_strup`.

If `_DEBUG` and `_CRTDBG_MAP_ALLOC` are defined, `_strup` and `_wcstrup` are replaced by calls to `_strup_dbg` and `_wcstrup_dbg`, to allow for debugging memory allocations. For more information, see `_strup_dbg`, `_wcstrup_dbg`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strup</code>	<code>&lt;string.h&gt;</code>
<code>_wcstrup</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mstrup</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strup.c

#include <string.h>
#include <stdio.h>

int main(void)
{
 char buffer[] = "This is the buffer text";
 char *newstring;
 printf("Original: %s\n", buffer);
 newstring = _strup(buffer);
 printf("Copy: %s\n", newstring);
 free(newstring);
}
```

```
Original: This is the buffer text
Copy: This is the buffer text
```

## See also

### String manipulation

<code>memset</code>	<code>wmemset</code>
<code>strcat</code>	<code>wcscat</code>
<code>_mbscat</code>	
<code>strcmp</code>	<code>wcscmp</code>
<code>_mbscmp</code>	
<code>strncat</code>	<code>_strncat_1</code>
<code>wcsncat</code>	<code>_wcsncat_1</code>
<code>_mbsncat</code>	<code>_mbsncat_1</code>
<code>strncmp</code>	<code>wcsncmp</code>
<code>_mbsncmp</code>	<code>_mbsncmp_1</code>
<code>strncpy</code>	<code>_strncpy_1</code>
<code>wcsncpy</code>	<code>_wcsncpy_1</code>
<code>_mbsncpy</code>	<code>_mbsncpy_1</code>
<code>_strnicmp</code>	<code>_wcsnicmp</code>
<code>_mbsnicmp</code>	<code>_strnicmp_1</code>
<code>_wcsnicmp</code>	<code>_wcsnicmp_1</code>
<code>_mbsnicmp_1</code>	
<code>strrchr</code>	<code>wcsrchr</code>
<code>_mbsrchr</code>	<code>_mbsrchr_1</code>
<code>strspn</code>	<code>wcsspn</code>
<code>_mbsspn</code>	<code>_mbsspn_1</code>

# `_strup_dbg`, `_wstrup_dbg`

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Versions of `strup` and `wstrup` that use the debug version of `malloc`.

## Syntax

```
char *_strup_dbg(
 const char *strSource,
 int blockType,
 const char *filename,
 int linenumber
)
wchar_t *_wstrup_dbg(
 const wchar_t *strSource,
 int blockType,
 const char *filename,
 int linenumber
)
```

### Parameters

`strSource`

Null-terminated source string.

`blockType`

Requested type of memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to name of source file that requested allocation operation or `NULL`.

`Linenum`

Line number in source file where allocation operation was requested or `NULL`.

## Return value

Each of these functions returns a pointer to the storage location for the copied string or `NULL` if storage can't be allocated.

## Remarks

The `strup_dbg` and `wstrup_dbg` functions are identical to `strup` and `wstrup` except that, when `_DEBUG` is defined, these functions use the debug version of `malloc`, `malloc_dbg`, to allocate memory for the duplicated string. For information on the debugging features of `malloc_dbg`, see [\\_malloc\\_dbg](#).

You don't need to call these functions explicitly in most cases. Instead, you can define the flag `_CRTDBG_MAP_ALLOC`. When `_CRTDBG_MAP_ALLOC` is defined, calls to `strup` and `wstrup` are remapped to `strup_dbg` and `wstrup_dbg`, respectively, with the `blockType` set to `_NORMAL_BLOCK`. Thus, you don't need to call these functions explicitly unless you want to mark the heap blocks as `_CLIENT_BLOCK`. For more information on block types, see [Types of blocks on the debug heap](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsdup_dbg</code>	<code>_strup_dbg</code>	<code>_mbsdup</code>	<code>_wcstrup_dbg</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strup_dbg</code> , <code>_wcstrup_dbg</code>	<code>&lt;crtdbg.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All debug versions of the [C run-time libraries](#).

## See also

[String manipulation](#)

`_strup`, `_wcstrup`, `_mbsdup`

[Debug versions of heap allocation functions](#)

`strerror`, `_strerror`, `_wcstrerror`, `_wcserror`

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Gets a system error message string (`strerror`, `_wcstrerror`) or formats a user-supplied error message string (`_strerror`, `_wcserror`). More secure versions of these functions are available; see `strerror_s`, `_strerror_s`, `_wcstrerror_s`, `_wcserror_s`.

## Syntax

```
char * strerror(
 int errnum);

char * _strerror(
 const char *strErrMsg);

wchar_t * _wcstrerror(
 int errnum);

wchar_t * __wcstrerror(
 const wchar_t *strErrMsg);
```

### Parameters

`errnum`

Error number.

`strErrMsg`

User-supplied message.

## Return value

All of these functions return a pointer to an error-message string, in a thread-local storage buffer owned by the runtime. Later calls on the same thread can overwrite this string.

## Remarks

The `strerror` function maps `errnum` to an error-message string and returns a pointer to the string. The `strerror` and `_strerror` functions don't actually print the message. To print, call an output function such as `fprintf`:

```
if ((_access("datafile", 2) == -1)
 fprintf(stderr, _strerror(NULL));
```

If `strErrMsg` is passed as `NULL`, `_strerror` returns a pointer to a string. It contains the system error message for the last library call that produced an error. The error-message string is terminated by the newline character ('\n'). When `strErrMsg` isn't `NULL`, the string contains, in order: your `strErrMsg` string, a colon, a space, the system error message, and a newline character. Your string message can be, at most, 94 characters long, in either narrow (`_strerror`) or wide (`__wcstrerror`) characters.

The actual error number for `_strerror` is stored in the variable `errno`. To produce accurate results, call `_strerror` immediately after a library routine returns an error. Otherwise, later calls to library routines may

overwrite the `errno` value.

`_wcsetError` and `_wcsetError` are wide-character versions of `strerror` and `_strerror`, respectively.

`_strerror`, `_wcsetError`, and `_wcsetError` are Microsoft-specific, not part of the Standard C library. We don't recommend you use them where you want portable code. For Standard C compatibility, use `strerror` instead.

To get error strings, we recommend `strerror` or `_wcsetError` instead of the deprecated macros `_sys_errlist` and `_sys_nerr` and the deprecated internal functions `_sys_errlist` and `_sys_nerr`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsetError</code>	<code>strerror</code>	<code>strerror</code>	<code>_wcsetError</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strerror</code>	<code>&lt;string.h&gt;</code>
<code>_strerror</code>	<code>&lt;string.h&gt;</code>
<code>_wcsetError</code> , <code>_wcsetError</code>	<code>&lt;string.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for  [perror](#).

## See also

### String manipulation

`clearerr`  
`ferror`  
`perror`, `_wperror`

`strerror_s`, `_strerror_s`, `_wcstrerror_s`,  
`_wcstrerror_s`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Get a system error message (`strerror_s`, `_wcstrerror_s`) or print a user-supplied error message (`_strerror_s`, `_wcstrerror_s`). These functions are versions of `strerror`, `_strerror`, `_wcstrerror`, `_wcstrerror` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t strerror_s(
 char *buffer,
 size_t sizeInBytes,
 int errnum
);
errno_t _strerror_s(
 char *buffer,
 size_t sizeInBytes,
 const char *strErrMsg
);
errno_t _wcstrerror_s(
 wchar_t *buffer,
 size_t sizeInWords,
 int errnum
);
errno_t __wcstrerror_s(
 wchar_t *buffer,
 size_t sizeInWords,
 const wchar_t *strErrMsg
);
```

```
template <size_t size>
errno_t strerror_s(
 char (&buffer)[size],
 int errnum
); // C++ only
template <size_t size>
errno_t _strerror_s(
 char (&buffer)[size],
 const char *strErrMsg
); // C++ only
template <size_t size>
errno_t _wcstrerror_s(
 wchar_t (&buffer)[size],
 int errnum
); // C++ only
template <size_t size>
errno_t __wcstrerror_s(
 wchar_t (&buffer)[size],
 const wchar_t *strErrMsg
); // C++ only
```

## Parameters

`buffer`

Buffer to hold error string.

`sizeInBytes`

The number of bytes in the buffer.

`sizeInWords`

The number of words in the buffer.

`errnum`

Error number.

`strErrMsg`

User-supplied message.

## Return value

Zero if successful, an error code on failure.

### Error conditions

<code>BUFFER</code>	<code>SIZEINBYTES / SIZEINWORDS</code>	<code>STRERRMSG</code>	CONTENTS OF <code>BUFFER</code>
<code>NULL</code>	any	any	n/a
any	0	any	not modified

## Remarks

The `strerror_s` function is thread-safe.

The `strerror_s` function maps `errnum` to an error-message string, returning the string in `buffer`. `_strerror_s` doesn't take the error number; it uses the current value of `errno` to determine the appropriate message. The message isn't printed or displayed by `strerror_s` or `_strerror_s`. To output the message, you need to call an output function such as `fprintf`:

```
if ((_access("datafile",2) == -1)
{
 _strerror_s(buffer, 80, NULL);
 fprintf(stderr, buffer);
}
```

If `strErrMsg` is `NULL`, `_strerror_s` returns a string in `buffer` that contains the system error message for the last library call that produced an error. The error-message string is terminated by the newline character ('\n'). If `strErrMsg` isn't equal to `NULL`, then `_strerror_s` returns a string in `buffer` that contains (in order) your string message, a colon, a space, the system error message for the last library call that produced an error, and a newline character. Your string message can be, at most, 94 characters long.

These functions truncate the error message if its length exceeds the size of the buffer - 1. The resulting string in `buffer` will always be null-terminated.

The actual error number for `_strerror_s` is stored in the variable `errno`. The system error messages are accessed through the variable `_sys_errlist`, which is an array of messages ordered by error number.

`_strerror_s` accesses the appropriate error message by using the `errno` value as an index to the variable `_sys_errlist`. The value of the variable `_sys_nerr` is defined as the maximum number of elements in the `_sys_errlist` array. To produce accurate results, call `_strerror_s` immediately after a library routine return with an error. Otherwise, subsequent calls to `strerror_s` or `_strerror_s` can overwrite the `errno` value.

`_wcsetError_s` and `_wcserror_s` are wide-character versions of `strerror_s` and `_strerror_s`, respectively.

These functions validate their parameters. If buffer is `NULL` or if the size parameter is 0, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `EINVAL` and set `errno` to `EINVAL`.

`_strerror_s`, `_wcsetError_s`, and `_wcserror_s` aren't part of the ANSI definition but are instead Microsoft extensions to it. Don't use them where portability is desired; for ANSI compatibility, use `strerror_s` instead.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [`\_CrtSetDebugFillThreshold`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsetError_s</code>	<code>strerror_s</code>	<code>strerror_s</code>	<code>_wcsetError_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strerror_s</code> , <code>_strerror_s</code>	<code>&lt;string.h&gt;</code>
<code>_wcsetError_s</code> , <code>_wcserror_s</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [`perror`](#).

## See also

### String manipulation

`clearerr`  
`ferror`  
`perror`, `_wperror`

`strftime`, `wcsftime`, `_strftime_l`, `_wcsftime_l`

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Format a time string.

## Syntax

```
size_t strftime(
 char *strDest,
 size_t maxsize,
 const char *format,
 const struct tm *timeptr
);
size_t _strftime_l(
 char *strDest,
 size_t maxsize,
 const char *format,
 const struct tm *timeptr,
 _locale_t locale
);
size_t wcsftime(
 wchar_t *strDest,
 size_t maxsize,
 const wchar_t *format,
 const struct tm *timeptr
);
size_t _wcsftime_l(
 wchar_t *strDest,
 size_t maxsize,
 const wchar_t *format,
 const struct tm *timeptr,
 _locale_t locale
);
```

### Parameters

`strDest`

Output string.

`maxsize`

Size of the `strDest` buffer, measured in characters (`char` or `wchar_t`).

`format`

Format-control string.

`timeptr`

`tm` data structure.

`Locale`

The locale to use.

## Return value

`strftime` returns the number of characters placed in `strDest` and `wcsftime` returns the corresponding number of wide characters.

If the total number of characters, including the terminating null, is more than `maxsize`, both `strftime` and `wcsftime` return 0 and the contents of `strDest` are indeterminate.

The number of characters in `strDest` is equal to the number of literal characters in `format`, plus any characters that may be added to `format` via formatting codes. The terminating null of a string isn't counted in the return value.

## Remarks

The `strftime` and `wcsftime` functions format the `tm` time value in `timeptr` according to the supplied `format` argument and store the result in the buffer `strDest`. At most, `maxsize` characters are placed in the string. For a description of the fields in the `timeptr` structure, see [asctime](#). `wcsftime` is the wide-character equivalent of `strftime`; its string-pointer argument points to a wide-character string. These functions behave identically otherwise.

This function validates its parameters. If `strDest`, `format`, or `timeptr` is a null pointer, or if the `tm` data structure addressed by `timeptr` is invalid (for example, if it contains out of range values for the time or date), or if the `format` string contains an invalid formatting code, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns 0 and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tcsftime</code>	<code>strftime</code>	<code>strftime</code>	<code>wcsftime</code>

The `format` argument consists of one or more codes; as in `printf`, the formatting codes are preceded by a percent sign (%). Characters that don't begin with % are copied unchanged to `strDest`. The `LC_TIME` category of the current locale affects the output formatting of `strftime`. (For more information on `LC_TIME`, see [setlocale](#).) The `strftime` and `wcsftime` functions use the currently set locale. The `_strftime_l` and `_wcsftime_l` versions of these functions are identical except that they take the locale as a parameter and use that instead of the currently set locale. For more information, see [Locale](#).

The `strftime` functions support these formatting codes:

CODE	REPLACEMENT STRING
<code>%a</code>	Abbreviated weekday name in the locale
<code>%A</code>	Full weekday name in the locale
<code>%b</code>	Abbreviated month name in the locale
<code>%B</code>	Full month name in the locale
<code>%c</code>	Date and time representation appropriate for locale
<code>%C</code>	The year divided by 100 and truncated to an integer, as a decimal number (00–99)

CODE	REPLACEMENT STRING
%d	Day of month as a decimal number (01 - 31)
%D	Equivalent to %m/%d/%y
%e	Day of month as a decimal number (1 - 31), where single digits are preceded by a space
%F	Equivalent to %Y-%m-%d
%g	The last 2 digits of the ISO 8601 week-based year as a decimal number (00 - 99)
%G	The ISO 8601 week-based year as a decimal number
%h	Abbreviated month name (equivalent to %b )
%H	Hour in 24-hour format (00 - 23)
%I	Hour in 12-hour format (01 - 12)
%j	Day of the year as a decimal number (001 - 366)
%m	Month as a decimal number (01 - 12)
%M	Minute as a decimal number (00 - 59)
%n	A newline character ( \n )
%p	The locale's A.M./P.M. indicator for 12-hour clock
%r	The locale's 12-hour clock time
%R	Equivalent to %H:%M
%S	Second as a decimal number (00 - 59)
%t	A horizontal tab character ( \t )
%T	Equivalent to %H:%M:%S , the ISO 8601 time format
%u	ISO 8601 weekday as a decimal number (1 - 7; Monday is 1)
%U	Week number of the year as a decimal number (00 - 53), where the first Sunday is the first day of week 1
%V	ISO 8601 week number as a decimal number (00 - 53)
%w	Weekday as a decimal number (0 - 6; Sunday is 0)

CODE	REPLACEMENT STRING
%W	Week number of the year as a decimal number (00 - 53), where the first Monday is the first day of week 1
%x	Date representation for the locale
%X	Time representation for the locale
%y	Year without century, as decimal number (00 - 99)
%Y	Year with century, as decimal number
%z	The offset from UTC in ISO 8601 format; no characters if time zone is unknown
%Z	Either the locale's time-zone name or time zone abbreviation, depending on registry settings; no characters if time zone is unknown
%%	Percent sign

As in the `printf` function, the `#` flag may prefix any formatting code. In that case, the meaning of the format code is changed as follows.

FORMAT CODE	MEANING
%#a , %#A , %#b , %#B , %#g , %#G , %#h , %#n , %#p , %#t , %#u , %#w , %#X , %#z , %#Z , %#%	# flag is ignored.
%#c	Long date and time representation, appropriate for the locale. For example: "Tuesday, March 14, 1995, 12:41:29".
%#x	Long date representation, appropriate to the locale. For example: "Tuesday, March 14, 1995".
%#d , %#D , %#e , %#F , %#H , %#I , %#j , %#m , %#M , %#r , %#R , %#S , %#T , %#U , %#V , %#W , %#y , %#Y	Remove leading zeros or spaces (if any).

The ISO 8601 week and week-based year produced by `%v`, `%g`, and `%G`, uses a week that begins on Monday. Week 1 is the week that contains the fourth day of January, which is the first week that includes at least four days of the year. If the first Monday of the year is the 2nd, 3rd, or 4th, the preceding days are part of the last week of the preceding year. For those days, `%v` is replaced by 53, and both `%g` and `%G` are replaced by the digits of the preceding year.

#### NOTE

When using one of the `strftime` functions with a `tm` pointer returned from `gmtime`, the values printed via the `%z` and `%z` specifiers will not be accurate. This is because the `tm` struct as specified by the C Standard does not contain the information for time zone name nor offset. Instead, the timezone information is populated via the global variables `_timezone` and `_dstbias`.

# Requirements

ROUTINE	REQUIRED HEADER
<code>strftime</code>	<code>&lt;time.h&gt;</code>
<code>wcsftime</code>	<code>&lt;time.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_strftime_l</code>	<code>&lt;time.h&gt;</code>
<code>_wcsftime_l</code>	<code>&lt;time.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

The `_strftime_l` and `_wcsftime_l` functions are Microsoft-specific. For more compatibility information, see [Compatibility](#).

## Example

See the example for [time](#).

## See also

[Locale](#)

[Time management](#)

[String manipulation](#)

[localeconv](#)

[setlocale](#), [\\_wsetlocale](#)

[strcoll](#) functions

[strxfrm](#), [wcsxfrm](#), [\\_strxfrm\\_l](#), [\\_wcsxfrm\\_l](#)

# `stricmp`, `wcsicmp`

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The Microsoft-specific function names `stricmp` and `wcsicmp` are deprecated aliases for the [`\_stricmp`](#) and [`\_wcsicmp`](#) functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use [`\_stricmp`](#) or [`\_wcsicmp`](#) instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_strcmp`, `_wcsicmp`, `_mbsicmp`, `_strcmp_l`,  
`_wcsicmp_l`, `_mbsicmp_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Performs a case-insensitive comparison of strings.

#### IMPORTANT

`_mbstrcmp` and `_mbstrcmp_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _strcmp(
 const char *string1,
 const char *string2
);
int _wcsicmp(
 const wchar_t *string1,
 const wchar_t *string2
);
int _mbsicmp(
 const unsigned char *string1,
 const unsigned char *string2
);
int _strcmp_l(
 const char *string1,
 const char *string2,
 _locale_t locale
);
int _wcsicmp_l(
 const wchar_t *string1,
 const wchar_t *string2,
 _locale_t locale
);
int _mbstrcmp_l(
 const unsigned char *string1,
 const unsigned char *string2,
 _locale_t locale
);
```

#### Parameters

`string1`, `string2`

Null-terminated strings to compare.

`Locale`

Locale to use.

## Return value

The return value indicates the relation of `string1` to `string2` as follows.

RETURN VALUE	DESCRIPTION
< 0	<code>string1</code> less than <code>string2</code>
0	<code>string1</code> identical to <code>string2</code>
> 0	<code>string1</code> greater than <code>string2</code>

On an error, `_mbsicmp` returns `_NLSCMPERROR`, which is defined in `<string.h>` and `<mbstring.h>`.

## Remarks

The `_stricmp` function compares `string1` and `string2` after converting each character to lowercase, and returns a value indicating their relationship. `_stricmp` differs from `_stricoll` in that the `_stricmp` comparison is only affected by `LC_CTYPE`, which determines which characters are upper and lowercase. The `_stricoll` function compares strings according to both the `LC_CTYPE` and `LC_COLLATE` categories of the locale, which includes both the case and the collation order. For more information about the `LC_COLLATE` category, see `setlocale` and [Locale categories](#). The versions of these functions without the `_1` suffix use the current locale for locale-dependent behavior. The versions with the suffix are identical except that they use the locale passed in instead. If the locale hasn't been set, the C locale is used. For more information, see [Locale](#).

### NOTE

`_stricmp` is equivalent to `_strcmpl`. They can be used interchangeably but `_stricmp` is the preferred standard.

The `_strcmpl` function is equivalent to `_stricmp` and is provided for backward compatibility only.

Because `_stricmp` does lowercase comparisons, it may result in unexpected behavior.

To illustrate when case conversion by `_stricmp` affects the outcome of a comparison, assume that you have the two strings `JOHNSTON` and `JOHN_HENRY`. The string `JOHN_HENRY` will be considered less than `JOHNSTON` because the "H" has a lower ASCII value than a lowercase S. In fact, any character that has an ASCII value between 91 and 96 will be considered less than any letter.

If the `strcmp` function is used instead of `_stricmp`, `JOHN_HENRY` will be greater than `JOHNSTON`.

`_wcsicmp` and `_mbsicmp` are wide-character and multibyte-character versions of `_stricmp`. The arguments and return value of `_wcsicmp` are wide-character strings. The arguments and return value of `_mbsicmp` are multibyte-character strings. `_mbsicmp` recognizes multibyte-character sequences according to the current multibyte code page and returns `_NLSCMPERROR` on an error. For more information, see [Code pages](#). These three functions behave identically otherwise.

`_wcsicmp` and `wcsicmp` behave identically except that `wcsicmp` doesn't convert its arguments to lowercase before comparing them. `_mbsicmp` and `_mbscmp` behave identically except that `_mbscmp` doesn't convert its arguments to lowercase before comparing them.

You'll need to call `setlocale` for `_wcsicmp` to work with Latin 1 characters. The C locale is in effect by default, so, for example, ä won't compare equal to Ä. Call `setlocale` with any locale other than the C locale before the call to `_wcsicmp`. The following sample demonstrates how `_wcsicmp` is sensitive to the locale:

```
// crt_strcmp_locale.c
By default, this function's global state is scoped to the application. To change this behavior, see [Global
state in the CRT](../global-state.md).

#include <string.h>
#include <stdio.h>
#include <locale.h>

int main() {
 setlocale(LC_ALL,"C"); // in effect by default
 printf("\n%d", _wcsicmp(L"ä", L"Ä")); // compare fails
 setlocale(LC_ALL,"");
 printf("\n%d", _wcsicmp(L"ä", L"Ä")); // compare succeeds
}
```

An alternative is to call `_create_locale`, `_wcreate_locale` and pass the returned locale object as a parameter to `_wcsicmp_l`.

All of these functions validate their parameters. If either `string1` or `string2` are null pointers, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`.

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsicmp</code>	<code>_strcmp</code>	<code>_mbstrcmp</code>	<code>_wcsicmp</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strcmp</code> , <code>_strcmp_l</code>	<code>&lt;string.h&gt;</code>
<code>_wcsicmp</code> , <code>_wcsicmp_l</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbstrcmp</code> , <code>_mbstrcmp_l</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_strcmp.c

#include <string.h>
#include <stdio.h>
#include <stdlib.h>

char string1[] = "The quick brown dog jumps over the lazy fox";
char string2[] = "The QUICK brown dog jumps over the lazy fox";

int main(void)
{
 char tmp[20];
 int result;

 // Case sensitive
 printf("Compare strings:\n %s\n %s\n\n", string1, string2);
 result = strcmp(string1, string2);
 if(result > 0)
 strcpy_s(tmp, _countof(tmp), "greater than");
 else if(result < 0)
 strcpy_s(tmp, _countof(tmp), "less than");
 else
 strcpy_s(tmp, _countof(tmp), "equal to");
 printf(" strcmp: String 1 is %s string 2\n", tmp);

 // Case insensitive (could use equivalent _stricmp)
 result = _stricmp(string1, string2);
 if(result > 0)
 strcpy_s(tmp, _countof(tmp), "greater than");
 else if(result < 0)
 strcpy_s(tmp, _countof(tmp), "less than");
 else
 strcpy_s(tmp, _countof(tmp), "equal to");
 printf(" _stricmp: String 1 is %s string 2\n", tmp);
}

}

```

Compare strings:

The quick brown dog jumps over the lazy fox  
The QUICK brown dog jumps over the lazy fox

strcmp: String 1 is greater than string 2  
\_stricmp: String 1 is equal to string 2

## See also

### [String manipulation](#)

<a href="#">memcmp</a>	<a href="#">wmemcmp</a>				
<a href="#">_memicmp</a>	<a href="#">_memicmp_l</a>				
<a href="#">strcmp</a>	<a href="#">wcscmp</a>	<a href="#">_mbscmp</a>			
<a href="#">strcoll</a>	<a href="#">functions</a>				
<a href="#">strncmp</a>	<a href="#">wcsncmp</a>	<a href="#">_mbsncmp</a>	<a href="#">_mbsncmp_l</a>		
<a href="#">_strnicmp</a>	<a href="#">_wcsnicmp</a>	<a href="#">_mbsnicmp</a>	<a href="#">_strnicmp_l</a>	<a href="#">_wcsnicmp_l</a>	<a href="#">_mbsnicmp_l</a>
<a href="#">strrchr</a>	<a href="#">wcsrchr</a>	<a href="#">_mbsrchr</a>	<a href="#">_mbsrchr_l</a>		
<a href="#">_strset</a>	<a href="#">_strset_l</a>	<a href="#">_wcset</a>	<a href="#">_wcset_l</a>	<a href="#">_mbsset</a>	<a href="#">_mbsset_l</a>
<a href="#">strspn</a>	<a href="#">wcspn</a>	<a href="#">_mbsspn</a>	<a href="#">_mbsspn_l</a>		

`_stricoll`, `_wcsicoll`, `_mbsicoll`, `_stricoll_l`,  
`_wcsicoll_l`, `_mbsicoll_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Compares strings by using locale-specific information.

#### IMPORTANT

`_mbsicoll` and `_mbsicoll_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _stricoll(
 const char *string1,
 const char *string2
);
int _wcsicoll(
 const wchar_t *string1,
 const wchar_t *string2
);
int _mbsicoll(
 const unsigned char *string1,
 const unsigned char *string2
);
int _stricoll_l(
 const char *string1,
 const char *string2,
 _locale_t locale
);
int _wcsicoll_l(
 const wchar_t *string1,
 const wchar_t *string2,
 _locale_t locale
);
int _mbsicoll_l(
 const unsigned char *string1,
 const unsigned char *string2,
 _locale_t locale
);
```

### Parameters

`string1`, `string2`

Null-terminated strings to compare.

`Locale`

The locale to use.

## Return value

Each of these functions returns a value indicating the relationship of `string1` to `string2`, as follows.

RETURN VALUE	RELATIONSHIP OF <code>STRING1</code> TO <code>STRING2</code>
< 0	<code>string1</code> less than <code>string2</code>
0	<code>string1</code> identical to <code>string2</code>
> 0	<code>string1</code> greater than <code>string2</code>
<code>_NLSCMPERROR</code>	An error occurred.

Each of these functions returns `_NLSCMPERROR`. To use `_NLSCMPERROR`, include either `<string.h>` or `<mbstring.h>`. `_wcsicoll` can fail if either `string1` or `string2` contains wide-character codes outside the domain of the collating sequence. When an error occurs, `_wcsicoll` may set `errno` to `EINVAL`. To check for an error on a call to `_wcsicoll`, set `errno` to 0 and then check `errno` after calling `_wcsicoll`.

## Remarks

Each of these functions performs a case-insensitive comparison of `string1` and `string2` according to the code page currently in use. These functions should be used only when there's a difference between the character set order and the lexicographic character order in the current code page and this difference is of interest for the string comparison.

`_stricmp` differs from `_stricoll` in that the `_stricmp` comparison is affected by `LC_CTYPE`, whereas the `_stricoll` comparison is according to the `LC_CTYPE` and `LC_COLLATE` categories of the locale. For more information on the `LC_COLLATE` category, see [setlocale](#) and [Locale categories](#). The versions of these functions without the `_1` suffix use the current locale; the versions with the `_1` suffix are identical except that they use the locale passed in instead. For more information, see [Locale](#).

All of these functions validate their parameters. If either `string1` or `string2` are `NULL` pointers, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsicoll</code>	<code>_stricoll</code>	<code>_mbsicoll</code>	<code>_wcsicoll</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_stricoll</code> , <code>_stricoll_1</code>	<code>&lt;string.h&gt;</code>
<code>_wcsicoll</code> , <code>_wcsicoll_1</code>	<code>&lt;wchar.h&gt;</code> , <code>&lt;string.h&gt;</code>
<code>_mbsicoll</code> , <code>_mbsicoll_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

[Locale](#)

[String manipulation](#)

[strcoll](#) functions

[localeconv](#)

[\\_mbsnbcoll](#), [\\_mbsnbcoll\\_1](#), [\\_mbsnbicoll](#), [\\_mbsnbicoll\\_1](#)

[setlocale](#), [\\_wsetlocale](#)

[strcmp](#), [wcscmp](#), [\\_mbscmp](#)

[\\_stricmp](#), [\\_wcsicmp](#), [\\_mbsicmp](#), [\\_stricmp\\_l](#), [\\_wcsicmp\\_l](#), [\\_mbsicmp\\_l](#)

[strncmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_l](#)

[\\_strnicmp](#), [\\_wcsnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_l](#), [\\_wcsnicmp\\_l](#), [\\_mbsnicmp\\_l](#)

[strxfrm](#), [wcsxfrm](#), [\\_strxfrm\\_l](#), [\\_wcsxfrm\\_l](#)

# `_string`, `_wcsinc`, `_mbsinc`, `_mbsinc_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Advances a string pointer by one character.

## IMPORTANT

`_mbsinc` and `_mbsinc_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_string(
 const char *current,
 _locale_t locale
);
wchar_t *_wcsinc(
 const wchar_t *current,
 _locale_t locale
);
unsigned char *_mbsinc(
 const unsigned char *current
);
unsigned char *_mbsinc_1(
 const unsigned char *current,
 _locale_t locale
);
```

## Parameters

`current`

Character pointer.

`Locale`

Locale to use.

## Return value

Each of these routines returns a pointer to the character that immediately follows `current`.

## Remarks

The `_mbsinc` function returns a pointer to the first byte of the multibyte character that immediately follows `current`. `_mbsinc` recognizes multibyte-character sequences according to the [multibyte code page](#) that's currently in use; `_mbsinc_1` is identical except that it instead uses the locale parameter that's passed in. For more information, see [Locale](#).

The generic-text function `_tcsinc`, defined in Tchar.h, maps to `_mbsinc` if `_MBCS` has been defined, or to `_wcsinc` if `_UNICODE` has been defined. Otherwise, `_tcsinc` maps to `_string`. `_string` and `_wcsinc` are single-byte-character and wide-character versions of `_mbsinc`. `_string` and `_wcsinc` are provided only for this mapping and shouldn't be used otherwise. For more information, see [Using generic-text mappings](#) and [Generic-text mappings](#).

If `current` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, this function returns `EINVAL` and sets `errno` to `EINVAL`.

#### IMPORTANT

These functions might be vulnerable to buffer overrun threats. Buffer overruns can be used for system attacks because they can cause an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsinc</code>	<code>&lt;mbstring.h&gt;</code>
<code>_mbsinc_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_strinc</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsinc</code>	<code>&lt;tchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### String manipulation

`_strdec`, `_wcsdec`, `_mbsdec`, `_mbsdec_1`  
`_strnextc`, `_wcsnextc`, `_mbsnextc`, `_mbsnextc_1`  
`_strninc`, `_wcsninc`, `_mbsninc`, `_mbsninc_1`

`strlen`, `wcslen`, `_mbslen`, `_mbslen_l`, `_mbstrlen`,  
`_mbstrlen_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Gets the length of a string, by using the current locale or a specified locale. More secure versions of these functions are available; see `strlen`, `strlen_s`, `wcsnlen`, `wcsnlen_s`, `_mbsnlen`, `_mbsnlen_l`, `_mbstrnlen`, `_mbstrnlen_l`

#### IMPORTANT

`_mbslen`, `_mbslen_l`, `_mbstrlen`, and `_mbstrlen_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
size_t strlen(
 const char *str
);
size_t wcslen(
 const wchar_t *str
);
size_t _mbslen(
 const unsigned char *str
);
size_t _mbslen_l(
 const unsigned char *str,
 _locale_t locale
);
size_t _mbstrlen(
 const char *str
);
size_t _mbstrlen_l(
 const char *str,
 _locale_t locale
);
```

#### Parameters

`str`

Null-terminated string.

`Locale`

Locale to use.

## Return value

Each of these functions returns the number of characters in `str`, excluding the terminal null. No return value is reserved to indicate an error, except for `_mbstrlen` and `_mbstrlen_l`, which return `((size_t)(-1))` if the string contains an invalid multibyte character.

## Remarks

`strlen` interprets the string as a single-byte character string, so its return value is always equal to the number of bytes, even if the string contains multibyte characters. `wcslen` is a wide-character version of `strlen`; the argument of `wcslen` is a wide-character string and the count of characters is in wide (two-byte) characters. `wcslen` and `strlen` behave identically otherwise.

**Security Note** These functions incur a potential threat brought about by a buffer overrun problem. Buffer overrun problems are a frequent method of system attack, resulting in an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcslen</code>	<code>strlen</code>	<code>strlen</code>	<code>wcslen</code>
<code>_tcsclen</code>	<code>strlen</code>	<code>_mbslen</code>	<code>wcslen</code>
<code>_tcsclen_1</code>	<code>strlen</code>	<code>_mbslen_1</code>	<code>wcslen</code>

`_mbslen` and `_mbslen_1` return the number of multibyte characters in a multibyte-character string but they don't test for multibyte-character validity. `_mbstrlen` and `_mbstrlen_1` test for multibyte-character validity and recognize multibyte-character sequences. If the string passed to `_mbstrlen` or `_mbstrlen_1` contains an invalid multibyte character for the code page, the function returns -1 and sets `errno` to `EILSEQ`.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>strlen</code>	<code>&lt;string.h&gt;</code>
<code>wcslen</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbslen</code> , <code>_mbslen_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_mbstrlen</code> , <code>_mbstrlen_1</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_strlen.c
// Determine the length of a string. For the multi-byte character
// example to work correctly, the Japanese language support for
// non-Unicode programs must be enabled by the operating system.

#include <string.h>
#include <locale.h>

int main()
{
 char* str1 = "Count.";
 wchar_t* wstr1 = L"Count.";
 char * mbstr1;
 char * locale_string;

 // strlen gives the length of single-byte character string
 printf("Length of '%s' : %d\n", str1, strlen(str1));

 // wcslen gives the length of a wide character string
 wprintf(L"Length of '%s' : %d\n", wstr1, wcslen(wstr1));

 // A multibyte string: [A] [B] [C] [katakana A] [D] [\0]
 // in Code Page 932. For this example to work correctly,
 // the Japanese language support must be enabled by the
 // operating system.
 mbstr1 = "ABC" "\x83\x40" "D";

 locale_string = setlocale(LC_CTYPE, "Japanese_Japan");

 if (locale_string == NULL)
 {
 printf("Japanese locale not enabled. Exiting.\n");
 exit(1);
 }
 else
 {
 printf("Locale set to %s\n", locale_string);
 }

 // _mbslen will recognize the Japanese multibyte character if the
 // current locale used by the operating system is Japanese
 printf("Length of '%s' : %d\n", mbstr1, _mbslen(mbstr1));

 // _mbstrlen will recognize the Japanese multibyte character
 // since the CRT locale is set to Japanese even if the OS locale
 // is not.
 printf("Length of '%s' : %d\n", mbstr1, _mbstrlen(mbstr1));
 printf("Bytes in '%s' : %d\n", mbstr1, strlen(mbstr1));
}

```

```

Length of 'Count.' : 6
Length of 'Count.' : 6
Length of 'ABCÐD' : 5
Length of 'ABCÐD' : 5
Bytes in 'ABCÐD' : 6

```

## See also

[String manipulation](#)

[Interpretation of multibyte-character sequences](#)

[Locale](#)

[setlocale](#) , [\\_wsetlocale](#)

strcat	wcscat	_mbscat
strcmp	wcsncmp	_mbscmp
strcoll functions		
strcpy	wcscpy	_mbscopy
strrchr	wcsrchr	_mbsrchr
_strset	_strset_1	_wcset
_wcset_1		
strspn	wcsspn	_mbsspn
_mbsspn_1		

# `strlwr`, `wcslwr`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function names `strlwr` and `wcslwr` are deprecated aliases for the `_strlwr` and `_wcslwr` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_strlwr` or `_wcslwr` or the security-enhanced `_strlwr_s` and `_wcslwr_s` functions instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_strlwr`, `_wcslwr`, `_mbslwr`, `_strlwr_s`,  
`_wcslwr_s`, `_mbslwr_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a string to lowercase. More secure versions of these functions are available; see `_strlwr_s`, `_strlwr_s`, `_mbslwr_s`, `_mbslwr_s`, `_wcslwr_s`, `_wcslwr_s`.

#### IMPORTANT

`_mbslwr` and `_mbslwr_s` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strlwr(
 char * str
);
wchar_t *_wcslwr(
 wchar_t * str
);
unsigned char *_mbslwr(
 unsigned char * str
);
char *_strlwr_l(
 char * str,
 _locale_t locale
);
wchar_t *_wcslwr_l(
 wchar_t * str,
 _locale_t locale
);
unsigned char *_mbslwr_l(
 unsigned char * str,
 _locale_t locale
);
template <size_t size>
char *_strlwr(
 char (&str)[size]
); // C++ only
template <size_t size>
wchar_t *_wcslwr(
 wchar_t (&str)[size]
); // C++ only
template <size_t size>
unsigned char *_mbslwr(
 unsigned char (&str)[size]
); // C++ only
template <size_t size>
char *_strlwr_l(
 char (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
wchar_t *_wcslwr_l(
 wchar_t (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
unsigned char *_mbslwr_l(
 unsigned char (&str)[size],
 _locale_t locale
);
// C++ only
```

## Parameters

`str`

Null-terminated string to convert to lowercase.

`locale`

The locale to use.

## Return value

Each of these functions returns a pointer to the converted string. Because the modification is done in place, the pointer returned is the same as the pointer passed as the input argument. No return value is reserved to indicate an error.

## Remarks

The `_strlwr` function converts any uppercase letters in `str` to lowercase as determined by the `LC_CTYPE` category setting of the locale. Other characters aren't affected. For more information on `LC_CTYPE`, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for their locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale passed in instead. For more information, see [Locale](#).

The `_wcslwr` and `_mbslwr` functions are wide-character and multibyte-character versions of `_strlwr`. The argument and return value of `_wcslwr` are wide-character strings. The argument and return value of `_mbslwr` are multibyte-character strings. These three functions behave identically otherwise.

If `str` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return the original string and set `errno` to `EINVAL`.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcslwr</code>	<code>_strlwr</code>	<code>_mbslwr</code>	<code>_wcslwr</code>
<code>_tcslwr_1</code>	<code>_strlwr_1</code>	<code>_mbslwr_1</code>	<code>_wcslwr_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strlwr</code> , <code>_strlwr_1</code>	<code>&lt;string.h&gt;</code>
<code>_wcslwr</code> , <code>_wcslwr_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbslwr</code> , <code>_mbslwr_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strlwr.c
// compile with: /W3
// This program uses _strlwr and _strupr to create
// uppercase and lowercase copies of a mixed-case string.
#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[100] = "The String to End All Strings!";
 char * copy1 = _strdup(string); // make two copies
 char * copy2 = _strdup(string);

 _strlwr(copy1); // C4996
 // Note: _strlwr is deprecated; consider using _strlwr_s instead
 _strupr(copy2); // C4996
 // Note: _strupr is deprecated; consider using _strupr_s instead

 printf("Mixed: %s\n", string);
 printf("Lower: %s\n", copy1);
 printf("Upper: %s\n", copy2);

 free(copy1);
 free(copy2);
}
```

```
Mixed: The String to End All Strings!
Lower: the string to end all strings!
Upper: THE STRING TO END ALL STRINGS!
```

## See also

[String manipulation](#)

Locale

[`\_strupr`](#), [`\_strupr\_1`](#), [`\_mbsupr`](#), [`\_mbsupr\_1`](#), [`\_wcsupr`](#), [`\_wcsupr\_1`](#)

`_strlwr_s`, `_strlwr_s_1`, `_mbslwr_s`, `_mbslwr_s_1`  
`_wcs1wr_s`, `_wcs1wr_s_1`

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Converts a string to lowercase, by using the current locale or a locale object that's passed in. These versions of `_strlwr`, `_wcs1wr`, `_mbslwr`, `_strlwr_1`, `_wcs1wr_1`, `_mbslwr_1` have security enhancements, as described in [Security features in the CRT](#).

**IMPORTANT**

`_mbslwr_s` and `_mbslwr_s_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t _strlwr_s(
 char *str,
 size_t numberOfElements
);
errno_t _strlwr_s_l(
 char *str,
 size_t numberOfElements,
 _locale_t locale
);
errno_t _mbslwr_s(
 unsigned char *str,
 size_t numberOfElements
);
errno_t _mbslwr_s_l(
 unsigned char *str,
 size_t numberOfElements,
 _locale_t locale
);
errno_t _wcslwr_s(
 wchar_t *str,
 size_t numberOfElements
);
errno_t _wcslwr_s_l(
 wchar_t *str,
 size_t numberOfElements,
 _locale_t locale
);
template <size_t size>
errno_t _strlwr_s(
 char (&str)[size]
); // C++ only
template <size_t size>
errno_t _strlwr_s_l(
 char (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
errno_t _mbslwr_s(
 unsigned char (&str)[size]
); // C++ only
template <size_t size>
errno_t _mbslwr_s_l(
 unsigned char (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
errno_t _wcslwr_s(
 wchar_t (&str)[size]
); // C++ only
template <size_t size>
errno_t _wcslwr_s_l(
 wchar_t (&str)[size],
 _locale_t locale
); // C++ only
```

## Parameters

`str`

Null-terminated string to convert to lowercase.

`numberOfElements`

Size of the buffer.

`Locale`

The locale to use.

## Return value

Zero if successful; a non-zero error code on failure.

These functions validate their parameters. If `str` isn't a valid null-terminated string, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `EINVAL` and set `errno` to `EINVAL`. If `numberOfElements` is less than the length of the string, the functions also return `EINVAL` and set `errno` to `EINVAL`.

## Remarks

The `_strlwr_s` function converts, in place, any uppercase letters in `str` to lowercase. `_mbslwr_s` is a multi-byte character version of `_strlwr_s`. `_wcslwr_s` is a wide-character version of `_strlwr_s`.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcslwr_s</code>	<code>_strlwr_s</code>	<code>_mbslwr_s</code>	<code>_wcslwr_s</code>
<code>_tcslwr_s_1</code>	<code>_strlwr_s_1</code>	<code>_mbslwr_s_1</code>	<code>_wcslwr_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strlwr_s</code> , <code>_strlwr_s_1</code>	<code>&lt;string.h&gt;</code>
<code>_mbslwr_s</code> , <code>_mbslwr_s_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_wcslwr_s</code> , <code>_wcslwr_s_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strlwr_s.cpp
// This program uses _strlwr_s and _strupr_s to create
// uppercase and lowercase copies of a mixed-case string.
//

#include <string.h>
#include <stdio.h>
#include <stdlib.h>

int main()
{
 char str[] = "The String to End All Strings!";
 char *copy1, *copy2;
 errno_t err;

 err = _strlwr_s(copy1 = _strdup(str), strlen(str) + 1);
 err = _strupr_s(copy2 = _strdup(str), strlen(str) + 1);

 printf("Mixed: %s\n", str);
 printf("Lower: %s\n", copy1);
 printf("Upper: %s\n", copy2);

 free(copy1);
 free(copy2);

 return 0;
}
```

```
Mixed: The String to End All Strings!
Lower: the string to end all strings!
Upper: THE STRING TO END ALL STRINGS!
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_strupr\\_s](#) , [\\_strupr\\_s\\_1](#) , [\\_mbsupr\\_s](#) , [\\_mbsupr\\_s\\_1](#) , [\\_wcsupr\\_s](#) , [\\_wcsupr\\_s\\_1](#)

`strncat`, `_strncat_l`, `wcsncat`, `_wcsncat_l`,  
`_mbsncat`, `_mbsncat_l`

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Appends characters of a string. More secure versions of these functions are available; see [`strncat\_s`](#), [`\_strncat\_s\_l`](#), [`wcsncat\_s`](#), [`\_wcsncat\_s\_l`](#), [`\_mbsncat\_s`](#), [`\_mbsncat\_s\_l`](#).

**IMPORTANT**

`_mbsncat` and `_mbsncat_l` can't be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```

char *strncat(
 char *strDest,
 const char *strSource,
 size_t count
);
wchar_t *wcsncat(
 wchar_t *strDest,
 const wchar_t *strSource,
 size_t count
);
unsigned char *_mbsncat(
 unsigned char *strDest,
 const unsigned char *strSource,
 size_t count
);
unsigned char *_mbsncat_l(
 unsigned char *strDest,
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
);
template <size_t size>
char *strncat(
 char (&strDest)[size],
 const char *strSource,
 size_t count
); // C++ only
template <size_t size>
wchar_t *wcsncat(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count
); // C++ only
template <size_t size>
unsigned char *_mbsncat(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count
); // C++ only
template <size_t size>
unsigned char *_mbsncat_l(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
); // C++ only

```

## Parameters

`strDest`

Null-terminated destination string.

`strSource`

Null-terminated source string.

`count`

Number of characters to append.

`Locale`

Locale to use.

## Return value

Returns a pointer to the destination string. No return value is reserved to indicate an error.

## Remarks

The `strncat` function appends, at most, the first `count` characters of `strSource` to `strDest`. The initial character of `strSource` overwrites the terminating null character of `strDest`. If a null character appears in `strSource` before `count` characters are appended, `strncat` appends all characters from `strSource`, up to the null character. If `count` is greater than the length of `strSource`, the length of `strSource` is used in place of `count`. In all cases, the resulting string is terminated with a null character. If copying takes place between strings that overlap, the behavior is undefined.

### IMPORTANT

`strncat` does not check for sufficient space in `strDest`; it is therefore a potential cause of buffer overruns. Keep in mind that `count` limits the number of characters appended; it is not a limit on the size of `strDest`. See the example below. For more information, see [Avoiding buffer overruns](#).

`wcsncat` and `_mbsncat` are wide-character and multibyte-character versions of `strncat`. The string arguments and return value of `wcsncat` are wide-character strings. The string arguments and return value of `_mbsncat` are multibyte-character strings. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior. The versions with the `_1` suffix are identical except they use the locale parameter passed in instead. For more information, see [Locale](#).

In C++, these functions have template overloads. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncat</code>	<code>strncat</code>	<code>_mbsnbcat</code>	<code>wcsncat</code>
<code>_tcsncat_1</code>	<code>_strncat_1</code>	<code>_mbsnbcat_1</code>	<code>_wcsncat_1</code>

### NOTE

`_strncat_1` and `_wcsncat_1` have no locale dependence and are not meant to be called directly. They are provided for internal use by `_tcsncat_1`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strncat</code>	<code>&lt;string.h&gt;</code>
<code>wcsncat</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_mbsncat</code>	<code>&lt;mbstring.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_mbsncat_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strncat.c
// Use strcat and strncat to append to a string.
#include <stdlib.h>

#define MAXSTRINGLEN 39

char string[MAXSTRINGLEN+1];
// or char *string = malloc(MAXSTRINGLEN+1);

void BadAppend(char suffix[], int n)
{
 strncat(string, suffix, n);
}

void GoodAppend(char suffix[], size_t n)
{
 strncat(string, suffix, __min(n, MAXSTRINGLEN-strlen(string)));
}

int main(void)
{
 string[0] = '\0';
 printf("string can hold up to %d characters\n", MAXSTRINGLEN);

 strcpy(string, "This is the initial string!");
 // concatenate up to 20 characters...
 BadAppend("Extra text to add to the string...", 20);
 printf("After BadAppend : %s (%d chars)\n", string, strlen(string));

 strcpy(string, "This is the initial string!");
 // concatenate up to 20 characters...
 GoodAppend("Extra text to add to the string...", 20);
 printf("After GoodAppend: %s (%d chars)\n", string, strlen(string));
}
```

## Output

```
string can hold up to 39 characters
After BadAppend : This is the initial string!Extra text to add to (47 chars)
After GoodAppend: This is the initial string!Extra text t (39 chars)
```

You can see that `BadAppend` caused a buffer overrun.

## See also

### String manipulation

<code>_mbsnbcat</code>	<code>_mbsnbcat_1</code>
<code>strcat</code>	<code>wcscat</code>
<code>_mbscat</code>	
<code>strcmp</code>	<code>wcscmp</code>
<code>_mbscmp</code>	
<code>strcpy</code>	<code>wcscpy</code>
<code>_mbscopy</code>	
<code>strncpy</code>	<code>wcsncmp</code>
<code>_mbsncmp</code>	<code>_mbsncmp_1</code>

`strncpy`, `_strncpy_l`, `wcsncpy`, `_wcsncpy_l`, `_mbsncpy`, `_mbsncpy_l`  
`_strnicmp`, `_wcsnicmp`, `_mbsnicmp`, `_strnicmp_l`, `_wcsnicmp_l`, `_mbsnicmp_l`  
`strrchr`, `wcsrchr`, `_mbsrchr`, `_mbsrchr_l`  
`_strset`, `_strset_l`, `_wcsetattr`, `_wcsetattr_l`, `_mbsset`, `_mbsset_l`  
`strspn`, `wcspn`, `_mbsspnp`, `_mbsspnp_l`

Locale

Interpretation of multibyte-character sequences\

`strncat_s`, `_strncat_s_l`, `wcsncat_s`,

`_wcsncat_s_l`, `_mbsncat_s`, `_mbsncat_s_l`

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Appends characters to a string. These versions of `strncat`, `_strncat_l`, `wcsncat`, `_wcsncat_l`, `_mbsncat`, `_mbsncat_l` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

`_mbsncat_s` and `_mbsncat_s_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t strncat_s(
 char *strDest,
 size_t numberOfElements,
 const char *strSource,
 size_t count
);
errno_t _strncat_s_l(
 char *strDest,
 size_t numberOfElements,
 const char *strSource,
 size_t count,
 _locale_t locale
);
errno_t wcsncat_s(
 wchar_t *strDest,
 size_t numberOfElements,
 const wchar_t *strSource,
 size_t count
);
errno_t _wcsncat_s_l(
 wchar_t *strDest,
 size_t numberOfElements,
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
);
errno_t _mbsncat_s(
 unsigned char *strDest,
 size_t numberOfElements,
 const unsigned char *strSource,
 size_t count
);
errno_t _mbsncat_s_l(
 unsigned char *strDest,
 size_t numberOfElements,
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
);
template <size_t size>
errno_t strncat_s(
 char (&strDest)[size],
 const char *strSource,
```

```
 size_t count
); // C++ only
template <size_t size>
errno_t _strncat_s_l(
 char (&strDest)[size],
 const char *strSource,
 size_t count,
 _locale_t locale
); // C++ only
template <size_t size>
errno_t wcsncat_s(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count
); // C++ only
template <size_t size>
errno_t _wcsncat_s_l(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
); // C++ only
template <size_t size>
errno_t _mbsncat_s(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count
); // C++ only
template <size_t size>
errno_t _mbsncat_s_l(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
); // C++ only
```

## Parameters

*strDest*

Null-terminated destination string.

*numberOfElements*

Size of the destination buffer.

*strSource*

Null-terminated source string.

*count*

Number of characters to append, or [\\_TRUNCATE](#).

*Locale*

Locale to use.

## Return value

Returns 0 if successful, an error code on failure.

## Error conditions

<code>STRDESTINATION</code>	<code>NUMBEROFELEMENTS</code>	<code>STRSOURCE</code>	<code>RETURN VALUE</code>	<code>CONTENTS OF STRDESTINATION</code>
<code>NULL</code> or unterminated	any	any	<code>EINVAL</code>	not modified
any	any	<code>NULL</code>	<code>EINVAL</code>	not modified
any	0, or too small	any	<code>ERANGE</code>	not modified

## Remarks

These functions try to append the first `D` characters of `strSource` to the end of `strDest`, where `D` is the lesser of `count` and the length of `strSource`. If appending those `D` characters will fit within `strDest` (whose size is given as `numberOfElements`) and still leave room for a null terminator, then those characters are appended, starting at the original terminating null of `strDest`, and a new terminating null is appended; otherwise, `strDest[0]` is set to the null character and the invalid parameter handler is invoked, as described in [Parameter validation](#).

There's an exception to the above paragraph. If `count` is `_TRUNCATE`, then as much of `strSource` as will fit is appended to `strDest` while still leaving room to append a terminating null.

For example,

```
char dst[5];
strncpy_s(dst, _countof(dst), "12", 2);
strncat_s(dst, _countof(dst), "34567", 3);
```

means that we're asking `strncat_s` to append three characters to two characters in a buffer five characters long; it would leave no space for the null terminator, so `strncat_s` zeroes out the string, and calls the invalid parameter handler.

If truncation behavior is needed, use `_TRUNCATE` or adjust the `count` parameter accordingly:

```
strncat_s(dst, _countof(dst), "34567", _TRUNCATE);
```

or

```
strncat_s(dst, _countof(dst), "34567", _countof(dst)-strlen(dst)-1);
```

In all cases, the resulting string is terminated with a null character. If copying takes place between strings that overlap, the behavior is undefined.

If `strSource` or `strDest` is `NULL`, or `numberOfElements` is zero, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the function returns `EINVAL` without modifying its parameters.

`wcsncat_s` and `_mbsncat_s` are wide-character and multibyte-character versions of `strncat_s`. The string arguments and return value of `wcsncat_s` are wide-character strings. The arguments and return value of `_mbsncat_s` are multibyte-character strings. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-

dependent behavior; the versions with the `_1` suffix are identical except they use the `locale` parameter passed in instead. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use [`\_CrtSetDebugFillThreshold`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tcsncat_s</code>	<code>strncat_s</code>	<code>_mbsnbcat_s</code>	<code>wcsncat_s</code>
<code>_tcsncat_s_l</code>	<code>_strncat_s_l</code>	<code>_mbsnbcat_s_l</code>	<code>_wcsncat_s_l</code>

`_strncat_s_1` and `_wcsncat_s_1` have no locale dependence; they're only provided for `_tcsncat_s_1`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strncat_s</code>	<string.h>
<code>wcsncat_s</code>	<string.h> or <wchar.h>
<code>_mbsncat_s</code> , <code>_mbsncat_s_l</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

## Example

```

strcpy_s(dest, _countof(dest), initialDest);

printf_s("\n");

if (count == _TRUNCATE)
 printf_s("Appending '%s' to %d-byte buffer dest with truncation semantics\n",
 src, _countof(dest));
else
 printf_s("Appending %d chars of '%s' to %d-byte buffer dest\n",
 count, src, _countof(dest));

printf_s(" old contents of dest: '%s'\n", dest);

errno_t err = strncat_s(dest, _countof(dest), src, count);

printf_s(" new contents of dest: '%s'\n", dest);

return err;
}

void Examples()
{
 strncat_s_tester("hi ", "there", 4);
 strncat_s_tester("hi ", "there", 5);
 strncat_s_tester("hi ", "there", 6);

 printf_s("\nDestination buffer too small:\n");
 strncat_s_tester("hello ", "there", 4);

 printf_s("\nTruncation examples:\n");

 errno_t err = strncat_s_tester("hello ", "there", _TRUNCATE);
 printf_s(" truncation %s occur\n", err == STRUNCATE ? "did"
 : "did not");

 err = strncat_s_tester("hello ", "!", _TRUNCATE);
 printf_s(" truncation %s occur\n", err == STRUNCATE ? "did"
 : "did not");

 printf_s("\nSecure template overload example:\n");

 char dest[10] = "cats and ";
 strncat(dest, "dachshunds", 15);
 // With secure template overloads enabled (see #define
 // at top of file), the preceding line is replaced by
 // strncat_s(dest, _countof(dest), "dachshunds", 15);
 // Instead of causing a buffer overrun, strncat_s invokes
 // the invalid parameter handler.
 // If secure template overloads were disabled, strncat would
 // append "dachshunds" and overrun the dest buffer.
 printf_s(" new contents of dest: '%s'\n", dest);
}

void myInvalidParameterHandler(
 const wchar_t* expression,
 const wchar_t* function,
 const wchar_t* file,
 unsigned int line,
 uintptr_t pReserved)
{
 wprintf_s(L"Invalid parameter handler invoked: %s\n", expression);
}

int main(void)
{
 _invalid_parameter_handler oldHandler, newHandler;

 newHandler = myInvalidParameterHandler;
 oldHandler = _set_invalid_parameter_handler(newHandler);
}

```

```
// Disable the message box for assertions.
_CrtSetReportMode(_CRT_ASSERT, 0);

Examples();
}
```

```
Appending 4 chars of 'there' to 10-byte buffer dest
old contents of dest: 'hi '
new contents of dest: 'hi ther'
```

```
Appending 5 chars of 'there' to 10-byte buffer dest
old contents of dest: 'hi '
new contents of dest: 'hi there'
```

```
Appending 6 chars of 'there' to 10-byte buffer dest
old contents of dest: 'hi '
new contents of dest: 'hi there'
```

Destination buffer too small:

```
Appending 4 chars of 'there' to 10-byte buffer dest
old contents of dest: 'hello '
Invalid parameter handler invoked: (L"Buffer is too small" && 0)
new contents of dest: ''
```

Truncation examples:

```
Appending 'there' to 10-byte buffer dest with truncation semantics
old contents of dest: 'hello '
new contents of dest: 'hello the'
truncation did occur
```

```
Appending '!' to 10-byte buffer dest with truncation semantics
old contents of dest: 'hello '
new contents of dest: 'hello !'
truncation did not occur
```

Secure template overload example:

```
Invalid parameter handler invoked: (L"Buffer is too small" && 0)
new contents of dest: ''
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_mbsnbcat](#), [\\_mbsnbcat\\_1](#)  
[strcat](#), [wcscat](#), [\\_mbscat](#)  
[strcmp](#), [wcscmp](#), [\\_mbscmp](#)  
[strcpy](#), [wcscopy](#), [\\_mbscopy](#)  
[strncmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_1](#)  
[strncpy](#), [\\_strncpy\\_1](#), [wcsncpy](#), [\\_wcsncpy\\_1](#), [\\_mbsncpy](#), [\\_mbsncpy\\_1](#)  
[\\_strnicmp](#), [\\_wcsnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_1](#), [\\_wcsnicmp\\_1](#), [\\_mbsnicmp\\_1](#)  
[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_1](#)  
[\\_strset](#), [\\_strset\\_1](#), [\\_wcsset](#), [\\_wcsset\\_1](#), [\\_mbsset](#), [\\_mbsset\\_1](#)  
[strspn](#), [wcsspn](#), [\\_mbsspn](#), [\\_mbsspn\\_1](#)

`strcmp`, `wcsncmp`, `_mbsncmp`, `_mbsncmp_1`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Compares up to the specified count of characters of two strings.

#### IMPORTANT

`_mbsncmp` and `_mbsncmp_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int strcmp(
 const char *string1,
 const char *string2,
 size_t count
);
int wcsncmp(
 const wchar_t *string1,
 const wchar_t *string2,
 size_t count
);
int _mbsncmp(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count
);
int _mbsncmp_1(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count,
 _locale_t locale
);int _mbsnbcmp(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count
);
```

### Parameters

`string1`, `string2`

Strings to compare.

`count`

Number of characters to compare.

`Locale`

Locale to use.

## Return value

The return value indicates the relation of the substrings of `string1` and `string2` as follows.

RETURN VALUE	DESCRIPTION
< 0	<code>string1</code> substring less than <code>string2</code> substring
0	<code>string1</code> substring identical to <code>string2</code> substring
> 0	<code>string1</code> substring greater than <code>string2</code> substring

On a parameter validation error, `_mbsncmp` and `_mbsncmp_1` return `_NLSCMPERROR`, which is defined in `<string.h>` and `<mbstring.h>`.

## Remarks

The `strcmp` function performs an ordinal comparison of at most the first `count` characters in `string1` and `string2` and returns a value indicating the relationship between the substrings. `strcmp` is a case-sensitive version of `_strnicmp`. `wcsncmp` and `_mbsncmp` are case-sensitive versions of `_wcsnicmp` and `_mbsnicmp`.

`wcsncmp` and `_mbsncmp` are wide-character and multibyte-character versions of `strcmp`. The arguments of `wcsncmp` are wide-character strings. The arguments of `_mbsncmp` are multibyte-character strings. `_mbsncmp` recognizes multibyte-character sequences according to a multibyte code page and returns `_NLSCMPERROR` on an error.

Also, `_mbsncmp` and `_mbsncmp_1` validate parameters. If `string1` or `string2` is a null pointer and `count` isn't equal to 0, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbsncmp` and `_mbsncmp_1` return `_NLSCMPERROR` and set `errno` to `EINVAL`. `strcmp` and `wcsncmp` don't validate their parameters. These functions behave identically otherwise.

The comparison behavior of `_mbsncmp` and `_mbsncmp_1` is affected by the setting of the `LC_CTYPE` category setting of the locale. This controls detection of leading and trailing bytes of multibyte characters. For more information, see [setlocale](#). The `_mbsncmp` function uses the current locale for this locale-dependent behavior. The `_mbsncmp_1` function is identical except that it uses the `Locale` parameter instead. For more information, see [Locale](#). If the locale is a single-byte locale, the behavior of these functions is identical to `strcmp`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcsnccmp</code>	<code>strcmp</code>	<code>_mbsncmp</code>	<code>wcsncmp</code>
<code>_tcsncmp</code>	<code>strcmp</code>	<code>_mbsnbncmp</code>	<code>wcsncmp</code>
<code>_tccmp</code>	Maps to macro or inline function	<code>_mbsncmp</code>	Maps to macro or inline function

## Requirements

ROUTINE	REQUIRED HEADER
<code>strcmp</code>	<code>&lt;string.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>wcsncmp</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsncmp</code> , <code>_mbsncmp_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strncmp.c
#include <string.h>
#include <stdio.h>

char string1[] = "The quick brown dog jumps over the lazy fox";
char string2[] = "The QUICK brown fox jumps over the lazy dog";

int main(void)
{
 char tmp[20];
 int result;
 printf("Compare strings:\n %s\n %s\n\n",
 string1, string2);
 printf("Function: strncmp (first 10 characters only)\n");
 result = strncmp(string1, string2 , 10);
 if(result > 0)
 strcpy_s(tmp, sizeof(tmp), "greater than");
 else if(result < 0)
 strcpy_s(tmp, sizeof(tmp), "less than");
 else
 strcpy_s(tmp, sizeof(tmp), "equal to");
 printf("Result: String 1 is %s string 2\n\n", tmp);
 printf("Function: strnicmp _strnicmp (first 10 characters only)\n");
 result = _strnicmp(string1, string2, 10);
 if(result > 0)
 strcpy_s(tmp, sizeof(tmp), "greater than");
 else if(result < 0)
 strcpy_s(tmp, sizeof(tmp), "less than");
 else
 strcpy_s(tmp, sizeof(tmp), "equal to");
 printf("Result: String 1 is %s string 2\n", tmp);
}
```

```
Compare strings:
The quick brown dog jumps over the lazy fox
The QUICK brown fox jumps over the lazy dog

Function: strncmp (first 10 characters only)
Result: String 1 is greater than string 2

Function: strnicmp _strnicmp (first 10 characters only)
Result: String 1 is equal to string 2
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[`\_mbsncmp`](#) , [`\_mbsncmp\_1`](#)

```
_mbsnbicmp , _mbsnbicmp_1
strcmp , wcscmp , _mbscmp
strcoll functions
_strnicmp , _wcsnicmp , _mbsnicmp , _strnicmp_1 , _wcsnicmp_1 , _mbsnicmp_1
strrchr , wcsrchr , _mbsrchr , _mbsrchr_1
_strset , _strset_1 , _wcsetattr , _wcsetattr_1 , _mbsset , _mbsset_1
strspn , wcspn , _mbsspn , _mbsspn_1
```

`_strncnt`, `_wcsncnt`, `_mbsnbcnt`, `_mbsnbcnt_1`,  
`_mbsnccnt`, `_mbsnccnt_1`

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Returns the number of characters or bytes within a specified count.

#### IMPORTANT

`_mbsnbcnt`, `_mbsnbcnt_1`, `_mbsnccnt`, and `_mbsnccnt_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
size_t _strncnt(
 const char *str,
 size_t count
);
size_t _wcsncnt(
 const wchar_t *str,
 size_t count
);
size_t _mbsnbcnt(
 const unsigned char *str,
 size_t count
);
size_t _mbsnbcnt_1(
 const unsigned char *str,
 size_t count,
 _locale_t locale
);
size_t _mbsnccnt(
 const unsigned char *str,
 size_t count
);
size_t _mbsnccnt_1(
 const unsigned char *str,
 size_t count,
 _locale_t locale
);
```

### Parameters

`str`

String to be examined.

`count`

Number of characters or bytes to be examined in `str`.

`Locale`

Locale to use.

### Return value

`_mbsnbcnt` and `_mbsnbcnt_1` return the number of bytes found in the first `count` of multibyte characters of

`str`, `_mbsnccnt` and `_mbsnccnt_1` return the number of characters found in the first `count` of bytes of `str`. If a null character is encountered before the examination of `str` has completed, they return the number of bytes or characters found before the null character. If `str` consists of fewer than `count` characters or bytes, they return the number of characters or bytes in the string. If `count` is less than zero, they return 0. In previous versions, these functions had a return value of type `int` rather than `size_t`.

`_strnccnt` returns the number of characters in the first `count` bytes of the single-byte string `str`. `_wcsnccnt` returns the number of characters in the first `count` wide characters of the wide-character string `str`.

## Remarks

`_mbsnbcnt` and `_mbsnbcnt_1` count the number of bytes found in the first `count` of multibyte characters of `str`. `_mbsnbcnt` and `_mbsnbcnt_1` replace `mtob` and should be used in place of `mtob`.

`_mbsnccnt` and `_mbsnccnt_1` count the number of characters found in the first `count` of bytes of `str`. If `_mbsnccnt` and `_mbsnccnt_1` encounter a null character in the second byte of a double-byte character, the first byte is also considered to be null and isn't included in the returned count value. `_mbsnccnt` and `_mbsnccnt_1` replace `btom` and should be used in place of `btom`.

If `str` is a `NULL` pointer or is `count` is 0, these functions invoke the invalid parameter handler as described in [Parameter validation](#), `errno` is set to `EINVAL`, and the function returns 0.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnbcnt</code>	<code>_strnccnt</code>	<code>_mbsnbcnt</code>	<code>_wcsnccnt</code>
<code>_tcsnccnt</code>	<code>_strnccnt</code>	<code>_mbsnbcnt</code>	n/a
<code>_wcsnccnt</code>	n/a	n/a	<code>_mbsnbcnt</code>
<code>_wcsnccnt</code>	n/a	n/a	<code>_mbsnccnt</code>
n/a	n/a	<code>_mbsnbcnt_1</code>	<code>_mbsnccnt_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnbcnt</code>	<code>&lt;mbstring.h&gt;</code>
<code>_mbsnbcnt_1</code>	<code>&lt;mbstring.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_mbsnccnt</code>	<code>&lt;mbstring.h&gt;</code>
<code>_mbsnccnt_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_strnccnt</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsnccnt</code>	<code>&lt;tchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_mbsnbcnt.c

#include <mbstring.h>
#include <stdio.h>

int main(void)
{
 unsigned char str[] = "This is a multibyte-character string.";
 unsigned int char_count, byte_count;
 char_count = _mbsnccnt(str, 10);
 byte_count = _mbsnbcnt(str, 10);
 if (byte_count - char_count)
 printf("The first 10 characters contain %d multibyte characters\n", char_count);
 else
 printf("The first 10 characters are single-byte.\n");
}
```

## Output

```
The first 10 characters are single-byte.
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[`\_mbsnbcat`](#) , [`\_mbsnbcat\_1`](#)

`_strncoll`, `_wcsncoll`, `_mbsncoll`, `_strncoll_l`,  
`_wcsncoll_l`, `_mbsncoll_l`

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Compares strings by using locale-specific information.

#### IMPORTANT

`_mbsncoll` and `_mbsncoll_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _strncoll(
 const char *string1,
 const char *string2,
 size_t count
);
int _wcsncoll(
 const wchar_t *string1,
 const wchar_t *string2,
 size_t count
);
int _mbsncoll(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count
);
int _strncoll_l(
 const char *string1,
 const char *string2,
 size_t count,
 _locale_t locale
);
int _wcsncoll_l(
 const wchar_t *string1,
 const wchar_t *string2,
 size_t count,
 _locale_t locale
);
int _mbsncoll_l(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count,
 _locale_t locale
);
```

#### Parameters

`string1`, `string2`

Null-terminated strings to compare.

`count`

The number of characters to compare.

## Locale

The locale to use.

## Return value

Each of these functions returns a value that indicates the relationship of the substrings of `string1` and `string2`, as follows.

RETURN VALUE	RELATIONSHIP OF <code>STRING1</code> TO <code>STRING2</code>
< 0	<code>string1</code> is less than <code>string2</code> .
0	<code>string1</code> is identical to <code>string2</code> .
> 0	<code>string1</code> is greater than <code>string2</code> .

Each of these functions returns `_NLSCMPERROR`. To use `_NLSCMPERROR`, include either STRING.h or MBSTRING.h.

`_wcsncoll` can fail if either `string1` or `string2` contains wide-character codes that are outside the domain of the collating sequence. When an error occurs, `_wcsncoll` may set `errno` to `EINVAL`. To check for an error on a call to `_wcsncoll`, set `errno` to 0, and then check `errno` after the `_wcsncoll` call.

## Remarks

Each of these functions performs a case-sensitive comparison of the first `count` characters in `string1` and `string2`, according to the code page that's currently in use. Use these functions only when there's a difference between the character set order and the lexicographic character order in the code page, and when this difference matters for the string comparison. The character set order is locale-dependent. The versions of these functions that don't have the `_1` suffix use the current locale, but the versions that have the `_1` suffix use the locale that's passed in. For more information, see [Locale](#).

All of these functions validate their parameters. If either `string1` or `string2` is a null pointer, or `count` is greater than `INT_MAX`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncoll</code>	<code>_strncoll</code>	<code>_mbsncoll</code>	<code>_wcsncoll</code>
<code>_tcsncoll_1</code>	<code>_strncoll_1</code>	<code>_mbsncoll_1</code>	<code>_wcsncoll_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strncoll</code> , <code>_strncoll_1</code>	<code>&lt;string.h&gt;</code>
<code>_wcsncoll</code> , <code>_wcsncoll_1</code>	<code>&lt;wchar.h&gt;</code> or <code>&lt;string.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_mbsnccoll</code> , <code>_mbsnccoll_1</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

## See also

[Locale](#)

[String manipulation](#)

`strcoll` functions

`localeconv`

`_mbsnbccoll` , `_mbsnbccoll_1` , `_mbsnbicoll` , `_mbsnbicoll_1`

`setlocale` , `_wsetlocale`

`strcmp` , `wcsncmp` , `_mbscmp`

`_stricmp` , `_wcsicmp` , `_mbsicmp` , `_stricmp_1` , `_wcsicmp_1` , `_mbsicmp_1`

`strncmp` , `wcsncmp` , `_mbsncmp` , `_mbsncmp_1`

`_strnicmp` , `_wcsnicmp` , `_mbsnicmp` , `_strnicmp_1` , `_wcsnicmp_1` , `_mbsnicmp_1`

`strxfrm` , `wcsxfrm` , `_strxfrm_1` , `_wcsxfrm_1`

`strncpy`, `_strncpy_l`, `wcsncpy`, `_wcsncpy_l`,  
`_mbsncpy`, `_mbsncpy_l`

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Copy characters of one string to another. More secure versions of these functions are available; see [`strncpy\_s`](#), [`\_strncpy\_s\_l`](#), [`wcsncpy\_s`](#), [`\_wcsncpy\_s\_l`](#), [`\_mbsncpy\_s`](#), [`\_mbsncpy\_s\_l`](#).

#### IMPORTANT

`_mbsncpy` and `_mbsncpy_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strncpy(
 char *strDest,
 const char *strSource,
 size_t count
);
char *_strncpy_l(
 char *strDest,
 const char *strSource,
 size_t count,
 _locale_t locale
);
wchar_t *wcsncpy(
 wchar_t *strDest,
 const wchar_t *strSource,
 size_t count
);
wchar_t *_wcsncpy_l(
 wchar_t *strDest,
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
);
unsigned char *_mbsncpy(
 unsigned char *strDest,
 const unsigned char *strSource,
 size_t count
);
unsigned char *_mbsncpy_l(
 unsigned char *strDest,
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
);
template <size_t size>
char *strncpy(
 char (&strDest)[size],
 const char *strSource,
 size_t count
); // C++ only
template <size_t size>
char *_strncpy_l(
 char (&strDest)[size],
 const char *strSource,
```

```
 size_t count,
 _locale_t locale
); // C++ only
template <size_t size>
wchar_t *wcsncpy(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count
); // C++ only
template <size_t size>
wchar_t *_wcsncpy_l(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
); // C++ only
template <size_t size>
unsigned char *_mbsncpy(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count
); // C++ only
template <size_t size>
unsigned char *_mbsncpy_l(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
); // C++ only
```

## Parameters

`strDest`

Destination string.

`strSource`

Source string.

`count`

Number of characters to be copied.

`Locale`

Locale to use.

## Return value

Returns `strDest`. No return value is reserved to indicate an error.

## Remarks

The `strncpy` function copies the initial `count` characters of `strSource` to `strDest` and returns `strDest`. If `count` is less than or equal to the length of `strSource`, a null character isn't appended automatically to the copied string. If `count` is greater than the length of `strSource`, the destination string is padded with null characters up to length `count`. The behavior of `strncpy` is undefined if the source and destination strings overlap.

## IMPORTANT

`strncpy` does not check for sufficient space in `strDest`; this makes it a potential cause of buffer overruns. The `count` argument limits the number of characters copied; it is not a limit on the size of `strDest`. See the following example. For more information, see [Avoiding buffer overruns](#).

If `strDest` or `strSource` is a `NULL` pointer, or if `count` is less than or equal to zero, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

`wcsncpy` and `_mbsncpy` are wide-character and multibyte-character versions of `strncpy`. The arguments and return value of `wcsncpy` and `_mbsncpy` vary accordingly. These six functions behave identically otherwise.

The versions of these functions with the `_1` suffix are identical except that they use the locale passed in instead of the current locale for their locale-dependent behavior. For more information, see [Locale](#).

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcscopy</code>	<code>strncpy</code>	<code>_mbsncpy</code>	<code>wcsncpy</code>
<code>_tcscopy_1</code>	<code>_strncpy_1</code>	<code>_mbsncpy_1</code>	<code>_wcsncpy_1</code>

## NOTE

`_strncpy_1` and `_wcsncpy_1` have no locale dependence; they are provided just for `_tcscopy_1` and are not intended to be called directly.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strncpy</code>	<code>&lt;string.h&gt;</code>
<code>wcsncpy</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsncpy</code> , <code>_mbsncpy_1</code>	<code>&lt;mbstring.h&gt;</code>

For more platform compatibility information, see [Compatibility](#).

## Example

The following example demonstrates the use of `strncpy` and how it can be misused to cause program bugs and security issues. The compiler generates a warning for each call to `strncpy` similar to `crt_strncpy_x86.c(15)` : `warning C4996: 'strncpy': This function or variable may be unsafe. Consider using strncpy_s`

instead. To disable deprecation, use `_CRT_SECURE_NO_WARNINGS`. See online help for details.

```
// crt_strncpy_x86.c
// Use this command in an x86 developer command prompt to compile:
// cl /TC /W3 crt_strncpy_x86.c

#include <stdio.h>
#include <string.h>

int main() {
 char t[20];
 char s[20];
 char *p = 0, *q = 0;

 strcpy_s(s, sizeof(s), "AA BB CC");
 // Note: strncpy is deprecated; consider using strcpy_s instead
 strcpy(s, "aa", 2); // "aa BB CC" C4996
 strcpy(s + 3, "bb", 2); // "aa bb CC" C4996
 strcpy(s, "ZZ", 3); // "ZZ", C4996
 // count greater than strSource, null added
 printf("%s\n", s);

 strcpy_s(s, sizeof(s), "AA BB CC");
 p = strstr(s, "BB");
 q = strstr(s, "CC");
 strcpy(s, "aa", p - s - 1); // "aa BB CC" C4996
 strcpy(p, "bb", q - p - 1); // "aa bb CC" C4996
 strcpy(q, "cc", q - s); // "aa bb cc" C4996
 strcpy(q, "dd", strlen(q)); // "aa bb dd" C4996
 printf("%s\n", s);

 // some problems with strncpy
 strcpy_s(s, sizeof(s), "test");
 strncpy(t, "this is a very long string", 20); // C4996
 // Danger: at this point, t has no terminating null,
 // so the printf continues until it runs into one.
 // In this case, it will print "this is a very long test"
 printf("%s\n", t);

 strcpy_s(t, sizeof(t), "dogs like cats");
 printf("%s\n", t);

 strncpy(t + 10, "to chase cars.", 14); // C4996
 printf("%s\n", t);

 // strncpy has caused a buffer overrun and corrupted string s
 printf("Buffer overrun: s = '%s' (should be 'test')\n", s);
 // Since the stack grows from higher to lower addresses, buffer
 // overruns can corrupt function return addresses on the stack,
 // which can be exploited to run arbitrary code.
}
```

## Output

```
ZZ
aa bb dd
this is a very long test
dogs like cats
dogs like to chase cars.
Buffer overrun: s = 'ars.' (should be 'test')
```

The layout of automatic variables and the level of error detection and code protection can vary with changed compiler settings. This example may have different results when built in other compilation environments or with other compiler options.

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_mbsnbcpy](#), [\\_mbsnbcpy\\_1](#)  
[strcat](#), [wcscat](#), [\\_mbscat](#)  
[strcmp](#), [wcscmp](#), [\\_mbscmp](#)  
[strcpy](#), [wcscopy](#), [\\_mbscopy](#)  
[strncat](#), [\\_strncat\\_1](#), [wcsncat](#), [\\_wcsncat\\_1](#), [\\_mbsncat](#), [\\_mbsncat\\_1](#)  
[strncmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_1](#)  
[\\_strnicmp](#), [\\_wcsnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_1](#), [\\_wcsnicmp\\_1](#), [\\_mbsnicmp\\_1](#)  
[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_1](#)  
[\\_strset](#), [\\_strset\\_1](#), [\\_wcsset](#), [\\_wcsset\\_1](#), [\\_mbsset](#), [\\_mbsset\\_1](#)  
[strspn](#), [wcsspn](#), [\\_mbsspnn](#), [\\_mbsspnn\\_1](#)  
[strncpy\\_s](#), [\\_strncpy\\_s\\_1](#), [wcsncpy\\_s](#), [\\_wcsncpy\\_s\\_1](#), [\\_mbsncpy\\_s](#), [\\_mbsncpy\\_s\\_1](#)  
[strcpy\\_s](#), [wcscopy\\_s](#), [\\_mbscopy\\_s](#)

`strncpy_s`, `_strncpy_s_l`, `wcsncpy_s`,

`_wcsncpy_s_l`, `_mbsncpy_s`, `_mbsncpy_s_l`

11/2/2022 • 7 minutes to read • [Edit Online](#)

Copies characters of one string to another. These versions of `strncpy`, `_strncpy_l`, `wcsncpy`, `_wcsncpy_l`, `_mbsncpy`, `_mbsncpy_l` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

`_mbsncpy_s` and `_mbsncpy_s_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t strncpy_s(
 char *strDest,
 size_t numberOfElements,
 const char *strSource,
 size_t count
);
errno_t _strncpy_s_l(
 char *strDest,
 size_t numberOfElements,
 const char *strSource,
 size_t count,
 _locale_t locale
);
errno_t wcsncpy_s(
 wchar_t *strDest,
 size_t numberOfElements,
 const wchar_t *strSource,
 size_t count
);
errno_t _wcsncpy_s_l(
 wchar_t *strDest,
 size_t numberOfElements,
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
);
errno_t _mbsncpy_s(
 unsigned char *strDest,
 size_t numberOfElements,
 const unsigned char *strSource,
 size_t count
);
errno_t _mbsncpy_s_l(
 unsigned char *strDest,
 size_t numberOfElements,
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
);
template <size_t size>
errno_t strncpy_s(
 char (&strDest)[size],
 const char *strSource,
```

```

 size_t count
); // C++ only
template <size_t size>
errno_t _strncpy_s_l(
 char (&strDest)[size],
 const char *strSource,
 size_t count,
 _locale_t locale
); // C++ only
template <size_t size>
errno_t wcsncpy_s(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count
); // C++ only
template <size_t size>
errno_t _wcsncpy_s_l(
 wchar_t (&strDest)[size],
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
); // C++ only
template <size_t size>
errno_t _mbsncpy_s(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count
); // C++ only
template <size_t size>
errno_t _mbsncpy_s_l(
 unsigned char (&strDest)[size],
 const unsigned char *strSource,
 size_t count,
 _locale_t locale
); // C++ only

```

## Parameters

`strDest`

Destination string.

`numberOfElements`

The size of the destination string, in characters.

`strSource`

Source string.

`count`

Number of characters to be copied, or `_TRUNCATE`.

`Locale`

The locale to use.

## Return value

Zero if successful, `STRUNCATE` if truncation occurred, otherwise an error code.

## Error conditions

<code>STRDEST</code>	<code>NUMBEROFELEMENTS</code>	<code>STRSOURCE</code>	<code>RETURN VALUE</code>	<code>CONTENTS OF STRDEST</code>
<code>NULL</code>	any	any	<code>EINVAL</code>	not modified

<code>STRDEST</code>	<code>NUMBEROFELEMENTS</code>	<code>STRSOURCE</code>	RETURN VALUE	CONTENTS OF <code>STRDEST</code>
any	any	<code>NULL</code>	<code>EINVAL</code>	<code>strDest[0]</code> set to 0
any	0	any	<code>EINVAL</code>	not modified
not <code>NULL</code>	too small	any	<code>ERANGE</code>	<code>strDest[0]</code> set to 0

## Remarks

These functions try to copy the first `D` characters of `strSource` to `strDest`, where `D` is the lesser of `count` and the length of `strSource`. If those `D` characters will fit within `strDest` (whose size is given as `numberOfElements`) and still leave room for a null terminator, then those characters are copied and a terminating null is appended; otherwise, `strDest[0]` is set to the null character and the invalid parameter handler is invoked, as described in [Parameter validation](#).

There's an exception to the above paragraph. If `count` is `_TRUNCATE`, then as much of `strSource` as will fit into `strDest` is copied while still leaving room for the terminating null, which is always appended.

For example,

```
char dst[5];
strncpy_s(dst, 5, "a long string", 5);
```

means that `strncpy_s` copies five characters into a 5-byte buffer. This copy would leave no space for the null terminator, so `strncpy_s` zeroes out the string, and calls the invalid parameter handler.

If truncation behavior is needed, use `_TRUNCATE` or (`size` - 1):

```
strncpy_s(dst, 5, "a long string", _TRUNCATE);
strncpy_s(dst, 5, "a long string", 4);
```

Unlike `strncpy`, if `count` is greater than the length of `strSource`, the destination string is NOT padded with null characters up to length `count`.

The behavior of `strncpy_s` is undefined if the source and destination strings overlap.

If `strDest` or `strSource` is `NULL`, or `numberOfElements` is 0, the invalid parameter handler is invoked. If execution is allowed to continue, the function returns `EINVAL` and sets `errno` to `EINVAL`.

`wcsncpy_s` and `_mbscopy_s` are wide-character and multibyte-character versions of `strncpy_s`. The arguments and return value of `wcsncpy_s` and `mbscopy_s` do vary accordingly. These six functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-

secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use

`_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tcsncpy_s</code>	<code>strncpy_s</code>	<code>_mbsncpy_s</code>	<code>wcsncpy_s</code>
<code>_tcsncpy_s_1</code>	<code>_strncpy_s_1</code>	<code>_mbsncpy_s_1</code>	<code>_wcsncpy_s_1</code>

#### NOTE

`_strncpy_s_1`, `_wcsncpy_s_1` and `_mbsncpy_s_1` have no locale dependence. They're provided just for `_tcsncpy_s_1` and aren't intended to be called directly.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strncpy_s</code> , <code>_strncpy_s_1</code>	<code>&lt;string.h&gt;</code>
<code>wcsncpy_s</code> , <code>_wcsncpy_s_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsncpy_s</code> , <code>_mbsncpy_s_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example: Copy chars to a buffer

```
// crt_strncpy_s_1.cpp
// compile with: /MTd

// these #defines enable secure template overloads
// (see last part of Examples() below)
#define _CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES 1
#define _CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT 1

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <crtdbg.h> // For _CrtSetReportMode
#include <errno.h>

// This example uses a 10-byte destination buffer.

errno_t strncpy_s_tester(const char * src,
 int count)
{
 char dest[10];

 printf("\n");
```

```

if (count == _TRUNCATE)
 printf("Copying '%s' to %d-byte buffer dest with truncation semantics\n",
 src, _countof(dest));
else
 printf("Copying %d chars of '%s' to %d-byte buffer dest\n",
 count, src, _countof(dest));

errno_t err = strncpy_s(dest, _countof(dest), src, count);

printf(" new contents of dest: '%s'\n", dest);

return err;
}

void Examples()
{
 strncpy_s_tester("howdy", 4);
 strncpy_s_tester("howdy", 5);
 strncpy_s_tester("howdy", 6);

 printf("\nDestination buffer too small:\n");
 strncpy_s_tester("Hi there!!", 10);

 printf("\nTruncation examples:\n");

 errno_t err = strncpy_s_tester("How do you do?", _TRUNCATE);
 printf(" truncation %s occur\n", err == STRUNCATE ? "did"
 : "did not");

 err = strncpy_s_tester("Howdy.", _TRUNCATE);
 printf(" truncation %s occur\n", err == STRUNCATE ? "did"
 : "did not");

 printf("\nSecure template overload example:\n");

 char dest[10];
 strcpy(dest, "very very very long", 15);
 // With secure template overloads enabled (see #defines at
 // top of file), the preceding line is replaced by
 // strncpy_s(dest, _countof(dest), "very very very long", 15);
 // Instead of causing a buffer overrun, strncpy_s invokes
 // the invalid parameter handler.
 // If secure template overloads were disabled, strcpy would
 // copy 15 characters and overrun the dest buffer.
 printf(" new contents of dest: '%s'\n", dest);
}

void myInvalidParameterHandler(
 const wchar_t* expression,
 const wchar_t* function,
 const wchar_t* file,
 unsigned int line,
 uintptr_t pReserved)
{
 wprintf(L"Invalid parameter handler invoked: %s\n", expression);
}

int main(void)
{
 _invalid_parameter_handler oldHandler, newHandler;

 newHandler = myInvalidParameterHandler;
 oldHandler = _set_invalid_parameter_handler(newHandler);
 // Disable the message box for assertions.
 _CrtSetReportMode(_CRT_ASSERT, 0);

 Examples();
}

```

```

Copying 4 chars of 'howdy' to 10-byte buffer dest
 new contents of dest: 'howd'

Copying 5 chars of 'howdy' to 10-byte buffer dest
 new contents of dest: 'howdy'

Copying 6 chars of 'howdy' to 10-byte buffer dest
 new contents of dest: 'howdy'

Destination buffer too small:

Copying 10 chars of 'Hi there!!!' to 10-byte buffer dest
Invalid parameter handler invoked: (L"Buffer is too small" && 0)
 new contents of dest: ''

Truncation examples:

Copying 'How do you do?' to 10-byte buffer dest with truncation semantics
 new contents of dest: 'How do yo'
 truncation did occur

Copying 'Howdy.' to 10-byte buffer dest with truncation semantics
 new contents of dest: 'Howdy.'
 truncation did not occur

Secure template overload example:
Invalid parameter handler invoked: (L"Buffer is too small" && 0)
 new contents of dest: ''

```

## Example: `strncpy` and `strncpy_s`

```

// crt_strncpy_s_2.c
// contrasts strncpy and strncpy_s

#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 char a[20] = "test";
 char s[20];

 // simple strncpy usage:

 strcpy_s(s, 20, "dogs like cats");
 printf("Original string:\n '%s'\n", s);

 // Here we can't use strncpy_s since we don't
 // want null termination
 strncpy(s, "mice", 4);
 printf("After strncpy (no null-termination):\n '%s'\n", s);
 strncpy(s+5, "love", 4);
 printf("After strncpy into middle of string:\n '%s'\n", s);

 // If we use strncpy_s, the string is terminated
 strncpy_s(s, _countof(s), "mice", 4);
 printf("After strncpy_s (with null-termination):\n '%s'\n", s);
}

```

```
Original string:
'dogs like cats'
After strcpy (no null-termination):
'mice like cats'
After strcpy into middle of string:
'mice love cats'
After strcpy_s (with null-termination):
'mice'
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_mbsncpy](#), [\\_mbsnbcpy\\_1](#)  
[strcat\\_s](#), [wcscat\\_s](#), [\\_mbscat\\_s](#)  
[strcmp](#), [wcscmp](#), [\\_mbscmp](#)  
[strcpy\\_s](#), [wcscopy\\_s](#), [\\_mbscopy\\_s](#)  
[strncat\\_s](#), [\\_strncat\\_s\\_1](#), [wcsncat\\_s](#), [\\_wcsncat\\_s\\_1](#), [\\_mbsncat\\_s](#), [\\_mbsncat\\_s\\_1](#)  
[strncmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_1](#)  
[\\_strnicmp](#), [\\_wcsnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_1](#), [\\_wcsnicmp\\_1](#), [\\_mbsnicmp\\_1](#)  
[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_1](#)  
[\\_strset](#), [\\_strset\\_1](#), [\\_wcsset](#), [\\_wcsset\\_1](#), [\\_mbsset](#), [\\_mbsset\\_1](#)  
[strspn](#), [wcsspn](#), [\\_mbsspn](#), [\\_mbsspn\\_1](#)

`_strnnextc`, `_wcsnnextc`, `_mbsnnextc`, `_mbsnnextc_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Finds the next character in a string.

#### IMPORTANT

`_mbsnnextc` and `_mbsnnextc_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
unsigned int _strnnextc(
 const char *str
);
unsigned int _wcsnnextc(
 const wchar_t *str
);
unsigned int _mbsnnextc(
 const unsigned char *str
);
unsigned int _mbsnnextc_1(
 const unsigned char *str,
 _locale_t locale
);
```

### Parameters

`str`

Source string.

`Locale`

Locale to use.

## Return value

Each of these functions returns the integer value of the next character in `str`.

## Remarks

The `_mbsnnextc` function returns the integer value of the next multibyte character in `str`, without advancing the string pointer. `_mbsnnextc` recognizes multibyte-character sequences according to the [multibyte code page](#) currently in use.

If `str` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns 0.

**Security Note** This API incurs a potential threat brought about by a buffer overrun problem. Buffer overrun problems are a frequent method of system attack, resulting in an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcsnextc</code>	<code>_strnextc</code>	<code>_mbsnextc</code>	<code>_wcsnextc</code>

`_strnextc` and `_wcsnextc` are single-byte-character string and wide-character string versions of `_mbsnextc`. `_wcsnextc` returns the integer value of the next wide character in `str`; `_strnextc` returns the integer value of the next single-byte character in `str`. `_strnextc` and `_wcsnextc` are provided only for this mapping and shouldn't be used otherwise. For more information, see [Using generic-text mappings](#) and [Generic-text mappings](#).

`_mbsnextc_1` is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsnextc</code>	<mbstring.h>
<code>_mbsnextc_1</code>	<mbstring.h>
<code>_strnextc</code>	<tchar.h>
<code>_wcsnextc</code>	<tchar.h>

For more compatibility information, see [Compatibility](#).

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`_strdec`, `_wcsdec`, `_mbsdec`, `_mbsdec_1`  
`_strinc`, `_wcsinc`, `_mbsinc`, `_mbsinc_1`  
`_strninc`, `_wcsninc`, `_mbsninc`, `_mbsninc_1`

# `strnicmp`, `wcsnicmp`

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The Microsoft-specific function names `strnicmp` and `wcsnicmp` are deprecated aliases for the [`\_strnicmp`](#) and [`\_wcsnicmp`](#) functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use [`\_strnicmp`](#) and [`\_wcsnicmp`](#) instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_strnicmp`, `_wcsnicmp`, `_mbsnicmp`, `_strnicmp_l`,  
`_wcsnicmp_l`, `_mbsnicmp_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Compares the specified number of characters of two strings without regard to case.

#### IMPORTANT

`_mbsnicmp` and `_mbsnicmp_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _strnicmp(
 const char *string1,
 const char *string2,
 size_t count
);
int _wcsnicmp(
 const wchar_t *string1,
 const wchar_t *string2,
 size_t count
);
int _mbsnicmp(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count
);
int _strnicmp_l(
 const char *string1,
 const char *string2,
 size_t count,
 _locale_t locale
);
int _wcsnicmp_l(
 const wchar_t *string1,
 const wchar_t *string2,
 size_t count,
 _locale_t locale
);
int _mbsnicmp_l(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count,
 _locale_t locale
);
```

#### Parameters

`string1`, `string2`

Null-terminated strings to compare.

`count`

Number of characters to compare.

## Locale

Locale to use.

## Return value

Indicates the relationship between the substrings, as follows.

RETURN VALUE	DESCRIPTION
< 0	<code>string1</code> substring is less than <code>string2</code> substring.
0	<code>string1</code> substring is identical to <code>string2</code> substring.
> 0	<code>string1</code> substring is greater than <code>string2</code> substring.

On a parameter validation error, these functions return `_NLSCMPERROR`, which is defined in `<string.h>` and `<mbstring.h>`.

## Remarks

The `_strnicmp` function compares, at most, the first `count` characters of `string1` and `string2`. The comparison is performed without regard to case by converting each character to lowercase. `_strnicmp` is a case-insensitive version of `strncmp`. The comparison ends if a terminating null character is reached in either string before `count` characters are compared. If the strings are equal when a terminating null character is reached in either string before `count` characters are compared, the shorter string is lesser.

The characters from 91 to 96 in the ASCII table ('[, '\', ']', '^', '\_', and '') evaluate as less than any alphabetic character. This ordering is identical to that of `strcmp`.

`_wcsnicmp` and `_mbsnicmp` are wide-character and multibyte-character versions of `_strnicmp`. The arguments of `_wcsnicmp` are wide-character strings. The arguments of `_mbsnicmp` are multibyte-character strings. `_mbsnicmp` recognizes multibyte-character sequences according to the current multibyte code page and returns `_NLSCMPERROR` on an error. For more information, see [Code pages](#). These three functions behave identically otherwise. These functions are affected by the locale setting—the versions that don't have the `_1` suffix use the current locale for their locale-dependent behavior; the versions that do have the `_1` suffix instead use the `Locale` that's passed in. For more information, see [Locale](#).

All of these functions validate their parameters. If either `string1` or `string2` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncicmp</code>	<code>_strnicmp</code>	<code>_mbsnicmp</code>	<code>_wcsnicmp</code>
<code>_tcsnicmp</code>	<code>_strnicmp</code>	<code>_mbsnbicmp</code>	<code>_wcsnicmp</code>
<code>_tcsncicmp_1</code>	<code>_strnicmp_1</code>	<code>_mbsnicmp_1</code>	<code>_wcsnicmp_1</code>

# Requirements

ROUTINE	REQUIRED HEADER
<code>_strnicmp</code> , <code>_strnicmp_1</code>	<code>&lt;string.h&gt;</code>
<code>_wcsnicmp</code> , <code>_wcsnicmp_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsnicmp</code> , <code>_mbsnicmp_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [`strcmp`](#).

## See also

### String manipulation

<code>strcat</code>	<code>wcscat</code>	<code>_mbscat</code>
<code>strcmp</code>	<code>wcscmp</code>	<code>_mbscmp</code>
<code>strcpy</code>	<code>wcscopy</code>	<code>_mbscpy</code>
<code>strncat</code>	<code>_strncat_1</code>	<code>wcsncat</code>
		<code>_wcsncat_1</code>
		<code>_mbsncat</code>
		<code>_mbsncat_1</code>
<code>strncpy</code>	<code>_strncpy_1</code>	<code>wcsncpy</code>
		<code>_wcsncpy_1</code>
		<code>_mbsncpy</code>
		<code>_mbsncpy_1</code>
<code>strrchr</code>	<code>wcsrchr</code>	<code>_mbsrchr</code>
<code>_strset</code>	<code>_strset_1</code>	<code>_wcsset</code>
		<code>_wcsset_1</code>
		<code>_mbsset</code>
		<code>_mbsset_1</code>
<code>strspn</code>	<code>wcsspn</code>	<code>_mbsspnn</code>
		<code>_mbsspnn_1</code>

`_strnicoll`, `_wcsnicoll`, `_mbsnicoll`,  
`_strnicoll_l`, `_wcsnicoll_l`, `_mbsnicoll_l`

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Compares strings by using locale-specific information.

#### IMPORTANT

`_mbsnicoll` and `_mbsnicoll_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _strnicoll(
 const char *string1,
 const char *string2,
 size_t count
);
int _wcsnicoll(
 const wchar_t *string1,
 const wchar_t *string2 ,
 size_t count
);
int _mbsnicoll(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count
);
int _strnicoll_l(
 const char *string1,
 const char *string2,
 size_t count,
 _locale_t locale
);
int _wcsnicoll_l(
 const wchar_t *string1,
 const wchar_t *string2 ,
 size_t count,
 _locale_t locale
);
int _mbsnicoll_l(
 const unsigned char *string1,
 const unsigned char *string2,
 size_t count,
 _locale_t locale
);
```

#### Parameters

`string1`, `string2`

Null-terminated strings to compare

`count`

Number of characters to compare

## Locale

The locale to use.

## Return value

Each of these functions returns a value indicating the relationship of the substrings of `string1` and `string2`, as follows.

RETURN VALUE	RELATIONSHIP OF STRING1 TO STRING2
< 0	<code>string1</code> less than <code>string2</code>
0	<code>string1</code> identical to <code>string2</code>
> 0	<code>string1</code> greater than <code>string2</code>

Each of these functions returns `_NLSCMPERROR`. To use `_NLSCMPERROR`, include either STRING.H or MBSTRING.H. `_wcsnicoll` can fail if either `string1` or `string2` contains wide-character codes outside the domain of the collating sequence. When an error occurs, `_wcsnicoll` may set `errno` to `EINVAL`. To check for an error on a call to `_wcsnicoll`, set `errno` to 0 and then check `errno` after calling `_wcsnicoll`.

## Remarks

Each of these functions performs a case-insensitive comparison of the first `count` characters in `string1` and `string2` according to the code page. These functions should be used only when there's a difference between the character set order and the lexicographic character order in the code page and this difference is of interest for the string comparison. The versions of these functions without the `_1` suffix use the current locale and code page. The versions with the `_1` suffix are identical except that they use the locale passed in instead. For more information, see [Locale](#).

All of these functions validate their parameters. If either `string1` or `string2` is a null pointer, or if `count` is greater than `INT_MAX`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `_NLSCMPERROR` and set `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsncicoll</code>	<code>_strnicoll</code>	<code>_mbsnbicoll</code>	<code>_wcsnicoll</code>
<code>_tcsnicoll</code>	<code>_strnicoll</code>	<code>_mbsnbicoll</code>	<code>_wcsnicoll</code>
<code>_tcsnicoll_1</code>	<code>_strnicoll_1</code>	<code>_mbsnbicoll_1</code>	<code>_wcsnicoll_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strnicoll</code> , <code>_strnicoll_1</code>	<code>&lt;string.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_wcsnicoll</code> , <code>_wcsnicoll_l</code>	<wchar.h> or <string.h>
<code>_mbsnicoll</code> , <code>_mbsnicoll_l</code>	<mbstring.h>

For more compatibility information, see [Compatibility](#).

## See also

[Locale](#)

[String manipulation](#)

`strcoll` functions

`localeconv`

`_mbsnbcoll`, `_mbsnbcoll_l`, `_mbsnbicoll`, `_mbsnbicoll_l`

`setlocale`, `_wsetlocale`

`strcmp`, `wcsncmp`, `_mbscmp`

`_stricmp`, `_wcscicmp`, `_mbsicmp`, `_stricmp_l`, `_wcscicmp_l`, `_mbsicmp_l`

`strncmp`, `wcsncmp`, `_mbsncmp`, `_mbsncmp_l`

`_strnicmp`, `_wcscnicmp`, `_mbsnicmp`, `_strnicmp_l`, `_wcscnicmp_l`, `_mbsnicmp_l`

`strxfrm`, `wcsxfrm`, `_strxfrm_l`, `_wcscxfrm_l`

Advances a string pointer by `n` characters.

**IMPORTANT**

`_mbsninc` and `_mbsninc_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strninc(
 const char *str,
 size_t count
);
wchar_t *_wcsninc(
 const wchar_t *str,
 size_t count
);
unsigned char *_mbsninc(
 const unsigned char *str,
 size_t count
);
unsigned char *_mbsninc(
 const unsigned char *str,
 size_t count,
 _locale_t locale
);
```

### Parameters

`str`

Source string.

`count`

Number of characters to increment a string pointer.

`Locale`

Locale to use.

## Return value

Each of these routines returns a pointer to `str` after `str` has been incremented by `count` characters or `NULL` if the supplied pointer is `NULL`. If `count` is greater than or equal to the number of characters in `str`, the result is undefined.

## Remarks

The `_mbsninc` function increments `str` by `count` multibyte characters. `_mbsninc` recognizes multibyte-character sequences according to the [multibyte code page](#) currently in use.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the](#)

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsninc</code>	<code>_strninc</code>	<code>_mbsninc</code>	<code>_wcsninc</code>

`_strninc` and `_wcsninc` are single-byte-character string and wide-character string versions of `_mbsninc`. `_wcsninc` and `_strninc` are provided only for this mapping and shouldn't be used otherwise. For more information, see [Using generic-text mappings](#) and [Generic-text mappings](#).

`_mbsninc_1` is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsninc</code>	<code>&lt;mbstring.h&gt;</code>
<code>_mbsninc_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_strninc</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsninc</code>	<code>&lt;tchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`_strdec`, `_wcsdec`, `_mbsdec`, `_mbsdec_1`  
`_strinc`, `_wcsinc`, `_mbsinc`, `_mbsinc_1`  
`_strnextc`, `_wcsnextc`, `_mbsnextc`, `_mbsnextc_1`

`strnlen`, `strnlen_s`, `wcsnlen`, `wcsnlen_s`,  
`_mbsnlen`, `_mbsnlen_1`, `_mbstrnlen`, `_mbstrnlen_1`

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Gets the length of a string by using the current locale or one that has been passed in. These functions are more secure versions of `strlen`, `wcslen`, `_mbslen`, `_mbslen_1`, `_mbstrlen`, `_mbstrlen_1`.

#### IMPORTANT

`_mbsnlen`, `_mbsnlen_1`, `_mbstrnlen`, and `_mbstrnlen_1` can't be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
size_t strnlen(
 const char *str,
 size_t numberOfElements
);
size_t strnlen_s(
 const char *str,
 size_t numberOfElements
);
size_t wcsnlen(
 const wchar_t *str,
 size_t numberOfElements
);
size_t wcsnlen_s(
 const wchar_t *str,
 size_t numberOfElements
);
size_t _mbsnlen(
 const unsigned char *str,
 size_t numberOfElements
);
size_t _mbsnlen_1(
 const unsigned char *str,
 size_t numberOfElements,
 _locale_t locale
);
size_t _mbstrnlen(
 const char *str,
 size_t numberOfElements
);
size_t _mbstrnlen_1(
 const char *str,
 size_t numberOfElements,
 _locale_t locale
);
```

### Parameters

`str`

Null-terminated string.

`numberOfElements`

The size of the string buffer.

#### Locale

Locale to use.

## Return value

These functions return the number of characters in the string, not including the terminating null character. If there's no null terminator within the first `numberOfElements` bytes of the string (or wide characters for `wcsnlen`), then `numberOfElements` is returned to indicate the error condition; null-terminated strings have lengths that are strictly less than `numberOfElements`.

`_mbstrnlen` and `_mbstrnlen_1` return -1 if the string contains an invalid multibyte character.

## Remarks

#### NOTE

`strnlen` is not a replacement for `strlen`; `strnlen` is intended to be used only to calculate the size of incoming untrusted data in a buffer of known size—for example, a network packet. `strnlen` calculates the length but doesn't walk past the end of the buffer if the string is unterminated. For other situations, use `strlen`. (The same applies to `wcsnlen`, `_mbsnlen`, and `_mbstrnlen`.)

Each of these functions returns the number of characters in `str`, not including the terminating null character. However, `strnlen` and `strnlen_s` interpret the string as a single-byte character string and therefore, the return value is always equal to the number of bytes, even if the string contains multibyte characters. `wcsnlen` and `wcsnlen_s` are wide-character versions of `strnlen` and `strnlen_s` respectively; the arguments for `wcsnlen` and `wcsnlen_s` are wide-character strings and the count of characters are in wide-character units. Otherwise, `wcsnlen` and `strnlen` behave identically, as do `strnlen_s` and `wcsnlen_s`.

`strnlen`, `wcsnlen`, and `_mbsnlen` don't validate their parameters. If `str` is `NULL`, an access violation occurs.

`strnlen_s` and `wcsnlen_s` validate their parameters. If `str` is `NULL`, the functions return 0.

`_mbstrnlen` also validates its parameters. If `str` is `NULL`, or if `numberOfElements` is greater than `INT_MAX`, `_mbstrnlen` generates an invalid parameter exception, as described in [Parameter validation](#). If execution is allowed to continue, `_mbstrnlen` sets `errno` to `EINVAL` and returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnlen</code>	<code>strnlen</code>	<code>strnlen</code>	<code>wcsnlen</code>
<code>_tcscnlen</code>	<code>strnlen</code>	<code>_mbsnlen</code>	<code>wcsnlen</code>
<code>_tcscnlen_1</code>	<code>strnlen</code>	<code>_mbsnlen_1</code>	<code>wcsnlen</code>

`_mbsnlen` and `_mbstrnlen` return the number of multibyte characters in a multibyte-character string. `_mbsnlen` recognizes multibyte-character sequences according to the multibyte code page that's currently in use or according to the locale that's passed in; it doesn't test for multibyte-character validity. `_mbstrnlen` tests for

multibyte-character validity and recognizes multibyte-character sequences. If the string that's passed to `_mbstrlen` contains an invalid multibyte character, `errno` is set to `EILSEQ`.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions are identical, except that the ones that don't have the `_1` suffix use the current locale for this locale-dependent behavior and the versions that have the `_1` suffix instead use the locale parameter that's passed in. For more information, see [Locale](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>strlen</code> , <code>strnlen_s</code>	<code>&lt;string.h&gt;</code>
<code>wcsnlen</code> , <code>wcsnlen_s</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsnlen</code> , <code>_mbsnlen_1</code>	<code>&lt;mbstring.h&gt;</code>
<code>_mbstrlen</code> , <code>_mbstrlen_1</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strlen.c

#include <string.h>

int main()
{
 // str1 is 82 characters long. str2 is 159 characters long

 char* str1 = "The length of a string is the number of characters\n"
 "excluding the terminating null.";
 char* str2 = "strnlen takes a maximum size. If the string is longer\n"
 "than the maximum size specified, the maximum size is\n"
 "returned rather than the actual size of the string.";
 size_t len;
 size_t maxsize = 100;

 len = strlen(str1, maxsize);
 printf("%s\n Length: %d \n\n", str1, len);

 len = strnlen(str2, maxsize);
 printf("%s\n Length: %d \n", str2, len);
}
```

```
The length of a string is the number of characters
excluding the terminating null.
Length: 82
```

```
strnlen takes a maximum size. If the string is longer
than the maximum size specified, the maximum size is
returned rather than the actual size of the string.
Length: 100
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[setlocale](#), [\\_wsetlocale](#)

[strncat](#), [\\_strncat\\_1](#), [wcscat](#), [\\_wcscat\\_1](#), [\\_mbscat](#), [\\_mbscat\\_1](#)

[strcmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_1](#)

[strcoll](#) functions

[strncpy\\_s](#), [\\_strncpy\\_s\\_1](#), [wcscopy\\_s](#), [\\_wcscopy\\_s\\_1](#), [\\_mbscpy\\_s](#), [\\_mbscpy\\_s\\_1](#)

[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_1](#)

[\\_strset](#), [\\_strset\\_1](#), [\\_wcset](#), [\\_wcset\\_1](#), [\\_mbsset](#), [\\_mbsset\\_1](#)

[strspn](#), [wcspn](#), [\\_mbsspnn](#), [\\_mbsspnn\\_1](#)

# `strnset`, `wcsnset`

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The Microsoft-specific function names `strnset` and `wcsnset` are deprecated aliases for the `_strnset` and `_wcsnset` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_strnset` and `_wcsnset` or the security-enhanced `_strnset_s` and `_wcsnset_s` functions instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_strnset`, `_strnset_l`, `_wcsnset`, `_wcsnset_l`,  
`_mbsnset`, `_mbsnset_l`

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Initializes characters of a string to a given character. More secure versions of these functions exist; see

`_strnset_s`, `_strnset_s_l`, `_wcsnset_s`, `_wcsnset_s_l`, `_mbsnset_s`, `_mbsnset_s_l`.

#### IMPORTANT

`_mbsnset` and `_mbsnset_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strnset(
 char *str,
 int c,
 size_t count
);
char *_strnset_l(
 char *str,
 int c,
 size_t count,
 _locale_t locale
);
wchar_t *_wcsnset(
 wchar_t *str,
 wchar_t c,
 size_t count
);
wchar_t *_wcsnset_l(
 wchar_t *str,
 wchar_t c,
 size_t count,
 _locale_t locale
);
unsigned char *_mbsnset(
 unsigned char *str,
 unsigned int c,
 size_t count
);
unsigned char *_mbsnset_l(
 unsigned char *str,
 unsigned int c,
 size_t count,
 _locale_t locale
);
```

## Parameters

`str`

String to be altered.

`c`

Character setting.

`count`

Number of characters to be set.

`Locale`

Locale to use.

## Return value

Returns a pointer to the altered string.

## Remarks

The `_strnset` function sets, at most, the first `count` characters of `str` to `c` (converted to `char`). If `count` is greater than the length of `str`, the length of `str` is used instead of `count`.

`_wcsnset` and `_mbsnset` are wide-character and multibyte-character versions of `_strnset`. The string arguments and return value of `_wcsnset` are wide-character strings. The string arguments and return value of `_mbsnset` are multibyte-character strings. These three functions behave identically otherwise.

`_mbsnset` validates its parameters; if `str` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbsnset` returns `NULL` and sets `errno` to `EINVAL`. `_strnset` and `_wcsnset` don't validate their parameters.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnset</code>	<code>_strnset</code>	<code>_mbsnset</code>	<code>_wcsnset</code>
<code>_tcsnset_1</code>	<code>_strnset_1</code>	<code>_mbsnset_1</code>	<code>_wcsnset_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strnset</code>	<code>&lt;string.h&gt;</code>
<code>_strnset_1</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsnset</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_wcsnset_1</code>	<code>&lt;tchar.h&gt;</code>
<code>_mbsnset</code> , <code>_mbsnset_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strnset.c
// compile with: /W3
#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[15] = "This is a test";
 /* Set not more than 4 characters of string to be '*'s */
 printf("Before: %s\n", string);
 _strnset(string, '*', 4); // C4996
 // Note: _strnset is deprecated; consider using _strnset_s
 printf("After: %s\n", string);
}
```

```
Before: This is a test
After: **** is a test
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_strcat](#) , [wcscat](#) , [\\_mbscat](#)  
[strcmp](#) , [wcscmp](#) , [\\_mbscmp](#)  
[strcpy](#) , [wcscopy](#) , [\\_mbscopy](#)  
[\\_strset](#) , [\\_strset\\_1](#) , [\\_wcsset](#) , [\\_wcset\\_1](#) , [\\_mbsset](#) , [\\_mbsset\\_1](#)

`_strnset_s`, `_strnset_s_l`, `_wcsnset_s`,  
`_wcsnset_s_l`, `_mbsnset_s`, `_mbsnset_s_l`

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Initializes characters of a string to a given character. These versions of `_strnset`, `_strnset_l`, `_wcsnset`, `_wcsnset_l`, `_mbsnset`, `_mbsnset_l` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

`_mbsnset_s` and `_mbsnset_s_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t _strnset_s(
 char *str,
 size_t numberOfElements,
 int c,
 size_t count
);
errno_t _strnset_s_l(
 char *str,
 size_t numberOfElements,
 int c,
 size_t count,
 _locale_t locale
);
errno_t _wcsnset_s(
 wchar_t *str,
 size_t numberOfElements,
 wchar_t c,
 size_t count
);
errno_t _wcsnset_s_l(
 wchar_t *str,
 size_t numberOfElements,
 wchar_t c,
 size_t count,
 _locale_t locale
);
errno_t _mbsnset_s(
 unsigned char *str,
 size_t numberOfElements,
 unsigned int c,
 size_t count
);
errno_t _mbsnset_s_l(
 unsigned char *str,
 size_t numberOfElements,
 unsigned int c,
 size_t count,
 _locale_t locale
);
```

## Parameters

`str`

String to be altered.

`numberOfElements`

The size of the `str` buffer.

`c`

Character setting.

`count`

Number of characters to be set.

`Locale`

Locale to use.

## Return value

Zero if successful, otherwise an error code.

These functions validate their arguments. If `str` isn't a valid null-terminated string or the size argument is less than or equal to 0, then the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return an error code and set `errno` to that error code. The default error code is `EINVAL` if a more specific value doesn't apply.

## Remarks

These functions set, at most, the first `count` characters of `str` to `c`. If `count` is greater than the size of `str`, the size of `str` is used instead of `count`. An error occurs if `count` is greater than `numberOfElements` and both those parameters are greater than the size of `str`.

`_wcsnset_s` and `_mbsnset_s` are wide-character and multibyte-character versions of `_strnset_s`. The string argument of `_wcsnset_s` is a wide-character string; that of `_mbsnset_s` is a multibyte-character string. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use

[`\_CrtSetDebugFillThreshold`](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsnset_s</code>	<code>_strnset_s</code>	<code>_mbsnset_s</code>	<code>_wcsnset_s</code>
<code>_tcsnset_s_1</code>	<code>_strnset_s_1</code>	<code>_mbsnset_s_1</code>	<code>_wcsnset_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strnset_s</code>	<code>&lt;string.h&gt;</code>
<code>_strnset_s_l</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsnset_s</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_wcsnset_s_l</code>	<code>&lt;tchar.h&gt;</code>
<code>_mbsnset_s</code> , <code>_mbsnset_s_l</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strnset_s.c
#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[15] = "This is a test";
 /* Set not more than 4 characters of string to be '*'s */
 printf("Before: %s\n", string);
 _strnset_s(string, sizeof(string), '*', 4);
 printf("After: %s\n", string);
}
```

```
Before: This is a test
After: **** is a test
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

<code>strcat</code>	<code>wcscat</code>	<code>_mbscat</code>
<code>strcmp</code>	<code>wcscmp</code>	<code>_mbscmp</code>
<code>strcpy</code>	<code>wcscopy</code>	<code>_mbscopy</code>
<code>_strset</code>	<code>_strset_l</code>	<code>_wcset</code>
<code>_wcset</code>	<code>_wcset_l</code>	<code>_mbsset</code>
<code>_mbsset</code>	<code>_mbsset_l</code>	

`strupr`, `wcspbrk`, `_mbspbrk`, `_mbspbrk_1`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Scans strings for characters in specified character sets.

**IMPORTANT**

`_mbspbrk` and `_mbspbrk_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strpbrk(
 const char *str,
 const char *str CharSet
); // C only
char *strpbrk(
 char *str,
 const char *str CharSet
); // C++ only
const char *strpbrk(
 const char *str,
 const char *str CharSet
); // C++ only
wchar_t *wcspbrk(
 const wchar_t *str,
 const wchar_t *str CharSet
); // C only
wchar_t *wcspbrk(
 wchar_t *str,
 const wchar_t *str CharSet
); // C++ only
const wchar_t *wcspbrk(
 const wchar_t *str,
 const wchar_t *str CharSet
); // C++ only
unsigned char *_mbspbrk(
 const unsigned char *str,
 const unsigned char *str CharSet
); // C only
unsigned char *_mbspbrk(
 unsigned char *str,
 const unsigned char *str CharSet
); // C++ only
const unsigned char *_mbspbrk(
 const unsigned char *str,
 const unsigned char *str CharSet
); // C++ only
unsigned char *_mbspbrk_l(
 const unsigned char *str,
 const unsigned char *str CharSet,
 _locale_t locale
); // C only
unsigned char *_mbspbrk_l(
 unsigned char *str,
 const unsigned char *str CharSet,
 _locale_t locale
); // C++ only
const unsigned char *_mbspbrk_l(
 const unsigned char *str,
 const unsigned char *str CharSet,
 _locale_t locale
); // C++ only
```

## Parameters

`str`

Null-terminated, searched string.

`str CharSet`

Null-terminated character set.

`Locale`

Locale to use.

## Return value

Returns a pointer to the first occurrence of any character from `str CharSet` in `str`, or a `NULL` pointer if the two string arguments have no characters in common.

## Remarks

The `strupr` function returns a pointer to the first occurrence of a character in `str` that belongs to the set of characters in `str CharSet`. The search doesn't include the terminating null character.

`wcspbrk` and `_mbspbrk` are wide-character and multibyte-character versions of `strupr`. The arguments and return value of `wcspbrk` are wide-character strings. The arguments and return value of `_mbspbrk` are multibyte-character strings.

`_mbspbrk` validates its parameters. If `str` or `str CharSet` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbspbrk` returns `NULL` and sets `errno` to `EINVAL`. `strupr` and `wcspbrk` don't validate their parameters. These three functions behave identically otherwise.

`_mbspbrk` is similar to `_mbcsn` except that `_mbspbrk` returns a pointer rather than a value of type `size_t`.

In C, these functions take a `const` pointer for the first argument. In C++, two overloads are available. The overload taking a pointer to `const` returns a pointer to `const`; the version that takes a pointer to non-`const` returns a pointer to non-`const`. The macro `_CRT_CONST_CORRECT_OVERLOADS` is defined if both the `const` and non-`const` versions of these functions are available. If you require the non-`const` behavior for both C++ overloads, define the symbol `_CONST_RETURN`.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale; for more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the version with the `_1` suffix is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcspbrk</code>	<code>strupr</code>	<code>_mbspbrk</code>	<code>wcspbrk</code>
n/a	n/a	<code>_mbspbrk_1</code>	n/a

## Requirements

ROUTINE	REQUIRED HEADER
<code>strupr</code>	<code>&lt;string.h&gt;</code>
<code>wcspbrk</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_mbspbrk</code> , <code>_mbspbrk_1</code>	<code>&lt;mbstring.h&gt;</code>

For more information about compatibility, see [Compatibility](#).

## Example

```
// crt_strpbrk.c

#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[100] = "The 3 men and 2 boys ate 5 pigs\n";
 char *result = NULL;

 // Return pointer to first digit in "string".
 printf("1: %s\n", string);
 result = strpbrk(string, "0123456789");
 printf("2: %s\n", result++);
 result = strpbrk(result, "0123456789");
 printf("3: %s\n", result++);
 result = strpbrk(result, "0123456789");
 printf("4: %s\n", result);
}
```

```
1: The 3 men and 2 boys ate 5 pigs
2: 3 men and 2 boys ate 5 pigs
3: 2 boys ate 5 pigs
4: 5 pigs
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[strcspn](#) , [wcscspn](#) , [\\_mbscspn](#) , [\\_mbscspn\\_1](#)  
[strchr](#) , [wcschr](#) , [\\_mbschr](#) , [\\_mbschr\\_1](#)  
[strrchr](#) , [wcsrchr](#) , [\\_mbsrchr](#) , [\\_mbsrchr\\_1](#)

`strnchr`, `wcsnchr`, `_mbsnchr`, `_mbsnchr_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Scans a string for the last occurrence of a character.

**IMPORTANT**

`_mbsrchr` and `_mbsrchr_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strrchr(
 const char *str,
 int c
); // C only
char *strrchr(
 char *str,
 int c
); // C++ only
const char *strrchr(
 const char *str,
 int c
); // C++ only
wchar_t *wcsrchr(
 const wchar_t *str,
 wchar_t c
); // C only
wchar_t *wcsrchr(
 wchar_t *str,
 wchar_t c
); // C++ only
const wchar_t *wcsrchr(
 const wchar_t *str,
 wchar_t c
); // C++ only
unsigned char *_mbsrchr(
 const unsigned char *str,
 unsigned int c
); // C only
unsigned char *_mbsrchr(
 unsigned char *str,
 unsigned int c
); // C++ only
const unsigned char *_mbsrchr(
 const unsigned char *str,
 unsigned int c
); // C++ only
unsigned char *_mbsrchr_l(
 const unsigned char *str,
 unsigned int c,
 _locale_t locale
); // C only
unsigned char *_mbsrchr_l(
 unsigned char *str,
 unsigned int c,
 _locale_t locale
); // C++ only
const unsigned char *_mbsrchr_l(
 const unsigned char *str,
 unsigned int c,
 _locale_t locale
); // C++ only
```

## Parameters

`str`

Null-terminated string to search.

`c`

Character to be located.

`Locale`

Locale to use.

## Return value

Returns a pointer to the last occurrence of `c` in `str`, or `NULL` if `c` isn't found.

## Remarks

The `strrchr` function finds the last occurrence of `c` (converted to `char`) in `str`. The search includes the terminating `NULL` character.

`wcsrchr` and `_mbsrchr` are wide-character and multibyte-character versions of `strrchr`. The arguments and return value of `wcsrchr` are wide-character strings. The arguments and return value of `_mbsrchr` are multibyte-character strings.

In C, these functions take a `const` pointer for the first argument. In C++, two overloads are available. The overload taking a pointer to `const` returns a pointer to `const`; the version that takes a pointer to non-`const` returns a pointer to non-`const`. The macro `_CRT_CONST_CORRECT_OVERLOADS` is defined if both the `const` and non-`const` versions of these functions are available. If you require the non-`const` behavior for both C++ overloads, define the symbol `_CONST_RETURN`.

`_mbsrchr` validates its parameters. If `str` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and `_mbsrchr` returns 0. `strrchr` and `wcsrchr` don't validate their parameters. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale; for more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsrchr</code>	<code>strrchr</code>	<code>_mbsrchr</code>	<code>wcsrchr</code>
n/a	n/a	<code>_mbsrchr_1</code>	n/a

## Requirements

ROUTINE	REQUIRED HEADER
<code>strrchr</code>	<code>&lt;string.h&gt;</code>
<code>wcsrchr</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsrchr</code> , <code>_mbsrchr_1</code>	<code>&lt;mbstring.h&gt;</code>

For more information about compatibility, see [Compatibility](#).

## Example

For an example of using `strrchr`, see [strchr](#).

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[strchr](#), [wcschr](#), [\\_mbschr](#), [\\_mbschr\\_1](#)  
[strcspn](#), [wcscspn](#), [\\_mbscspn](#), [\\_mbscspn\\_1](#)  
[\\_strnicmp](#), [\\_wcsnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_1](#), [\\_wcsnicmp\\_1](#), [\\_mbsnicmp\\_1](#)  
[strupr](#), [wcspbrk](#), [\\_mbspbrk](#), [\\_mbspbrk\\_1](#)  
[strspn](#), [wcspn](#), [\\_mbsspn](#), [\\_mbsspn\\_1](#)\

`strrev`, `wcsrev`

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The Microsoft-specific function names `strrev` and `wcsrev` are deprecated aliases for the `_strrev` and `_wcsrev` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_strrev` and `_wcsrev` instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_strrev`, `_wcsrev`, `_mbsrev`, `_mbsrev_1`

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Reverses the characters of a string.

#### IMPORTANT

`_mbsrev` and `_mbsrev_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strrev(
 char *str
);
wchar_t *_wcsrev(
 wchar_t *str
);
unsigned char *_mbsrev(
 unsigned char *str
);
unsigned char *_mbsrev_1(
 unsigned char *str,
 _locale_t locale
);
```

### Parameters

`str`

Null-terminated string to reverse.

`Locale`

Locale to use.

## Return value

Returns a pointer to the altered string. No return value is reserved to indicate an error.

## Remarks

The `_strrev` function reverses the order of the characters in `str`. The terminating null character remains in place. `_wcsrev` and `_mbsrev` are wide-character and multibyte-character versions of `_strrev`. The arguments and return value of `_wcsrev` are wide-character strings. The arguments and return value of `_mbsrev` are multibyte-character strings. For `_mbsrev`, the order of bytes in each multibyte character in `str` isn't changed. These three functions behave identically otherwise.

`_mbsrev` validates its parameters. If either `string1` or `string2` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbsrev` returns `NULL` and sets `errno` to `EINVAL`. `_strrev` and `_wcsrev` don't validate their parameters.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions are identical, except that the ones that don't have the `_1` suffix

use the current locale and the ones that do have the `_1` suffix instead use the locale parameter that's passed in. For more information, see [Locale](#).

#### IMPORTANT

These functions might be vulnerable to buffer overrun threats. Buffer overruns can be used for system attacks because they can cause an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsrev</code>	<code>_strrev</code>	<code>_mbsrev</code>	<code>_wcsrev</code>
n/a	n/a	<code>_mbsrev_1</code>	n/a

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strrev</code>	<code>&lt;string.h&gt;</code>
<code>_wcsrev</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_mbsrev</code> , <code>_mbsrev_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strrev.c
// This program checks a string to see
// whether it is a palindrome: that is, whether
// it reads the same forward and backward.
//

#include <string.h>
#include <stdio.h>

int main(void)
{
 char* string = "Able was I ere I saw Elba";
 int result;

 // Reverse string and compare (ignore case):
 result = _stricmp(string, _strrev(_strupr(string)));
 if(result == 0)
 printf("The string \"%s\" is a palindrome\n", string);
 else
 printf("The string \"%s\" is not a palindrome\n", string);
}
```

The string "Able was I ere I saw Elba" is a palindrome

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_strncpy](#), [\\_wcscpy](#), [\\_mbscopy](#)

[\\_strset](#), [\\_strset\\_1](#), [\\_wcsset](#), [\\_wcsset\\_1](#), [\\_mbsset](#), [\\_mbsset\\_1](#)

`strset`, `wcsset`

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These functions are deprecated. Use the ISO C++ conformant `_strset`, `_strset_l`, `_wcsset`, `_wcsset_l`, `_mbsset`, `_mbsset_l` or security-enhanced `_strset_s`, `_strset_s_l`, `_wcsset_s`, `_wcsset_s_l`, `_mbsset_s`, `_mbsset_s_l` instead.

`_strset`, `_strset_l`, `_wcsset`, `_wcsset_l`,  
`_mbsset`, `_mbsset_l`

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Sets characters of a string to a character. More secure versions of these functions are available; see [`\_strset\_s`](#), [`\_strset\_s\_l`](#), [`\_wcsset\_s`](#), [`\_wcsset\_s\_l`](#), [`\_mbsset\_s`](#), [`\_mbsset\_s\_l`](#).

#### IMPORTANT

`_mbsset` and `_mbsset_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strset(
 char *str,
 int c
);
char *_strset_l(
 char *str,
 int c,
 _locale_t locale
);
wchar_t *_wcsset(
 wchar_t *str,
 wchar_t c
);
wchar_t *_wcsset_l(
 wchar_t *str,
 wchar_t c,
 _locale_t locale
);
unsigned char *_mbsset(
 unsigned char *str,
 unsigned int c
);
unsigned char *_mbsset_l(
 unsigned char *str,
 unsigned int c,
 _locale_t locale
);
```

### Parameters

`str`

Null-terminated string to be set.

`c`

Character setting.

`Locale`

Locale to use.

## Return value

Returns a pointer to the altered string.

## Remarks

The `_strset` function sets all characters (except the terminating null character) of `str` to `c`, converted to `char`. `_wcsset` and `_mbsset_1` are wide-character and multibyte-character versions of `_strset`, and the data types of the arguments and return values vary accordingly. These functions behave identically otherwise.

`_mbsset` validates its parameters. If `str` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbsset` returns `NULL` and sets `errno` to `EINVAL`. `_strset` and `_wcsset` don't validate their parameters.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions are identical, except that the ones that don't have the `_1` suffix use the current locale and the ones that do have the `_1` suffix instead use the locale parameter that's passed in. For more information, see [Locale](#).

### IMPORTANT

These functions might be vulnerable to buffer overrun threats. Buffer overruns can be used for system attacks because they can cause an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsset</code>	<code>_strset</code>	<code>_mbsset</code>	<code>_wcsset</code>
<code>_tcsset_1</code>	<code>_strset_1</code>	<code>_mbsset_1</code>	<code>_wcsset_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strset</code>	<code>&lt;string.h&gt;</code>
<code>_strset_1</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsset</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_wcsset_1</code>	<code>&lt;tchar.h&gt;</code>
<code>_mbsset</code> , <code>_mbsset_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strset.c
// compile with: /W3

#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[] = "Fill the string with something.";
 printf("Before: %s\n", string);
 _strset(string, '*'); // C4996
 // Note: _strset is deprecated; consider using _strset_s instead
 printf("After: %s\n", string);
}
```

```
Before: Fill the string with something.
After: *****
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_mbsnbset](#), [\\_mbsnbset\\_1](#)  
[memset](#), [wmemset](#)  
[strcat](#), [wcscat](#), [\\_mbscat](#)  
[strcmp](#), [wcscmp](#), [\\_mbscmp](#)  
[strcpy](#), [wcscopy](#), [\\_mbscopy](#)  
[\\_strnset](#), [\\_strnset\\_1](#), [\\_wcsnset](#), [\\_wcsnset\\_1](#), [\\_mbsnset](#), [\\_mbsnset\\_1](#)

`_strset_s`, `_strset_s_l`, `_wcsset_s`, `_wcsset_s_l`  
`_mbsset_s`, `_mbsset_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets characters of a string to a character. These versions of `_strset`, `_strset_l`, `_wcsset`, `_wcsset_l`, `_mbsset`, `_mbsset_l` have security enhancements, as described in [Security features in the CRT](#).

### IMPORTANT

`_mbsset_s` and `_mbsset_s_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t _strset_s(
 char *str,
 size_t numberOfElements,
 int c
);
errno_t _strset_s_l(
 char *str,
 size_t numberOfElements,
 int c,
 _locale_t locale
);
errno_t _wcsset_s(
 wchar_t *str,
 size_t numberOfElements,
 wchar_t c
);
errno_t *_wcsset_s_l(
 wchar_t *str,
 size_t numberOfElements,
 wchar_t c,
 _locale_t locale
);
errno_t _mbsset_s(
 unsigned char *str,
 size_t numberOfElements,
 unsigned int c
);
errno_t _mbsset_s_l(
 unsigned char *str,
 size_t numberOfElements,
 unsigned int c,
 _locale_t locale
);
```

### Parameters

`str`

Null-terminated string to be set.

`numberOfElements`

The size of the `str` buffer.

`c`

Character setting.

`Locale`

Locale to use.

## Return value

Zero if successful, otherwise an error code.

These functions validate their arguments. If `str` is a null pointer, or the `numberOfElements` argument is less than or equal to 0, or the block passed in isn't null-terminated, then the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EINVAL` and set `errno` to `EINVAL`.

## Remarks

The `_strset_s` function sets all the characters of `str` to `c` (converted to `char`), except the terminating null character. `_wcset_s` and `_mbset_s` are wide-character and multibyte-character versions of `_strset_s`. The data types of the arguments and return values vary accordingly. These functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsset_s</code>	<code>_strset_s</code>	<code>_mbset_s</code>	<code>_wcset_s</code>
<code>_tcsset_s_1</code>	<code>_strset_s_1</code>	<code>_mbset_s_1</code>	<code>_wcset_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strset_s</code>	<code>&lt;string.h&gt;</code>
<code>_strset_s_1</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcset_s</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_wcset_s_1</code>	<code>&lt;tchar.h&gt;</code>
<code>_mbset_s</code> , <code>_mbset_s_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strset_s.c
#include <string.h>
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 char string[] = "Fill the string with something.";
 printf("Before: %s\n", string);
 _strset_s(string, _countof(string), '*');
 printf("After: %s\n", string);
}
```

```
Before: Fill the string with something.
After: *****
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_mbsnbset](#) , [\\_mbsnbset\\_1](#)  
[memset](#) , [wmemset](#)  
[strcat](#) , [wcscat](#) , [\\_mbscat](#)  
[strcmp](#) , [wcscmp](#) , [\\_mbscmp](#)  
[strcpy](#) , [wcscopy](#) , [\\_mbscopy](#)  
[\\_strnset](#) , [\\_strnset\\_1](#) , [\\_wcsnset](#) , [\\_wcsnset\\_1](#) , [\\_mbsnset](#) , [\\_mbsnset\\_1](#)

`strspn`, `wcsspn`, `_mbsspn`, `_mbsspn_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the index of the first character in a string that doesn't belong to a specified set of characters.

#### IMPORTANT

`_mbsspn` and `_mbsspn_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
size_t strspn(
 const char *str,
 const char *str CharSet
);
size_t wcsspn(
 const wchar_t *str,
 const wchar_t *str CharSet
);
size_t _mbsspn(
 const unsigned char *str,
 const unsigned char *str CharSet
);
size_t _mbsspn_1(
 const unsigned char *str,
 const unsigned char *str CharSet,
 _locale_t locale
);
```

### Parameters

`str`

Null-terminated string to search.

`str CharSet`

Null-terminated character set.

`Locale`

Locale to use.

## Return value

Returns an integer value specifying the length of the substring in `str` that consists entirely of characters in `str CharSet`. If `str` begins with a character not in `str CharSet`, the function returns 0.

## Remarks

The `strspn` function returns the index of the first character in `str` that doesn't belong to the set of characters in `str CharSet`. The search doesn't include terminating null characters.

`wcsspn` and `_mbsspn` are wide-character and multibyte-character versions of `strspn`. The arguments of `wcsspn` are wide-character strings. The arguments of `_mbsspn` are multibyte-character strings. `_mbsspn`

validates its parameters. If `str` or `strCharset` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbspn` sets `errno` to `EINVAL` and returns 0. `strspn` and `wcsspn` don't validate their parameters. These three functions behave identically otherwise.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior; the versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsspn</code>	<code>strspn</code>	<code>_mbsspn</code>	<code>wcsspn</code>
n/a	n/a	<code>_mbsspn_1</code>	n/a

## Requirements

ROUTINE	REQUIRED HEADER
<code>strspn</code>	<code>&lt;string.h&gt;</code>
<code>wcsspn</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_mbsspn</code> , <code>_mbsspn_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strspn.c
// This program uses strspn to determine
// the length of the segment in the string "cabbage"
// consisting of a's, b's, and c's. In other words,
// it finds the first non-abc letter.
//

#include <string.h>
#include <stdio.h>

int main(void)
{
 char string[] = "cabbage";
 int result;
 result = strspn(string, "abc");
 printf("The portion of '%s' containing only a, b, or c "
 "is %d bytes long\n", string, result);
}
```

The portion of 'cabbage' containing only a, b, or c is 5 bytes long

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[\\_strspnp](#), [\\_wcspnp](#), [\\_mbsspnp](#), [\\_mbsspnp\\_1](#)  
[strcspn](#), [wcscspn](#), [\\_mbscspn](#), [\\_mbscspn\\_1](#)  
[strncat](#), [\\_strncat\\_1](#), [wcsncat](#), [\\_wcsncat\\_1](#), [\\_mbsncat](#), [\\_mbsncat\\_1](#)  
[strcmp](#), [wcsncmp](#), [\\_mbsncmp](#), [\\_mbsncmp\\_1](#)  
[strncpy](#), [\\_strncpy\\_1](#), [wcscopy](#), [\\_wcscopy\\_1](#), [\\_mbsncpy](#), [\\_mbsncpy\\_1](#)  
[\\_strnicmp](#), [\\_wcnicmp](#), [\\_mbsnicmp](#), [\\_strnicmp\\_1](#), [\\_wcnicmp\\_1](#), [\\_mbsnicmp\\_1](#)  
[strrchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_1](#)

`_strspnp`, `_wcspnp`, `_mbsspnp`, `_mbsspnp_1`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns a pointer to the first character in a given string that isn't in another given string.

#### IMPORTANT

`_mbsspnp` and `_mbsspnp_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strspnp(
 const char *str,
 const char *charset
);
wchar_t *_wcspnp(
 const unsigned wchar_t *str,
 const unsigned wchar_t *charset
);
unsigned char *_mbsspnp(
 const unsigned char *str,
 const unsigned char *charset
);
unsigned char *_mbsspnp_1(
 const unsigned char *str,
 const unsigned char *charset,
 _locale_t locale
);
```

#### Parameters

`str`

Null-terminated string to search.

`charset`

Null-terminated character set.

`Locale`

Locale to use.

## Return value

`_strspnp`, `_wcspnp`, and `_mbsspnp` return a pointer to the first character in `str` that doesn't belong to the set of characters in `charset`. Each of these functions returns `NULL` if `str` consists entirely of characters from `charset`. For each of these routines, no return value is reserved to indicate an error.

## Remarks

The `_mbsspnp` function returns a pointer to the multibyte character that is the first character in `str` that doesn't belong to the set of characters in `charset`. `_mbsspnp` recognizes multibyte-character sequences according to the [multibyte code page](#) currently in use. The search doesn't include terminating null characters.

If either `str` or `charset` is a null pointer, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns `NULL` and sets `errno` to `EINVAL`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsspnp</code>	<code>_strspnp</code>	<code>_mbsspnp</code>	<code>_wcsspnp</code>

`_strspnp` and `_wcsspnp` are single-byte character and wide-character versions of `_mbsspnp`. `_strspnp` and `_wcsspnp` behave identically to `_mbsspnp` otherwise; they're provided only for this mapping and shouldn't be used for any other reason. For more information, see [Using generic-text mappings](#) and [Generic-text mappings](#).

`_mbsspnp_1` is identical except that it uses the locale parameter passed in instead. For more information, see [Locale](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_mbsspnp</code>	<code>&lt;mbstring.h&gt;</code>
<code>_strspnp</code>	<code>&lt;tchar.h&gt;</code>
<code>_wcsspnp</code>	<code>&lt;tchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_mbsspnp.c
#include <mbstring.h>
#include <stdio.h>

int main(void) {
 const unsigned char string1[] = "cabbage";
 const unsigned char string2[] = "c";
 unsigned char *ptr = 0;
 ptr = _mbsspnp(string1, string2);
 printf("%s\n", ptr);
}
```

## Output

```
abbage
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`strspn`, `wcsspn`, `_mbsspn`, `_mbsspn_1`  
`strncat_s`, `_strncat_s_l`, `wcsncat_s`, `_wcsncat_s_l`, `_mbsncat_s`, `_mbsncat_s_l`  
`strcmp`, `wcsncmp`, `_mbsncmp`, `_mbsncmp_1`  
`strncpy_s`, `_strncpy_s_l`, `wcsncpy_s`, `_wcsncpy_s_l`, `_mbsncpy_s`, `_mbsncpy_s_l`  
`_strnicmp`, `wcsnicmp`, `_mbsnicmp`, `_strnicmp_l`, `_wcsnicmp_l`, `_mbsnicmp_l`  
`strrchr`, `wcsrchr`, `_mbsrchr`, `_mbsrchr_1`

`strstr`, `wcsstr`, `_mbsstr`, `_mbsstr_1`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Returns a pointer to the first occurrence of a search string in a string.

**IMPORTANT**

`_mbsstr` and `_mbsstr_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strstr(
 const char *str,
 const char *strSearch
); // C only
char *strstr(
 char *str,
 const char *strSearch
); // C++ only
const char *strstr(
 const char *str,
 const char *strSearch
); // C++ only
wchar_t *wcsstr(
 const wchar_t *str,
 const wchar_t *strSearch
); // C only
wchar_t *wcsstr(
 wchar_t *str,
 const wchar_t *strSearch
); // C++ only
const wchar_t *wcsstr(
 const wchar_t *str,
 const wchar_t *strSearch
); // C++ only
unsigned char *_mbsstr(
 const unsigned char *str,
 const unsigned char *strSearch
); // C only
unsigned char *_mbsstr(
 unsigned char *str,
 const unsigned char *strSearch
); // C++ only
const unsigned char *_mbsstr(
 const unsigned char *str,
 const unsigned char *strSearch
); // C++ only
unsigned char *_mbsstr_l(
 const unsigned char *str,
 const unsigned char *strSearch,
 _locale_t locale
); // C only
unsigned char *_mbsstr_l(
 unsigned char *str,
 const unsigned char *strSearch,
 _locale_t locale
); // C++ only
const unsigned char *_mbsstr_l(
 const unsigned char *str,
 const unsigned char *strSearch,
 _locale_t locale
); // C++ only
```

## Parameters

`str`

Null-terminated string to search.

`strSearch`

Null-terminated string to search for.

`Locale`

Locale to use.

## Return value

Returns a pointer to the first occurrence of `strSearch` in `str`, or `NULL` if `strSearch` doesn't appear in `str`. If `strSearch` points to a string of zero length, the function returns `str`.

## Remarks

The `strstr` function returns a pointer to the first occurrence of `strSearch` in `str`. The search doesn't include terminating null characters. `wcsstr` is the wide-character version of `strstr` and `_mbsstr` is the multibyte-character version. The arguments and return value of `wcsstr` are wide-character strings. The arguments and return value of `_mbsstr` are multibyte-character strings. `_mbsstr` validates its parameters. If `str` or `strSearch` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_mbsstr` sets `errno` to `EINVAL` and returns 0. `strstr` and `wcsstr` don't validate their parameters. These three functions behave identically otherwise.

### IMPORTANT

These functions might incur a threat from a buffer overrun problem. Buffer overrun problems can be used to attack a system because they can allow the execution of arbitrary code, which can cause an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

In C, these functions take a `const` pointer for the first argument. In C++, two overloads are available. The overload that takes a pointer to `const` returns a pointer to `const`; the version that takes a pointer to non-`const` returns a pointer to non-`const`. The macro `_CRT_CONST_CORRECT_OVERLOADS` is defined if both the `const` and non-`const` versions of these functions are available. If you require the non-`const` behavior for both C++ overloads, define the symbol `_CONST_RETURN`.

The output value is affected by the locale-category setting of `LC_CTYPE`; for more information, see [setlocale](#), [\\_wsetlocale](#). The versions of these functions that don't have the `_1` suffix use the current locale for this locale-dependent behavior; the versions that have the `_1` suffix are identical except that they instead use the locale parameter that's passed in. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsstr</code>	<code>strstr</code>	<code>_mbsstr</code>	<code>wcsstr</code>
n/a	n/a	<code>_mbsstr_1</code>	n/a

## Requirements

ROUTINE	REQUIRED HEADER
<code>strstr</code>	<code>&lt;string.h&gt;</code>
<code>wcsstr</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsstr</code> , <code>_mbsstr_1</code>	<code>&lt;mbstring.h&gt;</code>

For more information about compatibility, see [Compatibility](#).

## Example

```
// crt strstr.c

#include <string.h>
#include <stdio.h>

char str[] = "lazy";
char string[] = "The quick brown dog jumps over the lazy fox";
char fmt1[] = " 1 2 3 4 5";
char fmt2[] = "12345678901234567890123456789012345678901234567890";

int main(void)
{
 char *pdest;
 int result;
 printf("String to be searched:\n %s\n", string);
 printf(" %s\n %s\n", fmt1, fmt2);
 pdest = strstr(string, str);
 result = (int)(pdest - string + 1);
 if (pdest != NULL)
 printf("%s found at position %d\n", str, result);
 else
 printf("%s not found\n", str);
}
```

```
String to be searched:
The quick brown dog jumps over the lazy fox
 1 2 3 4 5
12345678901234567890123456789012345678901234567890

lazy found at position 36
```

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[strcspn](#), [wcscspn](#), [\\_mbscspn](#), [\\_mbscspn\\_1](#)  
[strcmp](#), [wcscmp](#), [\\_mbscmp](#)  
[strupr](#), [wcstrupr](#), [\\_mbstrupr](#), [\\_mbstrupr\\_1](#)  
[strchr](#), [wcsrchr](#), [\\_mbsrchr](#), [\\_mbsrchr\\_1](#)  
[strspn](#), [wcspn](#), [\\_mbsspnn](#), [\\_mbsspnn\\_1](#)  
[basic\\_string::find](#)

# `_strtime`, `_wstrtime`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copy the time to a buffer. More secure versions of these functions are available; see [`\_strtime\_s`](#), [`\_wstrtime\_s`](#).

## Syntax

```
char *_strtime(
 char *timestr
);
wchar_t *_wstrtime(
 wchar_t *timestr
);
template <size_t size>
char *_strtime(
 char (×tr)[size]
); // C++ only
template <size_t size>
wchar_t *_wstrtime(
 wchar_t (×tr)[size]
); // C++ only
```

### Parameters

`timestr`

Time string.

## Return value

Returns a pointer to the resulting character string `timestr`.

## Remarks

The `_strtime` function copies the current local time into the buffer pointed to by `timestr`. The time is formatted as `hh:mm:ss`, where `hh` is two digits that represent the hour in 24-hour notation. `mm` is two digits for the minutes past the hour, and `ss` is two digits for seconds. For example, the string `18:23:44` represents 23 minutes and 44 seconds after 6 P.M. The buffer must be at least 9 bytes long.

`_wstrtime` is a wide-character version of `_strtime`; the argument and return value of `_wstrtime` are wide-character strings. These functions behave identically otherwise. If `timestr` is a `NULL` pointer or if `timestr` is formatted incorrectly, the invalid parameter handler is invoked, as described in [Parameter validation](#). If the exception is allowed to continue, these functions return a `NULL`, and set `errno` to `EINVAL` if `timestr` was a `NULL` or set `errno` to `ERANGE` if `timestr` is formatted incorrectly.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstrftime</code>	<code>_strftime</code>	<code>_strftime</code>	<code>_wstrftime</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strftime</code>	<code>&lt;time.h&gt;</code>
<code>_wstrftime</code>	<code>&lt;time.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt.strftime.c
// compile with: /W3

#include <time.h>
#include <stdio.h>

int main(void)
{
 char tbuffer [9];
 _strftime(tbuffer); // C4996
 // Note: _strftime is deprecated; consider using _strftime_s instead
 printf("The current time is %s \n", tbuffer);
}
```

```
The current time is 14:21:44
```

## See also

### Time management

<code>asctime</code>	<code>_wasctime</code>				
<code>ctime</code>	<code>_ctime32</code>	<code>_ctime64</code>	<code>_wctime</code>	<code>_wctime32</code>	<code>_wctime64</code>
<code>gmtime</code>	<code>_gmtime32</code>	<code>_gmtime64</code>			
<code>localtime</code>	<code>_localtime32</code>	<code>_localtime64</code>			
<code>mktime</code>	<code>_mktime32</code>	<code>_mktime64</code>			
<code>time</code>	<code>_time32</code>	<code>_time64</code>			
<code>_tzset</code>					

# `_strtime_s`, `_wstrtime_s`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Copy the current time to a buffer. These functions are versions of `_strtime`, `_wstrtime` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t _strtime_s(
 char *buffer,
 size_t numberOfElements
);
errno_t _wstrtime_s(
 wchar_t *buffer,
 size_t numberOfElements
);
template <size_t size>
errno_t _strtime_s(
 char (&buffer)[size]
); // C++ only
template <size_t size>
errno_t _wstrtime_s(
 wchar_t (&buffer)[size]
); // C++ only
```

## Parameters

`buffer`

A buffer, at least 10 bytes long, where the time will be written.

`numberOfElements`

The size of the buffer.

## Return value

Zero if successful.

If an error condition occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). The return value is an error code if there's a failure. Error codes are defined in `ERRNO.H`; see the following table for the exact errors generated by this function. For more information on error codes, see [errno constants](#).

## Error conditions

BUFFER	NUMBEROFELEMENTS	RETURN	CONTENTS OF BUFFER
NULL	(any)	EINVAL	Not modified
Not NULL (pointing to valid buffer)	0	EINVAL	Not modified
Not NULL (pointing to valid buffer)	0 < size < 9	EINVAL	Empty string

BUFFER	NUMBEROFELEMENTS	RETURN	CONTENTS OF BUFFER
Not <code>NULL</code> (pointing to valid buffer)	Size > 9	0	Current time formatted as specified in the remarks

## Security issues

Passing in an invalid non-`NULL` value for the buffer will result in an access violation if the `numberOfElements` parameter is greater than 9.

Passing a value for `numberOfElements` that is greater than the actual size of the buffer will result in buffer overrun.

## Remarks

These functions provide more secure versions of `_strftime` and `_wstrftime`. The `_strftime_s` function copies the current local time into the buffer pointed to by `buffer`. The time is formatted as `hh:mm:ss` where `hh` is two digits representing the hour in 24-hour notation, `mm` is two digits representing the minutes past the hour, and `ss` is two digits representing seconds. For example, the string `18:23:44` represents 23 minutes and 44 seconds after 6 P.M. The buffer must be at least 9 bytes long; the actual size is specified by the second parameter.

`_wstrftime_s` is a wide-character version of `_strftime_s`; the argument and return value of `_wstrftime_s` are wide-character strings. These functions behave identically otherwise.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with `0xFE`. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mapping

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tstrftime_s</code>	<code>_strftime_s</code>	<code>_strftime_s</code>	<code>_wstrftime_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strftime_s</code>	<code>&lt;time.h&gt;</code>
<code>_wstrftime_s</code>	<code>&lt;time.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// strftime_s.c

#include <time.h>
#include <stdio.h>

int main()
{
 char tmpbuf[9];
 errno_t err;

 // Set time zone from TZ environment variable. If TZ is not set,
 // the operating system is queried to obtain the default value
 // for the variable.
 //
 _tzset();

 // Display operating system-style date and time.
 err = _strtime_s(tmpbuf, 9);
 if (err)
 {
 printf("_strdate_s failed due to an invalid argument.");
 exit(1);
 }
 printf("OS time:\t\t\t\t%s\n", tmpbuf);
 err = _strdate_s(tmpbuf, 9);
 if (err)
 {
 printf("_strdate_s failed due to an invalid argument.");
 exit(1);
 }
 printf("OS date:\t\t\t\t%s\n", tmpbuf);

}

```

OS time:	14:37:49
OS date:	04/25/03

## See also

### [Time management](#)

<a href="#">asctime_s</a>	<a href="#">_wasctime_s</a>				
<a href="#">ctime_s</a>	<a href="#">_ctime32_s</a>	<a href="#">_ctime64_s</a>	<a href="#">_wctime_s</a>	<a href="#">_wctime32_s</a>	<a href="#">_wctime64_s</a>
<a href="#">gmtime_s</a>	<a href="#">_gmtime32_s</a>	<a href="#">_gmtime64_s</a>			
<a href="#">localtime_s</a>	<a href="#">_localtime32_s</a>	<a href="#">_localtime64_s</a>			
<a href="#">mktime</a>	<a href="#">_mktime32</a>	<a href="#">_mktime64</a>			
<a href="#">time</a>	<a href="#">_time32</a>	<a href="#">_time64</a>			
<a href="#">_tzset</a>					

`strtod`, `_strtod_l`, `wcstod`, `_wcstod_l`

11/2/2022 • 5 minutes to read • [Edit Online](#)

Convert strings to a double-precision value.

## Syntax

```
double strtod(
 const char *strSource,
 char **endptr
);
double _strtod_l(
 const char *strSource,
 char **endptr,
 _locale_t locale
);
double wcstod(
 const wchar_t *strSource,
 wchar_t **endptr
);
double _wcstod_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 _locale_t locale
);
```

### Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to character that stops scan.

`Locale`

The locale to use.

## Return value

`strtod` returns the value of the floating-point number, except when the representation would cause an overflow, in which case the function returns `+/- HUGE_VAL`. The sign of `HUGE_VAL` matches the sign of the value that can't be represented. `strtod` returns `0` if no conversion can be performed or an underflow occurs.

`wcstod` returns values analogously to `strtod`:

- For both functions, `errno` is set to `ERANGE` if overflow or underflow occurs.
- If there are invalid parameters, `errno` is set to `EINVAL` and the invalid parameter handler is invoked, as described in [Parameter validation](#).

For more information on this and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each function converts the input string `strSource` to a `double`. The `strtod` function converts `strSource` to a

double-precision value. `strtod` stops reading the string `strSource` at the first character it can't recognize as part of a number. This character may be the terminating null character. `wcstod` is a wide-character version of `strtod`; its `strSource` argument is a wide-character string. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcstod</code>	<code>strtod</code>	<code>strtod</code>	<code>wcstod</code>
<code>_tcstod_1</code>	<code>_strtod_1</code>	<code>_strtod_1</code>	<code>_wcstod_1</code>

The `LC_NUMERIC` category setting of the current locale determines recognition of the radix point character in `strSource`. For more information, see [setlocale](#). The functions without the `_1` suffix use the current locale; `_strtod_1` is identical to `_strtod` except the former uses the `Locale` passed in instead. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location pointed to by `endptr`.

`strtod` expects `strSource` to point to a string of one of the following forms:

```
[whitespace] [sign] { digits [radix digits] | radix digits } [{ e | E } [sign] digits]
[whitespace] [sign] { 0x | 0X } { hexdigits [radix hexdigits] | radix hexdigits } [{ p | P } [sign] digits]
[whitespace] [sign] { INF | INFINITY }
[whitespace] [sign] NAN [sequence]
```

The optional leading `whitespace` may consist of space and tab characters, which are ignored.

`sign` is either plus (+) or minus (-).

`digits` are one or more decimal digits.

`hexdigits` are one or more hexadecimal digits.

`radix` is the radix point character, either a period (.) in the default "C" locale, or the locale-specific value if the current locale is different or when `Locale` is specified.

A `sequence` is a sequence of alphanumeric or underscore characters.

In both decimal and hexadecimal number forms, if no digits appear before the radix point character, at least one must appear after the radix point character.

In the decimal form, the decimal digits can be followed by an exponent, which consists of an introductory letter (`e` or `E`) and an optionally signed integer.

In the hexadecimal form, the hexadecimal digits can be followed by an exponent, which consists of an introductory letter (`p` or `P`) and an optionally signed decimal integer that represents the exponent as a power of 2.

In either form, if there isn't an exponent part or a radix point character, a radix point character is assumed to follow the last digit in the string.

Case is ignored in both the `INF` and `NAN` forms. The first character that doesn't fit one of these forms stops the scan.

The UCRT versions of these functions don't support conversion of Fortran-style (`d` or `D`) exponent letters. This non-standard extension was supported by earlier versions of the CRT, and may be a breaking change for your code. The UCRT versions support hexadecimal strings and round-tripping of `INF` and `NAN` values, which weren't supported in earlier versions. This support can also cause breaking changes in your code. For example, the string "`0x1a`" would be interpreted by `strtod` as 0.0 in previous versions, but as 26.0 in the UCRT version.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtod</code> , <code>_strtod_l</code>	C: <code>&lt;stdlib.h&gt;</code> C++: <code>&lt;cstdlib&gt;</code> or <code>&lt;stdlib.h&gt;</code>
<code>wcstod</code> , <code>_wcstod_l</code>	C: <code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code> C++: <code>&lt;cstdlib&gt;</code> , <code>&lt;stdlib.h&gt;</code> , or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt strtod.c
// This program uses strtod to convert a
// string to a double-precision value; strtol to
// convert a string to long integer values; and strtoul
// to convert a string to unsigned long-integer values.
//

#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 char *string, *stopstring;
 double x;
 long l;
 int base;
 unsigned long ul;

 string = "3.1415926This stopped it";
 x = strtod(string, &stopstring);
 printf("string = %s\n", string);
 printf(" strtod = %f\n", x);
 printf(" Stopped scan at: %s\n\n", stopstring);

 string = "-10110134932This stopped it";
 l = strtol(string, &stopstring, 10);
 printf("string = %s\n", string);
 printf(" strtol = %ld\n", l);
 printf(" Stopped scan at: %s\n\n", stopstring);

 string = "10110134932";
 printf("string = %s\n", string);

 // Convert string using base 2, 4, and 8:
 for (base = 2; base <= 8; base *= 2)
 {
 // Convert the string:
 ul = strtoul(string, &stopstring, base);
 printf(" strtol = %ld (base %d)\n", ul, base);
 printf(" Stopped scan at: %s\n", stopstring);
 }

 // NaN
 x = strtod("+nan", &stopstring);
 printf("\n%f\n", x);

 // INF
 x = strtod("-INF", &stopstring);
 printf("\n%f\n", x);

 // e - exponent
 x = strtod("1.18973e+49", &stopstring);
 printf("\n%f\n", x);

 // doesn't handle Fortran style
 x = strtod("1.18973d+49", &stopstring);
 printf("\n%f\n", x);
 printf("No Fortran style support. Stopped parsing at %s\n", stopstring);
}

```

```
string = 3.1415926This stopped it
strtod = 3.141593
Stopped scan at: This stopped it

string = -10110134932This stopped it
strtol = -2147483648
Stopped scan at: This stopped it

string = 10110134932
strtol = 45 (base 2)
Stopped scan at: 34932
strtol = 4423 (base 4)
Stopped scan at: 4932
strtol = 2134108 (base 8)
Stopped scan at: 932

nan

-inf

1189729999999999421285862642874618947301378359296.000000

1.189730
No Fortran style support. Stopped parsing at d+49
```

## See also

[Data conversion](#)

[Math and floating-point support](#)

[Interpretation of multibyte-character sequences](#)

[Locale](#)

[String to numeric value functions](#)

[strtol](#), [wcstol](#), [\\_strtol\\_l](#), [\\_wcstol\\_l](#)  
[strtoul](#), [\\_strtoul\\_l](#), [wcstoul](#), [\\_wcstoul\\_l](#)  
[atof](#), [\\_atof\\_l](#), [\\_wtof](#), [\\_wtol\\_l](#)  
[localeconv](#)  
[\\_create\\_locale](#), [\\_wcreate\\_locale](#)  
[\\_free\\_locale](#)

`strtof`, `_strtof_l`, `wcstof`, `_wcstof_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts strings to a single-precision floating-point value.

## Syntax

```
float strtof(
 const char *strSource,
 char **endptr
);
float _strtof_l(
 const char *strSource,
 char **endptr,
 _locale_t locale
);
float wcstof(
 const wchar_t *strSource,
 wchar_t **endptr
);
float wcstof_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to the character that stops the scan.

`Locale`

The locale to use.

## Return value

`strtof` returns the value of the floating-point number, except when the representation would cause an overflow, in which case the function returns  $+$ / $-$  `HUGE_VALF`. The sign of `HUGE_VALF` matches the sign of the value that can't be represented. `strtof` returns 0 if no conversion can be performed or an underflow occurs.

`wcstof` returns values analogously to `strtof`. For both functions, `errno` is set to `ERANGE` if overflow or underflow occurs and the invalid parameter handler is invoked, as described in [Parameter validation](#).

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each function converts the input string `strSource` to a `float`. The `strtof` function converts `strSource` to a single-precision value. `strtof` stops reading the string `strSource` at the first character it can't recognize as part of a number. This character may be the terminating null character. `wcstof` is a wide-character version of `strtof`.

; its `strSource` argument is a wide-character string. Otherwise, these functions behave identically.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcstof</code>	<code>strtod</code>	<code>strtod</code>	<code>wcstod</code>
<code>_tcstof_1</code>	<code>_strtod_1</code>	<code>_strtod_1</code>	<code>_wcstod_1</code>

The `LC_NUMERIC` category setting of the current locale determines recognition of the radix character in `strSource`; for more information, see [setlocale](#), [wsetlocale](#). The functions that don't have the `_1` suffix use the current locale; the ones that have the suffix are identical except that they use the locale that's passed in instead. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location that's pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location that's pointed to by `endptr`.

`strtod` expects `strSource` to point to a string of the following form:

[`whitespace`] [`sign`] [`digits`] [. `digits`] [{ `e` | `E` } [`sign`] `digits`]

A `whitespace` may consist of space and tab characters, which are ignored; `sign` is either plus (+) or minus (-); and `digits` are one or more decimal digits. If no digits appear before the radix character, at least one must appear after the radix character. The decimal digits can be followed by an exponent, which consists of an introductory letter (`e` or `E`) and an optionally signed integer. If no exponent part or radix character appears, a radix character is assumed to follow the last digit in the string. The first character that doesn't fit this form stops the scan.

The UCRT versions of these functions don't support conversion of Fortran-style (`d` or `D`) exponent letters. This non-standard extension was supported by earlier versions of the CRT, and may be a breaking change for your code.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtod</code> , <code>_strtod_1</code>	C: <stdlib.h> C++: <cstdlib> or <stdlib.h>
<code>wcstod</code> , <code>_wcstod_1</code>	C: <stdlib.h> or <wchar.h> C++: <cstdlib>, <stdlib.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_strtof.c
// This program uses strtod to convert a
// string to a single-precision value.

#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 char *string;
 char *stopstring;
 float x;

 string = "3.14159This stopped it";
 x = strtod(string, &stopstring);
 printf("string = %s\n", string);
 printf(" strtod = %f\n", x);
 printf(" Stopped scan at: %s\n\n", stopstring);
}
```

```
string = 3.14159This stopped it
strtod = 3.141590
Stopped scan at: This stopped it
```

## See also

[Data conversion](#)

[Math and floating-point support](#)

[Interpretation of multibyte-character sequences](#)

[Locale](#)

[String to numeric value functions](#)

[strtod](#), [\\_strtod\\_l](#), [wcstod](#), [\\_wcstod\\_l](#)  
[strtol](#), [wcstol](#), [\\_strtol\\_l](#), [\\_wcstol\\_l](#)  
[strtoul](#), [\\_strtoul\\_l](#), [wcstoul](#), [\\_wcstoul\\_l](#)  
[atof](#), [\\_atof\\_l](#), [\\_wtod](#), [\\_wtod\\_l](#)  
[localeconv](#)  
[\\_create\\_locale](#), [\\_wcreate\\_locale](#)  
[\\_free\\_locale](#)

`_strtoi64`, `_wcstoi64`, `_strtoi64_l`, `_wcstoi64_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Convert a string to an `_int64` value.

## Syntax

```
_int64 _strtoi64(
 const char *strSource,
 char **endptr,
 int base
);
_int64 _wcstoi64(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
_int64 _strtoi64_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
_int64 _wcstoi64_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to character that stops scan.

`base`

Number base to use.

`Locale`

The locale to use.

## Return value

`_strtoi64` returns the value represented in the string `strSource`, except when the representation would cause an overflow, in which case it returns `_I64_MAX` or `_I64_MIN`. The function will return 0 if no conversion can be performed. `_wcstoi64` returns values analogously to `_strtoi64`.

`_I64_MAX` and `_I64_MIN` are defined in LIMITS.H.

If `strSource` is `NULL` or the `base` is nonzero and either less than 2 or greater than 36, `errno` is set to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_strtoi64` function converts `strSource` to an `__int64`. Both functions stop reading the string `strSource` at the first character they can't recognize as part of a number. It may be the terminating null character, or it may be the first numeric character greater than or equal to `base`. `_wcstoi64` is a wide-character version of `_strtoi64`; its `strSource` argument is a wide-character string. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcstoi64</code>	<code>_strtoi64</code>	<code>_strtoi64</code>	<code>_wcstoi64</code>
<code>_tcstoi64_1</code>	<code>_strtoi64_1</code>	<code>_strtoi64_1</code>	<code>_wcstoi64_1</code>

The locale's `LC_NUMERIC` category setting determines recognition of the radix character in `strSource`; for more information, see [setlocale](#). The functions without the `_1` suffix use the current locale; `_strtoi64_1` and `_wcstoi64_1` are identical to the corresponding function without the `_1` suffix except that they use the locale passed in instead. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location pointed to by `endptr`.

`_strtoi64` expects `strSource` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored. `digits` are one or more decimal digits. `Letters` are one or more of the letters 'a' through 'z' (or 'A' through 'Z'). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string pointed to by `strSource` are used to determine the base. If the first character is '0' and the second character isn't 'x' or 'X', the string is interpreted as an octal integer. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character will stop the scan.

## Requirements

FUNCTION	REQUIRED HEADER
<code>_strtoi64</code> , <code>_strtoi64_1</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wcstoi64</code> , <code>_wcstoi64_1</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

## Data conversion

### Locale

`localeconv`

`setlocale`, `_wsetlocale`

### String to numeric value functions

`strtod`, `_strtod_1`, `wcstod`, `_wcstod_1`

`strtoul`, `_strtoul_1`, `wcstoul`, `_wcstoul_1`

`atof`, `_atof_1`, `wtof`, `_wtof_1`

`strtoimax`, `_strtoimax_l`, `wcstoimax`,  
`_wcstoimax_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a string to an integer value of the largest supported signed integer type.

## Syntax

```
intmax_t strtoimax(
 const char *strSource,
 char **endptr,
 int base
);
intmax_t wcstoimax(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
intmax_t _strtoimax_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
intmax_t _wcstoimax_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to the character that stops the scan.

`base`

Number base to use.

`Locale`

The locale to use.

## Return value

`strtoimax` returns the value that's represented in the string `strSource`, except when the representation would cause an overflow—in that case, it returns `INTMAX_MAX` or `INTMAX_MIN`, and `errno` is set to `ERANGE`. The function returns 0 if no conversion can be performed. `wcstoimax` returns values analogously to `strtoimax`.

`INTMAX_MAX` and `INTMAX_MIN` are defined in `stdint.h`.

If `strSource` is `NULL` or the `base` is nonzero and either less than 2 or greater than 36, `errno` is set to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `strtoimax` function converts `strSource` to an `intmax_t`. The wide-character version of `strtoimax` is `wcstoimax`; its `strSource` argument is a wide-character string. Otherwise, these functions behave identically. Both functions stop reading the string `strSource` at the first character they can't recognize as part of a number. It may be the terminating null character, or it may be the first numeric character that's greater than or equal to `base`.

The locale's `LC_NUMERIC` category setting determines recognition of the radix character in `strSource`; for more information, see `setlocale`, `_wsetlocale`. The functions that don't have the `_1` suffix use the current locale; `_strtoimax_1` and `_wcstoimax_1` are identical to the corresponding functions that don't have the `_1` suffix except that they instead use the locale that's passed in. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location that's pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location that's pointed to by `endptr`.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcstoimax</code>	<code>strtoimax</code>	<code>strtoimax</code>	<code>wcstoimax</code>
<code>_tcstoimax_1</code>	<code>strtoimax_1</code>	<code>_strtoimax_1</code>	<code>_wcstoimax_1</code>

`strtoimax` expects `strSource` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored; `digits` are one or more decimal digits; `Letters` are one or more of the letters 'a' through 'z' (or 'A' through 'Z'). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string pointed to by `strSource` are used to determine the base. If the first character is '0' and the second character isn't 'x' or 'X', the string is interpreted as an octal integer. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character would stop the scan.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtoimax</code> , <code>_strtoimax_1</code> , <code>wcstoimax</code> , <code>_wcstoimax_1</code>	<code>&lt;inttypes.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

## Data conversion

### Locale

`localeconv`

`setlocale`, `_wsetlocale`

### String to numeric value functions

`strtod`, `_strtod_1`, `wcstod`, `_wcstod_1`

`strtol`, `wcstol`, `_strtol_1`, `_wcstol_1`

`strtoul`, `_strtoul_1`, `wcstoul`, `_wcstoul_1`

`strtoumax`, `_strtoumax_1`, `wcstoumax`, `_wcstoumax_1`

`atof`, `_atof_1`, `wtof`, `_wtof_1`

`strtok`, `_strtok_1`, `wcstok`, `_wcstok_1`, `_mbstok`,  
`_mbstok_1`

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Finds the next token in a string, by using the current locale or a specified locale that's passed in. More secure versions of these functions are available; see `strtok_s`, `_strtok_s_1`, `wcstok_s`, `_wcstok_s_1`, `_mbstok_s`, `_mbstok_s_1`.

#### IMPORTANT

`_mbstok` and `_mbstok_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *strtok(
 char *strToken,
 const char *strDelimit
);
char *strtok_1(
 char *strToken,
 const char *strDelimit,
 _locale_t locale
);
wchar_t *wcstok(
 wchar_t *strToken,
 const wchar_t *strDelimit
);
wchar_t *wcstok(
 wchar_t *strToken,
 const wchar_t *strDelimit,
 wchar_t **context
);
wchar_t *wcstok_1(
 wchar_t *strToken,
 const wchar_t *strDelimit,
 _locale_t locale
);
unsigned char *_mbstok(
 unsigned char *strToken,
 const unsigned char *strDelimit
);
unsigned char *_mbstok_1(
 unsigned char *strToken,
 const unsigned char *strDelimit,
 _locale_t locale
);
```

### Parameters

`strToken`

String containing token or tokens.

`strDelimit`

Set of delimiter characters.

#### Locale

Locale to use.

#### context

Points to memory used to store the internal state of the parser so that the parser can continue from where it left off the next time you call `wcstok`.

## Return value

Returns a pointer to the next token found in `strToken`. The functions return `NULL` when no more tokens are found. Each call modifies `strToken` by substituting a null character for the first delimiter that occurs after the returned token.

## Remarks

The `strtok` function finds the next token in `strToken`. The set of characters in `strDelimit` specifies possible delimiters of the token to be found in `strToken` on the current call. `wcstok` and `_mbstok` are wide-character and multibyte-character versions of `strtok`. The arguments and return value of `wcstok` are wide-character strings. The arguments and return value of `_mbstok` are multibyte-character strings. These three functions behave identically otherwise.

The two argument version of `wcstok` isn't standard. If you need to use that version, you'll need to define `_CRT_NON_CONFORMING_WCSTOK` before you `#include <wchar.h>` (or `#include <string.h>`).

#### IMPORTANT

These functions incur a potential threat brought about by a buffer overrun problem. Buffer overrun problems are a frequent method of system attack, resulting in an unwarranted elevation of privilege. For more information, see [Avoiding buffer overruns](#).

On the first call to `strtok`, the function skips leading delimiters and returns a pointer to the first token in `strToken`, terminating the token with a null character. More tokens can be broken out of the remainder of `strToken` by a series of calls to `strtok`. Each call to `strtok` modifies `strToken` by inserting a null character after the `token` returned by that call. To read the next token from `strToken`, call `strtok` with a `NULL` value for the `strToken` argument. The `NULL` `strToken` argument causes `strtok` to search for the next token in the modified `strToken`. The `strDelimit` argument can take any value from one call to the next so that the set of delimiters may vary.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information, see [setlocale](#).

The versions of these functions without the `_1` suffix use the current locale for this locale-dependent behavior. The versions with the `_1` suffix are identical except that they use the locale parameter passed in instead. For more information, see [Locale](#).

## NOTE

Each function uses a thread-local static variable for parsing the string into tokens. Therefore, multiple threads can simultaneously call these functions without undesirable effects. However, within a single thread, interleaving calls to one of these functions is highly likely to produce data corruption and inaccurate results. When parsing different strings, finish parsing one string before starting to parse the next. Also, be aware of the potential for danger when calling one of these functions from within a loop where another function is called. If the other function ends up using one of these functions, an interleaved sequence of calls will result, triggering data corruption.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
_tcstok	strtok	_mbstok	wcstok
_wcstok	_strtok_1	_mbstok_1	_wcstok_1

## Requirements

ROUTINE	REQUIRED HEADER
strtok	<string.h>
wcstok	<string.h> or <wchar.h>
_wcstok_1	<tchar.h>
_mbstok , _mbstok_1	<mbstring.h>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_strtok.c
// compile with: /W3
// In this program, a loop uses strtok
// to print all the tokens (separated by commas
// or blanks) in the string named "string".
//
#include <string.h>
#include <stdio.h>

char string[] = "A string\tof ,,tokens\nand some more tokens";
char seps[] = " ,\t\n";
char *token;

int main(void)
{
 printf("Tokens:\n");

 // Establish string and get the first token:
 token = strtok(string, seps); // C4996
 // Note: strtok is deprecated; consider using strtok_s instead
 while(token != NULL)
 {
 // While there are tokens in "string"
 printf("%s\n", token);

 // Get next token:
 token = strtok(NULL, seps); // C4996
 }
}

```

Tokens:  
A  
string  
of  
tokens  
and  
some  
more  
tokens

## See also

[String manipulation](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

<a href="#">strcspn</a>	<a href="#">wcscspn</a>	<a href="#">_mbscspn</a>	<a href="#">_mbscspn_1</a>
<a href="#">strspn</a>	<a href="#">wcsspn</a>	<a href="#">_mbsspn</a>	<a href="#">_mbsspn_1</a>

`strtok_s`, `_strtok_s_l`, `wcstok_s`, `_wcstok_s_l`,  
`_mbstok_s`, `_mbstok_s_l`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Finds the next token in a string, by using the current locale or a locale that's passed in. These versions of `strtok`, `_strtok_l`, `wcstok`, `_wcstok_l`, `_mbstok`, `_mbstok_l` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

`_mbstok_s` and `_mbstok_s_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char* strtok_s(
 char* str,
 const char* delimiters,
 char** context
);

char* _strtok_s_l(
 char* str,
 const char* delimiters,
 char** context,
 _locale_t locale
);

wchar_t* wcstok_s(
 wchar_t* str,
 const wchar_t* delimiters,
 wchar_t** context
);

wchar_t *_wcstok_s_l(
 wchar_t* str,
 const wchar_t* delimiters,
 wchar_t** context,
 _locale_t locale
);

unsigned char* _mbstok_s(
 unsigned char* str,
 const unsigned char* delimiters,
 char** context
);

unsigned char* _mbstok_s_l(
 unsigned char* str,
 const unsigned char* delimiters,
 char** context,
 _locale_t locale
);
```

## Parameters

`str`

A string containing the token or tokens to find.

`delimiters`

The set of delimiter characters to use.

`context`

Used to store position information between calls to the function.

`Locale`

The locale to use.

## Return value

Returns a pointer to the next token found in `str`. Returns `NULL` when no more tokens are found. Each call modifies `str` by substituting a null character for the first delimiter that occurs after the returned token.

### Error conditions

<code>STR</code>	<code>DELIMITERS</code>	<code>CONTEXT</code>	RETURN VALUE	<code>errno</code>
<code>NULL</code>	any	pointer to a null pointer	<code>NULL</code>	<code>EINVAL</code>
any	<code>NULL</code>	any	<code>NULL</code>	<code>EINVAL</code>
any	any	<code>NULL</code>	<code>NULL</code>	<code>EINVAL</code>

If `str` is `NULL` but `context` is a pointer to a valid context pointer, there's no error.

## Remarks

The `strtok_s` family of functions finds the next token in `str`. The set of characters in `delimiters` specifies possible delimiters of the token to be found in `str` on the current call. `wcstok_s` and `_mbstok_s` are wide-character and multibyte-character versions of `strtok_s`. The arguments and return values of `wcstok_s` and `_wcstok_s_1` are wide-character strings. The arguments and return values of `_mbstok_s` and `_mbstok_s_1` are multibyte-character strings. These functions behave identically otherwise.

This function validates its parameters. When an error condition occurs, as in the Error Conditions table, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `NULL`.

On the first call to `strtok_s`, the function skips leading delimiters and returns a pointer to the first token in `str`, terminating the token with a null character. More tokens can be broken out of the remainder of `str` by a series of calls to `strtok_s`. Each call to `strtok_s` modifies `str` by inserting a null character after the token returned by that call. The `context` pointer keeps track of which string is being read and where in the string the next token is to be read. To read the next token from `str`, call `strtok_s` with a `NULL` value for the `str` argument, and pass the same `context` parameter. The `NULL` `str` argument causes `strtok_s` to search for the next token in the modified `str`. The `delimiters` argument can take any value from one call to the next so that the set of delimiters may vary.

Since the `context` parameter supersedes the static buffers used in `strtok` and `_strtok_1`, it's possible to parse two strings simultaneously in the same thread.

The output value is affected by the setting of the `LC_CTYPE` category setting of the locale. For more information,

see [setlocale](#).

The versions of these functions without the `_1` suffix use the current thread locale for this locale-dependent behavior. The versions with the `_1` suffix are identical except they instead use the locale specified by the `Locale` parameter. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcstok_s</code>	<code>strtok_s</code>	<code>_mbstok_s</code>	<code>wcstok_s</code>
<code>_tcstok_s_1</code>	<code>_strtok_s_1</code>	<code>_mbstok_s_1</code>	<code>_wcstok_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtok_s</code>	<code>&lt;string.h&gt;</code>
<code>_strtok_s_1</code>	<code>&lt;string.h&gt;</code>
<code>wcstok_s</code> , <code>_wcstok_s_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbstok_s</code> , <code>_mbstok_s_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_strtok_s.c
// In this program, a loop uses strtok_s
// to print all the tokens (separated by commas
// or blanks) in two strings at the same time.

#include <string.h>
#include <stdio.h>

char string1[] =
 "A string\tof ,tokens\nand some more tokens";
char string2[] =
 "Another string\n\tparsed at the same time.";
char seps[] = " ,\t\n";
char *token1 = NULL;
char *token2 = NULL;
char *next_token1 = NULL;
char *next_token2 = NULL;

int main(void)
{
 printf("Tokens:\n");

 // Establish string and get the first token:
 token1 = strtok_s(string1, seps, &next_token1);
 token2 = strtok_s(string2, seps, &next_token2);

 // While there are tokens in "string1" or "string2"
 while ((token1 != NULL) || (token2 != NULL))
 {
 // Get next token:
 if (token1 != NULL)
 {
 printf(" %s\n", token1);
 token1 = strtok_s(NULL, seps, &next_token1);
 }
 if (token2 != NULL)
 {
 printf(" %s\n", token2);
 token2 = strtok_s(NULL, seps, &next_token2);
 }
 }
}

```

Tokens:

A

    Another

string

    string

of

    parsed

tokens

    at

and

    the

some

    same

more

    time.

tokens

## See also

[String manipulation](#)

## Locale

### Interpretation of multibyte-character sequences

[strcspn](#) , [wcscspn](#) , [\\_mbscspn](#) , [\\_mbscspn\\_1](#)

[strspn](#) , [wcsspn](#) , [\\_mbsspn](#) , [\\_mbsspn\\_1](#)

`strtol`, `wcstol`, `_strtol_l`, `_wcstol_l`

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Convert strings to a `long` integer value.

## Syntax

```
long strtol(
 const char *string,
 char **end_ptr,
 int base
);
long wcstol(
 const wchar_t *string,
 wchar_t **end_ptr,
 int base
);
long _strtol_l(
 const char *string,
 char **end_ptr,
 int base,
 _locale_t locale
);
long _wcstol_l(
 const wchar_t *string,
 wchar_t **end_ptr,
 int base,
 _locale_t locale
);
```

## Parameters

`string`

Null-terminated string to convert.

`end_ptr`

An output parameter, set to point to the character after the last interpreted character. Ignored, if `NULL`.

`base`

Number base to use.

`Locale`

Locale to use.

## Return value

`strtol`, `wcstol`, `_strtol_l`, and `_wcstol_l` return the value represented in `string`. They return 0 if no conversion is possible. When the representation would cause an overflow, they return `LONG_MAX` or `LONG_MIN`.

`errno` is set to `ERANGE` if overflow or underflow occurs. It's set to `EINVAL` if `string` is `NULL`. Or, if `base` is nonzero and less than 2, or greater than 36. For more information on `ERANGE`, `EINVAL`, and other return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

## Remarks

The `strtol`, `wcstol`, `_strtol_1`, and `_wcstol_1` functions convert `string` to a `long`. They stop reading `string` at the first character not recognized as part of a number. It may be the terminating-null character, or the first alphanumeric character greater than or equal to `base`.

`wcstol` and `_wcstol_1` are wide-character versions of `strtol` and `_strtol_1`. Their `string` argument is a wide-character string. These functions behave identically to `strtol` and `_strtol_1` otherwise. The locale's `LC_NUMERIC` category setting determines recognition of the radix character (the fractional marker or decimal point) in `string`. The functions `strtol` and `wcstol` use the current locale. `_strtol_1` and `_wcstol_1` use the locale passed in instead. For more information, see [`setlocale`] and [Locale](#).

When `end_ptr` is `NULL`, it's ignored. Otherwise, a pointer to the character that stopped the scan is stored at the location pointed to by `end_ptr`. No conversion is possible if no valid digits are found, or an invalid base is specified. The value of `string` is then stored at the location pointed to by `end_ptr`.

`strtol` expects `string` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [alphanumerics]
```

Square brackets (`[ ]`) surround optional elements. Curly braces and a vertical bar (`{ | }`) surround alternatives for a single element. `whitespace` may consist of space and tab characters, which are ignored. `alphanumerics` are decimal digits or the letters `'a'` through `'z'` (or `'A'` through `'Z'`). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is `0`, the initial characters of the string pointed to by `string` are used to determine the base. If the first character is `0`, and the second character isn't `'x'` or `'X'`, the string is interpreted as an octal integer. If the first character is `'0'` and the second character is `'x'` or `'X'`, the string is interpreted as a hexadecimal integer. If the first character is `'1'` through `'9'`, the string is interpreted as a decimal integer. The letters `'a'` through `'z'` (or `'A'` through `'Z'`) are assigned the values 10 through 35. The scan only allows letters whose values are less than `base`. The first character outside the range of the base stops the scan. For example, suppose `string` starts with `"01"`. If `base` is `0`, the scanner assumes it's an octal integer. An `'8'` or `'9'` character stops the scan.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcstol</code>	<code>strtol</code>	<code>strtol</code>	<code>wcstol</code>
<code>_tcstol_1</code>	<code>_strtol_1</code>	<code>_strtol_1</code>	<code>_wcstol_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtol</code>	<code>&lt;stdlib.h&gt;</code>
<code>wcstol</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_strtol_1</code>	<code>&lt;stdlib.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_wcstol_1</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

The `_strtol_1` and `_wcstol_1` functions are Microsoft-specific, not part of the Standard C library. For more compatibility information, see [Compatibility](#).

## Example

See the example for [`strtod`](#).

## See also

[Data conversion](#)

[Locale](#)

[`localeconv`](#)

[`setlocale`](#), [`\_wsetlocale`](#)

[String to numeric value functions](#)

[`strtod`](#), [`\_strtod\_1`](#), [`wcstod`](#), [`\_wcstod\_1`](#)

[`strtoll`](#), [`\_strtoll\_1`](#), [`wcstoll`](#), [`\_wcstoll\_1`](#)

[`strtoul`](#), [`\_strtoul\_1`](#), [`wcstoul`](#), [`\_wcstoul\_1`](#)

[`atof`](#), [`\_atof\_1`](#), [`wtof`](#), [`\_wtof\_1`](#)

`strtold`, `_strtold_l`, `wcstold`, `_wcstold_l`

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Converts strings to a long double-precision floating-point value.

## Syntax

```
long double strtold(
 const char *strSource,
 char **endptr
);
long double _strtold_l(
 const char *strSource,
 char **endptr,
 _locale_t locale
);
long double wcstold(
 const wchar_t *strSource,
 wchar_t **endptr
);
long double wcstold_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to the character that stops the scan.

`Locale`

The locale to use.

## Return value

`strtold` returns the value of the floating-point number as a `long double`, except when the representation would cause an overflow—in that case, the function returns `+/- HUGE_VALL`. The sign of `HUGE_VALL` matches the sign of the value that can't be represented. `strtold` returns 0 if no conversion can be performed or an underflow occurs.

`wcstold` returns values analogously to `strtold`. For both functions, `errno` is set to `ERANGE` if overflow or underflow occurs and the invalid parameter handler is invoked, as described in [Parameter validation](#).

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each function converts the input string `strSource` to a `long double`. The `strtold` function stops reading the string `strSource` at the first character it can't recognize as part of a number. It may be the terminating null character. The wide-character version of `strtold` is `wcstold`; its `strSource` argument is a wide-character string.

Otherwise, these functions behave identically.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
_tcstold	strtold	strtold	wcstold
_tcstold_l	_strtold_l	_strtold_l	_wcstold_l

The `LC_NUMERIC` category setting of the current locale determines the recognition of the radix character in `strSource`. For more information, see [setlocale](#), [wsetlocale](#). The functions without the `_l` suffix use the current locale; `_strtold_l` and `_wcstold_l` are identical to `_strtold` and `_wcstold` except that they instead use the locale that's passed in. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location that's pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location that's pointed to by `endptr`.

`strtold` expects `strSource` to point to a string of the following form:

```
[whitespace][sign][digits][. digits][{ d | D | e | E }][sign] digits]
```

A `whitespace` may consist of space and tab characters, which are ignored; `sign` is either plus (+) or minus (-); and `digits` are one or more decimal digits. If no digits appear before the radix character, at least one must appear after the radix character. The decimal digits can be followed by an exponent, which consists of an introductory letter (d, D, e, or E) and an optionally signed integer. If no exponent part or radix character appears, a radix character is assumed to follow the last digit in the string. The first character that doesn't fit this form stops the scan.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtold</code> , <code>_strtold_l</code>	<code>&lt;stdlib.h&gt;</code>
<code>wcstold</code> , <code>_wcstold_l</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt strtold.c
// Build with: cl /W4 /Tc crt strtold.c
// This program uses strtold to convert a
// string to a long double-precision value.

#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 char *string;
 char *stopstring;
 long double x;

 string = "3.1415926535898This stopped it";
 x = strtold(string, &stopstring);
 printf("string = %s\n", string);
 printf(" strtold = %.13Lf\n", x);
 printf(" Stopped scan at: %s\n\n", stopstring);
}

```

```

string = 3.1415926535898This stopped it
strtold = 3.1415926535898
Stopped scan at: This stopped it

```

## See also

[Data conversion](#)

[Math and floating-point support](#)

[Interpretation of multibyte-character sequences](#)

[Locale](#)

[String to numeric value functions](#)

<a href="#">strtod</a>	<a href="#">_strtod_l</a>	<a href="#">wcstod</a>	<a href="#">_wcstod_l</a>
<a href="#">strtol</a>	<a href="#">wcstol</a>	<a href="#">_strtol_l</a>	<a href="#">_wcstol_l</a>
<a href="#">strtoul</a>	<a href="#">_strtoul_l</a>	<a href="#">wcstoul</a>	<a href="#">_wcstoul_l</a>
<a href="#">atof</a>	<a href="#">_atof_l</a>	<a href="#">_wtof</a>	<a href="#">_wtof_l</a>
<a href="#">localeconv</a>			
<a href="#">_create_locale</a>		<a href="#">_wcreate_locale</a>	
<a href="#">_free_locale</a>			

`strtol`, `_strtol_l`, `wcstoll`, `_wcstoll_l`

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Converts a string to a `long long` value.

## Syntax

```
long long strtoll(
 const char *strSource,
 char **endptr,
 int base
);
long long wcstoll(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
long long _strtol_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
long long _wcstoll_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to the character that stops the scan.

`base`

Number base to use.

`Locale`

The locale to use.

## Return value

`strtoll` returns the value that's represented in the string `strSource`, except when the representation would cause an overflow—in that case, it returns `LLONG_MAX` or `LLONG_MIN`. The function returns 0 if no conversion can be performed. `wcstoll` returns values analogously to `strtoll`.

`LLONG_MAX` and `LLONG_MIN` are defined in LIMITS.H.

If `strSource` is `NULL` or the `base` is nonzero and either less than 2 or greater than 36, `errno` is set to `EINVAL`.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `strtoll` function converts `strSource` to a `long long`. Both functions stop reading the string `strSource` at the first character they can't recognize as part of a number. It may be the terminating null character, or it may be the first numeric character that's greater than or equal to `base`. `wcstoll` is a wide-character version of `strtoll`; its `strSource` argument is a wide-character string. Otherwise, these functions behave identically.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcstoll</code>	<code>strtoll</code>	<code>strtoll</code>	<code>wcstoll</code>
<code>_tcstoll_l</code>	<code>_strtoll_l</code>	<code>_strtoll_l</code>	<code>_wcstoll_l</code>

The locale's `LC_NUMERIC` category setting determines recognition of the radix character in `strSource`; for more information, see [setlocale](#), [\\_wsetlocale](#). The functions that don't have the `_l` suffix use the current locale; `_strtoll_l` and `_wcstoll_l` are identical to the corresponding functions that don't have the suffix, except that they instead use the locale that's passed in. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location that's pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location that's pointed to by `endptr`.

`strtoll` expects `strSource` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored; `digits` are one or more decimal digits; `Letters` are one or more of the letters 'a' through 'z' (or 'A' through 'Z'). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string that's pointed to by `strSource` are used to determine the base. If the first character is '0' and the second character isn't 'x' or 'X', the string is interpreted as an octal integer. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character stops the scan.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtoll</code> , <code>_strtoll_l</code>	<code>&lt;stdlib.h&gt;</code>
<code>wcstoll</code> , <code>_wcstoll_l</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

[Data conversion](#)

[Locale](#)

[localeconv](#)

[setlocale](#), [\\_wsetlocale](#)

[String to numeric value functions](#)

[strtod](#), [\\_strtod\\_1](#), [wcstod](#), [\\_wcstod\\_1](#)

[strtol](#), [wcstol](#), [\\_strtol\\_1](#), [\\_wcstol\\_1](#)

[strtoul](#), [\\_strtoul\\_1](#), [wcstoul](#), [\\_wcstoul\\_1](#)

[atof](#), [\\_atof\\_1](#), [\\_wtof](#), [\\_wtof\\_1](#)

`_strtoui64`, `_wcstoui64`, `_strtoui64_l`,  
`_wcstoui64_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Convert a string to an `unsigned __int64` value.

## Syntax

```
unsigned __int64 _strtoui64(
 const char *strSource,
 char **endptr,
 int base
);
unsigned __int64 _wcstoui64(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
unsigned __int64 _strtoui64_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
unsigned __int64 _wcstoui64_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to character that stops scan.

`base`

Number base to use.

`Locale`

Locale to use.

## Return value

`_strtoui64` returns the value represented in the string `strSource`, except when the representation would cause an overflow, in which case it returns `_UI64_MAX`. `_strtoui64` returns 0 if no conversion can be performed.

`_UI64_MAX` is defined in `LIMITS.H`.

If `strSource` is `NULL` or the `base` is nonzero and either less than 2 or greater than 36, `errno` is set to `EINVAL`.

For more information on return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_strtoui64` function converts `strSource` to an `unsigned __int64`. `_wcstoui64` is a wide-character version of `_strtoui64`; its `strSource` argument is a wide-character string. Otherwise these functions behave identically.

Both functions stop reading the string `strSource` at the first character they can't recognize as part of a number. It may be the terminating null character, or it may be the first numeric character greater than or equal to `base`.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcstoui64</code>	<code>_strtoui64</code>	<code>_strtoui64</code>	<code>_wcstoui64</code>
<code>_tcstoui64_1</code>	<code>_strtoui64_1</code>	<code>_strtoui64_1</code>	<code>_wcstoui64_1</code>

The current locale's `LC_NUMERIC` category setting determines recognition of the radix character in `strSource`; for more information, see [setlocale](#). The functions without the `_1` suffix use the current locale; `_strtoui64_1` and `_wcstoui64_1` are identical to the corresponding functions without the `_1` suffix except that they use the locale passed in instead. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location pointed to by `endptr`.

`_strtoui64` expects `strSource` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored. `digits` are one or more decimal digits. `Letters` are one or more of the letters 'a' through 'z' (or 'A' through 'Z'). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string pointed to by `strSource` are used to determine the base. If the first character is '0' and the second character isn't 'x' or 'X', the string is interpreted as an octal integer. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character will stop the scan.

## Requirements

FUNCTION	REQUIRED HEADER
<code>_strtoui64</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wcstoui64</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_strtoui64_1</code>	<code>&lt;stdlib.h&gt;</code>

FUNCTION	REQUIRED HEADER
<code>_wcstoui64_l</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt strtoui64.c
#include <stdio.h>

unsigned __int64 atoui64(const char *szUnsignedInt) {
 return _strtoui64(szUnsignedInt, NULL, 10);
}

int main() {
 unsigned __int64 u = atoui64("18446744073709551615");
 printf("u = %I64u\n", u);
}
```

```
u = 18446744073709551615
```

## See also

[Data conversion](#)

[Locale](#)

`localeconv`

`setlocale` , `_wsetlocale`

[String to numeric value functions](#)

`strtod` , `_strtod_l` , `wcstod` , `_wcstod_l`

`strtoul` , `_strtoul_l` , `wcstoul` , `_wcstoul_l`

`atof` , `_atof_l` , `wtof` , `_wtof_l`

`strtoul`, `_strtoul_l`, `wcstoul`, `_wcstoul_l`

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Convert strings to an unsigned long-integer value.

## Syntax

```
unsigned long strtoul(
 const char *strSource,
 char **endptr,
 int base
);
unsigned long _strtoul_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
unsigned long wcstoul(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
unsigned long _wcstoul_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to character that stops scan.

`base`

Number base to use.

`Locale`

Locale to use.

## Return value

`strtoul` returns the converted value, if any, or `ULONG_MAX` on overflow. `strtoul` returns 0 if no conversion can be performed. `wcstoul` returns values analogously to `strtoul`. For both functions, `errno` is set to `ERANGE` if overflow or underflow occurs.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions converts the input string `strSource` to an `unsigned long`.

`strtoul` stops reading the string `strSource` at the first character it can't recognize as part of a number. This character may be the terminating `NULL`, or it may be the first numeric character greater than or equal to `base`. The `LC_NUMERIC` category setting of the locale determines recognition of the radix character in `strSource`; for more information, see [setlocale](#). `strtoul` and `wcstoul` use the current locale; `_strtoul_1` and `_wcstoul_1` are identical except that they use the locale passed in instead. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location pointed to by `endptr`.

`wcstoul` is a wide-character version of `strtoul`; its `strSource` argument is a wide-character string. Otherwise these functions behave identically.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_tcstoul</code>	<code>strtoul</code>	<code>strtoul</code>	<code>wcstoul</code>
<code>_tcstoul_1</code>	<code>strtoul_1</code>	<code>_strtoul_1</code>	<code>_wcstoul_1</code>

`strtoul` expects `strSource` to point to a string of the following form:

```
[whitespace] [+ | -] [0 { x | X }] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored. `digits` are one or more decimal digits. `Letters` are one or more of the letters `a` through `z` (or `A` through `Z`). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string pointed to by `strSource` are used to determine the base. If the first character is 0 and the second character isn't `x` or `X`, the string is interpreted as an octal integer. If the first character is '0' and the second character is `x` or `X`, the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters `a` through `z` (or `A` through `Z`) are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character will stop the scan. `strtoul` allows a plus (+) or minus (-) sign prefix; a leading minus sign indicates that the return value is negated.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtoul</code>	<code>&lt;stdlib.h&gt;</code>
<code>wcstoul</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_strtoul_1</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wcstoul_1</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [strtod](#).

## See also

[Data conversion](#)

[Locale](#)

[localeconv](#)

[setlocale](#), [\\_wsetlocale](#)

[String to numeric value functions](#)

[strtod](#), [\\_strtod\\_l](#), [wcstod](#), [\\_wcstod\\_l](#)

[strtol](#), [wcstol](#), [\\_strtol\\_l](#), [\\_wcstol\\_l](#)

[atof](#), [\\_atof\\_l](#), [\\_wtok](#), [\\_wtok\\_l](#)

`strtoull`, `_strtoull_l`, `wcstoull`, `_wcstoull_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts strings to an `unsigned long long` integer value.

## Syntax

```
unsigned long long strtoull(
 const char *strSource,
 char **endptr,
 int base
);
unsigned long long _strtoull_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
unsigned long long wcstoull(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
unsigned long long _wcstoull_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to the character that stops the scan.

`base`

Number base to use.

`Locale`

Locale to use.

## Return value

`strtoull` returns the converted value, if any, or `ULLONG_MAX` on overflow. `strtoull` returns 0 if no conversion can be performed. `wcstoull` returns values analogously to `strtoull`. For both functions, `errno` is set to `ERANGE` if overflow or underflow occurs.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions converts the input string `strSource` to an `unsigned long long` integer value.

`strtoull` stops reading the string `strSource` at the first character it can't recognize as part of a number. It may be the terminating null character, or it may be the first numeric character that's greater than or equal to `base`. The setting of the `LC_NUMERIC` category of the locale determines recognition of the radix character in `strSource`; for more information, see [setlocale](#), [\\_wsetlocale](#). `strtoull` and `wcstoull` use the current locale; `_strtoull_1` and `_wcstoull_1` instead use the locale that's passed in but are identical otherwise. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location that's pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location that's pointed to by `endptr`.

`wcstoull` is a wide-character version of `strtoull` and its `strSource` argument is a wide-character string. Otherwise, these functions behave identically.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcstoull</code>	<code>strtoull</code>	<code>strtoull</code>	<code>wcstoull</code>
<code>_tcstoull_1</code>	<code>strtoull_1</code>	<code>_strtoull_1</code>	<code>_wcstoull_1</code>

`strtoull` expects `strSource` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored. `digits` are one or more decimal digits. `Letters` are one or more of the letters 'a' through 'z' (or 'A' through 'Z'). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string that's pointed to by `strSource` are used to determine the base. If the first character is '0' and the second character isn't 'x' or 'X', the string is interpreted as an octal integer. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character stops the scan. `strtoull` allows a plus sign (+) or minus sign (-) prefix; a leading minus sign indicates that the return value is negated.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtoull</code>	<code>&lt;stdlib.h&gt;</code>
<code>wcstoull</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_strtoull_1</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wcstoull_1</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [strtod](#).

## See also

[Data conversion](#)

[Locale](#)

[localeconv](#)

[setlocale](#), [\\_wsetlocale](#)

[String to numeric value functions](#)

[strtod](#), [\\_strtod\\_l](#), [wcstod](#), [\\_wcstod\\_l](#)

[strtol](#), [wcstol](#), [\\_strtol\\_l](#), [\\_wcstol\\_l](#)

[strtoul](#), [\\_strtoul\\_l](#), [wcstoul](#), [\\_wcstoul\\_l](#)

[strtoll](#), [\\_strtoll\\_l](#), [wcstoll](#), [\\_wcstoll\\_l](#)

[atof](#), [\\_atof\\_l](#), [wtok](#), [\\_wtok\\_l](#)

`strtoumax`, `_strtoumax_l`, `wcstoumax`,  
`_wcstoumax_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts strings to an integer value of the largest supported unsigned integer type.

## Syntax

```
uintmax_t strtoumax(
 const char *strSource,
 char **endptr,
 int base
);
uintmax_t _strtoumax_l(
 const char *strSource,
 char **endptr,
 int base,
 _locale_t locale
);
uintmax_t wcstoumax(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base
);
uintmax_t _wcstoumax_l(
 const wchar_t *strSource,
 wchar_t **endptr,
 int base,
 _locale_t locale
);
```

## Parameters

`strSource`

Null-terminated string to convert.

`endptr`

Pointer to the character that stops the scan.

`base`

Number base to use.

`Locale`

Locale to use.

## Return value

`strtoumax` returns the converted value, if any, or `UINTMAX_MAX` on overflow. `strtoumax` returns 0 if no conversion can be performed. `wcstoumax` returns values analogously to `strtoumax`. For both functions, `errno` is set to `ERANGE` if overflow or underflow occurs.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions converts the input string `strSource` to a `uintmax_t` integer value.

`strtoumax` stops reading the string `strSource` at the first character it can't recognize as part of a number. It may be the terminating null character, or it may be the first numeric character that's greater than or equal to `base`. The `LC_NUMERIC` category setting of the locale determines the recognition of the radix character in `strSource`. For more information, see `setlocale`, `_wsetlocale`. `strtoumax` and `wcstoumax` use the current locale; `_strtoumax_1` and `_wcstoumax_1` are identical except that they instead use the locale that's passed in. For more information, see [Locale](#).

If `endptr` isn't `NULL`, a pointer to the character that stopped the scan is stored at the location that's pointed to by `endptr`. If no conversion can be performed (no valid digits were found or an invalid base was specified), the value of `strSource` is stored at the location that's pointed to by `endptr`.

The wide-character version of `strtoumax` is `wcstoumax`; its `strSource` argument is a wide-character string. Otherwise, these functions behave identically.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcstoumax</code>	<code>strtoumax</code>	<code>strtoumax</code>	<code>wcstoumax</code>
<code>_tcstoumax_1</code>	<code>strtoumax_1</code>	<code>_strtoumax_1</code>	<code>_wcstoumax_1</code>

`strtoumax` expects `strSource` to point to a string of the following form:

```
[whitespace] [{ + | - }] [0 [{ x | X }]] [digits | letters]
```

A `whitespace` may consist of space and tab characters, which are ignored. `digits` are one or more decimal digits. `Letters` are one or more of the letters 'a' through 'z' (or 'A' through 'Z'). The first character that doesn't fit this form stops the scan. If `base` is between 2 and 36, then it's used as the base of the number. If `base` is 0, the initial characters of the string that's pointed to by `strSource` are used to determine the base. If the first character is '0' and the second character isn't 'x' or 'X', the string is interpreted as an octal integer. If the first character is '0' and the second character is 'x' or 'X', the string is interpreted as a hexadecimal integer. If the first character is '1' through '9', the string is interpreted as a decimal integer. The letters 'a' through 'z' (or 'A' through 'Z') are assigned the values 10 through 35; only letters whose assigned values are less than `base` are permitted. The first character outside the range of the base stops the scan. For example, if `base` is 0 and the first character scanned is '0', an octal integer is assumed and an '8' or '9' character would stop the scan. `strtoumax` allows a plus sign (+) or minus sign (-) prefix; a leading minus sign indicates that the return value is the two's complement of the absolute value of the converted string.

## Requirements

ROUTINE	REQUIRED HEADER
<code>strtoumax</code>	<code>&lt;stdlib.h&gt;</code>
<code>wcstoumax</code>	<code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_strtoumax_1</code>	<code>&lt;stdlib.h&gt;</code>

ROUTINE	REQUIRED HEADER
<code>_wcstoumax_1</code>	<stdlib.h> or <wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [strtod](#).

## See also

[Data conversion](#)

[Locale](#)

[localeconv](#)

[setlocale](#), [\\_wsetlocale](#)

[String to numeric value functions](#)

[strtod](#), [\\_strtod\\_1](#), [wcstod](#), [\\_wcstod\\_1](#)

[strtoimax](#), [\\_strtoimax\\_1](#), [wcstoimax](#), [\\_wcstoimax\\_1](#)

[strtol](#), [wcstol](#), [\\_strtol\\_1](#), [\\_wcstol\\_1](#)

[strtoul](#), [\\_strtoul\\_1](#), [wcstoul](#), [\\_wcstoul\\_1](#)

[strtoll](#), [\\_strtoll\\_1](#), [wcstoll](#), [\\_wcstoll\\_1](#)

[atof](#), [\\_atof\\_1](#), [\\_wtotf](#), [\\_wtotf\\_1](#)

# `strupr`, `wcsupr`

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The Microsoft-specific function names `strupr` and `wcsupr` are deprecated aliases for the `_strupr` and `_wcsupr` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_strupr` and `_wcsupr` or the security-enhanced `_strupr_s` and `_wcsupr_s` functions instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_strupr`, `_strupr_l`, `_mstrupr`, `_mstrupr_l`,  
`_wcsupr_l`, `_wcsupr`

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Converts a string to uppercase. More secure versions of these functions are available; see [`\_strupr\_s`](#), [`\_strupr\_s\_l`](#), [`\_mstrupr\_s`](#), [`\_mstrupr\_s\_l`](#), [`\_wcsupr\_s`](#), [`\_wcsupr\_s\_l`](#).

**IMPORTANT**

`_mstrupr` and `_mstrupr_l` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
char *_strupr(
 char *str
);
wchar_t *_wstrupr(
 wchar_t *str
);
unsigned char *_mstrupr(
 unsigned char *str
);
char *_strupr_l(
 char *str,
 _locale_t locale
);
wchar_t *_wstrupr_l(
 wchar_t *str,
 _locale_t locale
);
unsigned char *_mstrupr_l(
 unsigned char *str,
 _locale_t locale
);
template <size_t size>
char *_strupr(
 char (&str)[size]
); // C++ only
template <size_t size>
wchar_t *_wstrupr(
 wchar_t (&str)[size]
); // C++ only
template <size_t size>
unsigned char *_mstrupr(
 unsigned char (&str)[size]
); // C++ only
template <size_t size>
char *_strupr_l(
 char (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
wchar_t *_wstrupr_l(
 wchar_t (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
unsigned char *_mstrupr_l(
 unsigned char (&str)[size],
 _locale_t locale
);
// C++ only
```

## Parameters

`str`

String to capitalize.

`locale`

The locale to use.

## Return value

Returns a pointer to the altered string. Because the modification is done in place, the pointer returned is the same as the pointer passed as the input argument. No return value is reserved to indicate an error.

## Remarks

The `_strupr` function converts, in place, each lowercase letter in `str` to uppercase. The conversion is determined by the `LC_CTYPE` category setting of the locale. Other characters aren't affected. For more information on `LC_CTYPE`, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale; the versions with the `_1` suffix are identical except that they use the locale passed in instead. For more information, see [Locale](#).

`_wcsupr` and `_mbsupr` are wide-character and multibyte-character versions of `_strupr`. The argument and return value of `_wcsupr` are wide-character strings. The argument and return value of `_mbsupr` are multibyte-character strings. These three functions behave identically otherwise.

If `str` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return the original string and set `errno` to `EINVAL`.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsupr</code>	<code>_strupr</code>	<code>_mbsupr</code>	<code>_wcsupr</code>
<code>_tcsupr_1</code>	<code>_strupr_1</code>	<code>_mbsupr_1</code>	<code>_wcsupr_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strupr</code> , <code>_strupr_1</code>	<code>&lt;string.h&gt;</code>
<code>_wcsupr</code> , <code>_wcsupr_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>_mbsupr</code> , <code>_mbsupr_1</code>	<code>&lt;mbstring.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [`\_strlwr`](#).

## See also

[Locale](#)

[String manipulation](#)

[`\_strlwr`](#), [`\_wcslwr`](#), [`\_mbslwr`](#), [`\_strlwr\_1`](#), [`\_wcslwr\_1`](#), [`\_mbslwr\_1`](#)

`_strupr_s`, `_strupr_s_1`, `_mbsupr_s`, `_mbsupr_s_1`  
`_wstrupr_s`, `_wstrupr_s_1`

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Converts a string to uppercase, by using the current locale or a specified locale that's passed in. These versions of `_strupr`, `_strupr_1`, `_mbsupr`, `_mbsupr_1`, `_wstrupr`, `_wstrupr_1` have security enhancements, as described in [Security features in the CRT](#).

**IMPORTANT**

`_mbsupr_s` and `_mbsupr_s_1` cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
errno_t _strupr_s(
 char *str,
 size_t numberOfElements
);
errno_t _wcsupr_s(
 wchar_t * str,
 size_t numberOfElements
);
errno_t _strupr_s_l(
 char * str,
 size_t numberOfElements,
 _locale_t locale
);
errno_t _wcsupr_s_l(
 wchar_t * str,
 size_t numberOfElements,
 _locale_t locale
);
errno_t _mbsupr_s(
 unsigned char *str,
 size_t numberOfElements
);
errno_t _mbsupr_s_l(
 unsigned char *str,
 size_t numberOfElements,
 _locale_t locale
);
template <size_t size>
errno_t _strupr_s(
 char (&str)[size]
); // C++ only
template <size_t size>
errno_t _wcsupr_s(
 wchar_t (&str)[size]
); // C++ only
template <size_t size>
errno_t _strupr_s_l(
 char (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
errno_t _wcsupr_s_l(
 wchar_t (&str)[size],
 _locale_t locale
); // C++ only
template <size_t size>
errno_t _mbsupr_s(
 unsigned char (&str)[size]
); // C++ only
template <size_t size>
errno_t _mbsupr_s_l(
 unsigned char (&str)[size],
 _locale_t locale
); // C++ only
```

## Parameters

`str`

String to capitalize.

`numberOfElements`

Size of the buffer.

`Locale`

The locale to use.

## Return value

Zero if successful; a non-zero error code on failure.

These functions validate their parameters. If `str` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return `EINVAL` and set `errno` to `EINVAL`. If `numberOfElements` is less than the length of the string, the functions return `ERANGE` and set `errno` to `ERANGE`.

## Remarks

The `_strupr_s` function converts, in place, each lowercase letter in `str` to uppercase. `_wcsupr_s` is the wide-character version of `_strupr_s`. `_mbsupr_s` is the multi-byte character version of `_strupr_s`.

The conversion is determined by the `LC_CTYPE` category setting of the locale. Other characters aren't affected. For more information on `LC_CTYPE`, see [setlocale](#). The versions of these functions without the `_1` suffix use the current locale; the versions with the `_1` suffix are identical except that they use the locale passed in instead. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

The debug library versions of these functions first fill the buffer with 0xFE. To disable this behavior, use `_CrtSetDebugFillThreshold`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsupr_s</code>	<code>_strupr_s</code>	<code>_mbsupr_s</code>	<code>_wcsupr_s</code>
<code>_tcsupr_s_1</code>	<code>_strupr_s_1</code>	<code>_mbsupr_s_1</code>	<code>_wcsupr_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_strupr_s</code> , <code>_strupr_s_1</code>	<code>&lt;string.h&gt;</code>
<code>_wcsupr_s</code> , <code>_wcsupr_s_1</code> , <code>_mbsupr_s</code> , <code>_mbsupr_s_1</code>	<code>&lt;string.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for `_strlwr_s`, `_strlwr_s_1`, `_mbslwr_s`, `_mbslwr_s_1`, `_wslwr_s`, `_wslwr_s_1`.

## See also

[Locale](#)

## Interpretation of multibyte-character sequences

### String manipulation

`_strlwr_s`, `_strlwr_s_1`, `_mbslwr_s`, `_mbslwr_s_1`, `_wcslwr_s`, `_wcslwr_s_1`

`strxfrm`, `wcsxfrm`, `_strxfrm_l`, `_wcsxfrm_l`

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Transform a string based on locale-specific information.

## Syntax

```
size_t strxfrm(
 char *strDest,
 const char *strSource,
 size_t count
);
size_t wcsxfrm(
 wchar_t *strDest,
 const wchar_t *strSource,
 size_t count
);
size_t _strxfrm_l(
 char *strDest,
 const char *strSource,
 size_t count,
 _locale_t locale
);
size_t wcsxfrm_l(
 wchar_t *strDest,
 const wchar_t *strSource,
 size_t count,
 _locale_t locale
);
```

## Parameters

`strDest`

Destination string.

`strSource`

Source string.

`count`

Maximum number of characters to place in `strDest`.

`Locale`

The locale to use.

## Return value

Returns the length of the transformed string, not counting the terminating null character. If the return value is greater than or equal to `count`, the content of `strDest` is unpredictable. On an error, each function sets `errno` and returns `INT_MAX`. For an invalid character, `errno` is set to `EILSEQ`.

## Remarks

The `strxfrm` function transforms the string pointed to by `strSource` into a new collated form that is stored in `strDest`. No more than `count` characters, including the null character, are transformed and placed into the resulting string. The transformation is made using the locale's `LC_COLLATE` category setting. For more

information on `LC_COLLATE`, see [setlocale](#). `strxfrm` uses the current locale for its locale-dependent behavior; `_strxfrm_1` is identical except that it uses the locale passed in instead of the current locale. For more information, see [Locale](#).

After the transformation, a call to `strcmp` with the two transformed strings yields results identical to the results of a call to `strcoll` applied to the original two strings. As with `strcoll` and `stricoll`, `strxfrm` automatically handles multibyte-character strings as appropriate.

`wcsxfrm` is a wide-character version of `strxfrm`; the string arguments of `wcsxfrm` are wide-character pointers. For `wcsxfrm`, after the string transformation, a call to `wcscmp` with the two transformed strings yields results identical to the results of a call to `wcscol1` applied to the original two strings. `wcsxfrm` and `strxfrm` behave identically otherwise. `wcsxfrm` uses the current locale for its locale-dependent behavior; `_wcsxfrm_1` uses the locale passed in instead of the current locale.

These functions validate their parameters. If `strSource` is a null pointer, or `strDest` is a `NULL` pointer (unless `count` is zero), or if `count` is greater than `INT_MAX`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `INT_MAX`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tcsxfrm</code>	<code>strxfrm</code>	<code>strxfrm</code>	<code>wcsxfrm</code>
<code>_tcsxfrm_1</code>	<code>_strxfrm_1</code>	<code>_strxfrm_1</code>	<code>_wcsxfrm_1</code>

In the "C" locale, the order of the characters in the character set (ASCII character set) is the same as the lexicographic order of the characters. However, in other locales, the order of characters in the character set may differ from the lexicographic character order. For example, in certain European locales, the character 'a' (value 0x61) precedes the character 'ä' (value 0xE4) in the character set, but the character 'ä' precedes the character 'a' lexicographically.

In locales for which the character set and the lexicographic character order differ, use `strxfrm` on the original strings and then `strcmp` on the resulting strings to produce a lexicographic string comparison according to the current locale's `LC_COLLATE` category setting. Thus, to compare two strings lexicographically in the above locale, use `strxfrm` on the original strings, then `strcmp` on the resulting strings. Alternately, you can use `strcoll` rather than `strcmp` on the original strings.

`strxfrm` is basically a wrapper around `LCMapString` with `LCMAP_SORTKEY`.

The value of the following expression is the size of the array needed to hold the `strxfrm` transformation of the source string:

```
1 + strxfrm(NULL, string, 0)
```

In the "C" locale only, `strxfrm` is equivalent to the following function calls:

```
strncpy(_string1, _string2, _count);
return(strlen(_string1));
```

# Requirements

ROUTINE	REQUIRED HEADER
<code>strxfrm</code>	<code>&lt;string.h&gt;</code>
<code>wcsxfrm</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>
<code>_strxfrm_l</code>	<code>&lt;string.h&gt;</code>
<code>_wcsxfrm_l</code>	<code>&lt;string.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### Data conversion

<code>localeconv</code>
<code>setlocale</code> , <code>_wsetlocale</code>

### Locale

### String manipulation

<code>strcoll</code> functions
<code>strcmp</code> , <code>wcsncmp</code> , <code>_mbscmp</code> <code>strncmp</code> , <code>wcsncmp</code> , <code>_mbsncmp</code> , <code>_mbsncmp_l</code>

 swab11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `swab` is a deprecated alias for the `_swab` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_swab` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# \_swab

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Swaps bytes.

## Syntax

```
void _swab(
 char *src,
 char *dest,
 int n
);
```

## Parameters

`src`

Data to be copied and swapped.

`dest`

Storage location for swapped data.

`n`

Number of bytes to be copied and swapped.

## Return value

The `swab` function doesn't return a value. The function sets `errno` to `EINVAL` if either the `src` or `dest` pointer is null or `n` is less than zero, and the invalid parameter handler is invoked, as described in [Parameter validation](#).

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

If `n` is even, the `_swab` function copies `n` bytes from `src`, swaps each pair of adjacent bytes, and stores the result at `dest`. If `n` is odd, `_swab` copies and swaps the first `n - 1` bytes of `src`, and the final byte isn't copied. The `_swab` function is typically used to prepare binary data for transfer to a machine that uses a different byte order.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_swab</code>	C: <stdlib.h> C++: <cstdlib> or <cstdlib.h>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_swab.c

#include <stdlib.h>
#include <stdio.h>

char from[] = "BADCFEHGJILKNMPORQTSVUXWZY";
char to[] = ".....";

int main()
{
 printf("Before: %s %d bytes\n %s\n", from, sizeof(from), to);
 _swab(from, to, sizeof(from));
 printf("After: %s\n %s\n", from, to);
}
```

```
Before: BADCFEHGJILKNMPORQTSVUXWZY 27 bytes
.....
After: BADCFEHGJILKNMPORQTSVUXWZY
ABCDEFIGHIJKLMNOPQRSTUVWXYZ.
```

## See also

[Buffer manipulation](#)

# system, \_wsystem

11/2/2022 • 2 minutes to read • [Edit Online](#)

Executes a command.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int system(
 const char *command
);
int _wsystem(
 const wchar_t *command
);
```

## Parameters

*command*

The command to be executed.

## Return value

If *command* is `NULL` and the command interpreter is found, returns a nonzero value. If the command interpreter isn't found, returns 0 and sets *errno* to `ENOENT`. If *command* isn't `NULL`, `system` returns the value that is returned by the command interpreter. It returns the value 0 only if the command interpreter returns the value 0. A return value of -1 indicates an error, and *errno* is set to one of the following values:

VALUE	DESCRIPTION
<code>E2BIG</code>	The argument list (which is system-dependent) is too large.
<code>ENOENT</code>	The command interpreter can't be found.
<code>ENOEXEC</code>	The command-interpreter file can't be executed because the format isn't valid.
<code>ENOMEM</code>	Not enough memory is available to execute command; or available memory has been corrupted; or a non-valid block exists, which indicates that the calling process has been allocated incorrectly.

For more information about return codes, see [`errno`](#), [`\_doserrno`](#), [`\_sys\_errlist`](#), and [`\_sys\_nerr`](#).

## Remarks

The `system` function passes *command* to the command interpreter, which executes the string as an operating-

system command. `system` uses the `COMSPEC` and `PATH` environment variables to locate the command-interpreter file CMD.exe. If `command` is `NULL`, the function just checks whether the command interpreter exists.

You must explicitly flush, by using `fflush` or `_flushall`, or close any stream before you call `system`.

`_wsystem` is a wide-character version of `system`; the `command` argument to `_wsystem` is a wide-character string. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

<code>TCHAR.H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
<code>_tsystem</code>	<code>system</code>	<code>system</code>	<code>_wsystem</code>

## Requirements

<code>ROUTINE</code>	<code>REQUIRED HEADER</code>
<code>system</code>	<code>&lt;process.h&gt;</code> or <code>&lt;stdlib.h&gt;</code>
<code>_wsystem</code>	<code>&lt;process.h&gt;</code> or <code>&lt;stdlib.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

This example uses `system` to TYPE a text file.

```
// crt_system.c

#include <process.h>

int main(void)
{
 system("type crt_system.txt");
}
```

### Input: crt\_system.txt

```
Line one.
Line two.
```

### Output

```
Line one.
Line two.
```

## See also

[Process and environment control](#)

`_exec` , `_wexec` functions

`exit`, `_Exit`, `_exit`

`_flushall`

`_spawn`, `_wspawn` functions

`tan`, `tanf`, `tanl`

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Calculates the tangent.

## Syntax

```
double tan(double x);
float tanf(float x);
long double tanl(long double x);
#define tan(x) // Requires C11 or higher
```

```
float tan(float x); // C++ only
long double tan(long double x); // C++ only
```

### Parameters

`x`

Angle in radians.

## Return value

The `tan` functions return the tangent of `x`. If `x` is greater than or equal to 263, or less than or equal to -263, a loss of significance in the result occurs.

INPUT	SEH EXCEPTION	<code>_MATHERR</code> EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>
$\pm \text{INF}$	<code>INVALID</code>	<code>_DOMAIN</code>

## Remarks

Because C++ allows overloading, you can call overloads of `tan` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `tan` always takes and returns `double`.

If you use the `tan` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>tan</code> , <code>tanf</code> , <code>tanl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code> or <code>&lt;math.h&gt;</code>

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>tan</code> macro	<code>&lt;tgmath.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_tan.c
// This program displays the tangent of pi / 4
// Compile by using: cl crt_tan.c

#include <math.h>
#include <stdio.h>

int main(void)
{
 double pi = 3.1415926535;
 double x;

 x = tan(pi / 4);
 printf("tan(%f) = %f\n", pi/4, x);
}
```

```
tan(0.785398) = 1.000000
```

## See also

[Math and floating-point support](#)

<code>acos</code>	<code>acosf</code>	<code>acosl</code>
<code>asin</code>	<code>asinf</code>	<code>asinl</code>
<code>atan</code>	<code>atanf</code>	<code>atanl</code>
<code>atan2</code>	<code>atan2f</code>	<code>atan2l</code>
<code>cos</code>	<code>cosf</code>	<code>cosl</code>
<code>sin</code>	<code>sinf</code>	<code>sinl</code>
<code>_CItan</code>		

`tanh`, `tanhf`, `tanhl`

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Calculates the hyperbolic tangent.

## Syntax

```
double tanh(double x);
float tanhf(float x);
long double tanhl(long double x);
#define tanh(x) // Requires C11 or higher
```

```
float tanh(float x); // C++ only
long double tanh(long double x); // C++ only
```

### Parameters

`x`

Angle in radians.

## Return value

The `tanh` functions return the hyperbolic tangent of `x`. There's no error return.

INPUT	SEH EXCEPTION	_MATHERR EXCEPTION
$\pm \text{QNaN}, \text{IND}$	none	<code>_DOMAIN</code>

## Remarks

Because C++ allows overloading, you can call overloads of `tanh` that take and return `float` or `long double` values. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `tanh` always takes and returns `double`.

If you use the `tanh` macro from `<tgmath.h>`, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>tanh</code> , <code>tanhf</code> , <code>tanhl</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code> or <code>&lt;math.h&gt;</code>
<code>tanh</code> macro	<code>&lt;tgmath.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_tanh.c
// This program displays the tangent of pi / 4
// and the hyperbolic tangent of the result.
// Compile by using: cl crt_tanh.c

#include <math.h>
#include <stdio.h>

int main(void)
{
 double pi = 3.1415926535;
 double x, y;

 x = tan(pi / 4);
 y = tanh(x);
 printf("tan(%f) = %f\n", pi/4, x);
 printf("tanh(%f) = %f\n", x, y);
}
```

```
tan(0.785398) = 1.000000
tanh(1.000000) = 0.761594
```

## See also

### Math and floating-point support

<a href="#">acosh</a>	<a href="#">acoshf</a>	<a href="#">acoshl</a>
<a href="#">asinh</a>	<a href="#">asinhf</a>	<a href="#">asinhl</a>
<a href="#">atanh</a>	<a href="#">atanhf</a>	<a href="#">atanhl</a>
<a href="#">cosh</a>	<a href="#">coshf</a>	<a href="#">coshl</a>
<a href="#">sinh</a>	<a href="#">sinhf</a>	<a href="#">sinhl</a>

# tell

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The Microsoft-specific function name `tell` is a deprecated alias for the `_tell` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_tell` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# `_tell`, `_telli64`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Get the position of the file pointer.

## Syntax

```
long _tell(
 int handle
);
__int64 _telli64(
 int handle
);
```

### Parameters

`handle`

File descriptor referring to open file.

## Return value

The current position of the file pointer. On devices incapable of seeking, the return value is undefined.

A return value of -1L indicates an error. If `handle` is an invalid file descriptor, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EBADF` and return -1L.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_tell` function gets the current position of the file pointer (if any) associated with the `handle` argument. The position is expressed as the number of bytes from the beginning of the file. For the `_telli64` function, this value is expressed as a 64-bit integer.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_tell</code> , <code>_telli64</code>	<code>&lt;io.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_tell.c
// This program uses _tell to tell the
// file pointer position after a file read.
//

#include <io.h>
#include <stdio.h>
#include <fcntl.h>
#include <share.h>
#include <string.h>

int main(void)
{
 int fh;
 char buffer[500];

 if (_open_s(&fh, "crt_tell.txt", _O_RDONLY, _SH_DENYNO, 0))
 {
 char buff[50];
 _strerror_s(buff, sizeof(buff), NULL);
 printf(buff);
 exit(-1);
 }

 if(_read(fh, buffer, 500) > 0)
 printf("Current file position is: %d\n", _tell(fh));
 _close(fh);
}
```

### Input: crt\_tell.txt

```
Line one.
Line two.
```

### Output

```
Current file position is: 20
```

## See also

### Low-level I/O

<a href="#">ftell</a>	<a href="#">_ftelli64</a>
<a href="#">_lseek</a>	<a href="#">_lseeki64</a>

The Microsoft-implemented POSIX function name `tempnam` is a deprecated alias for the `_tempnam` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_tempnam` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

`_tempnam`, `_wtempnam`, `tmpnam`, `_wtmpnam`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Generate names you can use to create temporary files. More secure versions of some of these functions are available; see [`tmpnam\_s`](#), [`\_wtmpnam\_s`](#).

## Syntax

```
char *_tempnam(
 const char *dir,
 const char *prefix
);
wchar_t *_wtempnam(
 const wchar_t *dir,
 const wchar_t *prefix
);
char *tmpnam(
 char *str
);
wchar_t *_wtmpnam(
 wchar_t *str
);
```

### Parameters

`prefix`

The string that's prepended to names returned by `_tempnam`.

`dir`

The path used in the file name if there's no TMP environment variable, or if TMP isn't a valid directory.

`str`

Pointer that holds the generated name, identical to the name returned by the function. It's a convenient way to save the generated name.

## Return value

Each of these functions returns a pointer to the name generated or `NULL` if there's a failure. Failure can occur if you attempt more than `TMP_MAX` (see STDIO.H) calls with `tmpnam` or if you use `_tempnam` and there's an invalid directory name specified in the `TMP` environment variable and in the `dir` parameter.

### NOTE

The pointers returned by `tmpnam` and `_wtmpnam` point to internal static buffers. `free` should not be called to deallocate those pointers. `free` needs to be called for pointers allocated by `_tempnam` and `_wtempnam`.

## Remarks

Each of these functions returns the name of a file that doesn't currently exist. `tmpnam` returns a name that's unique in the designated Windows temporary directory returned by `GetTempPathW`. `_tempnam` generates a unique name in a directory other than the designated one. When a file name is prepended with a backslash and no path information, such as `\fname21`, it indicates that the name is valid for the current working directory.

For `_tmpnam`, you can store this generated file name in `str`. If `str` is `NULL`, then `_tmpnam` leaves the result in an internal static buffer. Thus any subsequent calls destroy this value. The name generated by `_tmpnam` consists of a program-generated file name and, after the first call to `_tmpnam`, a file extension of sequential numbers in base 32 (.1..vvu, when `TMP_MAX` in STDIO.H is 32,767).

`_tempnam` generates a unique file name for a directory chosen by the following rules:

- If the TMP environment variable is defined and set to a valid directory name, unique file names are generated for the directory specified by TMP.
- If the TMP environment variable isn't defined or if it's set to the name of a directory that doesn't exist, `_tempnam` uses the `dir` parameter as the path for which it generates unique names.
- If the TMP environment variable isn't defined or if it's set to the name of a directory that doesn't exist, and if `dir` is either `NULL` or set to the name of a directory that doesn't exist, `_tempnam` uses the current working directory to generate unique names. Currently, if both TMP and `dir` specify names of directories that don't exist, the `_tempnam` function call fails.

The name returned by `_tempnam` is a concatenation of `prefix` and a sequential number, which combine to create a unique file name for the specified directory. `_tempnam` generates file names that have no extension. `_tempnam` uses `malloc` to allocate space for the filename; the program is responsible for freeing this space when it's no longer needed.

`_tempnam` and `tmpnam` automatically handle multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the OEM code page obtained from the operating system.

`_wtempnam` is a wide-character version of `_tempnam`; the arguments and return value of `_wtempnam` are wide-character strings. `_wtempnam` and `_tempnam` behave identically except that `_wtempnam` doesn't handle multibyte-character strings. `_wttmpnam` is a wide-character version of `tmpnam`; the argument and return value of `_wttmpnam` are wide-character strings. `_wttmpnam` and `tmpnam` behave identically except that `_wttmpnam` doesn't handle multibyte-character strings.

If `_DEBUG` and `_CRTDBG_MAP_ALLOC` are defined, `_tempnam` and `_wtempnam` are replaced by calls to `_tempnam_dbg` and `_wtempnam_dbg`.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ttmpnam</code>	<code>tmpnam</code>	<code>tmpnam</code>	<code>_wttmpnam</code>
<code>_ttempnam</code>	<code>_tempnam</code>	<code>_tempnam</code>	<code>_wtempnam</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_tempnam</code>	<code>&lt;stdio.h&gt;</code>
<code>_wtempnam</code> , <code>_wttmpnam</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>
<code>tmpnam</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_tempnam.c
// compile with: /W3
// This program uses tmpnam to create a unique filename in the
// temporary directory, and _tempnam to create a unique filename
// in C:\\tmp.

#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 char * name1 = NULL;
 char * name2 = NULL;
 char * name3 = NULL;

 // Create a temporary filename for the current working directory:
 if ((name1 = tmpnam(NULL)) != NULL) { // C4996
 // Note: tmpnam is deprecated; consider using tmpnam_s instead
 printf("%s is safe to use as a temporary file.\n", name1);
 } else {
 printf("Cannot create a unique filename\n");
 }

 // Create a temporary filename in temporary directory with the
 // prefix "stq". The actual destination directory may vary
 // depending on the state of the TMP environment variable and
 // the global variable P_tmpdir.

 if ((name2 = _tempnam("c:\\\\tmp", "stq")) != NULL) {
 printf("%s is safe to use as a temporary file.\n", name2);
 } else {
 printf("Cannot create a unique filename\n");
 }

 // When name2 is no longer needed:
 if (name2) {
 free(name2);
 }

 // Unset TMP environment variable, then create a temporary filename in C:\\tmp.
 if (_putenv("TMP=") != 0) {
 printf("Could not remove TMP environment variable.\n");
 }

 // With TMP unset, we'll use C:\\tmp as the temporary directory.
 // Create a temporary filename in C:\\tmp with prefix "stq".
 if ((name3 = _tempnam("c:\\\\tmp", "stq")) != NULL) {
 printf("%s is safe to use as a temporary file.\n", name3);
 } else {
 printf("Cannot create a unique filename\n");
 }

 // When name3 is no longer needed:
 if (name3) {
 free(name3);
 }

 return 0;
}
```

```
C:\Users\LocalUser\AppData\Local\Temp\sriw.0 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\stq2 is safe to use as a temporary file.
c:\tmp\stq3 is safe to use as a temporary file.
```

## See also

### Stream I/O

[\\_getmbcp](#)

[malloc](#)

[\\_setmbcp](#)

[tmpfile](#)

[tmpfile\\_s](#)

`_tempnam_dbg`, `_wtempnam_dbg`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Function versions of `_tempnam`, `_wtempnam`, `tmpnam`, `wtmpnam` that use the debug version of `malloc`, `malloc_dbg`.

## Syntax

```
char *_tempnam_dbg(
 const char *dir,
 const char *prefix,
 int blockType,
 const char *filename,
 int linenumber
);
wchar_t *_wtempnam_dbg(
 const wchar_t *dir,
 const wchar_t *prefix,
 int blockType,
 const char *filename,
 int linenumber
);
```

### Parameters

`dir`

The path used in the file name if there's no TMP environment variable, or if TMP isn't a valid directory.

`prefix`

The string that will be pre-pended to names returned by `_tempnam`.

`blockType`

Requested type of memory block: `_CLIENT_BLOCK` or `_NORMAL_BLOCK`.

`filename`

Pointer to name of source file that requested allocation operation or `NULL`.

`linenumber`

Line number in source file where allocation operation was requested or `NULL`.

## Return value

Each function returns a pointer to the name generated or `NULL` if there's a failure. Failure can occur if there's an invalid directory name specified in the TMP environment variable and in the `dir` parameter.

### NOTE

`free` (or `free_dbg`) does need to be called for pointers allocated by `_tempnam_dbg` and `_wtempnam_dbg`.

## Remarks

The `_tempnam_dbg` and `_wtempnam_dbg` functions are identical to `_tempnam` and `_wtempnam` except that, when

`_DEBUG` is defined, these functions use the debug version of `malloc` and `malloc_dbg`, to allocate memory if `NULL` is passed as the first parameter. For more information, see [malloc\\_dbg](#).

You don't need to call these functions explicitly in most cases. Instead, you can define the flag `_CRTDBG_MAP_ALLOC`. When `_CRTDBG_MAP_ALLOC` is defined, calls to `_tempnam` and `_wtempnam` are remapped to `_tempnam_dbg` and `_wtempnam_dbg`, respectively, with the `bLockType` set to `_NORMAL_BLOCK`. Thus, you don't need to call these functions explicitly unless you want to mark the heap blocks as `_CLIENT_BLOCK`. For more information, see [Types of blocks on the debug heap](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ttempnam_dbg</code>	<code>_tempnam_dbg</code>	<code>_tempnam_dbg</code>	<code>_wtempnam_dbg</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_tempnam_dbg</code> , <code>_wtempnam_dbg</code>	<code>&lt;crtdbg.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

[\\_tempnam](#), [\\_wtempnam](#), [tmpnam](#), [\\_wtmpnam](#)

[Stream I/O](#)

[Debug versions of heap allocation functions](#)

# terminate (CRT)

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calls `abort` or a function you specify using `set_terminate`.

## Syntax

```
void terminate(void);
```

## Remarks

The `terminate` function is used with C++ exception handling and is called in the following cases:

- A matching catch handler can't be found for a thrown C++ exception.
- An exception is thrown by a destructor function during stack unwind.
- The stack is corrupted after throwing an exception.

`terminate` calls `abort` by default. You can change this default by writing your own termination function and calling `set_terminate` with the name of your function as its argument. `terminate` calls the last function given as an argument to `set_terminate`. For more information, see [Unhandled C++ Exceptions](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>terminate</code>	<code>&lt;eh.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_terminate.cpp
// compile with: /EHsc
#include <eh.h>
#include <process.h>
#include <iostream>
using namespace std;

void term_func();

int main()
{
 int i = 10, j = 0, result;
 set_terminate(term_func);
 try
 {
 if(j == 0)
 throw "Divide by zero!";
 else
 result = i/j;
 }
 catch(int)
 {
 cout << "Caught some integer exception.\n";
 }
 cout << "This should never print.\n";
}

void term_func()
{
 cout << "term_func() was called by terminate().\n";

 // ... cleanup tasks performed here

 // If this function does not exit, abort is called.

 exit(-1);
}

```

term\_func() was called by terminate().

## See also

### [Exception handling routines](#)

[abort](#)  
[\\_set\\_se\\_translator](#)  
[set\\_terminate](#)  
[set\\_unexpected](#)  
[unexpected](#)

# `tgamma`, `tgammaf`, `tgammal`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines the gamma function of the specified value.

## Syntax

```
double tgamma(
 double x
);

float tgammaf(
 float x
);

long double tgammal(
 long double x
);

#define tgamma(X) // Requires C11 or higher

float tgamma(
 float x
); //C++ only

long double tgamma(
 long double x
); //C++ only
```

## Parameters

`x`

The value to find the gamma of.

## Return value

If successful, returns the gamma of `x`.

A range error may occur if the magnitude of `x` is too large or too small for the data type. A domain error or range error may occur if `x <= 0`.

ISSUE	RETURN
<code>x = ±0</code>	<code>±INFINITY</code>
<code>x = negative integer</code>	<code>NaN</code>
<code>x = -INFINITY</code>	<code>NaN</code>
<code>x = +INFINITY</code>	<code>+INFINITY</code>
<code>x = NaN</code>	<code>NaN</code>

ISSUE	RETURN
domain error	NaN
pole error	$\pm \text{HUGE\_VAL}$ , $\pm \text{HUGE\_VALF}$ , or $\pm \text{HUGE\_VALL}$
overflow range error	$\pm \text{HUGE\_VAL}$ , $\pm \text{HUGE\_VALF}$ , or $\pm \text{HUGE\_VALL}$
underflow range error	the correct value, after rounding.

Errors are reported as specified in [\\_matherr](#).

## Remarks

Because C++ allows overloading, you can call overloads of `tgamma` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `tgamma` always takes and returns a `double`.

If you use the `<tgmath.h>` `tgamma()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

If  $x$  is a natural number, this function returns the factorial of  $(x-1)$ .

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

FUNCTION	C HEADER	C++ HEADER
<code>tgamma</code> , <code>tgammaf</code> , <code>tgammal</code>	<code>&lt;math.h&gt;</code>	<code>&lt;cmath&gt;</code>
<code>tgamma</code> macro	<code>&lt;tgmath.h&gt;</code>	

For more compatibility information, see [Compatibility](#).

## See also

[Alphabetical function reference](#)

`lgamma`, `lgammaf`, `lgammal`

`time`, `_time32`, `_time64`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Gets the system time.

## Syntax

```
time_t time(time_t *destTime);
__time32_t _time32(__time32_t *destTime);
__time64_t _time64(__time64_t *destTime);
```

### Parameters

`destTime`

Pointer to the storage location for time.

## Return value

Returns the time as seconds elapsed since midnight, January 1, 1970, or -1 if there's an error.

## Remarks

The `time` function returns the number of seconds elapsed since midnight (00:00:00), January 1, 1970, Coordinated Universal Time (UTC), according to the system clock. The return value is stored in the location given by `destTime`. This parameter may be `NULL`, in which case the return value isn't stored.

`time` is a wrapper for `_time64` and `time_t` is, by default, equivalent to `_time64_t`. If you need to force the compiler to interpret `time_t` as the old 32-bit `time_t`, you can define `_USE_32BIT_TIME_T`. We don't recommend `_USE_32BIT_TIME_T`, because your application may fail after January 18, 2038; the use of this macro isn't allowed on 64-bit platforms.

## Requirements

ROUTINE	REQUIRED C HEADER	REQUIRED C++ HEADER
<code>time</code> , <code>_time32</code> , <code>_time64</code>	<code>&lt;time.h&gt;</code>	<code>&lt;cctime&gt;</code> or <code>&lt;time.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_times.c
// compile with: /W3
// This program demonstrates these time and date functions:
// time _ftime ctime_s asctime_s
// _localtime64_s _gmtime64_s mktime _tzset
// _strftime_s _strdate_s strftime
//
// Also the global variable:
// _tzname
//
// Turn off deprecated unsafe CRT function warnings
```

```
// Turn off deprecated and/or CRT function warnings
#define _CRT_SECURE_NO_WARNINGS 1

#include <time.h>
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/timeb.h>
#include <string.h>

int main()
{
 char tmpbuf[128], timebuf[26], ampm[] = "AM";
 time_t ltime;
 struct _timeb tstruct;
 struct tm today, gmt, xmas = { 0, 0, 12, 25, 11, 93 };
 errno_t err;

 // Set time zone from TZ environment variable. If TZ is not set,
 // the operating system is queried to obtain the default value
 // for the variable.
 //
 _tzset();

 // Display operating system-style date and time.
 _strtime_s(tmpbuf, 128);
 printf("OS time:\t\t\t\t%s\n", tmpbuf);
 _strdate_s(tmpbuf, 128);
 printf("OS date:\t\t\t\t%s\n", tmpbuf);

 // Get UNIX-style time and display as number and string.
 time(<ime);
 printf("Time in seconds since UTC 1/1/70:\t%lld\n", (long long)ltime);
 err = ctime_s(timebuf, 26, <ime);
 if (err)
 {
 printf("ctime_s failed due to an invalid argument.");
 exit(1);
 }
 printf("UNIX time and date:\t\t\t%s", timebuf);

 // Display UTC.
 err = _gmtime64_s(&gmt, <ime);
 if (err)
 {
 printf("_gmtime64_s failed due to an invalid argument.");
 }
 err = asctime_s(timebuf, 26, &gmt);
 if (err)
 {
 printf("asctime_s failed due to an invalid argument.");
 exit(1);
 }
 printf("Coordinated universal time:\t\t\t%s", timebuf);

 // Convert to time structure and adjust for PM if necessary.
 err = _localtime64_s(&today, <ime);
 if (err)
 {
 printf("_localtime64_s failed due to an invalid argument.");
 exit(1);
 }
 if (today.tm_hour >= 12)
 {
 strcpy_s(ampm, sizeof(ampm), "PM");
 today.tm_hour -= 12;
 }
 if (today.tm_hour == 0) // Adjust if midnight hour.
 today.tm_hour = 12;
```

```
OS time: 13:51:23
OS date: 04/25/03
Time in seconds since UTC 1/1/70: 1051303883
UNIX time and date: Fri Apr 25 13:51:23 2003
Coordinated universal time: Fri Apr 25 20:51:23 2003
12-hour time: 01:51:23 PM
Plus milliseconds: 552
Zone difference in hours from UTC: 8
Time zone name: Pacific Standard Time
Daylight savings: YES
Christmas
```

Today is Friday, day 25 of April in the year 2003

## See also

Time management

[asctime](#) , [\\_wasctime](#)  
[asctime\\_s](#) , [\\_wasctime\\_s](#)  
[\\_ftime](#) , [\\_ftime32](#) , [\\_ftime64](#)  
[gmtime](#) , [\\_gmtime32](#) , [\\_gmtime64](#)  
[gmtime\\_s](#) , [\\_gmtime32\\_s](#) , [\\_gmtime64\\_s](#)  
[localtime](#) , [\\_localtime32](#) , [\\_localtime64](#)  
[localtime\\_s](#) , [\\_localtime32\\_s](#) , [\\_localtime64\\_s](#)  
[\\_utime](#) , [\\_utime32](#) , [\\_utime64](#) , [\\_wutime](#) , [\\_wutime32](#) , [\\_wutime64](#)

# `timespec_get`, `_ timespec32_get`, `_ timespec64_get`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the interval pointed to by the first argument to the current calendar time, based on the specified time base.

## Syntax

```
int timespec_get(
 struct timespec* const time_spec,
 int const base
);
int _ timespec32_get(
 struct _ timespec32* const time_spec,
 int const base
);
int _ timespec64_get(
 struct _ timespec64* const time_spec,
 int const base
);
```

### Parameters

`time_spec`

Pointer to a struct that is set to the time in seconds and nanoseconds since the start of the epoch.

`base`

A non-zero implementation-specific value that specifies the time base.

## Return value

The value of `base` if successful, otherwise it returns zero.

## Remarks

The `timespec_get` functions set the current time in the struct pointed to by the `time_spec` argument. All versions of this struct have two members, `tv_sec` and `tv_nsec`. The `tv_sec` value is set to the whole number of seconds and `tv_nsec` to the integral number of nanoseconds, rounded to the resolution of the system clock, since the start of the epoch specified by `base`.

### Microsoft Specific

These functions support only `TIME_UTC` as the `base` value. `TIME_UTC` sets the `time_spec` value to the number of seconds and nanoseconds since the epoch start, Midnight, January 1, 1970, Coordinated Universal Time (UTC). In a `_ timespec32`, `tv_sec` is a `_ time32_t` value. In a `_ timespec64`, `tv_sec` is a `_ time64_t` value. In a  `timespec`, `tv_sec` is a  `time_t` type, which is 32 bits or 64 bits in length depending on whether the preprocessor macro `_USE_32BIT_TIME_T` is defined. The `timespec_get` function is an inline function that calls `_ timespec32_get` if `_USE_32BIT_TIME_T` is defined; otherwise it calls `_ timespec64_get`.

### End Microsoft Specific

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

# Requirements

ROUTINE	REQUIRED HEADER
<code>timespec_get</code> , <code>_timespec32_get</code> , <code>_timespec64_get</code>	C: <time.h>, C++: <ctime> or <time.h>

For more compatibility information, see [Compatibility](#).

## See also

### Time management

<code>asctime</code> , <code>_wasctime</code>
<code>asctime_s</code> , <code>_wasctime_s</code>
<code>_ftime</code> , <code>_ftime32</code> , <code>_ftime64</code>
<code>gmtime</code> , <code>_gmtime32</code> , <code>_gmtime64</code>
<code>gmtime_s</code> , <code>_gmtime32_s</code> , <code>_gmtime64_s</code>
<code>localtime</code> , <code>_localtime32</code> , <code>_localtime64</code>
<code>localtime_s</code> , <code>_localtime32_s</code> , <code>_localtime64_s</code>
<code>time</code> , <code>_time32</code> , <code>_time64</code>
<code>_utime</code> , <code>_utime32</code> , <code>_utime64</code> , <code>_wutime</code> , <code>_wutime32</code> , <code>_wutime64</code>

# tmpfile

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates a temporary file. This function is deprecated because a more secure version is available; see [tmpfile\\_s](#).

## Syntax

```
FILE *tmpfile(void);
```

## Return value

If successful, `tmpfile` returns a stream pointer. Otherwise, it returns a `NULL` pointer.

## Remarks

The `tmpfile` function creates a temporary file and returns a pointer to that stream. The temporary file is created in the root directory. To create a temporary file in a directory other than the root, use `tmpnam` or `tempnam` with `fopen`.

If the file can't be opened, `tmpfile` returns a `NULL` pointer. This temporary file is automatically deleted when the file is closed, when the program terminates normally, or when `_rmtmp` is called, assuming that the current working directory doesn't change. The temporary file is opened in `w+b` (binary read/write) mode.

Failure can occur if you attempt more than TMP\_MAX (see STDO.H) calls with `tmpfile`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>tmpfile</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

### NOTE

This example requires administrative privileges to run on Windows Vista.

```
// crt_tmpfile.c
// compile with: /W3
// This program uses tmpfile to create a
// temporary file, then deletes this file with _rmtmp.
#include <stdio.h>

int main(void)
{
 FILE *stream;
 int i;

 // Create temporary files.
 for(i = 1; i <= 3; i++)
 {
 if((stream = tmpfile()) == NULL) // C4996
 // Note: tmpfile is deprecated; consider using tmpfile_s instead
 perror("Could not open new temporary file\n");
 else
 printf("Temporary file %d was created\n", i);
 }

 // Remove temporary files.
 printf("%d temporary files deleted\n", _rmtmp());
}
```

```
Temporary file 1 was created
Temporary file 2 was created
Temporary file 3 was created
3 temporary files deleted
```

## See also

### [Stream I/O](#)

[\\_rmtmp](#)

[\\_tempnam](#) , [\\_wtempnam](#) , [tmpnam](#) , [\\_wtmpnam](#)

# tmpfile\_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Creates a temporary file. It's a version of `tmpfile` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t tmpfile_s(
 FILE** pFilePtr
) ;
```

### Parameters

`pFilePtr`

The address of a pointer to store the address of the generated pointer to a stream.

## Return value

Returns 0 if successful, an error code on failure.

### Error conditions

<code>PFILEPTR</code>	RETURN VALUE	CONTENTS OF <code>PFILEPTR</code>
<code>NULL</code>	<code>EINVAL</code>	not changed

If the above parameter validation error occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and the return value is `EINVAL`.

## Remarks

The `tmpfile_s` function creates a temporary file and puts a pointer to that stream in the `pFilePtr` argument. The temporary file is created in the root directory. To create a temporary file in a directory other than the root, use `tmpnam_s` or `tempnam` with `fopen`.

If the file can't be opened, `tmpfile_s` writes `NULL` to the `pFilePtr` parameter. This temporary file is automatically deleted when the file is closed, when the program terminates normally, or when `_rmtemp` is called, assuming that the current working directory doesn't change. The temporary file is opened in `w+b` (binary read/write) mode.

Failure can occur if you attempt more than `TMP_MAX_S` (see `STDIO.H`) calls with `tmpfile_s`.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>tmpfile_s</code>	<code>&lt;stdio.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

### NOTE

This example may require administrative privileges to run on Windows.

```
// crt_tmpfile_s.c
// This program uses tmpfile_s to create a
// temporary file, then deletes this file with _rmtmp.
//

#include <stdio.h>

int main(void)
{
 FILE *stream;
 char tempstring[] = "String to be written";
 int i;
 errno_t err;

 // Create temporary files.
 for(i = 1; i <= 3; i++)
 {
 err = tmpfile_s(&stream);
 if(err)
 perror("Could not open new temporary file\n");
 else
 printf("Temporary file %d was created\n", i);
 }

 // Remove temporary files.
 printf("%d temporary files deleted\n", _rmtmp());
}
```

```
Temporary file 1 was created
Temporary file 2 was created
Temporary file 3 was created
3 temporary files deleted
```

## See also

[Stream I/O](#)

`_rmtmp`  
`_tempnam`, `_wtempnam`, `tmpnam`, `_wtmpnam`

# `tmpnam_s`, `_wtmpnam_s`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Generate names you can use to create temporary files. These functions are versions of `tmpnam` and `_wtmpnam` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t tmpnam_s(
 char * str,
 size_t sizeInChars
);
errno_t _wtmpnam_s(
 wchar_t *str,
 size_t sizeInChars
);
template <size_t size>
errno_t tmpnam_s(
 char (&str)[size]
); // C++ only
template <size_t size>
errno_t _wtmpnam_s(
 wchar_t (&str)[size]
); // C++ only
```

## Parameters

`str`

[out] Pointer that holds the generated name.

`sizeInChars`

[in] The size of the buffer in characters.

## Return value

Both of these functions return 0 if successful or an error number on failure.

## Error conditions

<code>STR</code>	<code>SIZEINCHARS</code>	RETURN VALUE	CONTENTS OF <code>STR</code>
<code>NULL</code>	any	<code>EINVAL</code>	not modified
not <code>NULL</code> (points to valid memory)	too short	<code>ERANGE</code>	not modified

If `str` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions set `errno` to `EINVAL` and return `EINVAL`.

## Remarks

Each of these functions returns the name of a file that doesn't currently exist. `tmpnam_s` returns a name unique in the designated Windows temporary directory returned by `GetTempPathW`. When a file name is prepended with

a backslash and no path information, such as `\fname21`, it indicates that the name is valid for the current working directory.

For `tmpnam_s`, you can store this generated file name in `str`. The maximum length of a string returned by `tmpnam_s` is `L_tmpnam_s`, defined in STDIO.H. If `str` is `NULL`, then `tmpnam_s` leaves the result in an internal static buffer. Thus any subsequent calls destroy this value. The name generated by `tmpnam_s` consists of a program-generated file name and, after the first call to `tmpnam_s`, a file extension of sequential numbers in base 32 (.1-.1vvvvv, when `TMP_MAX_S` in STDIO.H is `INT_MAX`).

`tmpnam_s` automatically handles multibyte-character string arguments as appropriate, recognizing multibyte-character sequences according to the OEM code page obtained from the operating system. `_wttmpnam_s` is a wide-character version of `tmpnam_s`; the argument and return value of `_wttmpnam_s` are wide-character strings. `_wttmpnam_s` and `tmpnam_s` behave identically except that `_wttmpnam_s` doesn't handle multibyte-character strings.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically, eliminating the need to specify a size argument. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tttmpnam_s</code>	<code>tmpnam_s</code>	<code>tmpnam_s</code>	<code>_wttmpnam_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>tmpnam_s</code>	<code>&lt;stdio.h&gt;</code>
<code>_wttmpnam_s</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_tmpnam_s.c
// This program uses tmpnam_s to create a unique filename in the
// current working directory.
//

#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 char name1[_tmpnam_s];
 errno_t err;
 int i;

 for (i = 0; i < 15; i++)
 {
 err = tmpnam_s(name1, _tmpnam_s);
 if (err)
 {
 printf("Error occurred creating unique filename.\n");
 exit(1);
 }
 else
 {
 printf("%s is safe to use as a temporary file.\n", name1);
 }
 }
}

```

```

C:\Users\LocalUser\AppData\Local\Temp\u19q8.0 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.1 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.2 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.3 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.4 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.5 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.6 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.7 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.8 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.9 is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.a is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.b is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.c is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.d is safe to use as a temporary file.
C:\Users\LocalUser\AppData\Local\Temp\u19q8.e is safe to use as a temporary file.

```

## See also

### Stream I/O

[\\_getmbcp](#)  
[malloc](#)  
[\\_setmbcp](#)  
[tmpfile\\_s](#)

# toascii , \_\_toascii

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts characters to 7-bit ASCII by truncation.

## Syntax

```
int __toascii(
 int c
);
#define toascii __toascii
```

### Parameters

c

Character to convert.

## Return value

`__toascii` converts the value of `c` to the 7-bit ASCII range and returns the result. There's no return value reserved to indicate an error.

## Remarks

The `__toascii` routine converts the given character to an ASCII character by truncating it to the low-order 7 bits. No other transformation is applied.

The `__toascii` routine is defined as a macro unless the preprocessor macro `_CTYPE_DISABLE_MACROS` is defined. For backward compatibility, `toascii` is defined as a macro only when `__STDC__` isn't defined or is defined as 0; otherwise it's undefined.

## Requirements

ROUTINE	REQUIRED HEADER
<code>toascii</code> , <code>__toascii</code>	C: <code>&lt;ctype.h&gt;</code> C++: <code>&lt;cctype&gt;</code> or <code>&lt;ctype.h&gt;</code>

The `toascii` macro is a POSIX extension, and `__toascii` is a Microsoft-specific implementation of the POSIX extension. For more compatibility information, see [Compatibility](#).

## See also

### Data conversion

`is` , `isw` routines

`to` functions

`tolower`, `_tolower`, `towlower`, `_tolower_l`,  
`_towlower_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a character to lowercase.

## Syntax

```
int tolower(
 int c
);
int _tolower(
 int c
);
int towlower(
 wint_t c
);
int _tolower_l(
 int c,
 _locale_t locale
);
int _towlower_l(
 wint_t c,
 _locale_t locale
);
```

### Parameters

`c`

Character to convert.

`Locale`

Locale to use for locale-specific translation.

## Return value

Each of these routines converts a copy of `c` to lower case if the conversion is possible, and returns the result. There's no return value reserved to indicate an error.

## Remarks

Each of these routines converts a given uppercase letter to a lowercase letter if it's possible and relevant. The case conversion of `towlower` is locale-specific. Only the characters relevant to the current locale are changed in case. The functions without the `_l` suffix use the currently set locale. The versions of these functions that have the `_l` suffix take the locale as a parameter and use that instead of the currently set locale. For more information, see [Locale](#).

In order for `_tolower` to give the expected results, `_isascii` and `isupper` must both return nonzero.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_totlower</code>	<code>tolower</code>	<code>_mbctolower</code>	<code>towlower</code>
<code>_totlower_l</code>	<code>_tolower_l</code>	<code>_mbctolower_l</code>	<code>_towlower_l</code>

#### NOTE

`_tolower_l` and `_towlower_l` have no locale dependence and are not meant to be called directly. They are provided for internal use by `_totlower_l`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>tolower</code>	<code>&lt;ctype.h&gt;</code>
<code>_tolower</code>	<code>&lt;ctype.h&gt;</code>
<code>towlower</code>	<code>&lt;ctype.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [to functions](#).

## See also

[Data conversion](#)

[is , isw routines](#)

[to functions](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`toupper`, `_toupper`, `towupper`, `_toupper_l`,  
`_towupper_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert character to uppercase.

## Syntax

```
int toupper(
 int c
);
int _toupper(
 int c
);
int towupper(
 wint_t c
);
int _toupper_l(
 int c ,
 _locale_t locale
);
int _towupper_l(
 wint_t c ,
 _locale_t locale
);
```

### Parameters

`c`

Character to convert.

`Locale`

Locale to use.

## Return value

Each of these routines converts a copy of `c`, if possible, and returns the result.

If `c` is a wide character for which `iswlower` is nonzero and there's a corresponding wide character for which `iswupper` is nonzero, `towupper` returns the corresponding wide character; otherwise, `towupper` returns `c` unchanged.

There's no return value reserved to indicate an error.

In order for `toupper` to give the expected results, `_isascii` and `islower` must both return nonzero.

## Remarks

Each of these routines converts a given lowercase letter to an uppercase letter if possible and appropriate. The case conversion of `towupper` is locale-specific. Only the characters relevant to the current locale are changed in case. The functions without the `_l` suffix use the currently set locale. The versions of these functions with the `_l` suffix take the locale as a parameter and use that instead of the currently set locale. For more information, see [Locale](#).

In order for `toupper` to give the expected results, `__isascii` and `isupper` must both return nonzero.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_totoupper</code>	<code>toupper</code>	<code>_mbctoupper</code>	<code>towupper</code>
<code>_totoupper_1</code>	<code>_toupper_1</code>	<code>_mbctoupper_1</code>	<code>_towupper_1</code>

#### NOTE

`_toupper_1` and `_towupper_1` have no locale dependence and are not meant to be called directly. They are provided for internal use by `_totoupper_1`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>toupper</code>	<code>&lt;ctype.h&gt;</code>
<code>_toupper</code>	<code>&lt;ctype.h&gt;</code>
<code>towupper</code>	<code>&lt;ctype.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example in [to functions](#).

## See also

[is , isw routines](#)  
[to functions](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

# towctrans

11/2/2022 • 2 minutes to read • [Edit Online](#)

Transforms a character.

## Syntax

```
wint_t towctrans(
 wint_t c,
 wctrans_t category
)
```

### Parameters

c

The character you want to transform.

category

An identifier that contains the return value of [wctrans](#).

## Return value

The character `c`, after `towctrans` used the transform rule in `category`.

## Remarks

The value of `category` must have been returned by an earlier successful call to [wctrans](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>towctrans</code>	<wctype.h>

For more compatibility information, see [Compatibility](#).

## Example

See [wctrans](#) for a sample that uses `towctrans`.

## See also

[Data conversion](#)

# `trunc`, `truncf`, `truncl`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines the nearest integer that is less than or equal to the specified floating-point value.

## Syntax

```
double trunc(double x);
long double truncl(long double x);
#define trunc(X) // Requires C11 or higher

long double trunc(long double x); //C++ only
float trunc(float x); //C++ only
```

## Parameters

`x`

The value to truncate.

## Return value

If successful, the functions return an integer value of `x`, rounded towards zero.

Otherwise, the functions may return one of the following values:

ISSUE	RETURN
<code>x</code> = ±INFINITY	<code>x</code>
<code>x</code> = ±0	<code>x</code>
<code>x</code> = NaN	NaN

Errors are reported as specified in [\\_matherr](#).

## Remarks

Because C++ allows overloading, you can call overloads of `trunc` that take and return `float` and `long double` types. In a C program, unless you're using the `<tgmath.h>` macro to call this function, `trunc` always takes and returns a `double`.

If you use the `<tgmath.h>` `trunc()` macro, the type of the argument determines which version of the function is selected. See [Type-generic math](#) for details.

Because the largest floating-point values are exact integers, this function won't overflow on its own. However, you may cause the function to overflow by returning a value into an integer type.

You can also round down by implicitly converting from floating-point to integral; however, doing so is limited to the values that can be stored in the target type.

## Requirements

FUNCTION	C HEADER	C++ HEADER
<code>trunc</code> , <code>truncf</code> , <code>truncl</code>	<math.h>	<cmath>
<code>trunc</code> macro	<tgmath.h>	

For more compatibility information, see [Compatibility](#).

## See also

[Alphabetical function reference](#)

<code>floor</code> , <code>floorf</code> , <code>floorl</code>
<code>ceil</code> , <code>ceilf</code> , <code>ceill</code>
<code>round</code> , <code>roundf</code> , <code>roundl</code>

# `tzset`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `tzset` is a deprecated alias for the `_tzset` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_tzset` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

# \_tzset

11/2/2022 • 3 minutes to read • [Edit Online](#)

Sets time environment variables.

## IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
void _tzset(void);
```

## Remarks

The `_tzset` function uses the current setting of the environment variable `TZ` to assign values to three global variables: `_daylight`, `_timezone`, and `_tzname`. These variables are used by the `_ftime` and `localtime` functions to make corrections from coordinated universal time (UTC) to local time, and by the `time` function to compute UTC from system time. Use the following syntax to set the `TZ` environment variable:

```
set TZ= tzn [+ | -] hh [: mm [: ss]][dzn]
```

`tzn`

Three-letter time-zone name, such as PST. You must specify the correct offset from local time to UTC.

`hh`

Difference in hours between UTC and local time. Sign (+) optional for positive values.

`mm`

Minutes. Separated from `hh` by a colon (:).

`ss`

Seconds. Separated from `mm` by a colon (:).

`dzn`

Three-letter daylight-saving-time zone such as PDT. If daylight saving time is never in effect in the locality, set `TZ` without a value for `dzn`. The C run-time library assumes the United States' rules for implementing the calculation of daylight saving time (DST).

## NOTE

Take care in computing the sign of the time difference. Because the time difference is the offset from local time to UTC (rather than the reverse), its sign may be the opposite of what you might intuitively expect. For time zones ahead of UTC, the time difference is negative; for those behind UTC, the difference is positive.

For example, to set the `TZ` environment variable to correspond to the current time zone in Germany, enter this command on the command line:

```
set TZ=GST-1GDT
```

This command uses GST to indicate German standard time. It assumes that UTC is one hour behind Germany (or in other words, that Germany is one hour ahead of UTC). And, it assumes that Germany observes daylight-saving time.

If the `TZ` value isn't set, `_tzset` attempts to use the time zone information specified by the operating system. In the Windows operating system, this information is specified in the Date/Time application in Control Panel. If `_tzset` can't obtain this information, it uses PST8PDT by default, which signifies the Pacific Time zone.

Based on the `TZ` environment variable value, the following values are assigned to the global variables `_daylight`, `_timezone`, and `_tzname` when `_tzset` is called:

GLOBAL VARIABLE	DESCRIPTION	DEFAULT VALUE
<code>_daylight</code>	Nonzero value if a daylight-saving-time zone is specified in <code>TZ</code> setting; otherwise, 0.	1
<code>_timezone</code>	Difference in seconds between local time and UTC.	28800 (28,800 seconds equals 8 hours)
<code>_tzname[0]</code>	String value of time-zone name from <code>TZ</code> environmental variable; empty if <code>TZ</code> hasn't been set.	PST
<code>_tzname[1]</code>	String value of daylight-saving-time zone; empty if daylight-saving-time zone is omitted from <code>TZ</code> environmental variable.	PDT

The default values shown in the preceding table for `_daylight` and the `_tzname` array correspond to "PST8PDT." If the DST zone is omitted from the `TZ` environmental variable, the value of `_daylight` is 0 and the `_ftime`, `gmtime`, and `localtime` functions return 0 for their DST flags.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_tzset</code>	<time.h>

The `_tzset` function is Microsoft-specific. For more information, see [Compatibility](#).

## Example

```
// crt_tzset.cpp
// This program uses _tzset to set the global variables
// named _daylight, _timezone, and _tzname. Since TZ is
// not being explicitly set, it uses the system time.

#include <time.h>
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
 _tzset();
 int daylight;
 _get_daylight(&daylight);
 printf("_daylight = %d\n", daylight);
 long timezone;
 _get_timezone(&timezone);
 printf("_timezone = %ld\n", timezone);
 size_t s;
 char tzname[100];
 _get_tzname(&s, tzname, sizeof(tzname), 0);
 printf("_tzname[0] = %s\n", tzname);
 exit(0);
}
```

```
_daylight = 1
_timezone = 28800
_tzname[0] = Pacific Standard Time
```

## See also

### Time management

[asctime](#), [\\_wasctime](#)  
[\\_ftime](#), [\\_ftime32](#), [\\_ftime64](#)  
[gmtime](#), [\\_gmtime32](#), [\\_gmtime64](#)  
[localtime](#), [\\_localtime32](#), [\\_localtime64](#)  
[time](#), [\\_time32](#), [\\_time64](#)  
[\\_utime](#), [\\_utime32](#), [\\_utime64](#), [\\_wutime](#), [\\_wutime32](#), [\\_wutime64](#)

The Microsoft-implemented POSIX function name `umask` is a deprecated alias for the `_umask` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_umask` or security-enhanced `_umask_s` function instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# \_umask

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the default file-permission mask. For a more secure version of this function, see [\\_umask\\_s](#).

## Syntax

```
int _umask(int pmode);
```

### Parameters

*pmode*

Default permission setting.

## Return value

`_umask` returns the previous value of `pmode`. There's no error return.

## Remarks

The `_umask` function sets the file-permission mask of the current process to the mode specified by `pmode`. The file-permission mask modifies the permission setting of new files created by `_creat`, `_open`, or `_sopen`. If a bit in the mask is 1, the corresponding bit in the file's requested permission value is set to 0 (disallowed). If a bit in the mask is 0, the corresponding bit is left unchanged. The permission setting for a new file isn't set until the file is closed for the first time.

The integer expression `pmode` contains one or both of the following manifest constants, defined in `SYS\STAT.H`:

<code>PMODE</code>	DESCRIPTION
<code>_S_IWRITE</code>	Writing permitted.
<code>_S_IREAD</code>	Reading permitted.
<code>_S_IREAD   _S_IWRITE</code>	Reading and writing permitted.

When both constants are given, they're joined with the bitwise-OR operator (`|`). If the `pmode` argument is `_S_IREAD`, reading isn't allowed (the file is write-only). If the `pmode` argument is `_S_IWRITE`, writing isn't allowed (the file is read-only). For example, if the write bit is set in the mask, any new files will be read-only. In MS-DOS and the Windows operating systems, all files are readable; it isn't possible to give write-only permission. Therefore, setting the read bit with `_umask` has no effect on the file's modes.

If `pmode` isn't a combination of one of the manifest constants or incorporates an alternate set of constants, the function ignores them.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

## Requirements

FUNCTION	REQUIRED HEADER
<code>_umask</code>	<code>&lt;io.h&gt;</code> , <code>&lt;sys/stat.h&gt;</code> , <code>&lt;sys/types.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Libraries

All versions of the [C run-time libraries](#).

## Example

```
// crt_umask.c
// compile with: /W3
// This program uses _umask to set
// the file-permission mask so that all future
// files will be created as read-only files.
// It also displays the old mask.
#include <sys/stat.h>
#include <sys/types.h>
#include <io.h>
#include <stdio.h>

int main(void)
{
 int oldmask;

 /* Create read-only files: */
 oldmask = _umask(_S_IWRITE); // C4996
 // Note: _umask is deprecated; consider using _umask_s instead
 printf("Oldmask = 0x%.4x\n", oldmask);
}
```

```
Oldmask = 0x0000
```

## See also

[File handling](#)

[Low-level I/O](#)

<a href="#">_chmod</a>	<a href="#">_wchmod</a>
<a href="#">_creat</a>	<a href="#">_wcreat</a>
<a href="#">_mkdir</a>	<a href="#">_wmkdir</a>
<a href="#">_open</a>	<a href="#">_wopen</a>

# \_umask\_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Sets the default file-permission mask. A version of `_umask` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t _umask_s(
 int mode,
 int* pOldMode
) ;
```

### Parameters

`mode`

Default permission setting.

`pOldMode`

The previous value of the permission setting.

## Return value

Returns an error code if `mode` doesn't specify a valid mode or the `pOldMode` pointer is `NULL`.

### Error conditions

MODE	POLDMODE	RETURN VALUE	CONTENTS OF POLDMODE
any	NULL	EINVAL	not modified
invalid mode	any	EINVAL	not modified

If one of the above conditions occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `_umask_s` returns `EINVAL` and sets `errno` to `EINVAL`.

## Remarks

The `_umask_s` function sets the file-permission mask of the current process to the mode specified by `mode`. The file-permission mask modifies the permission setting of new files created by `_creat`, `_open`, or `_sopen`. If a bit in the mask is 1, the corresponding bit in the file's requested permission value is set to 0 (disallowed). If a bit in the mask is 0, the corresponding bit is left unchanged. The permission setting for a new file isn't set until the file is closed for the first time.

The integer expression `mode` contains one or both of the following manifest constants, defined in `SYS\STAT.H`:

MODE	DESCRIPTION
<code>_S_IWRITE</code>	Writing permitted.

MODE	DESCRIPTION
<code>_S_IREAD</code>	Reading permitted.
<code>_S_IREAD   _S_IWRITE</code>	Reading and writing permitted.

When both constants are given, they're joined with the bitwise-OR operator (`|`). If the `mode` argument is `_S_IREAD`, reading isn't allowed (the file is write-only). If the `mode` argument is `_S_IWRITE`, writing isn't allowed (the file is read-only). For example, if the write bit is set in the mask, any new files will be read-only. In MS-DOS and the Windows operating systems, all files are readable; it isn't possible to give write-only permission. Therefore, setting the read bit with `_umask_s` has no effect on the file's modes.

If `mode` isn't a combination of one of the manifest constants or incorporates an alternate set of constants, the function ignores them.

By default, this function's global state is scoped to the application. To change it, see [Global state in the CRT](#).

## Requirements

FUNCTION	REQUIRED HEADER
<code>_umask_s</code>	<code>&lt;io.h&gt;</code> and <code>&lt;sys/stat.h&gt;</code> and <code>&lt;sys/types.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_umask_s.c
/* This program uses _umask_s to set
 * the file-permission mask so that all future
 * files will be created as read-only files.
 * It also displays the old mask.
 */

#include <sys/stat.h>
#include <sys/types.h>
#include <io.h>
#include <stdio.h>

int main(void)
{
 int oldmask, err;

 /* Create read-only files: */
 err = _umask_s(_S_IWRITE, &oldmask);
 if (err)
 {
 printf("Error setting the umask.\n");
 exit(1);
 }
 printf("Oldmask = 0x%.4x\n", oldmask);
}
```

```
Oldmask = 0x0000
```

## See also

[File handling](#)

[Low-level I/O](#)

<a href="#">_chmod</a>	<a href="#">_wchmod</a>
<a href="#">_creat</a>	<a href="#">_wcreat</a>
<a href="#">_mkdir</a>	<a href="#">_wmkdir</a>
<a href="#">_open</a>	<a href="#">_wopen</a>
<a href="#">_umask</a>	

## `__uncaught_exception`

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Indicates whether one or more exceptions have been thrown, but haven't yet been handled by the corresponding `catch` block of a `try-catch` statement.

### Syntax

```
bool __uncaught_exception();
```

### Return value

`true` from the time an exception is thrown in a `try` block until the matching `catch` block is initialized; otherwise, `false`.

### Remarks

### Requirements

ROUTINE	REQUIRED HEADER
<code>__uncaught_exception</code>	<code>&lt;eh.h&gt;</code>

### See also

[try, throw, and catch Statements \(C++\)](#)

# unexpected (CRT)

11/2/2022 • 2 minutes to read • [Edit Online](#)

Calls `terminate` or the function you specify by using `set_unexpected`.

## Syntax

```
void unexpected(void);
```

## Remarks

The `unexpected` routine isn't used with the current implementation of C++ exception handling. `unexpected` calls `terminate` by default. You can change this default behavior by writing a custom termination function. Call `set_unexpected` with the name of your function as its argument. `unexpected` calls the last function passed to `set_unexpected`.

## Requirements

ROUTINE	REQUIRED HEADER
<code>unexpected</code>	<code>&lt;eh.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### Exception handling routines

`abort`  
`_set_se_translator`  
`set_terminate`  
`set_unexpected`  
`terminate`

# `ungetc`, `ungetwc`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Pushes a character back onto the stream.

## Syntax

```
int ungetc(
 int c,
 FILE *stream
);
wint_t ungetwc(
 wint_t c,
 FILE *stream
);
```

### Parameters

`c`

Character to be pushed.

`stream`

Pointer to `FILE` structure.

## Return value

If successful, each of these functions returns the character argument `c`. If `c` can't be pushed back or if no character has been read, the input stream is unchanged and `ungetc` returns `EOF`; `ungetwc` returns `WEOF`. If `stream` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `EOF` or `WEOF` is returned, and `errno` is set to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `ungetc` function pushes the character `c` back onto `stream` and clears the end-of-file indicator. The stream must be open for reading. A subsequent read operation on `stream` starts with `c`. An attempt to push `EOF` onto the stream using `ungetc` is ignored.

Characters placed on the stream by `ungetc` may be erased if `fflush`, `fseek`, `fsetpos`, or `rewind` is called before the character is read from the stream. The file-position indicator will have the value it had before the characters were pushed back. The external storage corresponding to the stream is unchanged. On a successful `ungetc` call against a text stream, the file-position indicator is unspecified until all the pushed-back characters are read or discarded. On each successful `ungetc` call against a binary stream, the file-position indicator is decremented; if its value was 0 before a call, the value is undefined after the call.

Results are unpredictable if `ungetc` is called twice without a read or file-positioning operation between the two calls. After a call to `fscanf`, a call to `ungetc` may fail unless another read operation (such as `getc`) has been performed, because `fscanf` itself calls `ungetc`.

`ungetwc` is a wide-character version of `ungetc`. However, on each successful `ungetwc` call against a text or binary stream, the value of the file-position indicator is unspecified until all pushed-back characters are read or

discarded.

These functions are thread-safe and lock sensitive data during execution. For a non-locking version, see

[\\_ungetc\\_nolock](#), [\\_ungetwc\\_nolock](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_ungettc</code>	<code>ungetc</code>	<code>ungetc</code>	<code>ungetwc</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>ungetc</code>	<code>&lt;stdio.h&gt;</code>
<code>ungetwc</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## Example

```
// crt_ungetc.c
// This program first converts a character
// representation of an unsigned integer to an integer. If
// the program encounters a character that is not a digit,
// the program uses ungetc to replace it in the stream.
//

#include <stdio.h>
#include <ctype.h>

int main(void)
{
 int ch;
 int result = 0;

 // Read in and convert number:
 while(((ch = getchar()) != EOF) && isdigit(ch))
 result = result * 10 + ch - '0'; // Use digit.
 if(ch != EOF)
 ungetc(ch, stdin); // Put nondigit back.
 printf("Number = %d\nNext character in stream = '%c',
 result, getchar());
}
```

```
521aNumber = 521
Next character in stream = 'a'
```

## See also

### Stream I/O

<a href="#">getc</a>	<a href="#">getwc</a>
<a href="#">putc</a>	<a href="#">putwc</a>

## `_ungetc_nolock`, `_ungetwc_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Pushes a character back onto the stream.

## Syntax

```
int _ungetc_nolock(
 int c,
 FILE *stream
);
wint_t _ungetwc_nolock(
 wint_t c,
 FILE *stream
);
```

### Parameters

`c`

Character to be pushed.

`stream`

Pointer to `FILE` structure.

## Return value

If successful, each of these functions returns the character argument `c`. If `c` can't be pushed back or if no character has been read, the input stream is unchanged and `_ungetc_nolock` returns `EOF`; `_ungetwc_nolock` returns `WEOF`. If `stream` is `NULL`, `EOF` or `WEOF` is returned, and `errno` is set to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

These functions are non-locking versions of `ungetc` and `ungetwc`. The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads. They may be faster since they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_ungettc_nolock</code>	<code>_ungetc_nolock</code>	<code>_ungetc_nolock</code>	<code>_ungetwc_nolock</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_ungetc_nolock</code>	<code>&lt;stdio.h&gt;</code>
<code>_ungetwc_nolock</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

[getc](#) , [getwc](#)  
[putc](#) , [putwc](#)

The Microsoft-specific function name `ungetch` is a deprecated alias for the `_ungetch` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_ungetch` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

**IMPORTANT**

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

`_ungetch`, `_ungetwch`, `_ungetch_nolock`,  
`_ungetwch_nolock`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Pushes back the last character that's read from the console.

#### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _ungetch(
 int c
);
wint_t _ungetwch(
 wint_t c
);
int _ungetch_nolock(
 int c
);
wint_t _ungetwch_nolock(
 wint_t c
);
```

#### Parameters

`c`

Character to be pushed.

## Return value

Both functions return the character `c` if successful. If there's an error, `_ungetch` returns a value of `EOF` and `_ungetwch` returns `WEOF`.

## Remarks

These functions push the character `c` back to the console, causing `c` to be the next character read by `_getch` or `_getche` (or `_getwch` or `_getwche`). `_ungetch` and `_ungetwch` fail if they're called more than once before the next read. The `c` argument may not be `EOF` (or `WEOF`).

The versions with the `_nolock` suffix are identical except that they aren't protected from interference by other threads. They may be faster since they don't incur the overhead of locking out other threads. Use these functions only in thread-safe contexts such as single-threaded applications or where the calling scope already handles thread isolation.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_ungettch</code>	<code>_ungetch</code>	<code>_ungetch</code>	<code>_ungetwch</code>
<code>_ungettch_nolock</code>	<code>_ungetch_nolock</code>	<code>_ungetch_nolock</code>	<code>_ungetwch_nolock</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_ungetch</code> , <code>_ungetch_nolock</code>	<code>&lt;conio.h&gt;</code>
<code>_ungetwch</code> , <code>_ungetwch_nolock</code>	<code>&lt;conio.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_ungetch.c
// compile with: /c
// In this program, a white-space delimited
// token is read from the keyboard. When the program
// encounters a delimiter, it uses _ungetch to replace
// the character in the keyboard buffer.
//

#include <conio.h>
#include <ctype.h>
#include <stdio.h>

int main(void)
{
 char buffer[100];
 int count = 0;
 int ch;

 ch = _getche();
 while(isspace(ch)) // Skip preceding white space.
 ch = _getche();
 while(count < 99) // Gather token.
 {
 if(isspace(ch)) // End of token.
 break;
 buffer[count++] = (char)ch;
 ch = _getche();
 }
 _ungetch(ch); // Put back delimiter.
 buffer[count] = '\0'; // Null terminate the token.
 printf("\ntoken = %s\n", buffer);
}
```

Whitetoken = White

## See also

## Console and port I/O

[\\_cscanf](#) , [\\_cscanf\\_1](#) , [\\_cwscanf](#) , [\\_cwscanf\\_1](#)  
[\\_getch](#) , [\\_getwch](#)

# unlink

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `unlink` is a deprecated alias for the `_unlink` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_unlink` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# `_unlink`, `_wunlink`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Delete a file.

## Syntax

```
int _unlink(
 const char *filename
);
int _wunlink(
 const wchar_t *filename
);
```

### Parameters

`filename`

Name of file to remove.

## Return value

Each of these functions returns 0 if successful. Otherwise, the function returns -1 and sets `errno` to `EACCES`, which means the path specifies a read-only file or a directory, or to `ENOENT`, which means the file or path isn't found.

For more information about return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `_unlink` function deletes the file specified by `filename`. `_wunlink` is a wide-character version of `_unlink`; the `filename` argument to `_wunlink` is a wide-character string. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tunlink</code>	<code>_unlink</code>	<code>_unlink</code>	<code>_wunlink</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_unlink</code>	<code>&lt;iostream.h&gt;</code> and <code>&lt;stdio.h&gt;</code>
<code>_wunlink</code>	<code>&lt;iostream.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Code example

This program uses \_unlink to delete CRT\_UNLINK.TXT.

```
// crt_unlink.c

#include <stdio.h>

int main(void)
{
 if(_unlink("crt_unlink.txt") == -1)
 perror("Could not delete 'CRT_UNLINK.TXT'");
 else
 printf("Deleted 'CRT_UNLINK.TXT'\n");
}
```

### Input: crt\_unlink.txt

This file will be deleted.

### Sample output

Deleted 'CRT\_UNLINK.TXT'

## See also

### File handling

[\\_close](#)

[remove](#) , [\\_wremove](#)

# \_unlock\_file

11/2/2022 • 2 minutes to read • [Edit Online](#)

Unlocks a file, allowing other processes to access the file.

## Syntax

```
void _unlock_file(
 FILE* file
)
```

### Parameters

*file*

File handle.

## Remarks

The `_unlock_file` function unlocks the file specified by *file*. Unlocking a file allows access to the file by other processes. This function shouldn't be called unless `_lock_file` was previously called on the *file* pointer. Calling `_unlock_file` on a file that isn't locked may result in a deadlock. For an example, see [\\_lock\\_file](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_unlock_file</code>	<stdio.h>

For more compatibility information, see [Compatibility](#).

## See also

### File handling

[\\_creat](#) , [\\_wcreat](#)  
[\\_open](#) , [\\_wopen](#)  
[\\_lock\\_file](#)

`_utime`, `_utime32`, `_utime64`, `_wutime`,  
`_wutime32`, `_wutime64`

11/2/2022 • 4 minutes to read • [Edit Online](#)

Set the file modification time.

## Syntax

```
int _utime(
 const char *filename,
 struct _utimbuf *times
);
int _utime32(
 const char *filename,
 struct __utimbuf32 *times
);
int _utime64(
 const char *filename,
 struct __utimbuf64 *times
);
int _wutime(
 const wchar_t *filename,
 struct _utimbuf *times
);
int _wutime32(
 const wchar_t *filename,
 struct __utimbuf32 *times
);
int _wutime64(
 const wchar_t *filename,
 struct __utimbuf64 *times
);
```

### Parameters

`filename`

Pointer to a string that contains the path or filename.

`times`

Pointer to stored time values.

## Return value

Each of these functions returns 0 if the file-modification time was changed. A return value of -1 indicates an error. If an invalid parameter is passed, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1, and `errno` is set to one of the following values:

ERRNO VALUE	CONDITION
<code>EACCES</code>	Path specifies directory or read-only file
<code>EINVAL</code>	Invalid <code>times</code> argument

ERRNO	VALUE	CONDITION
EMFILE		Too many open files (the file must be opened to change its modification time)
ENOENT		Path or filename not found

For more information about return codes, see [errno](#), [\\_doserrno](#), [\\_sys\\_errlist](#), and [\\_sys\\_nerr](#).

The date can be changed for a file if the change date is after midnight, January 1, 1970, and before the end date of the function used. `_utime` and `_wutime` use a 64-bit time value, so the end date is 23:59:59, December 31, 3000, UTC. If `_USE_32BIT_TIME_T` is defined to force the old behavior, the end date is 23:59:59 January 18, 2038, UTC. `_utime32` or `_wutime32` use a 32-bit time type regardless of whether `_USE_32BIT_TIME_T` is defined, and always have the earlier end date. `_utime64` or `_wutime64` always use the 64-bit time type, so these functions always support the later end date.

## Remarks

The `_utime` function sets the modification time for the file specified by `filename`. The process must have write access to the file in order to change the time. In the Windows operating system, you can change the access time and the modification time in the `_utimbuf` structure. If `times` is a `NULL` pointer, the modification time is set to the current local time. Otherwise, `times` must point to a structure of type `_utimbuf`, defined in SYS\UTIME.H.

The `_utimbuf` structure stores file access and modification times used by `_utime` to change file-modification dates. The structure has the following fields, which are both of type `time_t`:

FIELD	DESCRIPTION
<code>actime</code>	Time of file access
<code>modtime</code>	Time of file modification

Specific versions of the `_utimbuf` structure (`_utimebuf32` and `_utimebuf64`) are defined using the 32-bit and 64-bit versions of the time type. These structures are used in the 32-bit and 64-bit specific versions of this function. `_utimbuf` itself by default uses a 64-bit time type unless `_USE_32BIT_TIME_T` is defined.

`_utime` is identical to `_futime` except that the `filename` argument of `_utime` is a filename or a path to a file, rather than a file descriptor of an open file.

`_wutime` is a wide-character version of `_utime`; the `filename` argument to `_wutime` is a wide-character string. These functions behave identically otherwise.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tutime</code>	<code>_utime</code>	<code>_utime</code>	<code>_wutime</code>
<code>_tutime32</code>	<code>_utime32</code>	<code>_utime32</code>	<code>_wutime32</code>

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_tutime64</code>	<code>_utime64</code>	<code>_utime64</code>	<code>_wutime64</code>

## Requirements

ROUTINE	REQUIRED HEADERS	OPTIONAL HEADERS
<code>_utime</code> , <code>_utime32</code> , <code>_utime64</code>	<code>&lt;sys/utime.h&gt;</code>	<code>&lt;errno.h&gt;</code>
<code>_utime64</code>	<code>&lt;sys/utime.h&gt;</code>	<code>&lt;errno.h&gt;</code>
<code>_wutime</code>	<code>&lt;utime.h&gt;</code> or <code>&lt;wchar.h&gt;</code>	<code>&lt;errno.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

This program uses `_utime` to set the file-modification time to the current time.

```

// crt_utime.c
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/utime.h>
#include <time.h>

int main(void)
{
 struct tm tma = {0}, tmm = {0};
 struct _utimbuf ut;

 // Fill out the accessed time structure
 tma.tm_hour = 12;
 tma.tm_isdst = 0;
 tma.tm_mday = 15;
 tma.tm_min = 0;
 tma.tm_mon = 0;
 tma.tm_sec = 0;
 tma.tm_year = 103;

 // Fill out the modified time structure
 tmm.tm_hour = 12;
 tmm.tm_isdst = 0;
 tmm.tm_mday = 15;
 tmm.tm_min = 0;
 tmm.tm_mon = 0;
 tmm.tm_sec = 0;
 tmm.tm_year = 102;

 // Convert tm to time_t
 ut.actime = mktime(&tma);
 ut.modtime = mktime(&tmm);

 // Show file time before and after
 system("dir crt_utime.c");
 if(_utime("crt_utime.c", &ut) == -1)
 perror("_utime failed\n");
 else
 printf("File time modified\n");
 system("dir crt_utime.c");
}

```

## Sample output

```

Volume in drive C has no label.
Volume Serial Number is 9CAC-DE74

Directory of C:\test

01/09/2003 05:38 PM 935 crt_utime.c
 1 File(s) 935 bytes
 0 Dir(s) 20,742,955,008 bytes free
File time modified

Volume in drive C has no label.
Volume Serial Number is 9CAC-DE74

Directory of C:\test

01/15/2002 12:00 PM 935 crt_utime.c
 1 File(s) 935 bytes
 0 Dir(s) 20,742,955,008 bytes free

```

## See also

Time management

[asctime](#), [\\_wasctime](#)  
[ctime](#), [\\_ctime32](#), [\\_ctime64](#), [\\_wctime](#), [\\_wctime32](#), [\\_wctime64](#)  
[\\_fstat](#), [\\_fstat32](#), [\\_fstat64](#), [\\_fstat64i32](#), [\\_fstat32i64](#), [\\_fstat64i32](#)  
[\\_ftime](#), [\\_ftime32](#), [\\_ftime64](#)  
[\\_futime](#), [\\_futime32](#), [\\_futime64](#)  
[gmtime](#), [\\_gmtime32](#), [\\_gmtime64](#)  
[localtime](#), [\\_localtime32](#), [\\_localtime64](#)  
[\\_stat](#), [\\_wstat](#) functions  
[time](#), [\\_time32](#), [\\_time64](#)

`va_arg`, `va_copy`, `va_end`, `va_start`

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Accesses variable-argument lists.

## Syntax

```
type va_arg(
 va_list arg_ptr,
 type
);
void va_copy(
 va_list dest,
 va_list src
); // (ISO C99 and later)
void va_end(
 va_list arg_ptr
);
void va_start(
 va_list arg_ptr,
 prev_param
); // (ANSI C89 and later)
void va_start(
 arg_ptr
); // (deprecated Pre-ANSI C89 standardization version)
```

### Parameters

`type`

Type of argument to be retrieved.

`arg_ptr`

Pointer to the list of arguments.

`dest`

Pointer to the list of arguments to be initialized from `src`

`src`

Pointer to the initialized list of arguments to copy to `dest`.

`prev_param`

Parameter that precedes the first optional argument.

## Return value

`va_arg` returns the current argument. `va_copy`, `va_start` and `va_end` don't return values.

## Remarks

The `va_arg`, `va_copy`, `va_end`, and `va_start` macros provide a portable way to access the arguments to a function when the function takes a variable number of arguments. There are two versions of the macros: The macros defined in `STDARG.H` conform to the ISO C99 standard; the macros defined in `VARARGS.H` are deprecated but are retained for backward compatibility with code that was written before the ANSI C89 standard.

These macros assume that the function takes a fixed number of required arguments, followed by a variable

number of optional arguments. The required arguments are declared as ordinary parameters to the function and can be accessed through the parameter names. The optional arguments are accessed through the macros in `STDARG.H` (or `VARARGS.H` for code that was written before the ANSI C89 standard), which sets a pointer to the first optional argument in the argument list, retrieves arguments from the list, and resets the pointer when argument processing is completed.

The C standard macros, defined in `STDARG.H`, are used as follows:

- `va_start` sets `arg_ptr` to the first optional argument in the list of arguments that's passed to the function. The argument `arg_ptr` must have the `va_list` type. The argument `prev_param` is the name of the required parameter that immediately precedes the first optional argument in the argument list. If `prev_param` is declared with the register storage class, the macro's behavior is undefined. `va_start` must be used before `va_arg` is used for the first time.
- `va_arg` retrieves a value of `type` from the location that's given by `arg_ptr`, and increments `arg_ptr` to point to the next argument in the list by using the size of `type` to determine where the next argument starts. `va_arg` can be used any number of times in the function to retrieve arguments from the list.
- `va_copy` makes a copy of a list of arguments in its current state. The `src` parameter must already be initialized with `va_start`; it may have been updated with `va_arg` calls, but must not have been reset with `va_end`. The next argument that's retrieved by `va_arg` from `dest` is the same as the next argument that's retrieved from `src`.
- After all arguments have been retrieved, `va_end` resets the pointer to `NULL`. `va_end` must be called on each argument list that's initialized with `va_start` or `va_copy` before the function returns.

#### NOTE

The macros in `VARARGS.H` are deprecated and are retained only for backwards compatibility with code that was written before the ANSI C89 standard. In all other cases, use the macros in `STDARGS.H`.

When they're compiled by using `/clr` ([Common Language Runtime Compilation](#)), programs that use these macros may generate unexpected results because of differences between native and common language runtime (CLR) type systems. Consider this program:

```

#include <stdio.h>
#include <stdarg.h>

void testit (int i, ...)
{
 va_list argptr;
 va_start(argptr, i);

 if (i == 0)
 {
 int n = va_arg(argptr, int);
 printf("%d\n", n);
 }
 else
 {
 char *s = va_arg(argptr, char*);
 printf("%s\n", s);
 }

 va_end(argptr);
}

int main()
{
 testit(0, 0xFFFFFFFF); // 1st problem: 0xffffffff is not an int
 testit(1, NULL); // 2nd problem: NULL is not a char*
}

```

Notice that `testit` expects its second parameter to be either an `int` or a `char*`. The arguments being passed are `0xffffffff` (an `unsigned int`, not an `int`) and `NULL` (actually an `int`, not a `char*`). When the program is compiled for native code, it produces this output:

```

-1
(null)

```

## Requirements

**Header:** `<stdio.h>` and `<stdarg.h>`

**Deprecated Header:** `<varargs.h>`

## Libraries

All versions of the [C run-time libraries](#).

## Example

```

// crt_va.c
// Compile with: cl /W3 /Tc crt_va.c
// The program below illustrates passing a variable
// number of arguments using the following macros:
// va_start va_arg va_copy
// va_end va_list

#include <stdio.h>
#include <stdarg.h>
#include <math.h>

double deviation(int first, ...);

int main(void)
{
 /* Call with 3 integers (-1 is used as terminator). */
 printf("Deviation is: %f\n", deviation(2, 3, 4, -1));

 /* Call with 4 integers. */
 printf("Deviation is: %f\n", deviation(5, 7, 9, 11, -1));

 /* Call with just -1 terminator. */
 printf("Deviation is: %f\n", deviation(-1));
}

/* Returns the standard deviation of a variable list of integers. */
double deviation(int first, ...)
{
 int count = 0, i = first;
 double mean = 0.0, sum = 0.0;
 va_list marker;
 va_list copy;

 va_start(marker, first); /* Initialize variable arguments. */
 va_copy(copy, marker); /* Copy list for the second pass */
 while (i != -1)
 {
 sum += i;
 count++;
 i = va_arg(marker, int);
 }
 va_end(marker); /* Reset variable argument list. */
 mean = sum ? (sum / count) : 0.0;

 i = first; /* reset to calculate deviation */
 sum = 0.0;
 while (i != -1)
 {
 sum += (i - mean)*(i - mean);
 i = va_arg(copy, int);
 }
 va_end(copy); /* Reset copy of argument list. */
 return count ? sqrt(sum / count) : 0.0;
}

```

```

Deviation is: 0.816497
Deviation is: 2.236068
Deviation is: 0.000000

```

## See also

### Argument access

[vfprintf](#), [\\_vfprintf\\_l](#), [vfwprintf](#), [\\_vfwprintf\\_l](#)

`_vcprintf`, `_vcprintf_l`, `_vcwprintf`,  
`_vcwprintf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes formatted output to the console by using a pointer to a list of arguments. More secure versions of these functions are available, see `_vcprintf_s`, `_vcprintf_s_l`, `_vcwprintf_s`, `_vcwprintf_s_l`.

#### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _vcprintf(
 const char* format,
 va_list argptr
);
int _vcprintf_l(
 const char* format,
 _locale_t locale,
 va_list argptr
);
int _vcwprintf(
 const wchar_t* format,
 va_list argptr
);
int _vcwprintf_l(
 const wchar_t* format,
 _locale_t locale,
 va_list argptr
);
```

#### Parameters

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

The number of characters written, or a negative value if an output error occurs. If `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and -1 is returned.

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to the console. `_vcwprintf` is the wide-character version of `_vprintf`. It takes a wide-character string as an argument.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#).

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vprintf</code>	<code>_vprintf</code>	<code>_vprintf</code>	<code>_vcwprintf</code>
<code>_vprintf_l</code>	<code>_vprintf_l</code>	<code>_vprintf_l</code>	<code>_vcwprintf_l</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_vprintf</code> , <code>_vprintf_l</code>	<code>&lt;conio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>_vcwprintf</code> , <code>_vcwprintf_l</code>	<code>&lt;conio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_vcprintf.cpp
// compile with: /c
#include <conio.h>
#include <stdarg.h>

// An error formatting function used to print to the console.
int eprintf(const char* format, ...)
{
 va_list args;
 va_start(args, format);
 int result = _vcprintf(format, args);
 va_end(args);
 return result;
}

int main()
{
 eprintf("(%d:%d): Error %s%d : %s\n", 10, 23, "C", 2111,
 "<some error text>");
 eprintf(" (Related to symbol '%s' defined on line %d).\n",
 "<symbol>", 5);
}
```

```
(10,23): Error C2111 : <some error text>
(Related to symbol '<symbol>' defined on line 5).
```

## See also

### Stream I/O

[vprintf](#) functions

[\\_cprintf](#), [\\_cprintf\\_l](#), [\\_cwprintf](#), [\\_cwprintf\\_l](#)  
[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)  
[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)  
[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)  
[va\\_arg](#), [va\\_copy](#), [va\\_end](#), [va\\_start](#)

`_vcprintf_p`, `_vcprintf_p_l`, `_vcwprintf_p`,  
`_vcwprintf_p_l`

11/2/2022 • 3 minutes to read • [Edit Online](#)

Writes formatted output to the console by using a pointer to a list of arguments, and supports positional parameters in the format string.

#### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _vcprintf_p(
 const char* format,
 va_list argptr
);
int _vcprintf_p_l(
 const char* format,
 _locale_t locale,
 va_list argptr
);
int _vcwprintf_p(
 const wchar_t* format,
 va_list argptr
);
int _vcwprintf_p_l(
 const wchar_t* format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`format`

The format specification.

`argptr`

A pointer to a list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax: printf and wprintf functions](#).

## Return value

The number of characters that are written, or a negative value if an output error occurs. If `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL`, and -1 is returned.

## Remarks

Each of these functions takes a pointer to an argument list, and then uses the `_putch` function to format and write the given data to the console. (`_vcwprintf_p` uses `_putwch` instead of `_putch`. `_vcwprintf_p` is the wide-character version of `_vprintf_p`. It takes a wide-character string as an argument.)

The versions of these functions that have the `_l` suffix are identical except that they use the locale parameter that's passed in instead of the current locale.

Each `argument` (if any) is converted and is output according to the corresponding format specification in `format`. The format specification supports positional parameters so that you can specify the order in which the arguments are used in the format string. For more information, see [printf\\_p Positional Parameters](#).

These functions don't translate line-feed characters on output into carriage return-line feed (CR-LF) combinations.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#).

These functions validate the input pointer and the format string. If `format` or `argument` is `NULL`, or if the format string contains invalid formatting characters, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vprintf_p</code>	<code>_vprintf_p</code>	<code>_vprintf_p</code>	<code>_vcwprintf_p</code>
<code>_vprintf_p_l</code>	<code>_vprintf_p_l</code>	<code>_vprintf_p_l</code>	<code>_vcwprintf_p_l</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_vprintf_p</code> , <code>_vprintf_p_l</code>	<conio.h> and <stdarg.h>
<code>_vcwprintf_p</code> , <code>_vcwprintf_p_l</code>	<conio.h> and <stdarg.h>

For more compatibility information, see [Compatibility](#).

## IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

## Example

```
// crt_vcprintf_p.c
// compile with: /c
#include <conio.h>
#include <stdarg.h>

// An error formatting function that's used to print to the console.
int eprintf(const char* format, ...)
{
 va_list args;
 va_start(args, format);
 int result = _vcprintf_p(format, args);
 va_end(args);
 return result;
}

int main()
{
 int n = eprintf("parameter 2 = %2$d; parameter 1 = %1$s\r\n",
 "one", 222);
 _cprintf_s("%d characters printed\r\n");
}
```

```
parameter 2 = 222; parameter 1 = one
38 characters printed
```

## See also

### Console and port I/O

`_cprintf`, `_cprintf_l`, `_cwprintf`, `_cwprintf_l`  
`va_arg`, `va_copy`, `va_end`, `va_start`

`printf_p` Positional Parameters

`_vcprintf_s`, `_vcprintf_s_l`, `_vcwprintf_s`,  
`_vcwprintf_s_l`

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Writes formatted output to the console by using a pointer to a list of arguments. These versions of `_vprintf`, `_vcprintf_1`, `_vcprintf`, `_vcwprintf`, `_vcwprintf_1` have security enhancements, as described in [Security features in the CRT](#).

#### IMPORTANT

This API cannot be used in applications that execute in the Windows Runtime. For more information, see [CRT functions not supported in Universal Windows Platform apps](#).

## Syntax

```
int _vcprintf(
 const char* format,
 va_list argptr
);
int _vcprintf(
 const char* format,
 _locale_t locale,
 va_list argptr
);
int _vcwprintf_s(
 const wchar_t* format,
 va_list argptr
);
int _vcwprintf_s_l(
 const wchar_t* format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`format`

Format specification.

`argptr`

Pointer to the list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#): `printf` and `wprintf` functions.

## Return value

The number of characters written, or a negative value if an output error occurs.

Like the less secure versions of these functions, if `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). Additionally, unlike the less secure versions of these functions, if

`format` doesn't specify a valid format, an invalid parameter exception is generated. If execution is allowed to continue, these functions return an error code and set `errno` to that error code. The default error code is `EINVAL` if a more specific value doesn't apply.

## Remarks

Each of these functions takes a pointer to an argument list, and then formats and writes the given data to the console. `_vcwprintf_s` is the wide-character version of `_vcprintf_s`. It takes a wide-character string as an argument.

The versions of these functions that have the `_1` suffix are identical except that they use the locale parameter that's passed in instead of the current locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#).

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vprintf_s</code>	<code>_vcprintf_s</code>	<code>_vcprintf_s</code>	<code>_vcwprintf_s</code>
<code>_vprintf_s_1</code>	<code>_vcprintf_s_1</code>	<code>_vcprintf_s_1</code>	<code>_vcwprintf_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_vcprintf_s</code> , <code>_vcprintf_s_1</code>	<conio.h> and <stdarg.h>	<varargs.h>*
<code>_vcwprintf_s</code> , <code>_vcwprintf_s_1</code>	<conio.h> or <wchar.h>, and <stdarg.h>	<varargs.h>*

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

### IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

## Example

```
// crt_vcprintf_s.cpp
#include <conio.h>
#include <stdarg.h>

// An error formatting function used to print to the console.
int eprintf_s(const char* format, ...)
{
 va_list args;
 va_start(args, format);
 int result = _vcprintf_s(format, args);
 va_end(args);
 return result;
}

int main()
{
 eprintf_s("(%d:%d): Error %s%d : %s\n", 10, 23, "C", 2111,
 "<some error text>");
 eprintf_s(" (Related to symbol '%s' defined on line %d).\n",
 "<symbol>", 5);
}
```

```
(10,23): Error C2111 : <some error text>
(Related to symbol '<symbol>' defined on line 5).
```

## See also

### Stream I/O

[vprintf functions](#)

[\\_cprintf](#), [\\_cprintf\\_l](#), [\\_cwprintf](#), [\\_cwprintf\\_l](#)  
[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)  
[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)  
[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)  
[va\\_arg](#), [va\\_copy](#), [va\\_end](#), [va\\_start](#)

`vfprintf`, `_vfprintf_l`, `vfwprintf`, `_vfwprintf_l`

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Write formatted output using a pointer to a list of arguments. More secure versions of these functions exist; see [`vfprintf\_s`](#), [`\_vfprintf\_s\_l`](#), [`vfwprintf\_s`](#), [`\_vfwprintf\_s\_l`](#).

## Syntax

```
int vfprintf(
 FILE *stream,
 const char *format,
 va_list argptr
);
int _vfprintf_l(
 FILE *stream,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int vfwprintf(
 FILE *stream,
 const wchar_t *format,
 va_list argptr
);
int _vfwprintf_l(
 FILE *stream,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`vfprintf` and `vfwprintf` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs. If either `stream` or `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see [`errno`](#), [`\_doserrno`](#), [`\_sys\_errlist`](#), and [`\_sys\_nerr`](#).

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to `stream`.

`vfwprintf` is the wide-character version of `vfprintf`; the two functions behave identically if the stream is opened in ANSI mode. `vfprintf` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vftprintf</code>	<code>vfprintf</code>	<code>vfprintf</code>	<code>vfwprintf</code>
<code>_vftprintf_1</code>	<code>_vfprintf_1</code>	<code>_vfprintf_1</code>	<code>_vfwprintf_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vfprintf</code> , <code>_vfprintf_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>vfwprintf</code> , <code>_vfwprintf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

`vprintf` functions

`fprintf`, `_fprintf_1`, `fwprintf`, `_fwprintf_1`

`printf`, `_printf_1`, `wprintf`, `_wprintf_1`

`sprintf`, `_sprintf_1`, `swprintf`, `_swprintf_1`, `_swprintf_1`

`va_arg`, `va_copy`, `va_end`, `va_start`

`_vfprintf_p`, `_vfprintf_p_l`, `_vfwprintf_p`,  
`_vfwprintf_p_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Write formatted output using a pointer to a list of arguments, with the ability to specify the order that arguments are used in the format string.

## Syntax

```
int _vfprintf_p(
 FILE *stream,
 const char *format,
 va_list argptr
);
int _vfprintf_p_l(
 FILE *stream,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vfwprintf_p(
 FILE *stream,
 const wchar_t *format,
 va_list argptr
);
int _vfwprintf_p_l(
 FILE *stream,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`_vfprintf_p` and `_vfwprintf_p` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs.

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to `stream`. These functions differ from the `_vfprintf_s` and `_vfwprintf_s` versions only in that they support positional parameters. For more information, see [printf\\_p Positional Parameters](#).

`_vfwprintf_p` is the wide-character version of `_vprintf_p`; the two functions behave identically if the stream is opened in ANSI mode. `_vprintf_p` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

If either `stream` or `format` is a null pointer, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vfprintf_p</code>	<code>_vfprintf_p</code>	<code>_vfprintf_p</code>	<code>_vfwprintf_p</code>
<code>_vfprintf_p_1</code>	<code>_vfprintf_p_1</code>	<code>_vfprintf_p_1</code>	<code>_vfwprintf_p_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_vfprintf_p</code> , <code>_vfprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>_vfwprintf_p</code> , <code>_vfwprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

[vprintf](#) functions

[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)

```
printf, _printf_l, wprintf, _wprintf_l
sprintf, _sprintf_l, swprintf, _swprintf_l, __swprintf_l
va_arg, va_copy, va_end, va_start
```

#### printf\_p Positional Parameters

```
_fprintf_p, _fprintf_p_l, _fwprintf_p, _fwprintf_p_l
_vsprintf_p, _vsprintf_p_l, _vswprintf_p, _vswprintf_p_l
_sprintf_p, _sprintf_p_l, _swprintf_p, _swprintf_p_l
```

`vfprintf_s`, `_vfprintf_s_l`, `vfwprintf_s`,  
`_vfwprintf_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Write formatted output using a pointer to a list of arguments. These functions are versions of `vfprintf`, `_vfprintf_l`, `vfwprintf`, `_vfwprintf_l` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
int vfprintf_s(
 FILE *stream,
 const char *format,
 va_list argptr
);
int _vfprintf_s_l(
 FILE *stream,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int vfwprintf_s(
 FILE *stream,
 const wchar_t *format,
 va_list argptr
);
int _vfwprintf_s_l(
 FILE *stream,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`vfprintf_s` and `vfwprintf_s` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs. If either `stream` or `format` is a null pointer, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to `stream`.

These functions differ from the non-secure versions only in that the secure versions check that the `format` string contains valid formatting characters.

`vfwprintf_s` is the wide-character version of `vfprintf_s`; the two functions behave identically if the stream is opened in ANSI mode. `vfprintf_s` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vfprintf_s</code>	<code>vfprintf_s</code>	<code>vfprintf_s</code>	<code>vfwprintf_s</code>
<code>_vfprintf_s_1</code>	<code>_vfprintf_s_1</code>	<code>_vfprintf_s_1</code>	<code>_vfwprintf_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vfprintf_s</code> , <code>_vfprintf_s_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>vfwprintf_s</code> , <code>_vfwprintf_s_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## See also

[Stream I/O](#)

[printf](#) functions

```
fprintf, _fprintf_l, fwprintf, _fwprintf_l
printf, _printf_l, wprintf, _wprintf_l
sprintf, _sprintf_l, swprintf, _swprintf_l, __swprintf_l
va_arg, va_copy, va_end, va_start
```

# `vfscanf`, `vfwscanf`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data from a stream. More secure versions of these functions are available; see [`vfscanf\_s`](#), [`vfwscanf\_s`](#).

## Syntax

```
int vfscanf(
 FILE *stream,
 const char *format,
 va_list argptr
);
int vfwscanf(
 FILE *stream,
 const wchar_t *format,
 va_list argptr
);
```

### Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format-control string.

`arglist`

Variable argument list.

## Return value

Each of these functions returns the number of fields that are successfully converted and assigned. The return value doesn't include fields that are read but not assigned. A return value of 0 indicates that no fields were assigned. If an error occurs, or if the end of the file stream is reached before the first conversion, the return value is `EOF` for `vfscanf` and `vfwscanf`.

These functions validate their parameters. If `stream` or `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

## Remarks

The `vfscanf` function reads data from the current position of `stream` into the locations that are given by the `arglist` argument list. Each argument in the list must be a pointer to a variable of a type that corresponds to a type specifier in `format`. `format` controls the interpretation of the input fields and has the same form and function as the `format` argument for `scanf`; see [scanf](#) for a description of `format`.

`vfwscanf` is a wide-character version of `vfscanf`; the format argument to `vfwscanf` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `vfscanf` doesn't support input from a UNICODE stream.

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_vftscanf</code>	<code>vscanf</code>	<code>vfscanf</code>	<code>vfwscanf</code>

For more information, see [Format specification fields](#): `scanf` and `wscanf` functions.

## Requirements

FUNCTION	REQUIRED HEADER
<code>vfscanf</code>	<code>&lt;stdio.h&gt;</code>
<code>vfwscanf</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_vfscanf.c
// compile with: /W3
// This program writes formatted
// data to a file. It then uses vfscanf to
// read the various data back from the file.

#include <stdio.h>
#include <stdarg.h>

FILE *stream;

int call_vfscanf(FILE * istream, char * format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vfscanf(istream, format, arglist);
 va_end(arglist);
 return result;
}

int main(void)
{
 long l;
 float fp;
 char s[81];
 char c;

 if (fopen_s(&stream, "vfscanf.out", "w+") != 0)
 {
 printf("The file vfscanf.out was not opened\n");
 }
 else
 {
 fprintf(stream, "%s %ld %f%c", "a-string",
 65000, 3.14159, 'x');
 // Security caution!
 // Beware loading data from a file without confirming its size,
 // as it may lead to a buffer overrun situation.

 // Set pointer to beginning of file:
 fseek(stream, 0L, SEEK_SET);

 // Read data back from file:
 call_vfscanf(stream, "%s %ld %f%c", s, &l, &fp, &c);

 // Output data read:
 printf("%s\n", s);
 printf("%ld\n", l);
 printf("%f\n", fp);
 printf("%c\n", c);

 fclose(stream);
 }
}

```

```

a-string
65000
3.141590
x

```

## See also

[Stream I/O](#)

`_cscanf`, `_cscanf_1`, `_cwscanf`, `_cwscanf_1`  
`fprintf`, `_fprintf_1`, `fwprintf`, `_fwprintf_1`  
`scanf`, `_scanf_1`, `wscanf`, `_wscanf_1`  
`sscanf`, `_sscanf_1`, `swscanf`, `_swscanf_1`  
`fscanf_s`, `_fscanf_s_1`, `fwscanf_s`, `_fwscanf_s_1`  
`vfscanf_s`, `vfwscanf_s`

# vfscanf\_s, vfwscanf\_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data from a stream. These versions of vfscanf, vfwscanf have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
int vfscanf_s(
 FILE *stream,
 const char *format,
 va_list arglist
);
int vfwscanf_s(
 FILE *stream,
 const wchar_t *format,
 va_list arglist
);
```

### Parameters

`stream`

Pointer to `FILE` structure.

`format`

Format-control string.

`arglist`

Variable argument list.

## Return value

Each of these functions returns the number of fields that are successfully converted and assigned. The return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. If an error occurs, or if the end of the file stream is reached before the first conversion, the return value is `EOF` for `vfscanf_s` and `vfwscanf_s`.

These functions validate their parameters. If `stream` is an invalid file pointer, or `format` is a null pointer, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

## Remarks

The `vfscanf_s` function reads data from the current position of `stream` into the locations that are given by the `arglist` argument list (if any). Each argument in the list must be a pointer to a variable of a type that corresponds to a type specifier in `format`. `format` controls the interpretation of the input fields and has the same form and function as the `format` argument for `scanf_s`; see [Format specification fields: scanf and wscanf functions](#) for a description of `format`. `vfwscanf_s` is a wide-character version of `vfscanf_s`; the format argument to `vfwscanf_s` is a wide-character string. These functions behave identically if the stream is opened in ANSI mode. `vfscanf_s` doesn't currently support input from a UNICODE stream.

The main difference between the more secure functions (that have the `_s` suffix) and the other versions is that

the more secure functions require the size in characters of each `c`, `C`, `s`, `S`, and `[` type field to be passed as an argument immediately following the variable. For more information, see `scanf_s`, `_scanf_s_1`, `wscanf_s`, `_wscanf_s_1` and `scanf` width specification.

#### NOTE

The size parameter is of type `unsigned`, not `size_t`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vftscanf_s</code>	<code>vscanf_s</code>	<code>vfscanf_s</code>	<code>vfwscanf_s</code>

## Requirements

FUNCTION	REQUIRED HEADER
<code>vfscanf_s</code>	<code>&lt;stdio.h&gt;</code>
<code>vfwscanf_s</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_vfscanf_s.c
// compile with: /W3
// This program writes formatted
// data to a file. It then uses vfscanf_s to
// read the various data back from the file.

#include <stdio.h>
#include <stdarg.h>
#include <stdlib.h>

FILE *stream;

int call_vfscanf_s(FILE *istream, char * format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vfscanf_s(istream, format, arglist);
 va_end(arglist);
 return result;
}

int main(void)
{
 long l;
 float fp;
 char s[81];
 char c;

 if (fopen_s(&stream, "vfscanf_s.out", "w+") != 0)
 {
 printf("The file vfscanf_s.out was not opened\n");
 }
 else
 {
 fprintf(stream, "%s %ld %f%c", "a-string",
 65000, 3.14159, 'x');
 // Security caution!
 // Beware loading data from a file without confirming its size,
 // as it may lead to a buffer overrun situation.

 // Set pointer to beginning of file:
 fseek(stream, 0L, SEEK_SET);

 // Read data back from file:
 call_vfscanf_s(stream, "%s %ld %f%c", s, _countof(s), &l, &fp, &c, 1);

 // Output data read:
 printf("%s\n", s);
 printf("%ld\n", l);
 printf("%f\n", fp);
 printf("%c\n", c);

 fclose(stream);
 }
}

```

```

a-string
65000
3.141590
x

```

## See also

## Stream I/O

```
_cscanf_s, _cscanf_s_1, _cwscanf_s, _cwscanf_s_1
fprintf_s, _fprintf_s_1, fwprintf_s, _fwprintf_s_1
scanf_s, _scanf_s_1, wscanf_s, _wscanf_s_1
sscanf_s, _sscanf_s_1, swscanf_s, _swscanf_s_1
fscanf, _fscanf_1, fwscanf, _fwscanf_1
vfscanf, vfwscanf
```

`vprintf`, `_vprintf_l`, `vwprintf`, `_vwprintf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes formatted output by using a pointer to a list of arguments. More secure versions of these functions are available, see `vprintf_s`, `_vprintf_s_l`, `vwprintf_s`, `_vwprintf_s_l`.

## Syntax

```
int vprintf(
 const char *format,
 va_list argptr
);
int _vprintf_l(
 const char *format,
 _locale_t locale,
 va_list argptr
);
int vwprintf(
 const wchar_t *format,
 va_list argptr
);
int _vwprintf_l(
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`vprintf` and `vwprintf` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs. If `format` is a null pointer, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to `stdout`.

`vwprintf` is the wide-character version of `vprintf`; the two functions behave identically if the stream is opened

in ANSI mode. `vprintf` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Invalid format strings are detected and result in an error. Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vprintf</code>	<code>vprintf</code>	<code>vprintf</code>	<code>vwprintf</code>
<code>_vprintf_1</code>	<code>_vprintf_1</code>	<code>_vprintf_1</code>	<code>_vwprintf_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vprintf</code> , <code>_vprintf_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>vwprintf</code> , <code>_vwprintf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

<code>vprintf</code> functions
<code>fprintf</code> , <code>_fprintf_1</code> , <code>fwprintf</code> , <code>_fwprintf_1</code>
<code>printf</code> , <code>_printf_1</code> , <code>wprintf</code> , <code>_wprintf_1</code>
<code>sprintf</code> , <code>_sprintf_1</code> , <code>swprintf</code> , <code>_swprintf_1</code> , <code>_swprintf_1</code>
<code>va_arg</code> , <code>va_copy</code> , <code>va_end</code> , <code>va_start</code>

`_vprintf_p`, `_vprintf_p_l`, `_vwprintf_p`,  
`_vwprintf_p_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes formatted output by using a pointer to a list of arguments, and enables specification of the order in which the arguments are used.

## Syntax

```
int _vprintf_p(
 const char *format,
 va_list argptr
);
int _vprintf_p_l(
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vwprintf_p(
 const wchar_t *format,
 va_list argptr
);
int _vwprintf_p_l(
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

## Parameters

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`_vprintf_p` and `_vwprintf_p` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs.

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to `stdout`. These functions differ from `vprintf_s` and `vwprintf_s` only in that they support the ability to specify the order in which the arguments are used. For more information, see [printf\\_p Positional Parameters](#).

`_vwprintf_p` is the wide-character version of `_vprintf_p`; the two functions behave identically if the stream is

opened in ANSI mode. `_vprintf_p` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

If `format` is a null pointer, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vprintf_p</code>	<code>_vprintf_p</code>	<code>_vprintf_p</code>	<code>_vwprintf_p</code>
<code>_vprintf_p_1</code>	<code>_vprintf_p_1</code>	<code>_vprintf_p_1</code>	<code>_vwprintf_p_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_vprintf_p</code> , <code>_vprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>_vwprintf_p</code> , <code>_vwprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

<code>vprintf</code> functions
<code>_fprintf_p</code> , <code>_fprintf_p_1</code> , <code>_fwprintf_p</code> , <code>_fwprintf_p_1</code>
<code>_printf_p</code> , <code>_printf_p_1</code> , <code>_wprintf_p</code> , <code>_wprintf_p_1</code>
<code>_sprintf_p</code> , <code>_sprintf_p_1</code> , <code>_swprintf_p</code> , <code>_swprintf_p_1</code>
<code>vsprintf_s</code> , <code>_vsprintf_s_1</code> , <code>vswprintf_s</code> , <code>_vswprintf_s_1</code>

`va_arg`, `va_copy`, `va_end`, `va_start`  
`_vfprintf_p`, `_vfprintf_p_l`, `_vfwprintf_p`, `_vfwprintf_p_l`  
`_printf_p`, `_printf_p_l`, `_wprintf_p`, `_wprintf_p_l`

printf\_p Positional Parameters

`vprintf_s`, `_vprintf_s_l`, `vwprintf_s`,  
`_vwprintf_s_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Writes formatted output by using a pointer to a list of arguments. These versions of `vprintf`, `_vprintf_l`, `vwprintf`, `_vwprintf_l` have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
int vprintf_s(
 const char *format,
 va_list argptr
);
int _vprintf_s_l(
 const char *format,
 _locale_t locale,
 va_list argptr
);
int vwprintf_s(
 const wchar_t *format,
 va_list argptr
);
int _vwprintf_s_l(
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`vprintf_s` and `vwprintf_s` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs. If `format` is a null pointer, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions takes a pointer to an argument list, then formats and writes the given data to `stdout`.

The secure versions of these functions differ from `vprintf` and `vwprintf` only in that the secure versions check that the format string contains valid formatting characters.

`vwprintf_s` is the wide-character version of `vprintf_s`; the two functions behave identically if the stream is opened in ANSI mode. `vprintf_s` doesn't currently support output into a UNICODE stream.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vprintf_s</code>	<code>vprintf_s</code>	<code>vprintf_s</code>	<code>vwprintf_s</code>
<code>_vprintf_s_1</code>	<code>_vprintf_s_1</code>	<code>_vprintf_s_1</code>	<code>_vwprintf_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vprintf_s</code> , <code>_vprintf_s_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>vwprintf_s</code> , <code>_vwprintf_s_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## See also

### Stream I/O

<code>vprintf</code> functions
<code>fprintf</code> , <code>_fprintf_1</code> , <code>fwprintf</code> , <code>_fwprintf_1</code>
<code>printf</code> , <code>_printf_1</code> , <code>wprintf</code> , <code>_wprintf_1</code>
<code>sprintf</code> , <code>_sprintf_1</code> , <code>swprintf</code> , <code>_swprintf_1</code> , <code>_swprintf_1</code>
<code>va_arg</code> , <code>va_copy</code> , <code>va_end</code> , <code>va_start</code>

# vscanf , vwscanf

11/2/2022 • 2 minutes to read • [Edit Online](#)

Reads formatted data from the standard input stream. More secure versions of these functions are available; see [vscanf\\_s](#) , [vwscanf\\_s](#) .

## Syntax

```
int vscanf(
 const char *format,
 va_list arglist
);
int vwscanf(
 const wchar_t *format,
 va_list arglist
);
```

### Parameters

`format`

Format control string.

`arglist`

Variable argument list.

## Return value

Returns the number of fields that are successfully converted and assigned; the return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned.

If `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return `EOF` and set `errno` to `EINVAL`.

For information about these and other error codes, see [errno](#) , [\\_doserrno](#) , [\\_sys\\_errlist](#) , and [\\_sys\\_nerr](#) .

## Remarks

The `vscanf` function reads data from the standard input stream `stdin` and writes the data into the locations that are given by the `arglist` argument list. Each argument in the list must be a pointer to a variable of a type that corresponds to a type specifier in `format`. If copying occurs between strings that overlap, the behavior is undefined.

### IMPORTANT

When you use `vscanf` to read a string, always specify a width for the `%s` format (for example, `"%32s"` instead of `"%s"`); otherwise, incorrectly formatted input can cause a buffer overrun. As an alternative, you can use [vscanf\\_s](#) , [vwscanf\\_s](#) or [fgets](#) .

`vwscanf` is a wide-character version of `vscanf`; the `format` argument to `vwscanf` is a wide-character string. `vwscanf` and `vscanf` behave identically if the stream is opened in ANSI mode. `vscanf` doesn't support input from a UNICODE stream.

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_vtscanf</code>	<code>vscanf</code>	<code>vscanf</code>	<code>wscanf</code>

For more information, see [Format specification fields](#): `scanf` and `wscanf` functions.

## Requirements

ROUTINE	REQUIRED HEADER
<code>vscanf</code>	<code>&lt;stdio.h&gt;</code>
<code>vwscanf</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## Example

```

// crt_vscanf.c
// compile with: /W3
// This program uses the vscanf and vwscanf functions
// to read formatted input.

#include <stdio.h>
#include <stdarg.h>

int call_vscanf(char *format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vscanf(format, arglist);
 va_end(arglist);
 return result;
}

int call_vwscanf(wchar_t *format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vwscanf(format, arglist);
 va_end(arglist);
 return result;
}

int main(void)
{
 int i, result;
 float fp;
 char c, s[81];
 wchar_t wc, ws[81];
 result = call_vscanf("%d %f %c %C %80s %80S", &i, &fp, &c, &wc, s, ws);
 printf("The number of fields input is %d\n", result);
 printf("The contents are: %d %f %c %C %s %S\n", i, fp, c, wc, s, ws);
 result = call_vwscanf(L"%d %f %hc %lc %80S %80ls", &i, &fp, &c, &wc, s, ws);
 wprintf(L"The number of fields input is %d\n", result);
 wprintf(L"The contents are: %d %f %C %c %hs %s\n", i, fp, c, wc, s, ws);
}

```

```

71 98.6 h z Byte characters
36 92.3 y n Wide charactersThe number of fields input is 6
The contents are: 71 98.599998 h z Byte characters
The number of fields input is 6
The contents are: 36 92.300003 y n Wide characters

```

## See also

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

<a href="#">fscanf</a>	<a href="#">_fscanf_l</a>	<a href="#">fwscanf</a>	<a href="#">_fwscanf_l</a>
<a href="#">printf</a>	<a href="#">_printf_l</a>	<a href="#">wprintf</a>	<a href="#">_wprintf_l</a>
<a href="#">sprintf</a>	<a href="#">_sprintf_l</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_l</a>
<a href="#">sscanf</a>	<a href="#">_sscanf_l</a>	<a href="#">swscanf</a>	<a href="#">_swscanf_l</a>
<a href="#">vscanf_s</a>	<a href="#">vwscanf_s</a>		

# vscanf\_s , vwscanf\_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Reads formatted data from the standard input stream. These versions of `vscanf` , `vwscanf` have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
int vscanf_s(
 const char *format,
 va_list arglist
);
int vwscanf_s(
 const wchar_t *format,
 va_list arglist
);
```

### Parameters

`format`

Format control string.

`arglist`

Variable argument list.

## Return value

Returns the number of fields successfully converted and assigned; the return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error, or if the end-of-file character or the end-of-string character is encountered in the first attempt to read a character. If `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `vscanf_s` and `vwscanf_s` return `EOF` and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno` , `_doserrno` , `_sys_errlist` , and `_sys_nerr` .

## Remarks

The `vscanf_s` function reads data from the standard input stream `stdin` and writes the data into the locations that are given by the `arglist` argument list. Each argument in the list must be a pointer to a variable of a type that corresponds to a type specifier in `format` . If copying occurs between strings that overlap, the behavior is undefined.

`vwscanf_s` is a wide-character version of `vscanf_s` ; the `format` argument to `vwscanf_s` is a wide-character string. `vwscanf_s` and `vscanf_s` behave identically if the stream is opened in ANSI mode. `vscanf_s` doesn't support input from a UNICODE stream.

Unlike `vscanf` and `vwscanf` , `vscanf_s` and `vwscanf_s` require the buffer size to be specified for all input parameters of type `c` , `C` , `s` , `S` , or string control sets that are enclosed in `[]` . The buffer size in characters is passed as another parameter immediately following the pointer to the buffer or variable. The buffer size in characters for a `wchar_t` string isn't the same as the size in bytes.

The buffer size includes the terminating null. You can use a width-specification field to ensure that the token that's read in will fit into the buffer. If no width specification field is used, and the token read in is too large to fit in the buffer, nothing is written to that buffer.

**NOTE**

The `size` parameter is of type `unsigned`, not `size_t`.

For more information, see [scanf Width Specification](#).

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vtscanf_s</code>	<code>vscanf_s</code>	<code>vscanf_s</code>	<code>wscanf_s</code>

For more information, see [Format specification fields: scanf and wscanf functions](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>vscanf_s</code>	<code>&lt;stdio.h&gt;</code>
<code>wscanf_s</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

The console isn't supported in Universal Windows Platform (UWP) apps. The standard stream handles that are associated with the console, `stdin`, `stdout`, and `stderr`, must be redirected before C run-time functions can use them in UWP apps. For more compatibility information, see [Compatibility](#).

## Example

```

// crt_vscanf_s.c
// compile with: /W3
// This program uses the vscanf_s and vwscanf_s functions
// to read formatted input.

#include <stdio.h>
#include <stdarg.h>
#include <stdlib.h>

int call_vscanf_s(char *format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vscanf_s(format, arglist);
 va_end(arglist);
 return result;
}

int call_vwscanf_s(wchar_t *format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vwscanf_s(format, arglist);
 va_end(arglist);
 return result;
}

int main(void)
{
 int i, result;
 float fp;
 char c, s[81];
 wchar_t wc, ws[81];
 result = call_vscanf_s("%d %f %c %C %s %S", &i, &fp, &c, 1,
 &wc, 1, s, _countof(s), ws, _countof(ws));
 printf("The number of fields input is %d\n", result);
 printf("The contents are: %d %f %c %C %s %S\n", i, fp, c, wc, s, ws);
 result = call_vwscanf_s(L"%d %f %hc %lc %S %ls", &i, &fp, &c, 2,
 &wc, 1, s, _countof(s), ws, _countof(ws));
 wprintf(L"The number of fields input is %d\n", result);
 wprintf(L"The contents are: %d %f %c %hs %s\n", i, fp, c, wc, s, ws);
}

```

When this program is given the input in the example, it produces this output:

```

71 98.6 h z Byte characters
36 92.3 y n Wide characters

```

```

The number of fields input is 6
The contents are: 71 98.599998 h z Byte characters
The number of fields input is 6
The contents are: 36 92.300003 y n Wide characters

```

## See also

[Math and floating-point support](#)

[Stream I/O](#)

[Locale](#)

[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)

`scanf`, `_scanf_l`, `wscanf`, `_wscanf_l`

`scanf_s`, `_scanf_s_l`, `wscanf_s`, `_wscanf_s_l`

`vscanf`, `vwscanf`

`_vscprintf`, `_vscprintf_l`, `_vscwprintf`,  
`_vscwprintf_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the number of characters in the formatted string using a pointer to a list of arguments.

## Syntax

```
int _vscprintf(
 const char *format,
 va_list argptr
);
int _vscprintf_l(
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vscwprintf(
 const wchar_t *format,
 va_list argptr
);
int _vscwprintf_l(
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

### Parameters

`format`

Format-control string.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`_vscprintf` returns the number of characters that would be generated if the string pointed to by the list of arguments was printed or sent to a file or buffer using the specified formatting codes. The value returned doesn't include the terminating null character. `_vscwprintf` performs the same function for wide characters.

The versions of these functions with the `_l` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

If `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

## Remarks

Each `argument` (if any) is converted according to the corresponding format specification in `format`. The format consists of ordinary characters and has the same form and function as the `format` argument for `printf`.

### IMPORTANT

Ensure that if `format` is a user-defined string, it is null terminated and has the correct number and type of parameters. For more information, see [Avoiding buffer overruns](#).

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `legacy_stdio_float_rounding.obj`.

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_vscprintf</code>	<code>_vscprintf</code>	<code>_vscprintf</code>	<code>_vscwprintf</code>
<code>_vscprintf_l</code>	<code>_vscprintf_l</code>	<code>_vscprintf_l</code>	<code>_vscwprintf_l</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_vscprintf</code> , <code>_vscprintf_l</code>	<code>&lt;stdio.h&gt;</code>
<code>_vscwprintf</code> , <code>_vscwprintf_l</code>	<code>&lt;stdio.h&gt; or &lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for `vsprintf`.

## See also

### Stream I/O

<code>fprintf</code> , <code>_fprintf_l</code> , <code>fwprintf</code> , <code>_fwprintf_l</code>
<code>printf</code> , <code>_printf_l</code> , <code>wprintf</code> , <code>_wprintf_l</code>
<code>scanf</code> , <code>_scanf_l</code> , <code>wscanf</code> , <code>_wscanf_l</code>
<code>sscanf</code> , <code>_sscanf_l</code> , <code>swscanf</code> , <code>_swscanf_l</code>
<code>vprintf</code> functions

`_vscprintf_p`, `_vscprintf_p_l`, `_vscwprintf_p`,  
`_vscwprintf_p_l`

11/2/2022 • 2 minutes to read • [Edit Online](#)

Returns the number of characters in the formatted string using a pointer to a list of arguments, with the ability to specify the order in which the arguments are used.

## Syntax

```
int _vscprintf_p(
 const char *format,
 va_list argptr
);
int _vscprintf_p_l(
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vscwprintf_p (
 const wchar_t *format,
 va_list argptr
);
int _vscwprintf_p_l(
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

## Parameters

`format`

Format-control string.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

`_vscprintf_p` returns the number of characters that would be generated if the string pointed to by the list of arguments was printed or sent to a file or buffer using the specified formatting codes. The value returned doesn't include the terminating null character. `_vscwprintf_p` performs the same function for wide characters.

## Remarks

These functions differ from `_vscprintf` and `_vscwprintf` only in that they support the ability to specify the order in which the arguments are used. For more information, see [printf\\_p Positional Parameters](#).

The versions of these functions with the `_l` suffix are identical except that they use the locale parameter passed

in instead of the current thread locale.

If `format` is a null pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

### IMPORTANT

Ensure that if `format` is a user-defined string, it is null terminated and has the correct number and type of parameters. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with '[legacy\\_stdio\\_float\\_rounding.obj](#)'.

## Generic-text routine mappings

TCHAR.H ROUTINE	_UNICODE AND _MBCS NOT DEFINED	_MBCS DEFINED	_UNICODE DEFINED
<code>_vsctprintf_p</code>	<code>_vscprintf_p</code>	<code>_vscprintf_p</code>	<code>_vscwprintf_p</code>
<code>_vsctprintf_p_l</code>	<code>_vscprintf_p_l</code>	<code>_vscprintf_p_l</code>	<code>_vscwprintf_p_l</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>_vscprintf_p</code> , <code>_vscprintf_p_l</code>	<code>&lt;stdio.h&gt;</code>
<code>_vscwprintf_p</code> , <code>_vscwprintf_p_l</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

See the example for [`vsprintf`](#).

## See also

[`vprintf` functions](#)  
`_scprintf_p`, `_scprintf_p_l`, `_scwprintf_p`, `_scwprintf_p_l`  
`_vscprintf`, `_vscprintf_l`, `_vscwprintf`, `_vscwprintf_l`\

`vsnprintf`, `_vsnprintf`, `_vsnprintf_l`,  
`_vsnwprintf`, `_vsnwprintf_l`

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Write formatted output using a pointer to a list of arguments. More secure versions of these functions are available; see `vsnprintf_s`, `_vsnprintf_s`, `_vsnprintf_s_l`, `_vsnwprintf_s`, `_vsnwprintf_s_l`.

## Syntax

```
int vsnprintf(
 char *buffer,
 size_t count,
 const char *format,
 va_list argptr
);
int _vsnprintf(
 char *buffer,
 size_t count,
 const char *format,
 va_list argptr
);
int _vsnprintf_l(
 char *buffer,
 size_t count,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vsnwprintf(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 va_list argptr
);
int _vsnwprintf_l(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
template <size_t size>
int vsnprintf(
 char (&buffer)[size],
 size_t count,
 const char *format,
 va_list argptr
); // C++ only
template <size_t size>
int _vsnprintf(
 char (&buffer)[size],
 size_t count,
 const char *format,
 va_list argptr
); // C++ only
template <size_t size>
int _vsnprintf_l(
 char (&buffer)[size],
 size_t count,
```

```

const char *format,
_locale_t locale,
va_list argptr
); // C++ only
template <size_t size>
int _vsnprintf(
 wchar_t (&buffer)[size],
 size_t count,
 const wchar_t *format,
 va_list argptr
); // C++ only
template <size_t size>
int _vsnwprintf_l(
 wchar_t (&buffer)[size],
 size_t count,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
); // C++ only

```

## Parameters

`buffer`

Storage location for output.

`count`

Maximum number of characters to write.

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

For more information, see [Format specification syntax](#).

## Return value

The `vsnprintf` function returns the number of characters that are written, not counting the terminating null character. If the buffer size specified by `count` isn't sufficiently large to contain the output specified by `format` and `argptr`, the return value of `vsnprintf` is the number of characters that would be written, not counting the null character, if `count` were sufficiently large. If the return value is greater than `count` - 1, the output has been truncated. A return value of -1 indicates that an encoding error has occurred.

Both `_vsnprintf` and `_vsnwprintf` functions return the number of characters written if the number of characters to write is less than or equal to `count`. If the number of characters to write is greater than `count`, these functions return -1 indicating that output has been truncated.

The value returned by all these functions doesn't include the terminating null, whether one is written or not.

- If `count` is zero and `buffer` is `NULL`, the value returned is the number of characters the functions would write. The value doesn't take into account a terminating `NULL`. You can use this result to allocate sufficient buffer space for the string and a terminating null, and then call the function again to fill the buffer.
- If `count` is zero but `buffer` isn't `NULL`, nothing is written and the function returns -1.
- If `format` is `NULL`, or if `buffer` is `NULL` and `count` isn't equal to zero, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

## Remarks

Each of these functions takes a pointer to an argument list, then formats the data, and writes up to `count` characters to the memory pointed to by `buffer`. The `vsnprintf` function always writes a null terminator, even if it truncates the output. When you use `_vsnprintf` and `_vsnwprintf`, the buffer is null-terminated only if there's room at the end (that is, if the number of characters to write is less than `count`).

### IMPORTANT

To prevent certain kinds of security risks, ensure that `format` isn't a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

### NOTE

To ensure that there's room for the terminating null when calling `_vsnprintf`, `_vsnprintf_l`, `_vsnwprintf` and `_vsnwprintf_l`, be sure that `count` is strictly less than the buffer length and initialize the buffer to null prior to calling the function.

Because `vsnprintf` always writes the terminating null, the `count` parameter may be equal to the size of the buffer.

Beginning with the UCRT in Visual Studio 2015 and Windows 10, `vsnprintf` is no longer identical to `_vsnprintf`. The `vsnprintf` function conforms to the C99 standard; `_vsnprintf` is kept for backward compatibility with older Visual Studio code.

The versions of these functions with the `_l` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vsnprintf</code>	<code>_vsnprintf</code>	<code>_vsnprintf</code>	<code>_vsnwprintf</code>
<code>_vsnprintf_l</code>	<code>_vsnprintf_l</code>	<code>_vsnprintf_l</code>	<code>_vsnwprintf_l</code>

## Requirements

ROUTINE	REQUIRED HEADER (C)	REQUIRED HEADER (C++)
<code>_vsnprintf</code> , <code>_vsnprintf_1</code>	<code>&lt;stdio.h&gt;</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;cstdio&gt;</code>
<code>_vsnwprintf</code> , <code>_vsnwprintf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>	<code>&lt;stdio.h&gt;</code> , <code>&lt;wchar.h&gt;</code> , <code>&lt;cstdio&gt;</code> , or <code>&lt;cwchar.h&gt;</code>

The `_vsnprintf`, `_vsnprintf_1`, `_vsnwprintf` and `_vsnwprintf_1` functions are Microsoft-specific. For more compatibility information, see [Compatibility](#).

## Example: Use wide characters with `_vsnwprintf()`

```
// crt_vsnwprintf.c
// compile by using: cl /W3 crt_vsnwprintf.c

// To turn off error C4996, define this symbol:
#define _CRT_SECURE_NO_WARNINGS

#include <stdio.h>
#include <wtypes.h>

#define BUFFCOUNT (10)

void FormatOutput(LPCWSTR formatstring, ...)
{
 int nSize = 0;
 wchar_t buff[BUFFCOUNT];
 memset(buff, 0, sizeof(buff));
 va_list args;
 va_start(args, formatstring);
 // Note: _vsnwprintf is deprecated; consider vsnwprintf_s instead
 nSize = _vsnwprintf(buff, BUFFCOUNT - 1, formatstring, args); // C4996
 wprintf(L"nSize: %d, buff: %ls\n", nSize, buff);
 va_end(args);
}

int main() {
 FormatOutput(L"%ls %ls", L"Hi", L"there");
 FormatOutput(L"%ls %ls", L"Hi", L"there!");
 FormatOutput(L"%ls %ls", L"Hi", L"there!!");
}
```

```
nSize: 8, buff: Hi there
nSize: 9, buff: Hi there!
nSize: -1, buff: Hi there!
```

The behavior changes if you use `vsnprintf` instead, along with narrow-string parameters. The `count` parameter can be the entire size of the buffer, and the return value is the number of characters that would have been written if `count` was large enough:

## Example: Use `vsnprintf()` with narrow strings

```

// crt_vsnprintf.c
// compile by using: cl /W4 crt_vsnprintf.c
#include <stdio.h>
#include <stdarg.h> // for va_list, va_start
#include <string.h> // for memset

#define BUFFCOUNT (10)

void FormatOutput(char* formatstring, ...)
{
 int nSize = 0;
 char buff[BUFFCOUNT];
 memset(buff, 0, sizeof(buff));
 va_list args;
 va_start(args, formatstring);
 nSize = vsnprintf(buff, sizeof(buff), formatstring, args);
 printf("nSize: %d, buff: %s\n", nSize, buff);
 va_end(args);
}

int main() {
 FormatOutput("%s %s", "Hi", "there"); // 8 chars + null
 FormatOutput("%s %s", "Hi", "there!"); // 9 chars + null
 FormatOutput("%s %s", "Hi", "there!!"); // 10 chars + null
}

```

```

nSize: 8, buff: Hi there
nSize: 9, buff: Hi there!
nSize: 10, buff: Hi there!

```

## See also

### [Stream I/O](#)

[vprintf](#) functions

Format specification syntax: [printf](#) and [wprintf](#) functions

[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)

[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)

[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)

[va\\_arg](#), [va\\_copy](#), [va\\_end](#), [va\\_start](#)

`vsnprintf_s`, `_vsnprintf_s`, `_vsnprintf_s_l`,  
`_vsnwprintf_s`, `_vsnwprintf_s_l`

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Write formatted output using a pointer to a list of arguments. These functions are versions of `vsnprintf`, `_vsnprintf`, `_vsnprintf_l`, `_vsnwprintf`, `_vsnwprintf_l` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```

int vsnprintf_s(
 char *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const char *format,
 va_list argptr
);
int _vsnprintf_s(
 char *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const char *format,
 va_list argptr
);
int _vsnprintf_s_l(
 char *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vsnwprintf_s(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const wchar_t *format,
 va_list argptr
);
int _vsnwprintf_s_l(
 wchar_t *buffer,
 size_t sizeOfBuffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
template <size_t size>
int _vsnprintf_s(
 char (&buffer)[size],
 size_t count,
 const char *format,
 va_list argptr
); // C++ only
template <size_t size>
int _vsnwprintf_s(
 wchar_t (&buffer)[size],
 size_t count,
 const wchar_t *format,
 va_list argptr
); // C++ only

```

## Parameters

`buffer`

Storage location for output.

`sizeOfBuffer`

The size of the `buffer` for output, as the character count.

`count`

Maximum number of characters to write (not including the terminating null), or `_TRUNCATE`.

`format`

Format specification.

### `argptr`

Pointer to list of arguments.

### `Locale`

The locale to use.

For more information, see [Format specifications](#).

## Return value

`vsnprintf_s`, `_vsnprintf_s` and `_vsnwprintf_s` return the number of characters written, not including the terminating null, or a negative value if either truncation of the data or an output error occurs.

- If `count` is less than `sizeOfBuffer` and the number of characters of data is less than or equal to `count`, or `count` is `_TRUNCATE` and the number of characters of data is less than `sizeOfBuffer`, then all of the data is written and the number of characters is returned.
- If `count` is less than `sizeOfBuffer` but the data exceeds `count` characters, then the first `count` characters are written. Truncation of the remaining data occurs and -1 is returned without invoking the invalid parameter handler.
- If `count` is `_TRUNCATE` and the number of characters of data equals or exceeds `sizeOfBuffer`, then as much of the string as will fit in `buffer` (with terminating null) is written. Truncation of the remaining data occurs and -1 is returned without invoking the invalid parameter handler.
- If `count` is equal to or exceeds `sizeOfBuffer` but the number of characters of data is less than `sizeOfBuffer`, then all of the data is written (with terminating null) and the number of characters is returned.
- If `count` and the number of characters of data both equal or exceed `sizeOfBuffer`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution continues after the invalid parameter handler, these functions set `buffer` to an empty string, set `errno` to `ERANGE`, and return -1.
- If `buffer` or `format` is a `NULL` pointer, or if `count` is less than or equal to zero, the invalid parameter handler is invoked. If execution is allowed to continue, these functions set `errno` to `EINVAL` and return -1.

## Error conditions

CONDITION	RETURN VALUE	<code>errno</code>
<code>buffer</code> is <code>NULL</code>	-1	<code>EINVAL</code>
<code>format</code> is <code>NULL</code>	-1	<code>EINVAL</code>
<code>count</code> $\leq 0$	-1	<code>EINVAL</code>
<code>sizeOfBuffer</code> too small (and <code>count</code> $\neq$ <code>_TRUNCATE</code> )	-1 (and <code>buffer</code> set to an empty string)	<code>ERANGE</code>

## Remarks

`vsnprintf_s` is identical to `_vsnprintf_s`. `vsnprintf_s` is included for conformance to the ANSI standard. `_vsnprintf` is retained for backward compatibility.

Each of these functions takes a pointer to an argument list, then formats and writes up to `count` characters of

the given data to the memory pointed to by `buffer` and appends a terminating null.

If `count` is `_TRUNCATE`, then these functions write as much of the string as will fit in `buffer` while leaving room for a terminating null. If the entire string (with terminating null) fits in `buffer`, then these functions return the number of characters written (not including the terminating null); otherwise, these functions return -1 to indicate that truncation occurred.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

#### IMPORTANT

Ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

#### NOTE

To ensure that there is room for the terminating null, be sure that `count` is strictly less than the buffer length, or use `_TRUNCATE`.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

#### TIP

If you get an undefined external `_vsnprintf_s` error and are using the Universal C Runtime, add `legacy_stdio_definitions.lib` to the set of libraries to link. The Universal C Runtime doesn't export this function directly and is instead defined inline in `<stdio.h>`. For more information, see [Overview of potential upgrade issues](#) and [Visual Studio 2015 conformance changes](#).

## Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vsnprintf_s</code>	<code>_vsnprintf_s</code>	<code>_vsnprintf_s</code>	<code>_vsnwprintf_s</code>
<code>_vsnprintf_s_1</code>	<code>_vsnprintf_s_1</code>	<code>_vsnprintf_s_1</code>	<code>_vsnwprintf_s_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vsnprintf_s</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>_vsnprintf_s</code> , <code>_vsnprintf_s_l</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>_vsnwprintf_s</code> , <code>_vsnwprintf_s_l</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_vsnprintf_s.cpp
#include <stdio.h>
#include <wtypes.h>

void FormatOutput(LPCSTR formatstring, ...)
{
 int nSize = 0;
 char buff[10];
 memset(buff, 0, sizeof(buff));
 va_list args;
 va_start(args, formatstring);
 nSize = vsnprintf_s(buff, _countof(buff), _TRUNCATE, formatstring, args);
 printf("nSize: %d, buff: %s\n", nSize, buff);
 va_end(args);
}

int main() {
 FormatOutput("%s %s", "Hi", "there");
 FormatOutput("%s %s", "Hi", "there!");
 FormatOutput("%s %s", "Hi", "there!!");
}
```

```
nSize: 8, buff: Hi there
nSize: 9, buff: Hi there!
nSize: -1, buff: Hi there!
```

## See also

### Stream I/O

<code>vprintf</code>	<code>functions</code>
<code>fprintf</code>	<code>, _fprintf_l</code>
<code>,</code>	<code>fwprintf</code>
<code>,</code>	<code>_fwprintf_l</code>
<code>printf</code>	<code>, _printf_l</code>
<code>,</code>	<code>wprintf</code>
<code>,</code>	<code>_wprintf_l</code>
<code>sprintf</code>	<code>, _sprintf_l</code>
<code>,</code>	<code>swprintf</code>
<code>,</code>	<code>_swprintf_l</code>
<code>,</code>	<code>_swprintf_l</code>
<code>va_arg</code>	<code>,</code>
<code>va_copy</code>	<code>,</code>
<code>va_end</code>	<code>,</code>
<code>va_start</code>	<code>\</code>

`vsprintf`, `_vsprintf_l`, `vswprintf`, `_vswprintf_l`  
, `_vswprintf_l`

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Write formatted output using a pointer to a list of arguments. More secure versions of these functions are available; see `vsprintf_s`, `_vsprintf_s_l`, `vswprintf_s`, `_vswprintf_s_l`.

## Syntax

```
int vsprintf(
 char *buffer,
 const char *format,
 va_list argptr
);
int _vsprintf_l(
 char *buffer,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int vswprintf(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 va_list argptr
);
int _vswprintf_l(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
int __vswprintf_l(
 wchar_t *buffer,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
template <size_t size>
int vsprintf(
 char (&buffer)[size],
 const char *format,
 va_list argptr
); // C++ only
template <size_t size>
int _vsprintf_l(
 char (&buffer)[size],
 const char *format,
 _locale_t locale,
 va_list argptr
); // C++ only
template <size_t size>
int vswprintf(
 wchar_t (&buffer)[size],
 const wchar_t *format,
 va_list argptr
); // C++ only
template <size_t size>
int _vswprintf_l(
 wchar_t (&buffer)[size],
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
); // C++ only
```

## Parameters

*buffer*

Storage location for output.

*count*

Maximum number of characters to store, in the wide string versions of this function.

*format*

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

## Return value

`vsprintf` and `vswprintf` return the number of characters written, not including the terminating `\0` character, or a negative value if an output error occurs. If `buffer` or `format` is a `NULL` pointer, these functions invoke the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions takes a pointer to an argument list, and then formats and writes the given data to the memory pointed to by `buffer`.

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

### IMPORTANT

Using `vsprintf`, there is no way to limit the number of characters written, which means that code using this function is susceptible to buffer overruns. Use `vsnprintf` instead, or call `vscprintf` to determine how large a buffer is needed. Also, ensure that `format` is not a user-defined string. For more information, see [Avoiding buffer overruns](#). Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

`vswprintf` conforms to the ISO C Standard, which requires the second parameter, `count`, of type `size_t`. To force the old nonstandard behavior, define `_CRT_NON_CONFORMING_SWPRINTFS`. The old behavior may not be in a future version, so code should be changed to use the new conformant behavior.

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

### Generic-text routine mappings

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vstprintf</code>	<code>vsprintf</code>	<code>vsprintf</code>	<code>vswprintf</code>
<code>_vstprintf_1</code>	<code>_vsprintf_1</code>	<code>_vsprintf_1</code>	<code>_vswprintf_1</code>

# Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vsprintf</code> , <code>_vsprintf_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>vswprintf</code> , <code>_vswprintf_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_vsprintf.c
// compile with: cl /W4 crt_vsprintf.c
// This program uses vsprintf to write to a buffer.
// The size of the buffer is determined by _vscprintf.

#define _CRT_SECURE_NO_WARNINGS
#include <stdlib.h>
#include <stdio.h>
#include <stdarg.h>

void test(char const * const format, ...)
{
 va_list args;
 int len;
 char *buffer;

 // retrieve the variable arguments
 va_start(args, format);

 len = _vscprintf(format, args) // _vscprintf doesn't count
 + 1; // terminating '\0'

 buffer = (char*)malloc(len * sizeof(char));
 if (0 != buffer)
 {
 vsprintf(buffer, format, args); // C4996
 // Note: vsprintf is deprecated; consider using vsprintf_s instead
 puts(buffer);

 free(buffer);
 }
 va_end(args);
}

int main(void)
{
 test("%d %c %d", 123, '<', 456);
 test("%s", "This is a string");
}
```

```
123 < 456
This is a string
```

## See also

## Stream I/O

`vprintf` functions

Format specification syntax: `printf` and `wprintf` functions

`fprintf`, `_fprintf_l`, `fwprintf`, `_fwprintf_l`

`printf`, `_printf_l`, `wprintf`, `_wprintf_l`

`sprintf`, `_sprintf_l`, `swprintf`, `_swprintf_l`, `_swprintf_l`

`va_arg`, `va_copy`, `va_end`, `va_start`

`_vsprintf_p`, `_vsprintf_p_l`, `_vswprintf_p`,  
`_vswprintf_p_l`

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Write formatted output using a pointer to a list of arguments, with the ability to specify the order in which the arguments are used.

## Syntax

```
int _vsprintf_p(
 char *buffer,
 size_t sizeInBytes,
 const char *format,
 va_list argptr
);
int _vsprintf_p_l(
 char *buffer,
 size_t sizeInBytes,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int _vswprintf_p(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 va_list argptr
);
int _vswprintf_p_l(
 wchar_t *buffer,
 size_t count,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
```

## Parameters

`buffer`

Storage location for output.

`sizeInBytes`

Size of `buffer` in characters.

`count`

Maximum number of characters to store, in the UNICODE version of this function.

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

## Return value

`_vsprintf_p` and `_vswprintf_p` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs.

## Remarks

Each of these functions takes a pointer to an argument list, and then formats and writes the given data to the memory pointed to by `buffer`.

These functions differ from the `vsprintf_s` and `vswprintf_s` only in that they support positional parameters. For more information, see [printf\\_p Positional Parameters](#).

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

If the `buffer` or `format` parameters are `NULL` pointers, if count is zero, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

### IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.35000000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vstprintf_p</code>	<code>_vsprintf_p</code>	<code>_vsprintf_p</code>	<code>_vswprintf_p</code>
<code>_vstprintf_p_1</code>	<code>_vsprintf_p_1</code>	<code>_vsprintf_p_1</code>	<code>_vswprintf_p_1</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>_vsprintf_p</code> , <code>_vsprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *
<code>_vswprintf_p</code> , <code>_vswprintf_p_1</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;</code> *

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_vsprintf_p.c
// This program uses vsprintf_p to write to a buffer.
// The size of the buffer is determined by _vscprintf_p.

#include <stdlib.h>
#include <stdio.h>
#include <stdarg.h>

void example(char * format, ...)
{
 va_list args;
 int len;
 char *buffer = NULL;

 va_start(args, format);

 // _vscprintf doesn't count the
 // null terminating string so we add 1.
 len = _vscprintf_p(format, args) + 1;

 // Allocate memory for our buffer
 buffer = (char*)malloc(len * sizeof(char));
 if (buffer)
 {
 _vsprintf_p(buffer, len, format, args);
 puts(buffer);
 free(buffer);
 }
 va_end(args);
}

int main(void)
{
 // First example
 example("%2$d %1$c %3$d", '<', 123, 456);

 // Second example
 example("%s", "This is a string");
}
```

```
123 < 456
This is a string
```

## See also

[Stream I/O](#)

[vprintf functions](#)

Format specification syntax: [printf](#) and [wprintf](#) functions

[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)

[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)

[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)

[va\\_arg](#), [va\\_copy](#), [va\\_end](#), [va\\_start](#)

```
vsprintf_s, __vsprintf_s_l, vswprintf_s,
_vswprintf_s_l
```

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Write formatted output using a pointer to a list of arguments. These functions are versions of [vsprintf](#), [\\_vsprintf\\_l](#), [vswprintf](#), [\\_vswprintf\\_l](#) with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
int vsprintf_s(
 char *buffer,
 size_t numberOfElements,
 const char *format,
 va_list argptr
);
int _vsprintf_s_l(
 char *buffer,
 size_t numberOfElements,
 const char *format,
 _locale_t locale,
 va_list argptr
);
int vswprintf_s(
 wchar_t *buffer,
 size_t numberOfElements,
 const wchar_t *format,
 va_list argptr
);
int _vswprintf_s_l(
 wchar_t *buffer,
 size_t numberOfElements,
 const wchar_t *format,
 _locale_t locale,
 va_list argptr
);
template <size_t size>
int vsprintf_s(
 char (&buffer)[size],
 const char *format,
 va_list argptr
); // C++ only
template <size_t size>
int vswprintf_s(
 wchar_t (&buffer)[size],
 const wchar_t *format,
 va_list argptr
); // C++ only
```

## Parameters

`buffer`

Storage location for output.

`numberOfElements`

Size of `buffer` in characters.

`format`

Format specification.

`argptr`

Pointer to list of arguments.

`Locale`

The locale to use.

## Return value

`vsprintf_s` and `vswprintf_s` return the number of characters written, not including the terminating null character, or a negative value if an output error occurs. If `buffer` or `format` is a null pointer, if `numberOfElements` is zero, or if the format string contains invalid formatting characters, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, the functions return -1 and set `errno` to `EINVAL`.

For information on these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

Each of these functions takes a pointer to an argument list, and then formats and writes the given data to the memory pointed to by `buffer`.

`vswprintf_s` conforms to the ISO C Standard for `vswprintf`, which requires the second parameter, `count`, of type `size_t`.

These functions differ from the non-secure versions only in that the secure versions support positional parameters. For more information, see [printf\\_p Positional Parameters](#).

The versions of these functions with the `_1` suffix are identical except that they use the locale parameter passed in instead of the current thread locale.

In C++, using these functions is simplified by template overloads. The overloads can infer buffer length automatically, eliminating the need to specify a size argument. And, they can automatically replace non-secure functions with their secure counterparts. For more information, see [Secure template overloads](#).

### IMPORTANT

Starting in Windows 10 version 2004 (build 19041), the `printf` family of functions prints exactly representable floating point numbers according to the IEEE 754 rules for rounding. In previous versions of Windows, exactly representable floating point numbers ending in '5' would always round up. IEEE 754 states that they must round to the closest even digit (also known as "Banker's Rounding"). For example, both `printf("%1.0f", 1.5)` and `printf("%1.0f", 2.5)` should round to 2. Previously, 1.5 would round to 2 and 2.5 would round to 3. This change only affects exactly representable numbers. For example, 2.35 (which, when represented in memory, is closer to 2.3500000000000008) continues to round up to 2.4. Rounding done by these functions now also respects the floating point rounding mode set by `fesetround`. Previously, rounding always chose `FE_TONEAREST` behavior. This change only affects programs built using Visual Studio 2019 version 16.2 and later. To use the legacy floating point rounding behavior, link with `'legacy_stdio_float_rounding.obj'`.

### Generic-text routine mappings

<code>TCHAR_H ROUTINE</code>	<code>_UNICODE AND _MBCS NOT DEFINED</code>	<code>_MBCS DEFINED</code>	<code>_UNICODE DEFINED</code>
------------------------------	---------------------------------------------	----------------------------	-------------------------------

<code>TCHAR.H</code> ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vstprintf_s</code>	<code>vsprintf_s</code>	<code>vsprintf_s</code>	<code>vswprintf_s</code>
<code>_vstprintf_s_l</code>	<code>_vsprintf_s_l</code>	<code>_vsprintf_s_l</code>	<code>_vswprintf_s_l</code>

## Requirements

ROUTINE	REQUIRED HEADER	OPTIONAL HEADERS
<code>vsprintf_s</code> , <code>_vsprintf_s_l</code>	<code>&lt;stdio.h&gt;</code> and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;*</code>
<code>vswprintf_s</code> , <code>_vswprintf_s_l</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code> , and <code>&lt;stdarg.h&gt;</code>	<code>&lt;varargs.h&gt;*</code>

\* Required for UNIX V compatibility.

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_vsprintf_s.c
// Compile with: cl /W4 crt_vsprintf_s.c
// This program uses vsprintf_s to write to a buffer.
// The size of the buffer is determined by _vscprintf.

#include <stdlib.h>
#include <stdio.h>
#include <stdarg.h>

void test(char const * const format, ...)
{
 va_list args;
 int len;
 char * buffer;

 va_start(args, format);
 len = _vscprintf(format, args) // _vscprintf doesn't count
 + 1; // terminating '\0'
 buffer = (char *) malloc(len * sizeof(char));
 if (NULL != buffer)
 {
 vsprintf_s(buffer, len, format, args);
 puts(buffer);
 free(buffer);
 }
 va_end(args);
}

int main(void)
{
 test("%d %c %d", 123, '<', 456);
 test("%s", "This is a string");
}
```

```
123 < 456
This is a string
```

## See also

Stream I/O

[vprintf](#) functions

Format specification syntax: [printf](#) and [wprintf](#) functions

[fprintf](#), [\\_fprintf\\_l](#), [fwprintf](#), [\\_fwprintf\\_l](#)

[printf](#), [\\_printf\\_l](#), [wprintf](#), [\\_wprintf\\_l](#)

[sprintf](#), [\\_sprintf\\_l](#), [swprintf](#), [\\_swprintf\\_l](#), [\\_\\_swprintf\\_l](#)

[va\\_arg](#), [va\\_copy](#), [va\\_end](#), [va\\_start](#)

# vsscanf , vswscanf

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Reads formatted data from a string. More secure versions of these functions are available; see [vscanf\\_s](#) , [vscanf\\_s](#) .

## Syntax

```
int vsscanf(
 const char *buffer,
 const char *format,
 va_list arglist
);
int vswscanf(
 const wchar_t *buffer,
 const wchar_t *format,
 va_list arglist
);
```

### Parameters

`buffer`

Stored data

`format`

Format-control string. For more information, see [Format specification fields: scanf and wscanf functions](#).

`arglist`

Variable argument list.

## Return value

Each of these functions returns the number of fields that are successfully converted and assigned. The return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error or if the end of the string is reached before the first conversion.

If `buffer` or `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno` , `_doserrno` , `_sys_errlist` , and `_sys_nerr` .

## Remarks

The `vsscanf` function reads data from `buffer` into the locations that are given by each argument in the `arglist` argument list. Every argument in the list must be a pointer to a variable that has a type that corresponds to a type specifier in `format` . The `format` argument controls the interpretation of the input fields and has the same form and function as the `format` argument for the `scanf` function. If copying takes place between strings that overlap, the behavior is undefined.

## IMPORTANT

When you use `vsscanf` to read a string, always specify a width for the `%s` format (for example, `"%32s"` instead of `"%s"`); otherwise, incorrectly formatted input can cause a buffer overrun.

`vswscanf` is a wide-character version of `vsscanf`; the arguments to `vswscanf` are wide-character strings. `vsscanf` doesn't handle multibyte hexadecimal characters. `vswscanf` doesn't handle Unicode full-width hexadecimal or "compatibility zone" characters. Otherwise, `vswscanf` and `vsscanf` behave identically.

## Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vstscanf</code>	<code>vsscanf</code>	<code>vsscanf</code>	<code>vswscanf</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>vsscanf</code>	<code>&lt;stdio.h&gt;</code>
<code>vswscanf</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_vsscanf.c
// compile with: /W3
// This program uses vsscanf to read data items
// from a string named tokenstring, then displays them.

#include <stdio.h>
#include <stdarg.h>

int call_vsscanf(char *tokenstring, char *format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vsscanf(tokenstring, format, arglist);
 va_end(arglist);
 return result;
}

int main(void)
{
 char tokenstring[] = "15 12 14...";
 char s[81];
 char c;
 int i;
 float fp;

 // Input various data from tokenstring:
 // max 80 character string:
 call_vsscanf(tokenstring, "%80s", s);
 call_vsscanf(tokenstring, "%c", &c);
 call_vsscanf(tokenstring, "%d", &i);
 call_vsscanf(tokenstring, "%f", &fp);

 // Output the data read
 printf("String = %s\n", s);
 printf("Character = %c\n", c);
 printf("Integer: = %d\n", i);
 printf("Real: = %f\n", fp);
}

```

```

String = 15
Character = 1
Integer: = 15
Real: = 15.000000

```

## See also

### Stream I/O

<a href="#">scanf</a>	<a href="#">_scanf_1</a>	<a href="#">wscanf</a>	<a href="#">_wscanf_1</a>
<a href="#">sscanf</a>	<a href="#">_sscanf_1</a>	<a href="#">swscanf</a>	<a href="#">_swscanf_1</a>
<a href="#">sprintf</a>	<a href="#">_sprintf_1</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_1</a>
<a href="#">vsscanf_s</a>	<a href="#">vswscanf_s</a>		

# vsscanf\_s, vswscanf\_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Reads formatted data from a string. These versions of `vsscanf`, `vswscanf` have security enhancements, as described in [Security features in the CRT](#).

## Syntax

```
int vsscanf_s(
 const char *buffer,
 const char *format,
 va_list argptr
);
int vswscanf_s(
 const wchar_t *buffer,
 const wchar_t *format,
 va_list arglist
);
```

### Parameters

`buffer`

Stored data

`format`

Format-control string. For more information, see [Format specification fields: scanf and wscanf functions](#).

`arglist`

Variable argument list.

## Return value

Each of these functions returns the number of fields that are successfully converted and assigned. The return value doesn't include fields that were read but not assigned. A return value of 0 indicates that no fields were assigned. The return value is `EOF` for an error or if the end of the string is reached before the first conversion.

If `buffer` or `format` is a `NULL` pointer, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, these functions return -1 and set `errno` to `EINVAL`.

For information about these and other error codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

## Remarks

The `vsscanf_s` function reads data from `buffer` into the locations that are given by each argument in the `arglist` argument list. The arguments in the argument list specify pointers to variables that have a type that corresponds to a type specifier in `format`. Unlike the less secure version `vsscanf`, a buffer size parameter is required when you use the type field characters `c`, `C`, `s`, `S`, or string-control sets that are enclosed in `[]`. The buffer size in characters must be supplied as another parameter immediately after each buffer parameter that requires it.

The buffer size includes the terminating null. A width specification field may be used to ensure that the token that's read in will fit into the buffer. If no width specification field is used, and the token read in is too large to fit in the buffer, nothing is written to that buffer.

For more information, see [scanf\\_s](#), [\\_scanf\\_s\\_1](#), [wscanf\\_s](#), [\\_wscanf\\_s\\_1](#) and [scanf Type Field Characters](#).

**NOTE**

The size parameter is of type `unsigned`, not `size_t`.

The `format` argument controls the interpretation of the input fields and has the same form and function as the `format` argument for the `scanf_s` function. If copying occurs between strings that overlap, the behavior is undefined.

`vswscanf_s` is a wide-character version of `vscanf_s`; the arguments to `vswscanf_s` are wide-character strings. `vscanf_s` doesn't handle multibyte hexadecimal characters. `vswscanf_s` doesn't handle Unicode full-width hexadecimal or "compatibility zone" characters. Otherwise, `vswscanf_s` and `vscanf_s` behave identically.

#### Generic-text routine mappings

TCHAR.H ROUTINE	<code>_UNICODE</code> AND <code>_MBCS</code> NOT DEFINED	<code>_MBCS</code> DEFINED	<code>_UNICODE</code> DEFINED
<code>_vstscanf_s</code>	<code>vscanf_s</code>	<code>vscanf_s</code>	<code>vwscanf_s</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>vscanf_s</code>	<code>&lt;stdio.h&gt;</code>
<code>vwscanf_s</code>	<code>&lt;stdio.h&gt;</code> or <code>&lt;wchar.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt_vsscanf_s.c
// compile with: /W3
// This program uses vsscanf_s to read data items
// from a string named tokenstring, then displays them.

#include <stdio.h>
#include <stdarg.h>
#include <stdlib.h>

int call_vsscanf_s(char *tokenstring, char *format, ...)
{
 int result;
 va_list arglist;
 va_start(arglist, format);
 result = vsscanf_s(tokenstring, format, arglist);
 va_end(arglist);
 return result;
}

int main(void)
{
 char tokenstring[] = "15 12 14...";
 char s[81];
 char c;
 int i;
 float fp;

 // Input various data from tokenstring:
 // max 80 character string:
 call_vsscanf_s(tokenstring, "%80s", s, _countof(s));
 call_vsscanf_s(tokenstring, "%c", &c, sizeof(char));
 call_vsscanf_s(tokenstring, "%d", &i);
 call_vsscanf_s(tokenstring, "%f", &fp);

 // Output the data read
 printf("String = %s\n", s);
 printf("Character = %c\n", c);
 printf("Integer: = %d\n", i);
 printf("Real: = %f\n", fp);
}

```

```

String = 15
Character = 1
Integer: = 15
Real: = 15.000000

```

## See also

### Stream I/O

<a href="#">scanf</a>	<a href="#">_scanf_l</a>	<a href="#">wscanf</a>	<a href="#">_wscanf_l</a>
<a href="#">sscanf</a>	<a href="#">_sscanf_l</a>	<a href="#">swscanf</a>	<a href="#">_swscanf_l</a>
<a href="#">sscanf_s</a>	<a href="#">_sscanf_s_l</a>	<a href="#">swscanf_s</a>	<a href="#">_swscanf_s_l</a>
<a href="#">sprintf</a>	<a href="#">_sprintf_l</a>	<a href="#">swprintf</a>	<a href="#">_swprintf_l</a>
<a href="#">vsscanf</a>	<a href="#">vswscanf</a>		

Convert a wide character into its multibyte character representation. A more secure version of this function is available; see [wcrtomb\\_s](#).

## Syntax

```
size_t wcrtomb(
 char *mbchar,
 wchar_t wchar,
 mbstate_t *mbstate
);
template <size_t size>
size_t wcrtomb(
 char (&mbchar)[size],
 wchar_t wchar,
 mbstate_t *mbstate
); // C++ only
```

### Parameters

`mbchar`

The resulting multibyte converted character.

`wchar`

A wide character to convert.

`mbstate`

A pointer to an `mbstate_t` object.

## Return value

Returns the number of bytes required to represent the converted multibyte character, otherwise a -1 if an error occurs.

## Remarks

The `wcrtomb` function converts a wide character, beginning in the specified conversion state contained in `mbstate`, from the value contained in `wchar`, into the address represented by `mbchar`. The return value is the number of bytes required to represent the corresponding multibyte character, but it will not return more than `MB_CUR_MAX` bytes.

If `mbstate` is null, the internal `mbstate_t` object containing the conversion state of `mbchar` is used. If the character sequence `wchar` doesn't have a corresponding multibyte character representation, a -1 is returned, and the `errno` is set to `EILSEQ`.

The `wcrtomb` function differs from `wctomb`, `_wctomb_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application would use `wcsrlen` rather than `wcsnlen`, if a subsequent call to `wcsrtombs` were used instead of `wcstombs`.

In C++, this function has a template overload that invokes the newer, secure counterparts of this function. For

more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Exceptions

The `wcrtomb` function is multithread safe as long as no function in the current thread calls `setlocale` while this function is executing and while the `mbstate` is null.

## Example

```
// crt_wcrtomb.c
// compile with: /W3
// This program converts a wide character
// to its corresponding multibyte character.

#include <string.h>
#include <stdio.h>
#include <wchar.h>

int main(void)
{
 size_t sizeOfCoverton = 0;
 mbstate_t mbstate;
 char mbStr = 0;
 wchar_t* wcStr = L"Q";

 // Reset to initial conversion state
 memset(&mbstate, 0, sizeof(mbstate));

 sizeOfCoverton = wcrtomb(&mbStr, *wcStr, &mbstate); // C4996
 // Note: wcrtomb is deprecated; consider using wcrtomb_s instead
 if (sizeOfCoverton > 0)
 {
 printf("The corresponding wide character \"");
 wprintf(L"%s\"", wcStr);
 printf(" was converted to the \"%c\" ", mbStr);
 printf("multibyte character.\n");
 }
 else
 {
 printf("No corresponding multibyte character "
 "was found.\n");
 }
}
```

The corresponding wide character "Q" was converted to the "Q" multibyte character.

## Requirements

ROUTINE	REQUIRED HEADER
<code>wcrtomb</code>	<wchar.h>

## See also

[Data conversion](#)

Locale

Interpretation of multibyte-character sequences

[mbsinit](#)

# wcrtomb\_s

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert a wide character into its multibyte character representation. A version of `wcrtomb` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t wcrtomb_s(
 size_t *pReturnValue,
 char *mbchar,
 size_t sizeOfmbchar,
 wchar_t *wchar,
 mbstate_t *mbstate
);
template <size_t size>
errno_t wcrtomb_s(
 size_t *pReturnValue,
 char (&mbchar)[size],
 wchar_t *wchar,
 mbstate_t *mbstate
); // C++ only
```

## Parameters

`pReturnValue`

Returns the number of bytes written or -1 if an error occurred.

`mbchar`

The resulting multibyte converted character.

`sizeOfmbchar`

The size of the `mbchar` variable in bytes.

`wchar`

A wide character to convert.

`mbstate`

A pointer to an `mbstate_t` object.

## Return value

Returns zero or an `errno` value if an error occurs.

## Remarks

The `wcrtomb_s` function converts a wide character, beginning in the specified conversion state contained in `mbstate`, from the value contained in `wchar`, into the address represented by `mbchar`. The `pReturnValue` value will be the number of bytes converted, but no more than `MB_CUR_MAX` bytes, or an -1 if an error occurred.

If `mbstate` is null, the internal `mbstate_t` conversion state is used. If the character contained in `wchar` doesn't have a corresponding multibyte character, the value of `pReturnValue` is -1, and the function returns the `errno` value of `EILSEQ`.

The `wcrtomb_s` function differs from `wctomb_s`, `_wctomb_s_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application would use `wcsrlen` rather than `wcslen`, if a subsequent call to `wcsrtombs_s` were used instead of `wcstombs_s`.

In C++, using this function is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Exceptions

The `wcrtomb_s` function is multithread safe as long as no function in the current thread calls `setlocale` while this function is executing and the `mbstate` is null.

## Example

```
// crt_wcrtomb_s.c
// This program converts a wide character
// to its corresponding multibyte character.
//

#include <string.h>
#include <stdio.h>
#include <wchar.h>

int main(void)
{
 errno_t returnValue;
 size_t pReturnValue;
 mbstate_t mbstate;
 size_t sizeOfmbStr = 1;
 char mbchar = 0;
 wchar_t* wchar = L"Q\0";

 // Reset to initial conversion state
 memset(&mbstate, 0, sizeof(mbstate));

 returnValue = wcrtomb_s(&pReturnValue, &mbchar, sizeof(char),
 *wchar, &mbstate);
 if (returnValue == 0) {
 printf("The corresponding wide character \"");
 wprintf(L"%s\"", wchar);
 printf(" was converted to a the \"%c\" ", mbchar);
 printf("multibyte character.\n");
 }
 else
 {
 printf("No corresponding multibyte character "
 "was found.\n");
 }
}
```

The corresponding wide character "Q" was converted to a the "Q" multibyte character.

## Requirements

ROUTINE	REQUIRED HEADER
wcrtomb_s	<wchar.h>

## See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

[mbsinit](#)

Convert a wide character string to its multibyte character string representation. A more secure version of this function is available; see [wcsrtombs\\_s](#).

## Syntax

```
size_t wcsrtombs(
 char *mbstr,
 const wchar_t **wcstr,
 sizeof count,
 mbstate_t *mbstate
);
template <size_t size>
size_t wcsrtombs(
 char (&mbstr)[size],
 const wchar_t **wcstr,
 sizeof count,
 mbstate_t *mbstate
); // C++ only
```

### Parameters

`mbstr`

The resulting converted multibyte character string's address location.

`wcstr`

Indirectly points to the location of the wide character string to be converted.

`count`

The number of characters to be converted.

`mbstate`

A pointer to an `mbstate_t` conversion state object.

## Return value

Returns the number of bytes successfully converted, not including the null terminating null byte (if any), otherwise a -1 if an error occurred.

## Remarks

The `wcsrtombs` function converts a string of wide characters, beginning in the specified conversion state contained in `mbstate`, from the values indirect pointed to in `wcstr`, into the address of `mbstr`. The conversion will continue for each character until: after a null terminating wide character is encountered, when a non corresponding character is encountered or when the next character would exceed the limit contained in `count`. If `wcsrtombs` encounters the wide-character null character (L'\0') either before or when `count` occurs, it converts it to an 8-bit 0 and stops.

Thus, the multibyte character string at `mbstr` is null-terminated only if `wcsrtombs` encounters a wide character null character during conversion. If the sequences pointed to by `wcstr` and `mbstr` overlap, the behavior of `wcsrtombs` is undefined. `wcsrtombs` is affected by the LC\_TYPE category of the current locale.

The `wcsrtombs` function differs from `wcstombs`, `_wcstombs_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application would use `wcsrlen` rather than `wcsnlen`, if a subsequent call to `wcsrtombs` were used instead of `wcstombs`.

If the `mbstr` argument is `NULL`, `wcsrtombs` returns the required size in bytes of the destination string. If `mbstate` is null, the internal `mbstate_t` conversion state is used. If the character sequence `wchar` doesn't have a corresponding multibyte character representation, a -1 is returned, and the `errno` is set to `EILSEQ`.

In C++, this function has a template overload that invokes the newer, secure counterpart of this function. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Exceptions

The `wcsrtombs` function is multithread safe as long as no function in the current thread calls `setlocale` while this function is executing and the `mbstate` isn't null.

## Example

```
// crt_wcsrtombs.cpp
// compile with: /W3
// This code example converts a wide
// character string into a multibyte
// character string.

#include <stdio.h>
#include <memory.h>
#include <wchar.h>
#include <errno.h>

#define MB_BUFFER_SIZE 100

int main()
{
 const wchar_t wcString[] =
 {L"Every good boy does fine."};
 const wchar_t *wcsIndirectString = wcString;
 char mbString[MB_BUFFER_SIZE];
 size_t countConverted;
 mbstate_t mbstate;

 // Reset to initial shift state
 ::memset((void*)&mbstate, 0, sizeof(mbstate));

 countConverted = wcsrtombs(mbString, &wcsIndirectString,
 MB_BUFFER_SIZE, &mbstate); // C4996
 // Note: wcsrtombs is deprecated; consider using wcsrtombs_s
 if (errno == EILSEQ)
 {
 printf("An encoding error was detected in the string.\n");
 }
 else
 {
 printf("The string was successfully converted.\n");
 }
}
```

The string was successfully converted.

## Requirements

ROUTINE	REQUIRED HEADER
<code>wcsrtombs</code>	<wchar.h>

## See also

[Data conversion](#)

[Locale](#)

[Interpretation of multibyte-character sequences](#)

`wcrtomb`

`wcrtomb_s`

`wctomb` , `_wctomb_l`

`wcstombs` , `_wcstombs_l`

`mbsinit`

## wcsrtombs\_s

11/2/2022 • 3 minutes to read • [Edit Online](#)

Convert a wide character string to its multibyte character string representation. A version of `wcsrtombs` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t wcsrtombs_s(
 size_t *pReturnValue,
 char *mbstr,
 size_t sizeInBytes,
 const wchar_t **wcstr,
 sizeof count,
 mbstate_t *mbstate
);
template <size_t size>
errno_t wcsrtombs_s(
 size_t *pReturnValue,
 char (&mbstr)[size],
 const wchar_t **wcstr,
 sizeof count,
 mbstate_t *mbstate
); // C++ only
```

## Parameters

`pReturnValue`

The size in bytes of the converted string, including the null terminator.

`mbstr`

The address of a buffer for the resulting converted multibyte character string.

`sizeInBytes`

The size in bytes of the `mbstr` buffer.

`wcstr`

Points to the wide character string to be converted.

`count`

The maximum number of bytes to be stored in the `mbstr` buffer, or [`\_TRUNCATE`](#).

`mbstate`

A pointer to an `mbstate_t` conversion state object.

## Return value

Zero if successful, an error code on failure.

ERROR CONDITION	RETURN VALUE AND <code>errno</code>
<code>mbstr</code> is <code>NULL</code> and <code>sizeInBytes</code> > 0	<code>EINVAL</code>

ERROR CONDITION	RETURN VALUE AND <code>errno</code>
<code>wcstr</code> is <code>NULL</code>	<code>EINVAL</code>
The destination buffer is too small to contain the converted string (unless <code>count</code> is <code>_TRUNCATE</code> ; see Remarks below)	<code>ERANGE</code>

If any of these conditions occurs, the invalid parameter exception is invoked as described in [Parameter validation](#). If execution is allowed to continue, the function returns an error code and sets `errno` as indicated in the table.

## Remarks

The `wcsrtombs_s` function converts a string of wide characters pointed to by `wcstr` into multibyte characters stored in the buffer pointed to by `mbstr`, using the conversion state contained in `mbstate`. The conversion will continue for each character until one of these conditions is met:

- A null wide character is encountered
- A wide character that can't be converted is encountered
- The number of bytes stored in the `mbstr` buffer equals `count`.

The destination string is always null-terminated (even if there's an error).

If `count` is the special value `_TRUNCATE`, then `wcsrtombs_s` converts as much of the string as will fit into the destination buffer, while still leaving room for a null terminator.

If `wcsrtombs_s` successfully converts the source string, it puts the size in bytes of the converted string, including the null terminator, into `*pReturnValue` (provided `pReturnValue` isn't `NULL`). The size is calculated even if the `mbstr` argument is `NULL`; it provides a way to determine the required buffer size. If `mbstr` is `NULL`, `count` is ignored.

If `wcsrtombs_s` encounters a wide character it can't convert to a multibyte character, it puts -1 in `*pReturnValue`, sets the destination buffer to an empty string, sets `errno` to `EILSEQ`, and returns `EILSEQ`.

If the sequences pointed to by `wcstr` and `mbstr` overlap, the behavior of `wcsrtombs_s` is undefined. `wcsrtombs_s` is affected by the LC\_TYPE category of the current locale.

### IMPORTANT

Ensure that `wcstr` and `mbstr` do not overlap, and that `count` correctly reflects the number of wide characters to convert.

The `wcsrtombs_s` function differs from `wcstombs_s`, `_wcstombs_s_1` by its restartability. The conversion state is stored in `mbstate` for subsequent calls to the same or other restartable functions. Results are undefined when mixing the use of restartable and nonrestartable functions. For example, an application would use `wcsrlen` rather than `wcslen`, if a subsequent call to `wcsrtombs_s` were used instead of `wcstombs_s`.

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Exceptions

The `wcsrtombs_s` function is multithread safe as long as no function in the current thread calls `setlocale` while this function is executing and the `mbstate` is null.

## Example

```
// crt_wcsrtombs_s.cpp
//
// This code example converts a wide
// character string into a multibyte
// character string.
//

#include <stdio.h>
#include <memory.h>
#include <wchar.h>
#include <errno.h>

#define MB_BUFFER_SIZE 100

int main()
{
 const wchar_t wcString[] =
 {L"Every good boy does fine."};
 const wchar_t *wcsIndirectString = wcString;
 char mbString[MB_BUFFER_SIZE];
 size_t countConverted;
 errno_t err;
 mbstate_t mbstate;

 // Reset to initial shift state
 ::memset((void*)&mbstate, 0, sizeof(mbstate));

 err = wcsrtombs_s(&countConverted, mbString, MB_BUFFER_SIZE,
 &wcsIndirectString, MB_BUFFER_SIZE, &mbstate);
 if (err == EILSEQ)
 {
 printf("An encoding error was detected in the string.\n");
 }
 else
 {
 printf("The string was successfully converted.\n");
 }
}
```

The string was successfully converted.

## Requirements

ROUTINE	REQUIRED HEADER
<code>wcsrtombs_s</code>	<wchar.h>

## See also

[Data conversion](#)

[Locale](#)

## Interpretation of multibyte-character sequences

`wcrtomb`  
`wcrtomb_s`  
`wctomb`, `_wctomb_1`  
`wcstombs`, `_wcstombs_1`  
`mbsinit`

# wcstombs , \_wcstombs\_l

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a sequence of wide characters to a corresponding sequence of multibyte characters. More secure versions of these functions are available; see [wcstombs\\_s](#) , [\\_wcstombs\\_s\\_l](#) .

## Syntax

```
size_t wcstombs(
 char *mbstr,
 const wchar_t *wcstr,
 size_t count
);
size_t _wcstombs_l(
 char *mbstr,
 const wchar_t *wcstr,
 size_t count,
 _locale_t locale
);
template <size_t size>
size_t wcstombs(
 char (&mbstr)[size],
 const wchar_t *wcstr,
 size_t count
); // C++ only
template <size_t size>
size_t _wcstombs_l(
 char (&mbstr)[size],
 const wchar_t *wcstr,
 size_t count,
 _locale_t locale
); // C++ only
```

## Parameters

### `mbstr`

The address of a sequence of multibyte characters.

### `wcstr`

The address of a sequence of wide characters.

### `count`

The maximum number of bytes that can be stored in the multibyte output string.

### `Locale`

The locale to use.

## Return value

If `wcstombs` successfully converts the multibyte string, it returns the number of bytes written into the multibyte output string, excluding the terminating `NULL` (if any). If the `mbstr` argument is `NULL`, `wcstombs` returns the required size in bytes of the destination string. If `wcstombs` encounters a wide character it can't convert to a multibyte character, it returns -1 cast to type `size_t` and sets `errno` to `EILSEQ`.

## Remarks

The `wcstombs` function converts the wide-character string pointed to by `wcstr` to the corresponding multibyte characters and stores the results in the `mbstr` array. The `count` parameter indicates the maximum number of bytes that can be stored in the multibyte output string (that is, the size of `mbstr`). In general, it isn't known how many bytes will be required when converting a wide-character string. Some wide characters will require only a single byte in the output string; others require 2 bytes. If there are 2 bytes in the multibyte output string for every wide character in the input string (including the wide character `NULL`), the result is guaranteed to fit.

If `wcstombs` encounters the wide-character `NULL` character (`L'\0'`) either before or when `count` occurs, it converts it to an 8-bit 0 and stops. Thus, the multibyte character string at `mbstr` is null-terminated only if `wcstombs` encounters a wide-character `NULL` character during conversion. If the sequences pointed to by `wcstr` and `mbstr` overlap, the behavior of `wcstombs` is undefined.

If the `mbstr` argument is `NULL`, `wcstombs` returns the required size in bytes of the destination string.

`wcstombs` validates its parameters. If `wcstr` is `NULL`, or if `count` is greater than `INT_MAX`, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function sets `errno` to `EINVAL` and returns -1.

`wcstombs` uses the current locale for any locale-dependent behavior; `_wcstombs_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

In C++, these functions have template overloads that invoke the newer, secure counterparts of these functions. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>wcstombs</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wcstombs_1</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

This program illustrates the behavior of the `wcstombs` function.

```

// crt_wcstombs.c
// compile with: /W3
// This example demonstrates the use
// of wcstombs, which converts a string
// of wide characters to a string of
// multibyte characters.

#include <stdlib.h>
#include <stdio.h>

#define BUFFER_SIZE 100

int main(void)
{
 size_t count;
 char *pMBBuffer = (char *)malloc(BUFFER_SIZE);
 wchar_t *pWCBuffer = L"Hello, world.";

 printf("Convert wide-character string:\n");

 count = wcstombs(pMBBuffer, pWCBuffer, BUFFER_SIZE); // C4996
 // Note: wcstombs is deprecated; consider using wcstombs_s instead
 printf(" Characters converted: %u\n",
 count);
 printf(" Multibyte character: %s\n\n",
 pMBBuffer);

 free(pMBBuffer);
}

```

```

Convert wide-character string:
Characters converted: 13
Multibyte character: Hello, world.

```

## See also

[Data conversion](#)

[Locale](#)

<a href="#">_mbclen</a>	<a href="#">mblen</a>	<a href="#">_mblen_l</a>
<a href="#">mbstowcs</a>	<a href="#">_mbstowcs_l</a>	
<a href="#">mbtowc</a>	<a href="#">_mbtowc_l</a>	
<a href="#">wctomb</a>	<a href="#">_wctomb_l</a>	
<a href="#">WideCharToMultiByte</a>		

## wcstombs\_s , \_wcstombs\_s\_l

11/2/2022 • 3 minutes to read • [Edit Online](#)

Converts a sequence of wide characters to a corresponding sequence of multibyte characters. A version of `wcstombs` , `_wcstombs_l` with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t wcstombs_s(
 size_t *pReturnValue,
 char *mbstr,
 size_t sizeInBytes,
 const wchar_t *wcstr,
 size_t count
);

errno_t _wcstombs_s_l(
 size_t *pReturnValue,
 char *mbstr,
 size_t sizeInBytes,
 const wchar_t *wcstr,
 size_t count,
 _locale_t locale
);

template <size_t size>
errno_t wcstombs_s(
 size_t *pReturnValue,
 char (&mbstr)[size],
 const wchar_t *wcstr,
 size_t count
); // C++ only

template <size_t size>
errno_t _wcstombs_s_l(
 size_t *pReturnValue,
 char (&mbstr)[size],
 const wchar_t *wcstr,
 size_t count,
 _locale_t locale
); // C++ only
```

## Parameters

`pReturnValue`

The size in bytes of the converted string, including the null terminator.

`mbstr`

The address of a buffer for the resulting converted multibyte character string.

`sizeInBytes`

The size in bytes of the `mbstr` buffer.

`wcstr`

Points to the wide character string to be converted.

`count`

The maximum number of bytes to store in the `mbstr` buffer, not including the terminating null character, or `_TRUNCATE`.

#### Locale

The locale to use.

## Return value

Zero if successful, an error code on failure.

ERROR CONDITION	RETURN VALUE AND <code>errno</code>
<code>mbstr</code> is <code>NULL</code> and <code>sizeInBytes</code> > 0	<code>EINVAL</code>
<code>wcstr</code> is <code>NULL</code>	<code>EINVAL</code>
The destination buffer is too small to contain the converted string (unless <code>count</code> is <code>_TRUNCATE</code> ; see Remarks below)	<code>ERANGE</code>

If any of these conditions occurs, the invalid parameter exception is invoked as described in [Parameter validation](#). If execution is allowed to continue, the function returns an error code and sets `errno` as indicated in the table.

## Remarks

The `wcstombs_s` function converts a string of wide characters pointed to by `wcstr` into multibyte characters stored in the buffer pointed to by `mbstr`. The conversion will continue for each character until one of these conditions is met:

- A null wide character is encountered
- A wide character that can't be converted is encountered
- The number of bytes stored in the `mbstr` buffer equals `count`.

The destination string is always null-terminated (even if there's an error).

If `count` is the special value `_TRUNCATE`, then `wcstombs_s` converts as much of the string as will fit into the destination buffer, while still leaving room for a null terminator. If the string is truncated, the return value is `STRUNCATE`, and the conversion is considered successful.

If `wcstombs_s` successfully converts the source string, it puts the size in bytes of the converted string, including the null terminator, into `*pReturnValue` (provided `pReturnValue` isn't `NULL`). The size is calculated even if the `mbstr` argument is `NULL`; it provides a way to determine the required buffer size. If `mbstr` is `NULL`, `count` is ignored.

If `wcstombs_s` encounters a wide character it can't convert to a multibyte character, it puts 0 in `*ReturnValue`, sets the destination buffer to an empty string, sets `errno` to `EILSEQ`, and returns `EILSEQ`.

If the sequences pointed to by `wcstr` and `mbstr` overlap, the behavior of `wcstombs_s` is undefined.

#### IMPORTANT

Ensure that `wcstr` and `mbstr` do not overlap, and that `count` correctly reflects the number of wide characters to convert.

`wcstombs_s` uses the current locale for any locale-dependent behavior; `_wcstombs_s_l` is identical to `wcstombs` except that it uses the locale passed in instead. For more information, see [Locale](#).

In C++, using these functions is simplified by template overloads; the overloads can infer buffer length automatically (eliminating the need to specify a size argument) and they can automatically replace older, non-secure functions with their newer, secure counterparts. For more information, see [Secure template overloads](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>wcstombs_s</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

This program illustrates the behavior of the `wcstombs_s` function.

```
// crt_wcstombs_s.c
// This example converts a wide character
// string to a multibyte character string.
#include <stdio.h>
#include <stdlib.h>
#include <assert.h>

#define BUFFER_SIZE 100

int main(void)
{
 size_t i;
 char *pMBBuffer = (char *)malloc(BUFFER_SIZE);
 const wchar_t*pWCBuffer = L"Hello, world.";

 printf("Convert wide-character string:\n");

 // Conversion
 wcstombs_s(&i, pMBBuffer, (size_t)BUFFER_SIZE,
 pWCBuffer, (size_t)BUFFER_SIZE - 1); // -1 so the appended NULL doesn't fall outside the
 // allocated buffer

 // Output
 printf(" Characters converted: %u\n", i);
 printf(" Multibyte character: %s\n\n", pMBBuffer);

 // Free multibyte character buffer
 if (pMBBuffer)
 {
 free(pMBBuffer);
 }

 return 0;
}
```

```
Convert wide-character string:
Characters converted: 14
Multibyte character: Hello, world.
```

## See also

[Data conversion](#)

[Locale](#)

[\\_mbclen](#), [mblen](#), [\\_mblen\\_l](#)

[mbstowcs](#), [\\_mbstowcs\\_l](#)

[mbtowc](#), [\\_mbtowc\\_l](#)

[wctomb\\_s](#), [\\_wctomb\\_s\\_l](#)

[WideCharToMultiByte](#)

# wctob

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines if a wide character corresponds to a multibyte character and returns its multibyte character representation.

## Syntax

```
int wctob(
 wint_t wchar
) ;
```

### Parameters

`wchar`

Value to translate.

## Return value

If `wctob` successfully converts a wide character, it returns its multibyte character representation only if the multibyte character is a single byte long. If `wctob` encounters a wide character it can't convert to a multibyte character, or if the multibyte character isn't a single byte long, it returns -1.

## Remarks

The `wctob` function converts a wide character contained in `wchar` to the corresponding multibyte character passed by the `int` return value, if the multibyte character is a single byte long.

If `wctob` was unsuccessful and no corresponding multibyte character was found, the function sets `errno` to `EILSEQ` and returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>wctob</code>	<wchar.h>

For more compatibility information, see [Compatibility](#).

## Example

This program illustrates the behavior of the `wctob` function.

```
// crt_wctob.c
#include <stdio.h>
#include <wchar.h>

int main(void)
{
 int bChar = 0;
 wint_t wChar = 0;

 // Set the corresponding wide character to exactly one byte.
 wChar = (wint_t)'A';

 bChar = wctob(wChar);
 if (bChar == WEOF)
 {
 printf("No corresponding multibyte character was found.\n");
 }
 else
 {
 printf("Determined the corresponding multibyte character to"
 " be \'%c\'.\n", bChar);
 }
}
```

Determined the corresponding multibyte character to be "A".

## See also

[Data conversion](#)

[Locale](#)

[\\_mbclen](#) , [mblen](#) , [\\_mblen\\_l](#)

[mbstowcs](#) , [\\_mbstowcs\\_l](#)

[mbtowc](#) , [\\_mbtowc\\_l](#)

[wctomb](#) , [\\_wctomb\\_l](#)

[WideCharToMultiByte](#)

# wctomb , \_wctomb\_l

11/2/2022 • 2 minutes to read • [Edit Online](#)

Convert a wide character to the corresponding multibyte character. More secure versions of these functions are available; see [wctomb\\_s](#) , [\\_wctomb\\_s\\_l](#) .

## Syntax

```
int wctomb(
 char *mbchar,
 wchar_t wchar
);
int _wctomb_l(
 char *mbchar,
 wchar_t wchar,
 _locale_t locale
);
```

### Parameters

`mbchar`

The address of a multibyte character.

`wchar`

A wide character.

## Return value

If `wctomb` converts the wide character to a multibyte character, it returns the number of bytes (which is never greater than `MB_CUR_MAX`) in the wide character. If `wchar` is the wide-character null character (`L'\0'`), `wctomb` returns 1. If the target pointer `mbchar` is `NULL`, `wctomb` returns 0. If the conversion isn't possible in the current locale, `wctomb` returns -1 and `errno` is set to `EILSEQ`.

## Remarks

The `wctomb` function converts its `wchar` argument to the corresponding multibyte character and stores the result at `mbchar`. You can call the function from any point in any program. `wctomb` uses the current locale for any locale-dependent behavior; `_wctomb_l` is identical to `wctomb` except that it uses the locale passed in instead. For more information, see [Locale](#).

`wctomb` validates its parameters. If `mbchar` is `NULL`, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `errno` is set to `EINVAL` and the function returns -1.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>wctomb</code>	<stdlib.h>

For more compatibility information, see [Compatibility](#).

## Example

This program illustrates the behavior of the wctomb function.

```
// crt_wctomb.cpp
// compile with: /W3
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 int i;
 wchar_t wc = L'a';
 char *pmb = (char *)malloc(MB_CUR_MAX);

 printf("Convert a wide character:\n");
 i = wctomb(pmb, wc); // C4996
 // Note: wctomb is deprecated; consider using wctomb_s
 printf(" Characters converted: %u\n", i);
 printf(" Multibyte character: %.1s\n\n", pmb);
}
```

```
Convert a wide character:
 Characters converted: 1
 Multibyte character: a
```

## See also

[Data conversion](#)

[Locale](#)

[\\_mbclen](#) , [mblen](#) , [\\_mblen\\_l](#)  
[mbstowcs](#) , [\\_mbstowcs\\_l](#)  
[mbtowc](#) , [\\_mbtowc\\_l](#)  
[wcstombs](#) , [\\_wcstombs\\_l](#)  
[WideCharToMultiByte](#)

# wctomb\_s, \_wctomb\_s\_l

11/2/2022 • 2 minutes to read • [Edit Online](#)

Converts a wide character to the corresponding multibyte character. A version of [wctomb](#), [\\_wctomb\\_l](#) with security enhancements as described in [Security features in the CRT](#).

## Syntax

```
errno_t wctomb_s(
 int *pRetValue,
 char *mbchar,
 size_t sizeInBytes,
 wchar_t wchar
);
errno_t _wctomb_s_l(
 int *pRetValue,
 char *mbchar,
 size_t sizeInBytes,
 wchar_t wchar,
 _locale_t locale
);
```

## Parameters

*pRetValue*

The number of bytes, or a code indicating the result.

*mbchar*

The address of a multibyte character.

*sizeInBytes*

Size of the buffer *mbchar*.

*wchar*

A wide character.

*Locale*

The locale to use.

## Return value

Zero if successful, an error code on failure.

### Error Conditions

<i>MBCHAR</i>	<i>SIZEINBYTES</i>	RETURN VALUE	<i>PRETVALUE</i>
NULL	>0	EINVAL	not modified
any	> <i>INT_MAX</i>	EINVAL	not modified
any	too small	EINVAL	not modified

If any of the above error conditions occurs, the invalid parameter handler is invoked, as described in [Parameter validation](#). If execution is allowed to continue, `wctomb` returns `EINVAL` and sets `errno` to `EINVAL`.

## Remarks

The `wctomb_s` function converts its `wchar` argument to the corresponding multibyte character and stores the result at `mbchar`. You can call the function from any point in any program.

If `wctomb_s` converts the wide character to a multibyte character, it puts the number of bytes (which is never greater than `MB_CUR_MAX`) in the wide character into the integer pointed to by `pRetValue`. If `wchar` is the wide-character null character (`L'\0'`), `wctomb_s` fills `pRetValue` with 1. If the target pointer `mbchar` is `NULL`, `wctomb_s` puts 0 in `pRetValue`. If the conversion isn't possible in the current locale, `wctomb_s` puts -1 in `pRetValue`.

`wctomb_s` uses the current locale for locale-dependent information; `_wctomb_s_1` is identical except that it uses the locale passed in instead. For more information, see [Locale](#).

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>wctomb_s</code>	<code>&lt;stdlib.h&gt;</code>
<code>_wctomb_s_1</code>	<code>&lt;stdlib.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

This program illustrates the behavior of the `wctomb_s` function.

```
// crt_wctomb_s.cpp
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
 int i;
 wchar_t wc = L'a';
 char *pmb = (char *)malloc(MB_CUR_MAX);

 printf_s("Convert a wide character:\n");
 wctomb_s(&i, pmb, MB_CUR_MAX, wc);
 printf_s(" Characters converted: %u\n", i);
 printf_s(" Multibyte character: %.1s\n\n", pmb);
}
```

```
Convert a wide character:
 Characters converted: 1
 Multibyte character: a
```

## See also

## Data conversion

### Locale

<a href="#">_mbclen</a>	<a href="#">_mblen</a>	<a href="#">_mblen_l</a>
<a href="#">mbstowcs</a>	<a href="#">_mbstowcs_l</a>	
<a href="#">mbtowc</a>	<a href="#">_mbtowc_l</a>	
<a href="#">wcstombs</a>	<a href="#">_wcstombs_l</a>	
<a href="#">WideCharToMultiByte</a>		

Determines a mapping from one set of character codes to another.

## Syntax

```
wctrans_t wctrans(
 const char *property
)
```

### Parameters

*property*

A string that specifies one of the valid transformations.

## Return value

If the `LC_CTYPE` category of the current locale doesn't define a mapping whose name matches the property string `property`, the function returns zero. Otherwise, it returns a nonzero value suitable for use as the second argument to a subsequent call to [towctrans](#).

## Remarks

This function determines a mapping from one set of character codes to another.

The following pairs of calls have the same behavior in all locales, but it's possible to define more mappings even in the "C" locale:

FUNCTION	SAME AS
<code>tolower(c)</code>	<code>towctrans(c, wctrans("towlower"))</code>
<code>toupper(c)</code>	<code>towctrans(c, wctrans("toupper"))</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>wctrans</code>	<code>&lt;wctype.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```
// crt_wctrans.cpp
// compile with: /EHsc
// This example determines a mapping from one set of character
// codes to another.

#include <wchar.h>
#include <wctype.h>
#include <stdio.h>
#include <iostream>

int main()
{
 wint_t c = 'a';
 printf_s("%d\n",c);

 wctrans_t i = wctrans("toupper");
 printf_s("%d\n",i);

 wctrans_t ii = wctrans("towlower");
 printf_s("%d\n",ii);

 wchar_t wc = towctrans(c, i);
 printf_s("%d\n",wc);
}
```

```
97
1
0
65
```

## See also

### Data conversion

[setlocale](#) , [\\_wsetlocale](#)

# wctype

11/2/2022 • 2 minutes to read • [Edit Online](#)

Determines a classification rule for wide-character codes.

## Syntax

```
wctype_t wctype(
 const char * property
)
```

### Parameters

*property*

Property string.

## Return value

If the `LC_CTYPE` category of the current locale doesn't define a classification rule whose name matches the property string *property*, the function returns zero. Otherwise, it returns a nonzero value suitable for use as the second argument to a subsequent call to `towctrans`.

## Remarks

The function determines a classification rule for wide-character codes. The following pairs of calls have the same behavior in all locales (but an implementation can define more classification rules even in the "C" locale):

FUNCTION	SAME AS
<code>iswalnum(c)</code>	<code>iswctype(c, wctype( "alnum" ))</code>
<code>iswalpha(c)</code>	<code>iswctype(c, wctype( "alpha" ))</code>
<code>iswcntrl(c)</code>	<code>iswctype(c, wctype( "cntrl" ))</code>
<code>iswdigit(c)</code>	<code>iswctype(c, wctype( "digit" ))</code>
<code>iswgraph(c)</code>	<code>iswctype(c, wctype( "graph" ))</code>
<code>iswlower(c)</code>	<code>iswctype(c, wctype( "lower" ))</code>
<code>iswprint(c)</code>	<code>iswctype(c, wctype( "print" ))</code>
<code>iswpunct(c)</code>	<code>iswctype(c, wctype( "punct" ))</code>
<code>iswspace(c)</code>	<code>iswctype(c, wctype( "space" ))</code>
<code>iswupper(c)</code>	<code>iswctype(c, wctype( "upper" ))</code>

FUNCTION	SAME AS
<code>iswxdigit(c)</code>	<code>iswctype(c, wctype( "xdigit" ))</code>

## Requirements

ROUTINE	REQUIRED HEADER
<code>wctype</code>	<code>&lt;wctype.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## See also

Data conversion

[`setlocale`](#) , [`\_wsetlocale`](#)

# write

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function name `write` is a deprecated alias for the `_write` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_write` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

# \_write

11/2/2022 • 3 minutes to read • [Edit Online](#)

Writes data to a file.

## Syntax

```
int _write(
 int fd,
 const void *buffer,
 unsigned int count
);
```

### Parameters

`fd`

File descriptor of file into which data is written.

`buffer`

Data to be written.

`count`

Number of bytes.

## Return value

If successful, `_write` returns the number of bytes written. If the actual space remaining on the disk is less than the size of the buffer the function is trying to write to the disk, `_write` fails and doesn't flush any of the buffer's contents to the disk. A return value of -1 indicates an error. If invalid parameters are passed, this function invokes the invalid parameter handler, as described in [Parameter validation](#). If execution is allowed to continue, the function returns -1 and `errno` is set to one of three values: `EBADF`, which means the file descriptor is invalid or the file isn't opened for writing; `ENOSPC`, which means there isn't enough space left on the device for the operation; or `EINVAL`, which means that `buffer` was a null pointer, or that an odd `count` of bytes was passed in Unicode mode.

For more information about these and other return codes, see `errno`, `_doserrno`, `_sys_errlist`, and `_sys_nerr`.

If the file is opened in text mode, each line feed character is replaced with a carriage return-line feed pair in the output. The replacement doesn't affect the return value.

When the file is opened in Unicode translation mode—for example, if `fd` is opened by using `_open` or `_sopen` and a mode parameter that includes `_O_WTEXT`, `_O_U16TEXT`, or `_O_U8TEXT`, or if it's opened by using `fopen` and a mode parameter that includes `ccs=UNICODE`, `ccs=UTF-16LE`, or `ccs=UTF-8`, or if the mode is changed to a Unicode translation mode by using `_setmode`—`buffer` is interpreted as a pointer to an array of `wchar_t` that contains `UTF-16` data. An attempt to write an odd number of bytes in this mode causes a parameter validation error.

## Remarks

The `_write` function writes `count` bytes from `buffer` into the file associated with `fd`. The write operation

begins at the current position of the file pointer (if any) associated with the given file. If the file is open for appending, the operation begins at the current end of the file. After the write operation, the file pointer is increased by the number of bytes written.

When it writes to files opened in text mode, `_write` treats a CTRL+Z character as the logical end of file. When it writes to a device, `_write` treats a CTRL+Z character in the buffer as an output terminator.

By default, this function's global state is scoped to the application. To change this behavior, see [Global state in the CRT](#).

## Requirements

ROUTINE	REQUIRED HEADER
<code>_write</code>	<code>&lt;io.h&gt;</code>

For more compatibility information, see [Compatibility](#).

## Example

```

// crt__write.c
//
// This program opens a file for output and uses _write to write
// some bytes to the file.

#include <io.h>
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <errno.h>
#include <share.h>

char buffer[] = "This is a test of '_write' function";

int main(void)
{
 int fileHandle = 0;
 unsigned bytesWritten = 0;

 if (_open_s(&fileHandle, "write.o", _O_RDWR | _O_CREAT,
 _SH_DENYNO, _S_IREAD | _S_IWRITE))
 return -1;

 if ((bytesWritten = _write(fileHandle, buffer, sizeof(buffer))) == -1)
 {
 switch(errno)
 {
 case EBADF:
 perror("Bad file descriptor!");
 break;
 case ENOSPC:
 perror("No space left on device!");
 break;
 case EINVAL:
 perror("Invalid parameter: buffer was NULL!");
 break;
 default:
 // An unrelated error occurred
 perror("Unexpected error!");
 }
 }
 else
 {
 printf_s("Wrote %u bytes to file.\n", bytesWritten);
 }
 _close(fileHandle);
}

```

Wrote 36 bytes to file.

## See also

### [Low-level I/O](#)

<a href="#">fwrite</a>
<a href="#">_open , _wopen</a>
<a href="#">_read</a>
<a href="#">_setmode</a>

# wcsicoll

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-specific function name `wcsicoll` is a deprecated alias for the `_wcsicoll` function. By default, it generates [Compiler warning \(level 3\) C4996](#). The name is deprecated because it doesn't follow the Standard C rules for implementation-specific names. However, the function is still supported.

We recommend you use `_wcsicoll` instead. Or, you can continue to use this function name, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).

An alternative to the `^` operator.

## Syntax

```
#define xor ^
```

## Remarks

The macro yields the operator `^`.

## Example

```
// iso646_xor.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main()
{
 using namespace std;
 int a = 3, b = 2, result;

 result= a ^ b;
 cout << result << endl;

 result= a xor_eq b;
 cout << result << endl;
}
```

```
1
1
```

## Requirements

Header: `<iso646.h>`

# xor\_eq

11/2/2022 • 2 minutes to read • [Edit Online](#)

An alternative to the `^=` operator.

## Syntax

```
#define xor_eq ^=
```

## Remarks

The macro yields the operator `^=`.

## Example

```
// iso646_xor_eq.cpp
// compile with: /EHsc
#include <iostream>
#include <iso646.h>

int main()
{
 using namespace std;
 int a = 3, b = 2, result;

 result= a ^= b;
 cout << result << endl;

 a = 3;
 b = 2;

 result= a xor_eq b;
 cout << result << endl;
}
```

```
1
1
```

## Requirements

**Header:** <iso646.h>

`y0`, `y1`, `yn`

11/2/2022 • 2 minutes to read • [Edit Online](#)

The Microsoft-implemented POSIX function names `y0`, `y1`, and `yn` are deprecated aliases for the `_y0`, `_y1`, and `_yn` functions. By default, they generate [Compiler warning \(level 3\) C4996](#). The names are deprecated because they don't follow the Standard C rules for implementation-specific names. However, the functions are still supported.

We recommend you use `_y0`, `_y1`, and `_yn` instead. Or, you can continue to use these function names, and disable the warning. For more information, see [Turn off the warning](#) and [POSIX function names](#).