NAME

dup, dup2 – duplicate a file descriptor

SYNOPSIS

#include <unistd.h>

int dup(int *oldfd***);**
int dup2(int *oldfd***, int** *newfd***);**

DESCRIPTION

dup() and **dup2**() create a copy of the file descriptor *oldfd*.

dup() uses the lowest-numbered unused descriptor for the new descriptor.

dup2() makes *newfd* be the copy of *oldfd*, closing *newfd* first if necessary, but note the following:

- If *oldfd* is not a valid file descriptor, then the call fails, and *newfd* is not closed.
- If *oldfd* is a valid file descriptor, and *newfd* has the same value as *oldfd*, then **dup2**() does nothing, and returns *newfd*.

After a successful return from **dup**() or **dup2**(), the old and new file descriptors may be used interchangeably. They refer to the same open file description (see **open**(2)) and thus share file offset and file status flags; for example, if the file offset is modified by using **lseek**(2) on one of the descriptors, the offset is also changed for the other.

The two descriptors do not share file descriptor flags (the close-on-exec flag). The close-on-exec flag (**FD_CLOEXEC**; see **fcntl**(2)) for the duplicate descriptor is off.

RETURN VALUE

dup() and **dup2**() return the new descriptor, or −1 if an error occurred (in which case, *errno* is set appropriately).

ERRORS

EBADF
oldfd isn't an open file descriptor, or *newfd* is out of the allowed range for file descriptors.

EBUSY
(Linux only) This may be returned by **dup2**() during a race condition with **open**(2) and **dup**().

EINTR
The **dup2**() call was interrupted by a signal; see **signal**(7).

EMFILE
The process already has the maximum number of file descriptors open and tried to open a new one.

SEE ALSO

close(2), **fcntl**(2), **open**(2)

NAME

exec, execl, execv, execle, execve, execlp, execvp – execute a file

SYNOPSIS

#include <unistd.h>

int execl(const char * *path***, const char *** *arg0***, . . ., const char *** *argn***, char *** /*NULL*/**);**

int execv(const char * *path***, char *const** *argv[ ]***);**

int execle(const char * *path***,char *const** *arg0[ ]***, . . . , const char *** *argn***,**
char * /*NULL*/**, char *const** *envp[ ]***);**

int execve (const char * *path***, char *const** *argv[ ]* **char *const** *envp[ ]***);**

int execlp (const char * *file***, const char *** *arg0***, . . ., const char *** *argn***, char *** /*NULL*/**);**

int execvp (const char * *file***, char *const** *argv[ ]***);**

DESCRIPTION

Each of the functions in the **exec** family overlays a new process image on an old process. The new process image is constructed from an ordinary, executable file. This file is either an executable object file, or a file of data for an interpreter. There can be no return from a successful call to one of these functions because the calling process image is overlaid by the new process image.

When a C program is executed, it is called as follows:

int main (int argc, char *argv[], char *envp[]);

where *argc* is the argument count, *argv* is an array of character pointers to the arguments themselves, and *envp* is an array of character pointers to the environment strings. As indicated, *argc* is at least one, and the first member of the array points to a string containing the name of the file.

The arguments *arg0***, . . .,** *argn* point to null-terminated character strings. These strings constitute the argument list available to the new process image. Conventionally at least *arg0* should be present. The *arg0* argument points to a string that is the same as *path* (or the last component of *path*). The list of argument strings is terminated by a **(char *)0** argument.

The *argv* argument is an array of character pointers to null-terminated strings. These strings constitute the argument list available to the new process image. By convention, *argv* must have at least one member, and it should point to a string that is the same as *path* (or its last component). The *argv* argument is terminated by a null pointer.

The *path* argument points to a path name that identifies the new process file.

The *file* argument points to the new process file. If *file* does not contain a slash character, the path prefix for this file is obtained by a search of the directories passed in the **PATH** environment variable (see **environ**(5)).

File descriptors open in the calling process remain open in the new process.

Signals that are being caught by the calling process are set to the default disposition in the new process image (see **signal**(3C)). Otherwise, the new process image inherits the signal dispositions of the calling process.

RETURN VALUES

If a function in the **exec** family returns to the calling process, an error has occurred; the return value is **−1** and **errno** is set to indicate the error.

NAME

fopen, fdopen, fileno – stream open functions

SYNOPSIS

#include <stdio.h>

FILE *fopen(const char * *path***, const char ***mode***);**
FILE *fdopen(int *fildes***, const char ***mode***);**
int fileno(FILE ***stream*);**

DESCRIPTION

The **fopen** function opens the file whose name is the string pointed to by *path* and associates a stream with it.

The argument *mode* points to a string beginning with one of the following sequences (Additional characters may follow these sequences.):

r Open text file for reading. The stream is positioned at the beginning of the file.

r+ Open for reading and writing. The stream is positioned at the beginning of the file.

w Truncate file to zero length or create text file for writing. The stream is positioned at the beginning of the file.

w+ Open for reading and writing. The file is created if it does not exist, otherwise it is truncated. The stream is positioned at the beginning of the file.

a Open for appending (writing at end of file). The file is created if it does not exist. The stream is positioned at the end of the file.

a+ Open for reading and appending (writing at end of file). The file is created if it does not exist. The stream is positioned at the end of the file.

The **fdopen** function associates a stream with the existing file descriptor, *fildes*. The *mode* of the stream (one of the values "r", "r+", "w", "w+", "a", "a+") must be compatible with the mode of the file descriptor. The file position indicator of the new stream is set to that belonging to *fildes*, and the error and end-of-file indicators are cleared. Modes "w" or "w+" do not cause truncation of the file. The file descriptor is not dup'ed, and will be closed when the stream created by **fdopen** is closed. The result of applying **fdopen** to a shared memory object is undefined.

The function **fileno**() examines the argument *stream* and returns its integer descriptor.

RETURN VALUE

Upon successful completion **fopen**, **fdopen** and **freopen** return a **FILE** pointer. Otherwise, **NULL** is returned and the global variable *errno* is set to indicate the error.

ERRORS

EINVAL
The *mode* provided to **fopen**, **fdopen**, or **freopen** was invalid.

The **fopen**, **fdopen** and **freopen** functions may also fail and set *errno* for any of the errors specified for the routine **malloc**(3).

The **fopen** function may also fail and set *errno* for any of the errors specified for the routine **open**(2).

The **fdopen** function may also fail and set *errno* for any of the errors specified for the routine **fcntl**(2).

SEE ALSO

open(2), **fclose**(3), **fileno**(3)

NAME

getpid, getppid – get process identification

SYNOPSIS

#include <sys/types.h>
#include <unistd.h>

pid_t getpid(void);
pid_t getppid(void);

DESCRIPTION

getpid() returns the process ID (PID) of the calling process. (This is often used by routines that generate unique temporary filenames.)

getppid() returns the process ID of the parent of the calling process. This will be either the ID of the process that created this process using **fork**(), or, if that process has already terminated, the ID of the process to which this process has been reparented (either **init**(1) or a "subreaper" process defined via the **prctl**(2) **PR_SET_CHILD_SUBREAPER** operation).

ERRORS

These functions are always successful.

SEE ALSO

fork(2), **kill**(2), **exec**(3)

NAME

open – open and possibly create a file

SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>

int open(const char *pathname, int flags);
int open(const char *pathname, int flags, mode_t mode);
```

DESCRIPTION

The **open**() system call opens the file specified by *pathname*. If the specified file does not exist, it may optionally (if **O_CREAT** is specified in *flags*) be created by **open**().

The return value of **open**() is a file descriptor, a small, nonnegative integer that is used in subsequent system calls (**read**(2), **write**(2), **lseek**(2), **fcntl**(2), etc.) to refer to the open file. The file descriptor returned by a successful call will be the lowest-numbered file descriptor not currently open for the process.

The argument *flags* must include one of the following *access modes*: **O_RDONLY**, **O_WRONLY**, or **O_RDWR**. These request opening the file read-only, write-only, or read/write, respectively.

The full list of file creation flags and file status flags is as follows:

O_CREAT

If *pathname* does not exist, create it as a regular file.

The *mode* argument specifies the file mode bits be applied when a new file is created. This argument must be supplied when **O_CREAT** or **O_TMPFILE** is specified in *flags*; if neither **O_CREAT** nor **O_TMPFILE** is specified, then *mode* is ignored. The effective mode is modified by the process's *umask* in the usual way: in the absence of a default ACL, the mode of the created file is *(mode & ˜umask)*. Note that this mode applies only to future accesses of the newly created file; the **open**() call that creates a read-only file may well return a read/write file descriptor.

The following symbolic constants are provided for *mode*:

S_IRWXU S_IRUSR S_IWUSR S_IXUSR S_IRWXG S_IRGRP S_IWGRP S_IXGRP S_IRWXO S_IROTH S_IWOTH S_IXOTH

RETURN VALUE

open() return the new file descriptor, or −1 if an error occurred (in which case, *errno* is set appropriately).

ERRORS

open() can fail with the following errors:

EACCES

The requested access to the file is not allowed, or search permission is denied for one of the directories in the path prefix of *pathname*, or the file did not exist yet and write access to the parent directory is not allowed. (See also **path_resolution**(7).)

...

NAME

opendir – open a directory / readdir – read a directory

SYNOPSIS

```
#include <sys/types.h>

#include <dirent.h>

DIR *opendir(const char *name);

struct dirent *readdir(DIR *dir);
```

DESCRIPTION opendir

The **opendir()** function opens a directory stream corresponding to the directory *name*, and returns a pointer to the directory stream. The stream is positioned at the first entry in the directory.

RETURN VALUE

The **opendir()** function returns a pointer to the directory stream or NULL if an error occurred.

DESCRIPTION readdir

The **readdir()** function returns a pointer to a dirent structure representing the next directory entry in the directory stream pointed to by *dir*. It returns NULL on reaching the end-of-file or if an error occurred. It is safe to use **readdir()** inside threads if the pointers passed as *dir* are created by distinct calls to **opendir()**.

The data returned by **readdir()** is overwritten by subsequent calls to **readdir()** for the **same** directory stream.

The *dirent* structure is defined as follows:

```
struct dirent {
     long              d_ino;         /* inode number */
     off_t             d_off;         /* offset to the next dirent */
     unsigned short    d_reclen;      /* length of this record */
     unsigned char     d_type;        /* type of file; not supported by all filesystem types */
     char              d_name[256];   /* filename */
};
```

RETURN VALUE

The **readdir()** function returns a pointer to a dirent structure, or NULL if an error occurs or end-of-file is reached.

ERRORS

EACCES

Permission denied.

ENOENT

Directory does not exist, or *name* is an empty string.

ENOTDIR

name is not a directory.

NAME

sigaction − POSIX signal handling functions.

SYNOPSIS

#include <signal.h>

int sigaction(int *signum***, const struct sigaction ****act***, struct sigaction ****oldact***);**

DESCRIPTION

The **sigaction** system call is used to change the action taken by a process on receipt of a specific signal.

signum specifies the signal and can be any valid signal except **SIGKILL** and **SIGSTOP**.

If *act* is non−null, the new action for signal *signum* is installed from *act*. If *oldact* is non−null, the previous action is saved in *oldact*.

The **sigaction** structure is defined as something like

```
struct sigaction {
      void        (*sa_handler)(int);
      void        (*sa_sigaction)(int, siginfo_t *, void *);
      sigset_t    sa_mask;
      int         sa_flags;
      void        (*sa_restorer)(void);
}
```

On some architectures a union is involved - do not assign to both *sa_handler* and *sa_sigaction*.

The *sa_restorer* element is obsolete and should not be used. POSIX does not specify a *sa_restorer* element.

sa_handler specifies the action to be associated with *signum* and may be **SIG_DFL** for the default action, **SIG_IGN** to ignore this signal, or a pointer to a signal handling function.

sa_mask gives a mask of signals which should be blocked during execution of the signal handler. In addition, the signal which triggered the handler will be blocked, unless the **SA_NODEFER** or **SA_NOMASK** flags are used.

sa_flags specifies a set of flags which modify the behaviour of the signal handling process. It is formed by the bitwise OR of zero or more of the following:

SA_NOCLDSTOP
If *signum* is **SIGCHLD**, do not receive notification when child processes stop (i.e., when child processes receive one of **SIGSTOP**, **SIGTSTP**, **SIGTTIN** or **SIGTTOU**).

SA_RESTART
Provide behaviour compatible with BSD signal semantics by making certain system calls restartable across signals.

RETURN VALUES

sigaction returns 0 on success and -1 on error.

ERRORS

EINVAL
An invalid signal was specified. This will also be generated if an attempt is made to change the action for **SIGKILL** or **SIGSTOP**, which cannot be caught.

SEE ALSO

kill(1), **kill**(2), **killpg**(2), **pause**(2), **sigsetops**(3),

NAME

sigprocmask − change and/or examine caller’s signal mask
sigsuspend − install a signal mask and suspend caller until signal

SYNOPSIS

#include <signal.h>

int sigprocmask(int *how***, const sigset_t ****set***, sigset_t ****oset***);**

int sigsuspend(const sigset_t ****set*);**

DESCRIPTION sigprocmask

The **sigprocmask( )** function is used to examine and/or change the caller’s signal mask. If the value is **SIG_BLOCK**, the set pointed to by the argument *set* is added to the current signal mask. If the value is **SIG_UNBLOCK**, the set pointed by the argument *set* is removed from the current signal mask. If the value is **SIG_SETMASK**, the current signal mask is replaced by the set pointed to by the argument *set*. If the argument *oset* is not NULL, the previous mask is stored in the space pointed to by *oset*. If the value of the argument *set* is NULL, the value *how* is not significant and the caller’s signal mask is unchanged; thus, the call can be used to inquire about currently blocked signals.

If there are any pending unblocked signals after the call to **sigprocmask( )**, at least one of those signals will be delivered before the call to **sigprocmask( )** returns.

It is not possible to block those signals that cannot be ignored this restriction is silently imposed by the system. See **sigaction**(2).

If **sigprocmask( )** fails, the caller’s signal mask is not changed.

RETURN VALUES

On success, **sigprocmask( )** returns **0**. On failure, it returns **−1** and sets **errno** to indicate the error.

ERRORS

sigprocmask( ) fails if any of the following is true:

EFAULT *set* or *oset* points to an illegal address.

EINVAL The value of the *how* argument is not equal to one of the defined values.

DESCRIPTION sigsuspend

sigsuspend( ) replaces the caller’s signal mask with the set of signals pointed to by the argument *set* and then suspends the caller until delivery of a signal whose action is either to execute a signal catching function or to terminate the process.

If the action is to terminate the process, **sigsuspend( )** does not return. If the action is to execute a signal catching function, **sigsuspend( )** returns after the signal catching function returns. On return, the signal mask is restored to the set that existed before the call to **sigsuspend( )**.

It is not possible to block those signals that cannot be ignored (see **signal**(5)); this restriction is silently imposed by the system.

RETURN VALUES

Since **sigsuspend( )** suspends process execution indefinitely, there is no successful completion return value. On failure, it returns −1 and sets **errno** to indicate the error.

ERRORS

sigsuspend( ) fails if either of the following is true:

EFAULT *set* points to an illegal address.

EINTR A signal is caught by the calling process and control is returned from the signal catching function.

SEE ALSO

sigaction(2), **sigsetops**(3C),

NAME

sigsetops, sigemptyset, sigfillset, sigaddset, sigdelset, sigismember – manipulate sets of signals

SYNOPSIS

#include <signal.h>

int sigemptyset(sigset_t ***set*);**

int sigfillset(sigset_t ***set*);**

int sigaddset(sigset_t ***set*, int** *signo***);**

int sigdelset(sigset_t ***set*, int** *signo***);**

int sigismember(sigset_t ***set*, int** *signo***);**

DESCRIPTION

These functions manipulate *sigset_t* data types, representing the set of signals supported by the implementation.

sigemptyset( ) initializes the set pointed to by *set* to exclude all signals defined by the system.

sigfillset( ) initializes the set pointed to by *set* to include all signals defined by the system.

sigaddset( ) adds the individual signal specified by the value of *signo* to the set pointed to by *set*.

sigdelset( ) deletes the individual signal specified by the value of *signo* from the set pointed to by *set*.

sigismember( ) checks whether the signal specified by the value of *signo* is a member of the set pointed to by *set*.

Any object of type *sigset_t* must be initialized by applying either **sigemptyset( )** or **sigfillset( )** before applying any other operation.

RETURN VALUES

Upon successful completion, the **sigismember( )** function returns a value of one if the specified signal is a member of the specified set, or a value of 0 if it is not. Upon successful completion, the other functions return a value of 0. Otherwise a value of −1 is returned and **errno** is set to indicate the error.

ERRORS

sigaddset( ), **sigdelset( )**, and **sigismember( )** will fail if the following is true:

EINVAL The value of the *signo* argument is not a valid signal number.

sigfillset( ) will fail if the following is true:

EFAULT The *set* argument specifies an invalid address.

SEE ALSO

sigaction(2), **sigpending**(2), **sigprocmask**(2), **sigsuspend**(2), **attributes**(5), **signal**(5)

NAME

stat, fstat, lstat – get file status

SYNOPSIS

#include <sys/types.h>
#include <sys/stat.h>
#include <unistd.h>

int stat(const char ***path*, struct stat ***buf***);**
int fstat(int *fd***, struct stat ***buf***);**
int lstat(const char ***path*, struct stat ***buf***);**

Feature Test Macro Requirements for glibc (see **feature_test_macros**(7)):

lstat(): _BSD_SOURCE || _XOPEN_SOURCE >= 500

DESCRIPTION

These functions return information about a file. No permissions are required on the file itself, but — in the case of **stat**() and **lstat**() — execute (search) permission is required on all of the directories in *path* that lead to the file.

stat() stats the file pointed to by *path* and fills in *buf*.

lstat() is identical to **stat**(), except that if *path* is a symbolic link, then the link itself is stat-ed, not the file that it refers to.

fstat() is identical to **stat**(), except that the file to be stat-ed is specified by the file descriptor *fd*.

All of these system calls return a *stat* structure, which contains the following fields:

```
struct stat {
    dev_t      st_dev;      /* ID of device containing file  */
    ino_t      st_ino;      /* inode number                  */
    mode_t     st_mode;     /* protection                    */
    nlink_t    st_nlink;    /* number of hard links          */
    uid_t      st_uid;      /* user ID of owner              */
    gid_t      st_gid;      /* group ID of owner             */
    dev_t      st_rdev;     /* device ID (if special file)   */
    off_t      st_size;     /* total size, in bytes          */
    blksize_t  st_blksize;  /* blocksize for file system I/O */
    blkcnt_t   st_blocks;   /* number of blocks allocated    */
    time_t     st_atime;    /* time of last access           */
    time_t     st_mtime;    /* time of last modification     */
    time_t     st_ctime;    /* time of last status change    */
};
```

The *st_dev* field describes the device on which this file resides.

The *st_rdev* field describes the device that this file (inode) represents.

The *st_size* field gives the size of the file (if it is a regular file or a symbolic link) in bytes. The size of a symlink is the length of the pathname it contains, without a trailing null byte.

The *st_blocks* field indicates the number of blocks allocated to the file, 512-byte units. (This may be smaller than *st_size*/512 when the file has holes.)

The *st_blksize* field gives the "preferred" blocksize for efficient file system I/O. (Writing to a file in smaller chunks may cause an inefficient read-modify-rewrite.)

Not all of the Linux file systems implement all of the time fields. Some file system types allow mounting in such a way that file accesses do not cause an update of the *st_atime* field. (See "noatime" in **mount**(8).)

The field *st_atime* is changed by file accesses, for example, by **execve**(2), **mknod**(2), **pipe**(2), **utime**(2) and **read**(2) (of more than zero bytes). Other routines, like **mmap**(2), may or may not update *st_atime*.

The field *st_mtime* is changed by file modifications, for example, by **mknod**(2), **truncate**(2), **utime**(2) and **write**(2) (of more than zero bytes). Moreover, *st_mtime* of a directory is changed by the creation or deletion of files in that directory. The *st_mtime* field is *not* changed for changes in owner, group, hard link count, or mode.

The field *st_ctime* is changed by writing or by setting inode information (i.e., owner, group, link count, mode, etc.).

The following POSIX macros are defined to check the file type using the *st_mode* field:

S_ISREG(m)	is it a regular file?
S_ISDIR(m)	directory?
S_ISCHR(m)	character device?
S_ISBLK(m)	block device?
S_ISFIFO(m)	FIFO (named pipe)?
S_ISLNK(m)	symbolic link? (Not in POSIX.1-1996.)
S_ISSOCK(m)	socket? (Not in POSIX.1-1996.)

RETURN VALUE

On success, zero is returned. On error, −1 is returned, and *errno* is set appropriately.

ERRORS

EACCES
Search permission is denied for one of the directories in the path prefix of *path*. (See also **path_resolution**(7).)

EBADF
fd is bad.

EFAULT
Bad address.

ELOOP
Too many symbolic links encountered while traversing the path.

ENAMETOOLONG
File name too long.

ENOENT
A component of the path *path* does not exist, or the path is an empty string.

ENOMEM
Out of memory (i.e., kernel memory).

ENOTDIR
A component of the path is not a directory.

SEE ALSO

access(2), **chmod**(2), **chown**(2), **fstatat**(2), **readlink**(2), **utime**(2), **capabilities**(7), **symlink**(7)

NAME

strcat, strchr, strcmp, strcpy, strdup, strlen, strncat, strncmp, strncpy, strstr, strtok − string operations

SYNOPSIS

#include <string.h>

char *strcat(char ****dest*, const char ****src***);**
Append the string *src* to the string *dest*, returning a pointer *dest*.

char *strchr(const char ****s*, int** *c***);**
Return a pointer to the first occurrence of the character *c* in the string *s*.

int strcmp(const char ****s1*, const char ****s2***);**
Compare the strings *s1* with *s2*. It returns an integer less than, equal to, or greater than zero if *s1* is found, respectively, to be less than, to match, or be greater than *s2*.

char *strcpy(char ****dest*, const char ****src***);**
Copy the string *src* to *dest*, returning a pointer to the start of *dest*.

char *strdup(const char ****s*);**
Return a duplicate of the string *s* in memory allocated using **malloc**(3).

size_t strlen(const char ****s*);**
Return the length of the string *s*.

char *strncat(char ****dest*, const char ****src***, size_t** *n***);**
Append at most *n* characters from the string *src* to the string *dest*, returning a pointer to *dest*.

int strncmp(const char ****s1*, const char ****s2***, size_t** *n***);**
Compare at most *n* bytes of the strings *s1* and *s2*. It returns an integer less than, equal to, or greater than zero if *s1* is found, respectively, to be less than, to match, or be greater than *s2*.

char *strncpy(char ****dest*, const char ****src***, size_t** *n***);**
Copy at most *n* bytes from string *src* to *dest*, returning a pointer to the start of *dest*.

char *strstr(const char ****haystack*, const char ****needle***);**
Find the first occurrence of the substring *needle* in the string *haystack*, returning a pointer to the found substring.

char *strtok(char ****s*, const char ****delim***);**
Extract tokens from the string *s* that are delimited by one of the bytes in *delim*.

DESCRIPTION

The string functions perform operations on null-terminated strings.

NAME

unlink − remove directory entry

SYNOPSIS

#include <unistd.h>

int unlink(const char ***path*);**

DESCRIPTION

The **unlink( )** function removes a link to a file. It removes the link named by the pathname pointed to by *path* and decrements the link count of the file referenced by the link.

When the file's link count becomes 0 and no process has the file open, the space occupied by the file will be freed and the file will no longer be accessible. If one or more processes have the file open when the last link is removed, the link will be removed before **unlink( )** returns, but the removal of the file contents will be postponed until all references to the file are closed.

RETURN VALUES

Upon successful completion, **0** is returned. Otherwise, **−1** is returned and **errno** is set to indicate the error.

ERRORS

The **unlink( )** function will fail and not unlink the file if:

EACCES Search permission is denied for a component of the *path* prefix.

EACCES Write permission is denied on the directory containing the link to be removed.

ENOENT The named file does not exist or is a null pathname.

ENOTDIR A component of the *path* prefix is not a directory.

EPERM The named file is a directory and the effective user of the calling process is not superuser.

NAME

waitpid − wait for child process to change state

SYNOPSIS

#include <sys/types.h>
#include <sys/wait.h>

pid_t waitpid(pid_t *pid***, int ***stat_loc***, int** *options***);**

DESCRIPTION

waitpid( ) suspends the calling process until one of its children changes state; if a child process changed state prior to the call to **waitpid( )**, return is immediate. *pid* specifies a set of child processes for which status is requested.

If *pid* is equal to **(pid_t)−1**, status is requested for any child process.

If *pid* is greater than **(pid_t)0**, it specifies the process ID of the child process for which status is requested.

If *pid* is equal to **(pid_t)0** status is requested for any child process whose process group ID is equal to that of the calling process.

If *pid* is less than **(pid_t)−1**, status is requested for any child process whose process group ID is equal to the absolute value of *pid*.

If **waitpid( )** returns because the status of a child process is available, then that status may be evaluated with the macros defined by **wstat**(5)**.** If the calling process had specified a non-zero value of *stat_loc*, the status of the child process will be stored in the location pointed to by *stat_loc*.

The *options* argument is constructed from the bitwise inclusive OR of zero or more of the following flags, defined in the header **<sys/wait.h>**:

WCONTINUED The status of any continued child process specified by *pid*, whose status has not been reported since it continued, is also reported to the calling process.

WNOHANG **waitpid( )** will not suspend execution of the calling process if status is not immediately available for one of the child processes specified by *pid*.

WNOWAIT Keep the process whose status is returned in *stat_loc* in a waitable state. The process may be waited for again with identical results.

If *wstatus* is not NULL, **wait**() and **waitpid**() store status information in the *int* to which it points. This integer can be inspected with the following macros (which take the integer itself as an argument, not a pointer to it, as is done in **wait**() and **waitpid**()!):

WIFEXITED(*wstatus***)**
returns true if the child terminated normally, that is, by calling **exit**(3) or **_exit**(2), or by returning from main().

WEXITSTATUS(*wstatus***)**
returns the exit status of the child. This consists of the least significant 8 bits of the *status* argument that the child specified in a call to **exit**(3) or **_exit**(2) or as the argument for a return statement in main(). This macro should be employed only if **WIFEXITED** returned true.

WIFSIGNALED(*wstatus***)**
returns true if the child process was terminated by a signal.

WTERMSIG(*wstatus***)**
returns the number of the signal that caused the child process to terminate. This macro should be employed only if **WIFSIGNALED** returned true.

RETURN VALUES

If **waitpid( )** returns because the status of a child process is available, this function returns a value equal to the process ID of the child process for which status is reported. If **waitpid( )** returns due to the delivery of a signal to the calling process, **−1** is returned and **errno** is set to **EINTR**. If this function was invoked with

WNOHANG set in *options*, it has at least one child process specified by *pid* for which status is not available, and status is not available for any process specified by *pid*, **0** is returned. Otherwise, **–1** is returned, and **errno** is set to indicate the error.

ERRORS

waitpid( ) will fail if one or more of the following is true:

ECHILD The process or process group specified by *pid* does not exist or is not a child of the calling process or can never be in the states specified by *options*.

EINTR **waitpid( )** was interrupted due to the receipt of a signal sent by the calling process.

EINVAL An invalid value was specified for *options*.

SEE ALSO

exec(2), **exit**(2), **fork**(2), **sigaction**(2)