

Multiprocessing

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

int fork(void)

Fork the current process creating a child.
Return 0 in the child process or child ID for the parent

int getpid(void)

Return the ID of the calling process

int getppid(void)

Return the ID of the parent of the calling process

void exit(status)

Process termination

unsigned int sleep(unsigned int seconds)

Pause the execution of the calling process for *seconds* seconds or until a signal is received

Process Synchronization

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

pid_t wait(*-status)

Wait until a child process terminate the execution;
On success return the pid of the child, on failure return -1;
status is the address of the variable containing the exit status

pid_t waitpid(pid_t pid, int *status, int options)

Wait until the child specified with the *pid* argument terminate the execution;
status is the exit status of the terminating process;

Shared Memory

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

int shmget Create a shared memory or connect to an existing segment;
(key_t key, int size, int shmflg) *key* is a numeric key assigned to the segment. If IPC_PRIVATE is used the segment can be only used by parent and children;
int shmflg *size* is the size of the memory segment; *shmflg* is a flag field: IPC_CREATE create a new segment, IPC_EXCL cause the command to fail if the segment already exist.
Return the shared memory segment id or -1 if fail.

Shared Memory (cont)

void shmatt(int shmid, const void *shmaddr, int shmflg) Attach to the shared memory segment and return the address.
shmid is the shared memory segment id;
shmaddr is the variable where the address of the segment is stored;
shmflg is used to specify the access permissions for the shared memory segment and to request special attachment conditions, such as a read-only segment.

int shmdt(const void *shmaddr) Detaches the shared memory segment located at the address specified by *shmaddr* from the address space of the calling process.

int shmctl(int shmid, int cmd, struct shm_ds *buf) Performs the control operation specified by *cmd* on the shared memory segment whose identifier is given in *shmid*. Typical usage: `shmctl(shmid, IPC_RMID, 0);`
Remove shared memory segment



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Message Queue

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

int msgget(key_t key, int flag) Creates a message queue. *key* is an integer that specifies the queue key; *flag* indicates creation conditions and access permissions (same as `shmget`). Return a message queue identifier or -1 in case of failure.

int msgsnd(int msqid, const void *msgp, size_t nbytes, int flag); Send a message on the queue. *msqid* is the identifier returned by `msgget` command; *msgp* is the pointer to the message struct.

```
Struct msgbuf {
    long mtype;
    char mtext [TEXT
LENGHT];
};
nbytes is the maximum
length of the message;
```

Message Queue (cont)

int msgrcv(int msqid, void *msgp, size_t msgsz, long msgtype, int msgflg) Receive a message from the queue. *msqid* corresponds to the message queue identifier; *msgp* is the pointer to a message struct (the same used in `msgsnd`); *msgsz* is the number of bytes to read; *msgtype* is used to filter the message in the queue. If != 0 read only a message with the same id on the queue; *msgflg* is a flag that modify the behavior of the command. Using `IPC_NOWAIT` return immediately if no message is found. The function return the number of bytes read or -1 if unsuccessful

int msgctl(int msqid, int cmd, struct msqid_ds *buf) Modifies the properties of the queue or delete it. *msqid* corresponds to the message queue identifier.

Typical usage:

```
msgctl(msqid, IPC_RMID,
0);
```

Removes queue

Unnamed Pipes

```
#include <unistd.h>
```

int pipe(int fd[2]) Creates an unnamed pipe (unidirectional). *fd[2]* are two descriptor associated with the "read" end of the pipe (`fd[0]`) and with the "write" end of the pipe (`fd[1]`). Return 0 if the kernel could allocate enough space, -1 otherwise.

int write(int fd, char *buf, int size) The classic write function is used to write inside the buffer. *fd* in this case is the descriptor of the write end of the pipe.

int read(int fd, char *buf, int size) The classic read function is used to read data from the pipe. *fd* is the descriptor of the read end of the pipe.

Named Pipes or FIFO

```
#include <fcntl.h>
```

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Named Pipes or FIFO (cont)

int mkfifo-
(const char
***path,**
mode_t
mode);

Creates a named pipe (FIFO)
path corresponds to the name of the pipe;
mode corresponds to the permission mode flags.

int
open(const
char *path,
int flags)

Open the fifo defined by the name saved in *path*, for the *flag* parameter use O_WRONLY for a write only pipe or O_RDONLY for a read only pipe.

int write (int
fd, char *
buf, int
size)

The classic write function is used to write inside the buffer.
fd in this case is the descriptor of the write end of the pipe.

int read (int
fd, char *
buf, int
size)

The classic read function is user to read data from the pipe.
fd is the descriptor of the read end of the pipe.

Signals

```
#include <signal.h>
```

Signals (cont)

int
kill(pid_t
pid, int
sig)

Send a signal to the process indicated by the parameter *pid*.
pid is the pid of the process that will receive the signal; if set to 0 all the processes in the process group of the current process receive the signal;
sig is the type of the signal

sighan-
dlr_t
signal(int
signum,
sighan-
dlr_t
handler)

Installs a new signal handler for the signal with number *signum*.
The signal handler is set to handler which may be a user specified function or a standard function as SIG_IGN

unsigned
int
alarm(-
unsigned
int
seconds)

Causes the system to generate a SIGALRM signal for the process after the number of real-time seconds specified by *seconds* have elapsed.

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