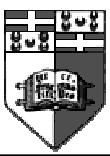
Signal Masks

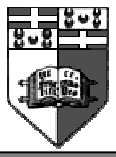
- Sometimes we need to block some signals, so that **critical sections** are not interrupted.
- Every process maintains a signal mask telling which signals are blocked.
- If a signal type is blocked, and signals of this type are received, they are suspended until process termination or until the signal type is unblocked.
- Signal masks are stored in the data type *sigset_t*.



Signal Masks

```
#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);
                                    return 0 if OK, -1 on error
int sigismember(const sigset_t *set, int signo);
                                    returns 1 if true, 0 if false
```

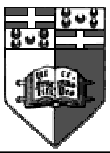
- The above are used to set the *set* value, not to set the process signal mask.
- Call *sigemptyset()* or *sigfillset()* at least once.
- *sigset_t* is guaranteed to be able to hold all signals supported by the UNIX implementation.



Signal Masks (cont)

```
#include <signal.h>
int sigpending(sigset_t *set);
        returns 0 if OK, -1 on error
```

- *sigpending()* tells us what signals are blocked and currently pending.
- The list of signals is returned inside *set.*
- Use *sigismember()* to find out what signals are present in *set.*



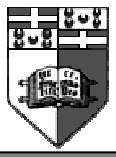
Masking Signals

```
#include <signal.h>
int sigprocmask(int how, const sigset_t *set,
                sigset_t *oset);
                 returns 0 if OK, -1 on error
```

***how* values**

SIG_BLOCK (union)
SIG_UNBLOCK (intersection)
SIG_SETMASK (equality)

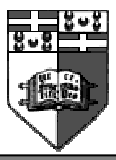
- If *oset* is non-NULL, the old signal mask is returned in it.
- *set* defines the signals we want to block or unblock.
- If there are any pending signals, and we unblock it with *sigprocmask(),* one of these signals is received before *sigprocmask()* returns.



Critical Sections

```
Setup signal mask
Call sigprocmask() to block signals
/* critical section */
Call sigprocmask() to unblock signals
Signals will be handled, etc.
```

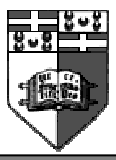
- Blocking signals makes sure that critical section are executed atomically.
- Yet what if we want to wait for a signal after unblocking the signal mask.
  - Calling *pause()* could make process wait forever!!



sigsuspend()

```
#include <signal.h>
int sigsuspend(const sigset_t *sigmask);
        returns –1 with errno set to EINTR
```

- *sigsuspend()* execution:
  1. Sets the signal mask to s*igmask*.
  2. Then it calls the *pause()* function.
  3. If *pause()* returns, the signal mask to set back to its original value.
- All the above steps are guaranteed to be performed atomically and we thus get no lost signals.



sigaction()

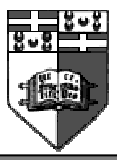
```
#include <signal.h>
int sigaction(int signo, const struct sigaction *act,
              const struct sigaction *oset);
                                    returns –1 on error
```

```
struct sigaction {
   void (*sa_handler)();
   sigset_t sa_mask;
   int sa_flags;
};
```

Values for *sa_flags*

SA_NOCLDSTOP
SA_RESTART
SA_ONSTACK
SA_NODEFER
SA_RESETHAND
SA_SIGINFO

- A more modern version of *signal()*.
- *sa_mask* specify the additional signals to block if the *sa_handler* is a user defined signal handler.
- Not all *sa_flags* values are implemented.



Exercises

- Protect a section of your program from being interrupted by signals.
- Disable the CTRL-C keyboard termination signal for a critical section.
- Send signals to terminate children processes and reap their termination status. See that no signal is lost.
- Re-implement *sleep()* using *sigsuspend()*.