



### Exercise 4.1 Examining Signal Priorities and Execution

We give you a **C** program that includes a signal handler that can handle any signal. The handler avoids making any system calls (such as those that might occur while doing I/O).

```
/*
 * Examining Signal Priorities and Execution.
 *
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 *
 */

#include <stdio.h>
#include <unistd.h>
#include <signal.h>
#include <stdlib.h>
#include <string.h>
#include <pthread.h>

#define NUMSIGS 64

/* prototypes of locally-defined signal handlers */

void (sig_handler) (int);

int sig_count[NUMSIGS + 1];          /* counter for signals received */
volatile static int line = 0;
volatile int signumbuf[6400], sigcountbuf[6400];

int main(int argc, char *argv[])
{
    sigset_t sigmask_new, sigmask_old;
    struct sigaction sigact, oldact;
    int signum, rc, i;
    pid_t pid;

    pid = getpid();

    /* block all possible signals */
    rc = sigfillset(&sigmask_new);
    rc = sigprocmask(SIG_SETMASK, &sigmask_new, &sigmask_old);

    /* Assign values to members of sigaction structures */
    memset(&sigact, 0, sizeof(struct sigaction));
    sigact.sa_handler = sig_handler;          /* we use a pointer to a handler */
    sigact.sa_flags = 0;                      /* no flags */
    /* VERY IMPORTANT */
    sigact.sa_mask = sigmask_new;             /* block signals in the handler itself */

    /*
     * Now, use sigaction to create references to local signal

```

```

    * handlers * and raise the signal to myself
    */

printf
    ("\nInstalling signal handler and Raising signal for signal number:\n\n");
for (signum = 1; signum <= NUMSIGS; signum++) {
    if (signum == SIGKILL || signum == SIGSTOP || signum == 32
        || signum == 33) {
        printf("  --");
        continue;
    }
    sigaction(signum, &sigact, &oldact);
    /* send the signal 3 times! */
    rc = raise(signum);
    rc = raise(signum);
    rc = raise(signum);
    if (rc) {
        printf("Failed on Signal %d\n", signum);
    } else {
        printf("%4d", signum);
        if (signum % 16 == 0)
            printf("\n");
    }
}
fflush(stdout);

/* restore original mask */
rc = sigprocmask(SIG_SETMASK, &sigmask_old, NULL);

printf("\nSignal  Number(Times Processed)\n");
printf("-----\n");
for (i = 1; i <= NUMSIGS; i++) {
    printf("%4d:%3d  ", i, sig_count[i]);
    if (i % 8 == 0)
        printf("\n");
}
printf("\n");

printf("\nHistory: Signal  Number(Count Processed)\n");
printf("-----\n");
for (i = 0; i < line; i++) {
    if (i % 8 == 0)
        printf("\n");
    printf("%4d(%1d)", signumbuf[i], sigcountbuf[i]);
}
printf("\n");
exit(EXIT_SUCCESS);
}

void sig_handler(int sig)
{
    sig_count[sig]++;
    signumbuf[line] = sig;
    sigcountbuf[line] = sig_count[sig];
    line++;
}

```

If you are taking the online self-paced version of this course, the source code is available for download from your **Lab** screen.

You will need to compile it and run it as in:

```

$ gcc -o signals signals.c
$ ./signals

```

When run, the program:

- Does not send the signals SIGKILL or SIGSTOP, which can not be handled and will always terminate a program.
- Stores the sequence of signals as they come in, and updates a counter array for each signal that indicates how many times the signal has been handled.
- Begins by suspending processing of all signals and then installs a new set of signal handlers for all signals.
- Sends every possible signal to itself multiple times and then unblocks signal handling and the queued up signal handlers will be called.
- Prints out statistics including:
  - The total number of times each signal was received.
  - The order in which the signals were received, noting each time the total number of times that signal had been received up to that point.

Note the following:

- If more than one of a given signal is **raised** while the process has blocked it, does the process **receive** it multiple times? Does the behavior of **real time** signals differ from normal signals?
- Are all signals received by the process, or are some handled before they reach it?
- What order are the signals received in?

One signal, SIGCONT (18 on **x86**) may not get through; can you figure out why?

**Note:**

On some **Linux** distributions signals 32 and 33 can not be blocked and will cause the program to fail. Even though system header files indicate SIGRTMIN=32, the command `kill -1` indicates SIGRTMIN=34.

Note that **POSIX** says one should use signal names, not numbers, which are allowed to be completely implementation dependent.

You should generally avoid sending these signals.