CSC209 Week 9 Notes

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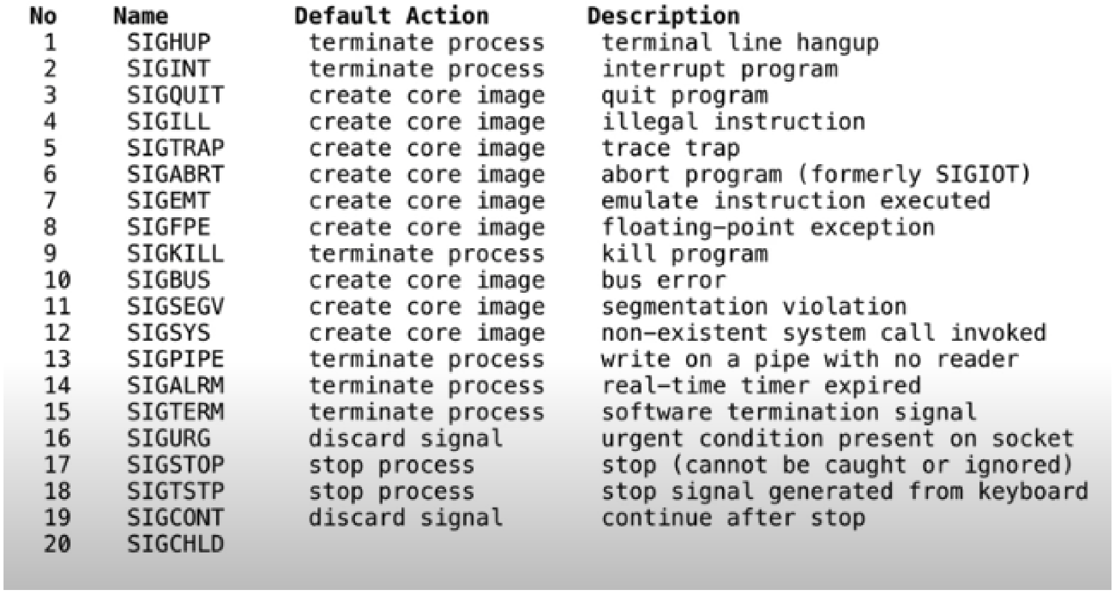
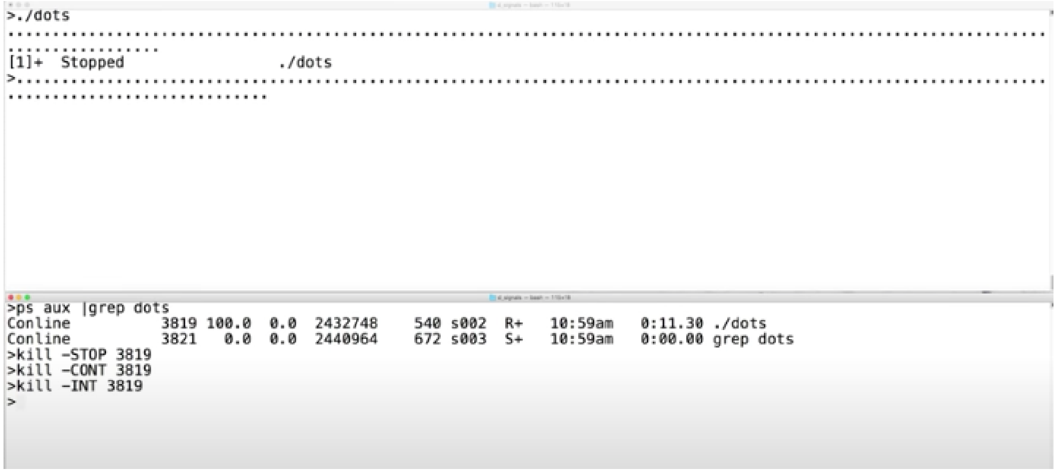
Signals 1 of 2

- Introduction to Signals
  - Signals
    - ∗ are mechanisms that allow process or the os to interrupt currently running process and notify that an event has occured



No	Name	Default Action	Description
1	SIGHUP	terminate process	terminal line hangup
2	SIGINT	terminate process	interrupt program
3	SIGQUIT	create core image	quit program
4	SIGILL	create core image	illegal instruction
5	SIGTRAP	create core image	trace trap
6	SIGABRT	create core image	abort program (formerly SIGIOT)
7	SIGEMT	create core image	emulate instruction executed
8	SIGFPE	create core image	floating-point exception
9	SIGKILL	terminate process	kill program
10	SIGBUS	create core image	bus error
11	SIGSEGV	create core image	segmentation violation
12	SIGSYS	create core image	non-existent system call invoked
13	SIGPIPE	terminate process	write on a pipe with no reader
14	SIGALRM	terminate process	real-time timer expired
15	SIGTERM	terminate process	software termination signal
16	SIGURG	discard signal	urgent condition present on socket
17	SIGSTOP	stop process	stop (cannot be caught or ignored)
18	SIGTSTP	stop process	stop signal generated from keyboard
19	SIGCONT	discard signal	continue after stop
20	SIGCHLD		

  - How it Works
    1. Using hotkey
       - ∗ i.e. *CTRL + C* in terminal sends SIGINT
       - ∗ i.e. *CTRL + Z* in terminal sends SIGSTOP
    2. Using kill command



```
>./dots
..............................................................................................................
.................
[1]+  Stopped                 ./dots
>.............................................................................................................
.............................
```

```
>ps aux |grep dots
Conline           3819 100.0  0.0  2432748    540 s002  R+    10:59am   0:11.30 ./dots
Conline           3821   0.0  0.0  2440964    672 s003  S+    10:59am   0:00.00 grep dots
>kill -STOP 3819
>kill -CONT 3819
>kill -INT 3819
>
```

```
 >>>./signals_example_1.out # <- This is done in separate terminal
 >>> ps aux | grep ./signals_example_1.out
 >>> kill -STOP <PID>
 >>> kill -CONT <PID>
 >>> kill -INT <PID>

```

Signals 2 of 2

- Signals Handling
  - sigaction
    - **Syntax:** int sigaction(int signum, const struct sigaction *act, NULL);
    - Is a part of *signal.h* library
    - Is used to change the action taken by a process on receipt of a specific signal
    - Works like try and catch in Python
    - Don't worry about NULL :). Not knowing won't bite.

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

void handler(int);

int main () {
    struct sigaction newact;
    newact.sa_handler = handler; // <- like catch statement in python
    newact.sa_flags = 0;
    sigemptyset(&newact.sa_mask);
```

```
        return(0);
    }

    void handler(int code) {
        fprintf(stderr, "Signal %d caught\n", code);
    }

```

- Use *CTRL + Z* to terminate
- *kill -KILL <PID >* and *kill -QUIT <PID >* are two guarenteed ways to terminate a program.

Bit Manipulation 1 of 4

- Introducing Bitwise Operations
  - When to use Bitwise Operations?
    - Lowlevel programming on embedded systems
  - Bitwise Operators in C
    - **&:** AND

a	b	a & b
0	0	0
0	1	1
1	0	0
1	1	1

Example:

```
    0   1   1   1   //<- this is 7
    0   1   0   0   //<- this is 4
    --------------
    0   1   0   0   //<- this is 4

    so, 7 & 4 = 4

```

- **|:** OR

a	b	a | b
0	0	0
0	1	1
1	0	1
1	1	1

Example:

```
    0   1   1   1   //<- this is 7
    0   1   0   0   //<- this is 4
    --------------
    0   1   1   1   //<- this is 7

    so, 7 | 4 = 4

```

* : NOT

a	∼ a
0	1
1	0

Example:

```
    0   1   1   1   //<- this is 7
    --------------
    1   0   0   0   //<- this is 8

    so, ˜ 7 = 8

```

* ˆ: XOR

a	b	a ˆ b
0	0	0
0	1	1
1	0	1
1	1	0

Example:

```
    0   1   1   1   //<- this is 7
    0   1   0   0   //<- this is 4
    --------------
    0   0   1   1   //<- this is 3

    so, 7 ˆ 4 = 3

```

Bit Manipulation 2 of 4

- Hexadecimal Numbers
  - Starts with ‘0x’ at front
  - Uses 10 symbols ‘$0, 1, 2, 3, 4, 5, 6, 7, 8, 9$’ and 6 extras ‘$A = 10, B = 11, C = 12, D = 13, E = 14, F = 15$’.
    - i.e. $FFFF = 15 \cdot 16^0 + 15 \cdot 16^1 + 15 \cdot 16^2 + 15 \cdot 16^3 + 15 \cdot 16^4 = 65535$
- The Shift Operators
  - $<<n$: LEFT SHIFT
    - Shifts all bits to left by n

    Example:

```
i = 7
j = i << 1

0   1   1   1   //<- this is 7
--------------
1   1   1   0   //<- this is 14

so, 7 << 1 = 14
```

  - $>>n$: RIGHT SHIFT
    - Shifts all bits to right by n

    Example:

```
i = 7
j = i >> 1

0   1   1   1   //<- this is 7
--------------
0   0   1   1   //<- this is 3

so, 7 >> 1 = 3
```