Lesson Module Status

- Slides – draft
- Properties - done
- Flash cards –
- First minute quiz –
- Web calendar summary –
- Web book pages –
- Commands – done
- Lab tested and uploaded –
- Supplies () - na
- Class PC's – na
- Supplies – chocolates

- Real test uploaded and permissions set – done
- CCC Confer wall paper – done

- Materials uploaded – done
- Backup headset charged – oops
- Backup slides, CCC info, handouts on flash drive - done

- Check that room headset is charged – done

CIS 90 - Lesson 10

Email me (risimms@cabrillo.edu) a relatively current photo of your face for 3 points extra credit

First Minute Quiz

Please close your books, notes, lesson materials, forum and answer these questions **in the order** shown:

No Quiz Today

but we do have a test!

email answers to: risimms@cabrillo.edu

[ ] Has the phone bridge been added?

[ ] Is recording on?

[ ] Does the phone bridge have the mike?

[ ] Share slides, putty (rsimms, simmsben, roddyduk), and Chrome

[ ] Disable spelling on PowerPoint

UNIX Processes

Objectives	Agenda
• Know the process life cycle • Interpret ps command output • Run or schedule jobs to run in the background • Send signals to processes • Configure process load balancing	• Questions from last week • Housekeeping • Process definition • Process lifecycle • Process information • Job control • Signals • Load balancing • Wrap up • Test #2

?'s

Previous material and assignment

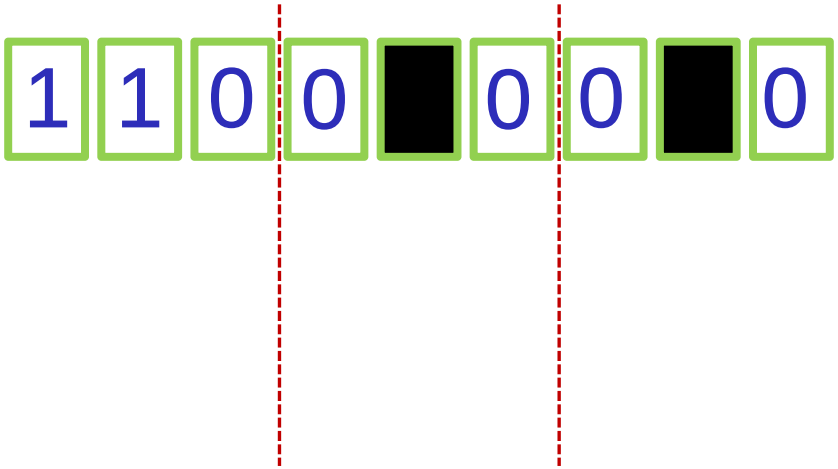
1. Questions on previous material?

- File management (Lesson 6)
- Permissions (Lesson 7)
- Input/output (Lesson 8)
- Labs
- Practice test

2. Questions regarding the test today?

- Test will start during the last hour of class.
- Should take about 30-50 minutes
- If you wish, you can keep working on it till midnight.
- You must do all the work on the test by yourself and not ask or give help to others regarding any of the test questions.

If the umask is 022 and the permissions on the file cinderella are rw--w--w-, then what would be the permissions of the file cinderella.bak after doing the following command?



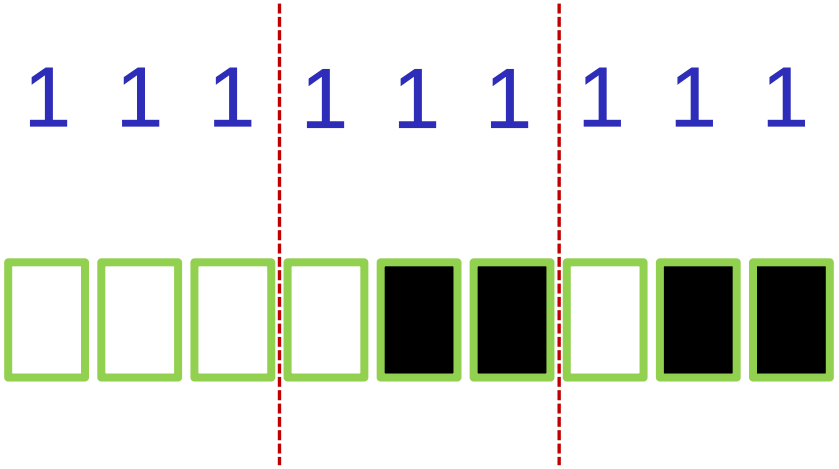
(622 = original file)

(022 = umask)

Answer: 600 (or rw- --- ---)

```
/home/cis90ol/simmsben $ touch cinderella
/home/cis90ol/simmsben $ chmod 622 cinderella
/home/cis90ol/simmsben $ umask 022
/home/cis90ol/simmsben $ cp cinderella cinderella.bak
/home/cis90ol/simmsben $ ls -l cinderella.bak
-rw------- 1 simmsben cis90ol 0 Apr 21 12:53 cinderella.bak
```

With a umask of 033 what permissions would a newly created directory have?



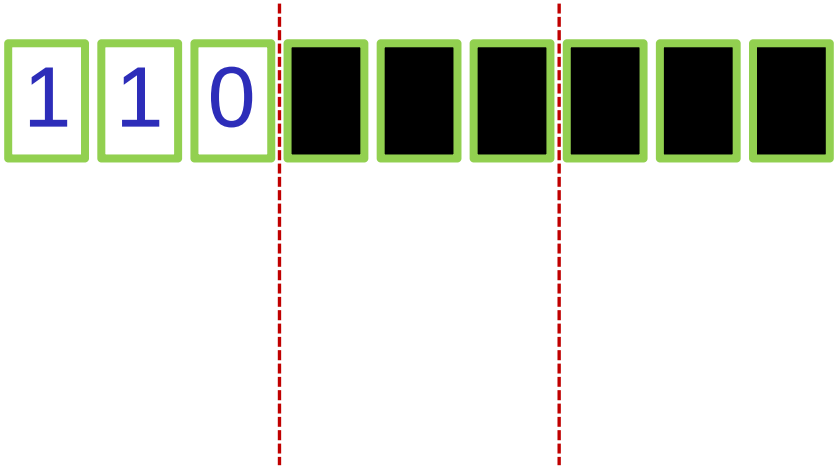
(777 = file default)

(033 = umask)

Answer: 744 (or rwx r-- r--)

```
/home/cis90ol/simmsben $ umask 033
/home/cis90ol/simmsben $ mkdir brandnewdir
/home/cis90ol/simmsben $ ls -ld brandnewdir/
drwxr--r-- 2 simmsben cis90ol 4096 Apr 21 12:46 brandnewdir/
```

With a umask of 077 what permissions would a newly created file have?



(666 = file default)

(077 = umask)

Answer: 600 (or rw- --- ---)

```
/home/cis90ol/simmsben $ umask 077
/home/cis90ol/simmsben $ touch brandnewfile
/home/cis90ol/simmsben $ ls -l brandnewfile
-rw------- 1 simmsben cis90ol 0 Apr 21 12:50 brandnewfile
```

FYI

shell debugging and { }

FYI **set –x, set +x**

```
/home/cis90/roddyduk $ set -x
+ set -x
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $ type /bin/pi*
+ type /bin/ping /bin/ping6
/bin/ping is /bin/ping
/bin/ping6 is /bin/ping6
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $ type -af /usr/bin/p[ek]*[ct] 2> /dev/null
+ type -af /usr/bin/perlcc /usr/bin/perldoc /usr/bin/pkcs11_inspect
/usr/bin/perlcc is /usr/bin/perlcc
/usr/bin/perldoc is /usr/bin/perldoc
/usr/bin/pkcs11_inspect is /usr/bin/pkcs11_inspect
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $ set +x
+ set +x
/home/cis90/roddyduk $
```

Enable shell debugging

Shows how pathnames get expanded

Disable shell debugging

***set –x** shows you the actual expansion done by bash and what options and arguments are passed to the command/program being run*

FYI **set –x, set +x**

```
/home/cis90/roddyduk $ set -x
+ set -x
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $ find . -name '$LOGNAME'
+ find . -name '$LOGNAME'
find: ./Hidden: Permission denied
find: ./testdir: Permission denied
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $ find . -name "$LOGNAME"
+ find . -name roddyduk
find: ./Hidden: Permission denied
./roddyduk
find: ./testdir: Permission denied
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $ set +x
+ set +x
/home/cis90/roddyduk $
```

Enable shell debugging

Show how quoted text strig are handled

Disable shell debugging

***set –x** shows you the actual expansion done by bash and what options and arguments are passed to the command/program being run*

FYI using {}

The braces { } are metacharacters

```
/home/cis90/roddyduk $ ls -ld test
drwxr-xr-x 2 roddyduk cis90 4096 Apr 22 09:46 test

/home/cis90/roddyduk $ ls test

/home/cis90/roddyduk $ touch test/file{1,2,3,4,5}

/home/cis90/roddyduk $ ls test
file1  file2  file3  file4  file5
```

Housekeeping

Housekeeping

- Chocolates
- Managing your grade

Chocolate Awards

Debian	Redhat	SUSE	Ubuntu
Emanuel Chris Yu-Chen Dan M Gabriel Jason	Tanner Bobby Terry Geoffrey Jesse	Merrick Craig Tommy Marisol Tajvia	Quinton Jeff Eric Josh Daniel W
17	8	8	9

4 chocolates will go to 1st place Debian
3 chocolates will go to 2nd place Ubuntu
2 chocolates will go to 3rd place Redhat and SUSE (tied)

Available in CIS Lab (Mondays 1:30-4:00) or TBA

Managing your grade

Points gone by

- 7 quizzes - 21 points
- 1 tests - 30 points
- 2 forum periods - 40 points
- 7 labs - 210 points

} 301 points

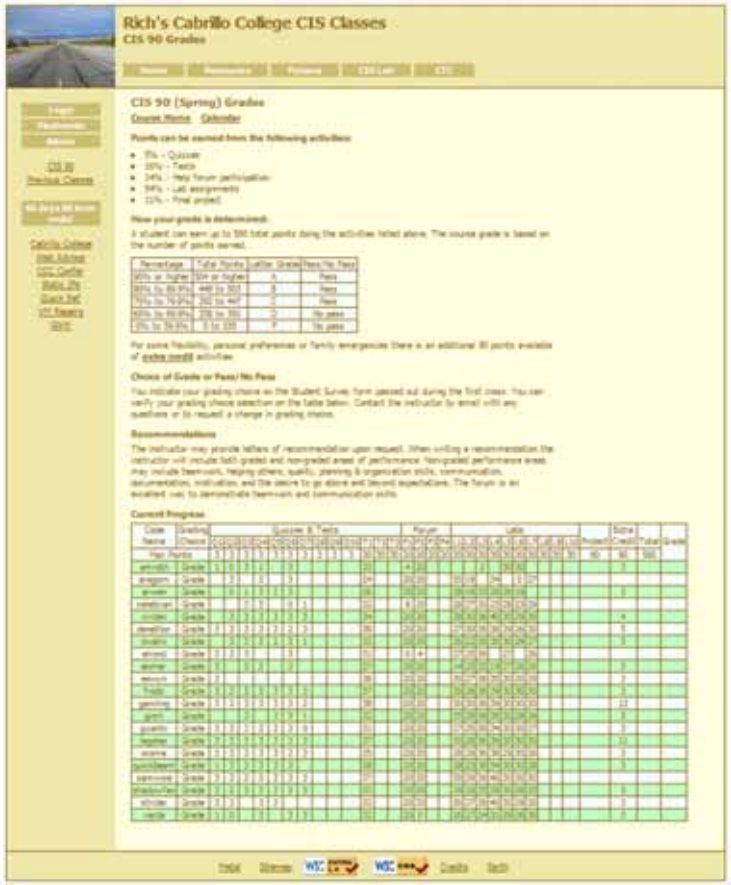
Points yet to earn

- 3 quizzes - 9 points
- 2 tests - 60 points
- 2 forum periods - 40 points
- 3 labs - 90 points
- 1 final project - 60 points

} 259 points

- Plus extra credit - up to 90 points

Managing your grade

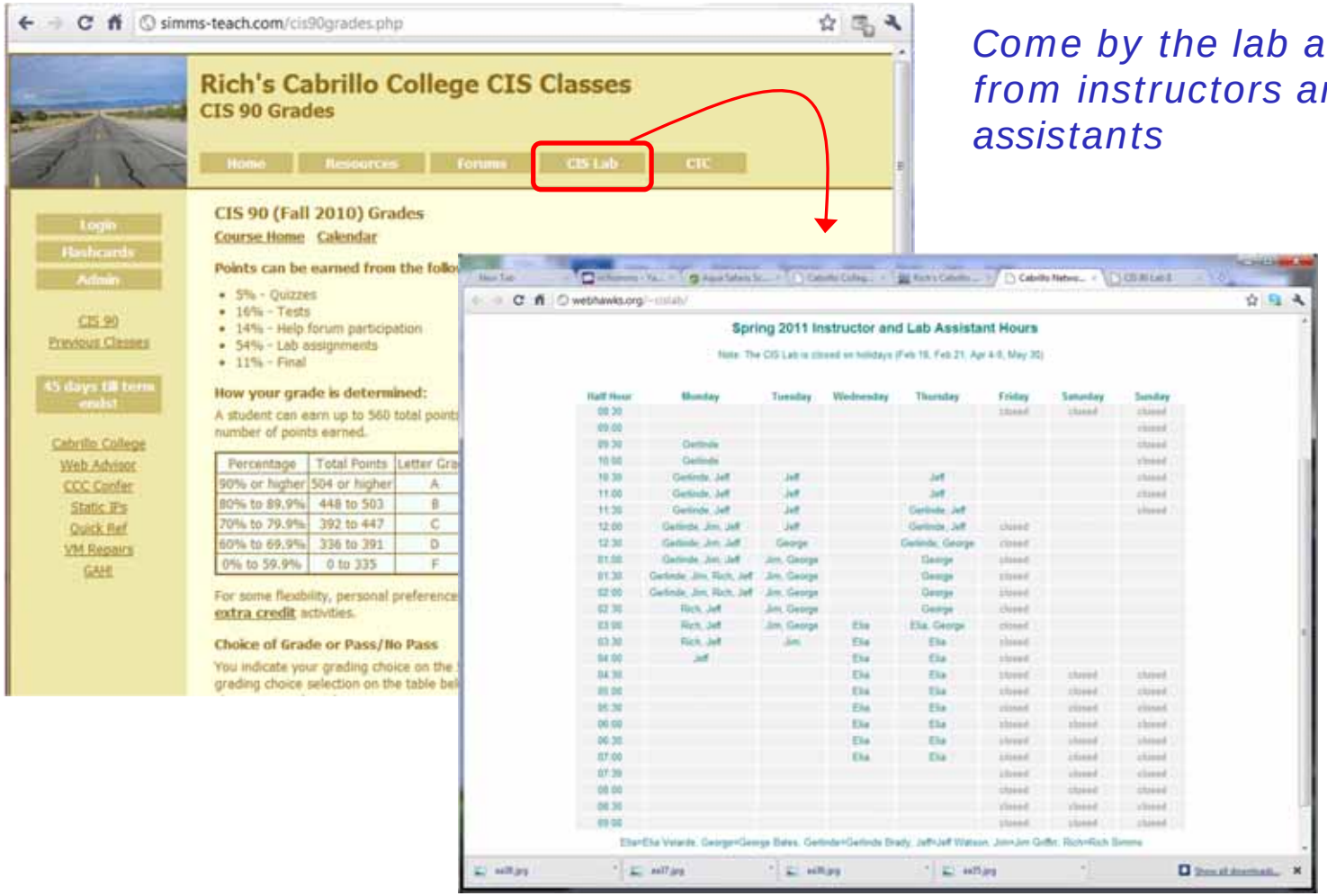



```
/home/cis90ol/simmsben $ tally

amroth: 39% (120 of 301 points)
aragorn: 60% (183 of 301 points)
arwen: 76% (229 of 301 points)
celebrian: 81% (245 of 301 points)
cirdan: 106% (320 of 301 points)
denethor: 104% (315 of 301 points)
dwalin: 99% (299 of 301 points)
elrond: 62% (188 of 301 points)
eomer: 82% (249 of 301 points)
eowyn: 96% (289 of 301 points)
frodo: 107% (324 of 301 points)
gamling: 111% (335 of 301 points)
gimli: 99% (298 of 301 points)
gwaihir: 100% (301 of 301 points)
legolas: 110% (332 of 301 points)
orome: 103% (312 of 301 points)
quickbeam: 98% (296 of 301 points)
samwise: 107% (323 of 301 points)
shadowfax: 103% (311 of 301 points)
strider: 102% (309 of 301 points)
varda: 85% (258 of 301 points)
```

Current total points and completion rates on April 19, 2011
*(the **tally** scripts calls Jesse's **checkgrades** script)*

Managing your grade

Getting extra help for CIS 90

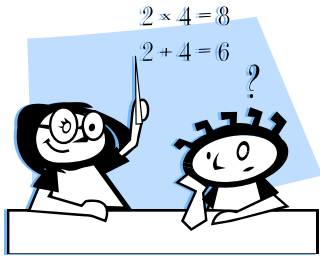


Come by the lab and get help from instructors and student assistants

Managing your grade

Getting extra help for CIS 90

- Free tutoring available: hsiehrr@yahoo.com
- Rich's Office Hours Th 12-12:50 or TBA
- Ask questions on the Forum at:
  http://opus.cabrillo.edu/forum/



Process Definition

Definition of a process

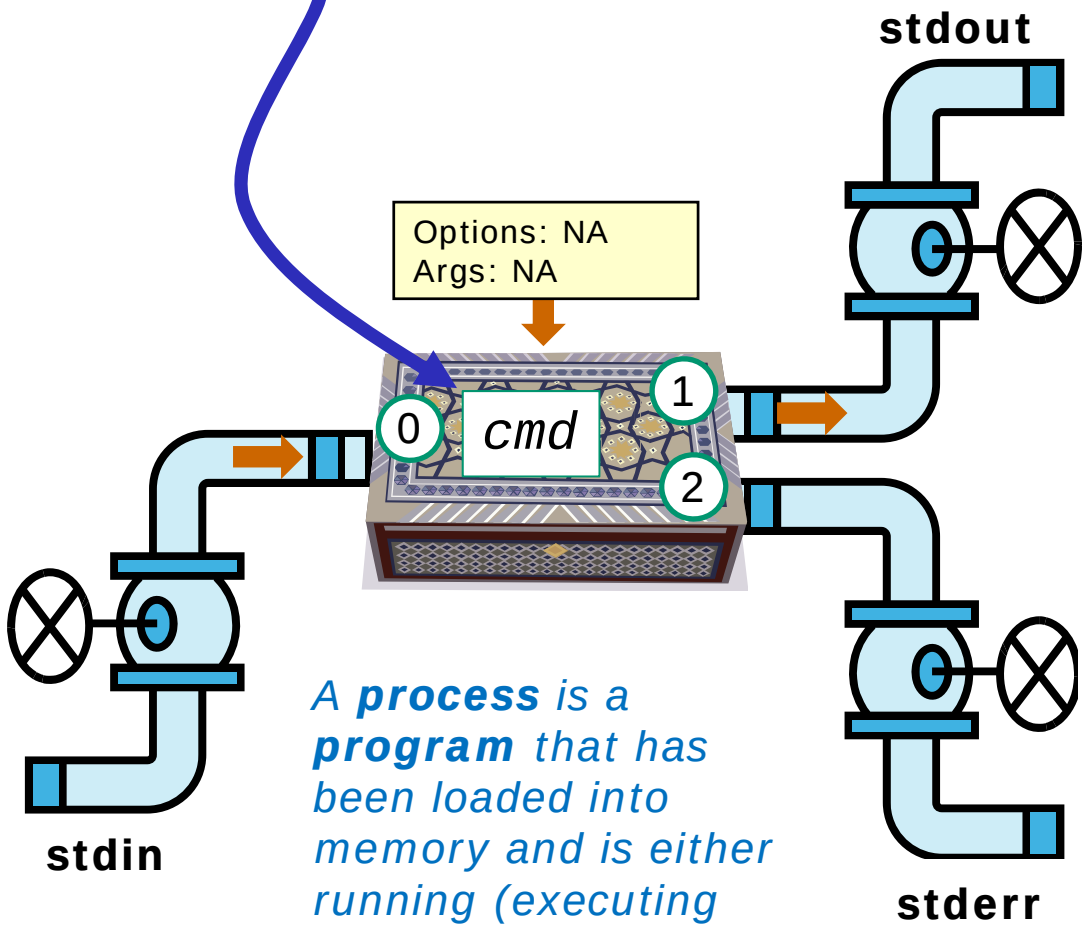
*A **process** is a **program** that has been copied (loaded) into memory by the kernel and is either running (executing instructions) or waiting to run.*

RAM (Random Access Memory) contains the instructions

The CPU executes the instructions in RAM

Program to process

```
/home/cis90/roddyduk $cmd
```

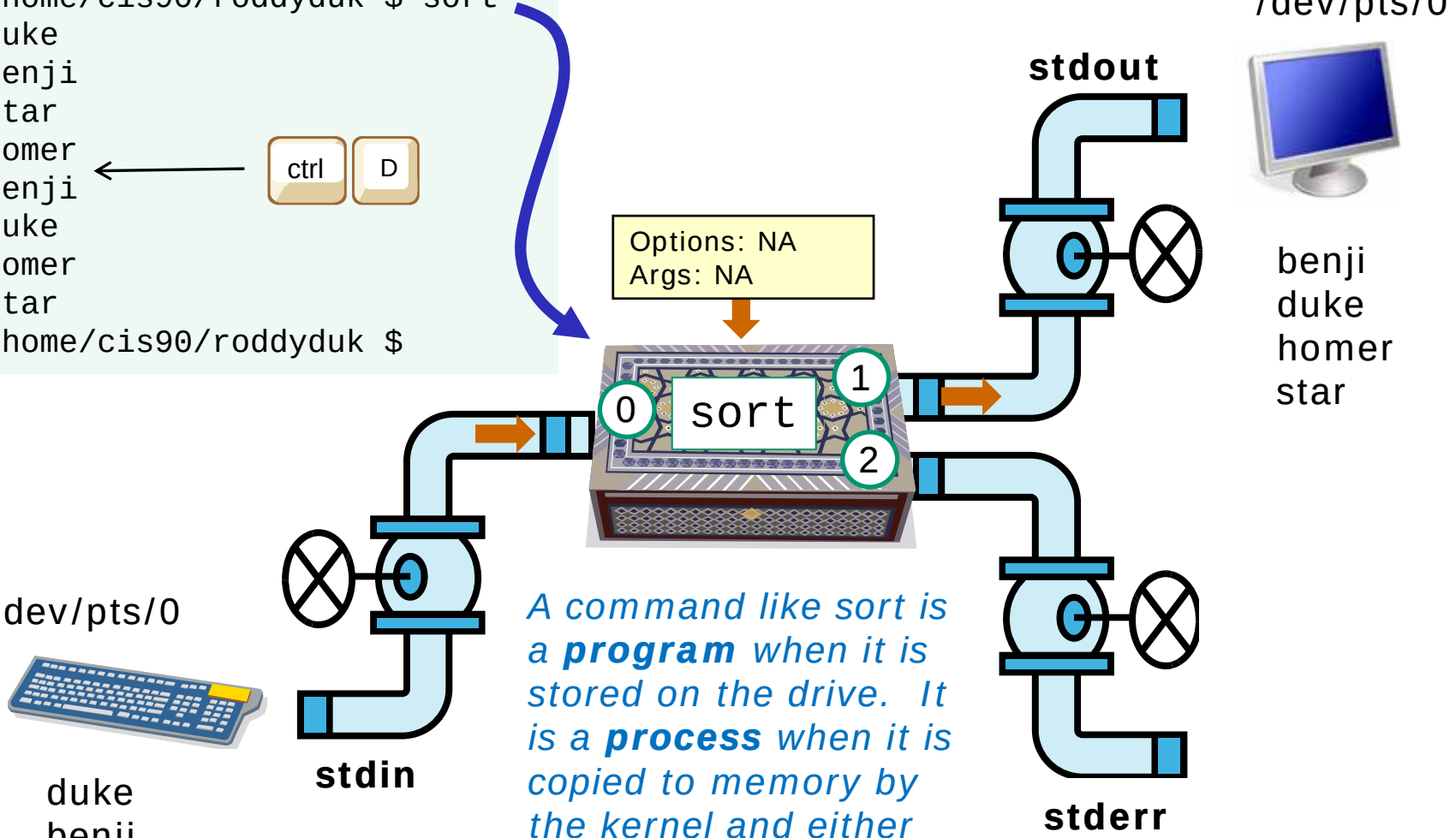


*A **process** is a **program** that has been loaded into memory and is either running (executing instructions) or waiting to run*

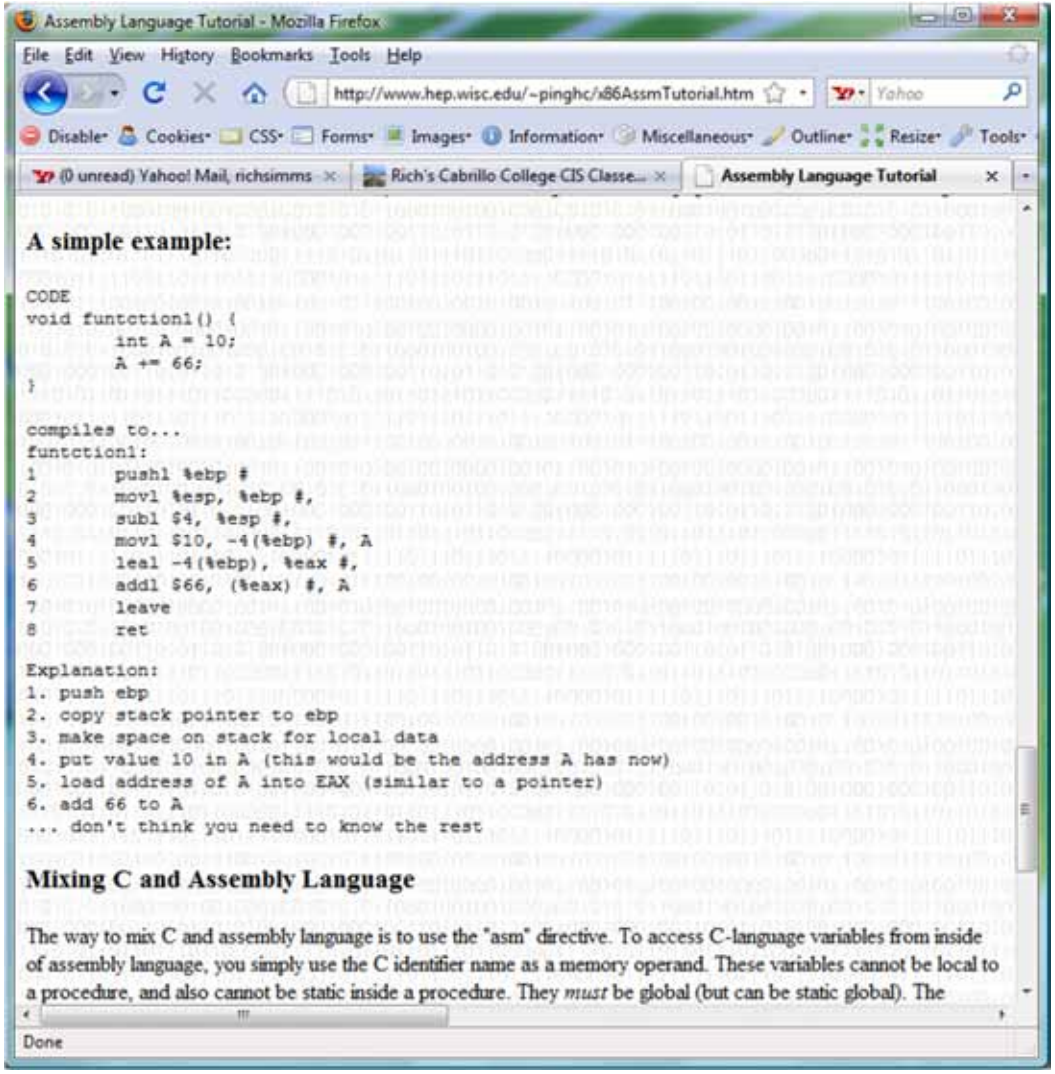
Example program to process: sort command

```
/home/cis90/roddyduk $ sort
duke
benji
star
homer
benji
duke
homer
star
/home/cis90/roddyduk $
```

ctrl D



*A command like sort is a **program** when it is stored on the drive. It is a **process** when it is copied to memory by the kernel and either running or waiting to run.*



Most programs are written in the C language

The C compiler translates the C code into binary machine code instructions the CPU can execute.

http://www.hep.wisc.edu/~pinghc/x86AssmTutorial.htm

Example program to process: sort command

```
[rsimms@opus ~]$ type sort
sort is /bin/sort

[rsimms@opus ~]$ file /bin/sort
/bin/sort: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), for GNU/Linux
2.6.9, dynamically linked (uses shared libs), for GNU/Linux 2.6.9, stripped
[rsimms@opus ~]$

[rsimms@opus ~]$ xxd /bin/sort | more
```

```
0000000: 7f45 4c46 0101 0100 0000 0000 0000 0000  .ELF............
0000010: 0200 0300 0100 0000 e093 0408 3400 0000  ............4...
0000020: 2cdb 0000 0000 0000 3400 2000 0800 2800  ,.......4. ...(.
0000030: 1f00 1e00 0600 0000 3400 0000 3480 0408  ........4...4...
0000040: 3480 0408 0001 0000 0001 0000 0500 0000  4...............
0000050: 0400 0000 0300 0000 3401 0000 3481 0408  ........4...4...
0000060: 3481 0408 1300 0000 1300 0000 0400 0000  4...............
0000070: 0100 0000 0100 0000 0000 0000 0080 0408  ................
0000080: 0080 0408 caca 0000 caca 0000 0500 0000  ................
0000090: 0010 0000 0100 0000 00d0 0000 0050 0508  .............P..
00000a0: 0050 0508 9404 0000 e80a 0000 0600 0000  .P..............
00000b0: 0010 0000 0200 0000 a0d1 0000 a051 0508  .............Q..
```

*A command like sort is a **program** when it is stored on the drive. It is a **process** when it is copied to memory by the kernel and either running or waiting to run by the CPU*

Definition of a process

*A **process** is a **program** that has been copied (loaded) into memory by the kernel and is either running (executing instructions) or waiting to run.*

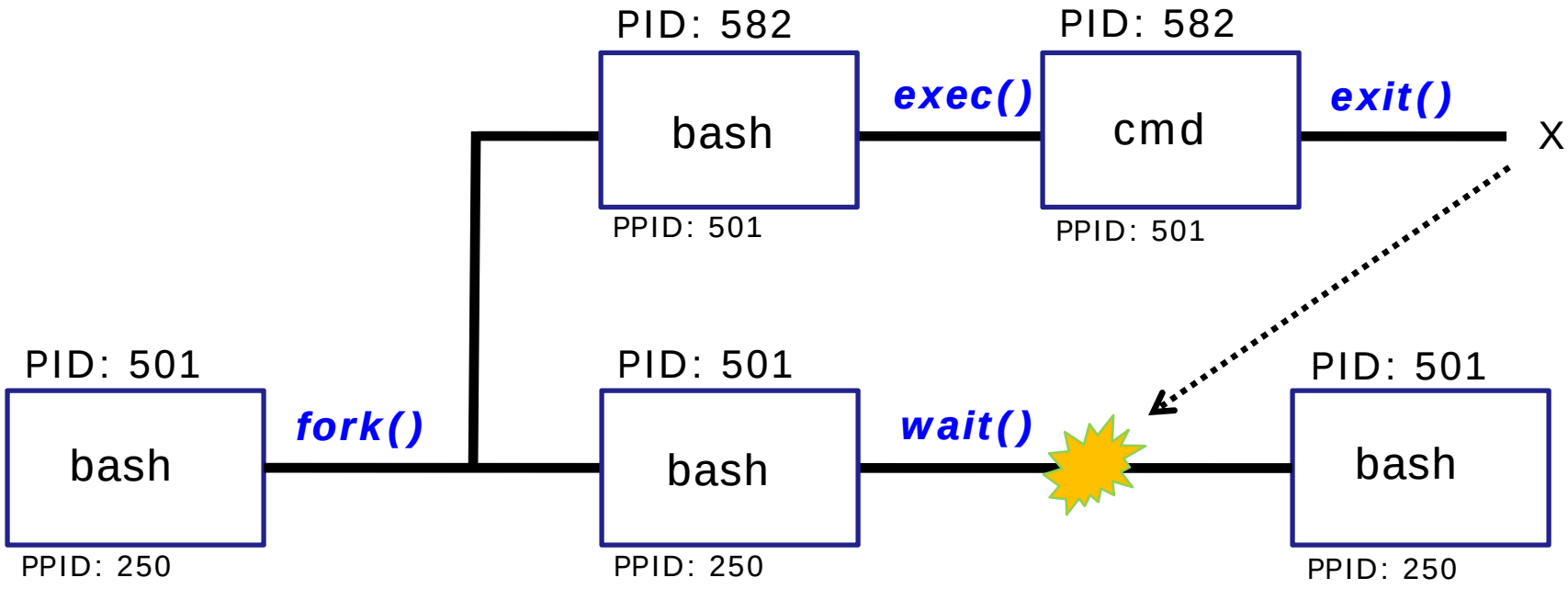
RAM (Random Access Memory) contains the instructions

The CPU executes the instructions in RAM

Process Life Cycle

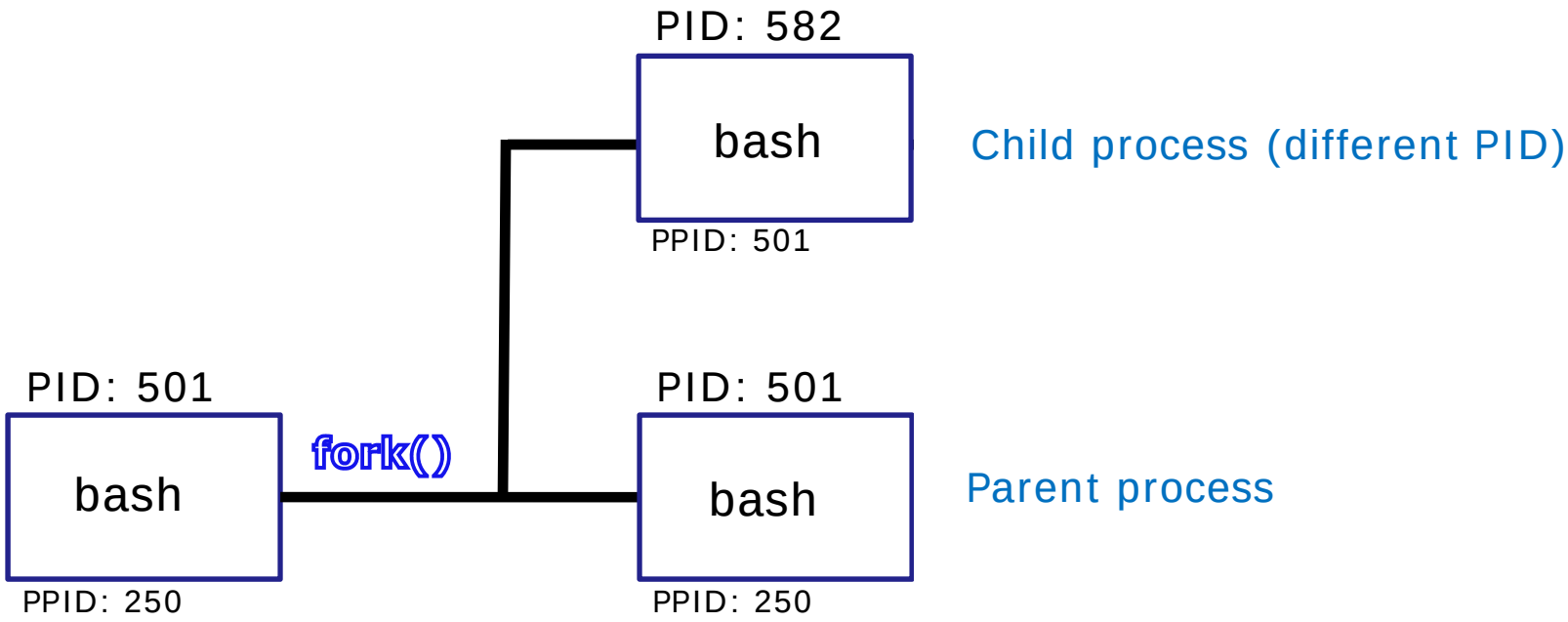
Process Lifecycle

Note: This diagram shows a generic command "cmd" being loaded and run by a user using the bash shell.



Note: A process uses system calls (e.g. fork, exec, wait, exit) to requests services from the kernel

Process Lifecycle

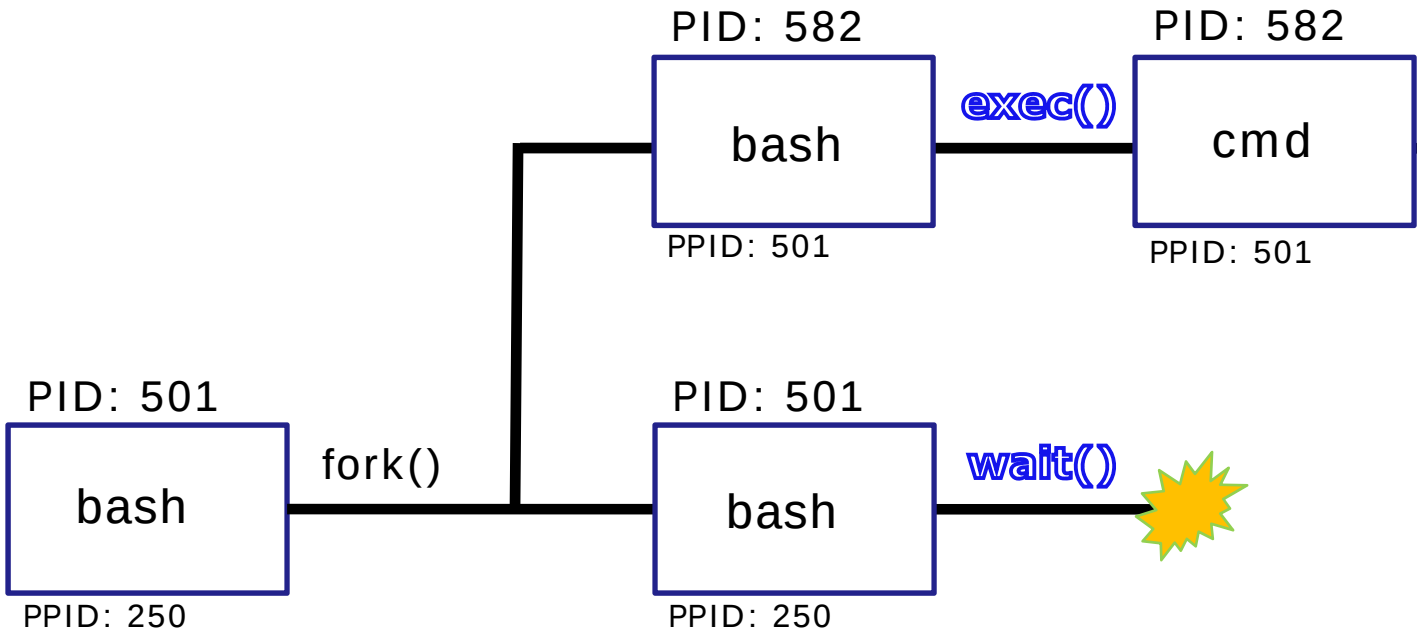


1) When a program is loaded into memory a new process must be created.

This is done by the **parent** process (bash) making a copy of itself using the ***fork*** system call.

The new **child** process is a duplicate of the **parent** but it has a different PID.

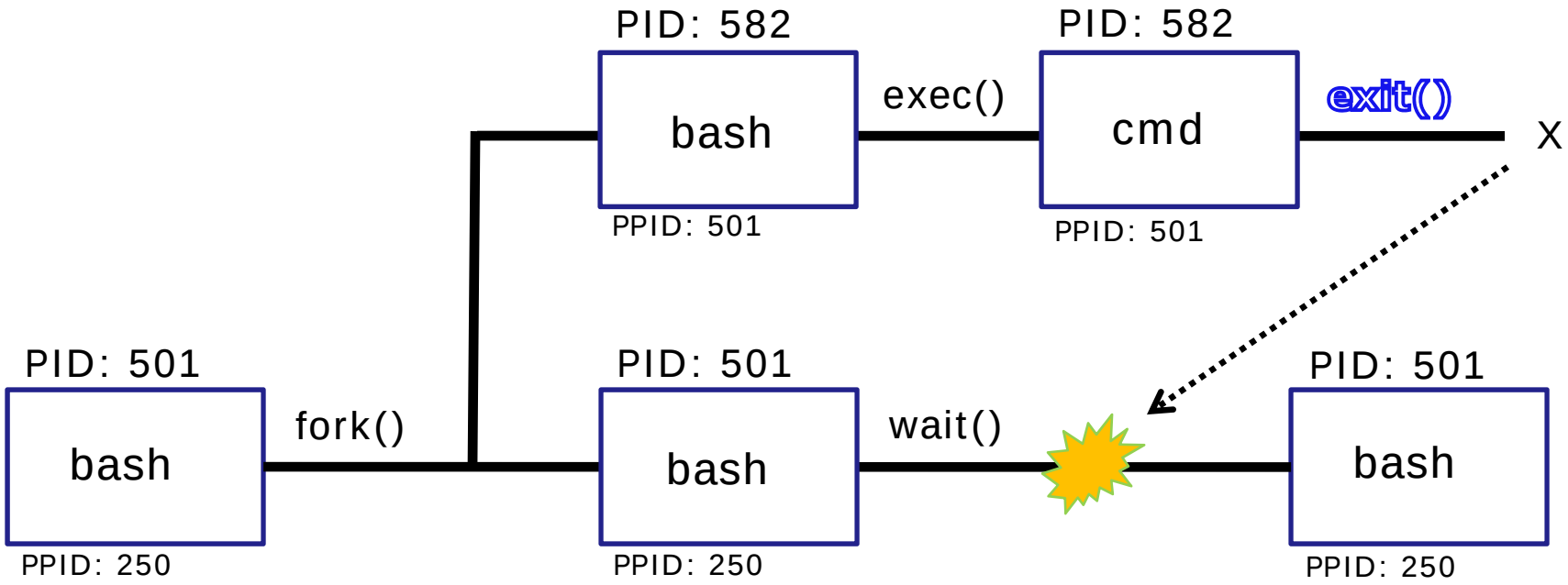
Process Lifecycle



2) An ***exec*** system call is issued to overlay the **child** process with the instructions of the requested command. The new instructions then are executed.

The **parent** process issues the ***wait*** system call and goes to sleep.

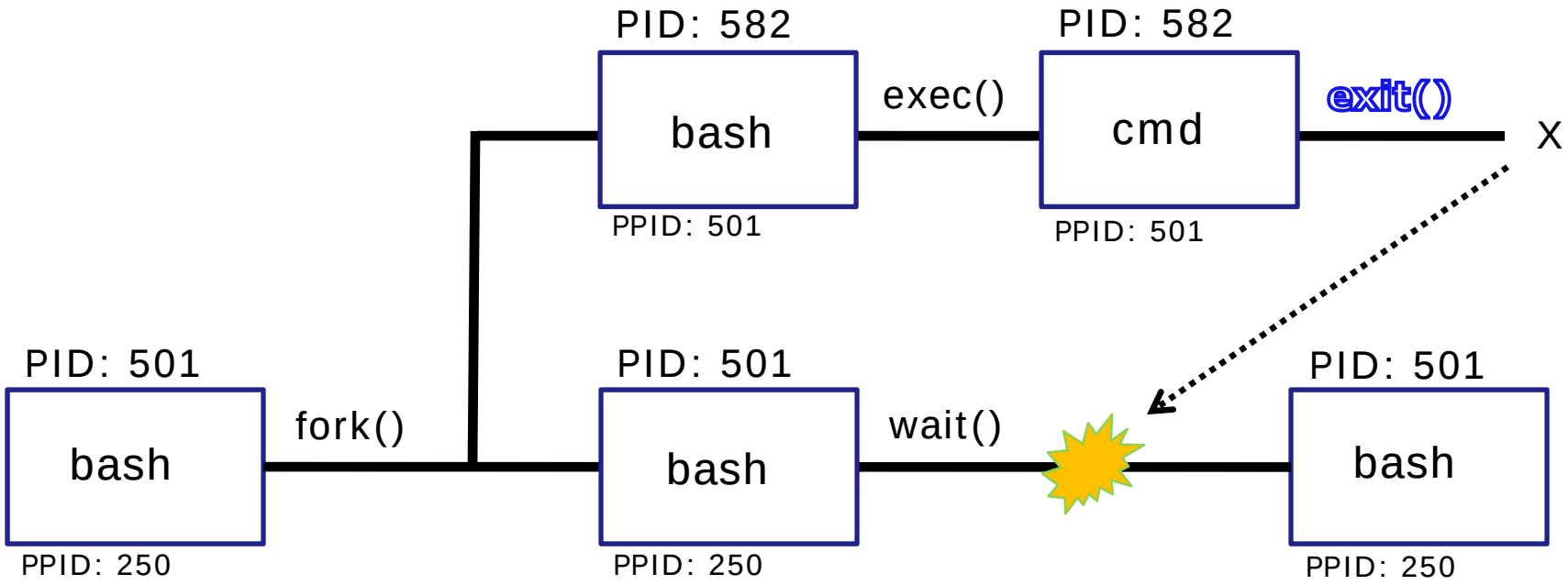
Process Lifecycle



3) When the **child** process finishes executing the instructions it issues the ***exit*** system call. At this point it gives up all its resources and becomes a **zombie**.

The **parent** is woken up and once the **parent** has informed the kernel it has finished working with the **child**, the **child** process is killed and removed from the process table.

Process Lifecycle



3) If the **parent** process were to die before the **child**, the zombie will become an **orphan**.

Fortunately the init process will adopt any orphaned **zombies!**

Process Information

Information	Description
PID	Process Identification Number, a unique number identifying the process
PPID	Parent PID, the PID of the parent process (like … in the file hierarchy)
UID	The user running the process
TTY	The terminal that the process's stdin and stdout are connected to
S	The status of the process: S=Sleeping, R=Running, T=Stopped, Z=Zombie
PRI	Process priority
SZ	Process size
CMD	The name of the process (the command being run)
C	The CPU utilization of the process
WCHAN	Waiting channel (name of kernel function in which the process is sleeping)
F	Flags (1=forked but didn't exit, 4=used superuser privileges)
TIME	Cumulative CPU time
NI	Nice value

Process Information

Just a few of the types of information kept on a process.

*Use **man ps** to see a lot more.*

Process Information

```
[rsimms@opus ~]$ ps
  PID TTY          TIME CMD
 6204 pts/6    00:00:00 bash
 6285 pts/6    00:00:00 ps
[rsimms@opus ~]$
```

Show just my processes. Note bash was started for me when I started my terminal session. ps is showing because it is running as this output is printed.

Process Information

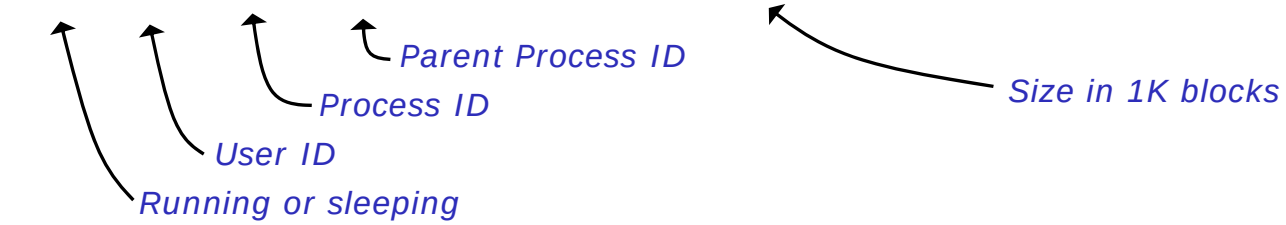
```
[rsimms@opus ~]$ cat /etc/passwd | grep Marcos
valdemar:x:1200:103:Marcos Valdebenito:/home/cis90/valdemar:/bin/bash

[rsimms@opus ~]$ ps -u 1200
  PID TTY          TIME CMD
 5971 ?        00:00:00 sshd
 5972 pts/5    00:00:00 bash
[rsimms@opus ~]$

[rsimms@opus ~]$ ps -u dymesdia
  PID TTY          TIME CMD
 6418 ?        00:00:00 sshd
 6419 pts/1    00:00:00 bash
[rsimms@opus ~]$

[rsimms@opus ~]$ ps -u rsimms
  PID TTY          TIME CMD
 5368 ?        00:00:00 sshd
 5369 pts/0    00:00:00 bash
 6173 pts/0    00:00:00 man
 6176 pts/0    00:00:00 sh
 6177 pts/0    00:00:00 sh
 6182 pts/0    00:00:00 less
 6203 ?        00:00:00 sshd
 6204 pts/6    00:00:00 bash
 6510 pts/6    00:00:00 ps
[rsimms@opus ~]$
```

Use the u option to look at processes owned by a specific user

Process Information

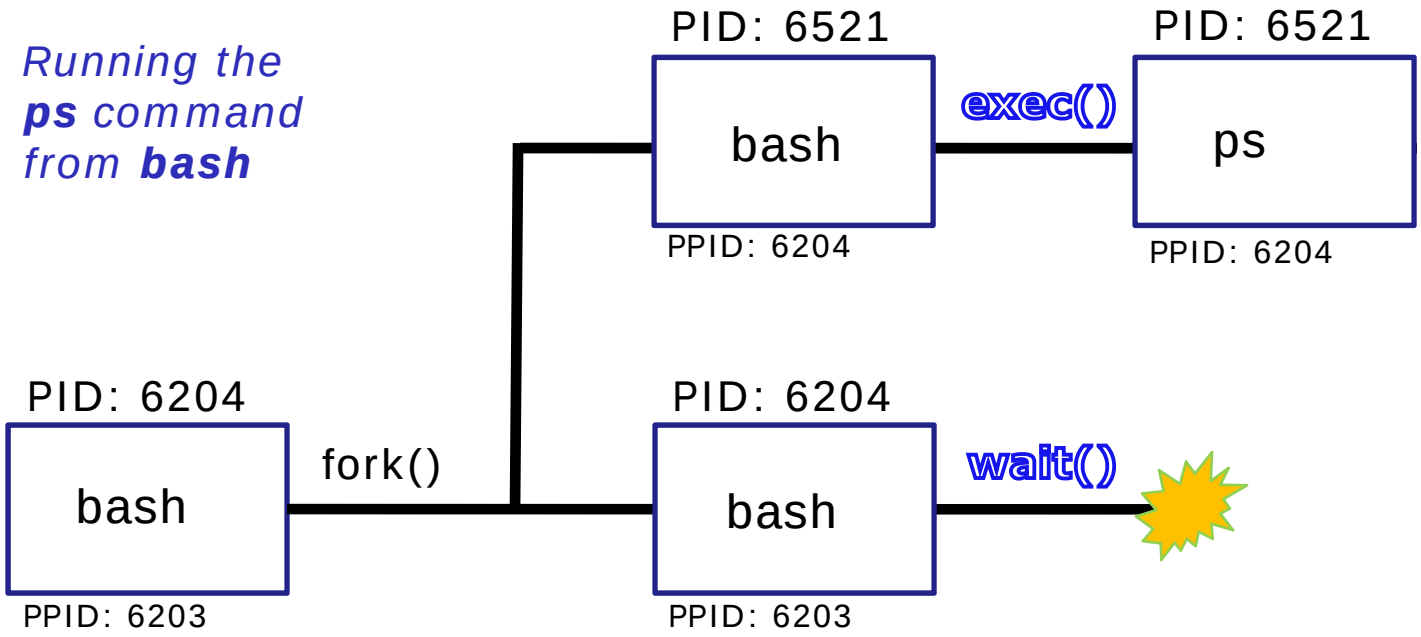
Use –l to show additional information

```
[rsimms@opus ~]$ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S   201  6204  6203  0  75   0 -  1165 wait   pts/6    00:00:00 bash
0 R   201  6521  6204  0  77   0 -  1050 -      pts/6    00:00:00 ps
```



Process Lifecycle

Running the ***ps*** *command from* ***bash***




```
[rsimms@opus ~]$ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S   201  6204  6203  0  75   0 -  1165 wait   pts/6    00:00:00 bash
0 R   201  6521  6204  0  77   0 -  1050 -      pts/6    00:00:00 ps
```

2) An exec system call is issued to overlay the **child** process with the instructions of the requested command. The new instructions then are executed.

The **child** process (**ps**) runs (status=R)
The **parent** process (**bash**) issues the wait system call and goes to sleep (status=S).

Process Information

```
[rsimms@opus ~]$ ps -ef
UID        PID  PPID  C STIME TTY          TIME CMD
root         1     0  0 Sep10 ?        00:00:05 init [3]
root         2     1  0 Sep10 ?        00:00:00 [migration/0]
root         3     1  0 Sep10 ?        00:00:00 [ksoftirqd/0]
root         4     1  0 Sep10 ?        00:00:00 [watchdog/0]
root         5     1  0 Sep10 ?        00:00:02 [migration/1]
root         6     1  0 Sep10 ?        00:00:00 [ksoftirqd/1]
root         7     1  0 Sep10 ?        00:00:00 [watchdog/1]
root         8     1  0 Sep10 ?        00:00:00 [events/0]
root         9     1  0 Sep10 ?        00:00:00 [events/1]
root        10     1  0 Sep10 ?        00:00:00 [khelper]
root        11     1  0 Sep10 ?        00:00:00 [kthread]
root        15    11  0 Sep10 ?        00:00:00 [kblockd/0]
root        16    11  0 Sep10 ?        00:00:00 [kblockd/1]
root        17    11  0 Sep10 ?        00:00:00 [kacpid]
root       109    11  0 Sep10 ?        00:00:00 [cqueue/0]
root       110    11  0 Sep10 ?        00:00:00 [cqueue/1]
root       113    11  0 Sep10 ?        00:00:00 [khubd]
root       115    11  0 Sep10 ?        00:00:00 [kseriod]
root       181    11  0 Sep10 ?        00:00:00 [pdflush]
root       182    11  0 Sep10 ?        00:00:07 [pdflush]
root       183    11  0 Sep10 ?        00:00:01 [kswapd0]
root       184    11  0 Sep10 ?        00:00:00 [aio/0]
root       185    11  0 Sep10 ?        00:00:00 [aio/1]
root       341    11  0 Sep10 ?        00:00:00 [kpsmoused]
root       371    11  0 Sep10 ?        00:00:00 [ata/0]
```

*Use **-ef** option to see every process running*

Process Information

```
root       372    11  0 Sep10 ?        00:00:00 [ata/1]
root       373    11  0 Sep10 ?        00:00:00 [ata_aux]
root       377    11  0 Sep10 ?        00:00:00 [scsi_eh_0]
root       378    11  0 Sep10 ?        00:00:00 [scsi_eh_1]
root       379    11  0 Sep10 ?        00:01:25 [kjournald]
root       412    11  0 Sep10 ?        00:00:00 [kauditd]
root       446     1  0 Sep10 ?        00:00:00 /sbin/udevd -d
root       869    11  0 Sep10 ?        00:00:01 [kedac]
root      1420    11  0 Sep10 ?        00:00:00 [kmpathd/0]
root      1421    11  0 Sep10 ?        00:00:00 [kmpathd/1]
root      2082     1  0 Sep10 ?        00:00:05 /usr/sbin/restorecond
root      2098     1  0 Sep10 ?        00:00:11 auditd
root      2100  2098  0 Sep10 ?        00:00:05 /sbin/audispd
root      2120     1  0 Sep10 ?        00:00:23 syslogd -m 0
root      2123     1  0 Sep10 ?        00:00:00 klogd -x
root      2160     1  0 Sep10 ?        00:00:20 mcstransd
rpc       2183     1  0 Sep10 ?        00:00:00 portmap
root      2201     1  0 Sep10 ?        00:01:18 /usr/bin/python -E /usr/sbin/setroub
rpcuser   2227     1  0 Sep10 ?        00:00:00 rpc.statd
root      2275     1  0 Sep10 ?        00:00:00 rpc.idmapd
root      2345     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-bridge -d /var/run/vm
root      2364     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-natd -d /var/run/vmne
dbus      2383     1  0 Sep10 ?        00:00:15 dbus-daemon --system
root      2434     1  0 Sep10 ?        00:00:51 pcscd
root      2472     1  0 Sep10 ?        00:00:00 /usr/bin/hidd --server
root      2493     1  0 Sep10 ?        00:00:02 automount
```

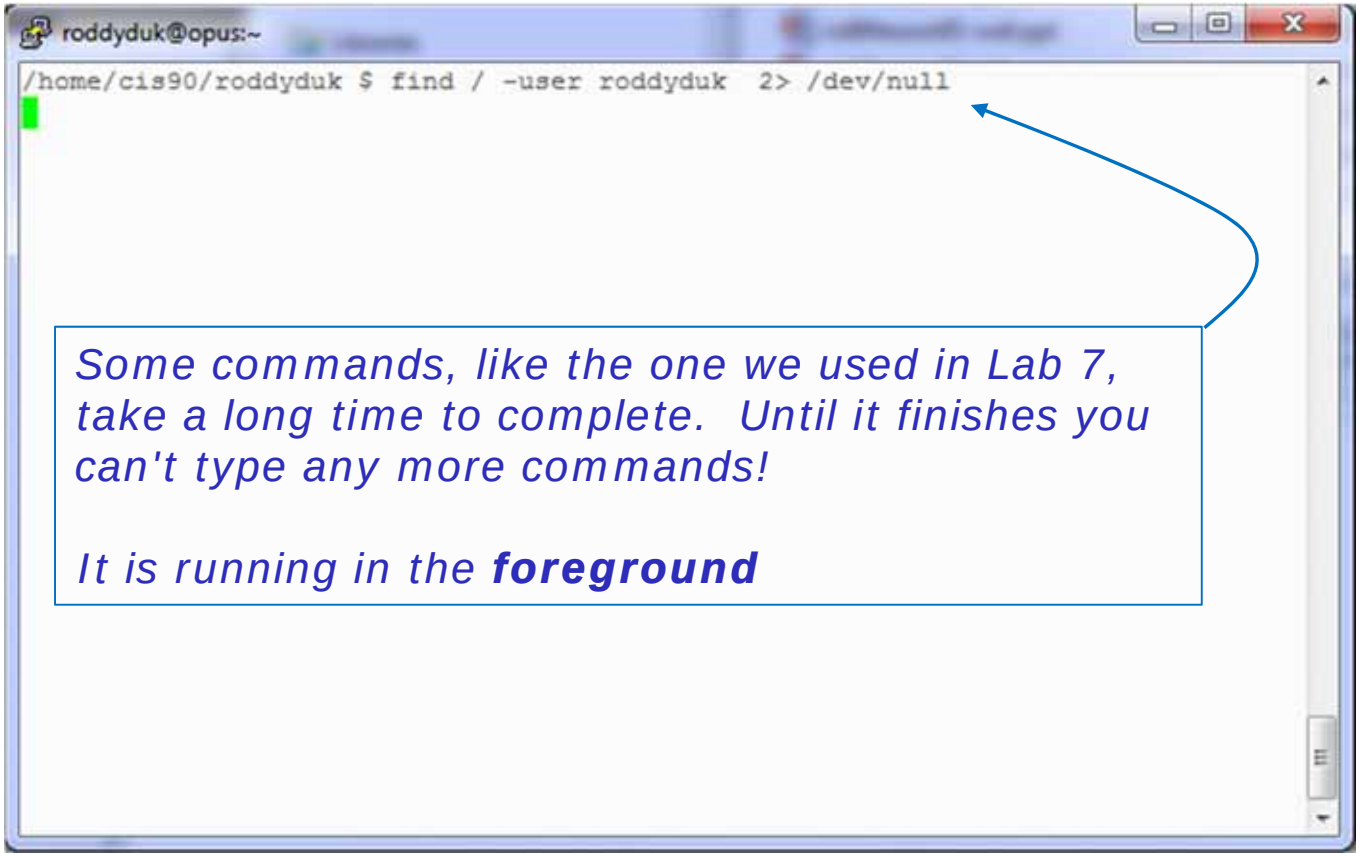
Process Information

```
root      2534     1  0 Sep10 ?        00:00:00 ./hpiod
root      2539     1  0 Sep10 ?        00:00:00 python ./hpssd.py
root      2556     1  0 Sep10 ?        00:00:00 cupsd
root      2575     1  0 Sep10 ?        00:00:11 /usr/sbin/sshd
root      2600     1  0 Sep10 ?        00:00:01 sendmail: accepting connections
smmsp     2609     1  0 Sep10 ?        00:00:00 sendmail: Queue runner@01:00:00 for
root      2626     1  0 Sep10 ?        00:00:00 crond
xfs       2662     1  0 Sep10 ?        00:00:00 xfs -droppriv -daemon
root      2693     1  0 Sep10 ?        00:00:00 /usr/sbin/atd
root      2710     1  0 Sep10 ?        00:00:00 rhnsd --interval 240
root      2743     1  0 Sep10 ?        00:01:33 /usr/bin/python -tt /usr/sbin/yum-up
root      2745     1  0 Sep10 ?        00:00:00 /usr/libexec/gam_server
root      2749     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-netifup -d /var/run/v
root      2758     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-netifup -d /var/run/v
root      2768     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-netifup -d /var/run/v
root      2827     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-dhcpd -cf /etc/vmware
root      2858     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-dhcpd -cf /etc/vmware
root      2859     1  0 Sep10 ?        00:00:00 /usr/bin/vmnet-dhcpd -cf /etc/vmware
68        2875     1  0 Sep10 ?        00:00:01 hald
root      2876  2875  0 Sep10 ?        00:00:00 hald-runner
68        2883  2876  0 Sep10 ?        00:00:00 hald-addon-acpi: listening on acpid
68        2886  2876  0 Sep10 ?        00:00:00 hald-addon-keyboard: listening on /d
68        2890  2876  0 Sep10 ?        00:00:00 hald-addon-keyboard: listening on /d
root      2898  2876  0 Sep10 ?        00:02:46 hald-addon-storage: polling /dev/hda
root      2944     1  0 Sep10 ?        00:00:00 /usr/sbin/smartd -q never
root      2949     1  0 Sep10 tty2     00:00:00 /sbin/mingetty tty2
```

Process Information

```
root      2950     1  0 Sep10 tty3     00:00:00 /sbin/mingetty tty3
root      5365  2575  0 08:19 ?        00:00:00 sshd: rsimms [priv]
rsimms    5368  5365  0 08:19 ?        00:00:00 sshd: rsimms@pts/0
rsimms    5369  5368  0 08:19 pts/0    00:00:00 -bash
root      5969  2575  0 10:14 ?        00:00:00 sshd: valdemar [priv]
valdemar  5971  5969  0 10:14 ?        00:00:00 sshd: valdemar@pts/5
valdemar  5972  5971  0 10:14 pts/5    00:00:00 -bash
rsimms    6173  5369  0 10:36 pts/0    00:00:00 man ps
rsimms    6176  6173  0 10:36 pts/0    00:00:00 sh -c (cd /usr/share/man && (echo ".
rsimms    6177  6176  0 10:36 pts/0    00:00:00 sh -c (cd /usr/share/man && (echo ".
rsimms    6182  6177  0 10:36 pts/0    00:00:00 /usr/bin/less -is
root      6200  2575  0 10:37 ?        00:00:00 sshd: rsimms [priv]
rsimms    6203  6200  0 10:37 ?        00:00:00 sshd: rsimms@pts/6
rsimms    6204  6203  0 10:37 pts/6    00:00:00 -bash
root      6408  2575  0 11:07 ?        00:00:00 sshd: dymesdia [priv]
dymesdia  6418  6408  0 11:08 ?        00:00:00 sshd: dymesdia@pts/1
dymesdia  6419  6418  0 11:08 pts/1    00:00:00 -bash
rsimms    6524  6204  0 11:15 pts/6    00:00:00 ps -ef
lyonsrob 12891     1  0 Oct01 ?        00:00:00 SCREEN
lyonsrob 12892 12891  0 Oct01 pts/3    00:00:00 /bin/bash
root     29218     1  0 Oct15 tty1     00:00:00 /sbin/mingetty tty1
[rsimms@opus ~]$
```

Job Control


roddyduk@opus:~
/home/cis90/roddyduk $ find / -user roddyduk 2> /dev/null
Some commands, like the one we used in Lab 7, take a long time to complete. Until it finishes you can't type any more commands!
It is running in the foreground

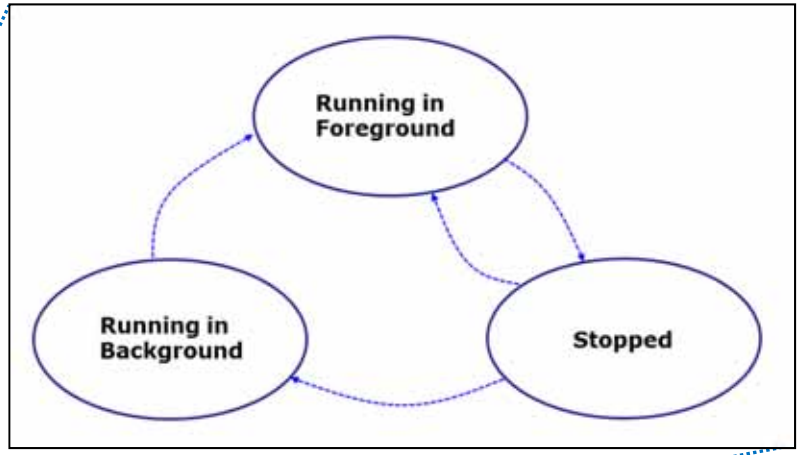
Job Control
A feature of the bash shell

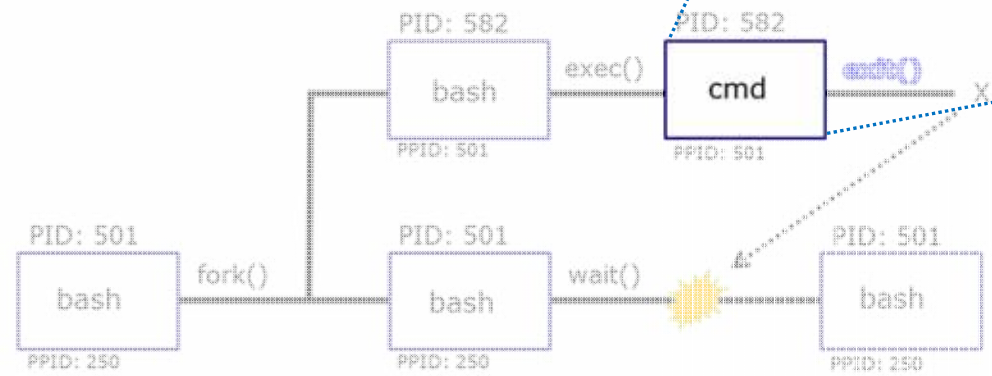
Foreground processes
- Processes that receive their input and write their output to the terminal.
- The parent shell waits on these processes to die.

Background Processes
- Processes that do not get their input from a user keyboard.
- The parent shell does not wait on these processes; it re-prompts the user for next command.

Job Control
A feature of the bash shell

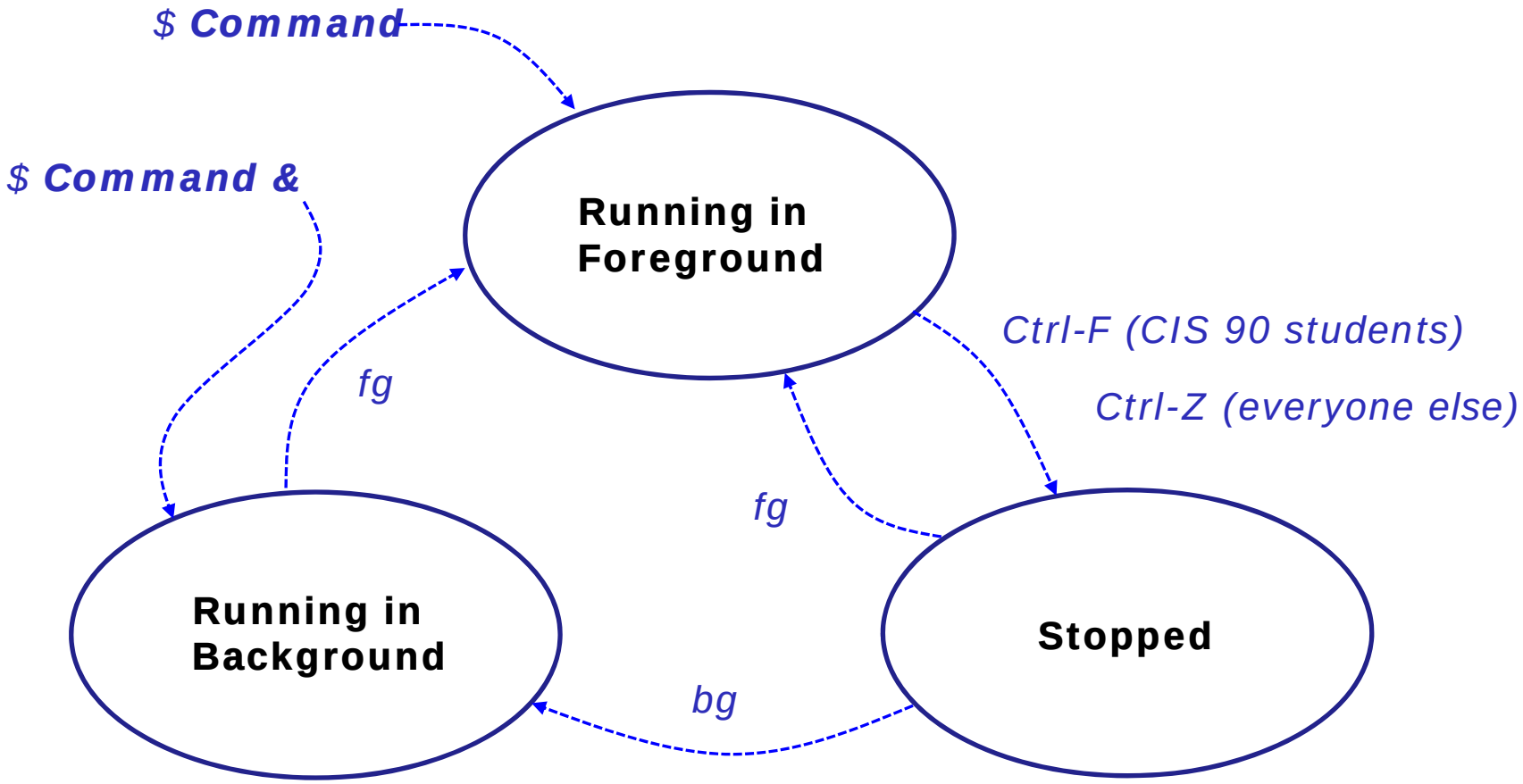
*When a process is **running** (status=R) the user can **stop** it (status=T) and choose whether it runs in the **background** or **foreground***





Job Control

A feature of the bash shell



*Use the **jobs** command to view stopped and background jobs*

Job Control
A feature of the bash shell

Ctrl-F

- Stops (suspends) a foreground process by sending it a "TTY Stop" (SIGTSTP) signal

Note, CIS 90 students will be using Ctrl-F which has been configured in their shell environement. Normally Ctrl-Z is used.

bg

- resumes the currently suspended process and runs it in the background

Job Control
A feature of the bash shell

Ctrl-Z or Ctrl-F

- To send a SIGTSTP signal from the keyboard
- Stops (suspends) a foreground process

```
/home/cis90/roddyduk $ stty -a
speed 38400 baud; rows 26; columns 78; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>;
eol2 = <undef>; swtch = <undef>; start = ^Q; stop = ^S; susp = ^F; rprnt = ^R;
werase = ^W; lnext = ^V; flush = ^O; min = 1; time = 0;
```

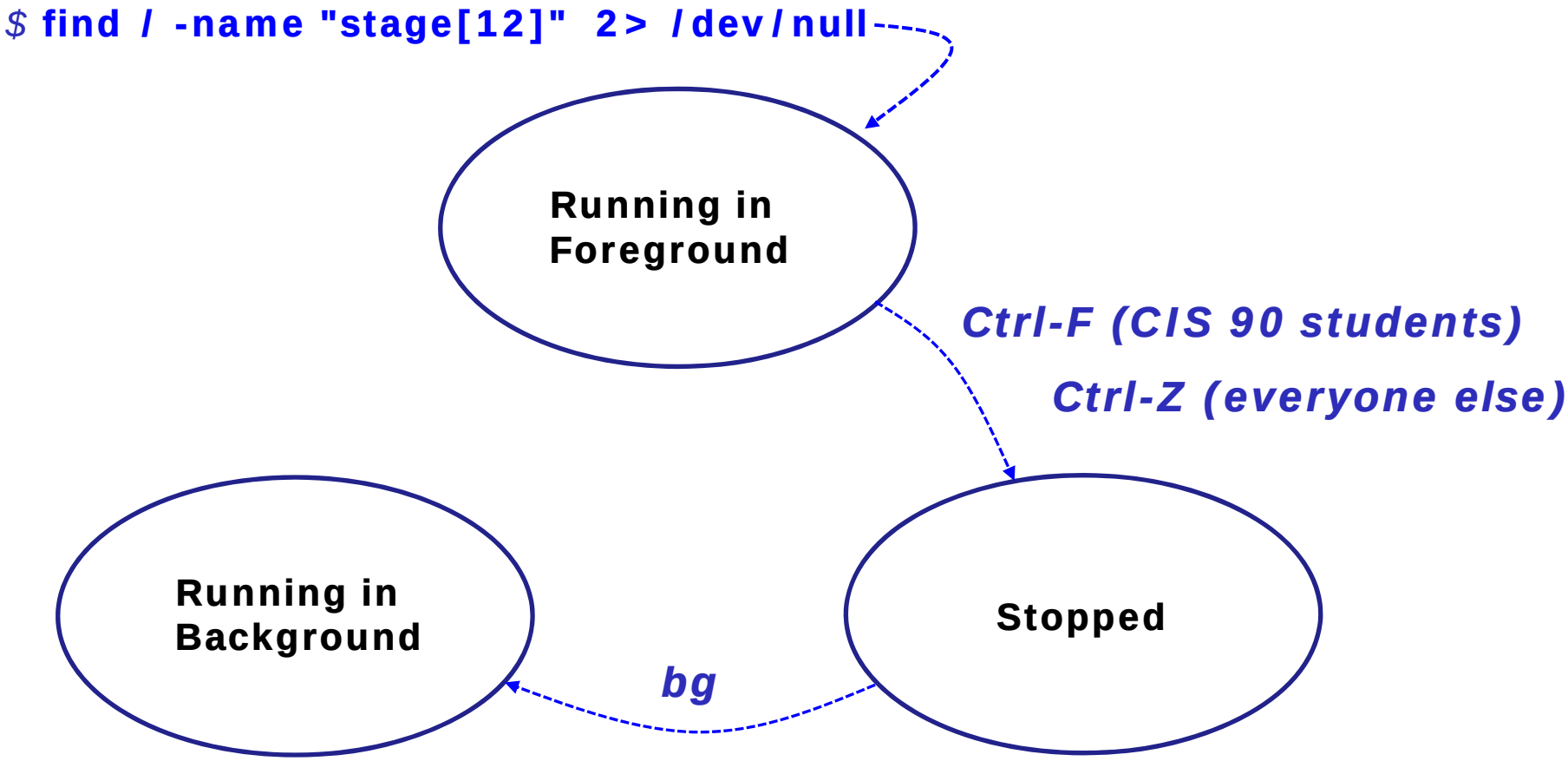
CIS 90 accounts use Ctrl-F

```
[rsimms@opus ~]$ stty -a
speed 38400 baud; rows 39; columns 84; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>; eol2 = <undef>;
swtch = <undef>; start = ^Q; stop = ^S; susp = ^Z; rprnt = ^R; werase = ^W;
lnext = ^V; flush = ^O; min = 1; time = 0;
```

Other Opus accounts use Ctrl-Z

The bash shell environment for the CIS 90 accounts was customized to use a different keystroke for sending a SIGTSTP signal

Job Control
Example 1



Suspend a long find command, then resume it in the background

Job Control
Example 1

```
[rsimms@opus ~]$ find / -name "stage[12]" 2> /dev/null

[1]+  Stopped                 find / -name "stage[12]" 2> /dev/null
[rsimms@opus ~]$ bg
[1]+ find / -name "stage[12]" 2> /dev/null &
[rsimms@opus ~]$
```

Notice, we can type more commands again after the find command was stopped

Ctrl-F *(CIS 90 accounts) or* ***Ctrl-Z*** *(other accounts) is tapped while find is running*

Process ID 25124 is stopped (status =T)

```
[rsimms@opus ~]$ ps -l -u rsimms
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
5 S   201 25055 25044  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25056 25055  0  78   0 -  1168 -      pts/3    00:00:00 bash
5 S   201 25087 25084  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25088 25087  0  75   0 -  1168 wait   pts/4    00:00:00 bash
0 T   201 25124 25056  2  78   0 -  1098 finish pts/3    00:00:00 find
0 R   201 25127 25088  0  77   0 -  1065 -      pts/4    00:00:00 ps
[rsimms@opus ~]$
```

Job Control
Example 1

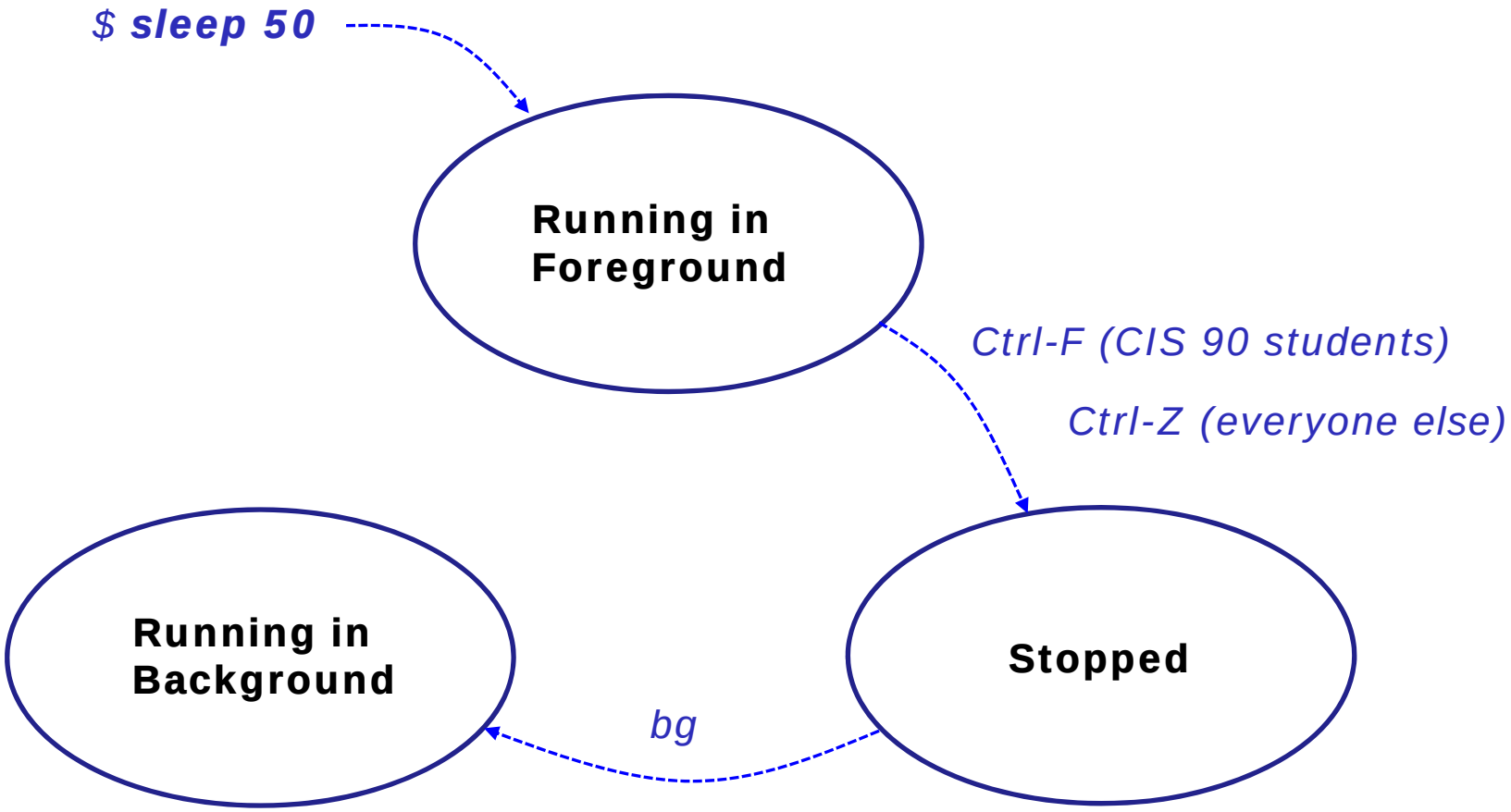
```
[rsimms@opus ~]$ find / -name "stage[12]" 2> /dev/null
/boot/grub/stage1
/boot/grub/stage2
/usr/share/grub/i386-redhat/stage1
/usr/share/grub/i386-redhat/stage2

[1]+  Stopped                 find / -name "stage[12]" 2> /dev/null
[rsimms@opus ~]$ bg
[1]+ find / -name "stage[12]" 2> /dev/null &
[rsimms@opus ~]$
```

bg *resumes the find command in the background*

Process ID 25124 is running again (status=R)

```
[rsimms@opus ~]$ ps -l -u rsimms
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
5 S   201 25055 25044  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25056 25055  0  75   0 -  1168 -      pts/3    00:00:00 bash
5 S   201 25087 25084  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25088 25087  0  75   0 -  1168 wait   pts/4    00:00:00 bash
0 R   201 25124 25056  1  78   0 -  1099 -      pts/3    00:00:00 find
0 R   201 25129 25088  0  77   0 -  1065 -      pts/4    00:00:00 ps
```

Job Control
Example 2



*Run the **sleep** command (for 50 seconds), stop it, then continue in the background*

Job Control
Example 2

```
[rsimms@opus ~]$ sleep 50

[1]+  Stopped                 sleep 50
[rsimms@opus ~]$


[rsimms@opus ~]$ jobs
[1]+  Stopped                 sleep 50
[rsimms@opus ~]$
```

Ctrl-F *(CIS 90 accounts)* *or* ***Ctrl-Z*** *(other accounts)* *is tapped while sleep is running*

jobs *commands shows sleep command is stopped*

PID 25389 is stopped

```
[rsimms@opus ~]$ ps -l -u rsimms
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
5 S   201 25055 25044  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25056 25055  0  76   0 -  1168 -      pts/3    00:00:00 bash
5 S   201 25087 25084  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25088 25087  0  75   0 -  1168 wait   pts/4    00:00:00 bash
0 T   201 25389 25056  0  76   0 -   929 finish pts/3    00:00:00 sleep
0 R   201 25391 25088  0  77   0 -  1065 -      pts/4    00:00:00 ps
[rsimms@opus ~]$
```

Job Control
Example 2

```
[rsimms@opus ~]$ bg
[1]+ sleep 50 &
[rsimms@opus ~]$ jobs
[1]+  Done                    sleep 50
[rsimms@opus ~]$
```

bg resumes the sleep command and it finishes

PID 25389 is sleeping and no longer stopped (status=S)

```
[rsimms@opus ~]$ ps -l -u rsimms
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
5 S   201 25055 25044  0  75   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25056 25055  0  75   0 -  1168 -      pts/3    00:00:00 bash
5 R   201 25087 25084  0  81   0 -  2481 stext  ?        00:00:00 sshd
0 S   201 25088 25087  0  75   0 -  1168 wait   pts/4    00:00:00 bash
0 S   201 25389 25056  0  75   0 -   929 322807 pts/3    00:00:00 sleep
0 R   201 25394 25088  0  77   0 -  1065 -      pts/4    00:00:00 ps
[rsimms@opus ~]$
```

Job Control
A feature of the bash shell

&

- Append to a command to run it in the background

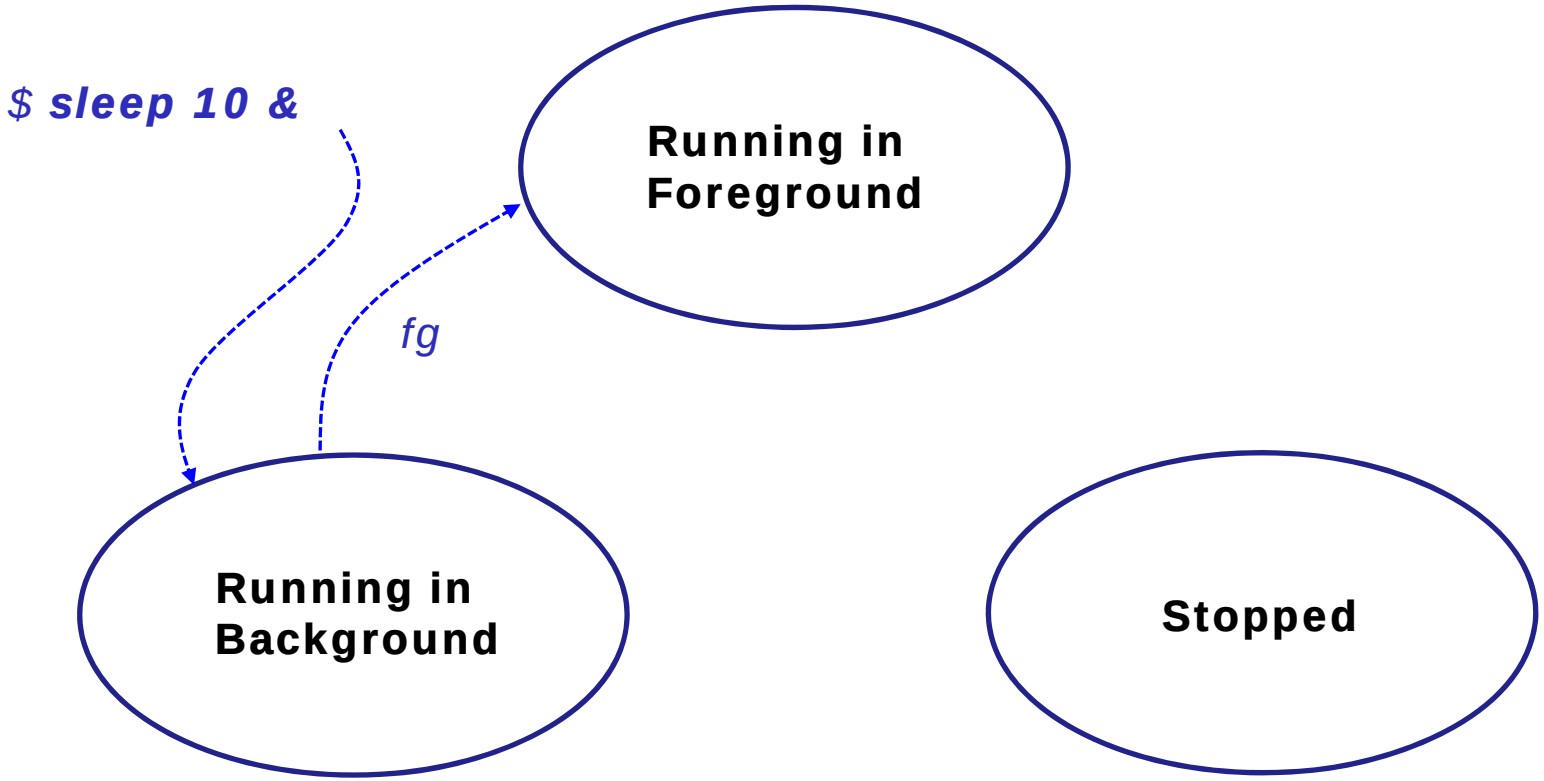
fg

- Brings the most recent background process to the foreground

jobs

- Lists all background jobs

Job Control
Example



The sleep command is started in the background, then brought to the foregorund

Job Control
Example

```
[rsimms@opus ~]$ sleep 10 &
[1] 7761
[rsimms@opus ~]$ jobs
[1]+  Running                 sleep 10 &
[rsimms@opus ~]$ fg
sleep 10
```

The & has sleep run in the background and jobs shows the shows it as the one and only background job

After fg, sleep now runs in the foreground. The prompt is gone. Need to wait until sleep finishes for prompt to return.

```
[rsimms@opus ~]$
[rsimms@opus ~]$
```

& is often used when running GUI tools like Firefox or Wireshark from the command line. This allows you to keep using the terminal for more commands while those applications run.

Signals

Signals

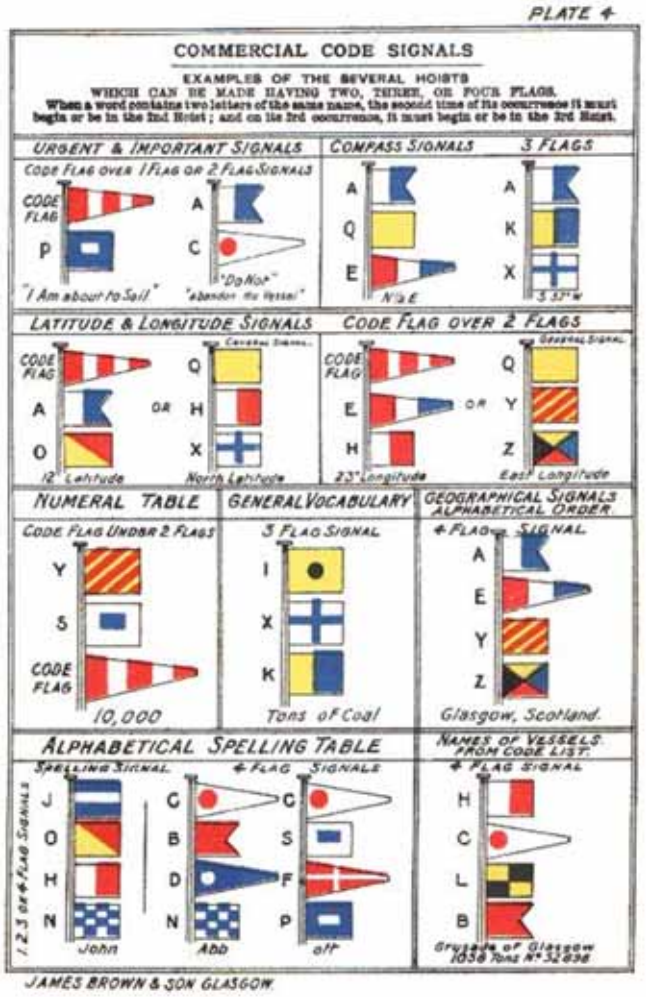


PLATE 4

COMMERCIAL CODE SIGNALS

EXAMPLES OF THE SEVERAL HOISTS WHICH CAN BE MADE HAVING TWO, THREE, OR FOUR FLAGS.

When a word contains two letters of the same name, the second time of its occurrence it must begin or be in the 2nd Hoist; and on the 3rd occurrence, it must begin or be in the 3rd Hoist.

URGENT & IMPORTANT SIGNALS — Code Flag over 1 Flag or 2 Flag Signals

Code Flag P — "I Am about to Sail"

A — C — "Do Not" "abandon the Vessel"

COMPASS SIGNALS — A Q E — N by E

3 FLAGS — A K X — S 32° W

LATITUDE & LONGITUDE SIGNALS — Code Flag A O — 12° Latitude

OR Q H X — North Latitude

CODE FLAG OVER 2 FLAGS — Code Flag E H — 23° Longitude

OR Q Y Z — East Longitude

NUMERAL TABLE — Code Flag under 2 Flags — Y S Code Flag — 10,000

GENERAL VOCABULARY — 3 Flag Signal — I X K — Tons of Coal

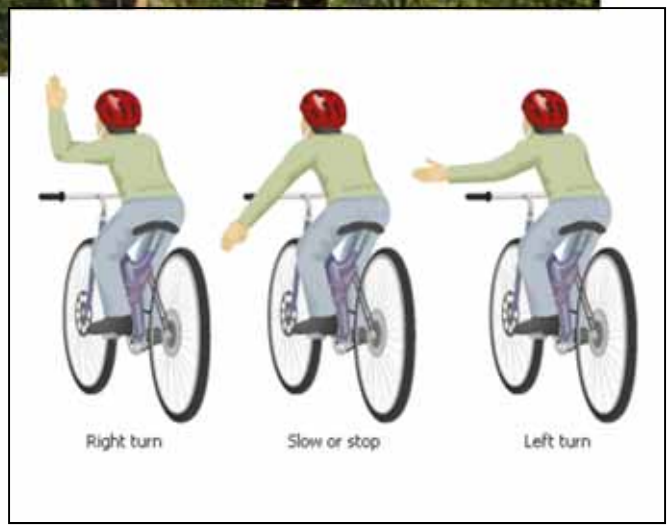
GEOGRAPHICAL SIGNALS ALPHABETICAL ORDER — 4 Flag Signal — A E Y Z — Glasgow, Scotland.

ALPHABETICAL SPELLING TABLE — Spelling Signal — 1.2.3 or 4 Flag Signals — J O H N — John

4 Flag Signals — C B D N — Abd — C S F P — off

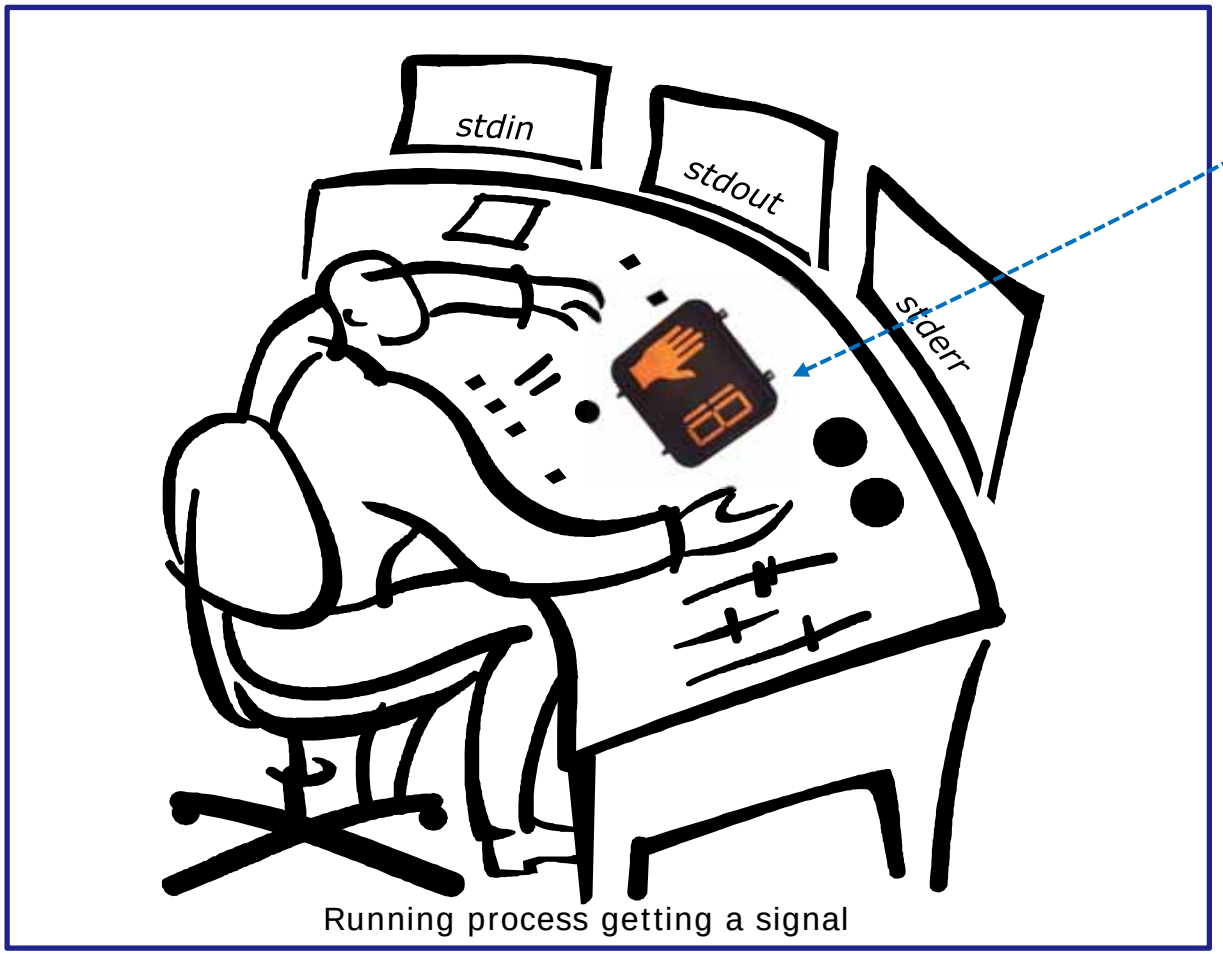
NAMES OF VESSELS FROM CODE LIST. — 4 Flag Signal — H C L B — Grussels of Glasgow 1038 Tons

JAMES BROWN & SON GLASGOW



Signals

Signals are asynchronous messages sent to processes



Running process getting a signal

Asynchronous means it can happen at any time

Signals

Signals are asynchronous messages sent to processes

They can result in one of three courses of action:

1. be ignored,
2. default action (die)
3. execute some predefined function.

Signals are sent:

- Using the kill command: **`$ kill -# PID`**
  - Where # is the signal number and PID is the process id.
  - if no signal number is specified, SIGTERM is sent.

- Using special keystrokes (e.g. Ctrl-Z for SIGTSTP/20)
  - limited to just a few signals
  - sent to the process running in the foreground

Use kill –l to see all signals

Signals

Signals are asynchronous messages sent to processes

Running process gets a signal

Signals

SIGHUP	1	Hangup (POSIX)
SIGINT	2	Terminal interrupt (ANSI) ***Ctrl-C***
SIGQUIT	3	Terminal quit (POSIX) ***Ctrl-***
SIGILL	4	Illegal instruction (ANSI)
SIGTRAP	5	Trace trap (POSIX)
SIGIOT	6	IOT Trap (4.2 BSD)
SIGBUS	7	BUS error (4.2 BSD)
SIGFPE	8	Floating point exception (ANSI)
SIGKILL	9	Kill (can't be caught or ignored) (POSIX)
SIGUSR1	10	User defined signal 1 (POSIX)
SIGSEGV	11	Invalid memory segment access (ANSI)
SIGUSR2	12	User defined signal 2 (POSIX)
SIGPIPE	13	Write on a pipe with no reader, Broken pipe (POSIX)
SIGALRM	14	Alarm clock (POSIX)
SIGTERM	15	Termination (ANSI) (default kill signal when not specified)

Use kill –l to see all signals

Signals

SIGSTKFLT	16	Stack fault
SIGCHLD	17	Child process has stopped or exited, changed (POSIX)
SIGCONT	18	Continue executing, if stopped (POSIX)
SIGSTOP	19	Stop executing(can't be caught or ignored) (POSIX)
SIGTSTP	20	Terminal stop signal (POSIX) ***Ctrl-Z or Ctrl-F***
SIGTTIN	21	Background process trying to read, from TTY (POSIX)
SIGTTOU	22	Background process trying to write, to TTY (POSIX)
SIGURG	23	Urgent condition on socket (4.2 BSD)
SIGXCPU	24	CPU limit exceeded (4.2 BSD)
SIGXFSZ	25	File size limit exceeded (4.2 BSD)
SIGVTALRM	26	Virtual alarm clock (4.2 BSD)
SIGPROF	27	Profiling alarm clock (4.2 BSD)
SIGWINCH	28	Window size change (4.3 BSD, Sun)
SIGIO	29	I/O now possible (4.2 BSD)
SIGPWR	30	Power failure restart (System V)

Use kill –l to see all signals

Signals

Use `kill -l` to see all of them

```
/home/cis90/roddyduk $ kill -l
 1) SIGHUP       2) SIGINT       3) SIGQUIT      4) SIGILL
 5) SIGTRAP      6) SIGABRT      7) SIGBUS       8) SIGFPE
 9) SIGKILL     10) SIGUSR1     11) SIGSEGV     12) SIGUSR2
13) SIGPIPE     14) SIGALRM     15) SIGTERM     16) SIGSTKFLT
17) SIGCHLD     18) SIGCONT     19) SIGSTOP     20) SIGTSTP
21) SIGTTIN     22) SIGTTOU     23) SIGURG      24) SIGXCPU
25) SIGXFSZ     26) SIGVTALRM   27) SIGPROF     28) SIGWINCH
29) SIGIO       30) SIGPWR      31) SIGSYS      34) SIGRTMIN
35) SIGRTMIN+1  36) SIGRTMIN+2  37) SIGRTMIN+3  38) SIGRTMIN+4
39) SIGRTMIN+5  40) SIGRTMIN+6  41) SIGRTMIN+7  42) SIGRTMIN+8
43) SIGRTMIN+9  44) SIGRTMIN+10 45) SIGRTMIN+11 46) SIGRTMIN+12
47) SIGRTMIN+13 48) SIGRTMIN+14 49) SIGRTMIN+15 50) SIGRTMAX-14
51) SIGRTMAX-13 52) SIGRTMAX-12 53) SIGRTMAX-11 54) SIGRTMAX-10
55) SIGRTMAX-9  56) SIGRTMAX-8  57) SIGRTMAX-7  58) SIGRTMAX-6
59) SIGRTMAX-5  60) SIGRTMAX-4  61) SIGRTMAX-3  62) SIGRTMAX-2
63) SIGRTMAX-1  64) SIGRTMAX
/home/cis90/roddyduk $
```

Signals
Special keystrokes

```
/home/cis90/roddyduk $ stty -a
speed 38400 baud; rows 26; columns 78; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>;
eol2 = <undef>; swtch = <undef>; start = ^Q; stop = ^S; susp = ^F; rprnt = ^R;
werase = ^W; lnext = ^V; flush = ^O; min = 1; time = 0;
```

```
[rsimms@opus ~]$ stty -a
speed 38400 baud; rows 39; columns 84; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>; eol2 = <undef>;
swtch = <undef>; start = ^Q; stop = ^S; susp = ^Z; rprnt = ^R; werase = ^W;
lnext = ^V; flush = ^O; min = 1; time = 0;
```

use stty –a to see special keystrokes

Signals

Jim's app script

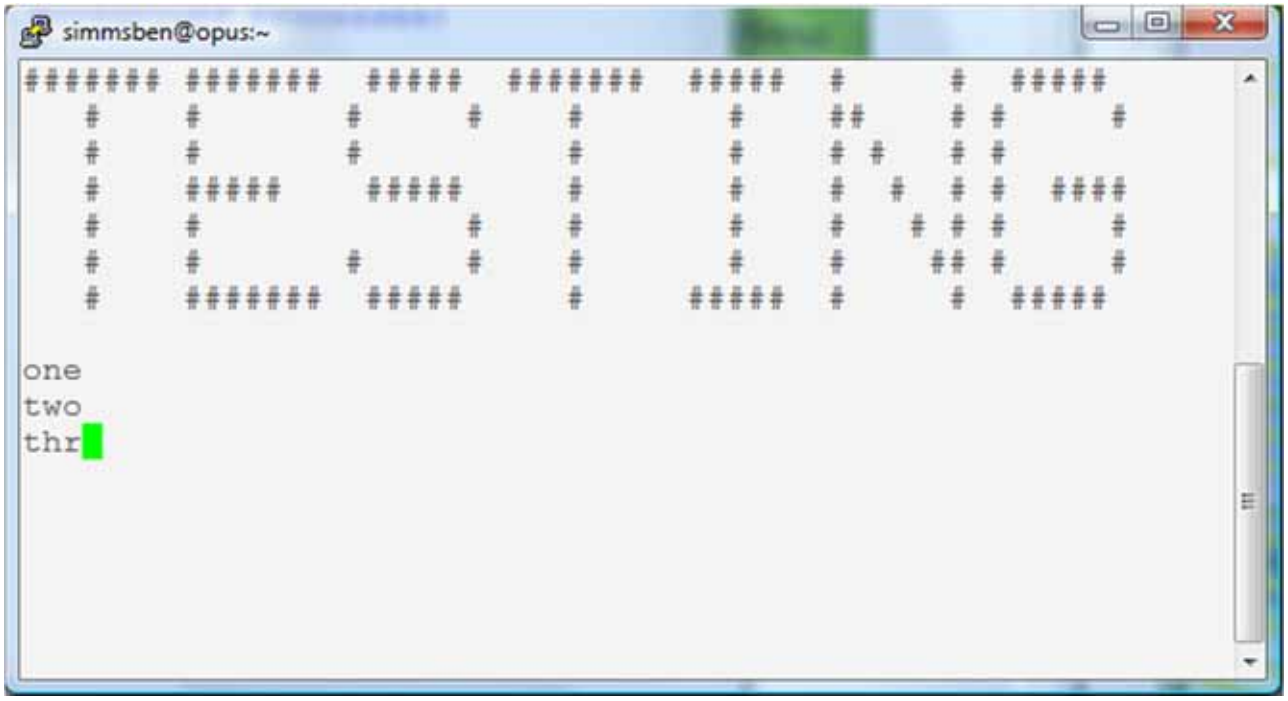
rsimms@opus:/home/cis90/depot

```
#!/bin/sh
#
# app - script to demostrate use of signals
#
# Usage:  run app with no options or parameters
#
# Send signals to it with keystrokes or kill command
#
# Notes:
# stty -echo stop the display of characters typed
# stty echo makes typed characters visible again
# stty susp ^Z sets suspend keystroke to Ctlr-Z (to stop forground processes)
# stty susp @ sets suspend character to @ (to stop foreground processes)
#
trap '' 2  #Ignore SIGINT
trap 'echo -n quit it!' 3 #Handle SIGQUIT
trap 'stty echo susp ^Z;echo ee; echo cleanup;exit' 15 #Handle SIGTERM
clear
banner testing
stty -echo susp @
sleep 1
echo  one
sleep 1
echo two
sleep 1
echo -n thr
while :
do sleep 1
done
~
                                                          13,1          All
```

Signals
Class Exercise

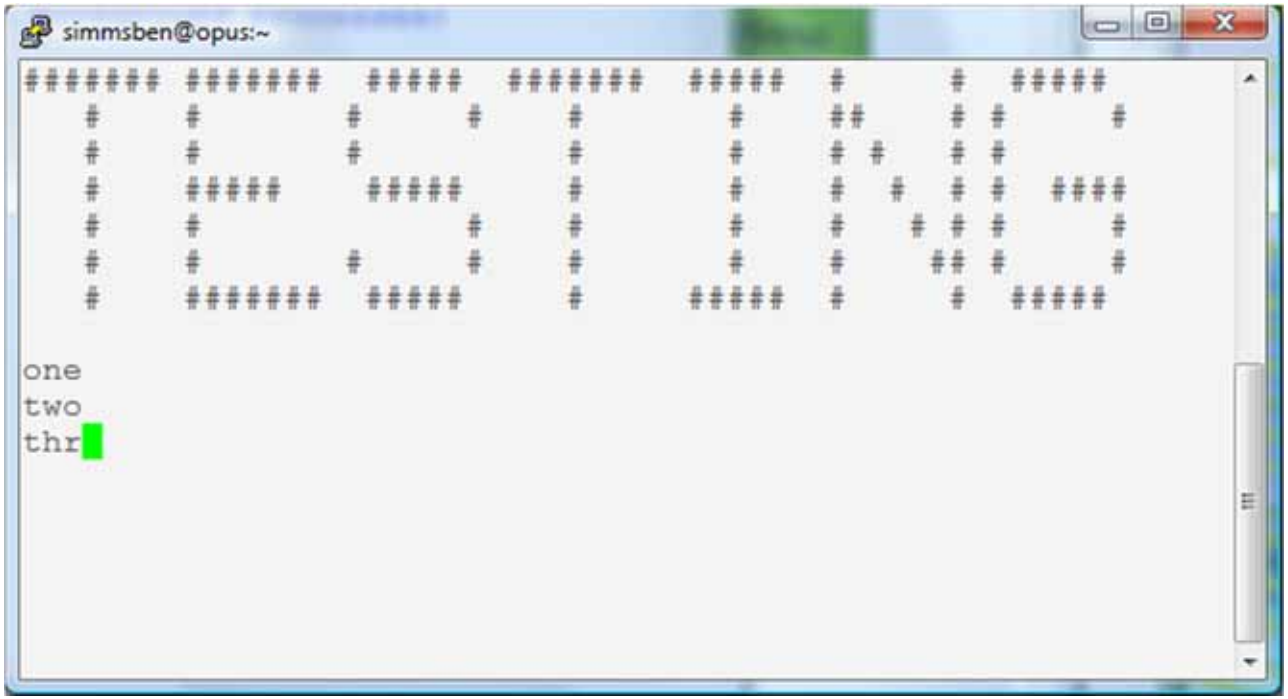
- View with **cat ../depot/app**
- Look for the three trap handlers
  - Signal 2 (SIGINT)
  - Signal 3 (SIGQUIT)
  - Signal 15 (SIGTERM)

Signals
Benji runs app



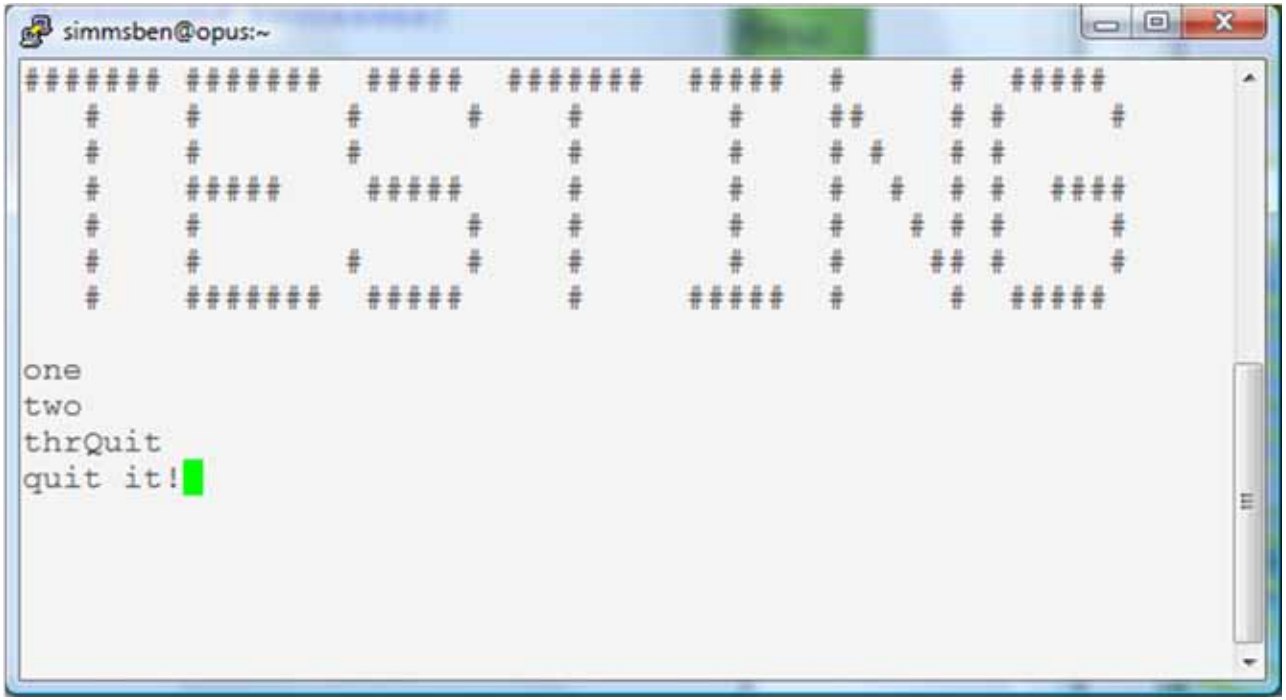
Benji logs in and runs app … uh oh, its stuck !

Signals
Benji runs app



Benji tries using the keyboard to send a SIGINT/2 using Ctrl-C but nothing happens (because app is ignoring SIGINT)

Signals
Benji runs app



Benji tries using the keyboard to send a SIGQUIT/3 using Ctrl-\ but app reacts by saying "quit it"

Signals
Benji runs app

```
roddyduk@opus:~
/home/cis90/roddyduk $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 7065 pts/2    00:00:00 app
 7579 pts/2    00:00:00 sleep
/home/cis90/roddyduk $ kill 7065
-bash: kill: (7065) - Operation not permitted
/home/cis90/roddyduk $
```

Benji asks his friend Duke to kill off his stalled app process. Duke uses ps to look it up but does not have permission to kill it off

Signals

Benji runs app

simmsben@opus:~

```
one
two
thrQuit
quit it!
```

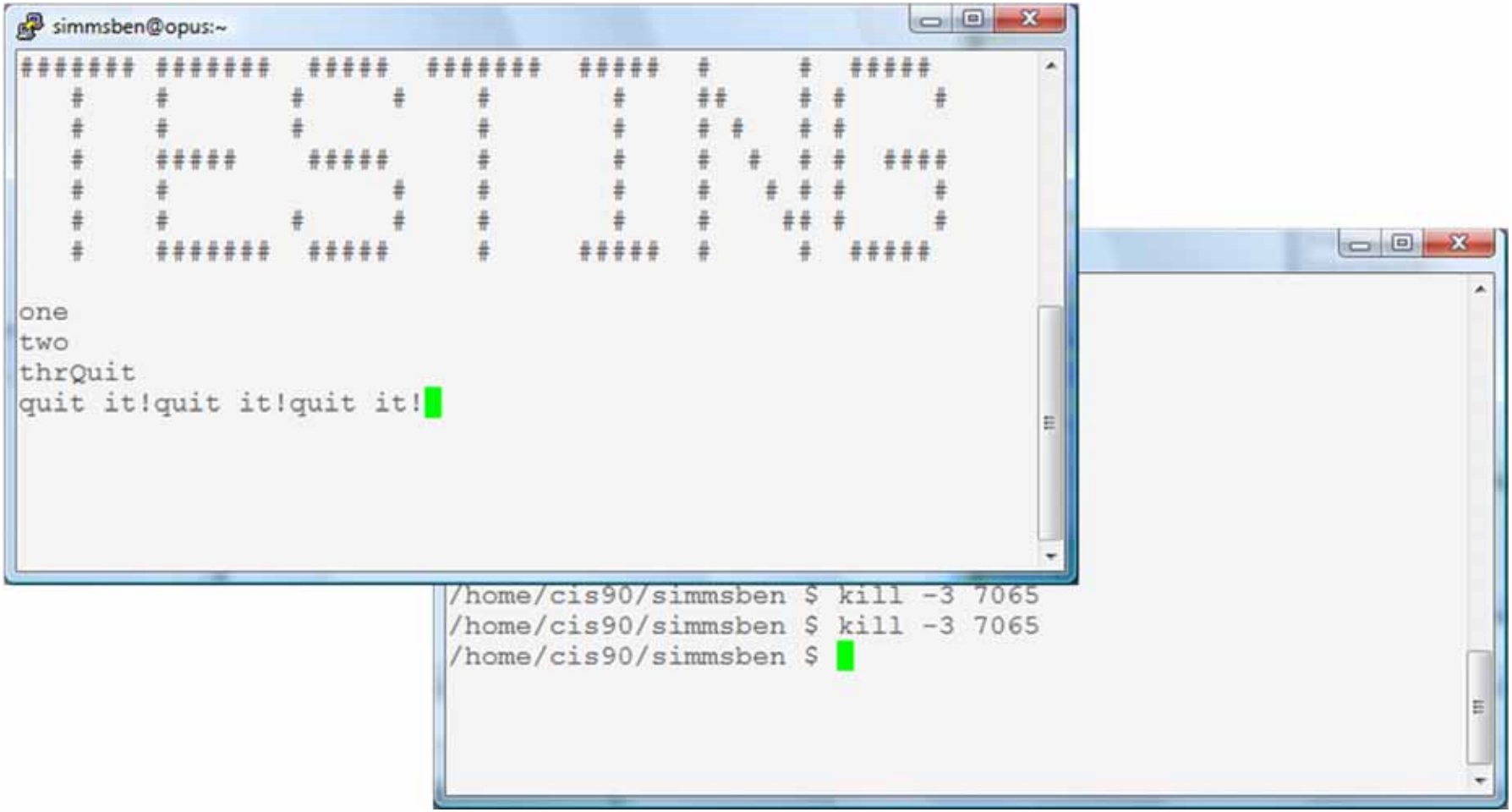
simmsben@opus:~

```
/home/cis90/simmsben $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 7065 pts/2    00:00:00 app
 7843 pts/2    00:00:00 sleep
 7844 pts/1    00:00:00 ps
/home/cis90/simmsben $ kill -2 7065
/home/cis90/simmsben $
```

Benji logs into another Putty session and sends a SIGINT/2 using the kill command .... but nothing happens

Signals

Benji runs app



Benji ups the anty and sends two SIGQUIT/3's but the app process shrugs them off with "quit it!" messages

Signals

Benji runs app

simmsben@opus:~

```
one
two
thrQuit
quit it!quit it!quit it!ee
cleanup
/home/cis90/simmsben $
```

```
/home/cis90/simmsben $ kill -3 7065
/home/cis90/simmsben $ kill -15 7065
/home/cis90/simmsben $
```

Benji decides to send a SIGTERM/15 this time and the app process finishes, cleans up and exits

Signals

Benji runs app

simmsben@opus:~

```
one
two
thr
```

simmsben@opus:~

```
/home/cis90/simmsben $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 8237 pts/2    00:00:00 app
 8279 pts/2    00:00:00 sleep
 8280 pts/1    00:00:00 ps
/home/cis90/simmsben $
```

The same thing happens again another day. This time Benji does not care what happens with app ...

Signals

Benji runs app

simmsben@opus:~

```
one
two
thrKilled
/home/cis90/simmsben $
```

simmsben@opus:~

```
/home/cis90/simmsben $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 8237 pts/2    00:00:00 app
 8279 pts/2    00:00:00 sleep
 8280 pts/1    00:00:00 ps
/home/cis90/simmsben $ kill -9 8237
/home/cis90/simmsben $
```

So he sends a SIGKILL/9 this time … and app never even sees it coming …. poof … app is gone

Signals
Class Exercise

- Run app
- Try sending it a SIGINT from the keyboard (Ctrl-C)
- Try sending it a SIGQUIT from the keyboard (Ctrl-\)
- Login to another Putty session
  - Use the ps –u $LOGNAME to find the app PID
  - Send it a SIGINT (kill -2 PID)
  - Send it a SIGQUIT (kill -3 PID)
  - Now send either a SIGKILL (9) or SIGTERM (15)

Load Balancing

Load Balancing

So that the multiprocessing CPU on a UNIX system does not get overloaded, some processes need to be run during low peak hours such as early in the morning or later in the day.

The **at** command reads from stdin for a list of commands to run, and begins running them at the time of day specified as the first argument

```
/home/cis90ol/simmsben $ at 10:30pm < batch_file

/home/cis90ol/simmsben $ at 11:59pm
at> cat files.out bigshell > lab08
at> cp lab08 /home/rsimms/cis90/$LOGNAME
at> Ctrl-D
/home/cis90ol/simmsben $
```

*Note: the **Ctrl-D** must be entered as the first character on the last line.*

Load Balancing

This job makes a backup of myscript and sends an email when finished

```
/home/cis90/roddyduk $ cat job1
cp bin/myscript bin/myscript.bak
echo "Job 1 - finished, myscript has been backed up" | mail -s "Job 1" roddyduk
/home/cis90/roddyduk $ at now + 5 minutes < job1
job 24 at 2008-11-12 12:14
/home/cis90/roddyduk $ at now + 2 hours < job1
job 25 at 2008-11-12 14:09
/home/cis90/roddyduk $ at teatime < job1
job 26 at 2008-11-12 16:00
/home/cis90/roddyduk $ at now + 1 week < job1
job 27 at 2008-11-19 12:10
/home/cis90/roddyduk $ at 3:00 12/12/2010 < job1
job 28 at 2008-12-12 03:00
/home/cis90/roddyduk $ jobs
/home/cis90/roddyduk $ atq
25      2008-11-12 14:09 a roddyduk
28      2008-12-12 03:00 a roddyduk
27      2008-11-19 12:10 a roddyduk
26      2008-11-12 16:00 a roddyduk
24      2008-11-12 12:14 a roddyduk
/home/cis90/roddyduk $
```

Several ways to specify a future time to run

*Use the **atq** command to show queued jobs*

Load Balancing

```
/home/cis90/roddyduk $ jobs
/home/cis90/roddyduk $ atq
25      2008-11-12 14:09 a roddyduk
28      2008-12-12 03:00 a roddyduk
27      2008-11-19 12:10 a roddyduk
26      2008-11-12 16:00 a roddyduk
24      2008-11-12 12:14 a roddyduk
```

*The **jobs** command lists processes running or suspended in the background.*

*The **atq** command lists jobs queued to run in the futures that were scheduled by at command*

```
/home/cis90/roddyduk $ atrm 24
/home/cis90/roddyduk $ atq
25      2008-11-12 14:09 a roddyduk
28      2008-12-12 03:00 a roddyduk
27      2008-11-19 12:10 a roddyduk
26      2008-11-12 16:00 a roddyduk
/home/cis90/roddyduk $
```

*The **atrm** command is used to remove jobs from the queue*

Load Balancing

```
/home/cis90ol/simmsben $ at now + 1 minute
at> kitty letter
at> <EOT>
job 150 at 2011-04-20 10:47
/home/cis90ol/simmsben $

/home/cis90ol/simmsben $ atq
150     2011-04-20 10:47 a simmsben
/home/cis90ol/simmsben $ atq
/home/cis90ol/simmsben $ mail
Mail version 8.1 6/6/93.  Type ? for help.
"/var/spool/mail/simmsben": 1 message 1 new
>N  1 simmsben@Opus.cabril  Wed Apr 20 10:47  16/709   "Output from your job "
& 1
Message 1:
From simmsben@Opus.cabrillo.edu  Wed Apr 20 10:47:01 2011
Date: Wed, 20 Apr 2011 10:47:01 -0700
From: Benji Simms <simmsben@Opus.cabrillo.edu>
Subject: Output from your job      150
To: simmsben@Opus.cabrillo.edu

/bin/bash: line 2: kitty: command not found
```

Oops, specified a non-existant command to run in the future

Because, you may not be online when the command runs, any error messages are mailed to you.

Wrap up

New commands:

Ctrl-Z or F	Suspends a foreground process
bg	Resumes suspended process
&	Runs command in the background
fg	Brings background job to foreground
jobs	show background jobs
kill	Send a signal to a process
at	Run job once in the future
atq	Show all *at* jobs queued to run
atrm	Remove *at* jobs from queue
sleep	Sleep for specified amount of time
stty	Terminal control

Next Class

Assignment: Check Calendar Page on web site to see what is due next week.

Lab 8 due

Quiz #8 questions for next class:

- What command shows the current running processes?
- Name four states a process can be in.
- What is the difference between the fork and exec system calls?

The Test

Add read permission on test2

Backup

A message from …

Greetings Professor Simms,

My name is Tim Hill. I'm chair of the MIS department in the College of Business at SJSU. I'm reaching out to computer information systems faculty and advisers in the local community colleges to raise awareness of our program and the important benefits community college transfer students should consider when exploring major options at SJSU. For students interested in combining computer technology and business, MIS represents an exceptional choice of concentration within the Bachelors of Science in Business Administration.

Management Information Systems (MIS) is the BSBA concentration at SJSU that currently garners *the highest starting salaries and yields the highest placement rate upon graduation*. And MIS students are the *only ones on the SJSU campus formally recruited Google*! But unfortunately, far too few transfer students are aware of MIS and its unique advantages. Please consider making them aware of the 4 attachments and the 6 critical bullet points below before they choose their concentration within the BSBA at SJSU.

If you would be so kind as to share this information as appropriate, it would be greatly appreciated. And please let me know if I can be of assistance. I would be happy to visit your campus to speak with you and/or your colleagues and/or students about the MIS program and job opportunities. Just call (408) 924-3512 or reply to this email and I'll get back to you promptly.

Recent developments to note:

The College of Business has just reduced the transfer GPA requirement from 3.4 down to 2.8, effective immediately.
SJSU is accepting applications for Fall 2011 through November 30.
(http://www.sjsu.edu/news/news_detail.jsp?id=3459)

SJSU has extended the Spring 2011 Admissions deadline to November 15 (http://www.sjsu.edu/news/news_detail.jsp?id=3468)

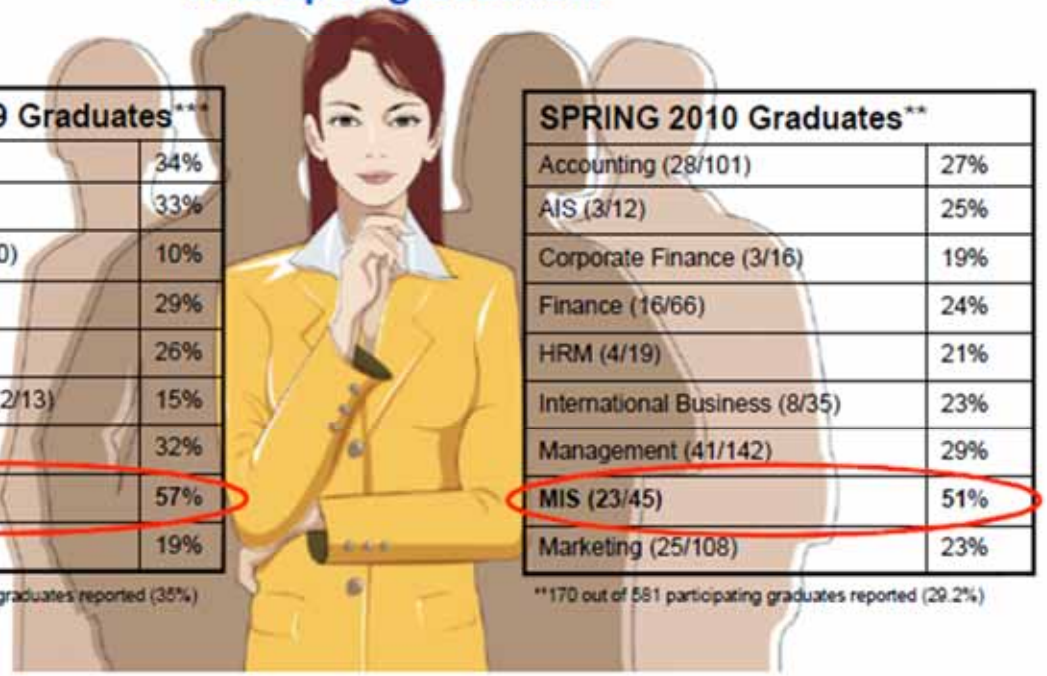
If you would be so kind as to share this information as appropriate, it would be greatly appreciated. And please let me know if I can be of assistance. I would be happy to visit your campus to speak with you and/or your colleagues and/or students about the MIS program and job opportunities. Just call (408) 924-3512 or reply to this email and I'll get back to you promptly.

Timothy R. Hill, Chair
Department of Management Information Systems
San Jose State University
One Washington Square
San Jose, CA 95192-0244
(408) 924-3512 (v)
http://www.cob.sjsu.edu/hill_t

College of Business Placement Rate at Graduation

(by concentration)

MIS Graduates lead in percentage of students with positions in career field upon graduation!



FALL 2009 Graduates***	
Accounting (28/82)	34%
AIS (2/6)	33%
Corporate Finance (1/10)	10%
Finance (13/45)	29%
HRM (5/19)	26%
International Business (2/13)	15%
Management (31/97)	32%
MIS (27/47)	**57%**
Marketing (14/74)	19%

***152 out of 434 participating graduates reported (35%)

SPRING 2010 Graduates**	
Accounting (28/101)	27%
AIS (3/12)	25%
Corporate Finance (3/16)	19%
Finance (16/66)	24%
HRM (4/19)	21%
International Business (8/35)	23%
Management (41/142)	29%
MIS (23/45)	**51%**
Marketing (25/108)	23%

**170 out of 581 participating graduates reported (29.2%)

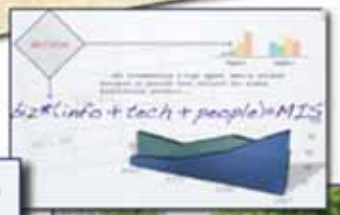
(Poll taken by SJSU Career Center)

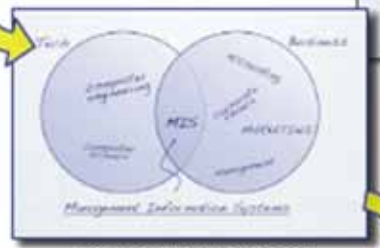
* Data collected only from students who chose to participate in this survey at the College of Business Convocations.

BS in Business Administration (avg new grad salary*)

Concentration:		
	☑ Management Information Systems	$58,555
	☐ Accounting Information Systems	$53,797
	☐ Finance	$52,733
	☐ Management	$52,174
	☐ International Business	$51,667
	☐ Accounting	$51,438
	☐ Corporate Financial Management	$48,750
	☐ Marketing	$46,597
	☐ Human Resources Management	$44,365

MIS is managing business technology ⇒ getting people the info they need to do their jobs





MIS students learn both sides

- ✓ interesting, dynamic, growing field – evolves with tech
- ✓ learn business + database, networking, web, security…
- ✓ award-winning faculty, academic & industry (IBM, Cisco, etc.)
- ✓ hands-on projects at local non-profits, eg. SJ City Parks Dept
- ✓ MIS grads work at HP, Cisco, Google, eBay…
- ✓ highest average salary of all SJSU Business concentrations*

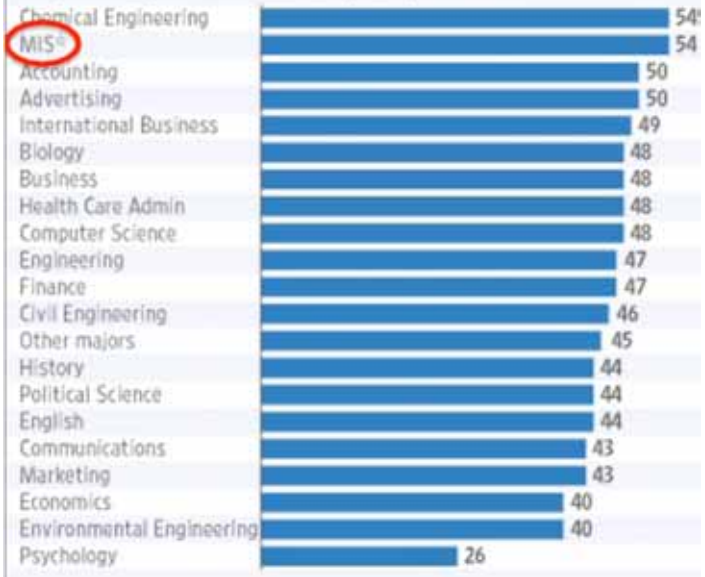
my ~~the~~ future is MIS

www.cob.sjsu.edu/mis

* according to 2009 SJSU Career Center survey

Satisfaction Not Guaranteed

Percentage of college graduates, sorted by major, who answered 'satisfied' or 'very satisfied' to the question: 'Overall, how satisfied are you with your current career path up to now?'



*Management Information Systems

Survey was conducted between April and June 2010, of people who graduated college between 1999 and 2010, with 10,800 respondents. Margin of error ranges between 2% and 7%, depending on major. Survey was limited to grads in a set of jobs deemed satisfying, well-paid and with growth potential. Source: PayScale.com

Google recruits SJSU business graduates

By Jaimie Collins
Spartan Daily
September 30, 2010

While visiting campus on Oct. 14, Google plans to recruit students from the College of Business for a two-year training program, said Google's global communications and public affairs representative.

"We are looking for people who are willing to tackle the big challenges and come up with innovative solutions — people who think outside the box," Jordan Newman said. "We definitely want people who aren't afraid to roll up their sleeves and get their hands dirty."

The Internal Technology Residency Program incorporates about 30 graduates and is designed to teach recruits how to support the technology and software systems used by Google employees, according to the program's website.

"We were very selective," Newman said. "At the end of the two years, there is always the possibility that (participants) will be converted into full-time employees."

Applications are only available to graduating seniors in the management information systems department, with interviews for those selected being held on Oct. 22, said department chair Timothy Hill.

"This is an exceptional program offered by the absolute world leader in technology, now and for the foreseeable future," Hill said. "It is really a golden opportunity for our graduates."

Junior accounting major Sarah Allen said she is glad Google will recruit from SJSU in the future.

"Having an opportunity like this will open tons of doors for grads," she said. "Being able to put Google on your resume when you've only been out of school for a few years — that's awesome."

The business department was honored last spring when four graduates were recruited for the program, Hill said.

According to an SJSU press release, the four students selected included Alex Khajehtoorian, Kobi Laredo, Marcos Ramirez and Ed Saucedo, all 2010 graduates from the management information systems department.

Of the students that were hired, Hill said two were members of the honors program and the entire group was highly distinguished among faculty.

"We are extremely proud," he said. "We think (their employment) says volumes about the kind of program we've built and the quality of

find command

Find all directories starting in my home directory that start with a capital B, S, Y or A.

```
[roddyduk@opus ~]$ find . -type d -name "[BSYA]*"
find: ./Hidden: Permission denied
./poems/Blake
./poems/Shakespeare
./poems/Yeats
./poems/Anon
[roddyduk@opus ~]$
```

Find all files starting in my home directory that contain town

```
[roddyduk@opus ~]$ find .  -name "\*town\*"
find: ./Hidden: Permission denied
[roddyduk@opus ~]$ find .  -name "*town*"
find: ./Hidden: Permission denied
./edits/small_town
./edits/better_town
[roddyduk@opus ~]$
```

grep command tips

*Use the "^ *1" to match all lines that start with zero or more blanks, a 1, followed by a blank.*

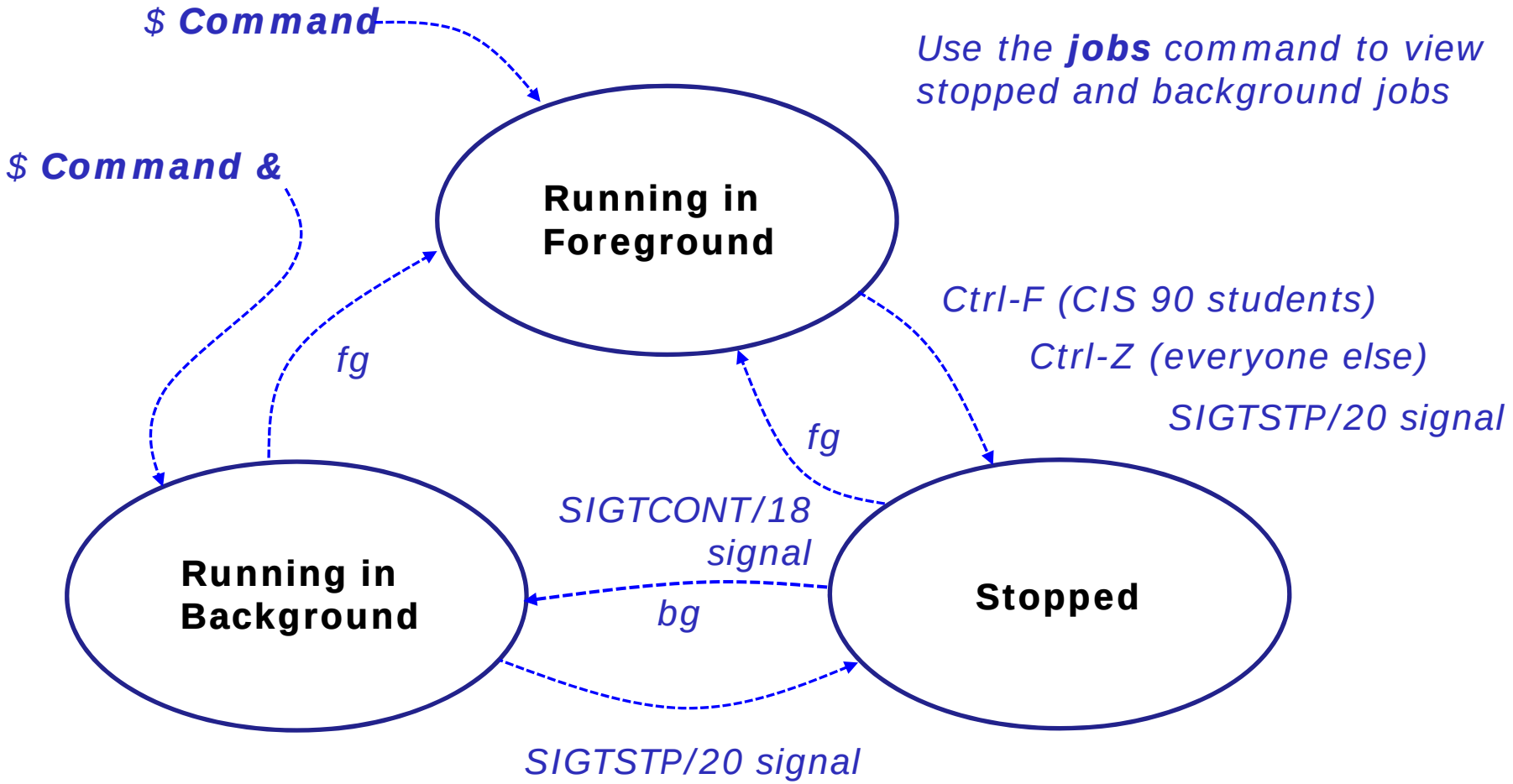
```
/home/cis90/roddyduk $ cat testfile
671 buster
 99 scout
125 benji
  1 homer
934 duke
100 lucy
 10 smokey
322 sky

/home/cis90/roddyduk $ grep "^ *1 " testfile
  1 homer
```

Use the B option to list lines preceding the matched line

```
/home/cis90/roddyduk $ grep -B 3  "^ *1 " testfile
671 buster
 99 scout
125 benji
  1 homer
```

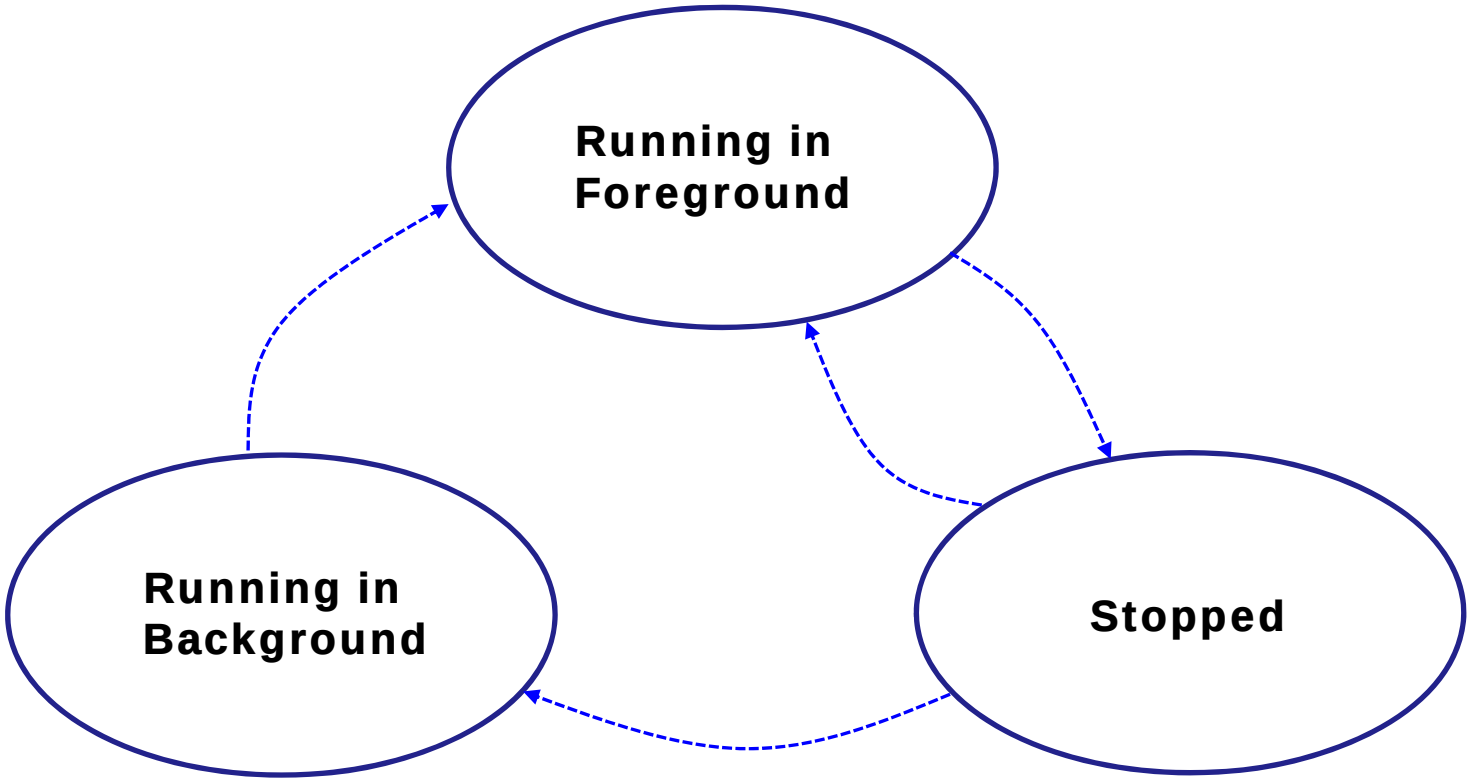
Job Control

A feature of the bash shell



Job Control

A feature of the bash shell



Process Information

Process ID number

```
[rsimms@opus ~]$ ps -a
  PID TTY          TIME CMD
 6173 pts/0    00:00:00 man
 6176 pts/0    00:00:00 sh
 6177 pts/0    00:00:00 sh
 6182 pts/0    00:00:00 less
 6294 pts/6    00:00:00 ps
[rsimms@opus ~]$
```

-a option shows all my processes not associated with a terminal. This includes my other login session where I'm doing a man command on ps.

```
[rsimms@opus ~]$ ps x
  PID TTY      STAT   TIME COMMAND
 5368 ?        S      0:00 sshd: rsimms@pts/0
 5369 pts/0    Ss     0:00 -bash
 6173 pts/0    S+     0:00 man ps
 6176 pts/0    S+     0:00 sh -c (cd /usr/share/man && (echo ".ll 7.5i"; echo ".nr L
 6177 pts/0    S+     0:00 sh -c (cd /usr/share/man && (echo ".ll 7.5i"; echo ".nr L
 6182 pts/0    S+     0:00 /usr/bin/less -is
 6203 ?        S      0:00 sshd: rsimms@pts/6
 6204 pts/6    Ss     0:00 -bash
 6312 pts/6    R+     0:00 ps x
```

The x option shows full commands being run and states (most are asleep).

Sleeping

Running (+ means running in the foreground)

I'm using two Putty sessions, in one session I have the man page open for ps, the other I'm issuing ps commands