Lesson Module Status

- Slides - draft
- Properties - done
- Flash cards - NA
- First minute quiz - done
- Web calendar summary - done
- Web book pages - gillay done
- Commands - done
- Lab tested – done
- Print latest class roster - na
- Opus accounts created for students submitting Lab 1 -
- CCC Confer room whiteboard – done
- Check that headset is charged - done
- Backup headset charged - done
- Backup slides, CCC info, handouts on flash drive - done

[ ] Has the phone bridge been added?

[ ] Is recording on?

[ ] Does the phone bridge have the mike?

[ ] Share slides, putty, VB, eko and Chrome

[ ] Disable spelling on PowerPoint

CIS 90 - Lesson 2

Instructor: **Rich Simms**
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Emanuel | Tanner | Merrick | Quinton | Christopher | Zachary | Bobby | Craig | Jeff

Yu-Chen | Greg L | Tommy | Eric | Dan M | Geoffrey | Marisol | Jason P | David | Josh

Leobardo | Gabriel | Jesse | Tajvia | Daniel W | Jason W | Terry? | James? | Glenn? | Aroshani?

Ken? | Luis? | Arturo? | Greg M? | Ian?

? = need to add (with add code) to enroll in this course

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:

1. What command shows the other users logged in to the computer?

2. What is the lowest level, inner-most component of a UNIX/Linux Operating System called?

3. What part of UNIX/Linux is both a user interface and a programming language?

email answers to: risimms@cabrillo.edu

Commands

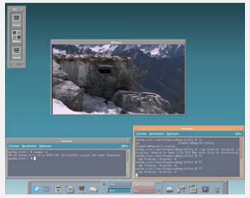
Objectives	Agenda
• Understand how the UNIX login operation works. • Meet John the Ripper and learn how vulnerable a poor password is. • Understand basic command syntax and operation. • Understand program files and what happens when they are run. • Understand how the shell works and environment variables. • Understand how to get documentation when online.	• Quiz • Questions and Review • SSH hopping • Deep dive on logging in • Personal Opus accounts • Passwords and cracking them • Making strong passwords • Programs files • Running programs/processes • Command line syntax • Environment variables • Life of the shell • Metacharacters • Docs • Wrap up

Questions?

Lab assignment?
Previous Material?

Review and clarifications

UNIX and Unix-like Operating Systems

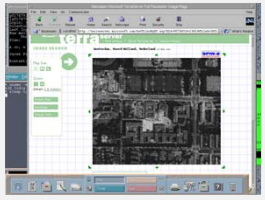


HP-UX

Sun Solaris

AT&T UNIX
(1969)

SCO



IBM AIX

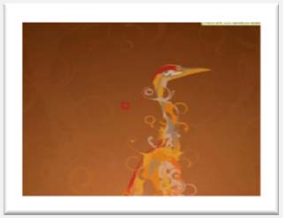
BSD UNIX

Mac OS X and iOS

Apple operating systems use the Mach Kernel

Linux operating systems use the Linux Kernel

Various GNU/Linux Distributions



Ubuntu

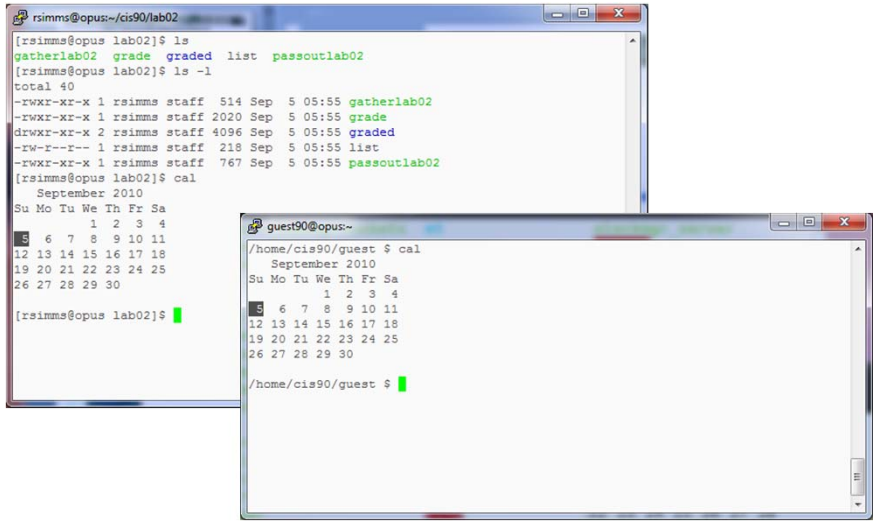
Red Hat

SUSE

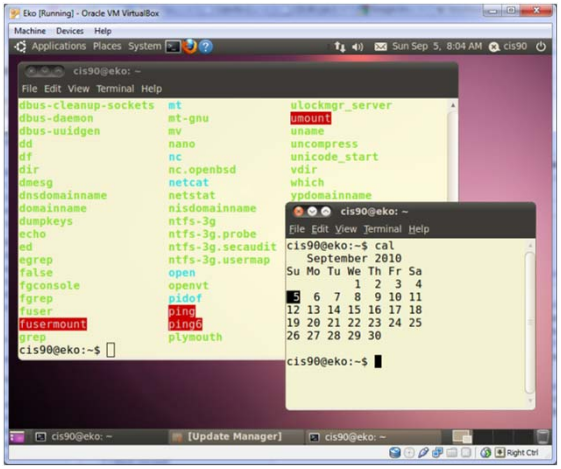
Debian

Embedded Linux

Terminals



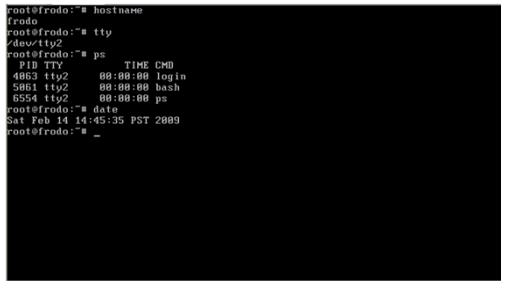
Putty terminals (with scroll bars, colors, customizable backgrounds, fonts and sizes) and runs on Windows



Graphical terminals (with scroll bars, colors, customizable backgrounds, fonts and sizes)

Terminals were used in the old days to interact with computers.

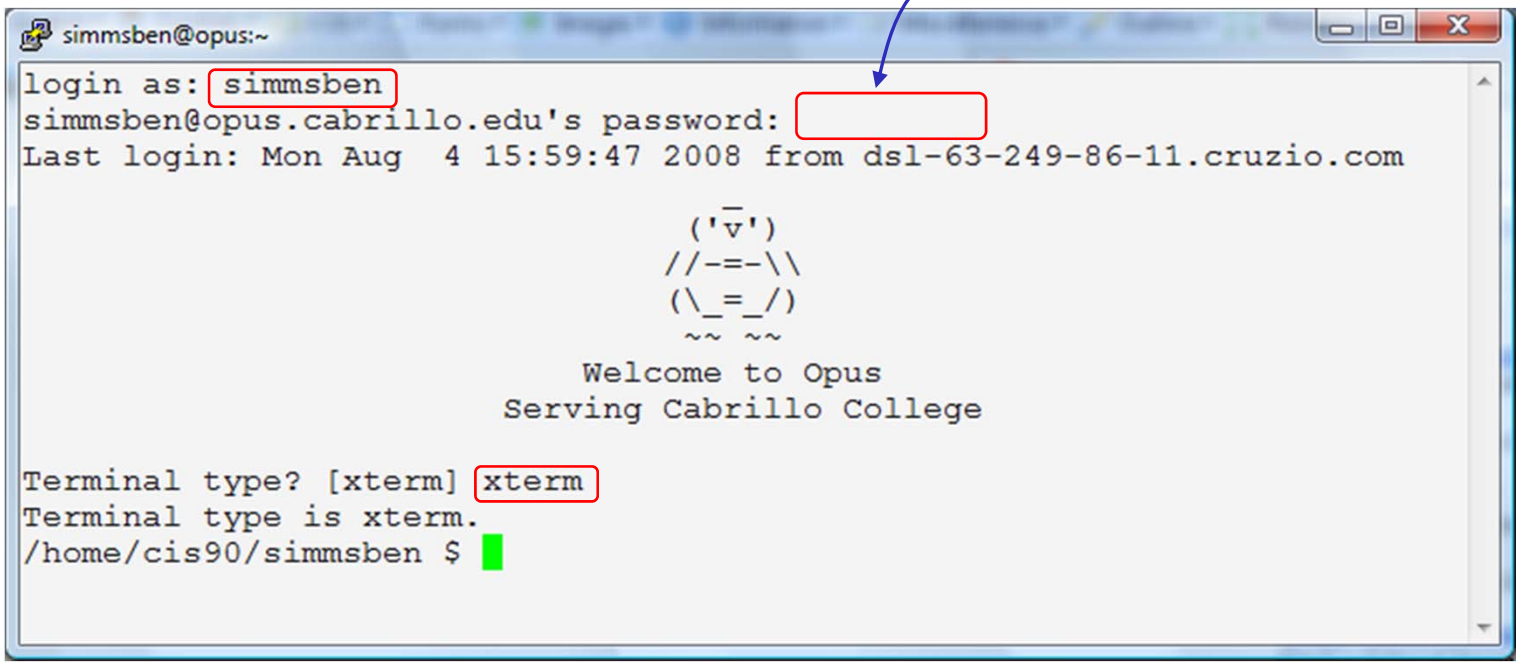
*Today we use **terminal emulators** that are software programs.*



Virtual terminals (use ctrl-alt-fn) (no scroll bar, also called a console)

Logging in

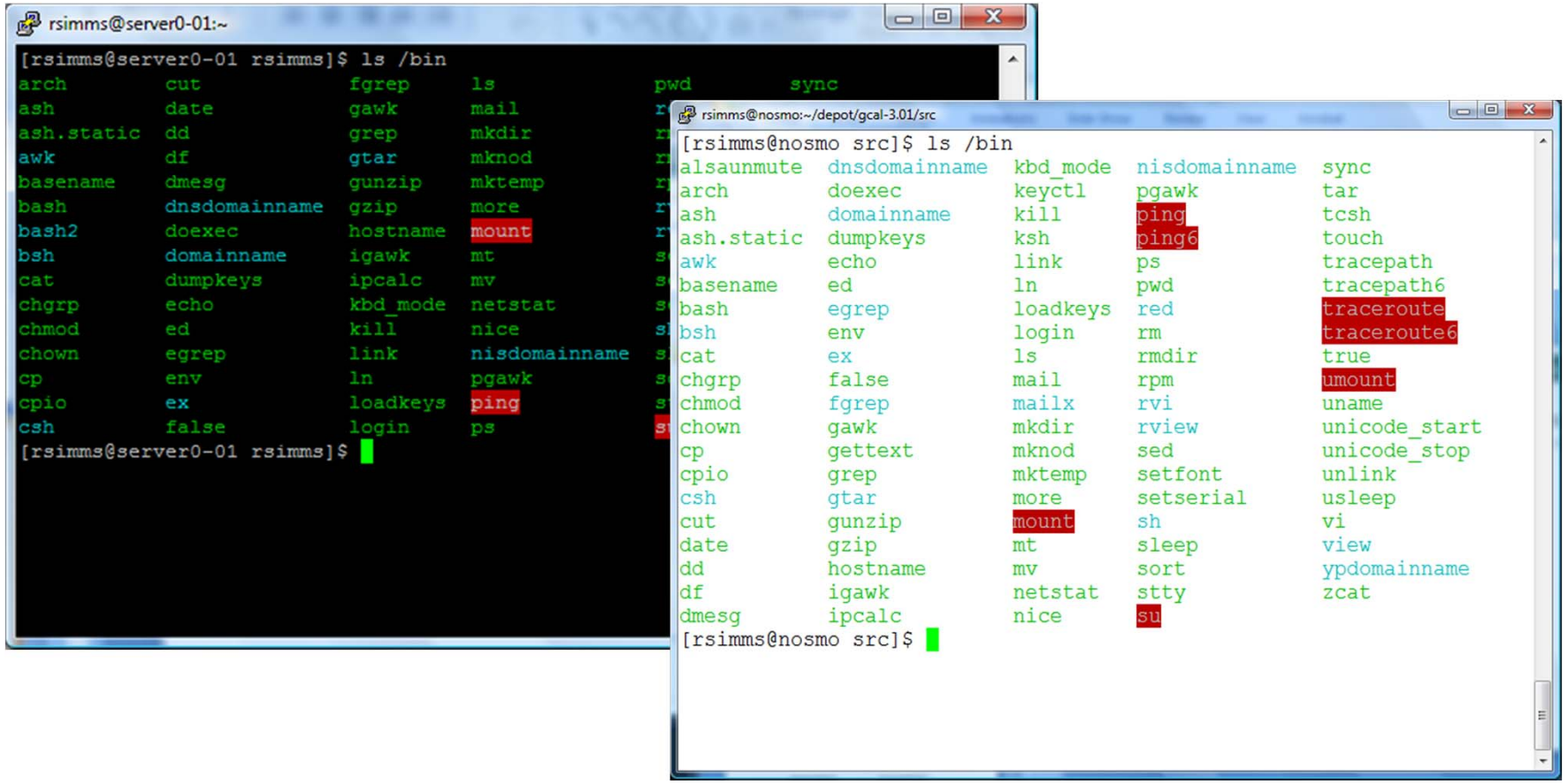
Note: the password is never echoed for security reasons



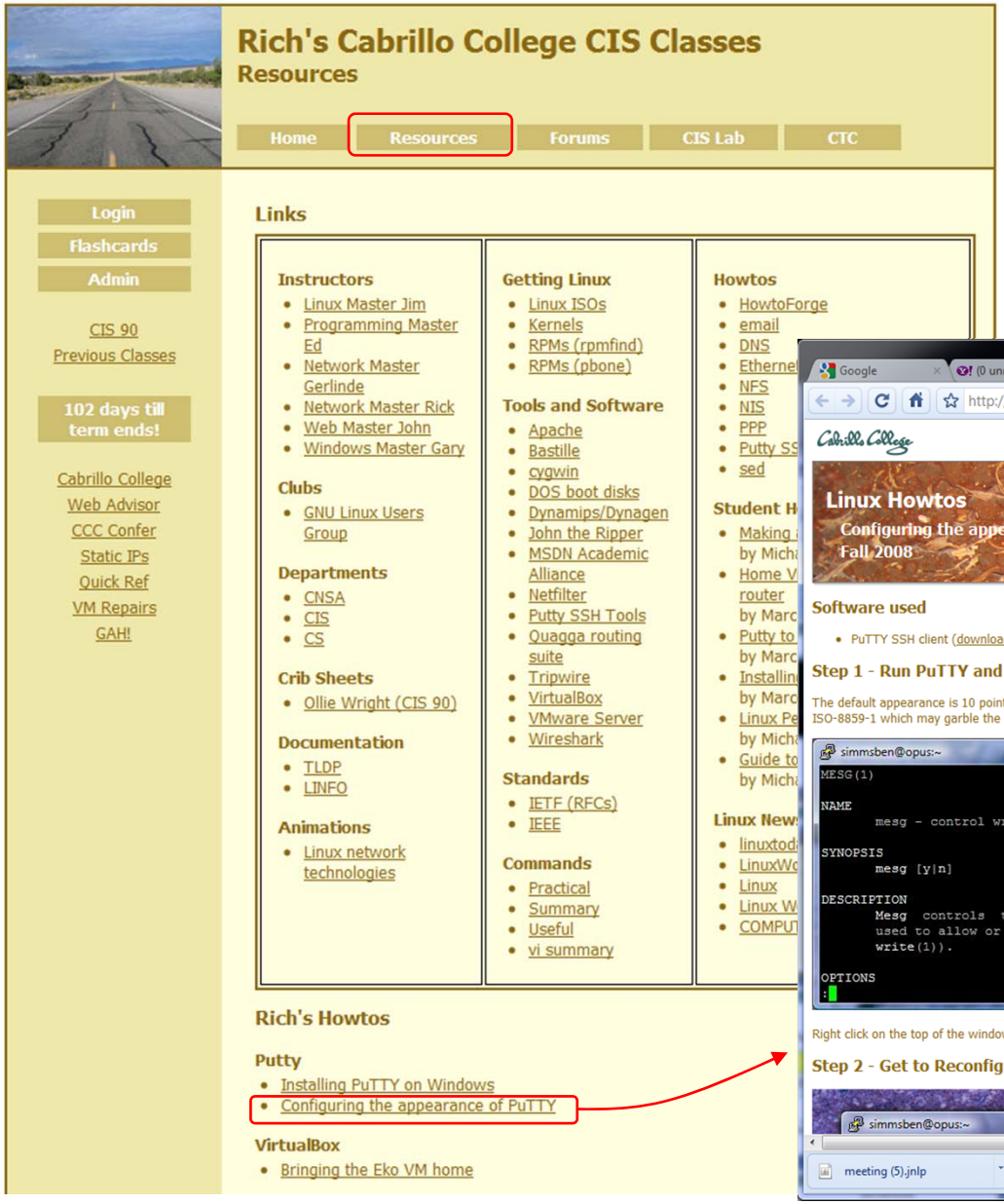
always requires:

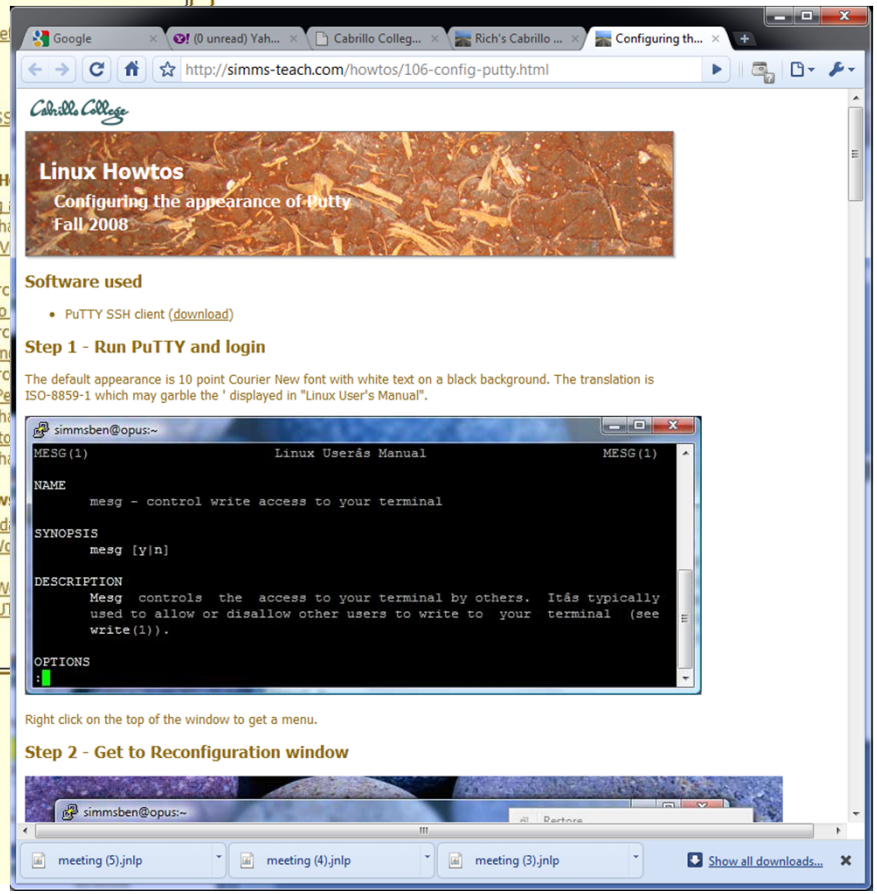
username + password + terminal type

The Putty program



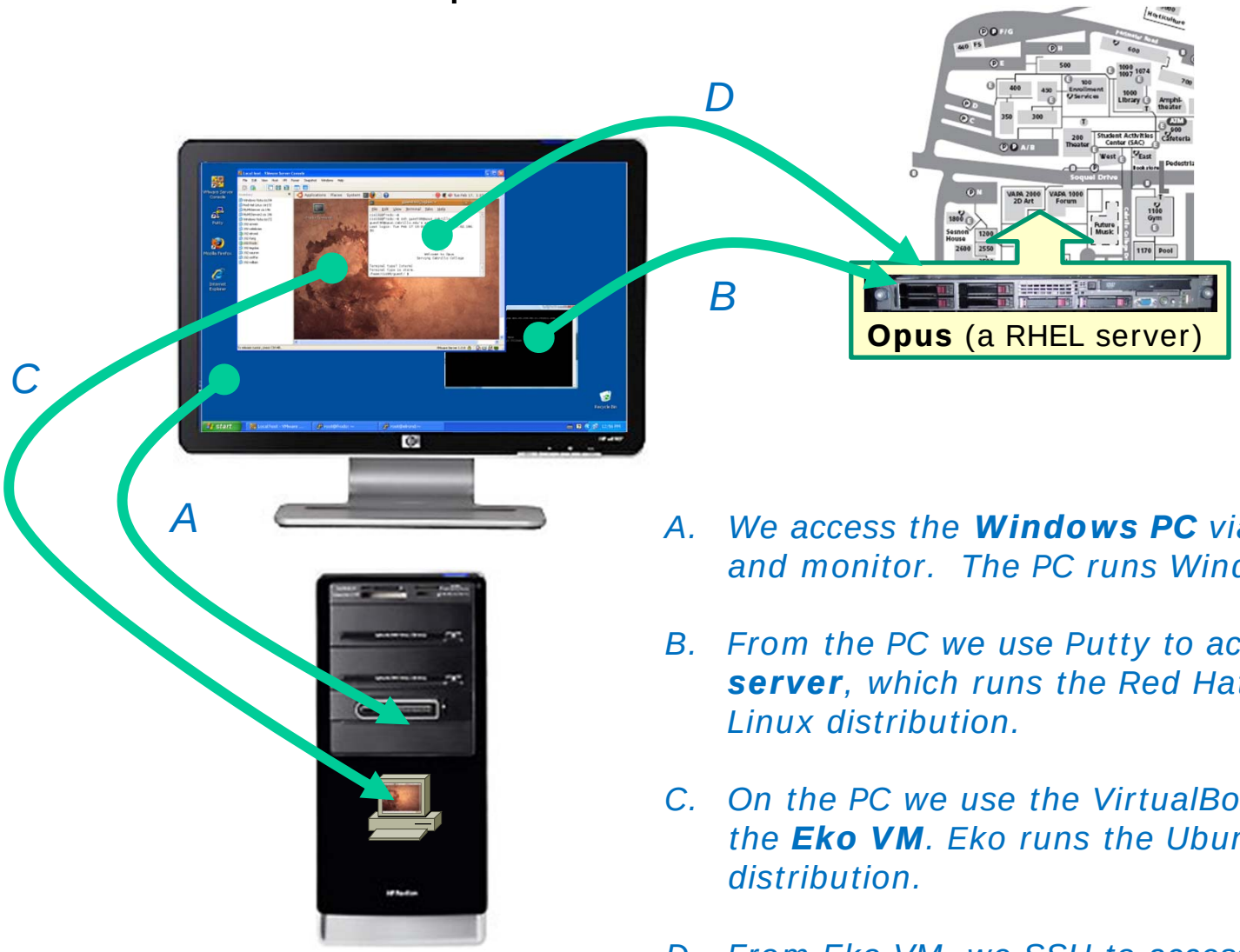
*Why does Putty sometimes have a **black background** and sometimes a **white background**?*





There is a Howto on the Resource page to walk you through customizing Putty

We used three computers for Lab 1 !!



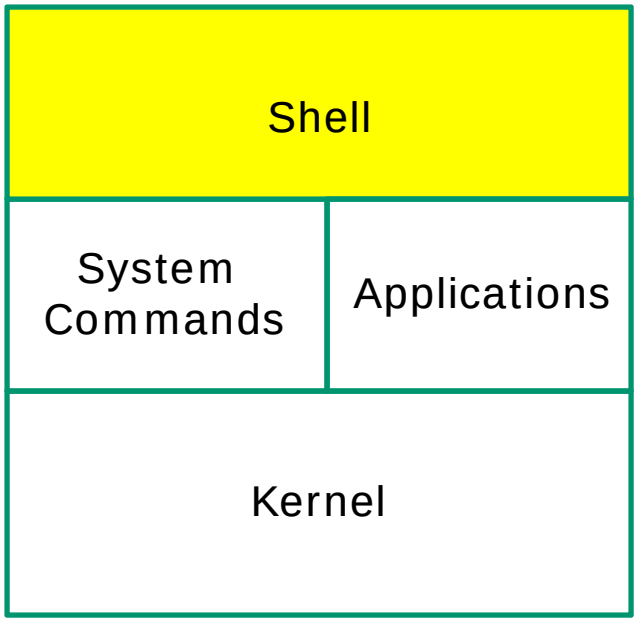
A. *We access the **Windows PC** via its keyboard and monitor. The PC runs Windows XP.*

B. *From the PC we use Putty to access the **Opus server**, which runs the Red Hat Enterprise Linux distribution.*

C. *On the PC we use the VirtualBox to access the **Eko VM**. Eko runs the Ubuntu Linux distribution.*

D. *From Eko VM, we SSH to access Opus (different session than B)*

The Shell



- Allows users to interact with the computer via a "**command line**".
- **Prompts** for a command, parses the command, finds the right program and gets that program executed.
- Is called a "**shell**" because it hides the underlying operating system.
- Multiple shell programs are available: **sh** (Bourne shell), **bash** (born again shell), **csh** (C shell), **ksh** (Korn shell).
- The shell is a **user interface** and a **programming language** (scripts).
- GNOME and KDE desktops could be called **graphical shells**

In Lab 1 you got to interact with the bash shell on Opus and Eko

Shell Prompt

*The shell **prompt** is a string of text ending with a $*

```
/home/cis90ol/cis90 $ date
Thu Feb 17 08:36:51 PST 2011
/home/cis90ol/cis90 $ who
rsimms   pts/1        2011-02-17 06:59 (dsl.dhcp.cruzio.com)
hsiehjac pts/2        2011-02-17 08:30 (dhcp.snlo.ca.charter.com)
cis90    pts/3        2011-02-17 08:34 (dsl.dhcp.cruzio.com)
root     :0           2010-11-02 16:18
root     pts/5        2010-11-02 16:18 (:0.0)
/home/cis90ol/cis90 $ who am i
cis90    pts/3        2011-02-17 08:34 (dsl.dhcp.cruzio.com)
/home/cis90ol/cis90 $ hostname
opus.cabrillo.edu
/home/cis90ol/cis90 $ id
uid=190(cis90) gid=190(cis90ol) groups=190(cis90ol)
context=user_u:system_r:unconfined_t
/home/cis90ol/cis90 $ ps
  PID TTY          TIME CMD
15027 pts/3    00:00:00 bash
15069 pts/3    00:00:00 ps
/home/cis90ol/cis90 $ tty
/dev/pts/3
/home/cis90ol/cis90 $
```

Shell Commands

*Entering various **shell commands** from Lab 1*

```
/home/cis90ol/cis90 $ date
Thu Feb 17 08:36:51 PST 2011
/home/cis90ol/cis90 $ who
rsimms   pts/1        2011-02-17 06:59 (dsl.dhcp.cruzio.com)
hsiehjac pts/2        2011-02-17 08:30 (dhcp.snlo.ca.charter.com)
cis90    pts/3        2011-02-17 08:34 (dsl.dhcp.cruzio.com)
root     :0           2010-11-02 16:18
root     pts/5        2010-11-02 16:18 (:0.0)
/home/cis90ol/cis90 $ who am i
cis90    pts/3        2011-02-17 08:34 (dsl.dhcp.cruzio.com)
/home/cis90ol/cis90 $ hostname
opus.cabrillo.edu
/home/cis90ol/cis90 $ id
uid=190(cis90) gid=190(cis90ol) groups=190(cis90ol)
context=user_u:system_r:unconfined_t
/home/cis90ol/cis90 $ ps
  PID TTY          TIME CMD
15027 pts/3    00:00:00 bash
15069 pts/3    00:00:00 ps
/home/cis90ol/cis90 $ tty
/dev/pts/3
/home/cis90ol/cis90 $
```

Shell Commands

***Output** from the various shell commands from Lab 1*

```
/home/cis90ol/cis90 $ date
Thu Feb 17 08:36:51 PST 2011
/home/cis90ol/cis90 $ who
rsimms   pts/1        2011-02-17 06:59 (dsl.dhcp.cruzio.com)
hsiehjac pts/2        2011-02-17 08:30 (dhcp.snlo.ca.charter.com)
cis90    pts/3        2011-02-17 08:34 (dsl.dhcp.cruzio.com)
root     :0           2010-11-02 16:18
root     pts/5        2010-11-02 16:18 (:0.0)
/home/cis90ol/cis90 $ who am i
cis90    pts/3        2011-02-17 08:34 (dsl.dhcp.cruzio.com)
/home/cis90ol/cis90 $ hostname
opus.cabrillo.edu
/home/cis90ol/cis90 $ id
uid=190(cis90) gid=190(cis90ol) groups=190(cis90ol)
context=user_u:system_r:unconfined_t
/home/cis90ol/cis90 $ ps
  PID TTY          TIME CMD
15027 pts/3    00:00:00 bash
15069 pts/3    00:00:00 ps
/home/cis90ol/cis90 $ tty
/dev/pts/3
/home/cis90ol/cis90 $
```

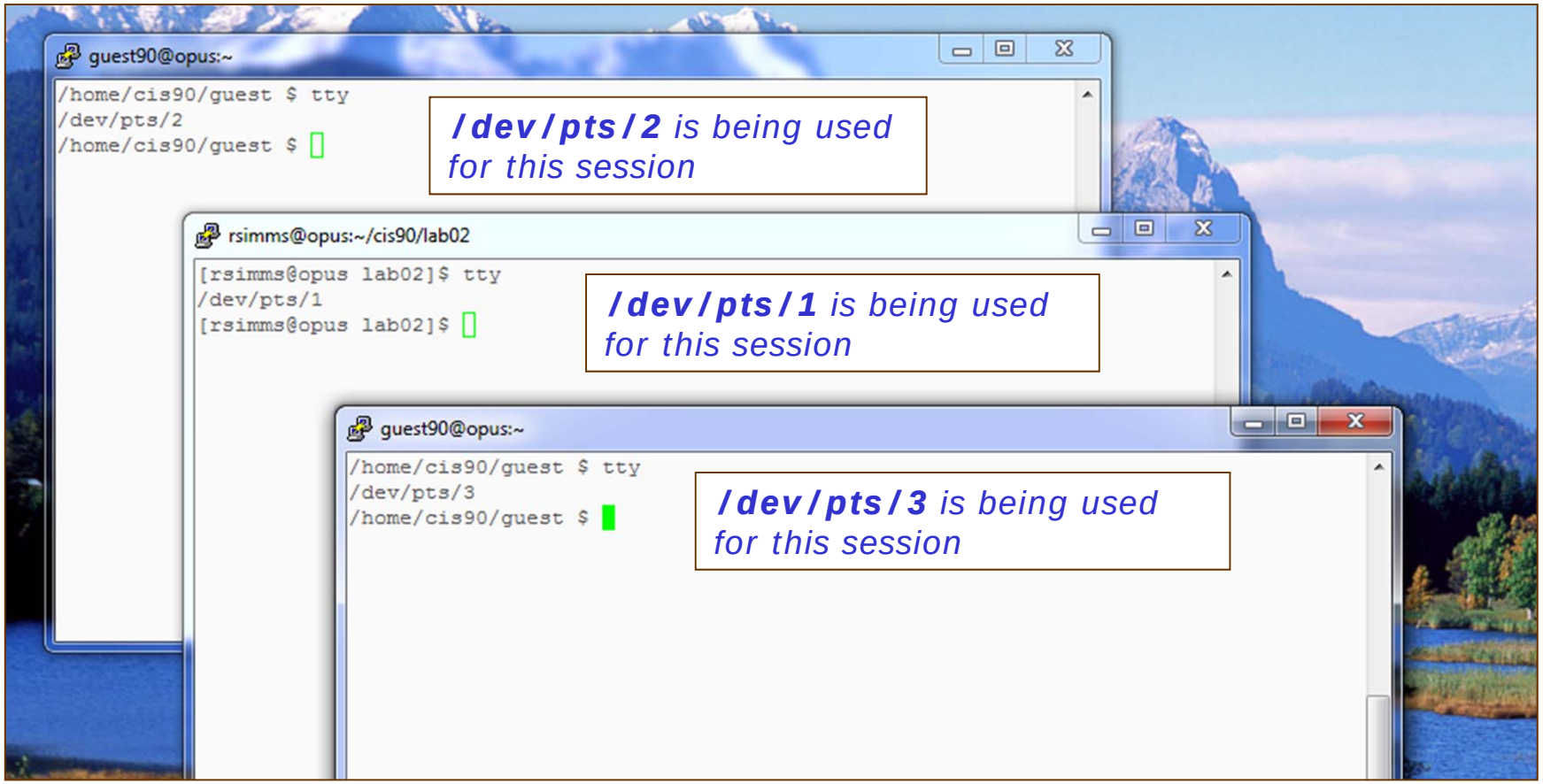
Commands from last week's lesson and lab

cal	*Prints calendars*
clear	*Clears the screen*
date	*Shows the time and date*
exit	*Exits login session*
history	*Shows previous commands*
hostname	*Shows name of computer being interacted with*
id	*Shows UID's, GID's and SELinux information*
ps	*Shows process information*
ssh	*Initiates connection and login to remote computer*
uname	*Shows name of operating system*
tty	*Shows terminal device being used for session*
who	*Shows all users who are logged in*
whoami	*Like **who**, but only shows your login session*

Note, each of these commands is actually a program residing in the /bin or /usr/bin directories.

Shell tty command

Running three Putty sessions at the same time to Opus. Note that each session is assigned a different terminal device.



*Use the **tty** command to identify the **terminal device** being used for a session*

Lab 1 Questions

Are there any questions on these questions?

1) On Opus, what was the prompt string?
2) What does the history command do?
3) On Opus, what was your uid (user id) number?
4) On Opus, what was the name of the shell program being run?
5) What terminal device did you use to access Opus?
6) On Eko, what is the output from the hostname command?
7) What command shows the other users that are logged in?
8) What command shows you the name of the computer you are interacting with?
9) On Eko, what three keys must be pressed locally to use terminal tty2?
10) On Eko, if you log off one session, do you get logged off all the other sessions?
11) On Eko, is your command history the same for all login sessions?
12) What command logs you off?

You can resubmit Lab 1 as many times as you want till midnight

More on ssh

ssh command

login to a remote system

Syntax: **ssh** *user@hostname*

Where
- user = the user login name
- hostname = the name or IP address of the remote computer

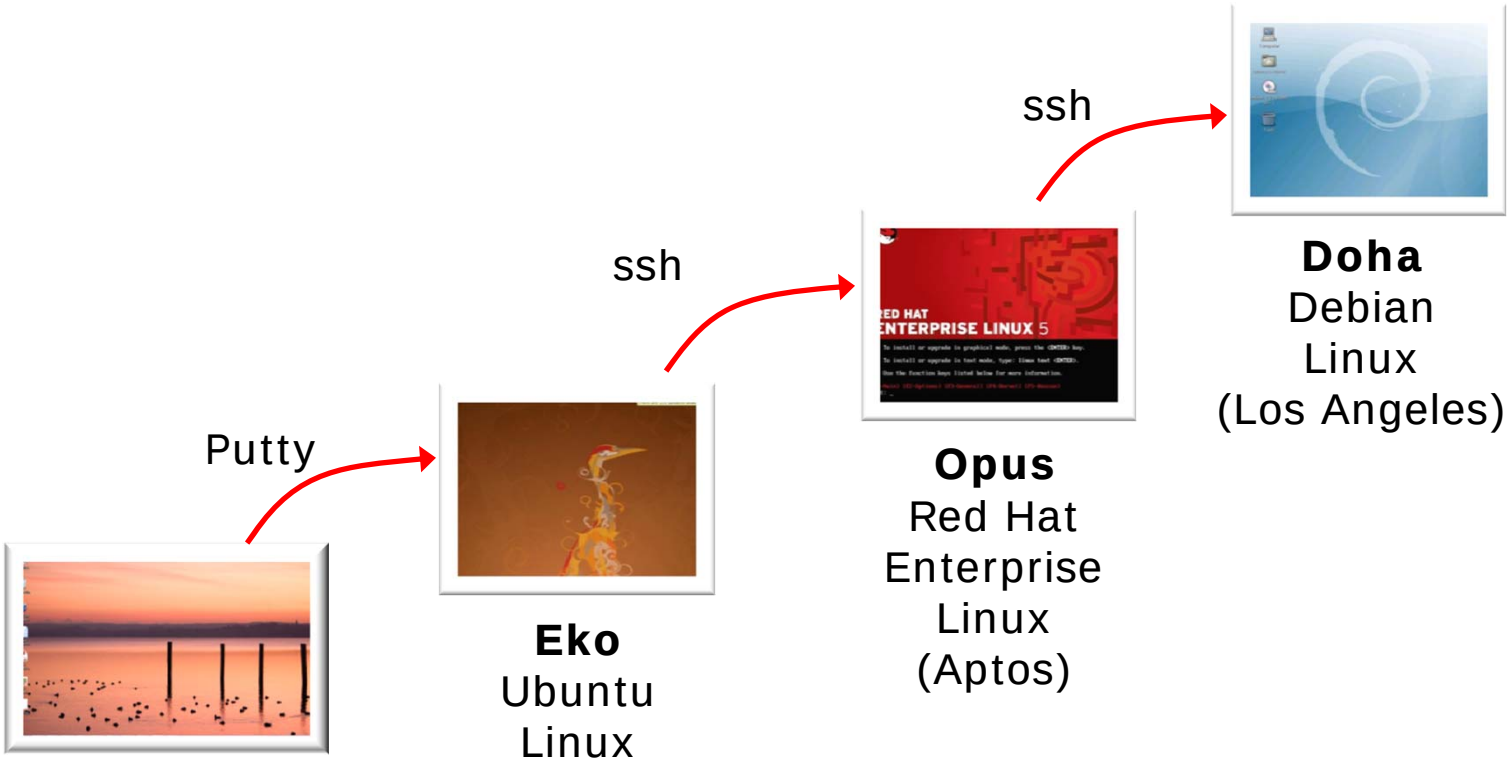
Examples:

ssh guest90@opus.cabrillo.edu

ssh cis90@172.30.1.198

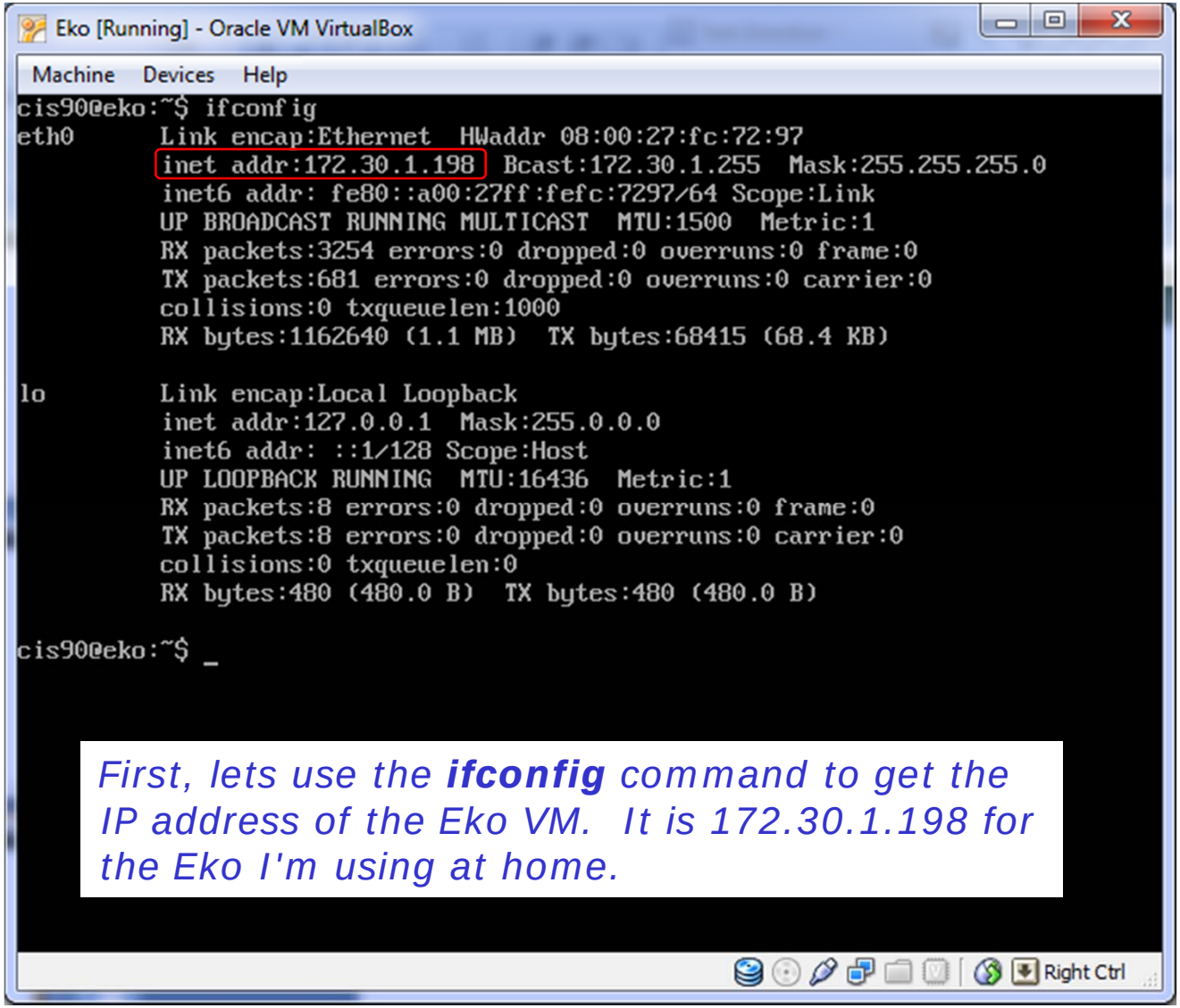
ssh root@frida

"SSH Hopping"

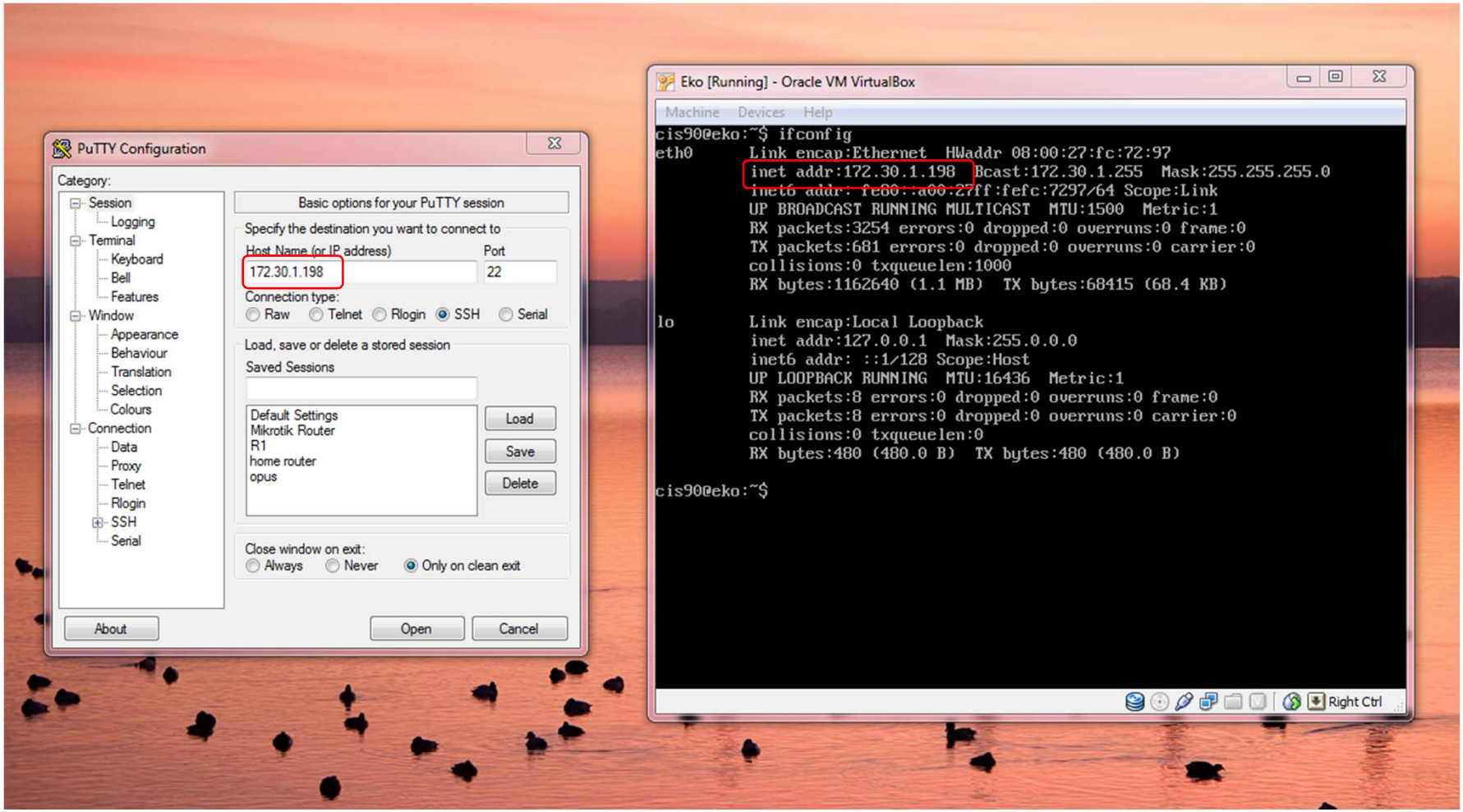


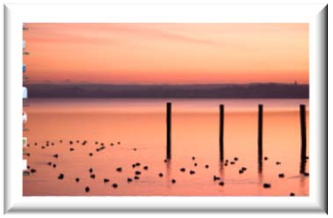
We will start on my Windows notebook computer dv2000. From dv2000 Putty into Eko. From Eko, ssh into Opus. From Opus ssh into simms-teach.com

"SSH Hopping"



If you try this command on Opus you will get an error message. It has to do with your path and we will cover that later in this lesson.



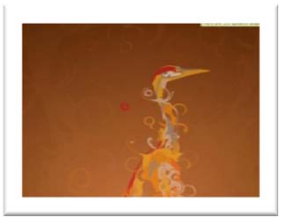


Ok, lets begin. Lets Putty from Windows to the Eko VM using the IP address we just determined

cis90@eko: ~

```
login as: cis90
Server refused our key
cis90@172.30.1.198's password:
Linux eko 2.6.32-24-generic #38-Ubuntu SMP Mon Jul 5 09:22:14 UTC 2010 i686 GNU/
Linux
Ubuntu 10.04.1 LTS

Welcome to Ubuntu!
 * Documentation:  https://help.ubuntu.com/

59 packages can be updated.
15 updates are security updates.

Last login: Sat Sep  4 16:10:07 2010
cis90@eko:~$ hostname
eko
cis90@eko:~$ uname
Linux
cis90@eko:~$ tty
/dev/pts/2
cis90@eko:~$ cat /etc/*-release
DISTRIB_ID=Ubuntu
DISTRIB_RELEASE=10.04
DISTRIB_CODENAME=lucid
DISTRIB_DESCRIPTION="Ubuntu 10.04.1 LTS"
cis90@eko:~$
```

Eko is an Ubuntu Linux 10.04 system and we came in using the /dev/pts/2 terminal device



*OK, now we have logged in to **Eko** from **dv2000***

guest90@opus:~

```
cis90@eko:~$ ssh guest90@opus.cabrillo.edu
guest90@opus.cabrillo.edu's password:
Last login: Sun Sep  5 17:44:37 2010 from adsl-70-143-65-176.dsl.pltn13.sbcgloba
l.net

                                   _
                                  ('v')
                                 //-=-\\
                                 (\_=_/)
                                  ~~ ~~
                             Welcome to Opus
                          Serving Cabrillo College


Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/guest $ hostname
opus.cabrillo.edu
/home/cis90/guest $ tty
/dev/pts/1
/home/cis90/guest $ uname
Linux
/home/cis90/guest $ cat /etc/*-release
Red Hat Enterprise Linux Server release 5.4 (Tikanga)
/home/cis90/guest $
```

Opus is a RHEL 5.4 system and we came in using the /dev/pts/1 terminal device

*OK, we have logged in to **Opus** from **Eko***

guest90@opus:~

```
/home/cis90/guest $ ssh rsimms@simms-teach.com
The authenticity of host 'simms-teach.com (69.163.236.47)' can't be established.
RSA key fingerprint is 0e:c2:f6:f4:d9:86:9d:4b:c4:3d:77:e7:a4:bb:59:14.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'simms-teach.com,69.163.236.47' (RSA) to the list of
known hosts.
rsimms@simms-teach.com's password:

 Welcome to doha.dreamhost.com

Any malicious and/or unauthorized activity is strictly forbidden.
All activity may be logged by DreamHost Web Hosting.

Last login: Sun Sep  5 18:04:16 2010 from 207.62.186.9
[doha]$ hostname
doha
[doha]$ tty
/dev/pts/16
[doha]$ uname
Linux
[doha]$ ls /etc/*_version
/etc/debian_version
[doha]$ cat /etc/*_version
5.0.5
[doha]$
```

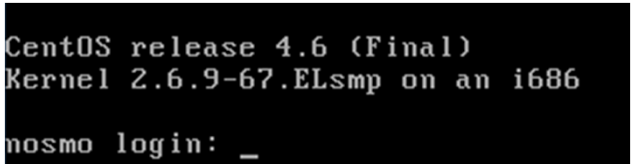
simms-teach.com is really named doha. It is a Debian Linux 5.0.5 system and we came in using the /dev/pts/16 terminal device.

*OK, we have logged into **simms-teach.com** (really named **doha**) from **Opus***

Opus Logins (A deep dive)

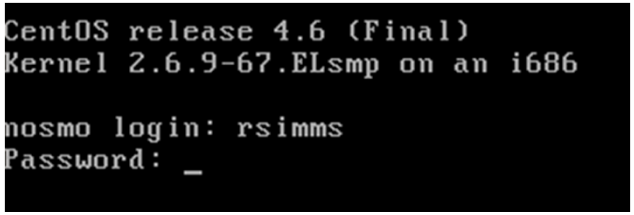
Login and Passwords

1) ***init*** *starts up the* ***mingetty*** *program for each terminal which then prompts for login username, gets it, then starts login.*



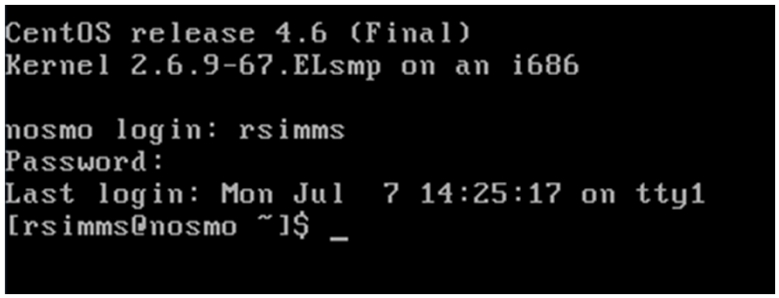

```
[root@nosmo ~]# ps t tty1
  PID TTY      STAT   TIME COMMAND
 3545 tty1     Ss+    0:00 /sbin/mingetty tty1
```

2) ***login*** *collects the password and checks it with /etc/passwd and /etc/shadow*



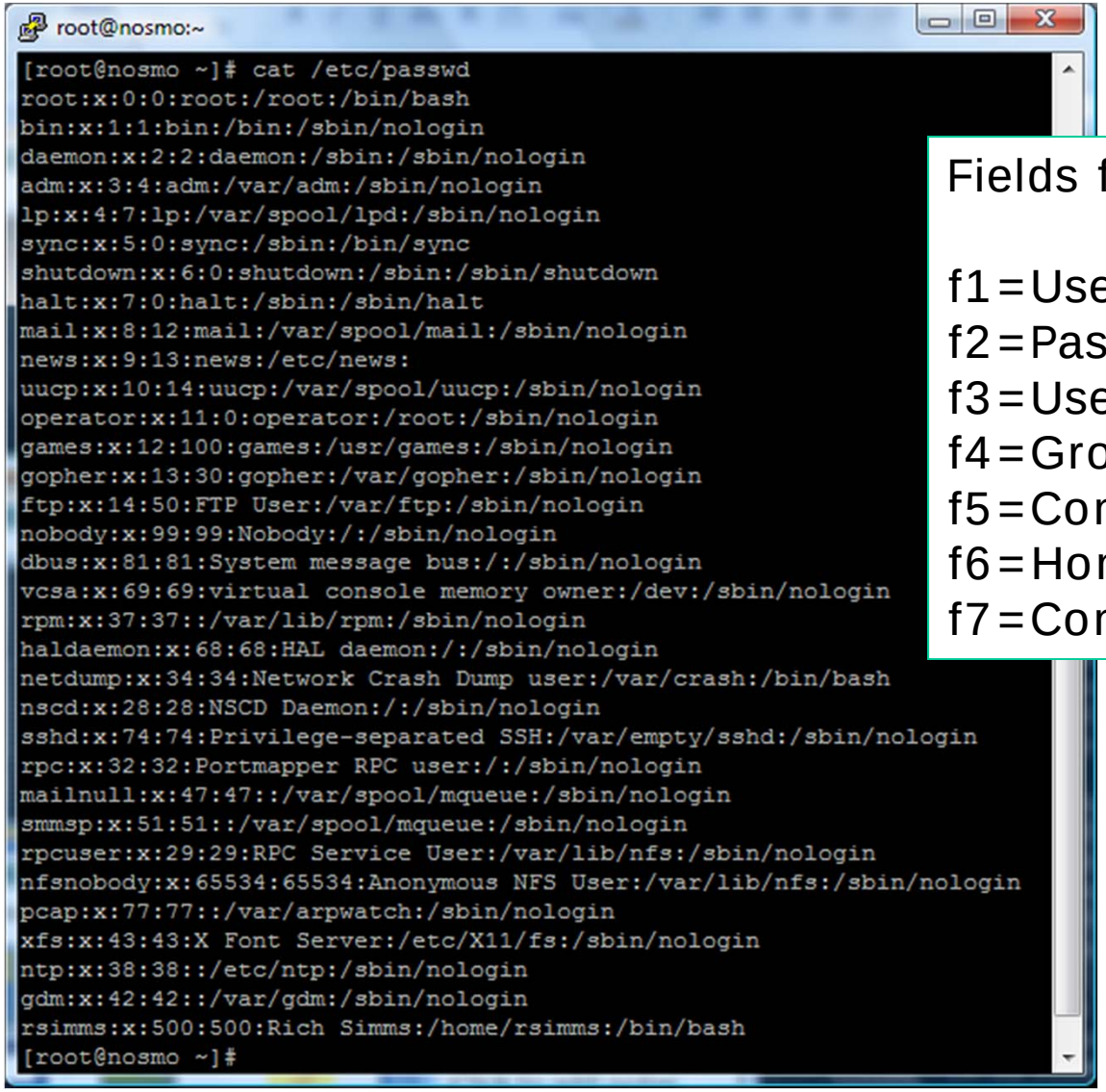

```
[root@nosmo ~]# ps t tty1
  PID TTY      STAT   TIME COMMAND
 3545 tty1     Ss+    0:00 /bin/login -
```

3) *If a match then* ***login*** *then starts up the shell specified in the /etc/passwd file*




```
[root@nosmo ~]# ps t tty1
  PID TTY      STAT   TIME COMMAND
 4917 tty1     Ss+    0:00 -bash
```

/etc/passwd

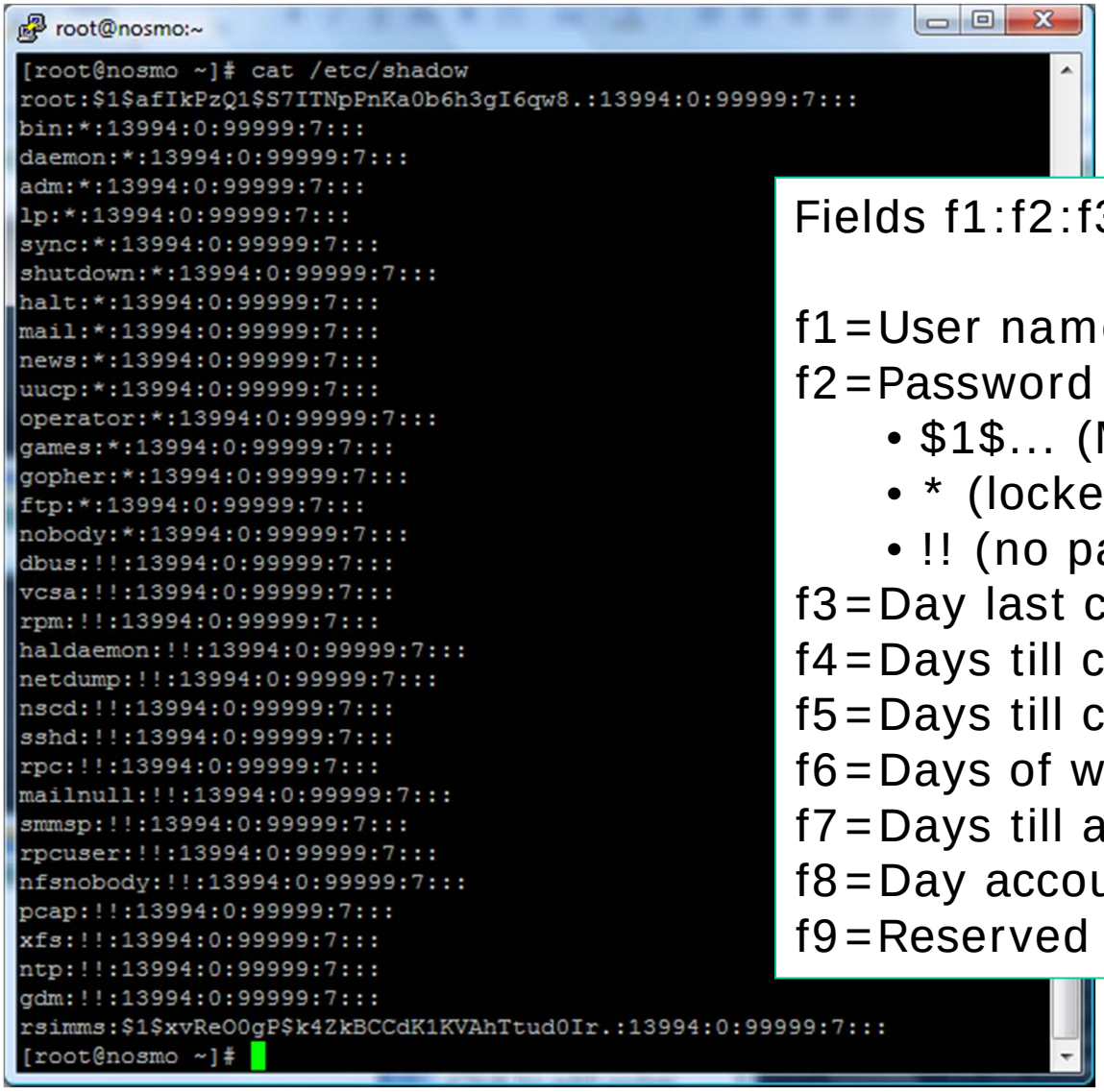


Fields f1:f2:f3:f4:f5:f6:f7

f1 = User name
f2 = Password
f3 = User id (uid)
f4 = Group id (gid)
f5 = Comment
f6 = Home directory
f7 = Command/shell

/etc/passwd has all the login accounts. It used to have passwords too but not anymore

/etc/shadow



The passwords are now kept in /etc/shadow and they are encrypted

Fields f1:f2:f3:f4:f5:f6:f7:f8:f9

f1 = User name
f2 = Password
- 1... (MD5 encrypted)
- * (locked)
- !! (no password set)

f3 = Day last changed (since 1/1/70)
f4 = Days till change is allowed
f5 = Days till change is required
f6 = Days of warning before change
f7 = Days till account is disabled
f8 = Day account was disabled
f9 = Reserved

Class Activity

Look at /etc/passwd and /etc/shadow files

1. login to Opus as cis90
2. **cat /etc/passwd**
3. **cat /etc/shadow**

What happens when you try to look at /etc/shadow?

Your Opus Account

Your new Opus user account

- The first time you log in with this account you will be prompted to change your password.
- Please make it a strong password!
- **Botnets** and **ne-er-do-wells** are constantly attempting to break into computers attached to the Internet! Even my little Frodo VM!

They never stop trying

```
Failed logins from:
   122.249.183.95 (x183095.ppp.asahi-net.or.jp): 3 times
   218.64.5.131 (131.5.64.218.broad.nc.jx.dynamic.163data.com.cn): 3 times

 Illegal users from:
   78.46.83.76 (static.76.83.46.78.clients.your-server.de): 3 times
   218.4.157.178: 3 times

 pam_succeed_if(sshd:auth): error retrieving information about user teamspeak : 1
time(s)
 reverse mapping checking getaddrinfo for
131.5.64.218.broad.nc.jx.dynamic.163data.com.cn failed - POSSIBLE BREAK-IN
ATTEMPT! : 3 time(s)
 pam_succeed_if(sshd:auth): error retrieving information about user ts : 2 time(s)
 pam_succeed_if(sshd:auth): error retrieving information about user plcmspip : 2
time(s)
 pam_succeed_if(sshd:auth): error retrieving information about user PlcmSpIp : 1
time(s)
```

We used to get up thousands of attempts every day until we made some changes to the firewall on Opus. Attacks always coming from different computers around the world.

logwatch

the ne'er-do-wells trying to break in …
this is why you need strong passwords

```
---------------------- SSHD Begin ------------------------

SSHD Killed: 1 Time(s)

SSHD Started: 1 Time(s)

Disconnecting after too many authentication failures for user:
   guest90 : 1 Time(s)


Failed logins from:
    76.254.22.196 (adsl-76-254-22-196.dsl.pltn13.sbcglobal.net): 2 times
    201.7.115.194 (201-7-115-194.spopa302.ipd.brasiltelecom.net.br): 2135 times
    210.240.12.14: 20 times

Illegal users from:
    201.7.115.194 (201-7-115-194.spopa302.ipd.brasiltelecom.net.br): 564 times
    210.240.12.14: 42 times


Users logging in through sshd:
   guest:
      76.254.22.196 (adsl-76-254-22-196.dsl.pltn13.sbcglobal.net): 2 times
   jimg:
      70.132.20.25 (adsl-70-132-20-25.dsl.snfc21.sbcglobal.net): 7 times
   ordazedw:
      76.254.22.196 (adsl-76-254-22-196.dsl.pltn13.sbcglobal.net): 1 time
   root:
      63.249.86.11 (dsl-63-249-86-11.cruzio.com): 3 times
      70.132.20.25 (adsl-70-132-20-25.dsl.snfc21.sbcglobal.net): 1 time
   rsimms:
      63.249.86.11 (dsl-63-249-86-11.cruzio.com): 2 times
```

/var/log/wtmp and var/log/btmp

```
[root@opus log]# lastb | sort | cut -f1 -d' ' | grep -v ^$ | uniq –c > bad
[root@opus log]# sort –g bad > bad.sort
[root@opus log]# cat  bad.sort | tail -50
    471 ftp
    472 public
    490 test
    490 tomcat
    498 user
    506 service
    508 mike
    508 username
    524 cyrus
    530 pgsql
    532 test1
    544 master
    554 linux
    554 toor
    576 paul
    584 support
    590 testuser
    604 irc
    610 test
    656 noc
    686 www
    690 postfix
    723 john
    734 testing
    738 adam
    746 alex
    754 info
    798 tester
    832 library
    935 guest
    990 admin
   1002 office
   1022 temp
   1070 ftpuser
   1138 webadmin
   1298 nagios
   1332 web
   1374 a
   1384 student
   1416 postgres
   1690 user
   1858 oracle
   1944 mysql
   2086 webmaste
   5324 test
  10803 root
  10824 admin
  18679 root
  24064 root
[root@opus log]#
```

Top 50 usernames used by the ne'er-do-wells

How to make a strong password

- The longer the better (8 or more characters)
- Not in any dictionary
- Use upper case, lowercase, punctuation, digits
- Something you can remember
- Keep it secret
- Change when compromised

`Wh0le#!!`	(Whole sh'bang)
`KuKu4(co)2`	(Cuckoo for Cocoa Puffs)
`#0p&s@ve`	(shop and save)
`Idl02$da`	(I do laundry on Tuesday)

passwd command

change password

*Use the **passwd** command to change your password*

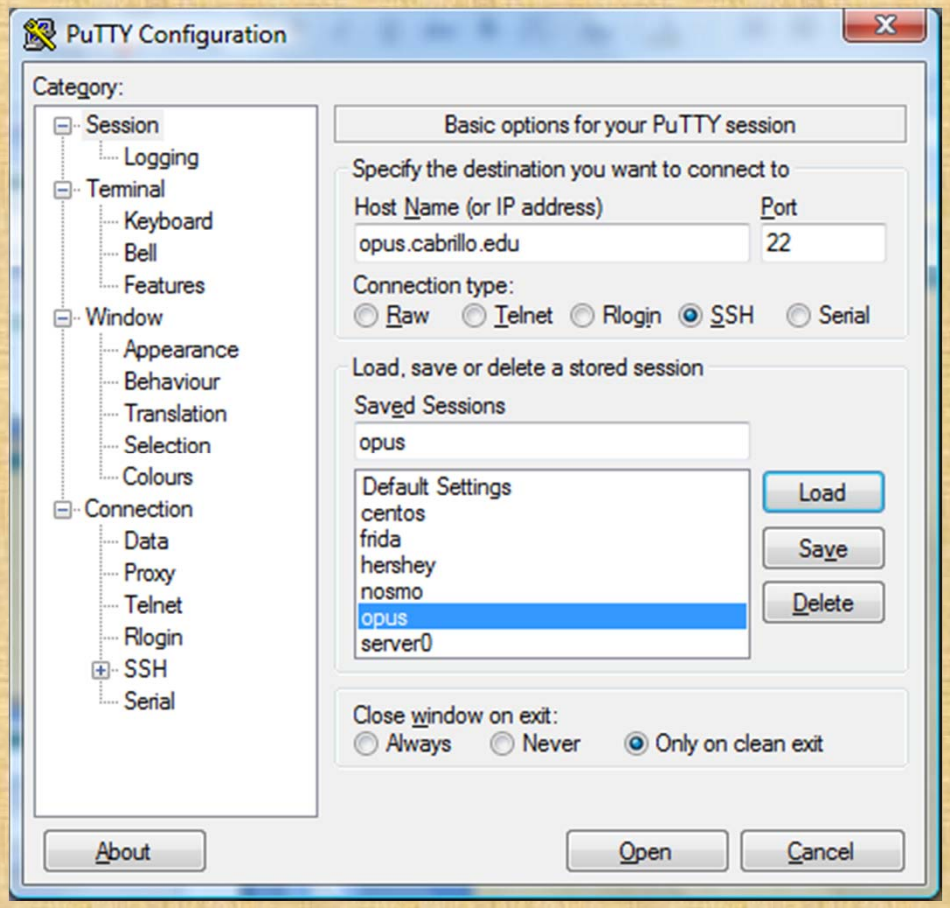
```
/home/cis90/simmsben $ passwd
Changing password for user simmsben.
Changing password for simmsben
(current) UNIX password:
New UNIX password:
Retype new UNIX password:
passwd: all authentication tokens updated successfully.
/home/cis90/simmsben $
```

Note, the passwords are not echoed as you type them.

Turn OFF the recording

Class Activity

Login to Opus and change passwords



Login to Opus:

1. Use new student accounts.
2. Change your password with the **passwd** command.

First 5 letters of last name

First 3 letters of first name

username: lllllfff

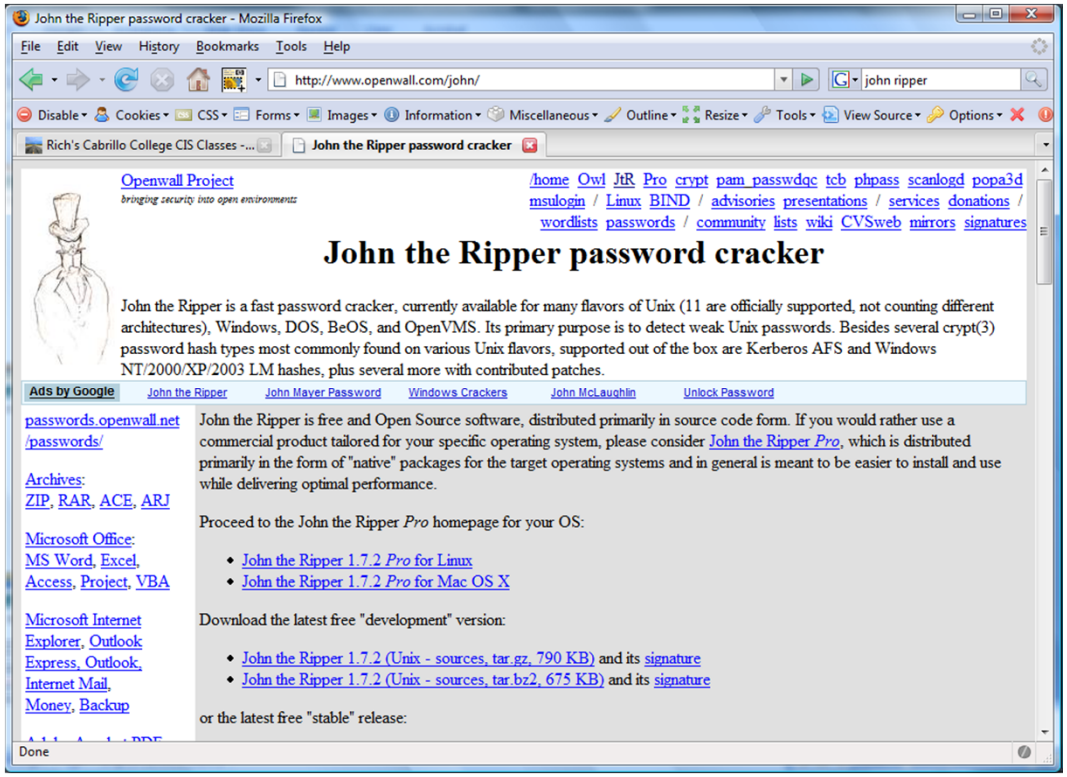
password: lllllfff1

The digit 1 (one)

Turn recording back ON

John the Ripper

An open source cracker that tries common passwords first followed by a brute force dictionary attack



john-1.7.2/run/password.lst has most popular passwords to try first

Housekeeping

Last weeks Assignment

1. Student surveys due today
2. Lab 1 due (by midnight)
3. Question on previous material?

Can I add this class?

- Yes, but you will need to move fast!
- Last day to add is 2/19
- If you need an add code, email me ASAP

Survey Forms

- I've been getting some blank surveys
- Please be sure to save them and verify what you send me is filled in.
- This works:
  - Download survey
  - Fill it out
  - Save it
  - Attach it to an email and cc: yourself (so you can verify it)
- We do tests the same way, so successfully emailing the survey is good preparation!

Tutoring Available

Jack Hsieh

- hsiehrr@yahoo.com
- Weekly session at set day and time for the semester
- Email Jack for more information.

Turn OFF the recording

Roll Call

Turn recording back ON

CIS 90 – Code Names

Lord of the Rings Characters

Current Progress

Code Name	Grading Choice	Q1	Q2	Q3	Q4
Max Points		3	3	3	3
aragorn	Grade				
arwen	Grade				
balrog	Grade				
boromir	Grade				
denethor	Grade				
dwalin	Grade				
elrond	Grade				
eomer	Grade				
eowyn	Grade				
faramir	Grade				
frodo	Grade				
galadriel	Grade				
gimli	Grade				
glorfindel	Grade				
ioreth	Grade				
legolas	Grade				
lobelia	Grade				
nazgul	Grade				
pippin	Grade				
saruman	Grade				
sauron	Grade				
theoden	Grade				
treebeard	Grade				

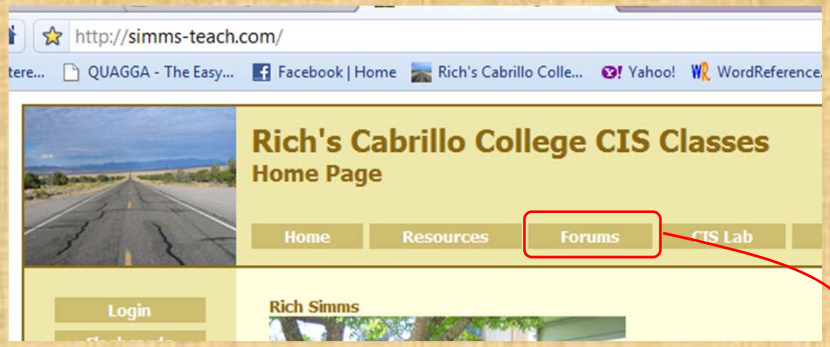
Everyone who is enrolled for this course will be assigned a code name.

I will use your grading choice on the survey you send me (you can change your mind later)

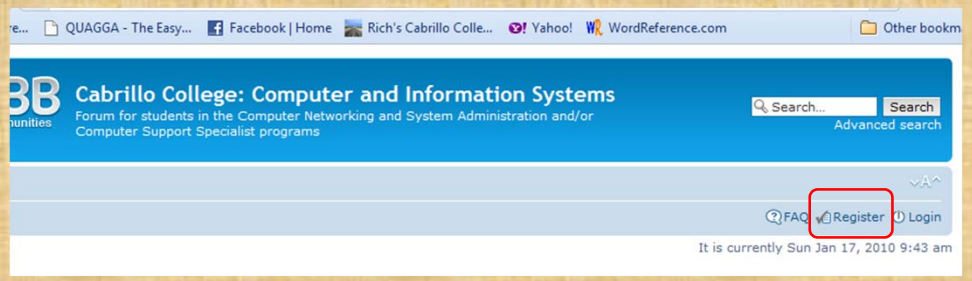
Email me after Friday for your code name.

Class Activity
Forum Registration

*There is a Forums link on **simms-teach.com***



*Or browse to **opus.cabrillo.edu/forum***



To Register:

1. Browse to the forum
2. Click on 

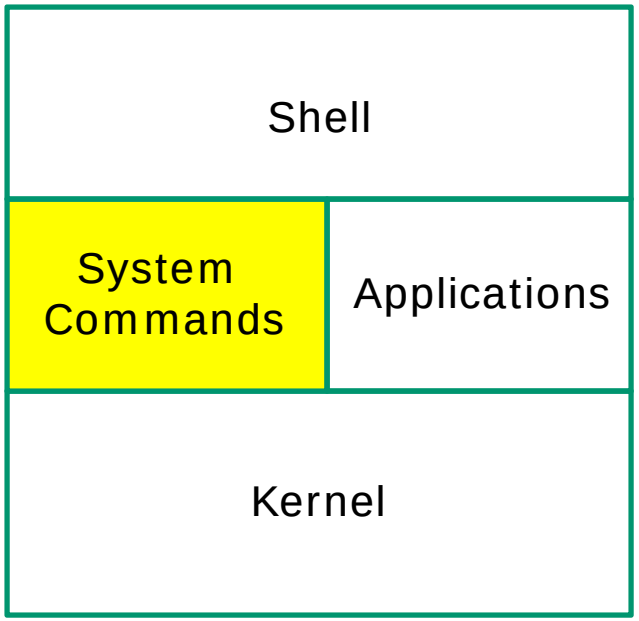
3. Review and agree to terms
4. Your **Username** must:
   - Be your first and last name separated by a space
   - e.g. Rich Simms
   - Not rsimms71 or richsimms
   - match a name on the class roster

Note: If you have any issues logging into the forum please email the instructor

Programs

UNIX/Linux Architecture

System Commands



- 100's of system commands and utilities .
- Commands like **ls** (list directories), **cat** (print a file), **rm** (remove a file), … etc.
- Utilities like **vi** (text editor), **sort** (sorts file contents), **find** (searches), … etc.
- Larger utilities like **sendmail** (email), **tar** (backup), **tcpdump** (sniffer), … etc.
- Administrative utilities like **useradd**, **groupadd**, **passwd** (change password), … etc.

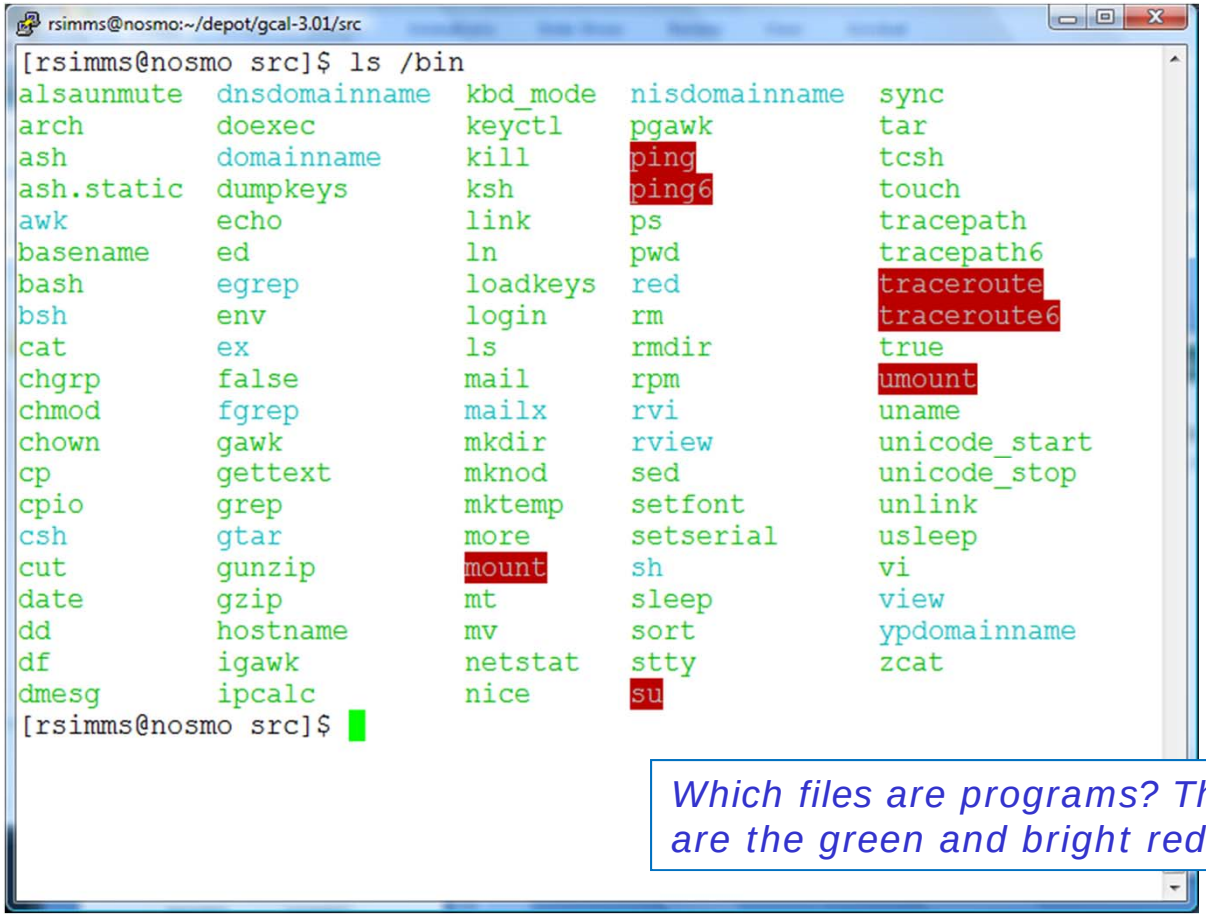
Introducing some new commands for this lesson

apropos *command*	*Looks up references in the whatis database*
cat *filename*	*print a file (from concatenate)*
cd *path*	*Change to a new directory*
echo *string*	*Print string (on screen)*
file *filename*	*Show file information*
ls *path*	*List files in a directory*
type *command*	*Shows where command resides on the path*
bc	*Binary calculator*

Programs

Executable binary code or scripts

*Use **ls /bin** to show files in the /bin directory*



Note, all UNIX/Linux commands (programs) are stored as files.

*Can you find the **date**, **hostname**, and **ps** commands we used in Lab 1?*

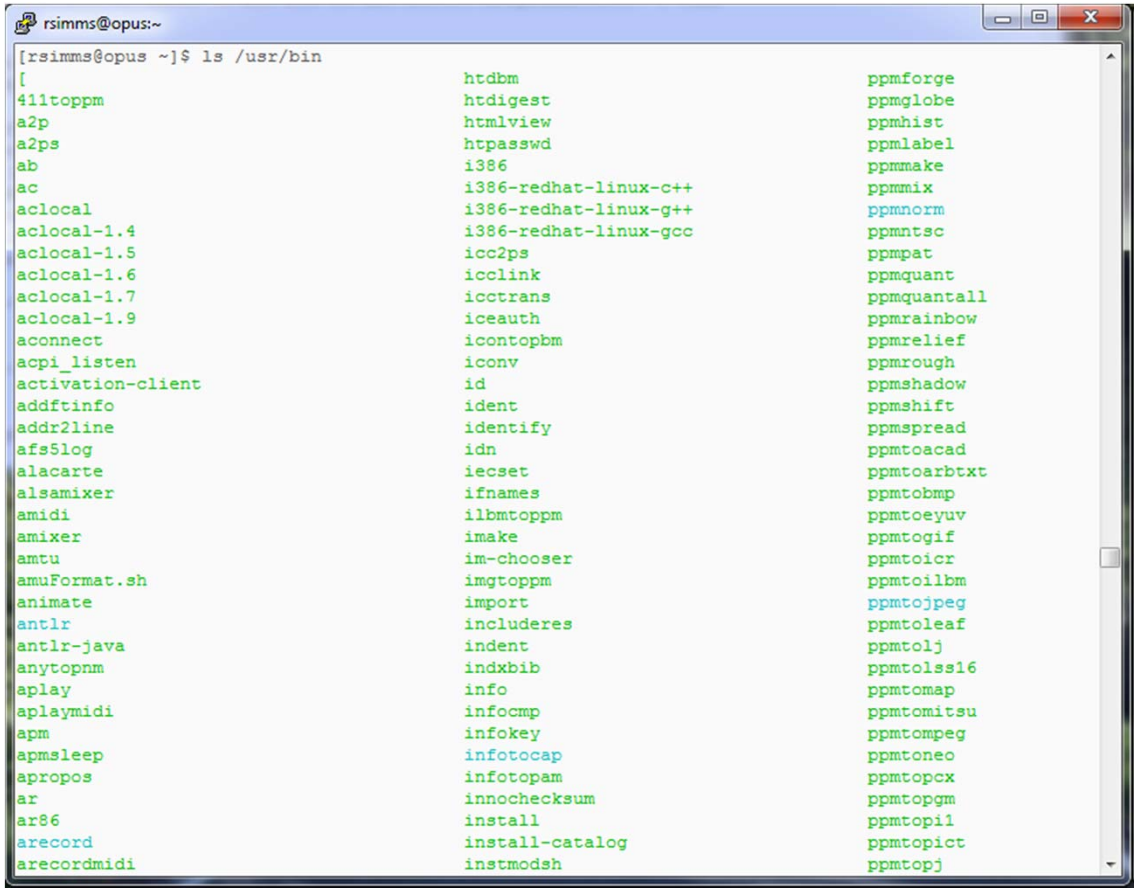
*Can you find the **bash** shell?*

Which files are programs? The simple answer is "they are the green and bright red ones .. you can run them"

Programs

Executable binary code or scripts

*Use **ls /usr/bin** to show files in the /usr/bin directory*



There are a "ton" of commands (programs) in this directory.

You will need to scroll through a lot of pages to see them all!

*Can you find the **id** command we used in Lab 1?*

Programs

Executable binary code or scripts

Lets take a deep dive on two random commands:

apropos and **cal**

apropos - searches the whatis database for a string of text
cal - prints a calendar

*We will be using the **ls**, **file, cat** and **type** commands to learn more about the **apropos** and **cal** commands*

I'll be using this graphic to indicate a program that has been loaded into memory to be run

Programs

Executable binary code or scripts

apropos

cal

```
[rsimms@nosmo src]$ apropos uname
oldolduname [obsolete] (2)  - obsolete system calls
olduname [obsolete]  (2)  - obsolete system calls
uname                (1p)  - return system name
uname                (1)  - print system information
uname                (2)  - get name and information about current kernel
uname                (3p)  - get the name of the current system
uuname               (1)  - List the names of the known remote UUCP sites
```

*Use **apropos** to look up a reference in the whatis database.*

```
[rsimms@nosmo src]$ cal
      July 2008
Su Mo Tu We Th Fr Sa
       1  2  3  4  5
 6  7  8  9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31
```

*Use **cal** to print a calendar*

Programs

Executable binary code or scripts

apropos

cal

*Note, the **ls** command shows both **apropos** and **cal** are in the /usr/bin directory. They show as green because they are programs.*

```
simmsben@opus:/usr/bin
/usr/bin $ ls apropos cal
apropos  cal
/usr/bin $
/usr/bin $
/usr/bin $ ls -l apropos cal
-rwxr-xr-x 1 root root  1786 Jul 12  2006 apropos
-rwxr-xr-x 1 root root 18764 Mar  3 10:43 cal
/usr/bin $
/usr/bin $
```

*Using the **-l** option on the **ls** command prints a "long listing" that shows additional information. The x's indicate the execute permission bits are set.*

Programs

Executable binary code or scripts

apropos

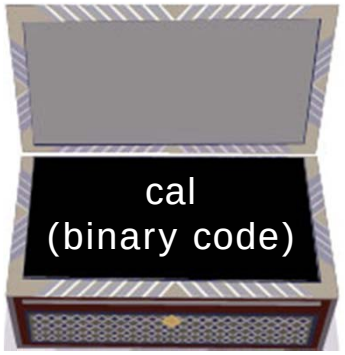
cal

*The **file** command shows that **apropos** is a shell script and **cal** is binary code (has been compiled)*

```
simmsben@opus:/usr/bin
/usr/bin $ file apropos
apropos: Bourne shell script text executable
/usr/bin $
/usr/bin $
/usr/bin $
/usr/bin $ file cal
cal: 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
/usr/bin $
```

Programs

Executable binary code or scripts



simmsben@opus:/usr/bin

```
/usr/bin $ cat apropos
#!/bin/sh
#
# apropos -- search the whatis database for keywords.
# whatis  -- idem, but match only commands (as whole words).
#
# Copyright (c) 1990, 1991, John W. Eaton.
# Copyright (c) 1994-1999, Andries E. Brouwer.
#
# You may distribute under the terms of the GNU General Public
# License as specified in the README file that comes with the man
# distribution.
#
# apropos/whatis-1.5m aeb 2003-08-01 (from man-1.6d)
#
# keep old PATH - 000323 - Bryan Henderson
# also look in /var/cache/man - 030801 - aeb

program=`basename $0`

# When man pages in your favorite locale look to grep like binary files
# (and you use GNU grep) you may want to add the 'a' option to *grepopt1.
ap
ap
wh
wh
gr
gr

if
then
    echo "usage: $program keyword ..."
    exit 1
fi

manpath=`man --path | tr : '\040'`

if [ "$manpath" = "" ]
then
    echo "$program: manpath is null"
    exit 1
```

*The **cat** command can print the apropos file because it is a readable **ASCII** script*

simmsben@opus:/usr/bin

```
/usr/bin $ cat cal
ELF4tD4(4444440909090040%i9iiÐÐHHH  PåtdÈ6ÈÈQåtd/lib/ld-linux.so.2GNU   libn
curses.so.5__gmon_start___Jv_RegisterClassestgetent_fini_inittputstgetstrlib
c.so.6_IO_stdin_usedstrcpy__printf_chkexit_IO_putcsetlocaleoptindstrrchr__sw
printf_chk__prognamedcgettextstrncpymbstowcs__stack_chk_failputcñêÓi3Ä÷EI¤9¨
IK'ý¯^o"HU"  dpßC2öFÏñ´F¼29öNôý°ñÿìñÿ¹ ð`$¤(CEÕì¼Pv¼íÊ¬KãÀ8òØqX³memcpy__strt
ìñÿB@ternalnl_langinfogetenv__q ype_b_locstderr__snprintf_chklocaltime__vfpr
intf_chkwcstombs__sprintf_chÀO ndtextdomain__libc_start_main_edata__bss_star
t_endGLIBC_2.3GLIBC_2.3.4GâR C_2.4GLIBC_2.0libdl.so.2/lib/ld-linux.so.2qFXHÊ
¿¹VSFXH QLû.SFXHRB]f9SFX`T £¹ì£¡Üÿÿÿ¡ ¡üÿÿÿ°¡Èÿÿÿ,¡Ðÿÿÿô¡ ¡$48¡Øÿÿÿ<¡ÔÿÿÿL¡h
¡¡ôÿÿÿ¬¡Äÿÿÿ´¡øÿÿÿÔ¡Ìÿÿÿ
$¼3*ÌÐÔØÜàè°    ì-ð°
ô°
 ø°
»°
 $(,04»
```

*The **cat** command "chokes" trying to print the **binary** cal file.*

That's because binary files contain unprintable characters.

Programs

Executable binary code or scripts

From: gcal-3.01.tar.gz

rsimms@nosmo:~/depot/gcal-3.01/src

```
[rsimms@nosmo src]$ head -50 gcal.c
/*
*  gcal.c:  Main part which controls the extended calendar program.
*
*
*  Copyright (c) 1994, 95, 96, 1997, 2000 Thomas Esken
*
*  This software doesn't claim completeness, correctness or usability.
*  On principle I will not be liable for ANY damages or losses (implicit
*  or explicit), which result from using or handling my software.
*  If you use this software, you agree without any exception to this
*  agreement, which binds you LEGALLY !!
*
*  This program is free software; you can redistribute it and/or modify
*  it under the terms of the `GNU General Public License' as published by
*  the `Free Software Foundation'; either version 2, or (at your option)
*  any later version.
*
*  You should have received a copy of the `GNU General Public License'
*  along with this program; if not, write to the:
*
*    Free Software Foundation, Inc.
*    59 Temple Place - Suite 330
*    Boston, MA 02111-1307,  USA
*/



static char rcsid[]="$Id: gcal.c

/*
*  Include header files.
*/
#include "tailor.h"
#if HAVE_ASSERT_H
#  include <assert.h>
```

cal

*Note: The **cal** binary code resulted from compiling the original gcal.c source code.*

rsimms@nosmo:~/depot/gcal-3.01/src

```
[rsimms@nosmo src]$ file /usr/bin/cal
/usr/bin/cal: ELF 32-bit LSB executable, Intel 80386, version 1
(SYSV), for GNU/Linux 2.2.5, dynamically linked (uses shared lib
s), stripped
[rsimms@nosmo src]$
```

Because GNU Linux software is licensed under the GPL you can make your own custom version of the commands or the kernel!

Programs

Executable binary code or scripts

Use the type command to locate where a command resides

```
[rsimms@opus run]$ type uname
uname is /bin/uname
[rsimms@opus run]$ type cal
cal is /usr/bin/cal
[rsimms@opus run]$ type uname cal
uname is /bin/uname
cal is /usr/bin/cal
```

name of the file (command/program)

name of the directory where file is found

Programs

Executable binary code or scripts

FYI: There are lots and LOTS of commands in the four "bin" (binary) directories

Class Exercise

Programs

```
/home/cis90/guest $ apropos uname
/home/cis90/guest $ cal
/home/cis90/guest $ type uname cal

/home/cis90/guest $ cd /usr/bin
/usr/bin $ ls apropos cal
/usr/bin $ ls -l apropos cal
/usr/bin $ file apropos cal
/usr/bin $ cat apropos
/usr/bin $ cat cal
/usr/bin $ reset
```

Issue these commands and compare what you get with the previous slides.

Do you know the name of the directory where the cal and apropos commands are kept?

Do you know which program is a ASCII text script and which is a binary executable?

Inputs to commands (programs)

You will get these questions when you submit Lab 2

Name a UNIX command that gets its input only from the command line?

Name an interactive command that reads its input from the keyboard?

Name a UNIX command that gets its input from the Operating System?

Name a UNIX command that gets its input only from the command line?

```
/home/cis90/simmsben $ echo hello world
hello world
```

*The **echo** command is an example of a command that gets its input from the command line*

Name a UNIX command that gets its input only from the command line?

```
/home/cis90/simmsben $ banner hello world
#      # ####### #        #        #######
#      # #       #        #        #     #
#      # #       #        #        #     #
######## #####   #        #        #     #
#      # #       #        #        #     #
#      # #       #        #        #     #
#      # ####### ####### ######## #######

#      # ####### ######  #        ######
#   #  # #      # #     # #        #     #
#   #  # #      # #     # #        #     #
#   #  # #      # ######  #        #     #
#   #  # #      # #   #   #        #     #
#   #  # #      # #    #  #        #     #
 ## ##  ####### #     # ######## ######
```

*The **banner** command is an example of a command that gets its input from the command line*

Name an interactive command that reads its input from the keyboard?

```
/home/cis90/simmsben $ bc
bc 1.06
Copyright 1991-1994, 1997, 1998, 2000 Free Software Foundation, Inc.
This is free software with ABSOLUTELY NO WARRANTY.
For details type `warranty'.
2+2
4
500-200+3
303
sqrt(64)
8
quit
```

*The **bc** (binary calculator) command is an example of an interactive command that reads its input from the keyboard*

Name an interactive command that reads its input from the keyboard?

```
/home/cis90/simmsben $ passwd
Changing password for user simmsben.
Changing password for simmsben
(current) UNIX password:
New UNIX password:
BAD PASSWORD: is too similar to the old one
New UNIX password:
Retype new UNIX password:
passwd: all authentication tokens updated successfully.
/home/cis90/simmsben $
```

*The **passwd** command is an example of an interactive command that reads its input from the keyboard*

Name a UNIX command that gets its input from the Operating System?

```
/home/cis90/simmsben $ who
dycktim  pts/1        2010-09-07 17:07 (nosmo-nat.cabrillo.edu)
root     :0           2009-12-18 17:30
velasoli pts/2        2010-09-07 17:08 (adsl-75-41-114-88.dsl.pltn13.sbcglobal.net)
guest90  pts/3        2010-09-07 16:56 (nosmo-nat.cabrillo.edu)
rsimms   pts/4        2010-09-07 15:54 (dsl-63-249-103-107.dhcp.cruzio.com)
guest90  pts/5        2010-09-07 16:59 (nosmo-nat.cabrillo.edu)
watsohar pts/6        2010-09-07 17:03 (nosmo-nat.cabrillo.edu)
swansgre pts/7        2010-09-07 17:10 (nosmo-nat.cabrillo.edu)
guest90  pts/8        2010-09-07 17:10 (nosmo-nat.cabrillo.edu)
abbenste pts/9        2010-09-07 17:11 (nosmo-nat.cabrillo.edu)
/home/cis90/simmsben $
```

*The **who** command is an example of a command that gets its input from the Operating System*

Name a UNIX command that gets its input from the Operating System?

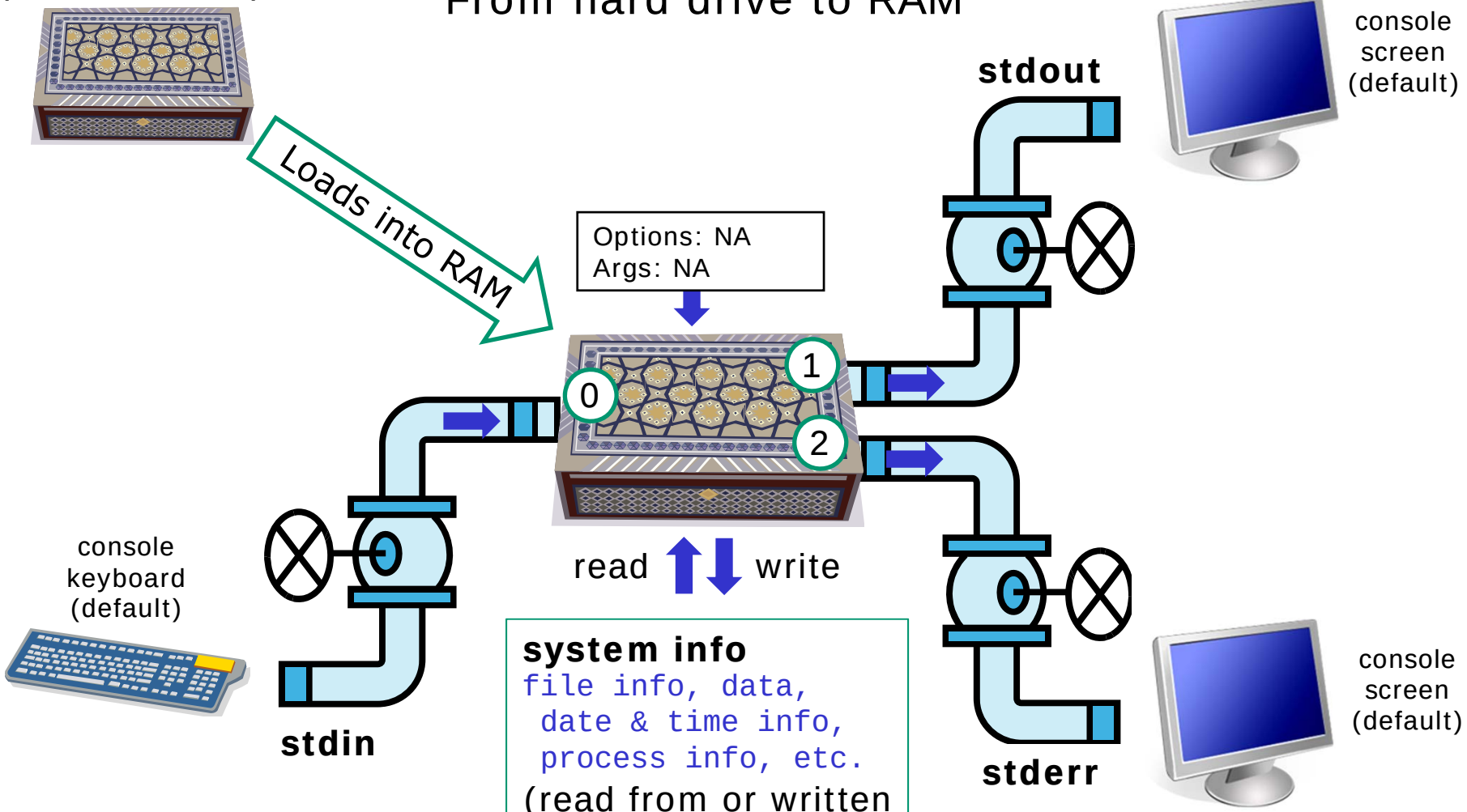
```
/home/cis90/simmsben $ uname
Linux
/home/cis90/simmsben $
```

*The **uname** command is an example of a command that gets its input from the Operating System*

Program to Process

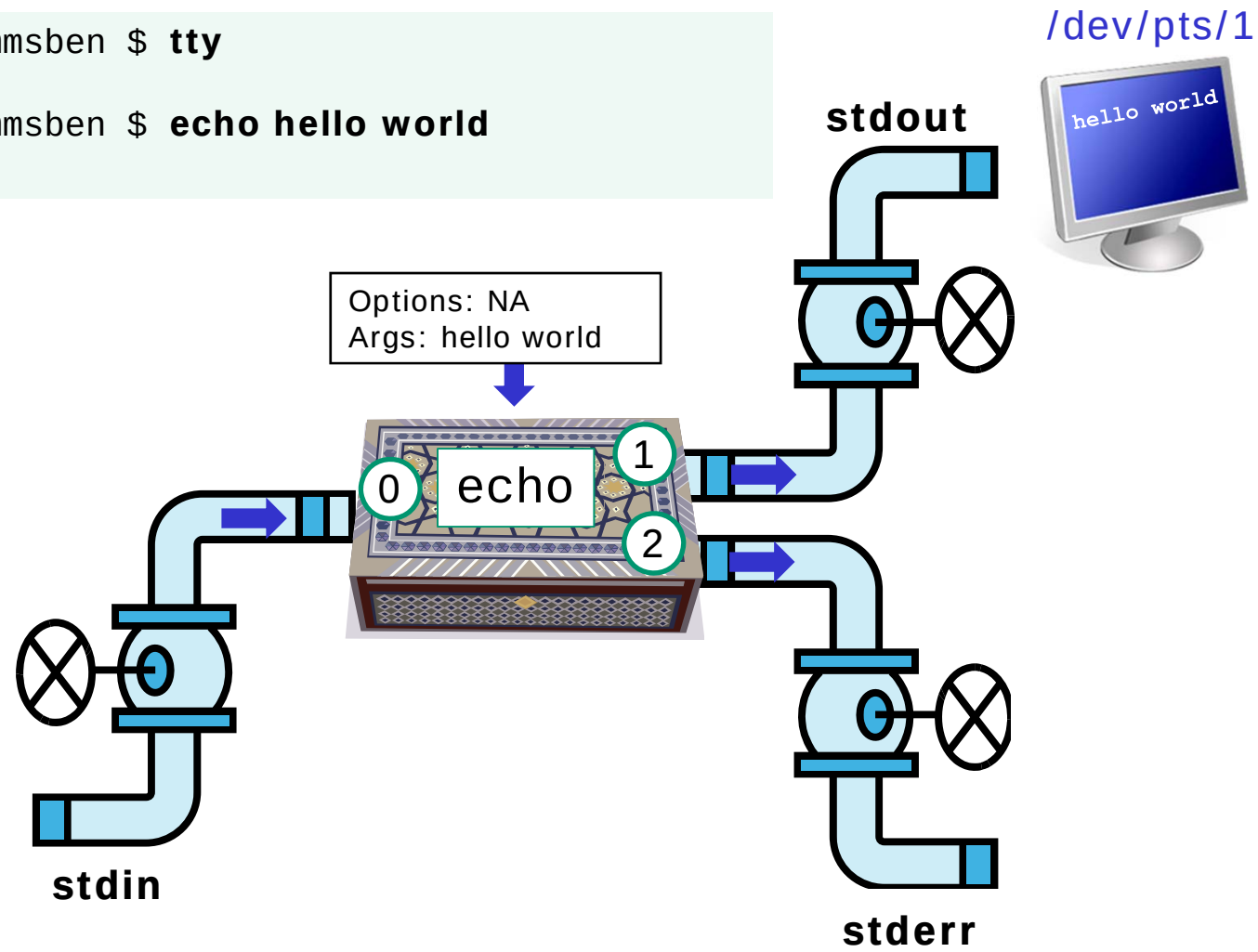
The next slides are a preview of future lessons on processes ... for now just you don't need to understand all the ins and outs of how this works.

Program to Process
From hard drive to RAM



Example program to process: echo command

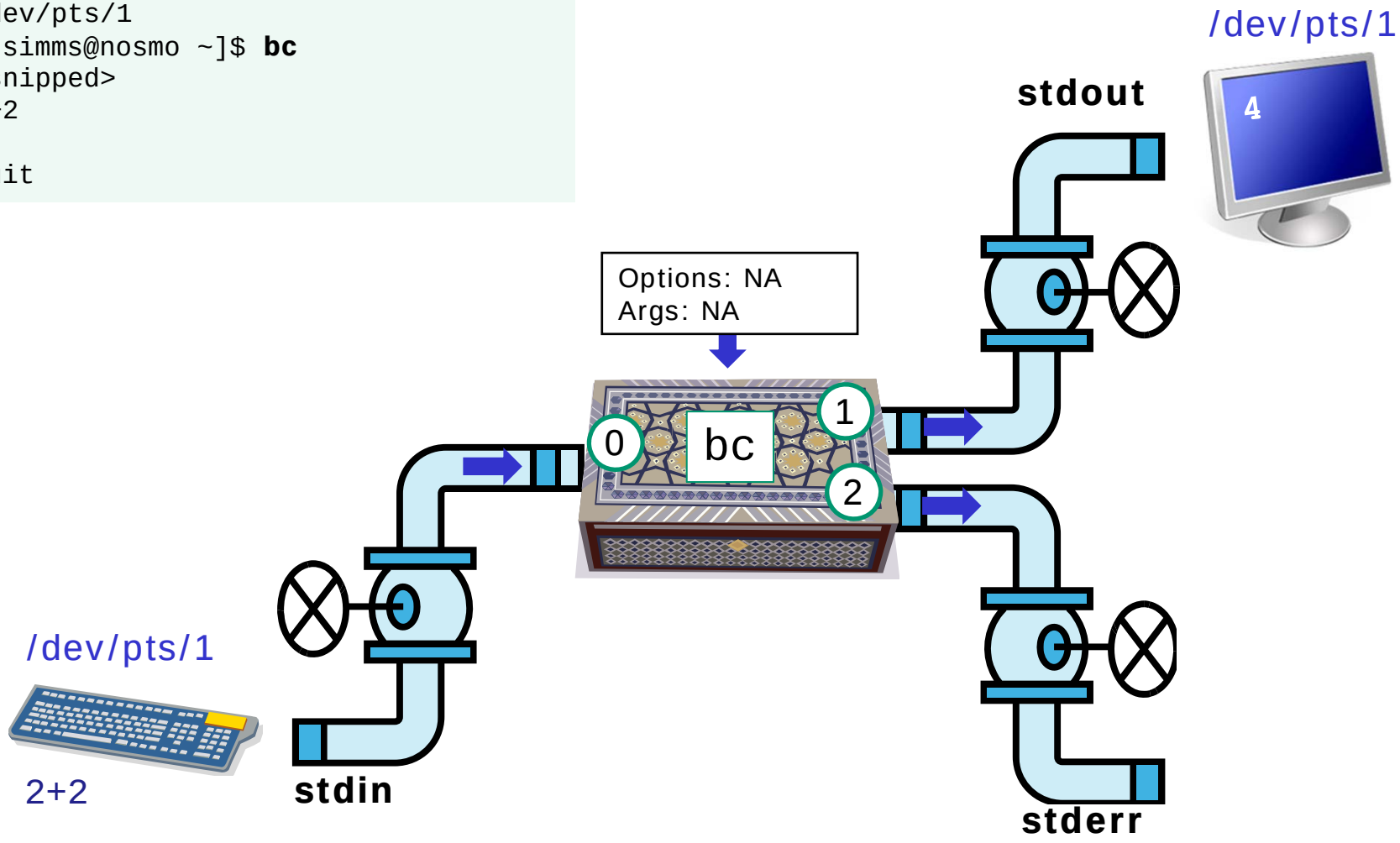
```
/home/cis90/simmsben $ tty
/dev/pts/1
/home/cis90/simmsben $ echo hello world
hello world
```



*The **echo** command is an example of a command that gets its input from the command line*

Example program to process: bc command

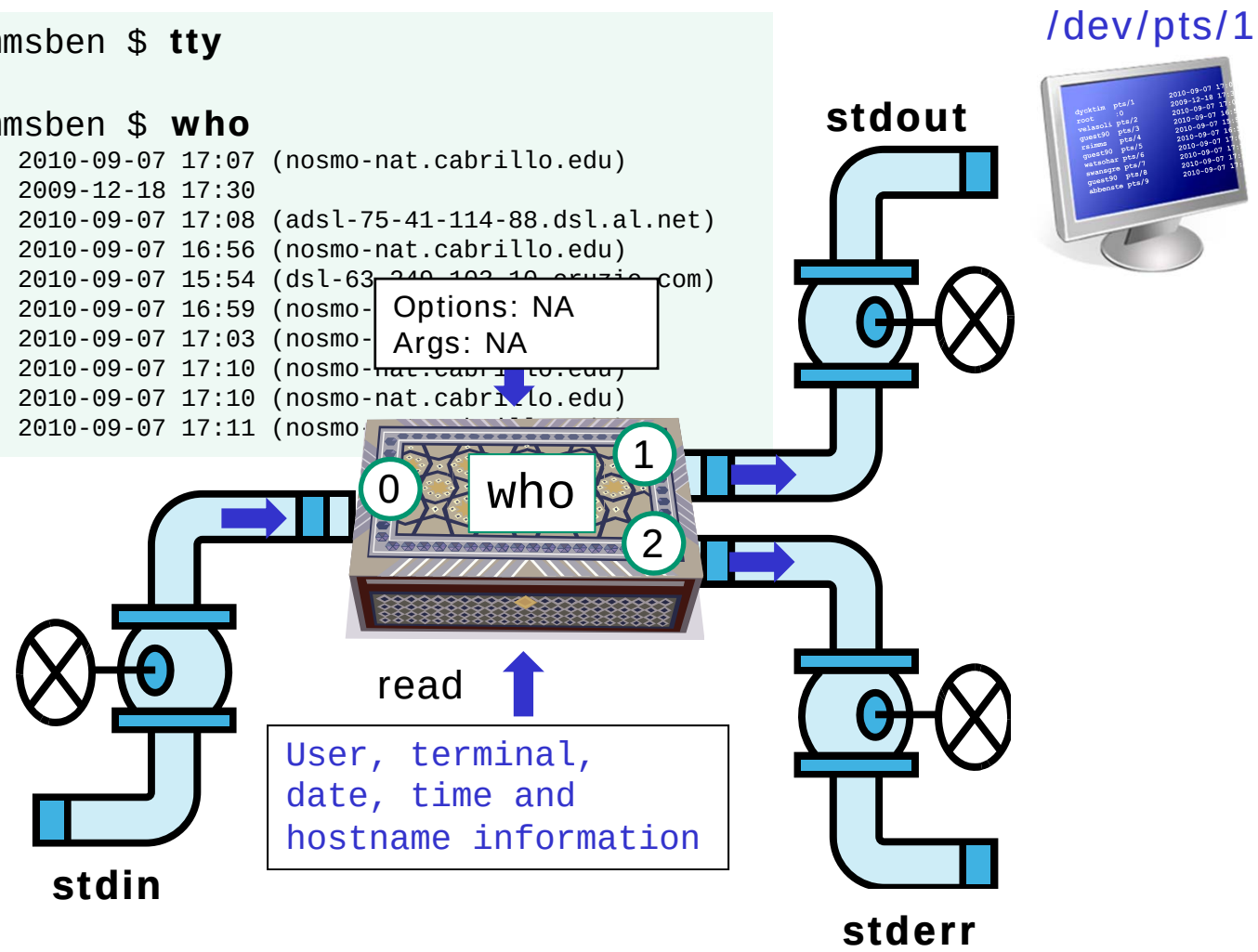
```
[rsimms@nosmo ~]$ tty
/dev/pts/1
[rsimms@nosmo ~]$ bc
<snipped>
2+2
4
quit
```



*The **bc** (binary calculator) command is an example of an interactive command that reads its input from the keyboard*

Example program to process: who command

```
/home/cis90/simmsben $ tty
/dev/pts/1
/home/cis90/simmsben $ who
dycktim  pts/1        2010-09-07 17:07 (nosmo-nat.cabrillo.edu)
root     :0           2009-12-18 17:30
velasoli pts/2        2010-09-07 17:08 (adsl-75-41-114-88.dsl.al.net)
guest90  pts/3        2010-09-07 16:56 (nosmo-nat.cabrillo.edu)
rsimms   pts/4        2010-09-07 15:54 (dsl-63-249-103-10.cruzio.com)
guest90  pts/5        2010-09-07 16:59 (nosmo-
watsohar pts/6        2010-09-07 17:03 (nosmo-
swansgre pts/7        2010-09-07 17:10 (nosmo-nat.cabrillo.edu)
guest90  pts/8        2010-09-07 17:10 (nosmo-nat.cabrillo.edu)
abbenste pts/9        2010-09-07 17:11 (nosmo-
```



*The **who** command is an example of a command that gets its input from the Operating System*

Class Exercise

Running Programs

1. What console device are you on? (use **tty**)

2. List the files in your current directory (use **ls** command). Where did the **ls** process get this file information?

3. Run the calculator program (the **bc** command).
   - Add 2 + 2
   - Multiply 5 * 7
   - Divide 5 / 0
   - Quit

   Where does the **bc** program get its input from?

Command Syntax

Command Syntax

Command | Options | Arguments | Redirection

Command – is the name of an executable program file.

Options – various options which control how the program will operate.

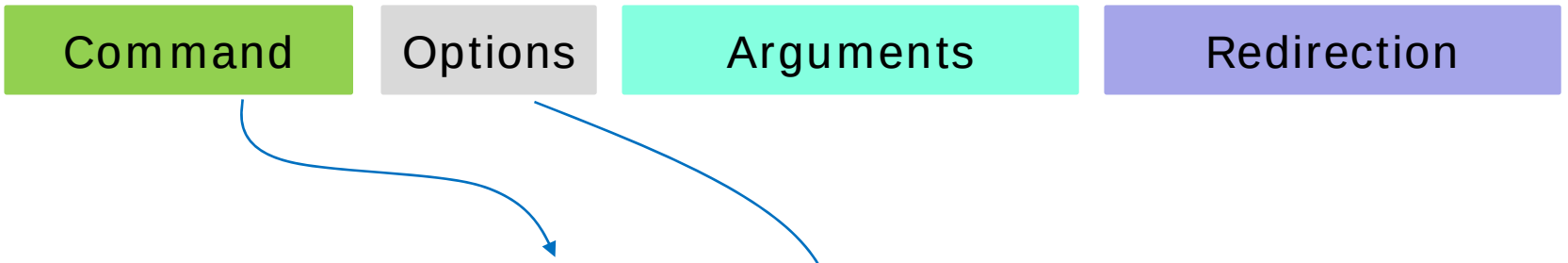
Arguments – the objects the command is directed to work upon. Multiple arguments are separated by spaces.

Redirection – The default input stream (stdin) is from the console keyboard, the default output (stdout) and error (stderr) streams go to the console screen. Redirection can modify these streams to other files or devices.

Command Syntax

Command	Options	Arguments	Redirection
clear			
hostname			
hostname	-i		
hostname	-s		
ps			
ps	-e		
ps	-F		
ps	-e -F		
ps	-eF		
ls			
ls	-l		
ls		/Blake	
ls	-l	/Blake	
ls	-l	/Blake	> blakepoems
echo		Red white Blue	

Command Syntax




```
[root@opus ~]# hostname
opus.cabrillo.edu

[root@opus ~]# hostname -i
127.0.0.1

[root@opus ~]# hostname -s
opus
```

Command Syntax

Command | Options | Arguments | Redirection

```
[root@opus ~]#ps          Using the ps command with no options
  PID TTY          TIME CMD
14801 pts/0    00:00:00 bash
15728 pts/0    00:00:00 ps

[rsimms@opus ~]$ ps -F    Using the ps command with the -F (extra full format) option
UID        PID  PPID  C    SZ   RSS PSR STIME TTY          TIME CMD
rsimms   14801 14800  0  1165  1452   0 06:50 pts/0    00:00:00 -bash
rsimms   15729 14801  0  1061   928   1 13:47 pts/0    00:00:00 ps -F

[rsimms@opus ~]$ ps -e    Using the ps command with the -e (all processes) option
  PID TTY          TIME CMD
    1 ?        00:00:05 init
    2 ?        00:00:00 migration/0
    3 ?        00:00:00 ksoftirqd/0
    4 ?        00:00:00 watchdog/0
    5 ?        00:00:00 migration/1
    6 ?        00:00:00 ksoftirqd/1
    7 ?        00:00:00 watchdog/1
    8 ?        00:00:00 events/0
    < snipped >
```

Command Syntax

Command	Options	Arguments	Redirection

```
[rsimms@opus ~]$ ps -e -F    Using the ps command with 2 options (separated)
UID        PID  PPID  C    SZ   RSS PSR STIME TTY          TIME CMD
root         1     0  0   515   628   0  2008 ?        00:00:07 init [3]
root         2     1  0     0     0   0  2008 ?        00:00:00 [migration/0]
root         3     1  0     0     0   0  2008 ?        00:00:00 [ksoftirqd/0]
root         4     1  0     0     0   0  2008 ?        00:00:00 [watchdog/0]
root         5     1  0     0     0   1  2008 ?        00:00:00 [migration/1]
root         6     1  0     0     0   1  2008 ?        00:00:00 [ksoftirqd/1]
< snipped >

[rsimms@opus ~]$ ps -eF    Using the ps command with 2options (combined)
UID        PID  PPID  C    SZ   RSS PSR STIME TTY          TIME CMD
root         1     0  0   515   628   0  2008 ?        00:00:07 init [3]
root         2     1  0     0     0   0  2008 ?        00:00:00 [migration/0]
root         3     1  0     0     0   0  2008 ?        00:00:00 [ksoftirqd/0]
root         4     1  0     0     0   0  2008 ?        00:00:00 [watchdog/0]
root         5     1  0     0     0   1  2008 ?        00:00:00 [migration/1]
root         6     1  0     0     0   1  2008 ?        00:00:00 [ksoftirqd/1]
< snipped >
```

Note: options can be combined to save a little typing

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simmsben/Poems $ ls
ant  Blake  nursery  Shakespeare  twister  Yeats
```

no options or arguments

```
/home/cis90/simmsben/Poems $ ls -l
total 48
-rw-r--r-- 1 simmsben cis90  237 Aug 26  2003 ant
drwxr-xr-x 2 simmsben cis90 4096 Jul 20  2001 Blake
-rw-r--r-- 1 simmsben cis90  779 Oct 12  2003 nursery
drwxr-xr-x 2 simmsben cis90 4096 Oct 31  2004 Shakespeare
-rw-r--r-- 1 simmsben cis90  151 Jul 20  2001 twister
drwxr-xr-x 2 simmsben cis90 4096 Jul 20  2001 Yeats
/home/cis90/simmsben/Poems $
```

1 option and no arguments

*The **-l** option on **ls** provides a "long listing" showing additional file information*

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simmsben/Poems $ ls Blake/  no options and 1 argument
jerusalem  tiger


/home/cis90/simmsben/Poems $ ls -l Blake/    1 option and 1 argument
total 16
-rw-r--r-- 1 simmsben cis90 582 Jul 20  2001 jerusalem
-rw-r--r-- 1 simmsben cis90 115 Jul 20  2001 tiger

/home/cis90/simmsben/poems $ ls -l Blake Yeats   1 option and 2 arguments
Blake:
total 16
-r--r--r-- 1 guest90 cis90 582 Jul 20  2001 jerusalem
-r--r--r-- 1 guest90 cis90 115 Jul 20  2001 tiger

Yeats:
total 24
-r--r--r-- 1 guest90 cis90 855 Jul 20  2001 mooncat
-r--r--r-- 1 guest90 cis90 520 Jul 20  2001 old
-r--r--r-- 1 guest90 cis90 863 Jul 20  2001 whitebirds
```

Note: Multiple arguments are separated by spaces

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simmsben/Poems $ ls -l Blake/ > blakepoems
```

1 options, 1 argument and some redirection

```
/home/cis90/simmsben/Poems $ cat blakepoems
total 16
-rw-r--r-- 1 simmsben cis90 582 Jul 20  2001 jerusalem
-rw-r--r-- 1 simmsben cis90 115 Jul 20  2001 tiger
```

0 options, 1 argument

Class Exercise
Command Line

```
clear

hostname
hostname -i
hostname -s

ps
ps -e
ps -F
ps -e -F
ps -eF

ls
ls -l
ls /bin
ls -l /bin
ls -lS /bin
ls –ls /bin > yourlastname
cat yourlastname
```

Try these commands out on your computer

Environment Variables

echo command

echo *prints the arguments supplied on the command line*

```
[rsimms@opus run]$ echo hello
hello
[rsimms@opus run]$ echo "My name is Rich"
My name is Rich
[rsimms@opus run]$ echo LOGNAME
LOGNAME
[rsimms@opus run]$ echo $LOGNAME
rsimms
```

What is the deal with $LOGNAME ???
... it is something called a ***variable***

variables

$LOGNAME

LOGNAME is a predefined variable that is set by the system to be your username

The $ is special metacharacter and it means "the value of"

Variables

A little tiny bit of "programming" now

Think of variables as named boxes and the $ in front of a variable name means "the contents of"

```
$ echo $LOGNAME
simmsben

$ echo $HOSTNAME
opus.cabrillo.edu

$ echo $HOME
/home/cis90/simmsben

$ echo $SHELL
/bin/bash
```

Shell (Environment) Variables

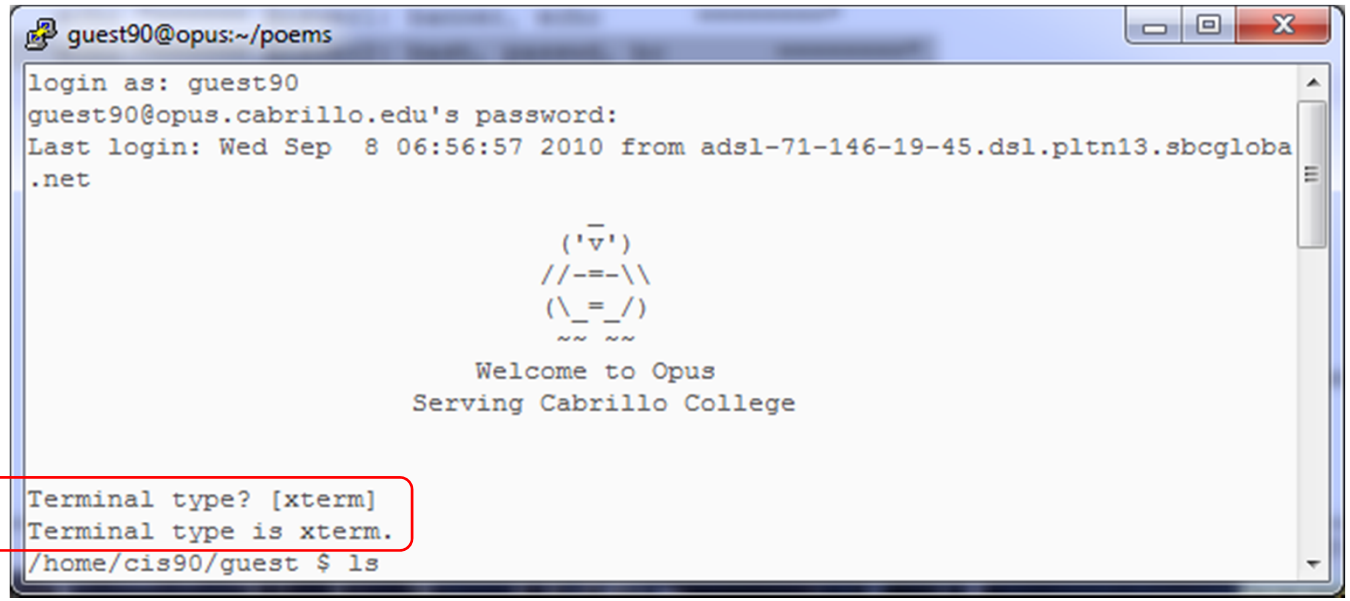
common environment variables

Shell Variable	Description
HOME	Users home directory (starts here after logging in and returns with a cd command (with no arguments)
LOGNAME	User's username for logging in with.
PATH	List of directories, separated by :'s, for the Shell to search for commands (which are program files) .
PS1	The prompt string.
PWD	Current working directory
SHELL	Name of the Shell program being used.
TERM	Type of terminal device , e.g. dumb, vt100, xterm, ansi, etc.

Shell (Environment) Variables

common environment variables

Shell Variable	Description
TERM	Type of terminal device , e.g. dumb, vt100, xterm, ansi, etc.



Note the TERM variable gets set every time we log into Opus

Shell (Environment) Variables

env command

```
/home/cis90/simmsben/Poems $env
HOSTNAME=opus.cabrillo.edu
SHELL=/bin/bash
TERM=xterm
HISTSIZE=1000
USER=simmsben
LS_COLORS=no=00:fi=00:di=00;34:ln=00;36:pi=40;33:so=00;35:bd=40;33;01:cd=40;33;01:or=01;05;37;41:mi
=01;05;37;41:ex=00;32:*.cmd=00;32:*.exe=00;32:*.com=00;32:*.btm=00;32:*.bat=00;32:*.sh=00;32:*.csh=
00;32:*.tar=00;31:*.tgz=00;31:*.arj=00;31:*.taz=00;31:*.lzh=00;31:*.zip=00;31:*.z=00;31:*.Z=00;31:*
.gz=00;31:*.bz2=00;31:*.bz=00;31:*.tz=00;31:*.rpm=00;31:*.cpio=00;31:*.jpg=00;35:*.gif=00;35:*.bmp=
00;35:*.xbm=00;35:*.xpm=00;35:*.png=00;35:*.tif=00;35:
USERNAME=
MAIL=/var/spool/mail/simmsben
PATH=/usr/kerberos/bin:/usr/local/bin:/bin:/usr/bin:/home/cis90/simmsben/../bin:/home/cis90/simmsbe
n/bin:.
INPUTRC=/etc/inputrc
PWD=/home/cis90/simmsben/Poems
LANG=en_US.UTF-8
SSH_ASKPASS=/usr/libexec/openssh/gnome-ssh-askpass
SHLVL=1
HOME=/home/cis90/simmsben
BASH_ENV=/home/cis90/simmsben/.bashrc
LOGNAME=simmsben
CVS_RSH=ssh
LESSOPEN=|/usr/bin/lesspipe.sh %s
G_BROKEN_FILENAMES=1
_=/bin/env
OLDPWD=/home/cis90/simmsben
/home/cis90/simmsben/Poems $
```

*The **env** command shows all the environment variables used by the shell*

Shell Variables

set command

```
/home/cis90/simmsben/Poems $set
BASH=/bin/bash
BASH_ARGC=()
BASH_ARGV=()
BASH_ENV=/home/cis90/simmsben/.bashrc
BASH_LINENO=()
BASH_SOURCE=()
BASH_VERSINFO=([0]="3" [1]="2" [2]="25" [3]="1"
[4]="release" [5]="i686-redhat-linux-gnu")
BASH_VERSION='3.2.25(1)-release'
COLORS=/etc/DIR_COLORS.xterm
COLUMNS=80
CVS_RSH=ssh
DIRSTACK=()
EUID=1160
GROUPS=()
G_BROKEN_FILENAMES=1
HISTFILE=/home/cis90/simmsben/.bash_history
HISTFILESIZE=1000
HISTSIZE=1000
HOME=/home/cis90/simmsben
HOSTNAME=opus.cabrillo.edu
HOSTTYPE=i686
IFS=$' \t\n'
IGNOREEOF=10
INPUTRC=/etc/inputrc
LANG=en_US.UTF-8
LESSOPEN='|/usr/bin/lesspipe.sh %s'
LINES=24
LOGNAME=simmsben
LS_COLORS='no=00:fi=00:di=00;34:ln=00;36:pi=40;33:so=00;35
:bd=40;33;01:cd=40;33;01:or=01;05;37;41:mi=01;05;37;41:ex=
00;32:*.cmd=00;32:*.exe=00;32:*.com=00;32:*.btm=00;32:*.ba
t=00;32:*.sh=00;32:*.csh=00;32:*.tar=00;31:*.tgz=00;31:*.a
rj=00;31:*.taz=00;31:*.lzh=00;31:*.zip=00;31:*.z=00;31:*.Z
=00;31:*.gz=00;31:*.bz2=00;31:*.bz=00;31:*.tz=00;31:*.rpm=
00;31:*.cpio=00;31:*.jpg=00;35:*.gif=00;35:*.bmp=00;35:*.x
bm=00;35:*.xpm=00;35:*.png=00;35:*.tif=00;35:'
MACHTYPE=i686-redhat-linux-gnu
MAIL=/var/spool/mail/simmsben
MAILCHECK=60
OLDPWD=/home/cis90/simmsben
OPTERR=1
OPTIND=1
OSTYPE=linux-gnu
PATH=/usr/kerberos/bin:/usr/local/bin:/bin:/usr/bin:/home/
cis90/simmsben/../bin:/home/cis90/simmsben/bin:.
PIPESTATUS=([0]="0")
PPID=26514
PROMPT_COMMAND='echo -ne
"\033]0;${USER}@${HOSTNAME%%.*}:${PWD/#$HOME/~}"; echo -ne
"\007"'
PS1='$PWD $'
PS2='> '
PS4='+ '
PWD=/home/cis90/simmsben/Poems
SHELL=/bin/bash
SHELLOPTS=braceexpand:emacs:hashall:histexpand:ignoreeof:i
nteractive-comments:monitor
SHLVL=1
SSH_ASKPASS=/usr/libexec/openssh/gnome-ssh-askpass
TERM=xterm
UID=1160
USER=simmsben
USERNAME=
_=env
consoletype=pty
```

*The **set** command shows all the variables used by the shell and by the user*

Environment variables

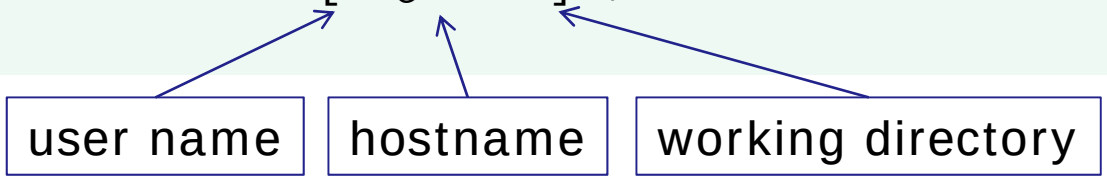
PATH, TERM, PS1, HOME

Use echo $_____ to show value

```
[rsimms@nosmo ~]$ echo $PATH
/usr/kerberos/bin:/usr/local/bin:/bin:/usr/bin:/usr/X11R6/bin:/home/rsimms/bin

[rsimms@nosmo ~]$ echo $TERM
xterm

[rsimms@nosmo ~]$ echo $HOME
/home/rsimms

[rsimms@nosmo ~]$ echo $PS1
[\u@\h \W]\$
```

Use = (no spaces, no $ sign) to change value

```
[rsimms@nosmo ~]$ PS1="By your command >"
By your command >
By your command >PS1="What can I do for you $LOGNAME? "
What can I do for you rsimms?
What can I do for you rsimms? PS1="[\u@\h \W]\$ "
[rsimms@nosmo ~]$
```



bash shell tip

changing the prompt

Prompt Code	Meaning
\!	history command number
\#	session command number
\d	date
\h	hostname
\n	new line
\s	shell name
\t	time
\u	user name
\w	entire path of working directory
\W	only working directory
\$	$ or # (for root user)

The prompt string can have any combination of text, variables and these special codes.

bash shell tip

changing the prompt

Prompt string	Result
PS1='$PWD $'	/home/cis90/simmsben/Poems $
PS1="\w $"	~/Poems $
PS1="\W $"	Poems $
PS1="\u@\h $"	simmsben@opus $
PS1='\u@\h $PWD $'	simmsben@opus /home/cis90/simmsben/Poems $
PS1='\u@\$HOSTNAME $PWD $'	simmsben@opus.cabrillo.edu /home/cis90/simmsben/Poems $
PS1='\u \! $PWD $'	simmsben 825 /home/cis90/simmsben/Poems $
PS1="[\u@\h \W/\$"	[simmsben@opus Poems/$
PS1='$PWD $'	/home/cis90/simmsben/Poems $

Important: Use single quotes around variables that change. For example if you use $PWD with double quotes, the prompt will not changes as you change directories! More on this later ...

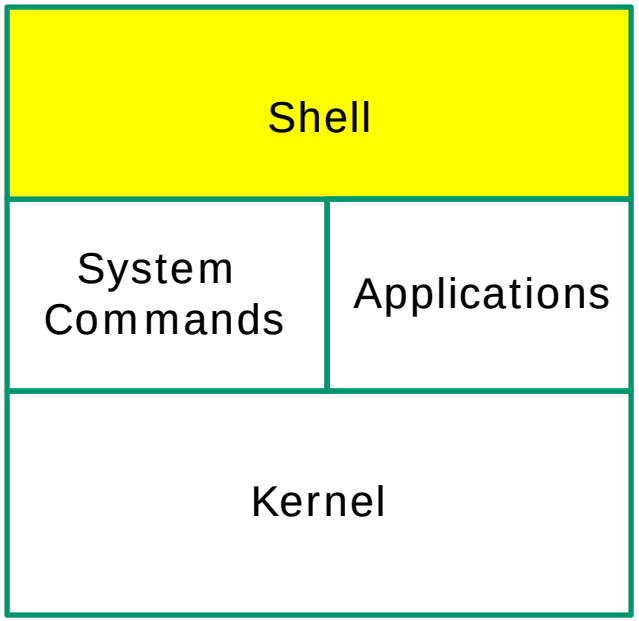
Class Exercise

Environment Variables

1. Print the name of your shell (hint **echo $SHELL**)
2. Print your path (hint: the PATH variable)
3. Print your username (hint: the LOGNAME variable)
4. Change your prompt to "What is your command master? "
5. Change your prompt to "[\u@\h \W]\$"
6. Print all of your environment variables.
7. What kind of terminal device are you using? (hint: the TERM variable)

Shell

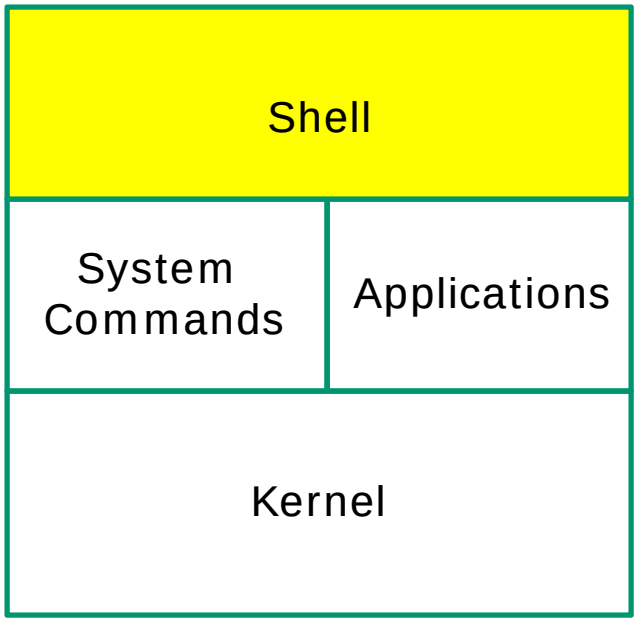
The Shell



- Allows users to interact with the computer via a "**command line**".
- **Prompts** for a command, parses the command, finds the right program and gets that program executed.
- Is called a "**shell**" because it hides the underlying operating system.

- Multiple shell programs are available: **sh** (Bourne shell), **bash** (born again shell), **csh** (C shell), **ksh** (Korn shell).
- The shell is a **user interface** and a **programming language** (scripts).
- GNOME and KDE desktops could be called **graphical shells**

Life of the Shell



1) Prompt
2) Parse
3) Search
4) Execute
5) Nap
6) Repeat

Life of the Shell

1) Prompt user for a command

(uses the PS1 environment variable)

Examples:

```
[rsimms@opus work]$ echo $PS1
[\u@\h \W]\$
[rsimms@opus work]$
```

Regular Opus prompt for non CIS 90 classes

```
[root@nosmo ~]# echo $PS1
[\u@\h \W]\$
[root@nosmo ~]#
```

Note the change to # when logged on as root

```
/usr/bin $ echo $PS1
$PWD $
/usr/bin $
```

We use this prompt in CIS 90 to show current path

Life of the Shell

2) Parse command user typed

(analyze and dissect text string into tokens)

This is the command which needs to match a program file or script to run.

This is an argument which is passed to the program when it is run

This indicates stdout will be redirected

```
[rsimms@opus work]$ ls -lR /bin/p* > pcommands
```

These are options which are passed to the program when it is run

This is a filename expansion metacharacter

This is the file that output from stdout is redirected to

Life of the Shell

3) Search for the program file to run

(only look in directories on the PATH)

/bin directory is on the path

```
[rsimms@opus work]$ echo $PATH
/usr/kerberos/bin:/usr/local/bin:/bin:/usr/bin:/hom
e/rsimms/bin

[rsimms@opus work]$ type -a ls
ls is aliased to `ls --color=tty'
ls is /bin/ls
[rsimms@opus work]$

[rsimms@opus work]$ ls /bin/ls
/bin/ls
```

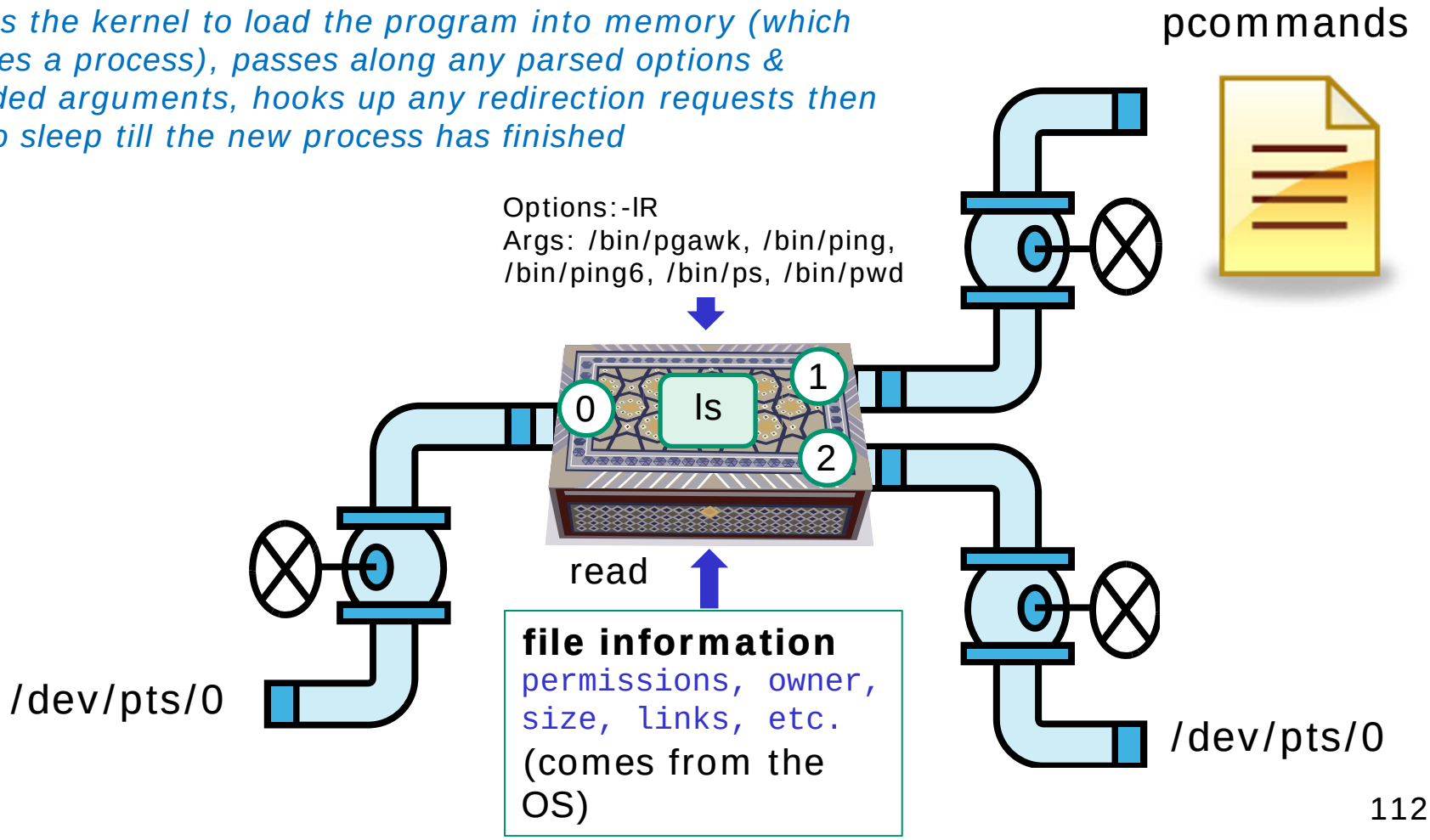
***type** command shows that **ls** is in the /bin directory*

***ls** command lists the **ls** file and it is executable (green)*

Life of the Shell

4) Execute the command

Invokes the kernel to load the program into memory (which becomes a process), passes along any parsed options & expanded arguments, hooks up any redirection requests then goes to sleep till the new process has finished



Life of the Shell

5) Nap while the command (process) runs to completion

(The shell (itself a loaded process) goes into the sleep state and waits till the command process is finished)

```
[rsimms@opus work]$ ls -lR /bin/p* > pcommands


[rsimms@opus work]$ cat pcommands
-rwxr-xr-x 1 root root 321216 Jan 15  2007 /bin/pgawk
-rwsr-xr-x 1 root root  35864 Dec 21  2006 /bin/ping
-rwsr-xr-x 1 root root  31244 Dec 21  2006 /bin/ping6
-r-xr-xr-x 1 root root  79068 Jan  2  2008 /bin/ps
-rwxr-xr-x 1 root root  22980 Nov 30  2007 /bin/pwd
[rsimms@opus work]$
```

Life of the Shell

6) And do it all over again … go to step 1

What the heck !!@@##

Four commands: **hostname, ps, iptables and ifconfig**

```
[rsimms@opus ~]$ ls /bin/hostname /bin/ps
/bin/hostname  /bin/ps
[rsimms@opus ~]$ ls /sbin/iptables /sbin/ifconfig
/sbin/ifconfig  /sbin/iptables
```

Two work and two don't:

```
[rsimms@opus ~]$ hostname
opus.cabrillo.edu
```

```
[rsimms@opus ~]$ ps
  PID TTY          TIME CMD
14801 pts/0    00:00:00 bash
14902 pts/0    00:00:00 ps
```

```
[rsimms@opus ~]$ iptables -L
-bash: iptables: command not found
```

 !!@@##

```
[rsimms@opus ~]$ ifconfig
-bash: ifconfig: command not found
```

 !!@@##

*The **hostname** and **ps** commands work fine. Why do the **iptables** and **ifconfig** commands get the "not found" error?*

... because they are not on the path

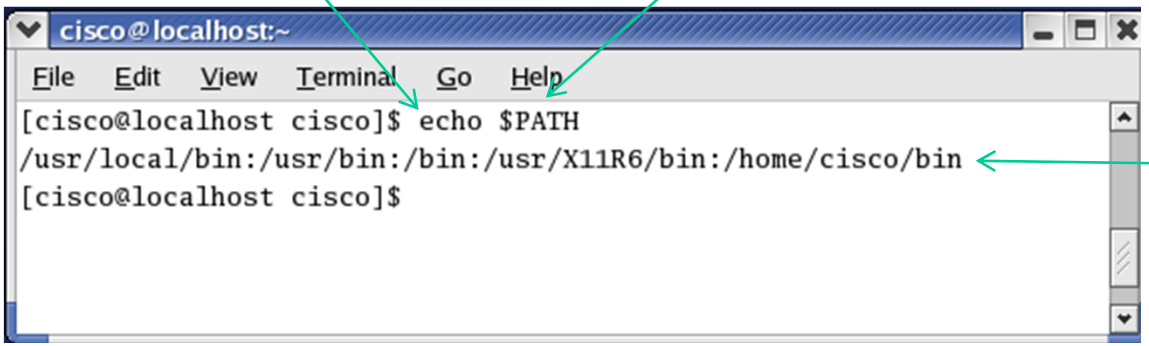
What the heck !!@@##

The Shell and the PATH

- The shell will only search for commands on the “path”
- The path is determined by the environment variable PATH
- Use **echo $PATH** to see your current path

echo command prints a text string

The $ means “the value of”



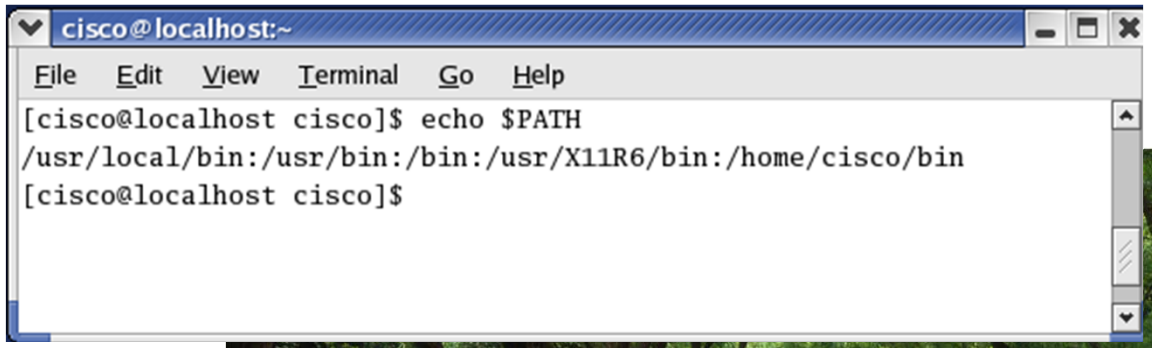
This user’s path has the following directories:

1. */usr/local/bin*
2. */usr/bin*
3. */bin*
4. */usr/X11R6/bin*
5. */home/cisco/bin*

The order is important as it determines the order in which the directories are searched by the shell for a command

What the heck !!@@##

The Shell and the PATH



Here is the path ... well not the actual path but the analogy works!

What the heck !!@@##

The Shell and the PATH

```
cisco@localhost:~
File  Edit  View  Terminal  Go  Help
[cisco@localhost cisco]$ echo $PATH
/usr/local/bin:/usr/bin:/bin:/usr/X11R6/bin:/home/cisco/bin
[cisco@localhost cisco]$
```

*These directories are **on** the path*

*This directory (and many others) is **NOT** on the path*

`/sbin`

`/home/cisco/bin`

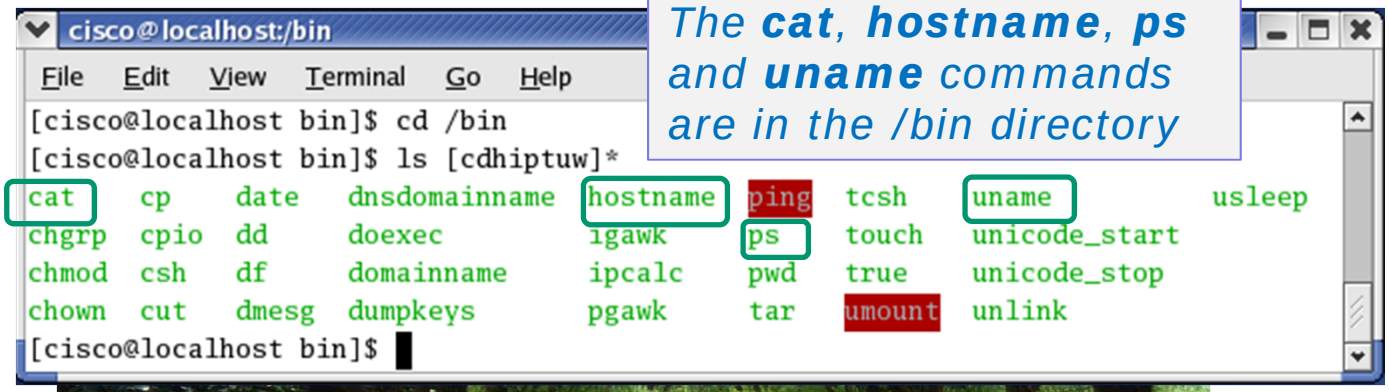
`/usr/X11R6/bin`

`/bin`

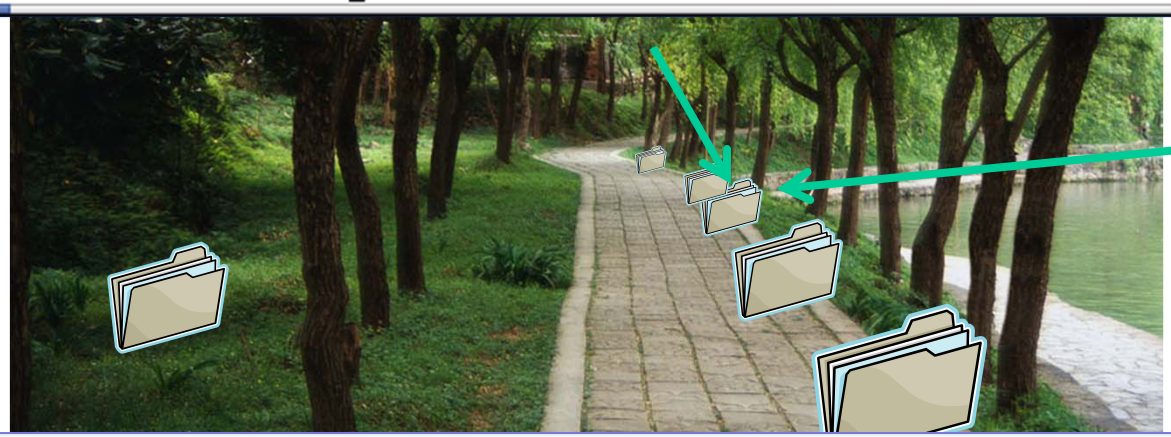
`/usr/bin`

`/usr/local/bin`

The Shell and the PATH



*The **cat**, **hostname**, **ps** and **uname** commands are in the /bin directory*



*The /bin directory is **on** the path*

```
[rsimms@opus ~]$ hostname
opus.cabrillo.edu
[rsimms@opus ~]$ ps
  PID TTY          TIME CMD
14801 pts/0    00:00:00 bash
14902 pts/0    00:00:00 ps
```

These commands work fine

The Shell and the PATH

*The **ifconfig** and **iptables** commands are in the /sbin directory*

*The /sbin directory is **NOT** on the path*

*These commands don't work because they were **not found** on the path.*

```
[rsimms@opus ~]$ iptables -L
-bash: iptables: command not found
[rsimms@opus ~]$ ifconfig
-bash: ifconfig: command not found
```

!!@@##

!!@@##

OK, makes sense now

Class Exercise

Life of the Shell

1. Issue a **uname** command and a **type uname** command. What happened?
2. Issue a **iptables –L** command and a **type iptables** command. What happened?
3. Try **ls -lR /bin/p* > *yourlastname*** and **cat *yourlastname*** What did the * do?
4. Show your path (hint use echo $PATH).
5. Show your prompt string (hint use echo $PS1)
6. Can you find iptables? hint use:

   find / -name iptables 2> /dev/null

Meta-characters

Metacharacters

<cr> (carriage return)

The unprintable carriage return <cr> marks the end of a command and lets the shell know to start processing it.

```
[rsimms@opus ~]$ ps
  PID TTY          TIME CMD
19015 pts/0    00:00:00 bash
19378 pts/0    00:00:00 ps

[rsimms@opus ~]$ hostname
opus.cabrillo.edu

[rsimms@opus ~]$ echo "Use <cr> to end the command"
Use <cr> to end the command
```

Pressing the Enter key here generates an invisible <cr>

Metacharacters
$ (the value of)

Use $ for the “value” of a variable

Analogy: Each variable is a named location. The contents of any location is the “value” of that variable.

```
$ echo $LOGNAME
simmsben

$ echo HOME
HOME

$ echo $HOME
/home/cis90/simmsben

$ echo $SHELL
/bin/bash

$ echo $HOSTNAME
opus.cabrillo.edu
```

Metacharacters

' " (single and double quotes)

- *One or more blanks between arguments is treated as a single blank*
- *Use "(double) or '(single) quotes for preserving blanks*

```
[rsimms@opus ~]$ echo 1 2 3
1 2 3

[rsimms@opus ~]$ echo 1        2                3
1 2 3

[rsimms@opus ~]$ echo "1        2                3"
1        2                3

[rsimms@opus ~]$ echo "1 2 3"
1 2 3

[rsimms@opus ~]$ echo '"1 2 3"'
"1 2 3"
```

The blanks in these commands are used to separate the arguments

Use quotes if blanks are important and are needed for spacing

Use single and double quotes together to show quote marks

Metacharacters

' " (quotes)

Note that strings in " (double) quotes allow the $ metacharacter to be interpreted by the shell

```
[simmsben@opus Poems]$ echo Hello   $LOGNAME
Hello simmsben

[simmsben@opus Poems]$ echo "Hello   $LOGNAME"
Hello   simmsben

[simmsben@opus Poems]$ echo 'Hello   $LOGNAME'
Hello   $LOGNAME
```

Not so with strings in ' (single) quotes

The use of a single quote will prevent the shell from interpreting the $ metacharacter

Metacharacters

\ (don't interpret next metacharacter)

Use \ (back slash) to not interpret the next metacharacter

```
[rsimms@opus ~]$ echo a b c
a b c

[rsimms@opus ~]$ echo a b c \
> d e f
a b c d e f

[rsimms@opus ~]$ echo $PS1
[\u@\h \W]\$

[rsimms@opus ~]$ echo \$PS1
$PS1

[rsimms@opus ~]$ echo "Hello World"
Hello World

[rsimms@opus ~]$ echo \"Hello World\"
"Hello World"
```

Do not interpret the invisible <cr> at the end of the line (from the Enter key)

Do not interpret the $ (which shows the value of the variable)

Do not interpret the double quote marks

Metacharacters

; (command separator)

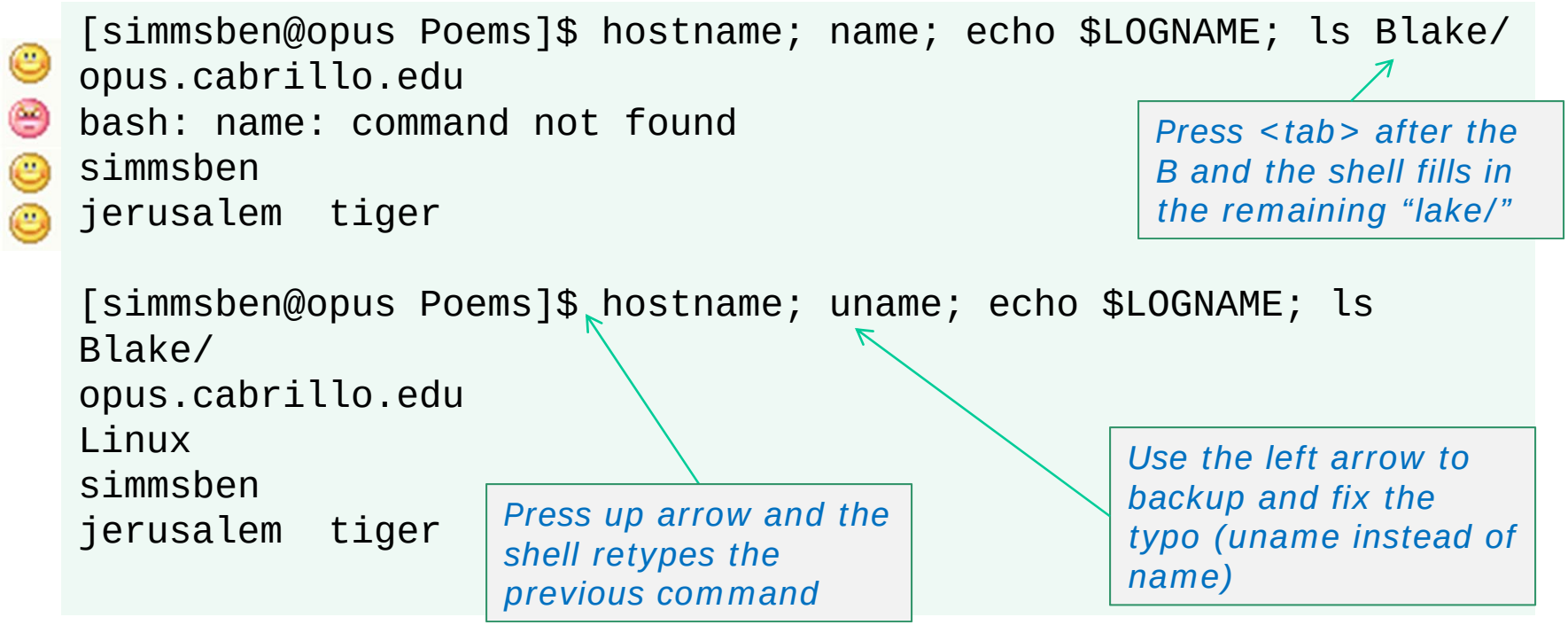
Use ; to put multiple commands on one line

```
[simmsben@opus Poems]$ hostname; uname; echo $LOGNAME; ls
opus.cabrillo.edu
Linux
simmsben
ant  Blake  nursery  Shakespeare  twister  Yeats
```

More on the Command Line

Handy Shortcuts

- Use up and down arrows to “retype” previous commands
- Left and right arrow for editing current command
- Use <tab> to complete filenames automatically



Class Exercise
Metacharacters

```
echo a b        c
echo "a b         c"

echo a b c \
>d e f

echo $PS1
echo \$PS1

echo "Hello $USERNAME"
echo 'Hello $USERNAME‘

echo ' "Hello World" '
echo \"Hello World\"

hostname; uname; echo $LOGNAME; ls
```

Try these commands out on your computer

Docs

Using man (manual) pages

*Type the **man** command followed by the name of the command you want documentation on.*

Example: **man bc**

```
simmsben@opus:~
/home/cis90/simmsben $
/home/cis90/simmsben $ man bc
bc(1)                                                          bc(1)

NAME
       bc - An arbitrary precision calculator language

SYNTAX
       bc [ -hlwsqv ] [long-options] [  file ... ]

VERSION
       This man page documents GNU bc version 1.06.

DESCRIPTION
       bc  is a language that supports arbitrary precision numbers with inter-
       active execution of statements.  There are  some  similarities  in  the
       syntax  to  the  C  programming  language.   A standard math library is
       available by command line option.  If requested, the  math  library  is
       defined before processing any files.  bc starts by processing code from
       all the files listed on the command line in the  order  listed.   After
       all  files  have been processed, bc reads from the standard input.  All
       code is executed as it is read.  (If a file contains a command to  halt
       the processor, bc will never read from the standard input.)
```

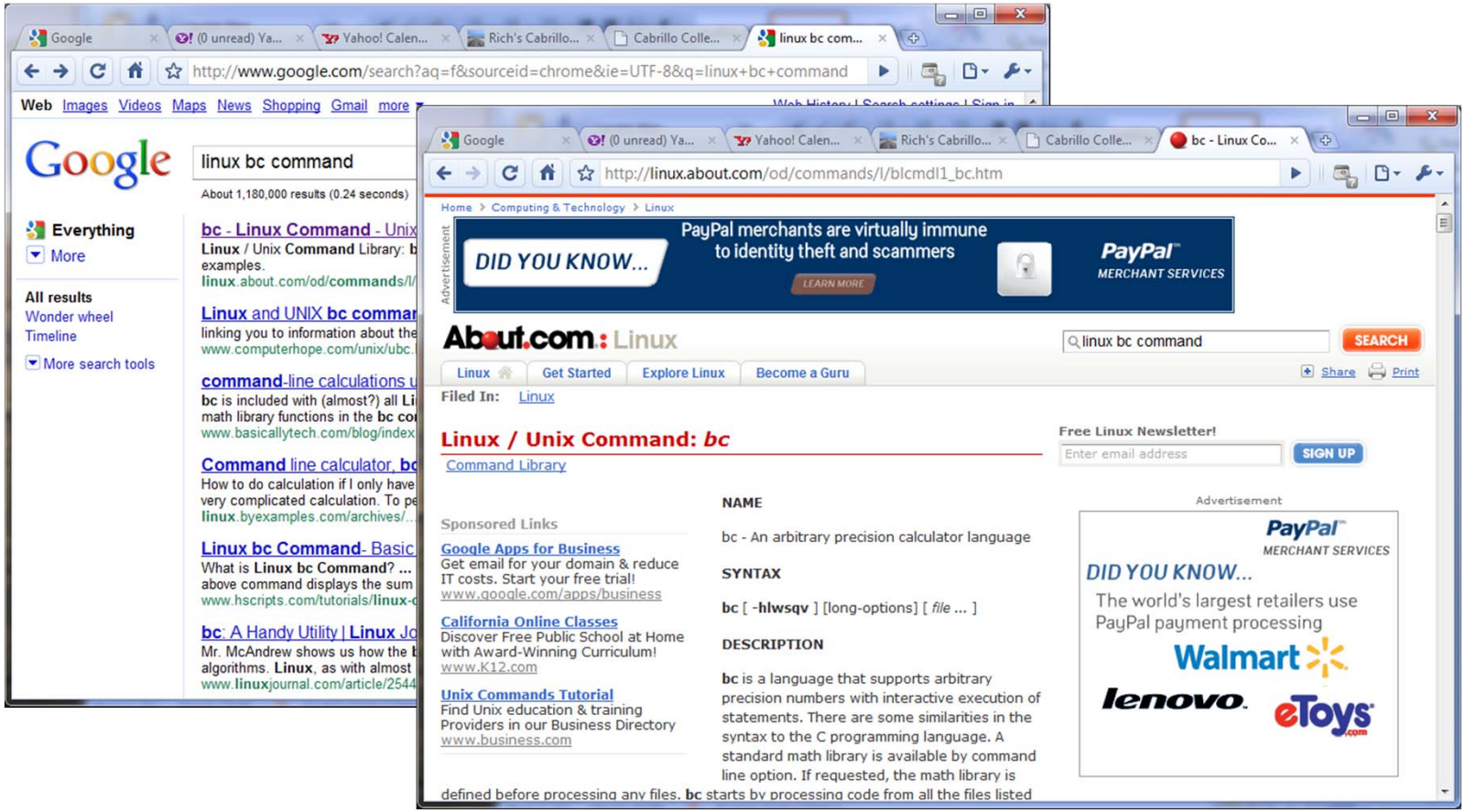
Use these keys to scroll

Use q key to quit

Using Google

Do a Google search on "linux xxx command" where xxx is the command you want documentation for.

Example: google linux bc command

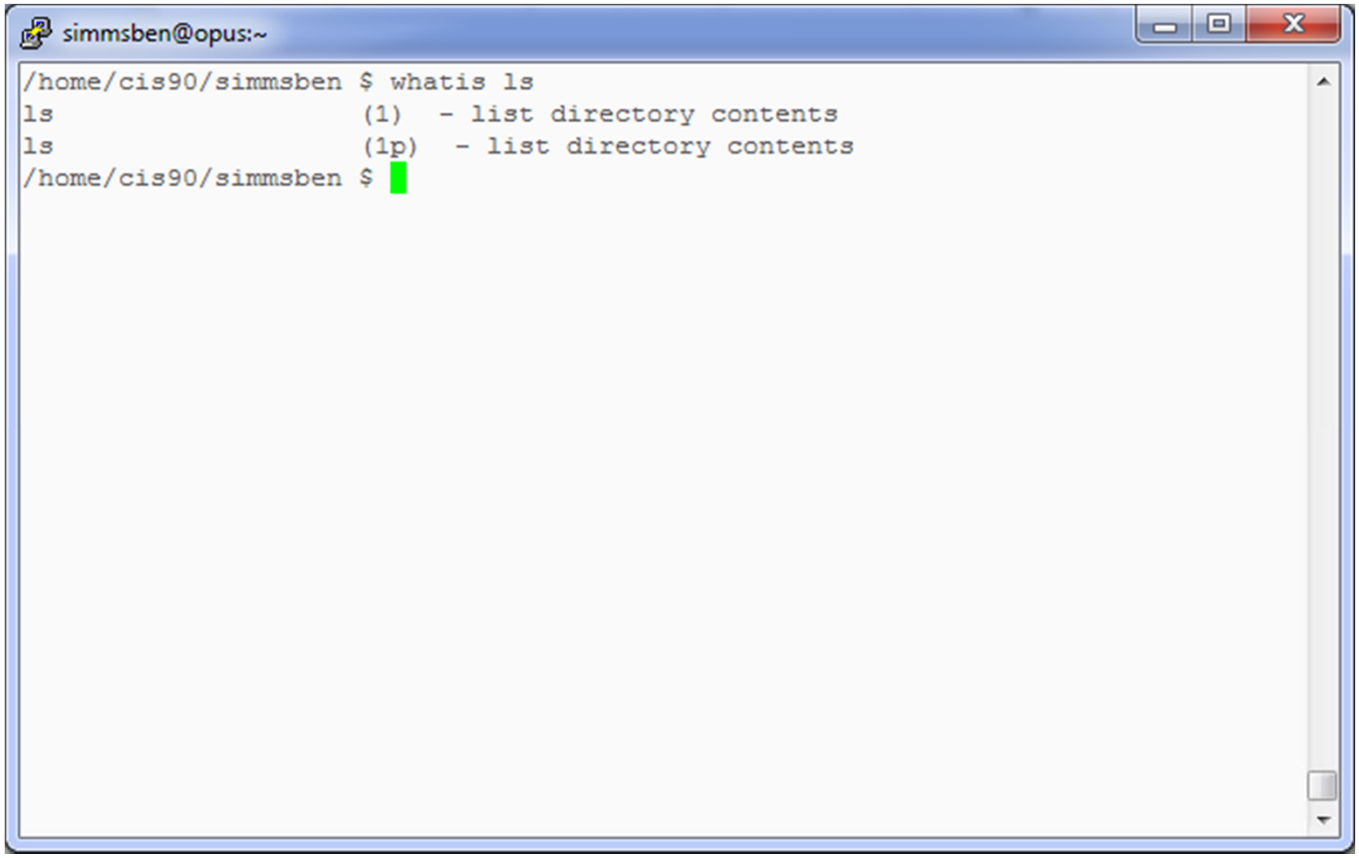


Other Documentation

- **whatis** *command* *same as the **man –f** command*
- **apropos** *command* *same as the **man –k** command*
- **info** *command*

Documentation examples

Example: **whatis ls**



whatis *searches the whatis database for a complete word. Same as the* ***man -f*** *command .*

Documentation examples

Example: **apropos kernel**

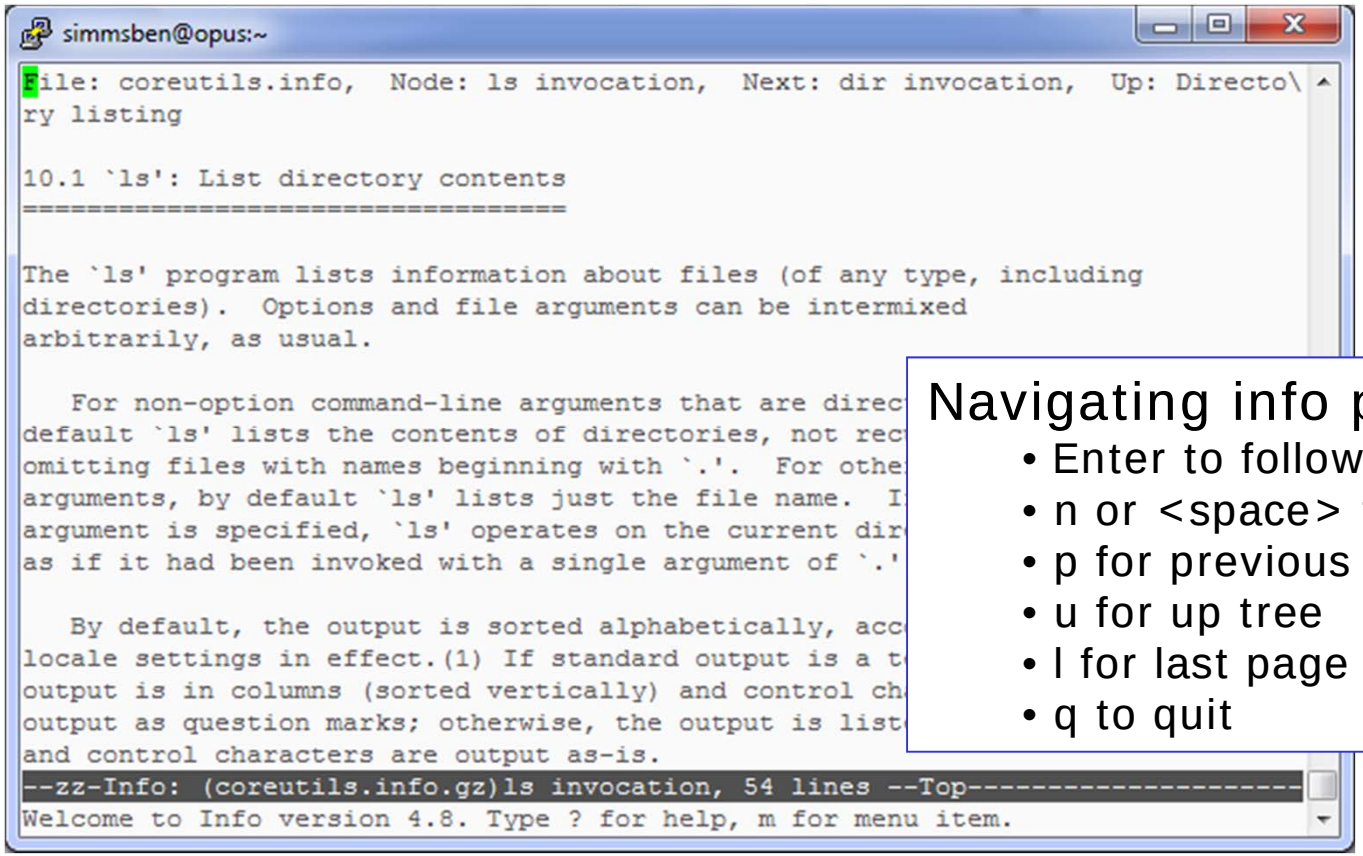
simmsben@opus:~

```
/home/cis90/simmsben $ apropos kernel
/proc/slabinfo [slabinfo] (5)  - Kernel slab allocator statistics
IPPROTO_ICMP [icmp]  (7)  - Linux IPv4 ICMP kernel module
add_key              (2)  - Add a key to the kernel's key management facility
adjtimex             (2)  - tune kernel clock
arp                  (7)  - Linux ARP kernel module
audit               (rpm) - User space tools for 2.6 kernel auditing
auditctl             (8)  - a utility to assist controlling the kernel's audit s
ystem
bootparam            (7)  - Introduction to boot time parameters of the Linux ke
rnel
curs_set [curs_kernel] (3x)  - low-level curses routines
def_prog_mode [curs_kernel] (3x)  - low-level curses routines
def_shell_mode [curs_kernel] (3x)  - low-level curses routines
dmesg                (8)  - print or control the kernel ring buffer
elksemu              (1)  - Embedded Linux Kernel Subset emulator
exports              (5)  - NFS file systems being exported (for Kernel based NF
S)
get_kernel_syms      (2)  - retrieve exported kernel and module symbols
getkeycodes          (8)  - print kernel scancode-to-keycode mapping table
getkeycreatecon      (3)  - get or set the SELinux security context used for cre
ating a new kernel keyrings
getsyx [curs_kernel] (3x)  - low-level curses routines
glGetConvolutionFilter (3gl)  - get current 1D or 2D convolution filter kernel
```

apropos *searches the whatis database for a string of text. Same as the* ***man -k*** *command .*

Documentation examples

Example: **info ls**

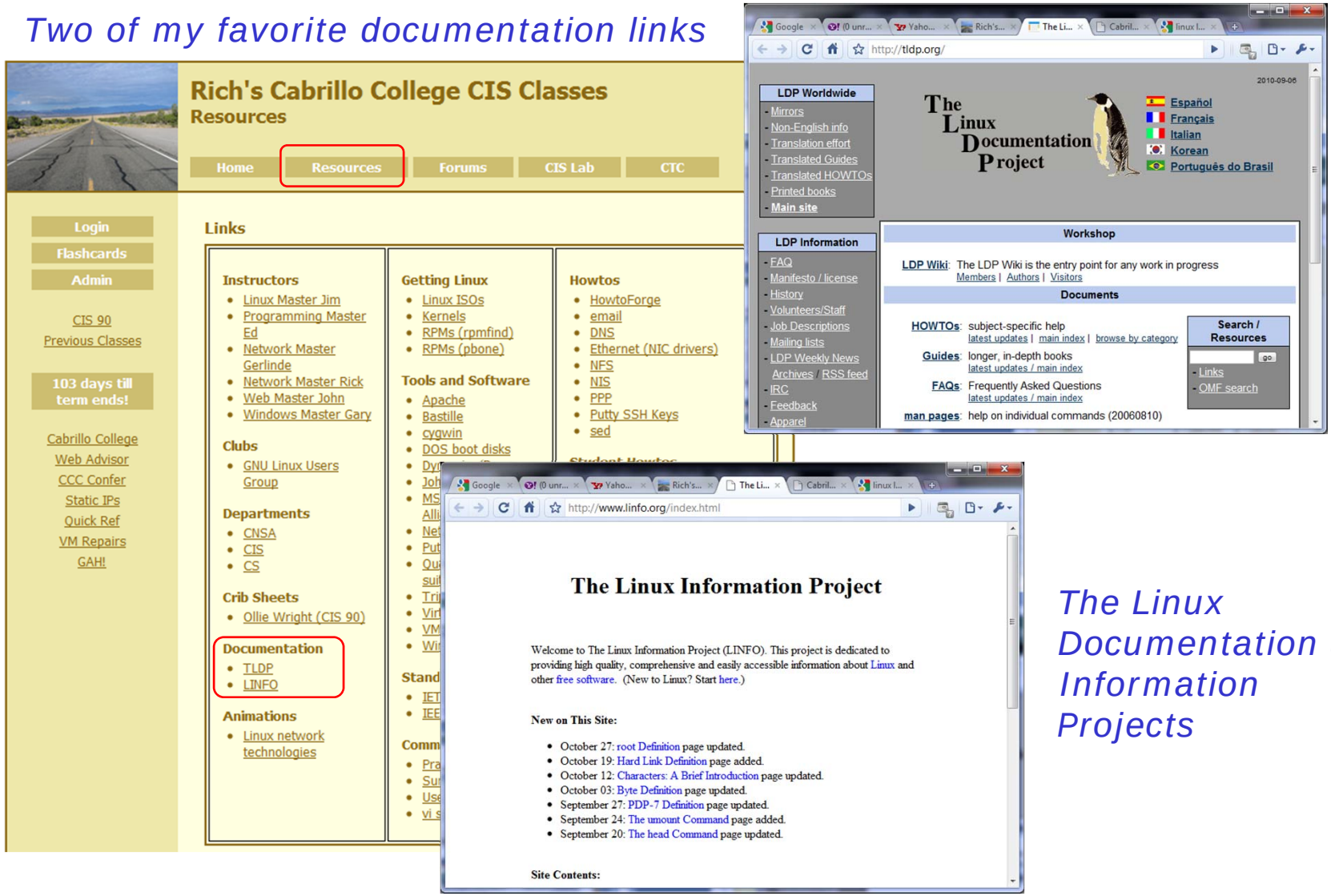


Navigating info pages:

- Enter to follow links (*'s)
- n or <space> for next page
- p for previous page
- u for up tree
- l for last page
- q to quit

Documentation

Two of my favorite documentation links



The Linux Documentation and Information Projects

Class Exercise
Documentation

Use the man command on itself:
- **man man**

Research the **ls** command using:
- The **whatis** command
- The **man** command
- The **info** command
- Google

Wrap up

New commands:

apropos	- search for string in whatis database
bc	- binary calculator
cat	- print file(s)
cd	- change directory
echo	- print text
env	- show shell environment variables
info	- online documentation with hot links
file	- show file information
ls	- show directory contents
passwd	- change password
set	- show (or set) shell variables
type	- show command location in path
man	- manual page for a command
whatis	- command summary

New Files and Directories:

/etc/passwd	- user accounts
/etc/shadow	- encrypted passwords
/bin	- directory of commands
/sbin	- directory of superuser commands
/usr/bin	- directory of commands, tools and utilities
/usr/sbin	- directory of superuser commands, tools and utilities

Next Class

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

Lab #2

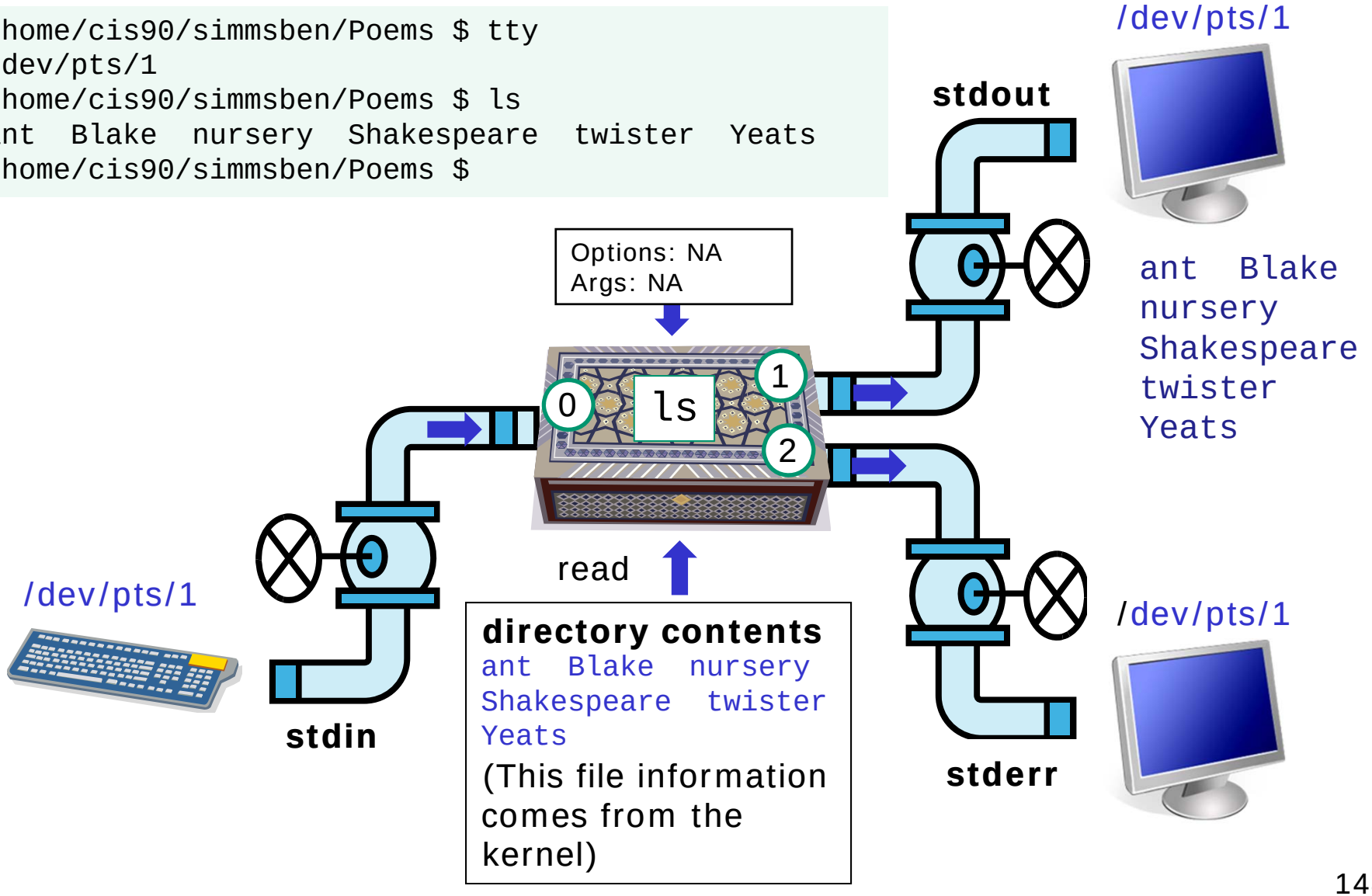
Quiz questions for next class:

- Name four directories where one can find commands?
- How do you show your path?
- What is the command to print the manual page for a command?

Backup

Example program to process: ls command

```
/home/cis90/simmsben/Poems $ tty
/dev/pts/1
/home/cis90/simmsben/Poems $ ls
ant  Blake  nursery  Shakespeare  twister  Yeats
/home/cis90/simmsben/Poems $
```

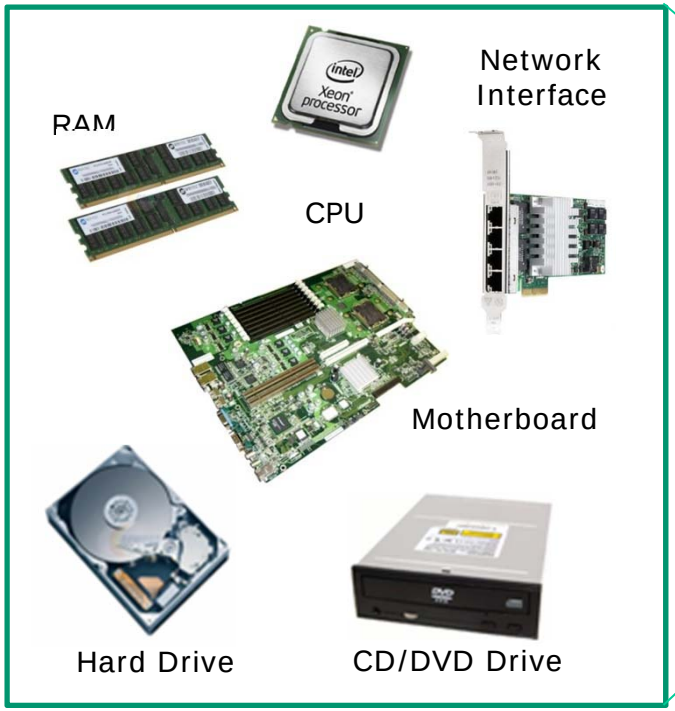


What is a computer?

Desktops, Mobiles, Servers and Virtual Machines

one or more users

Hardware



Various Computers

Software

Programs

Operating System

Software - Programs and Operating Systems

Users

Software

Programs (e.g. Word, Apache, PhotoShop, vi)
- Some programs come as part of the OS
- Some programs are add-ons purchases or downloads
- Programs include commands and utilities
- Depend an an OS for all access to the hardware

Operating System (e.g. Linux, Windows, UNIX)
- Interface to the hardware
- Shares hardware resources
- Schedules/executes programs
- Process management
- Input/output services
- System monitoring
- Network stack

Hardware