Lesson Module Checklist

- Slides
- WB converted fro PowerPoint

- Flash cards
- Properties
- Page numbers
- 1st minute quiz
- Web Calendar summary
- Web book pages
- Commands

- Lab tested (check Q1 kernel release number and finger user account)
- Opus - submit windows locked at 00:00:00 deadline

- Bring Add Codes
- Bring printed roster

- Backup slides, whiteboard slides, handouts on flash drive
- 9V backup battery for microphone
- Key card for door

Student Learner Outcomes

1. Navigate and manage the UNIX/Linux file system by viewing, copying, moving, renaming, creating, and removing files and directories.
2. Use the UNIX features of file redirection and pipelines to control the flow of data to and from various commands.
3. With the aid of online manual pages, execute UNIX system commands from either a keyboard or a shell script using correct command syntax.

Introductions and Credits

Jim Griffin
- Created this Linux course
- Created Opus and the CIS VLab
- Jim's site: http://cabrillo.edu/~jgriffin/

Rich Simms
- HP Alumnus
- Started teaching this course in 2008 when Jim went on sabbatical
- Rich's site: http://simms-teach.com

And thanks to:
- John Govsky for many teaching best practices: e.g. the First Minute quizzes, the online forum, and the point grading system (http://teacherjohn.com/)

Student checklist
(How to attend from home or in the classroom)

1) Browse to the CIS 90 website Calendar page
   - http://simms-teach.com
   - Click CIS 90 link on left panel
   - Click Calendar link near top of content area
   - Locate today's lesson on the Calendar

2) Download the presentation slides for today's lesson for easier viewing

3) Click Enter virtual classroom to join CCC Confer session

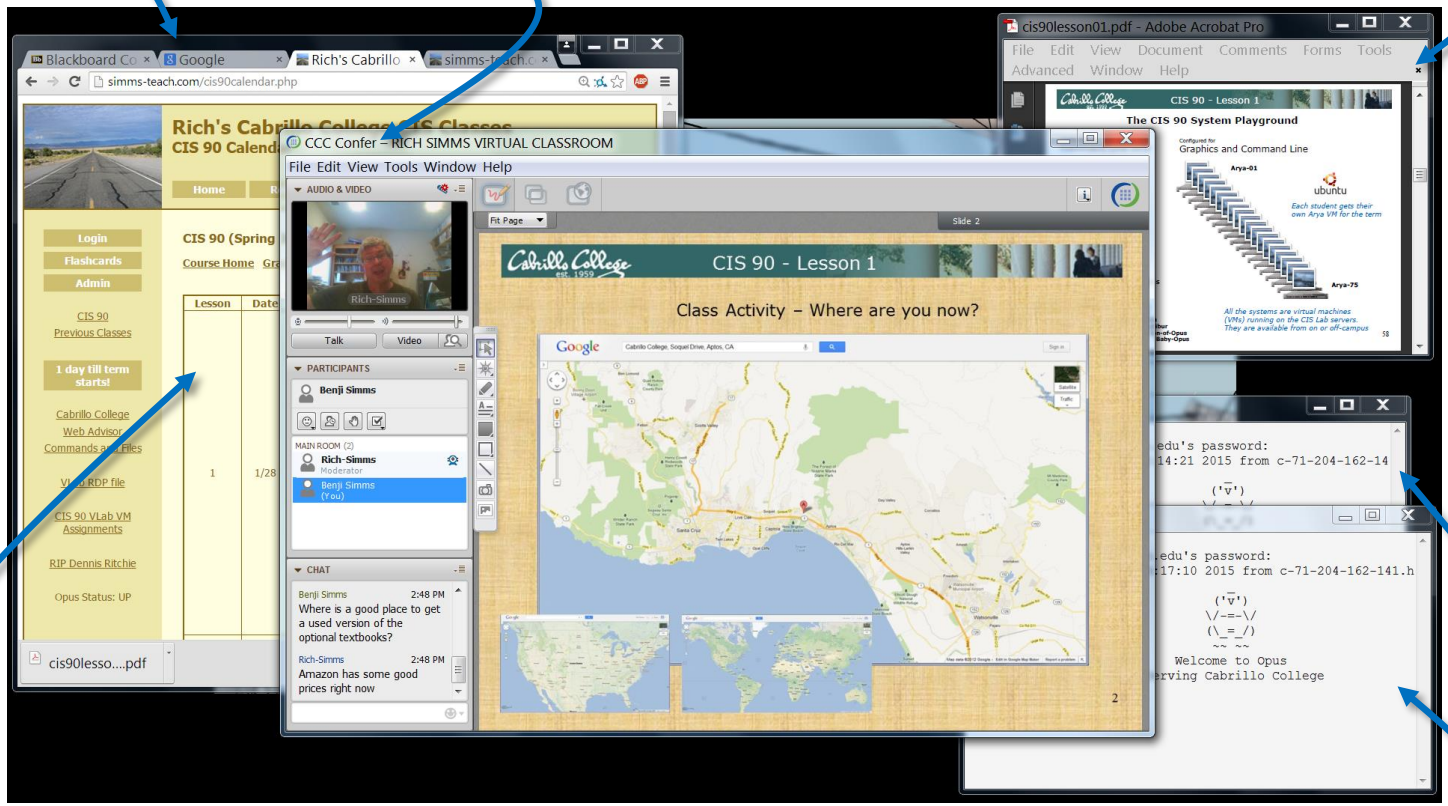
4) Connect to Opus using Putty or ssh command

Student checklist
(How to layout your screen when attending class)

Google

CCC Confer

Downloaded PDF of Lesson Slides

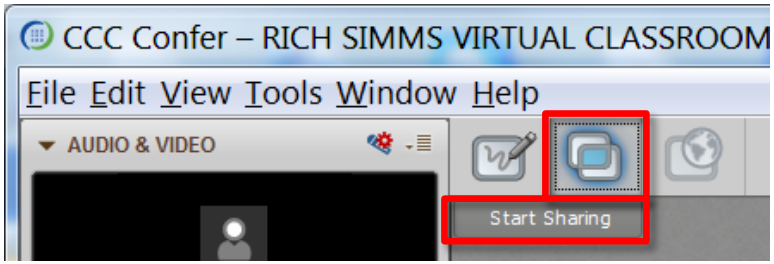


CIS 90 website Calendar page

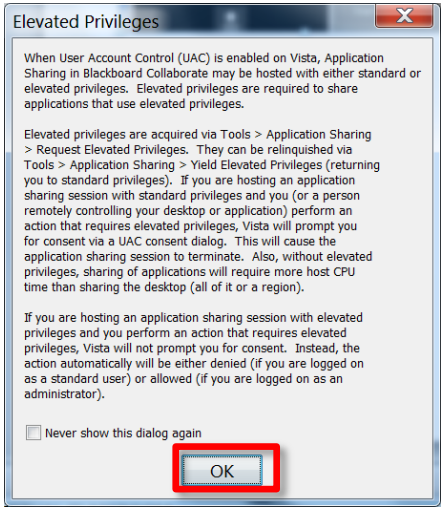
One or more login sessions to Opus

Student checklist
(To share your desktop with the class)

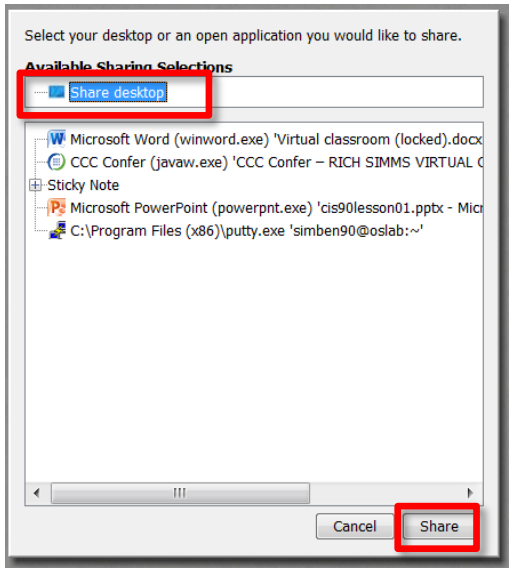
1) Instructor gives you sharing privileges



2) Click overlapping rectangles icon. If white "Start Sharing" text is present then click it as well.



3) Click OK button.



4) Select "Share desktop" and click Share button.

CIS 90 - Lesson 2

Instructor: **Rich Simms**
Dial-in: **888-886-3951**
Passcode: **136690**


Tim


Ryan


Cameron


Mario


John

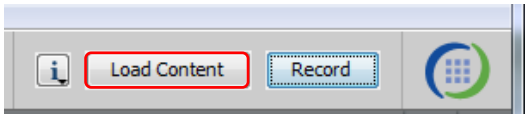

Django

Al, Emilio, Chris, Eddie, Clara, Ethan, Monte, Tanner, Tess, Ahmad, Mike F., Rebecca, Diego, Efrain, Ivers, Michael S., Ian, Abraham C., Benji, Abraham N., Roberto, Mateo, Melissa, Sean

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

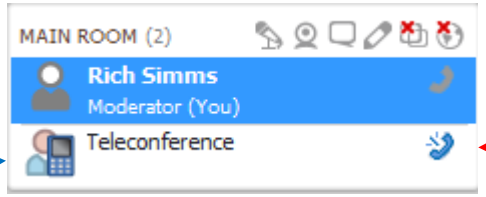
Rich's CCC Confer checklist - setup

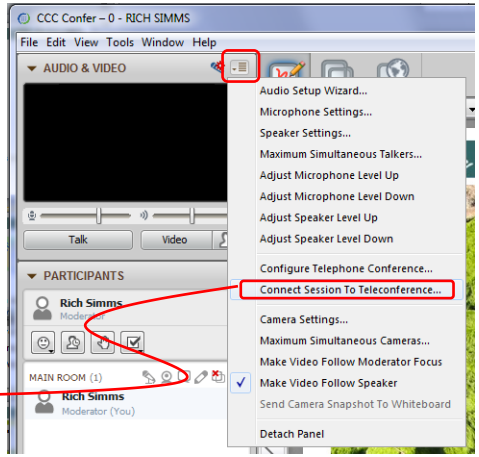
[ ] Preload White Board



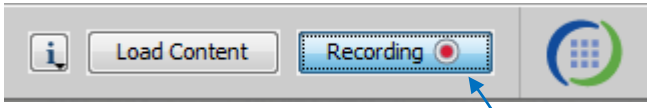
[ ] Connect session to Teleconference

Session now connected to teleconference





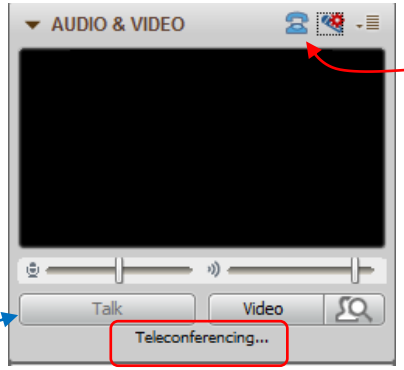
[ ] Is recording on?



Red dot means recording

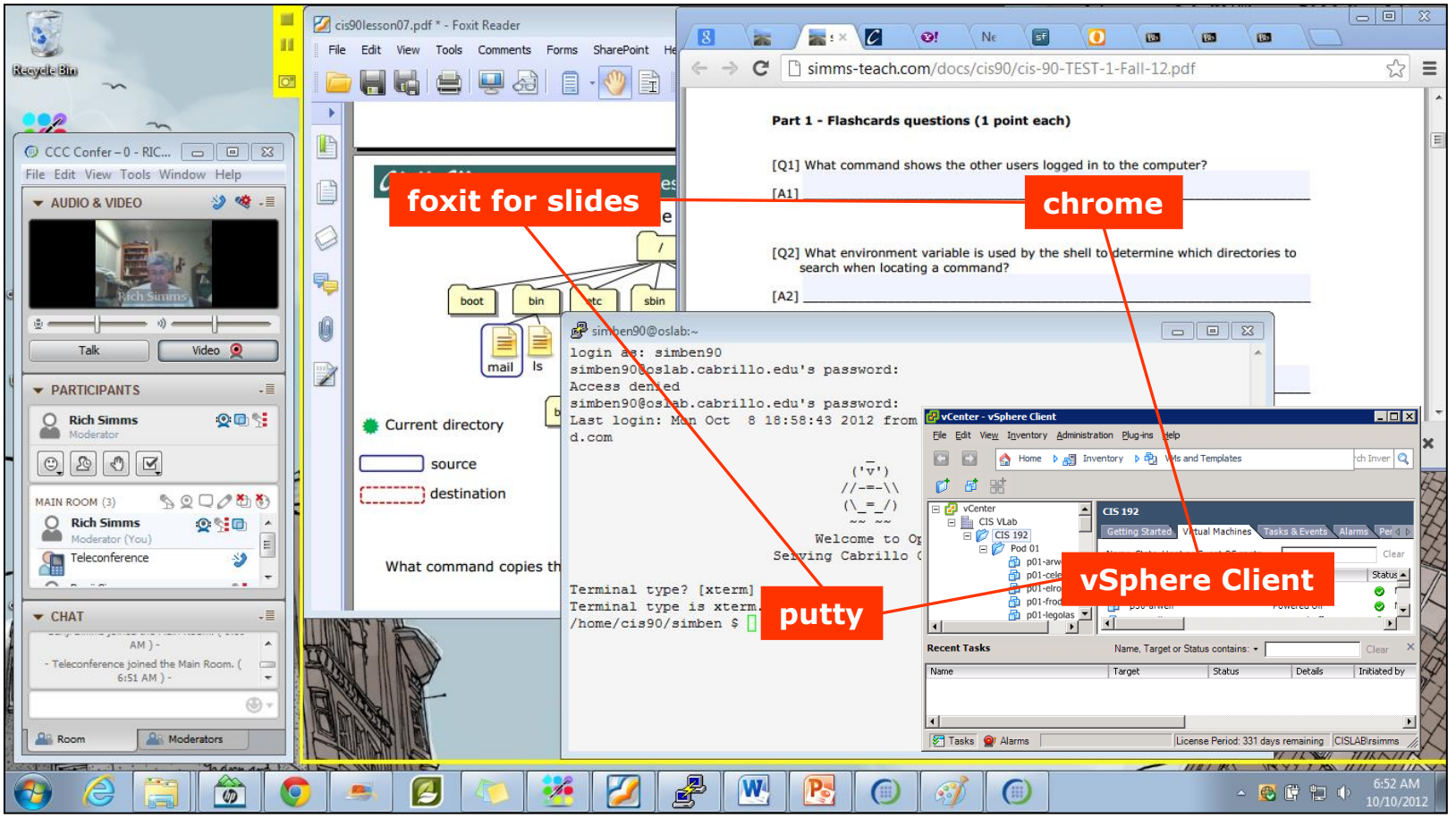
[ ] Use teleconferencing, not mic

Should be greyed out



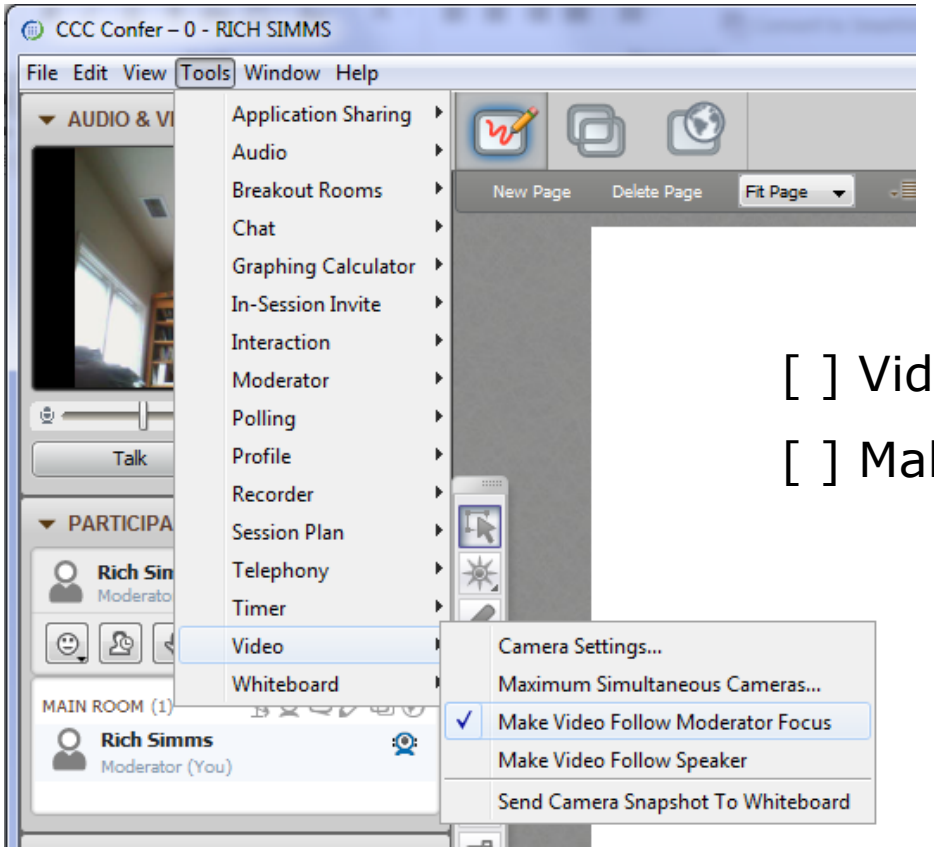
Should show as this live "off hook" telephone handset icon and the Teleconferencing … message displayed

Rich's CCC Confer checklist - app layout



[ ] layout and share apps

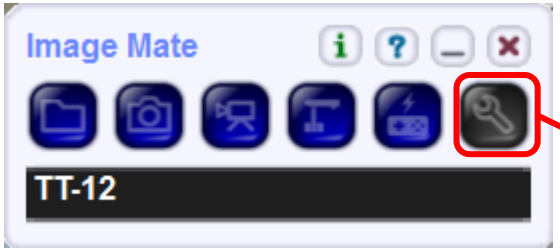
Rich's CCC Confer checklist - video

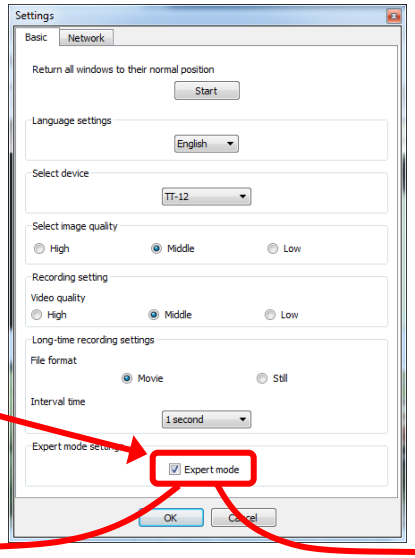


[ ] Video (webcam)

[ ] Make Video Follow Moderator Focus

Rich's CCC Confer checklist - Elmo



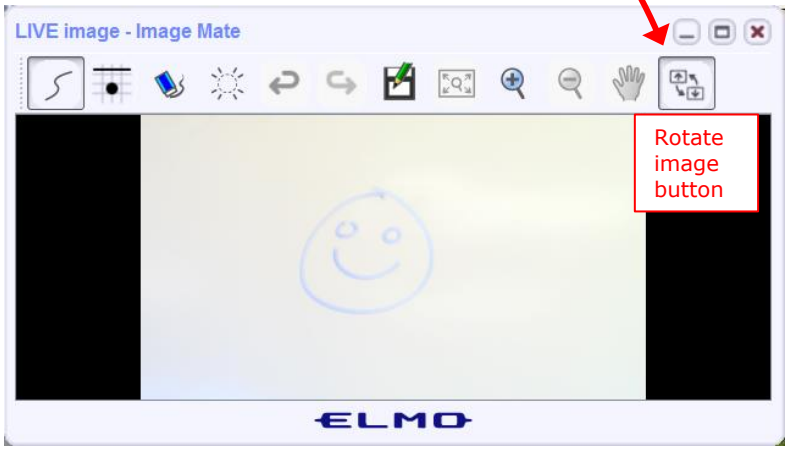


The "rotate image" button is necessary if you use both the side table and the white board.

Quite interesting that they consider you to be an "expert" in order to use this button!

Elmo rotated down to view side table

Elmo rotated up to view white board



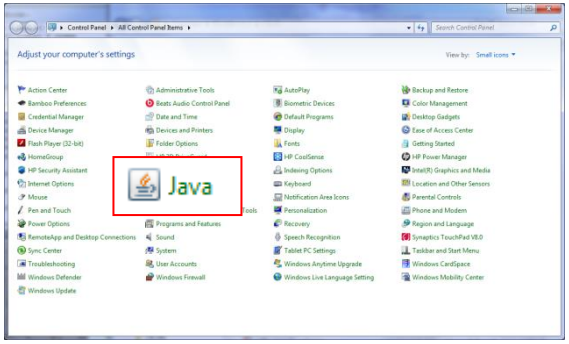
Run and share the Image Mate program just as you would any other app with CCC Confer

Rich's CCC Confer checklist - universal fix

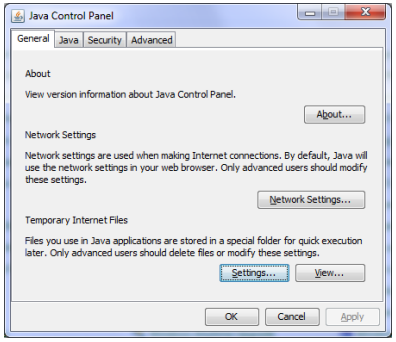
Universal Fix for CCC Confer:

1) Shrink (500 MB) and delete Java cache
2) Uninstall and reinstall latest Java runtime
3) http://www.cccconfer.org/support/technicalSupport.aspx

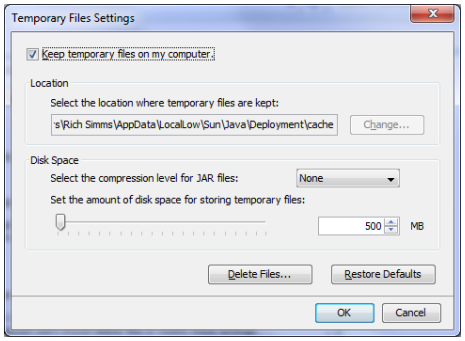
Control Panel (small icons)



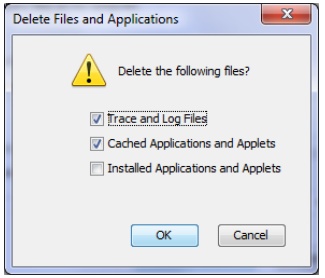
General Tab > Settings…



500MB cache size



Delete these



Google Java download

First Minute Quiz

Please answer these questions **in the order** shown:

Use CCC Confer White Board

email answers to: risimms@cabrillo.edu

(answers must be emailed within the first few minutes of class for credit)

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 • Logging in • Passwords • Housekeeping • New commands & locations • Programs & inputs • Command line syntax & parsing • Variables • Shell six steps • Metacharacters • Path • Docs • Wrap up

Questions

Questions

How this course works?

Past lesson material?

Previous labs?

Chinese Proverb	他問一個問題，五分鐘是個傻子，他不問一個問題仍然是一個傻瓜永遠。 *He who asks a question is a fool for five minutes; he who does not ask a question remains a fool forever.*

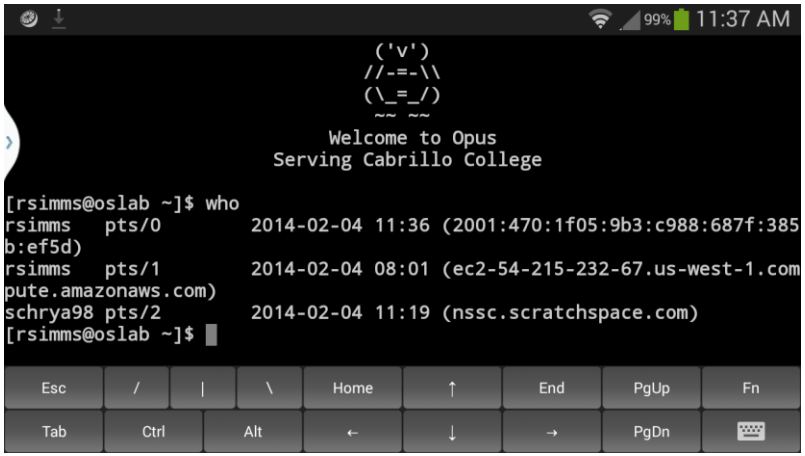
FYI

CIS 90 and Smartphones (Android)

Blackboard Collaborate App

Join CCC Confer virtual classroom

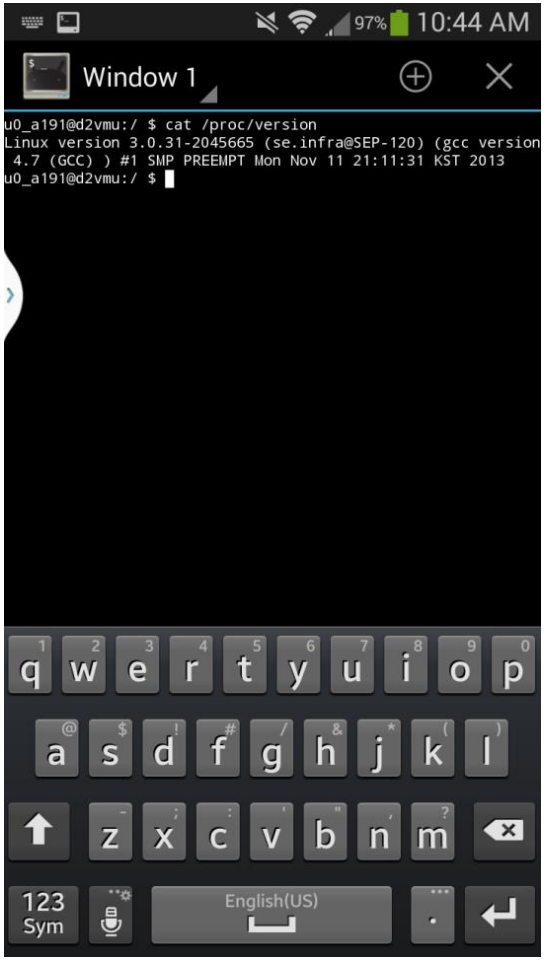
JuiceSSH - SSH Client app



Login to to Opus

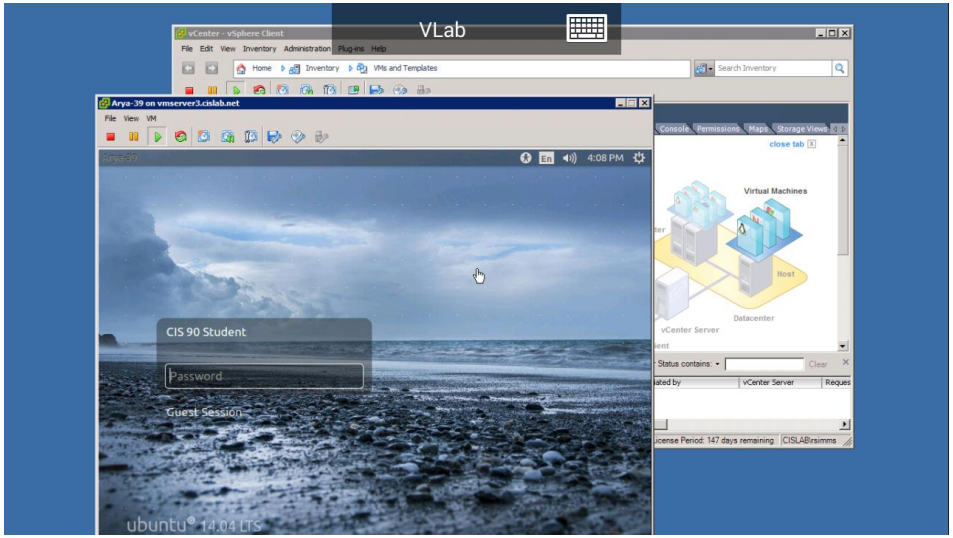
CIS 90 and Smartphones (Android)

Android Terminal App



Viewing kernel version on smartphone

Microsoft RDP App



Running Arya VM in VLab

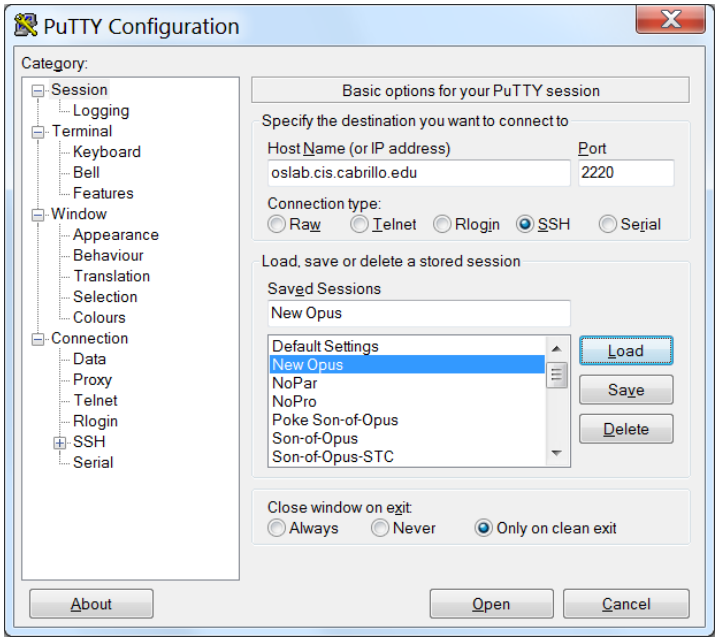
Logging In

http://www.gutenberg.org/files/15064/15064-h/images/269.png

Who goes there?

What's the password?

Logging in



Use Putty to login from Windows PCs

Putty is a terminal emulator for Windows that supports the SSH protocol standard

```
ssh -p 2220 simben90@oslab.cis.cabrillo.edu
```

Use the ssh command to login from Macs or UNIX/Linux systems

A username and password are required for login

Logging into Opus

username

```
login as: simben90
simben90@oslab.cis.cabrillo.edu's password:
Last login: Mon Sep  8 16:56:04 2014 from 2601:9:6680:53b:4d09:
                                    _
                                   ('v')
                                  \/-=-\/
                                  (\_=_/)
                                   ~~ ~~
                              Welcome to Opus
                           Serving Cabrillo College

Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $
```

For security reasons the password is not echoed as you type

Logging into Excalibur

username

```
/home/cis90/simben $ ssh -p 2226 simben90@excalibur
simben90@excalibur's password:
Last login: Tue Sep  9 08:29:57 2014 from opus.cis.cabrillo.edu
 _____________                          .__   ._____.
 \_   _____/__  ___ ____ _____  |   | |__\_ |__   __ _________
  |    __)_\  \/  // ___\\__  \ |   | |  ||  __ \|   |  \_  __ \
  |        \>    <\  \___ / __ \|   |_|   ||  \_\ \   |  /|   | \/
 /_______  /__/\_ \\____  >____  /____/__||___  /____/ |__|
         \/      \/     \/     \/              \/

[simben90@excalibur ~]$
```

For security reasons the password is not echoed as you type

The /etc/passwd file stores all user accounts

```
cat /etc/passwd
```

```
  _____
 /  _  \ ___.__._____
/  /_\  <   |  |\__  \
/    |    \  | \/\___  | / __ \_
\____|__  /__|   / ____|(____  /
        \/       \/          \/
       Winter is coming

Last login: Sun Sep  7 17:20:31 2014 from opus.cis.cabrillo.edu
cis90@Arya-35:~$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
```

The SUPER user

snipped

```
whoopsie:x:109:116::/nonexistent:/bin/false
speech-dispatcher:x:110:29:Speech Dispatcher,,,:/var/run/speech-dispatcher:/bin/
sh
avahi:x:111:117:Avahi mDNS daemon,,,:/var/run/avahi-daemon:/bin/false
lightdm:x:112:118:Light Display Manager:/var/lib/lightdm:/bin/false
colord:x:113:121:colord colour management daemon,,,:/var/lib/colord:/bin/false
hplip:x:114:7:HPLIP system user,,,:/var/run/hplip:/bin/false
pulse:x:115:122:PulseAudio daemon,,,:/var/run/pulse:/bin/false
sshd:x:116:65534::/var/run/sshd:/usr/sbin/nologin
cis90:x:1000:190:CIS 90 Student:/home/cis90:/bin/bash
cis90@Arya-35:~$
```

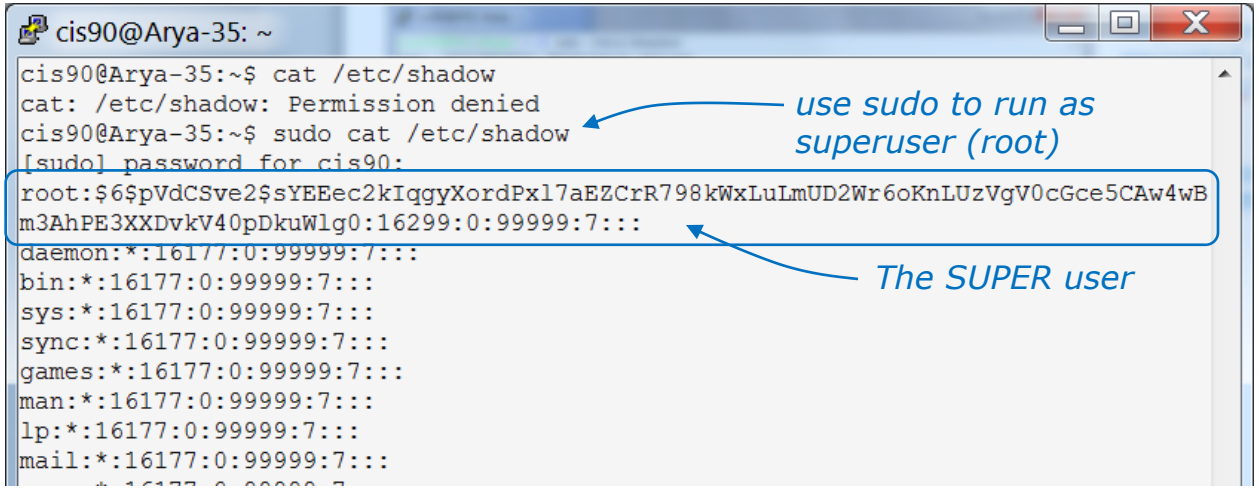
CIS 90 user

Your username must match one of the accounts in the /etc/passwd file

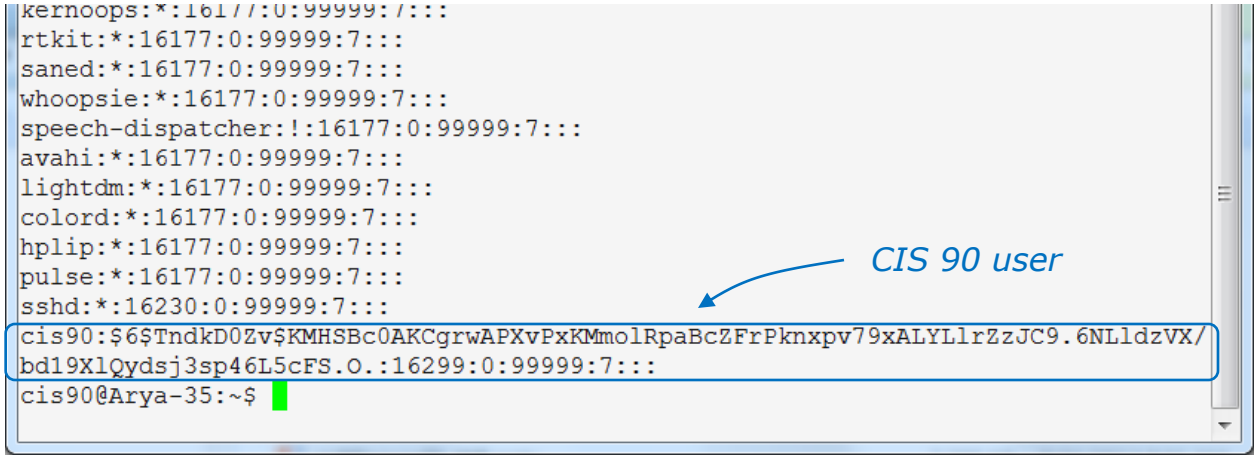
Note: this file no longer contains the passwords!

The /etc/shadow file stores the encrypted passwords

cat /etc/shadow



snipped



Your password must match the account password kept in the /etc/shadow file

Only the root user can view this file and the passwords are encrypted!

Viewing your account in /etc/passwd

*This command, which we will learn how to do later, outputs **just one line** of the /etc/passwd file on Opus*

```
/home/cis90/simben $ grep simben90 /etc/passwd
simben90:x:1201:190:Benji Simms:/home/cis90/simben:/bin/bash
```

username

password (just a placeholder now)

User ID (UID)

Group ID (GID)

Comment

Home directory

Shell

Note the fields in /etc/passwd are delimited with a ":"

```
/home/cis90/simben $ id
uid=1201(simben90) gid=190(cis90) groups=190(cis90),100(users)
context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023
```

Now you know where the id command get some of its information!

Class Activity

```
/home/cis90/simben $ grep simben90 /etc/passwd
simben90:x:1201:190:Benji Simms:/home/cis90/simben:/bin/bash
```

username
password (just a placeholder now)
User ID (UID)
Group ID (GID)
Comment
Home directory
Shell

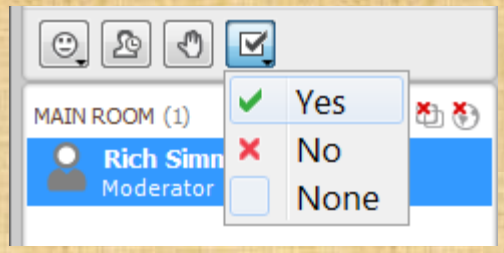
Note the field separator used in /etc/passwd is a ":"

1) Find your record in /etc/passwd

- Paste your UID (User ID) number in the chat window
- Paste you home directory in the chat window
- Paste your shell in the chat window

2) cat /etc/shadow

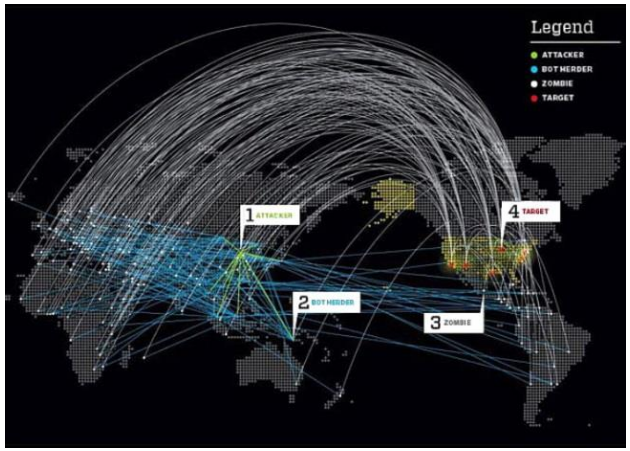
Give me a green check ✓ if you can view this file otherwise give me a red **x**



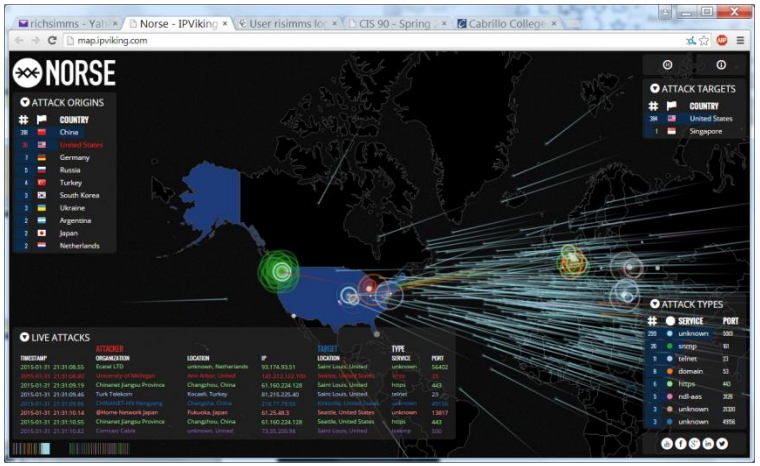
Passwords

Your password

- Strong passwords are critical!
- **Botnets** and malicious **ne-er-do-wells** are constantly attempting to break into computers attached to the Internet! (Even my little Frodo VM at home)



http://mac-internet-security-software-review.toptenreviews.com/how-do-i-know-if-my-computer-is-a-botnet-zombie-.html



http://map.ipviking.com/

They never stop trying

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

From a logwatch report showing malicious attempts to break into Opus

/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 when attacking Opus

How to make a strong password

10

- 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 user's password

Syntax:

passwd *[username]*

Example:

```
/home/cis90/simmsben $ passwd
Changing password for user simben90.
Changing password for simben90
(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.

This changes your password on Opus only (not other VMs, the forum or BlackBoard)

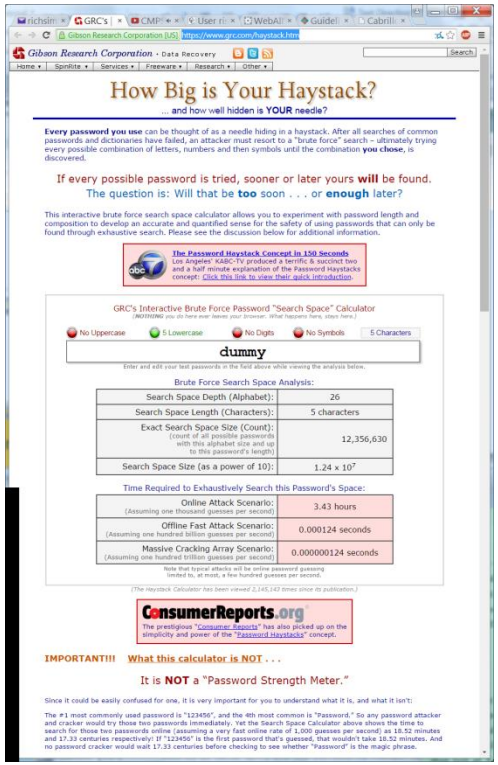
John the Ripper

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

Instructor: Use daughter and john-demo aliases to demo. Cat password.1st for common passwords.

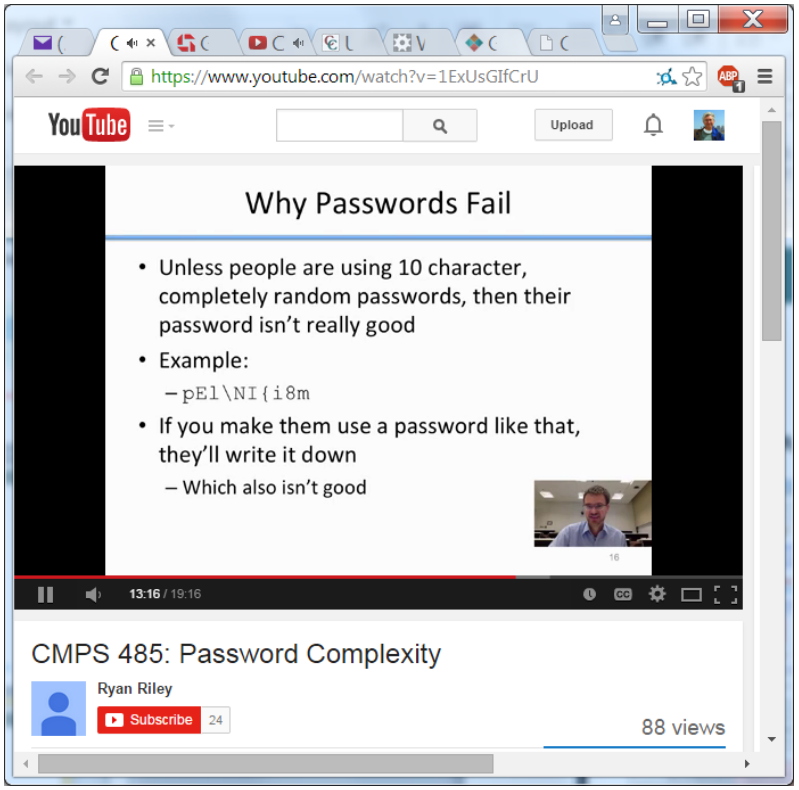
For Supplemental Study

https://www.grc.com/haystack.htm



Password strength calculator for random passwords

https://www.youtube.com/watch?v=1ExUsGIfCrU



Excellent presentation on making strong passwords

Housekeeping

Housekeeping

1. Send me your student survey
2. Lab 1 due by 11:59PM (Opus time) tonight

   Use **`submit`** to turn in your work

   Grading Rubric (30 points)
   5 points for each correct scavenger hunt item
   3 points - optional extra credit questions (1 point each).

   Use **`verify`** to see what your turned in

3. Last day to drop/add is Saturday Feb 7th

Roll Call

If you are watching the archived video please send me an email to let me know your were here.

Turn off recording

Do roll call using both rosters

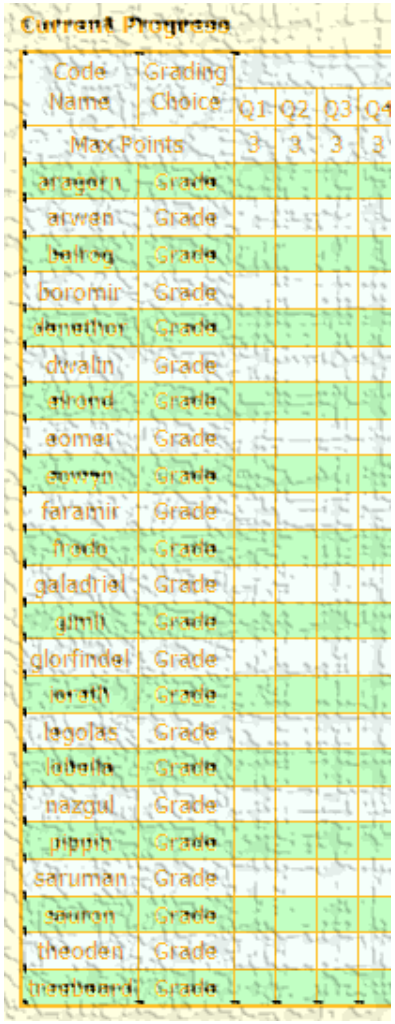
Turn on recording

Lab Assignments

Pearls of Wisdom:

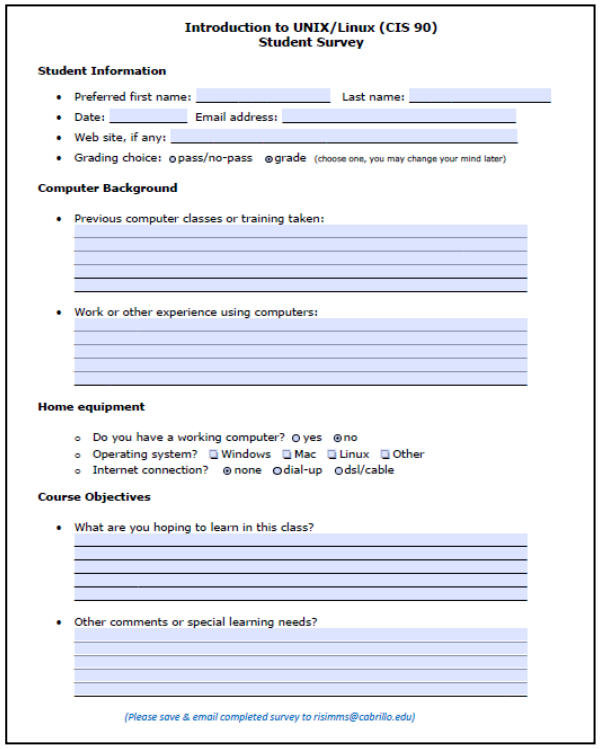
- Don't wait till the last minute to start.
- The *slower* you go the *sooner* you will be finished.
- A few minutes reading the forum can save you hour(s).
- Line up materials, references, equipment and software ahead of time.
- It's best if you fully understand each step as you do it. Use Google or refer back to lesson slides to understand the commands you are using.
- Use Google when trouble-shooting
- Keep a growing cheat sheet of commands and examples.
- Study groups are very productive and beneficial.
- Use the forum to collaborate, ask questions, get clarifications and share tips you learned while doing a lab.
- Plan for things to go wrong and give yourself time to ask questions and get answers.
- Late work is not accepted so submit what you have for partial credit.

Grading 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				
[illegible]	Grade				
boromir	Grade				
[illegible]	Grade				
dwalin	Grade				
[illegible]	Grade				
eomer	Grade				
[illegible]	Grade				
faramir	Grade				
[illegible]	Grade				
galadriel	Grade				
gimli	Grade				
glorfindel	Grade				
[illegible]	Grade				
legolas	Grade				
[illegible]	Grade				
nazgul	Grade				
pippin	Grade				
saruman	Grade				
[illegible]	Grade				
theoden	Grade				
[illegible]	Grade				

I'll start sending out LOR code names this week for ***everyone who sends or has sent me their survey****.*


Introduction to UNIX/Linux (CIS 90)
Student Survey

Student Information

- Preferred first name: _____ Last name: _____
- Date: _____ Email address: _____
- Web site, if any: _____
- Grading choice: ○ pass/no-pass ◉ grade (choose one, you may change your mind later)

Computer Background

- Previous computer classes or training taken:
- Work or other experience using computers:

Home equipment

- Do you have a working computer? ○ yes ◉ no
- Operating system? ☐ Windows ☐ Mac ☐ Linux ☐ Other
- Internet connection? ◉ none ○ dial-up ○ dsl/cable

Course Objectives

- What are you hoping to learn in this class?
- Other comments or special learning needs?

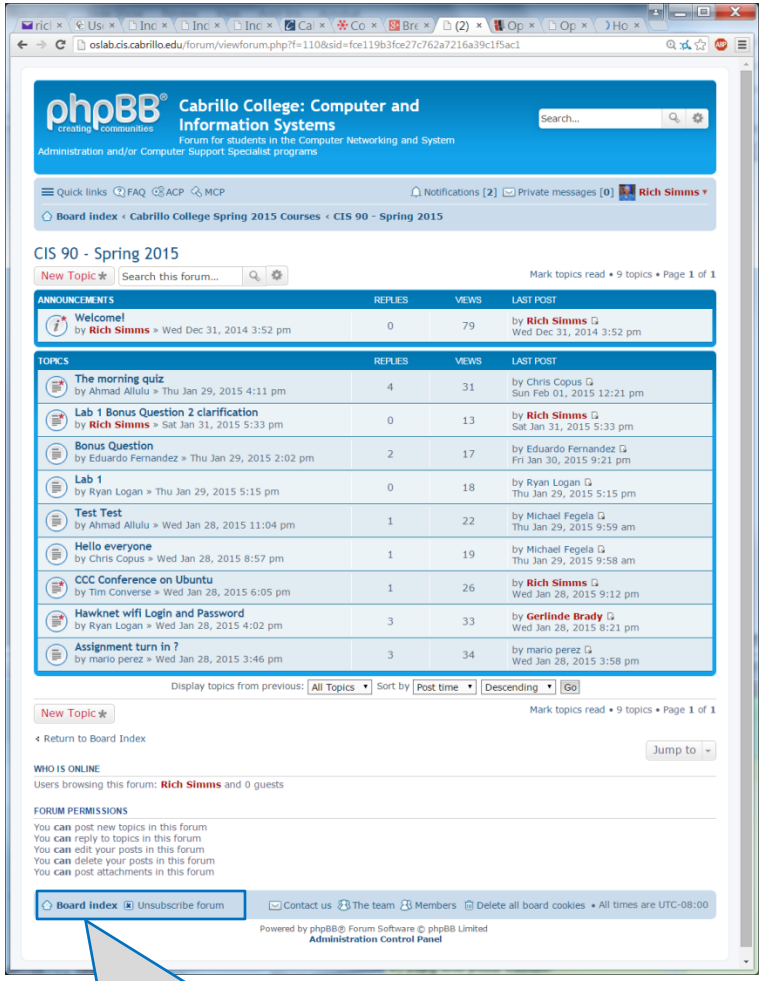
(Please save & email completed survey to risimms@cabrillo.edu)

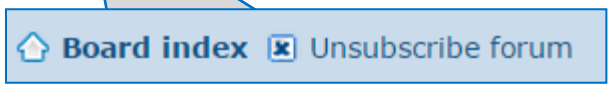
To get notifications of new forum posts

1) Login to the forum

2) Go to the CIS 90 forum

3) Click the "Subscribe" link at the bottom so that it changes to "Unsubscribe".





Help Available in the CIS Lab

Instructors, lab assistants and equipment are available for CIS students to work on assignments.

CIS 90 Student Lab Assistants:

Tess


Geoff

Nick

Linux Instructors


Rich Simms


Mike Matera

Look for Tess, Leandro, Nick, Rich or Mike on the schedule found here

CIS 90 Tutoring Available

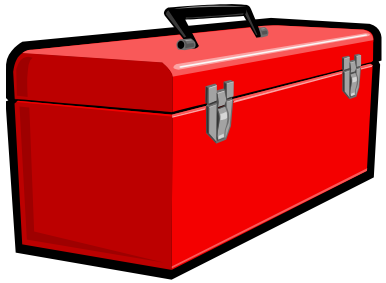
http://www.cabrillo.edu/services/tutorials/

Matt Smithey

All students interested in tutoring in CIS 90, 172, and 81 classes need to come directly to the Tutorials Center to schedule, register and fill out some paperwork. This is just a one-time visit.

The tutoring will take place at the STEM center and they will log in and log out on a computer you have designated (I will figure out exactly what that means).

Don't wait too long to sign up! Tutoring hours are limited!



Lesson 2 Commands

Lesson 2 commands for your toolbox

echo	*Print text and variables*
banner	*Make a banner*
ls	*List directory contents*
cat	*View file (name comes from concatenate)*
file	*Show additional information about a file*
type	*Shows where a command resides on the path*
apropos	*Searches the whatis database for strings*
whatis	*Searches the whatis database for commands*
man	*Show the manual page for a command*
info	*Alternate online documentation tool*
bc	*Binary calculator*
passwd	*Change password*
set	*List all shell variables*
env	*List all environment variables*

echo command

Print text and variables

Syntax:

echo *[string]*

```
/home/cis90/simben $ echo hello rich
hello rich

/home/cis90/simben $ echo joy to the world
joy to the world
```

banner command

Output a banner

Syntax:

banner *[string]*

banner *[string] [string] … [string]*

```
/home/cis90/simben $ banner I Love Linux
 #####
   #
   #
   #
   #
   #
 #####

#       ####### #     # #######
#       #     # #     # #
#       #     # #     # #
#       #     # #     # #####
#       #     #  #   #  #
#       #     #   # #   #
####### #######    #    #######

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

Similar to echo command but outputs banner sized letters instead

ls command

List files or directory contents

Syntax:

ls *[pathname]*

ls *[pathname] [pathname] … [pathname]*

```
/home/cis90/simben $ ls
bigfile  Lab2.0          mission    proposal3   text.fxd
bin      Lab2.1          Poems      small_town  timecal
empty    letter          proposal1  spellk      what_am_i
Hidden   Miscellaneous   proposal2  text.err
```

Listing the contents of the current directory

```
/home/cis90/simben $ ls Poems/
Angelou  Blake      Neruda   Shakespeare  Yeats
ant      Dickenson  nursery  twister
```

Listing the contents of the Poems directory

```
/home/cis90/simben $ ls mission /bin/ps /usr/local/bin/banner
/bin/ps  mission  /usr/local/bin/banner
```

Listing three files

Regular files show as black, directories show as blue and executable programs/scripts show as green

cat command

Concatenate and view file contents

Syntax:

cat *[pathname]*

cat *[pathname] [pathname] … [pathname]*

```
/home/cis90/simben $ cat letter
Hello Mother!  Hello Father!

Here I am at Camp Granada.  Things are very entertaining,
and they say we'll have some fun when it stops raining.

< snipped >

Wait a minute!  It's stopped hailing!  Guys are swimming!
Guys are sailing!  Playing baseball, gee that's better!
Mother, Father, kindly disregard this letter.

                                                Alan Sherman
```

type command

Locate a command on your path

Syntax:

type *[command]*

type *[command] [command] … [command]*

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

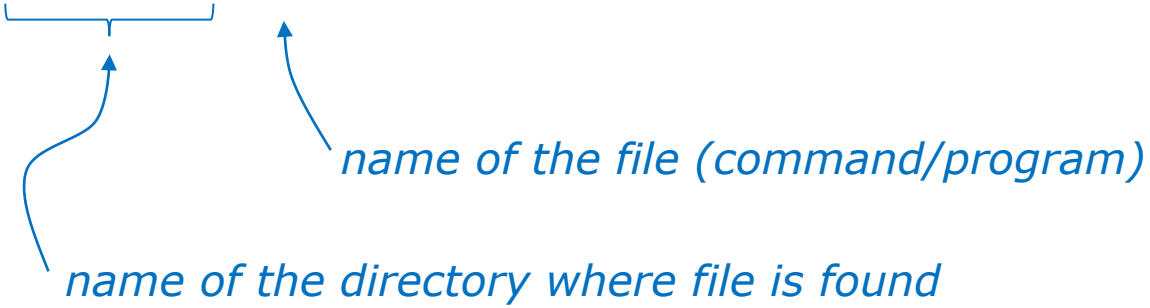
*The **cal** command is located in the **/usr/bin** directory*

```
/home/cis90/simben $ type bogus
-bash: type: bogus: not found
```

*The **bogus** command is not on the user's path*

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

*The **uname** command is in the **/bin** directory*
*The **cal** command is in the **/usr/bin** directory*



Class Activity

1) Where is the **ssh** command?

Type your answer in the chat window.

file command

Show additional file information

Syntax:

file *[pathname]*

file *[pathname] [pathname] … [pathname]*

```
/home/cis90/simben $ file letter
letter: ASCII English text

/home/cis90/simben $ file Miscellaneous/
Miscellaneous/: directory

/home/cis90/simben $ file timecal mission /usr/bin/cal
timecal:      Bourne-Again shell script text executable
mission:      ASCII English text
/usr/bin/cal: ELF 32-bit LSB executable, Intel 80386, version 1
(SYSV), dynamically linked (uses shared libs), for GNU/Linux
2.6.18, stripped
```

Class Activity

1) Where is the **cat** command?

2) What kind of file is the **cat** command?

Type your answers in the chat window.

apropos command

search the whatis database for strings

Syntax:

apropos *string*

```
/home/cis90/simben $ apropos echo
echo                    (1)  - display a line of text
echo                    (1p)  - write arguments to standard output
echo [builtins]         (1)  - bash built-in commands, see bash(1)
lessecho                (1)  - expand metacharacters
pam_echo                (8)  - PAM module for printing text messages
ping                    (8)  - send ICMP ECHO_REQUEST to network hosts
ping6 [ping]            (8)  - send ICMP ECHO_REQUEST to network hosts
```

whatis command

search the whatis database for commands

Syntax:

whatis *command*

```
/home/cis90/simben $ whatis echo
echo                    (1)  - display a line of text
echo                    (1p)  - write arguments to standard output
echo [builtins]         (1)  - bash built-in commands, see bash(1)
```

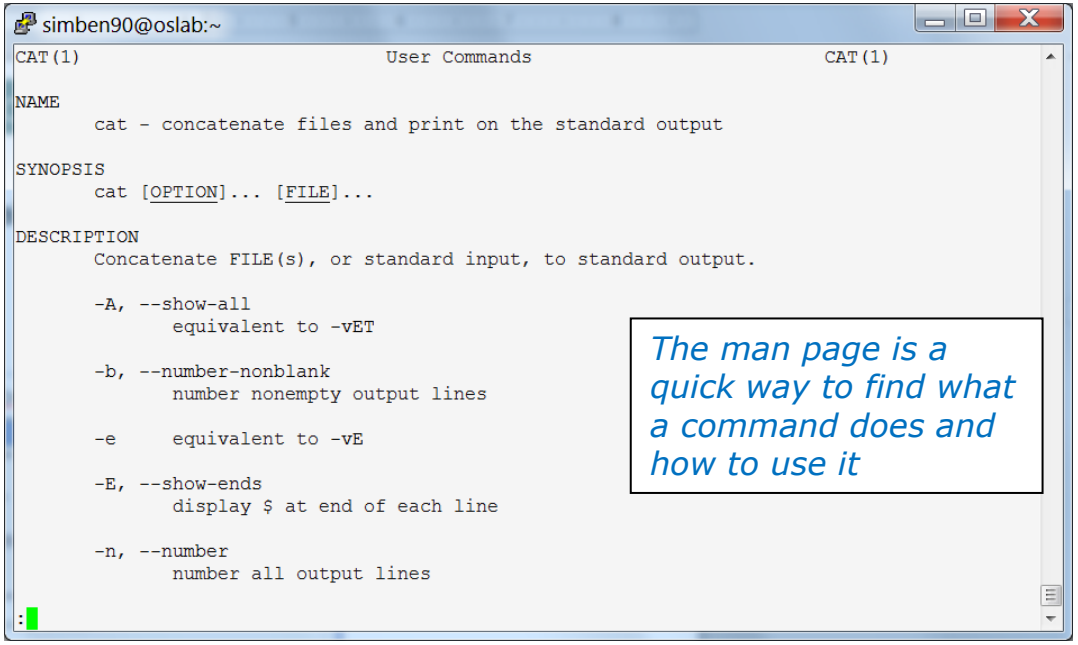
man command

Show the manual page (documentation) for a command

Syntax:

man *command*

```
/home/cis90/simben $ man cat
```



The man page is a quick way to find what a command does and how to use it

Use these keys to scroll

Use q key to quit

info command

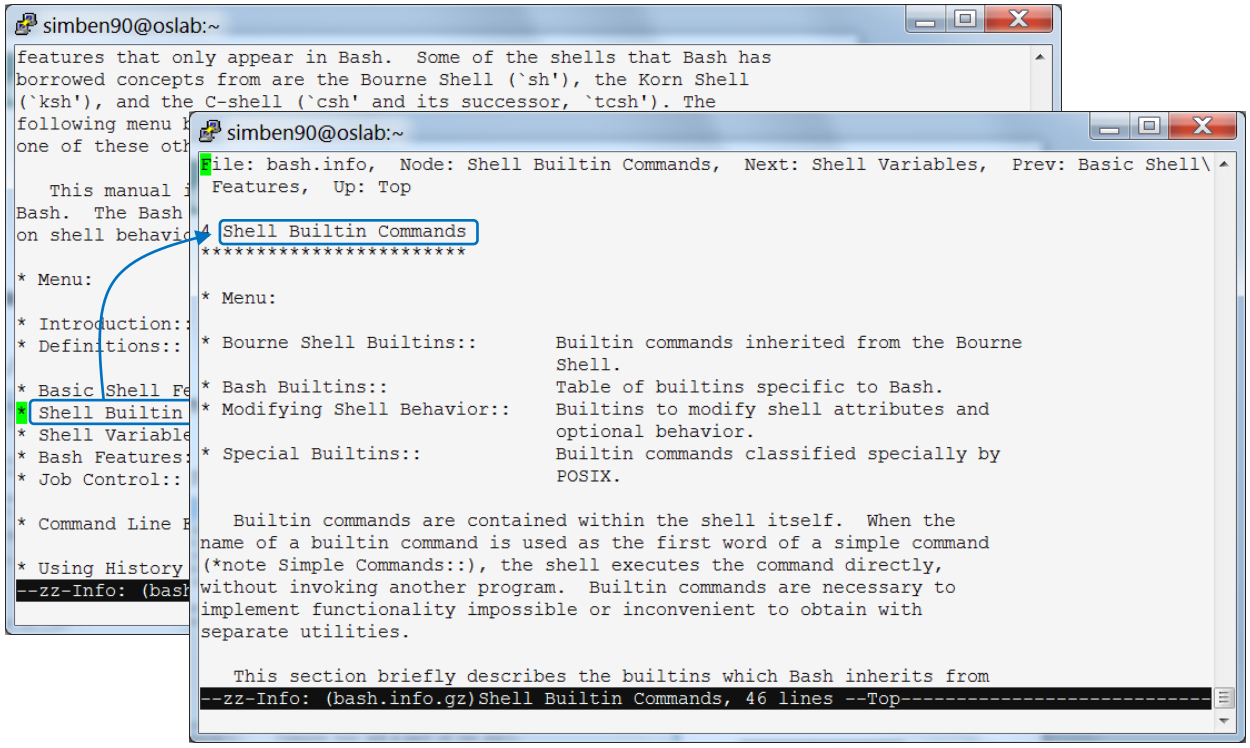
Alternate documentation tool for commands

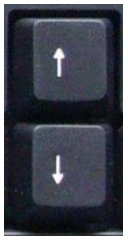
Syntax:

info *command*

Similar to man but has has links to additional pages

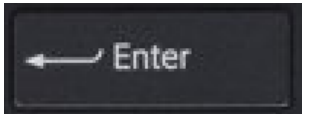
```
/home/cis90/simben $ info echo
```





Use these keys to scroll

Use q key to quit



Use Enter to follow a link (*)

Use L to go back to last page

*Move cursor over an * and press Enter to follow link*

Class Activity

1) Is **red** a UNIX command?
   Hint: use the **man** or **whatis** commands with red as the argument.

2) Is **blue** a UNIX command?

Type your answers in the chat window

bc command
A binary calculator

Syntax:
bc

```
/home/cis90/simben $ bc
bc 1.06.95
Copyright 1991-1994, 1997, 1998, 2000, 2004, 2006
Free Software Foundation, Inc.
This is free software with ABSOLUTELY NO WARRANTY.
For details type `warranty'.
2+2
4
3*30
90
(3*31)+251*1.5
469.5
quit
/home/cis90/simben $
```

Enter mathematical expressions for bc to solve

Use quit to end program

Class Activity

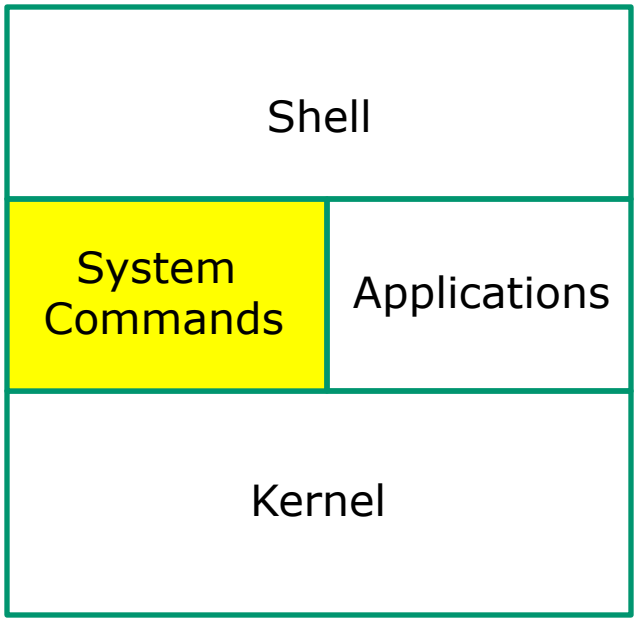
1) What does the following mathematical expression reduce to?

5342*56-2^5-299100+(2*35)

Type your answer in the chat window

Where are the UNIX/Linux commands?

UNIX/Linux Architecture
System Commands

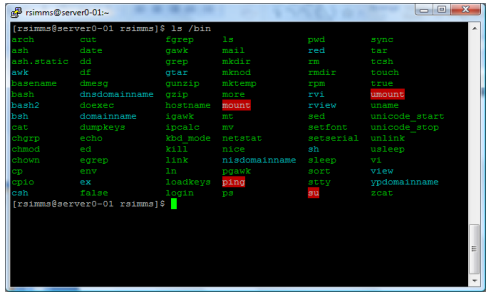


- 100's of system commands and utilities.
- Commands like **ls** (list directories), **cat** (print a file), **rm** (remove a file), … etc.
- Utilities like **vi** (text editor), **sort** (sorts file contents), **find** (searches), … etc.
- Larger utilities like **sendmail** (email), **tar** (backup),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

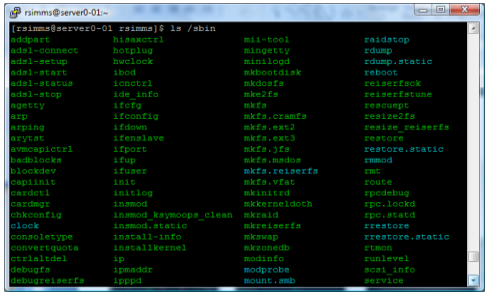
Commands and Utilities

Executable binary code (programs) or scripts

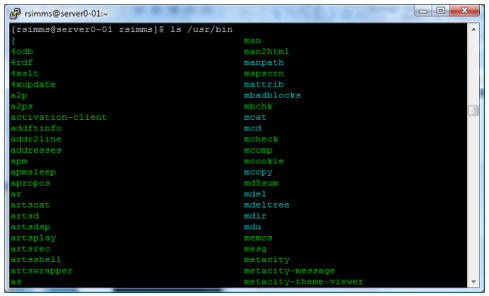
/bin



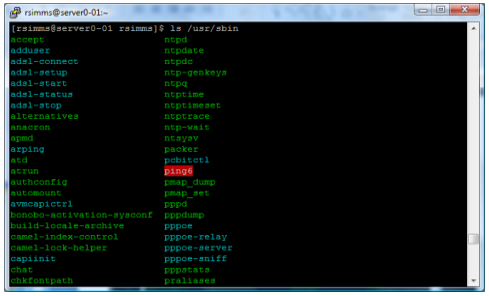
/sbin



/usr/bin



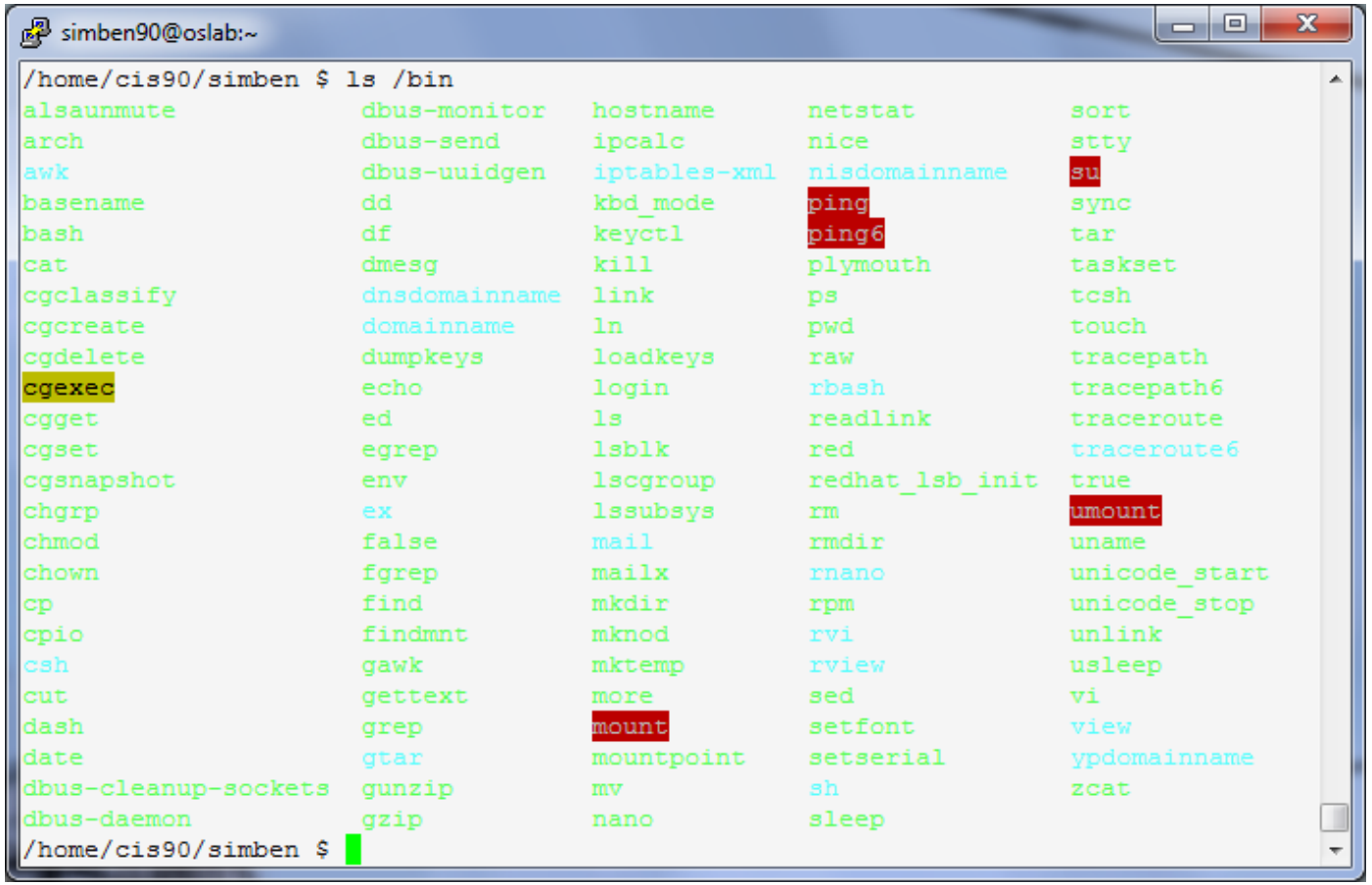
/usr/sbin



Most commands reside in these four directories. They can reside in other places as well.

The /bin directory

ls /bin



/bin has essential commands used by everyone.

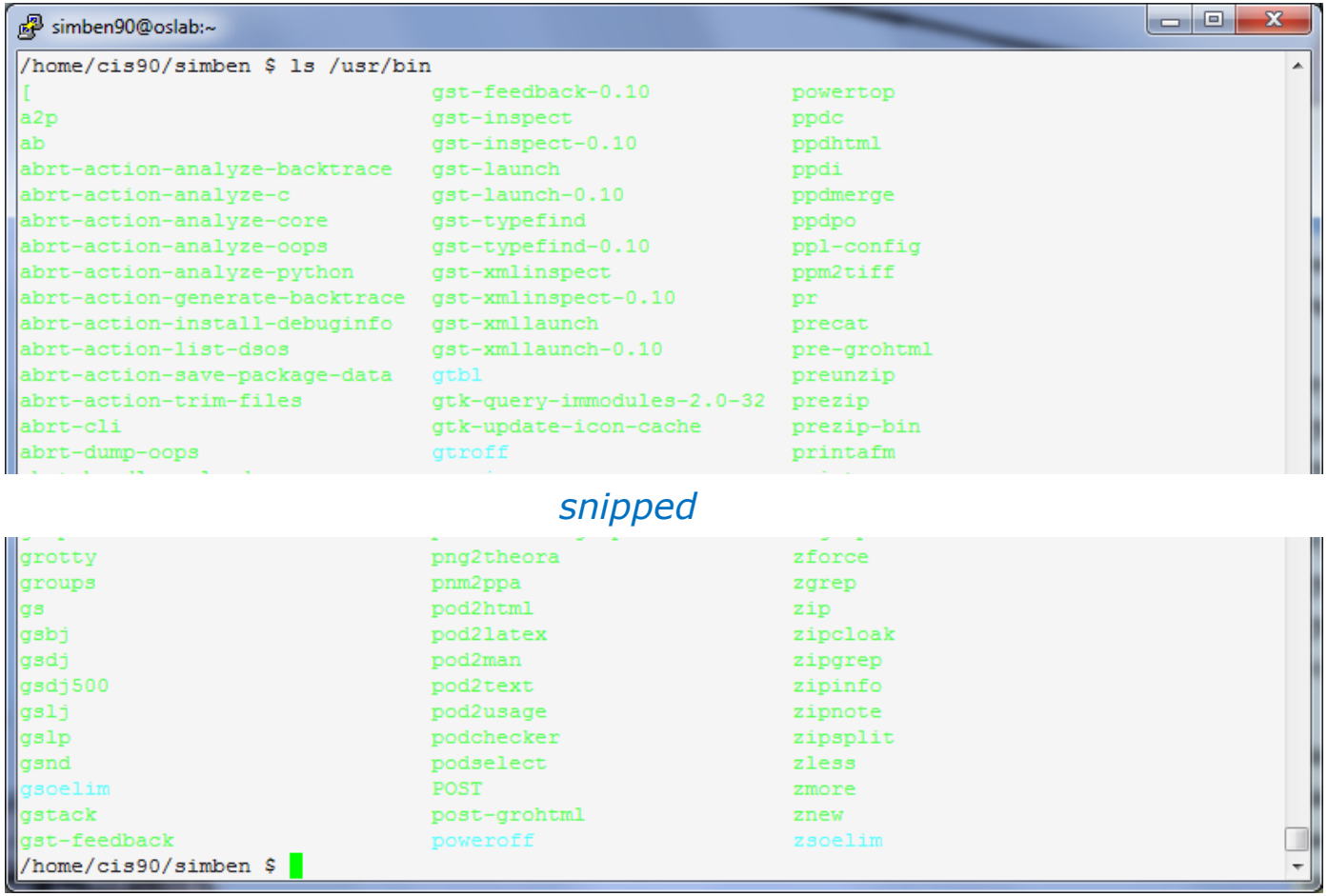
Can you find the Lesson 1 ***date****,* ***hostname****,* ***ps*** *and* ***uname*** *commands?*

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

Commands are either program or script files that can be executed

The /usr/bin directory

`ls /usr/bin`



snipped

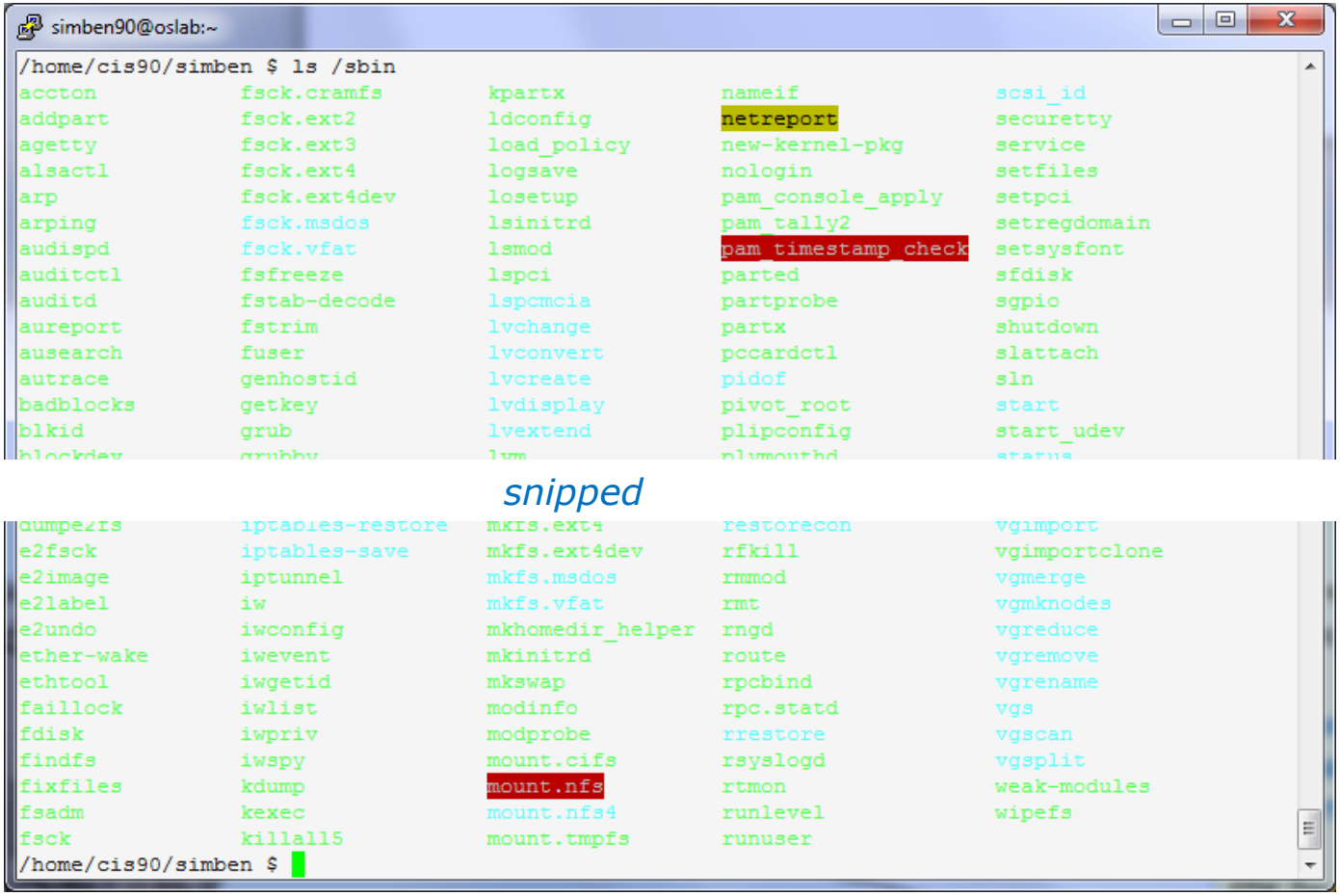
There are a "ton" of additional commands (programs) in this directory.

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

Can you find the Lesson 1 ***cal, clear****,* ***id, ssh, tty,*** *and* ***who*** *commands we used in Lab 1?*

The /sbin directory

ls /sbin



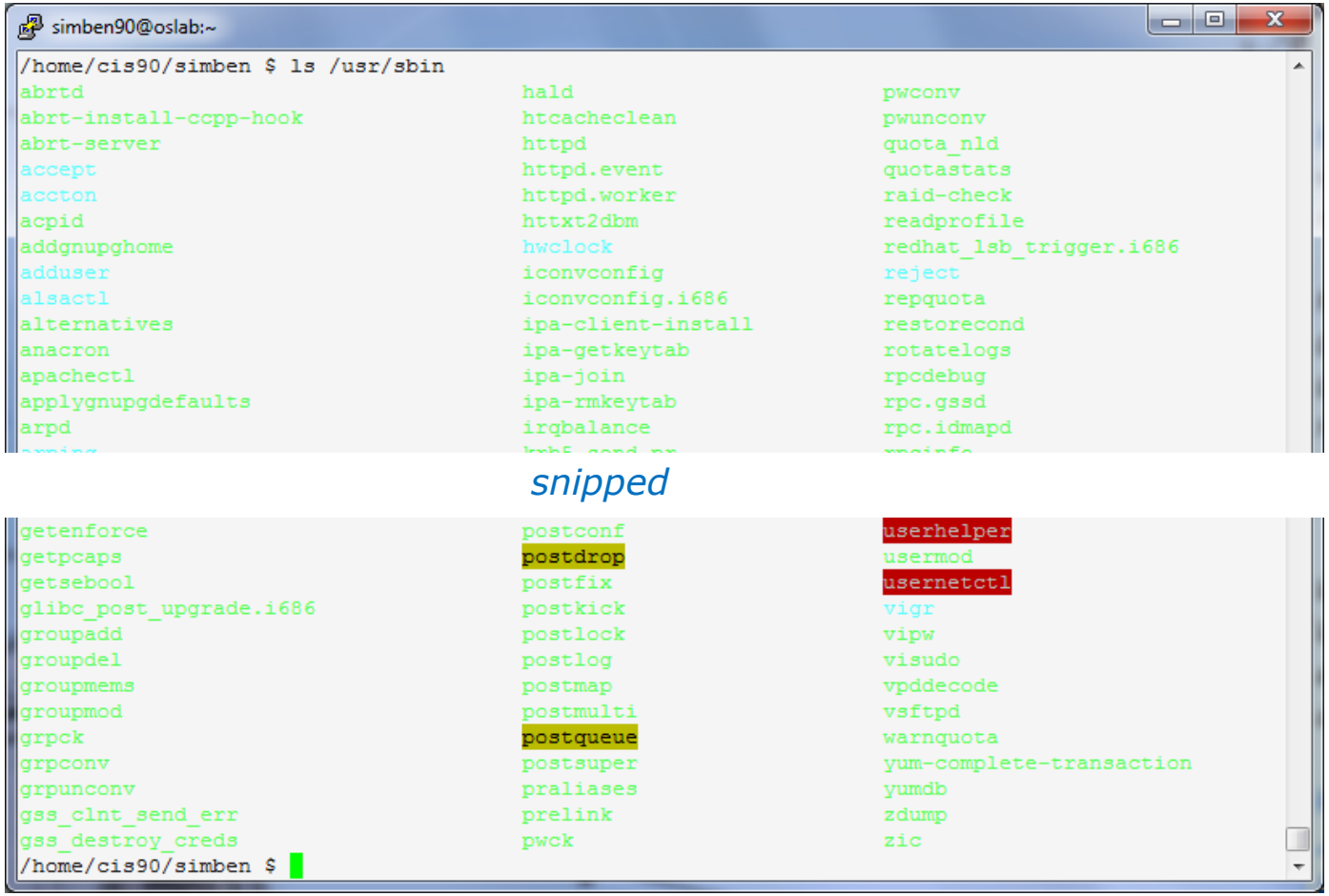
These are essential commands and utilities used by system administrators.

*This is where the **chkconfig**, **ifconfig** and **iptables** commands are found.*

You will learn how to use these commands in CIS 191 and CIS 192.

The /usr/sbin directory

`ls /usr/sbin`



These are additional commands and utilities are typically used by system administrators.

*This is where commands like **useradd, userdel, tcpdump** are located.*

You will learn how to use these commands in CIS 191 and CIS 192.

type command

Locate a command on your path

Syntax:

type *[command]*

type *[command] [command] … [command]*

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

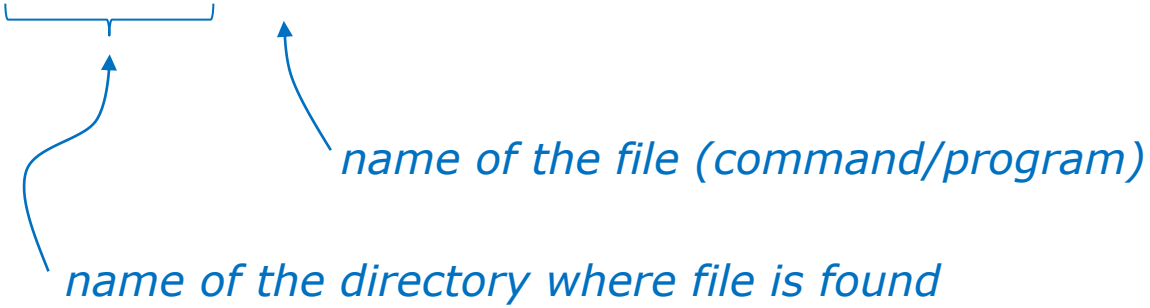
*The **cal** command is located in the **/usr/bin** directory*

```
/home/cis90/simben $ type bogus
-bash: type: bogus: not found
```

*The **bogus** command is not on the user's path*

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

*The **uname** command is in the **/bin** directory*
*The **cal** command is in the **/usr/bin** directory*



Class Activity

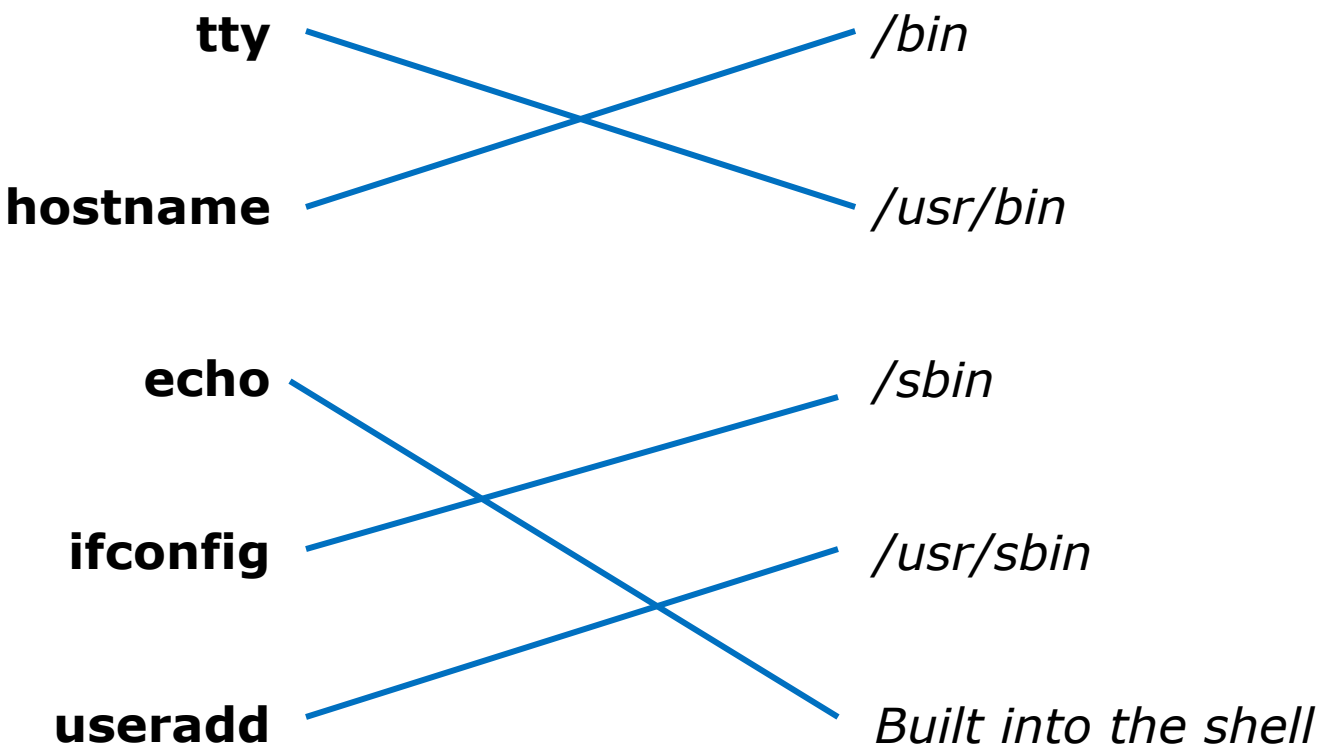
Draw a line connecting the command to the directory where it resides

bc	*/bin*
tty	*/usr/bin*
echo	*/sbin*
ifconfig	*/usr/sbin*
useradd	*Built into the shell*

You will learn more about useradd in CIS 191 and ifconfig in CIS 192

Class Activity

Draw a line connecting the command to the directory where it resides



Programs

Binary code
vs text scripts

UNIX commands & utilities are executable programs

A program can be <u>binary code</u>:

- Binary machine code is unprintable. A programmer must use hex dumps to examine it.
- Binary machine code executes very quickly and is targeted for a specific CPU instruction set.
- The binaries are produced by compiling source code written in a higher level language such as C, or C++.

A program can be a text-based <u>script</u>:

- A script can be directly viewed and printed.
- A script does not need to be compiled. It is interpreted on the fly and because of that doesn't run as fast as binary code.
- Common scripting languages include bash, perl and python.

Two example programs: apropos and cal

Lets take a deep dive on two random commands:

apropos - searches the whatis database for a string of text

cal - prints a calendar

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

What do they do?

apropos

cal

*The **apropos** command searches the whatis database.*

```
/home/cis90/simben $ apropos uname
oldolduname [obsolete] (2)  - obsolete system calls
olduname [obsolete]  (2)  - obsolete system calls
uname                (1)  - print system information
uname                (1p)  - return system name
uname                (2)  - get name and information about current kernel
uname                (3p)  - get the name of the current system
```

*The **cal** command prints a calendar*

```
/home/cis90/simben $ cal
   February 2012
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
```

Where are the programs located?

apropos

cal

```
/home/cis90/simben $ type apropos cal
apropos is hashed (/usr/bin/apropos)
cal is /usr/bin/cal
```

*The **apropos** and **cal** commands are both in the **/usr/bin** directory.*

Note: Sometimes you will see "Hashed" which means the command has been run previously and its location on the path has been temporarily "remembered". This is to speed up subsequent path searches for the same command.

Listing the program files

apropos

cal

```
/home/cis90/simben $ ls /usr/bin/apropos /usr/bin/cal
/usr/bin/apropos  /usr/bin/cal
```

Both files show as green because they are executables

```
/home/cis90/simben $ ls -F /usr/bin/apropos /usr/bin/cal
/usr/bin/apropos*  /usr/bin/cal*
```

*FYI, use the -F option if color blind. Executables have a * suffix.*

Getting additional information on the program files

apropos

cal

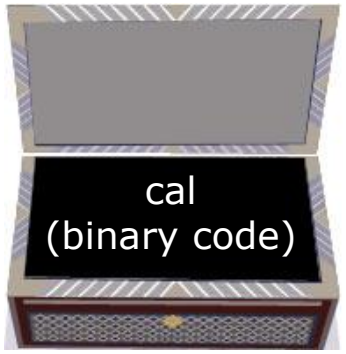
```
/usr/bin $ file apropos
apropos: Bourne shell script text executable
```

***apropos** is a shell script*

```
/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
```

***cal** is binary code (has been compiled from higher level source code)*

Viewing the contents of the program files



cat /usr/bin/apropos

simben90@oslab:~

```
/home/cis90/simben $ cat /usr/bin/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-1.6f)
#
# 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.
aproposgrepopt1='ai'
aproposgrepopt2=''
whatisgrepopt1='aiw'
whatisgrepopt2='^'
```

*The **cat** command can print the apropos file because it is a readable (and editable) **ASCII** text script*

cat /usr/bin/cal

simben90@oslab:~

```
P:`:l?'/home/cis90/simben $ PuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTT
TYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPu
TTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYP
uTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTY
PuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTT
YPuTTYPuTTYPuTTYPuTTYPuTTY
-bash: PuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPu
TTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYP
uTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTY
PuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTT
YPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuTTYPuT
TYPuTTYPuTTYPuTTYPuTTY: command not found
/home/cis90/simben $
```

*The **cat** command "chokes" trying to print the **binary** cal file because it is full of unprintable machine code.*

How binary programs are created

cal

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>
#endif
#if HAVE_CTYPE_H
#  include
```

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

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

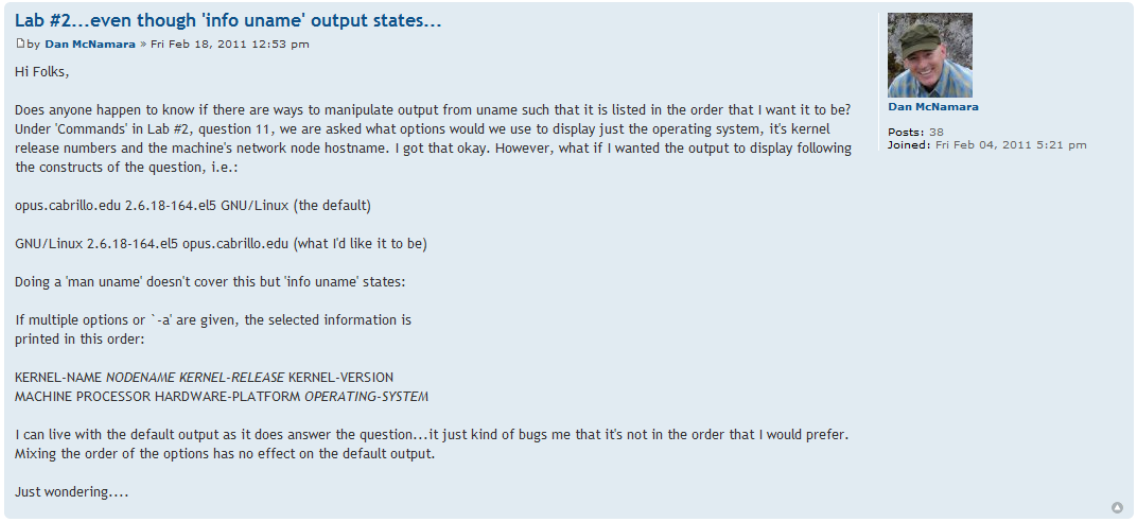
```
[rsimms@nosmo src]$ file /usr/bin/cal
/usr/bin/cal: ELF 32-bit LSB executable, Intel 80386, version 1
(SYSV), for GNU/Linux 2.2.5, dynamically linked (uses shared lib
s), stripped
[rsimms@nosmo src]$
```

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

FYI

See this forum post from a previous class for an example of obtaining the source code for a Linux command and modifying it:

http://oslab.cabrillo.edu/forum/viewtopic.php?f=31&t=683&p=2774



Lab #2...even though 'info uname' output states...

by **Dan McNamara** » Fri Feb 18, 2011 12:53 pm

Hi Folks,

Does anyone happen to know if there are ways to manipulate output from uname such that it is listed in the order that I want it to be? Under 'Commands' in Lab #2, question 11, we are asked what options would we use to display just the operating system, it's kernel release numbers and the machine's network node hostname. I got that okay. However, what if I wanted the output to display following the constructs of the question, i.e.:

opus.cabrillo.edu 2.6.18-164.el5 GNU/Linux (the default)

GNU/Linux 2.6.18-164.el5 opus.cabrillo.edu (what I'd like it to be)

Doing a 'man uname' doesn't cover this but 'info uname' states:

If multiple options or `-a' are given, the selected information is
printed in this order:

KERNEL-NAME *NODENAME KERNEL-RELEASE* KERNEL-VERSION
MACHINE PROCESSOR HARDWARE-PLATFORM *OPERATING-SYSTEM*

I can live with the default output as it does answer the question...it just kind of bugs me that it's not in the order that I would prefer. Mixing the order of the options has no effect on the default output.

Just wondering....

Dan McNamara

Posts: 38
Joined: Fri Feb 04, 2011 5:21 pm

*It all started when Dan did Lab 2 and wanted to change the way **uname** ordered its output!*

Class Activity

1) Where is the **scavenge** program?
   Hint: use the **type** command with scavenge as the argument.
   Type your answer in the chat window.

2) Is the **scavenge** command a binary executable or a shell script?
   Hint: use the **file** command with the location of scavenge as the argument.
   Type your answer in the chat window.

3) Can you **cat** the **scavenge** command?
   Paste a line of output in the chat window.

4) Is **scavenge** a UNIX command?
   Hint: use the **man** or **whatis** commands with scavenge as the argument.
   Type your answer in the chat window.

Inputs to commands

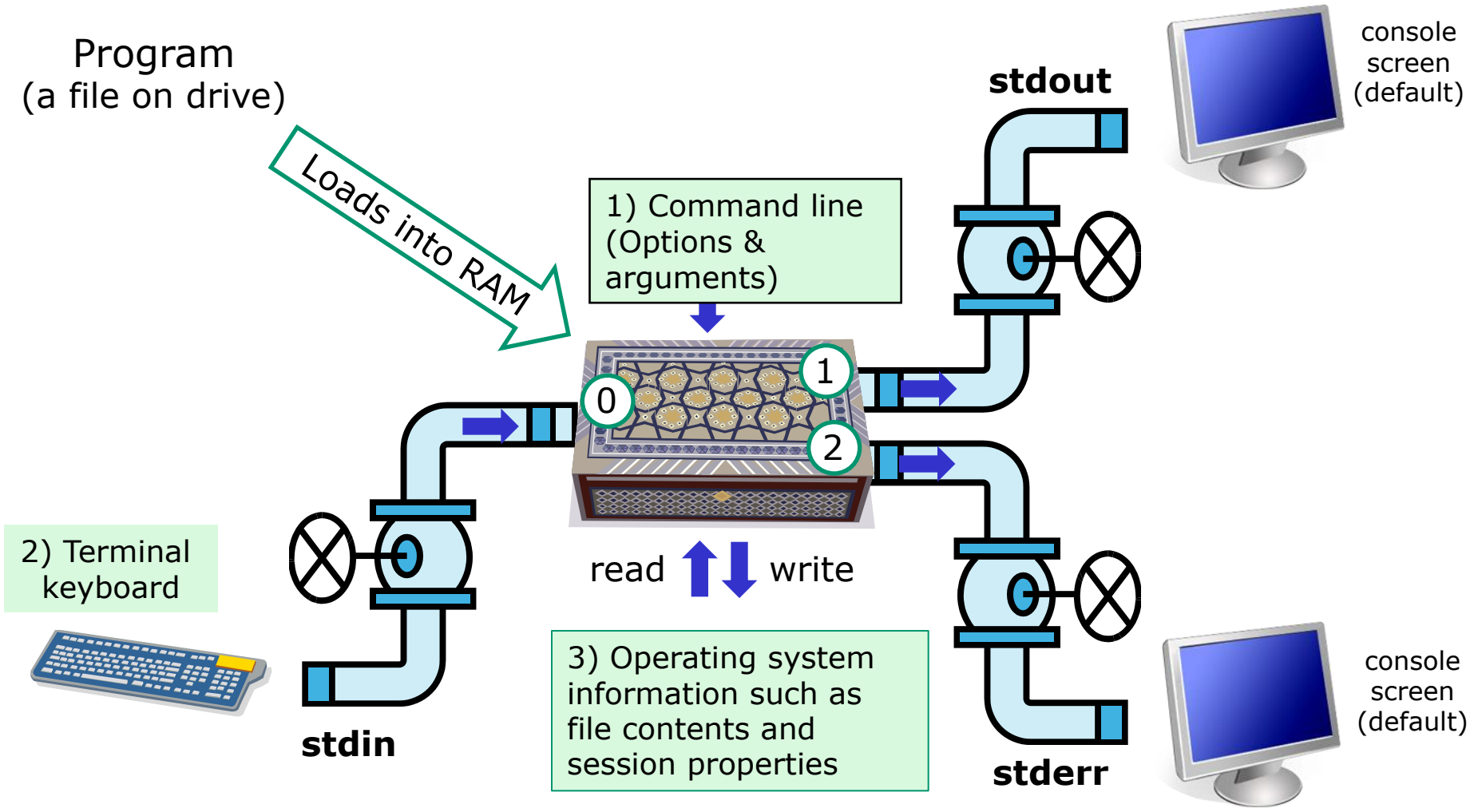
You will get these questions when you submit Lab 2

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

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

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

Inputs to Commands



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

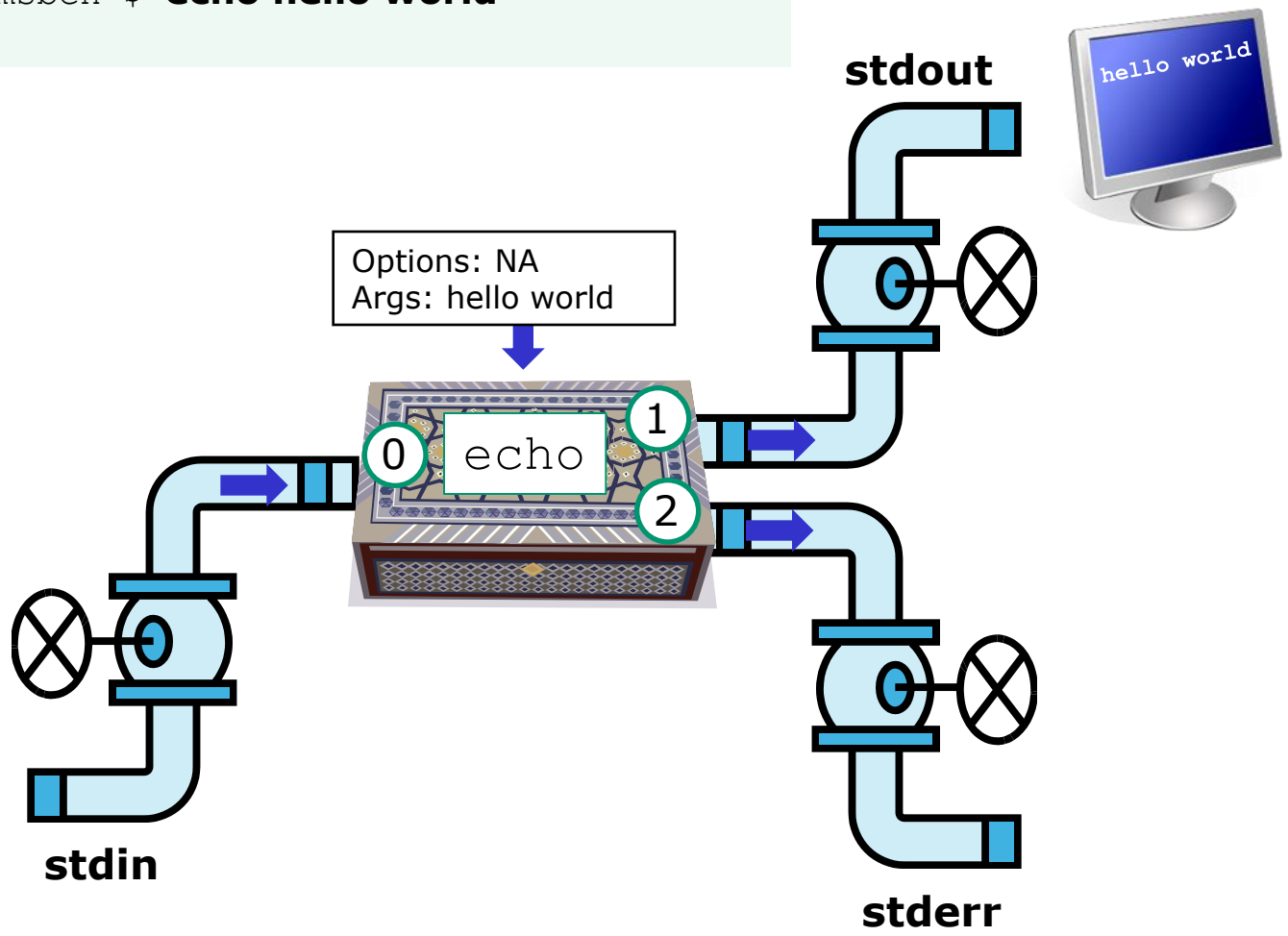
```
/home/cis90/simmen $ echo hello world
hello world
```

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

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

*The **echo** and **banner** commands are examples of commands that get their input from the command line*

echo command

```
/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 an interactive command that reads its input from the keyboard?

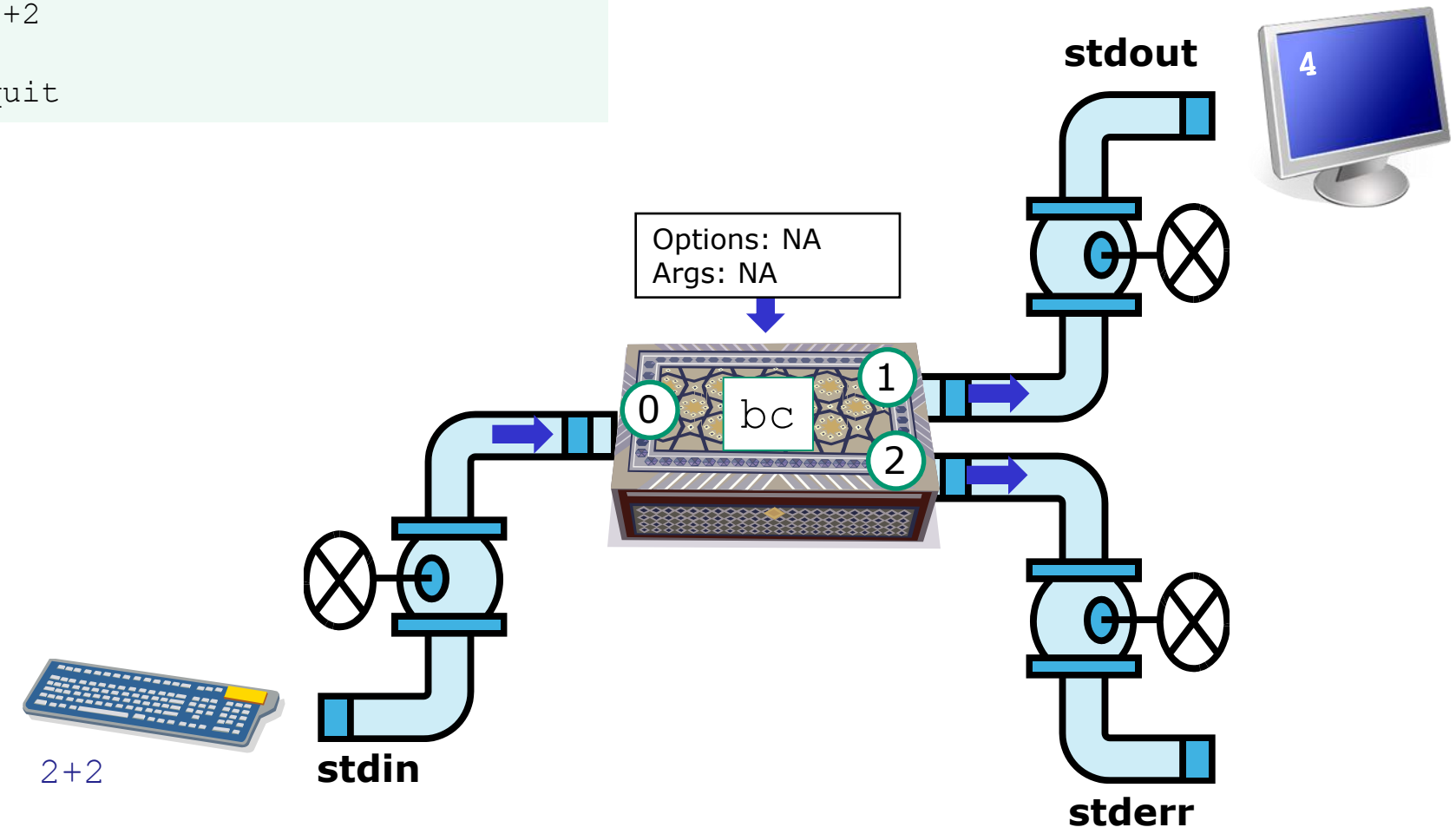
```
/home/cis90/simmsben $ bc
bc 1.06
Copyright 1991-1994, 1997, 1998, 2000 Free
Software Foundation, Inc.
This is free software with ABSOLUTELY NO
WARRANTY.
For details type `warranty'.
2+2
4
500-200+3
303
sqrt(64)
8
quit
```

```
/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.
```

*The **bc** (binary calculator) and **passwd** commands are examples of interactive commands that read their input from the keyboard*

bc command

```
[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*

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

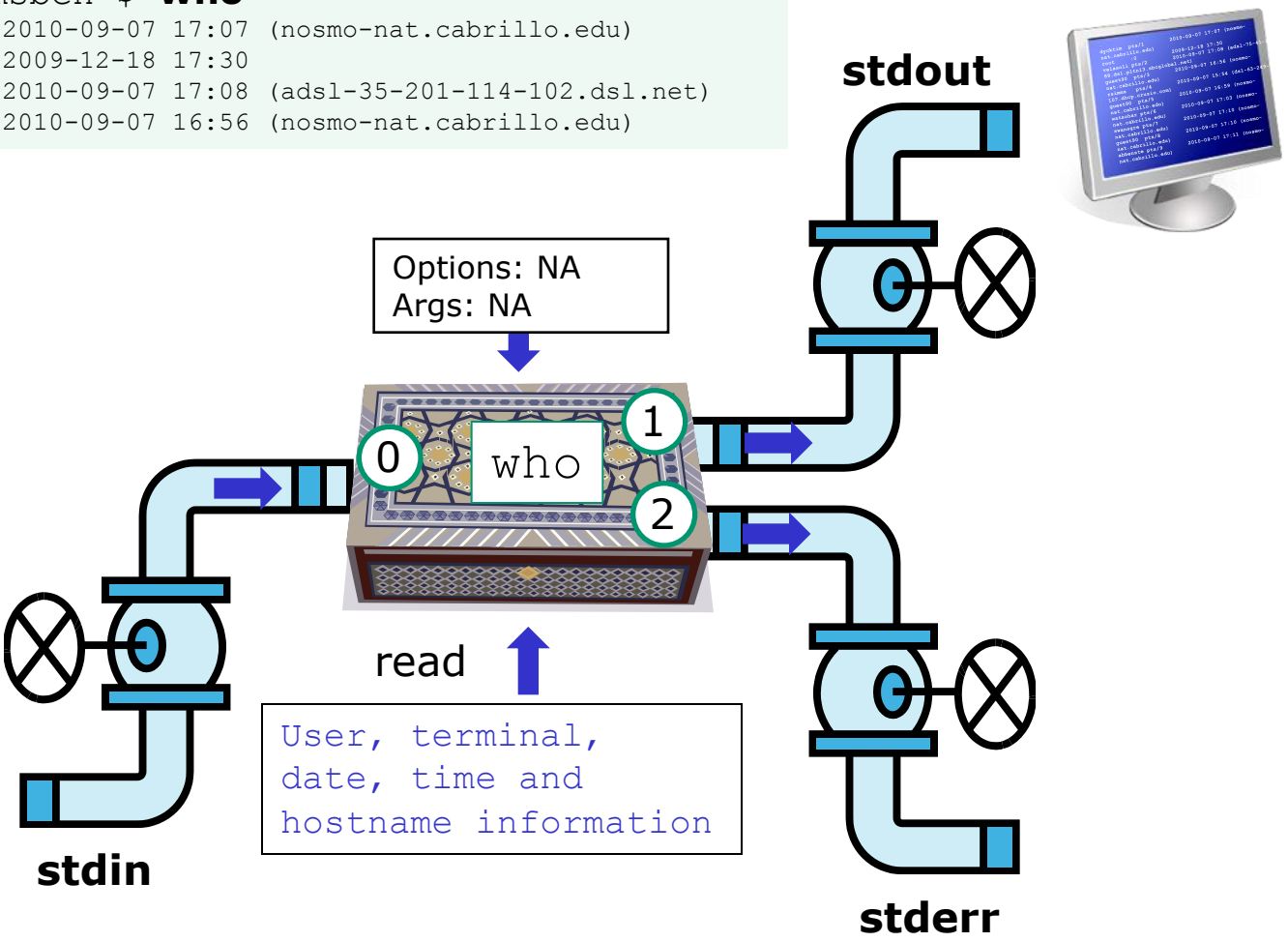
```
/home/cis90/simmen $ who
dycktim  pts/1        2010-09-07 17:07 (nosmo-nat.cabrillo.edu)
root     :0           2009-12-18 17:30
velasoli pts/2        2010-09-07 17:08 (adsl-35-201-114-102.dsl.net)
guest90  pts/3        2010-09-07 16:56 (nosmo-nat.cabrillo.edu)
rsimms   pts/4        2010-09-07 15:54 (dsl-45-78-13-81.dhcp.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/simben $ uname
Linux
```

*The **who** and **uname** commands are examples of commands that get their input from the Operating System*

who command

```
/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-35-201-114-102.dsl.net)
guest90  pts/3        2010-09-07 16:56 (nosmo-nat.cabrillo.edu)
```



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

Class Activity

Where is this **ps** command getting its input from?

```
/home/cis90/simben $ ps
  PID TTY          TIME CMD
26981 pts/2    00:00:00 bash
28587 pts/2    00:00:00 ps
/home/cis90/simben $
```

Type your answer in the chat window

Command Syntax

(grammar lesson)

from Dictionary.com

parse [pahrs, pahrz] ***verb, parsed, pars·ing*.**
verb (used with object)

1. to analyze (a sentence) in terms of grammatical constituents, identifying the parts of speech, syntactic relations, etc.

2. to describe (a word in a sentence) grammatically, identifying the part of speech, inflectional form, syntactic function, etc.

3. Computers . to analyze (a string of characters) in order to associate groups of characters with the syntactic units of the underlying grammar.

One of the things the shell does is parse what is typed by the user. This results in the command line being analyzed to identify the command, the options, the arguments and any redirection.

Command Syntax

Command	Options	Arguments	Redirection

Command – is the name of an executable program file.

Options – a special type of argument that is used to control how the program operate operates.

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 Rules

Command	Options	Arguments	Redirection

Command – usually at the beginning of the line

Options – follow the command, usually starts with a dash, may be combined after a single "-" or separated by spaces. Note that `-iad` is the same as `-i -a -d`

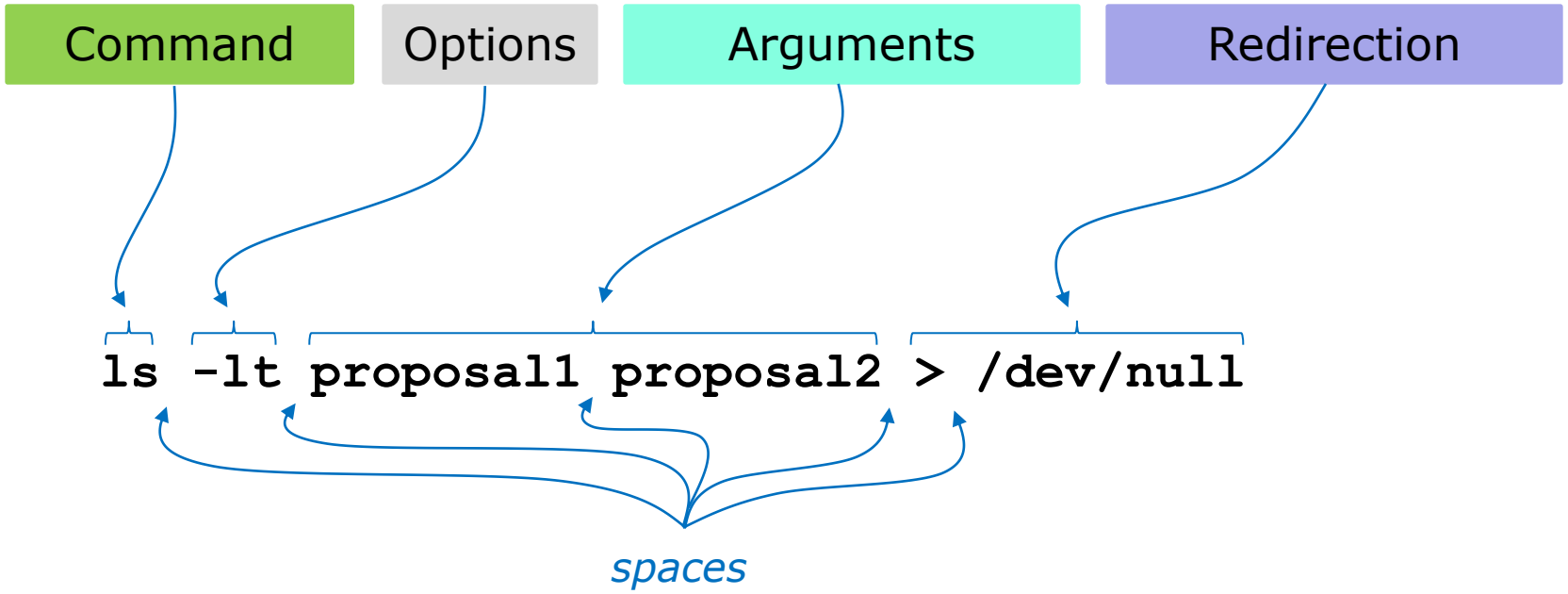
Arguments – follow the options. Multiple arguments must be separated by spaces.

Redirection – Will be a <, >, >>, 2> or | followed by the I/O redirection.

Spaces are required between commands, options, arguments and any redirection

Multiple spaces are treated as a single space (unless inside quotes)

Command Syntax Example



Don't worry now about what the example command above does, for now we just want to be able to parse it into the command, options, arguments and any redirection

More Command Syntax Examples

Command	Options	Arguments	Redirection

The command syntax is the underlying grammar used to parse the command line

```
/home/cis90/simben $ hostname
opus.cabrillo.edu

/home/cis90/simben $ uname -o
GNU/Linux

/home/cis90/simben $ ls -ld Poems/
drwxr-xr-x 5 simben90 cis90 4096 Jan 18  2004 Poems/

/home/cis90/simben $ ls -li letter > /dev/null
```

More on redirection in later lessons

Parsing Practice

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ echo I love Linux
I love Linux
```

Use the chat window to type your answers

Command:

Options:
- How many:
- What are they:

Arguments:
- How many:
- What are they:

Redirection:
- How many:
- What is redirected:

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ echo I love Linux
I love Linux
```

Please parse the command line above

Command: echo

Options:
- How many: NA
- What are they: NA

Arguments:
- How many: 3
- What are they: I, Love, Linux

Redirection:
- How many: NA
- What is redirected: NA

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ ls -ld /bin /usr/bin
drwxr-xr-x 2 root root  4096 Nov 23 13:49 /bin
drwxr-xr-x 2 root root 61440 Nov 23 13:49 /usr/bin
```

Use the chat window to type your answers

Command:

Options:
- How many:
- What are they:

Arguments:
- How many:
- What are they:

Redirection:
- How many:
- What is redirected:

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ ls -ld /bin /usr/bin
drwxr-xr-x 2 root root  4096 Nov 23 13:49 /bin
drwxr-xr-x 2 root root 61440 Nov 23 13:49 /usr/bin
```

Please parse the command line above

Command: ls

Options:

How many:	2
What are they:	l, d

Arguments:

How many:	2
What are they:	/bin, /usr/bin

Redirection:

How many:	NA
What is redirected:	NA

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ ls-ld/bin/usr/bin
-bash: ls-ld/bin/usr/bin: No such file or directory
```

Use the chat window to type your answers

Command:

Options:
- How many:
- What are they:

Arguments:
- How many:
- What are they:

Redirection:
- How many:
- What is redirected:

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ ls-ld/bin/usr/bin
-bash: ls-ld/bin/usr/bin: No such file or directory
```

Please parse the command line above

Command: ls-ld/bin/usr/bin

Options:
- How many: NA
- What are they: NA

Arguments:
- How many: NA
- What are they: NA

Redirection:
- How many: NA
- What is redirected: NA

Spaces are required between commands, options, arguments and any redirection

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ file proposal1 timecal
proposal1: ASCII English text
timecal:   shell archive or script for antique kernel text
```

Use the chat window to type your answers

Command:

Options:
- How many:
- What are they:

Arguments:
- How many:
- What are they:

Redirection:
- How many:
- What is redirected:

Command Syntax

Command	Options	Arguments	Redirection

```
/home/cis90/simben $ file proposal1 timecal
proposal1: ASCII English text
timecal:   shell archive or script for antique kernel text
```

Please parse the command line above

Command: file

Options:
- How many: NA
- What are they: NA

Arguments:
- How many: 2
- What are they: proposal1, timecal

Redirection:
- How many: NA
- What is redirected: NA

Variables

Shell Variables

- A shell variable gives a name to a location in memory where data can be kept during the session. This data value is lost when a session ends.
- The shell variables used to customize the users environment are called *Environment* variables.
- When parsing, the shell will look for a $ followed by a variable name and replace it with the value of the variable.

To show the value of a variable use the **echo** command and precede the variable name with a $

echo $PS1 *shows the current value of the PS1 variable*

To change the value of a variable, use an = sign with no surrounding blanks and no $

PS1="Enter next command: " *sets the PS1 prompt variable*

Shell Environment Variables

These variables are automatically set for you when you log in

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, linux, etc.

Showing environment variable values

```
/home/cis90/simben $ echo $TERM
xterm
```
Shows your terminal type

```
/home/cis90/simben $ echo $PWD
/home/cis90/simben
```
Shows your current working directory

```
/home/cis90/simben $ echo $PS1
$PWD $
```
Shows your level 1 prompt string

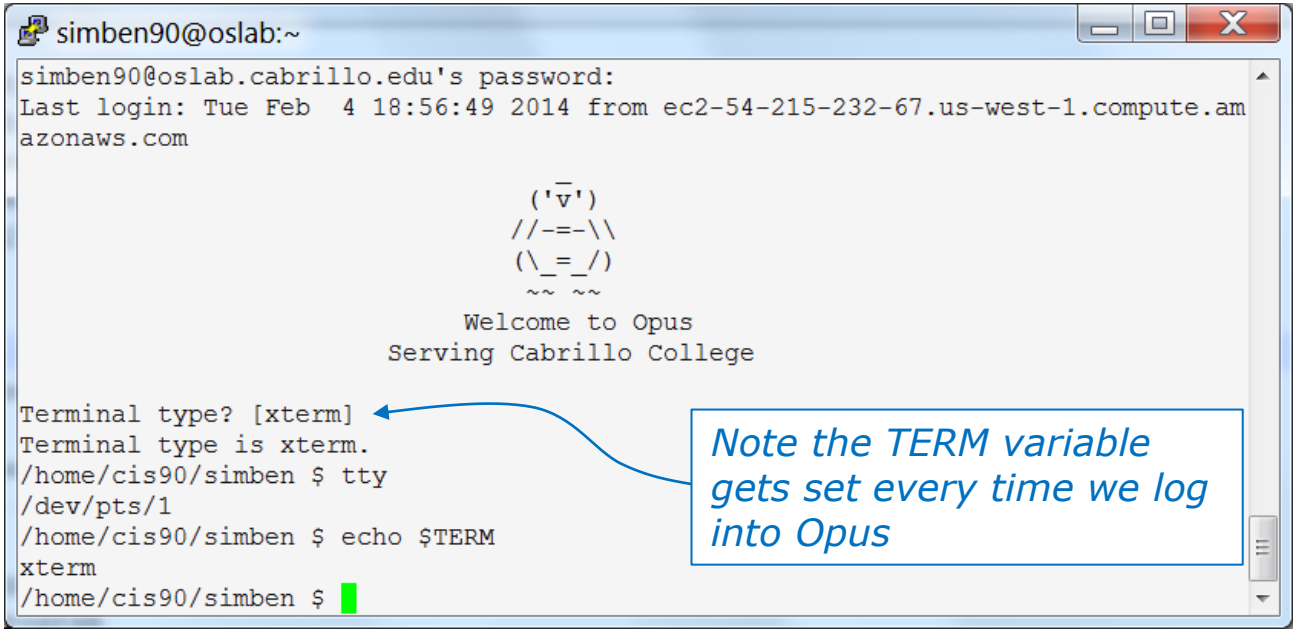
```
/home/cis90/simben $ echo $HOME
/home/cis90/simben
```
Shows your home directory

```
/home/cis90/simben $ echo $SHELL
/bin/bash
```
Shows your shell

```
/home/cis90/simben $ echo $PATH
/usr/lib/qt-3.3/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:
/usr/sbin:/sbin:/home/cis90/simben/../bin:/home/cis90/simben/bin:.
```
Shows the directories making up your path

Terminal type ≠ Terminal device

The TERM variable holds the terminal type which is different than the terminal device



*Use **tty** to see terminal device*

*Use **echo $TERM** to see terminal type*

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

Setting Variable Values

To change the value of a variable, use an = sign with no surrounding blanks and no $

```
/home/cis90/simben $ echo $TERM
xterm
```

Show the current terminal type

```
/home/cis90/simben $ TERM=dumb
/home/cis90/simben $ echo $TERM
dumb
```

Change the terminal type and display the new value

```
/home/cis90/simben $ TERM=xterm
/home/cis90/simben $ echo $TERM
xterm
```

Change the terminal type back to the original value

In Lab 2 you will see what happens when the terminal type is changed

The SHELL variable

```
/home/cis90/simben $ echo $SHELL
/bin/bash
```

The SHELL variable will be set to the name of the shell your are running. Benji is running the bash shell.

```
/home/cis90/simben $ ps
  PID TTY          TIME CMD
 7364 pts/1    00:00:00 bash
 7745 pts/1    00:00:00 ps
```

In Lesson 1 we used the ps command to see the shell being run

```
/home/cis90/simben $ cat /etc/passwd | grep simben
simben90:x:1201:190:Benji Simms:/home/cis90/simben:/bin/bash
```

The shell that is run is determined by the entry in /etc/passwd

The PS1 variable

```
/home/cis90/simben $ PS1="By your command > "
By your command > date
Mon Sep  3 17:25:32 PDT 2012
By your command >


By your command > PS1='What can I do for you $LOGNAME? '
What can I do for you simben90? date
Mon Sep  3 17:26:10 PDT 2012
What can I do for you simben90?


What can I do for you simben90? PS1='$PWD $ '
/home/cis90/simben $ date
Mon Feb  3 18:06:30 PST 2014
```

The PS1 variable determines your shell prompt

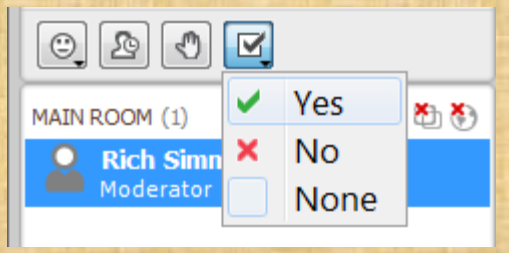
Class Exercise

PS1 "Prompt" variable

Change your prompt to "What is your command master? "

Include a space after the "?"

Give me a green check ✓ if you are successful and a red x if stuck on CCC Confer



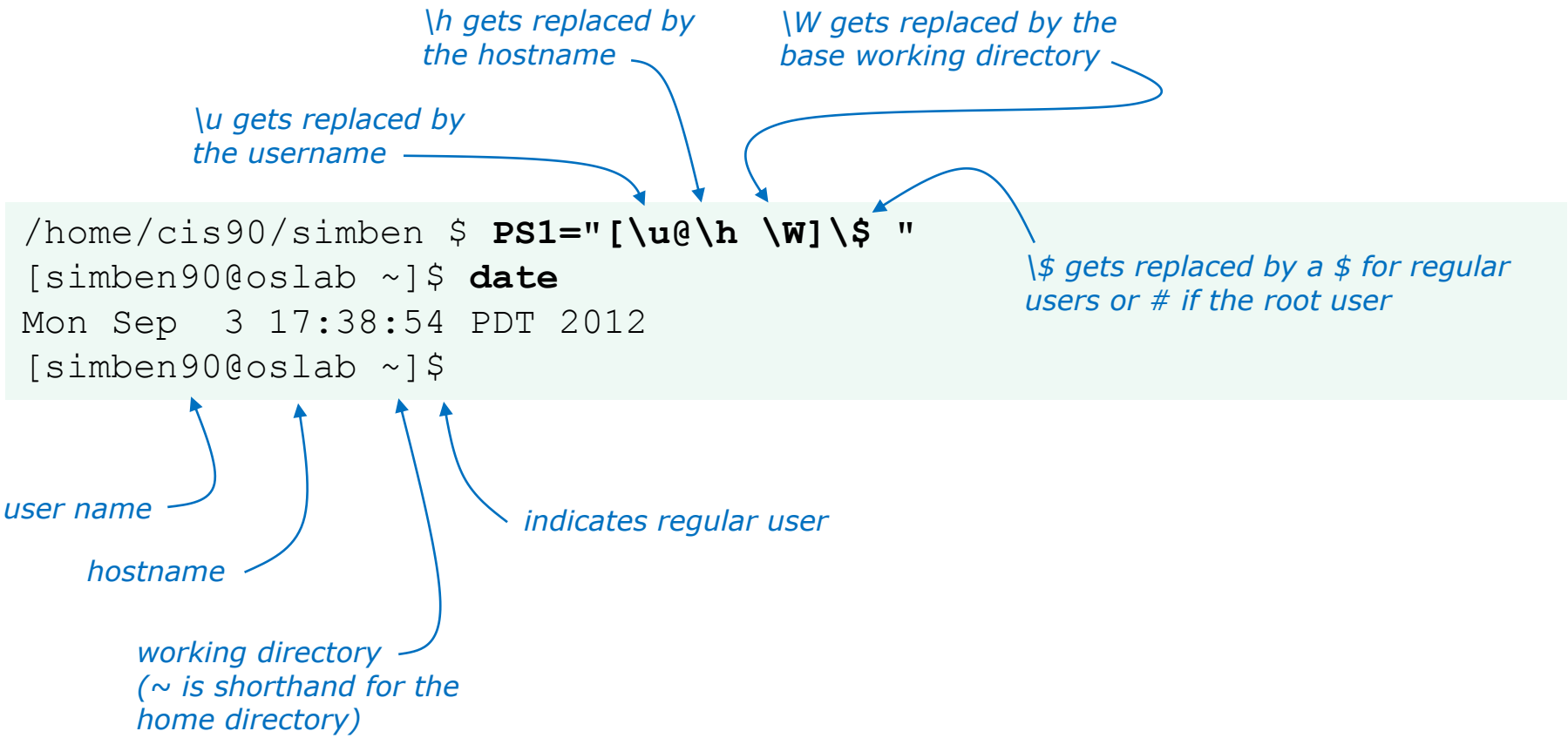
Need a fresh start -- just log out and back in again and your prompt will be back to normal!

Changing the shell prompt

(PS1 variable)

Changing the prompt

There are some special \codes you can insert when setting the prompt



Changing the prompt

Special Codes	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 PS1 variable (defines the prompt) can be set to any combination of text, variables and these special codes.

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] $

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 …

Need a fresh start -- just log out and back in again and your prompt will be back to normal!

Listing all the variables

Shell Variables
set command

```
/home/cis90/simben $ set
BASH=/bin/bash
BASHOPTS=checkwinsize:cmdhist:expand_aliases:extquote:force_fignore:hostco
mplete:interactive_comments:login_shell:progcomp:promptvars:sourcepath
BASH_ALIASES=()
BASH_ARGC=()
BASH_ARGV=()
BASH_CMDS=()
BASH_ENV=/home/cis90/simben/.bashrc
BASH_LINENO=()
BASH_SOURCE=()
BASH_VERSINFO=([0]="4" [1]="1" [2]="2" [3]="1" [4]="release" [5]="i386-
redhat-linux-gnu")
BASH_VERSION='4.1.2(1)-release'
COLORS=/etc/DIR_COLORS
COLUMNS=123
CVS_RSH=ssh
DIRSTACK=()
EUID=1001
GROUPS=()
G_BROKEN_FILENAMES=1
HISTCONTROL=ignoredups
HISTFILE=/home/cis90/simben/.bash_history
HISTFILESIZE=1000
HISTSIZE=1000
HOME=/home/cis90/simben
HOSTNAME=oslab.cabrillo.edu
HOSTTYPE=i386
ID=1001
IFS=$' \t\n'
IGNOREEOF=10
LANG=en_US.UTF-8
LESSOPEN='|/usr/bin/lesspipe.sh %s'
LINES=38
LOGNAME=simben90
LS_COLORS='rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;3
3;01:cd=40;33;01:or=40;31;01:mi=01;05;37;41:su=37;41:sg=30;43:ca=30;41:tw=
30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arj=01;31:*.taz
=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.zip=01;31:*.z=01
;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lz=01;31:*.xz=01;31:*.bz2=01;31:*.tb
z=01;31:*.tbz2=01;31:*.bz=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=0
1;31:*.rar=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;3
1:*.jpg=01;35:*.jpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35
:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:
*.png=01;35:*.svg=01;35:*.svgz=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*
.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.ogm=01;35:*.mp4=01;35:*.
m4v=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.as
f=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=
01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;3
5:*.emf=01;35:*.axv=01;35:*.anx=01;35:*.ogv=01;35:*.ogx=01;35:*.aac=01;36:
*.au=01;36:*.flac=01;36:*.mid=01;36:*.midi=01;36:*.mka=01;36:*.mp3=01;36:*
.mpc=01;36:*.ogg=01;36:*.ra=01;36:*.wav=01;36:*.axa=01;36:*.oga=01;36:*.sp
x=01;36:*.xspf=01;36:'
MACHTYPE=i386-redhat-linux-gnu
MAIL=/var/spool/mail/simben90
MAILCHECK=60
OLDPWD=/bin
OPTERR=1
OPTIND=1
OSTYPE=linux-gnu
PATH=/usr/lib/qt-
3.3/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/sbin:/home
/cis90/simben/../bin:/home/cis90/simben/bin:.
PIPESTATUS=([0]="127")
PPID=17309
PROMPT_COMMAND='printf "\033]0;%s@%s:%s\007" "${USER}" "${HOSTNAME%%.*}"
"${PWD/#$HOME/~}"'
PS1='$PWD $ '
PS2='> '
PS4='+ '
PWD=/home/cis90/simben
QTDIR=/usr/lib/qt-3.3
QTINC=/usr/lib/qt-3.3/include
QTLIB=/usr/lib/qt-3.3/lib
SELINUX_LEVEL_REQUESTED=
SELINUX_ROLE_REQUESTED=
SELINUX_USE_CURRENT_RANGE=
SHELL=/bin/bash
SHELLOPTS=braceexpand:emacs:hashall:histexpand:history:ignoreeof:interacti
ve-comments:monitor
SHLVL=1
SSH_CLIENT='50.0.68.235 51849 2220'
SSH_CONNECTION='50.0.68.235 51849 172.30.5.20 2220'
SSH_TTY=/dev/pts/2
TERM=xterm
UID=1001
USER=simben90
USERNAME=
_=ser
colors=/etc/DIR_COLORS
/home/cis90/simben $
```

*The **set** command shows all shell variables including the special environment variables.*

Shell (Environment) Variables

env command

```
/home/cis90/simben $ env
HOSTNAME=oslab.cabrillo.edu
SELINUX_ROLE_REQUESTED=
TERM=xterm
SHELL=/bin/bash
HISTSIZE=1000
SSH_CLIENT=50.0.68.235 51849 2220
SELINUX_USE_CURRENT_RANGE=
QTDIR=/usr/lib/qt-3.3
QTINC=/usr/lib/qt-3.3/include
SSH_TTY=/dev/pts/2
USER=simben90
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33;01:cd=40;33;01:or=40;31;01:mi=01;05;37;41:su=37;41:sg=30;43:ca=
30;41:tw=30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arj=01;31:*.taz=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31
:*.zip=01;31:*.z=01;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lz=01;31:*.xz=01;31:*.bz2=01;31:*.tbz=01;31:*.tbz2=01;31:*.bz=01;31:*.tz=01;31:*.
deb=01;31:*.rpm=01;31:*.jar=01;31:*.rar=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.jpg=01;35:*.jpeg=01;35:*.gif=01
;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:*.png=01;35:*.svg=01;35:*
.svgz=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01;35:*.mp4
v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=01;35
:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.axv=01;35:*.anx=01;35:*.ogv=01;35:*.ogx=01;35:*.aac=0
1;36:*.au=01;36:*.flac=01;36:*.mid=01;36:*.midi=01;36:*.mka=01;36:*.mp3=01;36:*.mpc=01;36:*.ogg=01;36:*.ra=01;36:*.wav=01;36:*.axa=01;36:*
.oga=01;36:*.spx=01;36:*.xspf=01;36:
USERNAME=
MAIL=/var/spool/mail/simben90
PATH=/usr/lib/qt-3.3/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/sbin:/home/cis90/simben/../bin:/home/cis90/simben/bin:.
PWD=/home/cis90/simben
LANG=en_US.UTF-8
SELINUX_LEVEL_REQUESTED=
HISTCONTROL=ignoredups
SHLVL=1
HOME=/home/cis90/simben
BASH_ENV=/home/cis90/simben/.bashrc
LOGNAME=simben90
QTLIB=/usr/lib/qt-3.3/lib
CVS_RSH=ssh
SSH_CONNECTION=50.0.68.235 51849 172.30.5.20 2220
LESSOPEN=|/usr/bin/lesspipe.sh %s
G_BROKEN_FILENAMES=1
_=/bin/env
OLDPWD=/bin
/home/cis90/simben $
```

*The **env** command shows just the environment variables (a subset of the shell varialbes)*

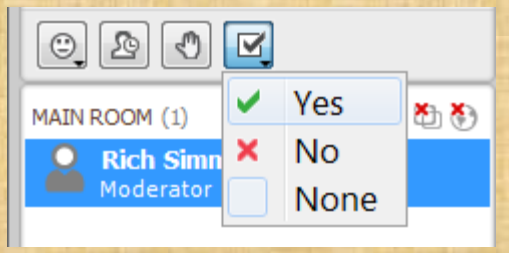
Class Exercise

PS1 "Prompt" variable

Change your prompt to "What is your command master? "

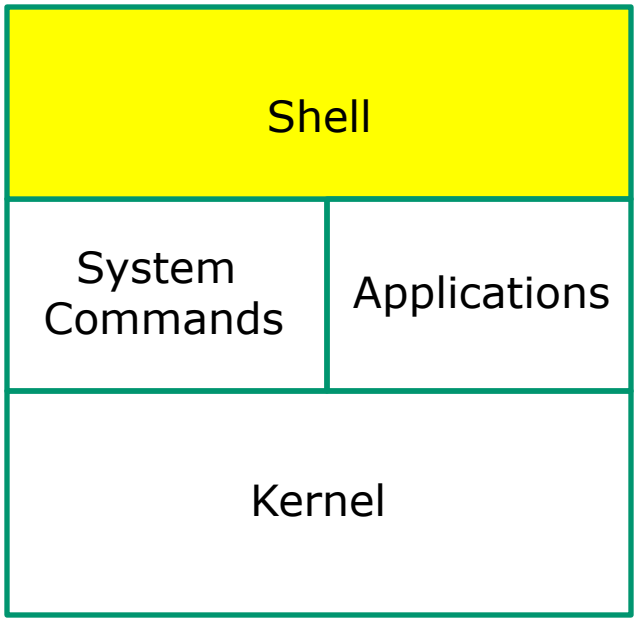
Include a space after the ?

Give me a green check ✓ if you are successful and a red x if stuck on CCC Confer



The Shell (Deep Dive)

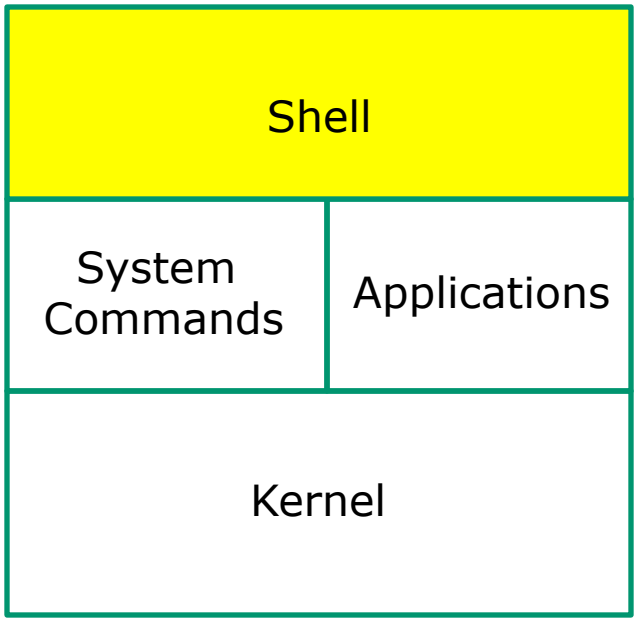
The Shell



- 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** (Bourne 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

Example:

```
/home/cis90/simben $ ls -lt proposal1 proposal2
-rw-r--r--. 1 simben90 cis90 1074 Aug 26  2003 proposal1
-rw-r--r--. 1 simben90 cis90 2175 Jul 20  2001 proposal2
/home/cis90/simben $
```

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

Lets take a deep dive into how a command gets executed.

Note it is always a team effort by both the shell and the command.

Life of the Shell

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

1) Prompt user for a command

Example:

The shell begins by outputting the prompt (which is based on the PS1 variable)

```
/home/cis90/simben $ ls -lt proposal1 proposal2
```

Then you type the command

FYI, you can mimic outputting the prompt yourself with these commands:

```
/home/cis90/simben $ echo $PS1
$PWD $
/home/cis90/simben $ echo $PWD $
/home/cis90/simben $
/home/cis90/simben $
```

to show value of PS1 variable

echo the output of the previous command

was output by the echo command above

was output by the shell (the same output)

Life of the Shell

2) Parse command user typed

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

Example:

```
ls -lt proposal1 proposal2
```

During the parse step the shell identifies all options & arguments, handles any metacharacters and redirection

- Command = ls
- 2 Options = l, t
- 2 Arguments = proposal1, proposal2
- 1 Redirection = NA

Life of the Shell

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

3) Search path for the program to run

`ls -lt proposal1 proposal2`

Use this command to see the path directories (separated by :'s) on your path

```
/home/cis90/simben $ echo $PATH
/usr/lib/qt-3.3/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
:/sbin:/home/cis90/simben/../bin:/home/cis90/simben/bin:.
```

*The shell will search each directory in order for an **ls** command*

```
/usr/lib/qt-3.3/bin   no ls command found here
/usr/local/bin        no ls command found here
/bin                  YES! – an ls command is in the /bin directory
/usr/bin
/usr/local/sbin
/usr/sbin
/sbin
/home/cis90/simben/../bin
/home/cis90/simben/bin
      .
```

Note: If the shell cannot find the command on the path it will output "command not found"

Try mimicking what the shell does to search for ls:

```
/home/cis90/simben $ ls /usr/lib/qt-3.3/bin/ls
ls: cannot access /usr/lib/qt-3.3/bin/ls: No
such file or directory

/home/cis90/simben $ ls /usr/local/bin/ls
ls: cannot access /usr/local/bin/ls: No such
file or directory

/home/cis90/simben $ ls /bin/ls
/bin/ls
```

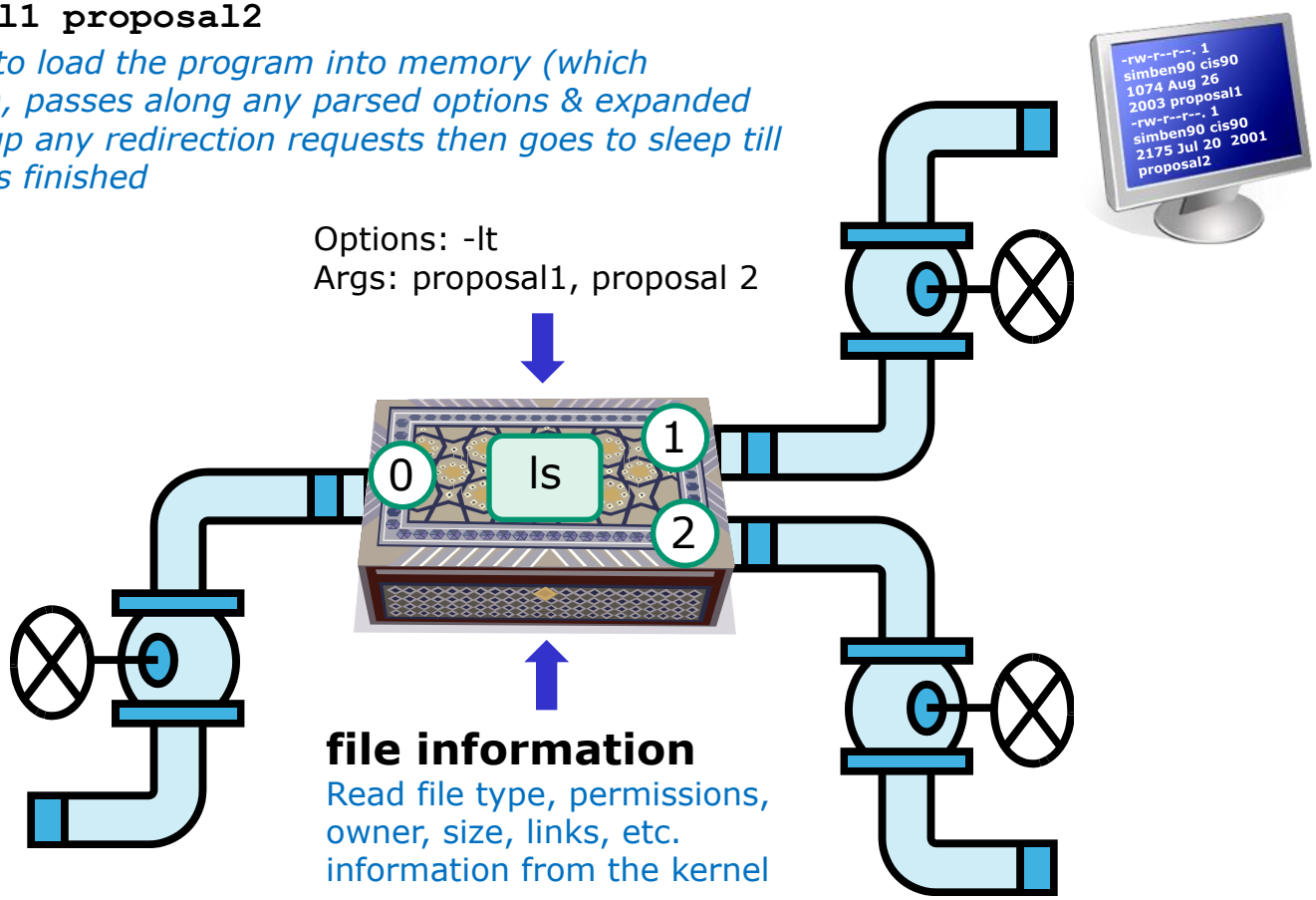
Life of the Shell

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

4) Execute the command

`ls -lt proposal1 proposal2`

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

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

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)

```
/home/cis90/simben $ ls -lt proposal1 proposal2
-rw-r--r--. 1 simben90 cis90 1074 Aug 26  2003 proposal1
-rw-r--r--. 1 simben90 cis90 2175 Jul 20  2001 proposal2
```

The shell sleeps while the ls process outputs these two lines

Life of the Shell

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

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

Life of the Shell

A
```
/home/cis90/simben $ Ls -lt proposal1 proposal2
-bash: Ls: command not found
```
What's wrong?
Who output the error?

B
```
/home/cis90/simben $ ls -lt proposal1 proposal5
ls: cannot access proposal5: No such file or directory
-rw-r--r--. 1 simben90 cis90 1074 Aug 26  2003 proposal1
```
What's wrong?
Who output the error?

C
```
/home/cis90/simben $ ls -lw proposal1 proposal2
ls: invalid line width: proposal1
```
What's wrong?
Who output the error?

D
```
/home/cis90/simben $ ls -lt proposal1proposal2
ls: cannot access proposal1proposal2: No such file or directory
```
What's wrong?
Who output the error?

E
```
/home/cis90/simben $ ls-lt proposal1 proposal2
-bash: ls-lt: command not found
```
What's wrong?
Who output the error?

Meta-characters

Metacharacters

When parsing, the shell gives special meaning to metacharacters

" - use double quotes to preserve blanks and allow variable expansion

' - use single quotes to preserve blanks and block variable expansion

$ - use to show the value rather than the name of a variable

; - allows multiple commands on one line

<enter key> - The invisible newline control character marking the end of a command

= - use to set variables to new values

**** - removes (escapes) the special powers of a metacharacter

Other metacharacters we will learn about later include:
*?, *, <, >, >>, !, |, [], {}, &, && and ||*

Metacharacters - quotes

- Double " quotes allow variable expansion
- Single ' quotes block variable expansion
- Both double and single quotes preserve blanks

```
/home/cis90/simben $ echo I am                    $LOGNAME      (3 arguments)
I am simben90 Extra blanks ignored, variable expanded
```

```
/home/cis90/simben $ echo "I am                   $LOGNAME"     (1 argument)
I am                 simben90  Extra blanks preserved, variable expanded to show value
```

```
/home/cis90/simben $ echo 'I am                   $LOGNAME'     (1 argument)
I am                 $LOGNAME  Extra blanks preserved, variable expansion blocked
```

Double quotes called weak quotes because they allow the shell to expand variables. Single quotes are called strong quotes because they block the shell from expanding variables.

Metacharacters - quotes

```
/home/cis90/simben $ echo '"double quotes"'
"double quotes"
```

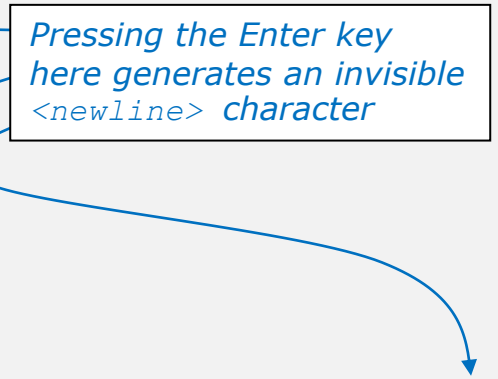
```
/home/cis90/simben $ echo "'single quotes'"
'single quotes'
```

Tip: single quotes can be used to output double quotes and vice-versa

Metacharacters - <enter key>

<enter key> - The invisible *newline* control character marking the end of a command

```
[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 <enter key> to end the command"
Use <enter key> to end the command
```



Metacharacters - \ (backslash)

The back slash \ removes (escapes) the special powers of a metacharacter

```
[rsimms@oslab ~]$ echo a b c d e f
a b c d e f

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

Escape the invisible newline <enter key> which marks the end of a command

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

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

Escape the $ (which shows the value of the variable)

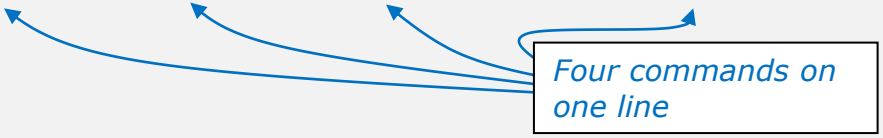
```
[rsimms@opus ~]$ echo "Hello World"
Hello World

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

Escape the double quote marks

Metacharacters - ; (semi-colon)

The semi-colon ; allows multiple commands on one line

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



Shortcuts

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

```
/home/cis90/simben $ hostname; name; echo $LOGNAME; ls Poems/Blake/
oslab.cishawks.net
-bash: name: command not found
simben90
jerusalem  tiger
/home/cis90/simben $ hostname; uname; echo $LOGNAME; ls Poems/Blake/
oslab.cishawks.net
Linux
simben90
jerusalem  tiger
```

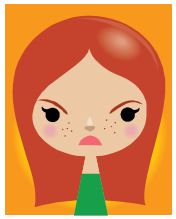
Press <tab> after the P and B and the shell fills in the rest

Press up arrow and the shell retypes the previous command

Use the left arrow to backup and fix the typo (uname instead of name)

Life without a path

-bash: *xxxx*: command not found

Don't get mad, just fix your path!

The Path

The shell uses your path to locate commands to execute

- A path is a ordered set of directories along which the shell will search to locate commands to execute
- The path is defined by the PATH variable
- Show your path with **echo $PATH**
- If you specify a command *xxxx* that the shell cannot find on the path it will print the following error message:

  -bash: *xxxx*: command not found

- To run a command that is not on your path the complete absolute pathname must be specified. e.g. /usr/bin/uname

The Path

Use this command to see the directories (separated by :'s) on your path

```
/home/cis90/simben $ echo $PATH
/usr/lib/qt-
3.3/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/sbin:/home/c
is90/simben/../bin:/home/cis90/simben/bin:.
```

The shell will search for the ls command along the path in this order:

```
/usr/lib/qt-3.3/bin
/usr/local/bin
/bin
/usr/bin
/usr/local/sbin
/usr/sbin
/sbin
/home/cis90/simben/../bin
/home/cis90/simben/bin
.
```

yes, . is a directory too and it is whatever directory you have currently changed into

Experiment – Breaking the Path

*The **echo** command is built into bash*

```
/home/cis90/simben $ type echo ps tty
echo is a shell builtin
ps is /bin/ps
tty is /usr/bin/tty
```

*the **ps** command is in the /bin directory*

/bin

*The **tty** command is in the /usr/bin directory*

/usr/bin

Experiment – Breaking the Path

Default path

```
/home/cis90/simben $ echo I love Linux
I love Linux
/home/cis90/simben $ date
Mon Sep  3 15:17:52 PDT 2012
/home/cis90/simben $ tty
/dev/pts/2
/home/cis90/simben $
```

TROUBLE!

```
/home/cis90/simben $ PATH=""
/home/cis90/simben $ echo $PATH

/home/cis90/simben $
```

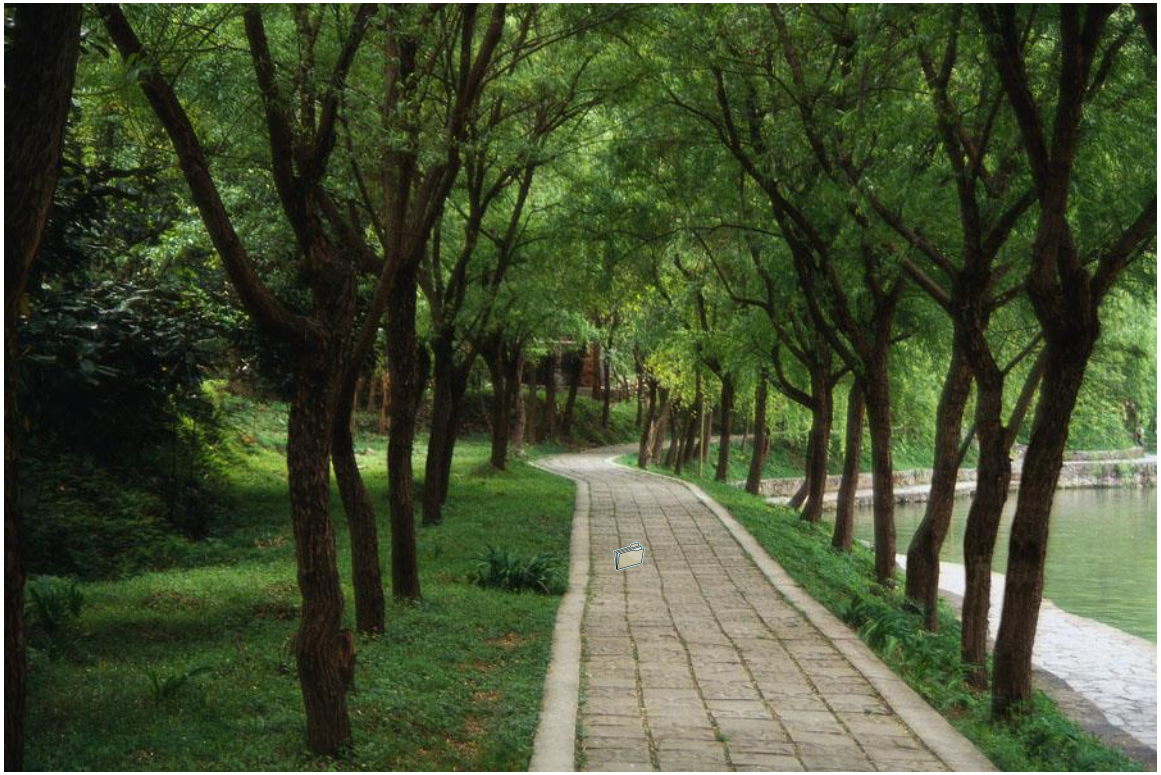
Break the path by setting it to null

No path

```
/home/cis90/simben $ echo I love Linux
I love Linux
/home/cis90/simben $ date
-bash: date: No such file or directory
/home/cis90/simben $ tty
-bash: tty: No such file or directory
```

*Only **echo** works because it is built into the shell!*

```
/home/cis90/simben $ echo $PATH

/home/cis90/simben $
```



There is nothing on the path!

Experiment – Restoring the Path

```
/home/cis90/simben $ PATH=/bin
/home/cis90/simben $ echo $PATH
/bin
/home/cis90/simben $

/home/cis90/simben $ echo I love Linux
I love Linux
/home/cis90/simben $ date
Mon Sep  3 15:24:19 PDT 2012
/home/cis90/simben $ tty
-bash: tty: No such file or directory
```

Add the /bin directory to the path

***echo** works because it is built into the shell*

***date** works because it resides in the /bin directory which is now on the path*

***tty** does not work because it is in the /usr/bin directory which is not on the path*

```
/home/cis90/simben $ echo $PATH
/bin
/home/cis90/simben $
```

Experiment – Restoring the Path

```
/home/cis90/simben $ PATH=$PATH:/usr/bin
/home/cis90/simben $ echo $PATH
/bin:/usr/bin
/home/cis90/simben $

/home/cis90/simben $ echo I love Linux
I love Linux
/home/cis90/simben $ date
Mon Sep  3 15:24:19 PDT 2012
/home/cis90/simben $ tty
/dev/pts/2
```

Append the /usr/bin directory to the path

All three commands work because /bin and /usr/bin are on the path.

The shell will only run commands found in the directories that make up the path

```
/home/cis90/simben $ echo $PATH
/bin:/usr/bin
/home/cis90/simben $
```

Need a fresh start -- just log out and back in again and your path will be back to normal!

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.)
```

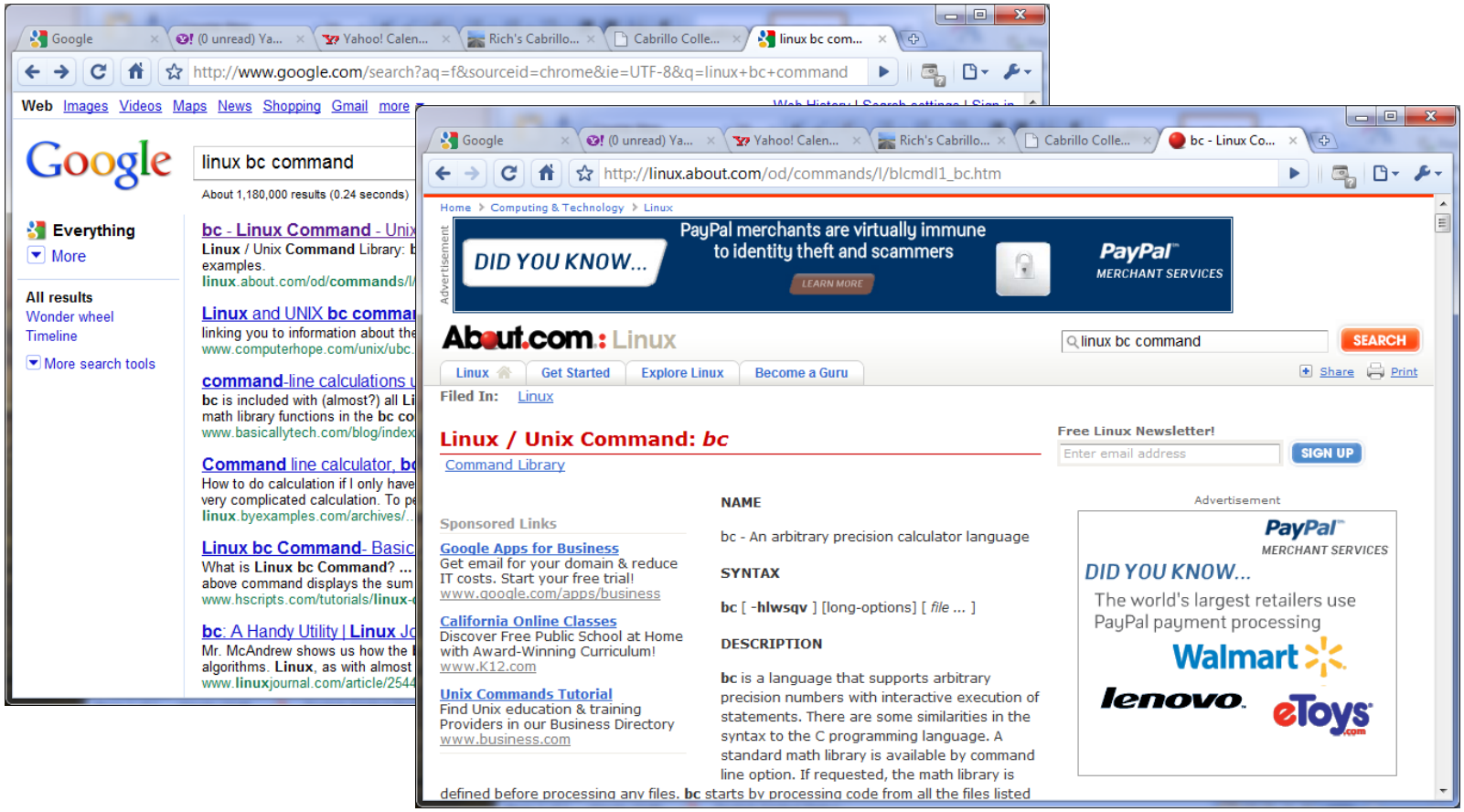
Use these keys to scroll

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

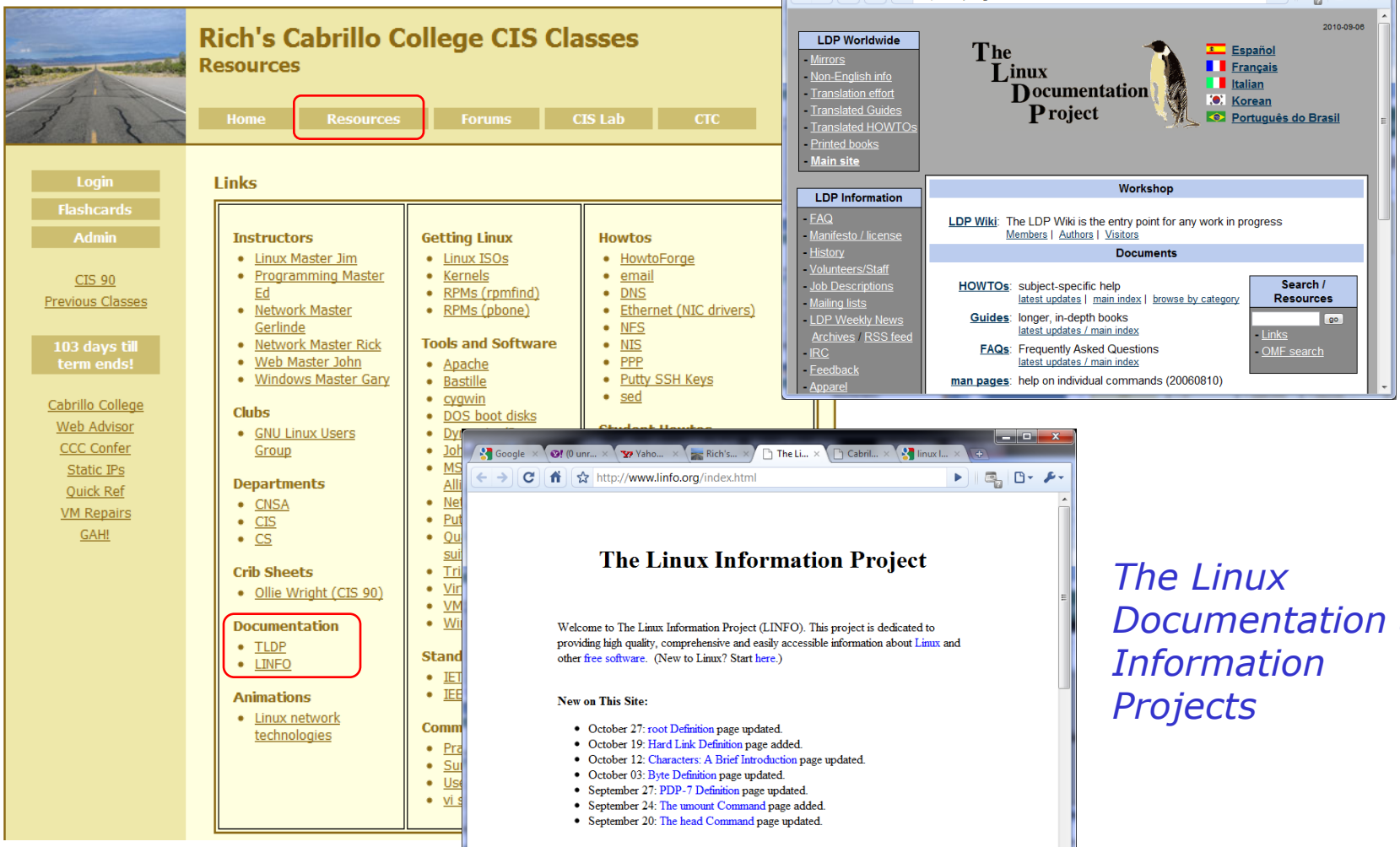


Other Documentation

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

Documentation

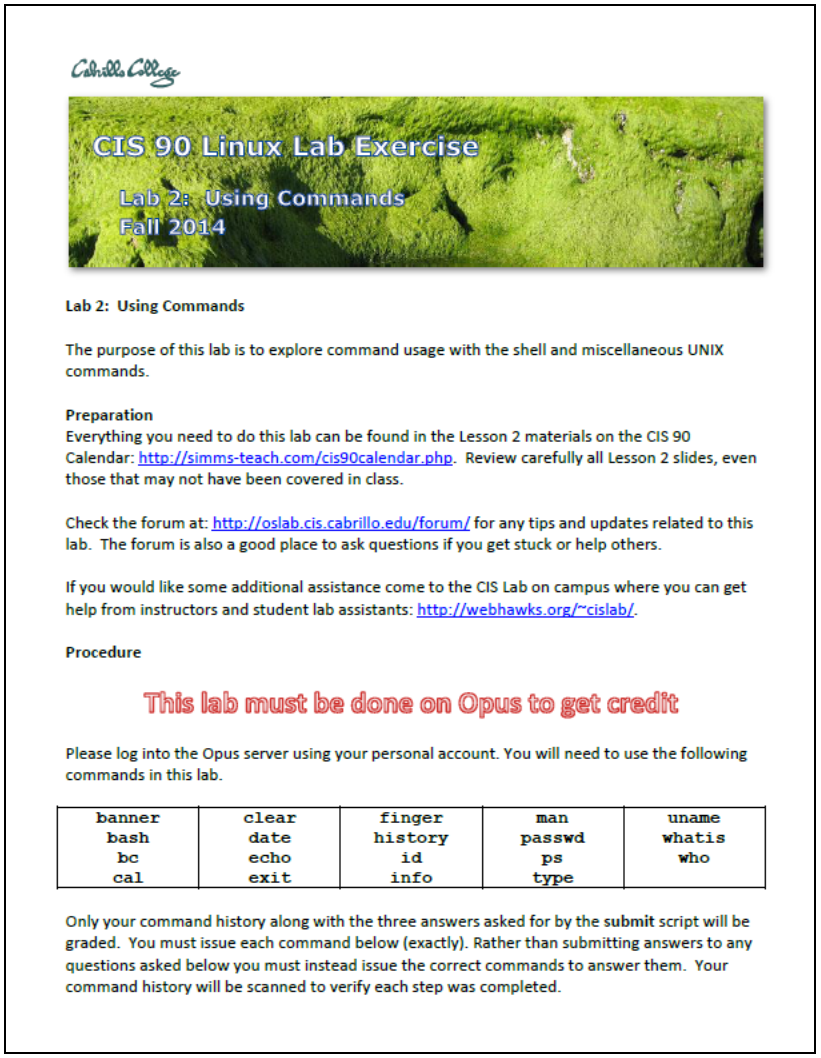
Two of my favorite documentation links



The Linux Documentation and Information Projects

Wrap up

Lab 2 - Using Commands



Cabrillo College

CIS 90 Linux Lab Exercise

Lab 2: Using Commands
Fall 2014

Lab 2: Using Commands

The purpose of this lab is to explore command usage with the shell and miscellaneous UNIX commands.

Preparation
Everything you need to do this lab can be found in the Lesson 2 materials on the CIS 90 Calendar: http://simms-teach.com/cis90calendar.php. Review carefully all Lesson 2 slides, even those that may not have been covered in class.

Check the forum at: http://oslab.cis.cabrillo.edu/forum/ for any tips and updates related to this lab. The forum is also a good place to ask questions if you get stuck or help others.

If you would like some additional assistance come to the CIS Lab on campus where you can get help from instructors and student lab assistants: http://webhawks.org/~cislab/.

Procedure

This lab must be done on Opus to get credit

Please log into the Opus server using your personal account. You will need to use the following commands in this lab.

banner	clear	finger	man	uname
bash	date	history	passwd	whatis
bc	echo	id	ps	who
cal	exit	info	type	

Only your command history along with the three answers asked for by the **submit** script will be graded. You must issue each command below (exactly). Rather than submitting answers to any questions asked below you must instead issue the correct commands to answer them. Your command history will be scanned to verify each step was completed.

- This lab MUST be done on Opus to get credit
- You don't need to turn in answers for steps 1-22. However I will check your command history to verify you entered the correct commands to answer those questions.
- There are three questions to answer on the **submit** script.

New commands:

apropos	- search for string in whatis database
bc	- binary calculator
cat	- print file(s)
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.

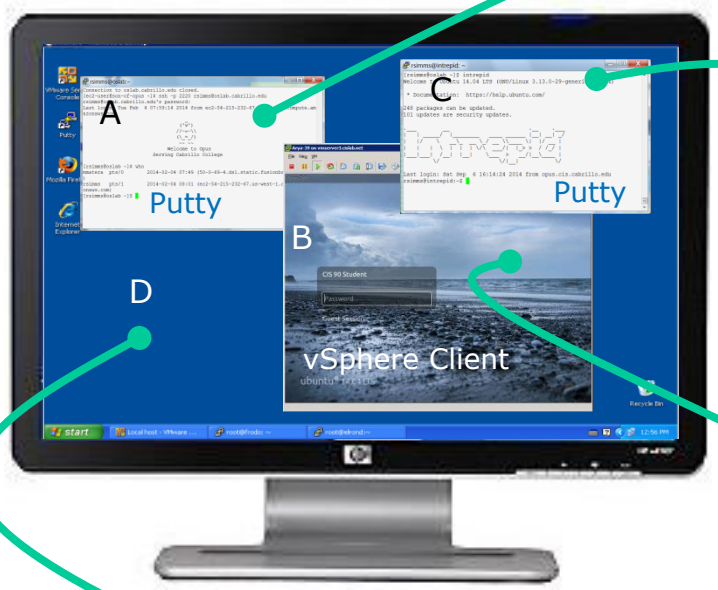
Lab #2

Quiz questions for next class:

- Which four directories typically contain the majority of the UNIX/Linux system commands?
- How do you show your path?
- What command would allow you to view the manual page for the who command?

Backup

Logging into the various CIS 90 systems from home or the lab



vmserver2 (a VMware ESXi server)

Opus

In room 830

vmserver3 (a VMware ESXi server)

In room 830

arya-xx
defiant
lexington
enterprise
intrepid
freedom
excalibur

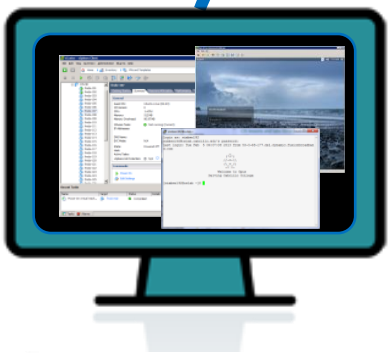
Your Computer
In the lab or at home

A) Opus (oslab.cis.cabrillo.edu) using ssh/Putty
B) Arya(s) using VLab
C) Lab 1 scavenger hunt systems using ssh/Putty
D) Your computer's desktop

Using CIS VLab (Virtual Lab)

Third driving lesson

Accessing CIS VLab VMs



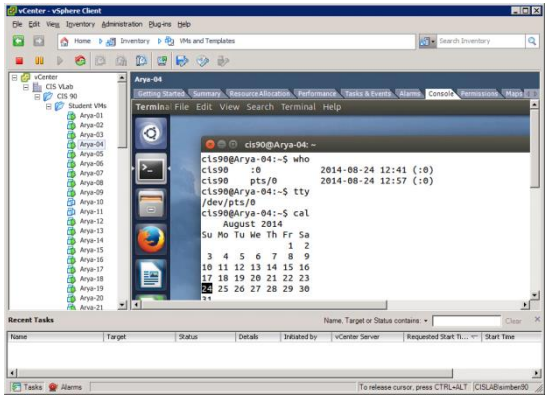
Home

School

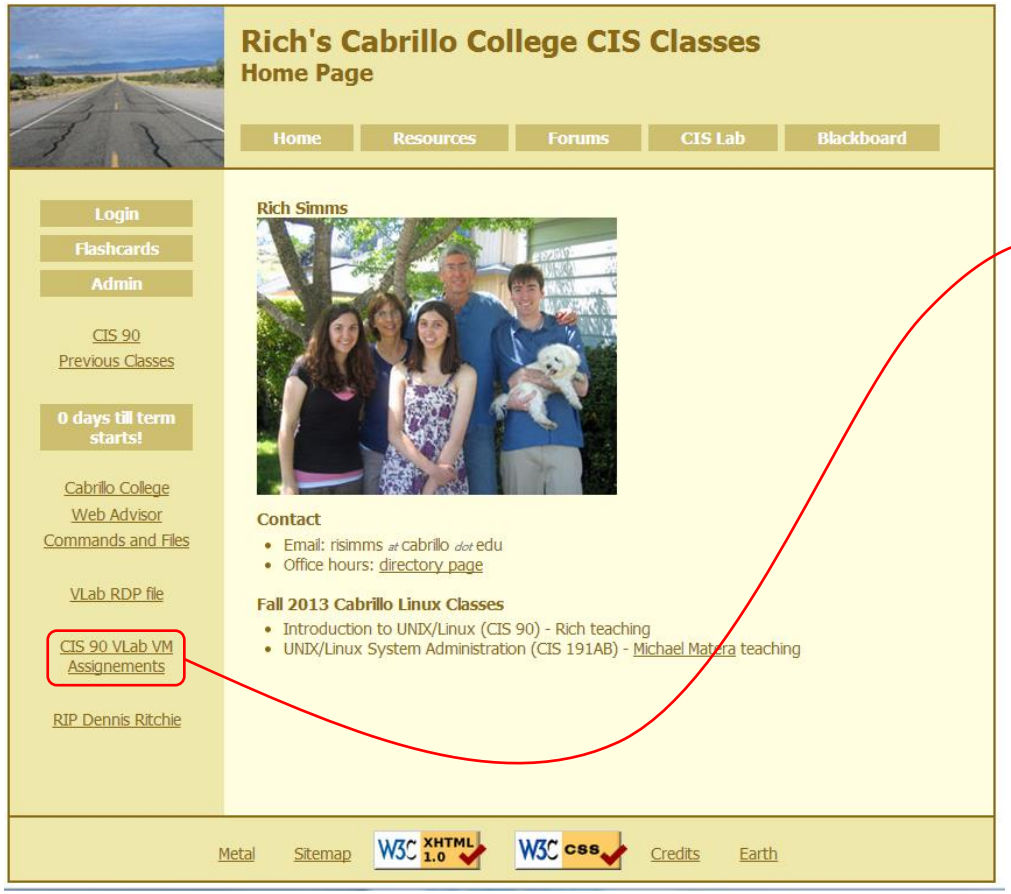
Travel

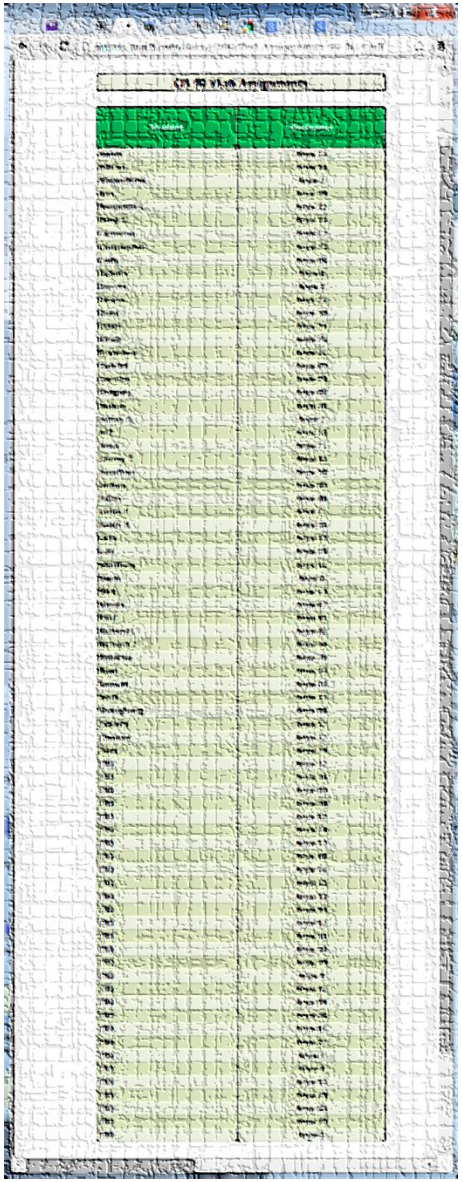
Internet

CIS Lab servers on the Aptos campus



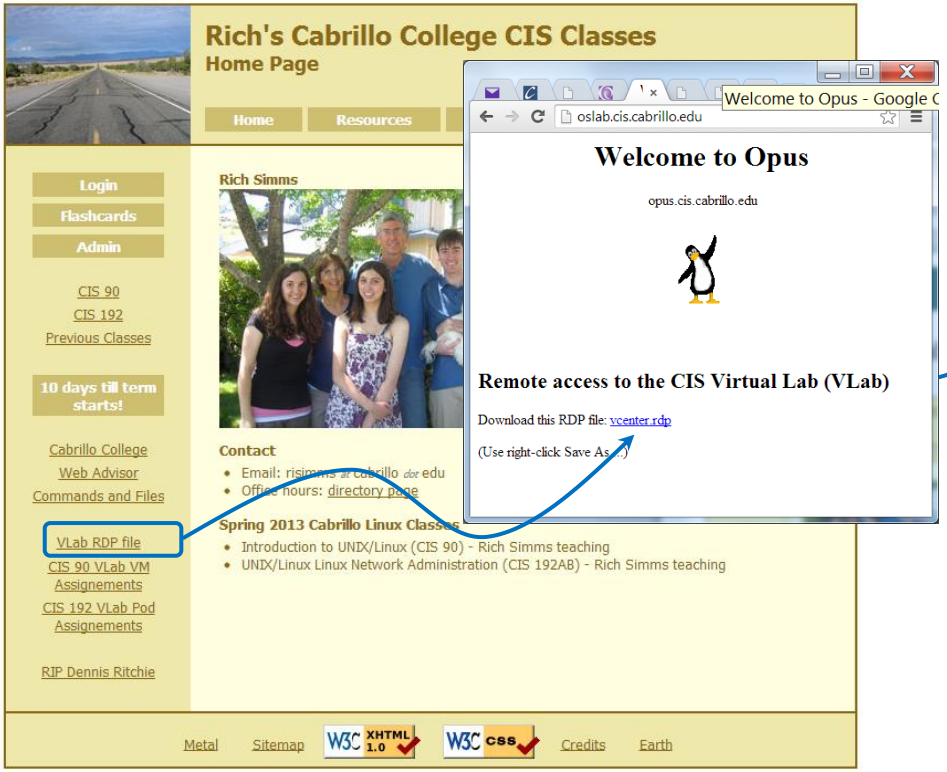
vmware

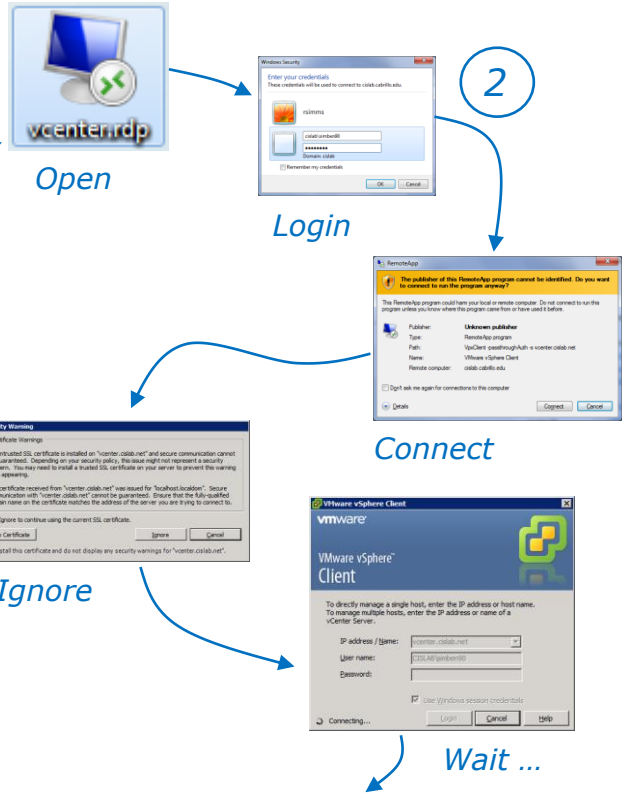


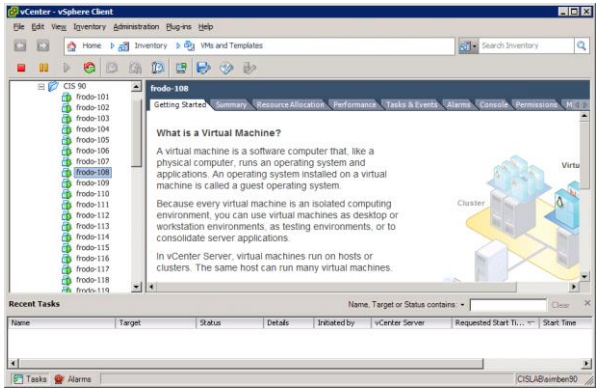


To see which Arya VM is yours use the link on the class website

Accessing CIS VLab







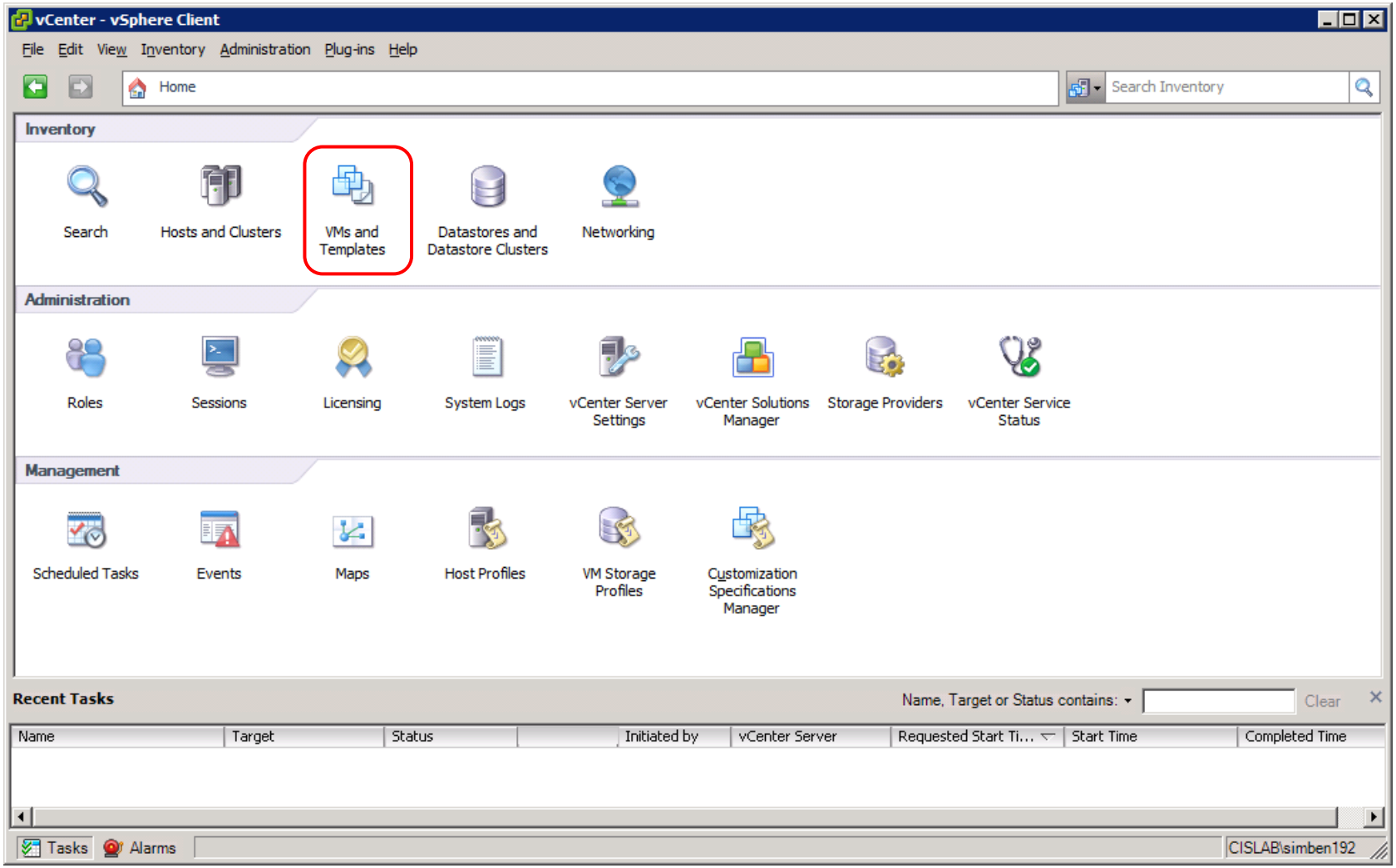
Locate and select your assigned VM

1) Download the vcenter.rdp file to your desktop and then open it to access VLab.

*2) Mac users will **need to install** CoRD.*

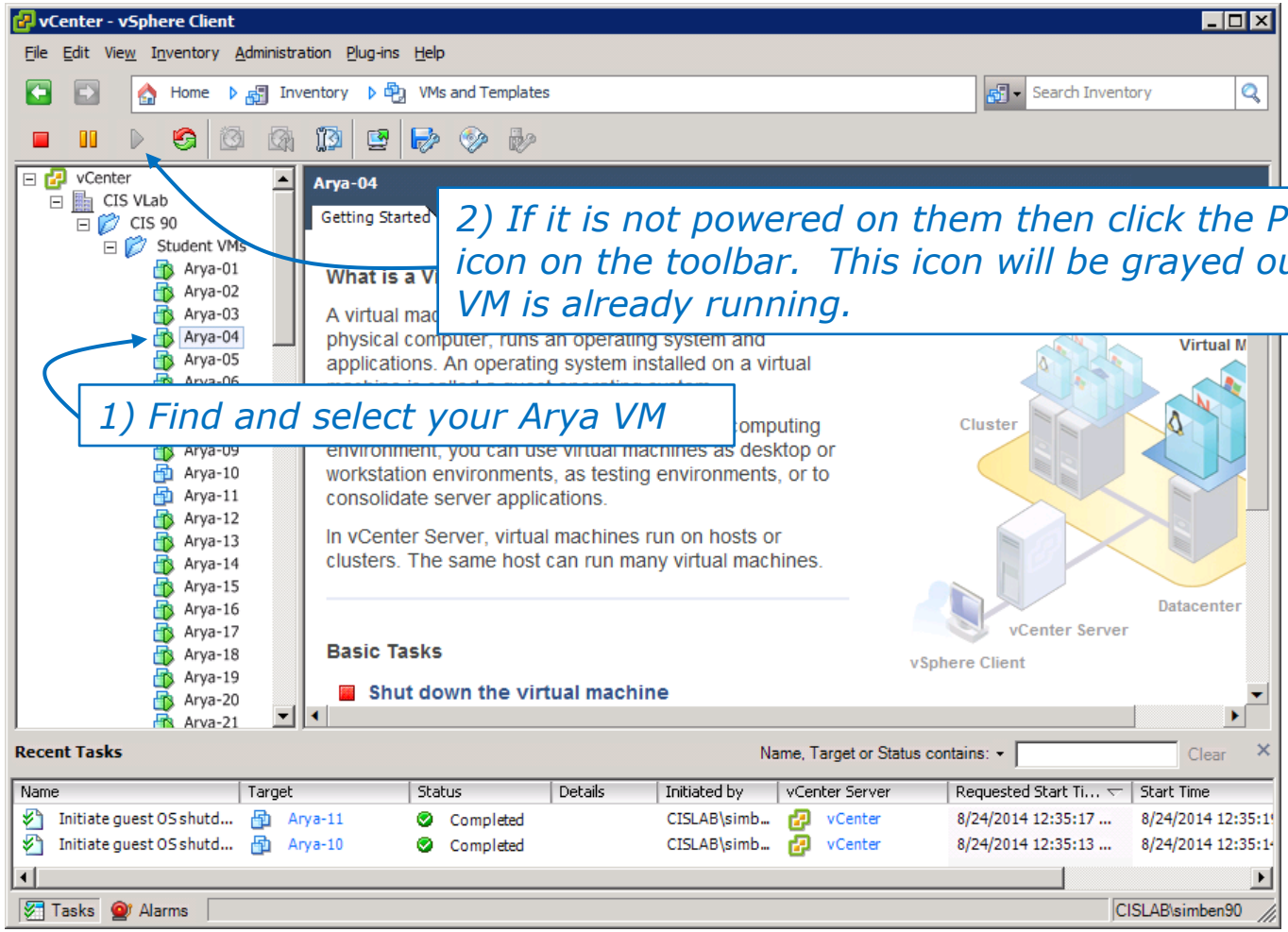
3) When entering your username and password you must preface your username with the "cislab\", for example Benji would use: cislab\simben90

CIS VLab Home View



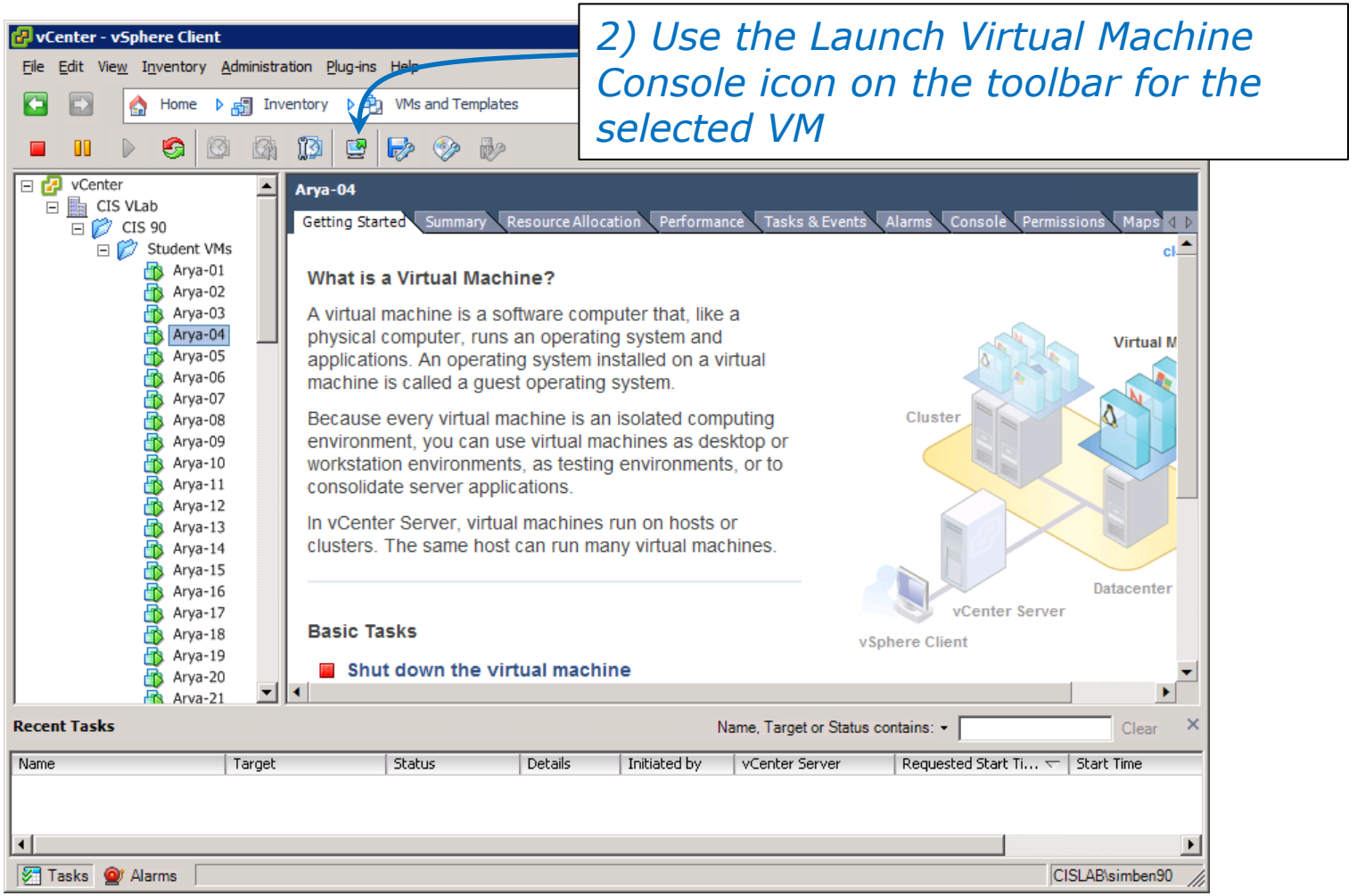
Click VMs and Templates to get to your course VMs

Selecting and powering on your VM

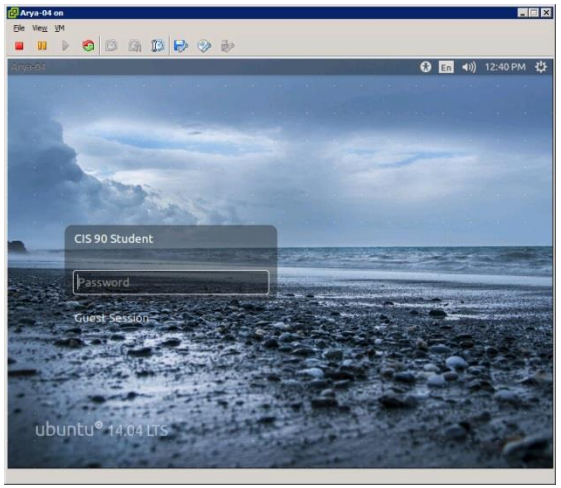


Note that the Arya-10 and Arya-11 VMs above are not powered on

Launching a graphical console



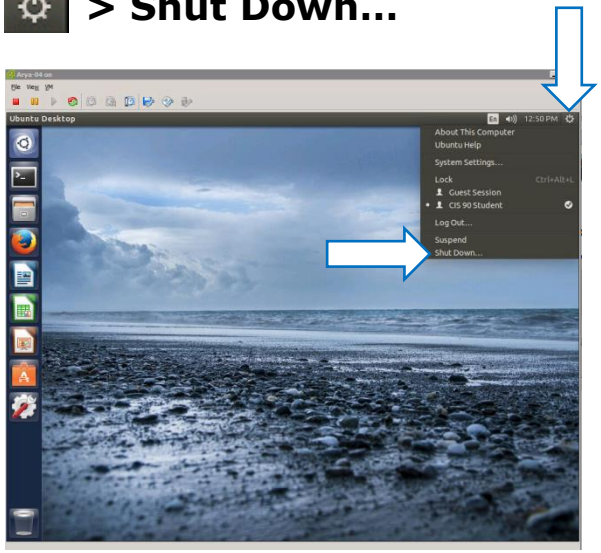
Log in as
CIS 90 Student



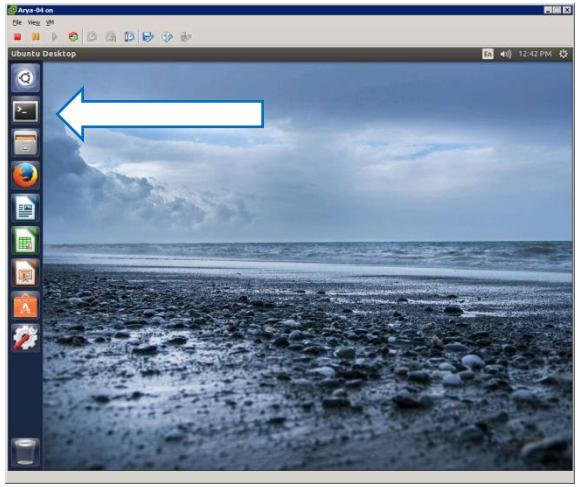
The Arya VM

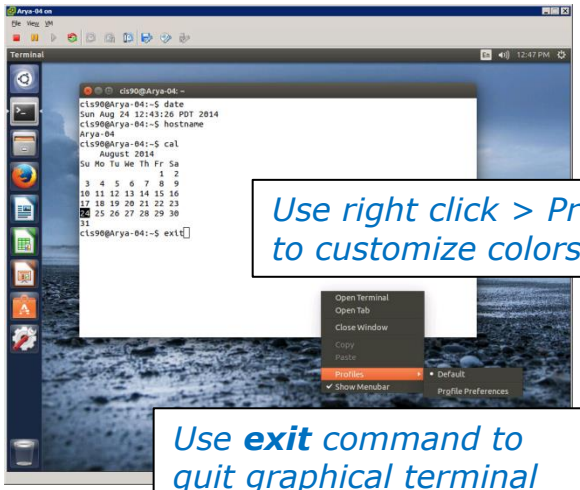
ubuntu

Shutdown using
> Shut Down…



To get a graphical terminal
Terminal icon (under System Settings)





Use right click > Profiles to customize colors

*Use **exit** command to quit graphical terminal*

Command Line vs Graphical Desktop

Access the UNIX/Linux systems using:

ssh when:

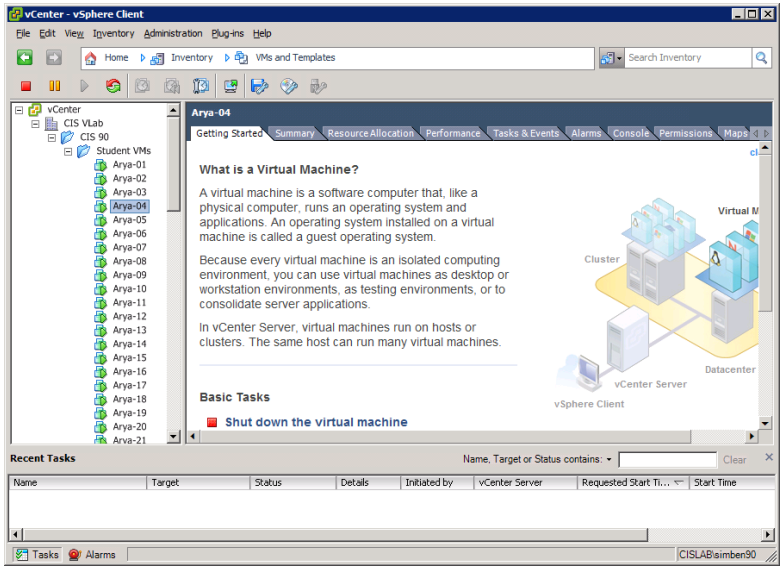
- You just need a command line
- Have a low or high speed network connection
- Note: Windows users can use Putty

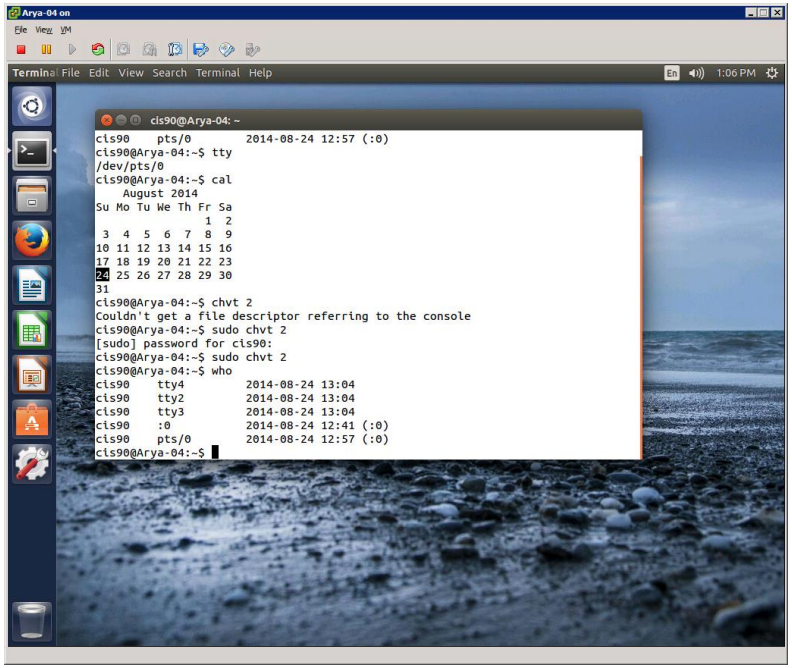
VLab when:

- You want a graphical desktop
- You want to use virtual terminals (the very basic black consoles)
- Note: High speed network connection is needed
- Note: Mac users can use CoRD
- Note: you may need a fix applied to your VM if you experience the dreaded "unintended repeating key" issue

VLab = using the VMware vSphere Client via a Remote Desktop (RDP) connection

Class Activity





Try logging into CIS VLab with your **own credentials**

- Find your VM
- Power it on (if it's not already)
- Open a separate console for your VM
- Login as CIS 90 Student into the graphical desktop
- Run a terminal on the graphical desktop

Virtual Terminals (consoles)

Fourth driving lesson

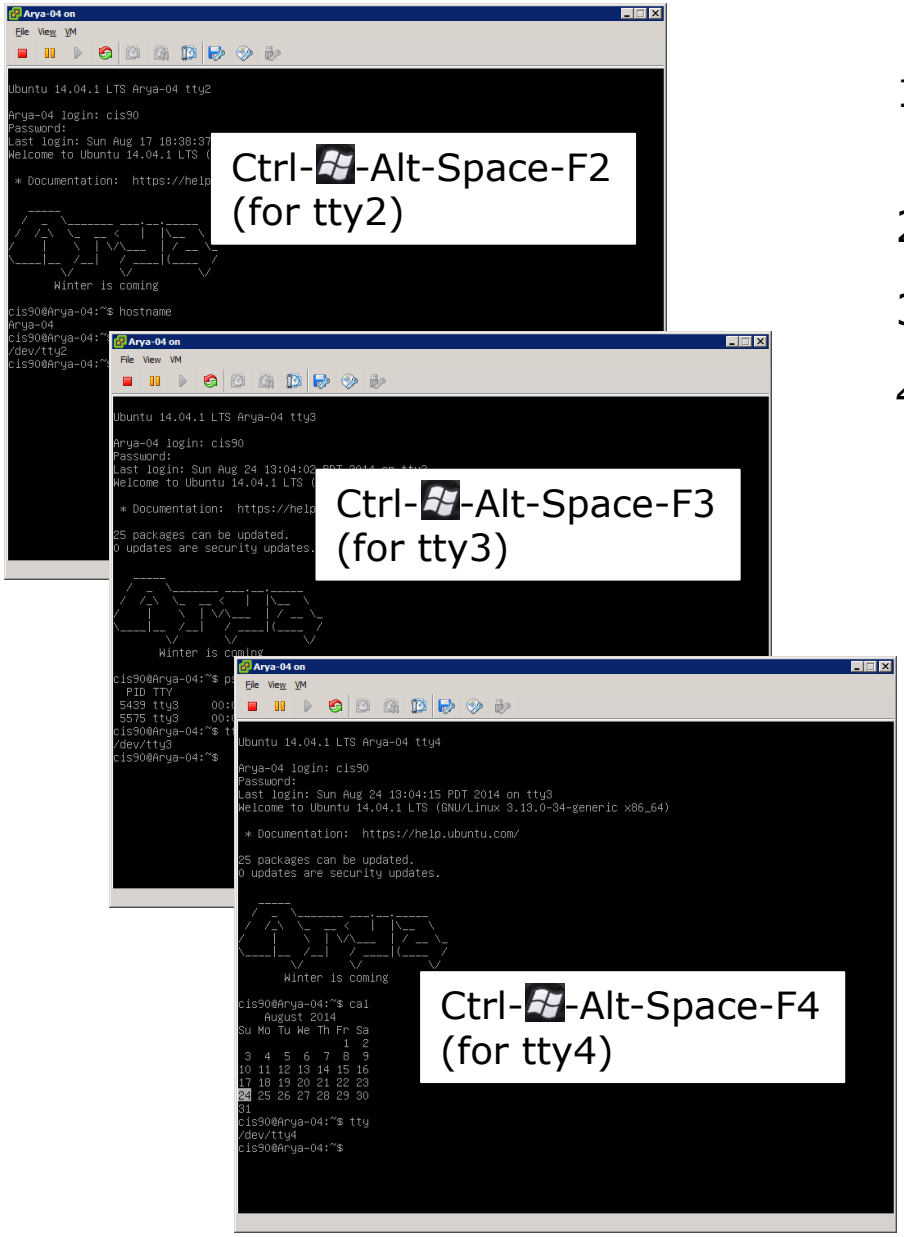
Virtual Terminals

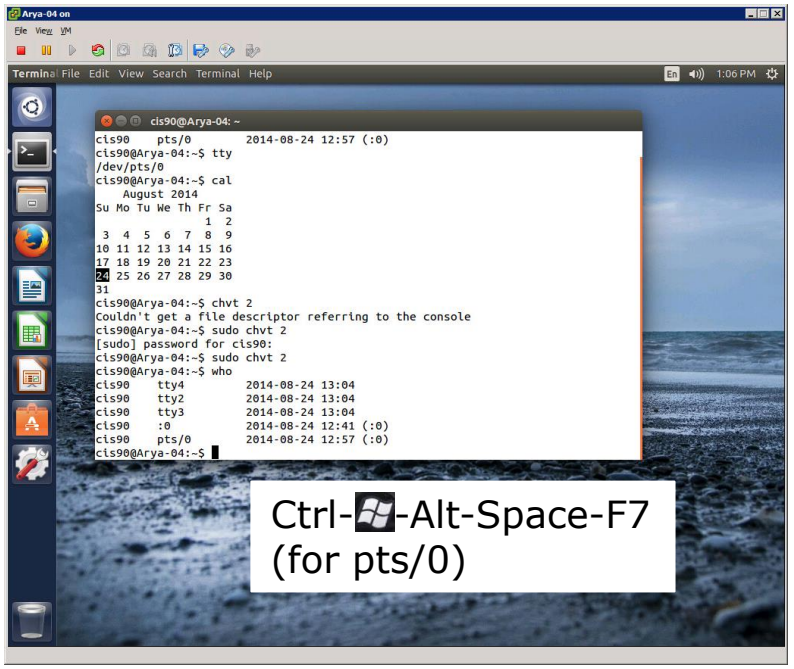
1) While holding down Crtl-⊞-Alt keys, tap Space, then tap F*n* key

2) or try: **chvt** *n*

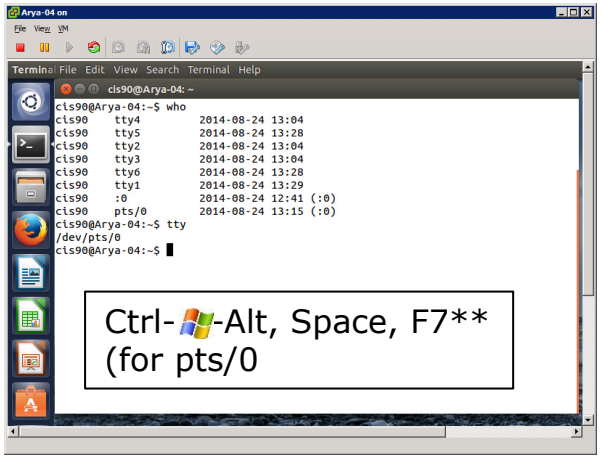
3) or try: **sudo chvt** *n*

4) or try: <alt-key> n
(in an Ubuntu virtual terminal)

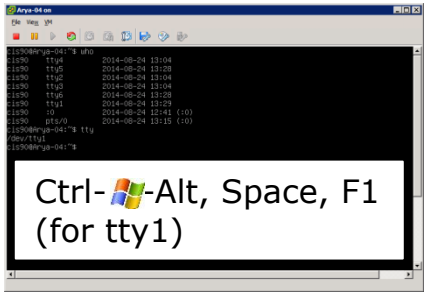


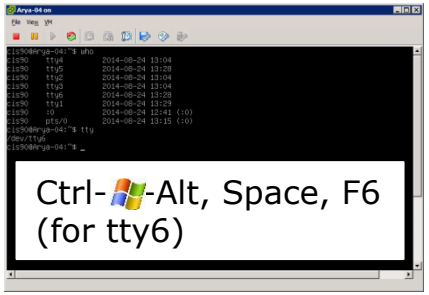


Changing Virtual TTY Terminals using **VMware vSphere**

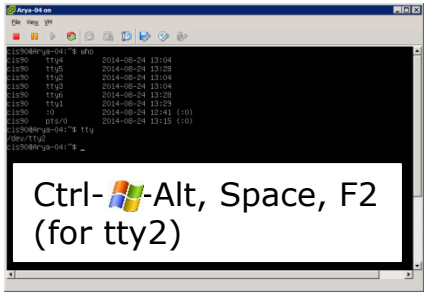


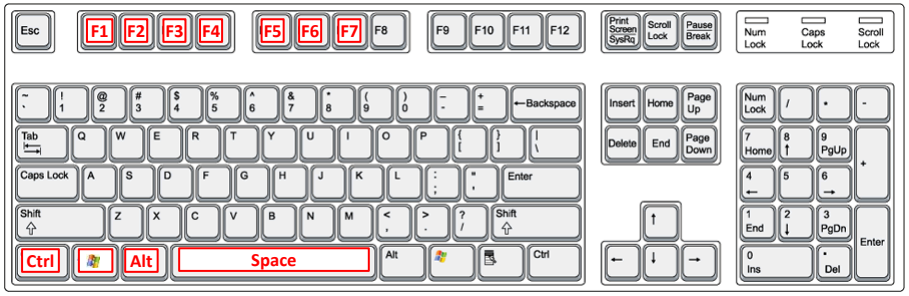
Windows PC Keyboard

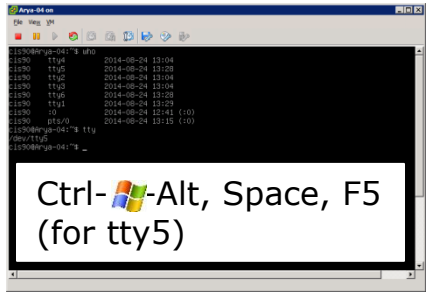


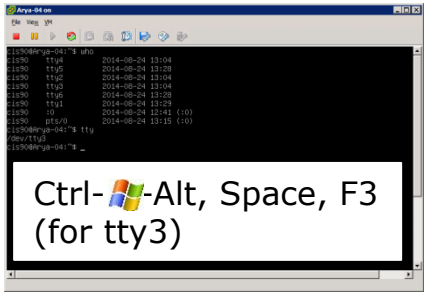


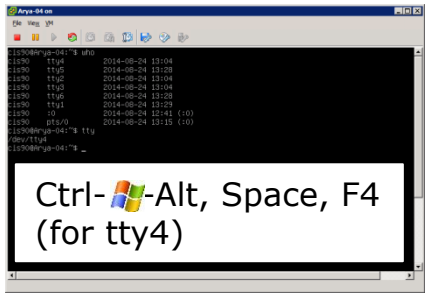
While holding down Crtl-⊞-Alt keys, tap Space, then tap Fn key*











*On some PC keyboards it is not necessary to use the ⊞ key

Note: This is for vSphere only. The ⊞ key and Space bar are not pressed for physical (non-VM) servers

Changing Virtual Terminals on VMware Linux VMs

VMware operations	
On PC Keyboard:	While holding down the Ctrl-⊞-Alt keys, tap spacebar then tap f1, f2, ... or f7.
On Mac keyboard:	Hold down Control and Option keys, tap the spacebar, hold down fn key (in addition to Control and Option keys) and tap f1, f2, ... or f7.

Pressing the ⊞ on some Windows keyboards may not be necessary

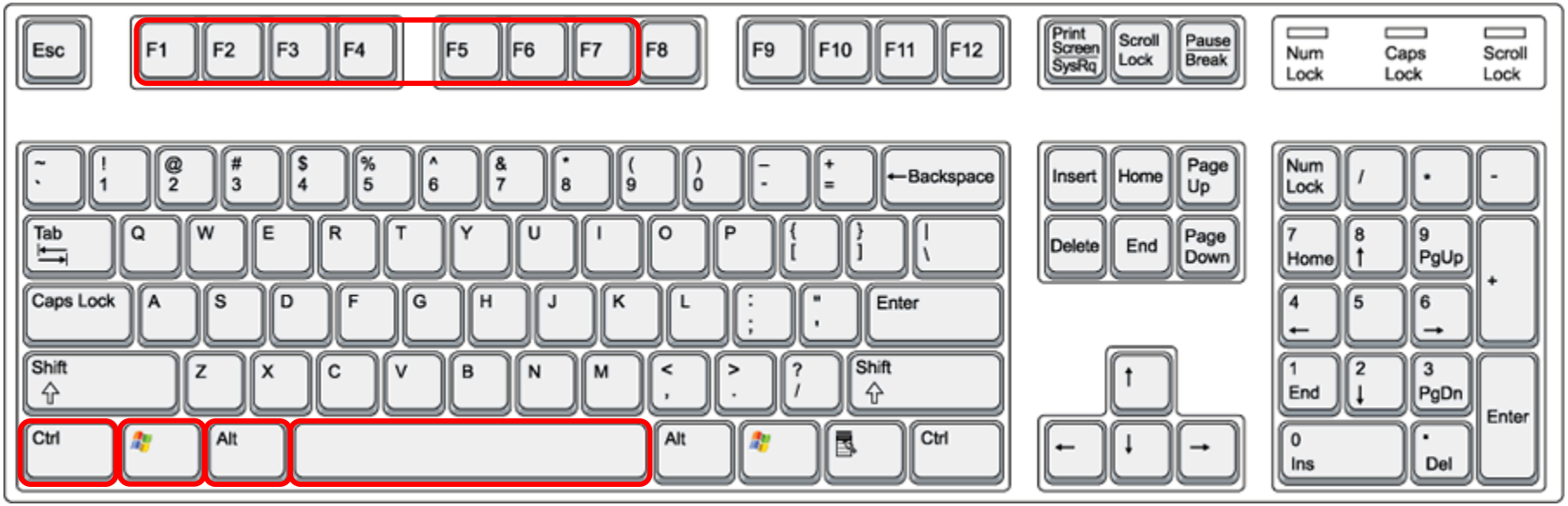
F7 is graphics mode for the Ubuntu VMs.

The Centos VMs do not have a graphics mode components installed (run level 3 only)

Note: the spacebar does not need to be tapped on a physical (non-VM) system. This is only required when changing virtual terminals on VMware VMs.

VMware VM Operations

Changing Virtual Terminals with a PC keyboard



On PC keyboard:

While holding down the **Ctrl-**⊞**-Alt** keys,
tap **Spacebar** then tap **F***n* key
(where *n*=1-7 to specify a function key)

VMware VM Operations

Changing Virtual Terminals with a Mac keyboard

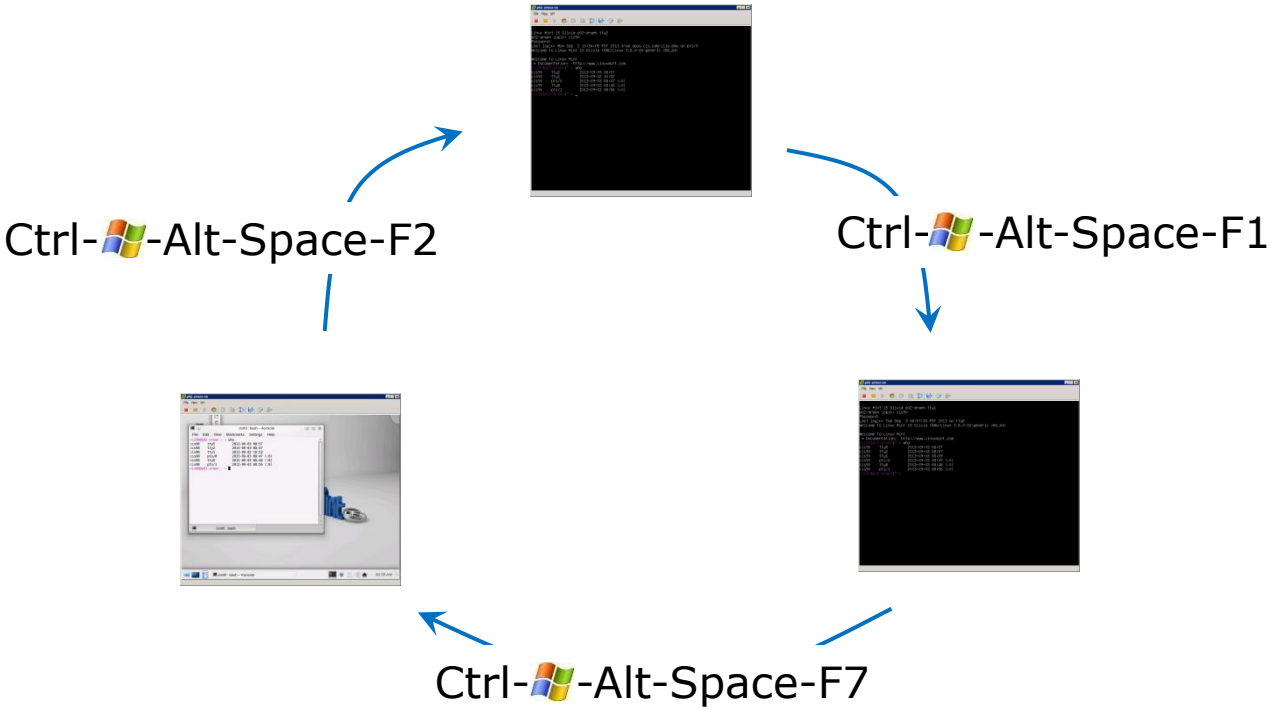
On Mac keyboard:

While holding down the **control-option** keys

tap **Spacebar** then tap **fn-F***n* keys

(where *n*=1-7 to specify a function key)

Class Activity



On your VM:

- Try changing between the graphical desktop and the TTYs
- Login as cis90 on tty1 and tty2
- Run a terminal on the graphical desktop
- Use the who command to see how many logins there are

Terminals

Hardware Terminals

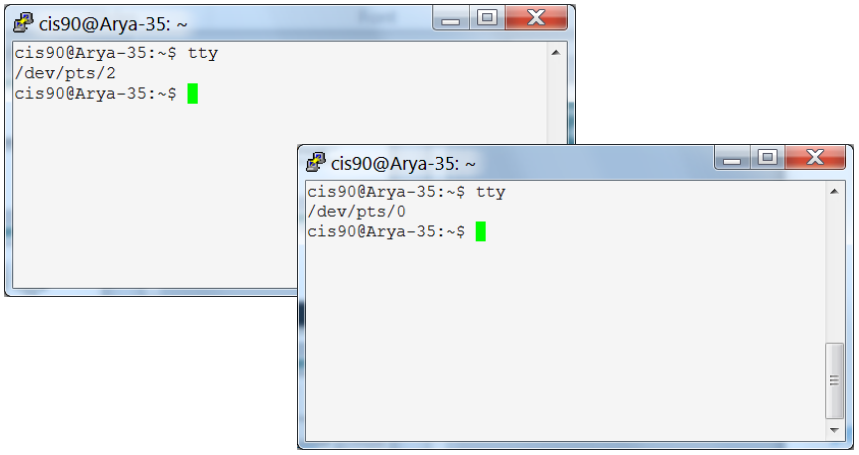
Teletype (TTY)

VT100

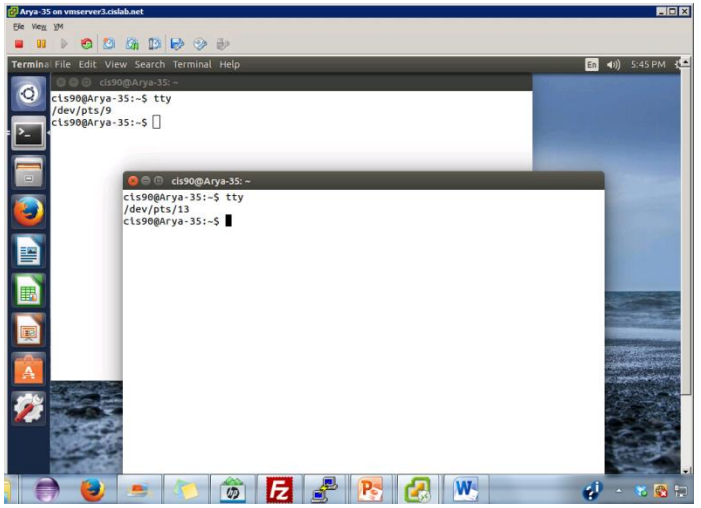
Terminals were used in the old days to interact with "minicomputers" and "mainframe" computers.

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

Software Terminals



Terminal emulators like PuTTY (with scroll bars, colors, customizable backgrounds, fonts and sizes) for Windows

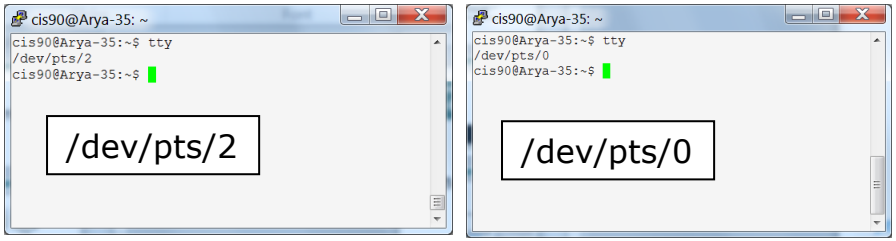


Graphical terminals (with scroll bars, colors, customizable backgrounds, fonts and sizes) built into Linux/Mac computers

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

Various terminal devices on an Arya VM

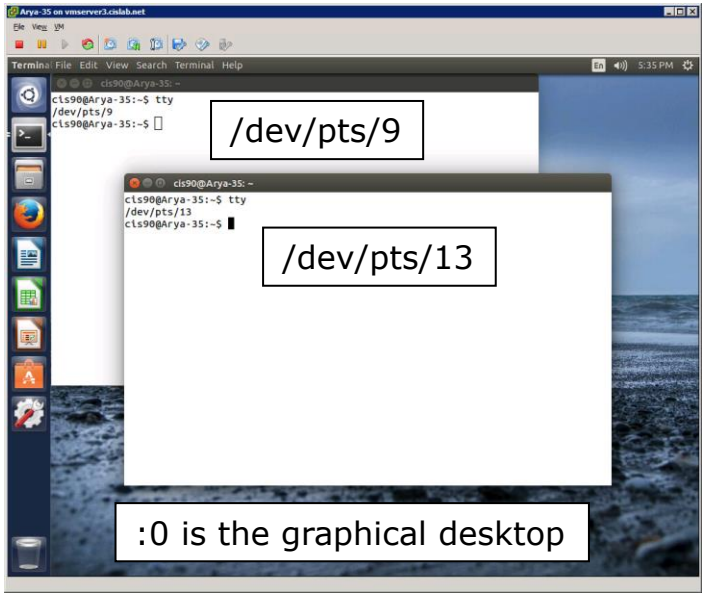
Terminal emulators (e.g. Putty)



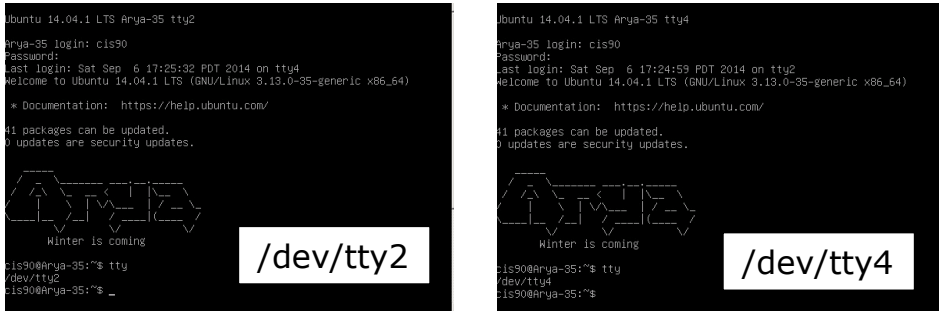

```
cis90@Arya-35:~$ who
cis90    tty4         2014-09-06 17:25
cis90    tty2         2014-09-06 17:25
cis90    pts/2        2014-09-06 17:20 (enterprise.cis.cabrillo.edu)
cis90    :0           2014-09-06 17:20 (:0)
cis90    pts/0        2014-09-06 17:21 (2601:9:6680:53b:4d09:e2b6:e7fc:d999)
cis90    pts/9        2014-09-06 17:22 (:0)
cis90    pts/13       2014-09-06 17:23 (:0)
```

pts=pseudo terminal,
tty=teletype
:n=an X window display number

Graphical terminals on graphical desktop



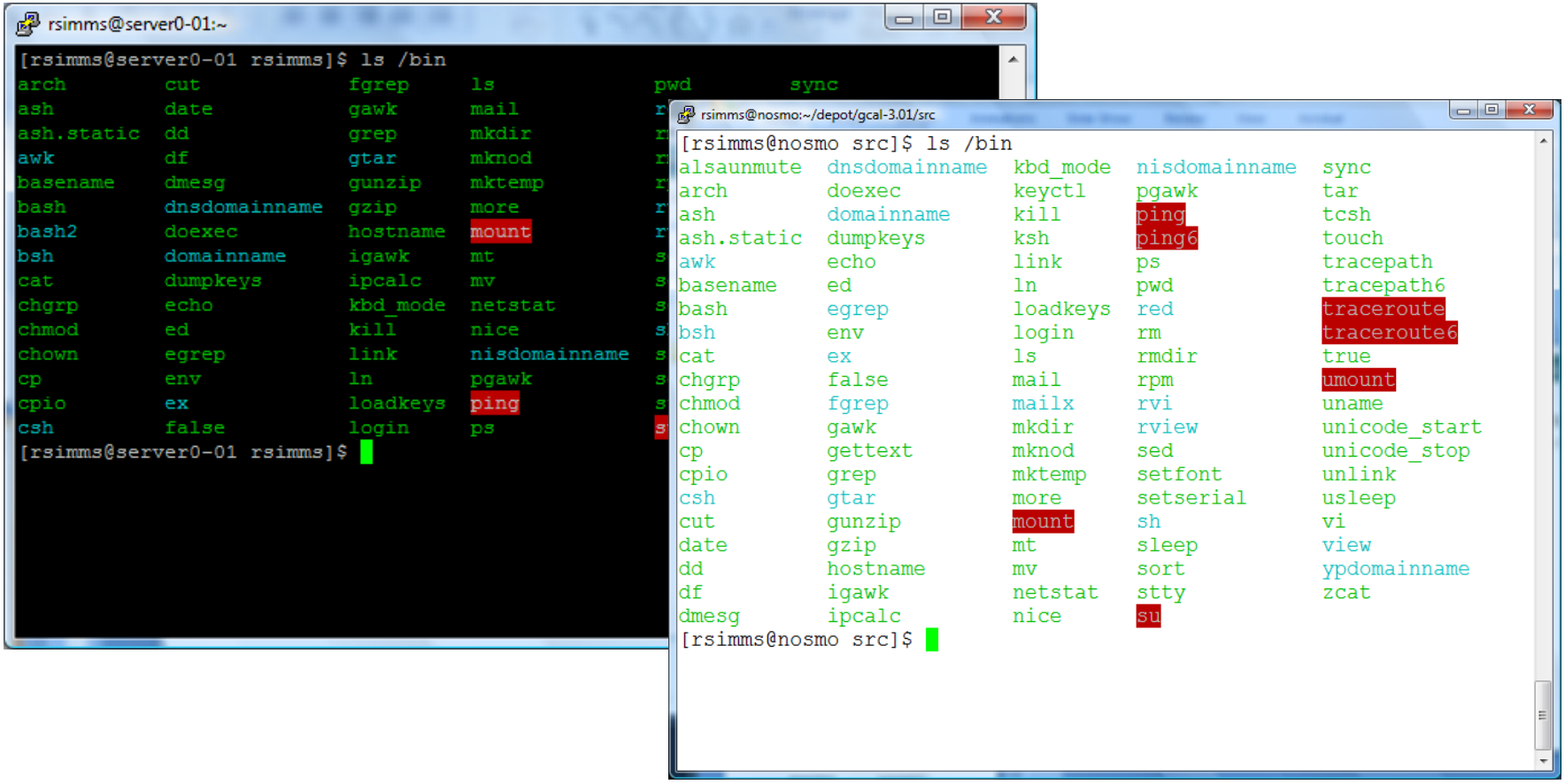
Virtual terminals



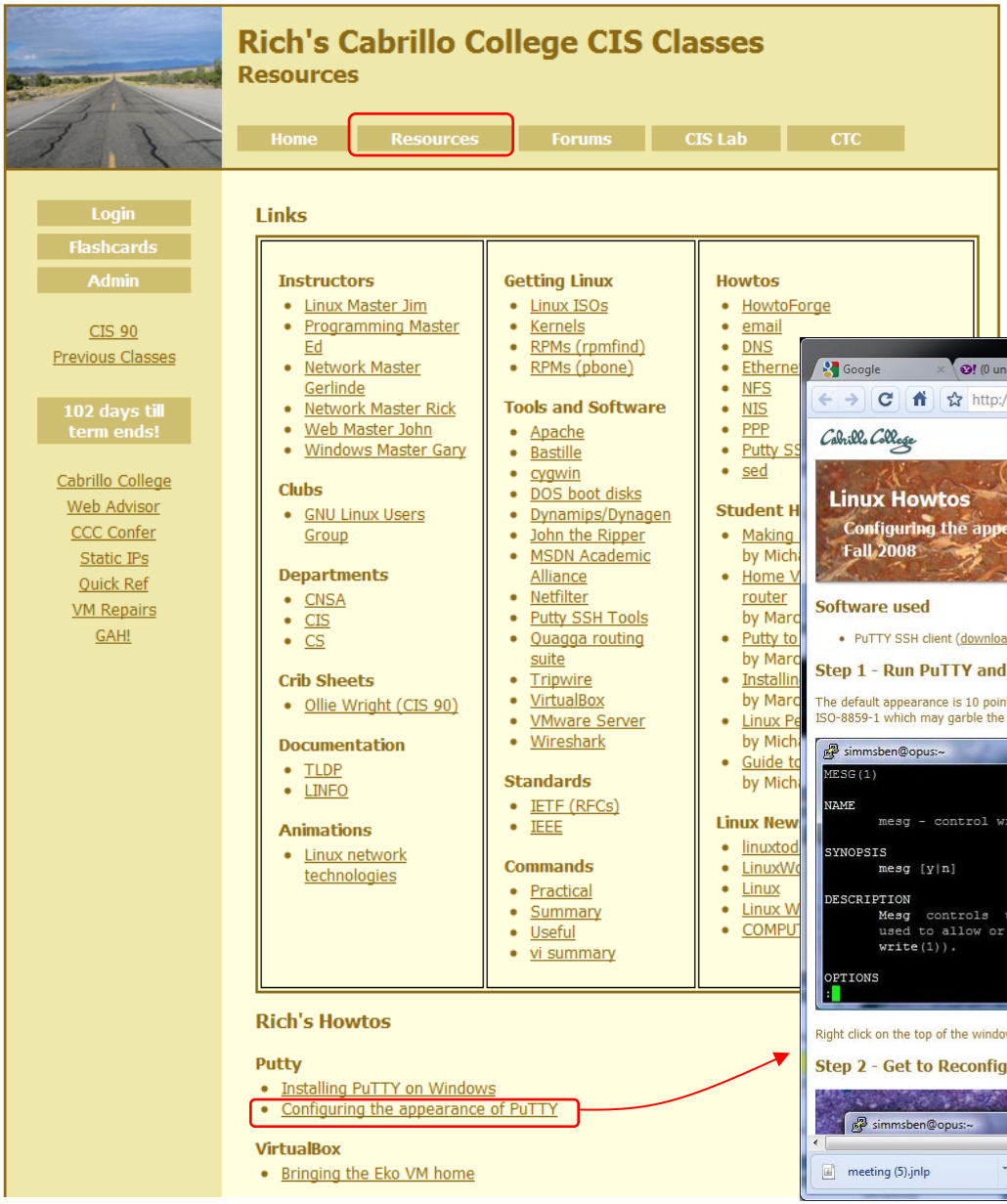
Putty Tips

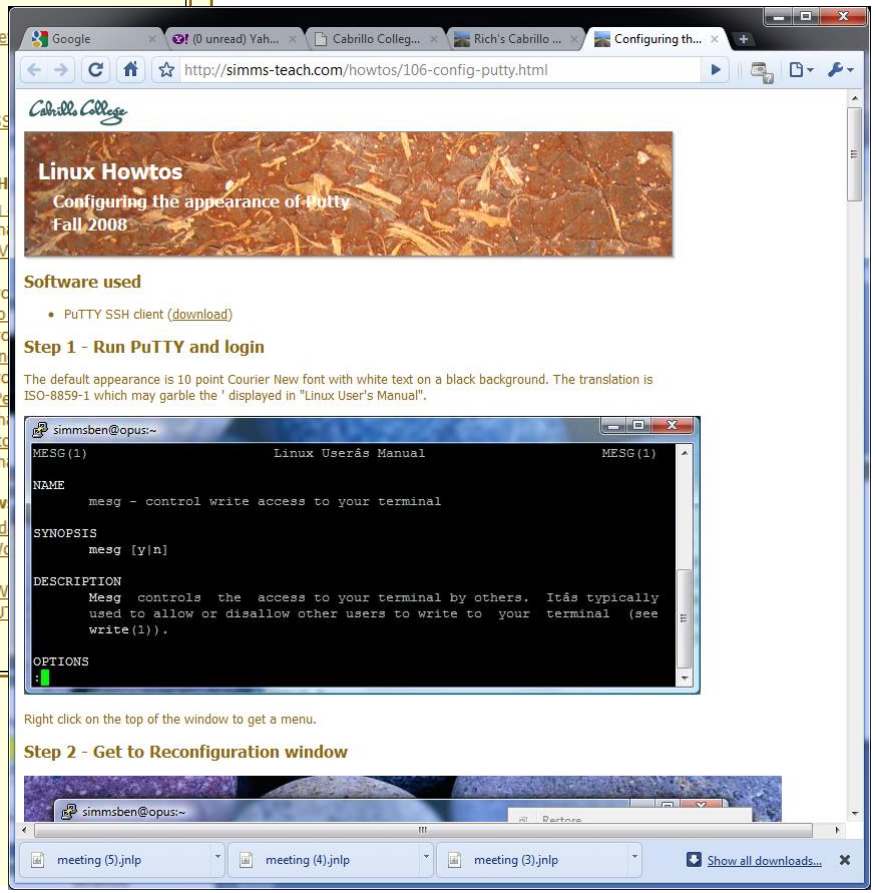
(Note: tty = teletype)

The Putty program



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

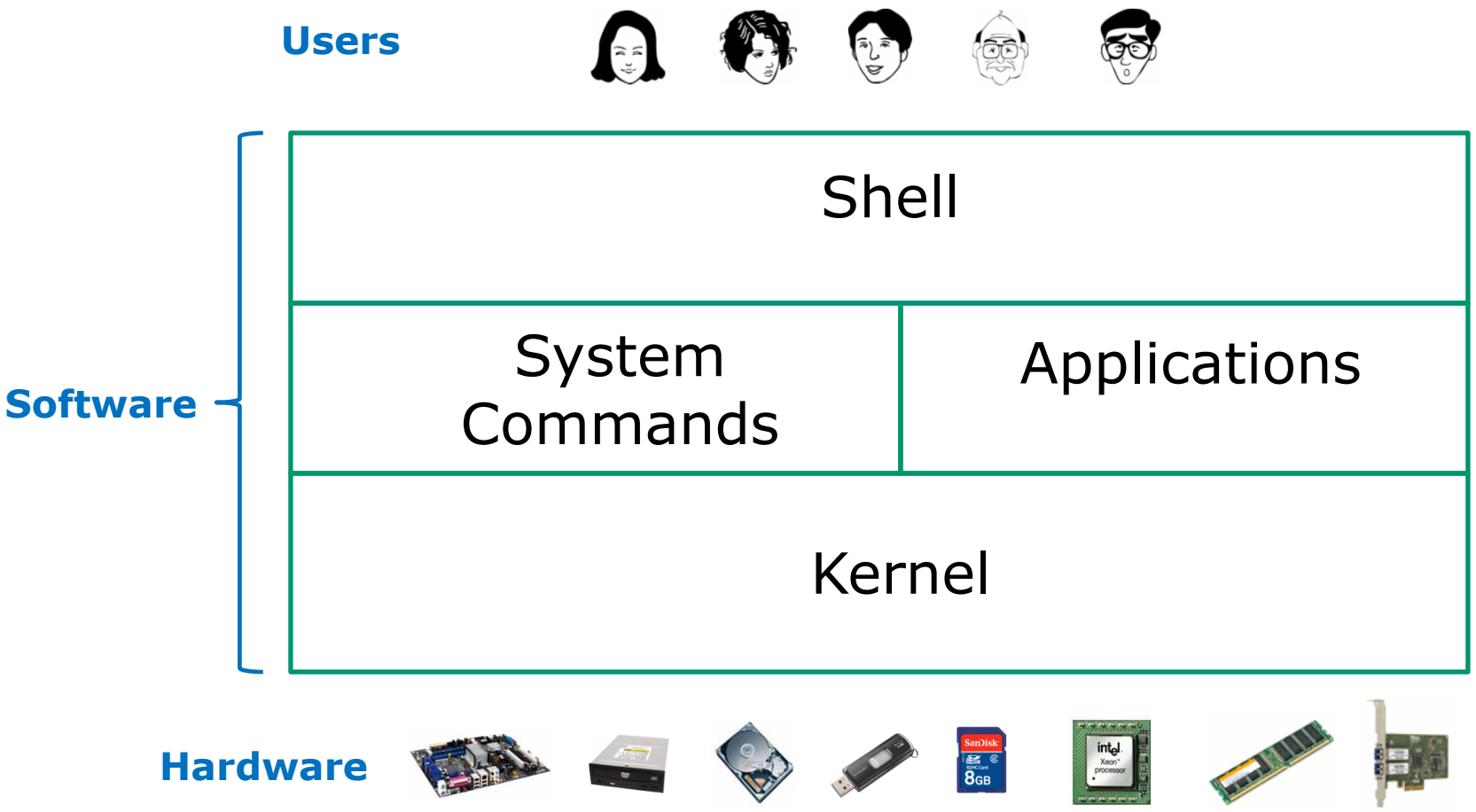




There is a Howto on the Resource page to walk you through customizing Putty

Lesson 1 Review

UNIX/Linux Architecture
Simplified View - Four Major Components

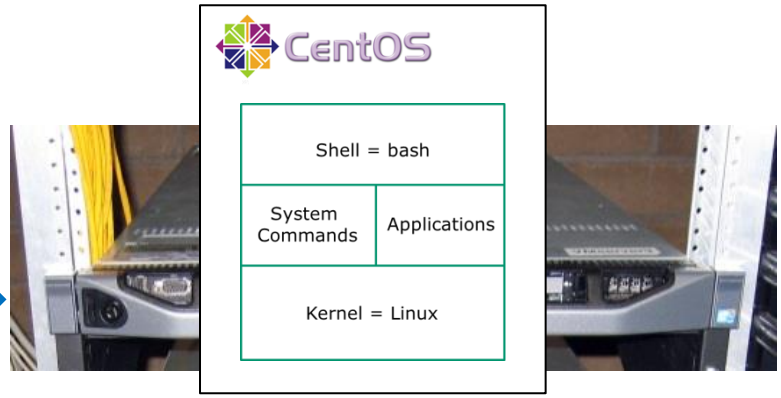


The Lesson 1 commands for your toolbox

cal	*Prints calendars*
date	*Shows the time and date*
clear	*Clears the screen*
exit	*Exits login session*
history	*Shows commands used previously*
id	*Shows your username and UID (and more)*
ps	*Shows your processes (including the name of the shell)*
ssh	*For connecting and logging into a remote computer*
hostname	*Shows the name of the computer being used*
uname	*Shows name of the operating system kernel*
cat /etc/issue	*Shows name of the "distro" (distribution)*
tty	*Shows which terminal device is being used*
who	*Shows all users who are logged in and from where*
who am i	*Like **who**, but only shows your login session*

"Name" Terminology

ssh -p 2220 simben90@oslab.cishawks.net

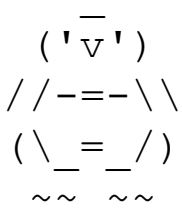


Opus AKA **oslab.cishawks.net** AKA **oslab.cis.cabrillo.edu**

Various "names" bandied about:	**To view:**
User's first and last **name**: Benji Simms	*/etc/passwd*
user**name** = simben90	**id**
name of terminal device used = /dev/pts/2	**tty**
(terminal type = xterm)	**echo $TERM**
host**name** = oslab.cishawks.net	**hostname**
Name of distro = CentOS	*/etc/issue*
Name of shell = bash	**ps**
Name of kernel = Linux	**uname**

Terminals types and devices

```
login as: simben90
simben90@oslab.cabrillo.edu's password:
Last login: Sat Sep  1 09:26:51 2012 from 50-0-68-
235.dsl.dynamic.fusionbroadband.com
```




```
Welcome to Opus
Serving Cabrillo College
```

Hit Enter to accept

```
Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $ tty
/dev/pts/3
```

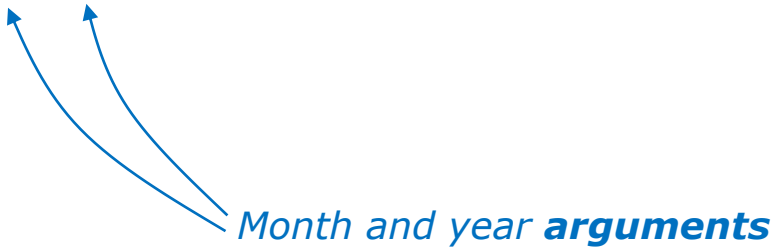
*The terminal type is **xterm***

*The terminal device for this session is **/dev/pts/3***

The **terminal type** is not the same as the **terminal device**

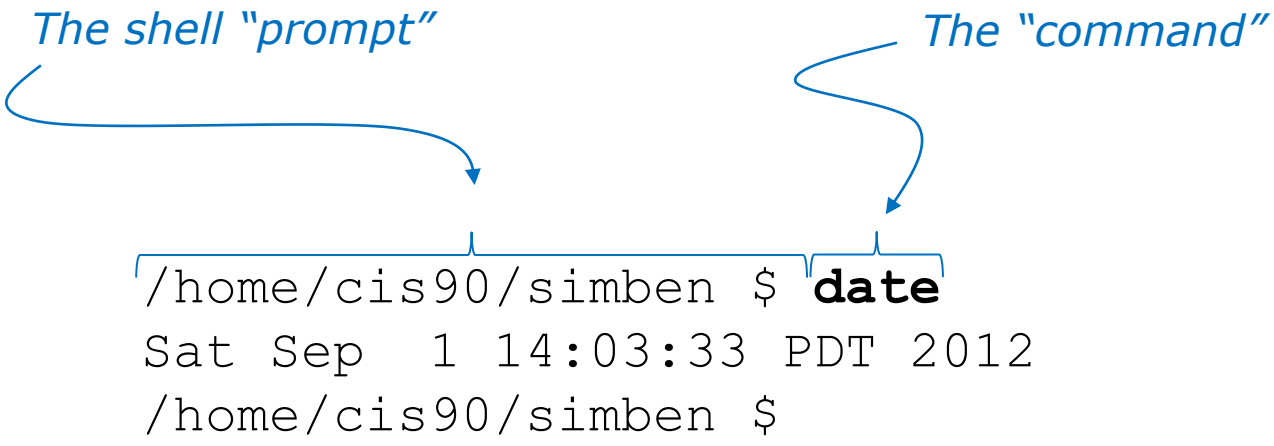
How can I print a calendar?

```
/home/cis90/simben $ cal
   September 2012
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

/home/cis90/simben $ cal 9 2001
   September 2001
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
/home/cis90/simben $
```



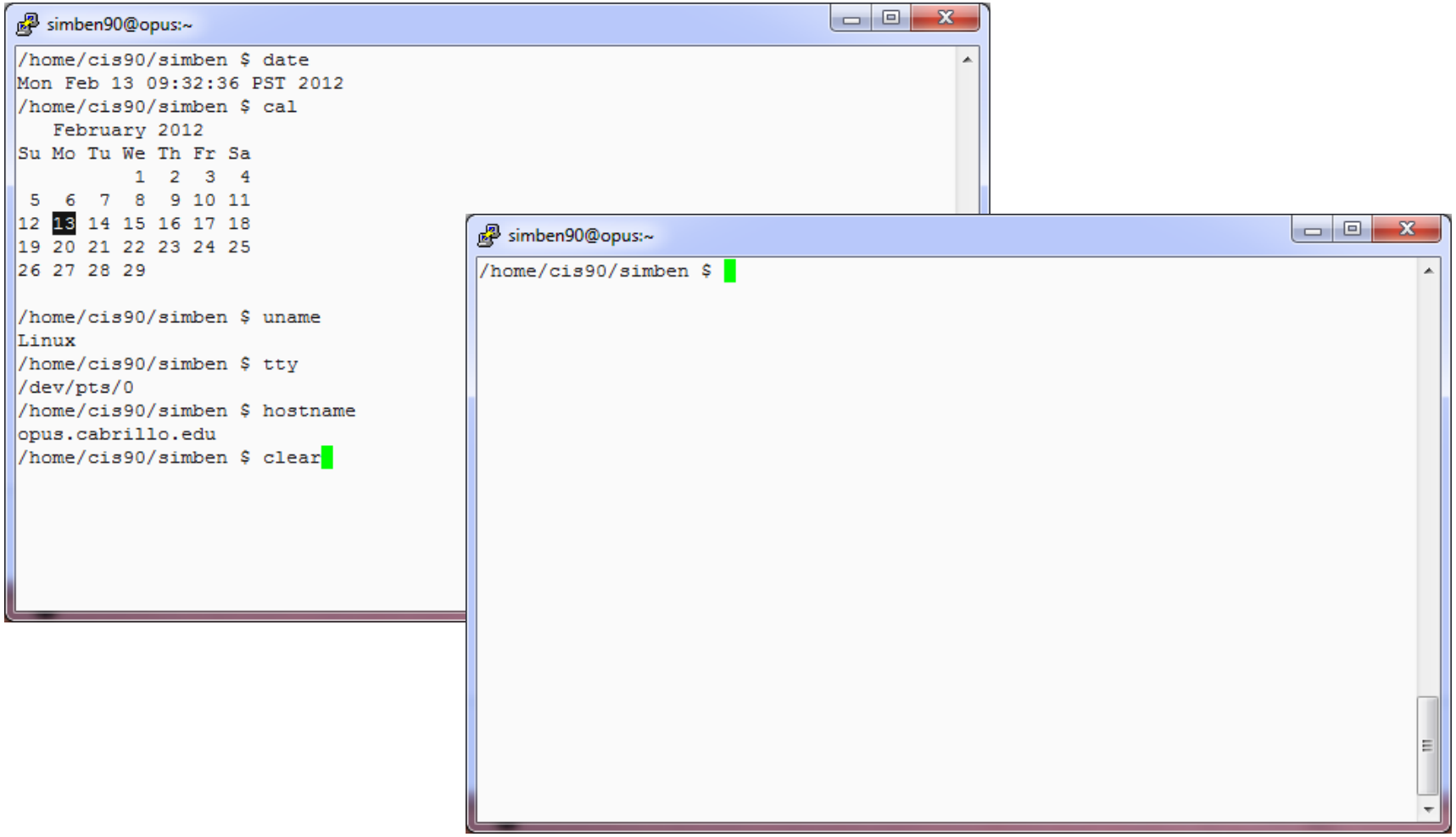
A command can have arguments

What is the current time and date?



The prompt is output by the shell, you type the command

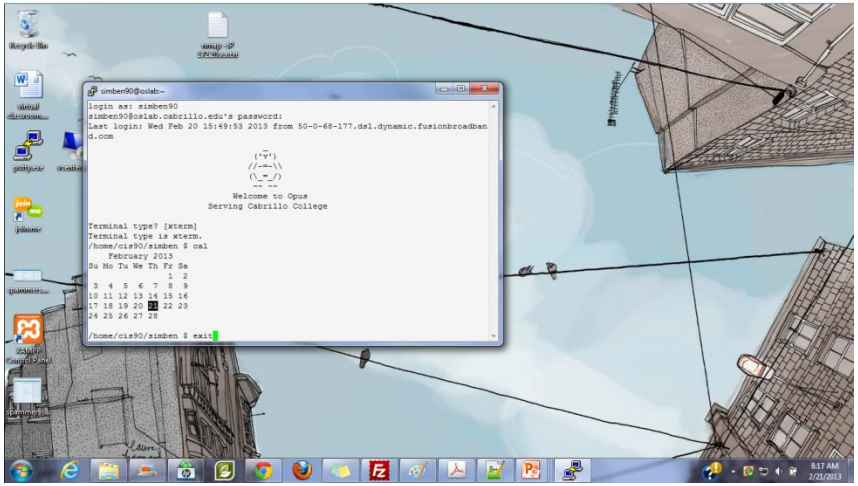
How do I clear the screen?



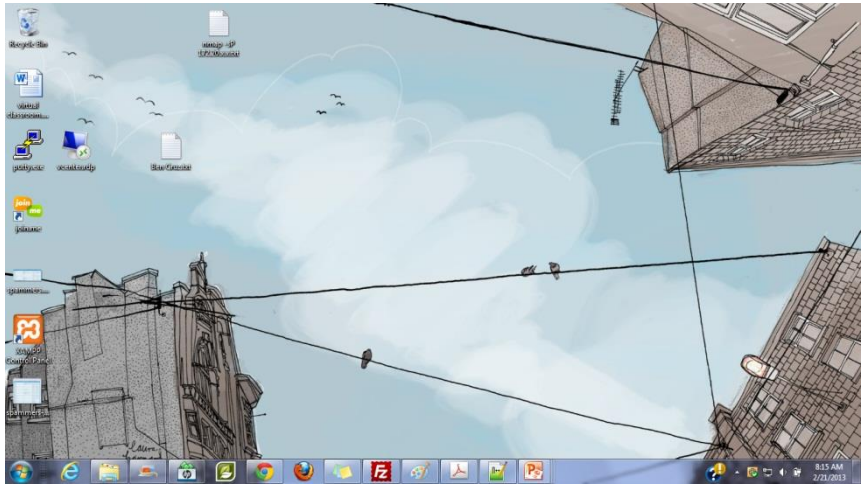
The **clear** command scrolls previous commands out of sight

How do I end this login session?

before **exit**



after **exit**



The **exit** command ends the session and the terminal window disappears ... POOF!

Viewing your command history

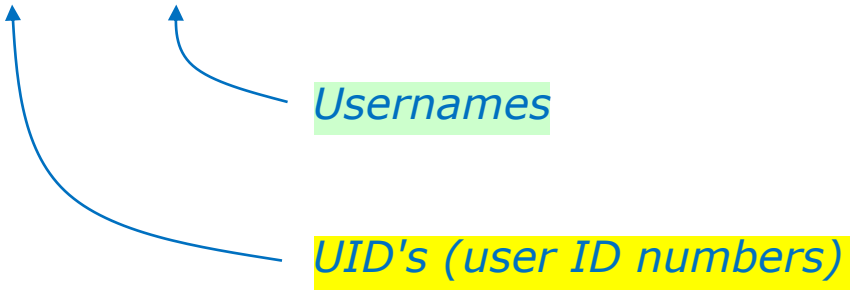
```
/home/cis90/simben $ history
    1  hostname
    2  exit
    3  who
    4  who -q
    5  ps -e
< snipped >
  177  cal 9 2001
  178  exit
  179  who
  180  cal
  181  tty
  182  uname
  183  ps
  184  id
  185  exit
  186  history
/home/cis90/simben $
```

*The **history** command outputs the commands used previously … even from previous login sessions*

Tip: Use the "Up Arrow" key to quickly re-issue a previous command!

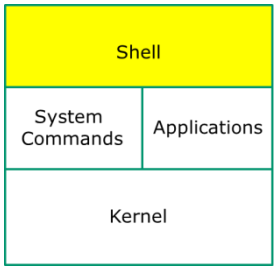
What is the UID (User ID) for my account or other accounts?

```
/home/cis90/simben $ id
uid=1001(simben90) gid=190(cis90) groups=190(cis90),100(users)
context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023

/home/cis90/simben $ id milhom90
uid=1002(milhom90) gid=190(cis90) groups=190(cis90),100(users)

/home/cis90/simben $ id simben90
uid=1001(simben90) gid=190(cis90) groups=190(cis90),100(users)
```



We are all just numbers to the Linux kernel

What shell am I using?



Process ID numbers

```
/home/cis90/simben $ ps
  PID TTY          TIME CMD
28994 pts/0    00:00:00 bash
29093 pts/0    00:00:00 ps
```

*the shell is sleeping and waiting for **ps** command to finish*

***ps** command is running as it outputs this*

Terminal device being used

The **ps** command outputs the current processes you own including the shell program you are using

How do I log into another computer system?

*Method 1: The **ssh** command using a hostname*

username on remote computer → `cis90@p06-arwen` ← *Hostname of remote computer*

```
/home/cis90/simben $ ssh cis90@p06-arwen
cis90@p06-arwen's password:
Welcome to Linux Mint 15 Olivia (GNU/Linux 3.8.0-26-generic x86_64)

Welcome to Linux Mint
 * Documentation:  http://www.linuxmint.com
Last login: Sun Sep  8 09:52:00 2013
cis90@p06-arwen:~ >
```

Notice how the prompt changes on the remote computer

*Note: You can also **ssh** into the same computer you are currently using for an additional session.*

How do I log into another computer system?

*Method 1: The **ssh** command using am IP address*

username on remote computer → `cis90@`

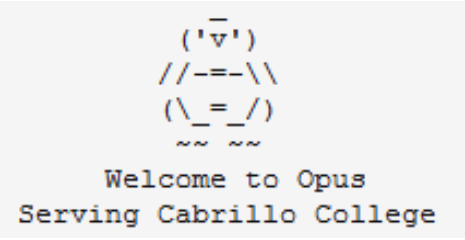
IP address of remote computer → `172.20.4.34`

```
/home/cis90/simben $ ssh cis90@172.20.4.34
cis90@172.20.4.34's password:
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-29-generic x86_64)

 * Documentation:  https://help.ubuntu.com/

361 packages can be updated.
109 updates are security updates.

Last login: Wed Feb 20 17:26:25 2013 from oslab.cabrillo.edu
cis90@frodo-108:~$
```

Notice how the prompt changes on the remote computer

What is the name of the computer I'm interacting with?

```
/home/cis90/simben $ hostname
oslab.cishawks.net
```

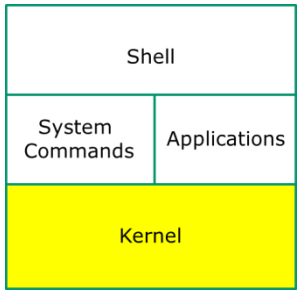


We still refer to Opus as "Opus" in this class however it's official hostname on the Internet is "oslab". This may change in the future after some network changes are made.

Opus is a member of two overlapping Internet domains:

- The **cis.cabrillo.edu** domain is a sub-domain of the college's domain.
- The **cishawks.net** domain is an alternate domain put in place to alleviate some DNS issues experienced during the CIS Lab move to building 800.

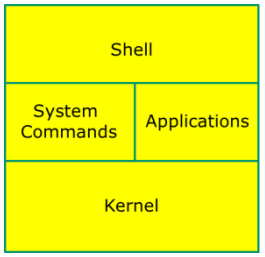
What kernel am I running on?




```
/home/cis90/simben $ uname
Linux
```

The **uname** command (with no arguments) outputs the name of the operating system kernel

What "distro" has been installed?




```
/home/cis90/simben $ cat /etc/issue
CentOS release 6.2 (Final)
Kernel \r on \l

/home/cis90/simben $ cat /etc/*-release
CentOS release 6.2 (Final)
CentOS release 6.2 (Final)
CentOS release 6.2 (Final)
```

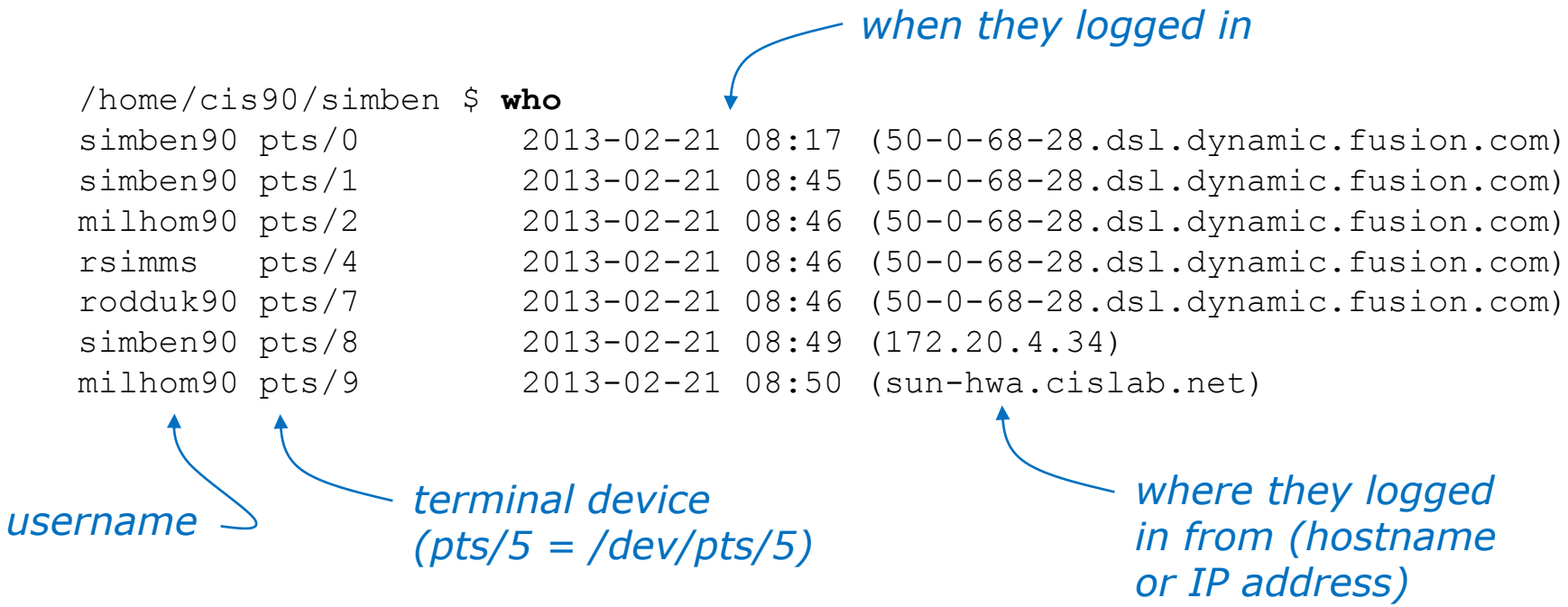
Catting out these files *usually* will show the distro name

What terminal device am I using?

```
/home/cis90/simben $ tty
/dev/pts/5
```

The **terminal type** is <u>not</u> the same as the **terminal device**

Who else is logged in and from where?



The who command shows who is logged in, their terminal device, when they logged in and from where they logged in

Which is my login session?

```
/home/cis90/simben $ who
simben90 pts/0        2013-02-21 08:17 (50-0-68-28.dsl.dynamic.fusion.com)
simben90 pts/1        2013-02-21 08:45 (50-0-68-28.dsl.dynamic.fusion.com)
milhom90 pts/2        2013-02-21 08:46 (50-0-68-28.dsl.dynamic.fusion.com)
rsimms   pts/4        2013-02-21 08:46 (50-0-68-28.dsl.dynamic.fusion.com)
rodduk90 pts/7        2013-02-21 08:46 (50-0-68-28.dsl.dynamic.fusion.com)
simben90 pts/8        2013-02-21 08:49 (172.20.4.34)
milhom90 pts/9        2013-02-21 08:50 (sun-hwa.cislab.net)

/home/cis90/simben $ who am i
simben90 pts/0        2013-02-21 08:17 (50-0-68-177.dsl.dynamic.fusion.com)

/home/cis90/simben $ tty
/dev/pts/0
```

When logged in multiple times use the terminal device to distinguish the sessions

Test your knowledge

What's the name of the terminal device I'm using right now?

```
login as: simben90
simben90@oslab.cabrillo.edu's password:
Last login: Sat Sep  1 09:26:51 2012 from 172.30.90.83

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

Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $
```

What's the name of the terminal device I'm using right now?

```
login as: simben90
simben90@oslab.cabrillo.edu's password:
Last login: Sat Sep  1 09:26:51 2012 from 172.30.90.83

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

Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $
/home/cis90/simben $ tty
/dev/pts/0
/home/cis90/simben $
```

Answer: /dev/pts/0

*Use the **tty** command to find out*

What type of terminal am I using right now?

```
login as: simben90
simben90@oslab.cabrillo.edu's password:
Last login: Sat Sep  1 09:26:51 2012 from 172.30.90.83

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

Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $
```

What type of terminal am I using right now?

```
login as: simben90
simben90@oslab.cabrillo.edu's password:
Last login: Sat Sep  1 09:26:51 2012 from 172.30.90.83

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

Terminal type? [xterm]
Terminal type is xterm.
/home/cis90/simben $
```

Answer: xterm

We have the answer already!

What is the hostname of the computer I'm using?

```
/home/cis90/simben $
```

What is the hostname of the computer I'm using?

```
/home/cis90/simben $
/home/cis90/simben $ hostname
oslab.cabrillo.edu
/home/cis90/simben $
```

Answer: oslab.cabrillo.edu

*Use the **hostname** command to find out*

What is the name of the OS (operating System) kernel?

```
/home/cis90/simben $
```

What is the name of the OS (operating System) kernel?

```
/home/cis90/simben $
/home/cis90/simben $ uname
Linux
/home/cis90/simben $
```

*Use the **uname** command to find out*

Answer: Linux

What is the name of the Linux Distribution being run?

```
/home/cis90/simben $
```

What is the name of the Linux Distribution being run?

```
/home/cis90/simben $ cat /etc/issue
CentOS release 6.2 (Final)
Kernel \r on \l

/home/cis90/simben $ cat /etc/*-release
CentOS release 6.2 (Final)
CentOS release 6.2 (Final)
CentOS release 6.2 (Final)
/home/cis90/simben $
```

Answer: CentOS

*Use either **cat /etc/issue** or **cat /etc/*-release** to find out*

What is my username and uid (user ID number)?

```
/home/cis90/simben $
```

What is my username and uid (user ID number)?

```
/home/cis90/simben $
/home/cis90/simben $ id
uid=1001(simben90) gid=190(cis90)
groups=190(cis90),100(users)
context=unconfined_u:unconfined_r:unconfined_t:s0-s0:c0.c1023
/home/cis90/simben $
```

Answer: username=simben90 and the uid=1001

*Use the **id** command to find out*

What is the name of the shell I'm using?

```
/home/cis90/simben $
```

What is the name of the shell I'm using?

```
/home/cis90/simben $
/home/cis90/simben $ ps
  PID TTY          TIME CMD
28237 pts/0    00:00:00 bash
28752 pts/0    00:00:00 ps
/home/cis90/simben $
```

Answer: bash

*Use the **ps** command to find out.*

We will soon learn another command for doing this.