Rich's lesson module checklist *Last Modified 4/29/2018*

- ❑ Zoom recording named and published for previous lesson

- ❑ Slides and lab posted
- ❑ Alt WB slides with 1st minute quiz
- ❑ Print out agenda slide and annotate page numbers

- ❑ 1st minute quiz
- ❑ Flash card check
- ❑ Calendar page updated

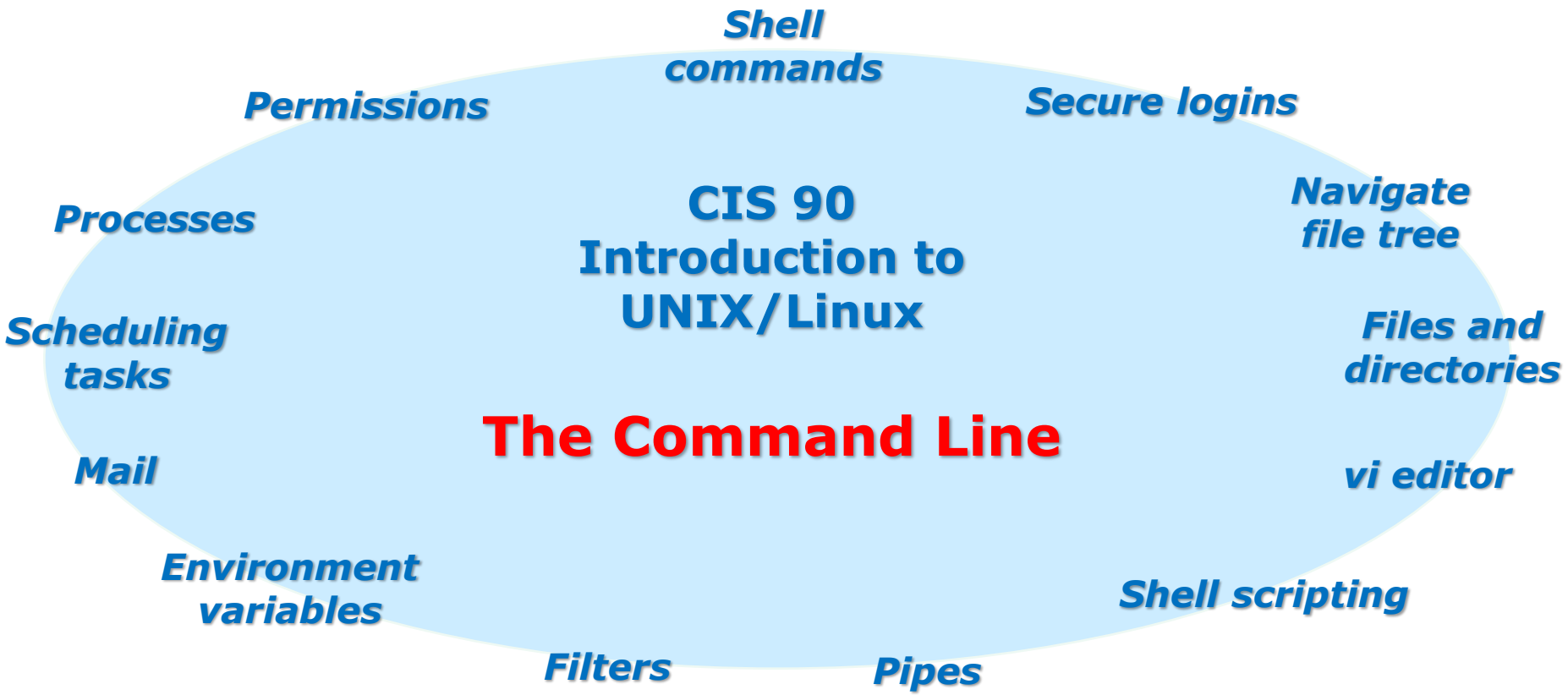
- ❑ Lab 1 update id-pod-map and test grade script
- ❑ Lab 2 tested (check Q11 kernel release number and finger user account)
- ❑ scripts/schedule-submit-locks

- ❑ Bring Add Codes
- ❑ Bring printed roster

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

- ❑ https://zoom.us

- ❑ Putty + Slides + Chrome
- ❑ Enable/Disable attendee sharing
  ^ > Advanced Sharing Options > Only Host
- ❑ Enable/Disable attended annotations
  Share > More > Disable Attendee Sharing



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.

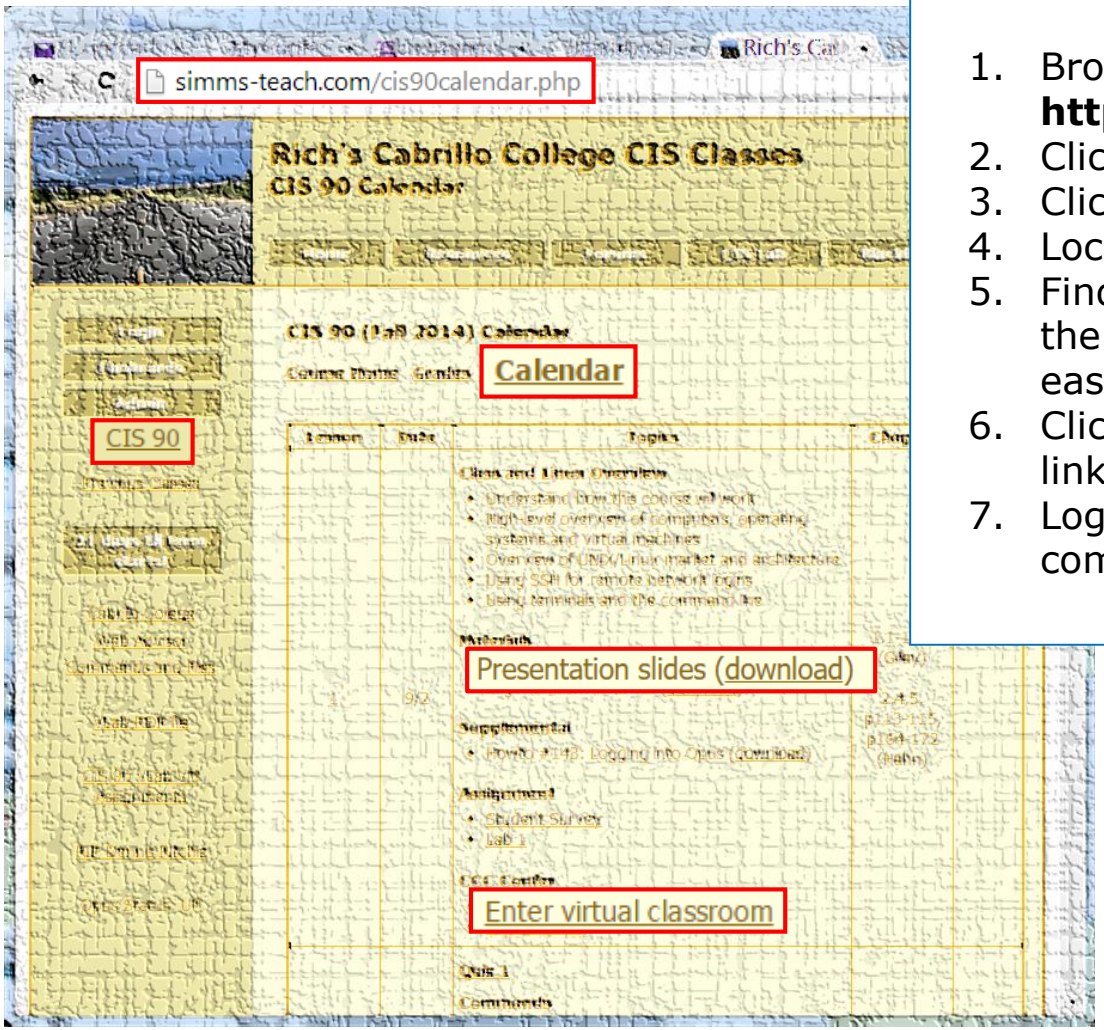
Introductions and Credits

Jim Griffin
- Created this Linux course
- Created Opus and the CIS VLab
- Jim's site: https://web.archive.org/web/20140209023942/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. John's site: http://teacherjohn.com/
- Jaclyn Kostner for many webinar best practices: e.g. mug shot page.

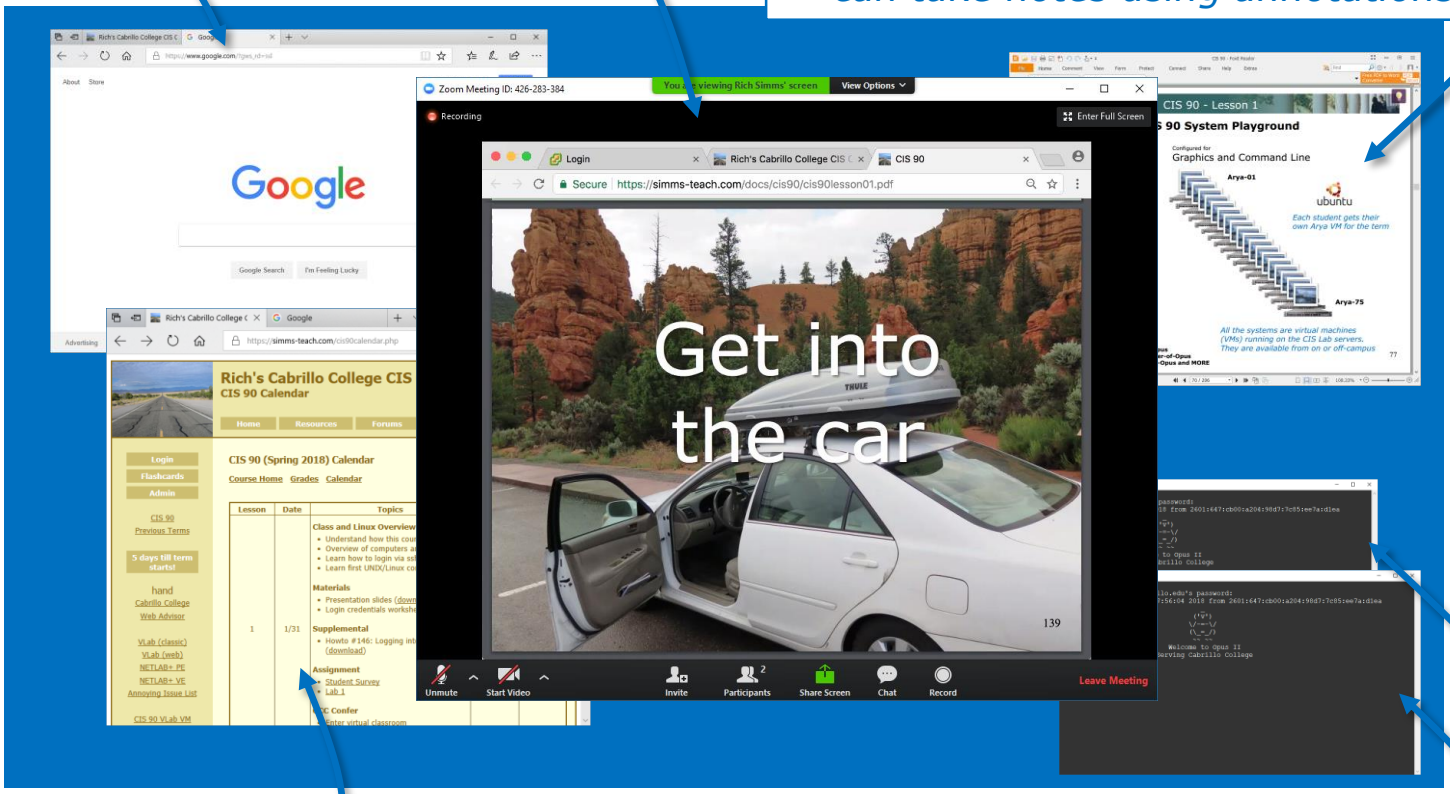
Student checklist - Before class starts



1. Browse to: **http://simms-teach.com**
2. Click the **CIS 90** link.
3. Click the **Calendar** link.
4. Locate today's lesson.
5. Find the **Presentation slides** for the lesson and **download** for easier viewing.
6. Click the **Enter virtual classroom** link to join ConferZoom.
7. Log into Opus-II with Putty or ssh command.

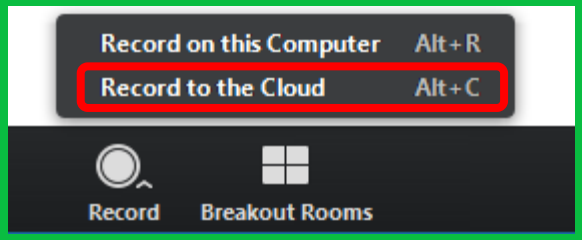
Student checklist - Before class starts

- ❑ *Google*
- ❑ *ConferZoom*
- ❑ *Downloaded PDF of Lesson Slides. I like Foxit Reader so I can take notes using annotations.*



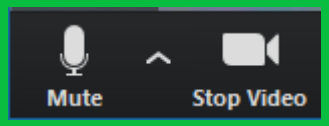
- ❑ *CIS 90 website Calendar page*
- ❑ *One or more login sessions to Opus-II*

Start



Start Recording

Audio Check



Start Recording

Audio & video Check

CIS 90 - Lesson 2

Instructor: **Rich Simms**
Dial-in: **408-638-0968 (toll)**
Meeting ID: **426 283 384**

Anita, Shane, Dan, Kage, Justin, Jo Anne, Moises, Laine, Luis, Christian






Jetta, Cesar, Paul, Hilary, Fritz, Jake, Richard, Fergus, Ciarán, Kimi



November, Jaymar, Elena, David, Claudius, Jose, Edgar, Adam, Nathanael T., Clara

Brandon, Henry, Nate P., Darren, Nathan K., David E.

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

First Minute Quiz

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

Only shown on separate slide deck
at very start of the class

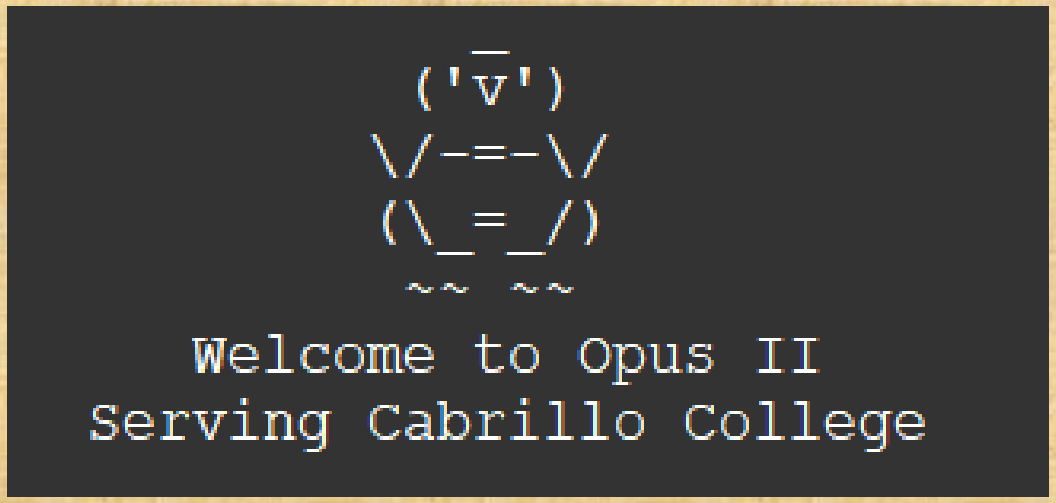
email answers to: risimms@cabrillo.edu

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

Commands

Objectives	Agenda
• Understand where account information is kept. • Understand why strong passwords are important. • Learn where commands are located. • Understand how the shell works to run commands. • Discover where to find documentation.	• Quiz • Questions • Using VLab • Virtual terminals • Logging in • Passwords • Housekeeping • Lesson 2 commands • The path • Location of common commands • Programs • Inputs to commands • Command syntax • Parsing • Variables • The shell (six steps) • Metacharacters • Shortcuts • Life without a path • Docs • Wrap up

Class Activity



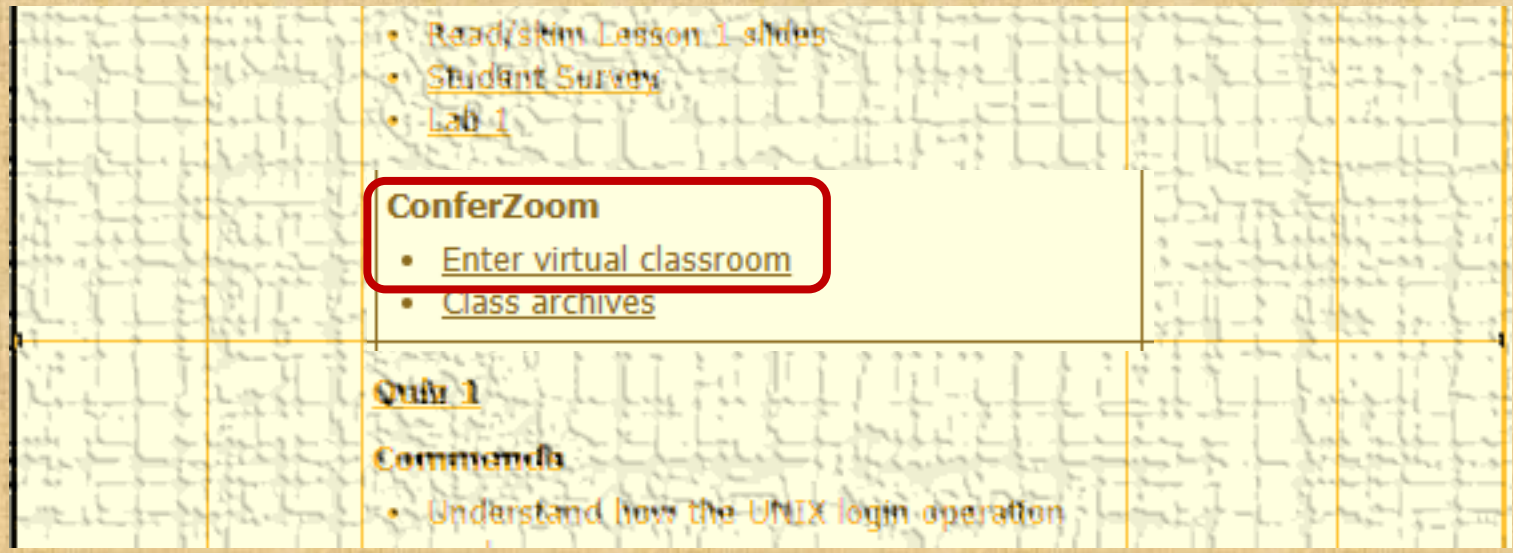
If you haven't already, log into Opus-II

Class Activity

https://simms-teach.com/cis90calendar.php

If you haven't already, download the lesson slides

Class Activity



https://simms-teach.com/cis90calendar.php

If you haven't already, join ConferZoom classroom

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.*

Lab Assignments -- Pearls of Wisdom

- Don't wait till the last minute to start.
- Plan for things to go wrong and give yourself time to ask questions and get answers.
- 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.
- Late work is not accepted so submit what you have for partial credit.

Extra Credit

On the forum

Be sure to monitor the forum as I may post extra credit opportunities without any other notice!

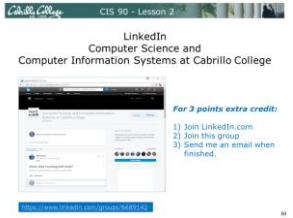
On some labs

Extra credit (2 points)

For a small taste of what you would learn in CIS 191 let's add a new user to your Arya VM. Once added we will see how the new account is represented in */etc/passwd* and */etc/shadow*.

1. Log into your Arya VM as the cis90 user. Make sure it's your VM and not someone else's.
2. Install the latest updates:
   ```
   sudo apt-get update
   sudo apt-get upgrade
   ```
3. Add a new user account for yourself. You may make whatever username you wish. The example below shows how Benji would make the same username he uses on Opus:
   ```
   sudo useradd -G sudo -c "Benji Simms" -m -s /bin/bash simben90
   ```

In lesson slides (search for extra credit)

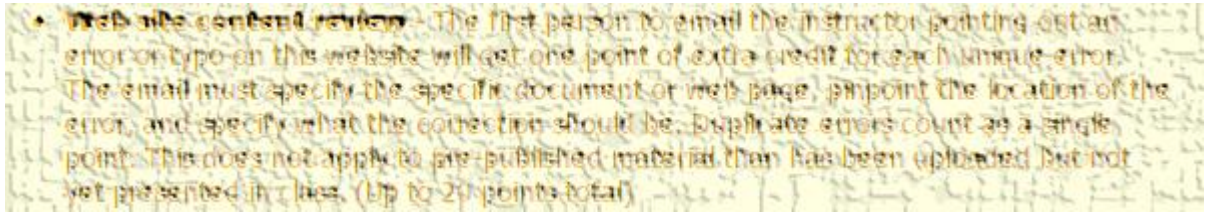


On the website

http://simms-teach.com/cis90grades.php

For some flexibility, personal preferences or family emergencies there is an additional 90 points available of **extra credit** activities.

http://simms-teach.com/cis90extracredit.php



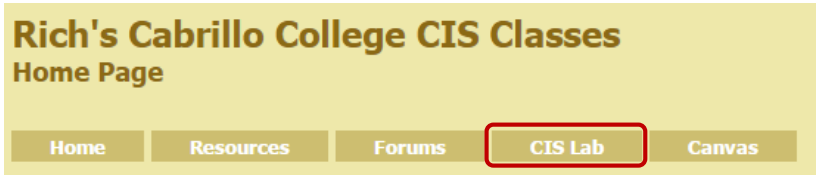
Getting Help When Stuck on a Lab Assignment

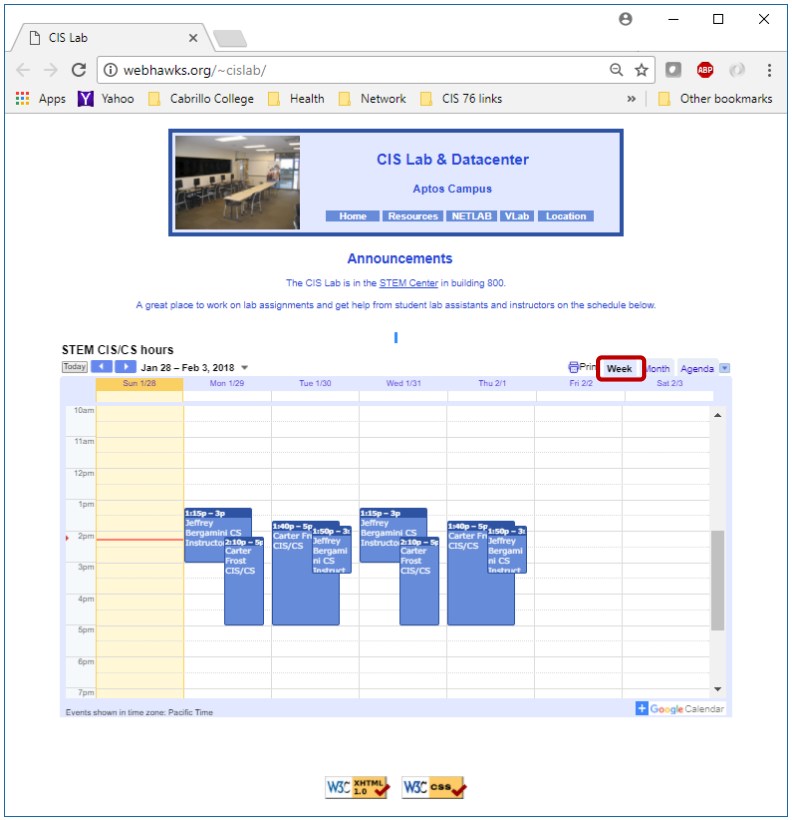
- Google the topic/error message.
- Search the Lesson Slides (they are PDFs) for a relevant example on how to do something.
- Post a question on the forum. Explain what you are trying to do and what you have tried so far.
- Talk to a STEM center tutor/assistant.
- Come see me during my office or lab hours. **I will be in the CTC (room 1403) every Wednesday afternoon from 3-5:30**.
- Make use of the Open Questions time at the start of every class.
- Make a cheat sheet of commands and examples so you never again get stuck on the same thing!

Expect to do a LOT of troubleshooting in this course!

Help Available in the CIS Lab

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





To see schedule, click the CIS Lab link on the website and use the "Week" calendar view

CTC - Building 1400
On lower campus

I will be in the CTC (room 1403) every Wednesday afternoon from 3-5:30

The slippery slope

1) If you didn’t submit the last lab ...
2) If you were in class and didn’t submit the last quiz ...
3) If you didn’t send me the student survey assigned in Lesson 1 ...
4) If you haven't made a forum post in the last quarter of the course ...

Please contact me by email, see me during my office hours or when I'm in the CTC

Email: risimms@cabrillo.edu

Logging In
(authentication)

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

Who goes there?

What's the password?

Logging in

```
Arya-27 login: cis90
Password:
```

Virtual terminal login

Graphical desktop login

```
[rsimms@opus-ii ~]$ ssh cis90@arya-27
cis90@arya-27's password:
```

SSH login

- A system administrator will create user accounts for each user that is allowed to login.
- To login you must be authenticated as one of those users.
- There are two common authentication methods used:
  1) Username and password.
  2) Public & private keys.

We will cover just usernames and passwords today

Where are user accounts and passwords stored?

- User accounts are kept in a file named **/etc/passwd**
- Passwords are kept encrypted in a file named **/etc/shadow**

Note: Systems can also be integrated with a directory service (e.g. Microsoft Active Directory). In that case the user accounts and passwords are will be stored on another server.

The /etc/passwd file

```
[rsimms@daughter-of-opus ~]$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
```

The SUPER user is named root

< Snipped >

Regular users

```
deanna:x:2009:1701:Deanna Troi:/home/deanna:/bin/bash
chakotay:x:2010:1701:Chakotay:/home/chakotay:/bin/bash
kira:x:2011:1701:Kira Nerys:/home/kira:/bin/bash
chekov:x:2012:1701:Pavel Chekov:/home/chekov:/bin/bash
[rsimms@daughter-of-opus ~]$
```

To login your username must match one of the accounts in the */etc/passwd file*

Note: In spite of its name, this file no longer contains the passwords!

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-II*

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

1) username

2) password (just a placeholder now)

3) User ID (UID)

4) Group ID (GID)

5) Comment

6) Home directory

7) 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!*

The /etc/shadow file

```
[rsimms@daughter-of-opus ~]$ cat /etc/shadow
cat: /etc/shadow: Permission denied
[rsimms@daughter-of-opus ~]$ sudo cat /etc/shadow
[sudo] password for rsimms:
root:$6$[redacted]:16226:0:99999:7:::
```

Use sudo to run command as superuser (root)

The SUPER user is named root

< Snipped>

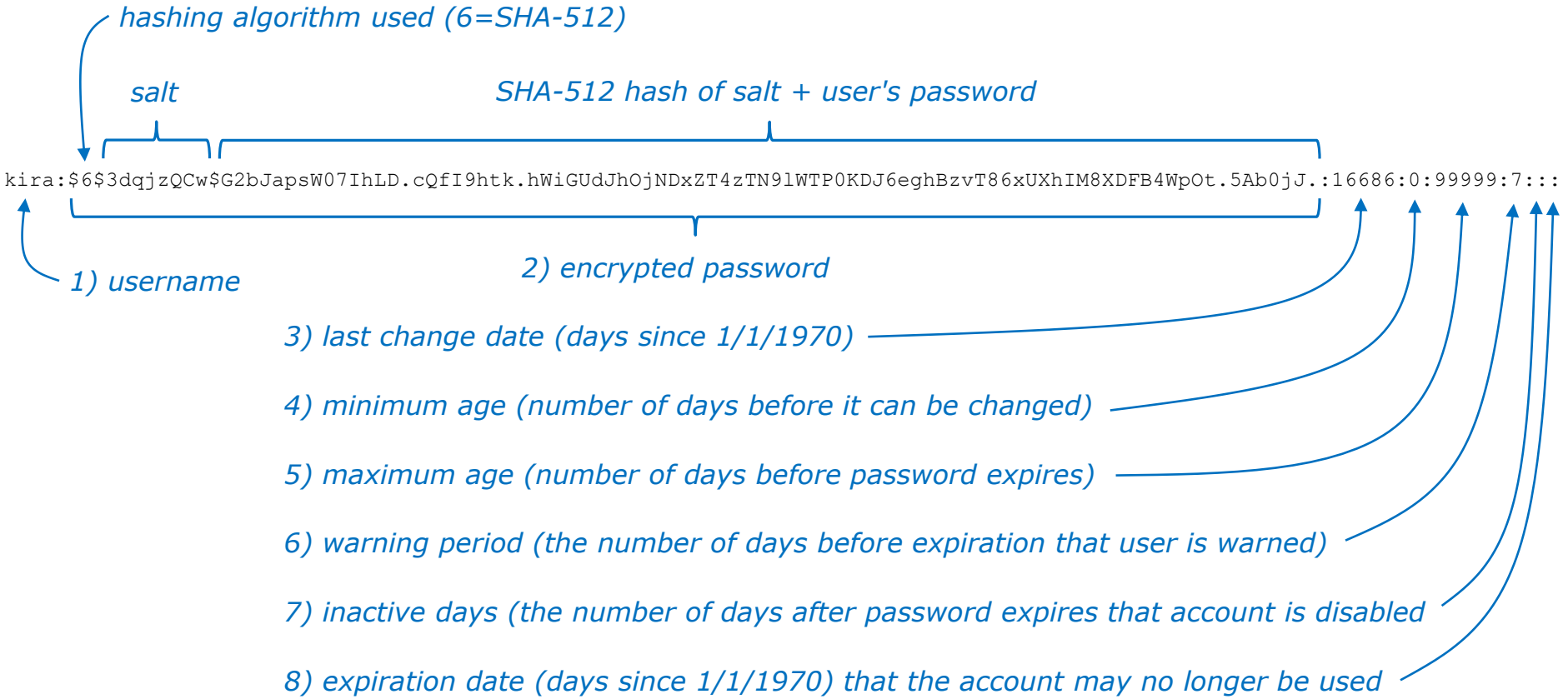
Regular users

```
deanna:$6$hsAXq0Jk$ndIt.oxiFL/qZ7pLAFOaGgxpxAHDEj7ukpd0PfeRN0J9q07Z6Cg0V
3hzo9eSAk0GlaywDtqwL5NefNEEwf9FR1:16686:0:99999:7:::
chakotay:$6$c/kFViIa$nTUJcvJRCut8PwvOSYLlopAI25UsFLNKerGF8OhQIkI78RHTXE1
KOOwvDRSW6BAi4pui7LLpi6JP8QCBMVU1s1:16686:0:99999:7:::
kira:$6$3dqjzQCw$G2bJapsW07IhLD.cQfI9htk.hWiGUdJhOjNDxZT4zTN9lWTP0KDJ6eg
hBzvT86xUXhIM8XDFB4WpOt.5Ab0jJ.:16686:0:99999:7:::
chekov:$6$jd4PMdv0$HPyW/k04DjMDeLO3qUfEzvQj0fWpLuUWMh9RvlOv1V3N/zQxhdhS3
YfSLdhHz0rKBe1wzGGx07CrzOfL3MKNa1:16686:0:99999:7:::
[rsimms@daughter-of-opus ~]$
```

To login, your password must match the encrypted (hashed) account password kept in the */etc/shadow* file

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

Viewing an account in the /etc/shadow file



Note the major fields in /etc/shadow are delimited with a ":". The encrypted password field is further delimited with a "$"

Class Activity

```
/home/cis90/simben $ grep simben90 /etc/passwd
simben90:x:1201:1090: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 your home directory in the chat window.
- Paste your shell in the chat window.

2) cat /etc/shadow

Annotate this table with a green check ✓ if you can view this file otherwise a red **x** if you can't.

Can View	Can't View

For Supplemental Study

https://www.slashroot.in/how-are-passwords-stored-linux-understanding-hashing-shadow-utils

Excellent article on how passwords created and stored

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)

https://www.fireeye.com/cyber-map/threat-map.html

http://map.norsecorp.com/#/

July 17, 2017 – Datacenter is idle over the summer but we still have lots of international visitors!

Top source countries

NoSweat : Monday, July 17, 2017

Source Country	Bytes	Sessions
172.16.0.0-172.31.255.255	6.80 G	352.34 k
192.168.0.0-192.168.255.255	7.80 M	67.41 k
United States	361.73 M	38.05 k
China	159.78 M	22.52 k
Netherlands	33.23 M	8.86 k
France	20.28 M	3.71 k
Ireland	567.29 k	1.39 k
Russian Federation	20.59 M	1.17 k
United Kingdom	334.86 M	776
Nigeria	458.03 M	740
Taiwan ROC	399.90 k	577
Brazil	2.24 M	518
Germany	2.54 M	491
Ukraine	6.62 M	430
Philippines	14.77 M	407
Czech Republic	2.95 M	292
Viet Nam	10.90 M	270
Japan	716.41 k	269
Thailand	5.02 M	264
Belgium	321.48 k	208
India	44.15 M	194
Poland	4.67 M	186
Singapore	319.91 k	170
Hong Kong	1.18 M	166
Greece	95.28 k	163
Sweden	823.54 k	153
Finland	56.20 k	150
Colombia	2.46 M	136

Tool: Palo Alto Networks PA-500 (one page of a daily report)

July 9, 2015 – Datacenter is idle over the summer break but we still have lots of strangers trying to log in!

Notice the brute force attacks

Threat Types

Top 5 Spyware

Spyware	Count
Morto RDP Request Traffic	13

Top 5 Vulnerabilities

Vulnerability	Count
LDAP: User Login Brute-force Attempt	12,302
MS-RDP Brute-force Attempt	3,369
SSH User Authentication Brute-force Atte..	9
PHP CGI Query String Parameter Handli...	6
PHP CGI Query String Parameter Handli...	6

Top 5 Viruses

No matching data found

Threat

Top 5 Attackers

Address	Count
cisvdc.cis.cabrillo.edu	12,302
162.242.228.100	3,186
195-154-157-104.rev.poneytelecom.eu	133
mail.vadimedical.com.tw	28
hosted-by.invisionarg.com	17

Top 5 Victims

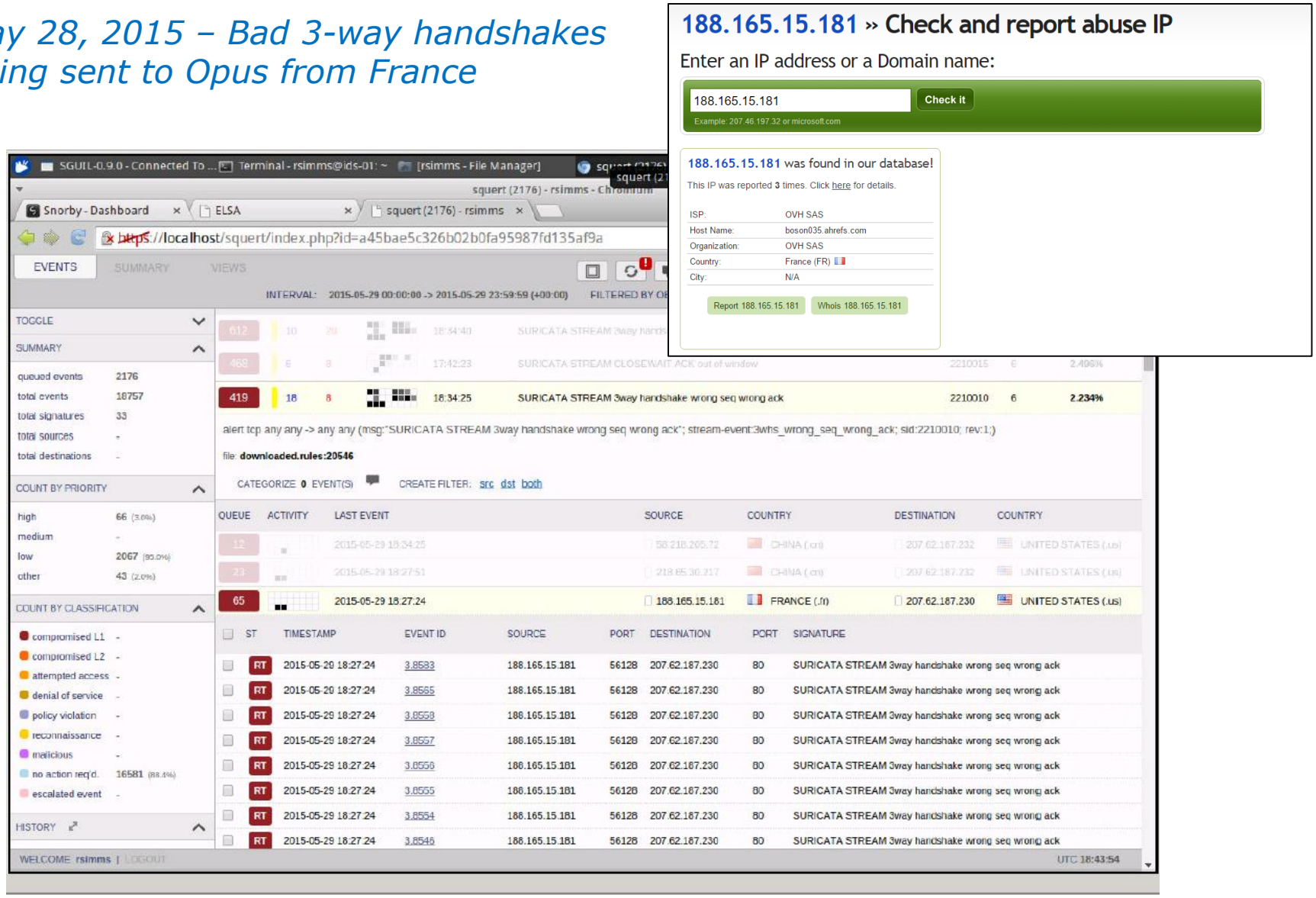
Address	Count
rdserver.cis.cabrillo.edu	15,684
ed.cis.cabrillo.edu	11
opus.cis.cabrillo.edu	2
vcenter.cis.cabrillo.edu	2
pengo.cis.cabrillo.edu	2

Top 5 Attacker Countries

Country	Count
172.16.0.0-172.31.255.255	12,302
United States	3,210
France	133
Taiwan ROC	28
Netherlands	17

Tool: Palo Alto Networks PA-500 (one page of a daily report)

May 28, 2015 – Bad 3-way handshakes being sent to Opus from France



Tool: Squert (part of the Security Onion IDS)

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

Tool: logwatch report showing malicious attempts to break into Opus

They never stop trying

The firewall on Opus slows down but does not end the attacks

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

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

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

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

/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

Current goal: require at least 2^{64} guesses

- Use upper case, lower case, punctuation, digits
- The longer the better (10 or more characters) 94^{10} => 65.64 bits of entropy
- Random, not in any dictionary
- Something you can remember (Google "best password managers")
- Different password for different services
- Keep it secret -- change when compromised
- A MUST for your email accounts!

GOOD (but not truly random)

`Wh0le#!!!!`	(Whole sh'bang)
`KuKu4(co)2`	(Cuckoo for Cocoa Puffs)
`#0p.&.s@ve`	(shop and save)
`Idl02$d@y`	(I do laundry on Tuesday)
`Iwb@tB0aWw`	(I was born at the bottom of a wishing well)

BETTER (pass phrases of 6 random words) 2000^6 => 65.79 bits of entropy

```
splendid roll arrest boiling silk shelter
heap pancake wooden complete inject ethereal
few balance note sedate alike tense
```

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 Canvas)

John the Ripper

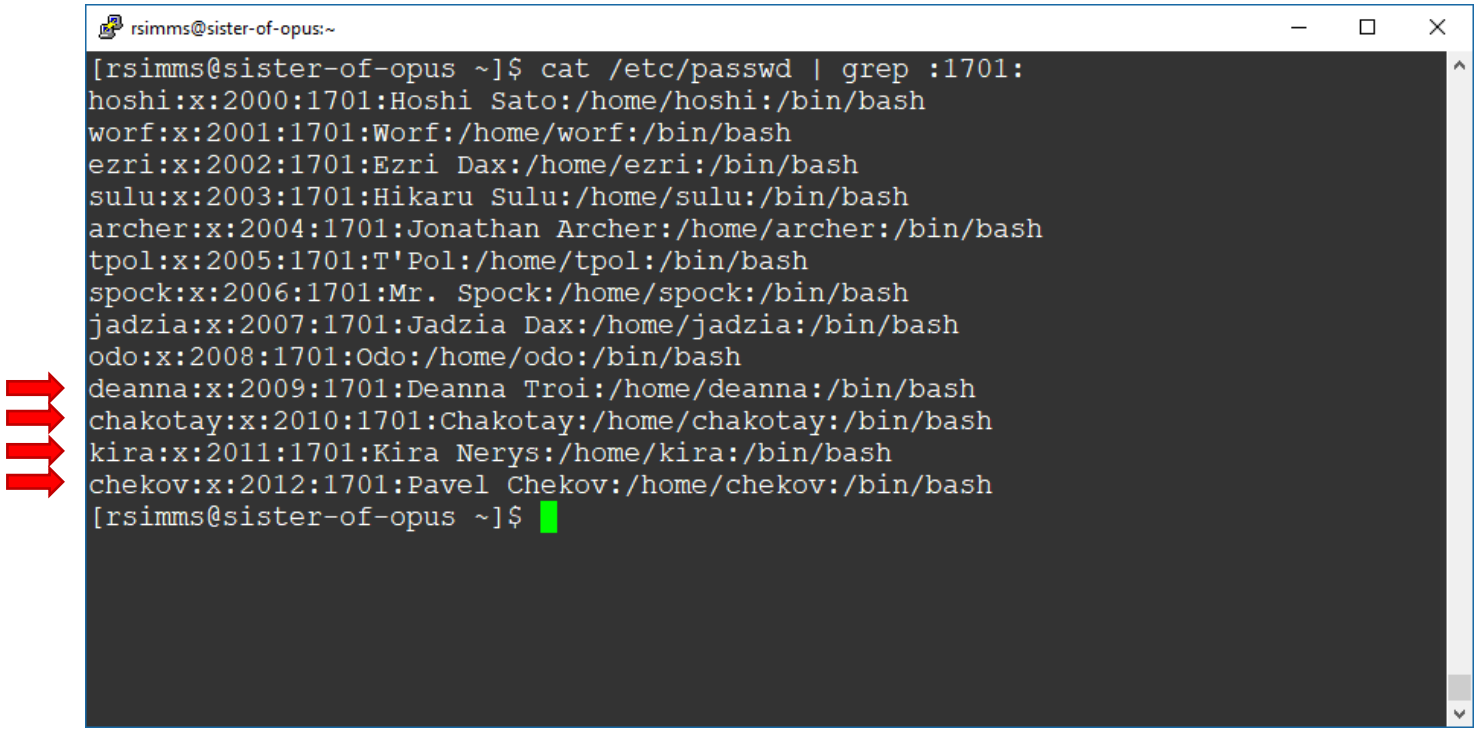
An open source cracker that tries common passwords first followed by a brute force dictionary attack

Instructor:

Use sister-of-opus and john* aliases to demo.

Show password.1st for common passwords.

/etc/passwd

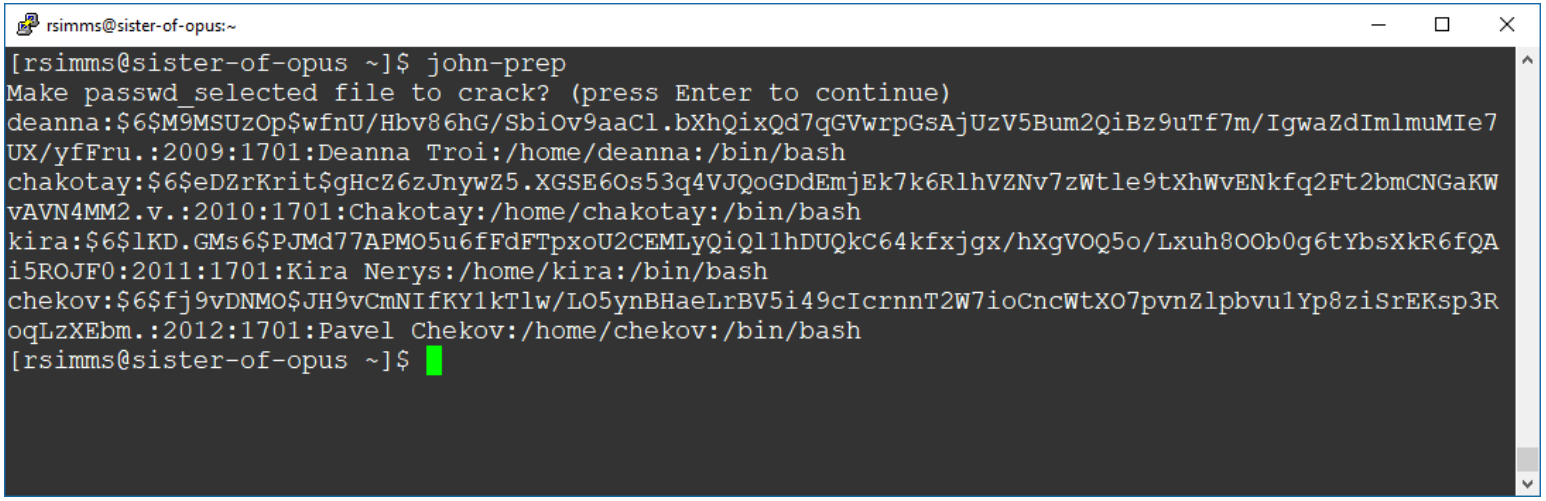


Four users: deanna, chakotay, kira and chekov have weak passwords:

1234567
secret
terces
chekov1

/etc/shadow

john-prep



Encrypted (hashed) passwords in /etc/shadow for deanna, chakotay, kira and chekov

password.1st

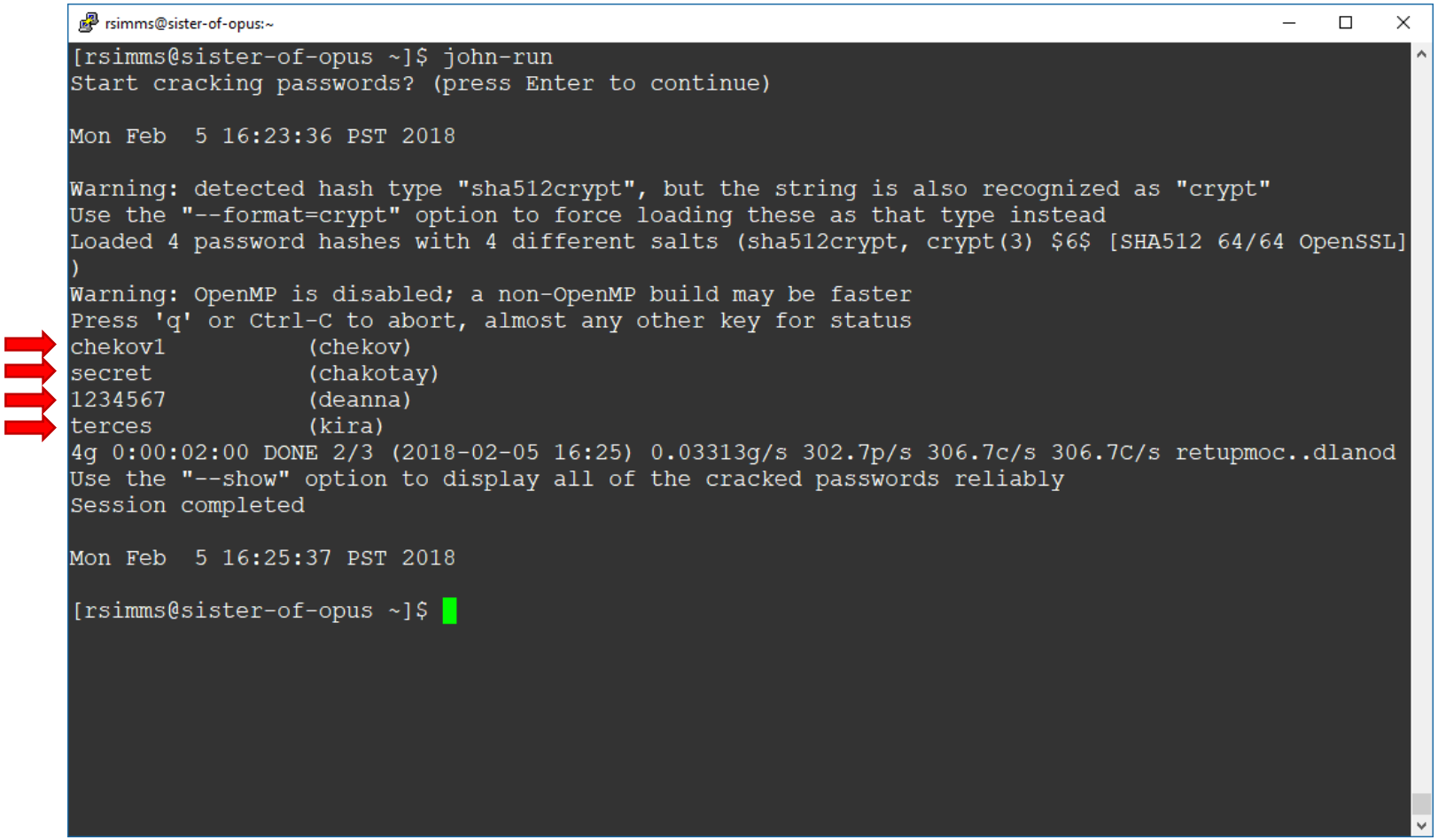
```
view security/john-1.8.0-jumbo-1/run/password.lst
```

```
rsimms@sister-of-opus:~
#!comment: This list has been compiled by Solar Designer of Openwall Project
#!comment: in 1996 through 2011.  It is assumed to be in the public domain.
#!comment:
#!comment: This list is based on passwords most commonly seen on a set of Unix
#!comment: systems in mid-1990's, sorted for decreasing number of occurrences
#!comment: (that is, more common passwords are listed first).  It has been
#!comment: revised to also include common website passwords from public lists
#!comment: of "top N passwords" from major community website compromises that
#!comment: occurred in 2006 through 2010.
#!comment:
#!comment: Last update: 2011/11/20 (3546 entries)
#!comment:
#!comment: For more wordlists, see http://www.openwall.com/wordlists/
123456
12345
password
password1
123456789
12345678
1234567890
abc123
computer
tigger
1234
qwerty
money
carmen
mickey
secret
Type  :quit<Enter>  to exit Vim
```

Common passwords John will try first

Cracking their passwords

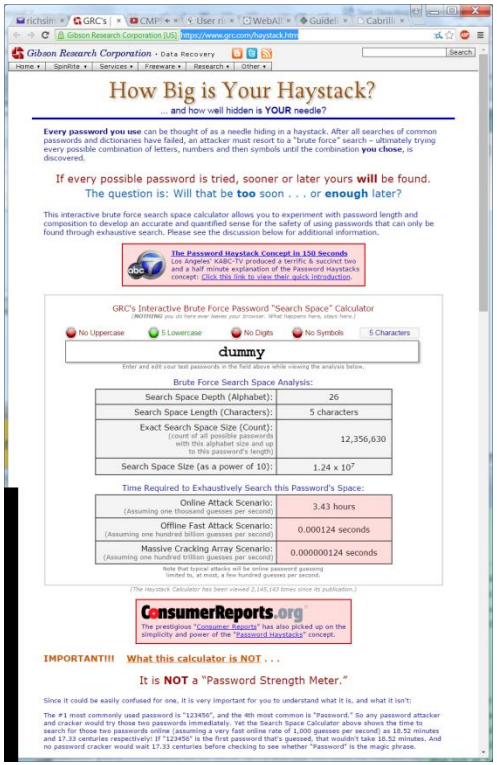
john-run



Doesn't take very long but these are very weak passwords!

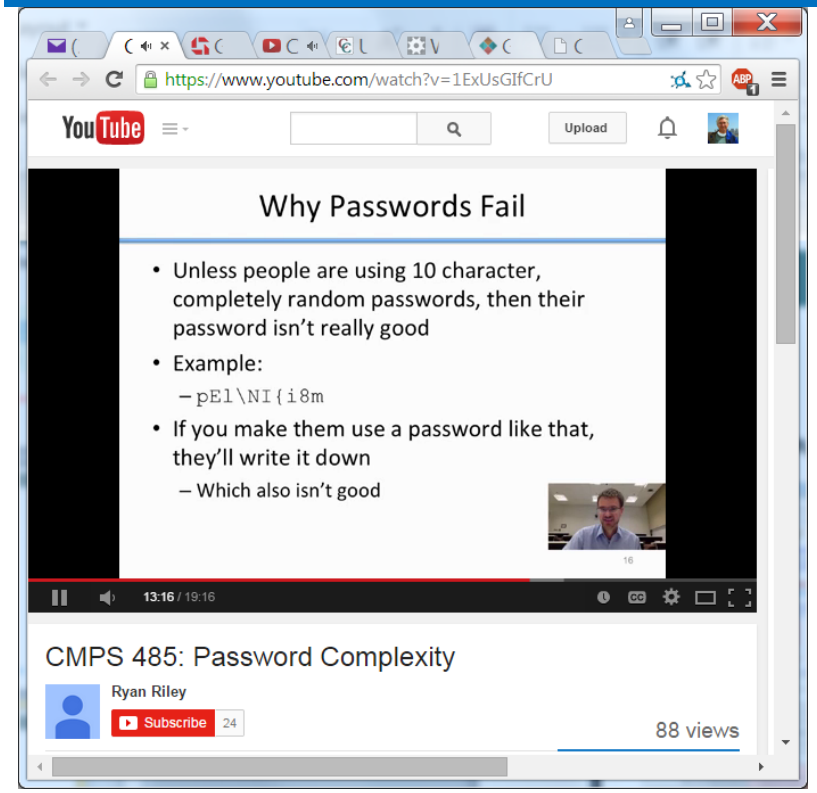
For Supplemental Study

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



Password strength calculator for random passwords

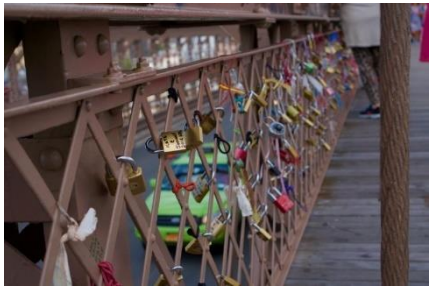
https://www.youtube.com/watch?v=1ExUsGIfCrU



Excellent presentation on making strong passwords

Best Practices

Beginners guide to beefing up your online privacy and security



http://arstechnica.com/security/2016/12/a-beginners-guide-to-beefing-up-your-privacy-and-security-online/

- Install updates (especially browser and OS).
- Use strong passwords and passcodes.
- Encrypt your phones and computers.
- Use two-factor authentication.
- Use a password managers (example products: 1Password and LastPass).
- Encrypt SMS and voice calls (example products, Signal).
- Use VPNs on public Wi-Fi (example services, Private Internet Access).
- Secure end-to-end email (example ProtonMail).
- Delete old emails.
- For more in-depth strategies see EFF's Surveillance Self-Defense page.

https://ssd.eff.org/

Housekeeping

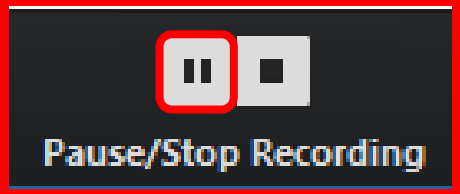
Housekeeping

1. Your student survey is due today.
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 you turned in
3. Last day to Drop with Refund is this Saturday.
4. Guest speaker next week on internships & apprenticeships.



Pause Recording

Audio Check

Roll Call

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

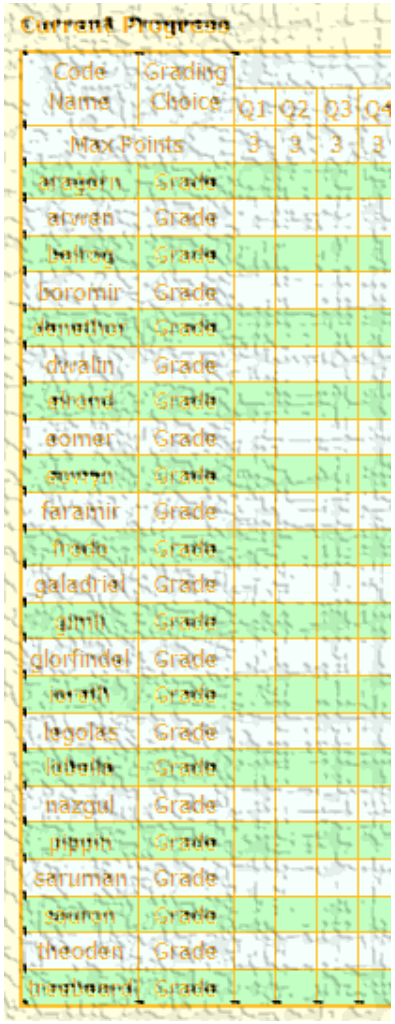
risimms@cabrillo.edu

Resume Recording

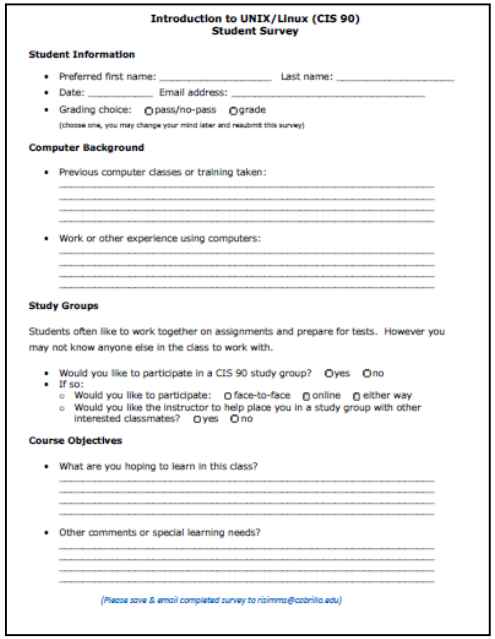
Audio Check

Grading Code Names

Lord of the Rings Characters



*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: _____
- Grading choice: ○ pass/no-pass ○ grade
  (choose one, you may change your mind later and resubmit this survey)

Computer Background

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

Study Groups

Students often like to work together on assignments and prepare for tests. However you may not know anyone else in the class to work with.

- Would you like to participate in a CIS 90 study group? ○ yes ○ no
- If so:
  - Would you like to participate: ○ face-to-face ○ online ○ either way
  - Would you like the instructor to help place you in a study group with other interested classmates? ○ yes ○ no

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)

See Lesson 1 assignments on the Calendar

To get notifications of new forum posts

Subscribe to the forum to get email notifications of new posts

After logging in:

1. Go to the CIS 90 class forum.
2. At the bottom of the page, click the "Subscribe forum" link on the lower left. When subscribed you get email notifications when new posts are made.
3. To unsubscribe, click it again.

Unsubscribed looks like this.

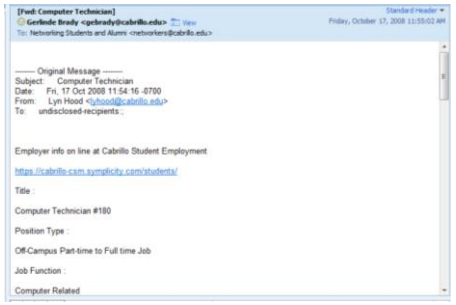
Subscribed looks like this.

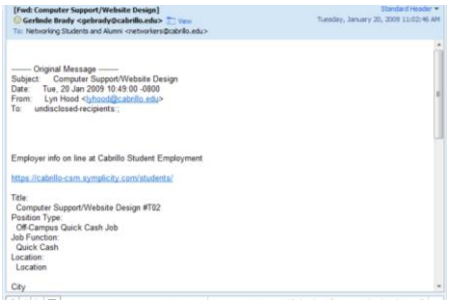
Cabrillo Networking Program Mailing list

Subscribe by sending an email (no subject or body) to:

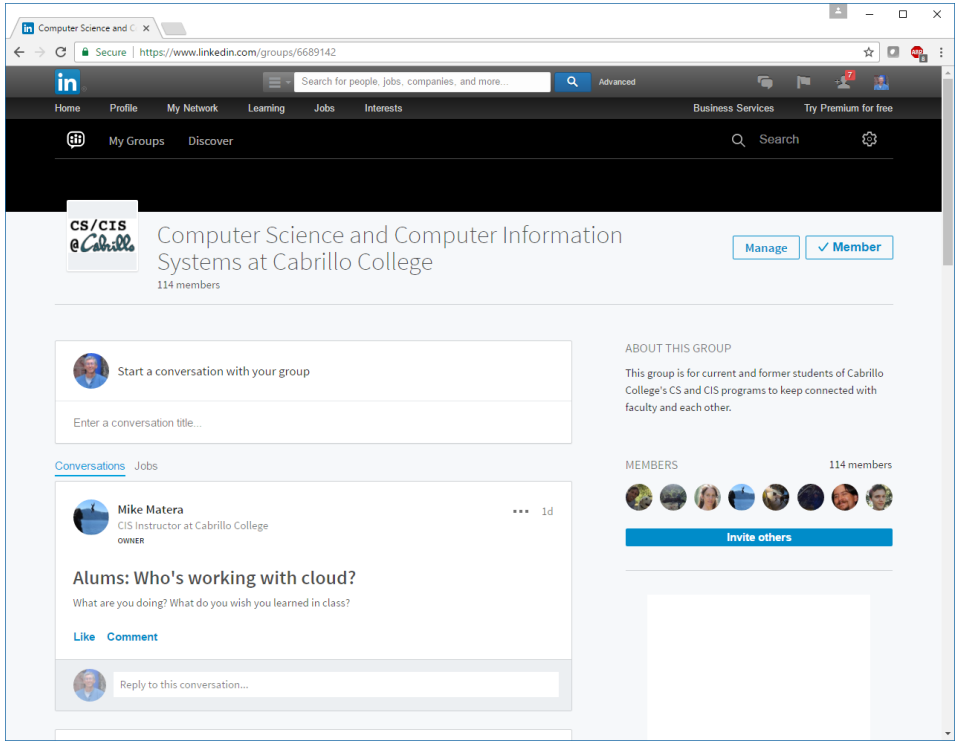
networkers-subscribe@cabrillo.edu

- Program information
- Certification information
- Career and job information
- Short-term classes, events, lectures, tours, etc.
- Surveys
- Networking info and links





LinkedIn
Computer Science and
Computer Information Systems at Cabrillo College

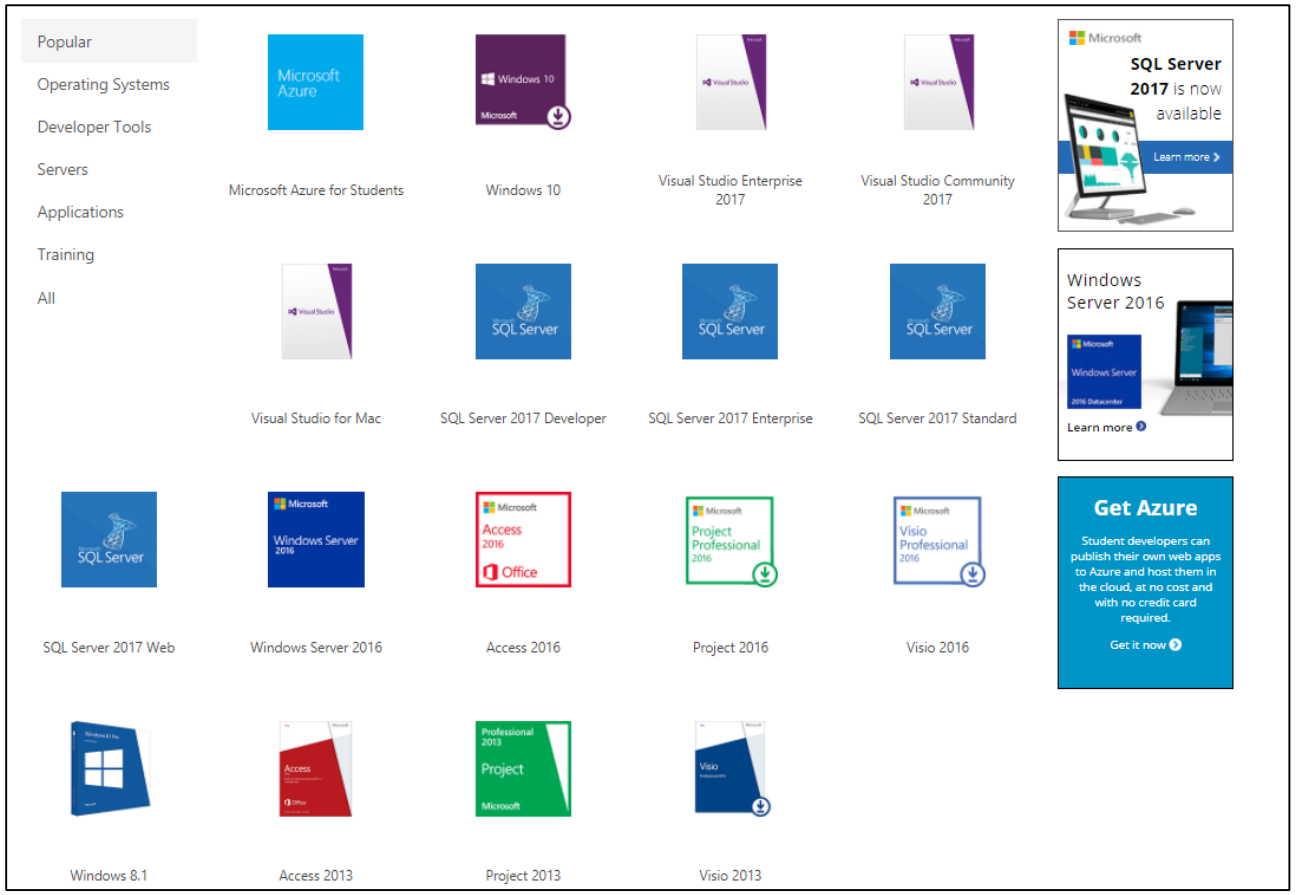


For 3 points extra credit:

1) Join LinkedIn.com
2) Join this group
3) Send me an email when finished.

https://www.linkedin.com/groups/6689142

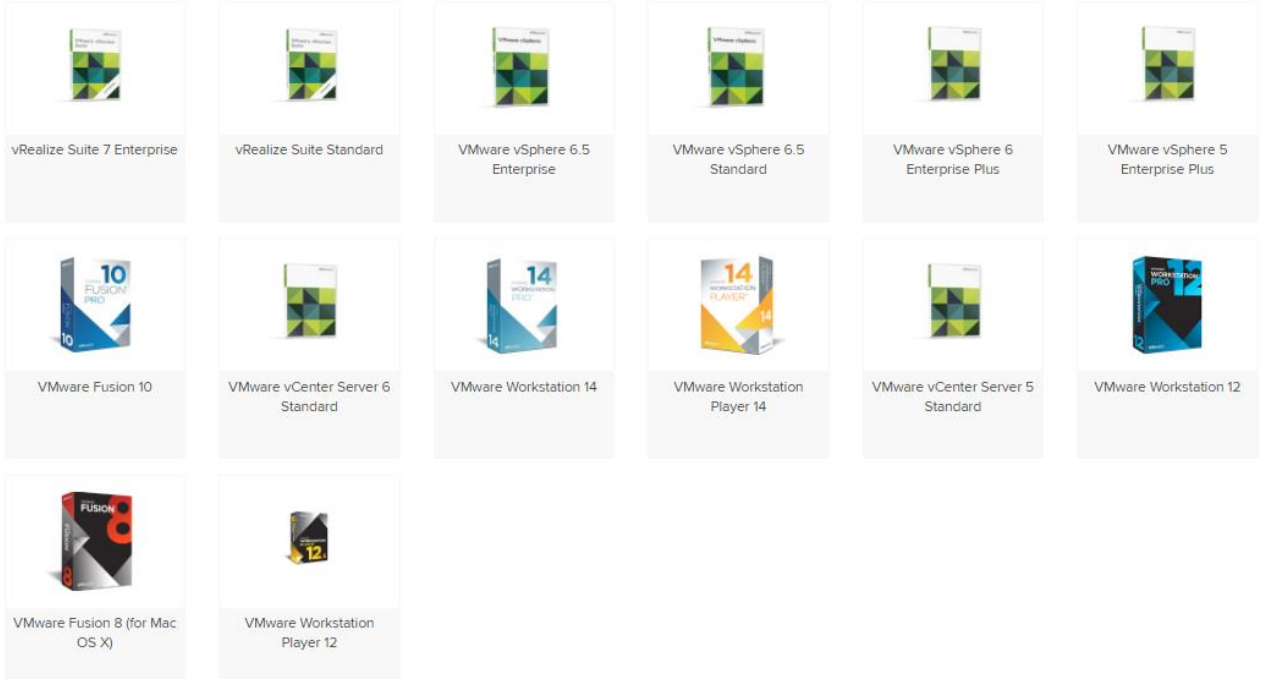
Microsoft Academic Webstore



- Microsoft software for students registered in a CIS or CS class at Cabrillo
- Available after registration is final (two weeks after first class)

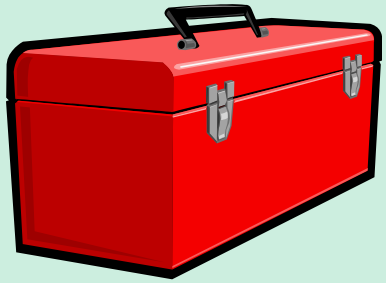
To get to this page, go to **http://simms-teach.com/resources** and click on the appropriate link in the *Academic Software for CIS Students* section.

VMware Academic Webstore



- VMware software for students registered in a CIS or CS class at Cabrillo
- Available after registration is final (two weeks after first class)

To get to this page, go to **http://simms-teach.com/resources** and click on the appropriate link in the *Academic Software for CIS Students* section.

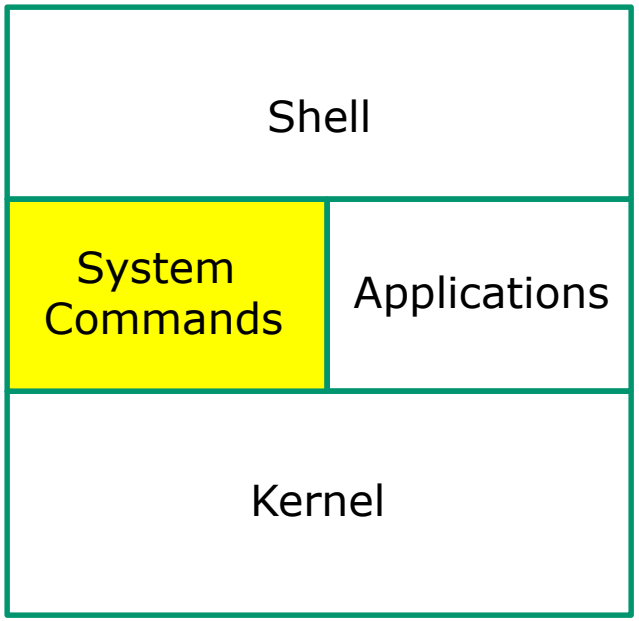


Lesson 2 Commands

Lesson 2 commands for your toolbox

echo	- Prints 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

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.

Follow Me

echo	- Prints 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

Lesson 2 Commands

Supplemental examples

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
```

What happens if you spell cat backwards instead? 

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
```

type command

#Barcelona

Search for a command on the path

Syntax:

type *[command]*

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

```
[rsimms@opus-ii ~]$ type cal
cal is /usr/bin/cal
```

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

name of the file (command/program)

name of the directory where file is found

```
[rsimms@opus-ii ~]$ type bogus
-bash: type: bogus: not found
```

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

```
[rsimms@opus-ii ~]$ type uname cal
uname is /bin/uname
cal is /usr/bin/cal
```

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

```
[rsimms@opus-ii ~]$ type type
type is a shell builtin
```

***type** is built into the shell program*

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:

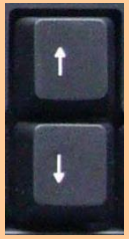
man *command*

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

simben90@oslab:~

```
CAT(1)                          User Commands                          CAT(1)

NAME
       cat - concatenate files and print on the standard output

SYNOPSIS
       cat [OPTION]... [FILE]...

DESCRIPTION
       Concatenate FILE(s), or standard input, to standard output.

       -A, --show-all
              equivalent to -vET

       -b, --number-nonblank
              number nonempty output lines

       -e     equivalent to -vE

       -E, --show-ends
              display $ at end of each line

       -n, --number
              number all output lines

:
```

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

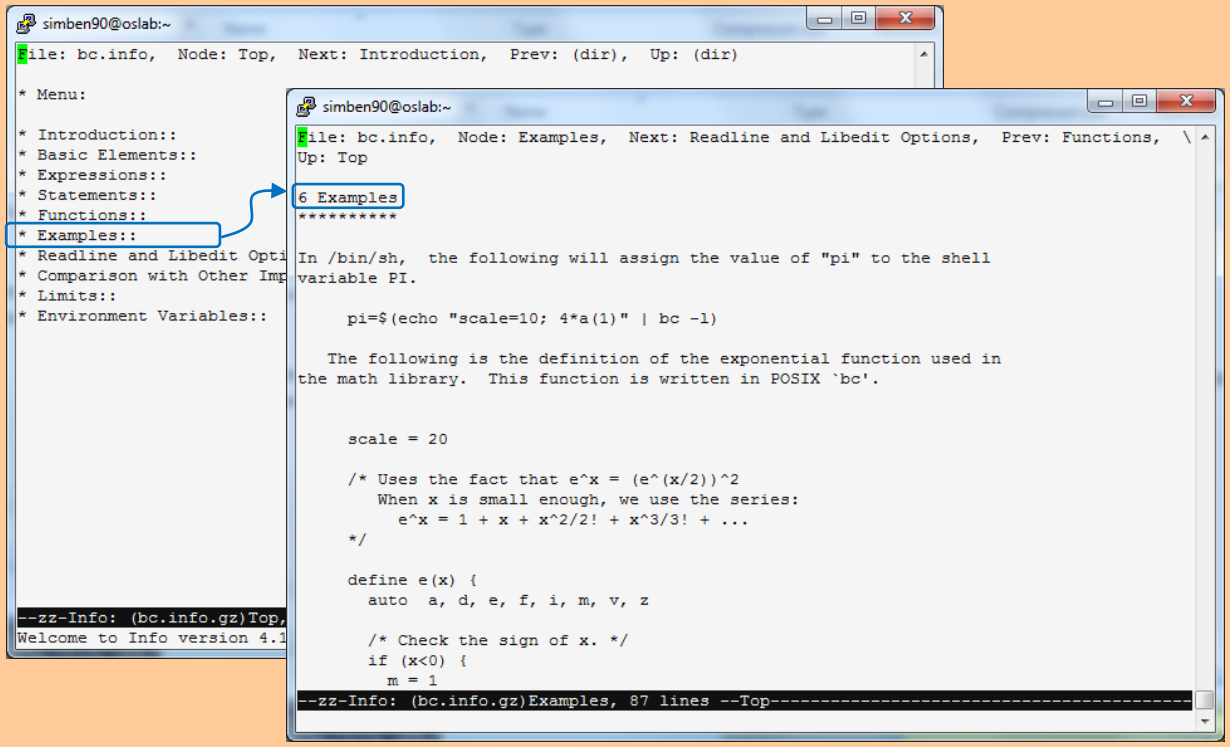
Alternate documentation tool for commands

Similar to man but has has links to additional pages

Syntax:

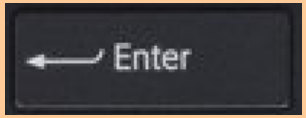
info *command*

```
/home/cis90/simben $ info bc
```



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*

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) 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

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

The Shell Path

The Path

The shell uses your path to locate commands to execute

- A path is an 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 is not on your path the shell will print an error message like:

  -bash: *xxxx*: command not found

- To run a command that is not on your path the complete absolute or relative pathname must be specified. e.g. **/usr/bin/uname** instead of just **uname.**
- To locate a command on your path use: **type** *command*
  where *command* is the name of the command you want to locate.

Show your shell path

```
/home/cis90/simben $ echo $PATH
/usr/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/home/cis90/si
mben/../bin:/home/cis90/simben/bin:.
```

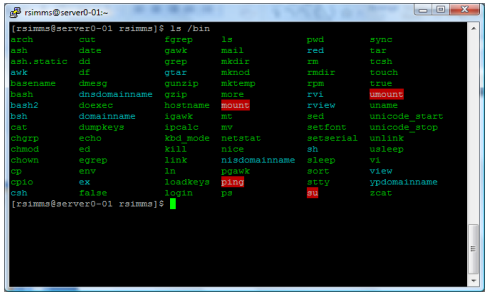
The colon character is used to separate directories on the path

1st directory: `/usr/local/bin`
2nd directory: `/usr/bin`
3rd directory: `/usr/local/sbin`
4th directory: `/usr/sbin`
5th directory: `/home/cis90/simben/../bin`
6th directory: `/home/cis90/simben/bin`
7th directory: `.`

Locations of common commands

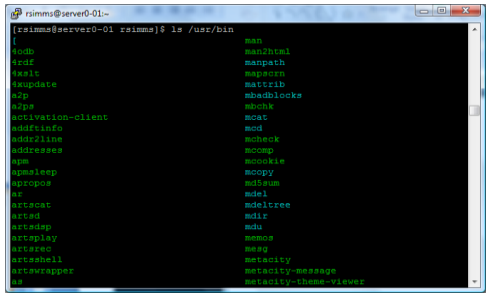
Directories of common commands

/bin

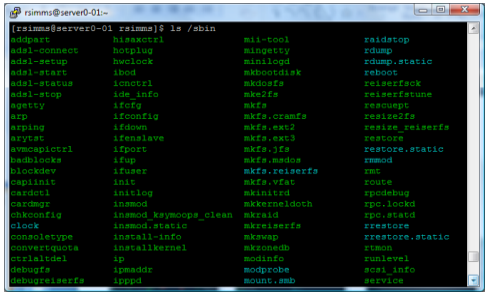


Commands for regular users are in /bin and /usr/bin

/usr/bin

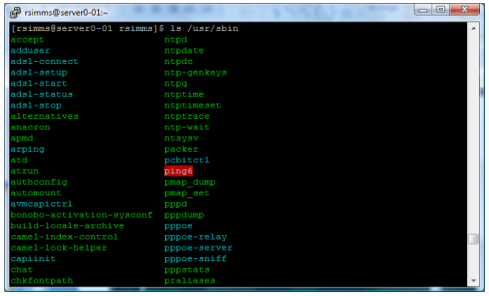


/sbin



System administration commands are in /sbin and /usr/sbin

/usr/sbin



*Most commands reside in these four directories. They can be found in other places as well. For example system administrators often put custom commands in **/usr/local/bin***

Red Hat 7 and Centos 7

```
/home/cis90/simben $ ls -l /bin /sbin
lrwxrwxrwx. 1 root root 7 Aug  4  2017 /bin -> usr/bin
lrwxrwxrwx. 1 root root 8 Aug  4  2017 /sbin -> usr/sbin
```

Starting with Red Hat and Centos version 7 the /bin and /usr/bin commands have been combined into the /usr/bin directory.

Same with /sbin and /usr/sbin.

Heads up on future tests

Memorize these five directories:

```
/bin
/usr/bin
/sbin
/usr/sbin
/usr/local/bin
```

I will mess with your path on almost every test!

To fix things you will need to look at your path and insure it has these directories!

Locate a command on the path

Example: Where is the **cal** command located?

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

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

name of the file (command/program)

name of the directory where file is found

```
/home/cis90/simben $ echo $PATH
/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/ho
me/cis90/simben/../bin:/home/cis90/simben/bin:.
/home/cis90/simben $ ls -l /bin /sbin
```

The /usr/bin directory is third directory on the path

Locate a command on the path

Example: Where is the **bogus** command located?

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

there is no command named bogus
in any of the path directories

```
/home/cis90/simben $ echo $PATH
/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/ho
me/cis90/simben/../bin:/home/cis90/simben/bin:.
/home/cis90/simben $ ls -l /bin /sbin
```

Locate a command on the path

Example: Where is the **type** command located?

```
/home/cis90/simben $ type type
type is a shell builtin
```

the type command is built into the shell

```
/home/cis90/simben $ echo $PATH
/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/ho
me/cis90/simben/../bin:/home/cis90/simben/bin:.
/home/cis90/simben $ ls -l /bin /sbin
```

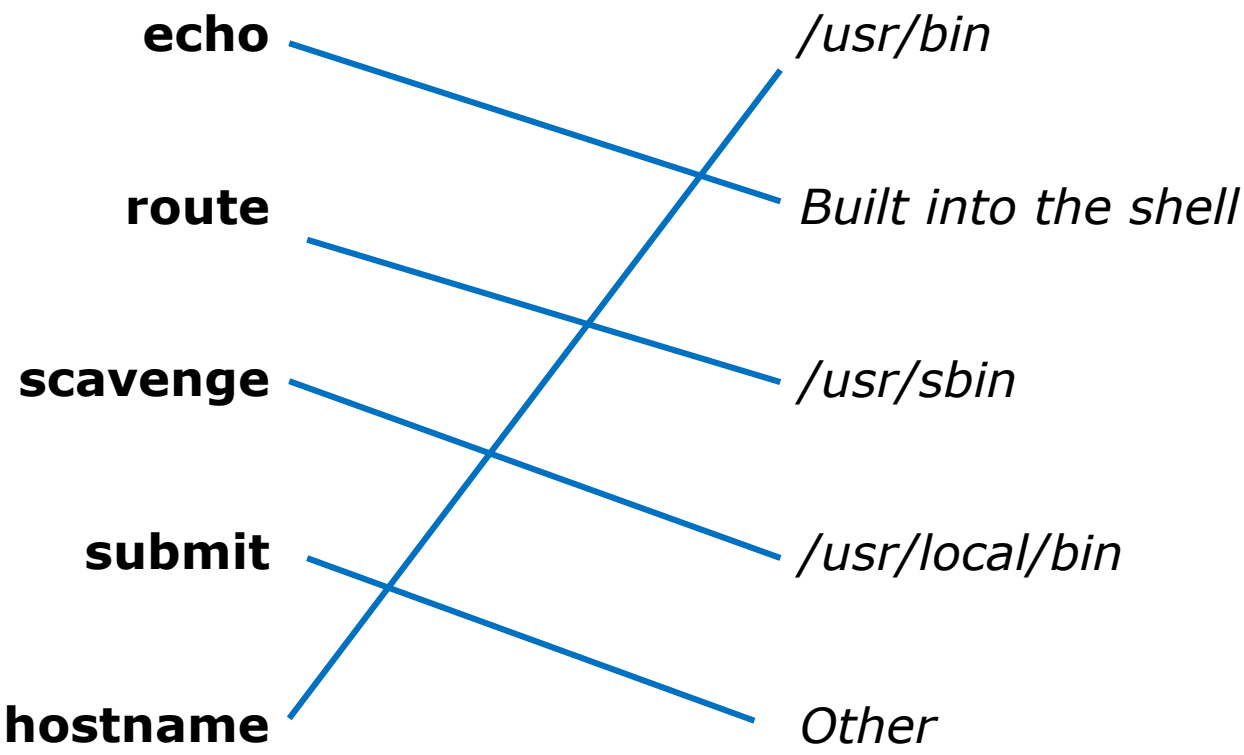
Class Activity

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

echo	*/usr/bin*
route	*Built into the shell*
scavenge	*/usr/sbin*
submit	*/usr/local/bin*
hostname	*Other*

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 binary code:

- 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++.
- Examples: The ls command, the uname command, the bash shell itself.

A program can be a text-based script:

- 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.
- Examples: The apropos command.

Class Activity

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

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

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

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

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

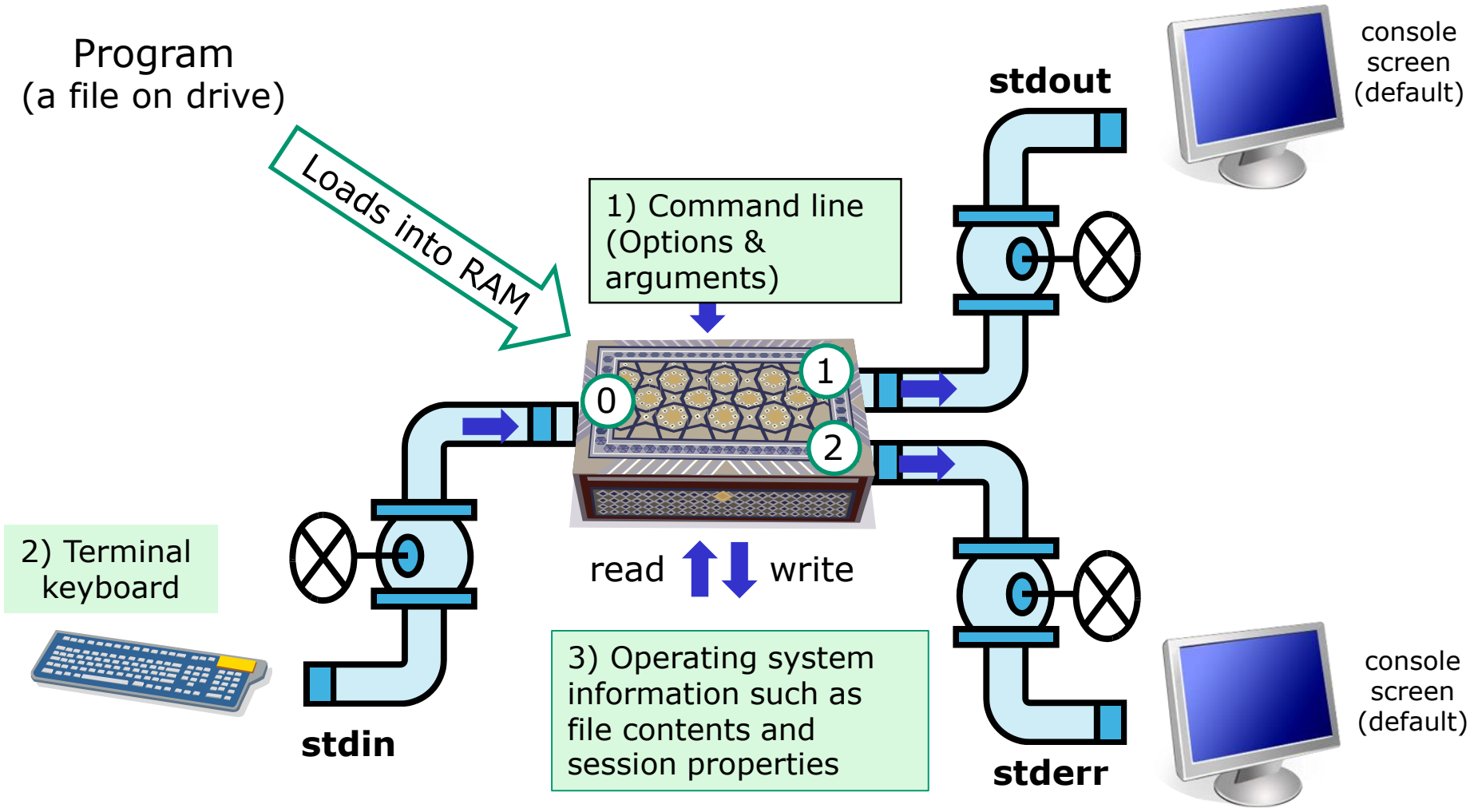
You will get these questions when you submit Lab 2

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?

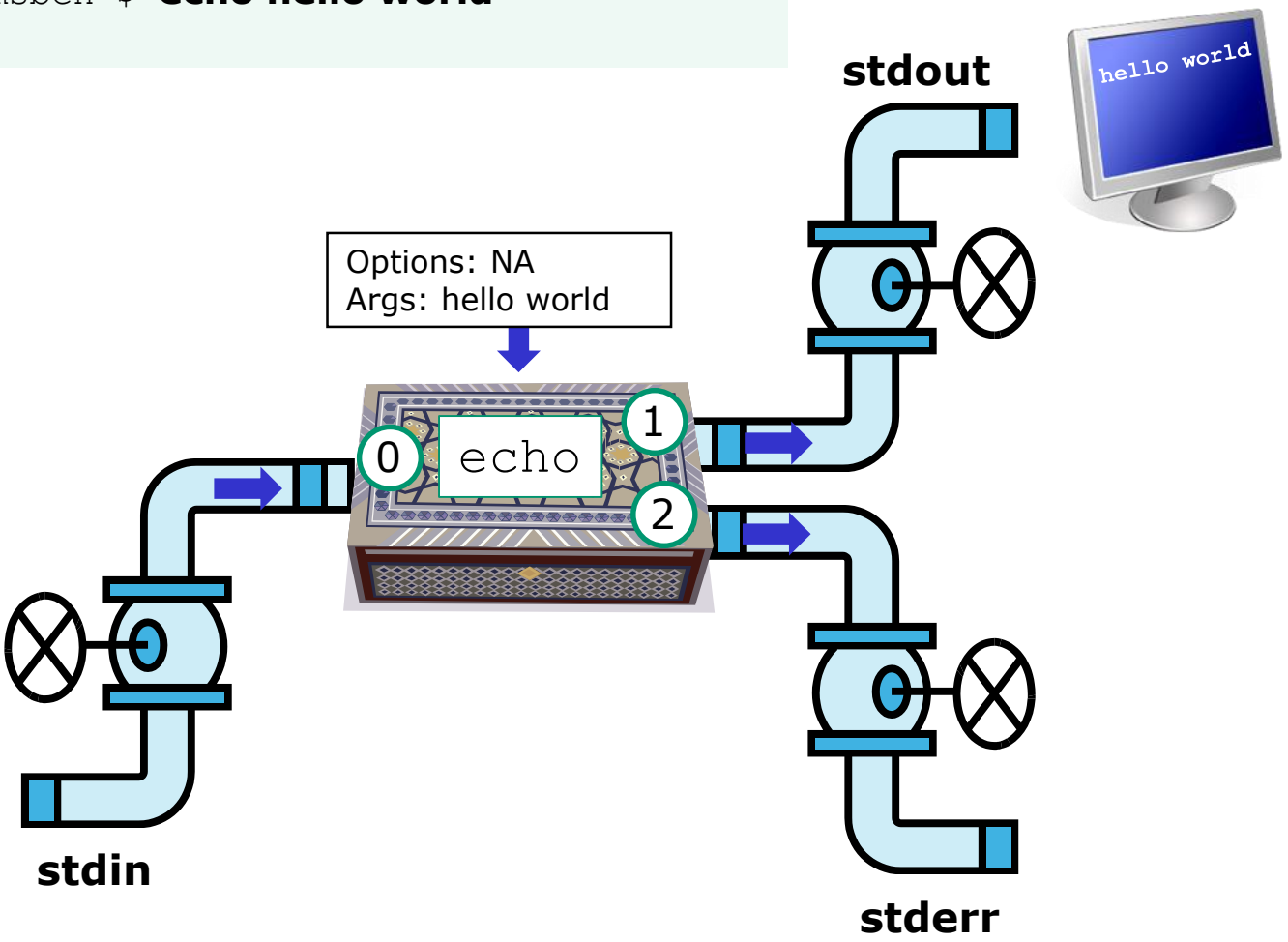
```
/home/cis90/simmen $ echo hello world
hello world
```

```
/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?

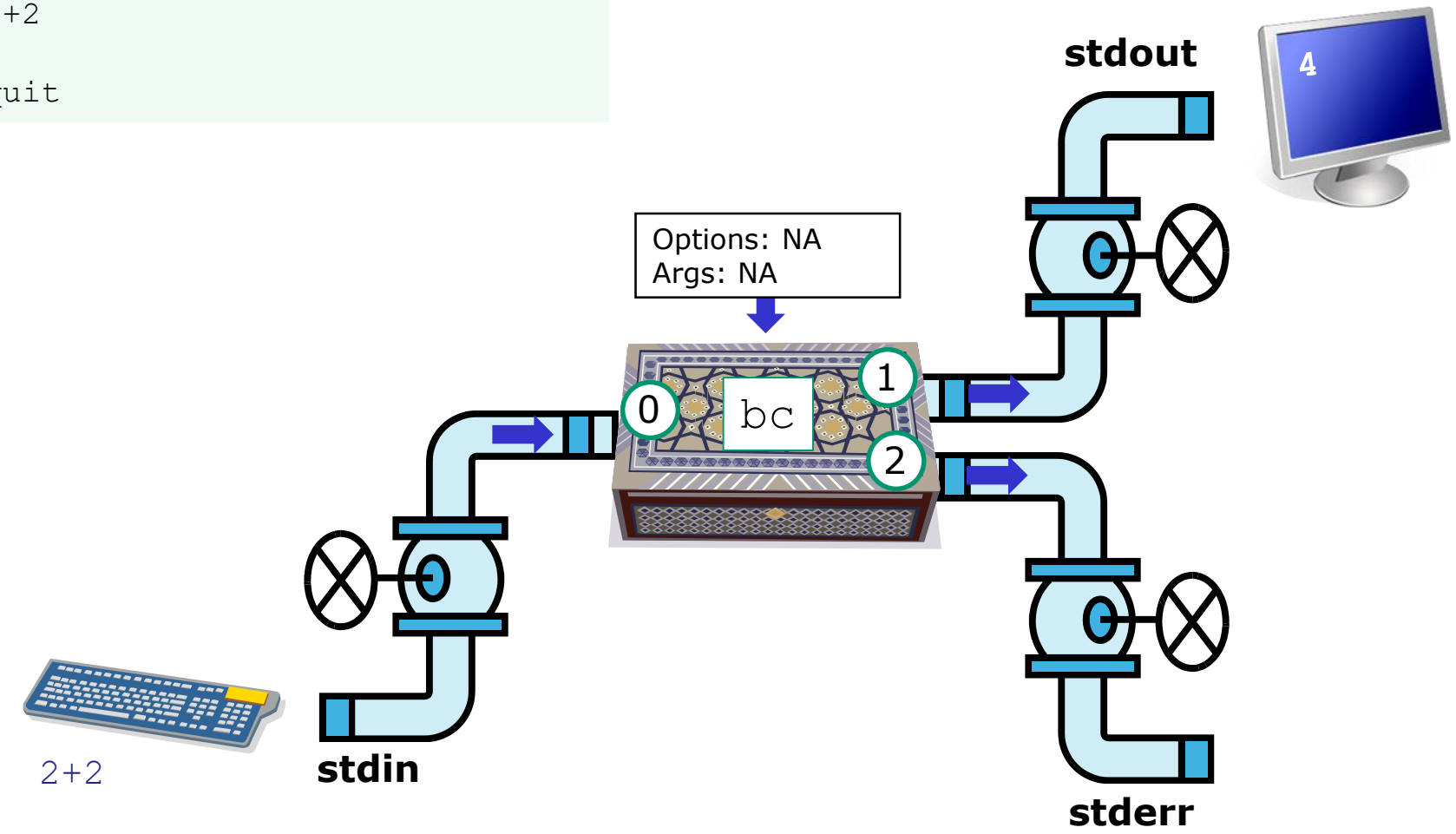
```
/home/cis90/simmsben $ bc
bc 1.06
Copyright 1991-1994, 1997, 1998, 2000 Free
Software Foundation, Inc.
This is free software with ABSOLUTELY NO
WARRANTY.
For details type `warranty'.
2+2
4
500-200+3
303
sqrt(64)
8
quit
```

```
/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?

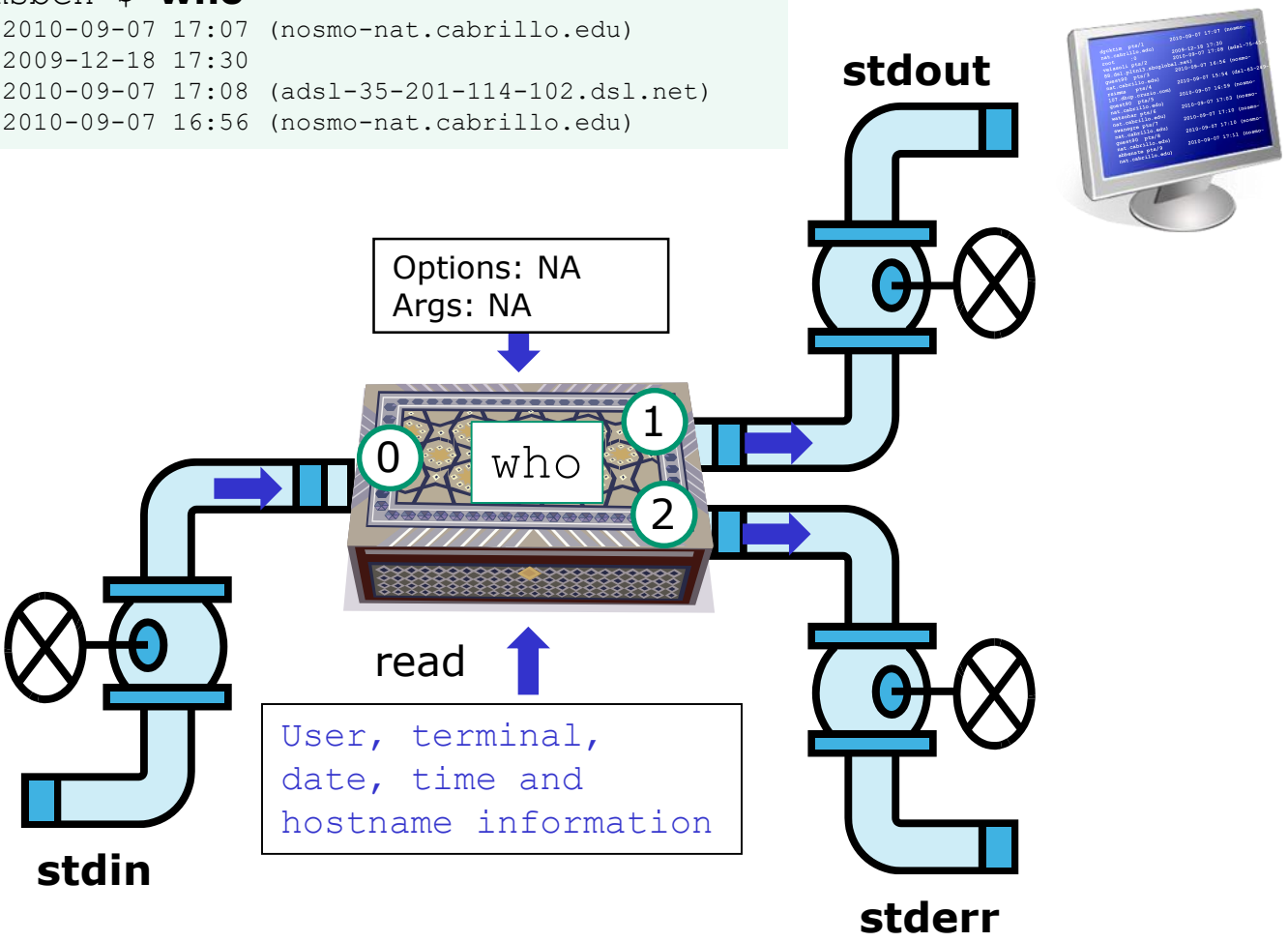
```
/home/cis90/simmen $ who
dycktim  pts/1        2010-09-07 17:07 (nosmo-nat.cabrillo.edu)
root     :0           2009-12-18 17:30
velasoli pts/2        2010-09-07 17:08 (adsl-35-201-114-102.dsl.net)
guest90  pts/3        2010-09-07 16:56 (nosmo-nat.cabrillo.edu)
rsimms   pts/4        2010-09-07 15:54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

Is this **ps** command getting its input from the command line, the keyboard or the operating system?

```
/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)

Some new vocabulary

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`

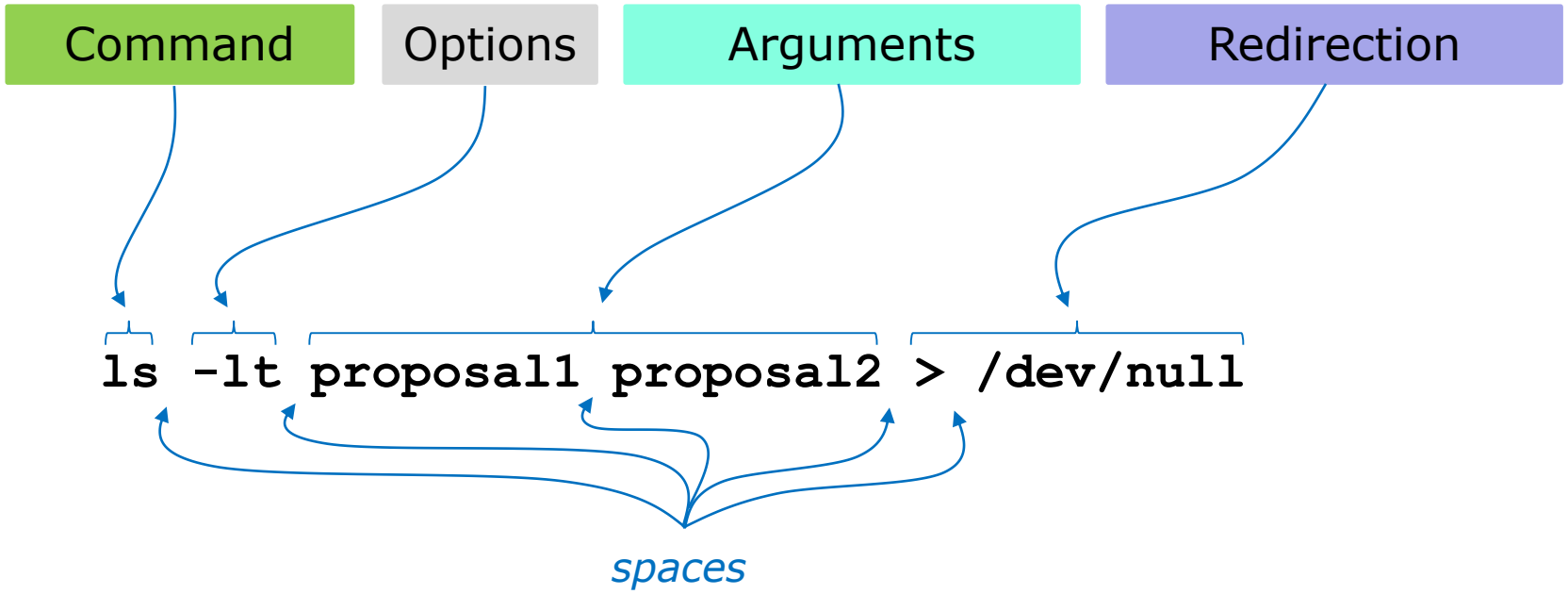
Arguments – follow the options. Multiple arguments must be separated by spaces.

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

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 common 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

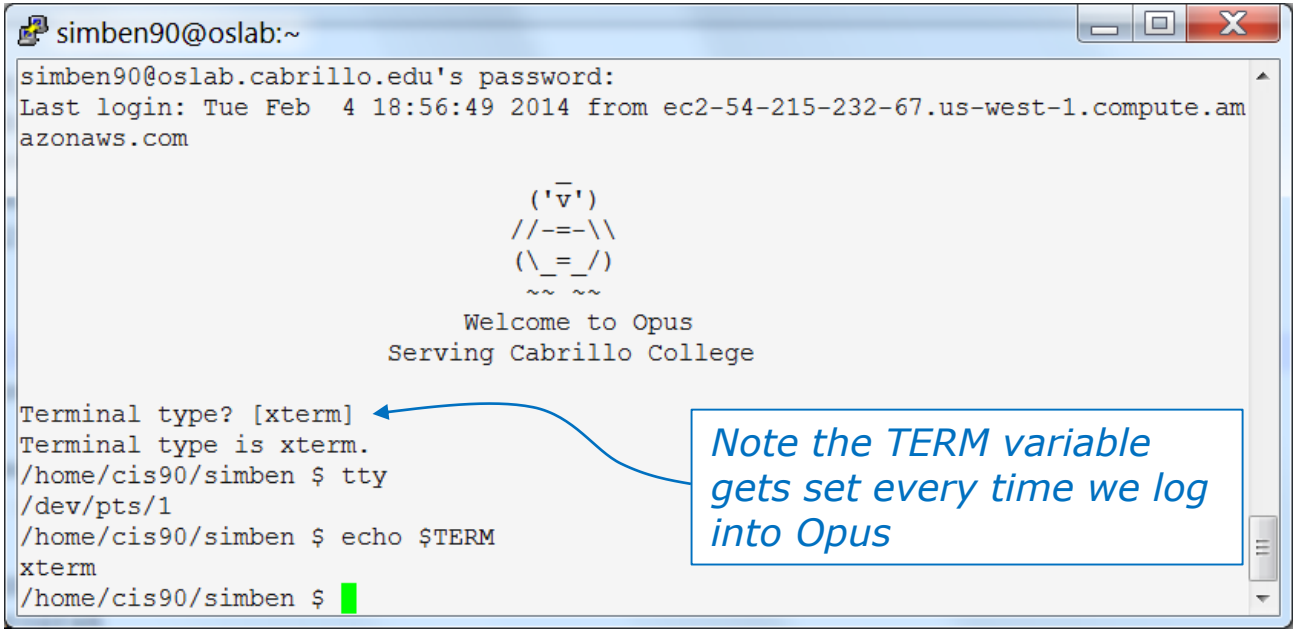
```
/home/cis90/simben $ echo $HOME
/home/cis90/simben
```
Shows your home directory

```
/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

Note that 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

Changing the shell prompt

(PS1 variable)

The PS1 variable

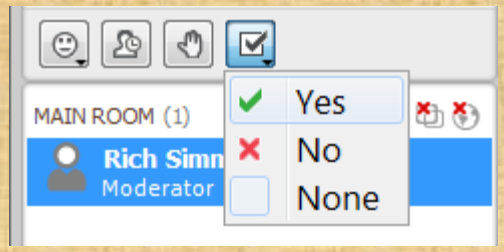
```
/home/cis90/simben $ echo $PS1
$PWD $
```

The PS1 variable defines the shell prompt

Follow Me

```
/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
```

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



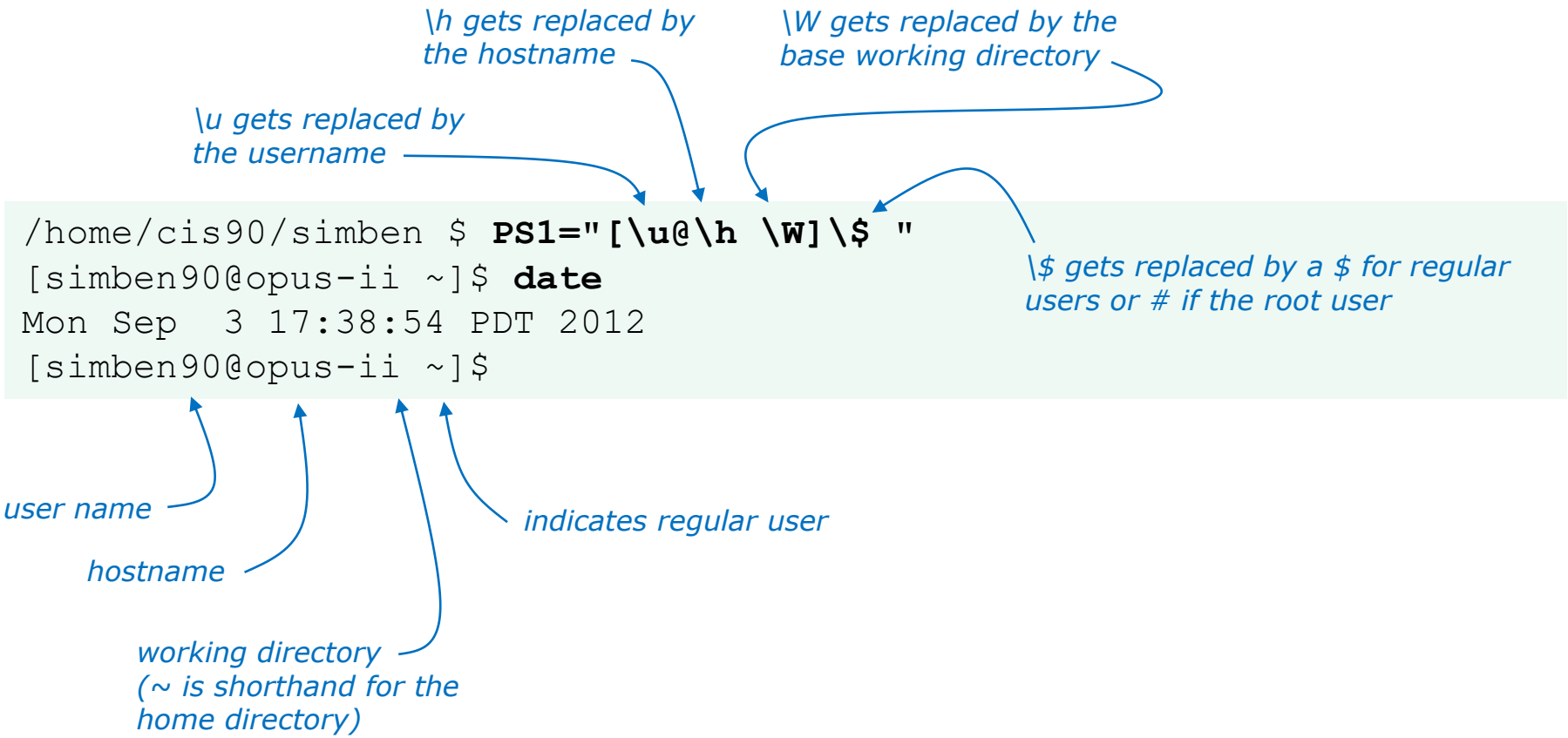
Need a fresh start -- just log out and back in again and your prompt will be back to normal!

Changing the shell prompt

More PS1 prompt examples

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 the environment 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=opus-ii.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=opus-ii.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 variables)*

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"
```

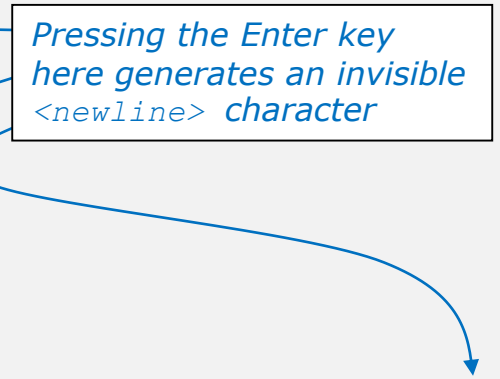
```
/home/cis90/simben $ echo "'single quotes'"
'single quotes'
```

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@opus-ii ~]$ echo a b c d e f
a b c d e f

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

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

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

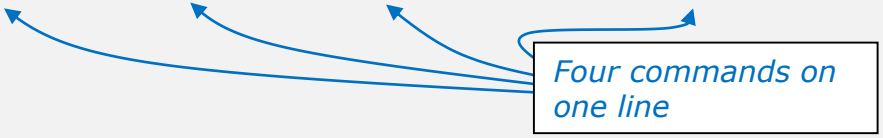
```
[rsimms@opus-ii ~]$ echo "Hello World"
Hello World

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

Escape the double quote marks

Metacharacters - ; (semi-colon)

The semi-colon ; allows multiple commands on one line

```
[simmsben@opus-ii 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/
opus-ii.cis.cabrillo.edu
-bash: name: command not found
simben90
jerusalem  tiger
/home/cis90/simben $ hostname; uname; echo $LOGNAME; ls Poems/Blake/
opus-ii.cis.cabrillo.edu
Linux
simben90
jerusalem  tiger
```

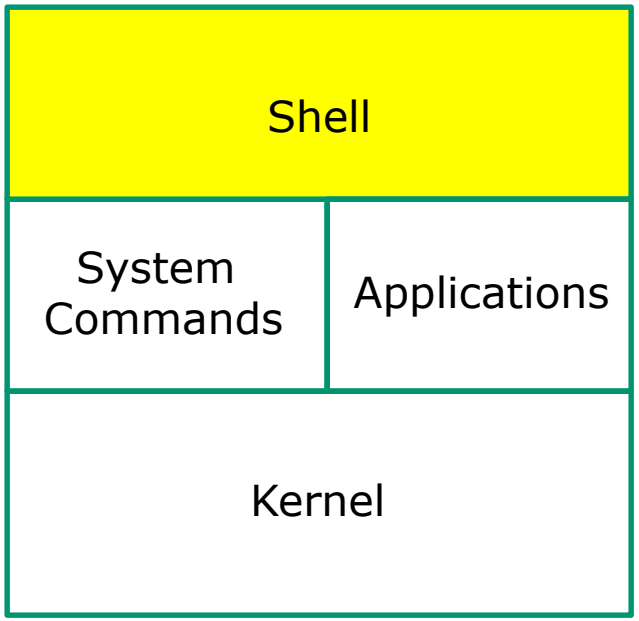
Press <tab> after the P and B and the shell fills in the rest

Press up arrow and the shell retypes the previous command

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

The Shell (six steps)

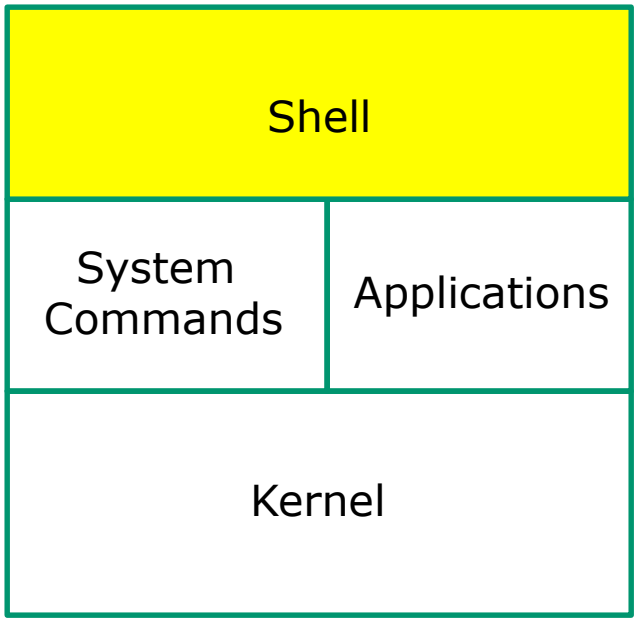
The Shell



- 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:

prompt *command*

```
/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 $
```

output

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`
- No Redirection

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/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/home/cis90/simben/../bin:
/home/cis90/simben/bin:.
```

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

1st directory: /usr/local/bin *nope, not found here*
2nd directory: /usr/bin *bingo, found here!*
3rd directory: /usr/local/sbin
4th directory: /usr/sbin
5th directory: /home/cis90/simben/../bin
6th directory: /home/cis90/simben/bin
7th directory: .
.
.

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

Try mimicking what the shell does to search for ls:

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

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

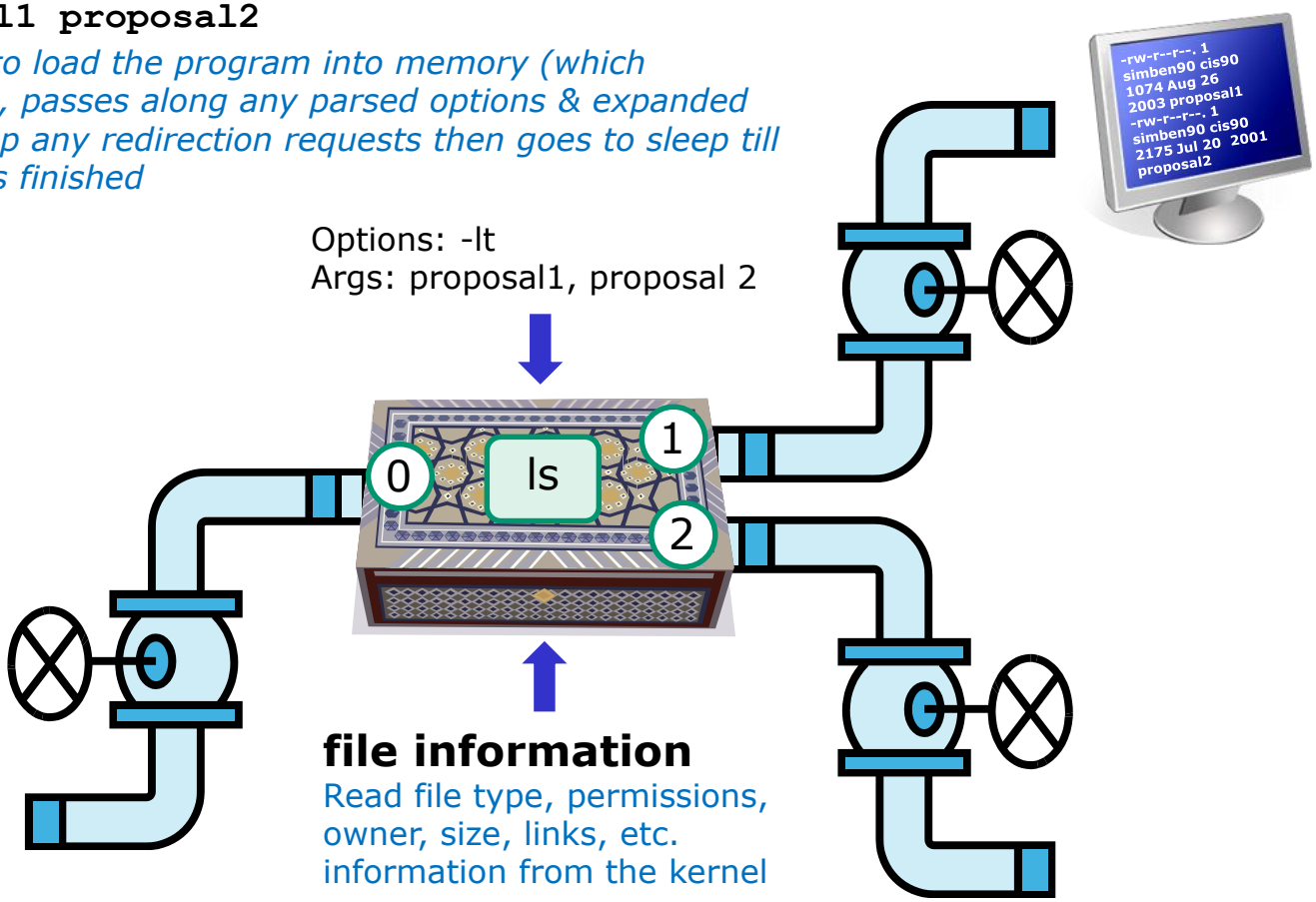
Life of the Shell

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?

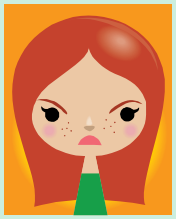
C
```
/home/cis90/simben $ ls -lw proposal1 proposal2
ls: invalid line width: proposal1
```
What's wrong?
Who output the error?

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?

Life without a path

-bash: *xxxx*: command not found

Don't get mad, just fix your path!

Life without a path

https://simms-teach.com/docs/cis90/cis90-life-with-no-path.pdf

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.)
```

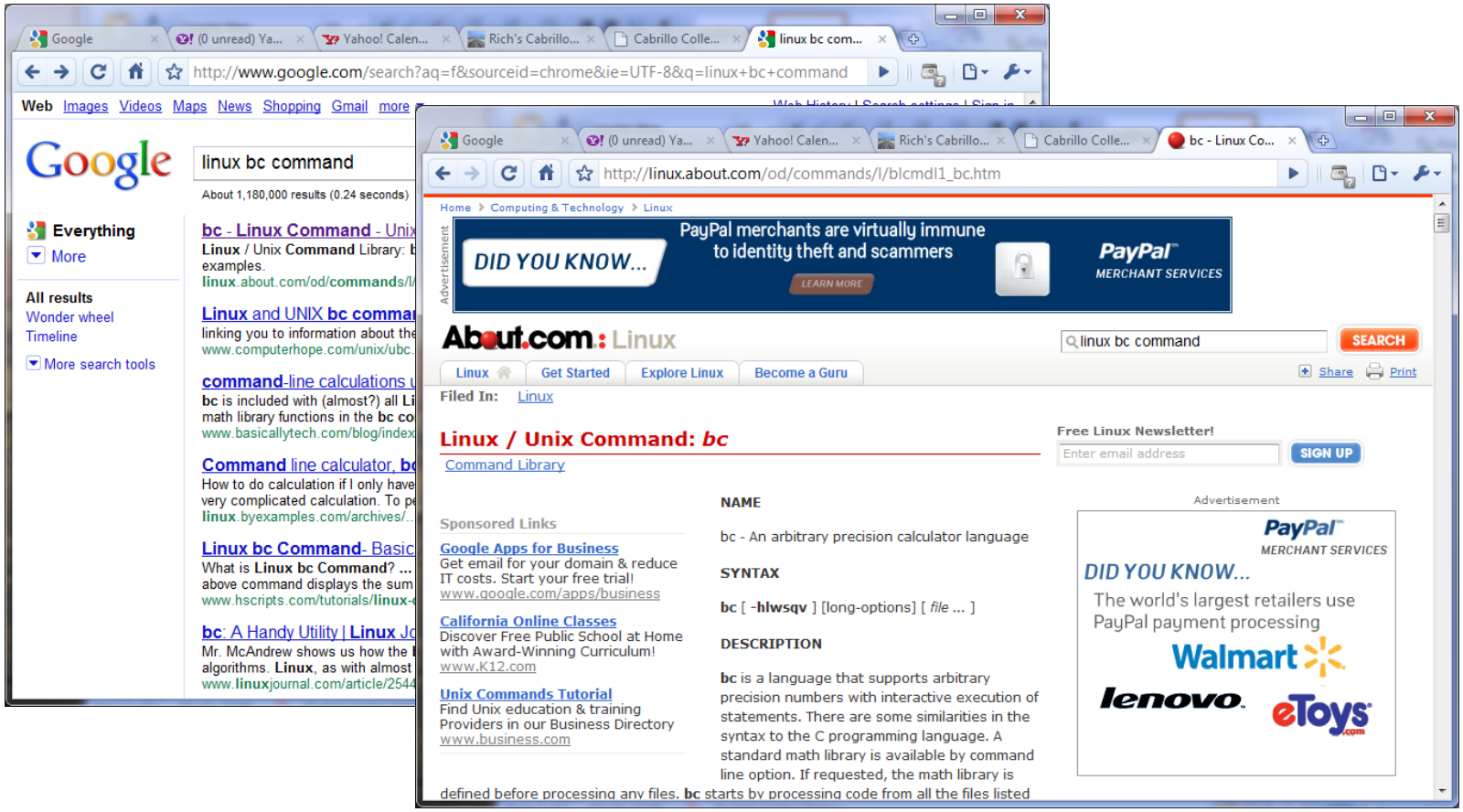
Use these keys to scroll

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

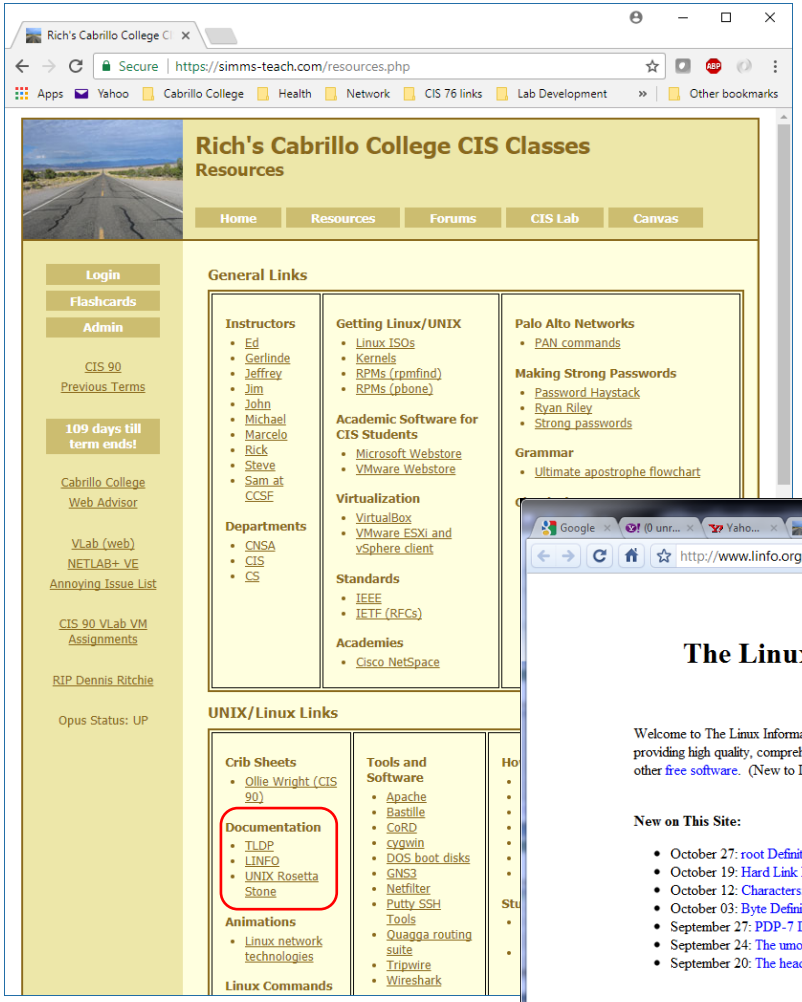


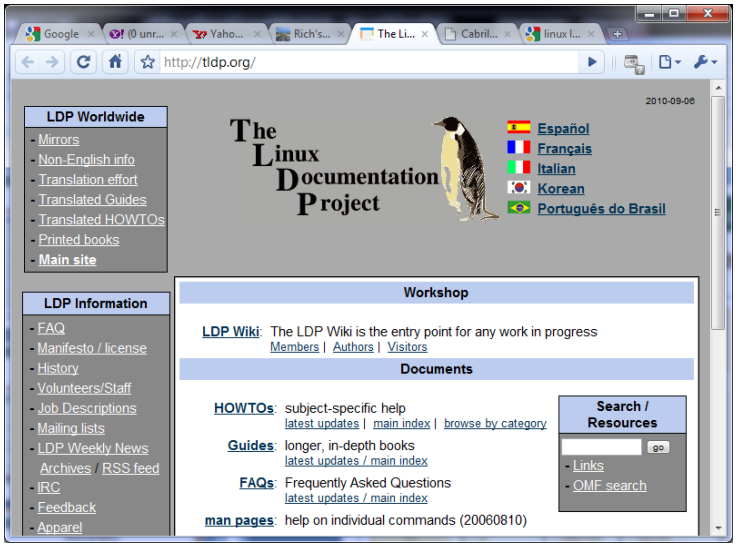
Other Documentation

- **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



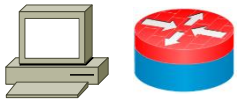


The Linux Documentation and Information Projects

If we have time, otherwise cover ZeroW, VLab, Virtual Terminal modules to Lesson 3

Navigating the Internet using SSH

Second driving lesson continued



Your home (private)

Internet

2220
son-of-opus.simms-teach.com
AWS (Oregon, public)

simms-teach.com
DreamHost
(Los Angeles, public)

2220
daughter-of-opus.simms-teach.com
OVH (Montreal, public)

CIS Server network (Aptos, public)

2220
Opus-II.cis.cabrillo.edu

Defiant (2221)
Intrepid (2224)
Enterprise (2223)
Freedom (2225)
Excalibur (2226)
Lexington (2222)
Sun-Hwa-xx
Arya-xx's
Home-ZeroW

uLab devices
Room 828 PCs
Room 829 PCs
Room 830 PCs

CIS Lab and Classroom networks
(Aptos, private)

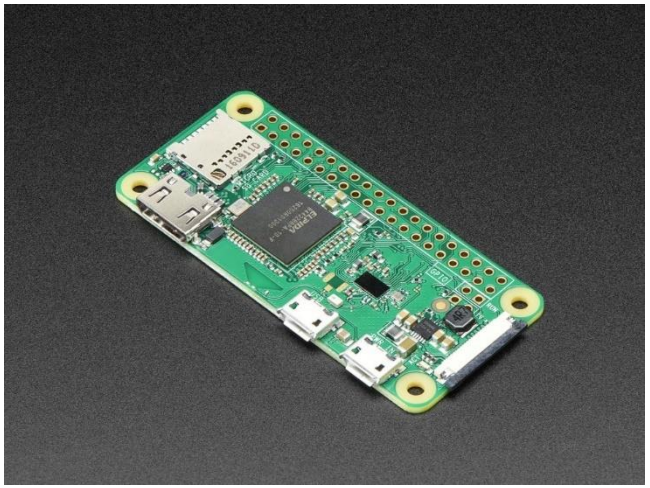
2225
brienne.simms-teach.com

baby-opus
(Soquel, private)

You cannot access servers with private IP addresses directly from the Internet.

Instead you must enter via server with a public address that is also connected to the private network.

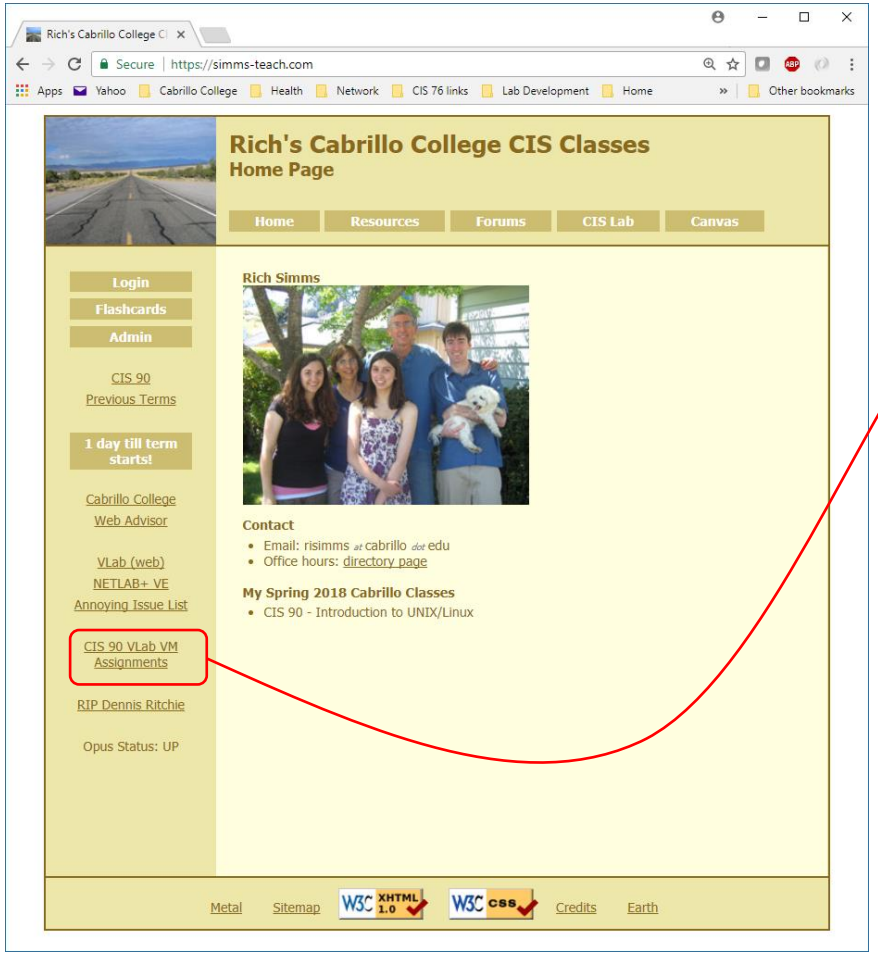
Raspberry Pi

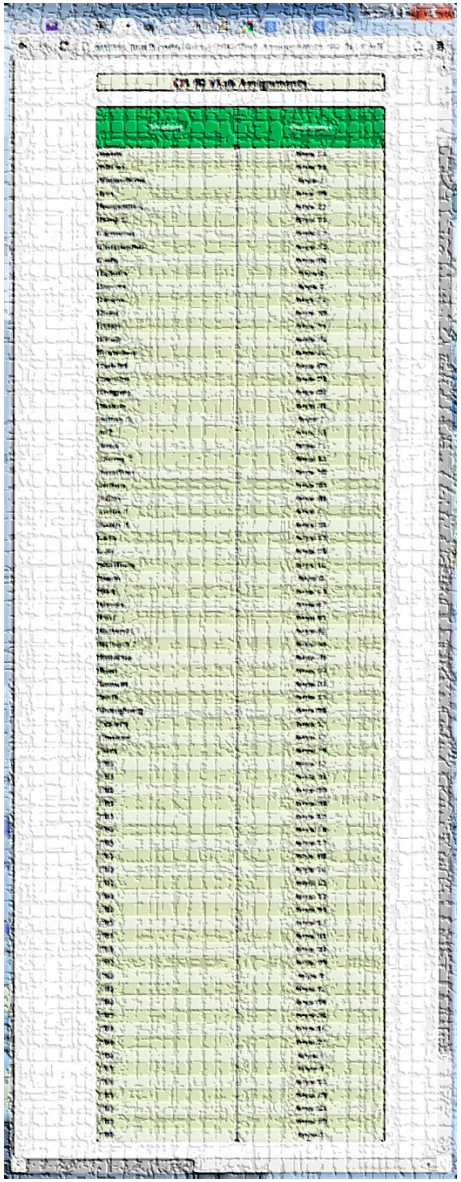


Raspberry Pi Zero W

https://www.adafruit.com/products/3400

http://simms-teach.com/

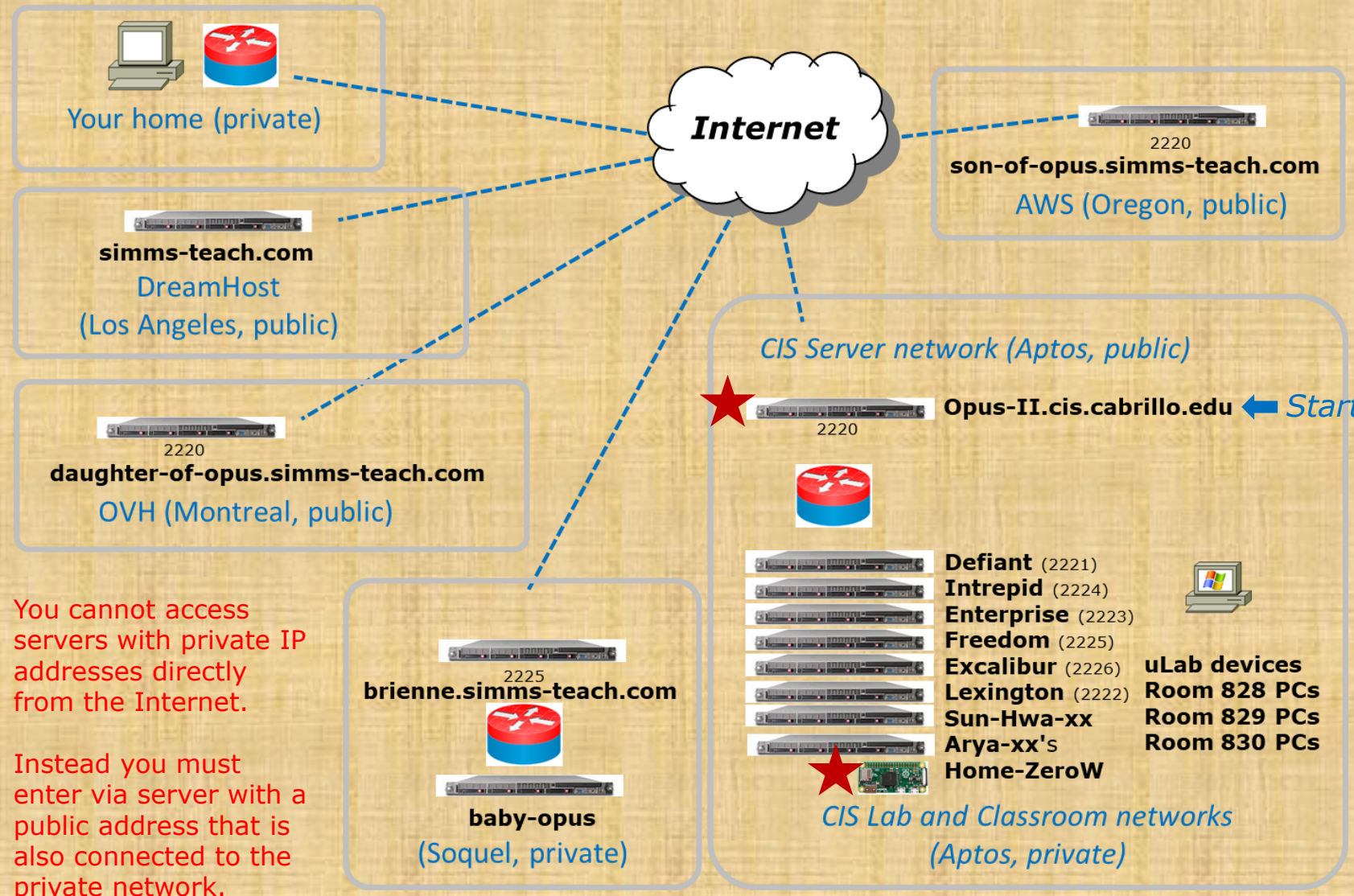




To see which Arya VM is yours use the link on the class website

Class Activity

Follow me if you can!

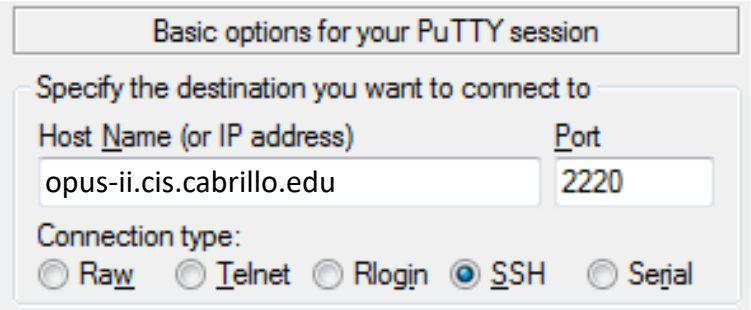


You cannot access servers with private IP addresses directly from the Internet.

Instead you must enter via server with a public address that is also connected to the private network.

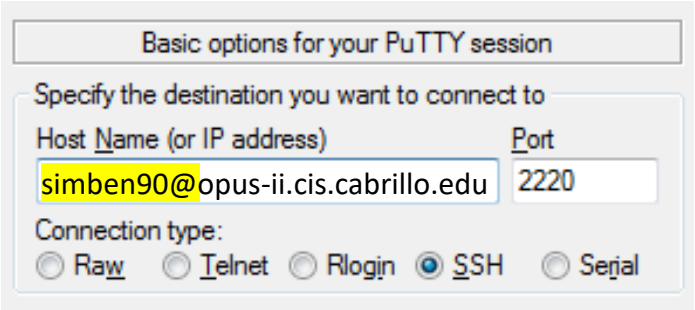
FYI, specifying the username on ssh logins

Putty from Windows PCs



If you don't specify your username the system will prompt you for both your username and password

```
login as: simben90
simben90@opus-ii.cis.cabrillo.edu's password:
```



If you specify your username the system will just prompt you for your password

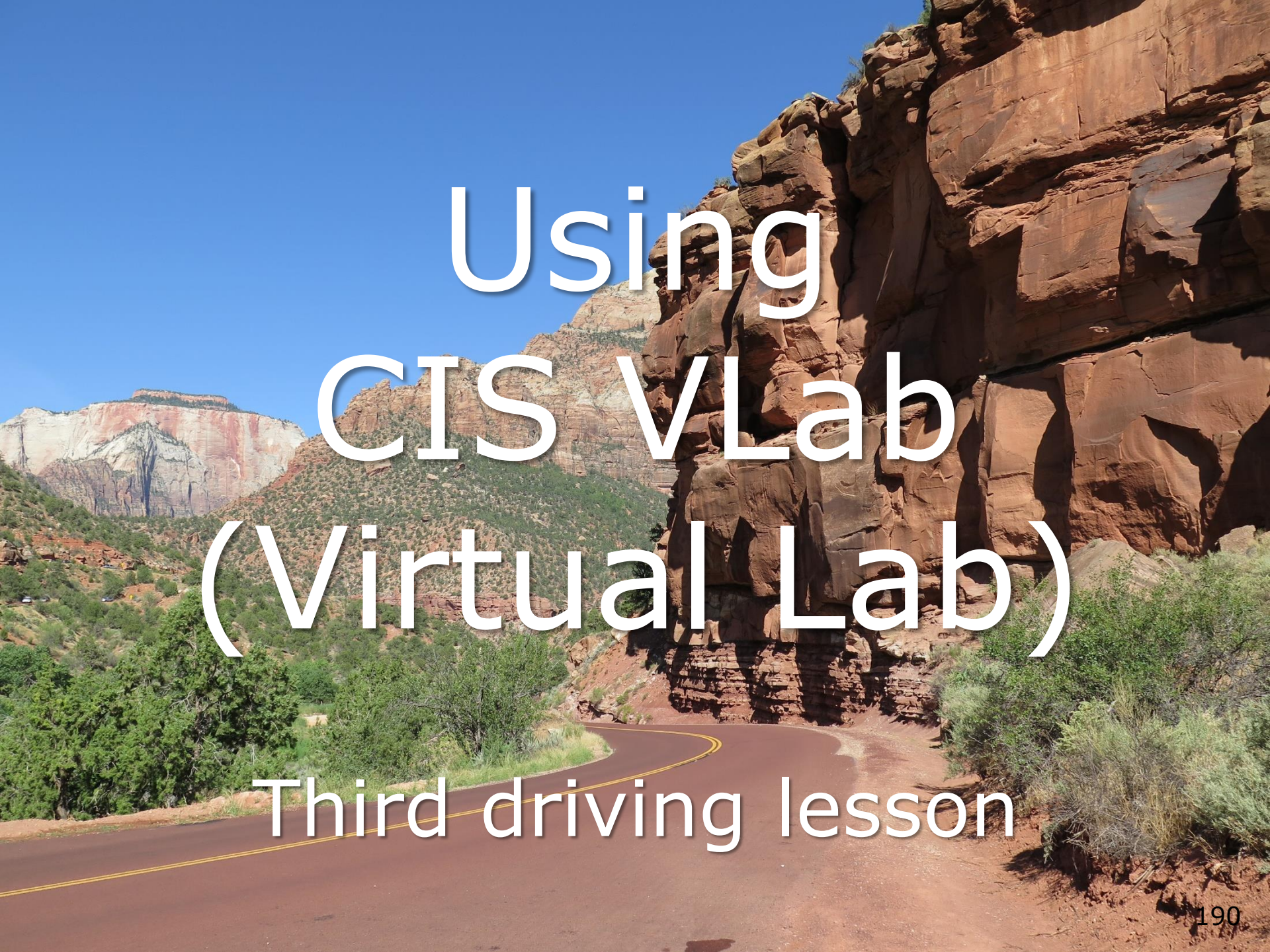
```
Using username "simben90".
simben90@opus-ii.cis.cabrillo.edu's password:
```

ssh command from Mac or UNIX/Linux systems

`ssh -p 2220 simben90@opus-ii.cis.cabrillo.edu`

If you don't specify a username the ssh command will use your current username. Be careful, that username may not exist on the remote system you are trying to login to.

```
[rsimms@daughter-of-opus ~]$ ssh -p 2220 simben90@opus-ii.cis.cabrillo.edu
simben90@opus-ii.cis.cabrillo.edu's password:
```


Using
CIS VLab
(Virtual Lab)
Third driving lesson

Command Line vs Graphical Desktop

Should I use SSH or VLab?

SSH when:

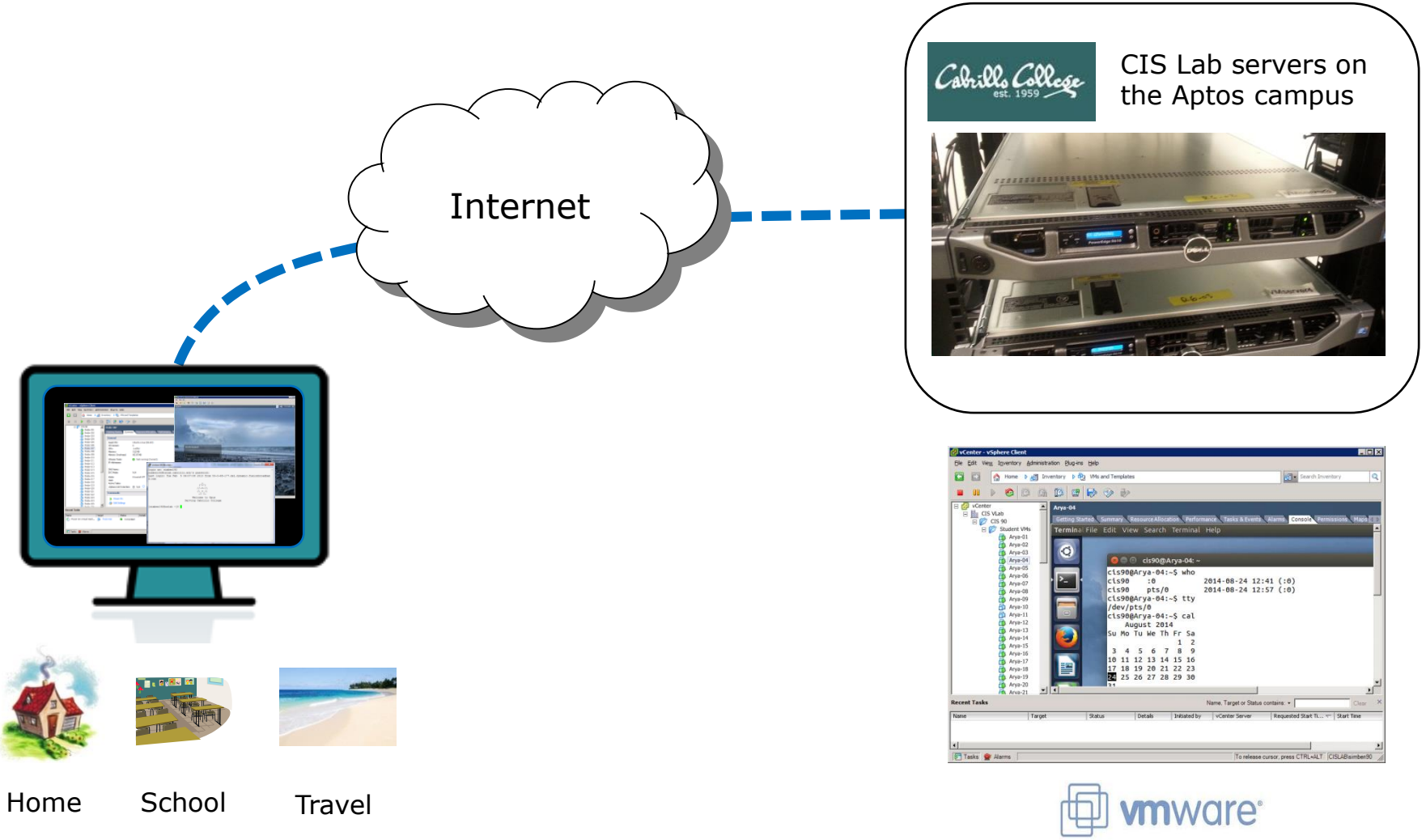
- You just need a command line.
- Have a low or high speed network connection.

VLab when:

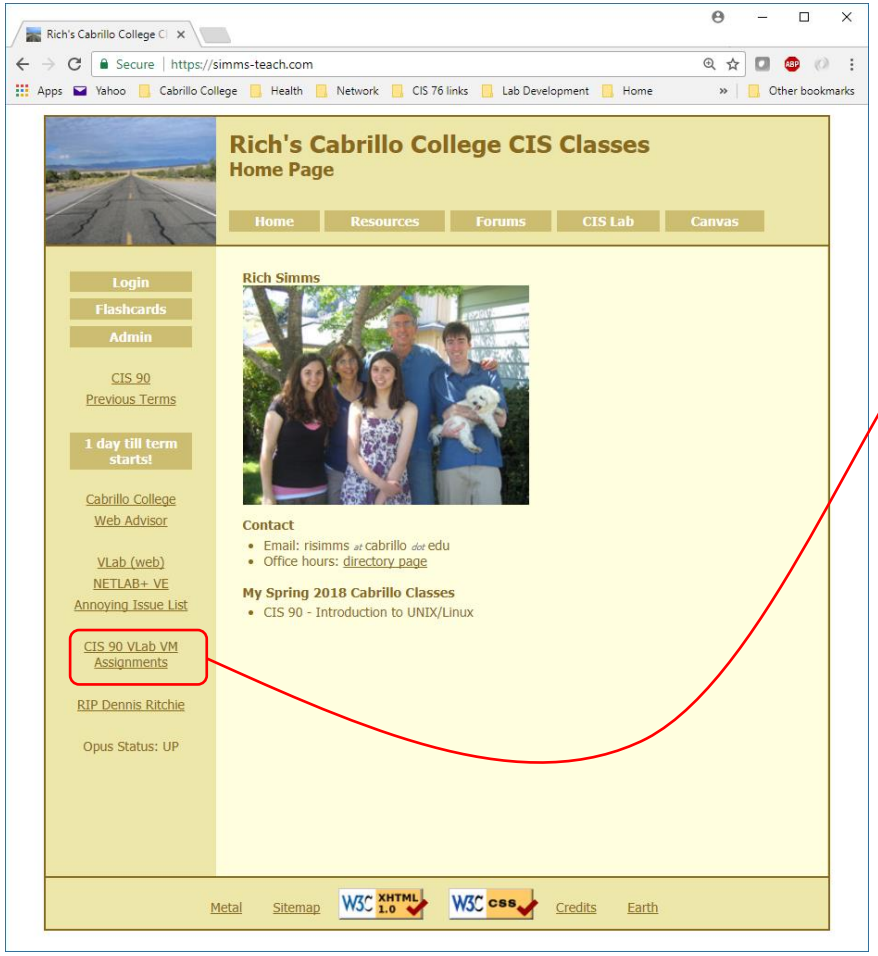
- You need to use a graphical desktop.
- You need to use virtual terminals (the very basic black consoles).
- Higher speed network connection is needed for the graphics.

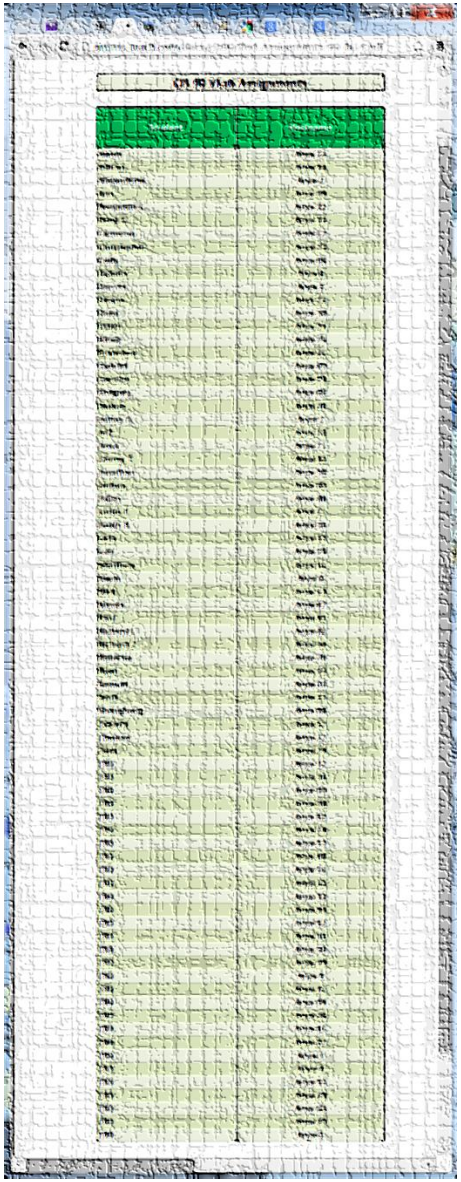
VLab = using the VMware vSphere Web Client over the Internet to access course VMs.

Accessing CIS VLab VMs



http://simms-teach.com/





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

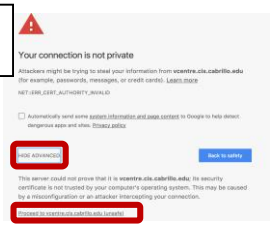
Accessing CIS VLab via vSphere Web (HTML5) Client Using Chrome Browser on PC or Pac

http://simms-teach.com/

1

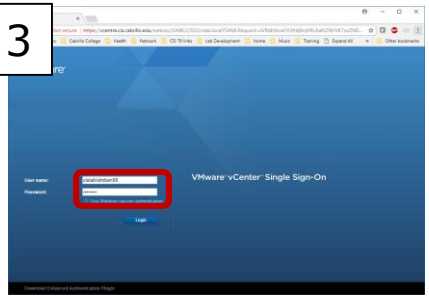
Click VLab (web) on left pane of website

2



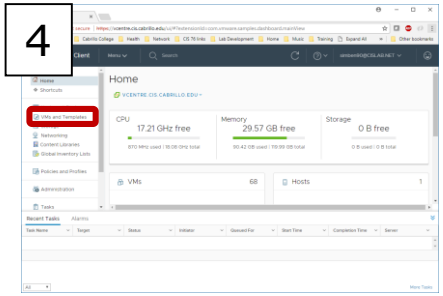
Select "Advanced" then "Proceed to vcentre ..."

3



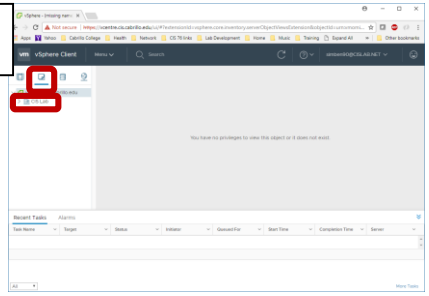
Login, username must start with cislab\

4



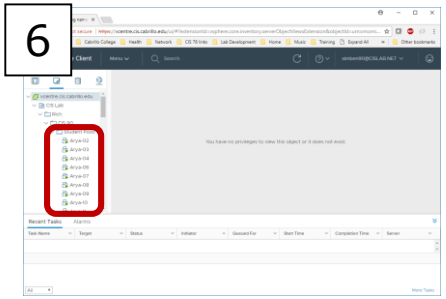
Select VMs and Templates

5



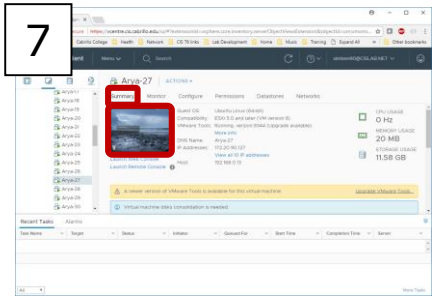
Expand tree by clicking each ">" till you see Student Pods

6



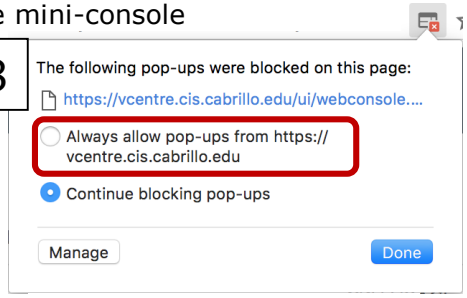
Scroll and select your Arya VM in the Student Pods folder

7



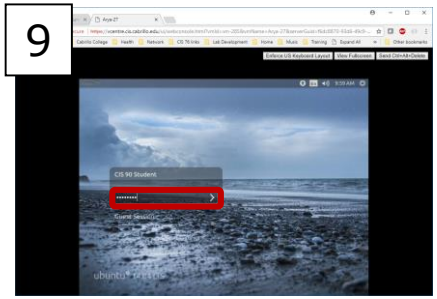
Under Summary tab, Click on the mini-console

8



Always allow pop-ups from vcentre

9



Enter password for "CIS 90 Student" (cis90 user)

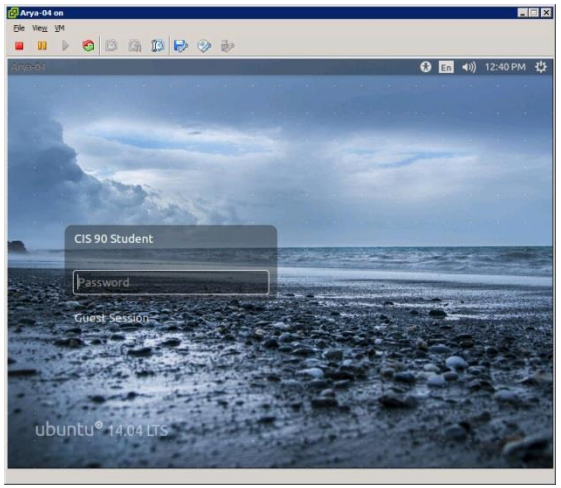
Accessing VLab Activity

Follow the instructor to open a graphical user desktop on your Arya-xx VM

- ❑ Browse to http://simms-teach.com
- ❑ Click VLab (web) link
- ❑ Accept warning
- ❑ Login with VLab credentials*
- ❑ Select VMs and Templates view
- ❑ Expand navigation tree
- ❑ Find your Arya VM
- ❑ Click the mini-console for your Arya-VM
- ❑ Allow browser pop-ups

*See the CIS 90 announcement in Canvas from the instructor for VLab login credentials

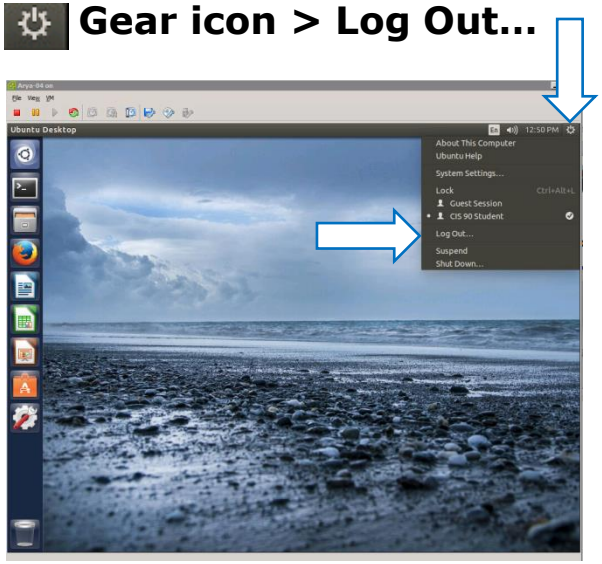
1) Log in as
CIS 90 Student



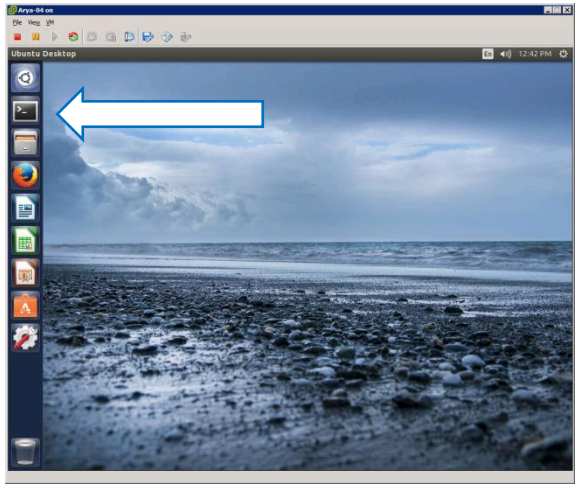
The Arya VM

ubuntu

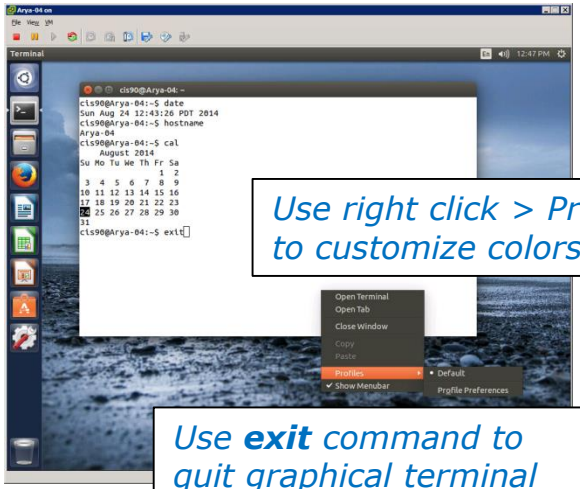
4) When finished
Gear icon > Log Out...



2) To get a graphical terminal
Terminal icon



3) Enter commands in the graphical terminal



Use right click > Profiles to customize colors

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

Using VLab VM Activity

Follow the instructor to login and use your VM

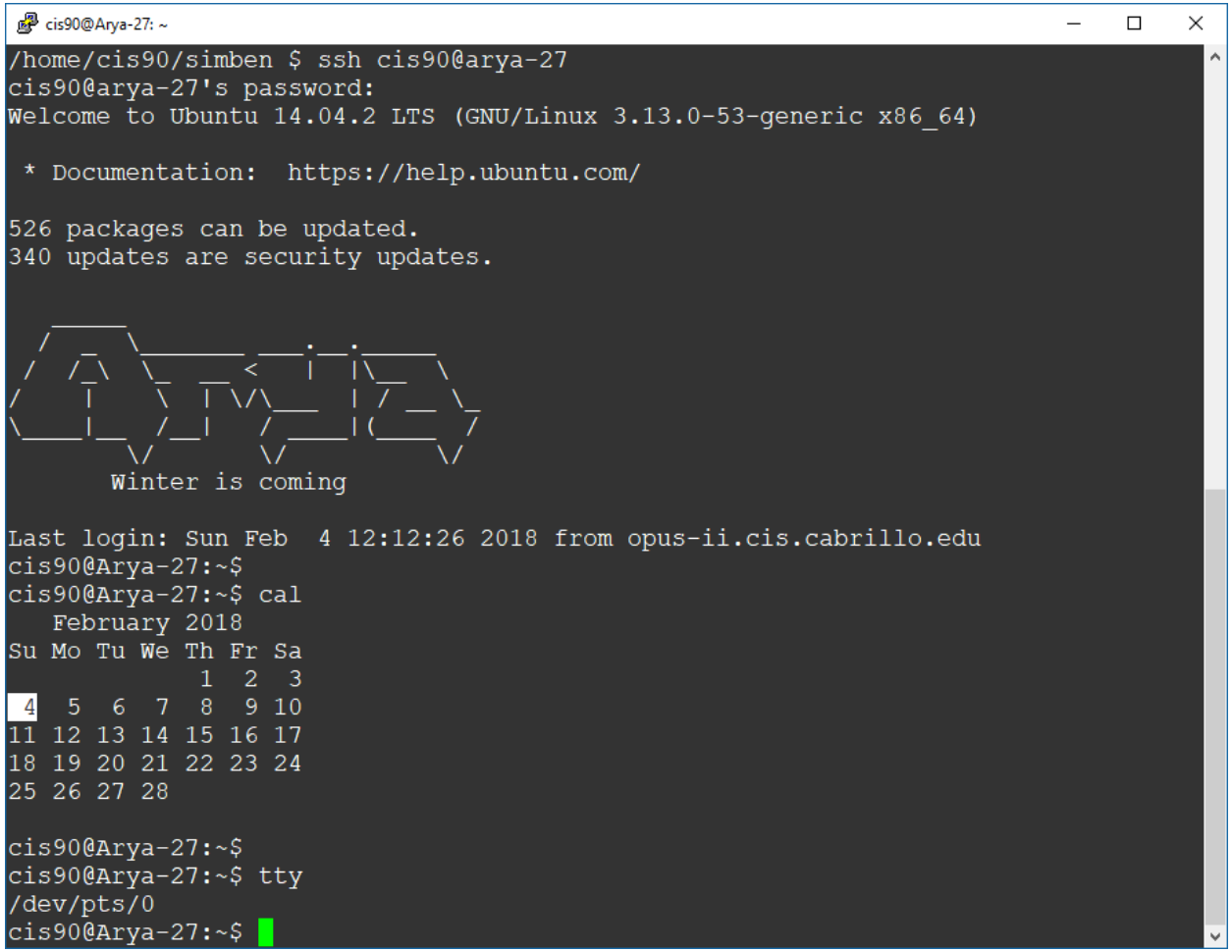
- ❑ Login to your Arya VM*
- ❑ Open a graphical terminal
- ❑ Use who command to see logins
- ❑ Find the "toothed gear" icon to logoff, restart or shutdown

*See the CIS 90 announcement in Canvas from the instructor for Arya login credentials

Virtual Terminals (consoles)

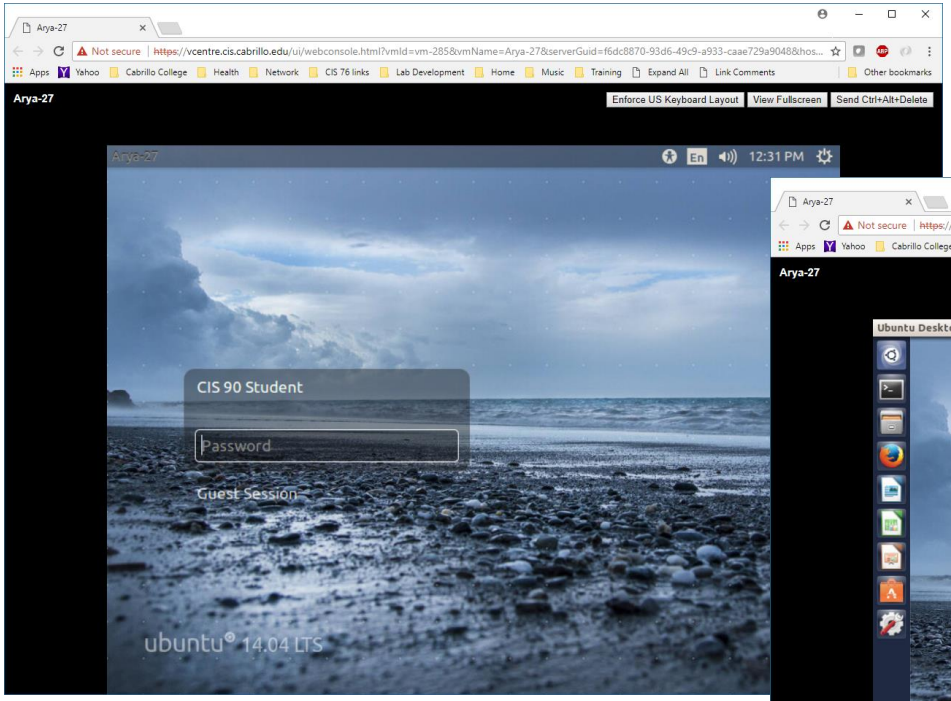
Fourth driving lesson

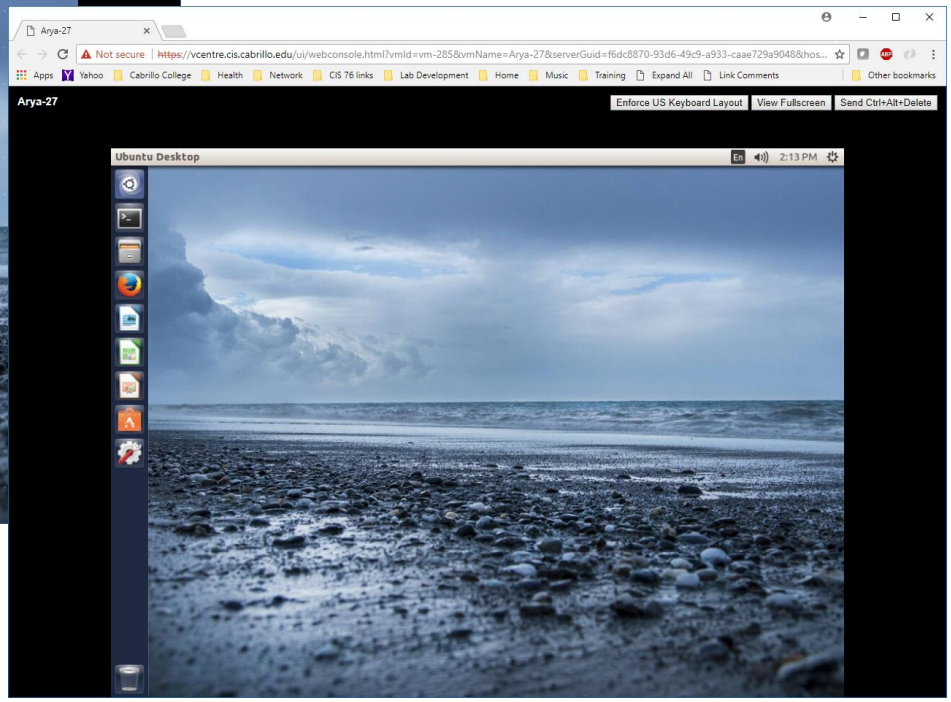
Remote Command Line Access
(via terminal emulator with SSH)



Using a terminal emulator like Putty we can login to our Arya system

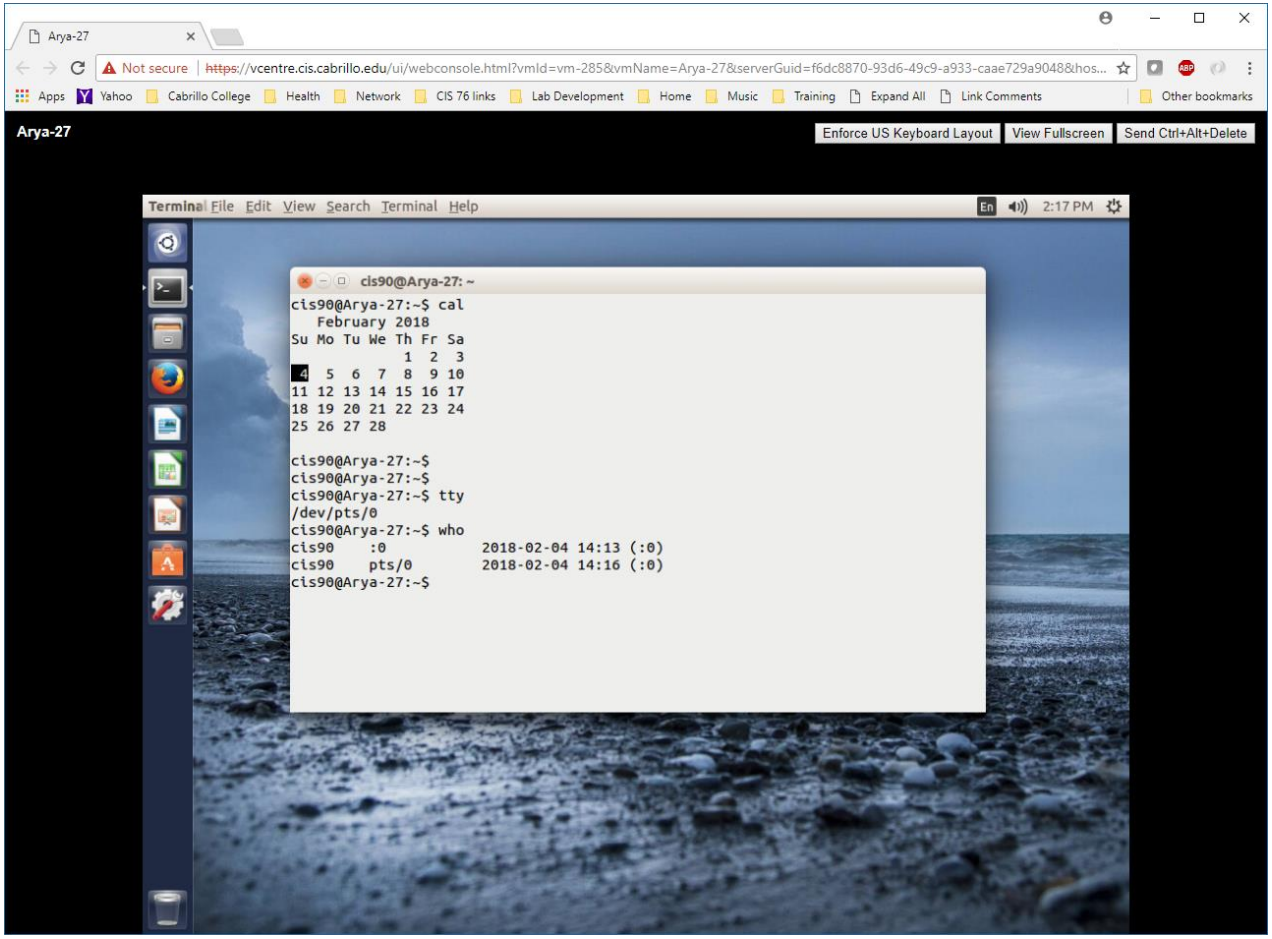
Local Graphical Desktop Access
(via connected monitor or virtualization product console)





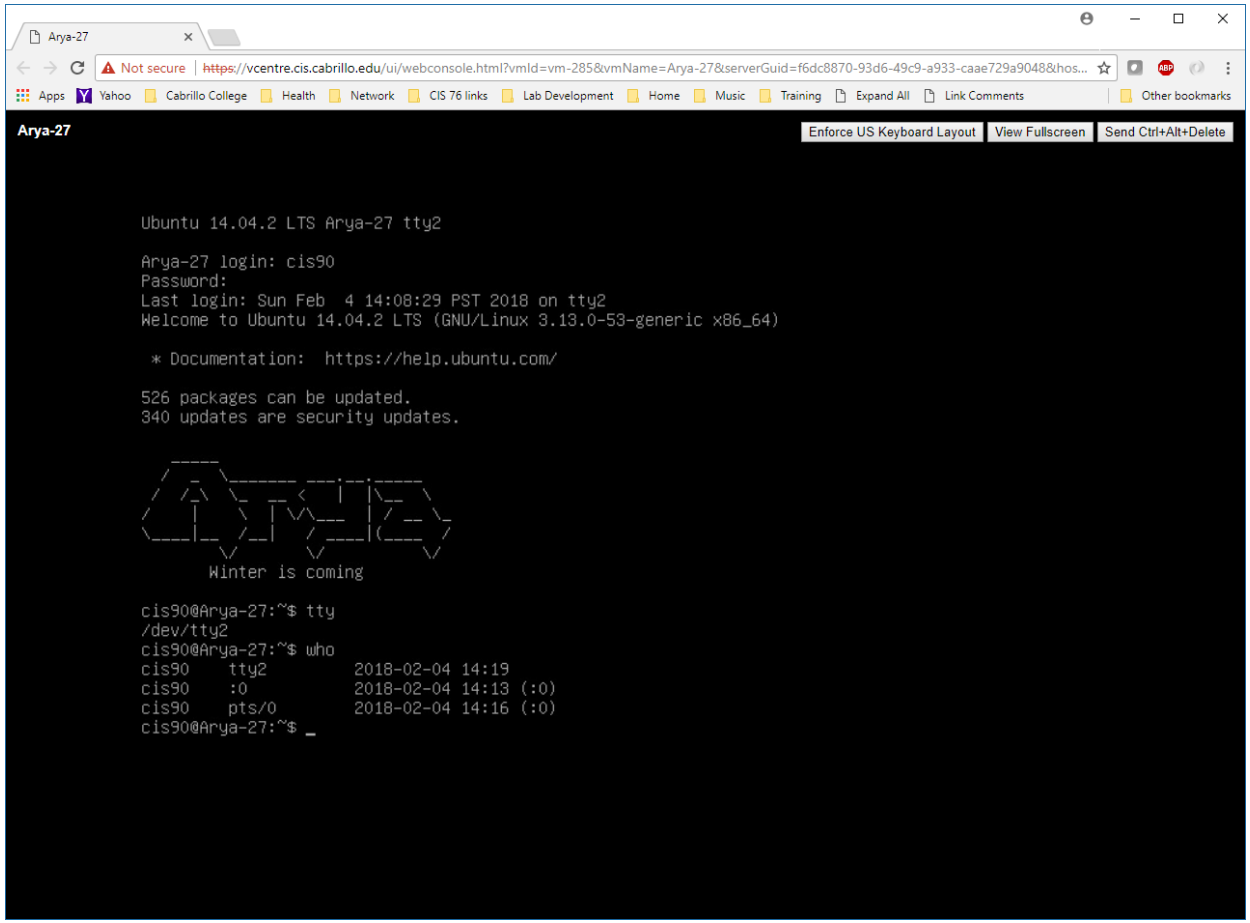
Using VLab we can login and use a graphical desktop on our Arya

Local Graphical Command Line Access
(via connected monitor or virtualization product console)



Running the terminal app on Arya gives us a graphical terminal

Local Command Line access (via connected monitor or virtualization tool)



We can also use one of several very basic TTY virtual terminals (no mouse, no scrolling, no fonts, etc.)

Keyboard Keys for using Virtual Terminals on VMware Linux VMs

VMware virtual terminal operations	
On PC Keyboard:	While holding down the **Ctrl**-⊞-**Alt** keys, tap **spacebar** then tap **f1**, **f2**, ... or **f7**.
On Mac keyboard:	Hold down **fn**, **control** and **option** keys, tap the **spacebar**, then tap **f1**, **f2**, ... or **f7**.

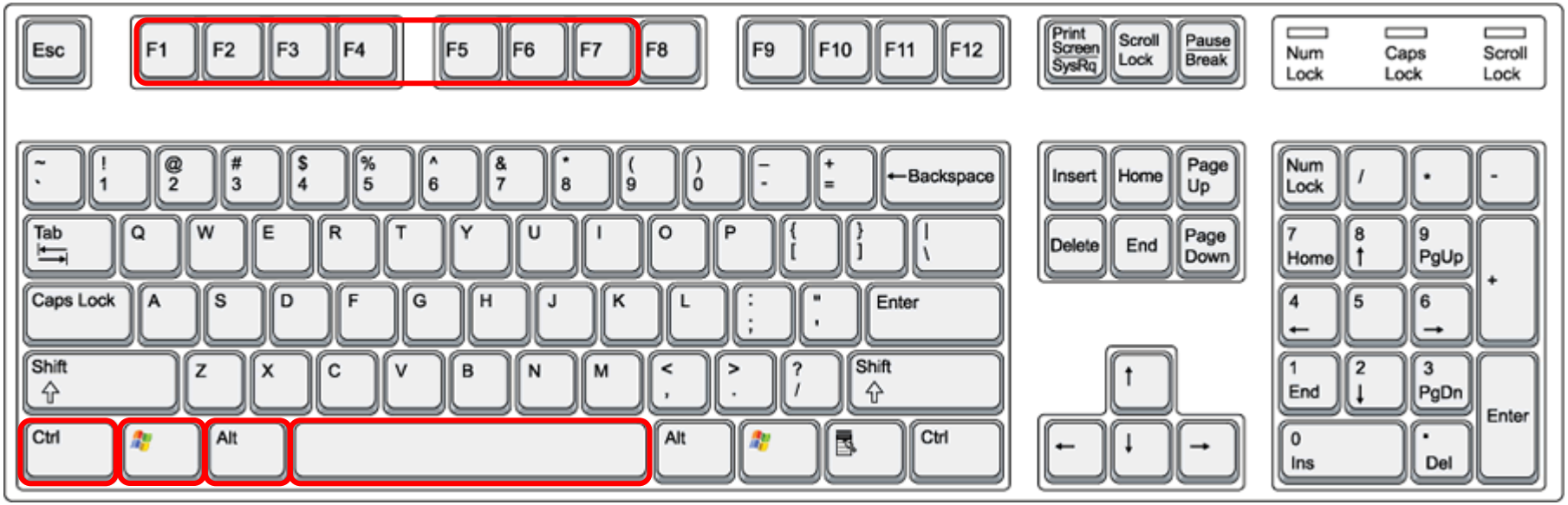
Pressing the ⊞ on some Windows keyboards may not be necessary

F7 is graphics mode for the Ubuntu VMs.

The Centos VMs, Like Opus-II, 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
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
Macbook Pro keyboard

On Macbook Pro keyboard:

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

tap **Spacebar** then tap **f***n* key

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

VMware VM Operations
Mac keyboard

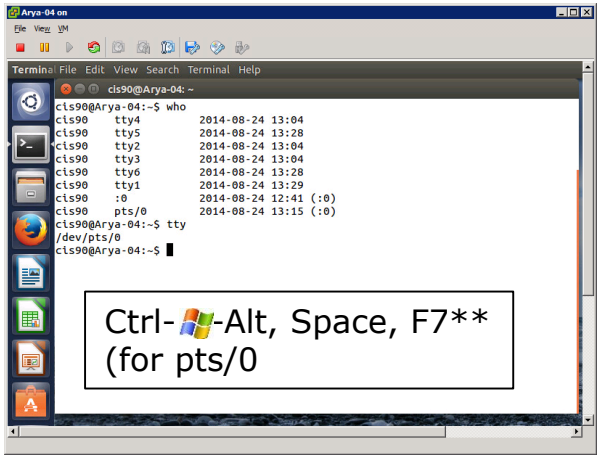
On Mac keyboard:

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

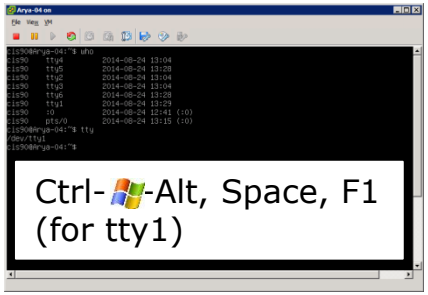
tap **Spacebar** then tap **f***n* key

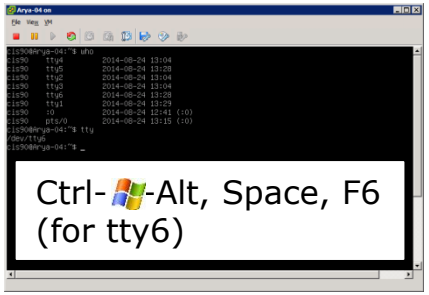
(where *n*=1-7 to specify a function key)

Changing Virtual TTY Terminals using **VMware vSphere**

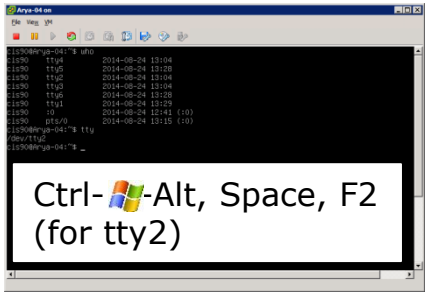


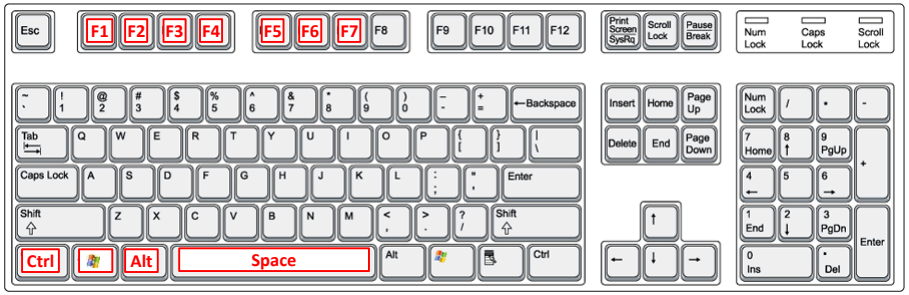
Mac users replace
ctrl-⊞-alt
with **fn-control-option**

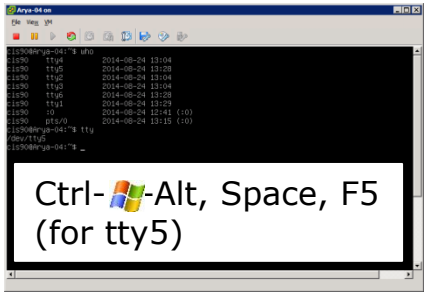


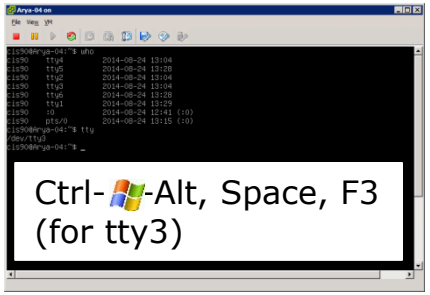


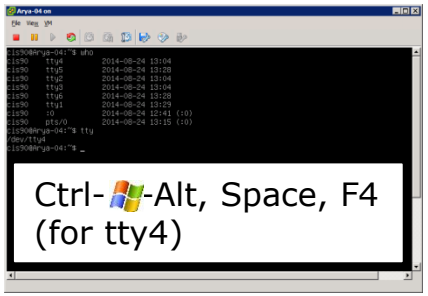
While holding down Crtl-⊞-Alt keys, tap Space, then tap Fn key*











*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

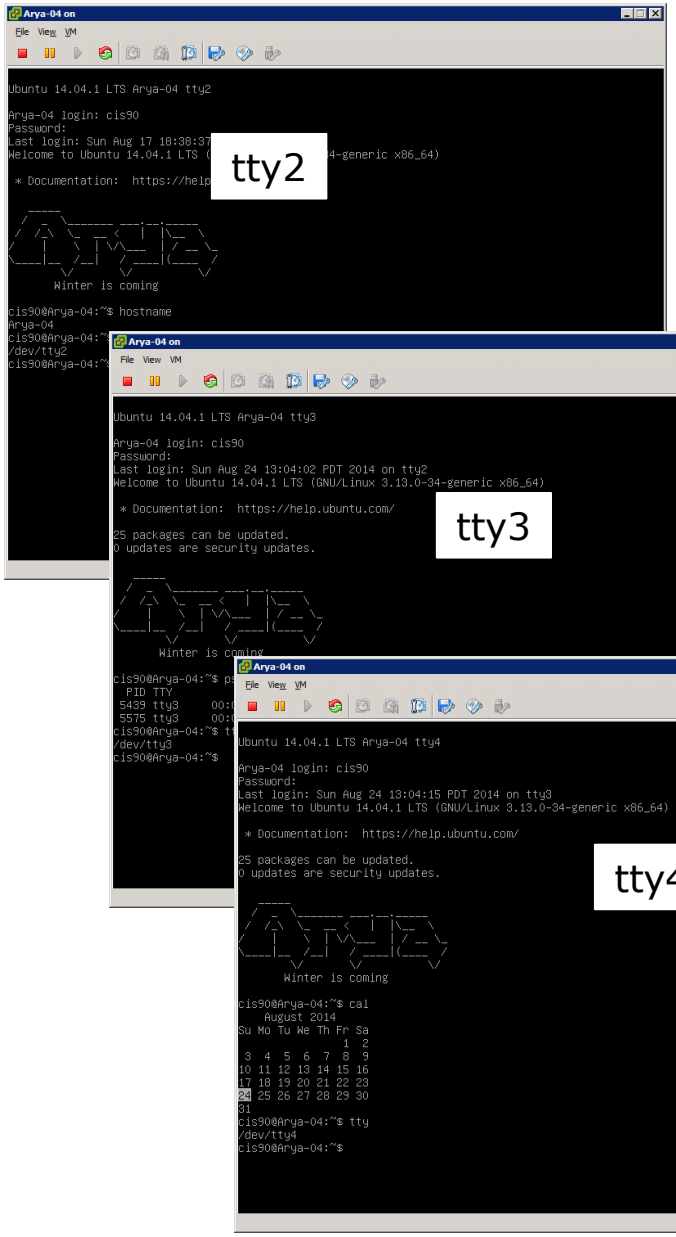
Virtual Terminals

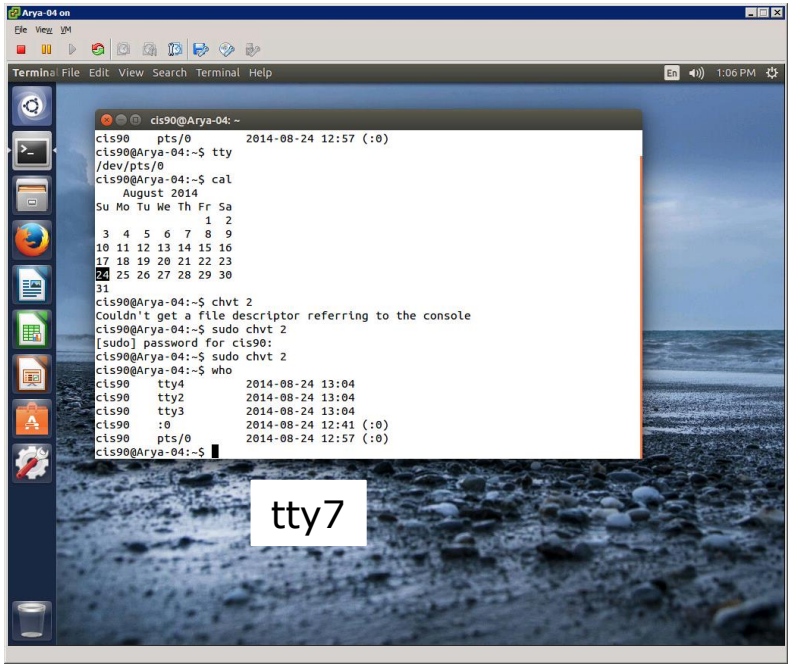
1) While holding down **crtl**-⊞-**alt** (PC) or **fn**-**control**-**option** (Mac) keys, tap **Space**, then tap **F*n*** key

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

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

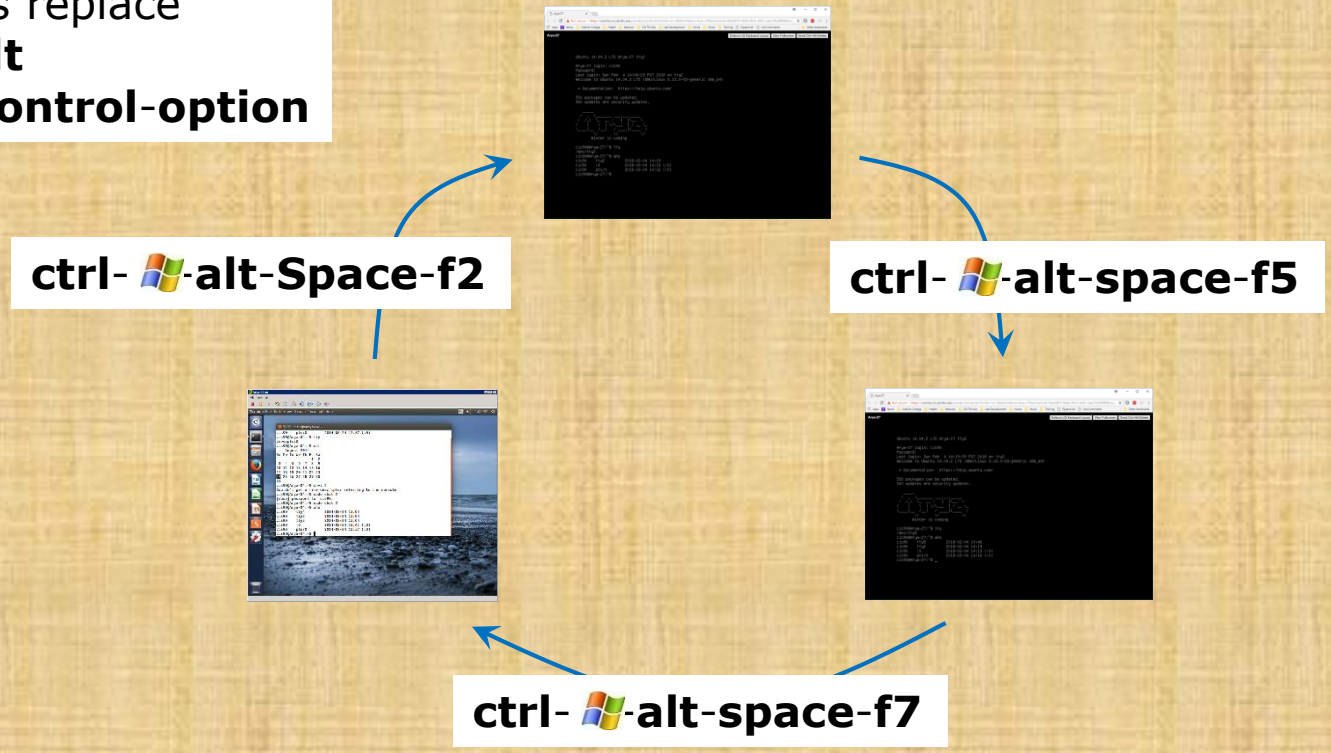
4) or try: *<alt-key> n*
(in an Ubuntu virtual terminal)





Virtual Terminal Class Activity

Mac users replace
ctrl-⊞-alt
with **fn-control-option**



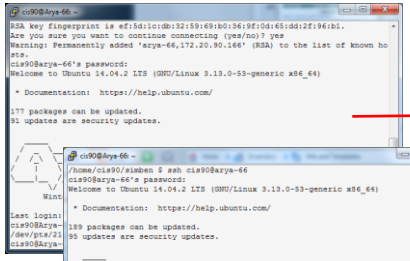
On your Arya:

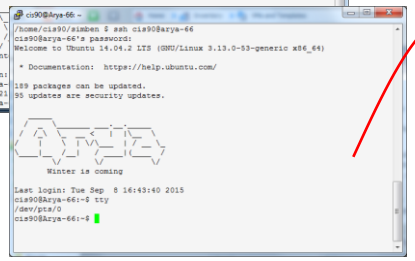
- Try changing between the graphical desktop and the TTYs
- Login as cis90 on tty2 and tty5
- Run a terminal on the graphical desktop
- Use the who command to see how many logins there are

Interpreting who output

tty1

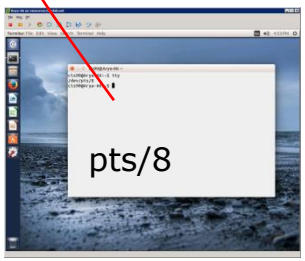
pts/21





pts/0

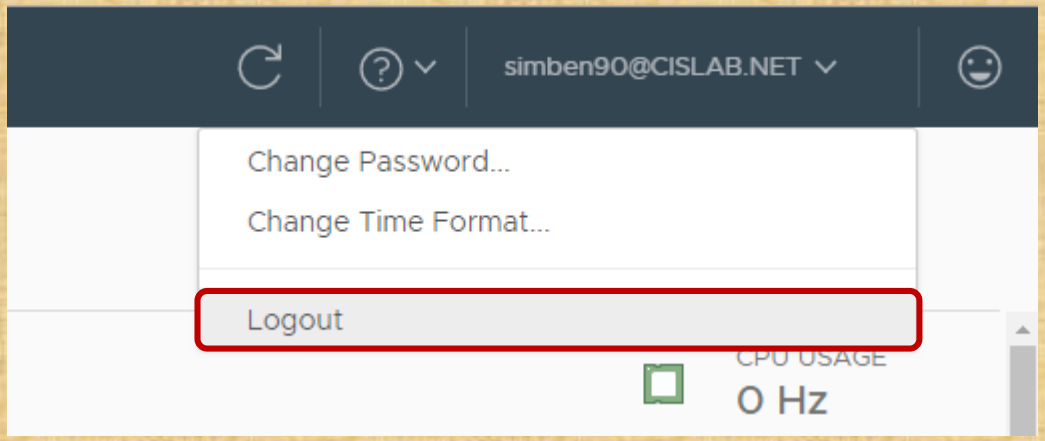
```
cis90@Arya-66:~$ who
cis90     tty1         2015-09-08 16:43
cis90     :0           2015-09-08 16:53 (:0)
cis90     pts/21       2015-09-08 16:39 (opus.cis.cabrillo.edu)
cis90     pts/0        2015-09-08 16:55 (opus.cis.cabrillo.edu)
cis90     pts/8        2015-09-08 16:53 (:0)
```



Let's login to an Arya using a virtual terminal, a graphical desktop, two ssh sessions and a graphical terminal on the graphical desktop

Logging out of VLab

Logging out of Arya Desktop Activity

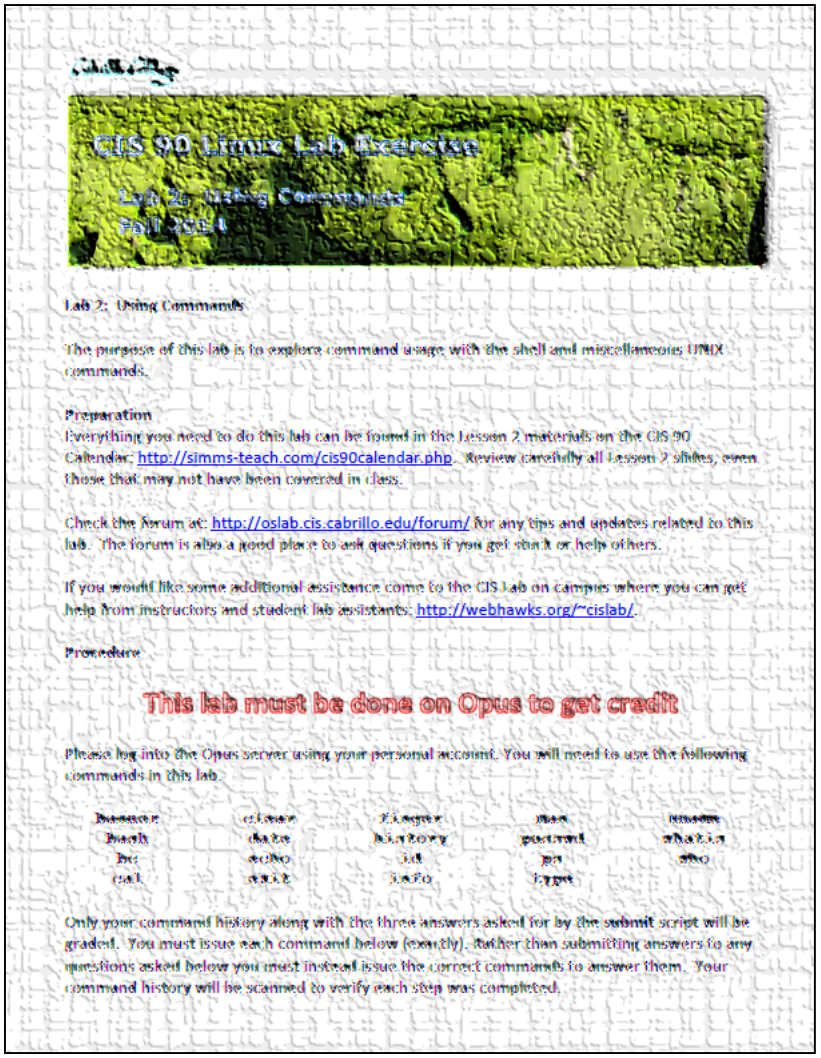


Logout of Vlab's vCenter

Your Arya VM will keep running even though you disconnect from vCenter


Assignment

Lab 2 - Using Commands



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	history	man	uname
bash	date	id	passwd	whatis
bc	echo	ls	pr	who
cal	exit	nano	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.


Wrap up

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
/usr/local/bin	- custom local commands

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?

End Meeting

Backup

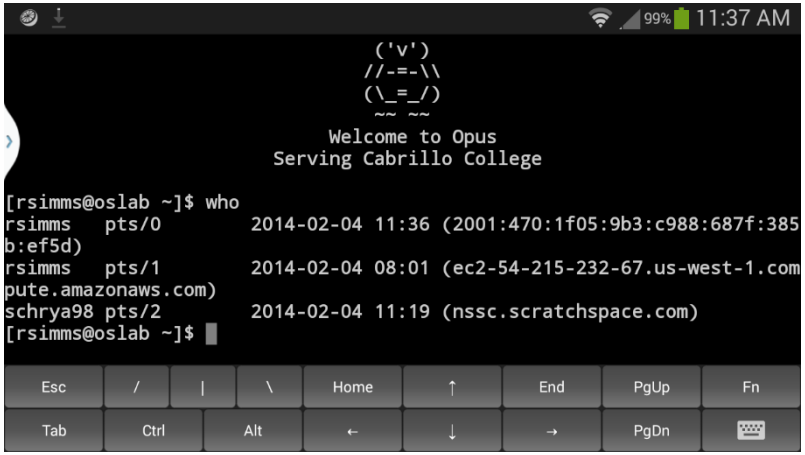
FYI

CIS 90 and Smartphones (Android)

Blackboard Collaborate App

Join CCC Confer virtual classroom

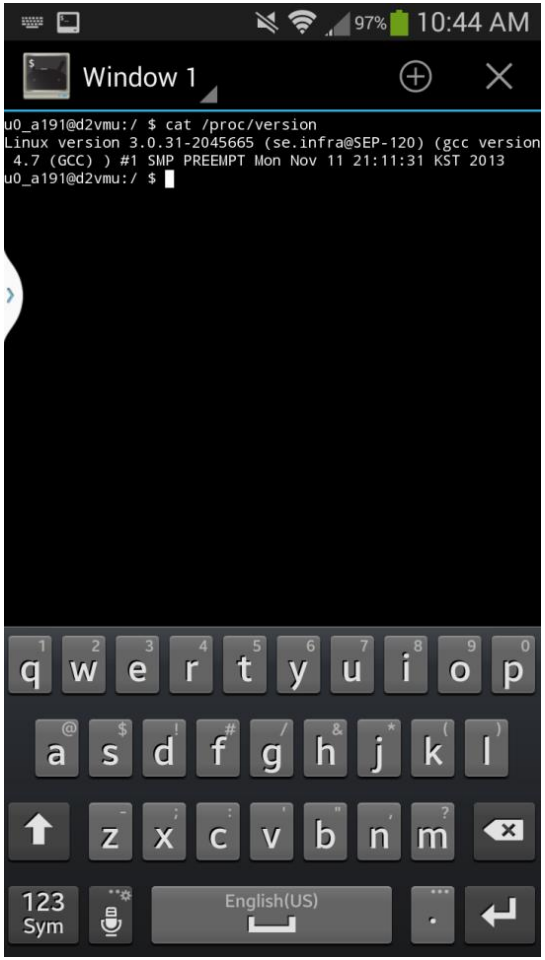
JuiceSSH - SSH Client app



Login to to Opus

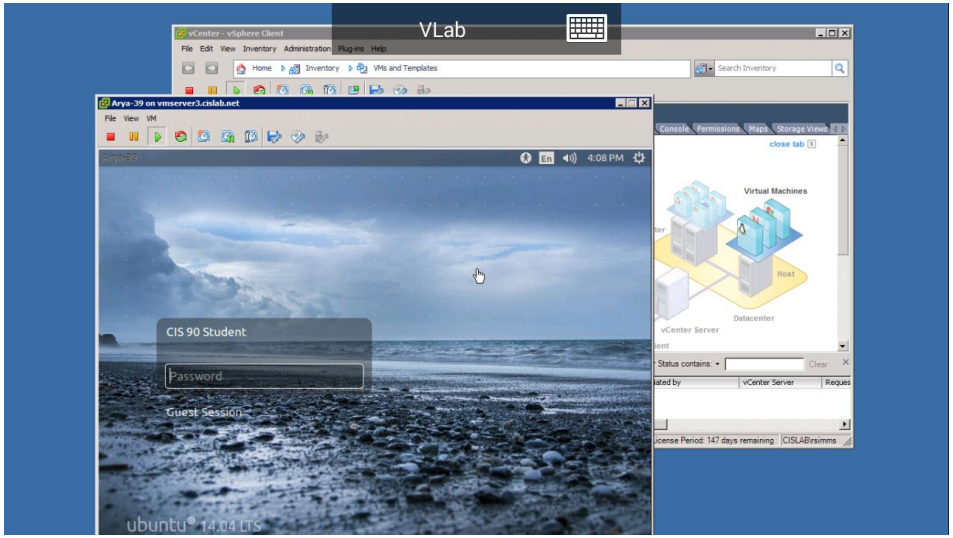
CIS 90 and Smartphones (Android)

Android Terminal App



Viewing kernel version on smartphone

Microsoft RDP App



Running Arya VM in VLab

Terminals

Hardware Terminals

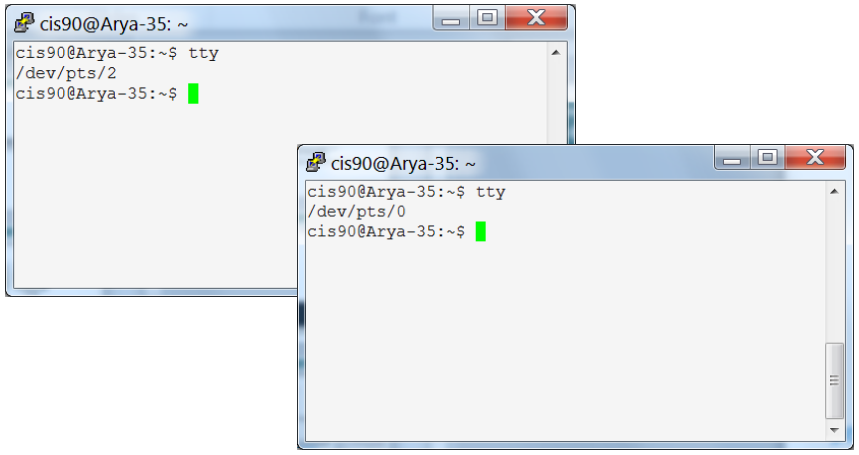
Teletype (TTY)

VT100

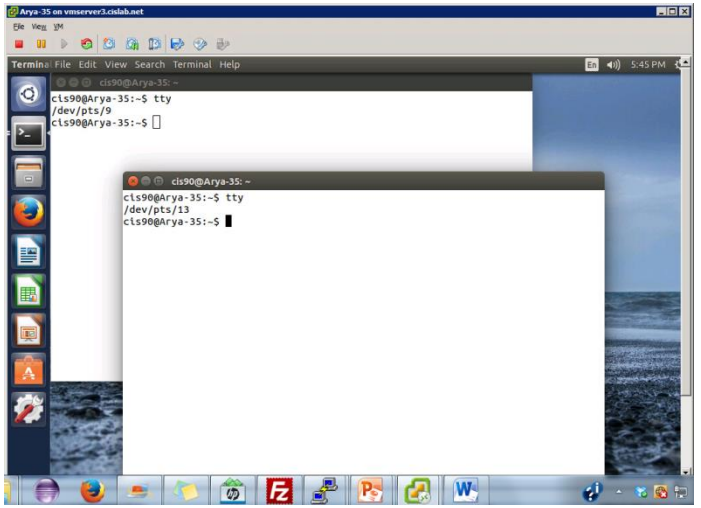
Terminals were used in the old days to interact with "minicomputers" and "mainframe" computers.

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

Software Terminals

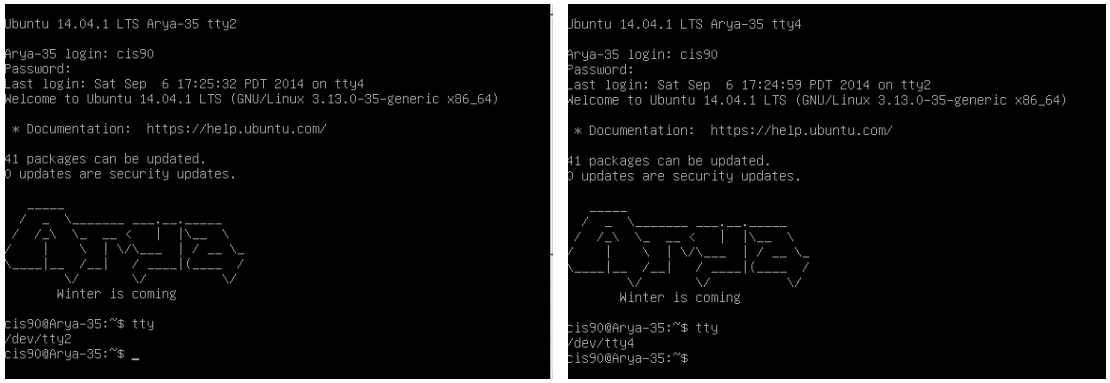


Terminal emulators like PuTTY (with scroll bars, colors, customizable backgrounds, fonts and sizes) for Windows



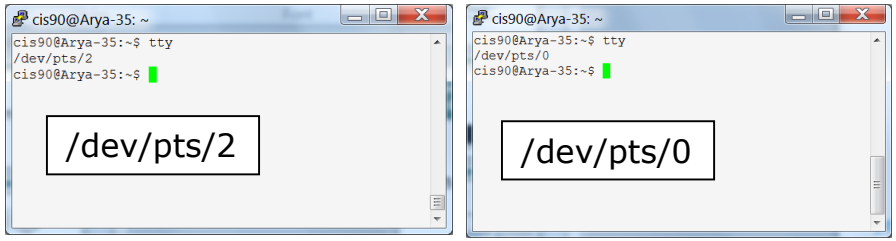
Graphical terminals (with scroll bars, colors, customizable backgrounds, fonts and sizes) built into Linux/Mac computers

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



Various terminal devices on an Arya VM

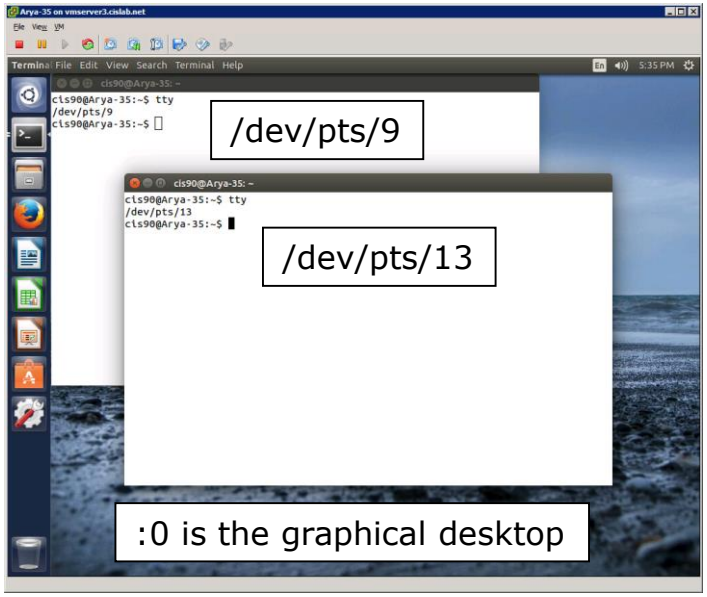
Terminal emulators (e.g. Putty)




```
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

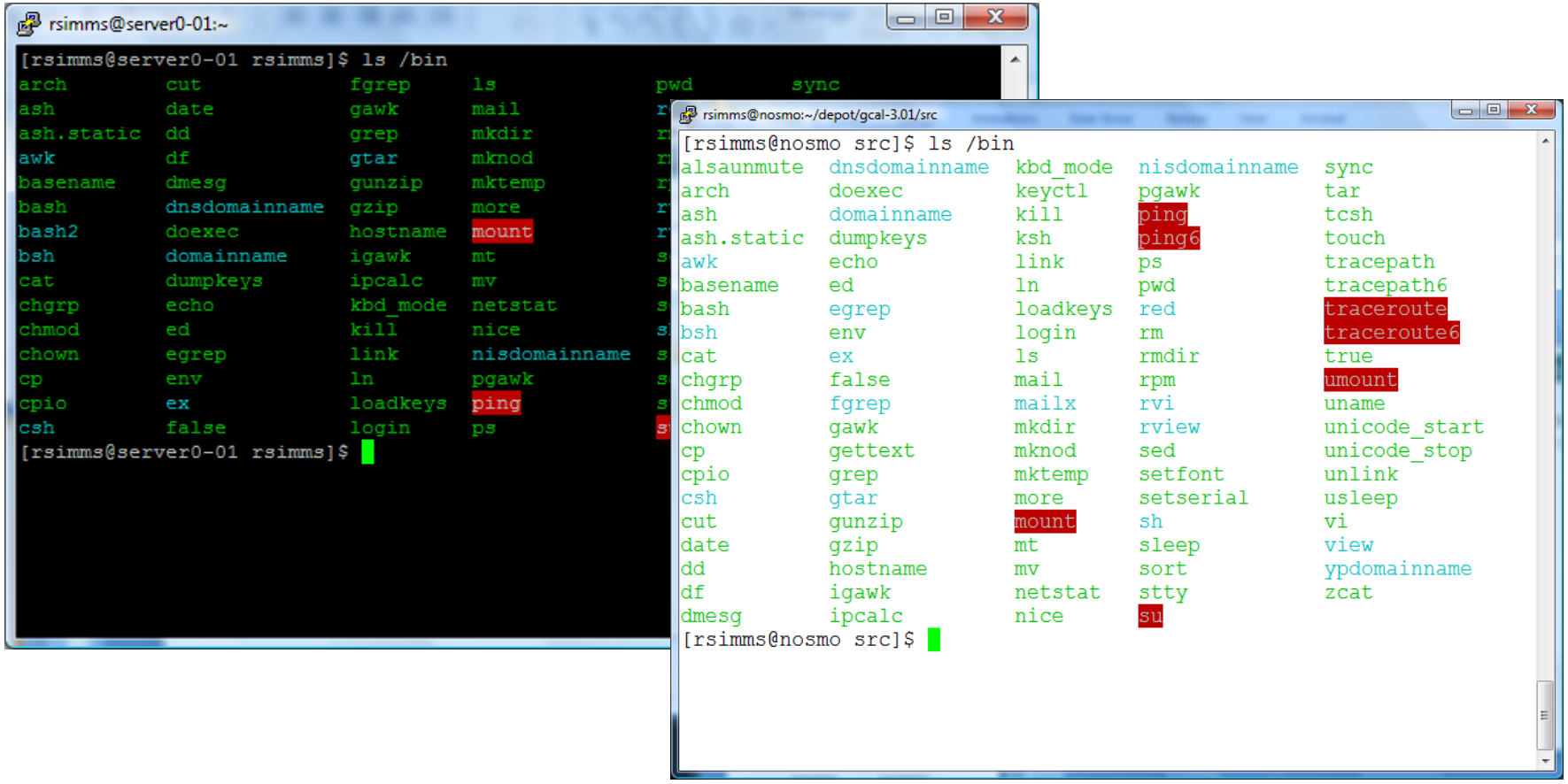


Virtual terminals

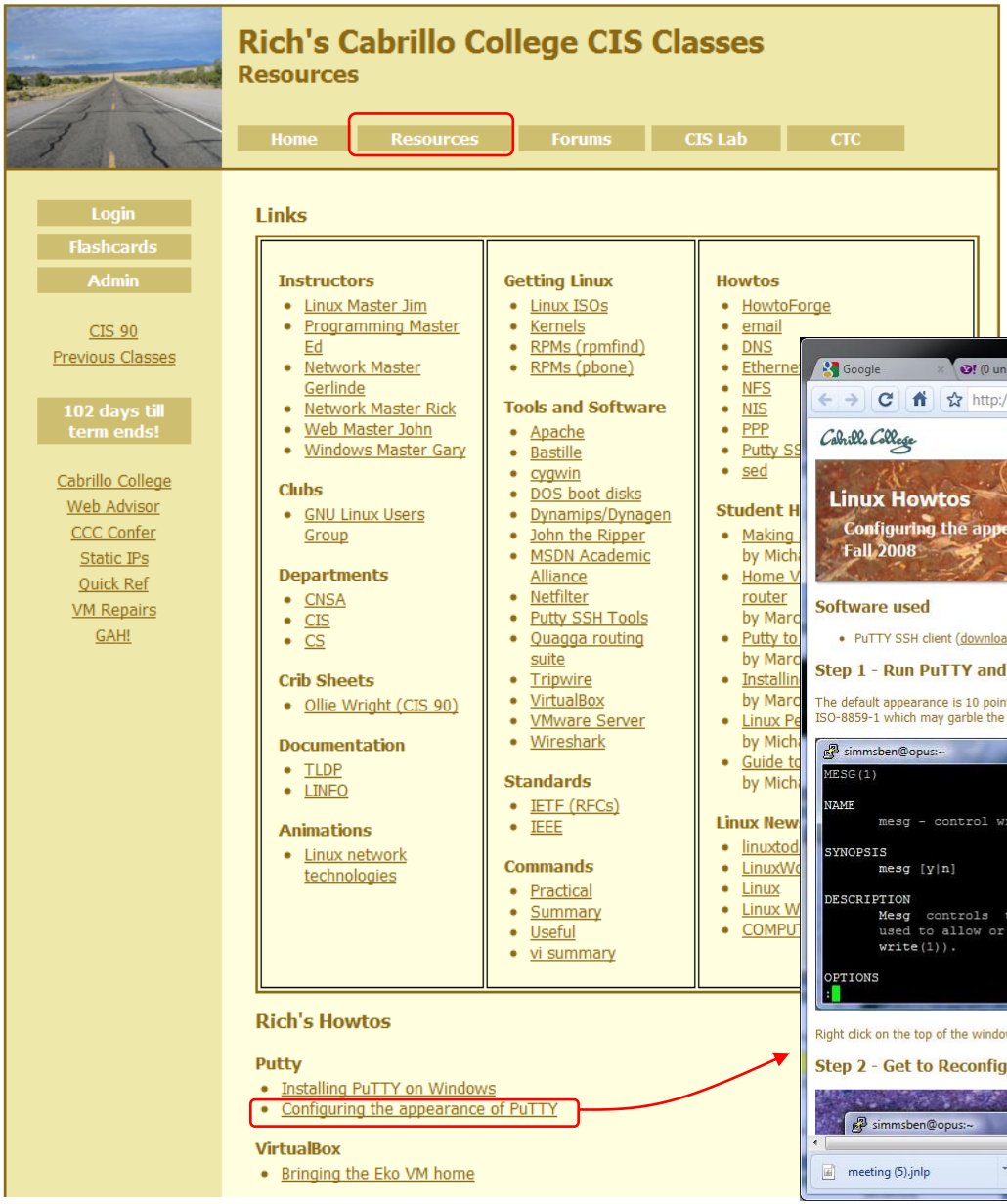
Putty Tips

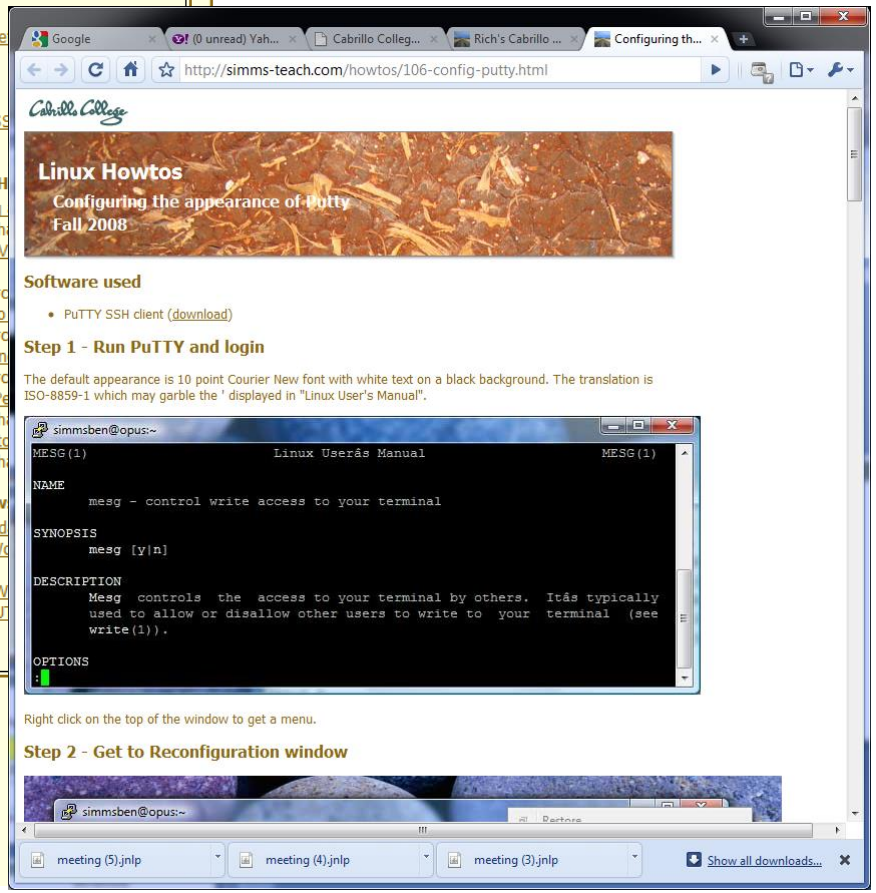
(Note: tty = teletype)

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

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

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

                                    _
                                   ('v')
                                  //-=-\\
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                                   _
                                  ('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
opus-ii.cabrillo.edu
/home/cis90/simben $
```

Answer: opus-ii.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.