

Introduction to UNIX/Linux

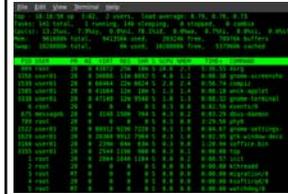
Biochemistry Boot Camp 2019
Session #3
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Some terms

- Operating system (OS)

Command-line interface (CLI)



```

root@G01:~# cat /proc/cpuinfo
cpu0:
cpu model: 0x100000000
cpu revision: 0x00000000
cpu type: 0x00000000
cpu0:
cpu model: 0x100000000
cpu revision: 0x00000000
cpu type: 0x00000000
cpu1:
cpu model: 0x100000000
cpu revision: 0x00000000
cpu type: 0x00000000
cpu1:
cpu model: 0x100000000
cpu revision: 0x00000000
cpu type: 0x00000000

```

Graphical user interface (GUI)



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Why UNIX?

- **Stability:** Systems can run for months or more
- **Multitasking:** Easy to running many programs at once (used to be very unique)
- **Flexibility:** Graphical environment is optional, can be pared down to bare minimum, optimizing performance

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Why UNIX?

- **Science focus:** Lots of scientific software runs exclusively on UNIX
- **Data Storage:** Unix handles lots of files well
- **Historical reasons:** mainframes, early software written on UNIX

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Where did Linux come from?

- Linus Torvalds created it
 - with assistance from programmers around the world
 - first posted on Internet in 1991
- Linux 1.0 in 1994; 2.2 in 1999
- Today used on 7-10 million computers
 - with 1000's of programmers working to enhance it

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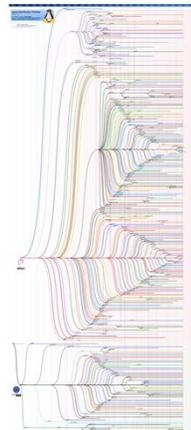
Flavors of Linux

- “Linux” only refers to the *kernel*: the core program that runs the operating system
- Many programs contribute to the OS experience:
 - Window environment (GUI)
 - Command line interface (CLI)
 - Even simple utilities like the list of printers
- Because Linux is open-source, there lots of combinations of programs that work around the same kernel
 - These are called *distributions* or *distros*

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Linux Distributions: History

- Distributions made installing software easier
 - Lots of software needed for a working system
 - Oldest and still active: “Slackware”
- Distributions frequently “forked” as new features added or removed
- Some distros also died out



“Linux Distribution,” Wikipedia (Debian and Slackware Distros)

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Common Linux Distributions

- **CentOS:** Very stable at the expense of some newer features & hardware support
- **Ubuntu:** User friendly, a good mix of “cutting edge” updates and stability
- **Debian:** Cutting edge, but stable software is available for installation too



CentOS



ubuntu



debian

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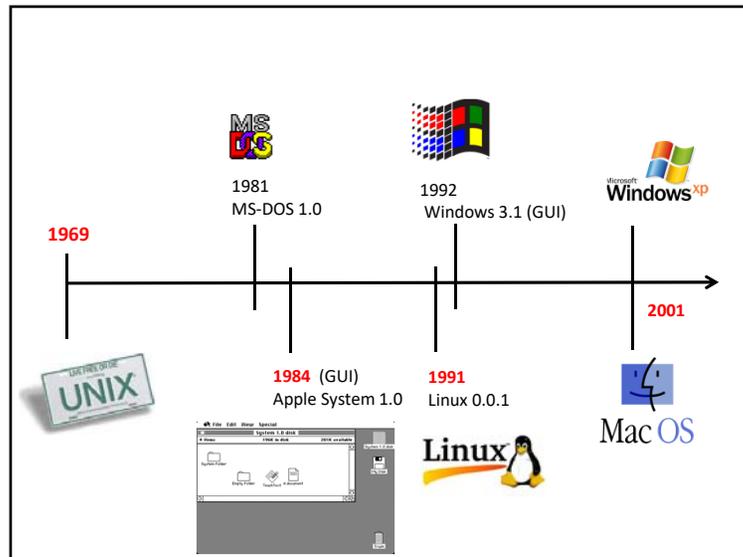


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Linux vs. "Linux-like" Environment

- An OS may provide a Linux-like (POSIX) environment without actually running the linux kernel
- **MacOS X:** XNU kernel, built around the "mach" kernel; readily supports Linux-like shell scripting and windowing environment (true POSIX)
- **Windows 10:** Windows kernel, but supports a Linux subsystem to provide a Linux feel (added in 2016)

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Practical Application

This is all very interesting, but...

How do you get to a Linux-like Command Line and what can you do when you get there?

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Mac Users

- Basic command line interface can be found in the “Applications/Utilities” folder – run the program “Terminal”
- We will use XQuartz as well, which can be found at www.xquartz.org
 - Download and install this program while PC owners struggle through tutorial!
- File Transfer Client: **Fugu**
<http://rsug.itd.umich.edu/software/fugu/>

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PC Users

- Getting to Linux is a bit more difficult
- Follow the instructions in the “Running X11 on Windows” handout
- File Transfer Client: **WinSCP**
<https://winscp.net/eng/download.php>

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Connect to a Linux Server via SSH

- Mac Users
 - Make sure XQuartz is running
 - Open a new XTerm window and run SSH
 - **Example:** `ssh -Y nfitzkee@bloch.chem.msstate.edu`
 - Replace `nfitzkee` with your user name!
- PC Users
 - Follow directions in X11 Handout using the SSH Secure Shell Program (Quick Connect)

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Getting Files To/From the Server

- **PC/Mac:** Open up WinSCP or Fugu
- **Old School:** Open up another Xterm, then:


```
sftp <username>@bloch.chem.msstate.edu
```

 - Need to use the `cd` command to navigate to the right folder, then get to copy the file
 - It will save the files to wherever you started the `sftp` program
 - File transfer software:

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Demo: Common Linux Tasks

- Navigating the file system: Where am I? What's here?
- Copying/Manipulating Files and Directories
- Running programs in the background
 - Ampersand (“&”) trick
 - Useful commands: Ctrl-Z, bg, fg
- Running software via X11
 - Text file editing (xemacs)

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Try It Yourself: Linux Tutorial

- Very helpful, and covers basic to advanced topics:

<http://www.ee.surrey.ac.uk/Teaching/Unix/>

- Your Linux account on bloch will be active for **30 days**, after which it will be disabled
 - Contact Dr. Fitzkee if you need more time

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File Commands	System Info
ls - directory listing	date - show the current date and time
ls -la - formatted listing with hidden files	cal - show this month's calendar
cd <i>dir</i> - change directory to <i>dir</i>	uptime - show current uptime
cd ~ - change to home directory (e.g. <i>/home/nf1tzkee</i>)	who - display who is online
pwd - show current directory	whoami - who you are logged in as
mkdir <i>dir</i> - create a directory <i>dir</i>	who -a - display information about user
rm -f <i>file</i> - delete <i>file</i>	wall - show kernel information
rm -r <i>dir</i> - delete directory <i>dir</i>	cat /proc/meminfo - memery information
rm -rf <i>dir</i> - force remove <i>dir</i> * (see warning below!)	man <i>command</i> - show the manual for <i>command</i>
cp <i>file1 file2</i> - copy <i>file1</i> to <i>file2</i>	df - show disk usage
cp -r <i>dir1 dir2</i> - copy <i>dir1</i> to <i>dir2</i> ; create <i>dir2</i> if it doesn't exist	du - show directory space usage
mv <i>file1 file2</i> - rename or move <i>file1</i> to <i>file2</i>	free - show memory and swap usage
mv -r <i>dir1 dir2</i> - rename or move <i>dir1</i> into directory <i>file2</i>	whereis <i>app</i> - show possible locations of <i>app</i>
ln -s <i>file link</i> - create symbolic link <i>link</i> to <i>file</i>	which <i>app</i> - show which <i>app</i> will be run by default
touch <i>file</i> - create or update <i>file</i>	
cat > <i>file</i> - places standard input into <i>file</i>	
more <i>file</i> - output the contents of <i>file</i> (alternatively: less <i>file</i>)	
head <i>file</i> - output the first 10 lines of <i>file</i>	
tail <i>file</i> - output the last 10 lines of <i>file</i>	
tail -f <i>file</i> - output the contents of <i>file</i> as it grows, starting with the last 10 lines	
	Process Management
	ps - display your currently active processes
	top - display all running processes
	htop - all process at pdl
	killall <i>prog</i> - kill all processes named <i>prog</i> *
	bg - take stopped or backgrounded jobs, resume a stopped job in the background
	fg - bring the most recent job to foreground
	fg %n - bring job <i>n</i> to the foreground
	File Permissions
	chmod <i>options file</i> - change the permissions of <i>file</i> to <i>octal</i> , which can be found separately for user, group, and world by adding: 4 - read (r) 2 - write (w) 1 - execute (x) Example: chmod 777 read, write, execute for all chmod 755 rwx for owner, rx for group and world chmod - more options: man <i>chmod</i>
	SSH
	ssh <i>user@host</i> - connect to <i>host</i> as <i>user</i>
	ssh -p <i>port user@host</i> - connect to <i>host</i> as <i>user</i> for file transfer
	sftp <i>user@host</i> - connect to <i>host</i> as <i>user</i> for file transfer
	rsync <i>pattern file</i> - search for <i>pattern</i> in <i>file</i>
	grep -r <i>pattern dir</i> - search recursively for <i>pattern</i> in <i>dir</i>
	grep -l <i>pattern</i> - search for <i>pattern</i> in the output of <i>command</i>
	find <i>file</i> - find all instances of <i>file</i>
	find -name <i>pattern</i> - search for the file named <i>pattern</i> in the current directory (or below); <i>pattern</i> can contain wildcards (e.g. *) * use with extreme caution.
	Compression
	tar -c <i>file tar file</i> - create a tar named <i>file tar</i> containing <i>file</i>
	tar -x <i>file tar</i> - extract the files from <i>file tar</i>
	tar -czf <i>file tar.gz file</i> - create a tar with Gzip compression
	tar -xzf <i>file tar.gz</i> - extract a tar using Gzip
	zip -r <i>file.zip file</i> - create a Windows-compatible zip archive
	unzip <i>file.zip</i> - extract zip archive
	gzip <i>file</i> - compresses <i>file</i> and renames it to <i>file.gz</i>
	gunzip -d <i>file.gz</i> - decompresses <i>file</i> or back to <i>file</i>
	File Services
	ping <i>host</i> - ping <i>host</i> and output results
	whois <i>domain</i> - get whois information for <i>domain</i>
	dig <i>domain</i> - get DNS information for <i>domain</i>
	nslookup <i>host</i> - resolve <i>host</i> and <i>ip</i>
	wget <i>file</i> - download <i>file</i>
	rsync -a <i>file</i> - synchronize a directory/download
	Linux Utilities
	dd - copy <i>source</i> to <i>target</i> or <i>url</i> = <i>malaysia</i>
	pipeband <i>file.P2P file.usf</i> - correct NMRPipe spectrum
	13C NMR
	/home/nf1tzkee/pdb/ - location of all PDB structures
	PDB Viewer (swmol or molmol or rammol or mol)
	Can display: names or names or ascii or vi
	3D can be interacted with a file, e.g. names <i>file</i>
	rsync -a - sync an executable file across the current directory
	Structure
	Ctrl-C - ends the current command
	Ctrl-D - ends the current command, resume with fg in the background
	Ctrl-Z - stop the current command, resume with fg in the background
	Ctrl-@ - last one of current session, similar to kill
	Ctrl-^ - resumes one word in the current line
	Ctrl-~ - type to bring up a recent command
	!! - repeats the last command
	!t - log out of current session

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File Commands
ls - directory listing
ls -la - formatted listing with hidden files
cd <i>dir</i> - change directory to <i>dir</i>
cd ~ - change to home directory (e.g. <i>/home/nf1tzkee</i>)
pwd - show current directory
mkdir <i>dir</i> - create a directory <i>dir</i>
rm <i>file</i> - delete <i>file</i>
rm -r <i>dir</i> - delete directory <i>dir</i>
rm -f <i>file</i> - force remove <i>file</i>
rm -rf <i>dir</i> - force remove directory <i>dir</i> * (see warning below!)
cp <i>file1 file2</i> - copy <i>file1</i> to <i>file2</i>
cp -r <i>dir1 dir2</i> - copy <i>dir1</i> to <i>dir2</i> ; create <i>dir2</i> if it doesn't exist
mv <i>file1 file2</i> - rename or move <i>file1</i> to <i>file2</i>
if <i>file2</i> is an existing directory, moves <i>file1</i> into directory <i>file2</i>
ln -s <i>file link</i> - create symbolic link <i>link</i> to <i>file</i>
touch <i>file</i> - create or update <i>file</i>
cat > <i>file</i> - places standard input into <i>file</i>
more <i>file</i> - output the contents of <i>file</i> (alternatively: less <i>file</i>)
head <i>file</i> - output the first 10 lines of <i>file</i>
tail <i>file</i> - output the last 10 lines of <i>file</i>
tail -f <i>file</i> - output the contents of <i>file</i> as it grows, starting with the last 10 lines

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Process Management	System Info
ps - display your currently active processes	date - show the current date and time
top - display all running processes	cal - show this month's calendar
kill pid - kill process id <i>pid</i>	uptime - show current uptime
killall proc - kill all processes named <i>proc</i> *	w - display who is online
bg - lists stopped or background jobs; resume a stopped job in the background	whoami - who you are logged in as
fg - brings the most recent job to foreground	finger user - display information about <i>user</i>
fg n - brings job <i>n</i> to the foreground	uname -a - show kernel information
File Permissions	cat /proc/cpuinfo - cpu information
chmod octal file - change the permissions of <i>file</i> to <i>octal</i> , which can be found separately for user, group, and world by adding:	cat /proc/meminfo - memory information
<ul style="list-style-type: none"> o 4 - read (r) o 2 - write (w) o 1 - execute (x) 	man command - show the manual for <i>command</i>
Examples:	df - show disk usage
chmod 755 - read, write, execute for all	du - show directory space usage
chmod 755 - rwx for owner, rx for group and world	free - show memory and swap usage
For more options, see man chmod	whereis app - show possible locations of <i>app</i>
SSH	which app - show which <i>app</i> will be run by default
ssh user@host - connect to <i>host</i> as <i>user</i>	Compression
ssh -p port user@host - connect to <i>host</i> on port <i>port</i> as <i>user</i>	tar of file.tar files - create a tar named <i>file.tar</i> containing files
sftp user@host - connect to <i>host</i> as <i>user</i> for file transfer	tar xf file.tar - extract the files from <i>file.tar</i>
ftps - sftp with file transfer client	tar czf file.tar.gz files - create a tar with Gzip compression
Searching	tar xzf file.tar.gz - extract a tar using Gzip
grep pattern files - search for <i>pattern</i> in <i>files</i>	zip -r file.zip files - create a Windows-compatible zip archive
grep -r pattern dir - search recursively for <i>pattern</i> in <i>dir</i>	unzip file.zip - extract zip archive
command grep pattern - search for <i>pattern</i> in the output of <i>command</i>	gzip file - compresses <i>file</i> and renames it to <i>file.gz</i>
locate file - find all instances of <i>file</i>	gzip -d file.gz - decompresses <i>file.gz</i> back to <i>file</i>
find -name "pattern" - search for the file named <i>pattern</i> in the current directory (or below); <i>pattern</i> can contain wildcards (e.g. <i>*.*</i>)	

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Network
ping host - ping <i>host</i> and output results
whois domain - get whois information for <i>domain</i>
dig domain - get DNS information for <i>domain</i>
dig -x host - reverse lookup <i>host</i>
wget file - download <i>file</i>
wget -c file - continue a stopped download
Lab Utilities
NMR Viewers: sparky or rnmDraw or rvj or analyse
pipe2ucsf file.ft2 file.ucsf - convert NMRPipe spectrum to UCSF format
/home/databases/pdb/ - location of all PDB structures
PDB Viewers: pymol or molmol or framol or vmd
Text editors: xemacs or emacs or gedit or vi
All can be invoked with a file, e.g. xemacs file
./script - run an executable file <i>script</i> in the current directory
Shortcuts
Ctrl+C - halts the current command
Ctrl+Z - stops the current command, resume with fg in the foreground or bg in the background
Ctrl+D - log out of current session, similar to exit
Ctrl+W - erases one word in the current line
Ctrl+U - erases the whole line
Ctrl+R - type to bring up a recent command
!! - repeats the last command
exit - log out of current session
* use with extreme caution.

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AN UPDATE IS AVAILABLE FOR YOUR COMPUTER

COOL, MORE FREE STUFF! (linux)

NOT AGAIN! (windows)

OOH, ONLY \$99! (mac)

When there is a problem:
Linux = be root
Windows = reboot

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