

Introduction to UNIX/Linux

Biochemistry Boot Camp 2018
Session #3
Nick Fitzkee
nfitzkee@chemistry.msstate.edu

Some terms

- Operating system (OS)

Command-line interface (CLI)

```
File Edit View Terminal Help
up: 10:18:10 up 3:57, 2 users, load average: 0.79, 0.70, 0.73
tasks: 341 total, 1 running, 140 sleeping, 0 stopped, 0 zombie
psrt(1): 12.27mb, 2.96s, 0.00s, 20.1mb, 0.00ms, 0.79s, 0.00s, 0.00s
Mem: 3010000 total, 341356 used, 266864 free, 78076k buffers
Swap: 1023000 total, 0k used, 1023000 free, 53700k cached

  PID USER   PR  NI  VIRT  RES  SHR  S#    %CPU  %MEM     time+  Command
 310 root    20   0 43072 220  100  0  R   0.0  0.0  0:00.35  sshd
3350 user01  20   0 30800 110  8892  0  R   0.0  0.0  0:00.30  gnome-screensho
1330 user01  20   0 60464 220  8824  0  R   0.0  0.0  0:50.74  compil
1320 user01  20   0 41004 120  100  0  R   0.0  0.0  0:00.12  ssh-agent
3310 user01  20   0 47140 120  9540  0  R   0.0  0.0  0:00.32  gnome-terminal
0 root    20   0 0 0 0 0  S   0.0  0.0  0:00.00  smmcs/0
670 message 20   0 3140 1500 764  0  S   0.0  0.0  0:01.29  dhcpcd
789 root    20   0 0 0 0 0  S   0.0  0.0  0:00.00  php
1522 user01  20   0 88012 3200 7200  0  S   0.0  0.0  0:04.47  gnome-nettngs-
1620 user01  20   0 20360 8912 7904  0  S   0.0  0.0  0:02.95  glib-window-deco
1400 user01  20   0 2100 400 600  0  S   0.0  0.0  0:00.00  soffice-bin
1330 user01  20   0 2344 1100 500  0  S   0.0  0.0  0:00.00  top
1 root    20   0 2804 1040 1104  0  S   0.0  0.0  0:00.57  init
2 root    20   0 0 0 0 0  S   0.0  0.0  0:00.00  kthreadd
3 root    RT  0 0 0 0 0  S   0.0  0.0  0:00.00  migration/0
4 root    20   0 0 0 0 0  S   0.0  0.0  0:00.00  kworker/0
5 root    RT  0 0 0 0 0  S   0.0  0.0  0:00.00  watchdog/0
```

Graphical user interface (GUI)



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

Why UNIX?

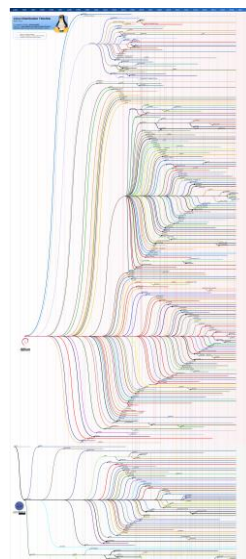
- **Science focus:** Lots of scientific software runs exclusively on UNIX
- **Data Storage:** Unix handles lots of files well
- **Historical reasons:** mainframes, early software written on UNIX

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*

Linux Distributions: History

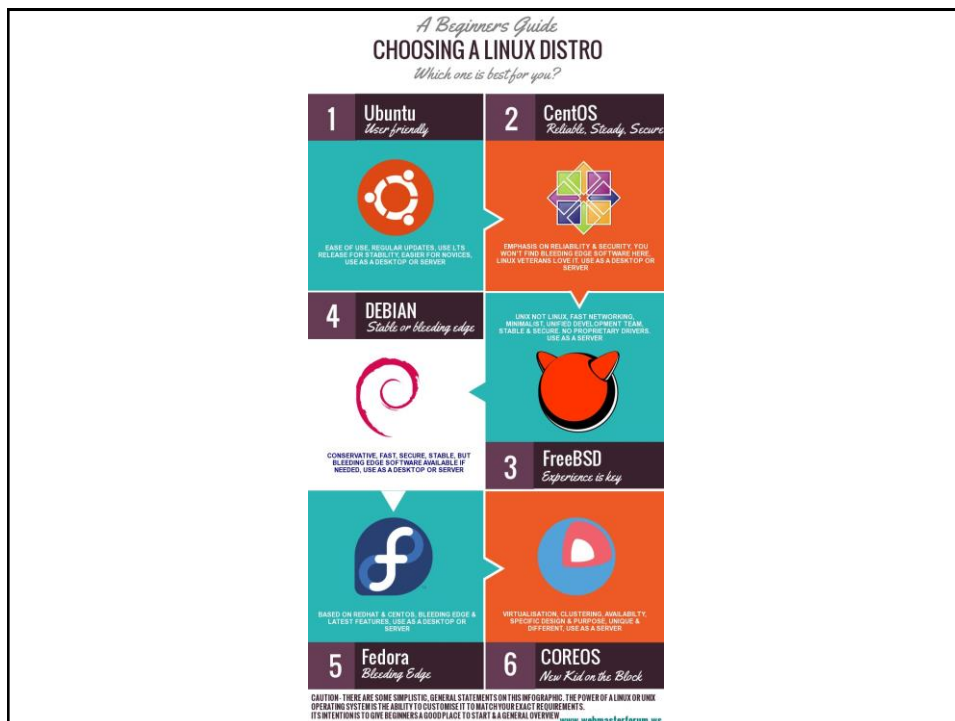
- Distributions made installing software easier
 - Lots of software needed for a working system
 - Oldest and still active: “Slackware”
- Distributions frequently “forked” as new features added or removed
- Some distros also died out



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

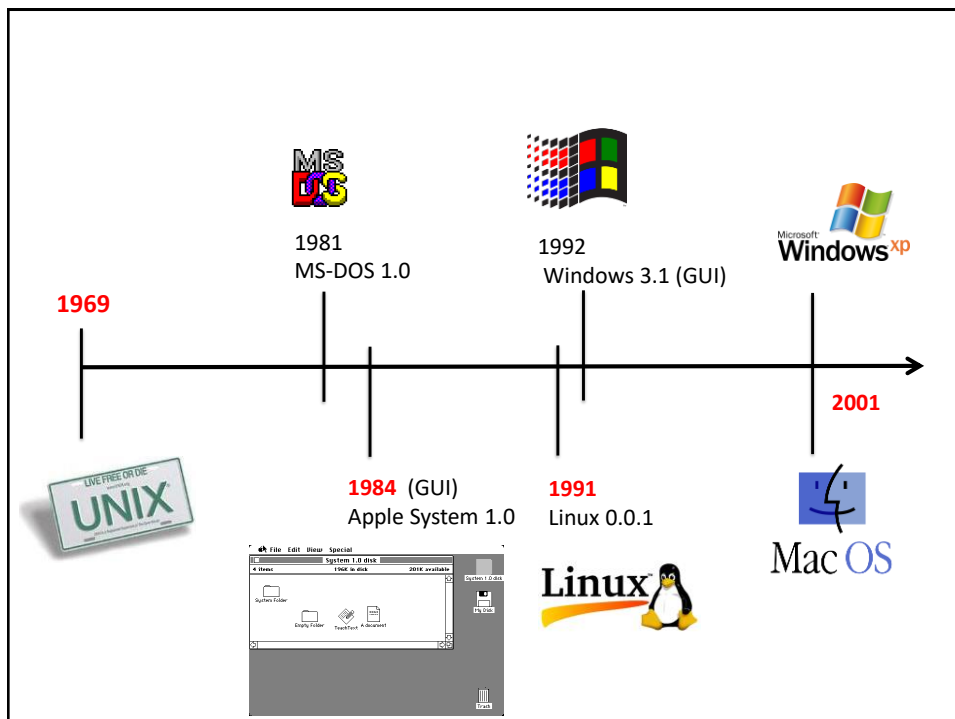
Common Linux Distributions

- **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



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)



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?

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/>

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>

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)

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:

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`)

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

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 dir - change directory to <i>dir</i>	uptime - show current uptime
cd - change to home directory (e.g. <code>/home/nf1tzkee</code>)	who - display who is online
pwd - show current directory	whoami - who you are logged in as
mkdir dir - create a directory <i>dir</i>	finger user - display information about user
rm file - delete file	uname -a - show kernel information
rm -r dir - delete directory <i>dir</i>	cat /proc/cpuinfo - cpu information
rm -f file - force remove file	cat /proc/meminfo - memory information
rm -rf dir - force remove directory <i>dir</i> * (see warning below!)	man command - show the manual for <i>command</i>
cp file1 file2 - copy <i>file1</i> to <i>file2</i>	df - show disk usage
cp -r dir1 dir2 - copy <i>dir1</i> to <i>dir2</i> ; create <i>dir2</i> if it doesn't exist	du - show directory space usage
mv file1 file2 - rename or move <i>file1</i> to <i>file2</i>	free - show memory and swap usage
if <i>file2</i> is an existing directory, moves <i>file1</i> into directory <i>file2</i>	whereis app - show possible locations of <i>app</i>
ln -s file link - create symbolic link <i>link</i> to <i>file</i>	which app - show which <i>app</i> will be run by default
touch file - create or update file	tar of file.tar file - create a tar named <i>file.tar</i> containing <i>file</i>
cat > file - places standard input into <i>file</i>	tar xf file.tar - extract the files from <i>file.tar</i>
more file - output the contents of <i>file</i> (alternatively: less file)	tar czf file.tar.gz file - create a tar with Gzip compression
head file - output the first 10 lines of <i>file</i>	tar xzf file.tar.gz - extract a tar using Gzip
tail file - output the last 10 lines of <i>file</i>	zip -r file.zip file - create a Windows-compatible zip archive
tail -f file - output the contents of <i>file</i> as it grows, starting with the last 10 lines	unzip file.zip - extract zip archive
	gzip file - compresses <i>file</i> and renames it to <i>file.gz</i>
	gunzip file.gz - decompresses <i>file.gz</i> back to <i>file</i>
Process Management	Network
ps - display your currently active processes	ping host - ping <i>host</i> and output results
top - display all running processes	whois domain - get whois information for <i>domain</i>
kill pid - kill process id <i>pid</i>	dig domain - get DNS information for <i>domain</i>
killall proc - kill all processes named <i>proc</i> *	dig -x host - reverse lookup <i>host</i>
bg - lists stopped or background jobs; resume a stopped job in the background	wget file - download <i>file</i>
fg - brings the most recent job to foreground	wget -O file - continue a stopped download
fg n - brings job <i>n</i> to the foreground	
File Permissions	Lab Utilities
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:	NMR Viewers: sparky or nmrDraw or nvj or analysio
<input type="checkbox"/> 4 - read (r) <input type="checkbox"/> 2 - write (w) <input type="checkbox"/> 1 - execute (x)	pipelinediff file.ft2 file.usaf - convert NMRPipe spectrum to UCSF format
Examples:	/home/databases/pdb/ - location of all PDB structures
chmod 777 - read, write, execute for all	PDB Viewers: symol or molmol or runmol or vad
chmod 755 - rwx for owner, rx for group and world	Text editors: xmmsc or emacs or gedit or vi
For more options, see man chmod	All can be invoked with a file, e.g. xmmsc file
SSH	/usr/lpt - run an executable file script in the current directory
ssh user@host - connect to <i>host</i> as <i>user</i>	
ssh -p port user@host - connect to <i>host</i> on port <i>port</i> as <i>user</i>	Ctrl+C - kills the current command
sftp user@host - connect to <i>host</i> as <i>user</i> for file transfer	Ctrl+Z - stops the current command, resume with fg in the foreground or bg in the background
sftp - graphical file transfer client	Ctrl+Q - log out of current session, similar to exit
Searching	Ctrl+W - erases one word in the current line
grep pattern files - search for <i>pattern</i> in <i>files</i>	Ctrl+U - erases the whole line
grep -r pattern dir - search recursively for <i>pattern</i> in <i>dir</i>	Ctrl+R - type to bring up a recent command
command grep pattern - search for <i>pattern</i> in the output of <i>command</i>	!! - repeats the last command
locate file - find all instances of <i>file</i>	exit - log out of current session
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. <code>***</code>)	
	* use with extreme caution.

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cd – change to home directory (e.g. <i>/home/nfitzkee</i>)
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rm file – delete <i>file</i>
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cp -r dir1 dir2 – copy <i>dir1</i> to <i>dir2</i> ; create <i>dir2</i> if it doesn't exist
mv file1 file2 – rename or move <i>file1</i> to <i>file2</i>
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touch file – create or update <i>file</i>
cat > file – places standard input into <i>file</i>
more file – output the contents of <i>file</i> (alternatively: less file)
head file – output the first 10 lines of <i>file</i>
tail file – output the last 10 lines of <i>file</i>
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top – display all running processes
kill pid – kill process id <i>pid</i>
killall proc – kill all processes named <i>proc</i> *
bg – lists stopped or background jobs; resume a stopped job in the background
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File Permissions
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:
<input type="checkbox"/> 4 – read (r) <input type="checkbox"/> 2 – write (w) <input type="checkbox"/> 1 – execute (x)
Examples:
chmod 777 – read, write, execute for all
chmod 755 – rwx for owner, rx for group and world
For more options, see man chmod .
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ssh user@host – connect to <i>host</i> as <i>user</i>
ssh -p port user@host – connect to <i>host</i> on port <i>port</i> as <i>user</i>
sftp user@host – connect to <i>host</i> as <i>user</i> for file transfer
gftp – graphical file transfer client
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command grep pattern – search for <i>pattern</i> in the output of <i>command</i>
locate file – find all instances of <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>*.txt</i>)

System Info
date – show the current date and time
cal – show this month's calendar
uptime – show current uptime
w – display who is online
whoami – who you are logged in as
finger user – display information about <i>user</i>
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cat /proc/cpuinfo – cpu information
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df – show disk usage
du – show directory space usage
free – show memory and swap usage
whereis app – show possible locations of <i>app</i>
which app – show which <i>app</i> will be run by default
Compression
tar cf file.tar files – create a tar named <i>file.tar</i> containing <i>files</i>
tar xf file.tar – extract the files from <i>file.tar</i>
tar czf file.tar.gz files – create a tar with Gzip compression
tar xzf file.tar.gz – extract a tar using Gzip
zip -r file.zip files – create a Windows-compatible zip archive
unzip file.zip – extract zip archive
gzip file – compresses <i>file</i> and renames it to <i>file.gz</i>
gzip -d file.gz – decompresses <i>file.gz</i> back to <i>file</i>

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 nmrDraw or nvj or analysis
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 rasmol 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.

