LINUX CLI 101

An Introduction to Linux CLI and Bash

IAN COURTNEY – SYSADMIN II – RESEARCH IT

TOPICS FOR TODAY

1. Introduction to Linux Philosophy and Distributions
2. Linux Shells
3. Naming Standards
4. Linux File System Layout
5. Moving around the Linux command line
6. Text Management
7. Small Break / QA
8. File Permissions
9. Bash Environment and History
10. Command Line KungFu

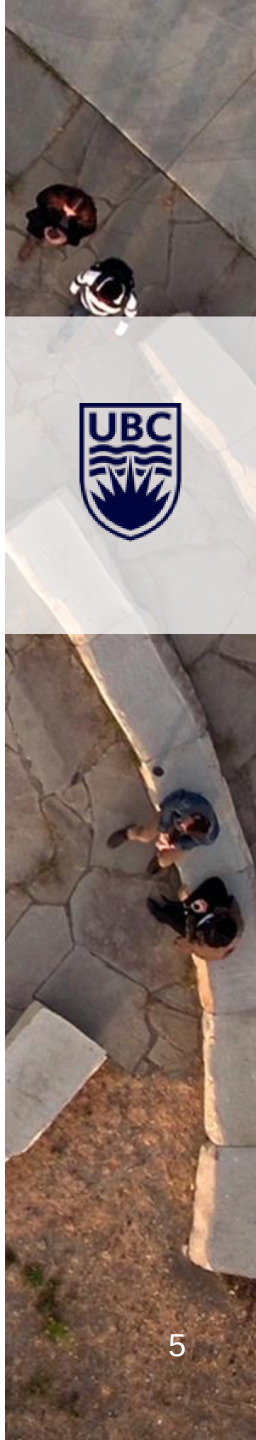
TOPICS CONTINUED

11. Text Editors
12. File System / Disk Usage
13. Finding Stuff in Linux
14. Process elevation (Root/Sudo/Su)
15. Process Management
16. Network Essentials
17. Security Contexts
18. Package Management
19. Getting Help
20. Remote Connectivity Options
21. Quick Intro to X Windows

LINUX IS USER FRIENDLY!

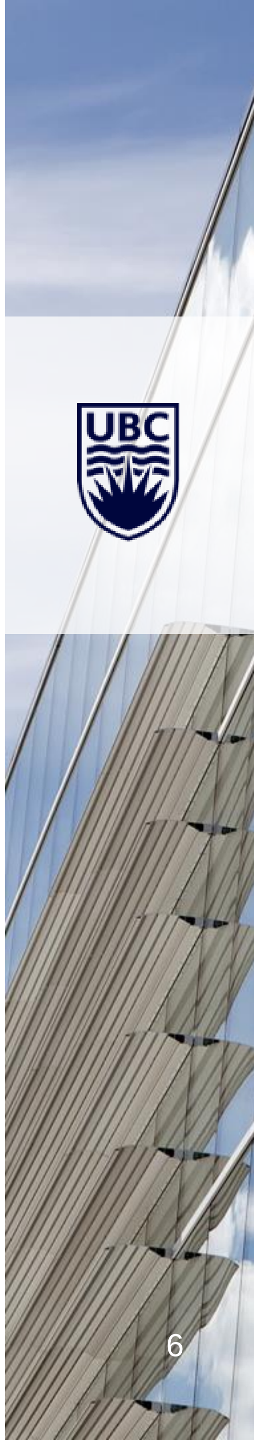
PREVAILING LINUX TENANTS

- Small is preferred
- Each program should do one thing really well
- Programs should work together
- KISS – Keep it Simple, Stupid!

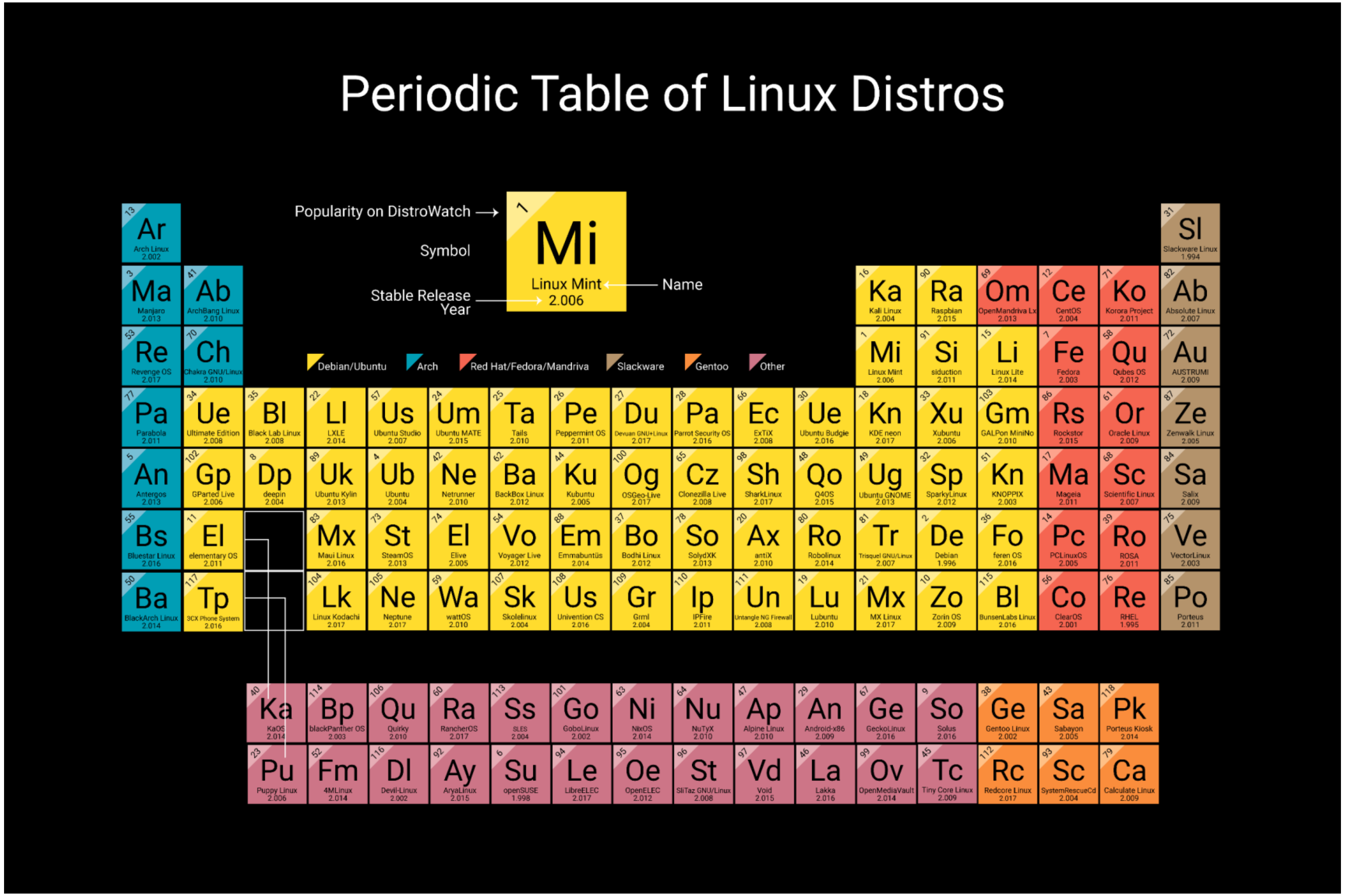


OPEN SOURCE MODELS

- The open-source model is a decentralized software development model that encourages open collaboration. A main principle of open-source software development is peer production, with products such as source code, blueprints, and documentation freely available to the public.
    - Ref - https://en.wikipedia.org/wiki/Open-source_model
- Number of different models:
    - GPL – GNU Public License
    - Apache Licensing
    - MIT Licensing
    - BSD License



LINUX DISTRIBUTIONS



Periodic Table of Linux Distros

Popularity on DistroWatch → 1
Symbol Mi
Name Linux Mint
Stable Release Year 2.006

🟨 Debian/Ubuntu 🟦 Arch 🟥 Red Hat/Fedora/Mandriva 🟫 Slackware 🟧 Gentoo 🟪 Other

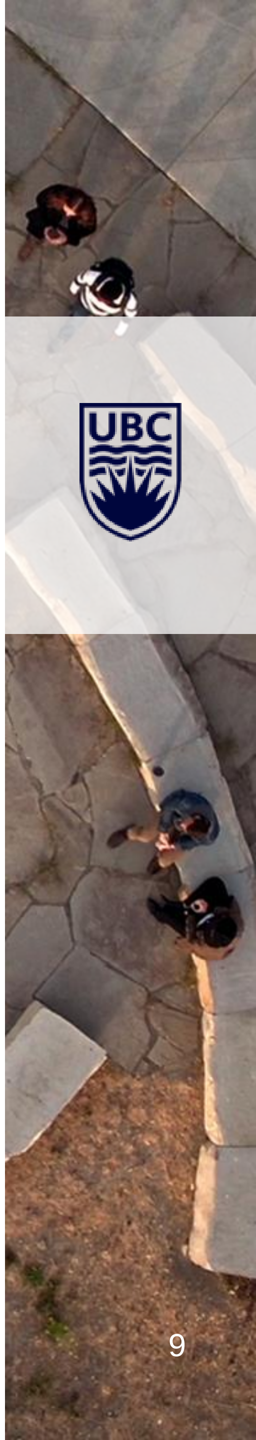
13 Ar Arch Linux 2.002																	31 Sl Slackware Linux 1.994
3 Ma Manjaro 2.013	41 Ab ArchBang Linux 2.010											16 Ka Kali Linux 2.004	90 Ra Raspbian 2.015	69 Om OpenMandriva Lx 2.013	12 Ce CentOS 2.004	71 Ko Korora Project 2.011	82 Ab Absolute Linux 2.007
53 Re Revenge OS 2.017	70 Ch Chakra GNU/Linux 2.010											1 Mi Linux Mint 2.006	91 Si siduction 2.011	15 Li Linux Lite 2.014	7 Fe Fedora 2.003	58 Qu Qubes OS 2.012	72 Au AUSTRUMI 2.009
77 Pa Parabola 2.011	34 Ue Ultimate Edition 2.008	35 Bl Black Lab Linux 2.008	22 Ll LXLE 2.014	57 Us Ubuntu Studio 2.007	24 Um Ubuntu MATE 2.015	25 Ta Tails 2.010	26 Pe Peppermint OS 2.011	27 Du Devuan GNU+Linux 2.017	28 Pa Parrot Security OS 2.016	66 Ec ExTiX 2.008	30 Ue Ubuntu Budgie 2.016	18 Kn KDE neon 2.017	33 Xu Xubuntu 2.006	103 Gm GALPon MiniNo 2.010	86 Rs Rockstor 2.015	61 Or Oracle Linux 2.009	87 Ze Zenwalk Linux 2.005
5 An Antergos 2.013	102 Gp GParted Live 2.006	8 Dp deepin 2.004	89 Uk Ubuntu Kylin 2.013	4 Ub Ubuntu 2.004	42 Ne Netrunner 2.010	62 Ba BackBox Linux 2.012	44 Ku Kubuntu 2.005	100 Og OSGeo-Live 2.017	65 Cz Clonezilla Live 2.008	98 Sh SharkLinux 2.017	48 Qo Q4OS 2.015	49 Ug Ubuntu GNOME 2.013	32 Sp SparkyLinux 2.012	51 Kn KNOPPIX 2.003	17 Ma Mageia 2.011	68 Sc Scientific Linux 2.007	84 Sa Salix 2.009
55 Bs Bluestar Linux 2.016	11 El elementary OS 2.011		83 Mx Maui Linux 2.016	73 St SteamOS 2.013	74 El Elive 2.005	54 Vo Voyager Live 2.012	88 Em Emmabuntüs 2.014	37 Bo Bodhi Linux 2.012	78 So SolydXK 2.013	20 Ax antiX 2.010	80 Ro Robolinux 2.014	81 Tr Trisquel GNU/Linux 2.007	2 De Debian 1.996	36 Fo feren OS 2.016	14 Pc PCLinuxOS 2.005	39 Ro ROSA 2.011	75 Ve VectorLinux 2.003
50 Ba BlackArch Linux 2.014	117 Tp 3CX Phone System 2.016		104 Lk Linux Kodachi 2.017	105 Ne Neptune 2.017	59 Wa wattOS 2.010	107 Sk Skolelinux 2.004	108 Us Univention CS 2.016	109 Gr Grml 2.004	110 Ip IPFire 2.011	111 Un Untangle NG Firewall 2.008	19 Lu Lubuntu 2.010	21 Mx MX Linux 2.017	10 Zo Zorin OS 2.009	115 Bl BunsenLabs Linux 2.016	56 Co ClearOS 2.001	76 Re RHEL 1.995	85 Po Porteus 2.011
		40 Ka KaOS 2.014	114 Bp blackPanther OS 2.003	106 Qu Quirky 2.010	60 Ra RancherOS 2.017	113 Ss SLES 2.004	101 Go GoboLinux 2.002	63 Ni NixOS 2.014	64 Nu NuTyX 2.010	47 Ap Alpine Linux 2.010	29 An Android-x86 2.009	67 Ge GeckoLinux 2.016	9 So Solus 2.016	38 Ge Gentoo Linux 2.002	43 Sa Sabayon 2.005	118 Pk Porteus Kiosk 2.014	
		23 Pu Puppy Linux 2.006	52 Fm 4MLinux 2.014	116 Dl Devil-Linux 2.002	92 Ay AryaLinux 2.015	6 Su openSUSE 1.998	94 Le LibreELEC 2.017	95 Oe OpenELEC 2.012	96 St SliTaz GNU/Linux 2.008	97 Vd Void 2.015	46 La Lakka 2.016	99 Ov OpenMediaVault 2.014	45 Tc Tiny Core Linux 2.009	112 Rc Redcore Linux 2.017	93 Sc SystemRescueCd 2.004	79 Ca Calculate Linux 2.009	

LINUX SHELLS

- What is a Shell:
  - In computing, a shell is a user interface for access to an operating system's services. In general, operating system shells use either a command-line interface (CLI) or graphical user interface (GUI), depending on a computer's role and particular operation.
- Common Shells:
  - SH/BASH: Shell, Bourne Again Shell
  - CSH/TCSH: C Shell, TCSH
  - KSH: Korn Shell
  - ZSH: Replaced BASH on macOS Catalina as of Oct 2019

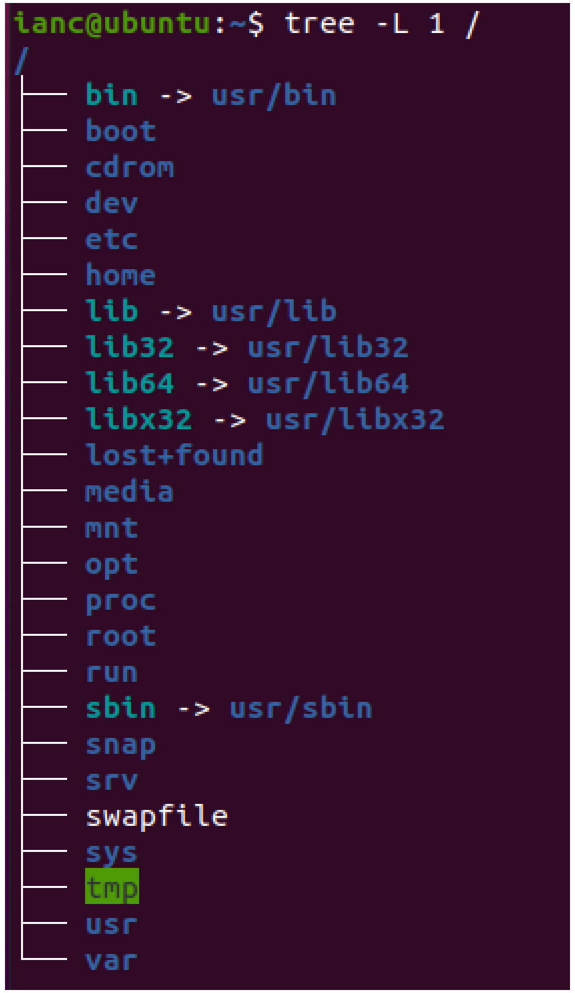
LINUX NAMING STANDARDS

- Files & Directories names are typically lowercase
- Spaces or strange punctuation are generally frowned upon
- Spaces can be replaced by underscores
- Files or Directories that start with a period are hidden
- Linux does and doesn’t use file extensions



FILE SYSTEM LAYOUT

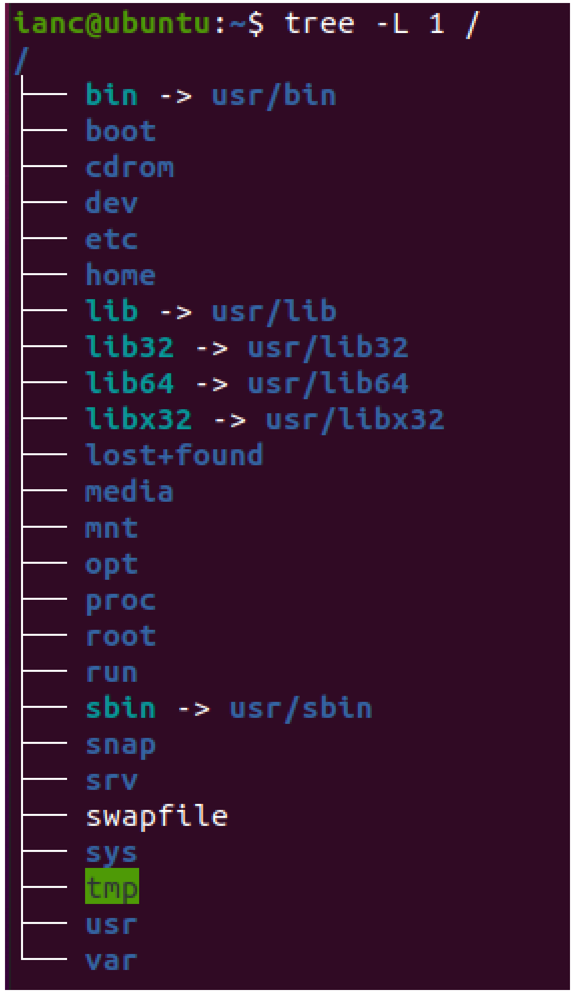
- /bin - Binaries these are your programs that run
- /boot – Contains the actual Linux kernel and other files pertaining to the boot of the system
- /dev – Is a virtual file system that maps to real hardware
- /etc – Most configuration files exist in this directory
- /home – Where user directories exist
- /cdrom, /media, /mnt – Different directories used for mounting removable media
- /opt – Typically where you will find Commercial products installed to



```
ianc@ubuntu:~$ tree -L 1 /
/
├── bin -> usr/bin
├── boot
├── cdrom
├── dev
├── etc
├── home
├── lib -> usr/lib
├── lib32 -> usr/lib32
├── lib64 -> usr/lib64
├── libx32 -> usr/libx32
├── lost+found
├── media
├── mnt
├── opt
├── proc
├── root
├── run
├── sbin -> usr/sbin
├── snap
├── srv
├── swapfile
├── sys
├── tmp
├── usr
└── var
```

FILE SYSTEM LAYOUT (CONTINUED)

- /proc – Another virtual filesystem that contains system and process information
- /root – Root’s home directory
- /run – Relatively new directory, added to contain transient files and sockets, process ids
- /sbin – System Admin Binaries, base level required root user
- /tmp – Temporary files – system will self clean this directory
- /usr – This is where the bulk of the files will be installed in Linux. User binaries and Read only data.
- /var – This would sort of be the counter point to /usr as the writeable directory. /var/log being one of the more important ones



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├── lost+found
├── media
├── mnt
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├── run
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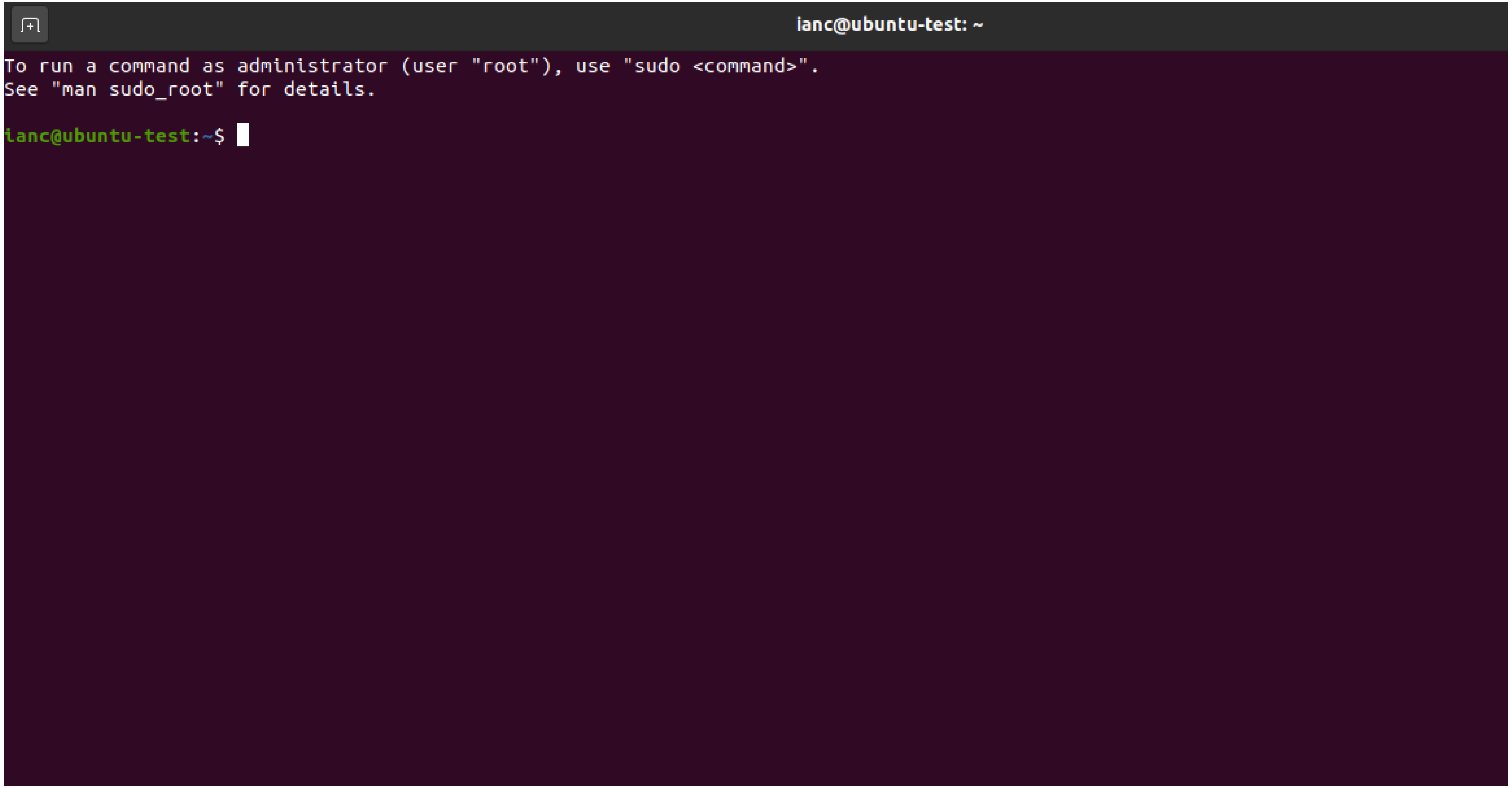
├── srv
├── swapfile
├── sys
├── tmp
├── usr
└── var
```

ARE YOU READY TO DRINK FROM THE FIREHOSE?

THE TERMINAL OR COMMAND PROMPT!



```
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

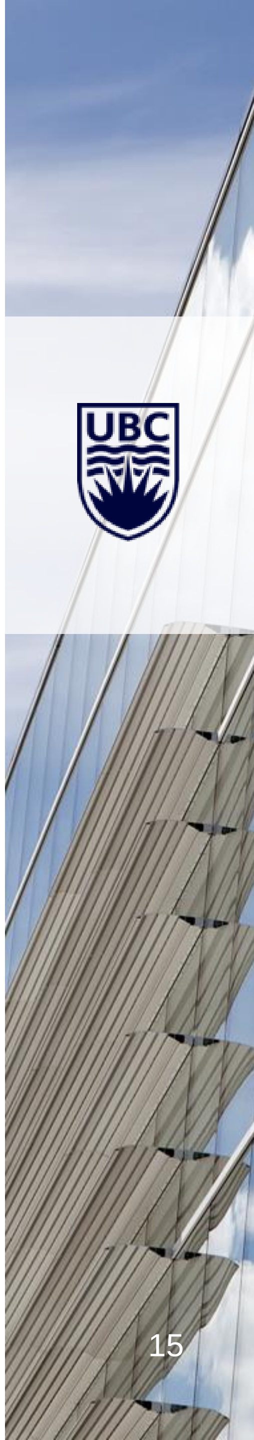
ianc@ubuntu-test:~$ 
```

FIRST COMMAND - LIST

- ls – List, shows you the files and directories
    - Some variants:
        - ls –ltr – long list, based on time, newest at bottom
        - ls –a – show hidden files
        - ll - aliases
        - la - aliases

BEYOND LISTING

- cd – Change directory
- touch – Simple command to create a file, update a time stamp
- mv – move a file from one spot to another, or to rename a file
- echo – echoes back what you give it
- The TAB Button – your new best friend



DIRECTORY MANAGEMENT

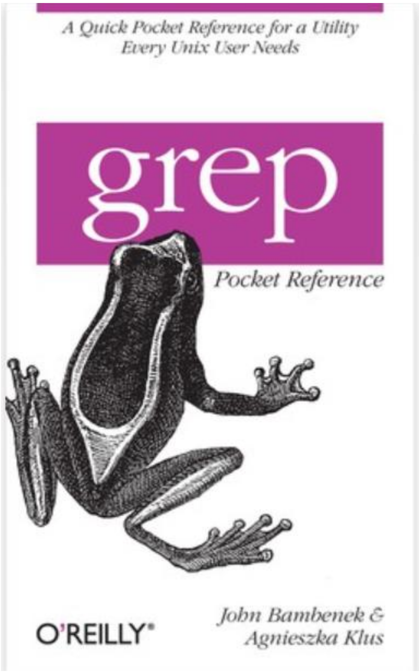
- mkdir – Make directory
- rmdir – Remove directory
- mv dir newdir – To rename a directory
- cp – copy files
- rm – remove files

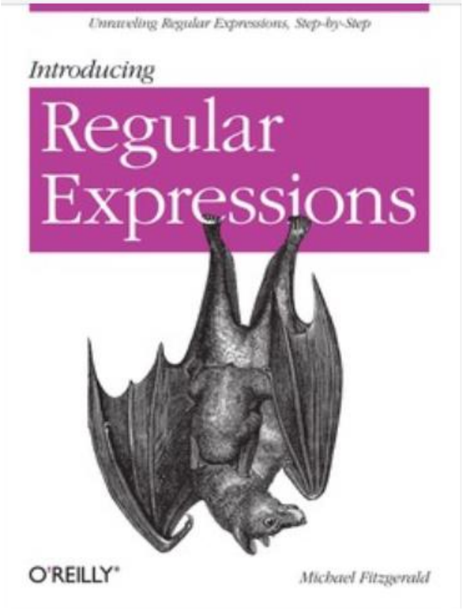
TEXT MANAGEMENT AND MANIPULATION

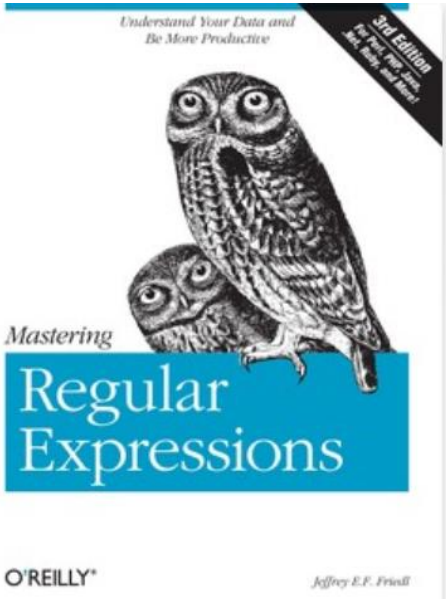
- cat – Concatenate, types a file out to the terminal
- more - Pages out content a page at a time
- less – Like more, but allows for line by line movement
- Ctrl-C – Break command
- head – Shows the top ten lines
- tail – Shows the bottom ten lines

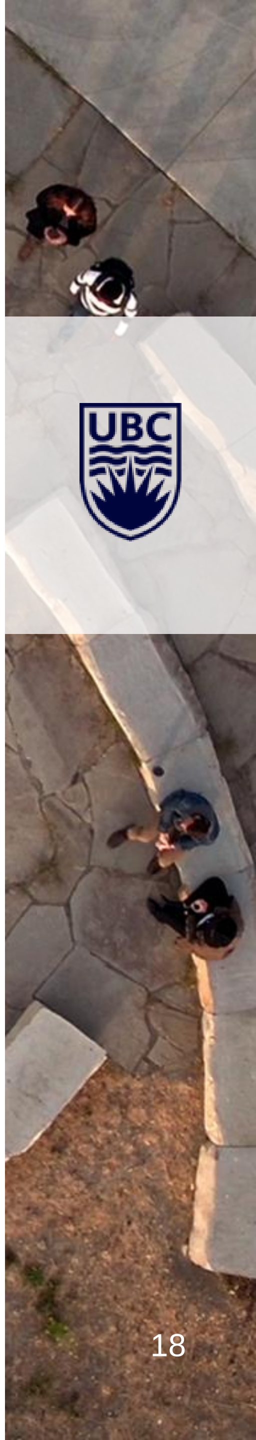
GREP

- Command line utility for searching for text strings, regular expressions


A Quick Pocket Reference for a Utility Every Unix User Needs
grep
Pocket Reference
O'REILLY
John Bambenek & Agnieszka Klus

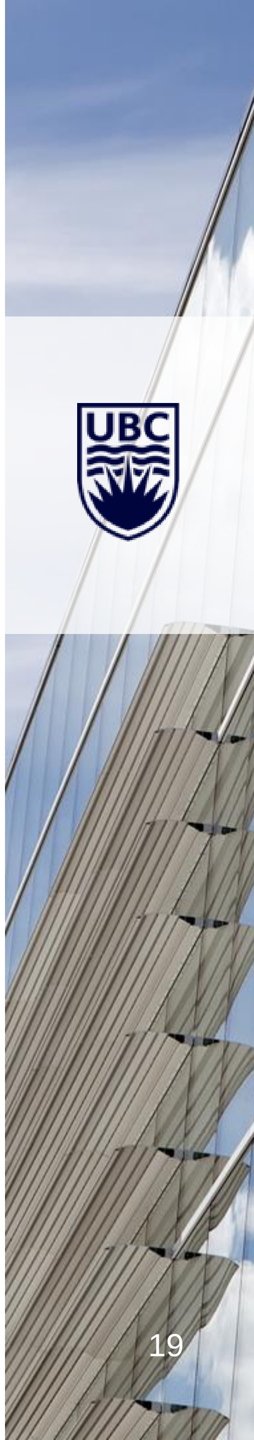



Understand Your Data and Be More Productive
3rd Edition
For Perl, PHP, Java, .NET, Ruby, and More!
Mastering
Regular Expressions
O'REILLY
Jeffrey E.F. Friedl



PUTTING IT ALL TOGETHER WITH SPECIAL CHARACTERS

- grep searchterm textfile > newfile.txt
- grep searchterm *.txt > newfile.txt
- grep searchterm otherfile >> newfile.txt
- cat files | grep searchterm



FEW MORE COMMANDS!

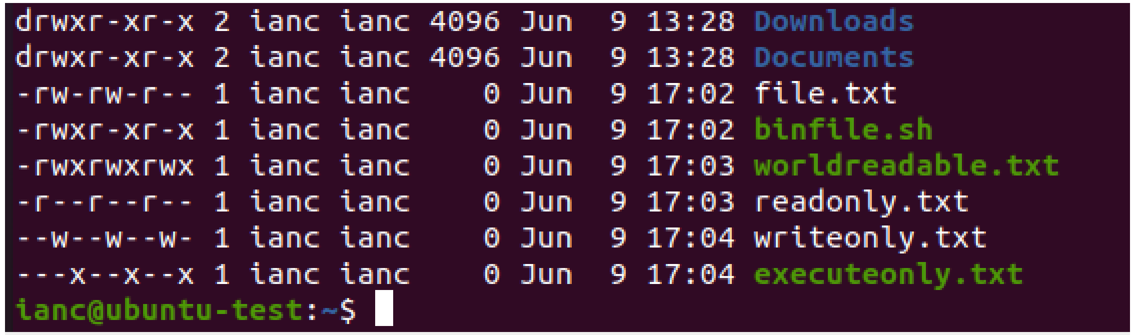
- sort – Will sort your output in a number of different ways
- uniq – Identical lines will be condensed to 1, can count them
- wc - Counts words, or lines
- cut – Helps extract data from a line of input

Bonus points for:

- awk – Manipulates data and generates reports
- sed – Stream editor – text transformations
- xargs – Used to build, and execute, commands from standard input

SMALL BREAK / QUESTIONS

FILE PERMISSIONS



```
drwxr-xr-x 2 ianc ianc 4096 Jun  9 13:28 Downloads
drwxr-xr-x 2 ianc ianc 4096 Jun  9 13:28 Documents
-rw-rw-r-- 1 ianc ianc    0 Jun  9 17:02 file.txt
-rwxr-xr-x 1 ianc ianc    0 Jun  9 17:02 binfile.sh
-rwxrwxrwx 1 ianc ianc    0 Jun  9 17:03 worldreadable.txt
-r--r--r-- 1 ianc ianc    0 Jun  9 17:03 readonly.txt
--w--w--w- 1 ianc ianc    0 Jun  9 17:04 writeonly.txt
---x--x--x 1 ianc ianc    0 Jun  9 17:04 executeonly.txt
ianc@ubuntu-test:~$ 
```

Permissions will get made up for the following:

4 – Read

2 – Write

1 – Execute

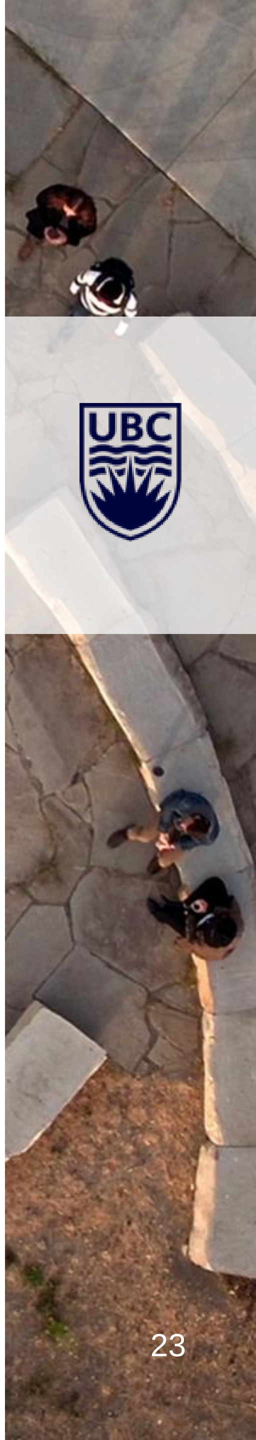
Commands:

- chmod – Change mode
- chown – Change ownership

BASH ENVIRONMENT

- Important files:
  - ~/.bashrc
  - ~/.bash_profile
  - /etc/bashrc and /etc/profile

- Important Commands:
  - env – environment, shows you the variables set
  - export – create new environmental variables

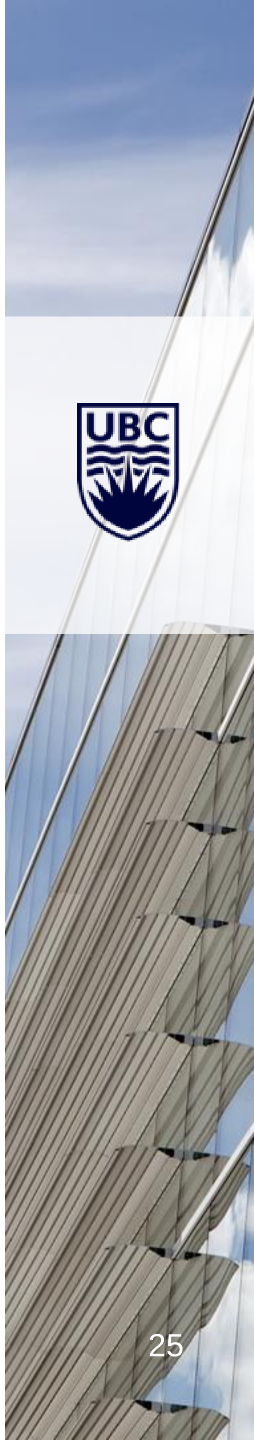


BASH HISTORY

- history : Shows you everything you’ve run (last 1000 commands)
- cat ~/.bash_history : Same thing
- !### : Putting a ! and then the number in the history will run that command again
- Ctrl-r : Will do a reverse search through history based on what you type

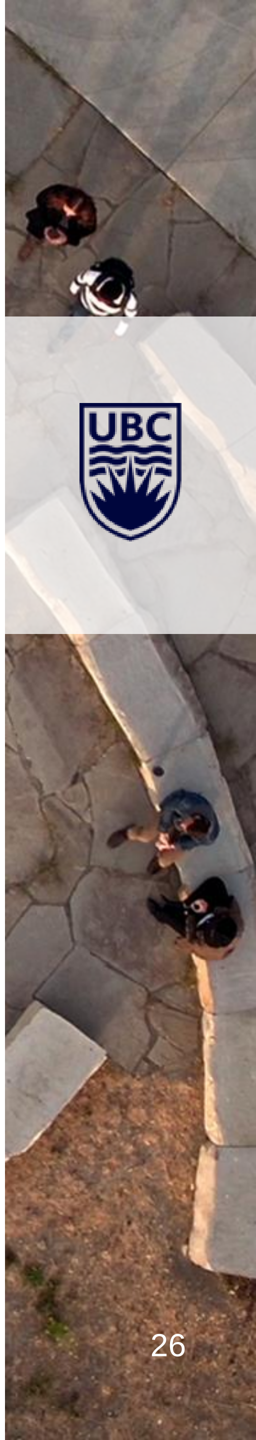
COMMAND LINE KUNG FU

- Ctrl a – beginning of line
- Ctrl e – end of line
- Ctrl k - cut from cursor forward
- Ctrl y – paste the cut
- Ctrl p – back (or up arrow)
- Ctrl n – next in CLI history (down arrow)
- Ctrl l – clear screen
- Ctrl s – freezes the screen (everyone accidentally hits it eventually)
- Ctrl q – will unlock your screen
- Ctrl h – a backspace replacement
- Ctrl d – if nothing is on the line, logs you out, otherwise functions as a delete
- Highlighting something in the terminal, you can paste with shift insert.



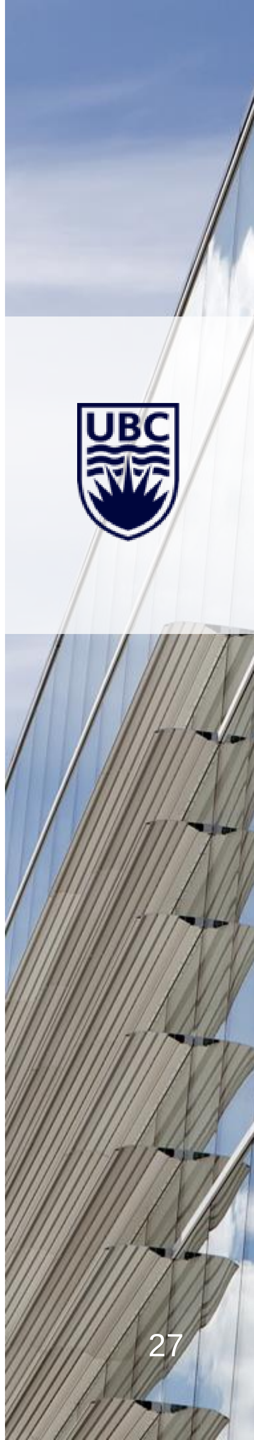
TEXT EDITORS

- pico / nano
- vi / vim
- emacs



VI / VIM

- **Command Mode**: Moving around and manipulating
  - Pressing A(ppend) or I(nsert) will get you into Edit mode.
  - Typed :q will quit, :wq will write and quit
- **Edit mode**: For your notepad style experience
  - Pressing the Escape button will return you to Command mode
- Other shortcuts:
  - dd – deletes lines (if you type 10 before you press dd, you will delete 10 lines)
  - yy – yanks lines (copies)
  - p – pastes lines
  - u – undo
  - / - search (press n or p for next / previous)
  - :number – takes you to that line number (:$ end of file, :1 beginning)



RUNNING STUFF ON TIME

- crontab –e

```
00 * * * * /run/something_on_the_hour
00 1 * * * /run/something_at_1_am
00 1 1 * * /run/something_at_1_am_on_the 1st of the month
00 1 1 1 * /run/something_at_1_am_on_the 1st of January
00 1 * * 1 /run/something_at_1_am_on_Mondays (0-6 Sunday to Saturday)
*/5 * * * * /run/something_every_5_minutes
```

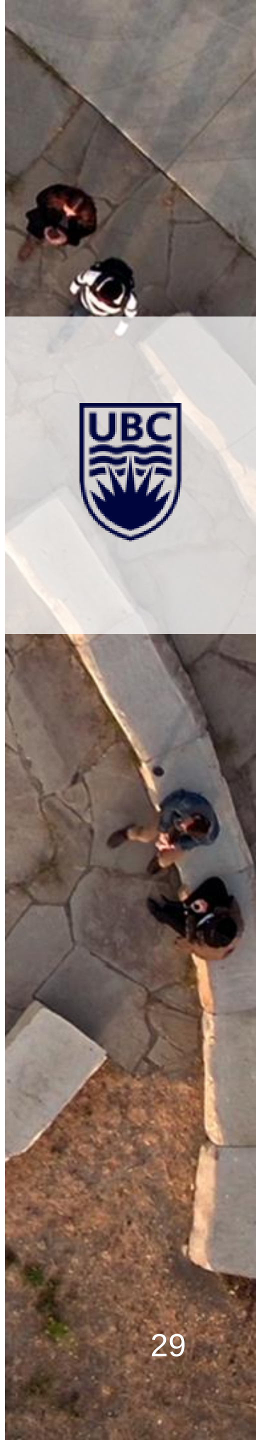
- at 3 pm

```
/run/somejob
ctrl-d
```

FILE SYSTEM INFORMATION

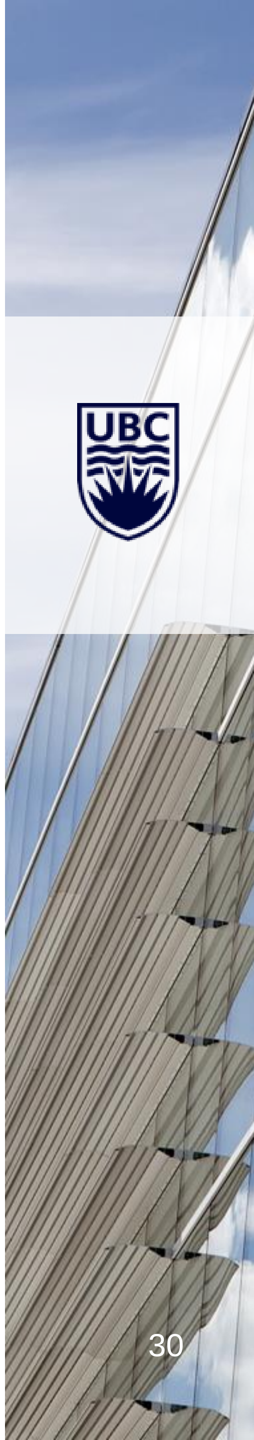
- df –h : Disk Free in human readable format
- du –max-depth=1 –h /usr: Disk Usage, max depth of 1 directory
- lsblk –f: list block devices with their UUID
- Some important files:
  - /etc/fstab – File System Table
  - /etc/mtab – Mounted table

- Extra marks to: fdisk, gparted, LVM, mkfs.*



FINDING STUFF IN LINUX

- find – powerful tool for finding files
- which – for figuring out where a binary runs from
- updatedb/locate – not on all systems, keeps a db of files



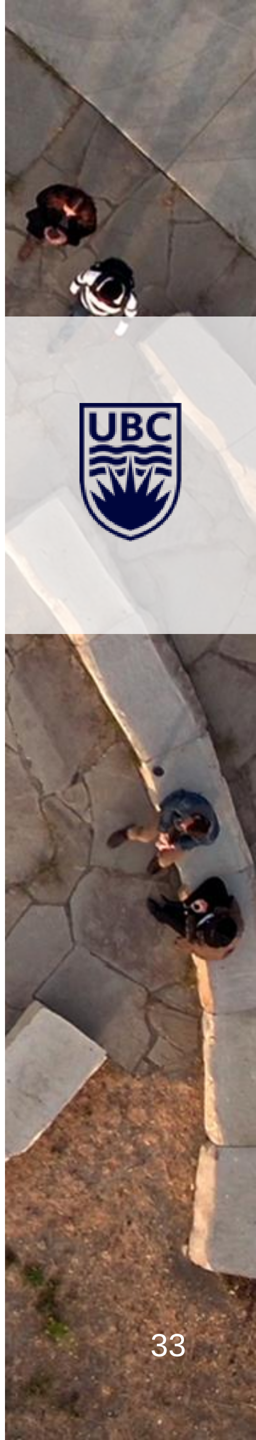
SMALL BREAK / QUESTIONS

PROCESS ELEVATION

- sudo – Sort of like a pretty please
    - Access guided by /etc/sudoers
- su – Super User, also used to “su” to another user
- id – Can be helpful to know who you are, what groups you belong to

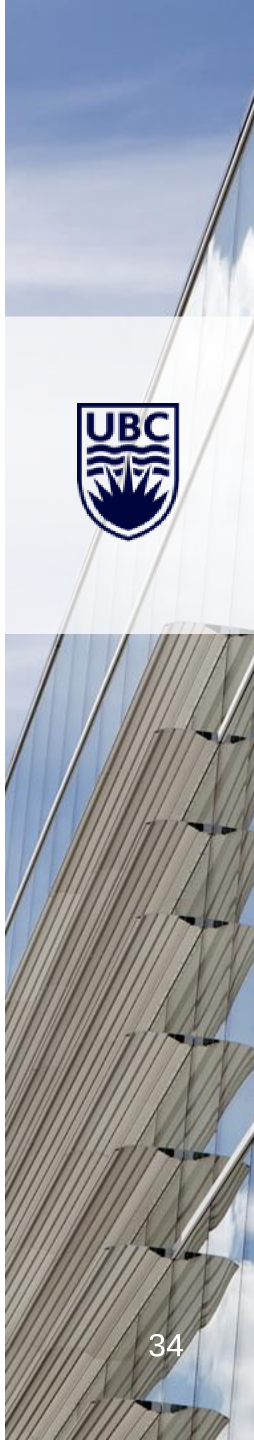
PROCESS MANAGEMENT

- Commands:
  - ps fax : Process list showing you a formatted list (add ww for word wrap)
  - top : System monitor, M for memory sort, P for processor, q to quit
  - kill #### : Needs the PID number, can be found in ps/top
  - killall process_name : Kills based on process name



PROCESS AND JOB MANAGEMENT

- Running processes in the background is simple:
    - ./command.sh &
- jobs - Will list running jobs
- fg – Foreground, will bring a job back to the foreground
- bg – Background, will start the job running in the background
- Ctrl-z – Suspends a running task, type bg to background it

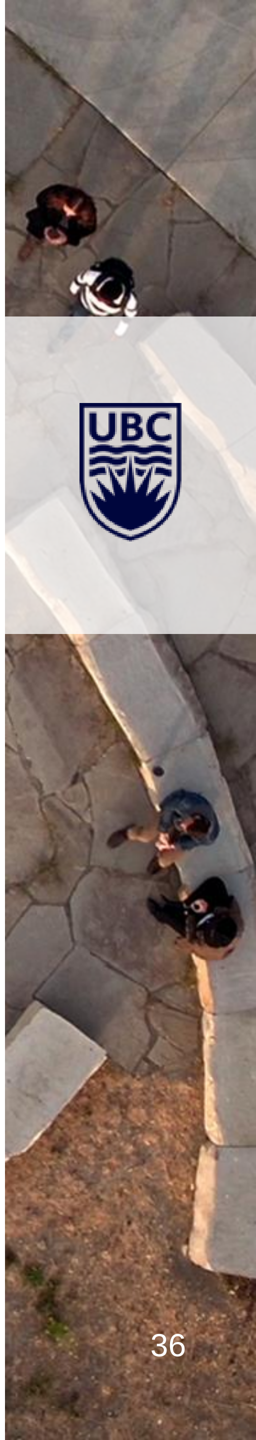


WORK LIKE NO ONES WATCHING

- screen:
  - Multiple shells open over a single connection
  - Leave things running and come back later
    - Even connect from somewhere else
  - Ctrl-a hotkey start
- tmux:
  - A new iteration of screen/replaces it
  - Ctrl-b hotkey start

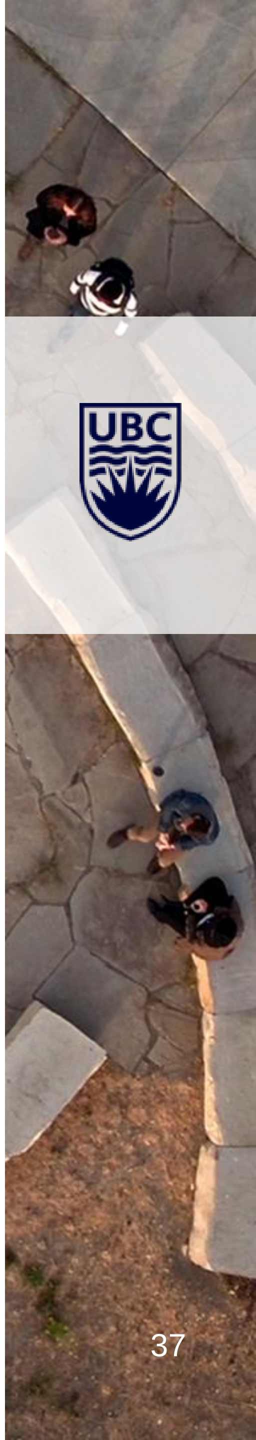
NETWORK ESSENTIALS

- ifconfig : Lists all network adapters, and their IP info
    - ip address – Shows much the same, ifconfig not always present
- ping : For seeing if you can reach another computer
- traceroute/tracepath : Shows the hops to get from one IP to another
- nslookup google.com : Changes the name to an IP address
- systemd-resolve –status : Will show you the DNS servers you are using
- netstat –nap and netstat –nr : Shows open ports and the processes holding them, nr shows your routing table



SECURITY CONTEXTS – WHY DOESN'T THIS WORK?!?

- For awareness, a couple other things:
    - iptables –L –n : Linux built in firewall
- SELinux (RHEL) vs AppArmor (Ubuntu)
    - sestatus : Tells you current status, enforcing means active
    - setenforce 0 : Disables SELinux until reboot
    - /etc/selinux/config : Config read at boot
- AppArmor: Less intrusive
    - aa-status : Tells you if there are any issues
    - aa-logprof : Will help you fix issues



PACKAGE MANAGEMENT

- A long long time ago…
    - tar zxvf programtarball.tar.gz
    - ./configure
    - make
    - make install
    - Cross fingers and hope

- Package Management has its own issues (Dep Hell), but…

UBUNTU / DEBIAN – DEB PACKAGE MANAGEMENT

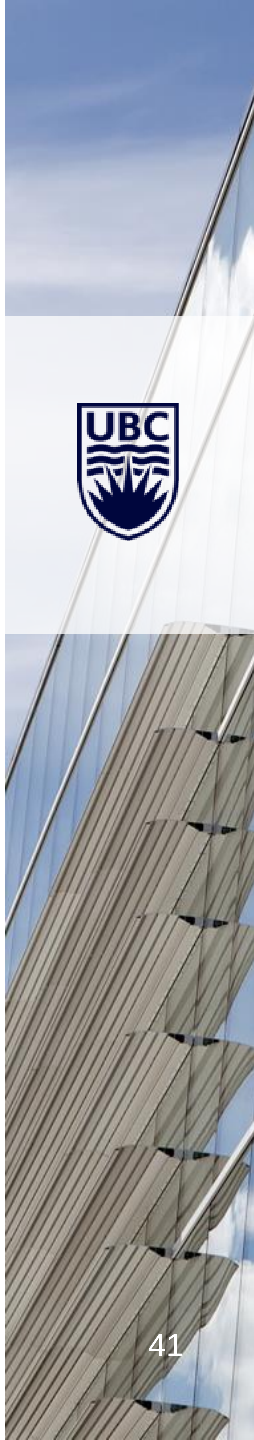
- apt – Apt, also occasionally shown as apt-get
- dpgk – debian package manager
- To update a Ubuntu/Debian system:
  - apt update
  - apt upgrade
- Other useful bits:
  - apt search package
  - apt install package
  - apt remove package
  - apt list –installed – show all installed package (|grep package name)
  - dpkg –i localpackage.deb (-I install)

RHEL/FEDORA/CENTOS – RPM BASED MANAGEMENT

- yum – Yellowdog update manager: their somewhat automated package management fetcher
- dnf – Dandified YUM, replacement for YUM
- rpm – rpm is what actually installs and updates packages
- To update a RHEL/CentOS box:
  - yum update
- Other useful commands:
  - yum install packagenames
  - yum whatprovides python3
  - yum search package
  - yum remove package
  - rpm –Uvh packagename.rpm (upgrade verbosely while showing hash symbols to track progress)
  - rpm –e packagename – erase / remove a package
  - rpm –qa - lists all packages
  - rpm –qif /local/file – tells you which package provided that file
  - rpm –qil packagename – lists all files from a package

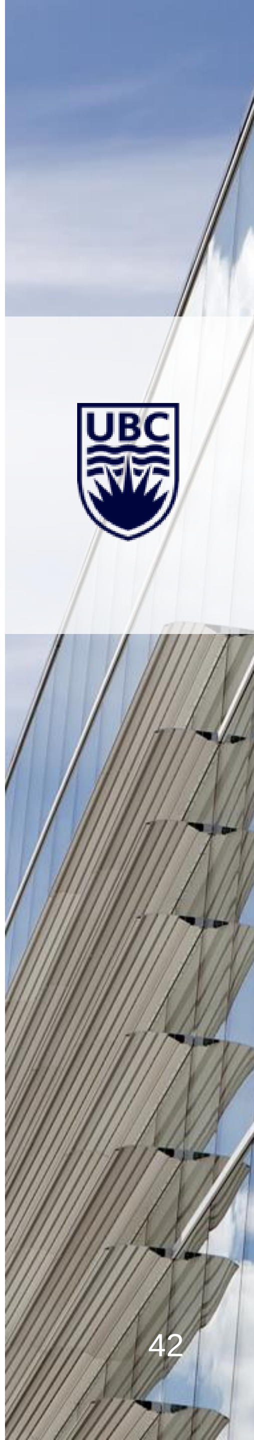
GETTING HELP!!!

- man – Manual/manpages in depth info on a command
- command –help – Almost all commands have some help available
- info – Almost a BASH 101 on its own
- https://google.com – Start here
- https://askubuntu.com
- https://www.tldp.org – The Linux Documentation Project
- Learning the Bash Shell – O’Reilly
- https://people.ok.ubc.ca/courtnei/LinuxCheatSheet.pdf



REMOTE CONNECTIVITY

- Command Line access:
  - SSH Clients:
    - Putty - https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
    - MobaXterm - https://mobaxterm.mobatek.net/
    - MacOS – Use your Terminal, SSH is built in
    - Windows – Enable WSL – Windows Subsystem for Linux
  - Copying Files:
    - SCP/SFTP
    - FTP (somewhat deprecated)
  - X Clients:
    - Various versions of VNC
    - X2Go - https://wiki.x2go.org/doku.php/download:start



QUICK INTRO TO THE DESKTOP

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