Introduction to Linux

University of Bristol - Advance Computing Research Centre
Operating Systems

- Program running all the time
- Interfaces between other programs and hardware
- Provides abstractions (common interfaces, e.g. filesystems)

- You may know
  - Windows
  - MacOS
  - iOS
  - Android
UNIX

- An operating system originating at Bell Labs. circa 1969 in the USA
User Interfaces

- Command Line
- GUI - Graphical User Interface
Kernels and Shells

- The kernel is the core of the operating system
- The shell is the interface between the user and the operating system
Linux

- A version of UNIX
- Written by Linux Torvalds when he was an undergrad in Finland
- Free (libre, gratis)
- One OS from Desktop -> Supercomputer
- Technically just the kernel
- Distributions bundle kernel, GNU tools and extra software
- BlueCrystal Phase 3 runs CentOS 6
Linux Philosophy

- Kit of parts
- One small thing does one thing well
- Small utilities can be joined together to perform more complicated tasks
At First...

$ ls | wc -l
But Later...

```bash
tr -cs A-Za-z \n |
tr A-Z a-z |
sort |
uniq -c |
sort -rn |
```
Logging On

We'll be working on the HPC (Blue Crystal)

- Start Putty
- Log in to bluecrystalp3.acrc.bris.ac.uk
- And off we go...
Filesystem Hierarchy

Part of the filesystem tree
Directories

- Pathnames and /
- Finding where you are (pwd)
- Changing to a different Directory (cd)
- The Directories . and ..
- Home directories (~)
Tasks 1

- find out where you are
- what is pathname one level above (go there)
- go back to your home directory (prove it)
New Files and Directories

- Listing files and directories (ls)
- Making Directories (mkdir)
Tasks 2

- What is in your home directory?
- What is on one level above?
- Make a new directory in your home directory (give it a one word name)
File Manipulation

- Copying Files (cp)
- Moving Files (mv)
- Removing Files and directories (rm)
Tasks 3

- copy example.txt to another filename
- rename your new file to something else
- move your new file into the directory you created earlier
- make another copy of example.txt
- delete your second copy
Examining File Contents

- Displaying the contents of a file on the screen (cat, less)
- The first lines in a file (head)
- The last lines in a file (tail)
- Searching the contents of a file (grep)
- Counting with grep (-c)
- UNIX is case sensitive
- grep -i
Tasks 4

- What is in example.txt
- What are the first 10 lines of example.txt
- What are the first 15 lines of example.txt
- What are the last 2 lines of example.txt
- Read through the whole of example.txt a page at a time
- Find all the lines that mention "GNU"
- Count the number of lines that have the word "Linux" (in any capitalisation)
Filenames

- Wildcards
  - ? Any character
  - * More Than One Character

- Filename Conventions (e.g. .c)
Tasks 5

- list all the two letter commands in /usr/bin
- list all the commands with "to" in their name
Getting Help

- man
- man -k
- Google (other search engines are available)
Tasks 6

- Read the man page for `head`
- Pick a random command from in `/usr/bin` and read it's manpage
Manipulating Files

- sort
- uniq
Redirecting the Output
   ○ > (overwrites)
   ○ >> (appends)

Redirecting the Input
   ○ <
Tasks 6

- sort the file authors into alphabetical order
- find the list of unique authors
- find how many times each appears in the original list
Pipes and Pipelines

- Take the standard output of one command and feed it in to the standard input of the next
- Uses the pipe (vertical bar) symbol |
- No intermediate files!
  - Efficient
$ wc -l *.pdb

$ wc -l *.pdb > lengths

$ wc -l *.pdb | sort -n | head -1

Output in Shell

Output in File

Output in Shell
Tasks 7

- without using intermediate files...
  - sort the authors file
  - find the count of unique authors
  - put that list in to numerical order
Text Editors

- not Word
- `vim` is mentioned a lot but don't use just yet
- we recommend `nano`
  - `^O` to save
  - `^X` to exit
Task 8

- add some more authors to the authors file
- rerun the previous analysis
- put the analysis command pipeline in to a file called author_count
File Permissions

- Displaying Permissions (ls -l)
- Understanding Permissions
  - User, Group, Other
- Changing Permissions (chmod)
Tasks 9

- create a test file
- what are the permissions on the file?
- change it so others have no permissions
- change it so the group has write permissions
- have a look at someone elses files (in the course - trainXX only!)
Processes and Job

- What is a Process?
- Listing Processes (ps)
- Background Process
- pstree
- Killing a process (kill)
Tasks 10

- run the task `sleep 300`
- background it
- find it in the process list (you will want to `grep` for "sleep" and your username)
- kill it
Variables

The Shell is a full programming language

- Conditionals, Loops, Functions
  - Above covered in a forthcoming course

- Variables
  - Built in and user
  - Normal - This shell
  - Environment - All processes started from this shell.
Tasks 11

- examine the variables in your shell
- set a variable
- display the value of the variable
Miscellany

- Disk Space (quota, du, df)
- Comparison (diff, cmp)
- Compression (gzip, zcat)
- Searching (find)
Tasks 12

- how many filesystems are there on BlueCrystal p3?
- which is the largest
Installing Software Packages

Normally installed by an administrator using a package manager

- \texttt{yum} for Redhat and Derivatives e.g. CentOS
- \texttt{apt} for Debian and Derivatives e.g. Ubuntu
Building Software Packages

Sometimes a package needs to be built from source

- Not in any repos
- Latest and greatest required
- No root (admin) access
Build process

- Downloading (wget)
- Extracting (tar)
- Configuring (configure)
- Building (make)
Running the Newly Built Package

- Run using path name
- PATH Environment Variable
- Startup files
Any Questions?
Resources - Where to practise

- macOS users can use the terminal
- Windows10 has Windows Subsystem for Linux
- Departmental resources
- Eligible users can apply for an account on the ACRC clusters
- Cloud vendors provide trial subscriptions
Resources

- hpc-help@bristol.ac.uk
- ACRC Website - [https://www.bristol.ac.uk/acrc/](https://www.bristol.ac.uk/acrc/)
- [http://www.ee.surrey.ac.uk/Teaching/Unix/](http://www.ee.surrey.ac.uk/Teaching/Unix/)
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