



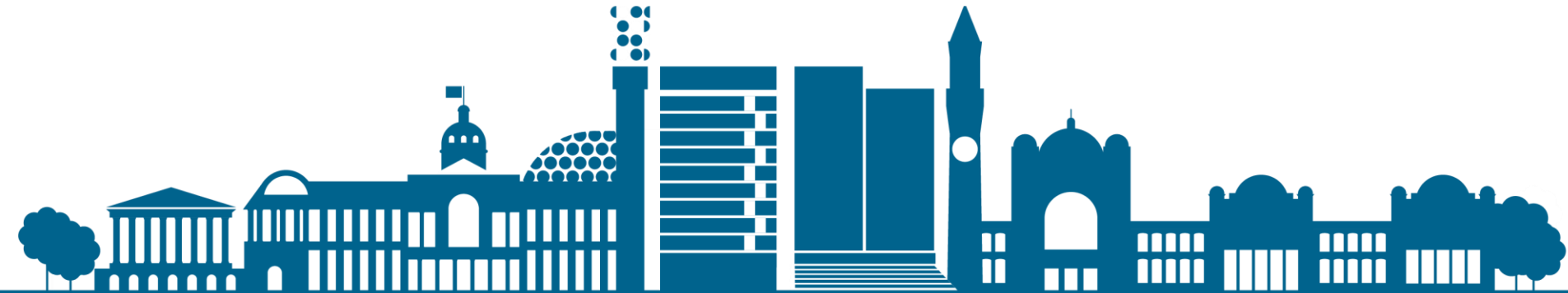
UNIVERSITY OF
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Introduction to Linux



April 2024

<https://www.birmingham.ac.uk/bear>

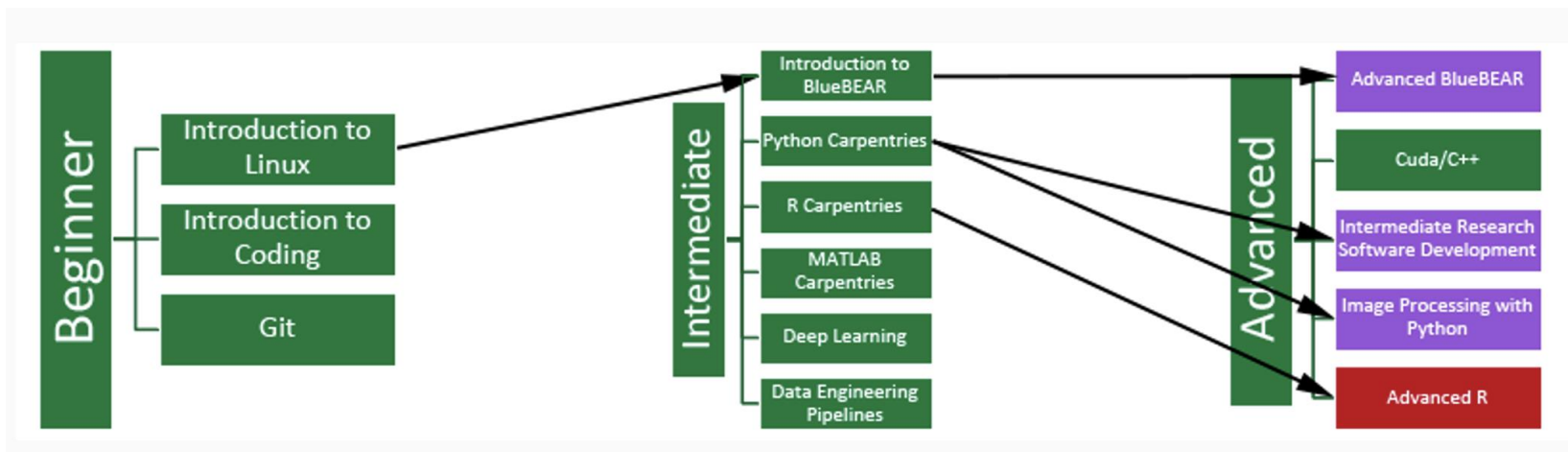


Housekeeping

- Today's workshop – a mixture of us talking and hands-on activities
- Ask questions as we go along
- Refreshment/comfort break during workshop
1
- Feedback – Forms questionnaire



Modular training structure



Overview

- Section 1
 - Using Linux with BlueBEAR
 - Understanding the BlueBEAR workflow
 - Accessing BlueBEAR
- Section 2
 - Creating files
- Section 3
 - Basic Linux commands
 - File management

Workshop 1
Directories and files
(20 mins)

Break – 10 mins

- Section 4
 - File permissions
 - Write and run a simple program
- Section 5
 - Next steps and other BEAR services

Workshop 2
Write & run a program
(20 mins)



Learning Outcomes

- ❑ To set up your computer for accessing BlueBEAR
- ❑ To log in to BlueBEAR
- ❑ To create and manage directories and files
- ❑ Understand and use some basic Linux commands
- ❑ To know how to create a job script
- ❑ To set permissions on a script to be able to run it





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Introduction to BlueBEAR

- Section 1



What is BEAR?

- <https://www.birmingham.ac.uk/bear>
- Birmingham Environment for Academic Research
- BEAR is a collection of services: HPC, storage, fast networking, ...
- BlueBEAR refers to the Linux High Performance Computing (HPC) environment
- BEAR services are FREE at the point of use



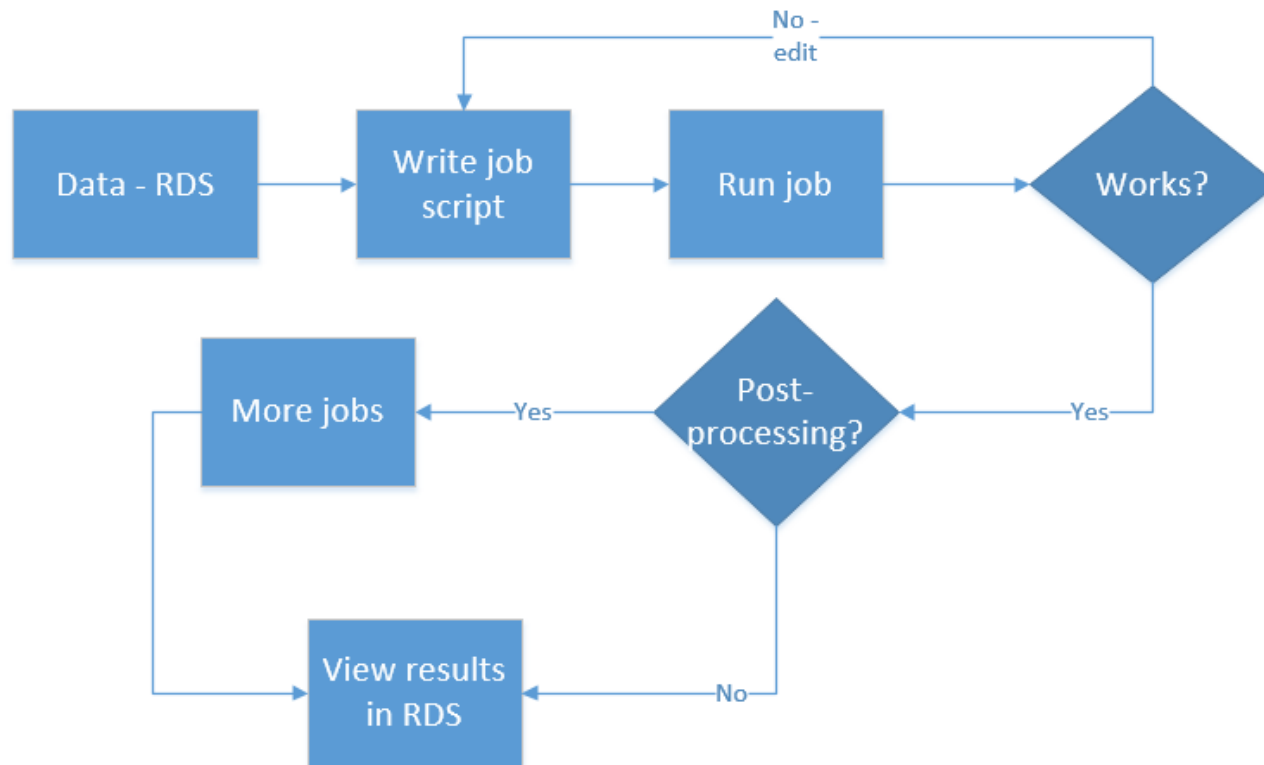
BlueBEAR

- ❑ Users need to register to use the service
- ❑ Users are attached to (multiple) projects
- ❑ Projects are created by staff and are for 5 years
- ❑ Projects are used to account for time on the cluster
- ❑ Registrations are via:

<https://www.birmingham.ac.uk/research/arc/bear/bluebear>



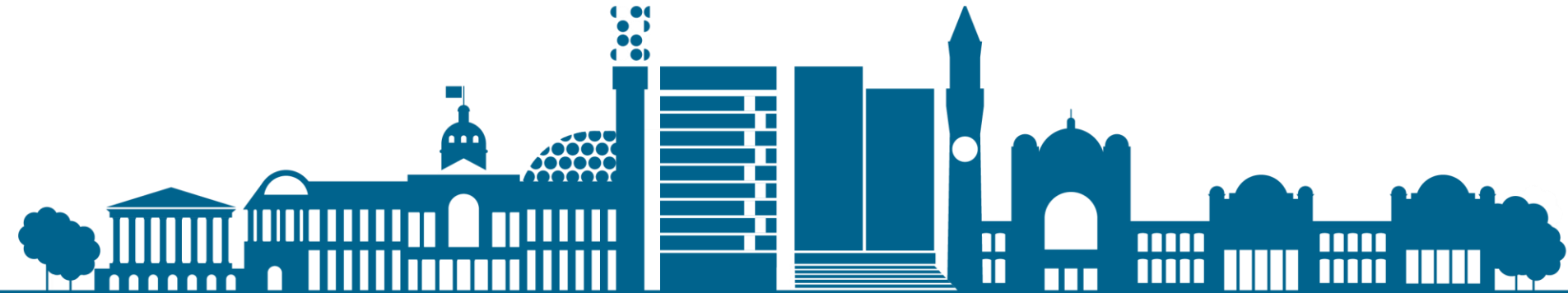
BlueBEAR Workflow





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Accessing and using BlueBEAR



About Linux

- The interface used for BlueBEAR – how we connect to it and tell it what to do
- It's a huge subject; we are only covering the basics
- There are often multiple ways of doing things



Accessing BlueBEAR

- ❑ You must have an active BEAR Linux account to access BlueBEAR
- ❑ You can connect to the cluster from the University network or via Remote Access Service (VPN)
- ❑ Use your normal University (ADF) username and password
- ❑ Access via BEAR Portal



BlueBEAR Portal

- Service allowing web-based, graphical interface access to a limited but expanding no. of applications including:
 - JupyterLab
 - RStudio
 - MATLAB
 - Stata
- Need access to a BlueBEAR project
- Needs Remote Access VPN when off-campus

BlueBEAR OnDemand Files Jobs Clusters Interactive Apps My Interactive Sessions

Home / My Interactive Sessions / RStudio Server

Interactive Apps

- Data Science
- JupyterLab
- RStudio Server**
- GUIs
- ANSYS Workbench
- Abaqus
- MATLAB
- ParaView
- Stata
- Servers
- Code Server

RStudio Server version: f786dfc
This app will launch **RStudio Server** an IDE for **R** on the **BlueBEAR** cluster.

BEAR Project

ghumraak-rescomp-engagement

Please select the BEAR Project to which the job will be attached to.

Number of hours

1

Queue

bbdefault

- Please select the Queue/QoS where your job will run. If you have multiple BEAR projects, only some of them may have access to the resources listed.
- **bbdefault (1-40 cores)** Use any available standard BlueBEAR node. This reduces the wait time as there are no node requirements.

Number of cores

1

Number of cores on node type (4 GB per core unless requesting whole node).

R version

3.6.2

This defines the version of R you want to load.

Include Bioconductor?
Should the **Bioconductor** module be included in the R environment.

Include Cellassign?
Should the **Cellassign** module be included in the R environment.

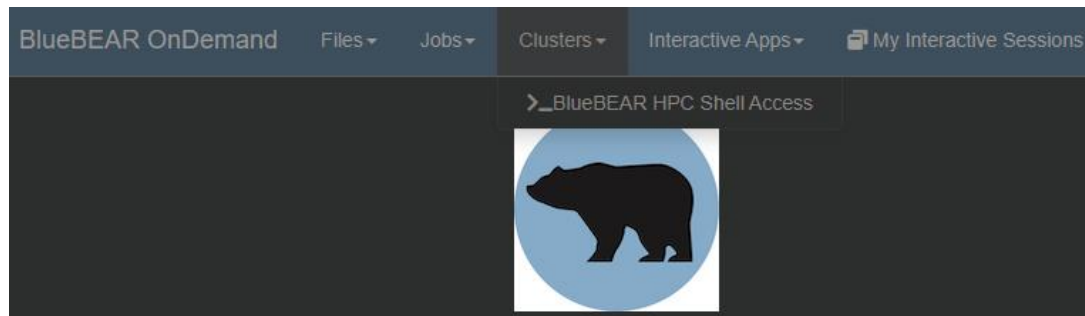
I would like to receive an email when the session starts

Launch



Logging in

- ❑ Log in to the VPN if off-campus
- ❑ Go to <https://portal.bear.bham.ac.uk/>
- ❑ Log in with your normal UoB username/password
- ❑ Click Clusters, >_BlueBEAR HPC Shell Access
- ❑ The command line will appear



<https://docs.bear.bham.ac.uk/portal/accessing/>



Logging in via SSH

□ **Windows:**

via command line interface - SSH (Secure Shell) client (e.g. PuTTY, MobaXterm)

□ **Mac:**

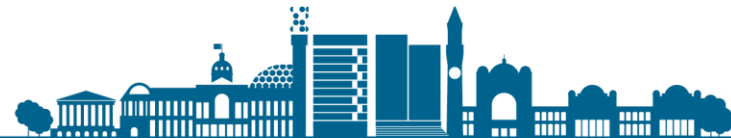
Open iTerm or Terminal

– Finder window – Applications>Utilities

□ **Connect to BlueBEAR:**

```
ssh <username>@bluebear.bham.ac.uk
```

https://youtu.be/uH4fYHze_y0



Section 2 -

Creating files



The Command Line

- ❑ Type in commands
- ❑ Commands, Files and programs are Case-Sensitive
- ❑ Spaces are key – get them in the right place
- ❑ You type commands into a program called the “shell” – `bash` is the default
- ❑ Text can be copied from other sources, e.g. Notepad



Directories and files

- Unlike Windows there are no “drives” (i.e. no ‘C:\’, ‘D:\’, ‘U:\’ etc.)
- Everything exists under a directory, ‘/’, called the root directory.
- Useful directories to know:
 - ‘`/rds/homes/u/username`’ – each user usually has a directory here with their own files in it, known as their ‘home directory’. 20 GB. For settings, user environment files (files that start with a dot).
 - RDS (`/rds/projects/p/project_title`)
 - Should be used for all data, job scripts, output etc.



Finding Applications

- A path is where the system looks to find programs (Not where you walk!)
`echo $PATH`
- These are already set up on BlueBEAR
- Command not found means the program isn't in your path



Creating a file - nano

- ❑ From the command prompt type `nano`
- ❑ Runs in the terminal window
- ❑ Enter text
- ❑ Commands are at the bottom of the screen –
`ctrl+letter`, e.g. `ctrl+w` to find (“Where
Is”), `ctrl+x` to exit
- ❑ `ctrl+o` to save (“WriteOut”), enter a file
name, press enter
- ❑ Alphanumeric filenames



Section 3 – Commands



Basic file commands:

- `ls`

list files

(don't delete
ones starting with . !)

- `ls -l`

list files with detail

- `cd`

change directory

- `pwd`

print current (working) directory

```
carterdj@trainingvm-ghumraak-bear-training:~/testing
login as: carterdj
carterdj@172.31.11.62's password:
Last login: Sun Mar  4 12:39:41 2018 from f5vpn-staff-snat.bham.ac.uk
Welcome to training VM!
You will learn to use Linux here.
[carterdj@trainingvm-ghumraak-bear-training ~]$ ls
ls.output  script  simple_script  testfile.txt  testing  welcome
[carterdj@trainingvm-ghumraak-bear-training ~]$ cd testing
[carterdj@trainingvm-ghumraak-bear-training testing]$ ls
bearcloud  bluebear  README  storage  test1
[carterdj@trainingvm-ghumraak-bear-training testing]$ pwd
/rds/homes/c/carterdj/testing
[carterdj@trainingvm-ghumraak-bear-training testing]$
```



Basic file commands:

```
[carterdj@trainingvm-ghumraak-bear-training testing]$ ls
bearcloud bluebear README storage test1
[carterdj@trainingvm-ghumraak-bear-training testing]$ cat README

Welcome to the Introduction to Linux course!

This course is designed to give you the basic Linux knowledge to use BlueBEAR and
prepare you for the Bear Necessities training course.
I hope you will find the course useful. Please log a call with the ServiceDesk if
you have any queries.

Debbie
BEAR Team
[carterdj@trainingvm-ghumraak-bear-training testing]$
```

□ Basic file commands:

`cat filename`

view the contents of a file, better for smaller files

`head filename`

watch the start of file as it grows

`tail -f filename`

watch the end of file as it grows



Command syntax

- Commands are used to tell the computer what you want it to do, e.g.
 ls [option(s)] [file(s)]
- Use the manual (man) or Google to see options

Command	Options	Arguments
What you want to do	Information that alters the behaviour of the command	File name or other data that is needed by the command
ls	-l	filename

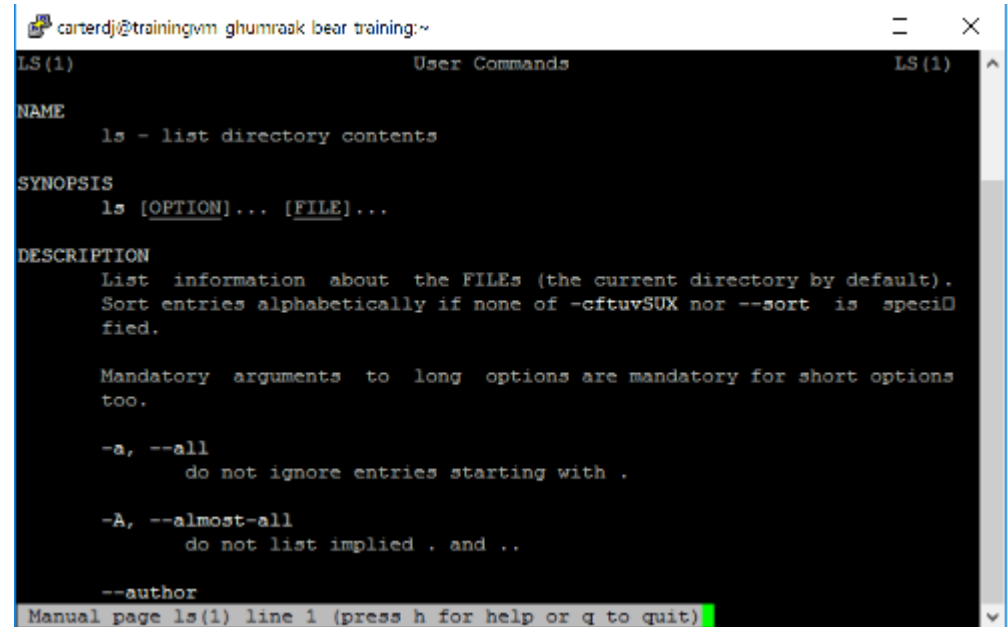


Help? How do I use this command?

- Each command *should* have a manual page for it.
 - To view it type `man command`, e.g. to view the manual for the `man` command type:

```
man man
```

- Press `q` to quit, use the arrow keys to scroll



```
carterdj@trainingvm ghumraak bear training:~
LS(1) User Commands LS(1)
NAME
  ls - list directory contents
SYNOPSIS
  ls [OPTION]... [FILE]...
DESCRIPTION
  List information about the FILES (the current directory by default).
  Sort entries alphabetically if none of -cftuvSUX nor --sort is speciD
  fied.

  Mandatory arguments to long options are mandatory for short options
  too.

  -a, --all
      do not ignore entries starting with .
  -A, --almost-all
      do not list implied . and ..

  --author
Manual page ls(1) line 1 (press h for help or q to quit)
```



Tips and tricks on the command line

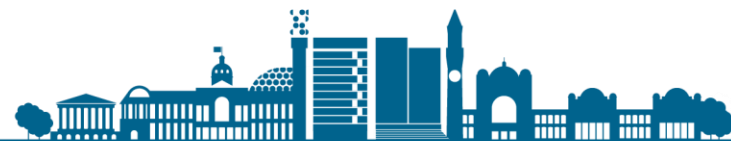
- ❑ Press the **up arrow** and you will see your previous commands, so can use them again
- ❑ Type `history` at the command prompt and you will see the history of what you have typed and re-run commands
- ❑ The '**tab**' key is magic, pressing it:
 - once: complete the current command or filename if there is one match
 - twice: list all the matching options if there is more than one match
- ❑ `CTRL+c` or `q` will return you to the command (\$) prompt
- ❑ `cd ~` returns to home directory
- ❑ `clear` clears screen and returns to \$ prompt
- ❑ to **paste text into PuTTY**, copy it from the source location, then right click in PuTTY and the text will be pasted, or use `CTRL+v`



File management:

- Basic directory management commands:
 - `mkdir newdirectory`
create directory
 - `rmdir directory`
remove directory (only works if directory is empty). Note there is no warning/confirmation message!

```
[carterdj@trainingvm-ghumraak-bear-training ~]$ ls
ls.output  script  simple_script  testfile.txt  testing  welcome
[carterdj@trainingvm-ghumraak-bear-training ~]$ mkdir matlab
[carterdj@trainingvm-ghumraak-bear-training ~]$
```



Organising files:

- Basic file management commands:
 - `touch file`
create an empty file
 - `rm file`
remove a file (there is no recycle bin!)
 - `cp file newfile`
copy a file (creates a duplicate)
 - `mv file newfile`
move a file (renames the file)



Editing files

- If a file has been created in Windows, you can use dos2unix to make it Linux-friendly
 - Windows files use different line endings

```
dos2unix ~/filename
```

- Lots of editors under Linux
 - nano is a basic, easy to use one
 - Others – joe, vim, emacs



Editing files

□ View and edit a file:

- Check the contents of the file:

```
cat filename
```

- Edit the file in nano:

try `CTRL+k`, `CTRL+u`, `CTRL+w` to
see what they do



A useful tool

□ **grep string filename** –

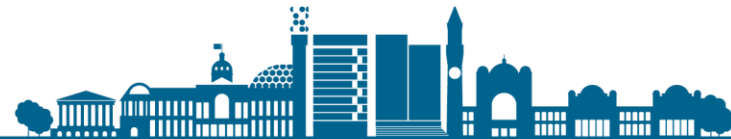
to search for alphanumeric or numeric characters in a specific file

- Look for number of occurrences in the file
e.g. bear

```
grep bear README
```

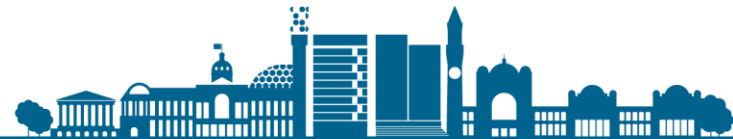
- What does

```
grep -i bear README do?
```



A cautionary tale....

How Toy Story 2 almost got deleted!



Workshop 1 – directories and files

Time: 30 minutes (including break)

□ Make sure you are in your home directory: `cd`

□ Copy some existing directories/files using this:

```
cp -r /rds/projects/c/carterdj-bear-training/testing .
```

(include the spaces as they are shown and the full stop at the end)

□ Move to testing directory – `cd testing`



Workshop 1 – directories and files

- ❑ View the example file **bearcloud** (in `testing` directory)
- ❑ Create a directory called **username_test**
- ❑ Create a file in nano or your preferred editor, add some content, save and close
- ❑ Edit the file
- ❑ List your files
- ❑ View the contents of the file(s) you created
- ❑ Advanced exercises – in Canvas



Section 4 –

File permissions

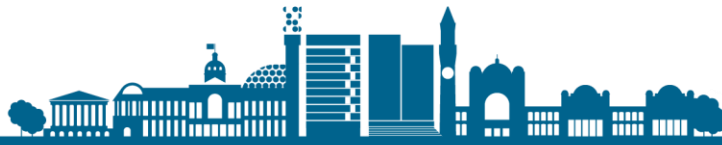
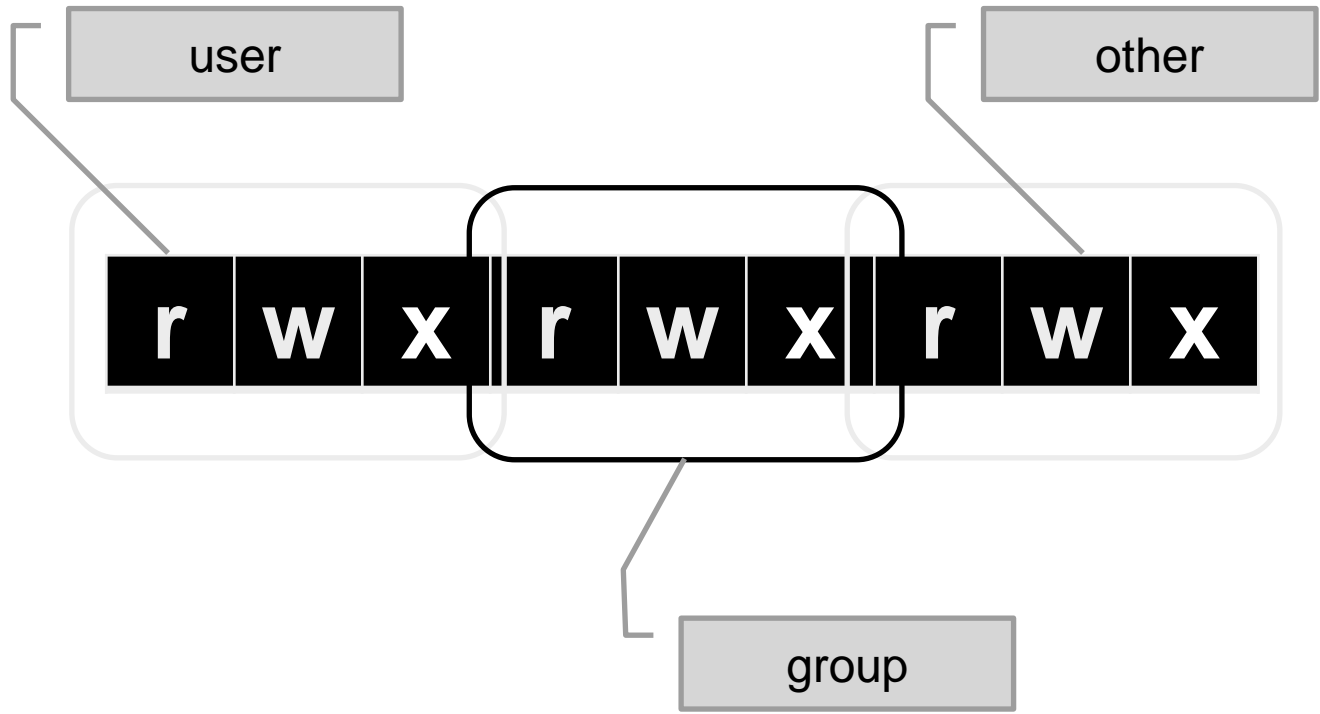


File permissions:

- Files (and directories) can have different permission sets for groups and users

Files	Directory
r – read the file	r – list contents of directory
w – write to the file	w – create new files/folders
x – execute (run)	x – traverse (e.g. cd to directory)





Example file permissions:

- Try doing
`ls -ld ~/`
- The command (`ls -l`) shows permissions on home directory

Permissions	Size of file	File or directory name
drwxr-xr-x	2	ghumraak users
d---r-xr-x	2	ghumraak users
-rw-r--r--	1	ghumraak users
drwxr-xr-x	6	ghumraak users
-rwxr--r--	1	ghumraak users
drwxr-xr-x	2	ghumraak users
-rwxr--r--	1	ghumraak users
-rwxr--r--	1	ghumraak users
-rwxr--r--	1	ghumraak users
-rw-r--r--	1	ghumraak users

4096	Nov 8 12:22	bearwiki
4096	Jan 4 2016	Documentation
83	Nov 12 15:42	file1
16384	Jan 30 2016	jre1.8.0_73
71759339	Feb 23 2016	jre-8u73-linux-x64.gz
4096	Nov 16 08:38	matlab
482322	Jun 9 2015	Research Data Storage v1.4.docx
14	Jul 21 2015	test-01.txt
0	Aug 20 2015	test-02.txt
58	Nov 12 14:20	test.sh

Username / Group

Date



Scripts

- Allow series of commands to be repeated
- Can pass arguments in, use variables etc.
- Need to be “executable” to run from command line
- First line shows the “interpreter” (or shell) to use, e.g.

```
#!/bin/bash
```
- Objective is to get it to run!



Scripts

1. Use a text editor, e.g. nano to create a new script file:
 - Set the shell in the first line `#!/bin/bash`
 - Use the echo command to print some text on screen eg. `echo "Hello Linux world"`
 - Save the file
2. Make it executable (`chmod`) – to get the right permissions to run it – e.g. `chmod u+x scriptname`
3. Run the script
`./scriptname`



Workshop 2 – writing a program, running a script

Time: 20 minutes

```
cd /rds/projects/c/carterdj-bear-training/
```

- View the example program **simple_script**
- Return to home directory `cd ~`
- Write a basic program to say “Hello ‘[your name]’, welcome to the Introduction to Linux workshop”
- Run the program
- Look at file permissions for the program



Example script

```
#!/bin/bash
```

```
read -p 'Enter Your Name:' name  
echo "Hello $name, Welcome to the  
Introduction to Linux workshop"
```



Learning Outcomes

- ❑ To set up your computer for accessing BlueBEAR
- ❑ To log in to BlueBEAR
- ❑ To create and manage directories and files
- ❑ Understand and use some basic Linux commands
- ❑ To know how to create a job script
- ❑ To set permissions on a script to be able to run it





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Section 5 -

Other BEAR services and further information



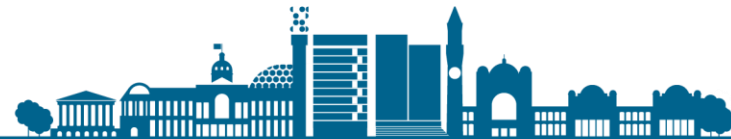
Next steps – further Linux

- ❑ Online resources - LinkedIn Learning Linux:
 1. <https://www.w3resource.com/linux-system-administration/linux-commands-introduction.php>

- ❑ Software Carpentries Linux course:
<https://bham-carpentries.github.io/shell-novice/>

- ❑ Introduction to BlueBEAR:
<https://www.birmingham.ac.uk/research/arc/bear/training/necessities>

- ❑ BEAR Training Page:
<https://www.birmingham.ac.uk/bear-training>



Other BEAR Services

- ❑ **Research Data Store (RDS):** FREE storage for research projects (up to 3TB per project)
- ❑ **BEAR Data Transfer:** Ability to share and receive large amounts of data
- ❑ **BEAR GitLab:** version control
- ❑ **BEAR Software:** free advice/help from BEAR Research Software Engineers & Data Scientists
- ❑ **Training:** Software Carpentry – Python, R, MATLAB, Git; NVIDIA, C++
- ❑ ... and more at <https://www.birmingham.ac.uk/research/arc/bear>



Special Interest Groups

- SIGs for (currently):
 - Computational Fluid Dynamics (CFD)
 - MATLAB
 - Materials Simulation and Modelling
 - Coding Club
 - We don't byte – student coding club
 - RSE Midlands

<https://intranet.birmingham.ac.uk/it/teams/infrastructure/research/bear/usergroups/index.aspx>



Help is available

If you're having any problems visit the IT Service Desk in a web browser:

<https://universityofbirmingham.service-now.com/>

Canvas course – self-register –

<https://canvas.bham.ac.uk/enroll/6MPPJW>

Regular drop-in sessions –

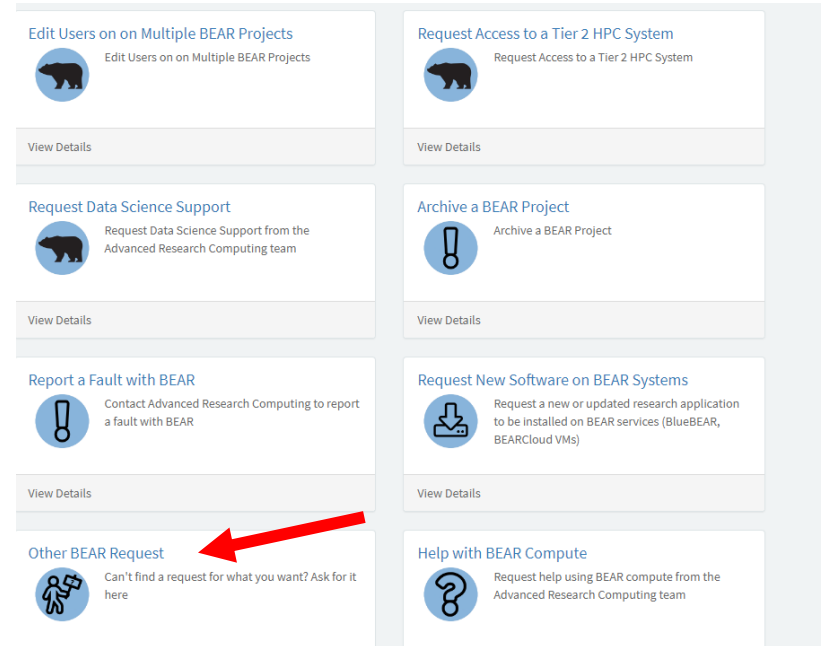
<https://www.birmingham.ac.uk/bear-drop-in>

BEAR Docs –









<https://docs.bear.bham.ac.uk/>

Join our mailing list –

Email bearinfo@contacts.bham.ac.uk



The screenshot displays a grid of help center tiles. Each tile includes an icon, a title, a brief description, and a 'View Details' link. A red arrow points to the 'Other BEAR Request' tile.

 Edit Users on on Multiple BEAR Projects Edit Users on on Multiple BEAR Projects View Details	 Request Access to a Tier 2 HPC System Request Access to a Tier 2 HPC System View Details
 Request Data Science Support Request Data Science Support from the Advanced Research Computing team View Details	 Archive a BEAR Project Archive a BEAR Project View Details
 Report a Fault with BEAR Contact Advanced Research Computing to report a fault with BEAR View Details	 Request New Software on BEAR Systems Request a new or updated research application to be installed on BEAR services (BlueBEAR, BEARCloud VMs) View Details
 Other BEAR Request Can't find a request for what you want? Ask for it here	 Help with BEAR Compute Request help using BEAR compute from the Advanced Research Computing team



Questions?

