HEP Computing
Part I
Very short intro to UNIX/LINUX
Marcella Bona

Lectures 1

© Adrian Bevan

Queen Mary University of London

m.bona@qmul.ac.uk

Lecture 1

- Recap simple UNIX commands for manipulation of files and directories.
- Communicating with remote machines
- Text Editing
- `sed` and `awk`
- Environment variables and aliases
- Archiving files

Some useful commands

ls <dir>	list the content of a directory
cd <dir>	change directory to the specified one
mkdir <–p> <dir>	make a new directory (–p makes missing parents)
cp <file> <newfile>	make a copy of a file
mv <file name> <new file name>	rename a file
tail <file>	look at the end of a file
head <file>	look at the start of a file
cat <file>	show the file from start to finish on the terminal
more <file>	file viewer
less <file>	file viewer (more versatile than more)
sleep <nSeconds>	sleep for a number of seconds before continuing
gzip <file>	zip a file up
tar cvf somefile.tar <directory>	make a tar file (archive files or directory trees)
tar xvf somefile.tar	unpack a tar file
tar cvzf somefile.tgz <directory>	make a tar file and zip it up in one go
tar xvzf somefile.tgz	unpack a zipped tar file

Looking at the content of a file

```
cat .bash_profile          # print the file to the screen
head .bash_profile         # print the first 10 lines
head -20 .bash_profile     # print first 20 lines
tail .bash_profile         # print last 10 lines
tail -30 .bash_profile     # print last 30 lines
more .bash_profile         # use more to look at the file
less .bash_profile         # use less to look at the file
```

N.B. use 'q' in more or less to quit and return to the command prompt

→ in less you can use the up and down arrows to move through the file

→ / followed by a string entered into less will search for that string

→ ? followed by a string entered into less will search *backwards* for that string

Communicating between different machines

Some group machines may use telnet and ftp for communication (login and copy).

```
> telnet somemachine.somedomain
> telnet MyComputer.MyUni.ac.uk

> ftp somemachine.somedomain
> ftp MyComputer.MyUni.ac.uk
```

ftp is generally discouraged.
It's a good idea not to use it!

Almost all machines you will encounter will not use these programs.
Instead you need to use ssh/scp to login or copy a file to a new machine.

```
> ssh <options> somemachine.somedomain
> ssh MyComputer.MyUni.ac.uk

> scp <options> <source> <target>
> scp test.eps MyComputer.MyUni.ac.uk:./myEpsFiles/
```

Local File | Remote Host | file path on remote host

where <options> are command line options that you can type in if you want to.
[N.B. the angled brackets are not to be input but indicate that this is an option]

Logon and copy examples:

Example of using ssh to log into a machine

```
> ssh -l username hostname.MyUni.ac.uk
> ssh username@hostname.MyUni.ac.uk
> ssh hostname.MyUni.ac.uk
```

Equivalent forms of using the command. N.B. if you don't specify the username it will be assumed that you want to use your for the connection.

Example of using scp

```
> scp test.ps username@hostname:./public_html/
```

copy a single file to a subdirectory on another machine

```
> scp -r test-dir username@hostname:./public_html/
```

recursively copy a directory to another machine

So why do/should you care?

→ most … if not all … of your work will be done at remote machines

Text editing

As soon as you want to start to do analysis/write reports etc … you need to edit files. There is nothing like word available for editing code so you have to learn how to use a text editor.

Some UNIX Text Editors:

(x)emacs nice gui/text based editor – most people use this

vi very useful for sysadmin/minimal system work

pico, vim, …

EMACS:

to start emacs:

&=run in background

> emacs <somefile> & to start a gui emacs session

> emacs –nw <somefile> to start a text session within your terminal

Useful resources can be found:

GNU's online manual

http://www.gnu.org/manual/manual.html

man pages give a summary of information

emacs help → enter this by opening emacs and pressing F1 twice

Some emacs

Aside: On mac OS you need to replace Alt with Esc

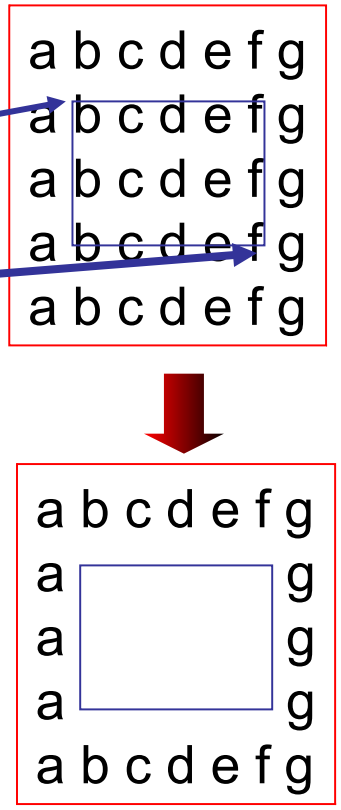
Some of the emacs commands you should know:

[ctrl-x]+[ctrl-f]	open a file
[ctrl-x]+i	insert a file
[ctrl-x]+[ctrl-s]	save a file
[ctrl-x]+[ctrl-c]	close emacs
[alt-x]+ispell-buffer	run ispell from emacs
[alt-x]+spell-region	run ispell from emacs
[alt-x]+goto-line	go to line #
[ctrl-x]+(	start defn. of a macro
[ctrl-x]+)	close dfn of a macro
[ctrl-x]+e	execute a macro
[ctrl-x]+u#	repeat next command # times
[alt-x]+query-replace	replace string with another one

Some more emacs

e.g. of editing a region

[ctrl-space]	mark the start of a region
[ctrl-w]	kill it
[ctrl-x]+r+s	copy it
[ctrl-x]+r+k	mark the end of a region and kill it
[ctrl-y]	paste



There are MANY more commands available
these are just the ones that I use most often

sed and awk

These are command line text editing utilities to help process information involving replacement of strings/extracting columns of text from files etc.

Some useful examples:

```
sed -e 's/A/B/' <filename>
```
substitute A for B in 1st instance on line in the whole file

```
sed -e 's/A/B/g' <filename>
```
substitute A for B in whole file

```
awk  '{print $1}' <filename>
```
print the first column of file [space separator used by default]

```
awk -F'=' '{print $1}'<filename>
```
use the '=' character as a separator

```
awk '{s+=$1}END{print "sum = " s}' <filename>
```
add up the numbers in the first column

Look at the GNU manuals for gawk & search on google for awk/sed

O'Reilly "sed & awk" is a good book to read

Some simple examples

```
sed 's/the/THE/g' test.txt
```
replace ‘the’ with ‘THE’

```
sed 's/the/THE/' test.txt
```
replace the first ‘the’ per line with ‘THE’

```
awk '{print $1}' test.txt
```
print the first word on each line

```
echo "hello world" | sed 's/world/universe/'
```
substitute `world` for `universe` in print out

sed and awk can do a lot more than shown here …
see extra material for a few ideas

Some more UNIX command line examples

```
grep <string> test.txt > myStringFile
```

search for `<string>` in the file and
redirect the output to a file called `myStringFile`

```
./myBin >& myBin.log &
 tail -f myBin.log
```

run the binary – writing to a log file (passing stdout and stderr to that log file) and then follow the tail of the log file as it gets written out

```
cat file2 >> file1
```

append the content of `file2`
at the end of `file1`

```
export MYVAR=val; ./mmyBin >& mylog &; tail -f mylog
```

do several things on one line

```
ls /usr/local/bin/?v*
```

e.g. pattern a search for binaries with
a single character followed
by a '`v`' and finishing with anything else.

Some more commands

check how much free space you have left on an **afs** file system

```
[somehost] ~ > fs lq
Volume Name           Quota      Used %Used   Partition
u.bona               500000    454441   91%<<       68%    <<WARNING
```

`rm <aFile>`

to remove the file aFile. Deleting a file on LINUX/UNIX means that it has gone!

now you've seen the rm command, you know how to delete things

→ you might want to use the following until you get more confident

`rm -i <aFile>`

- Note that the work areas you have and use are generally not backed up.

- if you have something that is important (e.g. thesis) you should ask how to make back up copies on a regular basis (if you don't know how to do it) so that you don't loose everything if you accidentally delete the original or a hardware failure looses the disk etc.

see *rsync*

- At outside labs there is usually a copy of your home area backed up once a day: check if this exists and if the backup it suits your needs.

Environment Variables

There are many so called environment variables set in a shell.
To list these type

`printenv`	tcsh/sh
`env`	tcsh/sh

The most important one is:

PATH — set the search path for commands so the system knows where to look for them. This is the search path that a shell uses to find a command. If a command is not in one of the directories listed in $PATH then you have to refer to it using the full path name e.g.

/usr/bin/perl

instead of perl

How do you know if you can see a command? Use `which` to search for it. If the shell can find a command by looking through the locations in $PATH it returns the one it finds first. e.g.

```
somehost ~ > which perl
/usr/bin/perl
```

Using environment variables

to set an environment variable

```
export myVar=value
```

variable name

value

to inspect an environment variable

```
echo $PATH
```

command to print something to the screen

the value of the `PATH` environment variable is accessed by prefixing `PATH` with `$`

to delete/unset an environment variable

```
unset myVar
```

Sometimes you want to append to an existing variable, e.g. PATH. You can do this like

```
export PATH=<new path to add>:$PATH
```

- `command not found` means just that – the system can not find the command when searching the directories listed in $PATH

These examples are for sh. For the tcsh they differ slightly and I'll leave it to you to find out how to manipulate the environment variables there.

A few other useful variables are:

EDITOR	set the default text editor
PRINTER	the default printer (what lpr will try to print to unless you tell it otherwise)
PAGER	e.g. set `more` or `less` as the default pager

e.g.

```
export EDITOR=emacs
export PAGER=less
export PRINTER=oa2
```

Aliases

An alias is a command short cut that you can specify.
These usually go into your login scripts such as .cshrc/.tcshrc etc
e.g.

```
alias rm='rm -i'
alias ls='ls -F'
```

`rm -i` prompts you to confirm you want to delete something

you can see the list of aliases by typing `alias` at the command line:

```
alias clean='rm *~'
alias l.='ls -d .* --color=tty'
alias ll='ls -l --color=tty'
alias ls='ls -l'
…
```

This can be useful so that you don't have to type in the full command to ssh to an outside lab all the time, or to customize your setup as you like.

Examples

- List the environment variables already set for you.

- Check the variables EDITOR, PAGER and PRINTER.
  Are these defaults ok? if not change them: e.g. I have

```
[somehost] ~ > env | grep EDITOR
EDITOR=vi
[somehost] ~ > env | grep PAGER
PAGER=less
[somehost] ~ > env | grep PRINTER
PRINTER=oa1
```

you probably want emacs

Ask a local what the names of your printers are

- Could have just echo(ed) the variables instead.

- Make a directory called `scripts` and add this to your PATH.
  You'll use this later on.

Compressing files and directories

- You can compress files to save space. The `gzip/gunzip` commands are used to zip/unzip files. Large savings in space can be had in compressing ascii files … on the other hand sometimes binary files are packed so efficiently that you don't get any gain from using these utilities to compress those files.

  - use `ls -l` to see how big a file is
    (`ls -lh` shows the file size in Kb/Mb/Gb)
  - e.g. compressing a single file

    ```
    gzip thesis.ps
    ```

    this command will write a compressed file called `thesis.ps.gz` that should be a lot smaller than the original thesis.ps
  - you can then unzip the file by using

    ```
    gunzip thesis.ps.gz
    ```
  - This can be quite handy if you have very limited disk space (e.g. at SLAC/CERN etc)
    - what about dealing with the content of a directory tree?

Archiving files

- If you have a lot of files that you want to store you can make an archive before moving/compressing them. The most common utility you will see for this is called `tar`. The name comes from the historical origin as a Tape ARchival program.
- Other programs exist such as dd & cpio etc.
- to make an archive of the directory test

```
cd                          # return to your home directory
tar cvf test.tar test/      # make the archive file
```

- you should now have a file called test.tar in your home directory that can be compressed using gzip. To unpack the archive in a new directory

```
mkdir new-test
cd new-test
cp ~/test.tar .
tar xvf test.tar    # unpack the archive in ~/new-test
```

here the destination is the current directory

so `new-test` now contains a complete copy of the directory tree test

What did the options given to tar mean???

- c create an archive file
- v verbose (print out files added/extracted from the “tarball”)
- f file – the f option should be followed by the name of the file to create
- x extract files from the archive.

```
tar cvf test.tar test/
```

archive file to create

directory to archive

if you use the option ‘z’ when using tar, you can compress the archive at the same time as making it. e.g.

```
tar zcvf test.tgz test/
tar zxvf test.tgz
```

- So How are you supposed to know all of this for the different commands?

Man Pages

- system commands usually come with man pages
  → these are instructions on how to use the command.
  e.g. type the following to look at the ls man page

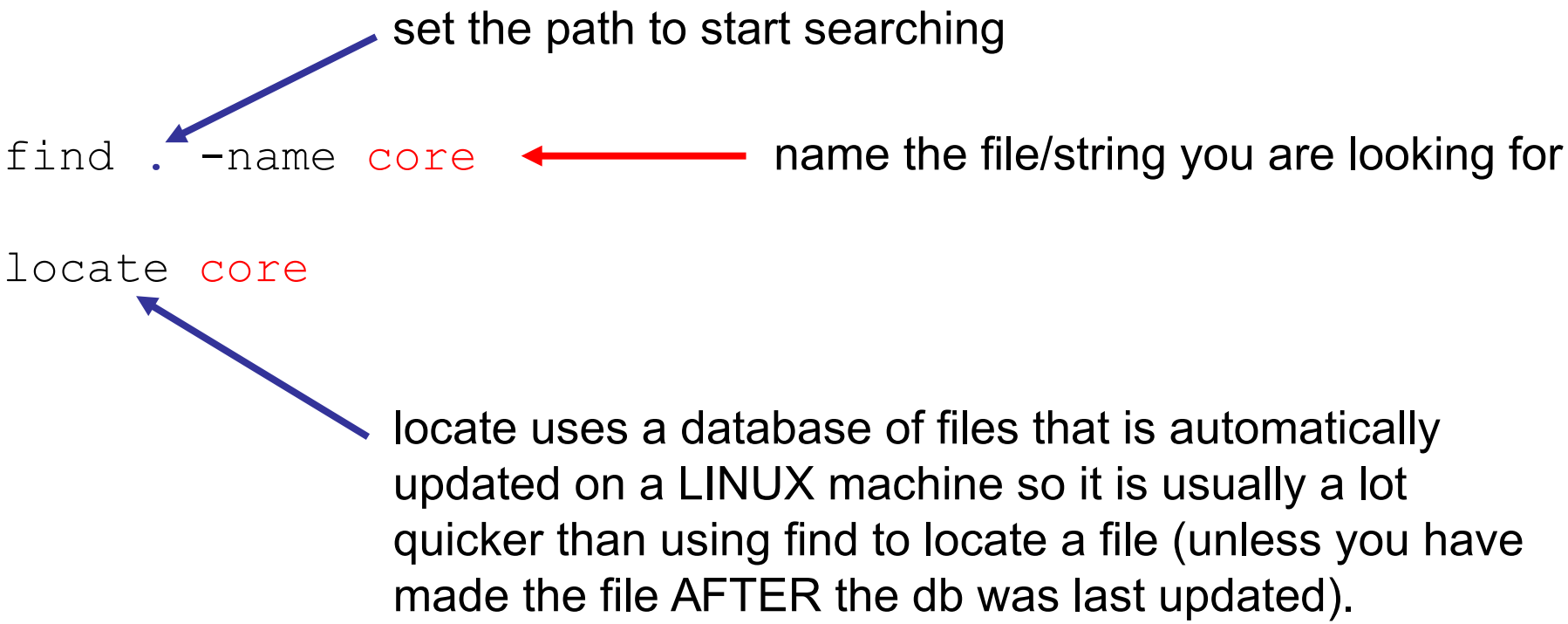
```
> man ls
```

```
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 -cftuSUX
       nor --sort.

       -a, --all
              do not hide entries starting with .

       -A, --almost-all
              do not list implied . and ..

       -b, --escape
              print octal escapes for nongraphic characters
```

If you are not sure of a command name you can always try using `man -k` followed by a search string to see if any matches might exist;
e.g. type `man -k copy`

Finding files

Sometimes you will loose track of where a particular file is. Either you are looking for something you have written, or something that you've been asked to find. There are two useful utils for tracking down files:



Exercise

1. Try following the examples on using `gzip` and tar to compress and archive the dummy directory
2. If you've not already done so, download the example tgz files and unpack these in your home directory. Look at the content of ~/Lectures for each new examples file you add.
3. Run the command

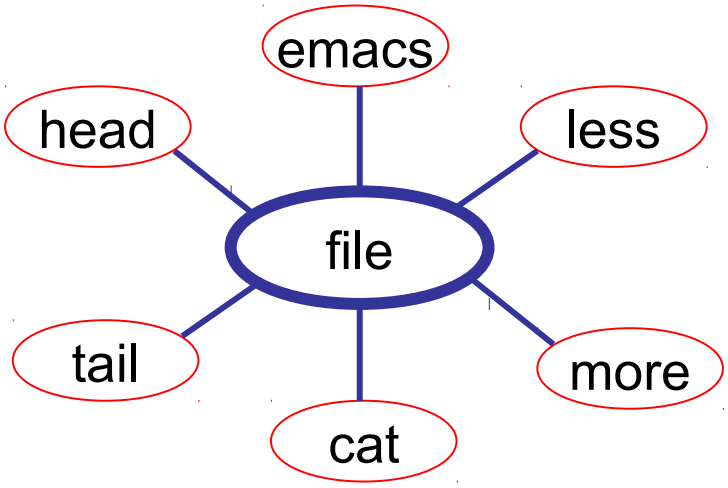
   ```
   du -sh ~/Lectures
   ```

   to see how much disk is used in total and compare this with the sum of file sizes for partN_examples.tgz that you've unpacked using `ls -lh`

   [N.B.] most of the space is taken up by root files that are already compressed so the reduction in size is not great for part3_examples.tgz.
4. Look at the man pages for some of the commands you now know.

   HINT: *the commands you know now do a lot more than you have learnt about so far. Details on the man page tell you what else they can do … sometimes the description isn't that easy to follow!*

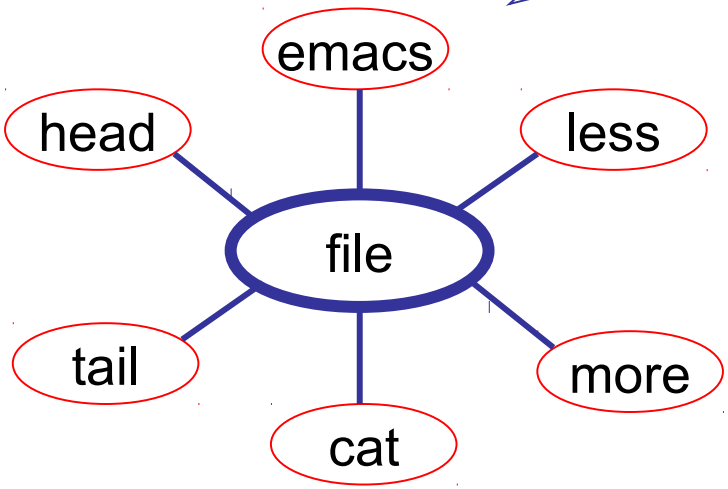
Command Relationship Summaries



Most of what you will do with computers is, in essence, manipulating information in files. These commands cover a range of ways to look at the content of files and edit them.

It's a good idea that you make yourself familiar with the behaviour of these Commands and know how to use them if you've not done so yet.

```
emacs -nw newFile.txt
```



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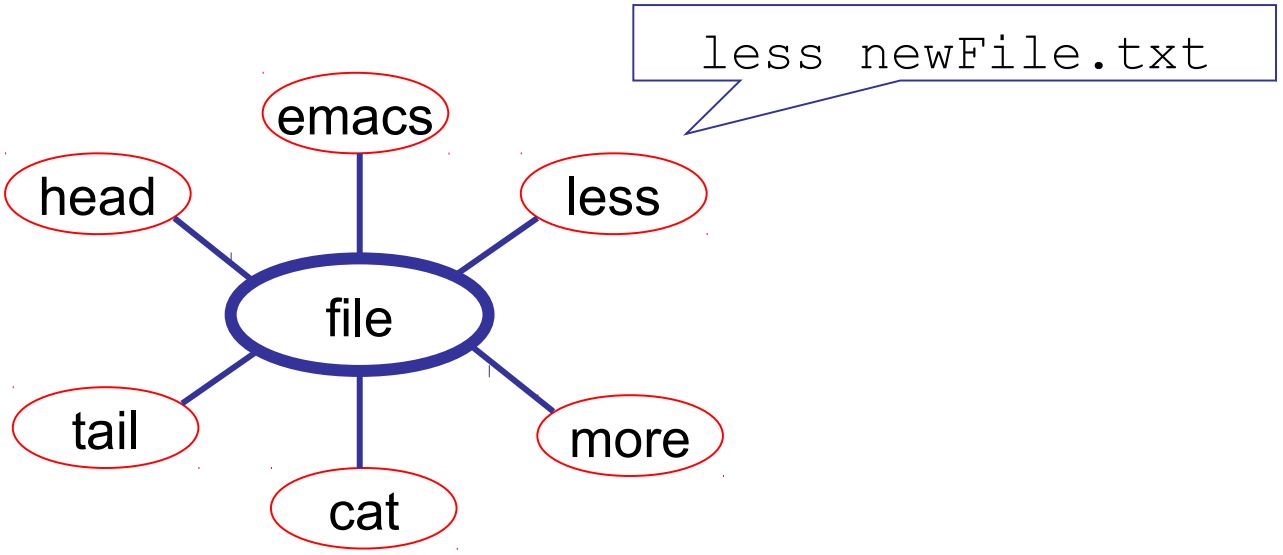

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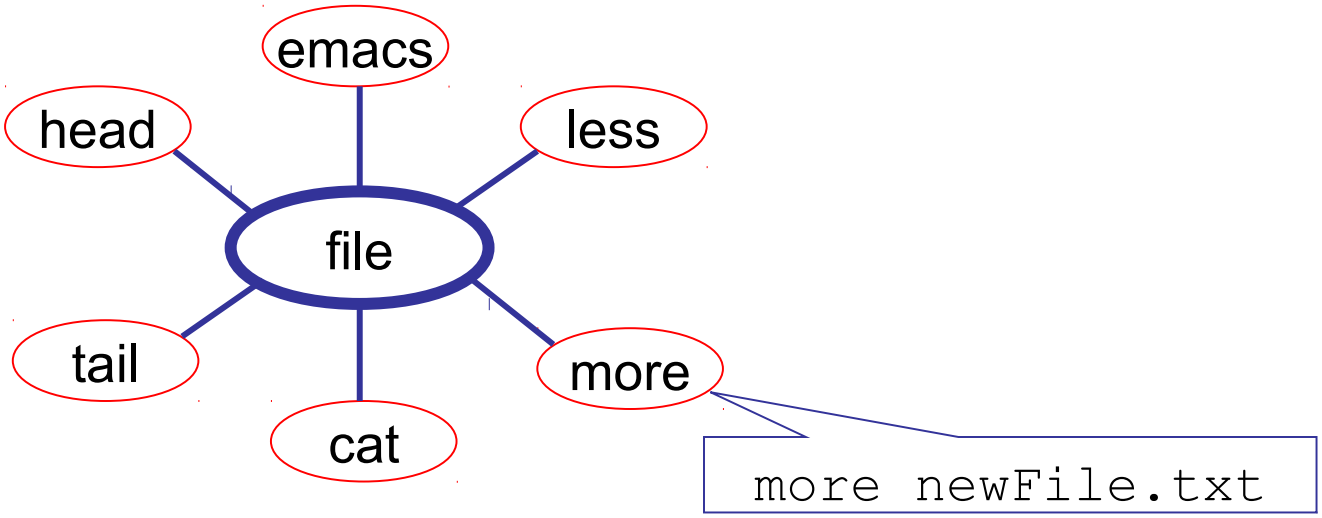

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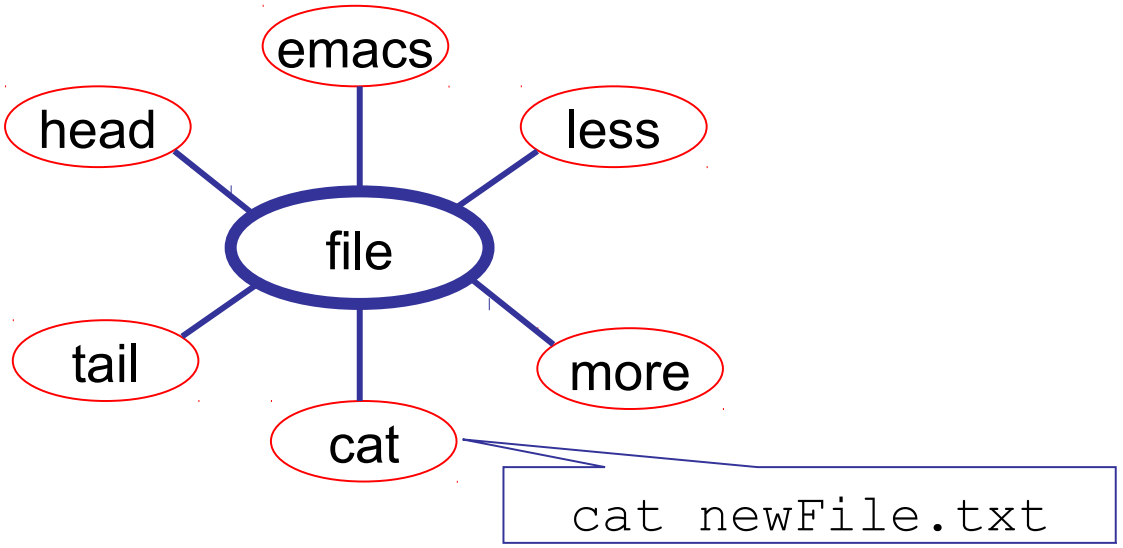

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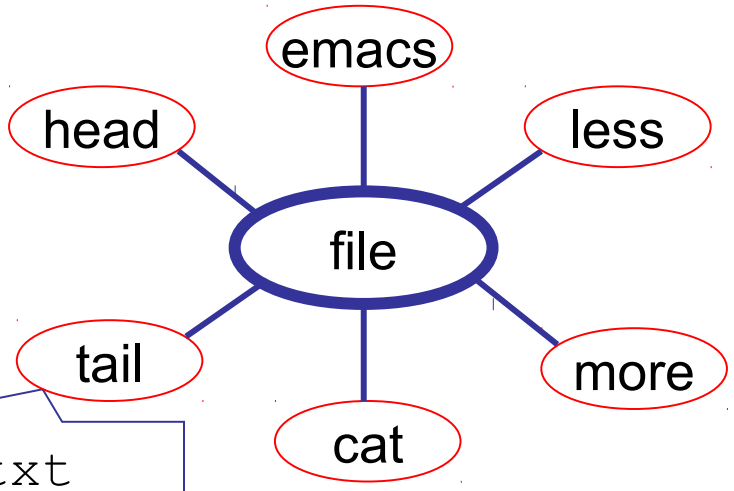


```
tail newFile.txt
tail -100 newFile.txt
```

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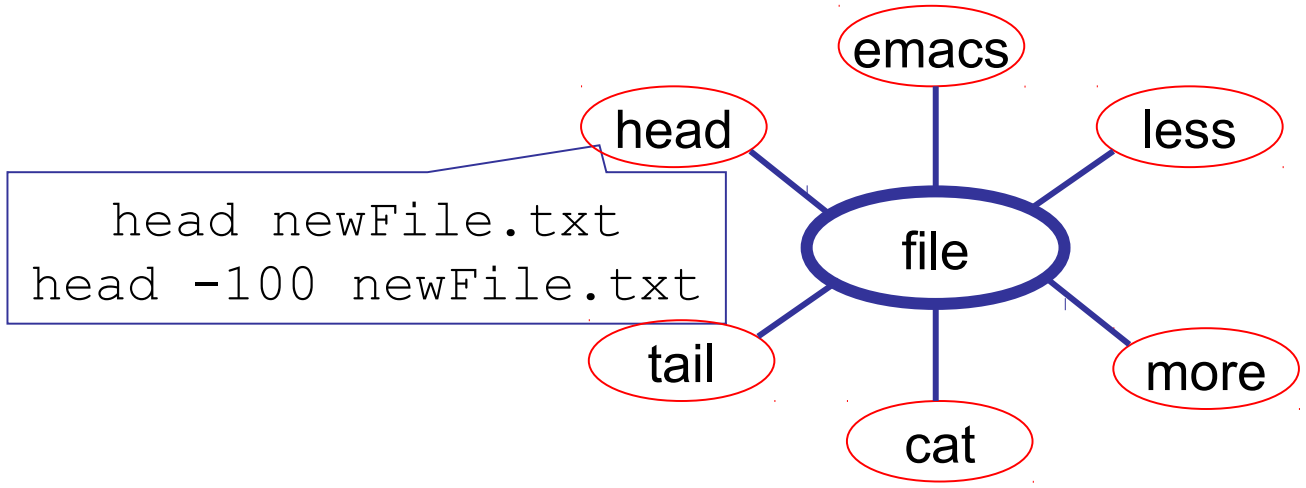

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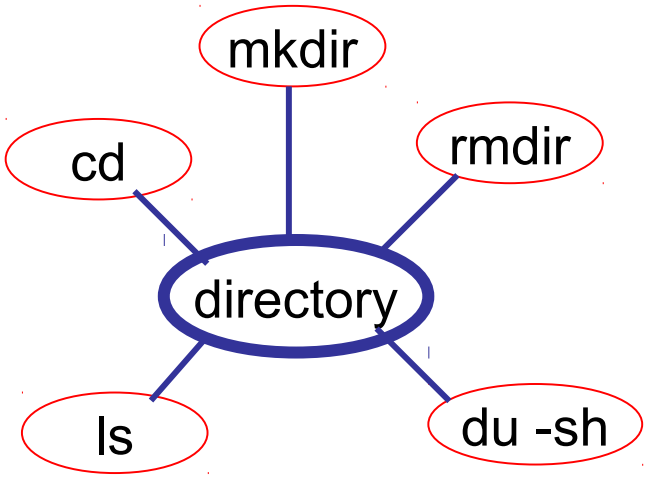
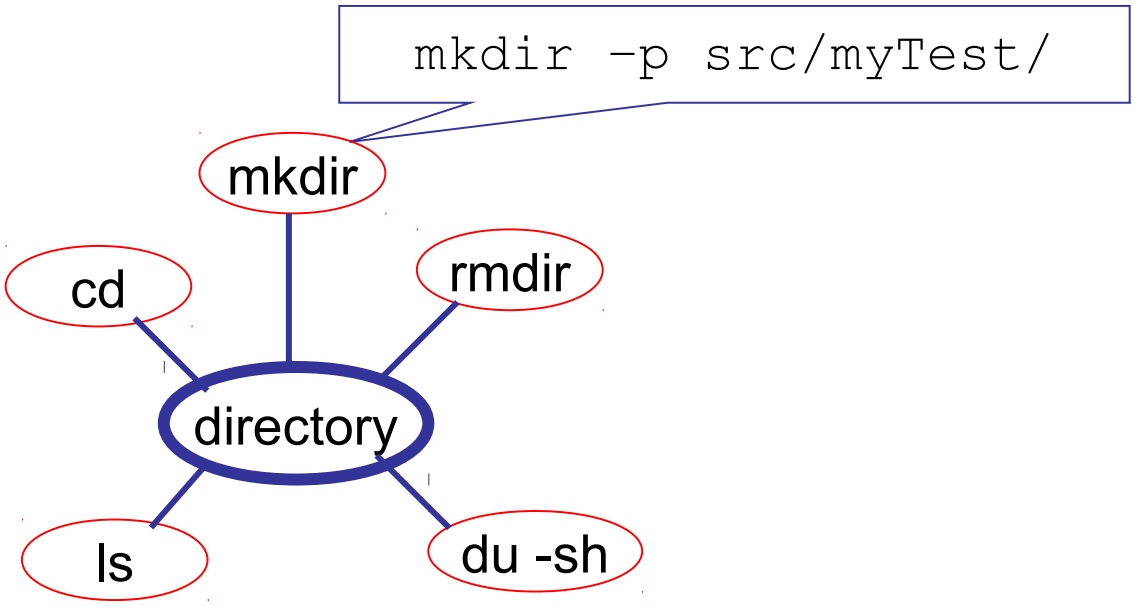


Very quickly you will see that a structured system for storing files is needed → you need sub-directories. These commands are useful to manipulate your directories.



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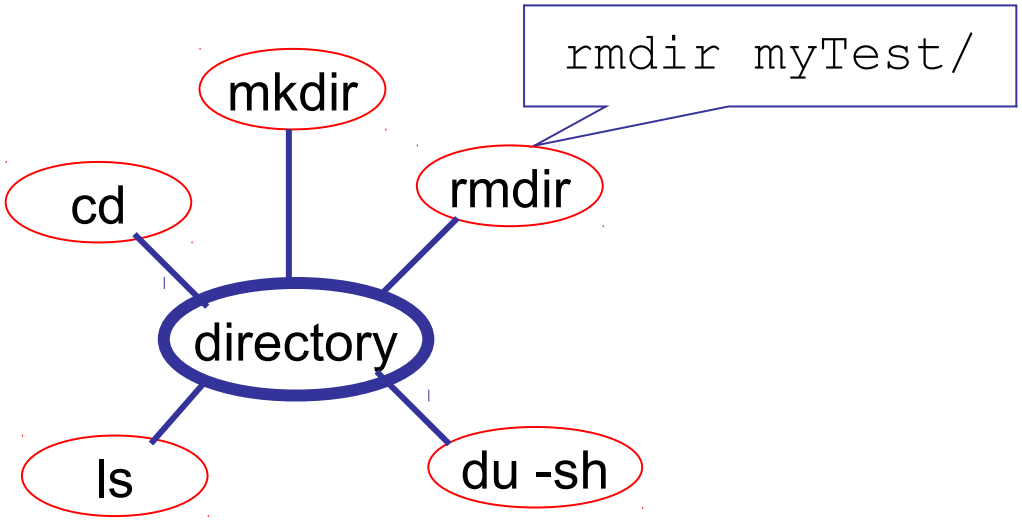

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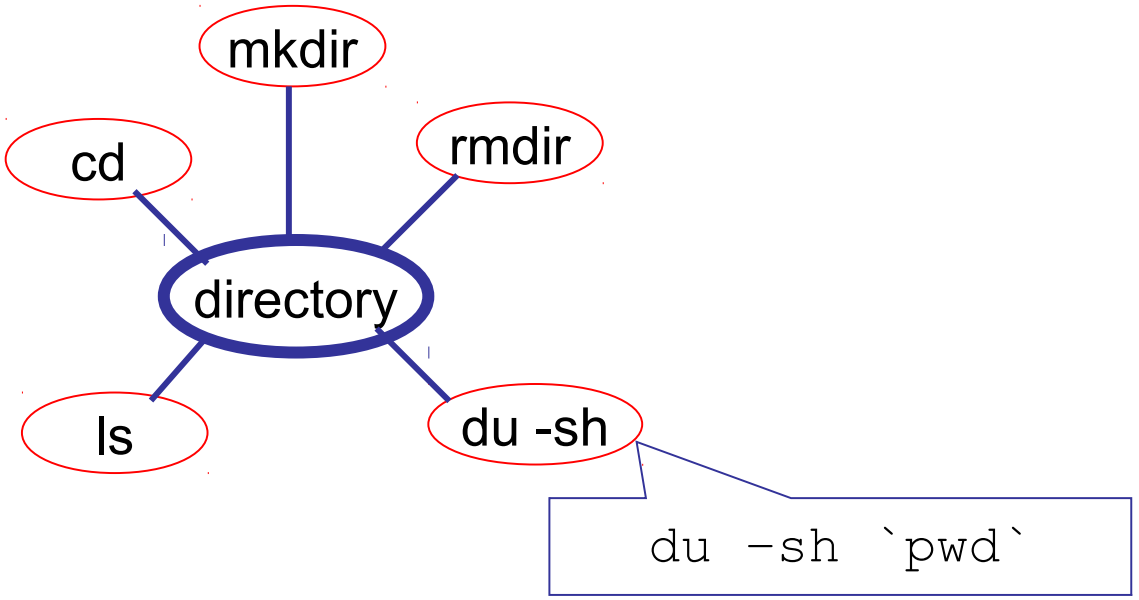

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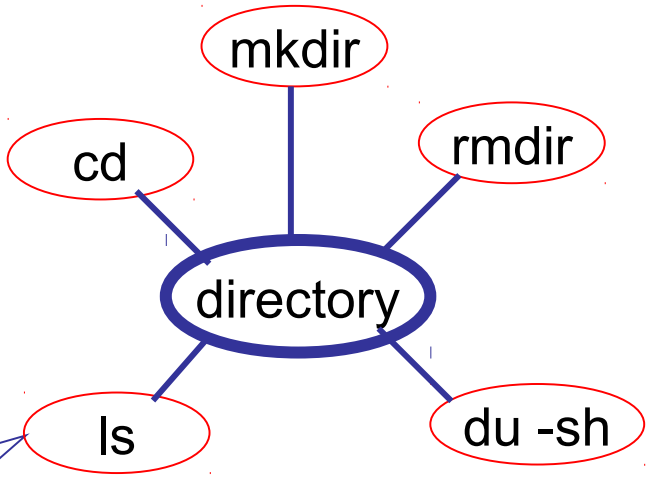


```
ls -l src/myTest/
```

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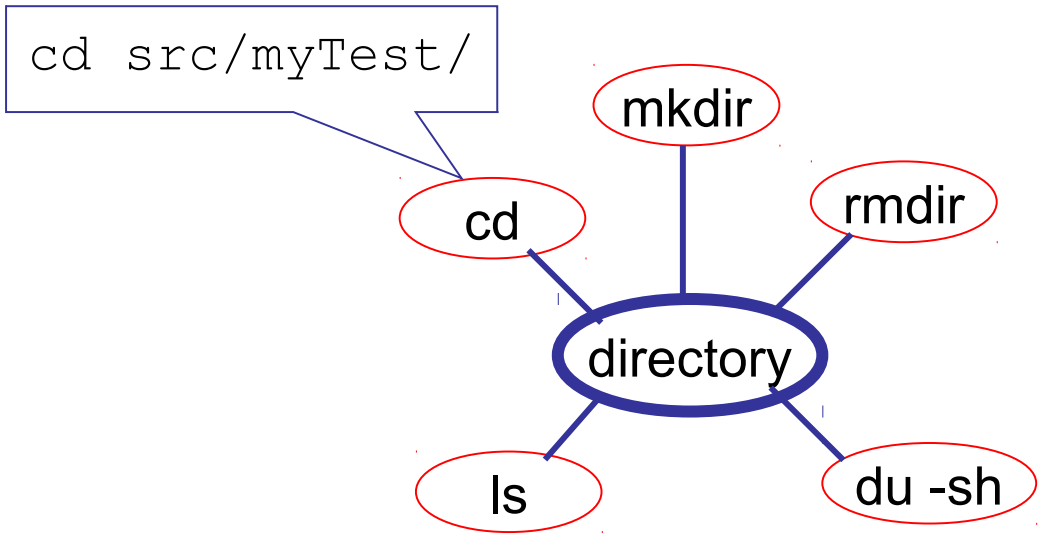

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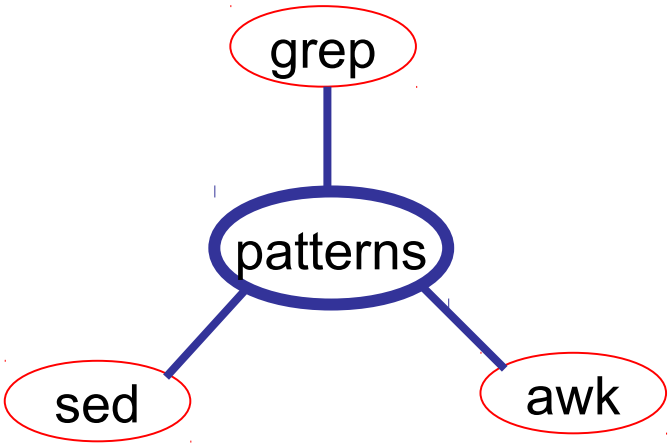
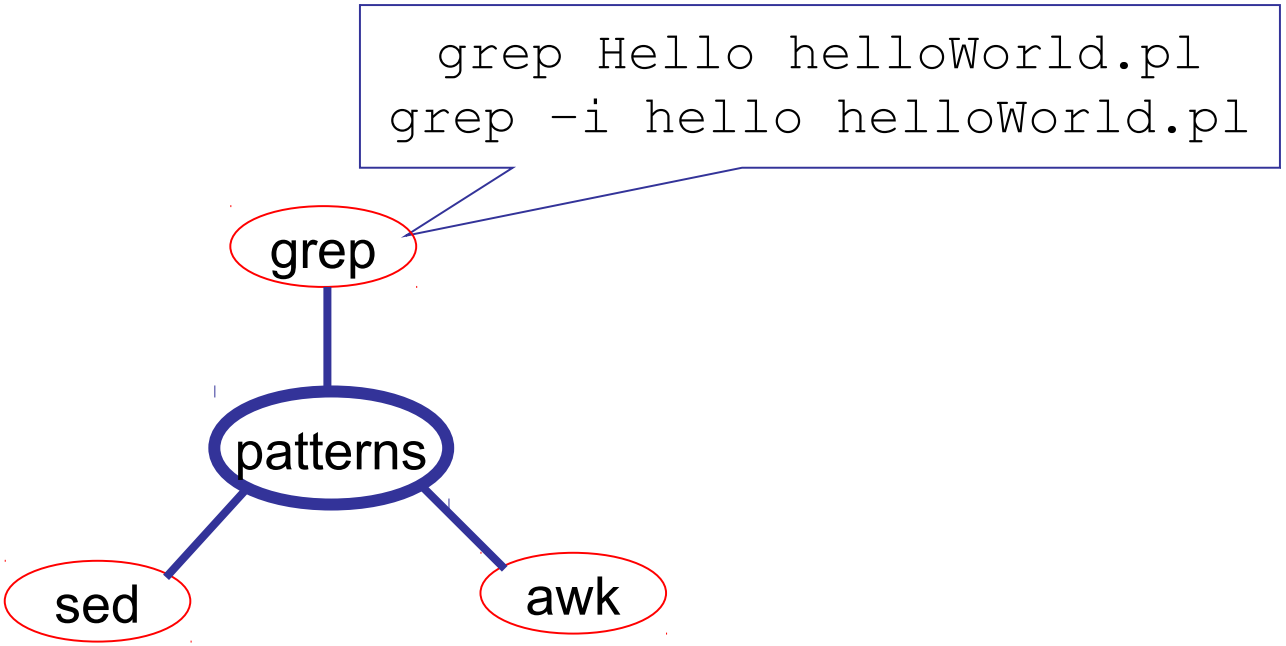
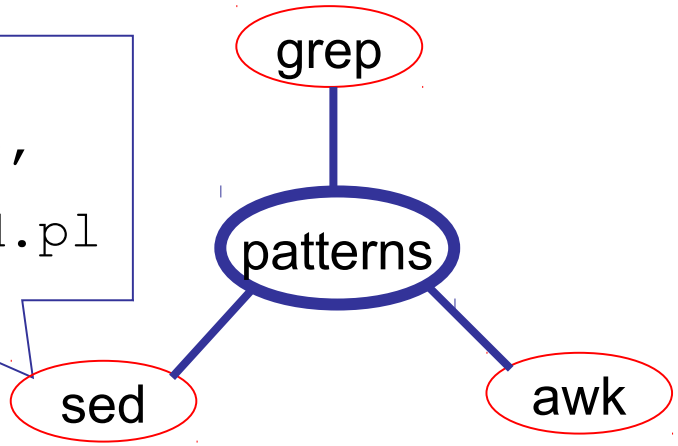


When manipulating files there will come a time when you want to look for a string or pattern, and either extract or modify it. Basic use of these commands can save enormous amounts of time with repetitive tasks.



When manipulating files there will come a time when you want to look for a string or pattern, and either extract or modify it. Basic use of these commands can save enormous amounts of time with repetitive tasks.

```
sed -e
 's/hello/HELLO/'
      helloWorld.pl
```



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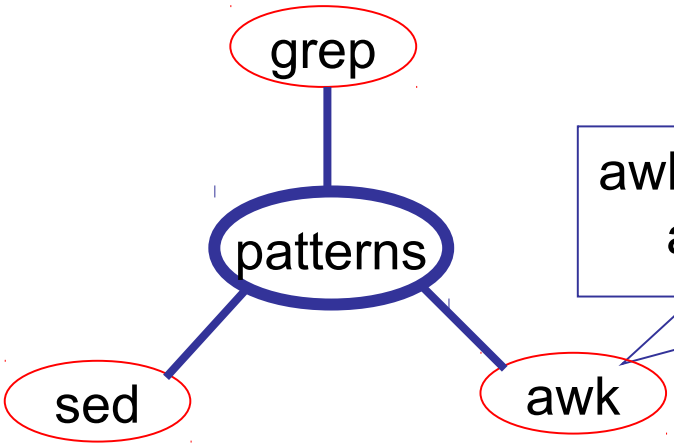


When manipulating files there will come a time when you want to look for a string or pattern, and either extract or modify it. Basic use of these commands can save enormous amounts of time with repetitive tasks.

Available Resources

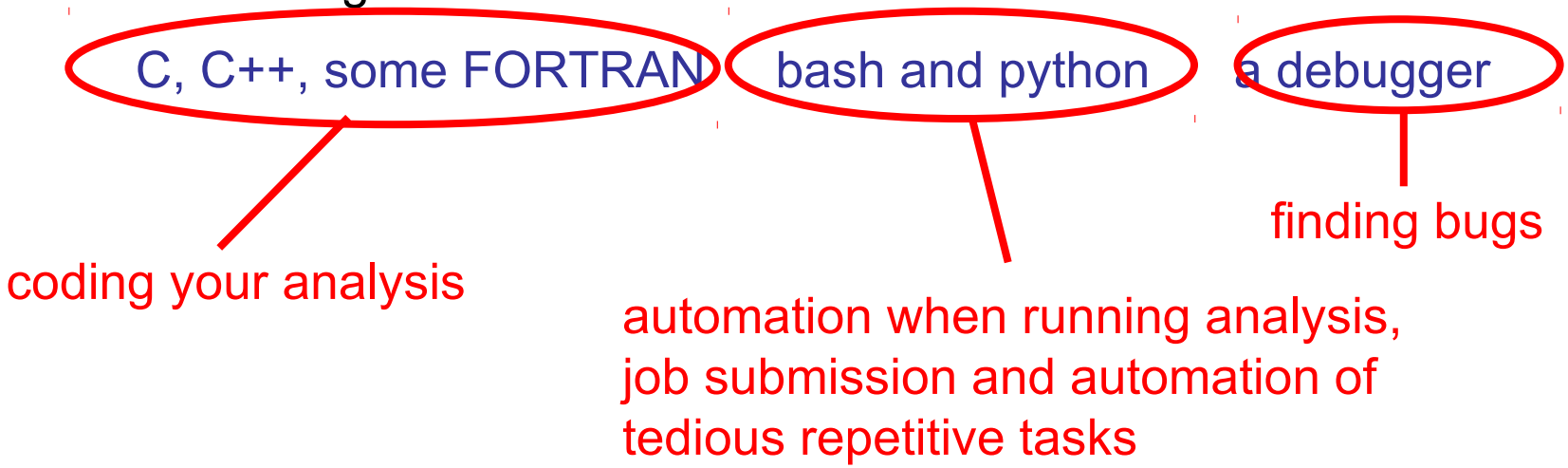
- If you are stuck with a problem there are several resources available to you:
  - collaborators in your group or on your experiment.
  - books: library, colleague's bookshelf etc.
  - web resources:
    - Google is surprisingly good in helping you find useful technical websites.
    - An alternative is cetus-links (URL on next page)

This website contains links to beginner and advanced web based resources on most programming languages you might want to use (*except FORTRAN*)

http://www.objenv.com/cetus/software.html

Code Development

Before moving on from this introduction, here is a biased opinion of what is worth knowing:



Along the way you may also learn a bit about design patterns and Object Orientated programming.

If you do, don't worry about good design to begin with just learn the syntax. When you know this then you'll start to pick up what is good and what is bad. Writing 'good code' takes a long time … so be patient and don't worry too much about making mistakes when you are learning.