Linux Basics

The following is an adaptation of the tutorial made available under the Creative Commons License from the University of Surrey (http://www.ee.surrey.ac.uk/Teaching/Unix/index.html)

Some of the screen captures might look different due to the a difference in the Operating System from which they were taken. These differences are only cosmetic and should not worry users of this tutorial.

UNIX Introduction

What is UNIX?

UNIX is an operating system which was first developed in the 1960s, and has been under constant development ever since. By operating system, we mean the suite of programs which make the computer work. It is a stable, multi-user, multi-tasking system for servers, desktops and laptops.

UNIX systems also have a graphical user interface (GUI) similar to Microsoft Windows which provides an easy to use environment. However, knowledge of UNIX is required for operations which aren't covered by a graphical program, or for when there is no windows interface available, for example, in a telnet session.

Types of UNIX

There are many different versions of UNIX, although they share common similarities. The most popular varieties of UNIX are Sun Solaris, GNU/Linux, and MacOS X.

Here in the School, we use Solaris on our servers and workstations, and Fedora Linux on the servers and desktop PCs.

The UNIX operating system

The UNIX operating system is made up of three parts; the kernel, the shell and the programs.

The kernel

The kernel of UNIX is the hub of the operating system: it allocates time and memory to programs and handles the filestore and communications in response to system calls.

As an illustration of the way that the shell and the kernel work together, suppose a user types rm myfile (which has the effect of removing the file myfile). The shell searches the filestore for the file containing the program rm, and then requests the kernel, through system calls, to execute the program rm on myfile. When the process rm myfile has finished running, the shell then returns the UNIX prompt % to the user, indicating that it is waiting for further commands.

The shell

The shell acts as an interface between the user and the kernel. When a user logs in, the login program checks the username and password, and then starts another program called the shell. The shell is a command line interpreter (CLI). It interprets the commands the user types in and arranges for them to be carried out. The commands are themselves programs: when they terminate, the shell gives the user another prompt (% on our systems).

The adept user can customise his/her own shell, and users can use different shells on the same machine. Staff and students in the school have the bash shell by default.

The bash shell has certain features to help the user inputting commands.

Filename Completion - By typing part of the name of a command, filename or directory and pressing the [Tab] key, the bash shell will complete the rest of the name automatically. If the shell finds more than one name beginning with those letters you have typed, it will beep, prompting you to type a few more letters before pressing the tab key again.

History - The shell keeps a list of the commands you have typed in. If you need to repeat a command, use the cursor keys to scroll up and down the list or type history for a list of previous commands.

Introduction to the Cheeses

Here at CHGR, the servers have traditionally been named after a type of cheese. These servers are available for use by students, faculty and staff and are capable of running jobs that might take a very long time to complete.

There are four *cheeses* in particular that users should remember. These are the machines which are provided as general purpose computing resources:

- brie
- queso
- provolone
- *romano

Romano is different from the other three machines. It has a special version of linux which allows it to run 64bit applications. It should also run non-64bit software just fine.

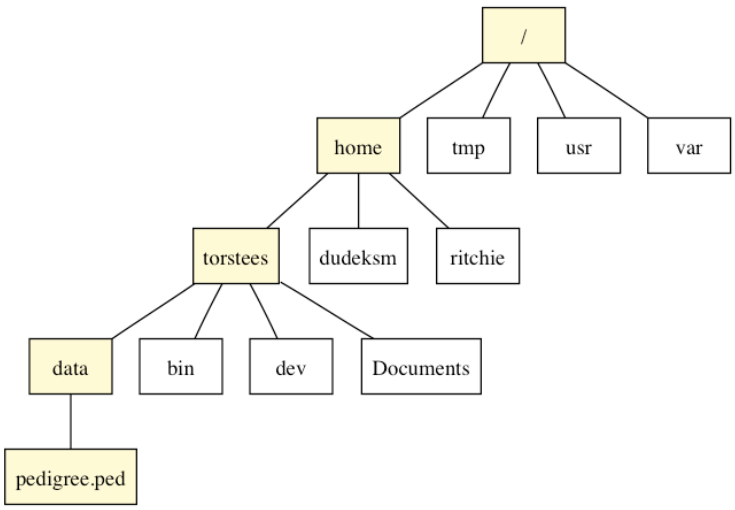
When connecting to a Unix/Linux machine, the user should use one of the servers listed above. There are other cheeses available on the network, but these machines are not appropriate for general use.

Files and processes

Everything in UNIX is either a file or a process.

A process is an executing program identified by a unique PID (process identifier).

A file is a collection of data. They are created by users using text editors, running compilers etc.



Examples of files:

- a document (report,

essay etc.)
- the text of a program written in some high-level programming language
- instructions comprehensible directly to the machine and incomprehensible to a casual user, for example, a collection of binary digits (an executable or binary file);
- a directory, containing information about its contents, which may be a mixture of other directories (subdirectories) and ordinary files.

The Directory Structure

All the files are grouped together in the directory structure. The file-system is arranged in a hierarchical structure, like an inverted tree. The top of the hierarchy is traditionally called root (written as a slash /)

In the diagram above, we see that the home directory of user torstees contains two four directories (data, bin, dev and Documents) and a file called pedigree.ped inside of the data directory.

The full path to the file pedigree.ped is "/home/home/torstees/data/pedigree.ped"

Starting an UNIX terminal

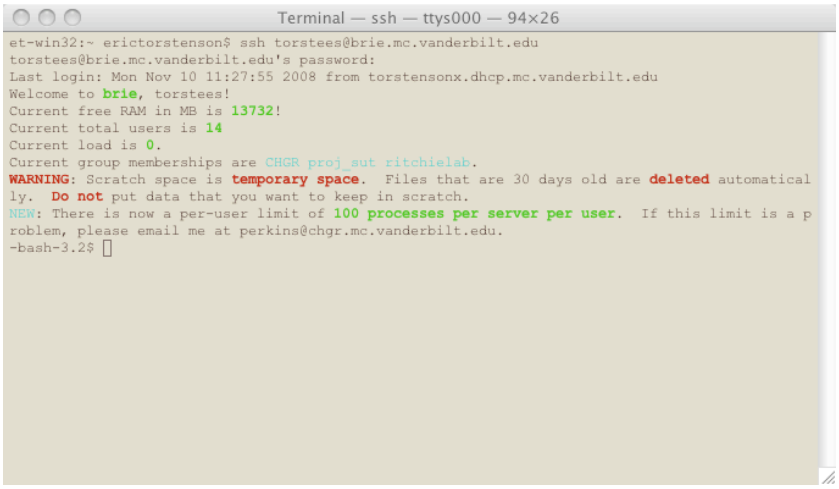
You communicate with the linux/Unix server using a Secure Shell Client. This program allows you to communicate with the server in such a way as to protect your password and activities from hackers.

To initiate a connection to one of the “cheeses”, find the SSH program: Start Menu->Program Files->SSH Secure Shell->Secure Shell Client.

Once the SSH program is open, choose “Quick Connect” to enter the server details.
- For Server, enter one of the cheese names in the following format: brie.mc.vanderbilt.edu
- For user, enter your VUNet ID

Once the connection has been made, it will prompt you for your password.

From there you should have a terminal session not unlike the one listed below.



You will notice a number of notices from the administrator. These notices can help you to determine if a particular machine is being used by too many people. If that is the case, your programs will run more slowly than if there were fewer active users. The last line is the prompt, designated by the %. This is where you will enter commands for the machine to follow.

Server Load

The administrative notices listed when users first log in can be used to determine if a machine is under heavy utilization.

```
Welcome to provolone, torstees!
Current free RAM in MB is 11640!
Current total users is 5
Current load is 1.
Current group memberships are CHGR proj_sut ritchielab.
WARNING: Scratch space is temporary space.  Files that are 30 days old are deleted automatically.  Do not put data that you want to keep in scratch.
NEW: There is now a per-user limit of 100 processes per server per user.  If this limit is a problem, please email me at perkins@chgr.mc.vanderbilt.edu.
```

In this example, the system shows 5 users online with a load of 1. If this number is higher than 4, it might be

a good idea to change to another machine. If it reaches 8, the server is under heavy utilization and will probably be slow to execute any given program.

UNIX Tutorial One

1.1 Listing files and directories

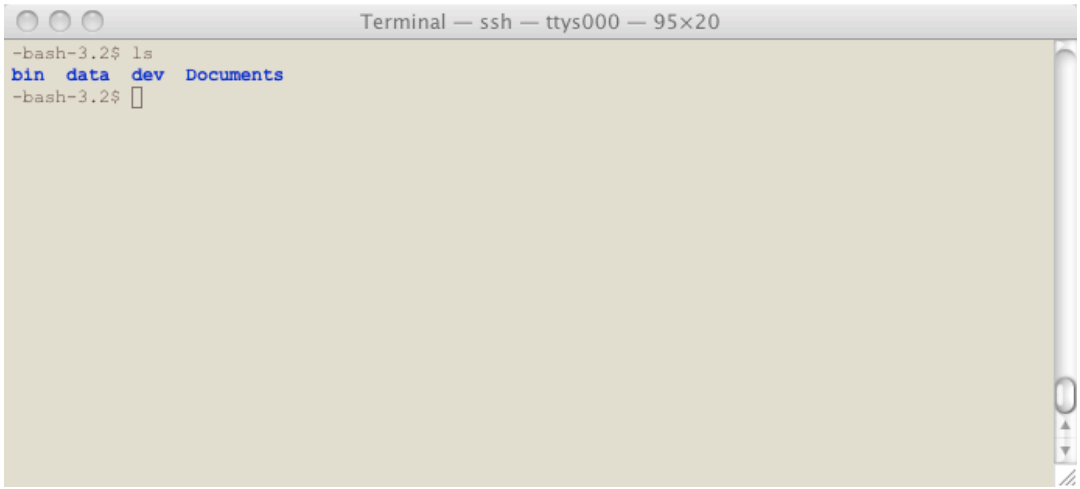
ls (list)

When you first login, your current working directory is your home directory. Your home directory has the same name as your user-name, for example, torstees, and it is where your personal files and subdirectories are saved.

To find out what is in your home directory, type

```
% ls
```

The ls command lists the contents of your current working directory.



There may be no files visible in your home directory, in which case, the UNIX prompt will be returned. Alternatively, there may already be some files inserted by the System Administrator when your account was created.

ls does not, in fact, cause all the files in your home directory to be listed, but only those ones whose name does not begin with a dot (.) Files beginning with a dot (.) are known as hidden files and usually contain important program configuration

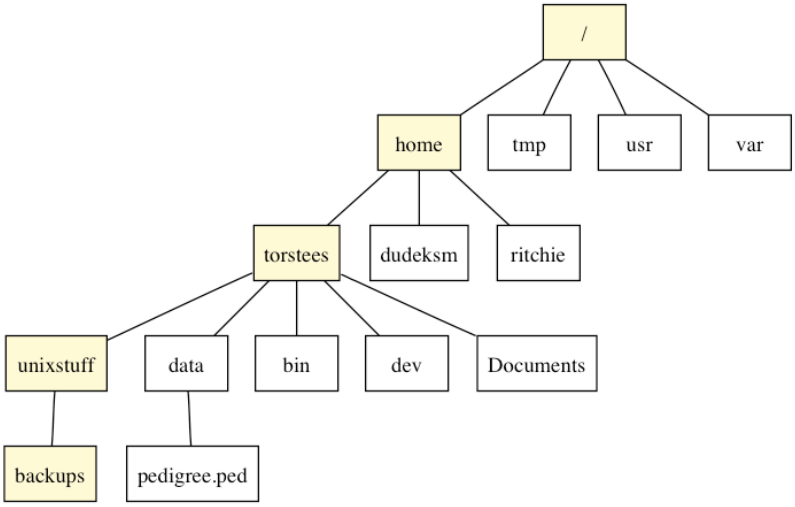
information. They are hidden because you should not change them unless you are very familiar with UNIX!!!

To list all files in your home directory including those whose names begin with a dot, type

```
% ls -a
```

As you can see, ls -a lists files that are normally hidden.

ls is an example of a command which can take options: -a is an example of an option. The options change the behavior of the command. There are online manual pages that tell you which options a particular command can take, and how each option modifies the behaviour of the command. (See later in this tutorial)



mkdir (make directory)

We will now make a subdirectory in your home directory to hold the files you will be creating and using in the course of this tutorial. To make a subdirectory called unixstuff in your current working directory type

```
% mkdir unixstuff
```

To see the directory you have just created, type

```
% ls
```

cd (change directory)

The command cd directory means change the current working directory to 'directory'. The current working directory may be thought of as the directory you are in, i.e. your current position in the file-system tree.

To change to the directory you have just made, type

```
% cd unixstuff
```

Type ls to see the contents (which should be empty)

Exercise 1a

Make another directory inside the **unixstuff** directory called **backups**

1.4 The directories . and ..

Still in the unixstuff directory, type

```
% ls -a
```

As you can see, in the unixstuff **directory** (and in all other directories), there are two special directories called (.) and (..)

The current directory (.)

In UNIX, (.) means the current directory, so typing

```
% cd .
```

NOTE: there is a space between cd and the dot

means stay where you are (the unixstuff directory).

This may not seem very useful at first, but using (.) as the name of the current directory will save a lot of typing, as we shall see later in the tutorial.

The parent directory (..)

(..) means the parent of the current directory, so typing

```
% cd ..
```

will take you one directory up the hierarchy (back to your home directory). Try it now.

Note: typing cd with no argument always returns you to your home directory. This is very useful if you are lost in the file system.

pwd (print working directory)

Pathnames enable you to work out where you are in relation to the whole file-system. For example, to find out the absolute pathname of your home-directory, type **cd** to get back to your home-directory and then type

```
% pwd
```

The full pathname will look something like this -

```
/home/torstees
```

which means that torstees (your home directory) is in the sub-directory home sub-directory, which is in the top-level root directory called " / " .

Exercise 1b

Use the commands **cd**, **ls** and **pwd** to explore the file system.

(Remember, if you get lost, type **cd** by itself to return to your home-directory)

Understanding pathnames

First type cd to get back to your home-directory, then type

```
% ls unixstuff
```

to list the conents of your unixstuff directory.

Now type

```
% ls backups
```

You will get a message like this -

```
backups: No such file or directory
```

The reason is, **backups** is not in your current working directory. To use a command on a file (or directory) not in the current working directory (the directory you are currently in), you must either **cd** to the correct directory, or specify its full pathname. To list the contents of your backups directory, you must type

```
% ls unixstuff/backups
```

~ (your home directory)

Home directories can also be referred to by the tilde ~ character. It can be used to specify paths starting at your home directory. So typing

```
% ls ~/unixstuff
```

will list the contents of your unixstuff directory, no matter where you currently are in the file system.

What do you think

```
% ls ~
```

would list?

What do you think

```
% ls ~/..
```

would list?

Command Summary

Command	Purpose
ls	list files and directories
ls -a	list all files and directories
mkdir	make a directory
cd *directory*	change to named directory
cd	change to home directory
cd ~	change to home directory
cd ..	change to parent directory
pwd	display the path of the current directory

UNIX Tutorial Two

2.1 Copying Files

cp (copy)

cp file1 file2 is the command which makes a copy of **file1** in the current working directory and calls it **file2**

What we are going to do now, is to take a file stored in an open access area of the file system, and use the **cp** command to copy it to your unixstuff directory.

First, **cd** to your **unixstuff** directory.

```
% cd ~/unixstuff
```

Then at the UNIX prompt, type,

```
% cp /projects/ritchie/marker-data/chr22.loc .
```

Note: Don't forget the dot . at the end. Remember, in UNIX, the dot means the current directory.

The above command means copy the file **chr22.loc** to the current directory, keeping the name the same.

*(Note: The directory **/projects/ritchie/** is an area to which everyone in the ritchie lab has read and copy access.)*

Exercise 2a

Create a backup of your **chr22.loc** file by copying it to a file called **chr22.loc.bak**

mv (move)

mv file1 file2 moves (or renames) **file1** to **file2**

To move a file from one place to another, use the mv command. This has the effect of moving rather than copying the file, so you end up with only one file rather than two.

It can also be used to rename a file, by moving the file to the same directory, but giving it a different name.

We are now going to move the file chrr22.loc.bak to your backup directory.

First, change directories to your **unixstuff** directory (can you remember how?). Then, inside the unixstuff directory, type

```
% mv chr22.loc.bak backups/.
```

Type ls and ls backups to see if it has worked.

2.3 Removing files and directories

rm (remove), rmdir (remove directory)

To delete (remove) a file, use the **rm** command. As an example, we are going to create a copy of the **chr22.loc** file then delete it.

Inside your **unixstuff** directory, type

```
% cp chr22.loc tempfile.loc
% ls
% rm tempfile.loc
% ls
```

You can use the **rmdir** command to remove a directory (make sure it is empty first). Try to remove the **backups** directory. You will not be able to since UNIX will not let you remove a non-empty directory.

Exercise 2b

Create a directory called **tempstuff** using **mkdir** , then remove it using the **rmdir** command.

2.4 Displaying the contents of a file on the screen

clear (clear screen)

Before you start the next section, you may like to clear the terminal window of the previous commands so the output of the following commands can be clearly understood.

At the prompt, type

```
% clear
```

This will clear all text and leave you with the % prompt at the top of the window.

cat (concatenate)

The command cat can be used to display the contents of a file on the screen. Type:

```
% cat chr22.loc
```

As you can see, the file is longer than than the size of the window, so it scrolls past making it unreadable.

less

The command less writes the contents of a file onto the screen a page at a time. Type

```
% less chr22.loc
```

Press the [**space-bar**] if you want to see another page, and type [**q**] if you want to quit reading. As you can see, **less** is used in preference to **cat** for long files.

head

The **head** command writes the first ten lines of a file to the screen.

First clear the screen then type

```
% head chr22.loc
```

Then type

```
% head -5 chr2.loc
```

What difference did the -5 do to the head command?

tail

The **tail** command writes the last ten lines of a file to the screen.

Clear the screen and type

```
% tail chr22.loc
```

Q. How can you view the last 15 lines of the file?

2.5 Searching the contents of a file

Simple searching using less

Using **less**, you can search though a text file for a keyword (pattern). For example, to search through **chr22.loc** for the word 'Freq', type

```
% less chr22.loc
```

then, still in **less**, type a forward slash [**/**] followed by the word to search

```
/Freq
```

As you can see, **less** finds and highlights the keyword. Type [**n**] to search for the next occurrence of the word.

grep (don't ask why it is called grep)

grep is one of many standard UNIX utilities. It searches files for specified words or patterns. First clear the screen, then type

```
% grep Freq chr22.loc
```

As you can see, **grep** has printed out each line containing the word **Freq**.

What **grep** actually displayed where the lines that contained Freq with a capitol F.

The **grep** command is case sensitive; it distinguishes between the letters ‘F’ and ‘f’.

To ignore upper/lower case distinctions, use the -i option, i.e. type

```
% grep -i Freq chr22.loc
```

To search for a phrase or pattern, you must enclose it in single quotes (the apostrophe symbol). For example to search for lines containing a column that starts with 44, type

```
% grep -i ' 44' chr22.loc
```

Some of the other options of grep are:

-v display those lines that do NOT match
-n precede each matching line with the line number
-c print only the total count of matched lines

Try some of them and see the different results. Don't forget, you can use more than one option at a time. For example, the number of lines without the word chr-22 is

```
% grep -ivc chr-22 chr22.loc
```

wc (word count)

A handy little utility is the **wc** command, short for word count. To do a word count on **chr22.loc**, type

```
% wc -w chr22.loc
```

To find out how many lines the file has, type

```
% wc -l chr22.loc
```

Summary

Command	Purpose
cp *file1 file2*	copy file1 and call it file2
mv *file1* file2	move or rename file1 to file2
rm *file*	remove a file
rmdir *directory*	remove a directory
cat *file*	display a file
less *file*	display a file a page a time
head *file*	display the first few lines of a file
tail *file*	display the last few lines of a file
grep '*keyword*' file	search a file for keywords
wc *file*	count the number of lines/words/ characters in a file

UNIX Tutorial Three

3.1 Redirection

Most processes initiated by UNIX commands write to the standard output (that is, they write to the terminal screen), and many take their input from the standard input (that is, they read it from the keyboard). There is also the standard error, where processes write their error messages, by default, to the terminal screen.

We have already seen one use of the **cat** command to write the contents of a file to the screen.

Now type **cat** without specifing a file to read

```
% cat
```

Then type a few words on the keyboard and press the [**Return**] key.

Finally hold the [**Ctrl**] key down and press [**d**] (written as **^D** for short) to end the input.

What has happened?

If you run the **cat** command without specifying a file to read, it reads the standard input (the keyboard), and on receiving the 'end of file' (**^D**), copies it to the standard output (the screen).

In UNIX, we can redirect both the input and the output of commands.

3.2 Redirecting the Output

We use the > symbol to redirect the output of a command. For example, to create a file called **list1** containing a list of fruit, type

```
% cat > list1
```

Then type in the names of some fruit. Press [**Return**] after each one.

```
pear
banana
apple
^D {this means press [Ctrl] and [d] to stop}
```

What happens is the cat command reads the standard input (the keyboard) and the > redirects the output, which normally goes to the screen, into a file called **list1**

To read the contents of the file, type

```
% cat list1
```

Exercise 3a

Using the above method, create another file called **list2** containing the following fruit: orange, plum, mango, grapefruit. Read the contents of **list2**

3.2.1 Appending to a file

The form >> appends standard output to a file. So to add more items to the file **list1**, type

```
% cat >> list1
```

Then type in the names of more fruit

```
peach
grape
orange
^D (Control D to stop)
```

To read the contents of the file, type

```
% cat list1
```

You should now have two files. One contains six fruit, the other contains four fruit.

We will now use the cat command to join (concatenate) **list1** and **list2** into a new file called **biglist**. Type

```
% cat list1 list2 > biglist
```

What this is doing is reading the contents of **list1** and **list2** in turn, then outputing the text to the file **biglist**

To read the contents of the new file, type

```
% cat biglist
```

3.3 Redirecting the Input

We use the < symbol to redirect the input of a command.

The command sort alphabetically or numerically sorts a list. Type

```
% sort
```

Then type in the names of some animals. Press [Return] after each one.

```
dog
cat
bird
ape
^D (control d to stop)
```

The output will be

```
ape
bird
cat
dog
```

Using < you can redirect the input to come from a file rather than the keyboard. For example, to sort the list of fruit, type

```
% sort < biglist
```

and the sorted list will be output to the screen.

To output the sorted list to a file, type,

```
% sort < biglist > slist
```

Use cat to read the contents of the file **slist**

3.4 Pipes

To see who is on the system with you, type

```
% who
```

One method to get a sorted list of names is to type,

```
% who > names.txt
% sort < names.txt
```

This is a bit slow and you have to remember to remove the temporary file called names when you have finished. What you really want to do is connect the output of the who command directly to the input of the sort command. This is exactly what pipes do. The symbol for a pipe is the vertical bar |

For example, typing

```
% who | sort
```

will give the same result as above, but quicker and cleaner.

To find out how many users are logged on, type

```
% who | wc -l
```

Exercise 3b

Using pipes, display all lines of **list1** and **list2** containing the letter 'p', and sort the result. (see answers at the end of document)

Summary

Command	Purpose
command > *file*	redirect standard output to a file
command >> *file*	append standard output to a file
command < *file*	redirect standard input from a file
command1 | command2	pipe the output of command1 to the input of command2
cat *file1 file2* > *file0*	concatenate file1 and file2 to file0
sort	sort data
who	list users currently logged in

UNIX Tutorial Four

4.1 Wildcards

The * wildcard

The character ***** is called a wildcard, and will match against none or more character(s) in a file (or directory) name. For example, in your **unixstuff** directory, type

```
% ls list*
```

This will list all files in the current directory starting with **list...**.

Try typing

```
% ls *list
```

This will list all files in the current directory ending with **....list**

The ? wildcard

The character **?** will match exactly one character.
So **?ouse** will match files like **house** and **mouse**, but not **grouse**.
Try typing

```
% ls ?list
```

4.2 Filename conventions

We should note here that a directory is merely a special type of file. So the rules and conventions for naming files apply also to directories.

In naming files, characters with special meanings such as **/ * & %** , should be avoided. Also, avoid using spaces within names. The safest way to name a file is to

use only alphanumeric characters, that is, letters and numbers, together with _ (underscore) and . (dot).

Good Filenames	Bad Filenames
project.txt	project
my_big_program.c	my big program.c
fred_dave.doc	fred & dave.doc

File names conventionally start with a lower-case letter, and may end with a dot followed by a group of letters indicating the contents of the file. For example, all files consisting of C code may be named with the ending **.c**, for example, **prog1.c** . Then in order to list all files containing C code in your home directory, you need only type **ls *.c** in that directory.

On-line Manuals

There are on-line manuals which gives information about most commands. The manual pages tell you which options a particular command can take, and how each option modifies the behaviour of the command. Type **man command** to read the manual page for a particular command.

For example, to find out more about the **wc** (word count) command, type

```
% man wc
```

Alternatively

```
% whatis wc
```

gives a one-line description of the command, but omits any information about options etc.

Apropos

When you are not sure of the exact name of a command,

```
% apropos keyword
```

will give you the commands with keyword in their manual page header. For example, try typing

```
% apropos copy
```

Command	Purpose
*	match any number of characters
?	match one character
man command	read the online manual page for a command
whatis command	brief description of a command
apropos keyword	match commands with keyword in their man pages

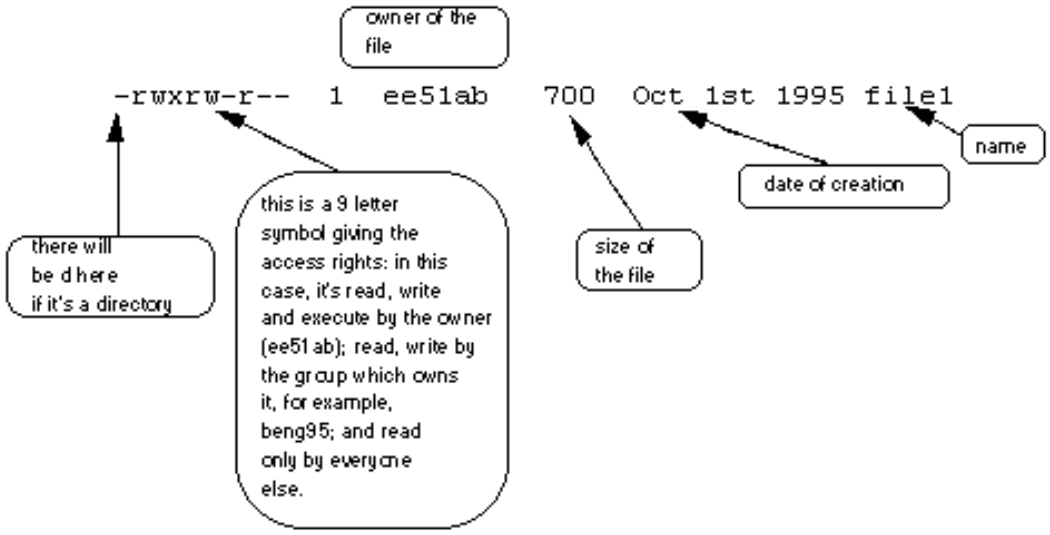
UNIX Tutorial Five

5.1 File system security (access rights)

In your **unixstuff** directory, type

```
% ls -l (l for long listing!)
```

You will see that you now get lots of details about the contents of your directory, similar to the example below.



Each file (and directory) has associated access rights, which may be found by typing **ls -l**. Also, **ls -lg** gives additional information as to which group owns the file (ritchielab in the following example):

-rwxrw-r-- 1 torstees ritchielab 2450 Sept29 11:52 file1

In the left-hand column is a 10 symbol string consisting of the symbols d, r, w, x, -, and, occasionally, s or S. If d is present, it will be at the left hand end of the string, and indicates a directory: otherwise - will be the starting symbol of the string.

The 9 remaining symbols indicate the permissions, or access rights, and are taken as three groups of 3.

- The left group of 3 gives the file permissions for the user that owns the file (or directory) (torstees in the above example);
- the middle group gives the permissions for the group of people to whom the file (or directory) belongs (ritchielab in the above example);
- the rightmost group gives the permissions for all others.

The symbols r, w, etc., have slightly different meanings depending on whether they refer to a simple file or to a directory.

Access rights on files.

- r (or -), indicates read permission (or otherwise), that is, the presence or absence of permission to read and copy the file
- w (or -), indicates write permission (or otherwise), that is, the permission (or otherwise) to change a file
- x (or -), indicates execution permission (or otherwise), that is, the permission to execute a file, where appropriate

Access rights on directories.

- r allows users to list files in the directory;
- w means that users may delete files from the directory or move files into it;
- x means the right to access files in the directory. This implies that you may read files in the directory provided you have read permission on the individual files.

So, in order to read a file, you must have execute permission on the directory containing that file, and hence on any directory containing that directory as a subdirectory, and so on, up the tree.

Some examples

-rwxrwxrwx	a file that everyone can read, write and execute (and delete)

-rw-------	a file that only the owner can read and write - no-one else can read or write and no-one has execution rights (e.g. your mailbox file)

chmod (changing a file mode)

Only the owner of a file can use chmod to change the permissions of a file. The options of chmod are as follows

Symbol	Meaning
u	user
g	group
o	other
a	all
r	read
w	write (and delete)
x	execute (and access directory)
+	add permission
-	take away permission

For example, to remove read write and execute permissions on the file **biglist** for the group and others, type

```
% chmod go-rwx biglist
```

This will leave the other permissions unaffected.

To give read and write permissions on the file **biglist** to all,

```
% chmod a+rw biglist
```

Exercise 5a

Try changing access permissions on the file **chr22.loc** and on the directory **backups**

Use **ls -l** to check that the permissions have changed.

5.3 Processes and Jobs

A process is an executing program identified by a unique PID (process identifier). To see information about your processes, with their associated PID and status, type

```
% ps
```

A process may be in the foreground, in the background, or be suspended. In general the shell does not return the UNIX prompt until the current process has finished executing.

Some processes take a long time to run and hold up the terminal. Backgrounding a long process has the effect that the UNIX prompt is returned immediately, and other tasks can be carried out while the original process continues executing.

Running background processes

To background a process, type an **&** at the end of the command line. For example, the command **sleep** waits a given number of seconds before continuing. Type

```
% sleep 10
```

This will wait 10 seconds before returning the command prompt %. Until the command prompt is returned, you can do nothing except wait.

To run sleep in the background, type

```
% sleep 10 &

[1] 6259
```

The **&** runs the job in the background and returns the prompt straight away, allowing you do run other programs while waiting for that one to finish.

The first line in the above example is typed in by the user; the next line, indicating job number and PID, is returned by the machine. The user is be notified of a job number (numbered from 1) enclosed in square brackets, together with a PID and is notified when a background process is finished. Backgrounding is useful for jobs which will take a long time to complete.

Backgrounding a current foreground process

At the prompt, type

```
% sleep 1000
```

You can suspend the process running in the foreground by typing **^Z**, i.e.hold down the [**Ctrl**] key and type [**z**]. Then to put it in the background, type

```
% bg
```

Note: do not background programs that require user interaction e.g. vi

5.4 Listing suspended and background processes

When a process is running, backgrounded or suspended, it will be entered onto a list along with a job number. To examine this list, type

```
% jobs
```

An example of a job list could be

```
[1] Suspended sleep 1000
[2] Running netscape
[3] Running matlab
```

To restart (foreground) a suspended processes, type

```
% fg %jobnumber
```

For example, to restart sleep 1000, type

```
% fg %1
```

Typing **fg** with no job number foregrounds the last suspended process.

5.5 Killing a process

kill (terminate or signal a process)

It is sometimes necessary to kill a process (for example, when an executing program is in an infinite loop)

To kill a job running in the foreground, type **^C** (control c). For example, run

```
% sleep 100
^C
```

To kill a suspended or background process, type

```
% kill %jobnumber
```

For example, run

```
% sleep 100 &
% jobs
```

If it is job number 4, type

```
% kill %4
```

To check whether this has worked, examine the job list again to see if the process has been removed.

ps (process status)

Alternatively, processes can be killed by finding their process numbers (PIDs) and using kill *PID_number*

```
% sleep 1000 &
% ps

PID TT S TIME COMMAND
20077 pts/5 S 0:05 sleep 1000
21563 pts/5 T 0:00 netscape
21873 pts/5 S 0:25 nedit
```

To kill off the process **sleep 1000**, type

```
% kill 20077
```

and then type **ps** again to see if it has been removed from the list.

If a process refuses to be killed, uses the **-9** option, i.e. type

```
% kill -9 20077
```

Note: It is not possible to kill off other users' processes !!!

Summary

Command	Purpose
ls -lag	list access rights for all files
chmod [options] *file*	change access rights for named file
command &	run command in background
^c	kill the job running in the foreground
^z	suspend the job running in the foreground
bg	background the suspended job
jobs	list current jobs

Command	Purpose
fg %1	foreground job number 1
kill %1	kill job number 1
ps	list current processes
kill 26152	kill process 26152

UNIX Tutorial Six

Other useful UNIX commands

quota

All students are allocated a certain amount of disk space on the file system for their personal files, usually about 100Mb. If you go over your quota, you are given 7 days to remove excess files.

To check your current quota and how much of it you have used, type

```
% quota -v
```

df

The **df** command reports on the space left on the file system. For example, to find out how much space is left on the fileserver, type

```
% df .
```

du

The **du** command outputs the number of kilobyes used by each subdirectory. Useful if you have gone over quota and you want to find out which directory has the most files. In your home-directory, type

```
% du -s *
```

The **-s** flag will display only a summary (total size) and the * means all files and directories.

gzip

This reduces the size of a file, thus freeing valuable disk space. For example, type

```
% ls -l chr22.loc
```

and note the size of the file using **ls -l** . Then to compress **chr22.loc**, type

```
% gzip chr22.loc
```

This will compress the file and place it in a file called **chr22.loc.gz**

To see the change in size, type **ls -l** again.

To expand the file, use the **gunzip** command.

```
% gunzip chf22.loc.gz
```

zcat

zcat will read gzipped files without needing to uncompress them first.

```
% zcat chr22.loc.gz
```

If the text scrolls too fast for you, pipe the output though **less**.

```
% zcat chr22.loc.gz | less
```

file

file classifies the named files according to the type of data they contain, for example ascii (text), pictures, compressed data, etc.. To report on all files in your home directory, type

```
% file *
```

diff

This command compares the contents of two files and displays the differences. Suppose you have a file called **file1** and you edit some part of it and save it as **file2**. To see the differences type

```
% diff file1 file2
```

Lines beginning with a **<** denotes file1, while lines beginning with a **>** denotes file2.

find

This searches through the directories for files and directories with a given name, date, size, or any other attribute you care to specify. It is a simple command but with many options - you can read the manual by typing **man find**.

To search for all fies with the extention **.txt**, starting at the current directory (.) and working through all sub-directories, then printing the name of the file to the screen, type

```
% find . -name "*.loc" -print
```

To find files over 1Mb in size, and display the result as a long listing, type

```
% find . -size +1M -ls
```

history

The bash shell keeps an ordered list of all the commands that you have entered. Each command is given a number according to the order it was entered.

```
% history (show command history list)
```

If you are using the C shell, you can use the exclamation character (**!**) to recall commands easily.

```
% !! (recall last command)

% !-3 (recall third most recent command)

% !5 (recall 5th command in list)

% !grep (recall last command starting with
grep)
```

You can increase the size of the history buffer by typing

```
% set history=100
```

Answers to Exercises

Exercise 3b

Using pipes, display all lines of list1 and list2 containing the letter ‘p’, and sort the result.

Answer

```
% cat list1 list2 | grep p | sort
```