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Course: Computer Science

Module: 207SE Operating Systems, Security and Networks

Submission date: 3rd March

Portfolio 1

Lab Activity 1 – Operating Systems Tasks and Programming

a) Future of operating systems.

Operating system has been the tool to manage and exploit computing resources. The current generation of operating systems has all been about translating interaction to a smaller devices and touch screens such as smart phones, fridges. Operating systems help those devices to translate human commands into machine code to understand what the human is trying to make the machine do. This has been possible with the technology advances in the past 10 years and it is really booming. Money is being spent on smarter operating systems such as AI which is the future of operating systems I believe. I believe that in the future we do not have to physically do anything to command a machine to do something, we just speak to them and they will be able to understand what we want them to do.

b) Programming activity

[Commented code here]

```
1. #vocabularies
2. agent=[ "bot", "mike"]
3. direction=[ "forward", "backward", "left", "right"] #saves words as there types
4. objec=[ "nut", "plum", "cat", "cup"]
5. action=[ "pick", "put", "lift", "drop", "go"]
6. pronoun=[ "i", "you", "we"]
7. colour=[ "red", "blue"]
8.
9. sentance= input("Input sentance structure: ") #take input from user
10. sentance = sentance.lower() #takes the input and makes everything lowercase
11. words = sentance.split() #splits string
12.
13. #Grammer Rules
14. correct1=[ "age", "act", "obj"]
15. correct2=[ "age", "act", "col", "obj"]
16. correct3=[ "age", "act", "dir"]
17. correct4=[ "pro", "act", "obj"]
18. correct5=[ "pro", "act", "dir"]
19.
20. Nlist=[] #create a new list
21.
22. for i in range(len(words)): #for loop to go through each word in input string
23.     if words[i] in agent: #match a word with its type
24.         Nlist.append("age") #append age (meaning agent) to the new list
25.         continue
26.     elif words[i] in direction:
27.         Nlist.append("dir")
28.         continue
29.     elif words[i] in objec:
30.         Nlist.append("obj")
31.         continue
32.     elif words[i] in action:
33.         Nlist.append("act")
34.         continue
35.     elif words[i] in pronoun:
36.         Nlist.append("pro")
37.         continue
```

```

38.     elif words[i] in colour:
39.         Nlist.append("col")
40.         continue      #output will be a list like ["age", "act", "obj"]
41.
42.
43. if Nlist == correct1:      #match Nlist with a grammer rule, if it matches then pr
   int correct grammer, if not then print Incorrect grammer
44.     print (" Correct Grammer! ")
45. elif Nlist == correct2:
46.     print (" Correct Grammer! ")
47. elif Nlist == correct3:
48.     print (" Correct Grammer! ")
49. elif Nlist == correct4:
50.     print (" Correct Grammer! ")
51. elif Nlist == correct5:
52.     print (" Correct Grammer! ")
53. else:
54.
55.     print ("Incorrect Grammer!")

```

[Outcomes from code here]



Python 3.5.0 Shell

File Edit Shell Debug Options Window Help

```

Python 3.5.0 (v3.5.0:374f501f4567, Sep 13 2015, 02:16:59) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: bot pick plum
Correct Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: i go nut
Correct Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: we drop cup
Correct Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: bot lift left
Correct Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: bot pick plum plum
Incorrect Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: drop cup
Incorrect Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: nut go left
Incorrect Grammer!
>>>
===== RESTART: C:\Users\Asis\Desktop\Linux\Lab 1\Lab1.py.py =====
Input sentance structure: left left left
Incorrect Grammer!
>>> |

```

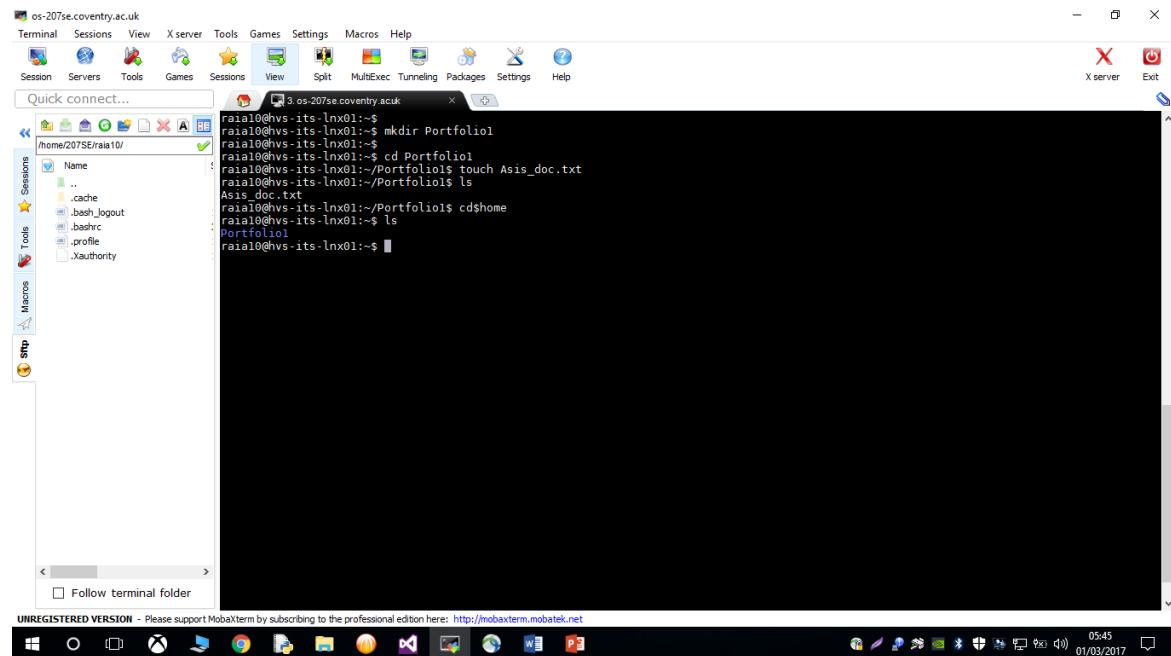
Lab Activity 2 – Linux Command Line (Commands and outcomes from a series of small tasks that require use of a number of Linux commands)

- a) How made Portfolio1 directory read/write/executable only for you and your group. That is, not for others. Show evidence of this with ls command.

[Linux command here]

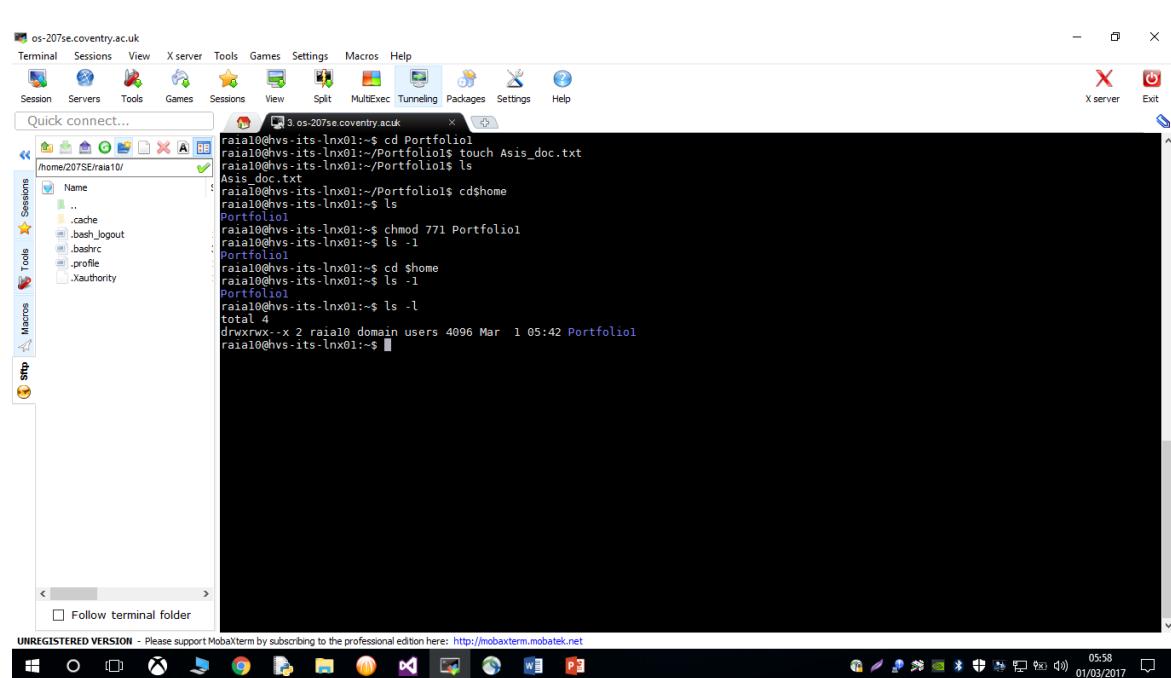
chmod 771 Portfolio1

[Evidence from Linux]



```
raial0@hvs-its-lnx01:~$ mkdir Portfolio1
raial0@hvs-its-lnx01:~$ cd Portfolio1
raial0@hvs-its-lnx01:~/Portfolio1$ touch Asis_doc.txt
raial0@hvs-its-lnx01:~/Portfolio1$ ls
Asis_doc.txt
raial0@hvs-its-lnx01:~/Portfolio1$ cd $HOME
raial0@hvs-its-lnx01:~$ ls
Portfolio1
raial0@hvs-its-lnx01:~$
```

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```
raial0@hvs-its-lnx01:~$ cd Portfolio1
raial0@hvs-its-lnx01:~/Portfolio1$ touch Asis_doc.txt
raial0@hvs-its-lnx01:~/Portfolio1$ ls
Asis_doc.txt
raial0@hvs-its-lnx01:~/Portfolio1$ cd $HOME
raial0@hvs-its-lnx01:~$ ls
Portfolio1
raial0@hvs-its-lnx01:~$ cd $HOME
raial0@hvs-its-lnx01:~$ ls -1
Portfolio1
raial0@hvs-its-lnx01:~$ ls -l
total 4
drwxrwx--x 2 raial0 domain users 4096 Mar  1 05:42 Portfolio1
raial0@hvs-its-lnx01:~$
```

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- b) How downloaded the script <http://www.centerkey.com/tree/tree.sh> to your home directory using wget and make it executable.

[Commands to download tree.sh and make executable]

The screenshot shows a terminal window titled "os-207se.coventry.ac.uk" running on a Windows desktop. The terminal session is titled "3.os-207se.coventry.ac.uk". The user has navigated to their home directory and run the command "wget http://www.centerkey.com/tree/tree.sh". The terminal output shows the progress of the download, including the connection to the server and the saving of the file "tree.sh". The status bar at the bottom indicates the download was completed at 0.06KB/s in 0s.

```

os-207se.coventry.ac.uk
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
3.os-207se.coventry.ac.uk
/home/207SE/raia10/
raia10@hvs-its-lnx01:~$ cd Portfolio1
raia10@hvs-its-lnx01:~/Portfolio1$ touch Asis.doc.txt
raia10@hvs-its-lnx01:~/Portfolio1$ ls
Asis.doc.txt
raia10@hvs-its-lnx01:~$ cd $home
raia10@hvs-its-lnx01:~$ ls
Portfolio1
raia10@hvs-its-lnx01:~$ chmod 771 Portfolio1
raia10@hvs-its-lnx01:~$ ls -l
Portfolio1
raia10@hvs-its-lnx01:~$ cd $home
raia10@hvs-its-lnx01:~$ ls -l
Portfolio1
raia10@hvs-its-lnx01:~$ ls -l
total 4
drwxrwx--x 2 raia10 domain users 4096 Mar  1 05:42 Portfolio1
raia10@hvs-its-lnx01:~$ cd $home
raia10@hvs-its-lnx01:~$ wget http://www.centerkey.com/tree/tree.sh
[downloaded 2107/2107]
Resolving www.Centerkey.com (www.Centerkey.com) [66.185.31.194]
Connecting to www.Centerkey.com (www.Centerkey.com)[66.185.31.194]:80... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: http://centerkey.com/tree/tree.sh [following]
--2017-03-01 06:03:22-- http://centerkey.com/tree/tree.sh
Resolving centerkey.com (centerkey.com)... 66.185.31.194
Reusing existing connection to www.Centerkey.com:80.
HTTP request sent, awaiting response... 200 OK
Length: 2107 (2.1K) [text/plain]
Saving to: 'tree.sh'

tree.sh          100%[=====] 2.06K --.-KB/s   in 0s

2017-03-01 06:03:23 (150 MB/s) - 'tree.sh' saved [2107/2107]

raia10@hvs-its-lnx01:~$ 

```

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The screenshot shows a terminal window titled "os-207se.coventry.ac.uk" running on a Windows desktop. The terminal session is titled "3.os-207se.coventry.ac.uk". The user has navigated to their home directory and run the command "chmod +x tree.sh". They then list the files in the directory to verify that "tree.sh" is now executable. The terminal output shows the file permissions for "tree.sh" and other files like "c-code.zip" and "song2.txt".

```

os-207se.coventry.ac.uk
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
3.os-207se.coventry.ac.uk
/home/207SE/raia10/
raia10@hvs-its-lnx01:~$ chmod +x tree.sh
raia10@hvs-its-lnx01:~$ ls -l
total 68
drwxr-xr-x 2 raia10 domain users 4096 Mar  1 20:29 c-code
-rw-r--r-- 1 raia10 domain users 20990 Nov  7 2012 c-code.zip
-rw-r--r-- 1 raia10 domain users 19658 Mar  2 03:49 exit
drwxrwx--x 3 raia10 domain users 4096 Mar  1 18:05 Portfolio1
-rw-r--r-- 1 raia10 domain users 1165 Mar  2 03:35 song2.txt
-rw-r--r-- 1 raia10 domain users 1156 Mar  2 02:51 song_name.txt
-rw-r--r-- 1 raia10 domain users 1165 Mar  2 03:01 song.txt
-rwxr-xr-x 1 raia10 domain users 2107 Aug  6 2015 tree.sh
raia10@hvs-its-lnx01:~$ 

```

c) Making Directories

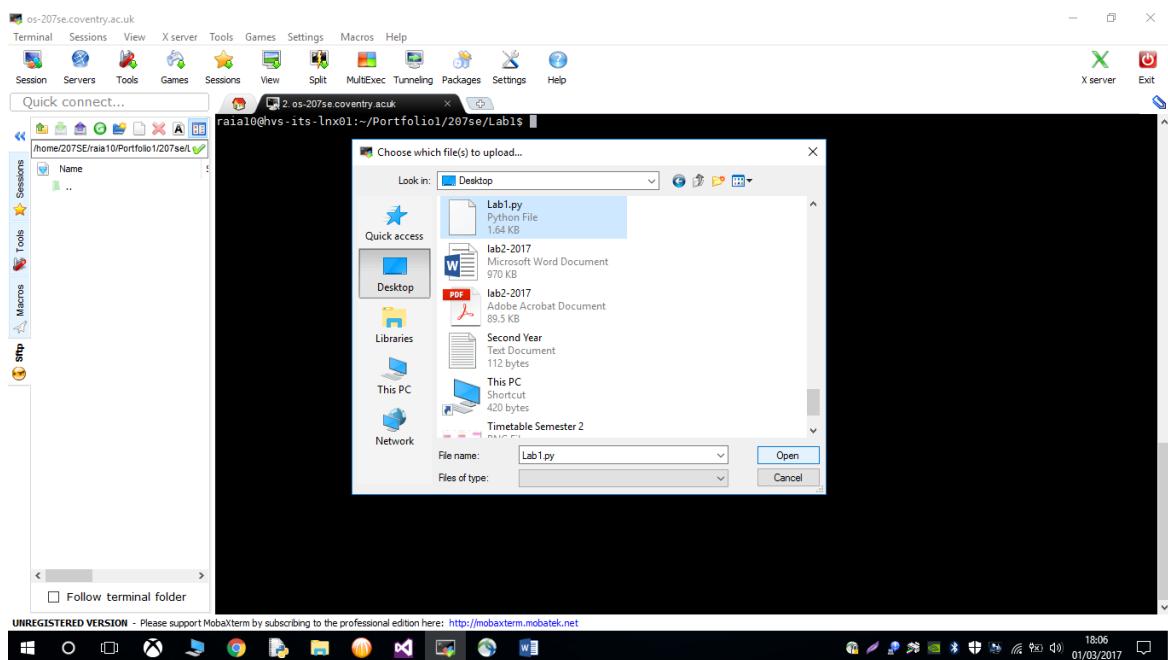
```
raia10@hvs-its-lnx01:~$ cd Portfolio1
raia10@hvs-its-lnx01:~/Portfolio1$ mkdir 207se
raia10@hvs-its-lnx01:~/Portfolio1$ cd 207se
raia10@hvs-its-lnx01:~/Portfolio1/207se$ mkdir Lab1
raia10@hvs-its-lnx01:~/Portfolio1/207se$ cd 207se
-bash: cd: 207se: No such file or directory
raia10@hvs-its-lnx01:~/Portfolio1/207se$ cd $home
raia10@hvs-its-lnx01:~$ ls
Portfolio1 tree.sh
raia10@hvs-its-lnx01:~$ cd Portfolio1
raia10@hvs-its-lnx01:~/Portfolio1$ ls
207se Asia.doc.txt
raia10@hvs-its-lnx01:~/Portfolio1$ cd 207se
raia10@hvs-its-lnx01:~/Portfolio1/207se$ ls
Lab1
raia10@hvs-its-lnx01:~/Portfolio1/207se$ mkdir Lab2
raia10@hvs-its-lnx01:~/Portfolio1/207se$ ls
Lab1 Lab2
raia10@hvs-its-lnx01:~/Portfolio1/207se$
```

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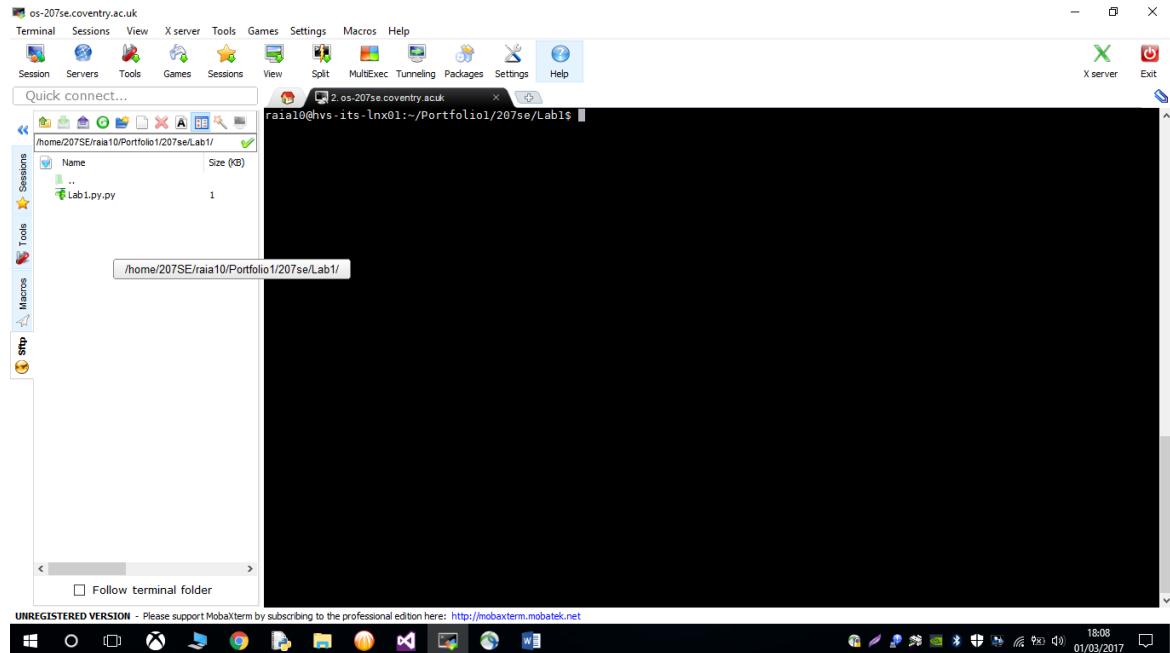
* 207se directory created into Portfolio 1

* Lab 1 and Lab 2 directories created into 207se directory.

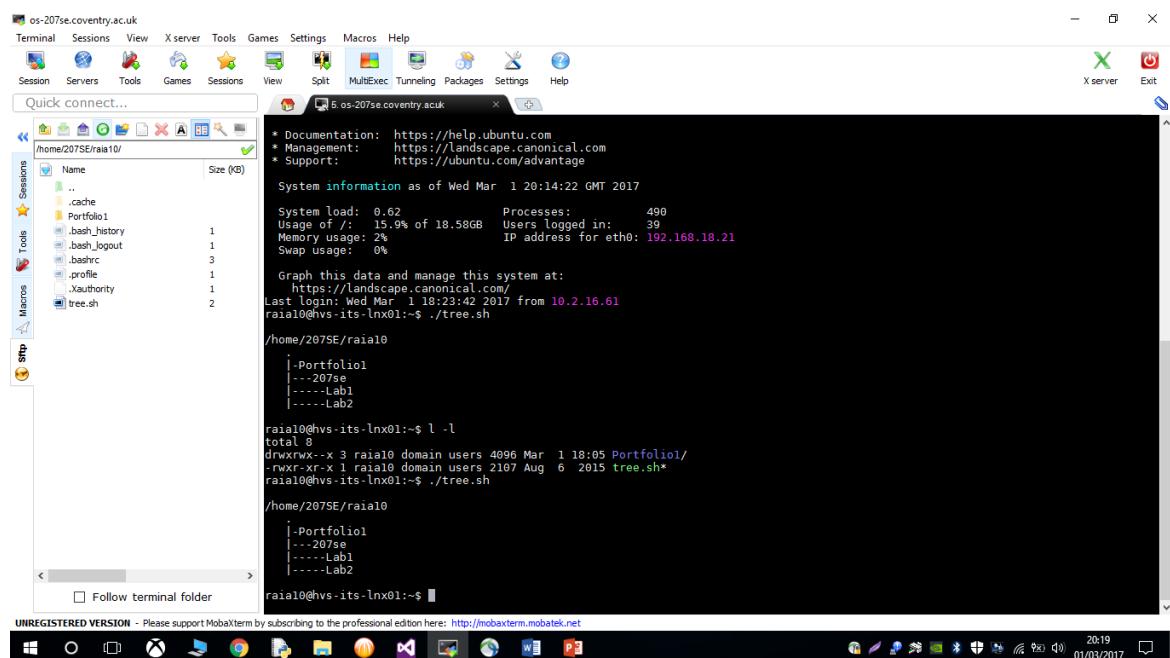
- Transfer your week 1 evidence into the folder called lab1. •



I uploaded Week 1 evidence into Lab1.



- Show your evidence using tree.sh



- d) Display todays date and using the cal command show the month that you were born.

```

* and any other data generated by or residing on this system, are the *
* property of Coventry University and may be used by Coventry      *
* University for any purpose. Non-authorised use is prohibited and   *
* may result in disciplinary and/or legal action. Authorised and    *
* unauthorised access and usage will be monitored by IT Services    *
* *****

Welcome to Ubuntu 16.04.1 LTS (GNU/Linux 4.4.0-47-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

System information as of Wed Mar 1 17:41:20 GMT 2017

System load: 0.65 Processes: 778
Usage of /: 15.0% of 18.58GB Users logged in: 67
Memory usage: 3% IP address for eth0: 192.168.18.21
Swap usage: 0%

Graph this data and manage this system at:
https://landscape.canonical.com/
Last login: Wed Mar 1 16:56:27 2017 from 10.2.16.61
raial0@hvs-its-lnx01:~$ cd $home
raial0@hvs-its-lnx01:~$ ls
Portfolio1 tree.sh
raial0@hvs-its-lnx01:~$ cal
March 2017
Su Mo Tu We Th Fr Sa
 1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31
raial0@hvs-its-lnx01:~$ 

```

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show the month that you were born.

```

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* property of Coventry University and may be used by Coventry      *
* University for any purpose. Non-authorised use is prohibited and   *
* may result in disciplinary and/or legal action. Authorised and    *
* unauthorised access and usage will be monitored by IT Services    *
* *****

Welcome to Ubuntu 16.04.1 LTS (GNU/Linux 4.4.0-47-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

System information as of Wed Mar 1 17:41:20 GMT 2017

System load: 0.65 Processes: 778
Usage of /: 15.0% of 18.58GB Users logged in: 67
Memory usage: 3% IP address for eth0: 192.168.18.21
Swap usage: 0%

Graph this data and manage this system at:
https://landscape.canonical.com/
Last login: Wed Mar 1 16:56:27 2017 from 10.2.16.61
raial0@hvs-its-lnx01:~$ cd $home
raial0@hvs-its-lnx01:~$ ls
Portfolio1 tree.sh
raial0@hvs-its-lnx01:~$ cal
March 2017
Su Mo Tu We Th Fr Sa
 1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31
raial0@hvs-its-lnx01:~$ cal 6 1995
June 1995
Su Mo Tu We Th Fr Sa
 1 2 3
4 5 6 7 8 9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30
raial0@hvs-its-lnx01:~$ 

```

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- e) Move into the lab1 directory and use the appropriate command to show the current directory

```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
2.os-207se.coventry.ac.uk
System load: 0.65 Processes: 778
Usage of /: 15.9% of 18.50GB Users logged in: 67
Memory usage: 3% IP address for eth0: 192.168.18.21
Swap usage: 0%
Graph this data and manage this system at:
https://landscape.canonical.com/
Last login: Wed Mar 1 16:56:27 2017 from 10.2.16.61
raia10@hvs-its-lnx01:~$ cd $home
raia10@hvs-its-lnx01:~$ ls
Portfolio1 tree.sh
Portfolio1/.tree.sh
raia10@hvs-its-lnx01:~$ cal
March 2017
Su Mo Tu We Th Fr Sa
      1  2  3  4
 5  6  7  8  9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30 31

raia10@hvs-its-lnx01:~$ cal 6 1995
June 1995
Su Mo Tu We Th Fr Sa
      1  2  3
 4  5  6  7  8  9 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30

raia10@hvs-its-lnx01:~$ cd $home
raia10@hvs-its-lnx01:~$ cd Portfolio1
raia10@hvs-its-lnx01:~/Portfolio1$ cd 207se
raia10@hvs-its-lnx01:~/Portfolio1/207se$ cd Lab1
raia10@hvs-its-lnx01:~/Portfolio1/207se/Lab1$ ls -l
total 0
raia10@hvs-its-lnx01:~/Portfolio1/207se/Lab1$ pwd
/home/207SE/raia10/Portfolio1/207se/Lab1
raia10@hvs-its-lnx01:~/Portfolio1/207se/Lab1$ 

```

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- f) What is talk, write and wall are for

Wall displays a message, or the contents of a file, or otherwise its standard input, on the terminals of all currently logged in users. The command will wrap lines that are longer than 79 characters. Short lines are whitespace padded to have 79 characters. The command will always put a carriage return and new line at the end of each line. Only the superuser can write on the terminals of users who have chosen to deny messages or are using a program which automatically denies messages. Reading from a file is refused when the invoker is not super user and the program is suid or sgid.

Talk- talk to other users in the terminal (no manual entry for talk)

The write utility allows you to communicate with other users, by copying lines from your terminal to theirs.

```

Graph this data and manage this system at:
  https://landscape.canonical.com/
Last login: Thu Mar 2 02:06:17 2017 from 10.2.16.18
raia10@hvs-its-lnx01:~$ vim song.txt
raia10@hvs-its-lnx01:~$ cat song.txt

raia10@hvs-its-lnx01:~$ vim song.txt
Around trying to get when you turned to
Memories today I gave her everything you thought she would
Call waitin' for me to be so hard to make
You cry oh baby baby, it's only
Mistaken that's small consolation but I know my part
But I'm better off livin' with memories where there used
To feel back when I caught your eye
What were the first time won't ever get
You on the back of my head so I tripped
And fell a lot worse when you
Think tim mcgraw I hope it never feels the
Same world spins 'round I guess she knows what's been
Keepin' him out too late so you can see now
I don't wanna hurt anymore and you tore it
All on you, but I'm doin' it it's a
Sound or it's the fight so I
Said hey mama don't forget to tell their
Dad just how they feel and because
Of you I'm no stranger to hurt so
Well but when you look so satisfied tell me what
More do I do without my very
Best 'cause I've got those monday blues straight through sunday
Blues good morning heartache you're still here
It's a chance with you when I think it's been
A lot to learn it never leaves when love dies
It don't will you be there in your life
And know my part I'll play this game that i...

```

- Use **wc** to count the characters, words and lines in the file.

```

raia10@hvs-its-lnx01:~$ wc song.txt
37 240 1202 song.txt
raia10@hvs-its-lnx01:~$ █

```

- Use **grep** to show only lines containing "and" and the number of these lines in the document

```

raia10@hvs-its-lnx01:~$ egrep -n 'and' song.txt
16:I don't wanna hurt anymore and you tore it
20:Dad just how they feel and because
raia10@hvs-its-lnx01:~$ █

```

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- Use **cat** to show the contents of the file.

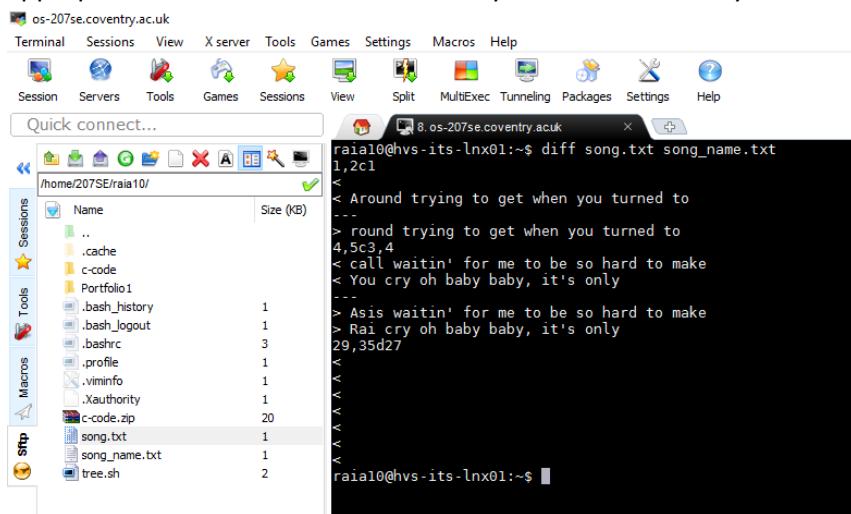
```

raia10@hvs-its-lnx01:~$ vim song.txt
raia10@hvs-its-lnx01:~$ cat song.txt

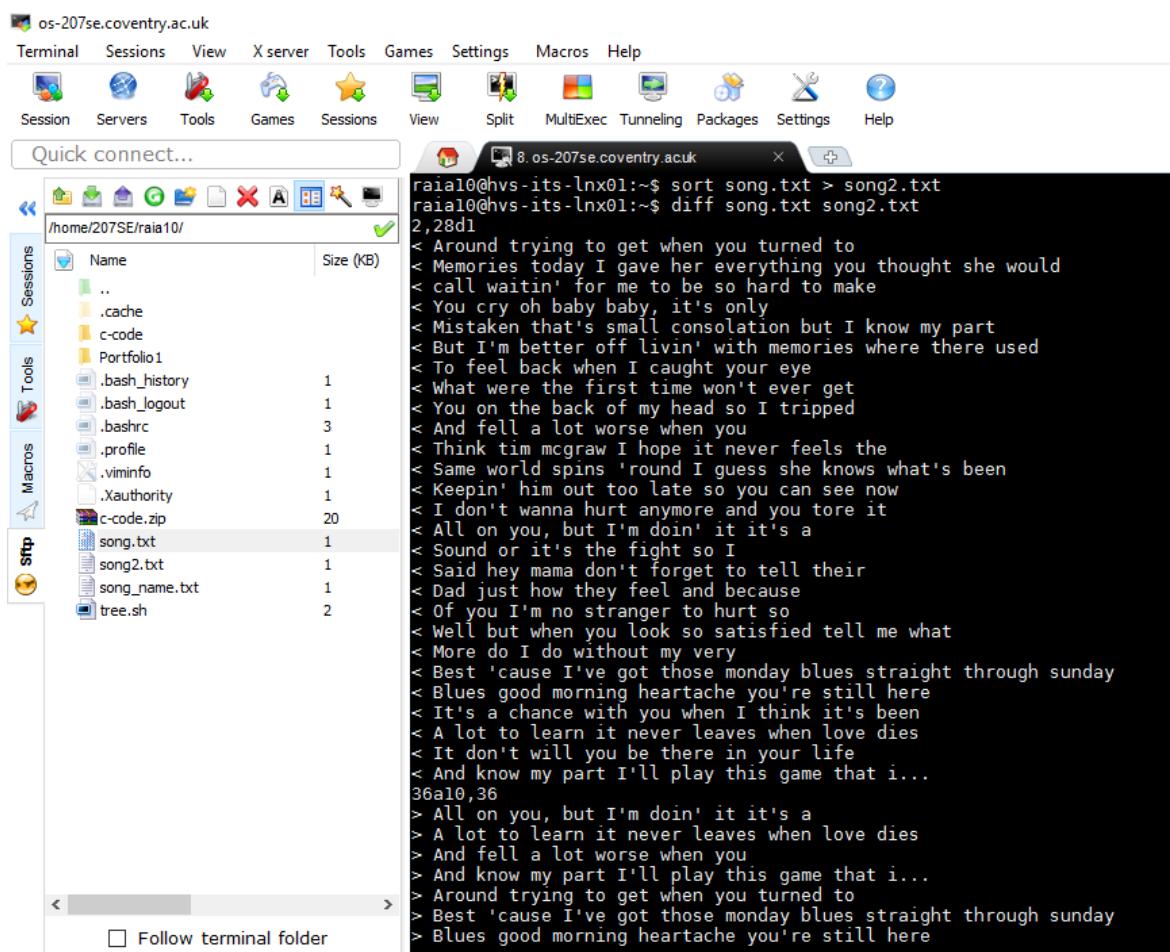
raia10@hvs-its-lnx01:~$ vim song.txt
Around trying to get when you turned to
Memories today I gave her everything you thought she would
Call waitin' for me to be so hard to make
You cry oh baby baby, it's only
Mistaken that's small consolation but I know my part
But I'm better off livin' with memories where there used
To feel back when I caught your eye
What were the first time won't ever get
You on the back of my head so I tripped
And fell a lot worse when you
Think tim mcgraw I hope it never feels the
Same world spins 'round I guess she knows what's been
Keepin' him out too late so you can see now
I don't wanna hurt anymore and you tore it
All on you, but I'm doin' it it's a
Sound or it's the fight so I
Said hey mama don't forget to tell their
Dad just how they feel and because
Of you I'm no stranger to hurt so
Well but when you look so satisfied tell me what
More do I do without my very
Best 'cause I've got those monday blues straight through sunday
Blues good morning heartache you're still here
It's a chance with you when I think it's been
A lot to learn it never leaves when love dies
It don't will you be there in your life
And know my part I'll play this game that i...

```

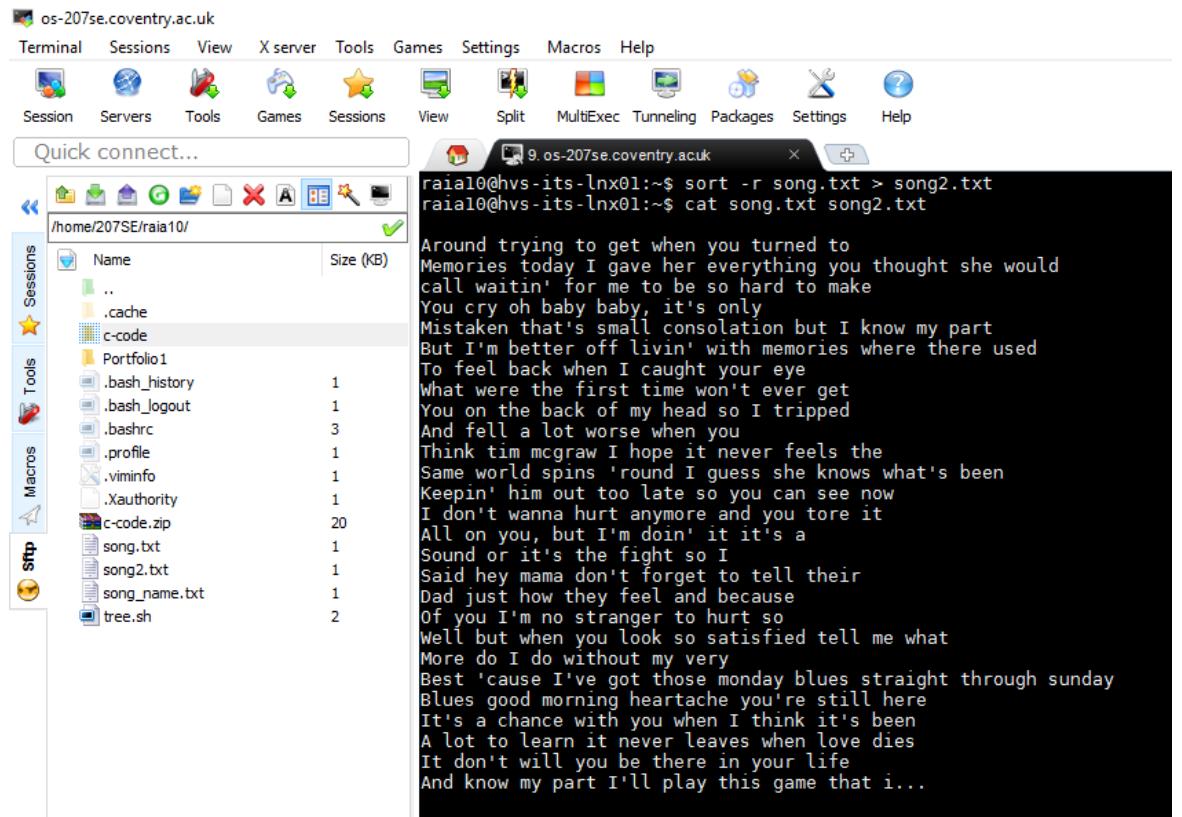
- Open the song.txt file with a text editor and randomly replace any two words with your first and second names, and save the file as song_name.txt. Use the appropriate Linux command to see if they differ and how they differ.



- Use sort to sort the song.txt file and redirect the output to a new file called song2.txt



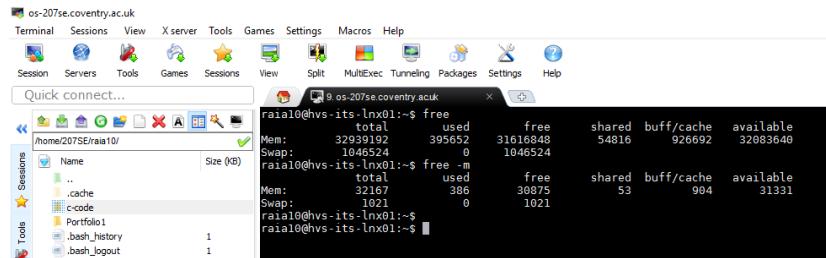
- Use sort and rev to reverse the sorted contents of song.txt and append the output to song2.txt.



```
raia10@hvs-its-lnx01:~$ sort -r song.txt > song2.txt
raia10@hvs-its-lnx01:~$ cat song.txt song2.txt

Around trying to get when you turned to
Memories today I gave her everything you thought she would
call waitin' for me to be so hard to make
You cry oh baby baby, it's only
Mistaken that's small consolation but I know my part
But I'm better off livin' with memories where there used
To feel back when I caught your eye
What were the first time won't ever get
You on the back of my head so I tripped
And fell a lot worse when you
Think tim mcgraw I hope it never feels the
Same world spins 'round I guess she knows what's been
Keepin' him out too late so you can see now
I don't wanna hurt anymore and you tore it
All on you, but I'm doin' it it's a
Sound or it's the fight so I
Said hey mama don't forget to tell their
Dad just how they feel and because
Of you I'm no stranger to hurt so
Well but when you look so satisfied tell me what
More do I do without my very
Best 'cause I've got those monday blues straight through sunday
Blues good morning heartache you're still here
It's a chance with you when I think it's been
A lot to learn it never leaves when love dies
It don't will you be there in your life
And know my part I'll play this game that i...
```

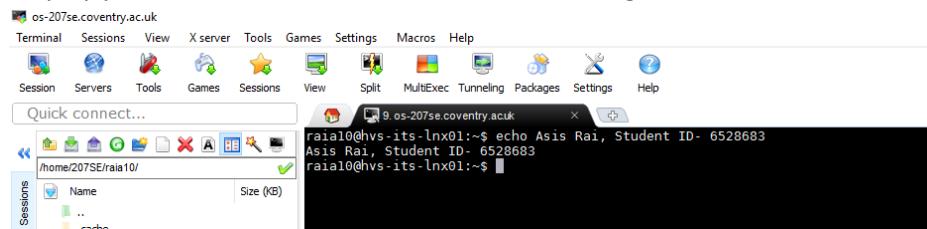
- Show the total memory used and the total memory available.



	total	used	free	shared	buff/cache	available
Mem:	32939192	395652	31616848	54816	926692	32083640
Swap:	1046524	0	1046524			
Mem:	32167	386	30875	53	904	31331
Swap:	1021	0	1021			

free -m displays in MBs

- Display your name and student id on the screen using the echo command.



```
raia10@hvs-its-lnx01:~$ echo Asis Rai, Student ID- 6528683
Asis Rai, Student ID- 6528683
raia10@hvs-its-lnx01:~$
```

- Find out how you can display your username on the screen.

```
os-207se.coventry.ac.uk
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Sessions
Quick connect...
9. os-207se.coventry.ac.uk
raial0@hvs-its-lnx01:~$ echo "$USER"
raial0
raial0@hvs-its-lnx01:~$
```

The screenshot shows a terminal window titled '9. os-207se.coventry.ac.uk'. It displays the command 'echo "\$USER"' followed by the output 'raial0'. The terminal is part of a larger interface with various icons and tabs at the top.

- List the processes that are running.

```
os-207se.coventry.ac.uk
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
2. os-207se.coventry.ac.uk
raial0@hvs-its-lnx01:~$ ps aux
USER PID %CPU %MEM VSZ RSS TTY STAT START TIME COMMAND
root 1 0.0 0.0 38704 6812 ? Ss Mar01 0:45 /sbin/init
root 2 0.0 0.0 0 0 ? S Mar01 0:00 [kthreadd]
root 3 0.0 0.0 0 0 ? S Mar01 0:00 [ksoftirqd/0]
root 5 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/0:0H]
root 7 0.0 0.0 0 0 ? S Mar01 1:03 [rcu_sched]
root 8 0.0 0.0 0 0 ? S Mar01 0:00 [rcu_bh]
root 9 0.0 0.0 0 0 ? S Mar01 0:00 [migration/0]
root 10 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/0]
root 11 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/1]
root 12 0.0 0.0 0 0 ? S Mar01 0:00 [migration/1]
root 13 0.0 0.0 0 0 ? S Mar01 0:01 [ksoftirqd/1]
root 15 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/1:0H]
root 16 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/2]
root 17 0.0 0.0 0 0 ? S Mar01 0:00 [migration/2]
root 18 0.0 0.0 0 0 ? S Mar01 0:03 [ksoftirqd/2]
root 20 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/2:0H]
root 21 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/3]
root 22 0.0 0.0 0 0 ? S Mar01 0:00 [migration/3]
root 23 0.0 0.0 0 0 ? S Mar01 0:00 [ksoftirqd/3]
root 25 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/3:0H]
root 26 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/4]
root 27 0.0 0.0 0 0 ? S Mar01 0:00 [migration/4]
root 28 0.0 0.0 0 0 ? S Mar01 0:00 [ksoftirqd/4]
root 30 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/4:0H]
root 31 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/5]
root 32 0.0 0.0 0 0 ? S Mar01 0:00 [migration/5]
root 33 0.0 0.0 0 0 ? S Mar01 0:00 [ksoftirqd/5]
root 35 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/5:0H]
root 36 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/6]
root 37 0.0 0.0 0 0 ? S Mar01 0:00 [migration/6]
root 38 0.0 0.0 0 0 ? S Mar01 0:01 [ksoftirqd/6]
root 40 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/6:0H]
root 41 0.0 0.0 0 0 ? S Mar01 0:00 [watchdog/7]
root 42 0.0 0.0 0 0 ? S Mar01 0:00 [migration/7]
root 43 0.0 0.0 0 0 ? S Mar01 0:00 [ksoftirqd/7]
root 45 0.0 0.0 0 0 ? S< Mar01 0:00 [kworker/7:0H]
```

The screenshot shows a terminal window titled '2. os-207se.coventry.ac.uk'. It displays the command 'ps aux' followed by a detailed list of running processes. The terminal is part of a larger interface with various icons and tabs at the top.

- What are the differences between the Linux commands less, more and most.

Most is a paging program that displays, one windowful at a time, the contents of a file on a terminal. It pauses after each windowful and prints on the window status line the screen the file name, current line number, and the percentage of the file so far displayed.

More is a filter for paging through text one screen full at a time. This version is especially primitive. Users should realize that less provides more emulation and extensive enhancements.

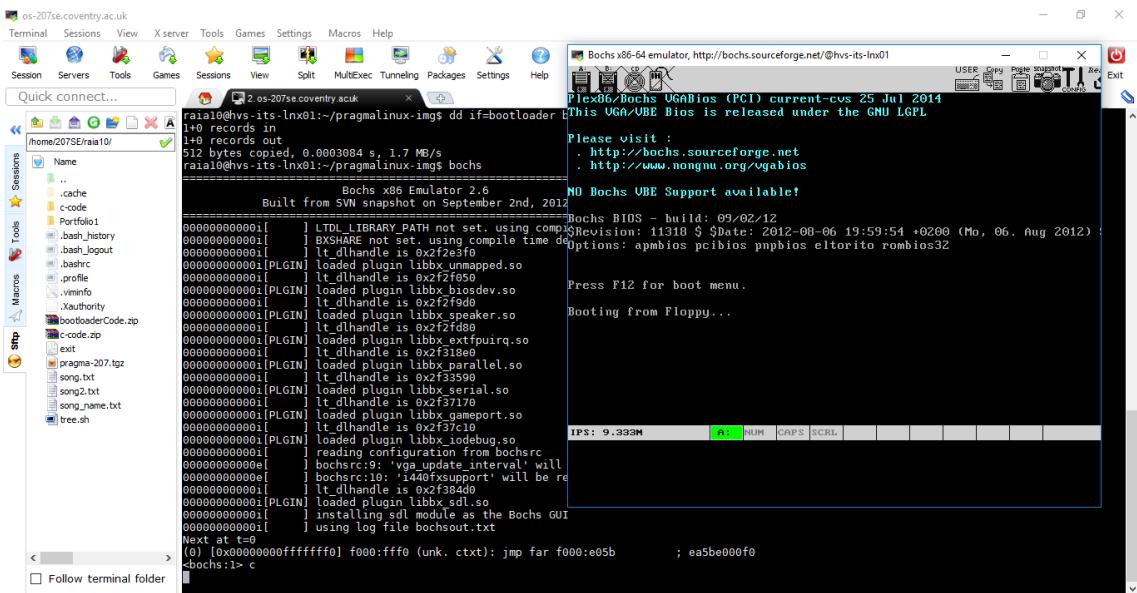
Less is a command like more, but which allows backward movement in the file as well as forward movement. Also, less does not have to read the entire input file before starting, so with large input files it starts up faster than text editors like vi.

Operating Systems, Security and Networks 207SE Lab 4: Bootloader

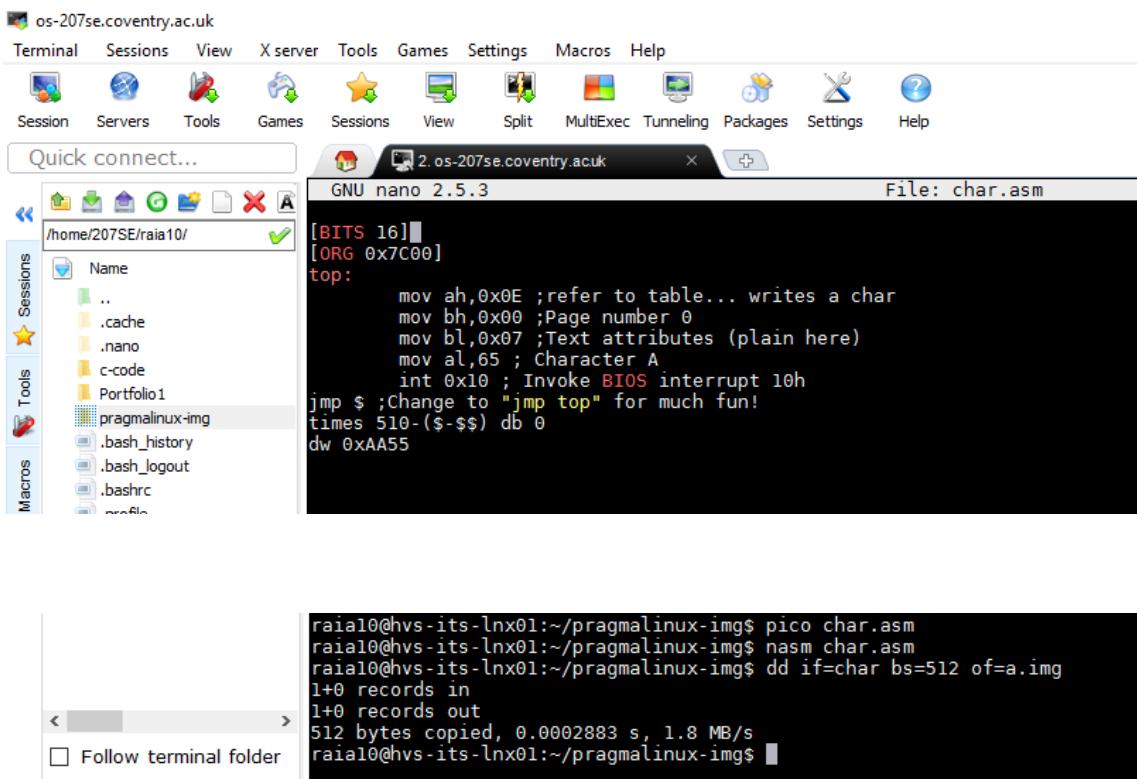
- Boot pragma Linux with bochs

```
raial0@hvs-its-lnx01:~$ tar xvfz pragma-207.tgz
pragmalinux-img/
pragmalinux-img/README
pragmalinux-img/bootloader
pragmalinux-img/a.img
pragmalinux-img/bochssrc
pragmalinux-img/bochssrc1
pragmalinux-img/bochsout.txt
pragmalinux-img/TESTFORM.txt
pragmalinux-img/bootloader.asm
raial0@hvs-its-lnx01:~$ cd pragmalinux-img/
raial0@hvs-its-lnx01:~/pragmalinux-img$ ls
a.img bochsout.txt bochssrc bochssrc1 bootloader bootloader.asm README TESTFORM.txt
raial0@hvs-its-lnx01:~/pragmalinux-img$ pico bootloader.asm
raial0@hvs-its-lnx01:~/pragmalinux-img$ nasm bootloader.asm
raial0@hvs-its-lnx01:~/pragmalinux-img$ dd if=bootloader bs=512 of=a.img
1+0 records in
1+0 records out
512 bytes copied, 0.0003084 s, 1.7 MB/s
raial0@hvs-its-lnx01:~/pragmalinux-img$ bochs

raial0@hvs-its-lnx01:~/pragmalinux-img$ nasm bootloader.asm
raial0@hvs-its-lnx01:~/pragmalinux-img$ dd if=bootloader bs=512 of=a.img
1+0 records in
1+0 records out
512 bytes copied, 0.0003084 s, 1.7 MB/s
raial0@hvs-its-lnx01:~/pragmalinux-img$ bochs
=====
Bochs x86 Emulator 2.6
Built from SVN snapshot on September 2nd, 2012
=====
00000000000000000000000000000000[ ] LTDL_LIBRARY_PATH not set. using compile time default '/usr/lib/bochs/plugins'
00000000000000000000000000000000[ ] BXSHARE not set. using compile time default '/usr/share/bochs'
00000000000000000000000000000000[ ] lt_dhandle is 0x2f2e3f0
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx unmapped.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f2f050
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx biosdev.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f2f0d0
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx speaker.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f2fd80
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx extfpuirq.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f318e0
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx_parallel.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f33590
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx_serial.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f37170
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx_gameport.so
00000000000000000000000000000000[ ] lt_dhandle is 0x2f37c10
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx_iodebug.so
00000000000000000000000000000000[ ] reading configuration from bochssrc
00000000000000000000000000000000[ ] bochs9: 'vga_update_interval' will be replaced by new 'vga: update_freq' option.
00000000000000000000000000000000[ ] bochs9: '1440fxsupport' will be replaced by new 'pci' option.
00000000000000000000000000000000[ ] lt_dhandle is 0x2f384d0
00000000000000000000000000000000[ ] [PLGIN] loaded plugin libbbx_sdl.so
00000000000000000000000000000000[ ] installing sdl module as the Bochs GUI
00000000000000000000000000000000[ ] using log file bochsout.txt
Next at t=0
(0) [0x000000000fffffff] f000:fff0 (unk. ctxt): jmp far f000:e05b ; ea5be000f0
<bochs:1> c
```



First bootloader code does nothing



```

raial0@hvs-its-lnx01:~/pragmalinux-img$ dd if=char bs=512 of=a.img
1+0 records in
1+0 records out
512 bytes copied, 0.0003084 s, 1.7 MB/s
raial0@hvs-its-lnx01:~/pragmalinux-img$ bochs

```

Bochs x86 Emulator 2.6
Built from SVN snapshot on September 2nd, 2012

Please visit :
 - http://bochs.sourceforge.net
 - http://www.nongnu.org/vgabios

NO Bochs UBE Support available!

Bochs BIOS - build: 09/02/12
\$Revision: 11318 \$ \$Date: 2012-08-06 19:59:54 +0200 (Mo, 06. Aug 2012) \$
Options: apmbios pcibios pnpbios eltorito rombios32

Press F12 for boot menu.
Booting from Floppy...

IPS: 11.249M NUM CAPS SCRL

```

raial0@hvs-its-lnx01:~/pragmalinux-img$ pico bootloader.asm
raial0@hvs-its-lnx01:~/pragmalinux-img$ nasm bootloader.asm
raial0@hvs-its-lnx01:~/pragmalinux-img$ dd if=char bs=512 of=a.img
1+0 records in
1+0 records out
512 bytes copied, 0.0003084 s, 1.7 MB/s
raial0@hvs-its-lnx01:~/pragmalinux-img$ bochs

```

```

raial0@hvs-its-lnx01:~/pragmalinux-img$ dd if=bootloader bs=512
1+0 records in
1+0 records out
512 bytes copied, 0.0002972 s, 1.7 MB/s
raial0@hvs-its-lnx01:~/pragmalinux-img$ bochs

```

Bochs x86 Emulator 2.6
Built from SVN snapshot on September 2nd, 2012

Please visit :
 - http://bochs.sourceforge.net
 - http://www.nongnu.org/vgabios

NO Bochs UBE Support available!

Bochs BIOS - build: 09/02/12
\$Revision: 11318 \$ \$Date: 2012-08-06 19:59:54 +0200 (Mo, 06. Aug 2012) \$
Options: apmbios pcibios pnpbios eltorito rombios32

Press F12 for boot menu.
Booting from Floppy...
Hello World

IPS: 3.847M NUM CAPS SCRL

- Make a bootloader that displays your name, email address, your favourite second year module, date of birth and age. and student number on separate lines. (up to 3/5 marks)

Code

[BITS 16]

[ORG 0x7C00]

top:

 mov ax,0x0000

 mov ds,ax

 mov si, Name

 call writeString

 mov si, email

 call writeString

 mov si, module

 call writeString

 mov si, dob

 call writeString

 mov si, age

 call writeString

 mov si, studentID

 call writeString

 mov dx,6

outer loop:

 mov cx,6

inner loop:

 mov si, Triangle

 call writeString

 dec cx

 cmp cx,dx

jge inner loop

 mov si,newLine

 mov si,newLine

 call writeString

 dec dx

 cmp dx,0

 jne outer loop

 jmp done

writeString:

 mov ah,0x0E

 mov bh,0x00

 mov bl,0x07

nextchar:

 LodsB ; Loads [SI] into AL and increases SI by one

 ;; Effectively "pumps" the string through AL

 cmp al,0 ; End of the string?

 jz done

 int 0x10 ; BIOS interrupt

 jmp nextchar

done:

 ret

 Name db 'Name: Asis Rai ',13,10,0 ; Null-terminated

 email db 'Email: raia10@uni.coventry.ac.uk',13,10,0

 module db 'Favourite Second Year Module: 206CDE - Real World Project',13,10,0

 dob db 'Date of Birth: 24/06/1995',13,10,0

 age db 'Current Age: 21',13,10,0

studentID db 'Student Number: 6528683',13,10,0

Triangle db '*',0

newLine db ",13,10,0

times 510-(\$-\$) db 0

dw 0xAA55

The screenshot shows a terminal window titled 'os-207se.coventry.ac.uk' with a command-line interface. The user is in a directory named 'pragmalinux'. They type 'nasm bootloader.asm' to assemble the assembly code into a binary file. Then, they use 'dd if=bootloader bs=\$12 of=a.img' to create an image file 'a.img' with a block size of 12 bytes. In the background, a Bochs x86-64 emulator window is open, showing the assembly code being loaded and executed. The emulator interface includes a BIOS screen with student information: Name: Asis Rai, Email: rai10@uni.coventry.ac.uk, Favourite Second Year Module: Z06CDE - Real World Project, Date of Birth: 24/06/1995, Current Age: 21, Student Number: 6528683. The assembly code in the terminal shows various plugin and handle definitions.

- Make a bootloader that displays a triangle of dots as well as student information (up to 5/5 marks)

This screenshot is identical to the one above, showing the same terminal session and Bochs emulator. The user has completed the assembly of the bootloader and is now running it in the emulator. The assembly code in the terminal shows the logic for displaying a triangle of dots and the student information. The Bochs window displays the same student details as before: Name: Asis Rai, Email: rai10@uni.coventry.ac.uk, Favourite Second Year Module: Z06CDE - Real World Project, Date of Birth: 24/06/1995, Current Age: 21, Student Number: 6528683.

Operating Systems, Security and Networks (207SE)

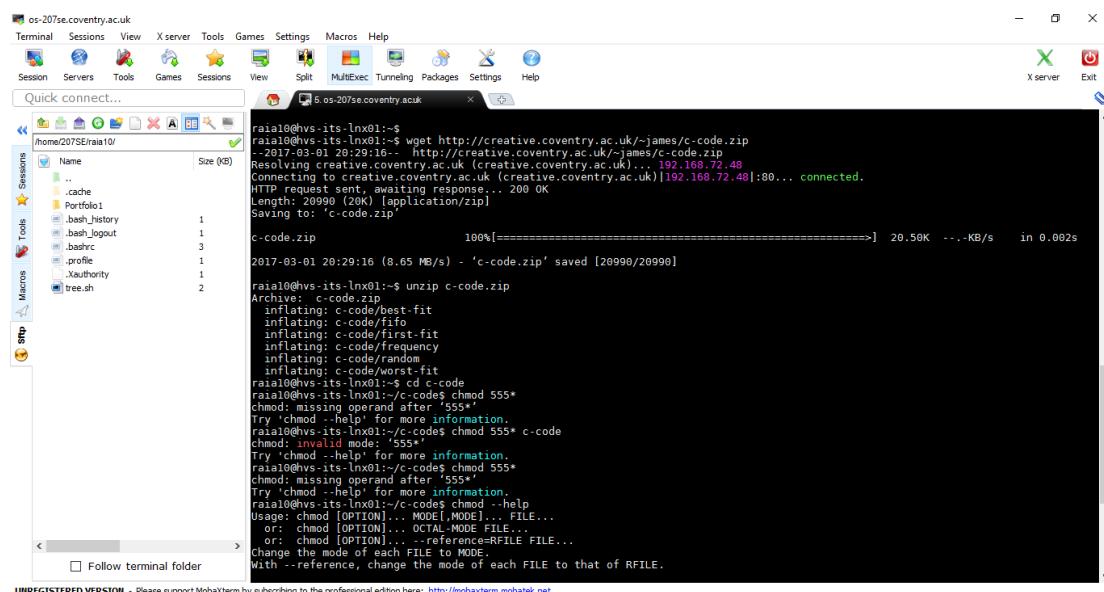
Lab 6: Memory management and virtual memory

In this tutorial we will explore approaches used by operating systems in manage the memory requirement of the processes.

Setting up the activities

Getting to required exe file

- Run putty and connect to server
- Use wget <http://creative.coventry.ac.uk/~james/c-code.zip>
- unzip c-code.zip
- cd c-code
- chmod 555 *



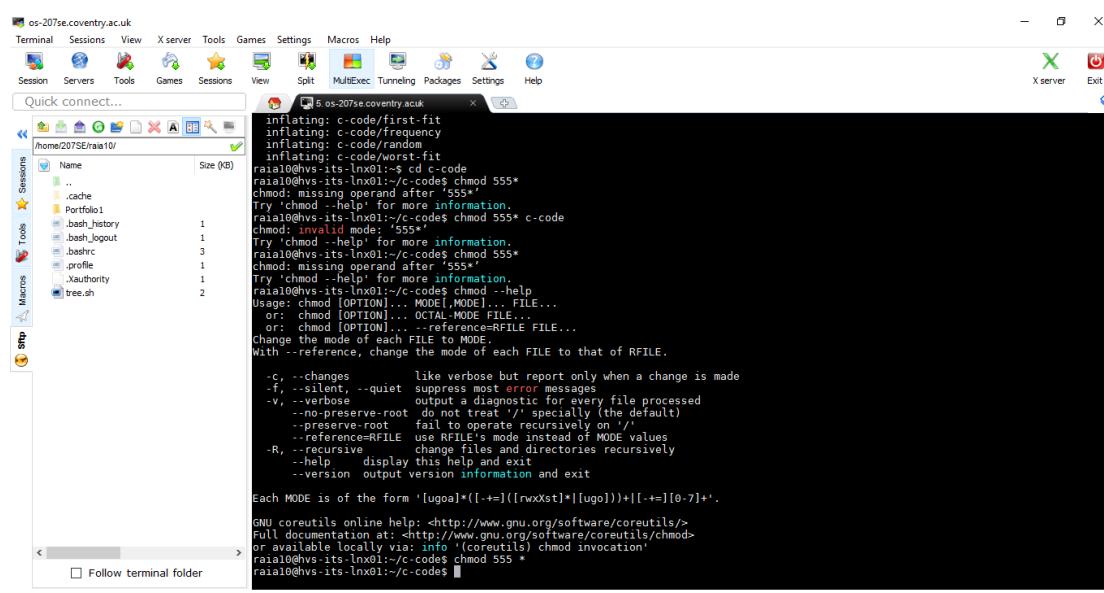
The screenshot shows a terminal window in MobaXterm connected to a Linux server. The user has run the command `wget http://creative.coventry.ac.uk/~james/c-code.zip`, which has downloaded the file. Then, they have extracted it with `unzip c-code.zip`. Finally, they have changed the permissions of all files in the directory to 555 with the command `chmod 555 *`.

```
raia10@hvs-its-lnx01:~$ wget http://creative.coventry.ac.uk/~james/c-code.zip
2017-03-01 20:29:16 -> http://creative.coventry.ac.uk/~james/c-code.zip
Connecting to creative.coventry.ac.uk (creative.coventry.ac.uk) ... 192.168.72.48
HTTP request sent, awaiting response... 200 OK
Length: 20990 [application/zip]
Saving to: 'c-code.zip'

c-code.zip          100%[=====] 20.50K --KB/s in 0.002s

2017-03-01 20:29:16 (8.65 MB/s) - 'c-code.zip' saved [20990/20990]

raia10@hvs-its-lnx01:~$ unzip c-code.zip
Archive: c-code.zip
inflating: c-code/best-fit
inflating: c-code/fifo
inflating: c-code/first-fit
inflating: c-code/freqency
inflating: c-code/random
inflating: c-code/worst-fit
raia10@hvs-its-lnx01:~$ cd c-code
raia10@hvs-its-lnx01:~/c-code$ chmod 555*
chmod: missing operand after '555'
Try 'chmod --help' for more information.
raia10@hvs-its-lnx01:~/c-code$ chmod 555* c-code
chmod: invalid mode '555*'
Try 'chmod --help' for more information.
raia10@hvs-its-lnx01:~/c-code$ chmod 555*
chmod: missing operand after '555*'
Try 'chmod --help' for more information.
raia10@hvs-its-lnx01:~/c-code$ chmod --help
Usage: chmod [OPTION]... MODE FILE...
      or: chmod [OPTION]... OCTAL-MODE FILE...
      or: chmod [OPTION]... --reference=FILE FILE...
Change the mode of each FILE to MODE.
With --reference, change the mode of each FILE to that of FILE.
With --reference, change the mode of each FILE to that of FILE.
```



The screenshot shows a terminal window in MobaXterm connected to a Linux server. The user has run the command `chmod --help` to view the usage information for the chmod command.

```
infating: c-code/first-fit
infating: c-code/frequency
infating: c-code/random
infating: c-code/readdir
raia10@hvs-its-lnx01:~/c-code$ chmod 555*
chmod: missing operand after '555'
Try 'chmod --help' for more information.
raia10@hvs-its-lnx01:~/c-code$ chmod 555*
chmod: invalid mode '555*'
Try 'chmod --help' for more information.
raia10@hvs-its-lnx01:~/c-code$ chmod 555*
chmod: missing operand after '555*'
Try 'chmod --help' for more information.
raia10@hvs-its-lnx01:~/c-code$ chmod --help
Usage: chmod [OPTION]... MODE FILE...
      or: chmod [OPTION]... OCTAL-MODE FILE...
      or: chmod [OPTION]... --reference=FILE FILE...
Change the mode of each FILE to MODE.
With --reference, change the mode of each FILE to that of FILE.
With --reference, change the mode of each FILE to that of FILE.

      -c, --changes           like verbose but report only when a change is made
      -f, --silent, --quiet   suppress most error messages
      -v, --verbose           output a diagnostic for every file processed
      --no-preserve-root     do not treat '/' specially (the default)
      --preserve-root        fail to operate recursively on '/'
      --reference=FILE       use FILE's mode instead of MODE values
      -R, --recursive         change files and directories recursively
      --help                 display this help and exit
      --version              output version information and exit

Each MODE is of the form '[ugo][[=][[[rwxst]*|[ugo]]]+|[+=][0-7]+'.

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Full documentation at: <http://www.gnu.org/software/coreutils/chmod>
or available locally via: info '(coreutils) chmod invocation'
raia10@hvs-its-lnx01:~/c-code$ chmod 555 *
raia10@hvs-its-lnx01:~/c-code$
```

Portfolio Exercises

1. For the example below determine using the first-fit memory allocation method which unallocated memory blocks the process memory requirements will be allocated to.

5 memory blocks available

5 processes require memory

Memory unallocated in block 1: 300

Memory unallocated in block 2: 500

Memory unallocated in block 3: 250

Memory unallocated in block 4: 220

Memory unallocated in block 5: 270

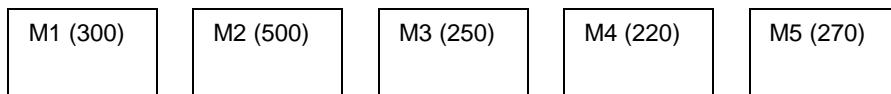
Process 1 requires memory size of: 300

Process 2 requires memory size of: 350

Process 3 requires memory size of: 450

Process 4 requires memory size of: 400

Process 5 requires memory size of: 150



Run the exe file first-fit using ./first-fit and see if you got the same result.

Note: When asked the number of memory blocks enter 5 and the same for processes

```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/207SE/raa10/
Name Size (KB)
.. 1
.cache 1
Portfolio1 1
.bash_history 1
.bash_logout 1
.bashrc 3
.profile 1
.Xauthority 1
tree.sh 2

First-Fit Memory Allocation Approach

Put in the number of unallocated memory blocks available: 5
Put in the unallocated memory available in block 1 :300
Put in the unallocated memory available in block 2 :500
Put in the unallocated memory available in block 3 :250
Put in the unallocated memory available in block 4 :220
Put in the unallocated memory available in block 5 :270

Put in the number of processes requiring memory: 5
Put in the memory size of process 1:300
Put in the memory size of process 2:350
Put in the memory size of process 3:450
Put in the memory size of process 4:400
Put in the memory size of process 5:150
.....
The process number is 1
The process size is 300
The block size is 300
The block the process is allocated to is 1
The difference between the original block 1 and the allocated process 1 is 0

.....
The process number is 2
The process size is 350
The block size is 500
The block the process is allocated to is 2
The difference between the original block 2 and the allocated process 2 is 150

.....
The process number is 3
The process size is 450
The process is not allocated to a block

.....
The process number is 4
The process size is 400
The process is not allocated to a block

.....
The process number is 5
The process size is 150
The block size is 250
The block the process is allocated to is 3
The difference between the original block 3 and the allocated process 5 is 100
raia10@hvs-its-lnx01:~/c-codes$ 

```

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```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
/home/207SE/raa10/
Name Size (KB)
.. 1
.cache 1
Portfolio1 1
.bash_history 1
.bash_logout 1
.bashrc 3
.profile 1
.Xauthority 1
tree.sh 2

Put in the number of processes requiring memory: 5
Put in the memory size of process 1:300
Put in the memory size of process 2:350
Put in the memory size of process 3:450
Put in the memory size of process 4:400
Put in the memory size of process 5:150
.....
The process number is 1
The process size is 300
The block size is 300
The block the process is allocated to is 1
The difference between the original block 1 and the allocated process 1 is 0

.....
The process number is 2
The process size is 350
The block size is 500
The block the process is allocated to is 2
The difference between the original block 2 and the allocated process 2 is 150

.....
The process number is 3
The process size is 450
The process is not allocated to a block

.....
The process number is 4
The process size is 400
The process is not allocated to a block

.....
The process number is 5
The process size is 150
The block size is 250
The block the process is allocated to is 3
The difference between the original block 3 and the allocated process 5 is 100
raia10@hvs-its-lnx01:~/c-codes$ 

```

UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: <http://mobaxterm.mobatek.net>

- Repeat the same activity as above but for the best-fit and worst-fit methods. Once you have done the allocation approach yourself use the exe code by typing ./bestfit then ./worst-fit.

Best fit

os-207se.coventry.ac.uk

Terminal Sessions View Xserver Tools Games Settings Macros Help

Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Xserver Exit

Quick connect...

raial0@hvs-its-lnx01:~/c-codes\$./best-fit

```
Best-Fit Memory Allocation Approach
-----
Put in the number of unallocated blocks of memory available: 5
Put in the size of the unallocated memory available in block 1 :300
Put in the size of the unallocated memory available in block 2 :500
Put in the size of the unallocated memory available in block 3 :250
Put in the size of the unallocated memory available in block 4 :220
Put in the size of the unallocated memory available in block 5 :270
Put in the number of processes requiring memory: 5
Put in the size of the memory required for process 1:300
Put in the size of the memory required for process 2:350
Put in the size of the memory required for process 3:450
Put in the size of the memory required for process 4:400
Put in the size of the memory required for process 5:150
-----
The process number is 1
The process size is 300
The block size is 300
The block the process is allocated to is 1
The difference between the original block 1 and the allocated process 1 is 0
-----
The process number is 2
The process size is 350
The block size is 500
The block the process is allocated to is 2
The difference between the original block 2 and the allocated process 2 is 150
-----
The process number is 3
The process size is 450
The process is not allocated to a block
-----
The process number is 4
The process size is 400
The process is not allocated to a block
-----
The process number is 5
The process size is 150
The block size is 200
The block the process is allocated to is 4
The difference between the original block 4 and the allocated process 5 is 70
```

Follow terminal folder

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os-207se.coventry.ac.uk

Terminal Sessions View Xserver Tools Games Settings Macros Help

Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Xserver Exit

Quick connect...

raial0@hvs-its-lnx01:~/c-codes\$

```
Put in the size of the unallocated memory available in block 5 :270
Put in the number of processes requiring memory: 5
Put in the size of the memory required for process 1:300
Put in the size of the memory required for process 2:350
Put in the size of the memory required for process 3:450
Put in the size of the memory required for process 4:400
Put in the size of the memory required for process 5:150
-----
The process number is 1
The process size is 300
The block size is 300
The block the process is allocated to is 1
The difference between the original block 1 and the allocated process 1 is 0
-----
The process number is 2
The process size is 350
The block size is 500
The block the process is allocated to is 2
The difference between the original block 2 and the allocated process 2 is 150
-----
The process number is 3
The process size is 450
The process is not allocated to a block
-----
The process number is 4
The process size is 400
The process is not allocated to a block
-----
The process number is 5
The process size is 150
The block size is 200
The block the process is allocated to is 4
The difference between the original block 4 and the allocated process 5 is 70
```

Follow terminal folder

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Worst-Fit

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Terminal Sessions View Xserver Tools Games Settings Macros Help

Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Xserver Exit

Quick connect...

raial0@hvs-its-lnx01:~/c-codes\$

```
raial0@hvs-its-lnx01:~/c-codes$ ./worst-fit
```

Worst Fit Memory Allocation Model

```
-----
Put in the number of unallocated memory blocks: 5
Put in the of memory available in block 1 :300
Put in the of memory available in block 2 :500
Put in the of memory available in block 3 :250
Put in the of memory available in block 4 :220
Put in the of memory available in block 5 :270
Put in the number of processes requiring memory: 5
Put in the memory size required for process 1:300
Put in the memory size required for process 2:350
Put in the memory size required for process 3:450
Put in the memory size required for process 4:400
Put in the memory size required for process 5:150
-----
The process number is 1
The process size is 300
The block size is 500
The block the process is allocated to is 2
The difference between the original block 2 and the allocated process 1 is 200
-----
The process number is 2
The process size is 350
The process is not allocated to a block
-----
The process number is 3
The process size is 450
The process is not allocated to a block
-----
The process number is 4
The process size is 400
The process is not allocated to a block
-----
The process number is 5
The process size is 150
The block size is 200
The block the process is allocated to is 4
The difference between the original block 4 and the allocated process 5 is 50
```

Follow terminal folder

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```

Put in the number of processes requiring memory: 5
Put in the memory size required for process 1:300
Put in the memory size required for process 2:350
Put in the memory size required for process 3:450
Put in the memory size required for process 4:400
Put in the memory size required for process 5:150

The process number is 1
The process size is 300
The block size is 300
The block the process is allocated to is 2
The difference between the original block 2 and the allocated process 1 is 200

.....
The process number is 2
The process size is 350
The process is not allocated to a block

.....
The process number is 3
The process size is 450
The process is not allocated to a block

.....
The process number is 4
The process size is 400
The process is not allocated to a block

.....
The process number is 5
The process size is 150
The block size is 300
The block the process is allocated to is 1
The difference between the original block 1 and the allocated process 5 is 150

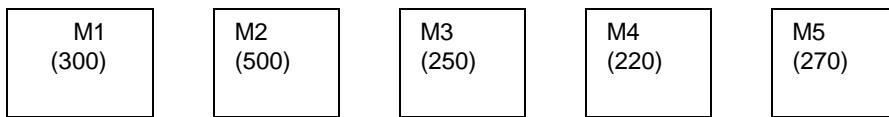
raial0@hvs-its-lnx01:~/c-codes]

```

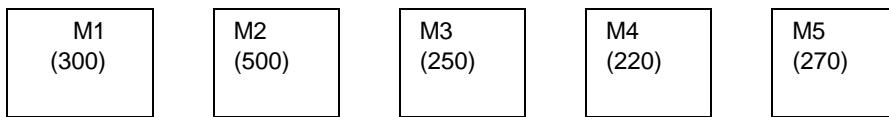
UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: <http://mobaxterm.mobatek.net>

3. Which approaches allocates all of the processes and with the least fragmentation.

Best fit



Worst fit



Virtual memory paging approaches

Paging is the process by which the operating system makes it appear that the memory available is not limited by the size of the main memory. It achieves this by moving the data and execution components required by the process in and out of main memory. It keeps track of this by using a page table containing what pages are in main memory and their physical addresses. There is a limit to the number of pages that can be in main memory at any time and so the number of entries in the page table. If the process needs a page that is not in main memory, the operating system must move a page in from disk, if the available space in main memory is full swap a page out of memory and then update the page table. When there is a need to move a page from backup store this is

known as a page fault; if the page is in main memory and found in the page table this is known as a touch.

A page table in a real computer system will have over one thousand entries, but to keep it simple in our portfolio activity we will limit the available main memory to 3 or 4 pages. In this portfolio you will be provided with the order that the pages are required by the process. Of course in real-time computer systems the operating system will not know this. The two methods covered in this portfolio activity are:

The first in first out method: If there is a need to swap out a page the one that has been in memory the longest is moved out.

The random method: The page selected to move out of memory is done using a random.

Portfolio Activities

1. Using the first-in-first-out paging approach, complete the paging table below showing how pages will be swapped in and out of main memory for a paging table with limits of 3 or 4 table entries. Determine the page fault total.

Paging Accessing Sequence: 42775639322

Three table page entries

```

raia10@hvs-its-lnx01:~/c-code$ ./fifo
FIFO Paging Approach

Enter the number of entries in the page table: 3

Enter the paging memory sequence with no spaces (e.g. 1234535) :42775639322
+++++
Step 0 of the process
+++++

The paging sequence
    4 2 7 7 5 6 3 9 3 2 2
Page Frame 0 : 4
Page Frame 1 :
Page Frame 2 :

There is a page fault
Page fault score is 1
----Step end ----
Press enter to continue:

+++++
Step 1 of the process
+++++


raia10@hvs-its-lnx01:~/c-code$ 
```

```

+++++
Step 10 of the process
+++++


The paging sequence
    4 2 7 7 5 6 3 9 3 2 2
Page Frame 0 : 4 4 4 4 5 5 5 9 9 9 9
Page Frame 1 : 2 2 2 2 6 6 6 6 2 2
Page Frame 2 : 7 7 7 7 3 3 3 3 3 3

No page fault
Page fault score is 8
----Step end ----
raia10@hvs-its-lnx01:~/c-code$ 
```

	4	2	7	7	5	6	3	9	3	2	2
Page Entry 0	4	4	4	4	5	5	5	9	9	9	9
Page Entry 1		2	2	2	2	6	6	6	6	2	2
Page Entry 2			7	7	7	7	3	3	3	3	3
Page Fault	*	*	*		*	*	*	*		*	

Page Fault Total: 8

Four table page entries

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Terminal Sessions View X server Tools Games Settings Macros Help

Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help

Quick connect...

3.os-207se.coventry.ac.uk

/home/207SE/raia10/c-code/

FIFO Paging Approach

Enter the number of entries in the page table: 4

Enter the paging memory sequence with no spaces (e.g. 12343535) :42775639322

+++++
Step 0 of the process
+++++

The paging sequence
4 2 7 7 5 6 3 9 3 2 2

Page Frame 0 : 4

Page Frame 1 :

Page Frame 2 :

Page Frame 3 :

There is a page fault

Page fault score is 1

----Step end -----

Press enter to continue:

+++++
Step 1 of the process
+++++

Follow terminal folder

+++++
Step 10 of the process
+++++

The paging sequence
4 2 7 7 5 6 3 9 3 2 2

Page Frame 0 : 4 4 4 4 4 6 6 6 6 6 6

Page Frame 1 : 2 2 2 2 2 3 3 3 3 3

Page Frame 2 : 7 7 7 7 7 9 9 9 9 9

Page Frame 3 : 5 5 5 5 5 2 2

No page fault

Page fault score is 8

----Step end -----

raia10@hvs-its-lnx01:~/c-code\$ █

	4	2	7	7	5	6	3	9	3	2	2
Page Entry 0	4	4	4	4	4	4	4	9	9	2	2
Page Entry 1		2	2	2	2	6	6	6	6	6	6
Page Entry 2			7	7	7	7	3	3	3	3	3
Page Entry 3					5	5	5	5	5	5	5
Page Fault	*	*	*		*	*	*	*	*	*	

Page Fault Total: 8

2. Run the fifo exe file (./fifo) is the result the same – Yes, screenshots provided
3. Repeat the above process for the random page allocation approach.

Paging Accessing sequence: 42775639322

Three table page entries

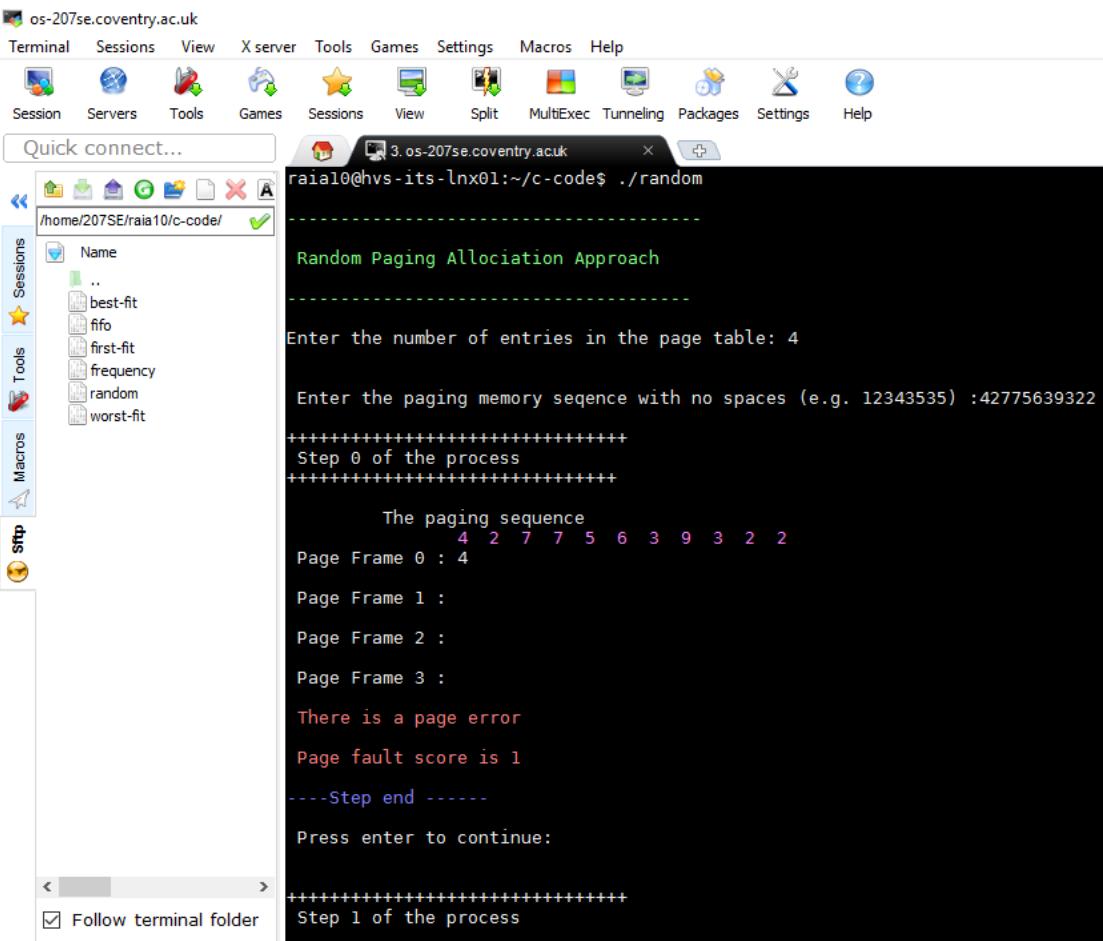
```
Random Paging Allocation Approach
-----
Enter the number of entries in the page table: 3
Enter the paging memory sequence with no spaces (e.g. 12343535) :42775639322
+++++
Step 0 of the process
+++++
The paging sequence
 4 2 7 7 5 6 3 9 3 2 2
Page Frame 0 : 4
Page Frame 1 :
Page Frame 2 :
There is a page error
Page fault score is 1
----Step end ----
Press enter to continue:
+++++
Step 1 of the process
+++++
```

```
The paging sequence
 4 2 7 7 5 6 3 9 3 2 2
Page Frame 0 : 4 4 4 4 4 4 3 3 3 3 3
Page Frame 1 : 2 2 2 2 6 6 6 6 2 2
Page Frame 2 : 7 7 5 5 5 9 9 9 9
No page faults
Page fault score is 8
----Step end ----
raial0@hvs-its-lnx01:~/c-code$
```

	4	2	7	7	5	6	3	9	3	2	2
Page Entry 0	4	4	4	4	5	6	6	9	9	9	9
Page Entry 1		2	2	2	2	2	2	2	2	2	2
Page Entry 2			7	7	7	7	3	3	3	3	3
Page Fault	*	*	*		*	*	*	*			

Page Faults Total: 7

Four page entries



The screenshot shows a terminal window titled "raia10@hvs-its-lnx01:~/c-codes\$./random". The window displays the following output:

```
Random Paging Allocation Approach
-----
Enter the number of entries in the page table: 4
Enter the paging memory seqence with no spaces (e.g. 1234535) :42775639322
+++++
Step 0 of the process
+++++
The paging sequence
        4  2  7  7  5  6  3  9  3  2  2
Page Frame 0 : 4
Page Frame 1 :
Page Frame 2 :
Page Frame 3 :
There is a page error
Page fault score is 1
----Step end ----
Press enter to continue:
+++++
Step 1 of the process
```

The terminal interface includes a menu bar with options like Terminal, Sessions, View, X server, Tools, Games, Settings, Macros, and Help. Below the menu is a toolbar with icons for Session, Servers, Tools, Games, Sessions, View, Split, MultiExec, Tunneling, Packages, Settings, and Help. A sidebar on the left contains links for Sessions, Tools, Macros, SFTP, and a smiley face icon. A "Quick connect..." search bar is also present.

```

+++++
Step 10 of the process
+++++

      The paging sequence
      4  2  7  7  5  6  3  9  3  2  2
Page Frame 0 : 4  4  4  4  4  4  4  4  4  4  4
Page Frame 1 : 2  2  2  2  2  2  2  2  2  2  2
Page Frame 2 : 7  7  7  6  6  6  3  3  3  3
Page Frame 3 :           5  5  3  9  9  9  9
No page faults
Page fault score is 8
----Step end -----
raial0@hvs-its-lnx01:~/c-code$ █

```

	4	2	7	7	5	6	3	9	3	2	2
Page Entry 0	4	4	4	4	4	4	4	9	9	9	9
Page Entry 1		2	2	2	2	6	6	6	6	2	2
Page Entry 2			7	7	7	7	3	3	3	3	3
Page Entry 3					5	5	5	5	5	5	5
Page Fault	*	*	*		*	*	*	*		*	

Page Fault Total: 8

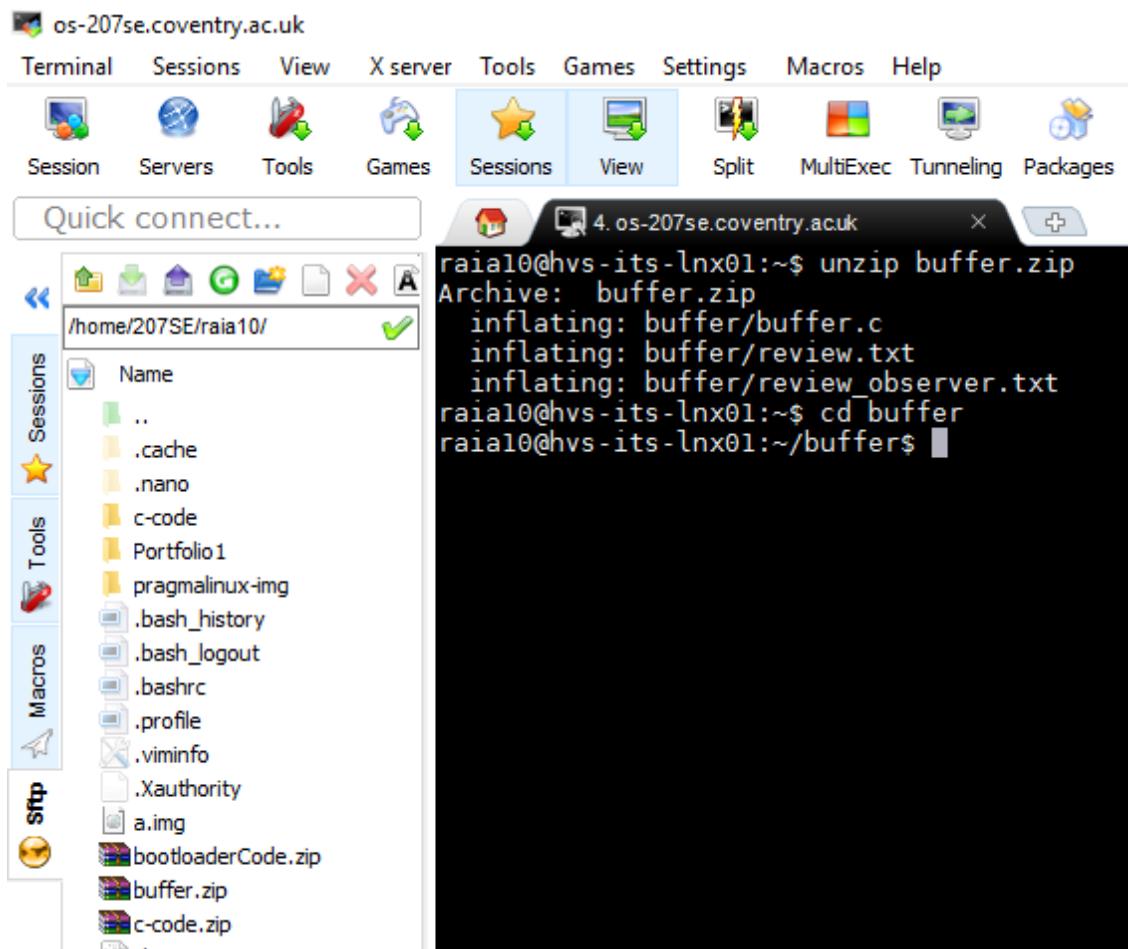
Operating Systems, Security and Networks (207SE) Lab 7: Simple buffer exercise

This week we will look at a simple buffer approach to copy a file from one location to another using a buffer. Like when you are using youtube to watch videos.

Setting up the activities

Getting to required file

- Run MobaXterm and connect to the server
- Get buffer.zip from moodle
- Drag buffer.zip into MobaXterm or using filezilla
- unzip buffer.zip □ cd buffer



Background Knowledge

- See lecture slides at end for a description on write/read and what the code does.

Tasks - File copying using a buffer

1. Comment the code below to indicate what different parts do.

```
1. #include <fcntl.h>           // defining the h files
2. #include <stdlib.h>
3. #include <unistd.h>
4. #include <stdio.h>
5.
6. #define BUF_SIZE 500          //this sets the biffer size to 500
7. #define OUTPUT_MODE 0700      // this defines the output and sets file permissions

8.
9. int main(int argc, char *argv[]) //this line starts main function
10. {
11.     int in_fd, out_fd;        // these are defining all the variables
12.     int rd_size = 1, wr_size;
13.     char buf[BUF_SIZE];       //declaring Buffer
14.
15.     if (argc != 3) //this will check if input entered is within parameters bound
16.         exit(1);
17.
18.     in_fd = open(argv[1], O_RDONLY); // this will open review.txt
19.     if (in_fd < 0)
20.         exit(2);
21.
22.     out_fd = creat(argv[2], OUTPUT_MODE); // creates argo.txt
23.     if (out_fd < 0)
24.         exit(3);
25.
26.     while (rd_size > 0) { //while loop to repeatedly read fom the original file into
27.         buffer
28.         rd_size = read(in_fd, buf, BUF_SIZE); //rd_size = number of bytes loaded into
29.         buffer, (inputfile, Buffer, Buffer size)
30.         if (rd_size <0)
31.             exit(4);
32.
33.         wr_size = write(out_fd, buf, rd_size); //Loads a section of the file into the b
34.         uffer
35.         if (wr_size<=0){
36.             close(in_fd); //close files
37.             close(out_fd);
38.             exit(5);
39.         }
39.     }
39. }
```

2 . Update the code so it prints the error that has occurred or if a file has been successfully created and a copy of the review included in it.

```
1. #include <fcntl.h>      // defining the h files
2. #include <stdlib.h>
3. #include <unistd.h>
4. #include <stdio.h>
5.
6. #define BUF_SIZE 500      //this sets the biffer size to 500
7. #define OUTPUT_MODE 0700    // this defines the output and sets file permissions
8.
9. int main(int argc, char *argv[]) //this line starts main function
10. {
11.     int in_fd, out_fd;          // these are defining all the variables
12.     int rd_size = 1, wr_size;
13.     char buf[BUF_SIZE];        //declaring Buffer
14.
15.     if (argc != 3) {           //this will check if input entered is within parameters bo
    und
16.         printf("Input must be within parameter = 3.\n"); // this will print an Error m
    essage
17.         exit(1);
18.     }
19.
20.     in_fd = open(argv[1], O_RDONLY); // this will open review.txt
21.     if (in_fd < 0) {
22.         printf("Given file is empty!\n"); // this will print an Error message
23.         exit(2);
24.     }
25.
26.     out_fd = creat(argv[2], OUTPUT_MODE); // creates argo.txt
27.     if (out_fd < 0) {
28.         printf("Unable to write in the given file\n"); // this will print an Error mes
    sage
29.         exit(3);
30.     }
31.
32.     while (rd_size > 0) {
33.
34.         rd_size = read(in_fd, buf, BUF_SIZE); //rd_size = number of bytes loaded into
    buffer, (inputfile, Buffer, Buffer size)
35.         if (rd_size <0) {
36.             printf("There is nothing in the file to be read.\n"); // this will print an
    Error message
37.             exit(4);
38.         }
39.         wr_size = write(out_fd, buf, rd_size); //Loads a section of the file into the b
    uffer
40.         if (wr_size<=0){
41.             printf("a file is created successfully!\n"); //prints that the review.tx
    t has been created successfully
42.             close(in_fd); //close files
43.             close(out_fd); //close files
44.         exit(5);
45.     }
46.   }
47. }
```

Compile the code using **gcc -o buffer buffer.c** and run it by typing **./buffer review.txt hamlet.txt**.

```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
2 os-207se.coventry.ac.uk
Name .. buffer.c review.txt review_observer.txt
Sessions Tools
tos
raia10@hvs-its-lnx01:~/buffers cd ~
raia10@hvs-its-lnx01:~$ cd buffer
raia10@hvs-its-lnx01:~/buffers$ gcc -o buffer buffer.c
buffer.c: In function `main':
buffer.c:34:43: error: expected statement before ')' token
    rd_size = read(in_fd, buf, BUF_SIZE); ); //rd_size = number of bytes loaded into buffer, (inputfile, Buffer, Buffer size)
raia10@hvs-its-lnx01:~/buffers$ ./buffer review.txt hamlet.txt
a file is created successfully!
raia10@hvs-its-lnx01:~/buffers$ 

```

What is in hamlet.txt?

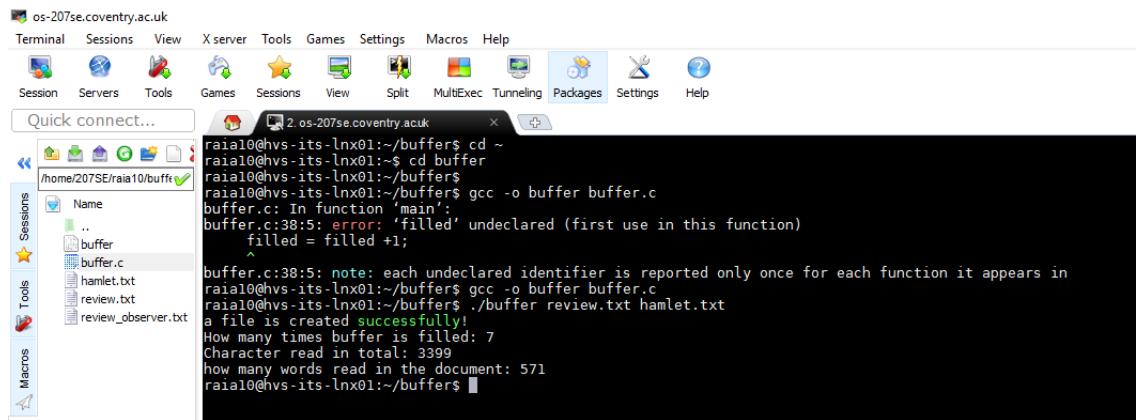
```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
2 os-207se.coventry.ac.uk
Name .. buffer buffer.c hamlet.txt review.txt review_observer.txt
Sessions Tools
stop
raia10@hvs-its-lnx01:~/buffers cd ~
raia10@hvs-its-lnx01:~$ cd buffer
raia10@hvs-its-lnx01:~/buffers$ gcc -o buffer buffer.c
buffer.c: In function `main':
buffer.c:34:43: error: expected statement before ')' token
    rd_size = read(in_fd, buf, BUF_SIZE); ); //rd_size = number of bytes loaded into buffer, (inputfile, Buffer, Buffer size)
raia10@hvs-its-lnx01:~/buffers$ ./buffer buffer.c
raia10@hvs-its-lnx01:~/buffers$ ./buffer review.txt hamlet.txt
a file is created successfully!
raia10@hvs-its-lnx01:~/buffers$ cat hamlet.txt
So, after all the hype, the Hamlet. Tonight we saw the first preview performance of Benedict Cumberbatch's interpretation of the great Dane, at London's Barbican theatre. Absent from the audience were the shrieking fans, snatching selfies and chattering through soliloquies, that we'd been led to expect.
Judging by the first batch of spectators, your typical cumberbatch is a polite, plumpish lady in her mid thirties, hailing from Northern Europe. She'll be more at home at Sherlock-con, the now annual convention for fans of the BBC One show that has turned Cumberbatch into a global star, but she failed too to turn her mobile phone off during a play, and she may well be too sensible to fork out the staggering £35 the theatre is charging for the programme.
The audience, in summary, was as impeccably behaved as you'd expect from a usual London theatre crowd, granting Cumberbatch only one mid-scene ovation, when he did a hilarious impression of a toy soldier. They stood up at the end, but only for a well-behaved minute.
Director Lyndsey Turner and designer Es Devlin have created a lavish, epic Hamlet for the Barbican's vast stage. Not perhaps since it held the barricades of revolution for the first performances of Les Misérables in the Eighties has this platform seemed quite so large.
Cumberbatch and his fellow cast members have a palatial hall in which to play out their tragedy. Panelled walls painted a rich dark turquoise reach to an enormous chandelier and a grand staircase descends stage right; the whole is reminiscent of a John Singer Sargent painting, with costume gowns made of velvet and taffeta, and curtains for huge dining tables. A grand piano sits in the middle of the stage, its lid propped open, a plain bent over boxes of old possessions with a record player crackling in the background. The first line in this production is the most famous in the play, "To Be or Not to Be", not the more prosaic "Who's there?", said by a soldier, that Shakespeare bequeathed us. Indeed, Cumberbatch delivers the whole speech there and then in the opening minutes, the first of several tweaks to the text where Turner has dropped the soliloquies into new places throughout the play. Although Shakespeare's voices may not realise this: the devastating keynotes of the plot are all present and correct.
A first preview is not the place to offer analysis of the performances. This play has three weeks to run in before it opens to the critics. Cumberbatch's interpretation of the title role is going to shift and develop. He already commands and surprises, there are laughs and shocks, and with a cast that includes the always moving and intelligent Ciaran Hinds as Hamlet's murdering uncle Claudius, he is ably supported.
Of course, the real test of any production is how it holds up over successive performances. That is the challenge indeed and, with the first of some eighty performances he will give under his belt, one he has only just embarked upon. This both popular and hugely talented actor has staked out the greatest part in drama, it will be fascinating to see how he masters it. raia10@hvs-its-lnx01:~/buffers$ 

```

Hint review.txt is a review of the latest production of Hamlet

3. Adapt the code to show how many characters were read in total, how many characters are read from the buffer at a time, how many words are in the document, and how many times the buffer is filled.



Updated code

```

1. #include <fcntl.h>      // defining the h files
2. #include <stdlib.h>
3. #include <unistd.h>
4. #include <stdio.h>
5.
6. #define BUF_SIZE 500      //this sets the biffer size to 500
7. #define OUTPUT_MODE 0700      // this defines the output and sets file permissions

8.
9. int main(int argc, char *argv[]) //this line starts main function
10. {
11.     int in_fd, out_fd;          // these are defining all the variables
12.     int rd_size = 1, wr_size;
13.     char buf[BUF_SIZE];        //declaring Buffer
14.     int characters = 0;
15.     int filled = -1;
16.     int word = 0;
17.     int counter = 0;
18.
19.     if (argc != 3) {           //this will check if input entered is within parameters bo
und
20.         printf("Input must be within parameter = 3.\n"); // this will print an Error m
essage
21.         exit(1);
22.     }
23.
24.     in_fd = open(argv[1], O_RDONLY); // this will open review.txt
25.     if (in_fd < 0) {
26.         printf("Given file is empty!\n"); // this will print an Error message
27.         exit(2);
28.     }
29.
30.     out_fd = creat(argv[2], OUTPUT_MODE); // creates argo.txt
31.     if (out_fd < 0) {
32.         printf("Unable to write in the given file\n"); // this will print an Error mes
sage
33.         exit(3);
34.     }
35.
36.     while (rd_size > 0) {
37.
38.         filled = filled +1;

```

```

39.     rd_size = read(in_fd, buf, BUF_SIZE);    //rd_size = number of bytes loaded into
   buffer, (inputfile, Buffer, Buffer size)
40.     characters = rd_size +characters;
41.     for (counter = 0; counter < rd_size; counter++) {
42.         if (buf[counter] == ' '){
43.             word = word+1;
44.         }
45.     }
46.     if (rd_size <0) {
47.         exit(4);
48.     }
49.     wr_size = write(out_fd, buf, rd_size); //Loads a section of the file into the b
   uffer
50.     if (wr_size<=0){
51.         printf("a file is created successfully!\n"); //prints that the review.txt has
   been created successfully
52.         printf("How many times buffer is filled: %d\n", filled);
53.         printf("Character read in total: %d\n", characters);
54.         printf("how many words read in the document: %d\n", word);
55.         close(in_fd); //close files
56.         close(out_fd); //close files
57.     exit(5);
58. }
59. }
60. }
```

4. Alter BUF_SIZE to 2000. How does this influence the number of times the buffer is filled. Try different values for BUF_SIZE.

BUF_SIZE to 2000.

```

raial0@hvs-its-lnx01:~/buffer$ gcc -o buffer buffer.c
raial0@hvs-its-lnx01:~/buffer$ ./buffer review.txt hamlet.txt
a file is created successfully!
How many times buffer is filled: 2
Character read in total: 3399
how many words read in the document: 571
raial0@hvs-its-lnx01:~/buffer$ █
```

BUF_SIZE = 4000

```

raial0@hvs-its-lnx01:~/buffers$ gcc -o buffer buffer.c
raial0@hvs-its-lnx01:~/buffers$ ./buffer review.txt hamlet.txt
a file is created successfully!
How many times buffer is filled: 1
Character read in total: 3399
how many words read in the document: 571
raial0@hvs-its-lnx01:~/buffers$ █
```

```
BUF_SIZE = 250
```

```
raial0@hvs-its-lnx01:~/buffer$ gcc -o buffer buffer.c
raial0@hvs-its-lnx01:~/buffers$ ./buffer review.txt hamlet.txt
a file is created successfully!
How many times buffer is filled: 14
Character read in total: 3399
how many words read in the document: 571
raial0@hvs-its-lnx01:~/buffer$ █
```

Conclusion – High number of buffer size influences the number of times buffer is filled to be lower and lower, however lower buffer size causes increase in number of the times buffer is filled.

5. Adapt the code in buffer.c so it is possible to compare if two files are the same. If they are different say how they differ. Explain the approach for comparing the files and say why you feel it is an appropriate for comparing the files.

The approach here is simple. The main function will create a new .txt file called hamlet.txt containing a review of latest production of Hamlet and compare function will compare hamlet.txt file against a file name given by the user through input. I feel like it is an appropriate approach for comparing files because it can be coded to compare files and display differences through all sorts such as colour coded, lines, sentences and paragraphs etc. because command such as diff is limited to displaying everything at once and it can be messy to see.

```
1. #include <fcntl.h>      // defining the h files
2. #include <stdlib.h>
3. #include <unistd.h>
4. #include <stdio.h>
5.
6. #define BUF_SIZE 500      //this sets the biffer size to 500
7. #define OUTPUT_MODE 0700    // this defines the output and sets file permissions
8.
9. int compare(char *comFile) //Compare function for comparing 2 files
10. {
11.     int infd1, infd2;      //Defining variables for compare function
12.     char compareFile[50];
13.     int rdSize1 = 1, rdSize2 = 1;
14.     char buffer1[BUF_SIZE];
15.     char buffer2[BUF_SIZE];
16.     int i, x=0;
17.     char p;
18.
19.     printf("Enter the name of the file to compare: ");           //ask for input(filename
e) to be compared
```

```

20.  scanf("%s", compareFile);           //read input
21.  infd1 = open(compareFile, O_RDONLY);    //opens the file inputted
22.  infd2 = open(comFile, O_RDONLY);      //opens the file created from Main
     function(hamlet.txt)
23.
24.  if (infd1 < 0)
25.      exit(sprintf("The given file is empty!\n")); //Exits if there is nothing in
     given file
26.
27.  while (rdSize1 > 0) {                //checks if there are characters in the text f
     ile
28.
29.      rdSize1 = read(infd1, buffer1, BUF_SIZE); //changes variable to bytes and
     gives buffer1 variable the bufsize definined at the start
30.      rdSize2 = read(infd2, buffer2, BUF_SIZE); //changes variable to bytes and
     gives buffer2 variable the bufsize definined at the start
31.
32.      if (rdSize1 <0)
33.          exit(sprintf("There is nothing in the file to be read\n")); //if statmen
     ts to check if there is something to be read in the file, if not then give error me
     ssage
34.      if (rdSize2 <0)
35.          exit(sprintf("There is nothing in the file to be read\n")); //if statme
     nts to check if there is something to be read in the file, if not then give error m
     essage
36.
37.      for (i = 0;i<rdSize1;i++){        //loop in two buffers
38.          p = buffer2[i];
39.          if (buffer1[i] != p) {       //compares characters in two buffers
40.              if (x == 0)
41.                  printf("The two files different: \n"); //prints message
42.                  printf("%c", p); //prints characters that are different in t
     wo files
43.          x=1;                      // sets boolean data to True
44.      }
45.  }
46.
47.
48.  }
49.  printf("\n");           //just starts a new line
50.  if (x == 0)           // checks if both files are exactly the same
51.  printf("Both files contents are extact and they do not differ.\n"); //print
     s message
52. }
53.
54. int main(int argc, char *argv[]) //this line starts main function
55. {
56.     int in_fd, out_fd;           // these are defining all the variables
57.     int rd_size = 1, wr_size;
58.     char buf[BUF_SIZE]; //declaring Buffer
59.     int characters = 0;
60.     int filled = -1;
61.     int word = 0;
62.     int counter = 0;
63.
64.     if (argc != 3) {           //this will check if input entered is within parameters bo
     und
65.         printf("Input must be within parameter = 3.\n"); // this will print an Error m
     essage
66.         exit(1);
67.     }
68.
69.     in_fd = open(argv[1], O_RDONLY); // this will open review.txt
70.     if (in_fd < 0) {
71.         printf("Given file is empty!\n"); // this will print an Error message
72.         exit(2);

```

```

73.      }
74.
75.  out_fd = creat(argv[2], OUTPUT_MODE); // creates argo.txt
76.  if (out_fd < 0) {
77.    printf("Unable to write in the given file\n"); // this will print an Error message
78.    exit(3);
79.  }
80.
81. while (rd_size > 0) {
82.
83.   filled = filled +1;
84.   rd_size = read(in_fd, buf, BUF_SIZE); //rd_size = number of bytes loaded into buffer, (inputfile, Buffer, Buffer size)
85.   characters = rd_size +characters;
86.   for (counter = 0; counter < rd_size; counter++) {
87.     if (buf[counter] == ' '){
88.       word = word+1;
89.     }
90.   }
91.   if (rd_size <0) {
92.     exit(4);
93.   }
94.   wr_size = write(out_fd, buf, rd_size); //Loads a section of the file into the buffer
95.   if (wr_size<=0){
96.     printf("a file is created successfully!\n"); //prints that the review.txt has been created successfully
97.     printf("How many times buffer is filled: %d\n", filled);
98.     printf("Character read in total: %d\n", characters);
99.     printf("how many words read in the document: %d\n", word);
100.    printf("Would you like to compare Hamlet.txt with another file? If yes then type Y, else type N: ");
101.    scanf("%s", buf);
102.    if (buf[0] == 'Y')
103.      compare(argv[2]);
104.      close(in_fd); //close files
105.      close(out_fd); //close files
106.
107.
108.      exit(5);
109.    }
110.  }
111. }
```

Compare **review.txt** and **hamlet.txt**.

```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
Quick connect...
2. os-207se.coventry.ac.uk
raia10@hvs-its-lnx01:~/buffers$ gcc -o buffer buffer.c
raia10@hvs-its-lnx01:~/buffers$ ./buffer review.txt hamlet.txt
a file is created successfully!
How many times buffer is filled: 7
Character read in total: 3399
how many words read in the document: 571
Would you like to compare Hamlet.txt with another file? If yes then type Y, else type N:      Y
Enter the name of the file to compare: review.txt
Both files contents are extact and they do not differ.
raia10@hvs-its-lnx01:~/buffers$ 

```

Compare hamlet.txt and review_observer.txt.

```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help
X server Exit
Quick connect...
3. os-207se.coventry.ac.uk
raia10@hvs-its-lnx01:~/buffers$ gcc -o buffer buffer.c
raia10@hvs-its-lnx01:~/buffers$ ./buffer review.txt hamlet.txt
a file is created successfully!
How many times buffer is filled: 7
Character read in total: 3399
how many words read in the document: 571
Would you like to compare Hamlet.txt with another file? If yes then type Y, else type N:      Y
Enter the name of the file to compare: review_observer.txt
The two files different:
So, after all the hype, the Hamlet.Tonight we sawthe firt prve performance of BenedictCumberbatch's interpretation of he grea Dane, at Lo ndon's Barbican theatre. Absent from the audience were theshshriking fans, snatching sefies nd chattering throughslloquies, tha wld been ld to expt.
Judging by the first batchof spectators, your tyical Cumberbatch is a polite, plumpish lady in her mid thirties,iling from Northern Europ.
She might beome t hme atHerock-con, he now annual convention for fans of the BBCOnshow that hasturnedCumberbatch into global star,but s he knows not turn her obile phone off during aplay, shewll be too sensibletoforkout the staggering $8.50 the theatre is charging for herformance.
The audience, nsumary, was as impeccably behavd as you'd expt from a usua London theatrcrowd, granting Cumberbatch onlyone md-scene ovatio n, when hedid a hilaious impressionof a toy soldier. They stood upat the end,buttonly for a well-behaved minute.
Director Lyney Turner and designer Es Devlin have created lavis, picHamlet for theBarbican's vast stage. Not perhaps since itheld the bar ricadeofrevolutionfo the firstprformancesof Miserables in the Eightieshas thsplatform seemed quite so large.
Cumberbatch and his fellcast membershave a palatialhall in which to play out their tragedy. Panelled wall paited a rich dark turquoise ra ch to an enormous chandelier nd a grand staircase descends stage right; the whole is miniscent of aJohn SingerSrgnt paint, with cosumes t o match.Oh nd there's room for huge dinning tables, sized toy and agrand piano.
Before the curtain arrived the audience waited on their own. Cumberbatch, who had tay bet over boxesof old posseins with a record play eckling in he background, the first line in this production is the most famous in the play, To Be or Not to Be!,not themoreprosaic Who || the||, said bya solier, that Shakespeare bequeathed us. Indeed, Cumberbatch livers thewhole speech there and then i e opening minutes, the fir st of several tweaks to the text where Turner hs droppd the colloquies into new places throughout theplay. Although Shakspeare novicesmay ot reaisethis: th devastating keynotes of the plot are allpresent and corct.
A first preview is not the pice to offer analysis of heperformances.This play has threeweeks to run in befr it opens to the critics.Cumberbatch's interpretation of the tile role sing to shift and develop. He already commands and surprises, thre arelaughsand shocks, and wit a cas that incuds the always moving and intelligent CiaranHinds asHamlet's murdering uncle claudius,he i ably supported.
Opposite critic DominicMouldin the paper yesterday had to sayHamlet's sum protein character is "to take on the challege of life itself". For Benedict Cumberbatch, still only 39, life affronts him almost before theASURE of living the fastest sellingLondon th eatre show since records began. That is a challenge indee and, whith the firs of some eight performances he will give under his belt, one he hasonly just mbarke upon.This both popular and hugely aleated acthasstaked out the greatest pat indrama, iwillbe fascinating o ee how he m asters it.ean character, is to take on the challege of lif itself. For Benedict Cumberbatch, still only 39, life in recent monthshasmeant b aringthe pressure f eading the fastest seling Londontheatre how sincerecords began.That is a challenge indeed ad, with the first of some eight performances he wil ve under isbelt, one he has only just embrked upon. This both popular andghely talnted actor has staked out the grea

```

Follow terminal folder

Operating Systems, Security and Networks (207SE) Lab

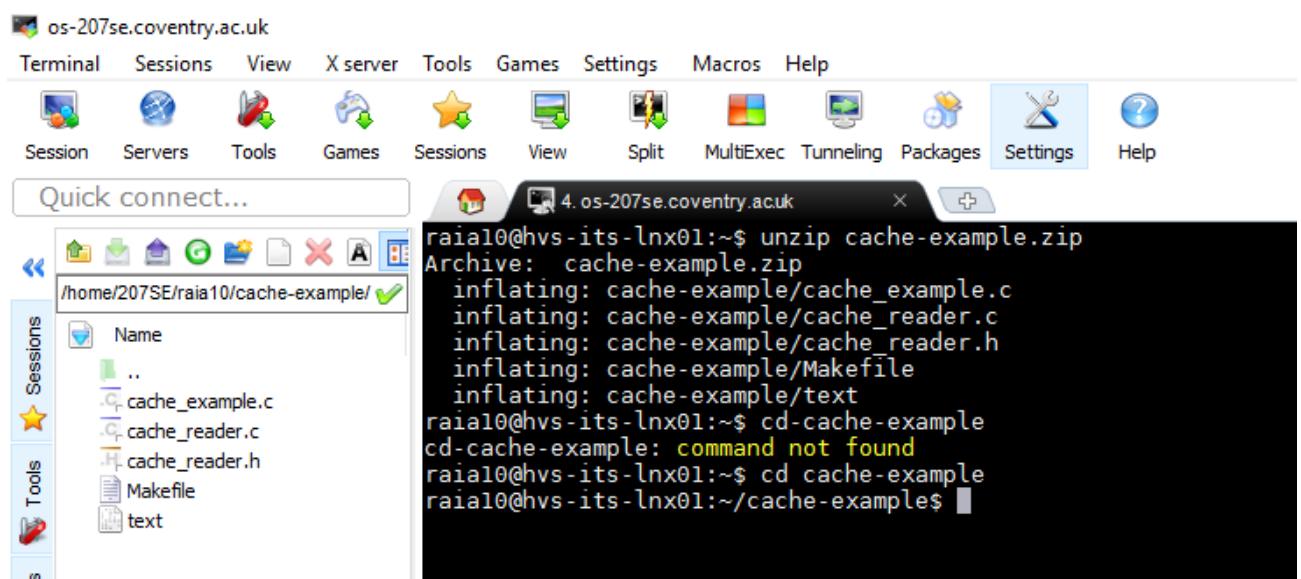
8: Cache Library exercise

This session we will explore an application that is a more elegant version of the last tutorial. It does this by using a structure that simulates a cache library.

Setting up the activities

Getting to required file

- Run MobaXterm and connect to the server
- Drag the zip file into MobaXterm or use filezilla to ftp the zip file to the server
- unzip cache-example.zip
- cd cache-example



Basic Portfolio Activity

The actual code required to complete the cr_read_byte function will be simple.

```
1. char cr_read_byte(cr_file* f)
2.
3. {
4.     if (f->usedbuffer == f-
>bufferlength) // If statement to check if the buffer is empty
5.     {
```

```

6.     refill(f); // if the buffer is empty then refill the buffer
7. }
8.
9.     char temp = f->buffer[f->usedbuffer]; // this will access char on index [usedbuffer]
10.    f->usedbuffer++; // incrementing index usedbuffer to access next char in index
11.
12.    return (temp); // returns the characters from until End Of File is reached
13.    return EOF; // this will make the compile work
14.
15. }
16. //your code goes here
17. //remember that this needs a return char (a byte, put another way...)

```

The correct output from the program should be the contents of the 'text' file!

```

raia10@hvs-its-lnx01:~$ cd cache-example
raia10@hvs-its-lnx01:~/cache-example$ make
make: 'Cache_example' is up to date.
raia10@hvs-its-lnx01:~/cache-example$ ./cache-example
Geographically, Iran is located in West Asia and borders the Caspian Sea, Persian Gulf, and Gulf of Oman. Its mountains have helped to shape both the political and the economic history of the country for several centuries. The mountains enclose several broad basins, or plateaus, on which major agricultural and urban settlements are located. Until the 20th century, when major highways and railroads were constructed through the mountains to connect the population centers, these basins tended to be relatively isolated from one another. Typically, one major town dominated each basin, and there were complex economic relationships between the town and the hundreds of villages that surrounded it. In the higher elevations of the mountains rimming the basins, tribally organized groups practiced transhumance, moving with their herds of sheep and goats between traditionally established summer and winter pastures. There are no major river systems in the country, and historically transportation was by means of caravans that followed routes traversing gaps and passes in the mountains. The mountains also impeded easy access to the Persian Gulf and the Caspian Sea. With an area of 1,648,000 square kilometres (636,000 sq mi), Iran ranks eighteenth in size among the countries of the world. Iran shares its northern borders with three post-Soviet states: Armenia, Azerbaijan, and Turkmenistan. These borders extend for more than 2,000 kilometres (1,200 mi), including nearly 650 kilometres (400 mi) of water along the southern shore of the Caspian Sea. Iran's western borders are with Turkey in the north and Iraq in the south, terminating at the Arvand Rud. The Persian Gulf and Gulf of Oman littorals form the entire 1,770 kilometres (1,100 mi) southern border. To the east lie Afghanistan on the north and Pakistan on the far south. Iran's diagonal distance from Azerbaijan in the northwest to Sistan and Baluchestan Province in the southeast is approximately 2,333 kilometres (1,450 mi). The history of Iran, commonly also known as Persia in the Western world, is intertwined with the history of a larger region, also to an extent known as Greater Iran, comprising the area from Anatolia, the Bosphorus, and Egypt in the west to the borders of Ancient India and the Syr Darya in the east, and from the Caucasus and the Eurasian Steppes in the north to the Persian Gulf and the Gulf of Oman in the south. Iran is home to one of the world's oldest continuous major civilizations, with historical and urban settlements dating back to 4000 BC.[1] The southwestern and western part of the Iranian Plateau participated in the traditional Ancient Near East with Elam, from the Early Bronze Age, and later with various other peoples, such as the Kassites, Mannaean, and Gutians. Georg Wilhelm Friedrich Hegel names the Persians as the first Historical People.[2] The Medes unified Iran as a nation and empire in 625 BC. The Achaemenid Empire (550–330 BC), founded by Cyrus the Great, was the first of the Persian empires to rule from the Balkans to North Africa and also Central Asia, spanning three continents, from their seat of power in Persepolis (Persepolis). It was the largest empire yet seen and the first world empire. The First Persian Empire was the only civilization in all of history to connect over 40% of the global population, accounting for approximately 49.4 million of the world's 112.4 million people in around 480 BC. They were succeeded by the Seleucid, Parthian, and Sasanian Empires, who successively governed Iran for almost 1,000 years and made Iran once again as a leading power in the world. Persia's arch-rival was the Roman Empire and its successor, the Byzantine Empire. The Persian Empire proper begins in the Iron Age, following the influx of Iranian peoples. Iranian people gave rise to the Medes, the Achaemenid, Parthian, and Sasanian Empires of classical antiquity. Once a major empire of superpower proportions, having conquered far and wide, Iran has endured invasions too, by the Greeks, Arabs, Turks, and the Mongols. Iran has continually reasserted its national identity throughout the centuries and has developed as a distinct political and cultural entity. The Muslim conquest of Persia (633–656) ended the Sasanian Empire and was a turning point in Iranian history. Islamization of Iran took place during the eighth to tenth centuries and led to the eventual decline of Zoroastrianism in Iran as well as many of its dependencies. However, the achievements of the previous Persian civilizations were not lost, but were to a great extent absorbed by the new Islamic polity and civilization. Iran was once again reunified as an independent state in 1501 by the

```

Additional Portfolio Activity

- How can you prove the file output is being buffered, given the output to the screen is essentially the contents of the file. Devise some way to show that **each byte is being read**, and **when the buffer is being refilled**. This may require (nominal) changes to the main program and the library code.

How I proved

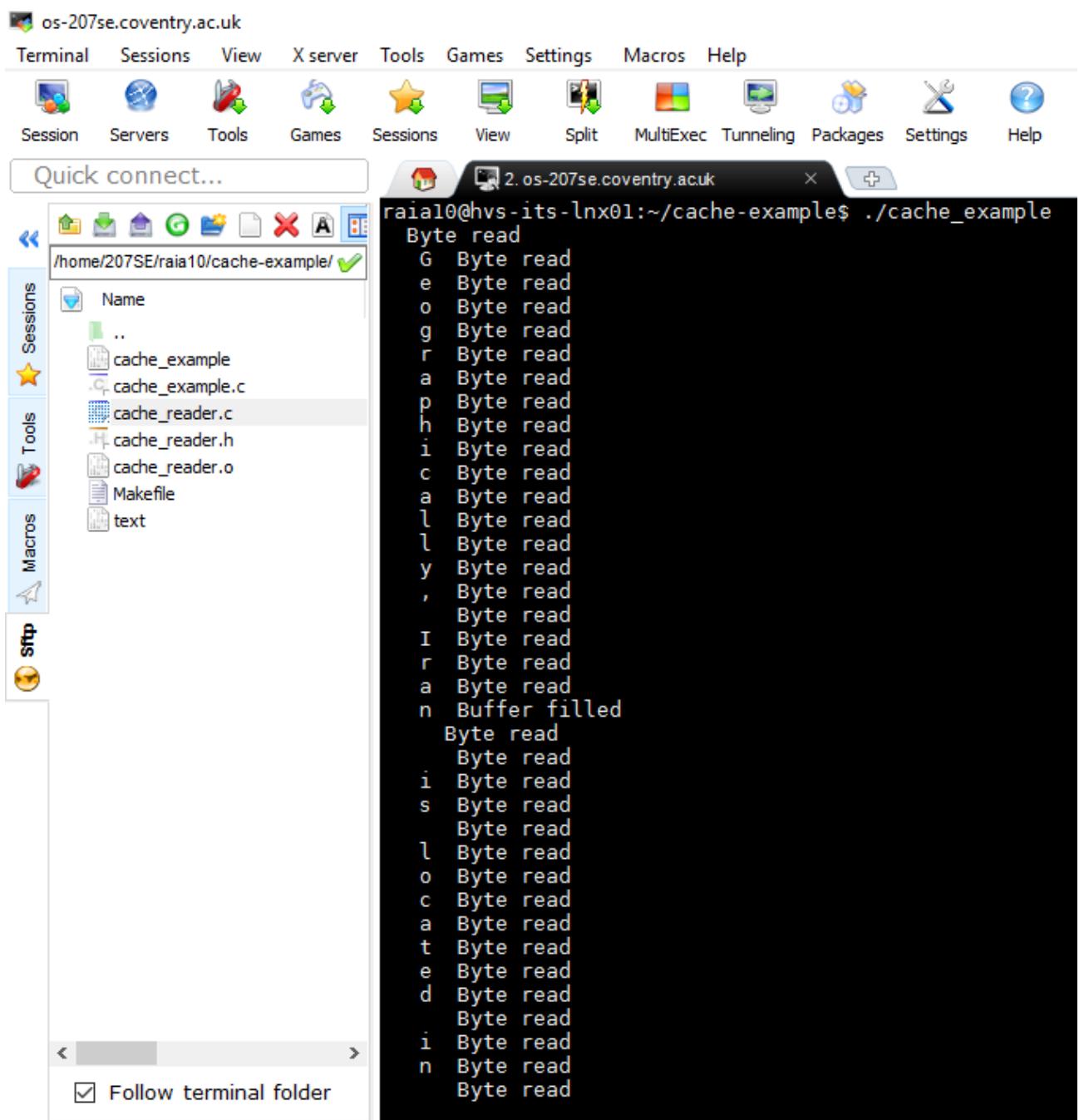
To prove that the file output is being buffered, I added a new code, ‘printf(“Buffer filled\n”);’, this will be printed every time a new buffer is being filled.

To prove that each byte is being read, I added a new code, ‘printf(“ byte read/n”)', this will be printed every time a character is read.

Updated code

```
1. char cr_read_byte(cr_file* f)
2.
3. {
4.     if (f->usedbuffer == f-
>bufferlength) // If statement to check if the buffer is empty
5.     {
6.         printf(" Buffer filled\n   "); //prints the message "buffer is being filled" in
a new line whenever a buffer is filled //advance task
7.         refill(f); // if the buffer is empty then refill the buffer
8.     };
9.
10.    printf(" Byte read\n   "); //this will make sure that message is printed everyti
me a buffer stores a character //advanced task
11.
12.    char temp = f->buffer[f-
>usedbuffer]; // this will access char on index [usedbuffer]
13.    f->usedbuffer++; // incrementing index usedbuffer to access next char in index
14.
15.    return (temp); // returns the characters from until End Of File is reached
16.    return EOF; // this will make the compile work
17.
18. }
19. //your code goes here
20. //remember that this needs a return char (a byte, put another way...)
```

Proof that the code works



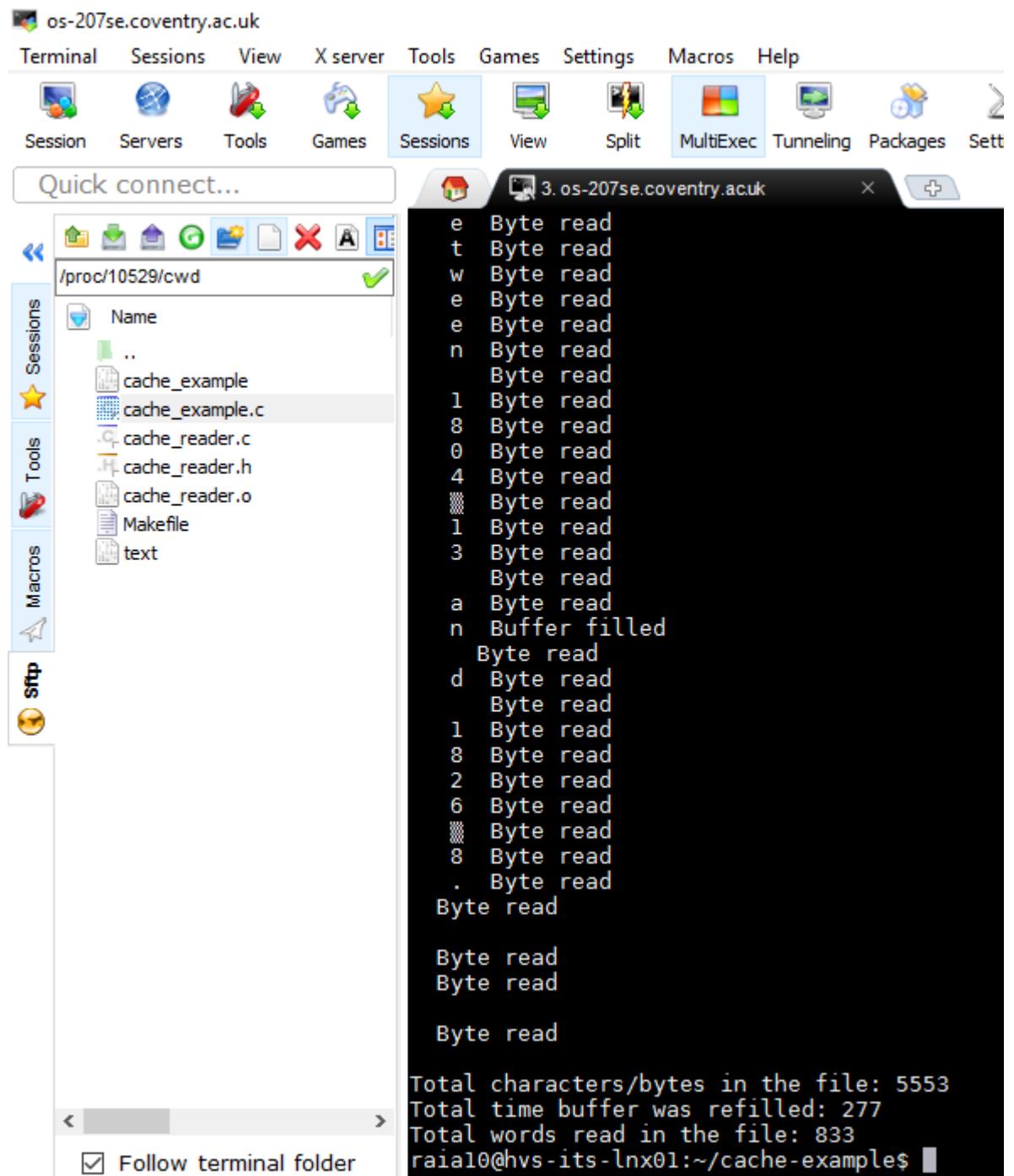
2. Provide some statistics in the cache_example.c code to show how many bytes were read in total, how many words were read in and how many times the buffer was refilled.

Updated Code

```
1. #import "cache_reader.h"
2.
3. //updated code to show how many 'bytes were read in total', 'how many words were re
   ad in' and 'how many times the buffer was refilled'
4.
5. int main(){
```

```
6. char c;
7. int bytecount = 0;
8. int buffercount=0;
9. int wordscount =0;
10.
11. //Open a file
12. cr_file* f = cr_open("text",20);
13.
14. //While there are useful bytes coming from it
15. while((c=cr_read_byte(f)) !=EOF) {
16.     //print them
17.     bytecount = bytecount + 1; //count each character in the file
18.     printf("%c", c);
19.
20.     //How many times buffer was filled = count with IF statement
21.     if (f->usedbuffer==f->bufferlength)//If statement to check if the buffer is empty
22.         buffercount=buffercount+1; //increments count which displays number of times buffer filled
23.
24.     //How many words were read = Word count with IF statement
25.     if ((f->buffer[f->usedbuffer])==' ') //this will transverse within spaces of characters
26.         wordscount = wordscount +1; //increments words if space is found between words
27. }
28.
29. printf("\n"); //sets a new line before printing the results
30. printf("Total characters/bytes in the file: %d\n", bytecount); //prints how many 'bytes were read in total', 'how many words were read in' and 'how many times the buffer was refilled'
31. printf("Total time buffer was refilled: %d\n", buffercount); //prints how many times the buffer was refilled
32. printf("Total words read in the file: %d\n", wordscount); //prints how many words were read in the file
33. cr_close(f);
34.
35. return 0;
36.
37. }
38.
```

Proof that code works



Operating Systems, security and Networks (207SE)

Lab 10: The Kernel Again

Your task

For up to 3/5 Change the cache_reader library from using the **fopen**, **fread**, **fclose** functions to the system call versions **open**, **read**, **close**

Code from cache_reader.c

```
1. #define _GNU_SOURCE //allowed access to other functions
2. #include "cache_reader.h"
3. #include <sys/stat.h>
4. #include <fcntl.h>
5. #include <unistd.h>
6. #include <sys/types.h>
7.
8. //http://www.phim.unibe.ch/comp_doc/c_manual/C/SYNTAX/struct.html
9. //http://vergil.chemistry.gatech.edu/resources/programming/c-
   tutorial/structs.html
10.
11. int refill(cr_file* buff){
12.     //Refills a buffer
13.     //Only works when completely used buffer
14.     if(buff->usedbuffer!=buff->bufferlength)
15.         return 0;
16.     else{
17.         buff->usedbuffer=0;
18.         int len=read(buff->file, buff->buffer, buff-
   >bufferlength); //read function format
19.         //If we didn't fill the buffer, fill up with EOF
20.         if(len<buff->bufferlength)
21.             for(int i=len;i<buff->bufferlength;i++)
22.                 buff->buffer[i]=EOF; //Accessing like an array!
23.         return len;
24.     }
25.
26. }
27.
28. void cr_close(cr_file* f){
29.
30.     free(f->buffer);
31.     close(f->file);
32. }
33.
34. cr_file* cr_open(char * filename, int buffersize){
35.     char buff[buffersize=512]; //needed to declare the buffer and its size
36.     //Info on malloc
37.     //http://www.space.unibe.ch/comp_doc/c_manual/C/FUNCTIONS/malloc.html
38.     FILE* f;
39.     if ((f = open(filename, O_RDONLY|O_DIRECT)) ==
```

```

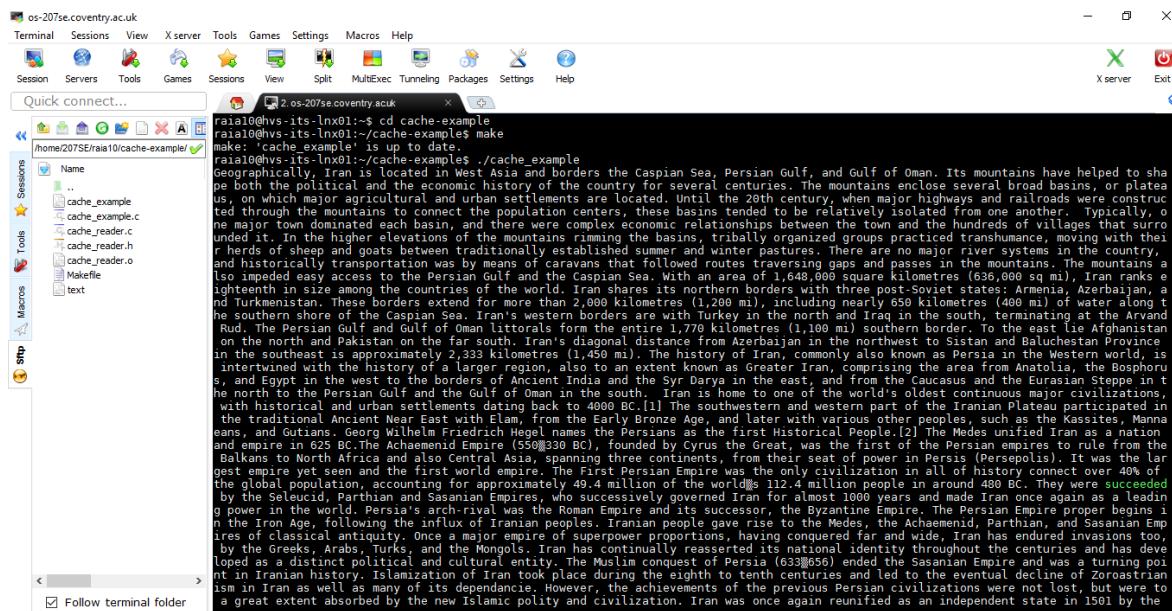
40.     fprintf(stderr, "Cannot open %s\n", filename);
41.     return 0;
42. }
43.
44. cr_file* a=(cr_file*)malloc(sizeof(cr_file));
45. a->file=f;
46. a->bufferlength=buffersize;
47. a-
    >usedbuffer=buffersize; //Start off with no characters, so refill will work as expe
    cted
48. a-
    >buffer=(char*)memalign(sizeof(char)*buffersize, sizeof(char)*buffersize); //needed
        to change mem type so used memalign instead of malloc.. this meant changing the st
        ruct a little bit due to syntax
49.
50. refill(a);
51. return a;
52. }
53.
54. //-----
55. char cr_read_byte(cr_file* f){
56.     printf(" "); //prints a space before each byte is read
57.     if (f->usedbuffer==f-
    >bufferlength){ //the character stored in the pointer of f is accessed by usedbuffe
    r, its then checked to see whether the buffer is full
58.     printf(" REFILL "); //prints refill when the buffer is full
59.     refill(f); //if buffer isnt full then it will continue filling
60.     }
61.     return f->buffer[f->usedbuffer++]; //incrementing usedbuffer by 1
62.
63.     return EOF; // this is just so the compile works...
64. }
```

Code from cache_reader.h

```

1. #include <stdio.h>
2. #include <stdlib.h>
3.
4.
5. //The internals of this struct aren't important
6. //from the user's point of view
7. typedef struct{
8.     int file;          //File being read, reads as ASCII
9.     int bufferlength; //Fixed buffer length
10.    int usedbuffer;   //Current point in the buffer
11.    char* buffer;     //A pointer to a piece of memory
12.                      // same length as "bufferlength"
13. } cr_file;
14.
15. //Open a file with a given size of buffer to cache with
16. cr_file* cr_open(char* filename, int buffersize);
17.
18.
19. //Close an open file
20. void cr_close(cr_file* f);
21.
22. //Read a byte. Will return EOF if empty.
23. char cr_read_byte(cr_file* f);
24.
25. //-----
26.
27. //Refill an empty buffer. Not intended for users
28. int refill(cr_file* buff);
```

Functions to the system call versions open, read, close gives following output



```
raial@hvs-its-lnx01:~/cache-example$ cd cache-example
raial@hvs-its-lnx01:~/cache-example$ make
make: 'cache_example' is up to date.
raial@hvs-its-lnx01:~/cache-example$ ./cache_example
Geographically, Iran is located in West Asia and borders the Caspian Sea, Persian Gulf, and Gulf of Oman. Its mountains have helped to shape both the political and the economic history of the country for several centuries. The mountains enclose several broad basins, or plateaus, on which major agricultural and urban settlements are located. Until the 20th century, when major highways and railroads were constructed through the mountains to connect the population centers, these basins tended to be relatively isolated from one another. Typically, one major town dominated each basin, and there were complex economic relationships between the town and the hundreds of villages that surrounded it. In the higher elevations of the mountains rimming the basins, tribally organized groups practiced transhumance, moving with their herds of sheep and goats between established summer and winter pastures. There are no major river systems in the country, and historically transportation was by means of caravans that followed routes offering gaps and passes in the mountains. The mountains also formed a natural barrier to invasions from the north and west. The total area of 1,640,000 square kilometers (636,000 mi2) is the eighteenth largest in size among the countries of the world. Iran shares its northern border with three post-Soviet states: Armenia, Azerbaijan, and Turkmenistan. These borders extend for more than 2,000 kilometers (1,200 mi), including nearly 650 kilometers (400 mi) of water along the southern shore of the Caspian Sea. Iran's western borders are with Turkey in the north and Iraq in the south, terminating at the Arvand Rud. The Persian Gulf and Gulf of Oman littorals form the entire 1,770 kilometers (1,100 mi) southern border. To the east lie Afghanistan on the north and Pakistan on the far south. Iran's diagonal distance from Azerbaijan in the northwest to Sistan and Baluchestan Province in the southeast is approximately 2,333 kilometers (1,450 mi). The history of Iran, commonly also known as Persia in the Western world, is intertwined with the history of a larger region, also to an extent known as Greater Iran, comprising the area from Anatolia, the Bosphorus, and Egypt in the west to the borders of Ancient India and the Syr Darya in the east, and from the Caucasus and the Eurasian Steppes in the north to the Persian Gulf and the Gulf of Oman in the south. Iran is home to one of the world's oldest continuous major civilizations, with historical and urban settlements dating back to 4000 BC.[1] The southwestern and western part of the Iranian Plateau participated in the traditional Ancient Near East with Elam, from the Early Bronze Age, and later with various other peoples, such as the Kassites, Mannaean, and Gutian. Georg Wilhelm Friedrich Hegel names the Persians as the first Historical People.[2] The Medes unified Iran as a nation and empire around 625 BC, with Achaeamenid Empire reaching its peak during the reign of Darius I. The Persian empire then spread to the Balkans to North Africa and also Central Asia, spanning three continents, from their seat of power in Persepolis. It was the largest empire yet seen and the first world empire. The First Persian Empire was the only civilization in all of history to connect over 40% of the global population, accounting for approximately 49.4 million of the world's 112.4 million people in around 480 BC. They were succeeded by the Seleucid, Parthian and Sasanian Empires, who successively governed Iran for almost 1000 years and made Iran once again as a leading power in the world. Persia's arch-rival was the Roman Empire and its successor, the Byzantine Empire. The Persian Empire proper begins in the Iron Age, following the influx of Iranian peoples. Iranian people gave rise to the Medes, the Achaemenid, Parthian, and Sasanian Empires of classical antiquity. Once a major empire of superpower proportions, having conquered far and wide, Iran has endured invasions too, by the Greeks, Arabs, Turks, and the Mongols. Iran has continually reasserted its national identity throughout the centuries and has developed as a distinct political and cultural entity. The Muslim conquest of Persia (633–656) ended the Sasanian Empire and was a turning point in Iranian history. Islamization of Iran took place during the eighth to tenth centuries and led to the eventual decline of Zoroastrianism in Iran as well as many of its dependencies. However, the achievements of the previous Persian civilizations were not lost, but were to a great extent absorbed by the new Islamic polity and civilization. Iran was once again reunified as an independent state in 1501 by the
```

For up to 5/5 Remove (as far as possible) the effects of caching on the library. The slides have a big hint, but you **will need the man pages and google for this.**

1. The code commented appropriately

Code from cache_reader.c

```
65. #define _GNU_SOURCE //allowed access to other functions
66. #include "cache_reader.h"
67. #include <sys/stat.h>
68. #include <fcntl.h>
69. #include <unistd.h>
70. #include <sys/types.h>
71.
72. //http://www.phim.unibe.ch/comp\_doc/c\_manual/C/SYNTAX/struct.html
73. //http://vergil.chemistry.gatech.edu/resources/programming/c-tutorial/structs.html
74.
75. int refill(cr_file* buff){
76.     //Refills a buffer
77.     //Only works when completely used buffer
78.     if(buff->usedbuffer!=buff->bufferlength)
79.         return 0;
80.     else{
```

```

81.     buff->usedbuffer=0;
82.     int len=read(buff->file, buff->buffer, buff-
83.         >bufferlength); //read function format
84.     //If we didn't fill the buffer, fill up with EOF
85.     if(len<buff->bufferlength)
86.         for(int i=len;i<buff->bufferlength;i++)
87.             buff->buffer[i]=EOF; //Accessing like an array!
88.     return len;
89. }
90. }
91.
92. void cr_close(cr_file* f){
93.
94.     free(f->buffer);
95.     close(f->file);
96. }
97.
98. cr_file* cr_open(char * filename, int buffersize){
99.     char buff[buffersize=512]; //needed to declare the buffer and its size
100.    //Info on malloc
101.    //http://www.space.unibe.ch/comp_doc/c_manual/C/FUNCTIONS/malloc.html
102.    FILE* f;
103.    if ((f = open(filename, O_RDONLY|O_DIRECT)) ==-
1 ) { //opened for reading only, format for open O_DIRECT is used to reduce the cac-
1 hing from/for a file
104.        fprintf(stderr, "Cannot open %s\n", filename);
105.        return 0;
106.    }
107.
108.    cr_file* a=(cr_file*)malloc(sizeof(cr_file));
109.    a->file=f;
110.    a->bufferlength=buffersize;
111.    a-
112.        >usedbuffer=buffersize; //Start off with no characters, so refill will work as expe-
1 cted
113.        a-
114.        >buffer=(char*)memalign(sizeof(char)*buffersize, sizeof(char)*buffersize); //needed
115.        to change mem type so used memalign instead of malloc.. this meant changing the st-
1 ruct a little bit due to syntax
116.    refill(a);
117.    return a;
118. }
119. -----
120. char cr_read_byte(cr_file* f){
121.     printf(" "); //prints a space before each byte is read
122.     if (f->usedbuffer==f-
123.         >bufferlength){ //the character stored in the pointer of f is accessed by usedbuffe-
1 r, its then checked to see whether the buffer is full
124.         printf(" REFILL "); //prints refill when the buffer is full
125.         refill(f); //if buffer isn't full then it will continue filling
126.     }
127.     return f->buffer[f->usedbuffer++]; //incrementing usedbuffer by 1
128. }

```

Code from cache_reader.h

```

29. #include <stdio.h>
30. #include <stdlib.h>
31.

```

```

32.
33. //The internals of this struct aren't important
34. //from the user's point of view
35. typedef struct{
36.     int file;          //File being read, reads as ASCII
37.     int bufferlength; //Fixed buffer length
38.     int usedbuffer;   //Current point in the buffer
39.     char* buffer;    //A pointer to a piece of memory
40.                           // same length as "bufferlength"
41. } cr_file;
42.
43. //Open a file with a given size of buffer to cache with
44. cr_file* cr_open(char* filename, int buffersize);
45.
46.
47. //Close an open file
48. void cr_close(cr_file* f);
49.
50. //Read a byte. Will return EOF if empty.
51. char cr_read_byte(cr_file* f);
52.
53. //-----
54.
55. //Refill an empty buffer. Not intended for users
56. int refill(cr_file* buff);

```

2. Screenshot of execution of the code

The screenshot shows a terminal window titled '2.02-207se.coventry.ac.uk' with the command 'cache_example' running. The terminal output is a dense block of text describing geographical features like mountains, rivers, and cities, likely generated by a simulation or a specific algorithm. The terminal interface includes a menu bar, toolbars, and a sidebar for sessions and macros.

```

os-207se.coventry.ac.uk
Terminal Sessions View Xserver Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultExec Tunneling Packages Settings Help
Quick connect...
<< ihome207SE!raia10@cache-example >>
raia10@raspberrypi:~/cache-example$ cd ~
raia10@raspberrypi:~$ cd cache-example
raia10@raspberrypi:~/cache-example$ make
make: 'cache_example' is up to date.
raia10@raspberrypi:~/cache-example$ ./cache_example
Geography is located in West Asia and Europe. It spans from the Caspian Sea to the Black Sea, through the Caucasus mountains, across Central Asia, and down to the Indian subcontinent. Major rivers include the Yangtze, Yellow, and Mekong in China, and the Ganges, Brahmaputra, and Indus in India. Major cities include Beijing, Tokyo, and New York. The terrain is varied, with high mountains like the Himalayas and lowlands like the Ganges Delta. The climate is diverse, ranging from tropical monsoons to arctic tundra. The economy is dominated by agriculture, with major crops like rice, wheat, and cotton. The population is over 7 billion, with most people living in rural areas. The environment is under pressure from deforestation and climate change. The future of the planet hangs in the balance.

```

