

## **Operating Systems Project Report**

### **Phase 1:**

To complete phase 1 of the project, we started off by researching how to implement a basic shell in C. This gave us an idea of what to do, and we started off with an infinite loop in main() which would take continuous user input. We also added the condition that if the input was “exit” the user will exit our shell.

We then pass our input string into a function which counts the number of pipes (“|”) in the input. If there are 0 pipes, which means it’s a normal separate command, it is passed into a functions which parses the input according to space and then these parsed arguments are passed into a method called execArgs which forks a child and uses execvp inside it to execute the commands.

In the case that there are pipes, we create pipe mechanisms to write the output of the first child to the read end of the next pipe/parent, whatever the case might be.

We also added a help function (which is called by entering “help”) to give the user more details about what can and cannot be entered. Currently all compound commands work if they’re entered singly without pipes. A thing we wanted to implement but didn’t get the time to was combining compound commands (like “ls -lh”) using pipes. It’s definitely one of the changes we would like to make in the future if we’re able to fit it in.

Here are some of the sample input and output test cases to see for yourself:

```
*****
****Bhavicka and Maisha's SHELL
****
*****

USER: @ nyuad
warning: this program uses gets(), which is unsafe.
Dir: /Users/nyuad/Downloads ls
Com.c          Hello          ManyCommand.c      PipeShareFile.c      Proj
Exam           Lab6updated.docx          NewestProj.c         Prac.c               SharedMemory.c

Dir: /Users/nyuad/Downloads pwd
/Users/nyuad/Downloads

Dir: /Users/nyuad/Downloads ps
PID TTY          TIME CMD
79822 ttys000      0:00.07 -bash
80663 ttys000      0:00.01 ./Proj

Dir: /Users/nyuad/Downloads date
Wed Mar 16 21:26:33 +04 2022

Dir: /Users/nyuad/Downloads ls -lh
total 192
-rw-r--r--@ 1 nyuad  staff   3.6K Mar 14 15:37 Com.c
-rwxr-xr-x@ 1 nyuad  staff   8.3K Mar  9 00:19 Exam
drwxr-xr-x  3 nyuad  staff   96B Mar 16 20:48 Hello
-rw-r--r--@ 1 nyuad  staff   20K Mar  6 13:10 Lab6updated.docx
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 17:30 ManyCommand.c
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 21:25 NewestProj.c
-rw-r--r--@ 1 nyuad  staff   2.6K Mar  9 15:10 PipeShareFile.c
-rw-r--r--@ 1 nyuad  staff   3.4K Mar 13 15:46 Prac.c
-rwxr-xr-x  1 nyuad  staff   13K Mar 16 21:26 Proj
-rw-r--r--@ 1 nyuad  staff   1.9K Mar  9 00:44 SharedMemory.c

Dir: /Users/nyuad/Downloads cp Lab6updated.docx lab6.docx

Dir: /Users/nyuad/Downloads ls
Com.c          Lab6updated.docx      PipeShareFile.c      SharedMemory.c
Exam           ManyCommand.c        Prac.c               lab6.docx
Hello          NewestProj.c          Proj

Dir: /Users/nyuad/Downloads mkdir hey

Dir: /Users/nyuad/Downloads ls
Com.c          Lab6updated.docx      PipeShareFile.c      SharedMemory.c
Exam           ManyCommand.c        Prac.c               hey
Hello          NewestProj.c          Proj               lab6.docx

Dir: /Users/nyuad/Downloads rmdik hey
Could not execute command [in function execArgs]
Dir: /Users/nyuad/Downloads rmdir hey

Dir: /Users/nyuad/Downloads ls
Com.c          Lab6updated.docx      PipeShareFile.c      SharedMemory.c
Exam           ManyCommand.c        Prac.c               lab6.docx
Hello          NewestProj.c          Proj

Dir: /Users/nyuad/Downloads mv lab6.docx Hello

Dir: /Users/nyuad/Downloads ls Hello
hi.docx        lab6.docx
```

```
*3 Dir: /Users/nyuad/Downloads ls|wc
a 10      10      104
*3
E1 Dir: /Users/nyuad/Downloads pwd|wc
1 1      1      23
/
Dir: /Users/nyuad/Downloads ls|sort
Com.c
Exam
Hello
Lab6updated.docx
ManyCommand.c
NewestProj.c
PipeShareFile.c
Prac.c
Proj
SharedMemory.c
d
Dir: /Users/nyuad/Downloads ls|sort|wc
10      10      104
Dir: /Users/nyuad/Downloads ls|more
Com.c
Exam
Hello
Lab6updated.docx
ManyCommand.c
NewestProj.c
+ PipeShareFile.c
& Prac.c
Proj
+ SharedMemory.c
L
Dir: /Users/nyuad/Downloads ls|more|sort|wc
10      10      104
p
1)
```

```
Dir: /Users/nyuad/Downloads cp Lab6updated.docx lab6.docs
n
Dir: /Users/nyuad/Downloads ls
Com.c      Lab6updated.docx      PipeShareFile.c      SharedMemory.c
Exam      ManyCommand.c      Prac.c      lab6.docs
Hello      NewestProj.c      Proj
+
Dir: /Users/nyuad/Downloads rm lab6.docs
&
Dir: /Users/nyuad/Downloads ls
Com.c      Hello      ManyCommand.c      PipeShareFile.c      Proj
+ Exam      Lab6updated.docx      NewestProj.c      Prac.c      SharedMemory.c
L
Dir: /Users/nyuad/Downloads █
p
1) == 0)
```

```
Downloads — Proj — 132x54
-rw-r--r--@ 1 nyuad staff 13391 Mar 16 21:25 NewestProj.c
-rw-r--r--@ 1 nyuad staff 13652 Mar 16 21:54 OS.docx
-rw-----@ 1 nyuad staff 2699 Mar 9 15:10 PipeShareFile.c
-rw-r--r--@ 1 nyuad staff 3505 Mar 13 15:46 Prac.c
-rwxr-xr-x 1 nyuad staff 13700 Mar 16 21:44 Proj
-rw-----@ 1 nyuad staff 1992 Mar 9 00:44 SharedMemory.c
-rw-----@ 1 nyuad staff 20183 Mar 16 21:52 lab6.docx

be: Dir: /Users/nyuad/Downloads ls -al|wc
be: ^C
((base) C2-LIB-AIR-05:Downloads nyuad$ ./Proj

up
*****

**:      ****Bhavicka and Maisha's SHELL
ka: ****
**:
SE:
" /
*****

USER: @ nyuad

warning: this program uses gets(), which is unsafe.
Dir: /Users/nyuad/Downloads ls ah
ls: ah: No such file or directory

Dir: /Users/nyuad/Downloads ls -al
total 288
drwx-----+ 16 nyuad staff 512 Mar 16 21:54 .
drwxr-xr-x+ 32 nyuad staff 1024 Mar 8 11:38 ..
-rw-r--r--@ 1 nyuad staff 8196 Mar 16 21:24 .DS_Store
-rw-----@ 1 nyuad staff 0 Aug 24 2021 .localized
-rw-----@ 1 nyuad staff 3704 Mar 14 15:37 Com.c
-rwxr-xr-x@ 1 nyuad staff 8520 Mar 9 00:19 Exam
drwxr-xr-x 4 nyuad staff 128 Mar 16 21:30 Hello
-rw-----@ 1 nyuad staff 20183 Mar 6 13:10 Lab6updated.docx
-rw-r--r--@ 1 nyuad staff 13690 Mar 16 17:30 ManyCommand.c
-rw-r--r--@ 1 nyuad staff 13391 Mar 16 21:25 NewestProj.c
-rw-r--r--@ 1 nyuad staff 13652 Mar 16 21:54 OS.docx
-rw-r--r--@ 1 nyuad staff 2699 Mar 9 15:10 PipeShareFile.c
-rw-r--r--@ 1 nyuad staff 3505 Mar 13 15:46 Prac.c
-rwxr-xr-x 1 nyuad staff 13700 Mar 16 21:44 Proj
-rw-----@ 1 nyuad staff 1992 Mar 9 00:44 SharedMemory.c
-rw-----@ 1 nyuad staff 20183 Mar 16 21:52 lab6.docx

sp: Dir: /Users/nyuad/Downloads
il) == 0)
```

```
Dir : /Users/nyuad/Downloads date
Wed Mar 16 22:12:54 +04 2022

Dir : /Users/nyuad/Downloads help
Welcome to our shell! You can enter single commands or piped commands here. A non-exhaustive list of commands includes:
ls
pwd
man
date
mkdir
rmdir
rm
cp
mv
ps
You can also try out commands with single (...|...), double (...|...|...) or triple (...|...|...|...) pipes.

PLEASE NOTE: All combinations work for single commands, but if you want to use pipes you must use single word non-combination commands. This means a|b, not a | b or a| b or a |b or a -c|b etc. Some examples you could try out are:
pwd|wc
ls|wc
ls|sort
ls|more|wc
ls|more|sort|wc

or any such commands in a similar vein
Could not execute command [in function execArgs]
Dir : /Users/nyuad/Downloads ls -a
.          Com.c          ManyCommand.c      PipeShareFile.c      lab6.docx
..         Exam          NewestProj.c         Prac.c               phase1
.DS_Store  Hello                 OS.docx              Proj
.localized Lab6updated.docx      Phase1Draft.c        SharedMemory.c

Dir : /Users/nyuad/Downloads
```

Comparison that the bash terminal and the normal shell give the same output as our built shell:

```
USER: @ nyuad
warning: this program uses gets(), which is unsafe.
Dir : /Users/nyuad/Downloads  ls
Com.c      Lab6updated.docx      OS.docx      PipeShareFile.c      lab6.docx
Exam       ManyCommand.c           P            Prac.c              phase1
Hello      NewestProj.c             Phase1Draft.c SharedMemory.c        proj

Dir : /Users/nyuad/Downloads  ls -a
.           Com.c      ManyCommand.c      Phase1Draft.c      lab6.docx
..          Exam       NewestProj.c         PipeShareFile.c    phase1
.DS_Store  Hello      OS.docx             Prac.c              proj
.localized Lab6updated.docx P                    SharedMemory.c

Dir : /Users/nyuad/Downloads  ls -lh
total 360
-rw-r--r--@ 1 nyuad  staff   3.6K Mar 14 15:37 Com.c
-rwxr-xr-x@ 1 nyuad  staff   8.3K Mar  9 00:19 Exam
drwxr-xr-x  4 nyuad  staff  128B Mar 16 21:30 Hello
-rw-r--r--@ 1 nyuad  staff   20K Mar  6 13:10 Lab6updated.docx
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 17:30 ManyCommand.c
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 21:25 NewestProj.c
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 21:54 OS.docx
-rwxr-xr-x  1 nyuad  staff   13K Mar 16 22:39 P
-rw-r--r--@ 1 nyuad  staff   12K Mar 16 23:16 Phase1Draft.c
-rw-r--r--@ 1 nyuad  staff   2.6K Mar  9 15:10 PipeShareFile.c
-rw-r--r--@ 1 nyuad  staff   3.4K Mar 13 15:46 Prac.c
-rw-r--r--@ 1 nyuad  staff   1.9K Mar  9 00:44 SharedMemory.c
-rw-r--r--@ 1 nyuad  staff   20K Mar 16 21:52 lab6.docx
-rwxr-xr-x  1 nyuad  staff   13K Mar 16 22:26 phase1
-rwxr-xr-x  1 nyuad  staff   14K Mar 16 23:17 proj

Dir : /Users/nyuad/Downloads  ^C
(base) C2-LIB-AIR-05:Downloads nyuad$ ls -lh
total 360
-rw-r--r--@ 1 nyuad  staff   3.6K Mar 14 15:37 Com.c
-rwxr-xr-x@ 1 nyuad  staff   8.3K Mar  9 00:19 Exam
drwxr-xr-x  4 nyuad  staff  128B Mar 16 21:30 Hello
-rw-r--r--@ 1 nyuad  staff   20K Mar  6 13:10 Lab6updated.docx
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 17:30 ManyCommand.c
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 21:25 NewestProj.c
-rw-r--r--@ 1 nyuad  staff   13K Mar 16 21:54 OS.docx
-rwxr-xr-x  1 nyuad  staff   13K Mar 16 22:39 P
-rw-r--r--@ 1 nyuad  staff   12K Mar 16 23:16 Phase1Draft.c
-rw-r--r--@ 1 nyuad  staff   2.6K Mar  9 15:10 PipeShareFile.c
-rw-r--r--@ 1 nyuad  staff   3.4K Mar 13 15:46 Prac.c
-rw-r--r--@ 1 nyuad  staff   1.9K Mar  9 00:44 SharedMemory.c
-rw-r--r--@ 1 nyuad  staff   20K Mar 16 21:52 lab6.docx
-rwxr-xr-x  1 nyuad  staff   13K Mar 16 22:26 phase1
-rwxr-xr-x  1 nyuad  staff   14K Mar 16 23:17 proj
(base) C2-LIB-AIR-05:Downloads nyuad$
```

Overall working on this phase of the project was a great learning experience in both making a shell and also debugging. We feel better prepared for the next one now. We would also like to thank our TA Shan Randhawa for his constant help and guidance.

Reference:

1. [www.geeksforgeeks.org/taking-string-input-space-c-3-different-methods](http://www.geeksforgeeks.org/taking-string-input-space-c-3-different-methods)
2. Codegrepper for exit keyword comparison
3. <https://web.stonehill.edu/compsci/CS314/Assignments/Assignment2.pdf>