

Operating Systems

Lab 1

Name: Ahmed Samir Said Ahmed

ID: 20010107

Overall Organization:

This code is an implementation of a basic shell program in C language. The shell supports changing directories, echoing user input, and setting environment variables using the `cd`, `echo`, and `export` commands respectively. It also allows running other commands by forking and calling `execvp()`.

Major Function:

- The main function of the code is the “`shell()`” function which creates a loop to receive input from the user and execute the entered command.
- The “`parse_input()`” function is responsible for parsing the input command entered by the user, and splitting it into an array of individual command arguments. It also sets a flag to determine whether the command should be run in the foreground or the background.
- The “`execute_command()`” function is responsible for creating a new process using the `fork()` system call, and then executing the command using the `execvp()` system call. If the command is to be run in the foreground, the

parent process waits for the child process to complete execution.

- The “execute_shell_builtin()” function handles the built-in commands such as cd, echo, and export. If the user enters a built-in command, this function is called to execute the command instead of creating a new process.
- The “setup_environment()” function is responsible for setting up the initial environment for the shell program.
- The “parent_signal_handler()” function is responsible for handling the SIGCHLD signal which is sent to the parent process when a child process terminates. This function checks whether the child process terminated normally or due to a signal and then writes a message to a file named output.txt.
- The “signal_handler()” function sets up the signal handler for the SIGCHLD signal.
- Lastly, the “main()” function initializes the environment, sets up the signal handler, and calls the shell() function to start the shell program loop.

Sample runs:

```
ahmed@ahmed-HP-ENVY-x360-Convertible-13m-bd1xxx:~/Desktop/Xcode$ ./main
/home/ahmed/Desktop/Xcode$ ls
main main.c output.txt test
/home/ahmed/Desktop/Xcode$ ls -a
. .. .git main main.c output.txt test .vscode
/home/ahmed/Desktop/Xcode$ ls -a -l -h
total 60K
drwxrwxr-x 5 ahmed ahmed 4.0K رم 9 02:08 .
drwxr-xr-x 5 ahmed ahmed 4.0K رم 6 22:54 ..
drwxrwxr-x 8 ahmed ahmed 4.0K رم 6 22:56 .git
-rwxrwxr-x 1 ahmed ahmed 25K رم 9 01:42 main
-rw-rw-r-- 1 ahmed ahmed 6.3K رم 9 02:19 main.c
-rw-rw-r-- 1 ahmed ahmed 440 رم 9 02:57 output.txt
drwxrwxr-x 2 ahmed ahmed 4.0K رم 9 02:08 test
drwxrwxr-x 2 ahmed ahmed 4.0K رم 8 23:30 .vscode
/home/ahmed/Desktop/Xcode$ cd test
/home/ahmed/Desktop/Xcode/test$ mkdir ahmed
/home/ahmed/Desktop/Xcode/test$ ls
ahmed output.txt
/home/ahmed/Desktop/Xcode/test$ cd ..
/home/ahmed/Desktop/Xcode$ ls
main main.c output.txt test
/home/ahmed/Desktop/Xcode$ chmod 777 main
```

```
/home/ahmed/Desktop/Xcode$ ls
main main.c output.txt test
/home/ahmed/Desktop/Xcode$ ls -a
. .. .git main main.c output.txt test .vscode
/home/ahmed/Desktop/Xcode$ ls -a -l -h
total 60K
drwxrwxr-x 5 ahmed ahmed 4.0K رم 9 02:08 .
drwxr-xr-x 5 ahmed ahmed 4.0K رم 6 22:54 ..
drwxrwxr-x 8 ahmed ahmed 4.0K رم 6 22:56 .git
-rwxrwxr-x 1 ahmed ahmed 25K رم 9 01:42 main
-rw-rw-r-- 1 ahmed ahmed 6.3K رم 9 02:19 main.c
-rw-rw-r-- 1 ahmed ahmed 440 رم 9 02:57 output.txt
drwxrwxr-x 2 ahmed ahmed 4.0K رم 9 02:08 test
drwxrwxr-x 2 ahmed ahmed 4.0K رم 8 23:30 .vscode
```

```
/home/ahmed/Desktop/Xcode$ ls
main main.c output.txt test
/home/ahmed/Desktop/Xcode$ pwd
/home/ahmed/Desktop/Xcode
/home/ahmed/Desktop/Xcode$ ls -a
. .. .git main main.c output.txt test .vscode
/home/ahmed/Desktop/Xcode$ mkdir mywork
/home/ahmed/Desktop/Xcode$ ls
main main.c mywork output.txt test
/home/ahmed/Desktop/Xcode$ ls -l
total 48
-rwxrwxrwx 1 ahmed ahmed 24624 رم 9 01:42 main
-rw-rw-r-- 1 ahmed ahmed 6376 رم 9 02:19 main.c
drwxrwxr-x 2 ahmed ahmed 4096 رم 9 03:03 mywork
-rw-rw-r-- 1 ahmed ahmed 1060 رم 9 03:03 output.txt
drwxrwxr-x 3 ahmed ahmed 4096 رم 9 02:57 test
/home/ahmed/Desktop/Xcode$ cd
/home/ahmed$ exit
```

```

/home/ahmed/Desktop/Xcode$ echo "hello world"
"hello world"
/home/ahmed/Desktop/Xcode$ export x="-a -l -h"
/home/ahmed/Desktop/Xcode$ ls $x
total 60K
drwxrwxr-x 5 ahmed ahmed 4.0K رم 9 02:08 .
drwxr-xr-x 5 ahmed ahmed 4.0K رم 6 22:54 ..
drwxrwxr-x 8 ahmed ahmed 4.0K رم 6 22:56 .git
-rwxrwxrwx 1 ahmed ahmed 25K رم 9 01:42 main
-rw-rw-r-- 1 ahmed ahmed 6.3K رم 9 02:19 main.c
-rw-rw-r-- 1 ahmed ahmed 564 رم 9 02:59 output.txt
drwxrwxr-x 3 ahmed ahmed 4.0K رم 9 02:57 test
drwxrwxr-x 2 ahmed ahmed 4.0K رم 8 23:30 .vscode
/home/ahmed/Desktop/Xcode$ hey
Error: execvp() failed
/home/ahmed/Desktop/Xcode$ hello
Error: execvp() failed
/home/ahmed/Desktop/Xcode$ ls-a-l-h
Error: execvp() failed
/home/ahmed/Desktop/Xcode$ █

```

```

/home/ahmed/Desktop/Xcode$ brave
WARNING: Kernel has no file descriptor comparison support: Operation not permitted
[5008:5008:0309/030041.991794:ERROR:sharing_service.cc(222)] Device registration failed with fatal error
[5008:5067:0309/030044.670924:ERROR:udev_watcher.cc(98)] Failed to begin udev enumeration.
[5072:5072:0309/030054.275766:ERROR:gl_surface_presentation_helper.cc(260)] GetVSyncParametersIfAvailable() failed for 1 times!
[5072:5072:0309/030054.282057:ERROR:gl_surface_presentation_helper.cc(260)] GetVSyncParametersIfAvailable() failed for 2 times!
/home/ahmed/Desktop/Xcode$ █

```

Screen shots:

The screenshot displays a Linux desktop environment. On the left, a code editor window titled 'Untitled Document 1' is open, showing a terminal session with the following commands and output:

```

/home/ahmed/Desktop/Xcode$ gedit &
/home/ahmed/Desktop/Xcode$ █

```

On the right, a process manager window is open, showing a list of running processes. The processes are organized into a tree structure, with the following details visible:

Process Name	User	% CPU	ID	Memory	Disk read
gdm-wayland-session	ahmed	0.00	1265	512.0 kB	53.2
gnome-session-binary	ahmed	0.00	1301	1.7 MB	8.1
gnome-keyring-daemon	ahmed	0.00	1246	1.1 MB	745.5
systemd	ahmed	0.00	1074	2.8 MB	126.9
gnome-keyring-daemon --daemonize --login	ahmed	0.00	1683	700.4 kB	81.9
chrome_crashpad_handler	ahmed	0.00	3367	184.3 kB	586.8
code --no-sandbox --enable-features=...	ahmed	0.18	3352	42.3 MB	49.8
code	ahmed	0.00	3456	42.6 MB	2.6
code	ahmed	0.00	3502	16.4 MB	1.1
code	ahmed	0.00	3476	23.7 MB	1.0
bash	ahmed	0.00	3981	1.8 MB	89.1
main	ahmed	0.00	4098	106.5 kB	187.1
gedit	ahmed	1.23	5772	16.6 MB	A
code	ahmed	0.00	3446	153.0 MB	41.6
code	ahmed	0.00	3870	16.2 MB	98.3
cpptools	ahmed	0.00	3892	15.3 MB	31.5
TabNine	ahmed	0.00	3547	14.3 MB	35.0

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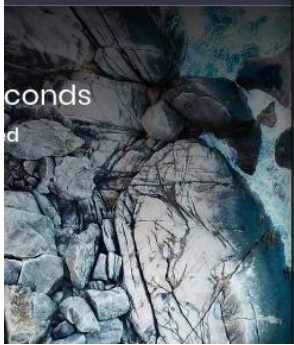
```
/home/ahmed/Desktop/Xcode$ gedit &
/home/ahmed/Desktop/Xcode$ ls
main main.c output.txt test
/home/ahmed/Desktop/Xcode$
```

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Process Name	User	% CPU	ID	Memory	Disk read t
gdm-wayland-session	ahmed	0.00	1265	512.0 kB	53.2 k
gnome-session-binary	ahmed	0.00	1301	1.7 MB	8.1 M
gnome-keyring-daemon	ahmed	0.00	1246	1.1 MB	745.5 k
systemd	ahmed	0.00	1074	2.8 MB	126.9 M
at-spi2-registryd	ahmed	0.00	1683	700.4 kB	81.9 k
chrome_crashpad_handl	ahmed	0.00	3367	184.3 kB	586.8 k
code --no-sandbox --enabl	ahmed	0.00	3352	42.7 MB	49.8 M
code	ahmed	0.00	3456	42.6 MB	2.6 M
code	ahmed	0.00	3502	16.4 MB	1.1 M
code	ahmed	0.00	3476	23.9 MB	1.0 M
bash	ahmed	0.00	3981	1.8 MB	89.1 k
main	ahmed	0.00	4098	106.5 kB	187.1 M
gedit	ahmed	1.78	5772	16.8 MB	N/A
code	ahmed	0.00	3446	152.8 MB	41.6 M
code	ahmed	0.00	3870	16.2 MB	98.3 k
cpptools	ahmed	0.00	3892	15.3 MB	31.5 M

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code --no-sandbox --enabl ahmed0.00335241.3 MB49.8 MB2.5 MB

code ahmed0.00345642.3 MB2.6 MB315.4 kB

code ahmed0.00350216.4 MB1.1 MBN/A

code ahmed0.04347622.4 MB1.0 MB4.1 kB

bash ahmed0.0039811.8 MB89.1 kBN/A

main ahmed0.004098106.5 kB4.1 kB36.9 kB

snap ahmed0.004912598.0 kB4.0 MBN/A

brave ahmed0.005008114.2 MB180.2 MB21.2 MB

brave ahmed0.00507515.2 MB2.3 MB8.2 kB

brave ahmed0.00501913.4 MB334.8 kBN/A

bra ahmed0.00502113.5 MB299.0 kB36.9 kB

t ahmed0.00513845.0 MB7.4 MBN/A

t ahmed0.00509724.6 MB6.6 MBN/A

t ahmed0.00509617.7 MB1.7 MBN/A

t ahmed0.00508313.9 MB492.5 kB16.4 kB

brave ahmed0.00501813.5 MB3.1 MBN/A

bra ahmed0.04507242.1 MB27.3 MBN/A

cat ahmed0.005007114.7 kB4.1 kBN/A

cat ahmed0.005006114.7 kBN/A

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```
/home/ahmed/Desktop/Xcode$ gedit

```

ProcessesResourcesFile Systems🔍⋮_□×

Process Name	User	% CPU	ID	Memory	Disk read t
gdm-wayland-session	ahmed	0.00	1265	512.0 kB	53.2 k
gnome-session-binary	ahmed	0.00	1301	1.7 MB	8.1 M
gnome-keyring-daemon	ahmed	0.00	1246	1.1 MB	745.5 k
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at-spi2-registryd	ahmed	0.00	1683	700.4 kB	81.9 k
chrome_crashpad_handl	ahmed	0.00	3367	184.3 kB	586.8 k
code --no-sandbox --enabl	ahmed	0.00	3352	42.3 MB	49.8 M
code	ahmed	0.00	3456	40.2 MB	2.6 M
code	ahmed	0.00	3502	16.4 MB	1.1 M
code	ahmed	0.00	3476	23.6 MB	1.0 M
bash	ahmed	0.00	3981	1.8 MB	89.1 k
main	ahmed	0.00	4098	106.5 kB	187.1 M
gedit	ahmed	0.00	5623	16.8 MB	N/A
code	ahmed	0.00	3446	153.5 MB	41.6 M
code	ahmed	0.00	3870	16.2 MB	98.3 k
cpptools	ahmed	0.00	3892	15.3 MB	31.5 M