

# Operating Systems – COC 3071L

## SE 5th A – Fall 2025 Part

### 1: File and Directory Operations

1. Create the following directory structure in your home directory:

```
Lab_3/  
├── docs/  
│   └── drafts/  
├── data/  
│   ├── raw/  
│   └── processed/  
└── scripts/
```

2. Inside `docs/`:

- Create three files: `intro.txt`, `notes.txt`, `summary.txt`.
- Add at least **two lines of text** into each using `echo >>`.
- Copy `summary.txt` into the `drafts/` folder using `cp` command.

3. Inside `data/raw/`:

- Create two files: `raw1.txt`, `raw2.txt`.
- Append the **current date** into `raw1.txt` using the `date` command.
- Move `raw2.txt` into `processed/` using `mv`. The syntax is:

```
mv source destination
```

4. Inside `scripts/`:

- Create a script named `hello.sh` with the following content:

```
echo "Hello World"  
pwd  
ls -lh
```

- Later, you will make it executable (in Part 3).

5. Display the directory structure recursively and take a screenshot:

```
ls -R
```

```
fizza1157@DESKTOP-P8HNL3: ~$ cd ~
fizza1157@DESKTOP-P8HNL3: ~$ mkdir -p Lab_3/docs
fizza1157@DESKTOP-P8HNL3: ~$ mkdir -p Lab_3/drafts/data/raw
fizza1157@DESKTOP-P8HNL3: ~$ mkdir -p Lab_3/drafts/data/processed
fizza1157@DESKTOP-P8HNL3: ~$ mkdir -p Lab_3/drafts/scripts
fizza1157@DESKTOP-P8HNL3: ~$ cd ~/Lab_3/docs
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ echo "This is the introduction file." >> intro.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ echo "It contains the basic overview of Lab 3." >> intro.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ echo "These are some important notes for Lab 3." >> notes.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ echo "Remember to follow the directory structure carefully." >> notes.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ echo "This is the summary file for Lab 3." >> summary.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ echo "It includes a brief recap of the tasks." >> summary.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ cp summary.txt ~/Lab_3/drafts/
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ cd ~/Lab_3/drafts/data/raw
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/drafts/data/raw$ touch raw1.txt raw2.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/drafts/data/raw$ date >> raw1.txt
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/drafts/data/raw$ mv raw2.txt ../processed/
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/drafts/data/raw$ cd ~/Lab_3
tree
Command 'tree' not found, but can be installed with:
sudo snap install tree # version 2.1.3+pkg-5852, or
sudo apt install tree # version 2.1.1-2
See 'snap info tree' for additional versions.
fizza1157@DESKTOP-P8HNL3: ~/Lab_3$ sudo apt install tree -y
[sudo] password for fizza1157:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  libllvm19
Use 'sudo apt autoremove' to remove it.
The following NEW packages will be installed:
  tree
```

```
fizza1157@DESKTOP-P8HNL3: ~$ cd ~/Lab_3
fizza1157@DESKTOP-P8HNL3: ~/Lab_3$ echo "Hello world"
Hello world
fizza1157@DESKTOP-P8HNL3: ~/Lab_3$ pwd
/home/fizza1157/Lab_3
fizza1157@DESKTOP-P8HNL3: ~/Lab_3$ ls -lh
total 8.0K
drwxr-xr-x 2 fizza1157 fizza1157 4.0K Oct  5 14:08 docs
drwxr-xr-x 4 fizza1157 fizza1157 4.0K Oct  5 14:08 drafts
fizza1157@DESKTOP-P8HNL3: ~/Lab_3$ ls -R
.:
docs drafts

./docs:
intro.txt notes.txt summary.txt

./drafts:
data scripts summary.txt

./drafts/data:
processed raw

./drafts/data/processed:
raw2.txt

./drafts/data/raw:
raw1.txt

./drafts/scripts:
fizza1157@DESKTOP-P8HNL3: ~/Lab_3$
```

```
fizza1157@DESKTOP-P8HNL3: ~
./docs:
intro.txt  notes.txt  summary.txt

./drafts:
data  scripts  summary.txt

./drafts/data:
processed  raw

./drafts/data/processed:
raw2.txt

./drafts/data/raw:
raw1.txt

./drafts/scripts:
fizza1157@DESKTOP-P8HNL3:~/Lab_3$ tree
.
├── docs
│   ├── intro.txt
│   ├── notes.txt
│   └── summary.txt
├── drafts
│   ├── data
│   │   ├── processed
│   │   │   └── raw2.txt
│   │   └── raw
│   │       └── raw1.txt
│   └── scripts
│       └── summary.txt
└── .

7 directories, 6 files
fizza1157@DESKTOP-P8HNL3:~/Lab_3$
```

## Part 2: Practice with Basic Linux Commands

Run the following commands inside `Lab_3/` and note their outputs:

- `pwd` → Show current working directory.
- `whoami` → Display the current logged-in user.
- `touch extra.txt` → Create an empty file. `cat`
- `intro.txt` → Display file contents. `rm extra.txt` →
- Delete a file.
- `history` | `tail -n 5` → Show your last 5 executed commands. `clear` → Clear
- the terminal.

Take screenshots of commands and outputs.

```
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ pwd
/home/fizza1157/Lab_3
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ whoami
fizza1157
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ touch extra.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ intro.txt
intro.txt: command not found
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ cat docs/intro.txt
This is the introduction file.
It contains the basic overview of Lab 3.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ history | tail -n 5
549  whoami
550  touch extra.txt
551  intro.txt
552  cat docs/intro.txt
553  history | tail -n 5
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$
```

## Part 3: File Permissions and Ownership

1. Change the permissions of `hello.sh` so that:

- Owner → Read, Write & Execute
- Group → Read, Write & Execute
- Others → No permissions
- Run the script using:

```
./hello.sh
```

Take a screenshot of its output.

2. Change the permissions of `intro.txt` using **numeric notation** so that:

- Owner → Read & Write
- Group → Read & Write
- Others → Read only

3. Change the permissions of `notes.txt` using **symbolic notation** so that others don't have any permission on it.

4. Verify all changes with:

```
ls -l
```

Take a screenshot of the output.

```
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ echo -e '#!/bin/bash\nnecho "Hello world! This is my first shell script."' > hello.sh
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ chmod 770 hello.sh
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ./hello.sh
Hello world! This is my first shell script.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ls -l hello.sh
-rwxrwx--- 1 fizza1157 fizza1157 63 Oct  5 14:26 hello.sh
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ./hello.sh
Hello world! This is my first shell script.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ chmod 664 docs/intro.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ls -l docs/intro.txt
-rw-rw-r-- 1 fizza1157 fizza1157 72 Oct  5 14:07 docs/intro.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ chmod o-rwx docs/notes.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ls -l docs/notes.txt
-rw-r----- 1 fizza1157 fizza1157 96 Oct  5 14:07 docs/notes.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ls -l docs/hello.sh
-rwxrwx--- 1 fizza1157 fizza1157 63 Oct  5 14:26 hello.sh
docs:
total 12
-rw-rw-r-- 1 fizza1157 fizza1157 72 Oct  5 14:07 intro.txt
-rw-r----- 1 fizza1157 fizza1157 96 Oct  5 14:07 notes.txt
-rw-r----- 1 fizza1157 fizza1157 76 Oct  5 14:08 summary.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$ ./hello.sh
Hello world! This is my first shell script.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3$
```

## Part 4: Reading & Searching Files

Inside docs/:

1. Count the number of lines, words, and characters in notes.txt using wc .
2. Show only the **first 2 lines** of summary.txt using head -n 2 .
3. Show the **last line** of summary.txt using tail -n 1 .
4. Search for a keyword (of your choice) in intro.txt using grep .

Take screenshots.

```
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$ cd ~\Lab_3\docs
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$ wc notes.txt
 2 15 96 notes.txt
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$ head -n 2 summary.txt
This is the summary file for Lab 3.
It includes a brief recap of the tasks.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$ tail -n 1 summary.txt
It includes a brief recap of the tasks.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$ grep "file" intro.txt
This is the introduction file.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$ grep "Lab" intro.txt
It contains the basic overview of Lab 3.
fizza1157@DESKTOP-P8HNL3: ~\Lab_3\docs$
```

# Part 5: Linux Process Commands

## 1. Exploring Processes

- Use `ps -ef` and identify **3 processes** running on your system. Note their **PID**, **PPID**, and **command**.
- Run `top` for 20–30 seconds. Write down:
  - Which process is consuming the most CPU.
  - Which process is consuming the most memory.

```
fizza1157@DESKTOP-P8HNL3:~/Lab_3/docs$ ps -ef
UID          PID    PPID  C STIME TTY          TIME CMD
root           1        0  0 14:04 ?        00:00:01 /sbin/init
root           2        1  0 14:04 ?        00:00:00 /init
root           7        2  0 14:04 ?        00:00:00 plan9 --cont
root          46        1  0 14:04 ?        00:00:00 /usr/lib/sys
root          93        1  0 14:04 ?        00:00:00 /usr/lib/sys
systemd+     154        1  0 14:04 ?        00:00:00 /usr/lib/sys
systemd+     158        1  0 14:04 ?        00:00:00 /usr/lib/sys
root         167        1  0 14:04 ?        00:00:00 /usr/sbin/cr
message+     168        1  0 14:04 ?        00:00:00 @dbus-daemon
root         181        1  0 14:04 ?        00:00:00 /usr/lib/sys
root         183        1  0 14:04 ?        00:00:00 /usr/libexec
root         187        1  0 14:04 hvc0    00:00:00 /sbin/agetty
syslog       192        1  0 14:04 ?        00:00:00 /usr/sbin/rs
root         208        1  0 14:04 tty1    00:00:00 /sbin/agetty
root         216        1  0 14:04 ?        00:00:00 /usr/bin/pyt
root         319        2  0 14:04 ?        00:00:00 /init
root         320        319  0 14:04 ?        00:00:00 /init
fizza1157+   321        320  0 14:04 pts/0    00:00:00 -bash
root         322        2  0 14:04 pts/1    00:00:00 /bin/login -
fizza1157+   368        1  0 14:04 ?        00:00:00 /usr/lib/sys
fizza1157+   369       368  0 14:04 ?        00:00:00 (sd-pam)
fizza1157+   388       322  0 14:04 pts/1    00:00:00 -bash
polkitd      646        1  0 14:09 ?        00:00:00 /usr/lib/pol
fizza1157+   925       321  0 14:34 pts/0    00:00:00 ps -ef

fizza1157@DESKTOP-P8HNL3:~/Lab_3/docs$ top
top - 14:34:53 up 30 min, 1 user, load average: 0.00, 0.00, 0.00
Tasks: 24 total, 1 running, 23 sleeping, 0 stopped, 0 zombie
%Cpu(s):  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem : 7880.2 total, 7391.9 free,  493.9 used, 146.6 buff/cache
MiB Swap: 2048.0 total, 2048.0 free,  0.0 used. 7386.3 avail Mem
```

```
fizza1157@DESKTOP-P8HNL3:~/Lab_3/docs$ top
top - 14:35:29 up 30 min, 1 user, load average: 0.06, 0.01, 0.00
Tasks: 24 total, 1 running, 23 sleeping, 0 stopped, 0 zombie
%Cpu(s):  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem : 7880.2 total, 7380.5 free,  505.3 used, 146.6 buff/cache
MiB Swap: 2048.0 total, 2048.0 free,  0.0 used. 7374.9 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM    TIME+  COMMAND
  926 fizza1157+ 20   0   9276   5504   3328  R   0.7   0.1   0:00.03 top
    1 root       20   0  21664  12240   9168  S   0.0   0.2   0:01.29 systemd
    2 root       20   0   3072   1792   1792  S   0.0   0.0   0:00.01 init-systemd(Ub
    7 root       20   0   3072   1792   1792  S   0.0   0.0   0:00.00 init
   46 root      19  -1  66816  16720  15824  S   0.0   0.2   0:00.39 systemd-journal
   93 root       20   0  25140   6144   4864  S   0.0   0.1   0:00.28 systemd-udev
  154 systemd+  20   0  21456  12544  10368  S   0.0   0.2   0:00.29 systemd-resolve
  158 systemd+  20   0  91024  7552   6656  S   0.0   0.1   0:00.18 systemd-timesyn
  167 root       20   0   4236   2560   2432  S   0.0   0.0   0:00.01 cron
  168 message+  20   0   9632   4480   4096  S   0.0   0.1   0:00.11 dbus-daemon
  181 root       20   0   17964   8192   7296  S   0.0   0.1   0:00.14 systemd-logind
  183 root       20   0 1755840 12032  10368  S   0.0   0.1   0:00.18 wsl-pro-service
  187 root       20   0   3160   1920   1792  S   0.0   0.0   0:00.00 agetty
  192 syslog    20   0 222508  5760   4480  S   0.0   0.1   0:00.12 rsyslogd
  208 root       20   0   3116   1792   1664  S   0.0   0.0   0:00.01 agetty
  216 root       20   0 107012  22400  13056  S   0.0   0.3   0:00.19 unattended-upgr
  319 root       20   0   3080   1024    896  S   0.0   0.0   0:00.00 SessionLeader
  320 root       20   0   3096   1156   1024  S   0.0   0.0   0:00.10 Relay(321)
  321 fizza1157+  20   0   6204   4992   3456  S   0.0   0.1   0:00.20 bash
  322 root       20   0   6660   4352   3712  S   0.0   0.1   0:00.01 login
  368 fizza1157+  20   0  20312  11136   9088  S   0.0   0.1   0:00.16 systemd
  369 fizza1157+  20   0  21152   3516   1792  S   0.0   0.0   0:00.00 (sd-pam)
  388 fizza1157+  20   0   6072   4480   3200  S   0.0   0.1   0:00.04 bash
  646 polkitd    20   0 308164   7680   6912  S   0.0   0.1   0:00.08 polkitd
```

## 2. Practice with Infinite Process

- Start:

```
yes > /dev/null &
```

- Locate its PID using `ps -ef | grep yes`.
- Kill it using `kill <PID>` and verify using `ps`.

## 3. Foreground & Background Jobs

- Run `sleep 60` in **foreground** and terminate it with **Ctrl + C**.
- Run `sleep 60 &` in **background**, bring it to foreground with `fg`, stop with **Ctrl + Z**, then resume in background using `bg`.

```
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ yes > /dev/null &
[1] 929
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ ps -ef | grep yes
fizza11+  929    321  99 14:35 pts/0    00:00:10 yes
fizza11+  931    321   0 14:36 pts/0    00:00:00 grep --color=auto yes
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ kill 929
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ ps -ef | grep yes
fizza11+  933    321   0 14:36 pts/0    00:00:00 grep --color=auto yes
[1]+  Terminated yes > /dev/null
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ sleep 15
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ sleep 15 &
[1] 935
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ jobs
[1]+  Running sleep 15 &
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ fg %1
-bash: fg: job has terminated
[1]+  Done sleep 15
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ bg %1
-bash: bg: %1: no such job
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ ps
  PID TTY          TIME CMD
   321 pts/0    00:00:00 bash
   936 pts/0    00:00:00 ps
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ jobs
fizza1157@DESKTOP-P8HNL3: ~/Lab_3/docs$ |
```

# Part 6: C Programs on Processes

## Program 1 – Exec with top

- Modify the exec program so that the child runs `top` instead of `ls -l`.
- Run the program.
- In another terminal, use `ps -ef | grep top` (or `run top`) to find the child's PID.
- Use the child's process ID to kill it manually.

```
fizza1157@DESKTOP-P8HNL3: ~$ ls -l
total 48
drwxr-xr-x 3 fizza1157 fizza1157 4096 Oct 3 15:55 'Lab 3_OS'
drwxr-xr-x 2 fizza1157 fizza1157 4096 Oct 9 17:16 Lab3_HomeTask
drwxr-xr-x 4 fizza1157 fizza1157 4096 Oct 5 14:19 Lab_3
-rw-r--r-- 1 fizza1157 fizza1157 19 Sep 26 16:01 combined.txt
-rwxr-xr-x 1 fizza1157 fizza1157 9 Sep 26 16:02 file.txt
-rw-r--r-- 1 fizza1157 fizza1157 19 Sep 26 15:52 file1.txt
-rw-r--r-- 1 fizza1157 fizza1157 0 Sep 26 15:18 file2.txt
-rw-r--r-- 1 fizza1157 fizza1157 0 Sep 26 15:18 file3.txt
-rw-r--r-- 1 fizza1157 fizza1157 13 Sep 26 15:22 hello.txt
drwxr-xr-x 5 fizza1157 fizza1157 4096 Sep 26 19:23 mylab2
drwxr-xr-x 2 fizza1157 fizza1157 4096 Sep 26 14:40 recycleBin
drwxr-xr-x 2 fizza1157 fizza1157 4096 Sep 26 15:46 repos
drwxr-xr-x 3 fizza1157 fizza1157 4096 Sep 26 15:18 test
drwxr-xr-x 4 fizza1157 fizza1157 4096 Sep 24 16:25 wsl_lab1
fizza1157@DESKTOP-P8HNL3:~$ ps -ef | grep top
fizza11+ 1298 1244 0 17:29 pts/5 00:00:00 grep --color=auto top
fizza1157@DESKTOP-P8HNL3:~$
```

## Program 2 – Incomplete Program

```
#include <stdio.h>
#include <unistd.h>
#include <sys/wait.h>

int main() {

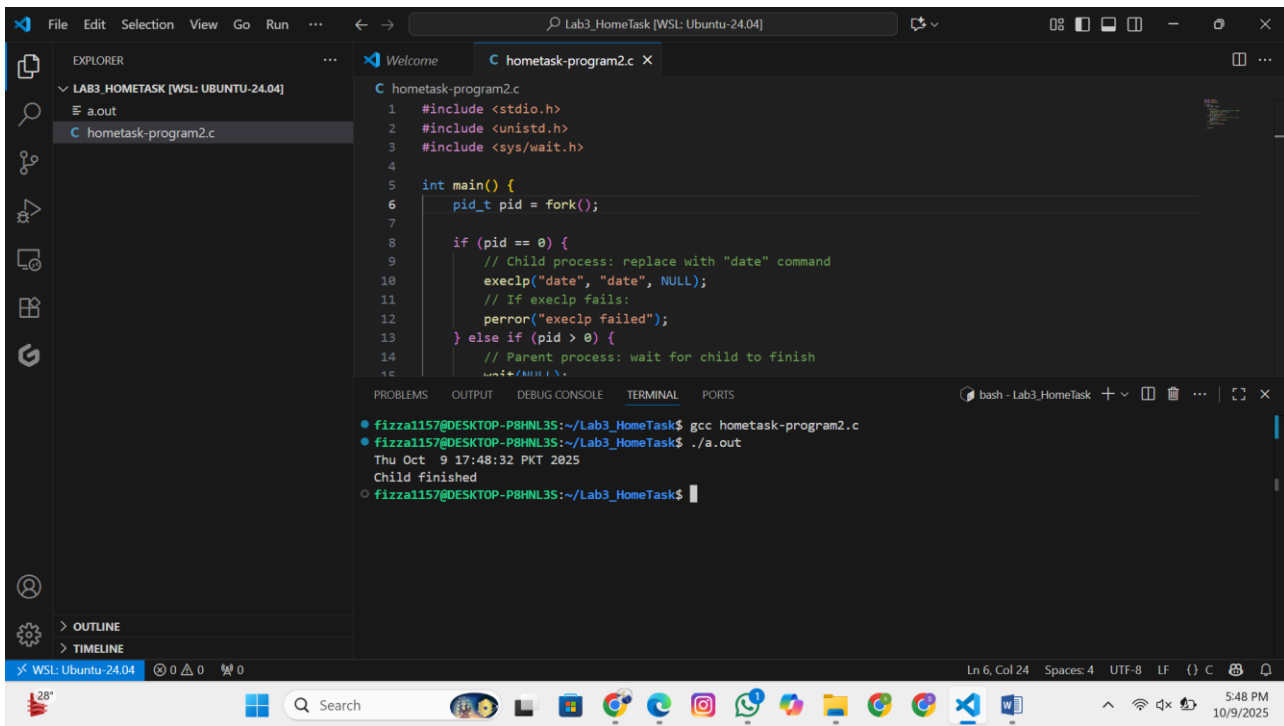
    pid_t pid = fork();

    if (pid == 0) {
        // TODO: Replace this child process with the "date" command using
        // Hint: execlp("date", "date", NULL);
    } else {
        // TODO: Make parent wait for child before printing "Child finished"
    }

    return 0;
}
```

**Task:** Complete the missing parts, run the program, and take a screenshot of the output.





```
1 #include <stdio.h>
2 #include <unistd.h>
3 #include <sys/wait.h>
4
5 int main() {
6     pid_t pid = fork();
7
8     if (pid == 0) {
9         // Child process: replace with "date" command
10        execlp("date", "date", NULL);
11        // If execlp fails:
12        perror("execlp failed");
13    } else if (pid > 0) {
14        // Parent process: wait for child to finish
15    }
```

```
● fizza1157@DESKTOP-P8HNL3S:~/Lab3_HomeTask$ gcc hometask-program2.c
● fizza1157@DESKTOP-P8HNL3S:~/Lab3_HomeTask$ ./a.out
Thu Oct  9 17:48:32 PKT 2025
Child finished
○ fizza1157@DESKTOP-P8HNL3S:~/Lab3_HomeTask$
```

## Submission Guidelines

- Submit a **single PDF file** including:
  - Screenshots of all said commands & outputs.
  - Modified & completed C program code and outputs.
- **Deadline:** 9th October, 2025, 11:59 PM.