

Error! Filename not specified.

National Textile University

Department of Computer Science

Subject

Operating System

Submitted to:

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Submitted by:

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Registration Number

23-NTU-CS-1167

Lab No.

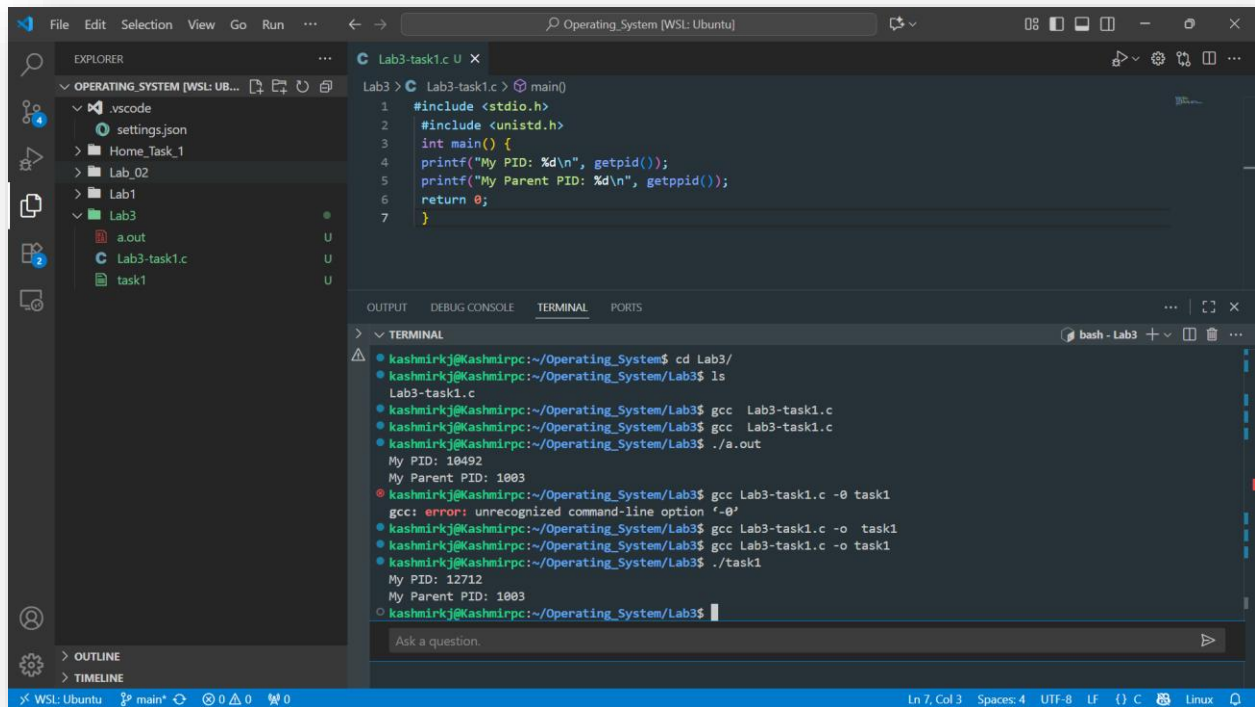
03

Semester

5th

C Programs on Processes

Program 1: Print PID and PPID:



The screenshot shows a Visual Studio Code editor window with a C program in `Lab3-task1.c`. The program uses `getpid()` and `getppid()` to print the current process ID and its parent process ID. The terminal output shows the program being compiled with `gcc` and executed, resulting in the output: `My PID: 10492` and `My Parent PID: 1003`. The terminal also shows several failed attempts to run the program with incorrect flags, such as `gcc Lab3-task1.c -o task1` and `gcc Lab3-task1.c -o task1`, which resulted in errors like `gcc: error: unrecognized command-line option '-o'` and `gcc: error: unrecognized command-line option '-o'`.

```
1 #include <stdio.h>
2 #include <unistd.h>
3 int main() {
4     printf("My PID: %d\n", getpid());
5     printf("My Parent PID: %d\n", getppid());
6     return 0;
7 }
```

```
kashmirkj@Kashmirpc:~/Operating_System$ cd Lab3/
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ls
Lab3-task1.c
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task1.c
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task1.c
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./a.out
My PID: 10492
My Parent PID: 1003
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task1.c -o task1
gcc: error: unrecognized command-line option '-o'
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task1.c -o task1
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task1.c -o task1
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./task1
My PID: 12712
My Parent PID: 1003
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

Program 2: Fork – Creating Child Process:

The screenshot shows the Visual Studio Code editor with the file explorer on the left displaying the project structure. The main editor window shows the code for `Lab3-task2.c`, which uses `fork()` to create a child process. The terminal at the bottom shows the execution of the program, including the compilation of `Lab3-task2.c` and the execution of `a.out` and `simple-process`. The output shows the parent and child PIDs and the parent's PID.

```
int main() {
    pid_t pid = fork();
    if (pid == 0) {
        // This block runs in the child process
        printf("Child: PID=%d, Parent=%d\n", getpid(), getppid());
    } else {
        // This block runs in the parent process
        printf("Parent: PID=%d, Child=%d\n", getpid(), pid);
    }
    return 0;
}
```

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task2.c
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./a.out
Parent: PID=21726, Child=21727
Child: PID=21727, Parent=21726
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task2.c -o simple-process
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./simple-process
Parent: PID=22027, Child=22028
Child: PID=22028, Parent=22027
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

Program 3: Exec1 – Replacing a Process:

The screenshot shows the Visual Studio Code editor with the file explorer on the left displaying the project structure. The main editor window shows the code for `Lab3-task3.c`, which uses `exec1()` to replace the current process. The terminal at the bottom shows the execution of the program, including the compilation of `Lab3-task3.c` and the execution of `a.out` and `without-wait`. The output shows the parent and child PIDs and the parent's PID.

```
int main() {
    // ...
} else {
    printf("Parent still running...\n");
}
return 0;
```

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task3.c
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./a.out
Parent still running...
total 60
-rw-r--r-- 1 kashmirkj kashmirkj 145 Oct 3 14:41 Lab3-task1.c
-rw-r--r-- 1 kashmirkj kashmirkj 352 Oct 3 15:01 Lab3-task2.c
-rw-r--r-- 1 kashmirkj kashmirkj 279 Oct 3 15:15 Lab3-task3.c
-rwxr-xr-x 1 kashmirkj kashmirkj 16048 Oct 3 15:15 a.out
-rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:12 simple-process
-rwxr-xr-x 1 kashmirkj kashmirkj 16056 Oct 3 14:47 task1
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task3.c -o without-wait
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./without-wait
Parent still running...
total 76
-rw-r--r-- 1 kashmirkj kashmirkj 145 Oct 3 14:41 Lab3-task1.c
-rw-r--r-- 1 kashmirkj kashmirkj 352 Oct 3 15:01 Lab3-task2.c
-rw-r--r-- 1 kashmirkj kashmirkj 279 Oct 3 15:15 Lab3-task3.c
-rwxr-xr-x 1 kashmirkj kashmirkj 16048 Oct 3 15:15 a.out
-rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:12 simple-process
-rwxr-xr-x 1 kashmirkj kashmirkj 16056 Oct 3 14:47 task1
-rwxr-xr-x 1 kashmirkj kashmirkj 16048 Oct 3 15:16 without-wait
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

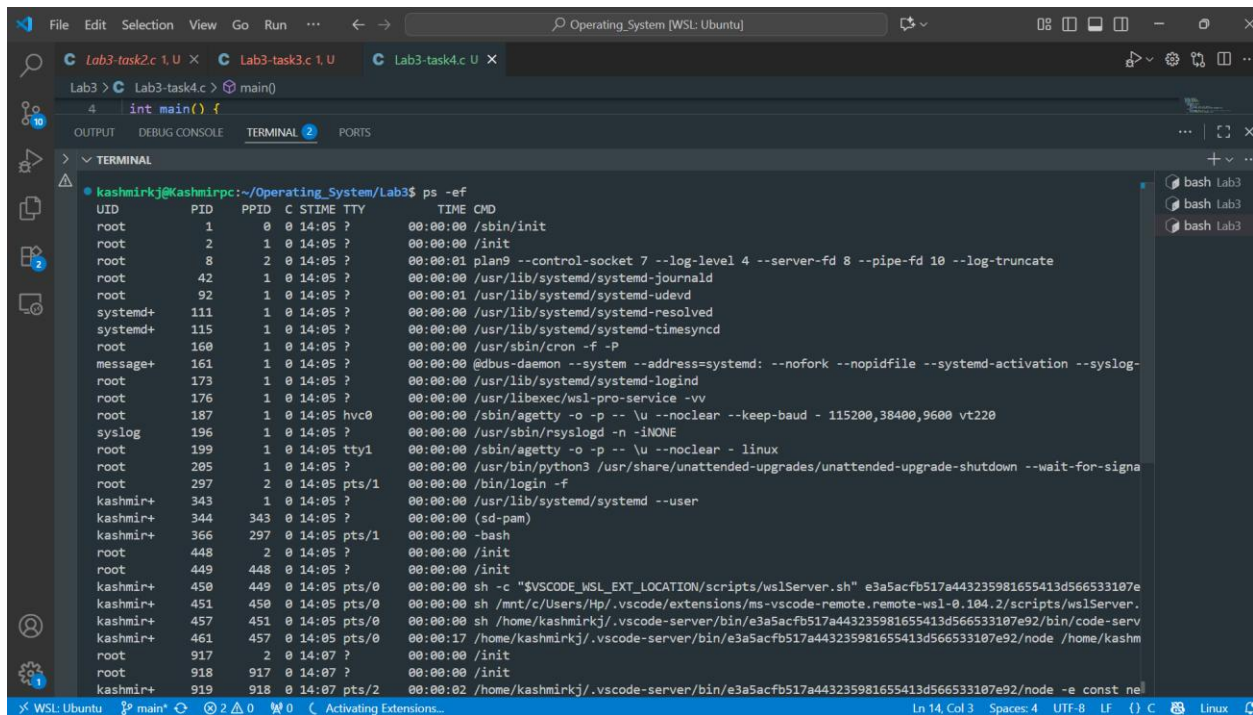
Program 4: Wait – Synchronization:

```
Lab3 > C Lab3-task4.c > main()
4 int main() {
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task4.c
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./a.out
    total 80
    -rw-r--r-- 1 kashmirkj kashmirkj 145 Oct 3 14:41 Lab3-task1.c
    -rw-r--r-- 1 kashmirkj kashmirkj 352 Oct 3 15:01 Lab3-task2.c
    -rw-r--r-- 1 kashmirkj kashmirkj 279 Oct 3 15:15 Lab3-task3.c
    -rw-r--r-- 1 kashmirkj kashmirkj 371 Oct 3 15:17 Lab3-task4.c
    -rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:18 a.out
    -rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:12 simple-process
    -rwxr-xr-x 1 kashmirkj kashmirkj 16056 Oct 3 14:47 task1
    -rwxr-xr-x 1 kashmirkj kashmirkj 16048 Oct 3 15:16 without-wait
    Parent still running...
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$ gcc Lab3-task4.c -o wait
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ./wait
    total 96
    -rw-r--r-- 1 kashmirkj kashmirkj 145 Oct 3 14:41 Lab3-task1.c
    -rw-r--r-- 1 kashmirkj kashmirkj 352 Oct 3 15:01 Lab3-task2.c
    -rw-r--r-- 1 kashmirkj kashmirkj 279 Oct 3 15:15 Lab3-task3.c
    -rw-r--r-- 1 kashmirkj kashmirkj 371 Oct 3 15:17 Lab3-task4.c
    -rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:18 a.out
    -rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:12 simple-process
    -rwxr-xr-x 1 kashmirkj kashmirkj 16056 Oct 3 14:47 task1
    -rwxr-xr-x 1 kashmirkj kashmirkj 16096 Oct 3 15:18 wait
    -rwxr-xr-x 1 kashmirkj kashmirkj 16048 Oct 3 15:16 without-wait
    Parent still running...
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

Ps Command:

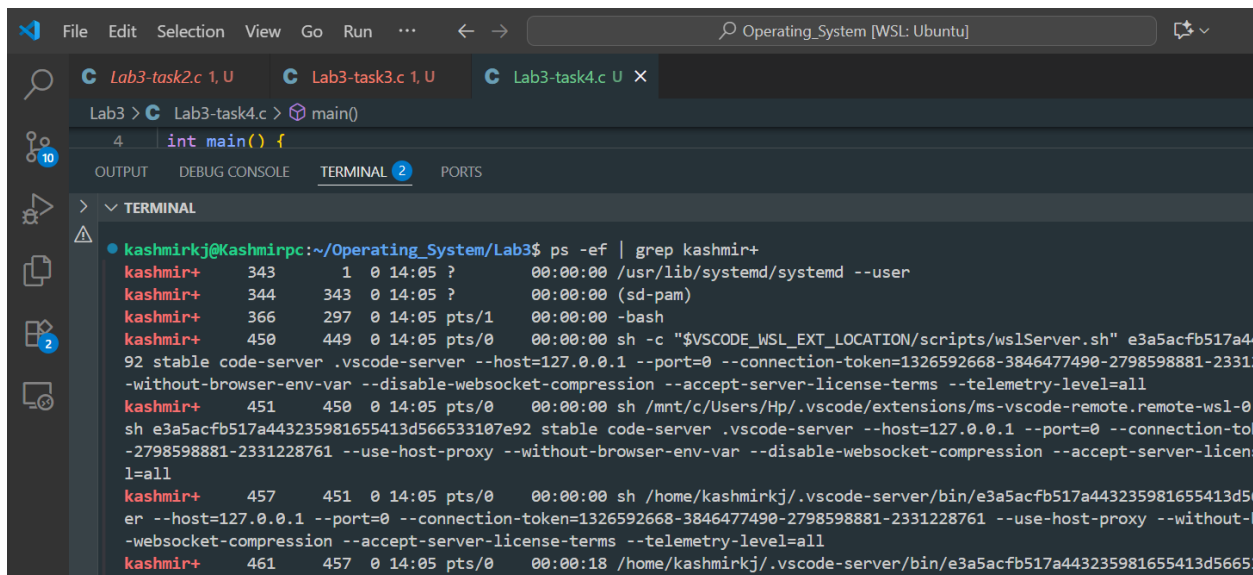
```
Lab3 > C Lab3-task4.c > main()
4 int main() {
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ps
    PID TTY          TIME CMD
    18470 pts/8        00:00:00 bash
    26735 pts/8        00:00:00 ps
    kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

ps -ef → Full list of all processes:



```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ps -ef
UID          PID    PPID  C STIME TTY          TIME CMD
root           1      0  0 14:05 ?        00:00:00 /sbin/init
root           2      1  0 14:05 ?        00:00:00 /init
root           8      2  0 14:05 ?        00:00:01 plan9 --control-socket 7 --log-level 4 --server-fd 8 --pipe-fd 10 --log-truncate
root          42      1  0 14:05 ?        00:00:00 /usr/lib/systemd/systemd-journald
root          92      1  0 14:05 ?        00:00:01 /usr/lib/systemd/systemd-udevd
systemd+     111      1  0 14:05 ?        00:00:00 /usr/lib/systemd/systemd-resolved
systemd+     115      1  0 14:05 ?        00:00:00 /usr/lib/systemd/systemd-timesyncd
root         160      1  0 14:05 ?        00:00:00 /usr/sbin/cron -f -P
message+    161      1  0 14:05 ?        00:00:00 @dbus-daemon --system --address=systemd: --nofork --nopidfile --systemd-activation --syslog-
root         173      1  0 14:05 ?        00:00:00 /usr/lib/systemd/systemd-logind
root         176      1  0 14:05 ?        00:00:00 /usr/libexec/wsl-pro-service -vv
root         187      1  0 14:05 hvc0     00:00:00 /sbin/agetty -o -p -- \u --noclear --keep-baud - 115200,38400,9600 vt220
syslog      196      1  0 14:05 ?        00:00:00 /usr/sbin/rsyslogd -n -iNONE
root        199      1  0 14:05 tty1     00:00:00 /sbin/agetty -o -p -- \u --noclear - linux
root        205      1  0 14:05 ?        00:00:00 /usr/bin/python3 /usr/share/unattended-upgrades/unattended-upgrade-shutdown --wait-for-signa
root        297      2  0 14:05 pts/1    00:00:00 /bin/login -f
kashmir+    343      1  0 14:05 ?        00:00:00 /usr/lib/systemd/systemd --user
kashmir+    344      343  0 14:05 ?        00:00:00 (sd-pam)
kashmir+    366      297  0 14:05 pts/1    00:00:00 -bash
root        448      2  0 14:05 ?        00:00:00 /init
root        449      448  0 14:05 ?        00:00:00 /init
kashmir+    450      449  0 14:05 pts/0    00:00:00 sh -c "$VSCODE_WSL_EXT_LOCATION/scripts/wslServer.sh" e3a5acfb517a443235981655413d566533107e
kashmir+    451      450  0 14:05 pts/0    00:00:00 sh /mnt/c/Users/Hp/.vscode/extensions/ms-vscode-remote.remote-wsl-0.104.2/scripts/wslServer.
kashmir+    457      451  0 14:05 pts/0    00:00:00 sh /home/kashmirkj/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/bin/code-serv
kashmir+    461      457  0 14:05 pts/0    00:00:17 /home/kashmirkj/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node /home/kashm
root         917      2  0 14:07 ?        00:00:00 /init
root         918      917  0 14:07 ?        00:00:00 /init
kashmir+    919      918  0 14:07 pts/2    00:00:02 /home/kashmirkj/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node -e const ne
```

ps -ef | grep bash:



```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ ps -ef | grep bash
kashmir+    343      1  0 14:05 ?        00:00:00 /usr/lib/systemd/systemd --user
kashmir+    344      343  0 14:05 ?        00:00:00 (sd-pam)
kashmir+    366      297  0 14:05 pts/1    00:00:00 -bash
kashmir+    450      449  0 14:05 pts/0    00:00:00 sh -c "$VSCODE_WSL_EXT_LOCATION/scripts/wslServer.sh" e3a5acfb517a443235981655413d566533107e92 stable code-server .vscode-server --host=127.0.0.1 --port=0 --connection-token=1326592668-3846477490-2798598881-2331228761 --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
kashmir+    451      450  0 14:05 pts/0    00:00:00 sh /mnt/c/Users/Hp/.vscode/extensions/ms-vscode-remote.remote-wsl-0.104.2/scripts/wslServer.sh e3a5acfb517a443235981655413d566533107e92 stable code-server .vscode-server --host=127.0.0.1 --port=0 --connection-token=1326592668-3846477490-2798598881-2331228761 --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
kashmir+    457      451  0 14:05 pts/0    00:00:00 sh /home/kashmirkj/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/bin/code-server --host=127.0.0.1 --port=0 --connection-token=1326592668-3846477490-2798598881-2331228761 --use-host-proxy --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
kashmir+    461      457  0 14:05 pts/0    00:00:18 /home/kashmirkj/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node -e const ne
```

top → Dynamic process viewer:

```
Lab3 > C Lab3-task4.c > main()
4 int main() {

o kashmirkj@Kashmirpc:~/Operating_System/Lab3$ top
top - 15:30:07 up 1:26, 1 user, load average: 0.05, 0.06, 0.04
Tasks: 52 total, 1 running, 51 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.4 us, 0.5 sy, 0.0 ni, 99.0 id, 0.1 wa, 0.0 hi, 0.1 si, 0.0 st
MiB Mem : 7784.2 total, 5258.9 free, 2391.6 used, 288.8 buff/cache
MiB Swap: 2048.0 total, 2048.0 free, 0.0 used, 5392.6 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM    TIME+  COMMAND
 6288 kashmir+  20   0 52.6g 830712 55412 S  2.7  10.4  1:20.19 node
 949  kashmir+  20   0 52.5g 855212 57888 S  1.3  10.7  1:55.66 node
 919  kashmir+  20   0 1031292 73356 42880 S  0.3   0.9   0:02.38 node
 928  kashmir+  20   0 1012916 55092 42752 S  0.3   0.7   0:02.69 node
 972  kashmir+  20   0 1087584 83684 46976 S  0.3   1.0   0:11.16 node
29712 kashmir+  20   0  9276   5504  3456 R  0.3   0.1   0:00.01 top
   1  root      20   0 21660 12368 9296 S  0.0   0.2   0:00.56 systemd
   2  root      20   0  3072  1920 1792 S  0.0   0.0   0:00.00 init-systemd(Ub
   8  root      20   0  3120  2152 1920 S  0.0   0.0   0:01.03 init
  42  root     19  -1 50428 15744 14848 S  0.0   0.2   0:00.28 systemd-journal
   92  root      20   0 25272  6400 4992 S  0.0   0.1   0:01.25 systemd-udev
 111  systemd+  20   0 21456 12160 10240 S  0.0   0.2   0:00.08 systemd-resolve
115  systemd+  20   0 91024  7424 6656 S  0.0   0.1   0:00.13 systemd-timesyn
160  root      20   0  4236  2560 2432 S  0.0   0.0   0:00.02 cron
161  message+  20   0  9536  4736 4352 S  0.0   0.1   0:00.12 dbus-daemon
173  root      20   0 17968  8320 7424 S  0.0   0.1   0:00.08 systemd-logind
176  root      20   0 1756096 12544 10368 S  0.0   0.2   0:00.17 wsl-pro-service
187  root      20   0  3160  2048 1920 S  0.0   0.0   0:00.00 agetty
196  syslog    20   0 222508 5504 4480 S  0.0   0.1   0:00.11 rsyslogd
199  root      20   0  3116  1920 1792 S  0.0   0.0   0:00.00 agetty
205  root      20   0 107032 22400 13184 S  0.0   0.3   0:00.09 unattended-upgr
297  root      20   0  6664  4352 3712 S  0.0   0.1   0:00.00 login
```

Foreground and Background Jobs:

```
Lab3 > C Lab3-task4.c > main()
4 int main() {

o kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 5
```

This screenshot shows the Visual Studio Code interface with the 'Operating_System [WSL: Ubuntu]' window. The editor has three tabs: 'Lab3-task2.c 1, U', 'Lab3-task3.c 1, U', and 'Lab3-task4.c U'. The 'Lab3-task4.c' tab is active, showing a C program with a `main()` function. The 'TERMINAL' panel is open, displaying the following commands and output:

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 10 &
[1] 31103
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

This screenshot shows the Visual Studio Code interface with the 'Operating_System [WSL: Ubuntu]' window. The editor has three tabs: 'Lab3-task2.c 1, U', 'Lab3-task3.c 1, U', and 'Lab3-task4.c U'. The 'Lab3-task4.c' tab is active, showing a C program with a `main()` function. The 'TERMINAL' panel is open, displaying the following commands and output:

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 10 &
[1] 31766
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ jobs
[1]+  Running                  sleep 10 &
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

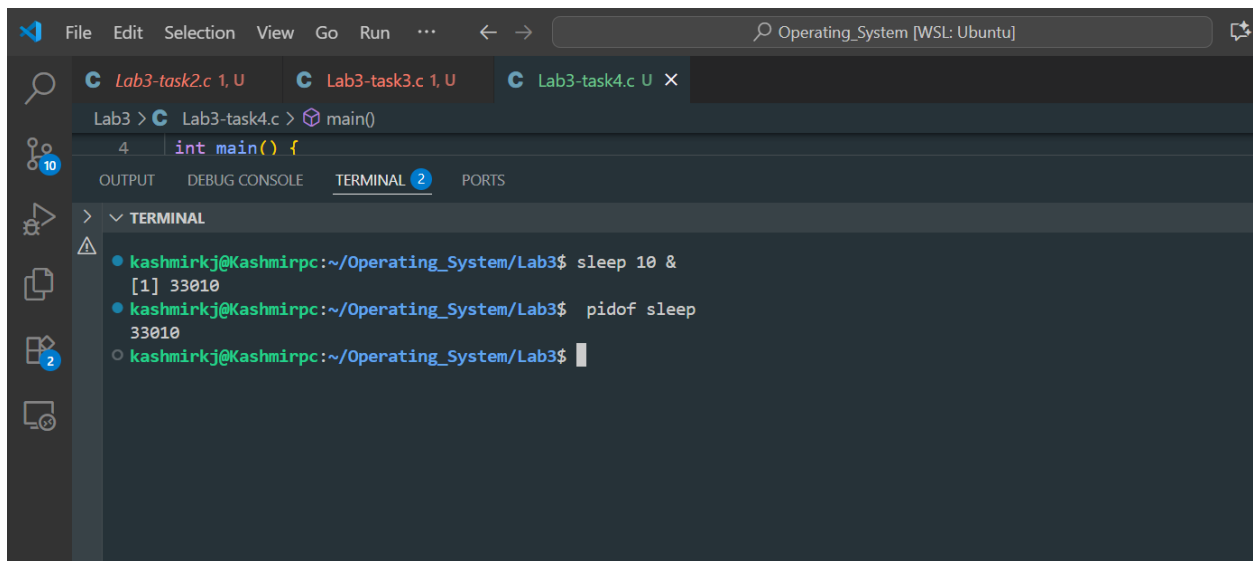

This screenshot shows the Visual Studio Code interface with a terminal window open. The terminal is running a C program named Lab3-task4.c. The user has executed the command `sleep 10 &` in the terminal, which has returned the PID [1] 32222. The user then presses `fg 1` to bring the background process to the foreground, and the terminal shows `sleep 10` being executed.

```
Lab3 > C Lab3-task4.c > main()
4 int main() {
  OUTPUT  DEBUG CONSOLE  TERMINAL 2  PORTS
  > TERMINAL
  • kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 10 &
    [1] 32222
  • kashmirkj@Kashmirpc:~/Operating_System/Lab3$ fg 1
    sleep 10
```

This screenshot shows the Visual Studio Code interface with a terminal window open. The terminal is running a C program named Lab3-task4.c. The user has executed the command `sleep 10 &` in the terminal, which has returned the PID [1] 32489. The user then presses `bg 1` to bring the background process to the background, but the terminal shows the error message `bash: bg: job 1 already in background`. The user then presses `fg 1` to bring the background process to the foreground, and the terminal shows `sleep 10` being executed.

```
Lab3 > C Lab3-task4.c > main()
4 int main() {
  OUTPUT  DEBUG CONSOLE  TERMINAL 2  PORTS
  > TERMINAL
  • kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 10 &
    [1] 32489
  • kashmirkj@Kashmirpc:~/Operating_System/Lab3$ bg 1
    bash: bg: job 1 already in background
  • kashmirkj@Kashmirpc:~/Operating_System/Lab3$ fg 1
    sleep 10
```

Process Identification:



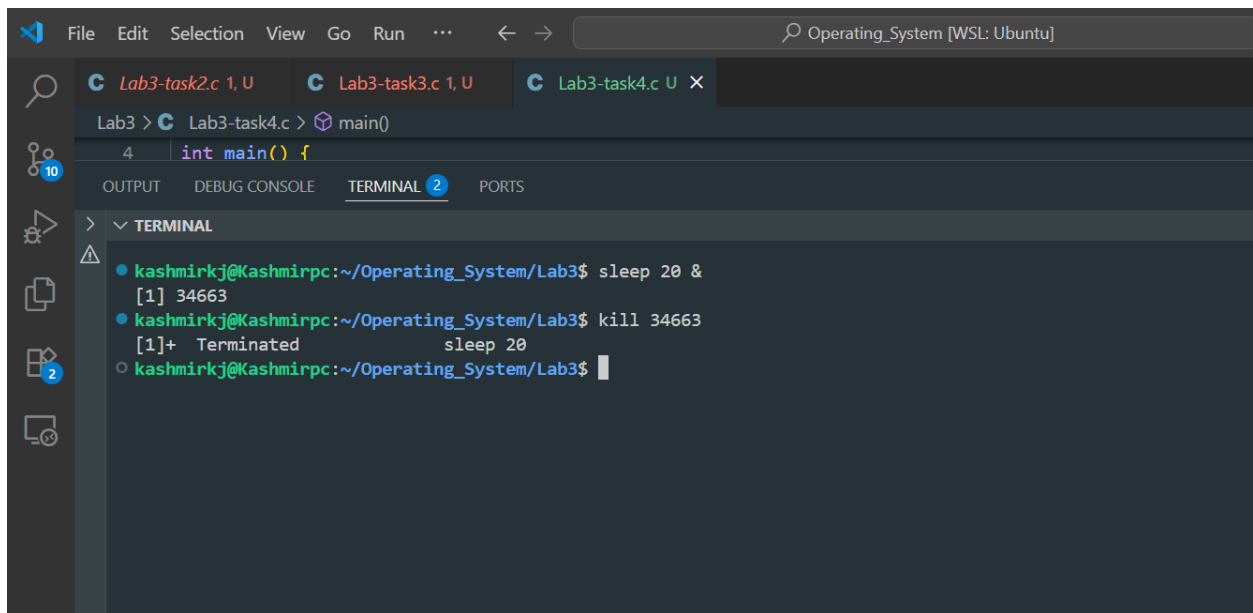
The screenshot shows the Visual Studio Code interface with a terminal window open. The terminal is titled "Operating_System [WSL: Ubuntu]". The file explorer on the left shows three files: "Lab3-task2.c 1, U", "Lab3-task3.c 1, U", and "Lab3-task4.c U X". The editor window shows the code for "Lab3-task4.c" with the following content:

```
Lab3 > C Lab3-task4.c > main()
4 int main() {
```

The terminal output shows the following commands and their results:

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 10 &
[1] 33010
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ pidof sleep
33010
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```

Killing Processes:

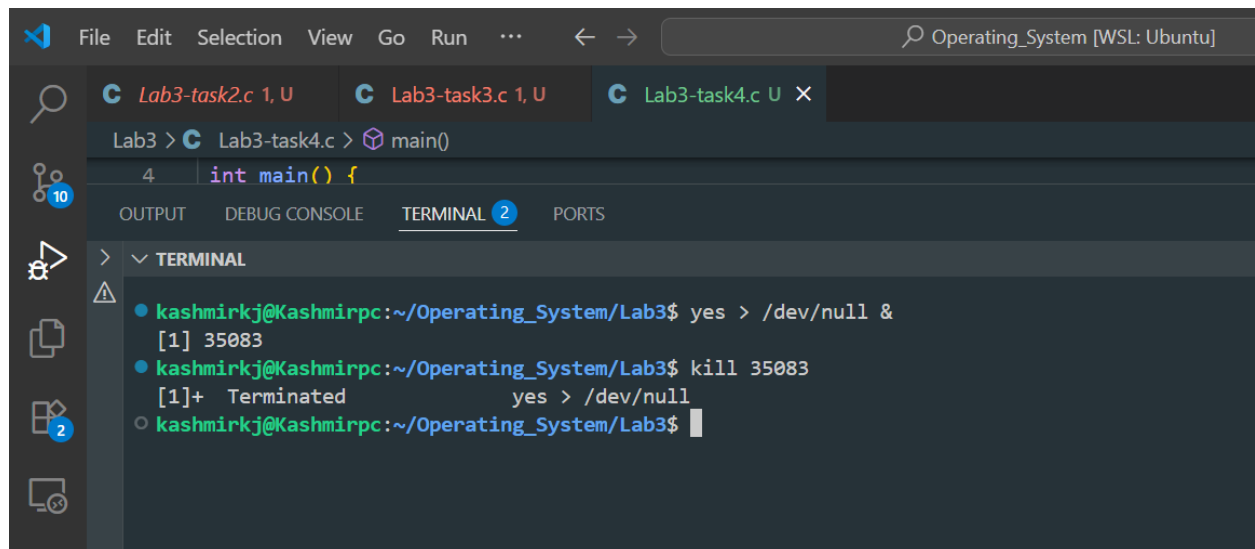


The screenshot shows the Visual Studio Code interface with a terminal window open. The terminal is titled "Operating_System [WSL: Ubuntu]". The file explorer on the left shows three files: "Lab3-task2.c 1, U", "Lab3-task3.c 1, U", and "Lab3-task4.c U X". The editor window shows the code for "Lab3-task4.c" with the following content:

```
Lab3 > C Lab3-task4.c > main()
4 int main() {
```

The terminal output shows the following commands and their results:

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ sleep 20 &
[1] 34663
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ kill 34663
[1]+  Terminated                  sleep 20
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```



The image shows a Visual Studio Code editor window with the title bar "Operating_System [WSL: Ubuntu]". The editor has three tabs open: "Lab3-task2.c 1, U", "Lab3-task3.c 1, U", and "Lab3-task4.c U X". The active tab is "Lab3-task4.c", which contains the following C code:

```
Lab3 > C Lab3-task4.c > main()
4 int main() {
```

Below the editor, there are four panels: "OUTPUT", "DEBUG CONSOLE", "TERMINAL 2", and "PORTS". The "TERMINAL 2" panel is active and shows the following output:

```
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ yes > /dev/null &
[1] 35083
kashmirkj@Kashmirpc:~/Operating_System/Lab3$ kill 35083
[1]+  Terminated                  yes > /dev/null
kashmirkj@Kashmirpc:~/Operating_System/Lab3$
```