



# **National Textile University**

*Department of Computer Science*

**Subject:**

**Operating System**

**Submitted To:**

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**Registration No:**

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**Lab No:**

**3**

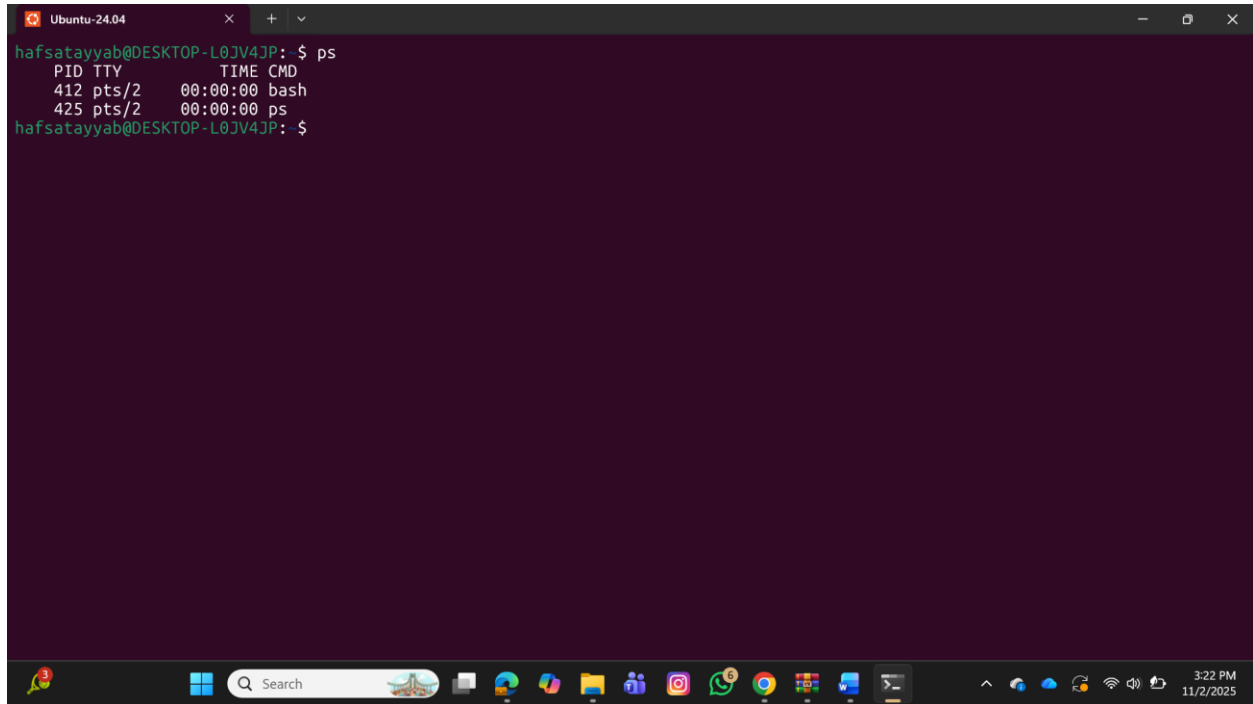
**Semester:**

**5<sup>th</sup>**

## 2. Linux Process Commands

### 2.1 Viewing Processes

**ps** → **Process Status**



A terminal window titled 'Ubuntu-24.04' showing the output of the 'ps' command. The output is a table with columns: PID, TTY, TIME, and CMD. It lists two processes: 'bash' (PID 412) and 'ps' (PID 425). The terminal prompt is 'hafsatayyab@DESKTOP-L0JV4JP: \$'.

```
hafsatayyab@DESKTOP-L0JV4JP: $ ps
  PID TTY          TIME CMD
   412 pts/2    00:00:00 bash
   425 pts/2    00:00:00 ps
hafsatayyab@DESKTOP-L0JV4JP: $
```

**ps -ef** → Full list of all processes

```
hafsatayyab@DESKTOP-L0JV43P: ~$ ps -ef
UID          PID    PPID  C  STIME TTY          TIME CMD
root           1        0  0  15:21 ?        00:00:01 /sbin/init
root           2        1  0  15:21 ?        00:00:00 /init
root           7        2  0  15:21 ?        00:00:00 plan9 --control-socket 7 --log-level 4 --server-fd 8 --pipe-fd 10 --log-
root          43        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-journald
root          93        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-udev
systemd+     122        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-resolved
systemd+     127        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-timesyncd
root         164        1  0  15:21 ?        00:00:00 /usr/sbin/cron -f -P
message+    165        1  0  15:21 ?        00:00:00 @dbus-daemon --system --address=systemd: --nofork --nopidfile --systemd-
root         175        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-logind
root         177        1  0  15:21 ?        00:00:00 /usr/libexec/wsl-pro-service -vv
root         194        1  0  15:21 hvc0    00:00:00 /sbin/agetty -o -p -- \u --noclear --keep-baud - 115200,38400,9600 vt220
syslog      197        1  0  15:21 ?        00:00:00 /usr/sbin/rsyslogd -n -iNONE
root        200        1  0  15:21 tty1    00:00:00 /sbin/agetty -o -p -- \u --noclear - linux
root        207        1  0  15:21 ?        00:00:00 /usr/bin/python3 /usr/share/unattended-upgrades/unattended-upgrade-shutd
root        282        2  0  15:21 pts/1   00:00:00 /bin/login -f
hafsata+    340        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd --user
hafsata+    341       340    0  15:21 ?        00:00:00 (sd-pam)
hafsata+    362       282    0  15:21 pts/1   00:00:00 -bash
root        408        2  0  15:22 ?        00:00:00 /init
root        410       408    0  15:22 ?        00:00:00 /init
hafsata+    412       410    0  15:22 pts/2   00:00:00 -bash
hafsata+    440       412    0  15:23 pts/2   00:00:00 ps -ef
hafsatayyab@DESKTOP-L0JV43P: ~$
```

**ps -ef | grep bash** This finds all processes related to the bash shell

```
hafsatayyab@DESKTOP-L0JV43P: ~$ ps -ef
UID          PID    PPID  C  STIME TTY          TIME CMD
root           1        0  0  15:21 ?        00:00:01 /sbin/init
root           2        1  0  15:21 ?        00:00:00 /init
root           7        2  0  15:21 ?        00:00:00 plan9 --control-socket 7 --log-level 4 --server-fd 8 --pipe-fd 10 --log-
root          43        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-journald
root          93        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-udev
systemd+     122        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-resolved
systemd+     127        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-timesyncd
root         164        1  0  15:21 ?        00:00:00 /usr/sbin/cron -f -P
message+    165        1  0  15:21 ?        00:00:00 @dbus-daemon --system --address=systemd: --nofork --nopidfile --systemd-
root         175        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd-logind
root         177        1  0  15:21 ?        00:00:00 /usr/libexec/wsl-pro-service -vv
root         194        1  0  15:21 hvc0    00:00:00 /sbin/agetty -o -p -- \u --noclear --keep-baud - 115200,38400,9600 vt220
syslog      197        1  0  15:21 ?        00:00:00 /usr/sbin/rsyslogd -n -iNONE
root        200        1  0  15:21 tty1    00:00:00 /sbin/agetty -o -p -- \u --noclear - linux
root        207        1  0  15:21 ?        00:00:00 /usr/bin/python3 /usr/share/unattended-upgrades/unattended-upgrade-shutd
root        282        2  0  15:21 pts/1   00:00:00 /bin/login -f
hafsata+    340        1  0  15:21 ?        00:00:00 /usr/lib/systemd/systemd --user
hafsata+    341       340    0  15:21 ?        00:00:00 (sd-pam)
hafsata+    362       282    0  15:21 pts/1   00:00:00 -bash
root        408        2  0  15:22 ?        00:00:00 /init
root        410       408    0  15:22 ?        00:00:00 /init
hafsata+    412       410    0  15:22 pts/2   00:00:00 -bash
hafsata+    440       412    0  15:23 pts/2   00:00:00 ps -ef
hafsatayyab@DESKTOP-L0JV43P: ~$ ps -ef |grep bash
hafsata+    362       282    0  15:21 pts/1   00:00:00 -bash
hafsata+    412       410    0  15:22 pts/2   00:00:00 -bash
hafsata+    446       412    0  15:24 pts/2   00:00:00 grep --color=auto bash
hafsatayyab@DESKTOP-L0JV43P: ~$
```

## 2.2 Monitoring Processes Interactively

top → Dynamic process viewer

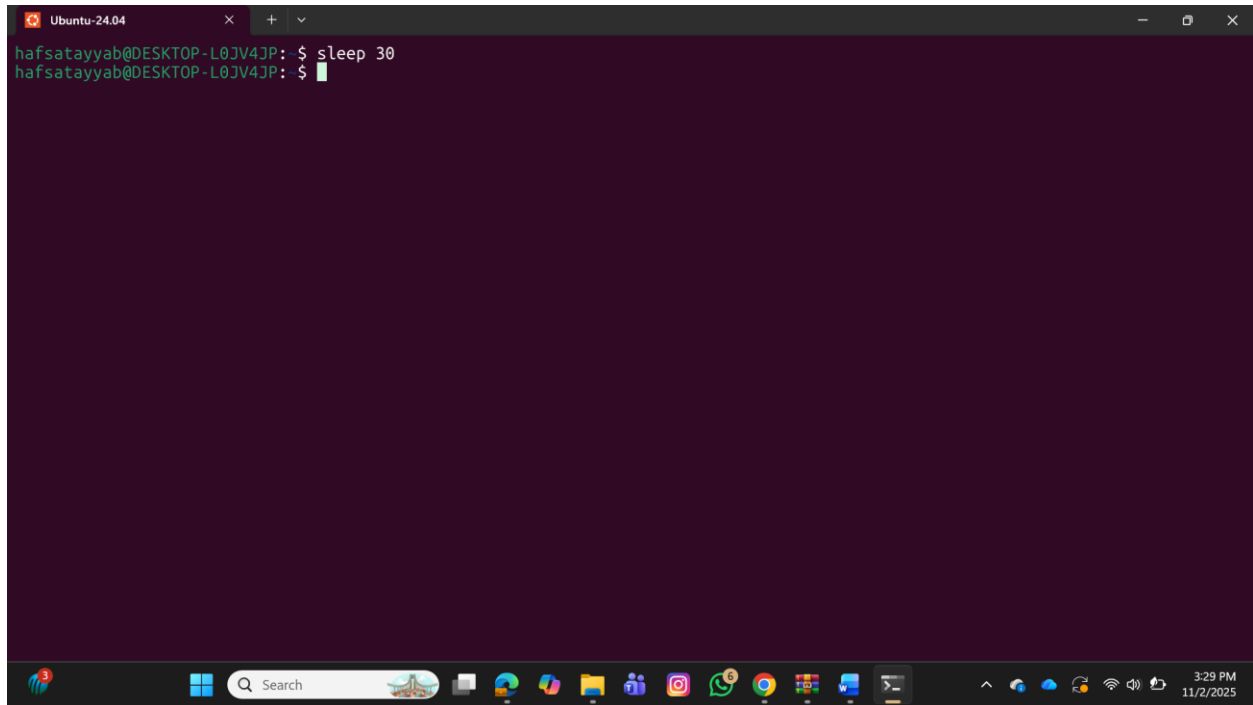
```
hafsatayyah@DESKTOP-L0JV43P:~$ top
top - 15:26:07 up 4 min, 1 user, load average: 0.00, 0.00, 0.00
Tasks: 23 total, 1 running, 22 sleeping, 0 stopped, 0 zombie
%Cpu(s):  0.0 us,  0.0 sy,  0.0 ni, 99.9 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem : 7690.2 total, 6909.1 free, 498.7 used, 431.2 buff/cache
MiB Swap: 2048.0 total, 2048.0 free,  0.0 used, 7191.5 avail Mem

  PID USER      PR  NI  VIRT  RES  SHR  S  %CPU  %MEM     TIME+ COMMAND
    1 root        20   0   21720 12480 9408 S   0.0   0.2   0:01.05 system
    2 root        20   0    3072  1664  1664 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
   43 root       19  -1   50432 17012 16116 S   0.0   0.2   0:00.30 systemd-journal
   93 root        20   0   25136  5760  4864 S   0.0   0.1   0:00.29 systemd-udev
  122 systemd+    20   0   21456 12544 10368 S   0.0   0.2   0:00.23 systemd-resolve
  127 systemd+    20   0   91024  7680  6912 S   0.0   0.1   0:00.12 systemd-timesyn
  164 root        20   0    4236  2560  2432 S   0.0   0.0   0:00.01 cron
  165 message+    20   0    9528  4480  4096 S   0.0   0.1   0:00.10 dbus-daemon
  175 root        20   0   17968  8448  7552 S   0.0   0.1   0:00.14 systemd-logind
  177 root        20   0  1755840 12032 10368 S   0.0   0.2   0:00.19 wsl-pro-service
  194 root        20   0    3160  1920  1792 S   0.0   0.0   0:00.01 agetty
  197 syslog      20   0  222508  5632  4480 S   0.0   0.1   0:00.12 rsyslogd
  200 root        20   0    3116  1920  1792 S   0.0   0.0   0:00.02 agetty
  207 root        20   0  107012 22400 13184 S   0.0   0.3   0:00.22 unattended-upgr
  282 root        20   0    6660  4224  3712 S   0.0   0.1   0:00.02 login
  340 hafsata+    20   0   20312 11264  9216 S   0.0   0.1   0:00.15 systemd
  341 hafsata+    20   0   21156  3520  1792 S   0.0   0.0   0:00.00 (sd-pam)
  362 hafsata+    20   0    6072  4864  3456 S   0.0   0.1   0:00.03 bash
  408 root        20   0    3076  1028   896 S   0.0   0.0   0:00.00 SessionLeader
  410 root        20   0    3092  1032   896 S   0.0   0.0   0:00.03 Relay(412)
  412 hafsata+    20   0    6204  5376  3584 S   0.0   0.1   0:00.09 bash
  454 hafsata+    20   0    9276  5504  3456 R   0.0   0.1   0:00.00 top
```

## 2.3 Foreground and Background Jobs

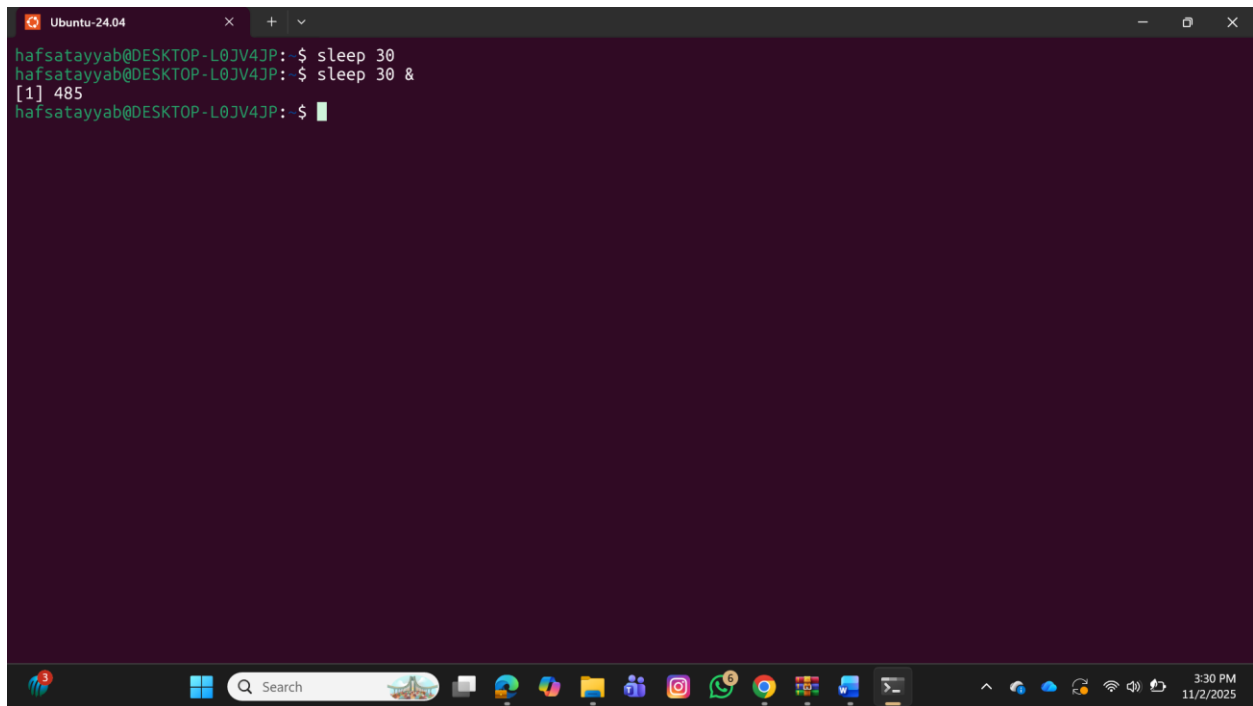
**Foreground:** A process that takes control of the terminal until it finishes.

**sleep 30**



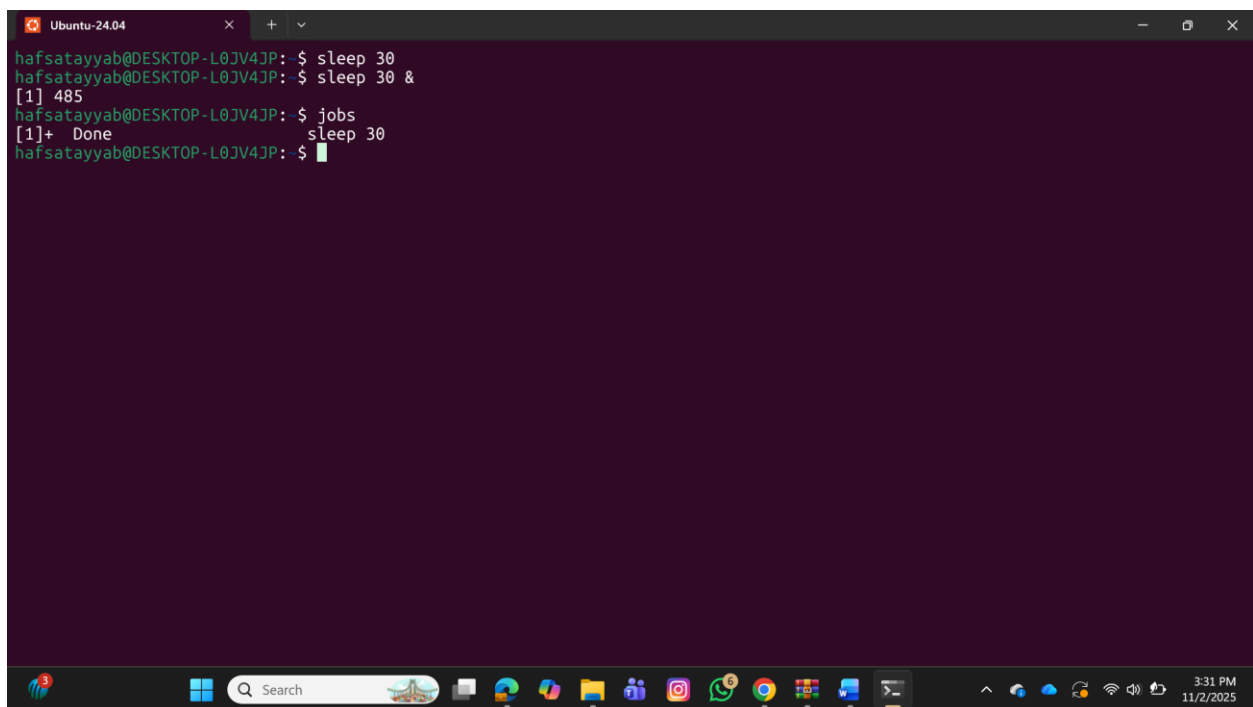
**Background: Add & to run without blocking.**

**sleep 30 &**

A terminal window titled 'Ubuntu-24.04' with a dark purple background. The prompt is 'hafsatayyab@DESKTOP-L0JV4JP:'. The user enters 'sleep 30', then 'sleep 30 &'. The prompt returns, and the user enters '[1] 485'. The prompt returns again, and the user enters '\$'. The terminal shows the command being executed in the background.

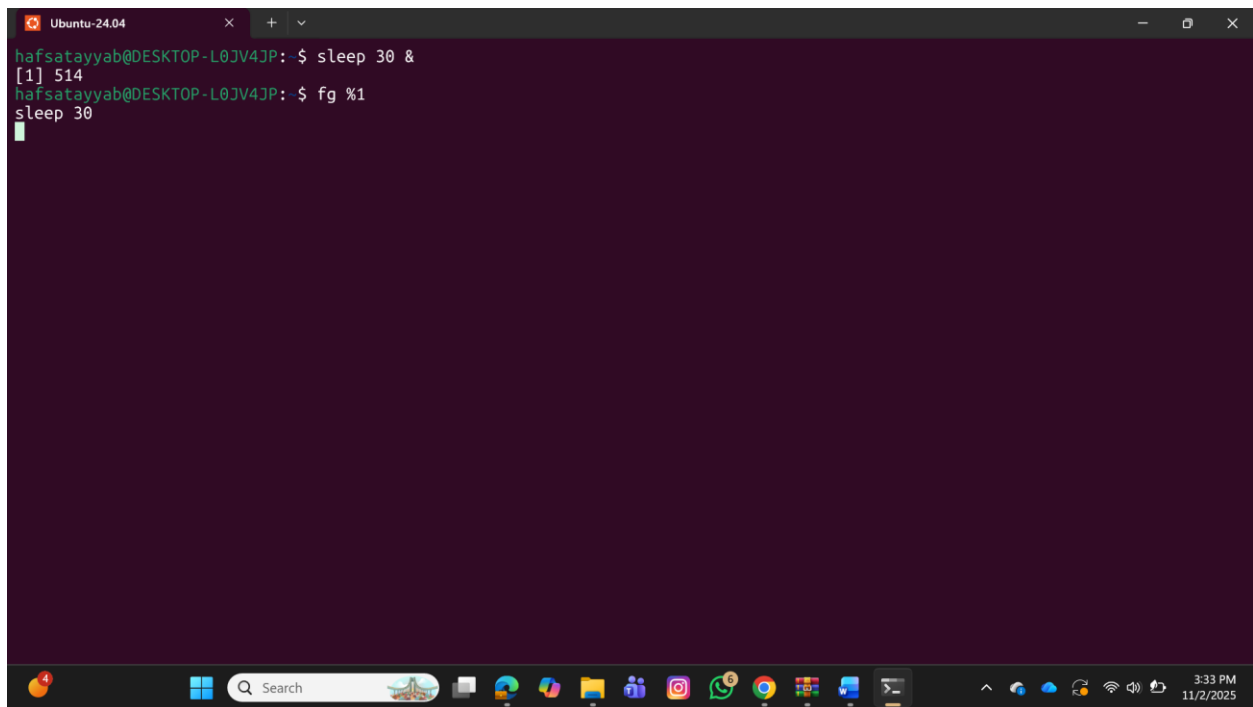
```
hafsatayyab@DESKTOP-L0JV4JP: $ sleep 30
hafsatayyab@DESKTOP-L0JV4JP: $ sleep 30 &
[1] 485
hafsatayyab@DESKTOP-L0JV4JP: $
```

**Check background jobs: jobs**

A terminal window titled 'Ubuntu-24.04' with a dark purple background. The prompt is 'hafsatayyab@DESKTOP-L0JV4JP:'. The user enters 'sleep 30', then 'sleep 30 &'. The prompt returns, and the user enters '[1] 485'. The prompt returns again, and the user enters '\$ jobs'. The output is '[1]+ Done sleep 30'. The prompt returns, and the user enters '\$'.

```
hafsatayyab@DESKTOP-L0JV4JP: $ sleep 30
hafsatayyab@DESKTOP-L0JV4JP: $ sleep 30 &
[1] 485
hafsatayyab@DESKTOP-L0JV4JP: $ jobs
[1]+  Done                  sleep 30
hafsatayyab@DESKTOP-L0JV4JP: $
```

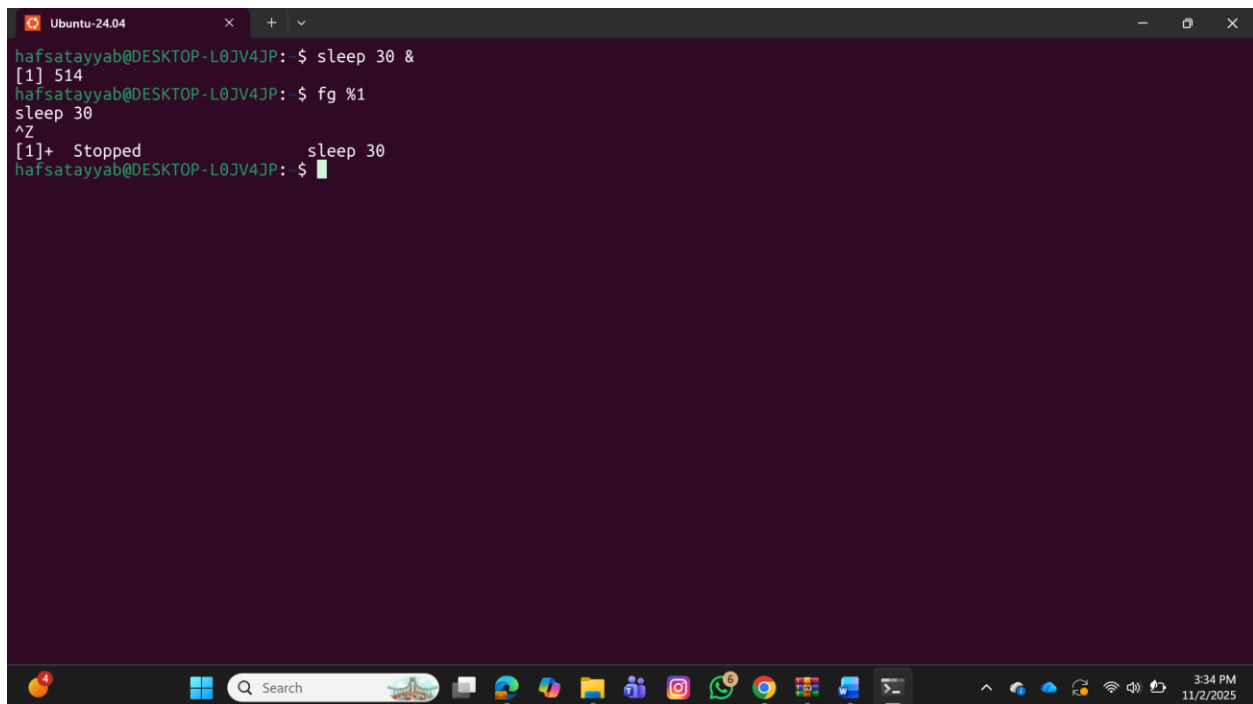
## Bring a job to foreground: fg %1



```
hafsatayyab@DESKTOP-L0JV4JP: ~$ sleep 30 &
[1] 514
hafsatayyab@DESKTOP-L0JV4JP: ~$ fg %1
sleep 30
```

The screenshot shows a terminal window titled 'Ubuntu-24.04'. The user has executed the command `sleep 30 &`, which runs in the background. The prompt then changes to `[1] 514`. The user then enters `fg %1` to bring the background job to the foreground. The prompt returns to `hafsatayyab@DESKTOP-L0JV4JP: ~$` with `sleep 30` displayed on the line. The desktop environment at the bottom shows various application icons and a system clock indicating 3:33 PM on 11/2/2025.

## Suspend a job: Press Ctrl + Z while it runs.



```
hafsatayyab@DESKTOP-L0JV4JP: ~$ sleep 30 &
[1] 514
hafsatayyab@DESKTOP-L0JV4JP: ~$ fg %1
sleep 30
^Z
[1]+  Stopped                  sleep 30
hafsatayyab@DESKTOP-L0JV4JP: ~$
```

The screenshot shows the same terminal window as before. The user has entered `fg %1` and the prompt is `hafsatayyab@DESKTOP-L0JV4JP: ~$` with `sleep 30` on the line. The user then presses `Ctrl+Z`, which is represented by `^Z` on the line. The prompt changes to `[1]+ Stopped sleep 30`, indicating the job has been suspended. The user then enters a new prompt `hafsatayyab@DESKTOP-L0JV4JP: ~$`. The desktop environment at the bottom shows various application icons and a system clock indicating 3:34 PM on 11/2/2025.

## Resume suspended job in background: bg %1

```
hafsatayyab@DESKTOP-L0JV4JP: $ sleep 30 &
[1] 514
hafsatayyab@DESKTOP-L0JV4JP: $ fg %1
sleep 30
^Z
[1]+  Stopped                  sleep 30
hafsatayyab@DESKTOP-L0JV4JP: $ bg %1
[1]+ sleep 30 &
hafsatayyab@DESKTOP-L0JV4JP: $
```

## 2.4 Process Identification

Get PID of a process by name: pidof sleep

Search using ps and grep : ps -ef | grep firefox

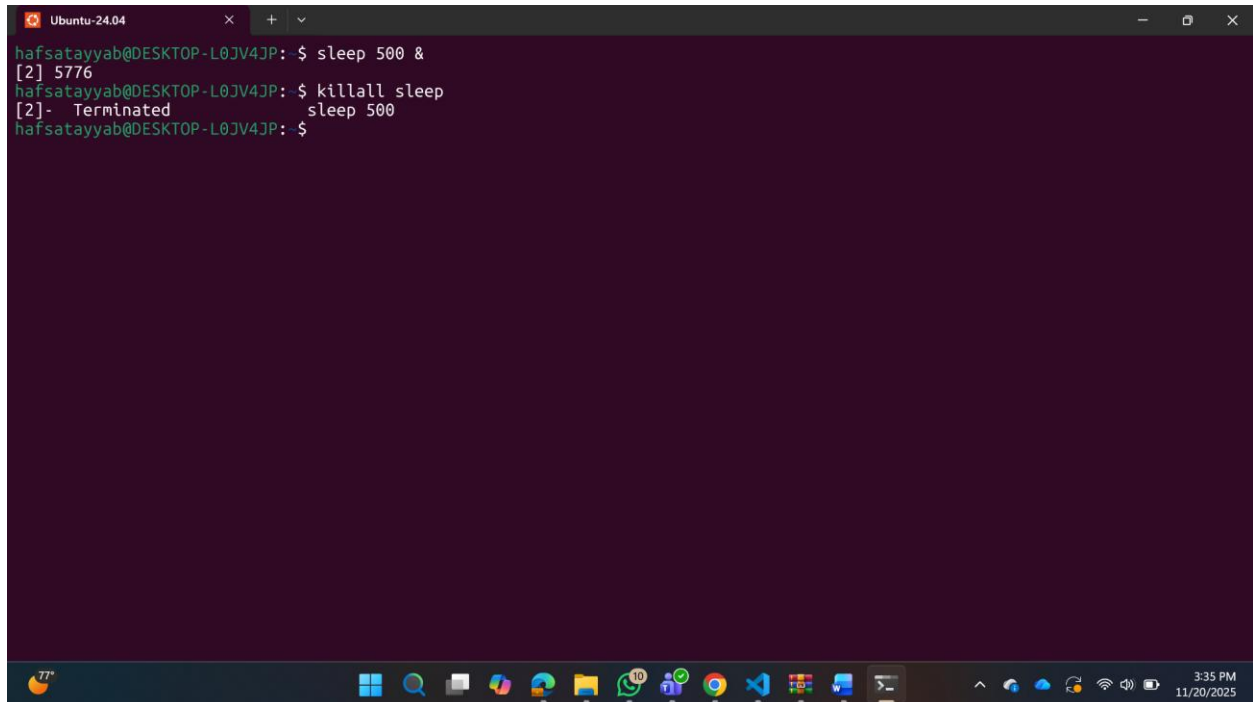
```
hafsatayyab@DESKTOP-L0JV4JP: $ sleep 30 &
[1] 2309
hafsatayyab@DESKTOP-L0JV4JP: $ pidof sleep
2309
hafsatayyab@DESKTOP-L0JV4JP: $ ps -ef | grep firefox
ps -ef: command not found
hafsatayyab@DESKTOP-L0JV4JP: $ ps -ef | grep firefox
hafsata+  2435   1520  0 15:00 pts/5    00:00:00 grep --color=auto firefox
[1]+  Done                    sleep 30
hafsatayyab@DESKTOP-L0JV4JP: $
```



## 2.5 Killing Processes

**Kill by PID:** `kill-9 3421-9` → force kill (SIGKILL).

**Kill all processes by name:** `killall sleep`

A screenshot of a terminal window titled 'Ubuntu-24.04'. The terminal shows a user named 'hafsatayyab@DESKTOP-L0JV4JP' running a series of commands. First, they run 'sleep 500 &', which returns '[2] 5776'. Then, they run 'killall sleep', which returns '[2]- Terminated sleep 500'. The prompt returns to '\$'. The terminal window has a dark purple background and a taskbar at the bottom with various application icons and system status indicators like temperature (77°) and time (3:35 PM 11/20/2025).

```
hafsatayyab@DESKTOP-L0JV4JP: ~$ sleep 500 &
[2] 5776
hafsatayyab@DESKTOP-L0JV4JP: ~$ killall sleep
[2]- Terminated sleep 500
hafsatayyab@DESKTOP-L0JV4JP: ~$
```

### Practice Task:

**Run an infinite process:** `yes > /dev/null &` ( yes prints “y” forever; redirected to /dev/null to hide output).

**2. Find it with:** `ps -ef | grep yes`

**3. Kill it with:** `kill-9`

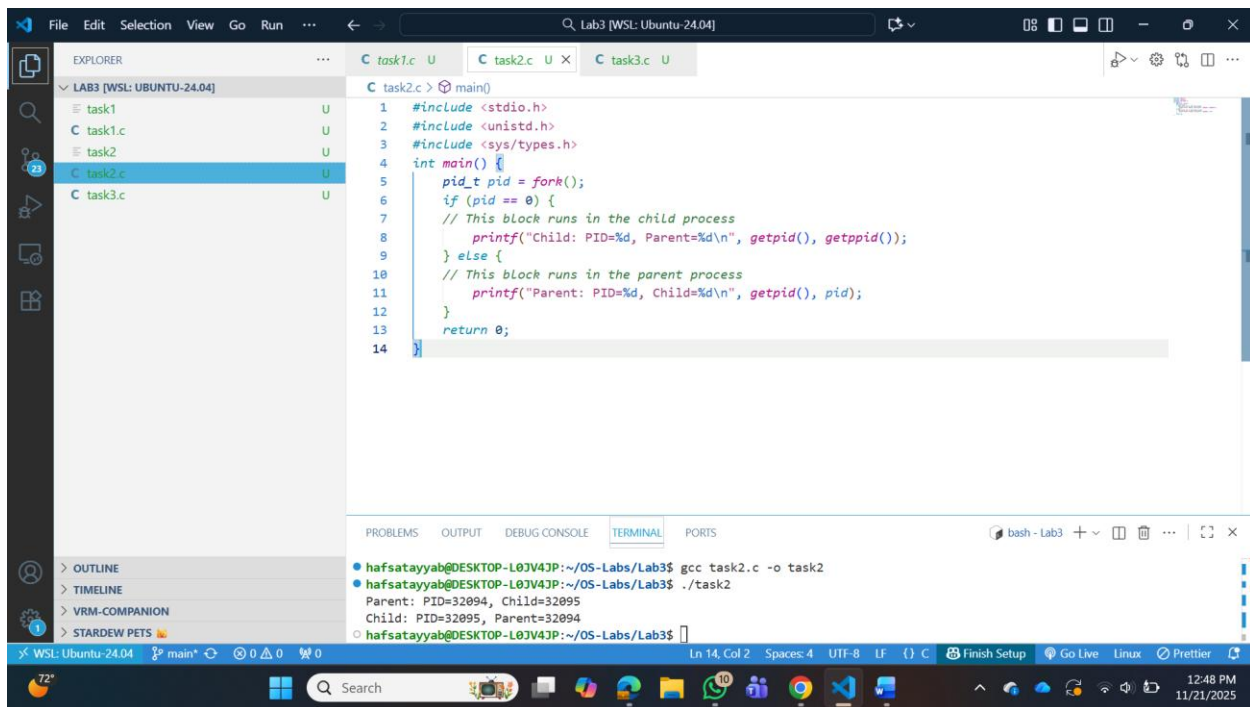
```
Ubuntu-24.04
hafsatayyab@DESKTOP-L0JV4JP: $ yes > /dev/null &
[4] 6546
hafsatayyab@DESKTOP-L0JV4JP: $ ps -ef | grep yes
hafsata+ 6119 1520 99 15:37 pts/5 00:02:37 yes
hafsata+ 6218 1520 99 15:37 pts/5 00:02:09 yes
hafsata+ 6546 1520 99 15:39 pts/5 00:00:22 yes
hafsata+ 6614 1520 0 15:39 pts/5 00:00:00 grep --color=auto yes
hafsatayyab@DESKTOP-L0JV4JP: $ kill -9 6119
hafsatayyab@DESKTOP-L0JV4JP: $ ps -ef | grep yes
hafsata+ 6218 1520 99 15:37 pts/5 00:02:54 yes
hafsata+ 6546 1520 99 15:39 pts/5 00:01:07 yes
hafsata+ 6752 1520 0 15:40 pts/5 00:00:00 grep --color=auto yes
[2] Killed yes > /dev/null
hafsatayyab@DESKTOP-L0JV4JP: $ kill -9 6218
hafsatayyab@DESKTOP-L0JV4JP: $ kill -9 6546
[3] Killed yes > /dev/null
hafsatayyab@DESKTOP-L0JV4JP: $ ps -ef | grep yes
hafsata+ 6826 1520 0 15:40 pts/5 00:00:00 grep --color=auto yes
[4]- Killed yes > /dev/null
hafsatayyab@DESKTOP-L0JV4JP: $ kill -9 6826
-bash: kill: (6826) - No such process
hafsatayyab@DESKTOP-L0JV4JP: $
```

### 3. C Programs on Processes

#### Program 1: Print PID and PPID

```
File Edit Selection View Go Run ... Lab3 [WSL: Ubuntu-24.04]
EXPLORER
LAB3 [WSL: UBUNTU-24.04]
task1
task1.c
C task1.c U X
C task1.c > main()
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 }
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
hafsatayyab@DESKTOP-L0JV4JP:~/OS-Labs/Lab3$ task1.c gcc -o task1
task1.c: command not found
hafsatayyab@DESKTOP-L0JV4JP:~/OS-Labs/Lab3$ gcc task1.c -o task1
hafsatayyab@DESKTOP-L0JV4JP:~/OS-Labs/Lab3$ ./task1
My PID: 29881
My Parent PID: 29587
hafsatayyab@DESKTOP-L0JV4JP:~/OS-Labs/Lab3$
```

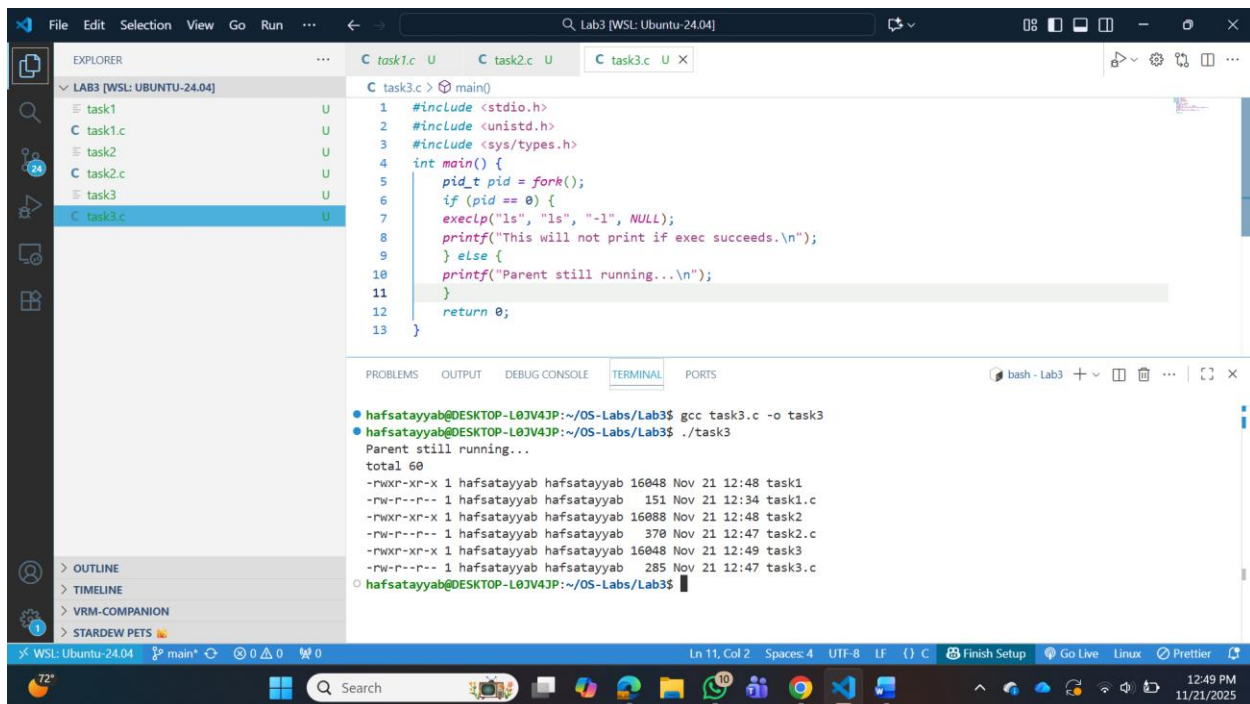
## Program 2: Fork – Creating Child Process



```
1 #include <stdio.h>
2 #include <unistd.h>
3 #include <sys/types.h>
4 int main() {
5     pid_t pid = fork();
6     if (pid == 0) {
7         // This block runs in the child process
8         printf("Child: PID=%d, Parent=%d\n", getpid(), getppid());
9     } else {
10        // This block runs in the parent process
11        printf("Parent: PID=%d, Child=%d\n", getpid(), pid);
12    }
13    return 0;
14 }
```

```
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$ gcc task2.c -o task2
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$ ./task2
Parent: PID=32094, Child=32095
Child: PID=32095, Parent=32094
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$
```

## Program 3: Execl – Replacing a Process



```
1 #include <stdio.h>
2 #include <unistd.h>
3 #include <sys/types.h>
4 int main() {
5     pid_t pid = fork();
6     if (pid == 0) {
7         execl("ls", "ls", "-l", NULL);
8         printf("This will not print if exec succeeds.\n");
9     } else {
10        printf("Parent still running...\n");
11    }
12    return 0;
13 }
```

```
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$ gcc task3.c -o task3
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$ ./task3
Parent still running...
total 60
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16048 Nov 21 12:48 task1
-rw-r--r-- 1 hafsatayyab hafsatayyab 151 Nov 21 12:34 task1.c
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16088 Nov 21 12:48 task2
-rw-r--r-- 1 hafsatayyab hafsatayyab 370 Nov 21 12:47 task2.c
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16048 Nov 21 12:49 task3
-rw-r--r-- 1 hafsatayyab hafsatayyab 285 Nov 21 12:47 task3.c
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$
```

## Program 4: Wait – Synchronization

The screenshot displays a Windows 11 desktop with a Visual Studio Code (VS Code) editor window open. The editor is configured with a dark theme and has the 'Lab3 [WSL: UBUNTU-24.04]' workspace loaded. The Explorer sidebar on the left shows a file tree with files named task1.c through task4.c. The main editor area shows the content of task4.c, which is a C program using `fork()` to create child processes. The program includes `<stdio.h>`, `<unistd.h>`, and `<sys/wait.h>`. It defines a `main()` function that forks a child process, prints a message, and then waits for the child to finish using `waitpid()`. The terminal at the bottom shows the execution of the program, displaying the output of the child processes and the parent process.

**Visual Studio Code Interface:**

- File Explorer (Left):** Shows the file tree for 'Lab3 [WSL: UBUNTU-24.04]' with files task1.c, task2.c, task3.c, and task4.c.
- Editor (Center):** Displays the code for task4.c.

```
C task4.c U x
C task4.c U x
main()
1 #include <stdio.h>
2 #include <unistd.h>
3 #include <sys/wait.h>
4 int main() {
5     pid_t pid = fork();
6     if (pid == 0) {
7         execlp("ls", "ls", "-l", NULL);
8         printf("This will not print if exec succeeds.\n");
9     } else {
10        waitpid(pid, NULL, 0); // Wait for the child process to finish
11        printf("Parent still running...\n");
12    }
13    return 0;
14 }
```
- Terminal (Bottom):** Shows the execution of the program.

```
bash - Lab3 + - - - - -
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$ gcc task4.c -o task4
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$ ./task4
total 80
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16048 Nov 21 12:48 task1
-rw-r--r-- 1 hafsatayyab hafsatayyab 151 Nov 21 12:34 task1.c
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16088 Nov 21 12:48 task2
-rw-r--r-- 1 hafsatayyab hafsatayyab 370 Nov 21 12:47 task2.c
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16048 Nov 21 12:49 task3
-rw-r--r-- 1 hafsatayyab hafsatayyab 285 Nov 21 12:47 task3.c
-rwxr-xr-x 1 hafsatayyab hafsatayyab 16088 Nov 21 12:51 task4
-rw-r--r-- 1 hafsatayyab hafsatayyab 351 Nov 21 12:50 task4.c
Parent still running...
hafsatayyab@DESKTOP-L0JV43P:~/OS-Labs/Lab3$
```