



National Textile University

Department of Computer Science

Subject:

Operating System

Submitted to:

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Submitted by:

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Reg number:

23-NTU-CS-1151

Lab no: **3**

Semester: **5th**

3. C Programs on Processes

Program 1: Print PID and PPID

```
#include <stdio.h>

#include <unistd.h>

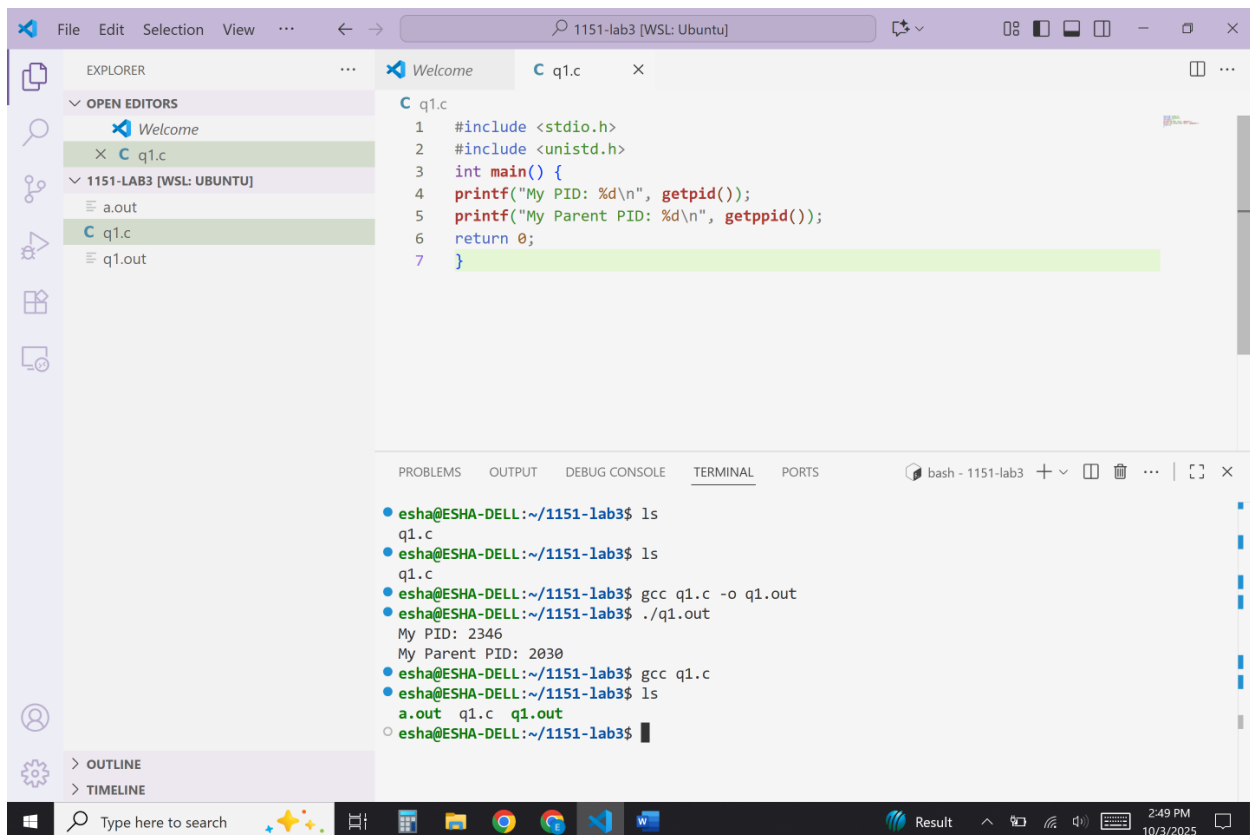
int main() {

printf("My PID: %d\n", getpid());

printf("My Parent PID: %d\n", getppid());

return 0;

}
```



The screenshot shows the Visual Studio Code editor with a C program named `q1.c` open. The program's code is as follows:

```
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 }
```

The terminal window at the bottom shows the execution of the program:

```
esha@ESHA-DELL:~/1151-lab3$ ls
q1.c
esha@ESHA-DELL:~/1151-lab3$ ls
q1.c
esha@ESHA-DELL:~/1151-lab3$ gcc q1.c -o q1.out
esha@ESHA-DELL:~/1151-lab3$ ./q1.out
My PID: 2346
My Parent PID: 2030
esha@ESHA-DELL:~/1151-lab3$ gcc q1.c
esha@ESHA-DELL:~/1151-lab3$ ls
a.out q1.c q1.out
esha@ESHA-DELL:~/1151-lab3$
```

Program 2: Fork – Creating Child Process

```
#include <stdio.h>
```

```

#include <unistd.h>

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;
}

```

The screenshot shows the Visual Studio Code interface with the following components:

- EXPLORER:** Displays the file structure of the project '1151-LAB3 [WSL: UBUNTU]', including files like `q1.c`, `q2.c`, `q1.out`, and `q2.out`.
- EDITOR:** Shows the source code for `q2.c`, which is the same code as provided in the first block. The code is color-coded, and the parent process block is highlighted in green.
- TERMINAL:** Shows the execution of the program. The commands and output are as follows:


```

esha@ESHA-DELL:~/1151-lab3$ ls
a.out q1.c q1.out q2.c q2.out
esha@ESHA-DELL:~/1151-lab3$ gcc q2.c -o q2.out
esha@ESHA-DELL:~/1151-lab3$ ./q2.out
Parent: PID=5360, Child=5361
Child: PID=5361, Parent=5360
esha@ESHA-DELL:~/1151-lab3$

```
- STATUS BAR:** At the bottom, it shows the system status: 34°C Mostly sunny, 3:03 PM, 10/3/2025.

Program 3: Execl – Replacing a Process

```
#include <stdio.h>

#include <unistd.h>

int main() {

    pid_t pid = fork();

    if (pid == 0) {

        execlp("ls", "ls", "-l", NULL);

        printf("This will not print if exec succeeds.\n");

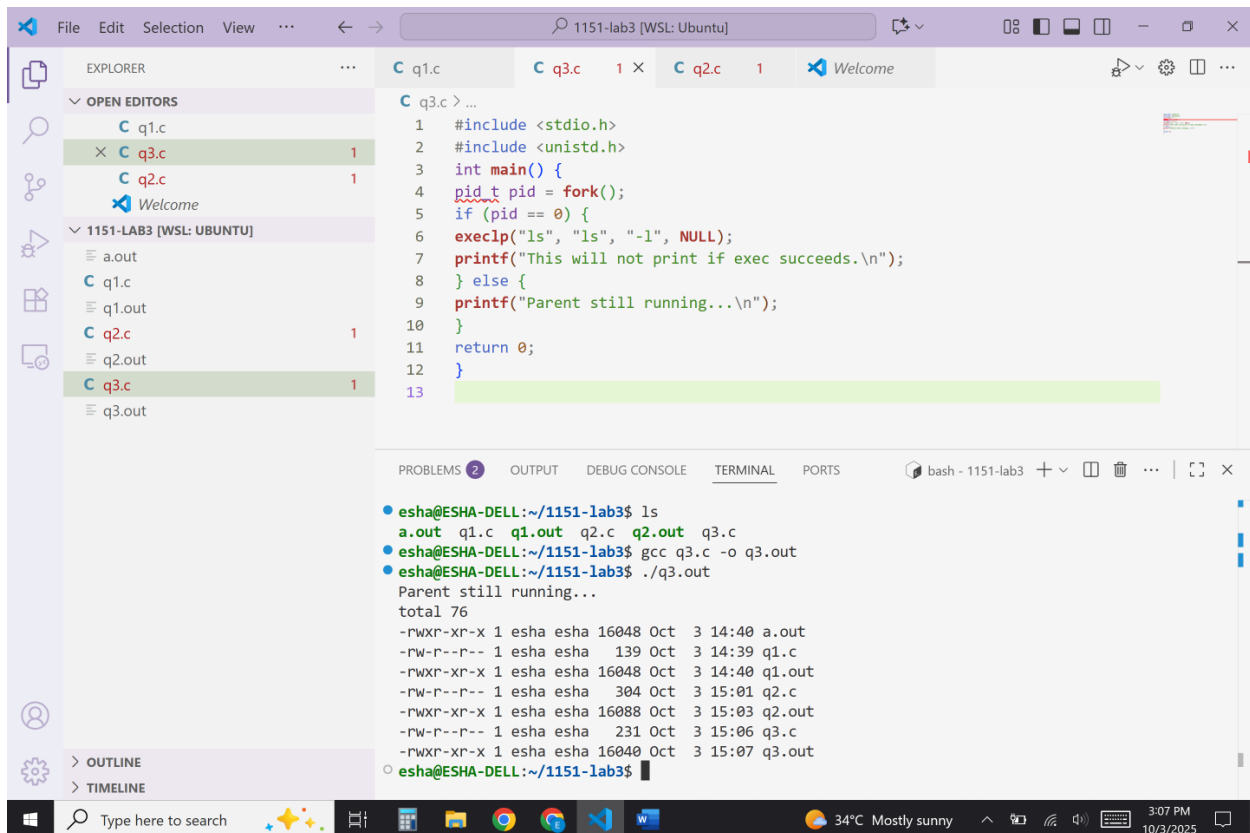
    } else {

        printf("Parent still running...\n");

    }

    return 0;

}
```



The screenshot shows the Visual Studio Code editor interface. The Explorer panel on the left displays the file structure for '1151-LAB3 [WSL: UBUNTU]', including files 'a.out', 'q1.c', 'q1.out', 'q2.c', 'q2.out', 'q3.c', and 'q3.out'. The main editor window shows the source code for 'q3.c', which is the same program as shown in the previous block. The TERMINAL panel at the bottom shows the execution of the program. The user runs 'ls' and 'gcc q3.c -o q3.out', then executes './q3.out'. The output shows the parent process still running, displaying the directory listing for the current directory.

```
esha@ESHA-DELL:~/1151-lab3$ ls
a.out q1.c q1.out q2.c q2.out q3.c
esha@ESHA-DELL:~/1151-lab3$ gcc q3.c -o q3.out
esha@ESHA-DELL:~/1151-lab3$ ./q3.out
Parent still running...
total 76
-rwxr-xr-x 1 esha esha 16048 Oct 3 14:40 a.out
-rw-r--r-- 1 esha esha 139 Oct 3 14:39 q1.c
-rwxr-xr-x 1 esha esha 16048 Oct 3 14:40 q1.out
-rw-r--r-- 1 esha esha 304 Oct 3 15:01 q2.c
-rwxr-xr-x 1 esha esha 16088 Oct 3 15:03 q2.out
-rw-r--r-- 1 esha esha 231 Oct 3 15:06 q3.c
-rwxr-xr-x 1 esha esha 16040 Oct 3 15:07 q3.out
esha@ESHA-DELL:~/1151-lab3$
```

Program 4: Wait – Synchronization

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main() {

    pid_t pid = fork();

    if (pid == 0) {

        execlp("ls", "ls", "-l", NULL);

        printf("This will not print if exec succeeds.\n");

    } else {

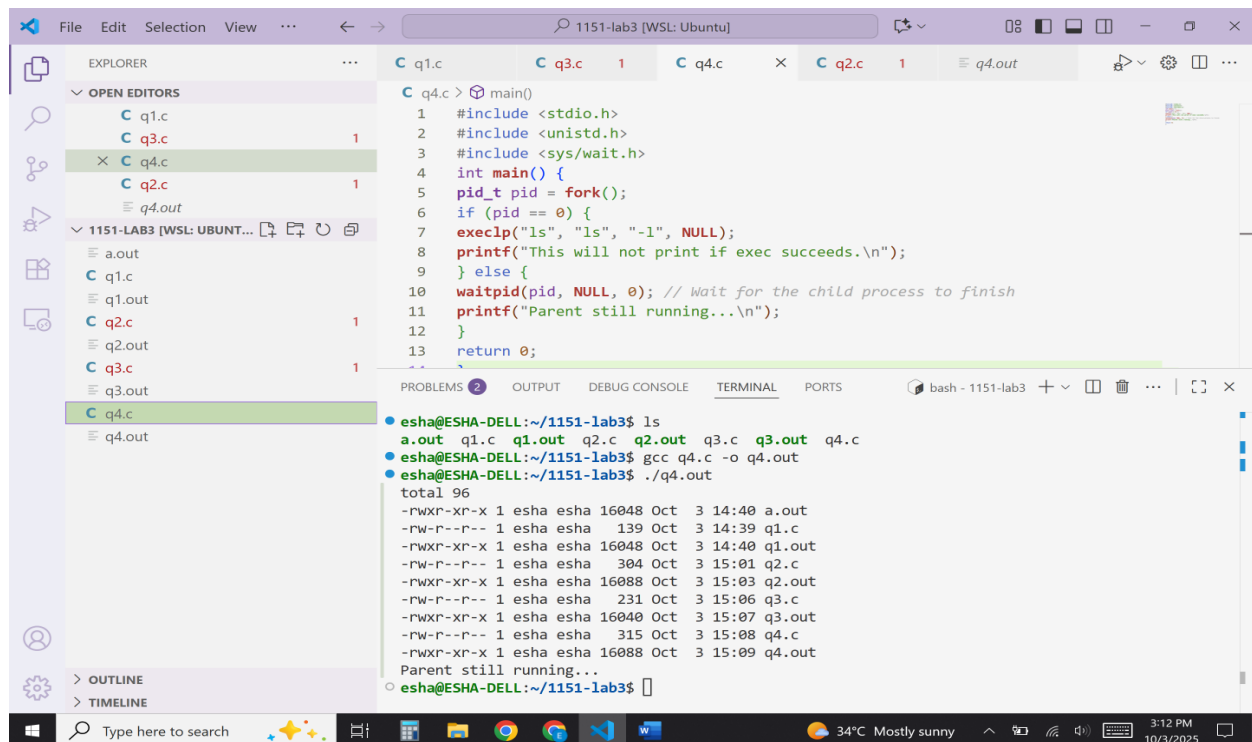
        waitpid(pid, NULL, 0); // Wait for the child process to finish

        printf("Parent still running...\n");

    }

    return 0;

}
```



2. Linux Process Commands

ps → Process Status

ps -ef → Full list of all processes


```
esha@ESHA-DELL:~$ ps -ef | grep "esha"
esha 403 1 0 14:27 ? 00:00:00 /usr/lib/systemd/systemd --user
esha 406 403 0 14:27 ? 00:00:00 (sd-pam)
esha 430 349 0 14:27 pts/1 00:00:00 -bash
esha 1589 1588 0 14:34 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=778287855-3443161195-2104553248-3762103988 --use-host-proxy --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
esha 1590 1589 0 14:34 pts/0 00:00:00 sh /mnt/c/Users/m s/.vscode/extensions/ms-vscode-remote.remote-wsl-0.104.3/scripts/wslServer.sh e3a5acfb517a443235981655413d566533107e92 stable code-server .vscode-server --host=127.0.0.1 --port=0 --connection-token=778287855-3443161195-2104553248-3762103988 --use-host-proxy --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
esha 1596 1590 0 14:34 pts/0 00:00:00 sh /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/bin/code-server --host=127.0.0.1 --port=0 --connection-token=778287855-3443161195-2104553248-3762103988 --use-host-proxy --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
esha 1600 1596 1 14:34 pts/0 00:00:39 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/out/server-main.js --host=127.0.0.1 --port=0 --connection-token=778287855-3443161195-2104553248-3762103988 --use-host-proxy --without-browser-env-var --disable-websocket-compression --accept-server-license-terms --telemetry-level=all
esha 1613 1612 0 14:34 pts/2 00:00:05 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node -e const net = require('net'); process.stdin.pause(); const client = net.createConnection({ host: '127.0.0.1', port: 45157 }, () => { client.pipe(process.stdout); process.stdin.pipe(client); }); client.on('close', function (hadError) { console.error(hadError ? 'Remote close with error' : 'Remote close'); process.exit(hadError ? 1 : 0); }); client.on('error', function (err) { process.stderr.write(err && (err.stack || err.message) || String(err)); });
esha 1626 1625 0 14:34 pts/3 00:00:05 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node -e const net = require('net'); process.stdin.pause(); const client = net.createConnection({ host: '127.0.0.1', port: 45157 }, () => { client.pipe(process.stdout); process.stdin.pipe(client); }); client.on('close', function (hadError) { console.error(hadError ? 'Remote close with error' : 'Remote close'); process.exit(hadError ? 1 : 0); }); client.on('error', function (err) { process.stderr.write(err && (err.stack || err.message) || String(err)); });
esha 1640 1600 0 14:34 pts/0 00:00:01 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/out/bootstrap-fork --type=fileWatcher
esha 1660 1600 5 14:34 pts/0 00:03:07 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node --dns-result-order=ipv4first /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/out/bootstrap-fork --type=extensionHost --transformURIs --useHostProxy=true
esha 1697 1696 0 14:34 pts/4 00:00:00 /bin/sh -c cd '/home/esha/1151-lab3' && /bin/sh
esha 1698 1697 0 14:34 pts/4 00:00:00 /bin/sh
esha 1708 1698 0 14:34 pts/4 00:00:00 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node /home/esha/.vscode-remote-containers/dist/vscode-remote-containers-server-0.427.0.js
esha 1731 1708 0 14:34 pts/4 00:00:00 /bin/sh
esha 2010 1600 0 14:39 pts/0 00:00:11 /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/node /home/esha/.vscode-server/bin/e3a5acfb517a443235981655413d566533107e92/out/bootstrap-fork --type=ptyHost --logsPath /home/esha/.vscode-server/data/logs/20251003T143414
esha 5426 1660 0 15:03 pts/0 00:00:05 /home/esha/.vscode-server/extensions/ms-vscode.cpptools-1.27.7-linux-x64/bin/cpptools
esha 5473 1588 0 15:03 pts/0 00:00:00 /home/esha/.vscode-server/extensions/ms-vscode.cpptools-1.27.7-linux-x64/bin/cpptools-srv 5426 {AFD68743-1761-4A76-AA04-AF706C0580D3}
esha 5556 1588 0 15:04 pts/0 00:00:00 /home/esha/.vscode-server/extensions/ms-vscode.cpptools-1.27.7-linux-x64/bin/cpptools-srv 5426 {80A5405E-398C-416C-96C2-2AE18640C5CA}
esha 5760 1588 0 15:06 pts/0 00:00:00 /home/esha/.vscode-server/extensions/ms-vscode.cpptools-1.27.7-linux-x64/bin/cpptools-srv 5426 {A8686F48-06EA-4B7D-9919-8612FF63F4D3}
esha 6180 1588 0 15:08 pts/0 00:00:00 /home/esha/.vscode-server/extensions/ms-vscode.cpptools-1.27.7-linux-x64/bin/cpptools-srv 5426 {688D28C2-E57B-48B6-8782-C60E1483E343}
esha 7984 7982 0 15:21 pts/5 00:00:00 -bash
esha 8691 7984 0 15:27 pts/5 00:00:00 ps -ef
esha 8692 7984 0 15:27 pts/5 00:00:00 grep --color=auto esha
esha@ESHA-DELL:~$
```

top → Dynamic process viewer


```
esha@ESHA-DELL: ~  
esha@ESHA-DELL:~$ top  
top - 15:29:54 up 1:02, 1 user, load average: 0.03, 0.03, 0.06  
Tasks: 49 total, 1 running, 48 sleeping, 0 stopped, 0 zombie  
%Cpu(s): 0.3 us, 1.1 sy, 0.0 ni, 98.4 id, 0.0 wa, 0.0 hi, 0.2 si, 0.0 st  
MiB Mem : 3721.2 total, 2068.2 free, 1528.0 used, 202.5 buff/cache  
MiB Swap: 1024.0 total, 1024.0 free, 0.0 used, 2193.3 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1660	esha	20	0	62.7g	863804	53760	S	2.6	22.7	3:11.65	node
1600	esha	20	0	11.3g	132784	51712	S	0.3	3.5	0:39.54	node
5556	esha	20	0	4263876	23168	14592	S	0.3	0.6	0:00.38	cpptools-srv
5760	esha	20	0	4264284	23020	16536	S	0.3	0.6	0:00.46	cpptools-srv
9019	esha	20	0	9312	5504	3328	R	0.3	0.1	0:00.09	top
1	root	20	0	21816	12480	9408	S	0.0	0.3	0:03.68	systemd
2	root	20	0	3072	1920	1792	S	0.0	0.1	0:00.37	init-systemd(Ub
6	root	20	0	3112	2080	1920	S	0.0	0.1	0:00.55	init
48	root	19	-1	50428	15744	14848	S	0.0	0.4	0:01.41	systemd-journal
102	root	20	0	25140	6144	4864	S	0.0	0.2	0:01.83	systemd-udev
119	systemd+	20	0	21456	12288	10240	S	0.0	0.3	0:00.53	systemd-resolve
125	systemd+	20	0	91024	7424	6656	S	0.0	0.2	0:00.55	systemd-timesyn
176	root	20	0	4236	2432	2304	S	0.0	0.1	0:00.03	cron
177	message+	20	0	9636	4736	4352	S	0.0	0.1	0:00.54	dbus-daemon
190	root	20	0	17964	8320	7424	S	0.0	0.2	0:00.35	systemd-logind
192	root	20	0	1756096	13696	11264	S	0.0	0.4	0:02.34	wsd-pro-service
199	root	20	0	3160	1920	1792	S	0.0	0.1	0:00.01	agetty
202	syslog	20	0	222508	5632	4352	S	0.0	0.1	0:00.68	rsyslogd
208	root	20	0	3116	1792	1664	S	0.0	0.0	0:00.02	agetty
221	root	20	0	107032	22400	13184	S	0.0	0.6	0:00.64	unattended-upgr
349	root	20	0	6820	4096	3584	S	0.0	0.1	0:00.02	login
403	esha	20	0	20312	11136	9088	S	0.0	0.3	0:00.24	systemd
406	esha	20	0	21152	3520	1792	S	0.0	0.1	0:00.00	(sd-pam)
430	esha	20	0	6072	4864	3328	S	0.0	0.1	0:00.00	bash
1587	root	20	0	3088	1024	896	S	0.0	0.0	0:00.00	SessionLeader
1588	root	20	0	3088	1164	1024	S	0.0	0.0	0:00.00	Relay(1589)
1589	esha	20	0	2800	1536	1536	S	0.0	0.0	0:00.02	sh
1590	esha	20	0	2800	1664	1664	S	0.0	0.0	0:00.00	sh
1596	esha	20	0	2800	1664	1664	S	0.0	0.0	0:00.00	sh
1611	root	20	0	3080	900	768	S	0.0	0.0	0:00.00	SessionLeader
1612	root	20	0	3096	1164	1024	S	0.0	0.0	0:01.16	Relay(1613)
1613	esha	20	0	1018496	60780	43008	S	0.0	1.6	0:05.42	node
1624	root	20	0	3080	1028	896	S	0.0	0.0	0:00.00	SessionLeader
1625	root	20	0	3096	1164	1024	S	0.0	0.0	0:01.62	Relay(1626)
1626	esha	20	0	1012884	55312	42880	S	0.0	1.5	0:05.98	node
1640	esha	20	0	1262048	58840	46720	S	0.0	1.5	0:01.28	node
1695	root	20	0	3088	1028	896	S	0.0	0.0	0:00.00	SessionLeader
1696	root	20	0	3088	1036	896	S	0.0	0.0	0:00.02	Relay(1697)
1697	esha	20	0	2800	1536	1536	S	0.0	0.0	0:00.01	sh
1698	esha	20	0	2800	1664	1664	S	0.0	0.0	0:00.00	sh
1708	esha	20	0	1012592	46728	38912	S	0.0	1.2	0:00.19	node

Foreground:

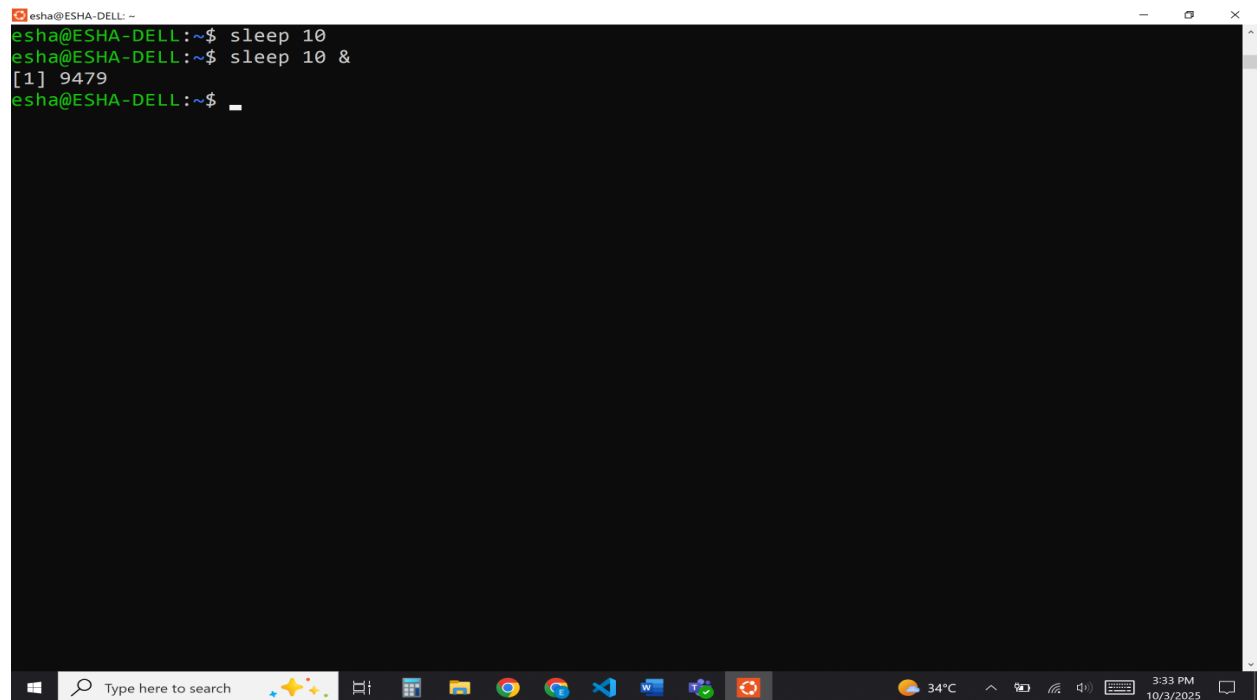
SLEEP 10

```
esha@ESHA-DELL: ~  
esha@ESHA-DELL:~$ sleep 10  
esha@ESHA-DELL:~$
```

Background:

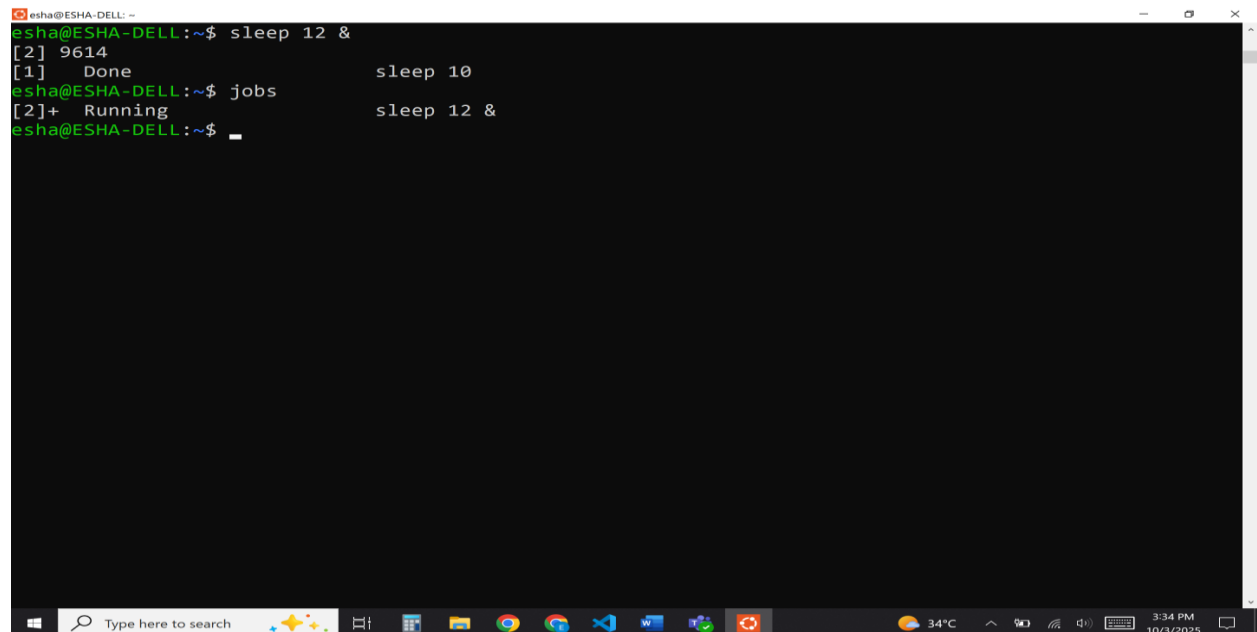
SLEEP 10 &

```
esha@ESHA-DELL: ~$ sleep 10
esha@ESHA-DELL: ~$ sleep 10 &
[1] 9479
esha@ESHA-DELL: ~$
```



JOBS

```
esha@ESHA-DELL: ~$ sleep 12 &
[2] 9614
[1] Done
esha@ESHA-DELL: ~$ jobs
[2]+  Running                  sleep 12 &
esha@ESHA-DELL: ~$
```



FG

```
esha@ESHA-DELL: ~$ sleep 15 &
[3] 9711
[2] Done sleep 12
esha@ESHA-DELL:~$ fg 9711
-bash: fg: 9711: no such job
esha@ESHA-DELL:~$ fg 3
-bash: fg: job has terminated
[3]+ Done sleep 15
esha@ESHA-DELL:~$ sleep 15 &
[1] 9822
esha@ESHA-DELL:~$ fg 1
sleep 15
```

Process Identification:

```
esha@ESHA-DELL: ~$ sleep 15 &
[1] 9903
esha@ESHA-DELL:~$ pidof sleep
9903
esha@ESHA-DELL:~$
```

Killing Proces

```
esha@ESHA-DELL: ~$ sleep 20 &
[2] 10043
[1] Done sleep 15
esha@ESHA-DELL: ~$ kill 10043
esha@ESHA-DELL: ~$ jobs
[2]+ Terminated sleep 20
esha@ESHA-DELL: ~$
```

To kill multiple commands:

```
esha@ESHA-DELL: ~$ sleep 20 &
[2] 10043
[1] Done sleep 15
esha@ESHA-DELL: ~$ kill 10043
esha@ESHA-DELL: ~$ jobs
[2]+ Terminated sleep 20
esha@ESHA-DELL: ~$ kill all
-bash: kill: all: arguments must be process or job IDs
esha@ESHA-DELL: ~$ killall sleep
sleep: no process found
esha@ESHA-DELL: ~$
esha@ESHA-DELL: ~$
```

