SIKSHA ‘O’ ANUSANDHAN
DEEMED TO BE UNIVERSITY

Admission Batch : 2021 - 25 **Session : 2023 - 24**

Laboratory Assignment #4

DESIGN OF OPERATING SYSTEMS
(CSE 4049)

Submitted By -

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Branch & Section	:	CSE - B
Semester	:	5th Semester

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Objective of this Assignment:

- To trace the different states of a process during its execution
- To learn the use of different system calls such as (fork (), vfork (), wait (), execl ()) for process handling in Unix environment.

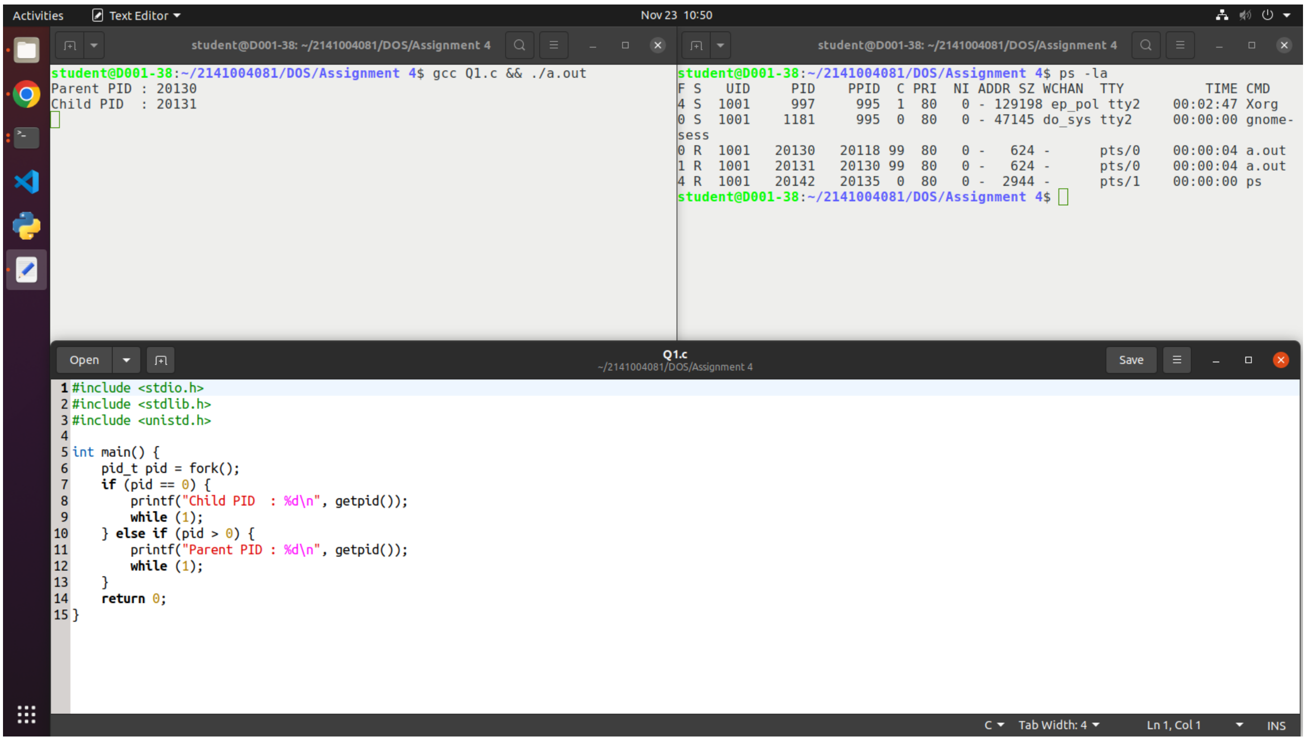
Q1. Write a C program to create a child process using fork() system call. The child process will print the message "Child" with its process identifier and then continue in an indefinite loop. The parent process will print the message "Parent" with its process identifier and then continue in an indefinite loop.

A) Run the program and trace the state of both processes.
B) Terminate the child process. Then trace the state of processes.
C) Run the program and trace the state of both processes. Terminate the parent process. Then trace the state of processes.
D) Modify the program so that the parent process after displaying the message will wait for child process to complete its task. Again run the program and trace the state of both processes.
E) Terminate the child process. Then trace the state of processes

Command:

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <sys/wait.h>
int main() {
    pid_t pid = fork();
    if (pid == 0) {
        printf("Child PID  : %d\n", getpid());
        exit (0);
    } else if (pid > 0) {
        printf("Parent PID : %d\n", getpid());
        wait (NULL);
        while (1);
    }
    return 0;
}
```

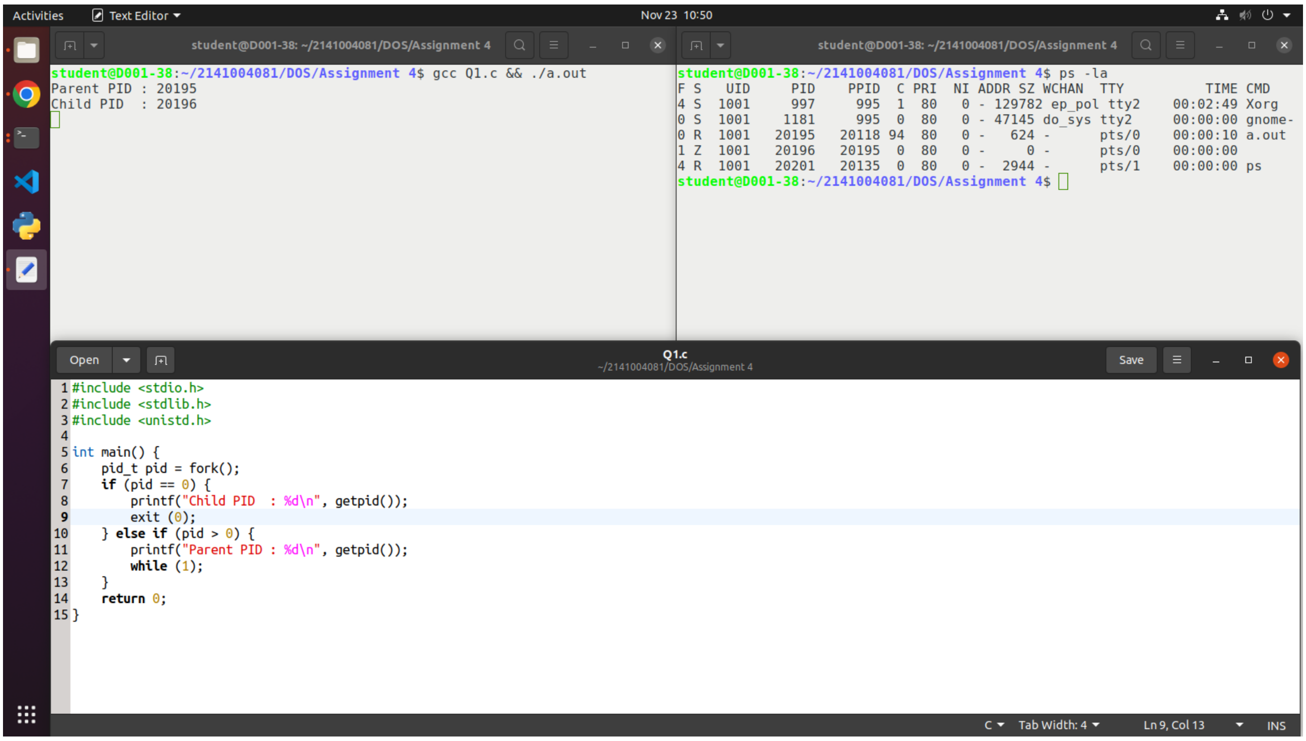
Output:


Activities
Text Editor
Nov 23 10:50
student@D001-38: ~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4
Open
Q1.c
~/2141004081/DOS/Assignment 4
Save
C
Tab Width: 4
Ln 1, Col 1
INS

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q1.c && ./a.out
Parent PID : 20130
Child PID  : 20131
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ ps -la
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S  1001     997     995  1  80   0 - 129198 ep_pol tty2    00:02:47 Xorg
0 S  1001    1181     995  0  80   0 - 47145 do_sys tty2     00:00:00 gnome-
sess
0 R  1001   20130   20118 99  80   0 -   624 -      pts/0    00:00:04 a.out
1 R  1001   20131   20130 99  80   0 -   624 -      pts/0    00:00:04 a.out
4 R  1001   20142   20135  0  80   0 -  2944 -      pts/1    00:00:00 ps
student@D001-38:~/2141004081/DOS/Assignment 4$
```

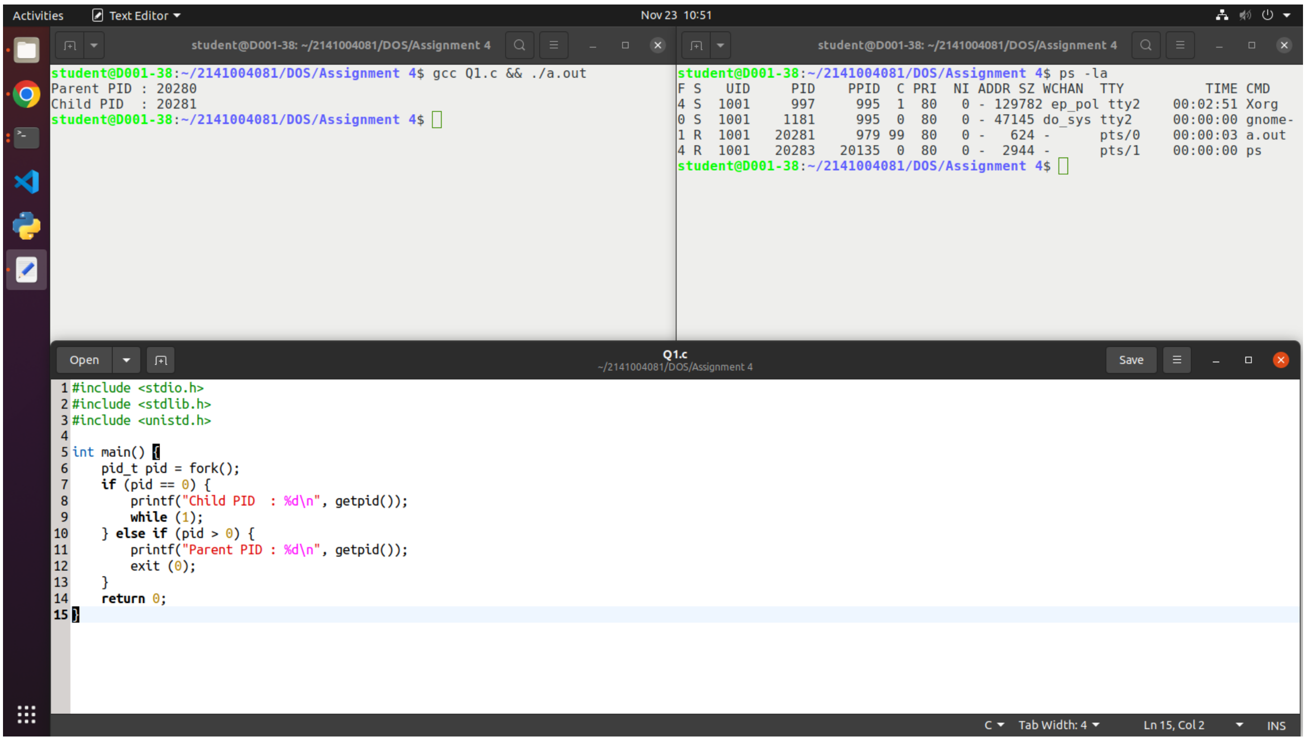
```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>

int main() {
    pid_t pid = fork();
    if (pid == 0) {
        printf("Child PID  : %d\n", getpid());
        while (1);
    } else if (pid > 0) {
        printf("Parent PID : %d\n", getpid());
        while (1);
    }
    return 0;
}
```


Activities
Text Editor
Nov 23 10:50
student@D001-38: ~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4
Open
Q1.c
~/2141004081/DOS/Assignment 4
Save
C
Tab Width: 4
Ln 9, Col 13
INS

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q1.c && ./a.out
Parent PID : 20195
Child PID  : 20196
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ ps -la
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S  1001     997     995  1  80   0 - 129782 ep_pol tty2    00:02:49 Xorg
0 S  1001    1181     995  0  80   0 - 47145 do_sys tty2     00:00:00 gnome-
0 R  1001   20195   20118 94  80   0 -   624 -      pts/0    00:00:10 a.out
1 Z  1001   20196   20195  0  80   0 -     0 -      pts/0    00:00:00
4 R  1001   20201   20135  0  80   0 -  2944 -      pts/1    00:00:00 ps
student@D001-38:~/2141004081/DOS/Assignment 4$
```

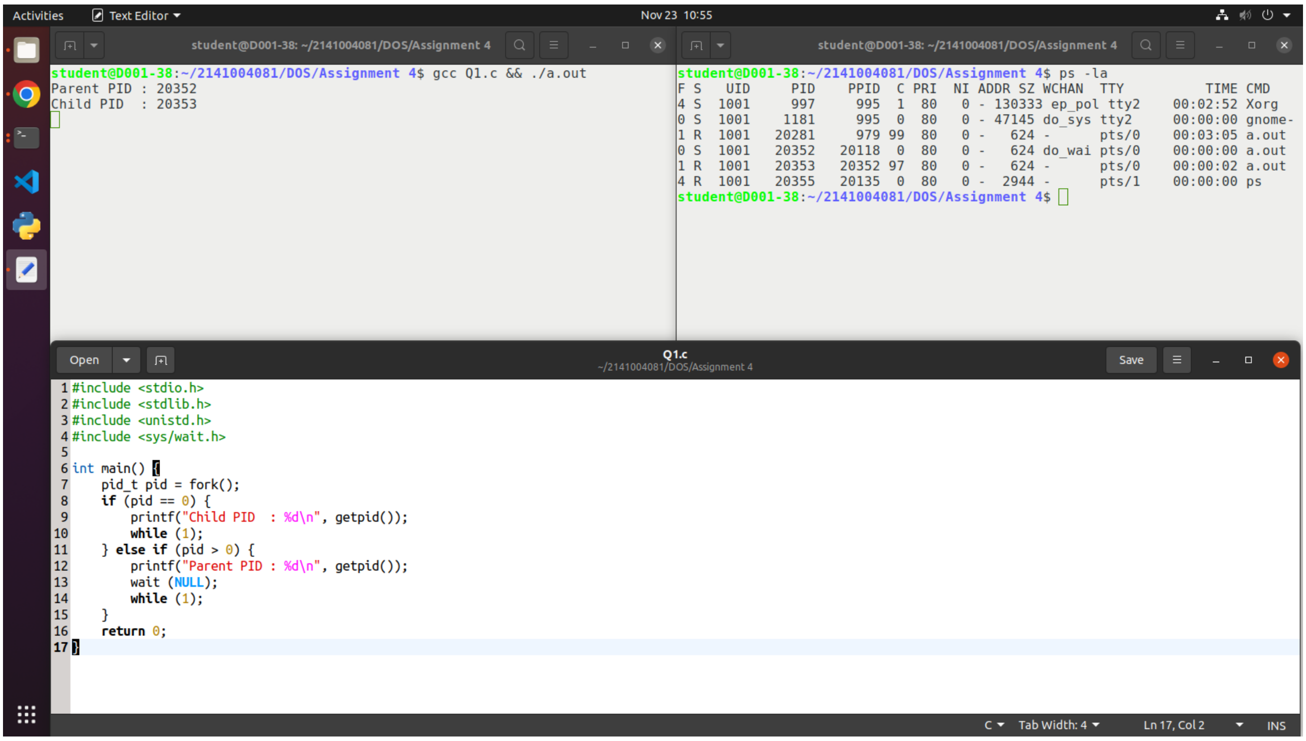
```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>

int main() {
    pid_t pid = fork();
    if (pid == 0) {
        printf("Child PID  : %d\n", getpid());
        exit (0);
    } else if (pid > 0) {
        printf("Parent PID : %d\n", getpid());
        while (1);
    }
    return 0;
}
```


Activities
Text Editor
Nov 23 10:51
student@D001-38: ~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4
Open
Q1.c
~/2141004081/DOS/Assignment 4
Save
C
Tab Width: 4
Ln 15, Col 2
INS

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q1.c && ./a.out
Parent PID : 20280
Child PID  : 20281
student@D001-38:~/2141004081/DOS/Assignment 4$
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ ps -la
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S  1001     997     995  1  80   0 - 129782 ep_pol tty2    00:02:51 Xorg
0 S  1001    1181     995  0  80   0 - 47145 do_sys tty2    00:00:00 gnome-
1 R  1001   20281     979 99  80   0 -   624 -      pts/0    00:00:03 a.out
4 R  1001   20283   20135  0  80   0 -  2944 -      pts/1    00:00:00 ps
student@D001-38:~/2141004081/DOS/Assignment 4$
```

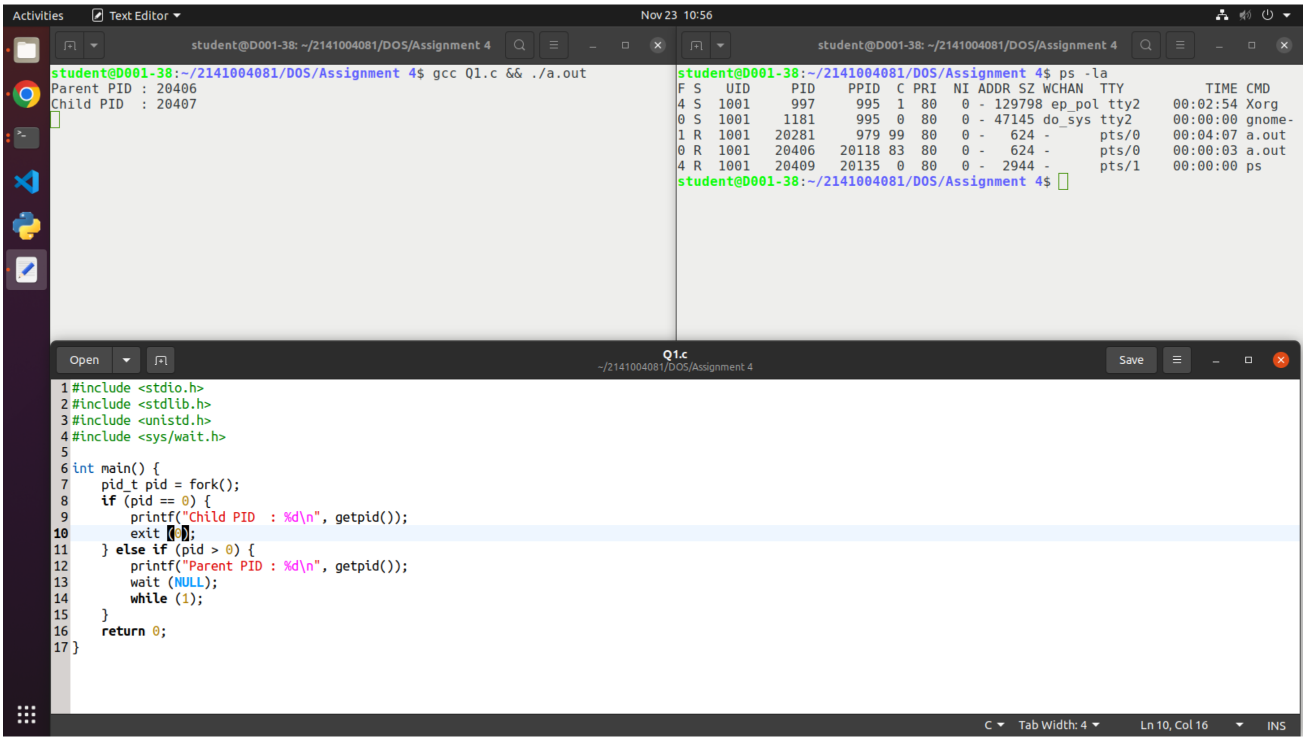
```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>

int main() {
    pid_t pid = fork();
    if (pid == 0) {
        printf("Child PID  : %d\n", getpid());
        while (1);
    } else if (pid > 0) {
        printf("Parent PID : %d\n", getpid());
        exit (0);
    }
    return 0;
}
```


Activities
Text Editor
Nov 23 10:55
student@D001-38: ~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4
Open
Q1.c
~/2141004081/DOS/Assignment 4
Save
C
Tab Width: 4
Ln 17, Col 2
INS

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q1.c && ./a.out
Parent PID : 20352
Child PID  : 20353
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ ps -la
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S  1001     997     995  1  80   0 - 130333 ep_pol tty2    00:02:52 Xorg
0 S  1001    1181     995  0  80   0 - 47145 do_sys tty2    00:00:00 gnome-
1 R  1001   20281     979 99  80   0 -   624 -      pts/0    00:03:05 a.out
0 S  1001   20352   20118  0  80   0 -   624 do_wai pts/0    00:00:00 a.out
1 R  1001   20353   20352 97  80   0 -   624 -      pts/0    00:00:02 a.out
4 R  1001   20355   20135  0  80   0 -  2944 -      pts/1    00:00:00 ps
student@D001-38:~/2141004081/DOS/Assignment 4$
```

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

int main() {
    pid_t pid = fork();
    if (pid == 0) {
        printf("Child PID  : %d\n", getpid());
        while (1);
    } else if (pid > 0) {
        printf("Parent PID : %d\n", getpid());
        wait (NULL);
        while (1);
    }
    return 0;
}
```



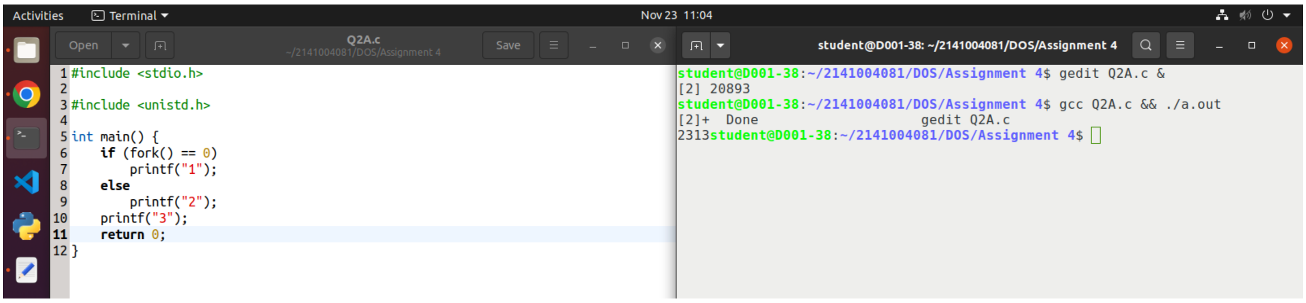
```
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q1.c && ./a.out
Parent PID : 20406
Child PID  : 20407
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ ps -la
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
4 S  1001     997     995  1  80   0 - 129798 ep_pol tty2    00:02:54 Xorg
0 S  1001    1181     995  0  80   0 - 47145 do_sys tty2    00:00:00 gnome-
1 R  1001   20281     979 99  80   0 -   624 -      pts/0    00:04:07 a.out
0 R  1001   20406   20118 83  80   0 -   624 -      pts/0    00:00:03 a.out
4 R  1001   20409   20135  0  80   0 -  2944 -      pts/1    00:00:00 ps
student@D001-38:~/2141004081/DOS/Assignment 4$
```

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

int main() {
    pid_t pid = fork();
    if (pid == 0) {
        printf("Child PID  : %d\n", getpid());
        exit (0);
    } else if (pid > 0) {
        printf("Parent PID : %d\n", getpid());
        wait (NULL);
        while (1);
    }
    return 0;
}
```

Q2. Trace the output of the following codes:

A.
```
int main( ) {
        if(fork()==0)
                printf("1");
        else
                printf("2");
        printf("3");
        return 0;
}
```

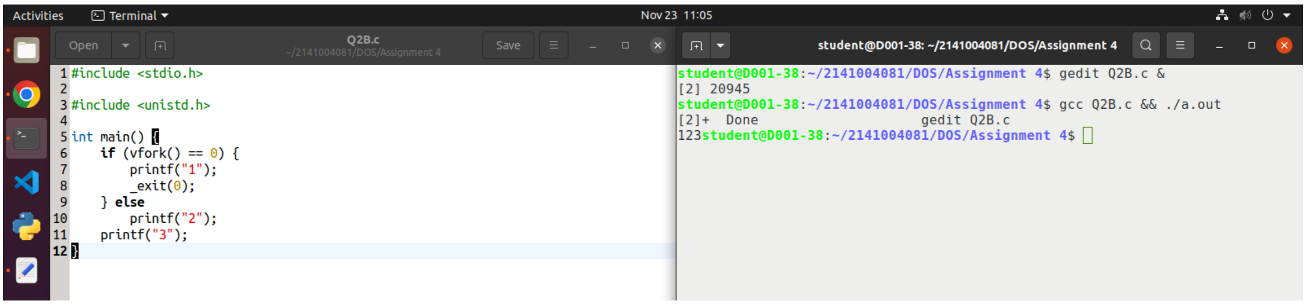


```
#include <stdio.h>

#include <unistd.h>

int main() {
    if (fork() == 0)
        printf("1");
    else
        printf("2");
    printf("3");
    return 0;
}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2A.c &
[2] 20893
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2A.c && ./a.out
[2]+  Done                    gedit Q2A.c
2313student@D001-38:~/2141004081/DOS/Assignment 4$
```

B.

```
int main( ) {
        if(vfork()==0) {
            printf("1");
            exit(0);
        } else
            printf("2");
            printf("3");
}
```

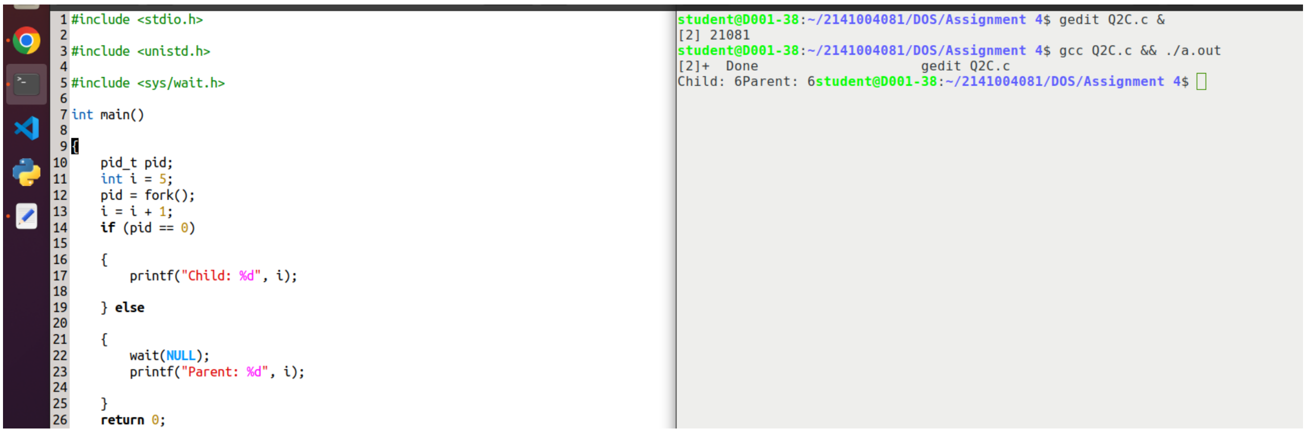

Activities
Terminal
Nov 23 11:05
Open
Q2B.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

int main() {
    if (vfork() == 0) {
        printf("1");
        _exit(0);
    } else
        printf("2");
    printf("3");
}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2B.c &
[2] 20945
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2B.c && ./a.out
[2]+  Done                    gedit Q2B.c
123student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

C.

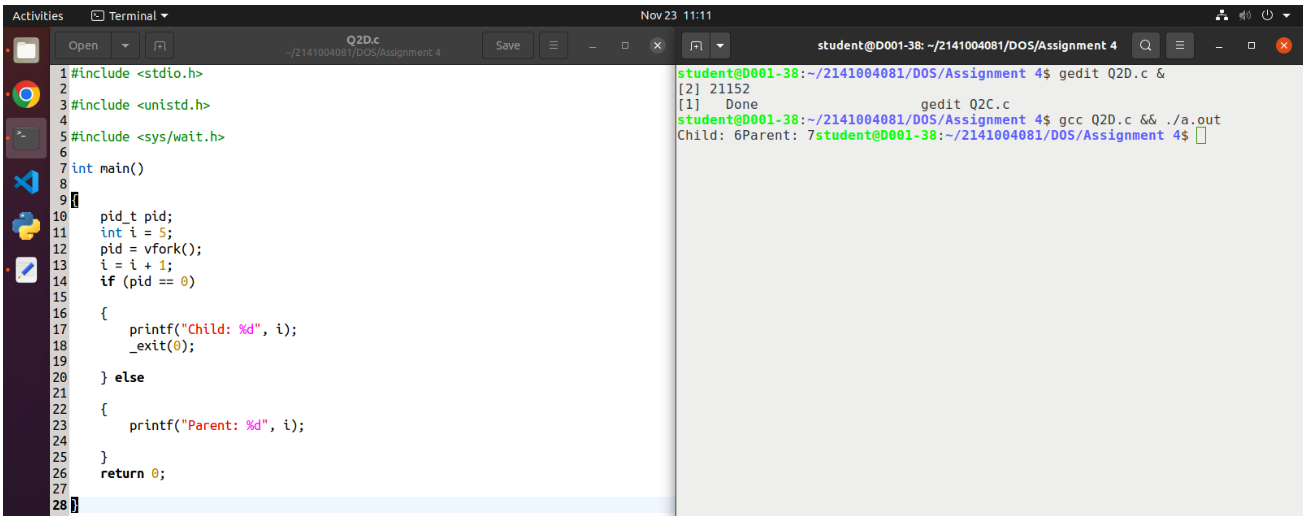
```
int main() {
    pid_t pid;
    int i = 5;
    pid = fork();
    i = i + 1;
    if (pid = = 0) {
        printf("Child: %d", i);
    } else {
        wait(NULL);
        printf("Parent: %d", i);
    }
    return 0;
}
```



```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    pid_t pid;
    int i = 5;
    pid = fork();
    i = i + 1;
    if (pid == 0)

    {
        printf("Child: %d", i);

    } else

    {
        wait(NULL);
        printf("Parent: %d", i);

    }
    return 0;
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2C.c &
[2] 21081
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2C.c && ./a.out
[2]+  Done                    gedit Q2C.c
Child: 6Parent: 6student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

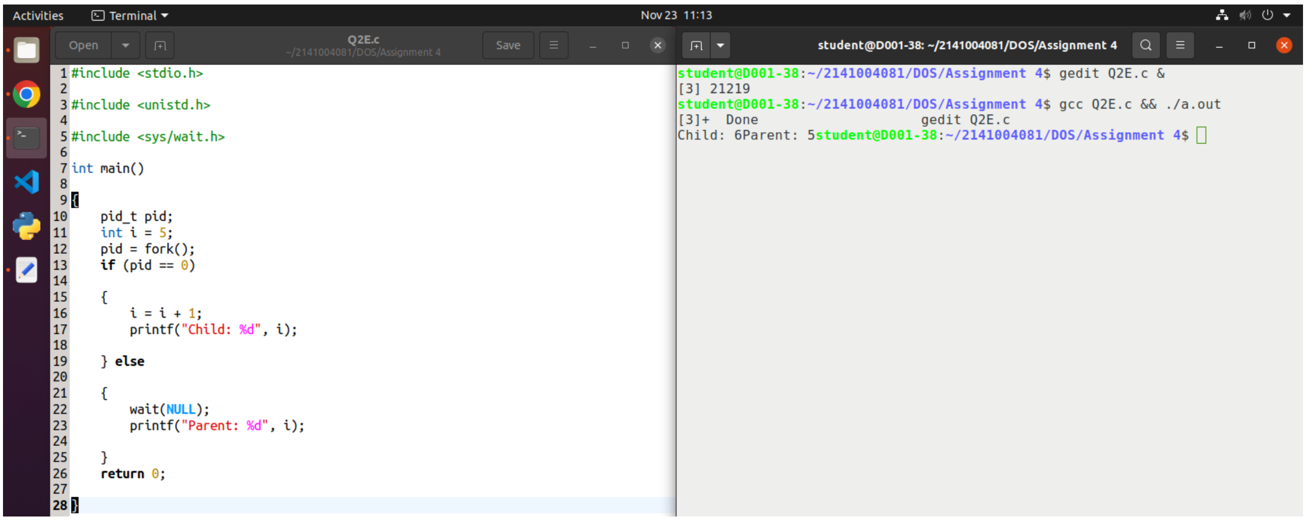
D.
```
int main() {
    pid_t pid;
    int i = 5;
    pid = vfork();
    i = i + 1;
    if (pid == 0) {
        printf("Child: %d", i);
        exit(0);
    } else {
        printf("Parent: %d", i);
    }
    return 0;
}
```


Activities
Terminal
Nov 23 11:11
Open
Save
Q2D.c
~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    pid_t pid;
    int i = 5;
    pid = vfork();
    i = i + 1;
    if (pid == 0)

    {
        printf("Child: %d", i);
        _exit(0);

    } else

    {
        printf("Parent: %d", i);

    }
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2D.c &
[2] 21152
[1]   Done                    gedit Q2C.c
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2D.c && ./a.out
Child: 6Parent: 7student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

E.
```
int main() {
    pid_t pid;
    int i = 5;
    pid = fork();
    if (pid = = 0) {
        i = i + 1;
        printf("Child: %d", i);
    } else {
        wait(NULL);
        printf("Parent: %d", i);
    } return 0;
}
```

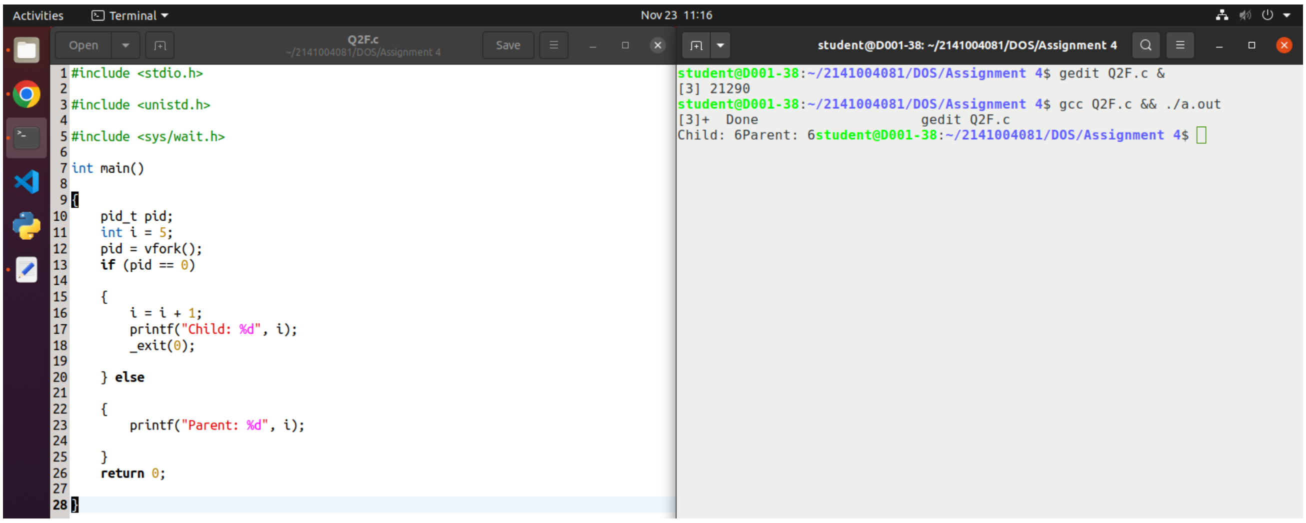

Activities
Terminal
Nov 23 11:13
Open
Q2E.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    pid_t pid;
    int i = 5;
    pid = fork();
    if (pid == 0)

    {
        i = i + 1;
        printf("Child: %d", i);

    } else

    {
        wait(NULL);
        printf("Parent: %d", i);

    }
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2E.c &
[3] 21219
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2E.c && ./a.out
[3]+  Done                    gedit Q2E.c
Child: 6Parent: 5student@D001-38:~/2141004081/DOS/Assignment 4$
```

F.

```c
int main() {
    pid_t pid;
    int i = 5;
    pid = vfork();
    if (pid == 0) {
        i = i + 1;
        printf("Child: %d", i);
        exit(0);
    } else {
        printf("Parent: %d", i);
    }
    return 0;
}
```

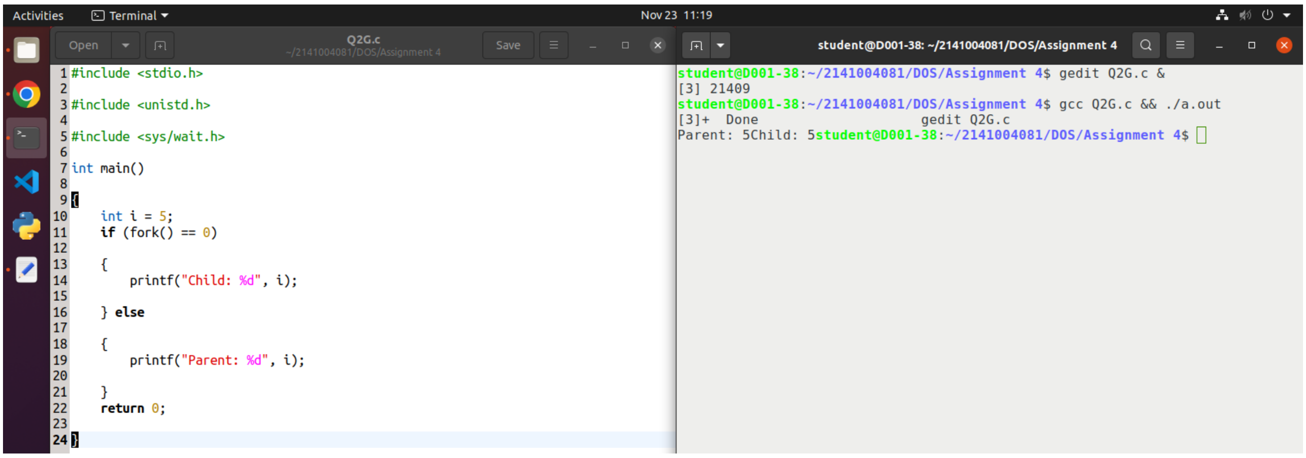

Activities
Terminal
Nov 23 11:16
Open
Q2F.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    pid_t pid;
    int i = 5;
    pid = vfork();
    if (pid == 0)

    {
        i = i + 1;
        printf("Child: %d", i);
        _exit(0);

    } else

    {
        printf("Parent: %d", i);

    }
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2F.c &
[3] 21290
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2F.c && ./a.out
[3]+  Done                    gedit Q2F.c
Child: 6Parent: 6student@D001-38:~/2141004081/DOS/Assignment 4$
```

G.

```
int main() {
    int i = 5;
    if (fork() == 0) {
        printf("Child: %d", i);
    } else {
        printf("Parent: %d", i);
    }
    return 0;
}
```



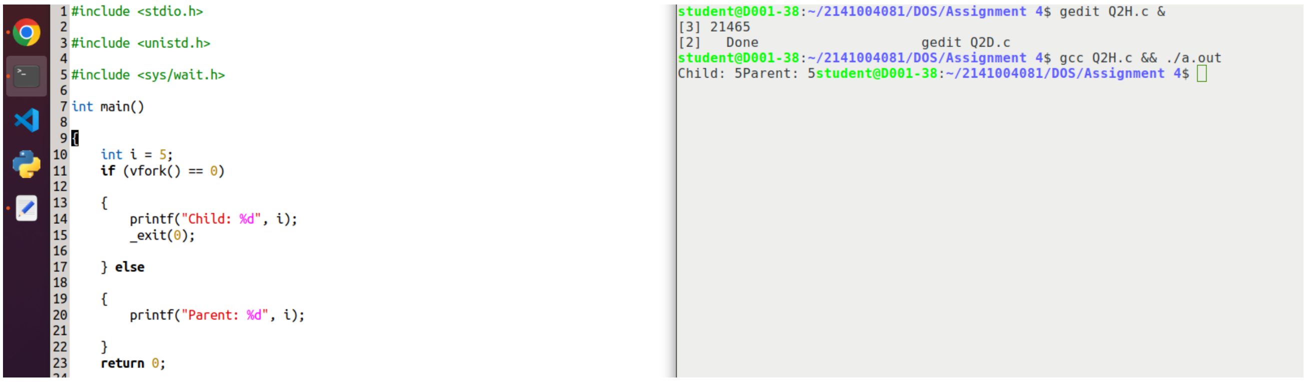
Activities
Terminal
Nov 23 11:19
Open
Q2G.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{

    int i = 5;
    if (fork() == 0)

    {
        printf("Child: %d", i);

    } else

    {
        printf("Parent: %d", i);

    }
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2G.c &
[3] 21409
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2G.c && ./a.out
[3]+  Done                    gedit Q2G.c
Parent: 5Child: 5student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

H.

```
int main() {
    int i = 5;
    if (vfork() == 0) {
        printf("Child: %d", i);
        _exit(0);
    } else {
        printf("Parent: %d", i);
    }
    return 0;
}
```

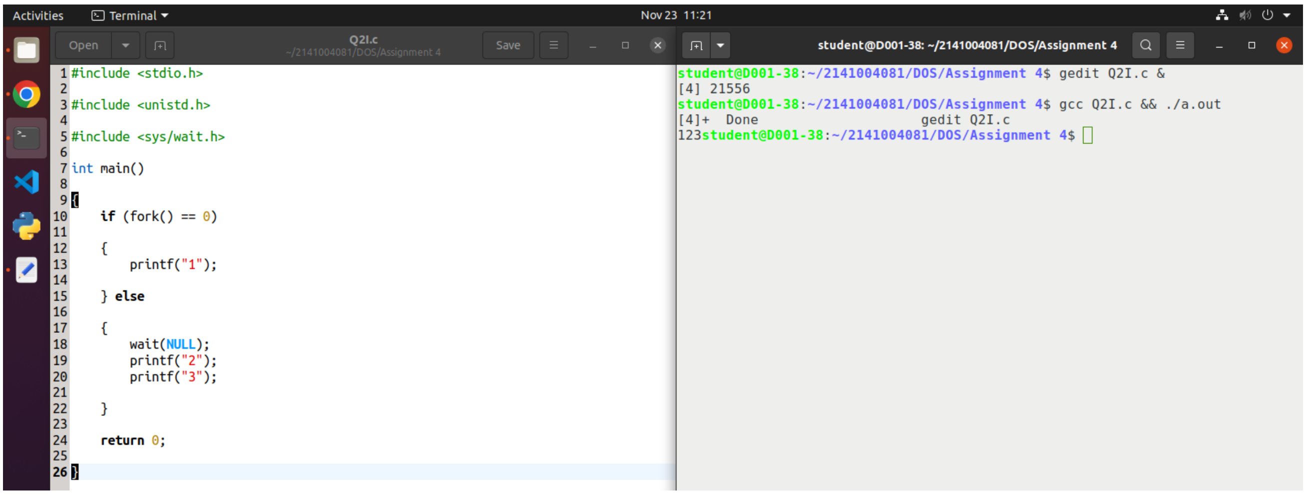


```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{

    int i = 5;
    if (vfork() == 0)

    {
        printf("Child: %d", i);
        _exit(0);

    } else

    {
        printf("Parent: %d", i);

    }
    return 0;
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2H.c &
[3] 21465
[2]   Done                    gedit Q2D.c
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2H.c && ./a.out
Child: 5Parent: 5student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

I.

```
int main() {
    if (fork() == 0) {
        printf("1");
    } else {
        wait(NULL);
        printf("2");
        printf("3");
    }
    return 0;
}
```

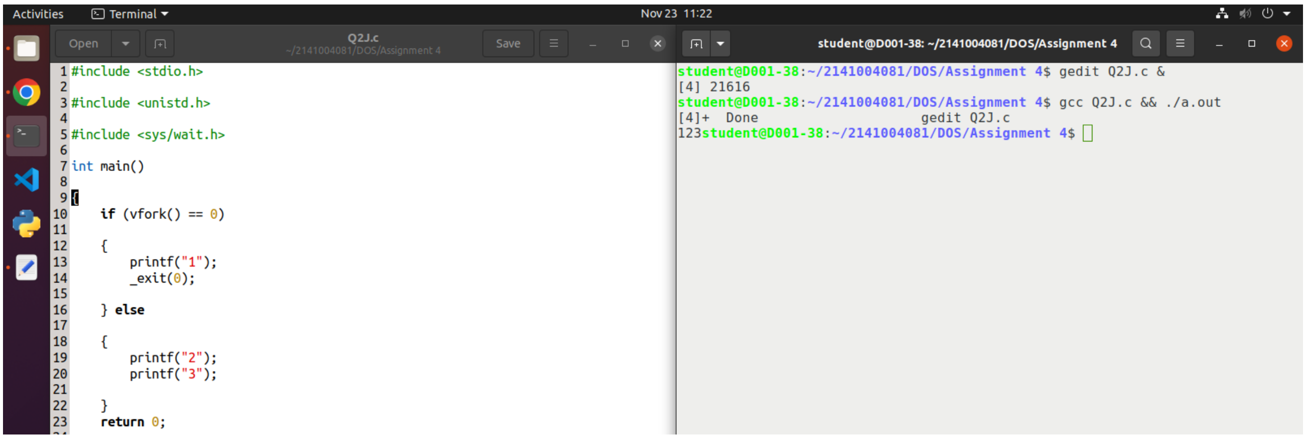

Activities
Terminal
Nov 23 11:21
Open
Q2I.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    if (fork() == 0)

    {
        printf("1");

    } else

    {
        wait(NULL);
        printf("2");
        printf("3");

    }

    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2I.c &
[4] 21556
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2I.c && ./a.out
[4]+  Done                    gedit Q2I.c
123student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

J.

```
int main() {
    if (vfork() == 0) {
        printf("1");
        exit(0);
    } else {
        printf("2");
        printf("3");
    }
    return 0;
}
```

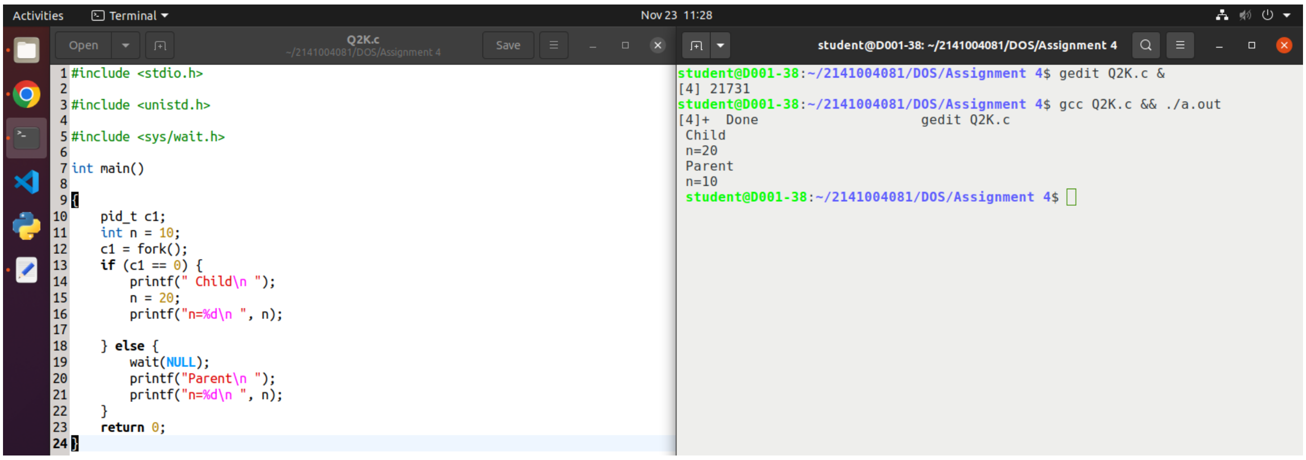

Activities
Terminal
Nov 23 11:22
Open
Q2J.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    if (vfork() == 0)

    {
        printf("1");
        _exit(0);

    } else

    {
        printf("2");
        printf("3");

    }
    return 0;
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2J.c &
[4] 21616
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2J.c && ./a.out
[4]+  Done                    gedit Q2J.c
123student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

K.

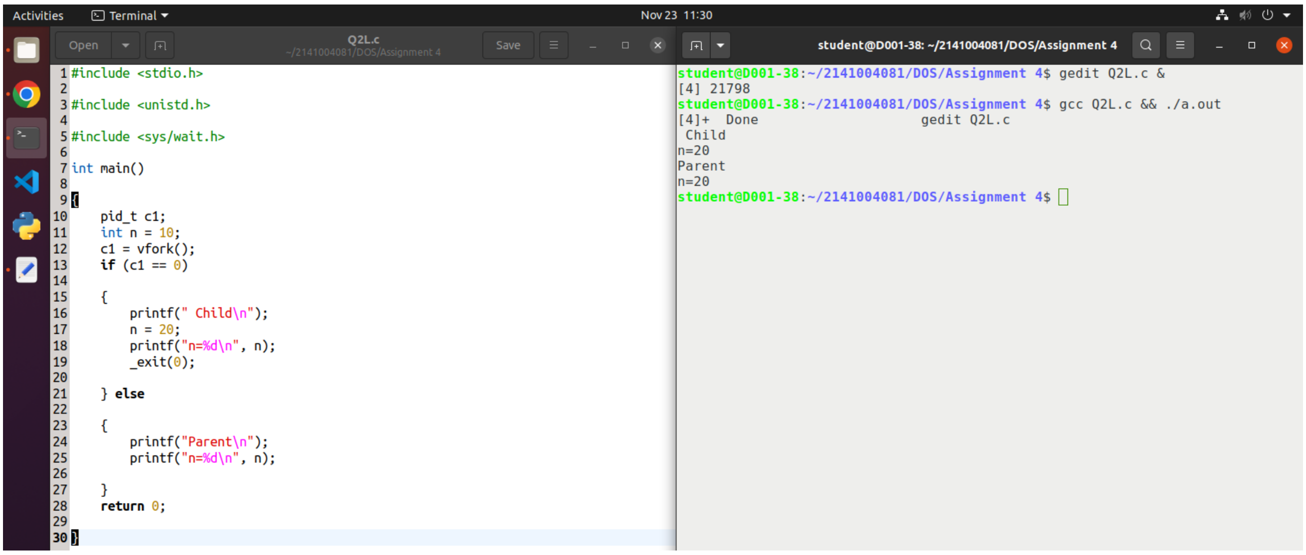
```
int main() {
    pid_t c1;
    int n = 10;
    c1 = fork();
    if (c1 == 0) {
        printf(" Child\n");
        n = 20;
        printf("n=%d\n", n);
    } else {
        wait(NULL);
        printf("Parent\n");
        printf("n=%d\n", n);
    }
    return 0;
}
```


Activities
Terminal
Nov 23 11:28
Open
Q2K.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    pid_t c1;
    int n = 10;
    c1 = fork();
    if (c1 == 0) {
        printf(" Child\n ");
        n = 20;
        printf("n=%d\n ", n);

    } else {
        wait(NULL);
        printf("Parent\n ");
        printf("n=%d\n ", n);
    }
    return 0;
}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2K.c &
[4] 21731
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2K.c && ./a.out
[4]+  Done                    gedit Q2K.c
 Child
 n=20
 Parent
 n=10
 student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

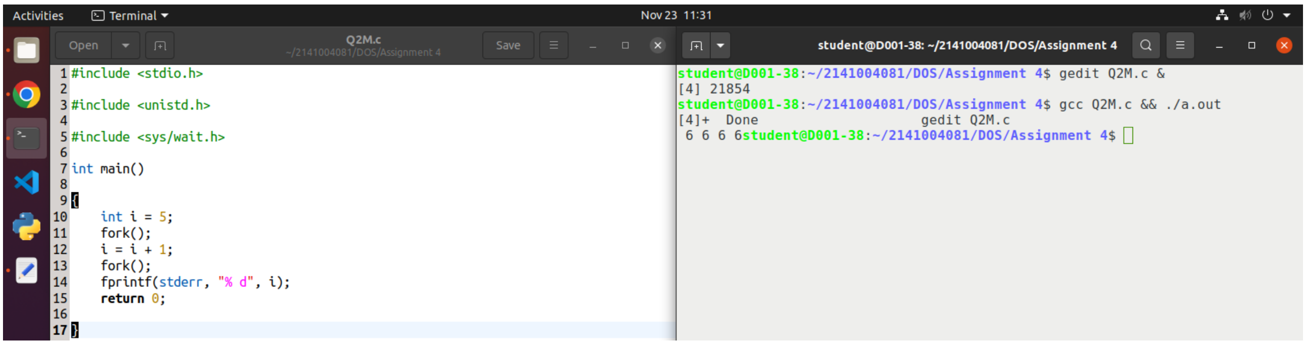
L.
```
int main() {
    pid_t c1;
    int n = 10;
    c1 = vfork();
    if (c1 == 0) {
        printf(" Child\n");
        n = 20;
        printf("n=%d\n", n);
        exit(0);
    } else {
        printf("Parent\n");
        printf("n=%d\n", n);
    }
    return 0;
}
```


Activities
Terminal
Nov 23 11:30
Open
Save
Q2L.c
~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    pid_t c1;
    int n = 10;
    c1 = vfork();
    if (c1 == 0)

    {
        printf(" Child\n");
        n = 20;
        printf("n=%d\n", n);
        _exit(0);

    } else

    {
        printf("Parent\n");
        printf("n=%d\n", n);

    }
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2L.c &
[4] 21798
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2L.c && ./a.out
[4]+  Done                    gedit Q2L.c
 Child
n=20
Parent
n=20
student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

M.
```
int main() {
    int i = 5;
    fork();
    i = i + 1;
    fork();
    fprintf(stderr, "% d", i);
    return 0;
}
```

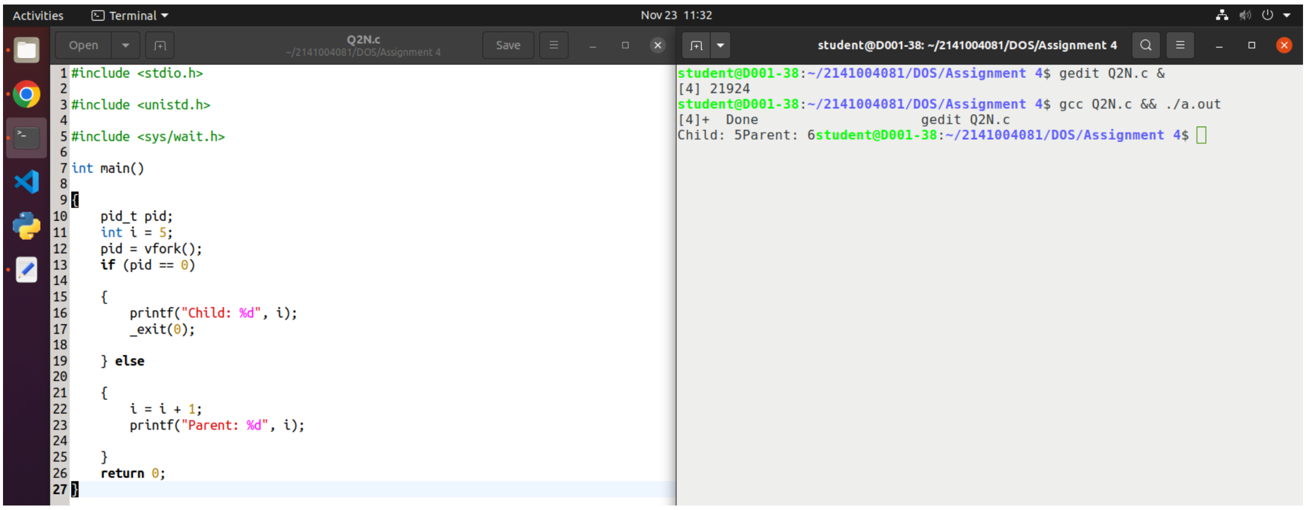

Activities
Terminal
Nov 23 11:31
Open
Save
Q2M.c
~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{

    int i = 5;
    fork();
    i = i + 1;
    fork();
    fprintf(stderr, "% d", i);
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2M.c &
[4] 21854
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2M.c && ./a.out
[4]+  Done                    gedit Q2M.c
 6 6 6 6student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

N.

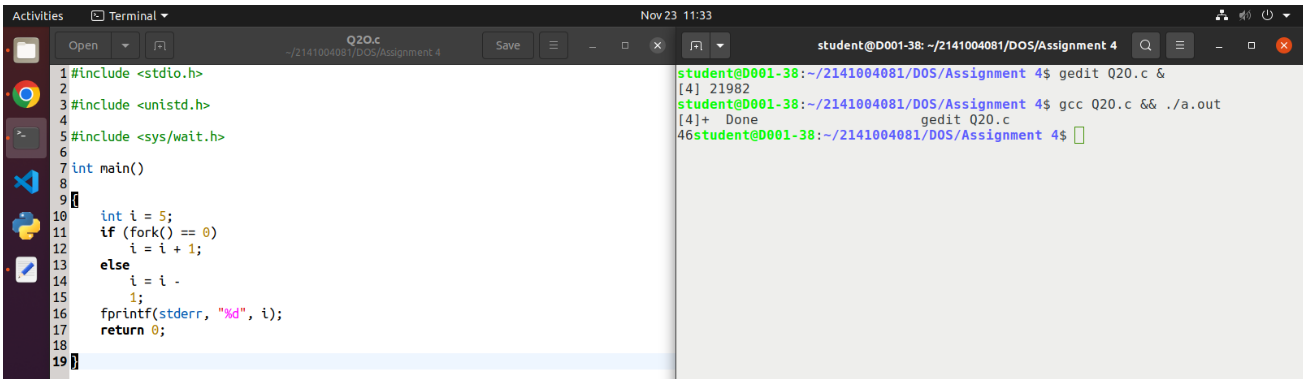
```c
int main() {
    pid_t pid;
    int i = 5;
    pid = vfork();
    if (pid == 0) {
        printf("Child: %d", i);
        exit(0);
    } else {
        i = i + 1;
        printf("Parent: %d", i);
    }
    return 0;
}
```


Activities
Terminal
Nov 23 11:32
Open
Save
Q2N.c
~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{

    pid_t pid;
    int i = 5;
    pid = vfork();
    if (pid == 0)

    {
        printf("Child: %d", i);
        _exit(0);

    } else

    {
        i = i + 1;
        printf("Parent: %d", i);

    }
    return 0;
}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2N.c &
[4] 21924
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2N.c && ./a.out
[4]+  Done                    gedit Q2N.c
Child: 5Parent: 6student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

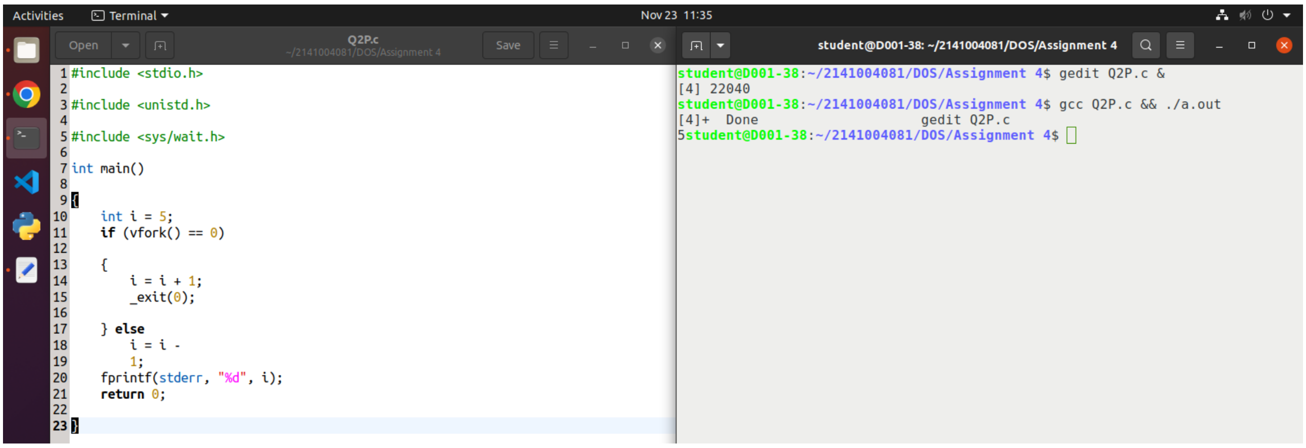
O.
```
int main() {
    int i = 5;
    if (fork() == 0)
        i = i + 1;
    else
        i = i - 1;
    fprintf(stderr, "%d", i);
    return 0;
}
```


Activities
Terminal
Nov 23 11:33
Open
Q2O.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    int i = 5;
    if (fork() == 0)
        i = i + 1;
    else
        i = i -
        1;
    fprintf(stderr, "%d", i);
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2O.c &
[4] 21982
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2O.c && ./a.out
[4]+  Done                    gedit Q2O.c
46student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

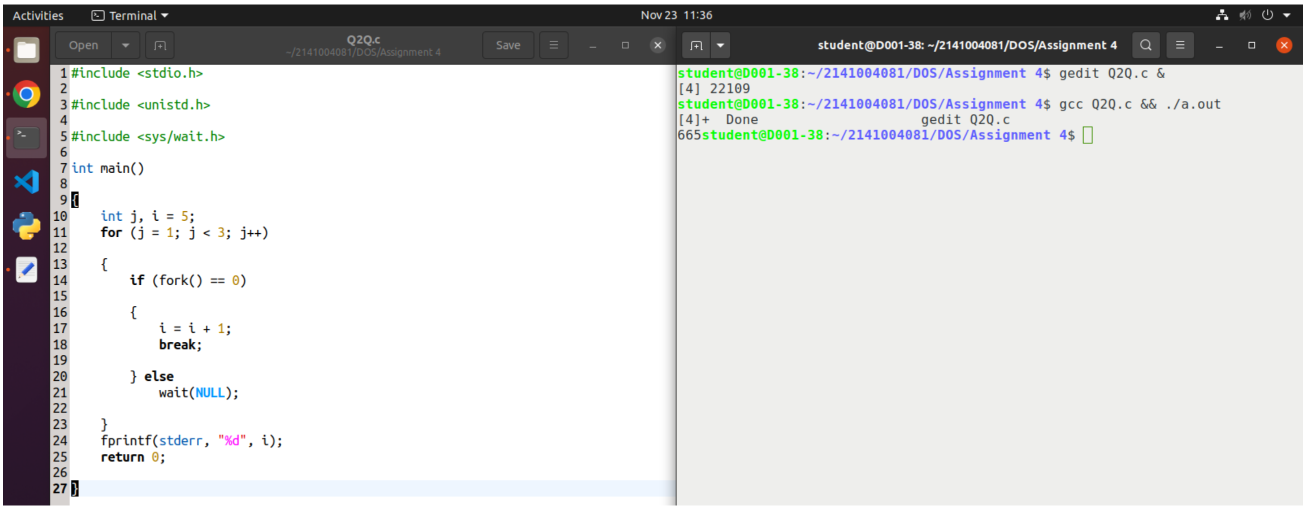
P.
```
int main() {
    int i = 5;
    if (vfork() == 0) {
        i = i + 1;
        exit(0);
    } else
        i = i - 1;
    fprintf(stderr, "%d", i);
    return 0;
}
```


Activities
Terminal
Nov 23 11:35
Open
Q2P.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    int i = 5;
    if (vfork() == 0)

    {
        i = i + 1;
        _exit(0);

    } else
        i = i -
        1;
    fprintf(stderr, "%d", i);
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2P.c &
[4] 22040
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2P.c && ./a.out
[4]+  Done                    gedit Q2P.c
5student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

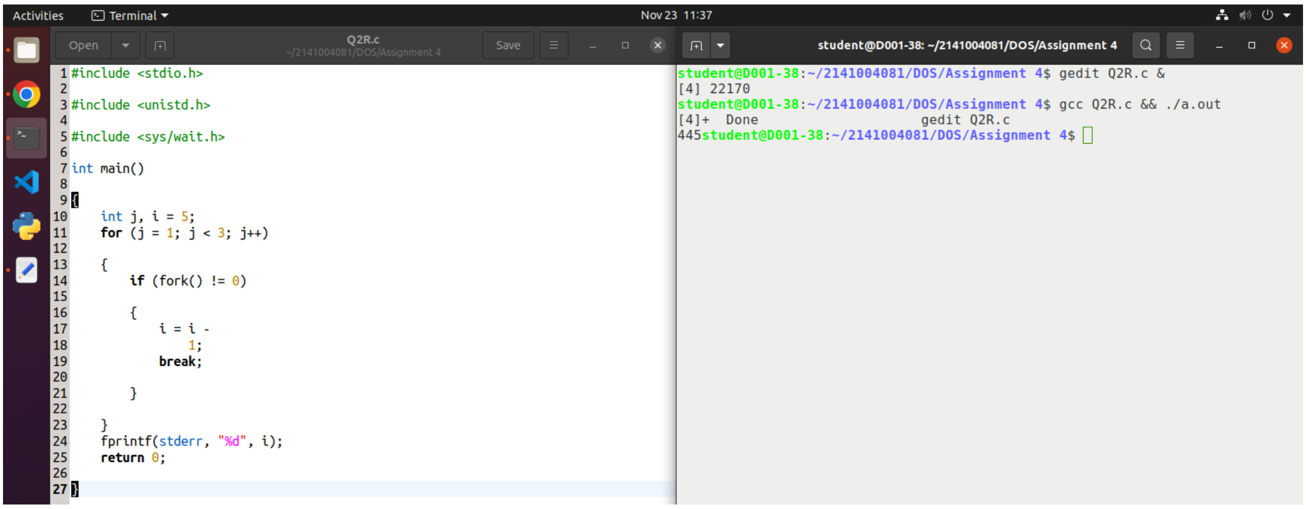
```
Q.  int main() {
        int j, i = 5;
        for (j = 1; j < 3; j++) {
            if (fork() == 0) {
                i = i + 1;
                break;
            } else
                wait(NULL);
        }
        fprintf(stderr, "%d", i);
        return 0;
    }
```


Activities
Terminal
Nov 23 11:36
Open
Save
Q2Q.c
~/2141004081/DOS/Assignment 4
student@D001-38: ~/2141004081/DOS/Assignment 4

```
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{

    int j, i = 5;
    for (j = 1; j < 3; j++)

    {
        if (fork() == 0)

        {
            i = i + 1;
            break;

        } else
            wait(NULL);

    }
    fprintf(stderr, "%d", i);
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2Q.c &
[4] 22109
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2Q.c && ./a.out
[4]+  Done                    gedit Q2Q.c
665student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

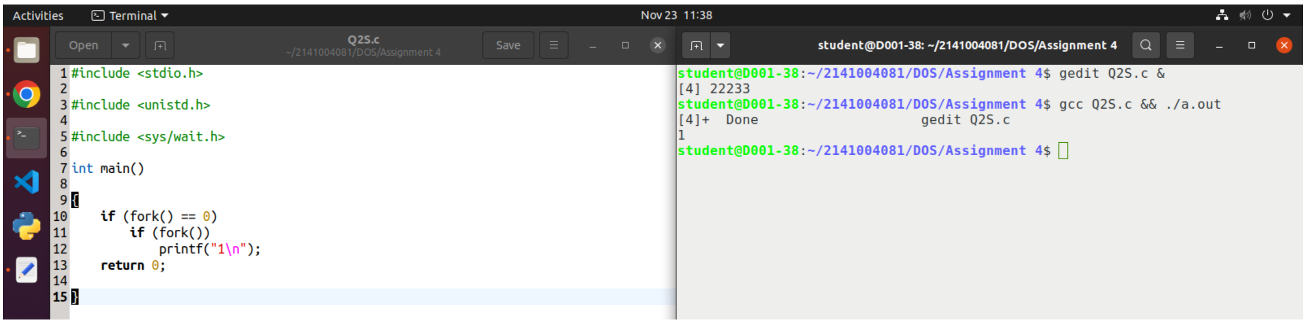
```
R.  int main() {
        int j, i = 5;
        for (j = 1; j < 3; j++) {
            if (fork() != 0) {
                i = i - 1;
                break;
            }
        }
        fprintf(stderr, "%d", i);
        return 0;
    }
```


Activities
Terminal
Nov 23 11:37
Open
Q2R.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    int j, i = 5;
    for (j = 1; j < 3; j++)

    {
        if (fork() != 0)

        {
            i = i -
                1;
            break;

        }

    }
    fprintf(stderr, "%d", i);
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2R.c &
[4] 22170
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2R.c && ./a.out
[4]+  Done                    gedit Q2R.c
445student@D001-38:~/2141004081/DOS/Assignment 4$
```

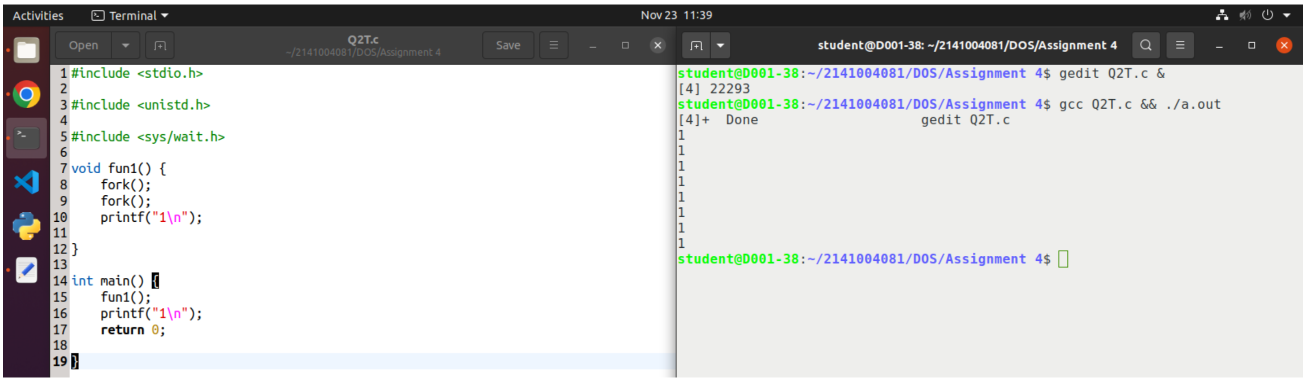
```
S.   int main() {
          if (fork() == 0)
               if (fork())
                    printf("1\n");
          return 0;
     }
```


Activities
Terminal
Nov 23 11:38
Open
Q2S.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

int main()

{
    if (fork() == 0)
        if (fork())
            printf("1\n");
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2S.c &
[4] 22233
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2S.c && ./a.out
[4]+  Done                    gedit Q2S.c
1
student@D001-38:~/2141004081/DOS/Assignment 4$
```

```
T.   void fun1() {
          fork();
          fork();
          printf("1\n");
     }
     int main() {
          fun1();
          printf("1\n");
          return 0;
     }
```


Activities
Terminal
Nov 23 11:39
Open
Q2T.c
~/2141004081/DOS/Assignment 4
Save
student@D001-38: ~/2141004081/DOS/Assignment 4

```c
#include <stdio.h>

#include <unistd.h>

#include <sys/wait.h>

void fun1() {
    fork();
    fork();
    printf("1\n");

}

int main() {
    fun1();
    printf("1\n");
    return 0;

}
```

```
student@D001-38:~/2141004081/DOS/Assignment 4$ gedit Q2T.c &
[4] 22293
student@D001-38:~/2141004081/DOS/Assignment 4$ gcc Q2T.c && ./a.out
[4]+  Done                    gedit Q2T.c
1
1
1
1
1
1
1
1
student@D001-38:~/2141004081/DOS/Assignment 4$ 
```

Q3. Write a C program that will create three child process to perform the following operations respectively:

- First child will copy the content of file1 to file2

- Second child will display the content of file2

- Third child will display the sorted content of file2 in reverse order.

- Each child process being created will display its id and its parent process id with appropriate message.

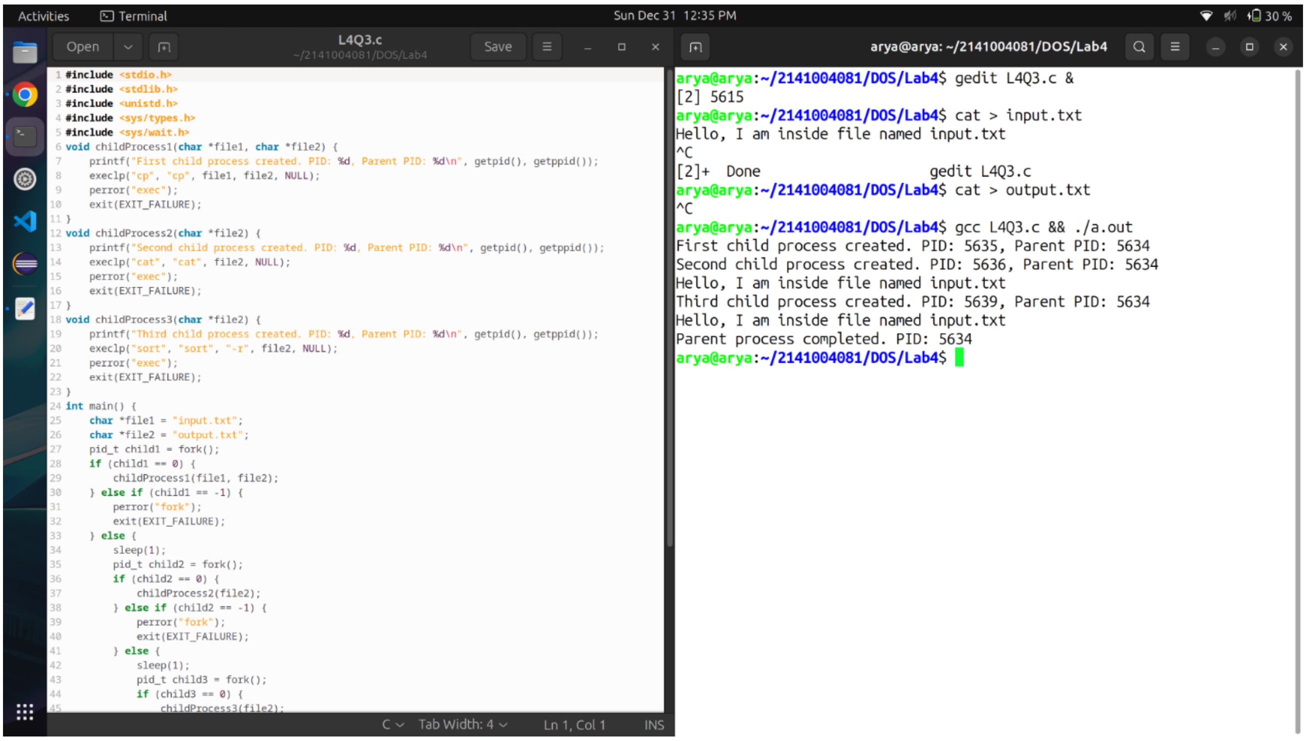
- The parent process will be delayed for 1 second after creation of each child process. It will display appropriate message with its id after completion of all the child processes.

Command:

```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
void childProcess1(char *file1, char *file2) {
    printf("First child process created. PID: %d,
Parent PID: %d\n", getpid(), getppid());
    execlp("cp", "cp", file1, file2, NULL);
    perror("exec");
    exit(EXIT_FAILURE);
}
void childProcess2(char *file2) {
    printf("Second child process created. PID: %d,
Parent PID: %d\n", getpid(), getppid());
```

```
    execlp("cat", "cat", file2, NULL);
    perror("exec");
    exit(EXIT_FAILURE);
}
void childProcess3(char *file2) {
    printf("Third child process created. PID: %d,
Parent PID: %d\n", getpid(), getppid());
    execlp("sort", "sort", "-r", file2, NULL);
    perror("exec");
    exit(EXIT_FAILURE);
}
int main() {
    char *file1 = "input.txt";
    char *file2 = "output.txt";
    pid_t child1 = fork();
    if (child1 == 0) {
        childProcess1(file1, file2);
    } else if (child1 == -1) {
        perror("fork");
        exit(EXIT_FAILURE);
    } else {
        sleep(1);
        pid_t child2 = fork();
        if (child2 == 0) {
            childProcess2(file2);
        } else if (child2 == -1) {
            perror("fork");
            exit(EXIT_FAILURE);
        } else {
            sleep(1);
            pid_t child3 = fork();
            if (child3 == 0) {
                childProcess3(file2);
            } else if (child3 == -1) {
                perror("fork");
                exit(EXIT_FAILURE);
            } else {
                sleep(1);
                wait(NULL);
                wait(NULL);
                wait(NULL);
                printf("Parent process completed. PID:
%d\n", getpid());
            }
        }
    }
    return 0;
}
```

Output:



```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
void childProcess1(char *file1, char *file2) {
    printf("First child process created. PID: %d, Parent PID: %d\n", getpid(), getppid());
    execlp("cp", "cp", file1, file2, NULL);
    perror("exec");
    exit(EXIT_FAILURE);
}
void childProcess2(char *file2) {
    printf("Second child process created. PID: %d, Parent PID: %d\n", getpid(), getppid());
    execlp("cat", "cat", file2, NULL);
    perror("exec");
    exit(EXIT_FAILURE);
}
void childProcess3(char *file2) {
    printf("Third child process created. PID: %d, Parent PID: %d\n", getpid(), getppid());
    execlp("sort", "sort", "-r", file2, NULL);
    perror("exec");
    exit(EXIT_FAILURE);
}
int main() {
    char *file1 = "input.txt";
    char *file2 = "output.txt";
    pid_t child1 = fork();
    if (child1 == 0) {
        childProcess1(file1, file2);
    } else if (child1 == -1) {
        perror("fork");
        exit(EXIT_FAILURE);
    } else {
        sleep(1);
        pid_t child2 = fork();
        if (child2 == 0) {
            childProcess2(file2);
        } else if (child2 == -1) {
            perror("fork");
            exit(EXIT_FAILURE);
        } else {
            sleep(1);
            pid_t child3 = fork();
            if (child3 == 0) {
                childProcess3(file2);
```

```
arya@arya:~/2141004081/DOS/Lab4$ gedit L4Q3.c &
[2] 5615
arya@arya:~/2141004081/DOS/Lab4$ cat > input.txt
Hello, I am inside file named input.txt
^C
[2]+  Done                    gedit L4Q3.c
arya@arya:~/2141004081/DOS/Lab4$ cat > output.txt
^C
arya@arya:~/2141004081/DOS/Lab4$ gcc L4Q3.c && ./a.out
First child process created. PID: 5635, Parent PID: 5634
Second child process created. PID: 5636, Parent PID: 5634
Hello, I am inside file named input.txt
Third child process created. PID: 5639, Parent PID: 5634
Hello, I am inside file named input.txt
Parent process completed. PID: 5634
arya@arya:~/2141004081/DOS/Lab4$ 
```

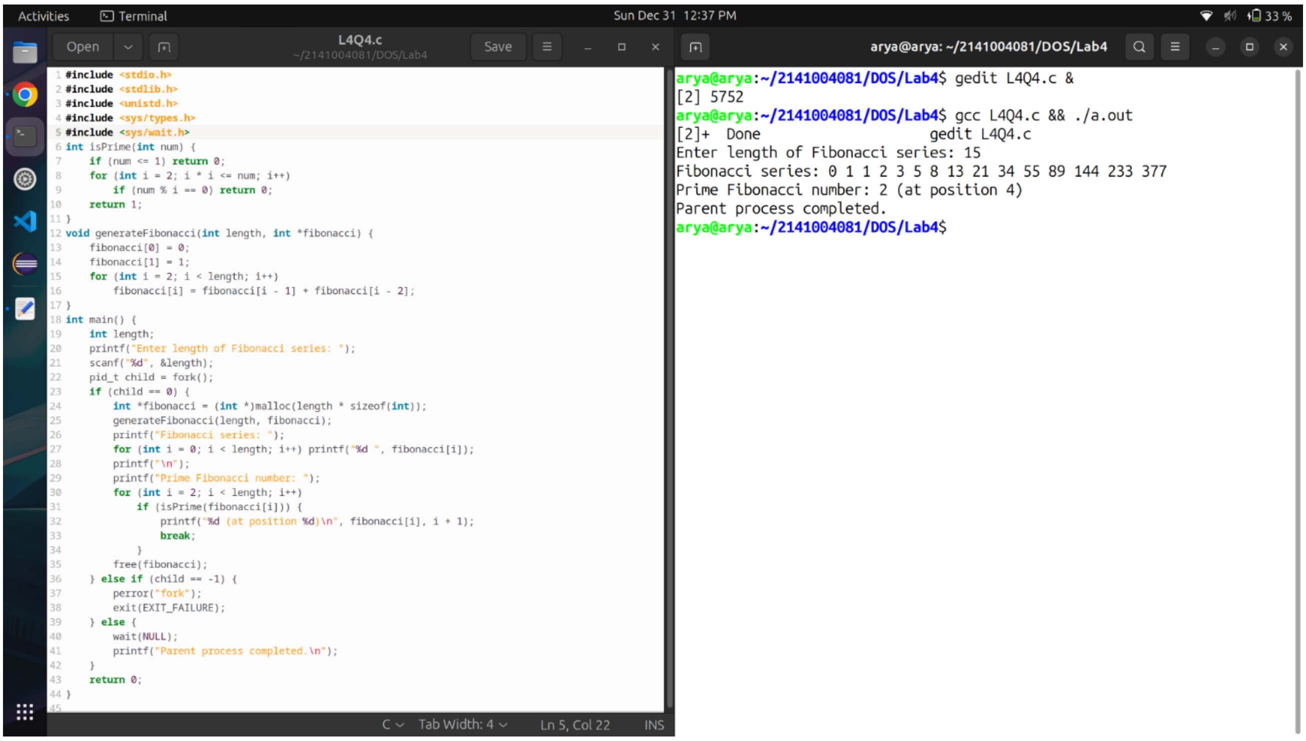
Q3. Write a C program that will create a child process to generate a Fibonacci series of specified length and store it in an array. The parent process will wait for the child to complete its task and then display the Fibonacci series and then display the prime Fibonacci number in the series along with its position with appropriate message.

Command:

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
int isPrime(int num) {
    if (num <= 1) return 0;
    for (int i = 2; i * i <= num; i++)
        if (num % i == 0) return 0;
    return 1;
}
void generateFibonacci(int length, int *fibonacci) {
    fibonacci[0] = 0;
    fibonacci[1] = 1;
    for (int i = 2; i < length; i++)
        fibonacci[i] = fibonacci[i - 1] + fibonacci[i
- 2];
}
int main() {
    int length;
    printf("Enter length of Fibonacci series: ");
    scanf("%d", &length);
    pid_t child = fork();
    if (child == 0) {
        int *fibonacci = (int *)malloc(length *
sizeof(int));
        generateFibonacci(length, fibonacci);
        printf("Fibonacci series: ");
```

```
            for (int i = 0; i < length; i++) printf("%d ",
fibonacci[i]);
            printf("\n");
            printf("Prime Fibonacci number: ");
            for (int i = 2; i < length; i++)
                if (isPrime(fibonacci[i])) {
                    printf("%d   (at   position   %d)\n",
fibonacci[i], i + 1);
                    break;
                }
            free(fibonacci);
        } else if (child == -1) {
            perror("fork");
            exit(EXIT_FAILURE);
        } else {
            wait(NULL);
            printf("Parent process completed.\n");
        }
        return 0;
    }
```

Output:



```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
int isPrime(int num) {
    if (num <= 1) return 0;
    for (int i = 2; i * i <= num; i++)
        if (num % i == 0) return 0;
    return 1;
}
void generateFibonacci(int length, int *fibonacci) {
    fibonacci[0] = 0;
    fibonacci[1] = 1;
    for (int i = 2; i < length; i++)
        fibonacci[i] = fibonacci[i - 1] + fibonacci[i - 2];
}
int main() {
    int length;
    printf("Enter length of Fibonacci series: ");
    scanf("%d", &length);
    pid_t child = fork();
    if (child == 0) {
        int *fibonacci = (int *)malloc(length * sizeof(int));
        generateFibonacci(length, fibonacci);
        printf("Fibonacci series: ");
        for (int i = 0; i < length; i++) printf("%d ", fibonacci[i]);
        printf("\n");
        printf("Prime Fibonacci number: ");
        for (int i = 2; i < length; i++)
            if (isPrime(fibonacci[i])) {
                printf("%d (at position %d)\n", fibonacci[i], i + 1);
                break;
            }
        free(fibonacci);
    } else if (child == -1) {
        perror("fork");
        exit(EXIT_FAILURE);
    } else {
        wait(NULL);
        printf("Parent process completed.\n");
    }
    return 0;
}
```

```
arya@arya:~/2141004081/DOS/Lab4$ gedit L4Q4.c &
[2] 5752
arya@arya:~/2141004081/DOS/Lab4$ gcc L4Q4.c && ./a.out
[2]+  Done                    gedit L4Q4.c
Enter length of Fibonacci series: 15
Fibonacci series: 0 1 1 2 3 5 8 13 21 34 55 89 144 233 377
Prime Fibonacci number: 2 (at position 4)
Parent process completed.
arya@arya:~/2141004081/DOS/Lab4$
```