Q1

As the child process is a whole copy and has its own pcb which is not shared. Both child and parent processes have a separate copy of the variable count = 10. So, they both run 10 times.
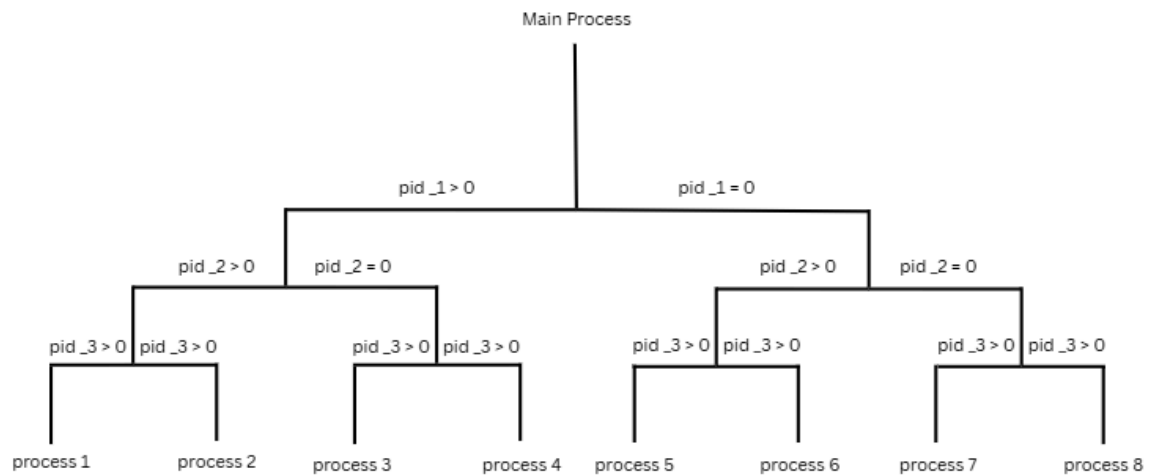
```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q1 Q1.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q1
Parent's Counter: 10
Parent's Counter: 9
Child's Counter: 10
Child's Counter: 9
Parent's Counter: 8
Parent's Counter: 7
Parent's Counter: 6
Parent's Counter: 5
Parent's Counter: 4
Parent's Counter: 3
Parent's Counter: 2
Parent's Counter: 1
Child's Counter: 8
Child's Counter: 7
Child's Counter: 6
Child's Counter: 5
Child's Counter: 4
Child's Counter: 3
Child's Counter: 2
Child's Counter: 1
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q1
```

Q2_A

8 processes are created in total

```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q2_A Q2_A.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q2_A
HI
HI
HI
HI
HI
HI
HI
HI
iuser@iuser-virtual-machine:~/Desktop/Asjad$ []
```
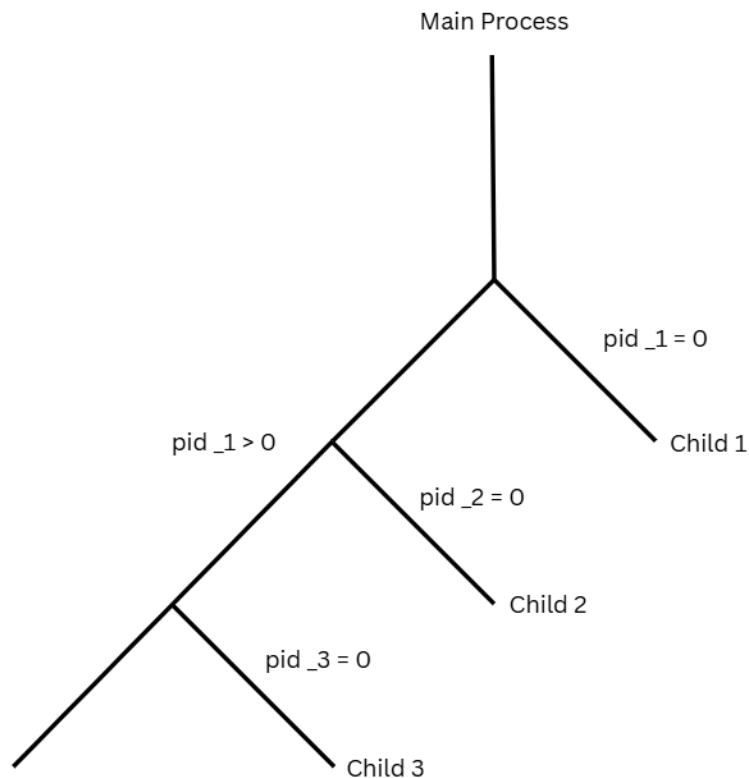
Process Tree:


```
                              Main Process
                                  │
              ┌───────────────────┴───────────────────┐
          pid _1 > 0                              pid _1 = 0
        ┌─────┴─────┐                          ┌──────┴──────┐
    pid _2 > 0   pid _2 = 0                 pid _2 > 0    pid _2 = 0
     ┌───┴───┐    ┌───┴───┐                 ┌───┴───┐      ┌───┴───┐
pid_3>0 pid_3>0 pid_3>0 pid_3>0       pid_3>0 pid_3>0 pid_3>0 pid_3>0
   │      │       │       │              │      │        │       │
process1 process2 process3 process4  process5 process6 process7 process8
```

Q2_B

```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q2_B Q2_B.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q2_B
This is the 1st child
This is the 3rd child
This is the 2nd child
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q2_B
```

Process Tree:

Main Process

pid _1 = 0

Child 1

pid _1 > 0

pid _2 = 0

Child 2

pid _3 = 0

Child 3

Q3_A
Zombie process observed.
We can see that PID 10690 is shown in the list of Zombie processes using ps command

```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q3_A Q3_A.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q3_A
Child process running (PID = 10690)
Exitting from the child process now.
Exitting from the parent process now.
```

```
iuser@iuser-virtual-machine:~$ ps -aux | grep defunct
ps -l | grep Z
iuser       10690  0.0  0.0       0      0 pts/0     Z+    15:39    0:00 [Q3_A] <defunct>
iuser       10694  0.0  0.0    9564   2688 pts/1     S+    15:39    0:00 grep --color=auto defunct
F S   UID      PID     PPID  C PRI  NI ADDR SZ WCHAN   TTY            TIME CMD
iuser@iuser-virtual-machine:~$ S
```

(Both the program and ps command were executed in parallel to check.)

Q3_B
Added the wait(NULL) in the parent process now.
No zombie process observed.
PID 11101 is not in the list of Zombie processes

```
iuser@iuser-virtual-machine:~$ ps -aux | grep defunct
ps -l | grep Z
iuser        11104  0.0  0.0   9564  2688 pts/1    S+   15:42   0:00 grep --color=auto defunct
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
iuser@iuser-virtual-machine:~$ []
```

```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q3_B Q3_B.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q3_B
Child process running (PID = 11101)
Exitting from the child process now.
Exitting from the parent process now.
iuser@iuser-virtual-machine:~/Desktop/Asjad$ []
```

(Both the program and ps command were executed in parallel to check.)

Q4

```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ which cat
/usr/bin/cat
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q4 Q4.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q4
Hi!
My name is Syed Asjad Raza
My roll number is 24L-0583
My section is BCS 4A
Bye!
iuser@iuser-virtual-machine:~/Desktop/Asjad$ $[]
```


Q5
All three commands were executed by 3 children using execlp()
It can be seen from ls that the garbage.txt was removed as well.

```
iuser@iuser-virtual-machine:~/Desktop/Asjad$ which pwd
/usr/bin/pwd
iuser@iuser-virtual-machine:~/Desktop/Asjad$ which date
/usr/bin/date
iuser@iuser-virtual-machine:~/Desktop/Asjad$ which rm
/usr/bin/rm
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ls
file.txt  garbage.txt  Q1  Q1.c  Q2_A  Q2_A.c  Q2_B  Q2_B.c  Q3_A  Q3_A.c  Q3_B  Q3_B.c  Q4  Q4.c  Q5  Q5.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ gcc -o Q5 Q5.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ./Q5
This is the 1st child. It will run pwd.
This is the 3rd child. It will run date.
This is the 2nd child. It will run rm garbage.txt.
/home/iuser/Desktop/Asjad
16:01:57 و PKT 2026 فروری 13 ت
iuser@iuser-virtual-machine:~/Desktop/Asjad$ ls
file.txt  Q1  Q1.c  Q2_A  Q2_A.c  Q2_B  Q2_B.c  Q3_A  Q3_A.c  Q3_B  Q3_B.c  Q4  Q4.c  Q5  Q5.c
iuser@iuser-virtual-machine:~/Desktop/Asjad$ []
```