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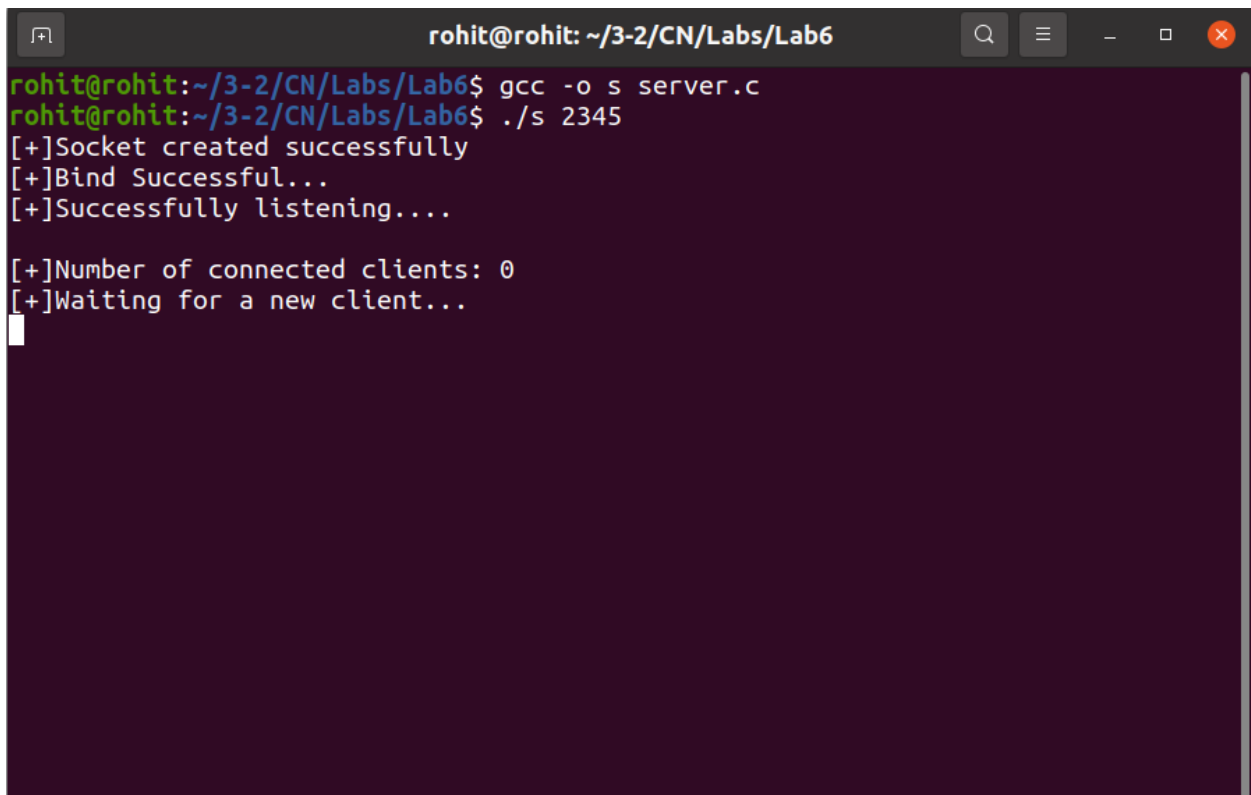
# COMPUTER NETWORKS

## CS F303

### Lab-6

**1. The server as a command line argument accepts the port number to which it should bind. (1 mark)**

The server executable(./s) accepts server port number i.e. 2345 from command-line argument and binds the socket. Server is now listening passively to incoming client connections if any.

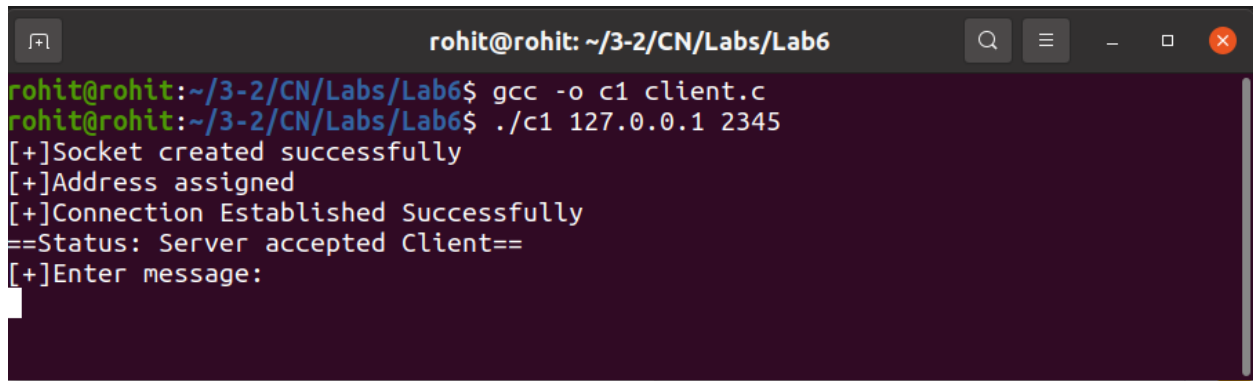
A terminal window with a dark purple background and white text. The window title is 'rohit@rohit: ~/3-2/CN/Labs/Lab6'. The terminal shows the following commands and output:

```
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

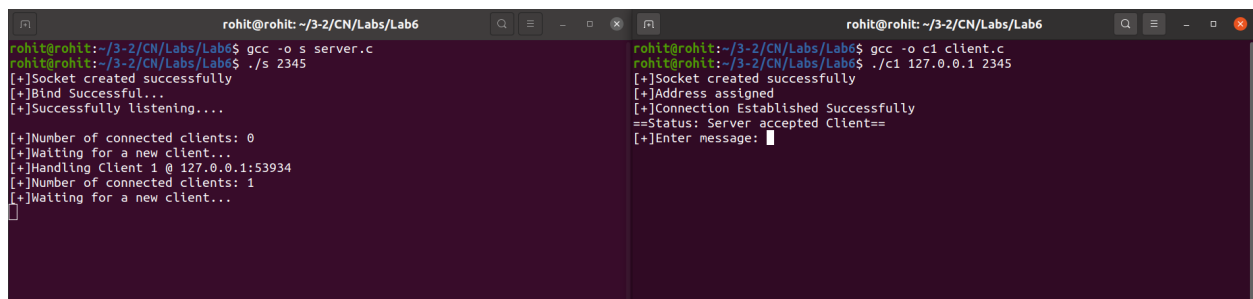
[+]Number of connected clients: 0
[+]Waiting for a new client...
```

## 2. The client, as command line arguments, accepts the IP address and the port number at which it will find the server. (1 mark)

The client executable (./c1) takes server's IP address and server port number(here 2345) as cmd-arguments in order and sends a connection request to the server. The server connects to the server since the number of clients initially was 0 and now its 1 ( $\leq 4$ ).



```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c1 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
```



```
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....
[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:53934
[+]Number of connected clients: 1
[+]Waiting for a new client...
```

```
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c1 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message: 
```

3. After connecting to the server, the client reads a line from the standard input and sends it to the server. (1 mark)

client(/c1) reads "client1 here" from standard input and sends this string to the server.

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
client1 here
█
```

server terminal is updated and server prints the received string in reverse order

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54372
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]New Message from Client!:
ereh 1tneilc
[+]Enter Message:
```

Complete client-server view:

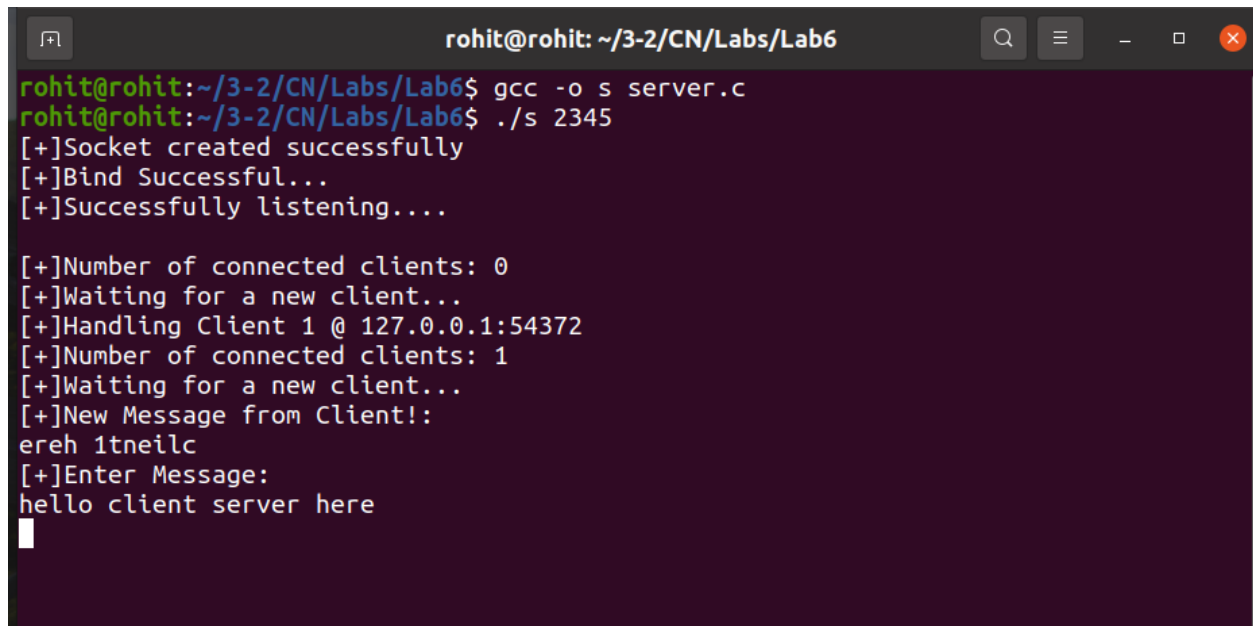
```
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54372
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]New Message from Client!:
ereh 1tneilc
[+]Enter Message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
client1 here
█
```

**4. The server prints the received line in the reverse order (2 marks) and reads a line from the standard input and sends it to the client or all the clients. (1 mark)**

The server program receives the string “client1 here” and prints the string in reverse order on std output as “ereh 1tneilc”. Server now reads the input from stdin as “hello client server here” and sends it to the client who had messaged it first. In this case it is c1 and hence sends it to c1.

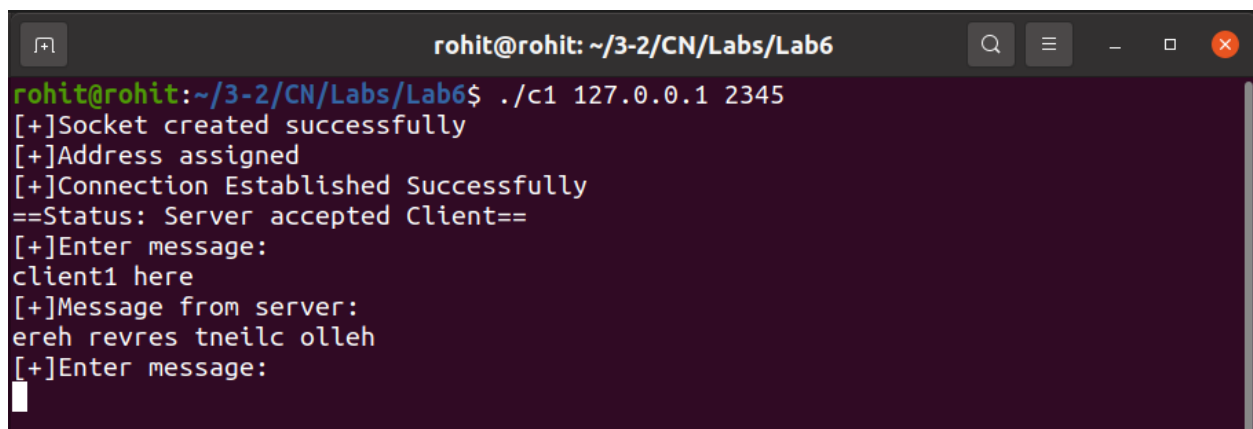
A terminal window titled 'rohit@rohit: ~/3-2/CN/Labs/Lab6' showing the execution of a server program. The user runs 'gcc -o s server.c' and './s 2345'. The program outputs status messages: '[+]Socket created successfully', '[+]Bind Successful...', and '[+]Successfully listening....'. It then reports '[+]Number of connected clients: 0' and '[+]Waiting for a new client...'. A client connects, and it shows '[+]Handling Client 1 @ 127.0.0.1:54372' and '[+]Number of connected clients: 1'. The server receives a message and prints '[+]New Message from Client!: ereh 1tneilc'. It then prompts '[+]Enter Message:' and the user enters 'hello client server here'.

```
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54372
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]New Message from Client!:
ereh 1tneilc
[+]Enter Message:
hello client server here
█
```

**5. The client prints the received line in the reverse order and is ready to accept a new line from the user. (2 marks)**

The client program receives the string “hello client server here” and prints the string in reverse order on std output as “ereh revres tneilc olleh”. Client is now ready for new input from stdin.

A terminal window titled 'rohit@rohit: ~/3-2/CN/Labs/Lab6' showing the execution of a client program. The user runs './c1 127.0.0.1 2345'. The program outputs status messages: '[+]Socket created successfully', '[+]Address assigned', and '[+]Connection Established Successfully'. It then shows '==Status: Server accepted Client=='. The client enters a message and receives a response. It prints '[+]Message from server: ereh revres tneilc olleh' and prompts '[+]Enter message:'.

```
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
client1 here
[+]Message from server:
ereh revres tneilc olleh
[+]Enter message:
█
```

## 6. The client exits if the user types "exit". (1 mark)

User types exits at the terminal and the client informs the server and then exits the connection.

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
client1 here
[+]Message from server:
ereh revres tneilc olleh
[+]Enter message:
exit
[+]Client Exiting...rohit@rohit:~/3-2/CN/Labs/Lab6$
```

The server is informed about client exiting and server then seeks a new client.

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54372
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]New Message from Client!:
ereh 1tneilc
[+]Enter Message:
hello client server here
[+]Client Abruptly Terminated...
[+]0 clients still connected...

```

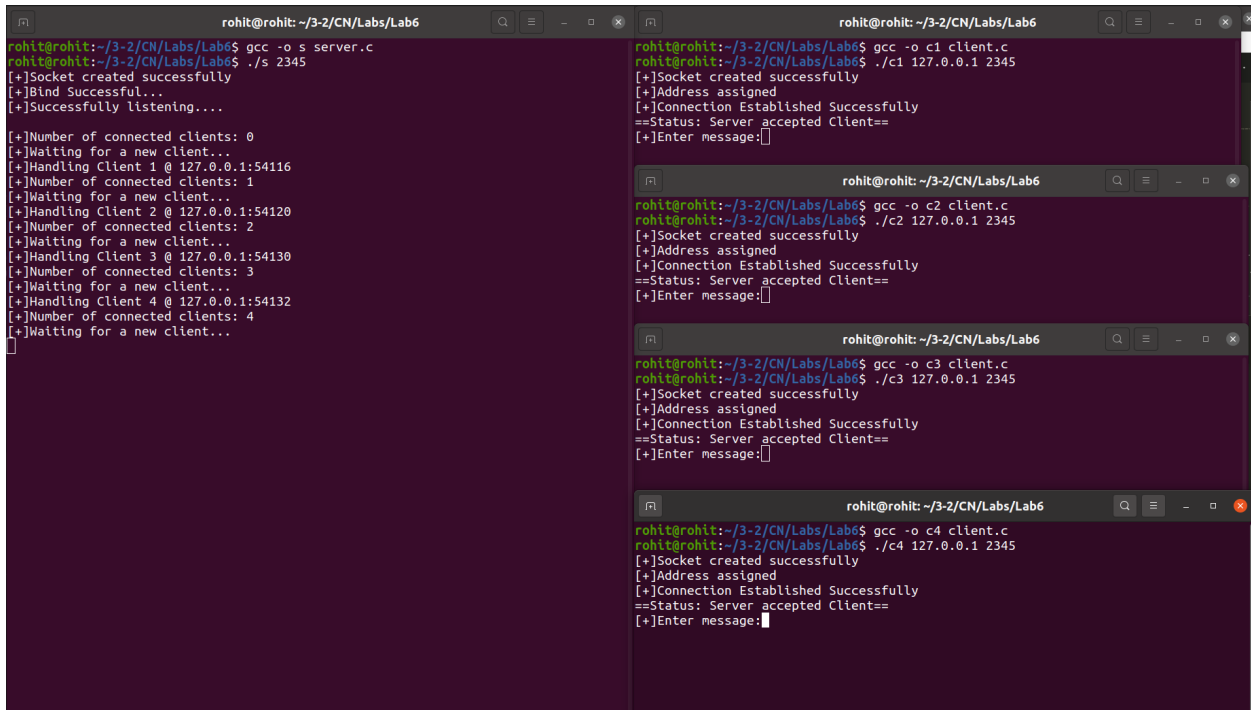
```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening...

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54372
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]New Message from Client!:
ereh 1tneilc
[+]Enter Message:
hello client server here
[+]Client Abruptly Terminated...
[+]0 clients still connected...

rohit@rohit:~/3-2/CN/Labs/Lab6$
```

**7. The server at a time accepts at the most four clients. (4 marks) Any client above the limit is rejected. (4 marks) As and when the number is less than the limit, the server accepts the new client. (2 marks)**

Server is capable of handling a maximum of 4 concurrent clients. Here 4 clients c1 c2 c3 c4 connect successfully to the server.



```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54116
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]Handling Client 2 @ 127.0.0.1:54120
[+]Number of connected clients: 2
[+]Waiting for a new client...
[+]Handling Client 3 @ 127.0.0.1:54130
[+]Number of connected clients: 3
[+]Waiting for a new client...
[+]Handling Client 4 @ 127.0.0.1:54132
[+]Number of connected clients: 4
[+]Waiting for a new client...

rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c1 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c2 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c2 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c3 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c3 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c4 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c4 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
```

If additional client now tries to joins the server, the connection is refused by the server



```
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c5 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c5 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Declined
rohit@rohit:~/3-2/CN/Labs/Lab6$
```

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54492
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]Handling Client 2 @ 127.0.0.1:54494
[+]Number of connected clients: 2
[+]Waiting for a new client...
[+]Handling Client 3 @ 127.0.0.1:54496
[+]Number of connected clients: 3
[+]Waiting for a new client...
[+]Handling Client 4 @ 127.0.0.1:54498
[+]Number of connected clients: 4
[+]Maximum Client Limit Reached...
[+]Refusing Connection to new client...
[+]Number of connected clients: 4
[+]Waiting for a new client...

rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c5 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c5 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Declined
rohit@rohit:~/3-2/CN/Labs/Lab6$

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c2 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c3 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c4 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
```

Suppose c1 exits from the server, now total 3 clients are still connected to the server.

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
exit
[+]Client Exiting...rohit@rohit:~/3-2/CN/Labs/Lab6$
```

But When one of the clients exits, it creates space for the client. So again when our client no.5 tries to connect, it connects successfully. So the total number of active clients remains at most 4.

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54492
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]Handling Client 2 @ 127.0.0.1:54494
[+]Number of connected clients: 2
[+]Waiting for a new client...
[+]Handling Client 3 @ 127.0.0.1:54496
[+]Number of connected clients: 3
[+]Waiting for a new client...
[+]Handling Client 4 @ 127.0.0.1:54498
[+]Number of connected clients: 4
[+]Waiting for a new client...
[+]Maximum Client Limit Reached...
[+]Refusing Connection to new client...
[+]Number of connected clients: 4
[+]Waiting for a new client...
[+]Client Abruptly Terminated...
[+]3 clients still connected...
[+]Handling Client 4 @ 127.0.0.1:54532
[+]Number of connected clients: 4
[+]Waiting for a new client...

```

```
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
exit
[+]Client Exiting...rohit@rohit:~/3-2/CN/Labs/Lab6$

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c2 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c3 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c5 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Declined
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c5 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:

rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c4 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
```



Note: Additionally client can also exit the connection using ctrl+c interrupt.

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o c1 client.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./c1 127.0.0.1 2345
[+]Socket created successfully
[+]Address assigned
[+]Connection Established Successfully
==Status: Server accepted Client==
[+]Enter message:
^C
Client Terminated
```

```
rohit@rohit: ~/3-2/CN/Labs/Lab6
rohit@rohit:~/3-2/CN/Labs/Lab6$ gcc -o s server.c
rohit@rohit:~/3-2/CN/Labs/Lab6$ ./s 2345
[+]Socket created successfully
[+]Bind Successful...
[+]Successfully listening....

[+]Number of connected clients: 0
[+]Waiting for a new client...
[+]Handling Client 1 @ 127.0.0.1:54556
[+]Number of connected clients: 1
[+]Waiting for a new client...
[+]Client Abruptly Terminated...
[+]0 clients still connected...
```