

# CS359 Assignment 3 - Client Server Calculator

Mihir Parag Mantri  
2001CS46

**Running the client:** `python[version] client.py [IP Address] [Port Number]`

E.g. `python3 client.py localhost 5000` (used throughout the report)

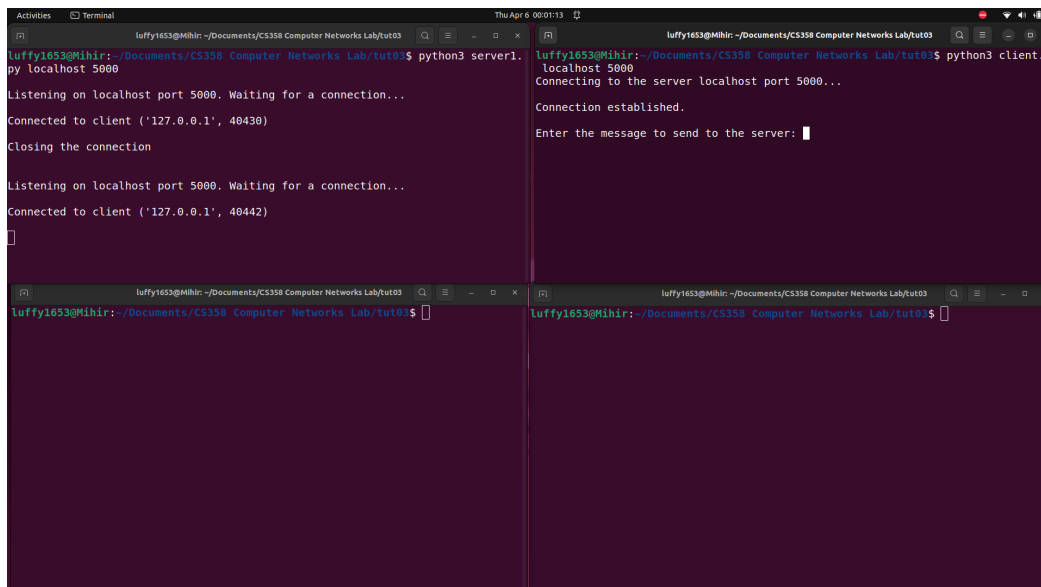
**Running the servers:** `python[version] server[number].py [IP Address] [Port Number]`

E.g. `python3 server1.py localhost 5000`

## Server 1: Single process server - handles one client at a time

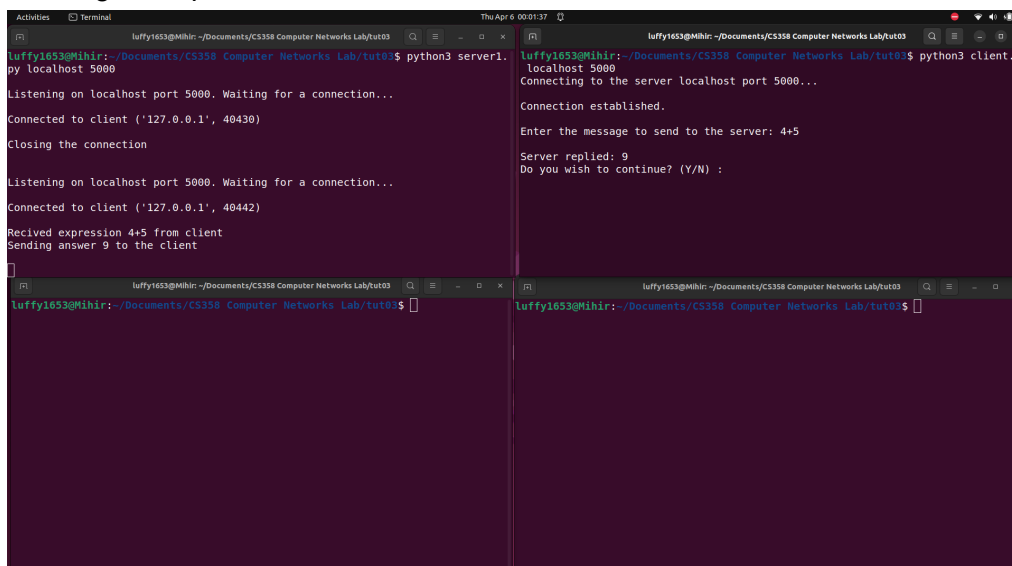
Connecting one client to server 1. Successful connection is seen, as shown below.

Note: There are two client connections seen on the server side. As explained in the code and in the video, it is done to solve the problem of two clients connecting at a time. We create a 'fake' client



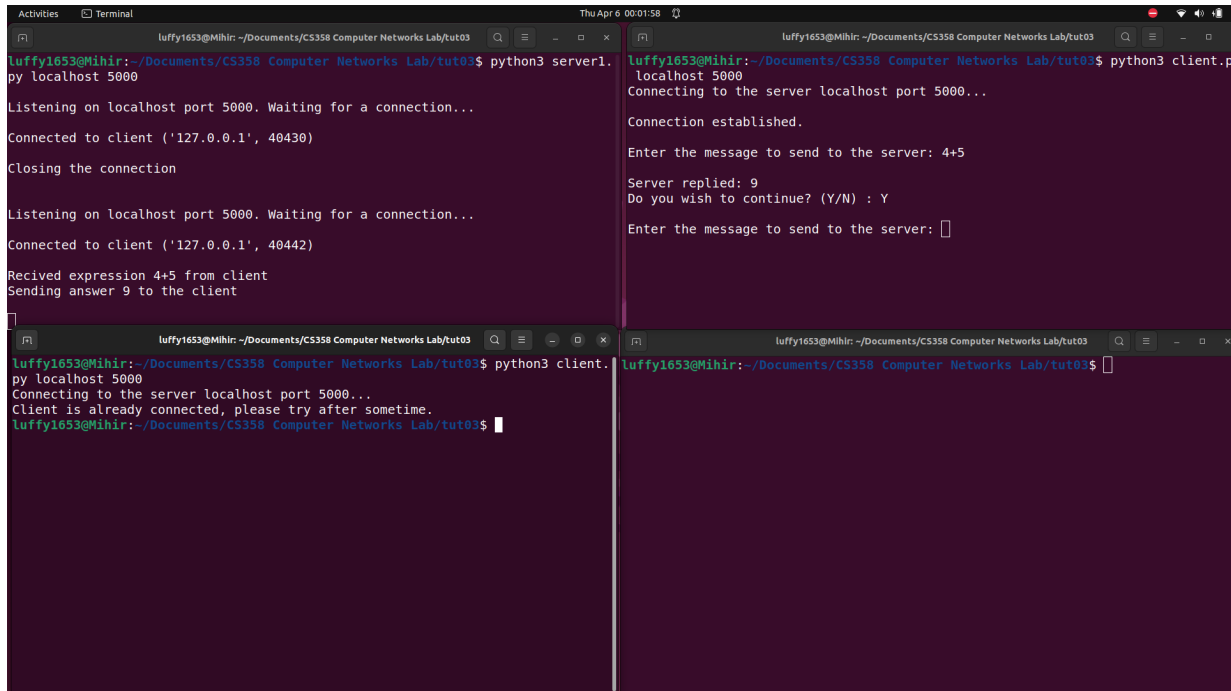
The screenshot shows two terminal windows. The left window is the server process, and the right window is the client process. The server is listening on port 5000. The client connects to the server. The server prints 'Listening on localhost port 5000. Waiting for a connection...' and 'Connected to client ('127.0.0.1', 40430)'. The client prints 'Connecting to the server localhost port 5000...' and 'Connection established.' The server then prints 'Closing the connection' and 'Listening on localhost port 5000. Waiting for a connection...'. The client prints 'Enter the message to send to the server: '.

Sending an expression to the server for calculation. Server returns the correct answer.



The screenshot shows two terminal windows. The left window is the server process, and the right window is the client process. The server is listening on port 5000. The client connects to the server. The server prints 'Listening on localhost port 5000. Waiting for a connection...' and 'Connected to client ('127.0.0.1', 40430)'. The client prints 'Connecting to the server localhost port 5000...' and 'Connection established.' The server then prints 'Closing the connection' and 'Listening on localhost port 5000. Waiting for a connection...'. The client prints 'Enter the message to send to the server: 4+5'. The server prints 'Server replied: 9' and 'Do you wish to continue? (Y/N) :'. The client prints 'Y'.

Attempting to connect two clients at a time. As shown below, the second client is unable to connect and gets an error saying that another client is already connected, please try after sometime.



```
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
python3 server1.py localhost 5000

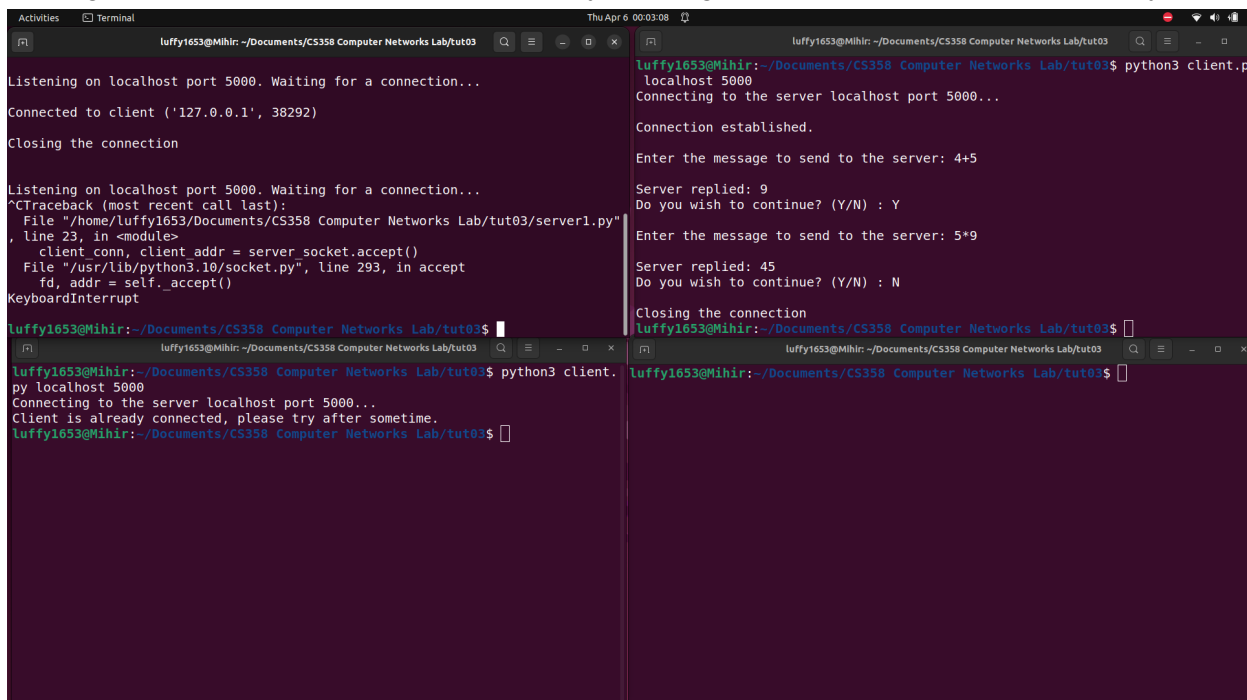
Listening on localhost port 5000. Waiting for a connection...
Connected to client ('127.0.0.1', 40430)
Closing the connection

Listening on localhost port 5000. Waiting for a connection...
Connected to client ('127.0.0.1', 40442)
Received expression 4+5 from client
Sending answer 9 to the client

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: 4+5
Server replied: 9
Do you wish to continue? (Y/N) : Y
Enter the message to send to the server:

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...
Client is already connected, please try after sometime.
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$
```

Closing the connection from the client side, by entering N. Further, the server is closed by pressing Ctrl+C.



```
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
python3 server1.py localhost 5000

Listening on localhost port 5000. Waiting for a connection...
Connected to client ('127.0.0.1', 38292)
Closing the connection

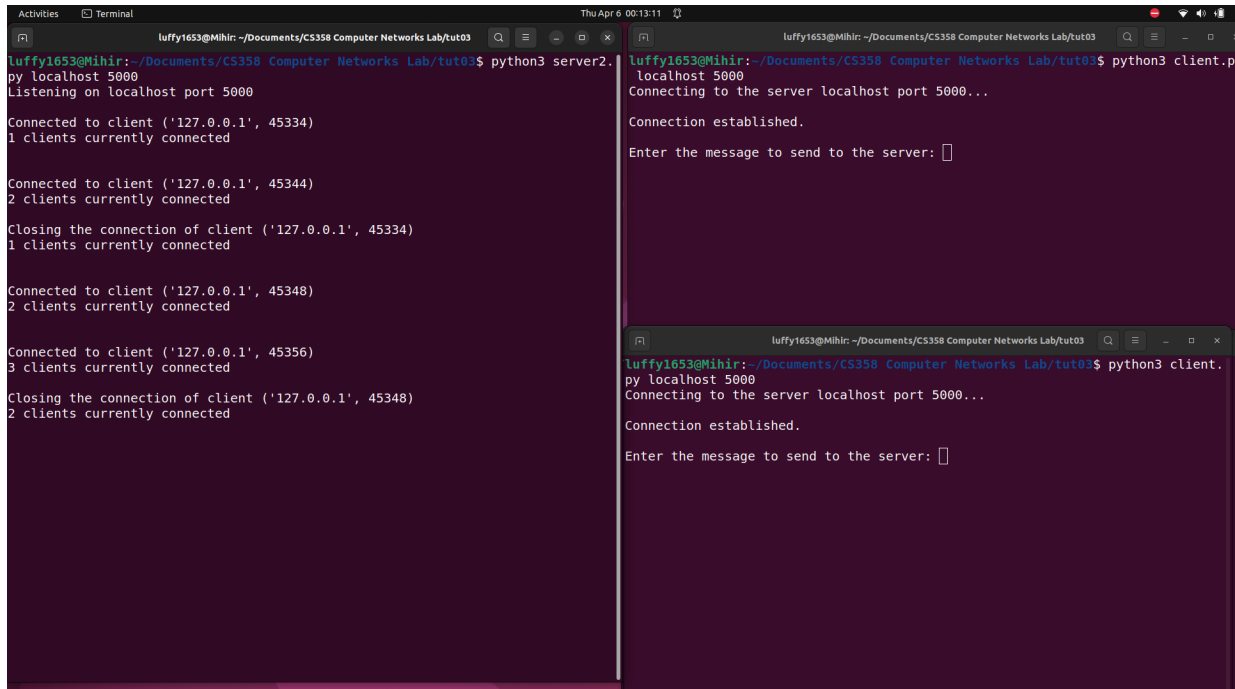
Listening on localhost port 5000. Waiting for a connection...
^CTraceback (most recent call last):
  File "/home/luffy1653/Documents/CS358 Computer Networks Lab/tut03/server1.py", line 23, in <module>
    client conn, client addr = server_socket.accept()
  File "/usr/lib/python3.10/socket.py", line 293, in accept
    fd, addr = self._accept()
KeyboardInterrupt

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: 4+5
Server replied: 9
Do you wish to continue? (Y/N) : Y
Enter the message to send to the server: 5*9
Server replied: 45
Do you wish to continue? (Y/N) : N
Closing the connection

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...
Client is already connected, please try after sometime.
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$
```

## Server 2: Multi-threaded server - handles multiple clients

Connecting two clients at a time. As shown below, the connection is successful. Each client is running on a separate thread. Also, the server displays the number of clients currently connected.



The screenshot shows two terminal windows. The left window is the server, and the right window is a client. The server is running a multi-threaded server script that listens on port 5000. It shows connections from two clients at different times, with the number of currently connected clients increasing from 1 to 2. The client is running a script that connects to the server on port 5000 and prompts the user to enter a message to send to the server.

```
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 server2.py
py localhost 5000
Listening on localhost port 5000

Connected to client ('127.0.0.1', 45334)
1 clients currently connected

Connected to client ('127.0.0.1', 45344)
2 clients currently connected

Closing the connection of client ('127.0.0.1', 45334)
1 clients currently connected

Connected to client ('127.0.0.1', 45348)
2 clients currently connected

Connected to client ('127.0.0.1', 45356)
3 clients currently connected

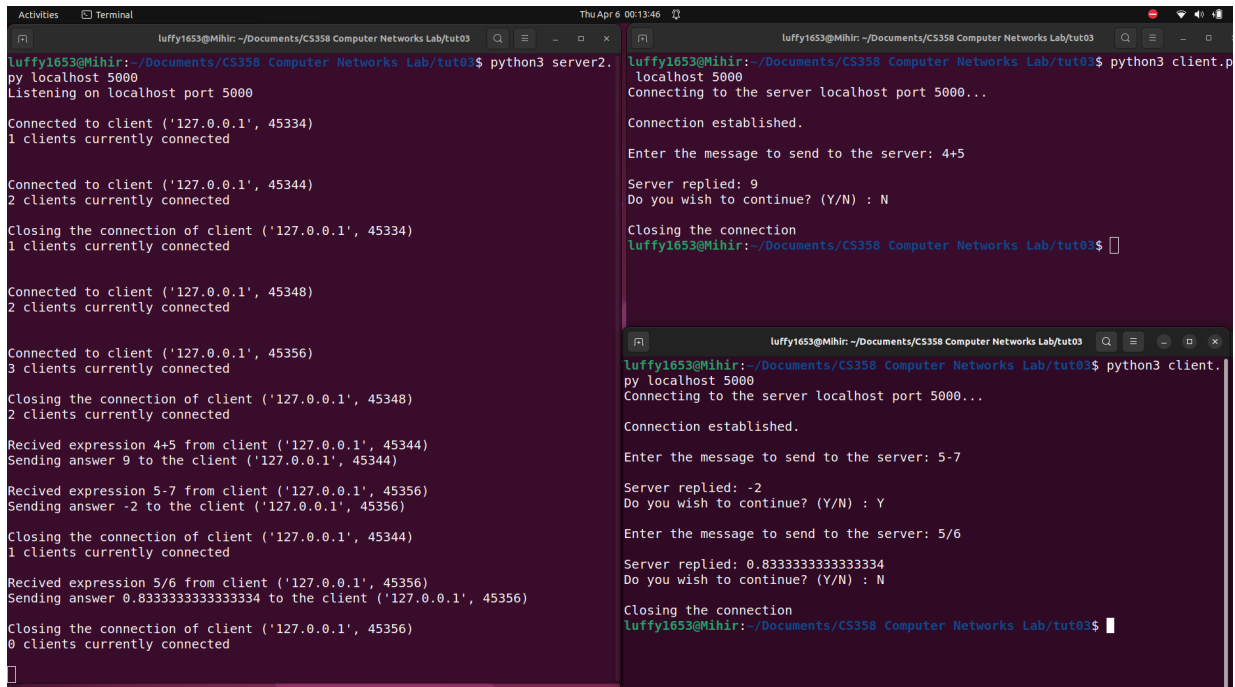
Closing the connection of client ('127.0.0.1', 45348)
2 clients currently connected

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 
```

Both the clients send requests to the server. The server answers all the requests. The clients then close the connection by pressing N. All this is also shown in the server as notifications.



The screenshot shows two terminal windows. The left window is the server, and the right window is a client. The server is running a multi-threaded server script that listens on port 5000. It shows connections from two clients at different times, with the number of currently connected clients increasing from 1 to 2. The client is running a script that connects to the server on port 5000 and prompts the user to enter a message to send to the server. The server responds with the calculated result of the expression and asks if the user wishes to continue.

```
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 server2.py
py localhost 5000
Listening on localhost port 5000

Connected to client ('127.0.0.1', 45334)
1 clients currently connected

Connected to client ('127.0.0.1', 45344)
2 clients currently connected

Closing the connection of client ('127.0.0.1', 45334)
1 clients currently connected

Connected to client ('127.0.0.1', 45348)
2 clients currently connected

Connected to client ('127.0.0.1', 45356)
3 clients currently connected

Closing the connection of client ('127.0.0.1', 45348)
2 clients currently connected

Received expression 4+5 from client ('127.0.0.1', 45344)
Sending answer 9 to the client ('127.0.0.1', 45344)

Received expression 5-7 from client ('127.0.0.1', 45356)
Sending answer -2 to the client ('127.0.0.1', 45356)

Closing the connection of client ('127.0.0.1', 45344)
1 clients currently connected

Received expression 5/6 from client ('127.0.0.1', 45356)
Sending answer 0.8333333333333334 to the client ('127.0.0.1', 45356)

Closing the connection of client ('127.0.0.1', 45356)
0 clients currently connected

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 4+5

Server replied: 9
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 5-7

Server replied: -2
Do you wish to continue? (Y/N) : Y

Enter the message to send to the server: 5/6

Server replied: 0.8333333333333334
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$
```

Connecting 3 clients to the server at a time. Each client sends an expression to the server, and the server answers all the requests as shown below.

```
Activities Terminal Thu Apr 6 00:14:57

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Connected to client ('127.0.0.1', 59980)
3 clients currently connected

Closing the connection of client ('127.0.0.1', 59972)
3 clients currently connected

Recived expression 1 from client ('127.0.0.1', 34100)
Sending answer 1 to the client ('127.0.0.1', 34100)

Recived expression 2 from client ('127.0.0.1', 59970)
Sending answer 2 to the client ('127.0.0.1', 59970)

Recived expression 3 from client ('127.0.0.1', 59980)
Sending answer 3 to the client ('127.0.0.1', 59980)

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Enter the message to send to the server: 5-7

Server replied: -2
Do you wish to continue? (Y/N) : Y

Enter the message to send to the server: 5/6

Server replied: 0.8333333333333334
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 2

Server replied: 2
Do you wish to continue? (Y/N) :

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Connection established.

Enter the message to send to the server: 4+5

Server replied: 9
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 1

Server replied: 1
Do you wish to continue? (Y/N) :
```

Closing the connection of all the three clients. The server is further closed by using Ctrl+C

```
Activities Terminal Thu Apr 6 00:21:02

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Closing the connection of client ('127.0.0.1', 59970)
2 clients currently connected

Closing the connection of client ('127.0.0.1', 59980)
1 clients currently connected

Closing the connection of client ('127.0.0.1', 34100)
0 clients currently connected

^CTraceback (most recent call last):
  File "/home/luffy1653/Documents/CS358 Computer Networks Lab/tut03/server2.py", line 59, in <module>
    client conn, client addr = server socket.accept()
  File "/usr/lib/python3.10/socket.py", line 293, in accept
    fd, addr = self._accept()
KeyboardInterrupt

Server replied: -2
Do you wish to continue? (Y/N) : Y

Enter the message to send to the server: 5/6

Server replied: 0.8333333333333334
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 2

Server replied: 2
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Server replied: 9
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 1

Server replied: 1
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Connection established.

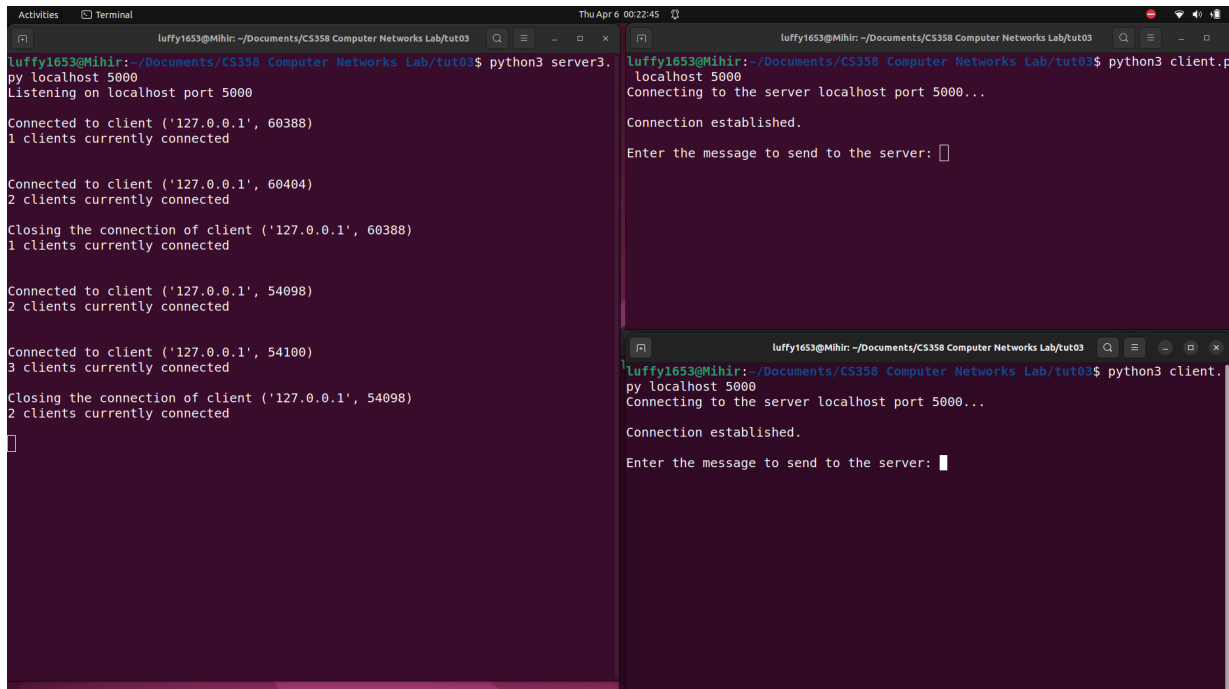
Enter the message to send to the server: 3

Server replied: 3
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$
```

### Server 3: Single process server using 'select' method - handles multiple clients

Connecting two clients at a time. As shown below, the connection is successful. Both the clients are running on the same program, on two different sockets. Each client will be assigned a separate socket, message queue, etc and other such data structures. The server stores all the pending input and output requests in separate lists. The select method gives the order of which requests to address at what time, etc.



The screenshot shows two terminal windows. The left window is the server, and the right window is the client. The server is running 'python3 server3.py' and is listening on localhost port 5000. It shows connections from clients at IP 127.0.0.1 with ports 60388, 60404, 54098, and 54100. The client is running 'python3 client.py' and is connecting to the server on localhost port 5000. It shows the connection established and prompts for a message to send to the server.

```
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 server3.py
py localhost 5000
Listening on localhost port 5000

Connected to client ('127.0.0.1', 60388)
1 clients currently connected

Connected to client ('127.0.0.1', 60404)
2 clients currently connected

Closing the connection of client ('127.0.0.1', 60388)
1 clients currently connected

Connected to client ('127.0.0.1', 54098)
2 clients currently connected

Connected to client ('127.0.0.1', 54100)
3 clients currently connected

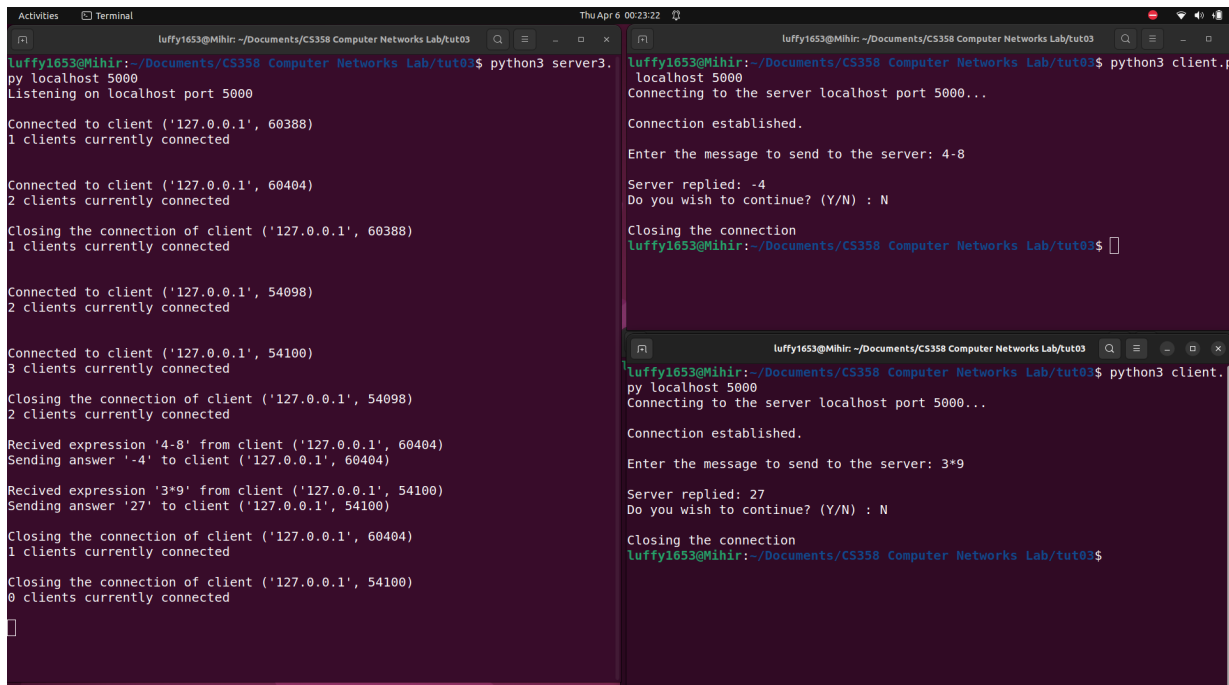
Closing the connection of client ('127.0.0.1', 54098)
2 clients currently connected

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 
```

Both the clients send expressions to the server. The server calculates the value and sends replies back to the clients, as shown below. The clients then close the connection by pressing N. This is also notified in the server.



The screenshot shows the same two terminal windows as before, but now with data exchange. The client sends '4-8' and '3\*9' to the server. The server replies with '-4' and '27' respectively. The client then presses 'N' to close the connection, which is reflected in the server's output.

```
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 server3.py
py localhost 5000
Listening on localhost port 5000

Connected to client ('127.0.0.1', 60388)
1 clients currently connected

Connected to client ('127.0.0.1', 60404)
2 clients currently connected

Closing the connection of client ('127.0.0.1', 60388)
1 clients currently connected

Connected to client ('127.0.0.1', 54098)
2 clients currently connected

Connected to client ('127.0.0.1', 54100)
3 clients currently connected

Closing the connection of client ('127.0.0.1', 54098)
2 clients currently connected

Received expression '4-8' from client ('127.0.0.1', 60404)
Sending answer '-4' to client ('127.0.0.1', 60404)

Received expression '3*9' from client ('127.0.0.1', 54100)
Sending answer '27' to client ('127.0.0.1', 54100)

Closing the connection of client ('127.0.0.1', 60404)
1 clients currently connected

Closing the connection of client ('127.0.0.1', 54100)
0 clients currently connected

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

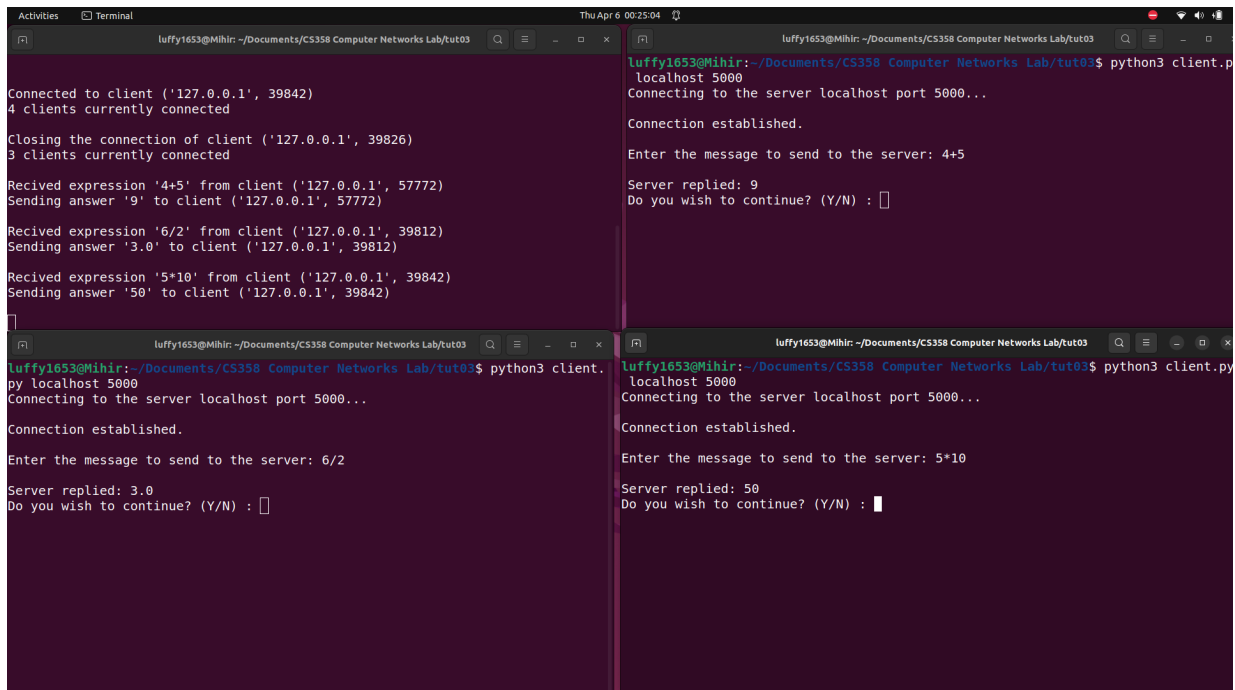
Connection established.

Enter the message to send to the server: 4-8

Server replied: -4
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ 
```

Connecting three clients to the server at a time. All the clients send some requests to the server and receive an answer respectively. This is also notified on the server side.



```
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Connected to client ('127.0.0.1', 39842)
4 clients currently connected

Closing the connection of client ('127.0.0.1', 39826)
3 clients currently connected

Recived expression '4+5' from client ('127.0.0.1', 57772)
Sending answer '9' to client ('127.0.0.1', 57772)

Recived expression '6/2' from client ('127.0.0.1', 39812)
Sending answer '3.0' to client ('127.0.0.1', 39812)

Recived expression '5*10' from client ('127.0.0.1', 39842)
Sending answer '50' to client ('127.0.0.1', 39842)

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 4+5

Server replied: 9
Do you wish to continue? (Y/N) :

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 6/2

Server replied: 3.0
Do you wish to continue? (Y/N) :

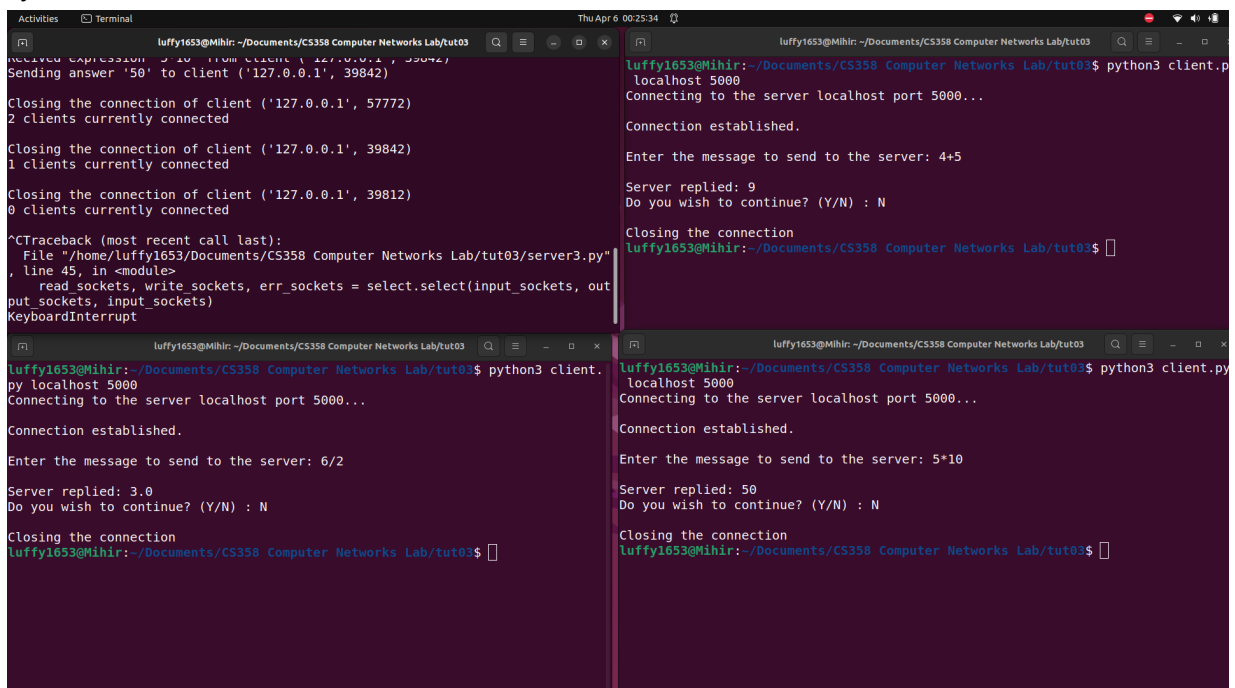
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 5*10

Server replied: 50
Do you wish to continue? (Y/N) :
```

All the three clients close the connection by pressing N. This is notified in the server. Further, the server closes by Ctrl+C.



```
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Recived expression '5*10' from client ('127.0.0.1', 39842)
Sending answer '50' to client ('127.0.0.1', 39842)

Closing the connection of client ('127.0.0.1', 57772)
2 clients currently connected

Closing the connection of client ('127.0.0.1', 39842)
1 clients currently connected

Closing the connection of client ('127.0.0.1', 39812)
0 clients currently connected

^CTraceback (most recent call last):
  File "/home/luffy1653/Documents/CS358 Computer Networks Lab/tut03/server3.py", line 45, in <module>
    read_sockets, write_sockets, err_sockets = select.select(input_sockets, output_sockets, input_sockets)
KeyboardInterrupt

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 6/2

Server replied: 3.0
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 4+5

Server replied: 9
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...

Connection established.

Enter the message to send to the server: 5*10

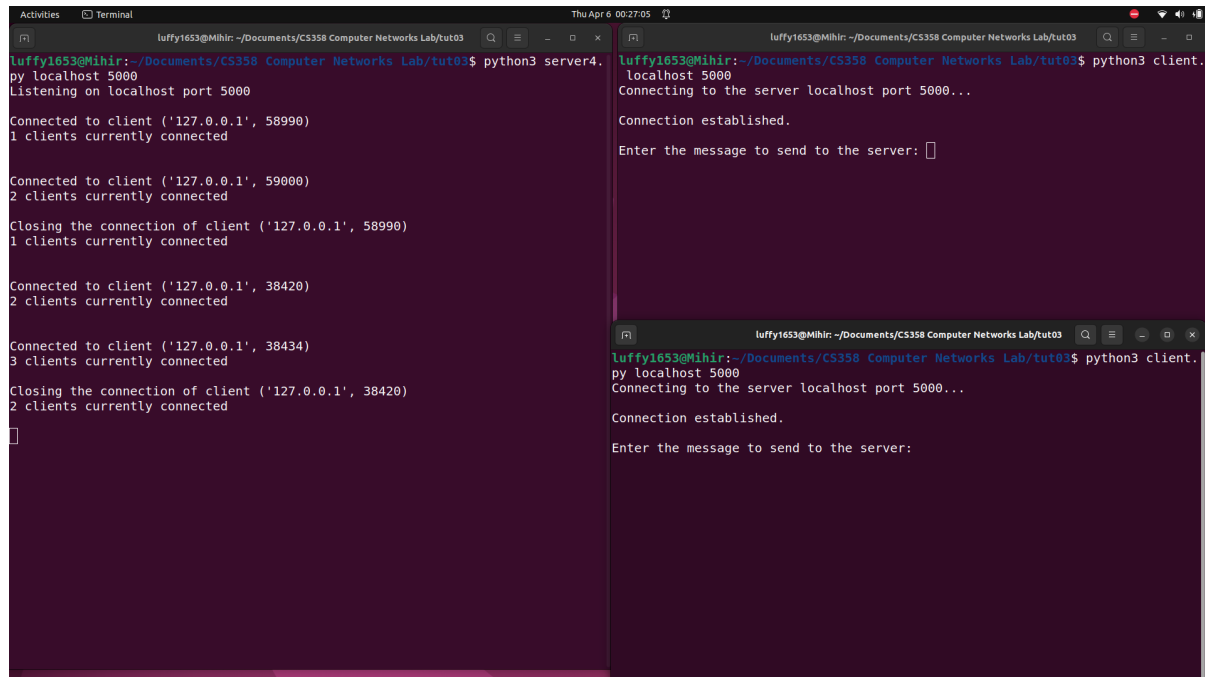
Server replied: 50
Do you wish to continue? (Y/N) : N

Closing the connection
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03$
```

## Server 4: Single process echo server using 'select' method - handles multiple clients

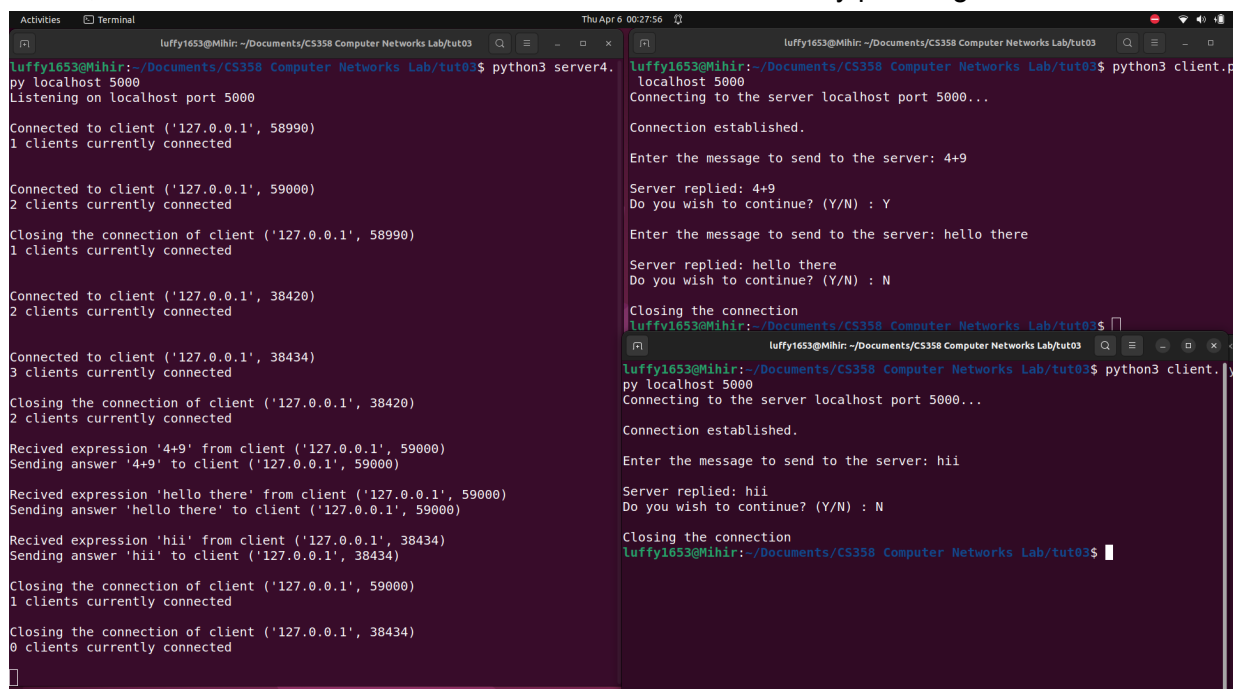
This server works in the same way as server 3. The only difference is that, this server will echo whatever it receives from the client, back to the client. Basically, an “echo” server.

Connecting two clients at a time. As shown below, the connection is successful. Both the clients are running on the same program, on two different sockets. The select method gives the order of which requests to address at what time, etc.



The screenshot shows two terminal windows. The left window is running the server4.py script, which listens on port 5000. It shows three clients connecting sequentially: first at 58990, then at 59000, and finally at 38420. The right window shows the client.py script being run twice. The first instance connects to the server and prompts the user to enter a message. The second instance also connects and prompts for a message.

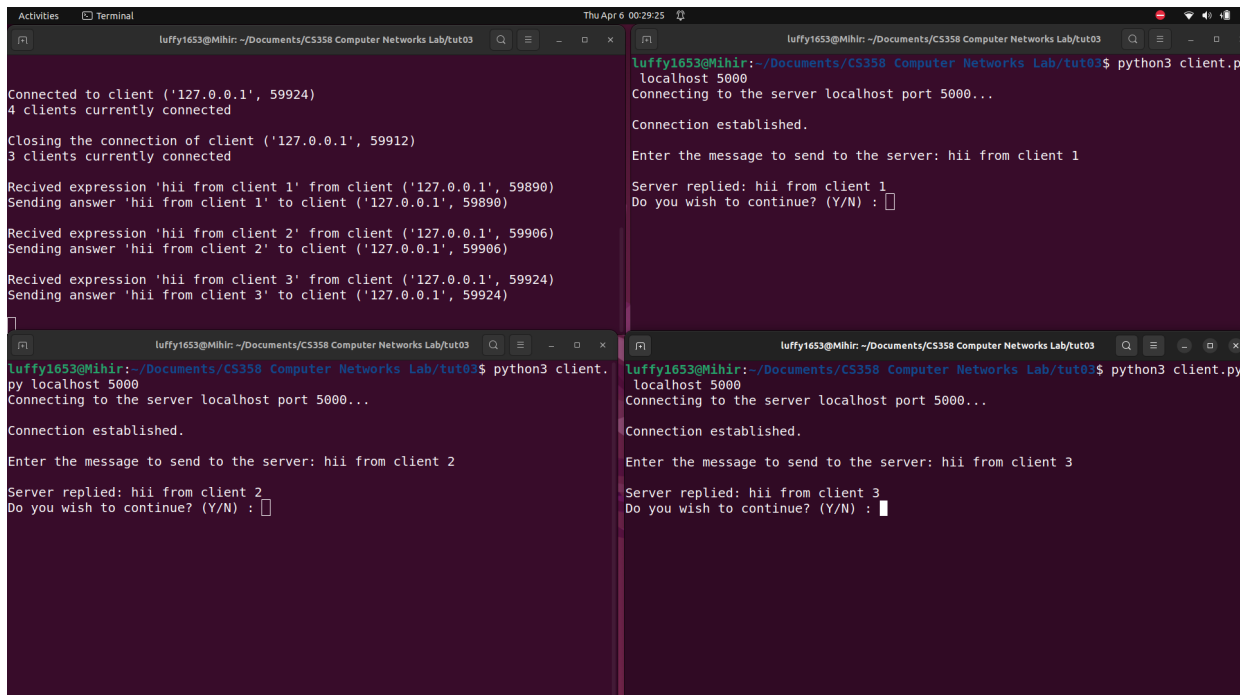
Both the clients send messages to the server. The server receives the messages and echoes them back to the clients, as shown below. The clients then close the connection by pressing N. This is also notified in the server.



This screenshot shows the same two terminal windows as before, but with more interaction. The server4.py window now shows the server receiving and echoing messages from the clients. The first client (59000) sends '4+9' and the server replies '4+9'. The second client (59000) sends 'hello there' and the server replies 'hello there'. The third client (38434) sends 'hii' and the server replies 'hii'. The client.py window shows the user entering these messages and the server replying. The client then prompts 'Do you wish to continue? (Y/N) : Y' and the user enters 'Y'. The client then prompts 'Do you wish to continue? (Y/N) : N' and the user enters 'N', which causes the client to close the connection. The server4.py window shows the server closing the connection for the client at 59000 and then for the client at 38434, leaving 0 clients currently connected.



Connecting three clients to the server at a time. All the clients send some requests to the server and receive an answer respectively. This is also notified on the server side.



```
Activities Terminal Thu Apr 6 00:29:25

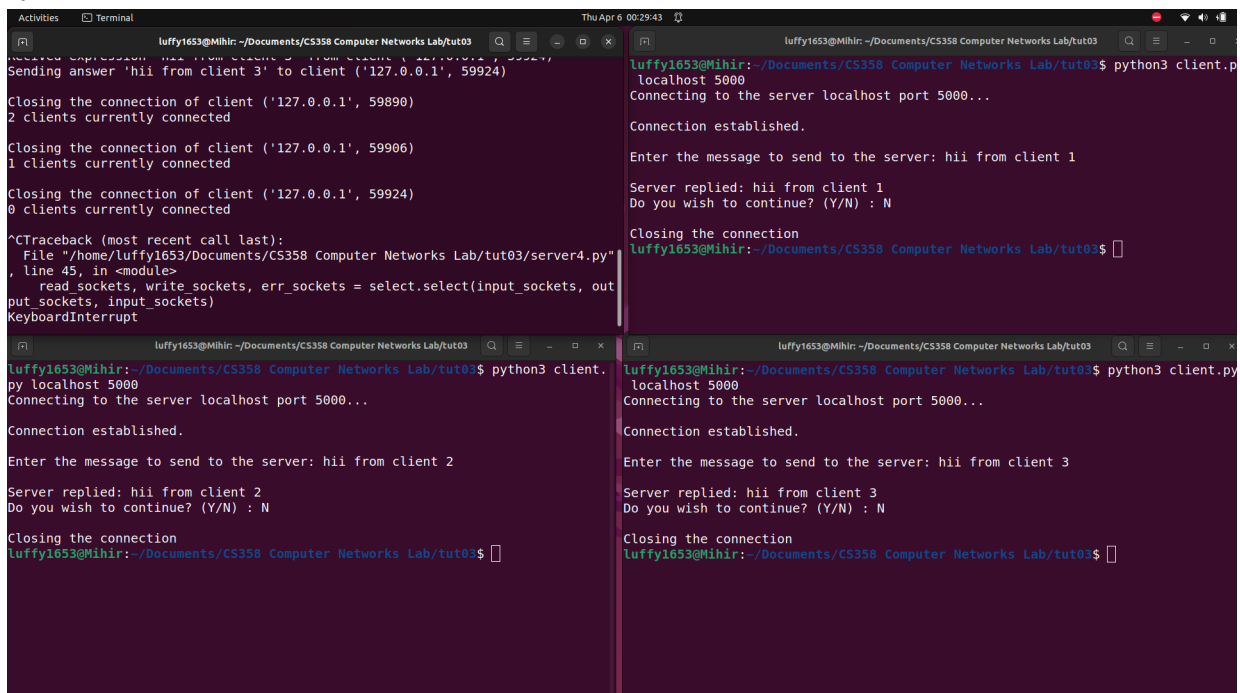
luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Connected to client ('127.0.0.1', 59924)
4 clients currently connected
Closing the connection of client ('127.0.0.1', 59912)
3 clients currently connected
Recived expression 'hii from client 1' from client ('127.0.0.1', 59890)
Sending answer 'hii from client 1' to client ('127.0.0.1', 59890)
Recived expression 'hii from client 2' from client ('127.0.0.1', 59906)
Sending answer 'hii from client 2' to client ('127.0.0.1', 59906)
Recived expression 'hii from client 3' from client ('127.0.0.1', 59924)
Sending answer 'hii from client 3' to client ('127.0.0.1', 59924)

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: hii from client 1
Server replied: hii from client 1
Do you wish to continue? (Y/N) :

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: hii from client 2
Server replied: hii from client 2
Do you wish to continue? (Y/N) :

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: hii from client 3
Server replied: hii from client 3
Do you wish to continue? (Y/N) :
```

All the three clients close the connection by pressing N. This is notified in the server. Further, the server closes by Ctrl+C.



```
Activities Terminal Thu Apr 6 00:29:43

luffy1653@Mihir: ~/Documents/CS358 Computer Networks Lab/tut03
Sending answer 'hii from client 3' to client ('127.0.0.1', 59924)
Closing the connection of client ('127.0.0.1', 59890)
2 clients currently connected
Closing the connection of client ('127.0.0.1', 59906)
1 clients currently connected
Closing the connection of client ('127.0.0.1', 59924)
0 clients currently connected
^CTraceback (most recent call last):
  File "~/home/luffy1653/Documents/CS358 Computer Networks Lab/tut03/server4.py",
    line 45, in <module>
    read_sockets, write_sockets, err_sockets = select.select(input_sockets, out
put_sockets, input_sockets)
KeyboardInterrupt

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: hii from client 1
Server replied: hii from client 1
Do you wish to continue? (Y/N) : N
Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: hii from client 2
Server replied: hii from client 2
Do you wish to continue? (Y/N) : N
Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$

luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$ python3 client.py
localhost 5000
Connecting to the server localhost port 5000...
Connection established.
Enter the message to send to the server: hii from client 3
Server replied: hii from client 3
Do you wish to continue? (Y/N) : N
Closing the connection
luffy1653@Mihir:~/Documents/CS358 Computer Networks Lab/tut03$
```