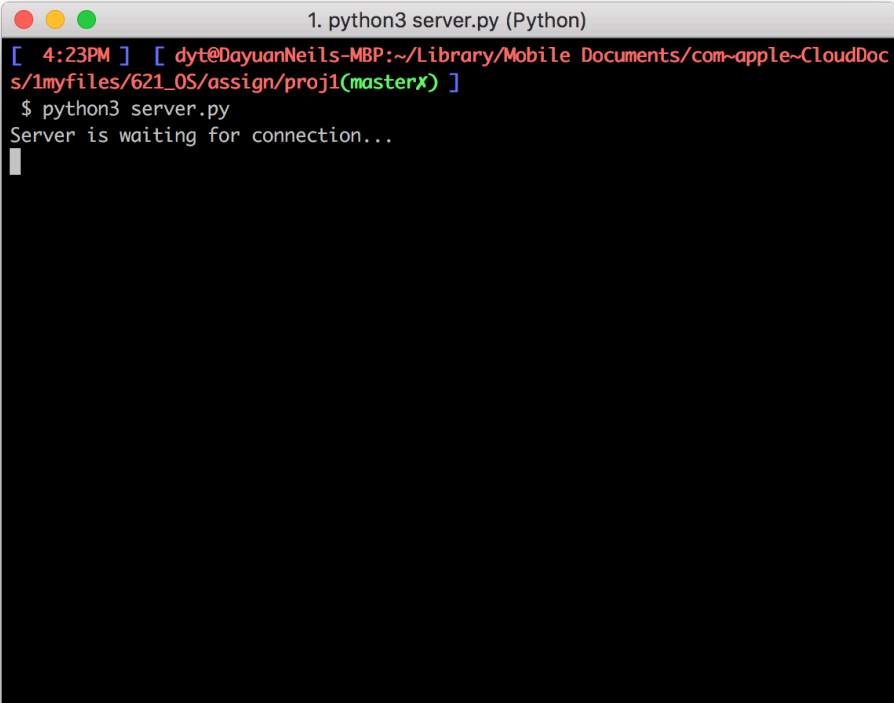


1. Summary

- After download and unzip, go to right directory.
 - (1) Execute “python3 server.py” command to run server.
 - (2) Execute “python3 client.py” command to run client. You can repeat executing “python3 client.py” command to run as much clients as you want but each client must be a separate terminate.
 - (3) Input “stop” to close clients.
 - (4) Ctrl + C to stop server.
- “client.py” is the source code for clients, in which I create a socket and connect to server, and send/receive message to/from server. **Multiple clients working at same time is supported.**
- “server.py” is the source code for server, in which I create a socket and it listens. A separate thread will be created for each client connection.
- Server will say “Welcome” first to client when connection is created, then users are asked to input any message they want to send to server. Then client will send that message. Server will reverse whatever it receives and send back the reversed message.

2. Screenshots show

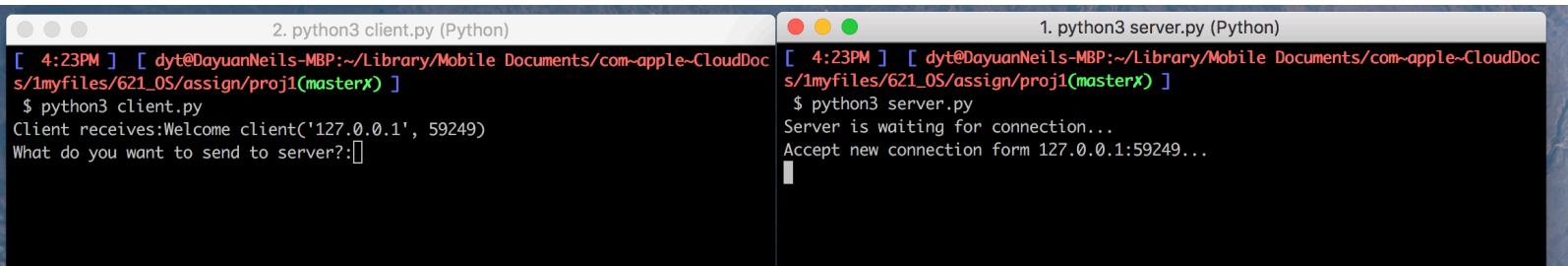
Step 1: Run server. We can see in the screenshot, server is listening:



```
1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 server.py
Server is waiting for connection...
```

Step 2: Run No. 1 client. Now we can see **server (at right)** accepted the connection from **client No. 1 (59249)** and reply it with "Welcome client('127.0.0.1', 59249)".

Client No. 1 (at left) is waiting for us to input something, which will be sent to server:



The image shows two terminal windows side-by-side. The left window is titled '2. python3 client.py (Python)' and shows the command prompt where 'python3 client.py' has been executed. It displays 'Client receives:Welcome client('127.0.0.1', 59249)' and then prompts 'What do you want to send to server?:'. The right window is titled '1. python3 server.py (Python)' and shows 'python3 server.py' executed. It displays 'Server is waiting for connection...' followed by 'Accept new connection from 127.0.0.1:59249...'.

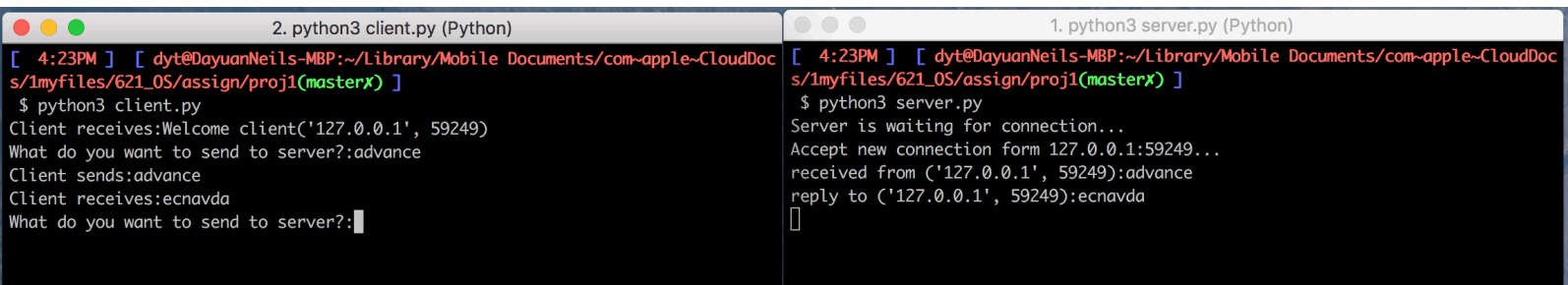
```
2. python3 client.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterx) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59249)
What do you want to send to server?:

1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterx) ]
$ python3 server.py
Server is waiting for connection...
Accept new connection from 127.0.0.1:59249...
```

Step 3: Let's input "advance" in Client No. 1 (59249) (at left).

We can see **client No. 1 (at left)** receives the response from server quickly, and the reply is "ecnavda". And then client No. 1 is waiting for us to input a new message.

From **server** side we can see more detail (at right). It shows message "advance" from client No. 1 (59249) has been received and reply "ecnavda" has been sent to client.

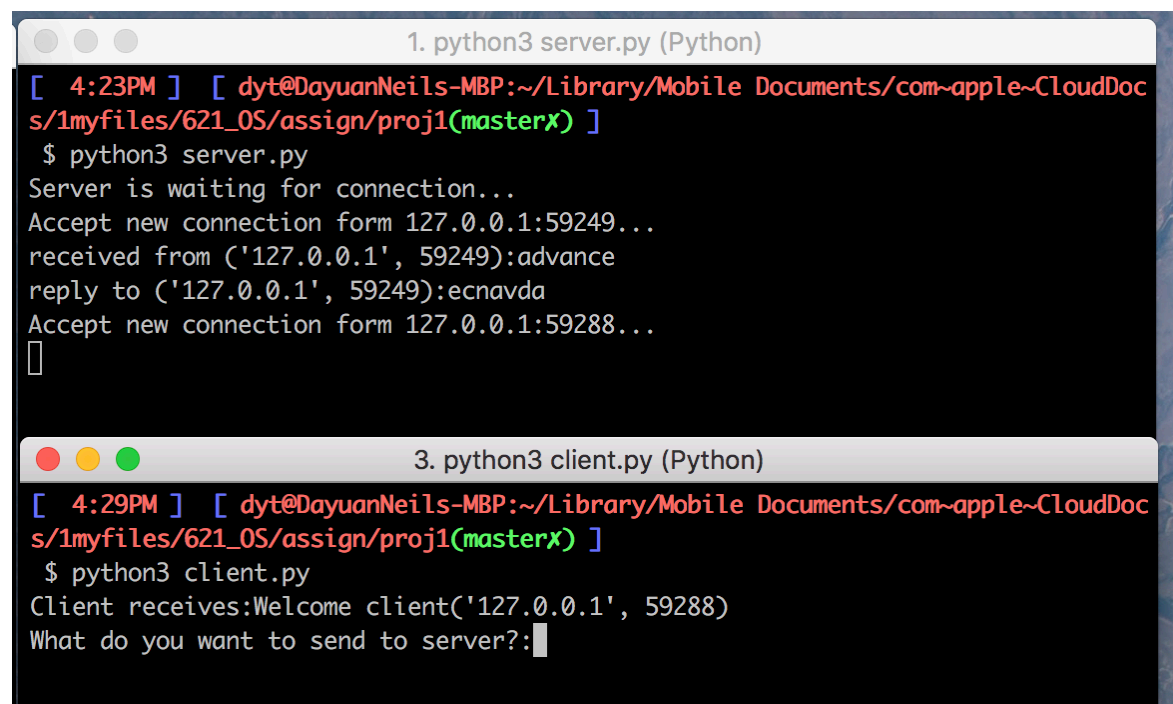


The image shows the same two terminal windows as before, but with more progress. In the left window, 'advance' has been entered at the prompt, and 'ecnavda' has been received. The right window now shows 'received from ('127.0.0.1', 59249):advance' and 'reply to ('127.0.0.1', 59249):ecnavda'.

```
2. python3 client.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterx) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59249)
What do you want to send to server?:advance
Client sends:advance
Client receives:ecnavda
What do you want to send to server?:

1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterx) ]
$ python3 server.py
Server is waiting for connection...
Accept new connection from 127.0.0.1:59249...
received from ('127.0.0.1', 59249):advance
reply to ('127.0.0.1', 59249):ecnavda
```

Step 4: Run a new client. Call it **client No. 2 (59288)** (at bottom). We can see **server (at top)** accepted the connection from it. And client No. 2 (59288) is now waiting us to input message.



The image shows two terminal windows. The top window is the same server terminal as before, but it now shows 'Accept new connection from 127.0.0.1:59288...' after the previous client's session. The bottom window is a new terminal titled '3. python3 client.py (Python)' showing 'python3 client.py' executed, displaying 'Client receives:Welcome client('127.0.0.1', 59288)' and the prompt 'What do you want to send to server?:'.

```
1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterx) ]
$ python3 server.py
Server is waiting for connection...
Accept new connection from 127.0.0.1:59249...
received from ('127.0.0.1', 59249):advance
reply to ('127.0.0.1', 59249):ecnavda
Accept new connection from 127.0.0.1:59288...

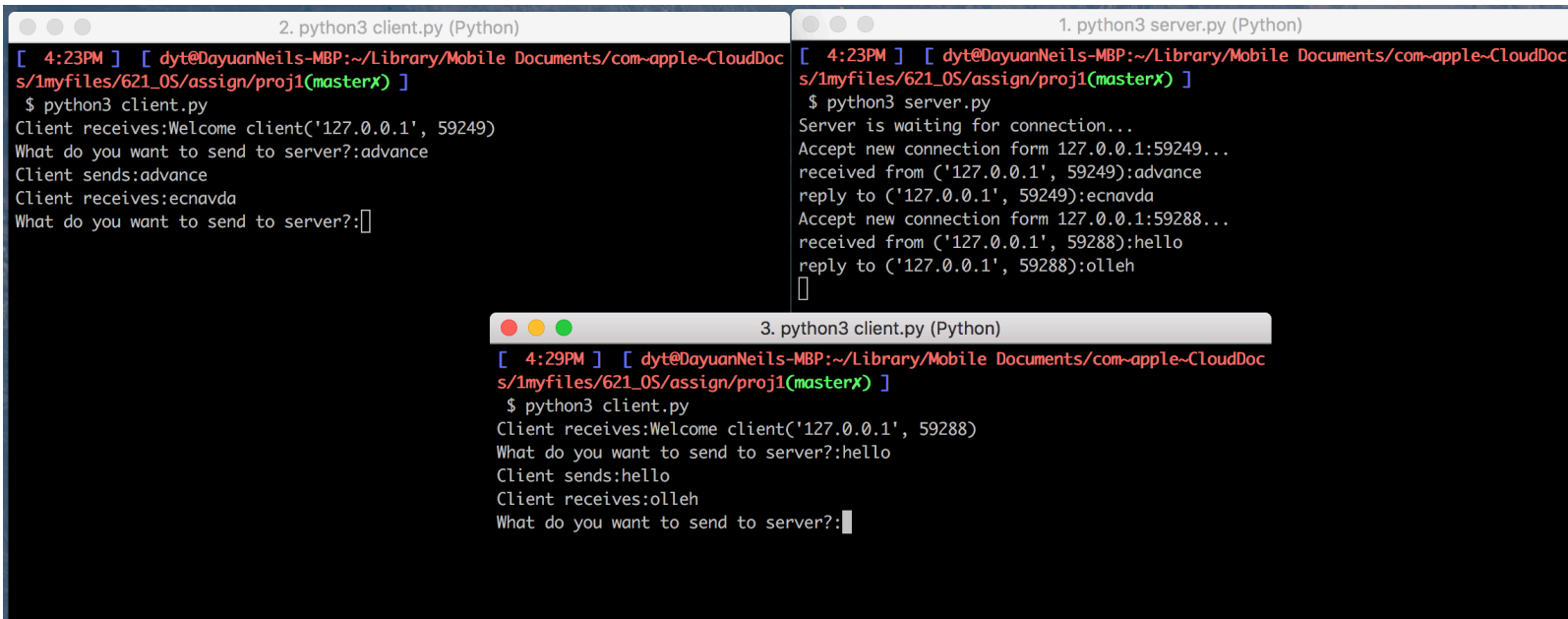
3. python3 client.py (Python)
[ 4:29PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterx) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59288)
What do you want to send to server?:
```

Step 5: Input “hello” in **Client No. 2 (59288) (at bottom)**.

At **server** we can see server received the message from client No.2 59288 “hello” and reply to it with “olleh”. (at top right)

At **client No. 2 (59288)** we can see it sent “hello” and receive “olleh”. And then it is waiting for us again.

Pay attention **Client No. 1(59249) (at top left)** is still waiting for us. At this moment, two clients are both connected to server and each has a thread for them.

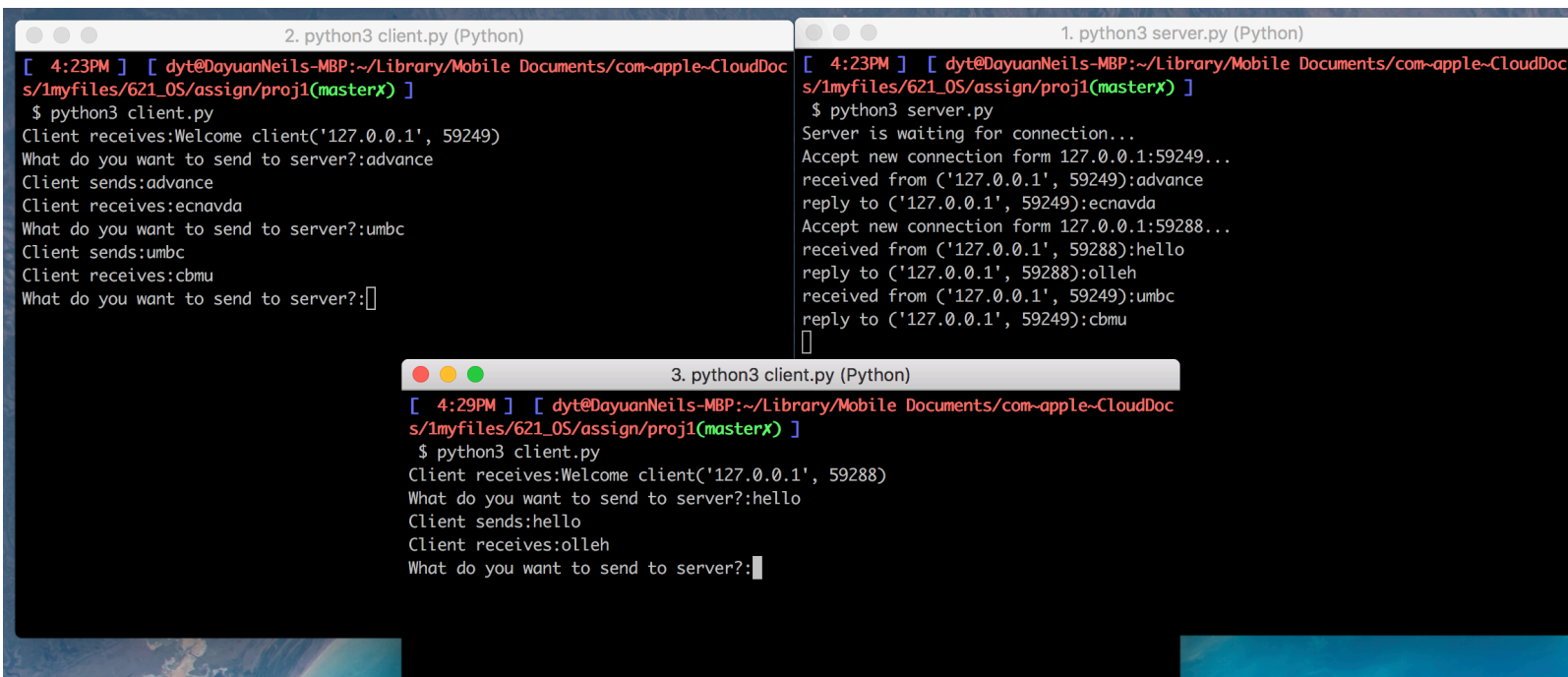


```
2. python3 client.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com-apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59249)
What do you want to send to server?:advance
Client sends:advance
Client receives:ecnavda
What do you want to send to server?:

1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com-apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 server.py
Server is waiting for connection...
Accept new connection form 127.0.0.1:59249...
received from ('127.0.0.1', 59249):advance
reply to ('127.0.0.1', 59249):ecnavda
Accept new connection form 127.0.0.1:59288...
received from ('127.0.0.1', 59288):hello
reply to ('127.0.0.1', 59288):olleh

3. python3 client.py (Python)
[ 4:29PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com-apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59288)
What do you want to send to server?:hello
Client sends:hello
Client receives:olleh
What do you want to send to server?:
```

Step 6: Let’s input “umbc” in **client No. 1 (59249) (at top left)**. We can see log changes in Client No. 1 (59249) and **Server (at top right)**, meaning communication is successful, while **Client No. 2 (59288) (at bottom)** is still waiting for us to input.



```
2. python3 client.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com-apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59249)
What do you want to send to server?:advance
Client sends:advance
Client receives:ecnavda
What do you want to send to server?:umbc
Client sends:umbc
Client receives:cbmu
What do you want to send to server?:

1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com-apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 server.py
Server is waiting for connection...
Accept new connection form 127.0.0.1:59249...
received from ('127.0.0.1', 59249):advance
reply to ('127.0.0.1', 59249):ecnavda
Accept new connection form 127.0.0.1:59288...
received from ('127.0.0.1', 59288):hello
reply to ('127.0.0.1', 59288):olleh
received from ('127.0.0.1', 59249):umbc
reply to ('127.0.0.1', 59249):cbmu

3. python3 client.py (Python)
[ 4:29PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com-apple~CloudDocs/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59288)
What do you want to send to server?:hello
Client sends:hello
Client receives:olleh
What do you want to send to server?:
```

Step 7: Input “stop” in clients to stop clients. Server says connection is closed.

```
2. dyt@DayuanNeils-MBP: ~/Library/Mobile Documents/com~apple~CloudDocs/1...
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59249)
What do you want to send to server?:advance
Client sends:advance
Client receives:ecnavda
What do you want to send to server?:umbc
Client sends:umbc
Client receives:cbmu
What do you want to send to server?:stop
[ 4:40PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterX) ]
$ █

1. python3 server.py (Python)
[ 4:23PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 server.py
Server is waiting for connection...
Accept new connection form 127.0.0.1:59249...
received from ('127.0.0.1', 59249):advance
reply to ('127.0.0.1', 59249):ecnavda
Accept new connection form 127.0.0.1:59288...
received from ('127.0.0.1', 59288):hello
reply to ('127.0.0.1', 59288):olleh
received from ('127.0.0.1', 59249):umbc
reply to ('127.0.0.1', 59249):cbmu
Connection form 127.0.0.1:59249 closed.
Connection form 127.0.0.1:59288 closed.
█

3. dyt@DayuanNeils-MBP: ~/Library/Mobile Documents/com~apple~CloudDocs/1...
[ 4:29PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterX) ]
$ python3 client.py
Client receives:Welcome client('127.0.0.1', 59288)
What do you want to send to server?:hello
Client sends:hello
Client receives:olleh
What do you want to send to server?:stop
[ 4:40PM ] [ dyt@DayuanNeils-MBP:~/Library/Mobile Documents/com~apple~CloudDoc
s/1myfiles/621_OS/assign/proj1(masterX) ]
$ █
```