

Code Documentation:

First the code creates a `main_socket` that listens for incoming connections on the port number that has been designated to it.

Then all the file descriptors that are currently active are added to `readfds` using `FD_SET()`. After that the maximum value of the file descriptors is obtained for using the `select()` call. After the `select` call returns we check which file descriptor is now set using `FD_ISSET()`.

If it is the `main_socket`, it denotes an incoming connection request.

So we accept the connection using `accept()` and read the message sent using `read()`

We extract the details of the sender from the static user table list and add the details to the active connections list (`conn_list`) and the file descriptor list (`fd_list`). Finally we display the incoming message.

If it is the `fd = 0` (`STDIN`) we first read from the console using `read()`. From the message read, we extract the name of the receiver (string before `'/'`) and find his details from the static user table. Then we check if a connection to the user already exists among the list of active connections in `conn_info`.

- If it exists we directly write the message into the socket corresponding to the recipient
- If it does not exist, we create a new socket and send a new connection request to the recipient using `connect()`. Once the request is accepted, the message is sent to the recipient using `write()`

If it is none of the above two, it indicates an incoming message from an already existing connection. So we find exactly which client has sent the message using the `FD_ISSET()` call over all active file descriptors. Then we read the message from the corresponding condition using `read()`.

- If `read` returns something `<0`, it implies that the client has closed the connection. So we free the corresponding entries in the `conn_list` and `fd_list` and close the connection from our end also.
- If it returns `> 0`, it means that it has received a message from a client. We extract the name of the client and the element in `conn_list` corresponding to the sender and update its last active time.

Everytime we also check for timeouts. So we iterate over the list of active connections and find if for any transaction the value of `current_time - last_time > TIMEOUT` interval. If found we close that particular connection and free its entries in `fd_list` and `conn_list`.

How to run:

It has enclosed 5 c++ codes corresponding to each client.

Run `make` command to compile all the codes and generate the executables. Run the executables using `./p2p(executable_number)`.

`./p2p1` is the first client (Sag)

`./p2p2` is the second client (Roy)

`./p2p3` is the third client (Avi)

`./p2p4` is the fourth client (Sas)

`./p2p5` is the fifth client (Soh)

Sample Input and Output:

In this sample input/output, we run using 4 clients, namely "Sag", "Roy", "Avi" and "Sas". Sag initiates by sending a Hello type message to all. The other three send messages to each other, but not Sag, letting this connection run to timeout. This also checks if the timeout feature is working correctly, along with the core functionality of enabling communication. The terminal results are copied as under:

```
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$ ./p2p1
Waiting for incoming connections
Roy/Hello
Avi/Hi
Sas/Hey bro
Closing connection due to timeout with: Roy
Closing connection due to timeout with: Avi
Closing connection due to timeout with: Sas
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$
```

```
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$ ./p2p2
Waiting for incoming connections
Sag:Hello
Avi/Hiya
Sas/How you doin bro?
Sas:Just fine
Sas:Any plans today?
Avi/Free?
Sas/Nope
Closing connection due to timeout with: Sag
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$
```

```
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$ ./p2p3
Waiting for incoming connections
Sag:Hi
Roy:Hiya
Sas/Hey man
Sas:Heyy
Sas/Free today?
Roy:Free?
Closing connection due to timeout with: Sag
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$
```

```
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$ ./p2p4
Waiting for incoming connections
Sag:Hey bro
Roy:How you doin bro?
```

```

Avi:Hey man
Roy/Just fine
Avi/Heyy
Avi:Free today?
Roy/Any plans today?
Roy:Nope
Closing connection due to timeout with: Sag
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks
Lab/Assn8_NetworksLab$

```

Screenshot of the terminal corresponding to above sample i/o:

The screenshot displays four terminal windows arranged in a 2x2 grid, each showing a different user's interaction with a network lab. The windows are titled 'sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn 8_NetworksLab\$'. The interactions are as follows:

- Top Left (User Sag):**

```

sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$ ./p2p1
Waiting for incoming connections
Roy/Hello
Avi/Hi
Sas/Hey bro
Closing connection due to timeout with: Roy
Closing connection due to timeout with: Avi
Closing connection due to timeout with: Sas
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$

```
- Top Right (User Roy):**

```

sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$ ./p2p2
Waiting for incoming connections
Sag:Hello
Avi/Hiya
Sas/How you doin bro?
Sas:Just fine
Sas:Any plans today?
Avi/Free?
Sas/Nope
Closing connection due to timeout with: Sag
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$

```
- Bottom Left (User Avi):**

```

sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$ ./p2p3
Waiting for incoming connections
Sag:Hi
Roy:Hiya
Sas/Hey man
Sas:Heyy
Sas/Free today?
Roy:Free?
Closing connection due to timeout with: Sag
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$

```
- Bottom Right (User Sas):**

```

sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$ ./p2p4
Waiting for incoming connections
Sag:Hey bro
Roy:How you doin bro?
Avi:Hey man
Roy/Just fine
Avi/Heyy
Avi:Free today?
Roy/Any plans today?
Roy:Nope
Closing connection due to timeout with: Sag
^C
sagnikroy@SROY-Primary:/mnt/c/Users/Sagnik Roy/Desktop/Networks Lab/Assn
8_NetworksLab$

```

In this picture:

- Top Left: User Sag**
- Top Right: User Roy**
- Bottom Left: User Avi**
- Bottom Right: User Sas**

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