**COMP3331 Report Jackie Wang z5166105**

DESIGN CHOICES

**How It Works**The program works first by having the client log into the server. Once the client has successfully logged in, the client program spawns a new thread which reads in input from the command line. Once the client has entered in a supported command (listed in the requirements), the client program sends a package containing the command and the necessary information to the server. The server then processes the command and sends a package back to the user which prints out the package contents to the command line or requests the user to complete additional actions.

Peer to peer connections work in the client program through a ServerSocket listening to any incoming connections. A client initiates a peer to peer connection after the Server returns the respective port number and IP Address of the peer the client wants to connect to. Once the client establishes a socket connection, a new thread is created to listen to any commands on the private socket.

**Code Reusability & Minimising Computation**One of the major design principles I tried to follow during my code was to have reusable packet headers and functions. For example, instead of having separate headers for displaying messages to users e.g. broadcast, private and message I used a standard packet header (“msg/user”) to capture that functionality. In addition to this, I tried to minimise the use of computer resources by only creating threads when needed, rather than having them open all the time. For example, I only created a thread to listen to user input once they have successfully logged in. Furthermore, for clients, rather than having a thread that continuously loops for incoming peer to peer connections, the client program only accepts incoming connections once it receives confirmation from the server.

IMPROVEMENTS/TRADEOFFS

**ServerSocket Address**Currently when I’m storing each clients’ ServerSocket IP address, I am returning the localhost / loopback address 127.0.0.1 using the code in the line below:   
I believe that this method could be improved by using the proper way to get the ServerSocket address through the getLocalInetAddress() function.

However, I could not do so in this case because I have instantiated ServerSockets using only the port number as a parameter, whereby this method returns 0.0.0.0 as the sockets IP. As this IP listens to all IPv4 addresses on your computer, you cannot establish a specific socket connection using 0.0.0.0 as the address parameter.

The way I could improve this design is by giving an IP address as an additional parameter when I start my client program and use this address to instantiate the Client’s ServerSocket.

**Logging out on Client Side**As in the requirements, the client terminal must be terminated when the client failed to login 3 times, logged out or timed out. I was unsure of how to do this but after reading this article (<https://www.baeldung.com/java-thread-stop>), I decided to stop my threads through interruptions and exceptions rather than deliberately setting a flag in my program. I have two different types of threads within my program, a thread for listening to client commands and threads to listen to each peer to peer connection.

For my client command thread, I stop the thread through an interruption. However, because the *‘for’* loop is checking for when an interruption is received by the thread, it does not immediately close and requires the user to press the enterkey (write to STDIN) an additional time before the program is terminated.

For the threads that listen to peer connections, I close the thread by closing the socket connection. As this raises an EOFException, I catch this exception and then ask the thread to return. I believe that I could of improved this by using a thread interrupt again as currently I would not know whether the connection was deliberately closed or closed through an error.

Nested IF ELSE Statements & Blocking STDOUT   
I currently make use of multiple nested IF ELSE statements as I wanted to reduce computation and reduce duplicated code. However, it has made the code less legible. In addition to this, another possible improvement I could’ve made was locking the client program from printing to STDOUT as a user is typing in a command to STDIN.

APPLICATION LAYER PROTOCOL

For the application layer protocol, I tried to replicate HTTP and created an object that I could easily transfer between my clients to server and peer to peer. I named this object *‘TCPackage’.* It implements the ‘*Serializable’* interface and as such it can be transferred between clients or server through an ‘*ObjectOutputStream’.* The *‘TCPackage’* class contains 5 different fields including:

**Content** – the message that is sent between clients or between the client and server e.g. messages between clients or error messages sent by the server. This field is ALWAYS printed out to the terminal by the client program.

**User** – stores the username of the person you want to message/interact with. Only prior to login, this field is used to store your own username

**IPAddress & Port** – Used to store the InetAddress and port number for private messaging / P2P connection.

**Header –** Below is the table of headers that the respective client or server would expect to receive and parse.

## **CLIENT**

|  |  |  |
| --- | --- | --- |
| **Header** | **Description** | **Action** |
| Login/pass | User has successfully logged in | Spawns a thread that reads STDIN and sends data to the server |
| Login/fail/retry | Correct username but wrong password was entered | User is prompted to re-enter their password |
| Login/fail/user | Username does not exist in “credentials.txt” | User is prompted to re-enter their username and password |
| Logout/user | User has either logged out, timed out or been blocked by the server for failed password entries | All threads and socket connections to the user is closed. Program is terminated |
| Msg/user | Default heading for all standard messages between client & server | Do nothing (as package content is already printed out) |
| Private/connect | User accepts any incoming socket connections for peer to peer messaging | ServerSocket accepts connection. Spawns a new thread that listens for messages on that connection |
| Private/start | User starts connection with peer | Server returns packet with IP and port number of peer. Client creates a new socket with those parameters |
| Private/close | ‘X’ Peer you have privately connected to has closed their side of the connection | Removes ‘X’ peer from respective listings stored in HashMaps. |

## SERVER

|  |  |  |
| --- | --- | --- |
| **Header** | **Description** | **Action** |
| User/authenticate | User wants to login | Checks username and password to ensure user exists and password is correct |
| User/broadcast | User wants to broadcast a message | Goes through list of all logged in users and sends them the user’s message |
| User/msg | User wants to send a message to another user | Finds output stream of other user and sends them the message if not blocked |
| User/whoelse | User wants to see who else is logged on | Sends list of all logged in users (excluding current user) back to the user |
| User/whoselsesince | User wants to see who else is logged on within the last ‘X’ seconds | Sends list of all logged in users within last ‘X’ seconds (excluding current user) back to user |
| User/block | User wants to block ‘X’ user | Adds user to ‘X’ users list of users that have blocked him/her |
| User/unblock | User wants to unblock ‘X’ user | Removes user from ‘X’ users list of users that have blocked him/her |
| User/logout | User wants to logout | Removes user from list of users logged in and updates other respective lists. Sends request to user to close connection |
| User/startprivate | User wants to start a private connection with ‘X’ user | Finds port number and IP address of ‘X’ user’s ServerSocket. Sends these parameters back to the User. Then sends a packet to ‘X’ user to accept the incoming connection |