Assignment 6: Build a Chatroom

CS 5010 Fall 2021
Northeastern University—Seattle

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This assignment is due Sunday, December 12th at 11:59pm. Submissions should be made using your group repo.

In this assignment, you will build a simple chat room. It will consist of a client and a server. The server will be responsible for managing the client connections (up to 10 clients can be connected and in a chat room at one time), accepting messages from one client and sending the messages to all attached clients. Clients will be able to either send a message that is public in the chat room, or that goes directly to a single, specified client.

To add some interest to the chatroom, participants can also send a randomly generated insult to another client in the chatroom. You'll add this feature by either:

- Creating a simple component that returns a random insult/sentence. There should be at least 5 different randomly chosen statements.
- Incorporating your random sentence generator from Assignment 4.

Objectives

- Build competence with socket programming
- Apply your multi-threading skills
- [Optional] Re-use code you've built before as a library
- Programming to an interface (that is, the protocol)

Details

Server

The server is responsible for allowing clients to connect, get a list of all other clients connected, and disconnect. It also handles sending messages to all clients or just one.

When the server starts up, it should start listening on an available port. Once it is up and listening, it should print a reasonable message on the console that includes what port it is listening on (so clients can connect).

The server will need to continually listen for more connections (handling them appropriately), as well as handle each connected client. The server should handle up to 10 clients connected at a single time. The server will be responsible for listening for commands from the client as well as sending messages to the client.

Client

The client will open a socket to communicate with the server. It will maintain the socket to listen for incoming messages from the server (public or private messages), as well as listen to the UI (terminal) for messages from the user to send to the server.

When starting the client, you will need to pass in the IP address (or `localhost`) and port for the server. Not providing these details should result in a graceful failure.

Client interface

In addition to your client allowing a user to send messages and all chat room messages to be displayed, it will require additional commands.

Your client must list all commands when the user types a **?** (a question mark alone on a line—you can ignore question marks as part of a message).

Other commands your client must provide for:

- **logoff**: sends a DISCONNECT_MESSAGE to the server
- **who**: sends a QUERY_CONNECTED_USERS to the server
- **@user**: sends a DIRECT_MESSAGE to the specified user to the server
- **@all**: sends a BROADCAST_MESSAGE to the server, to be sent to all users connected
- **!user**: sends a SEND_INSULT message to the server, to be sent to the specified user

While the above commands must be implemented, you do not need to call them these words specifically (you may choose to use different words, and possibly include shortcut commands), but this functionality needs to exist. You *ARE*, however, required to implement the '?' to print the command menu. You may have an additional menu command if you would like.

Chatroom Protocol

The application data for the chatroom consists of a sequence of data. The format depends on what kind of message is being sent. All frames of application data begin with a message identifier. Strings are sent as a byte array; before a string is sent, an `int` indicating the length of the array/string is sent. Each field of a frame will be separated by a single space character.

Example:
The following frame sends a message that a new client is connecting to the server with the username of "aha":

19		3		aha

Or as a string: "19 3 aha".

All of the supported messages/frames are described below.

Connect message:

`int` Message Identifier: CONNECT_MESSAGE
`int` size of username: integer denoting size of the username being sent
`byte`[]: username

Connect response:

`int` Message Identifier: CONNECT_RESPONSE
`boolean` success: true if connection was successful
`int` msgSize: size of message sent in response
`byte[]` message: String in byte[]. If the connect was successful, should respond with a message such as "There are X other connected clients". If the connect failed, a message explaining.

Disconnect message:

`int` Message Identifier: DISCONNECT_MESSAGE
`int` size of username: integer denoting size of the username being sent
`byte`[]: username

Disconnect response:

`int` Message Identifier: CONNECT_RESPONSE
`int` msgSize: size of message sent in response
`byte`[] message: String in byte[]. If the disconnect was successful, the message should be "You are no longer connected.". If the disconnect failed, a message explaining.

Query users:

`int` Message Identifier: QUERY_CONNECTED_USERS
`int` size of username: integer noting the size of the username
`byte`[] username: username (who's requesting)

Query response:

`int` Message Identifier: QUERY_USER_RESPONSE
`int` numberOfUsers: if the request fails this will be 0. If there are no other users connected, this will be 0.
`int` usernameSize1: length of the first username
byte[] username: username1
…
`int` usernameSize2: length of the last username
`byte`[] username: usernameX

When responding to a query, the server must make sure the request is coming from an already connected user. A list of all the OTHER connected users will be sent.

Note: The server will need to send a block of data for *every* connected user.

Broadcast Message:

`int` Message Identifier: BROADCAST_MESSAGE
`int` sender username size: length of sender's username

`byte`[]: sender username
`int` message size: length of message
`byte`[]: Message

Server will broadcast this message to all connected users, specifying that it came from sender. If the sender username is invalid, the server will respond with a FAILED_MESSAGE.

Direct Message:

`int` Message Identifier: DIRECT_MESSAGE
`int` sender username size: length of sender's username
`byte`[]: sender username
`int` recipient username size: length of recipient's username
`byte`[]: recipient username
`int` message size: length of message
`byte`[]: Message

Sending a direct message will fail if the sender or recipient ID is invalid.

Failed Message:

`int` Message Identifier: FAILED_MESSAGE
`int` message size: length of message
`byte`[]: Message describing the failure.

Send Insult:

`int` Message Identifier: SEND_INSULT
`int` sender username size: length of sender's username
`byte[]`: sender username
`int` recipient username size: length of recipient's username
`byte[]`: recipient username

The server will randomly generate an insult (either from a simple insult generator you create for this assignment or optionally from using your Assignment 4's Random Sentence Generator) and broadcast it to the chat room. Something like the following should be posted:

```
aha -> sparky: You mutilated goat.
```

When the client receives either a BROADCAST_MESSAGE or a DIRECT_MESSAGE, it should print the message out to the console. When printing out a message, please indicate which username sent the message in some way.

Message Identifiers

Message Type	Value
CONNECT_MESSAGE	19

CONNECT_RESPONSE	20
DISCONNECT_MESSAGE	21
QUERY_CONNECTED_USERS	22
QUERY_USER_RESPONSE	23
BROADCAST_MESSAGE	24
DIRECT_MESSAGE	25
FAILED_MESSAGE	26
SEND_INSULT	27

Tips

- If you decide to use your A4 insult generator, do not simply copy and paste your code from A4 into A6. Package it up into a jar and include it as a library. There is a lot of online documentation on how to generate and consume jar files. See below for one way to do it via IntelliJ
- Be sure to program to the protocol and ask questions if you have any.
- When you program to the protocol, your server can communicate with someone else's client, and vice versa.
- If you would like to enhance the protocol by ADDING message types, you may. If you do so:
    - Be sure to document the new message types and include the documentation (as an .md or .pdf file) in your project repo
    - Ensure that your client and server work with the base protocol, and is NOT DEPENDENT on the enhanced protocol to work properly
- This is an example of a program that will use multiple threads, but not for the purpose of attempting to improve throughput.
    - It is not possible to implement this project properly without multiple threads.
- It would be lovely to send compliments rather than insults. If you would like to implement a compliment grammar rather than the insult grammar, you are welcome to replace the insults with compliments. Feel free to share it with the class if you like.

Logistics

Grading

The correctness grade for this assignment will be based on:

- Following and implementing the protocol correctly (your code should be able to work with a client/server of our own)
- Properly handling multiple clients on the server side
- Properly handling the UI, sending messages to the server, and receiving messages from the server on the client side.
- [Optional] Utilizing A4 as a library.

- If A4 is not used, then a simple component must still exist to return/generate an insult/compliment. There should be at least 5 possible statements (more is fine).

Gradle and Github

The Gradle requirements are the same as for the previous assignments.

As with your previous team assignments, the team should create an **assignment6** feature branch and each individual group member should create their own branch off of that feature branch while working on this assignment. You may submit pull requests and merge to the feature branch as often as you like but you should not tag your TA until you are ready to create a PR into the main branch and submit.

Deliverables

- All of your source and test code, no class files or other binaries
- [Optional] Your a4.jar (this is separate from the "no other binaries" bullet point above) if you decide to use your A4 insult generator.
    - You may include a grammar file
        - This could be included in the a4.jar—you decide if that's appropriate or not.
- A README.md file, where you describe how to run your program
    - Include the entry point to your program.
        - Include how to run your server and client
    - Give a high-level description of key classes/methods.
    - Include any assumptions you made about the nature of the problem.
    - Include steps you took to ensure correctness.
    - Make sure it's clear how to run your program from the command line or from the IntelliJ UI.
    - If you'd like, you can include an example of the client or server side output
        - See https://guides.github.com/features/mastering-markdown/ for info on formatting code/terminal snippets properly
- A class diagram representing your code (UML as pdf/image) showing associations and relationships between your objects.

Consuming a jar file (Optional for homework)

If you decide to consume a jar file, it must be committed to your repo and work. You may want to have a second clone of your repo to make sure everything builds and works as expected.

Finding and generating your jar file

If you'd like to import your grammar from A4, you can use the already created .jar file from IntelliJ, or craft your own jar file (see online resources if you want to do that).

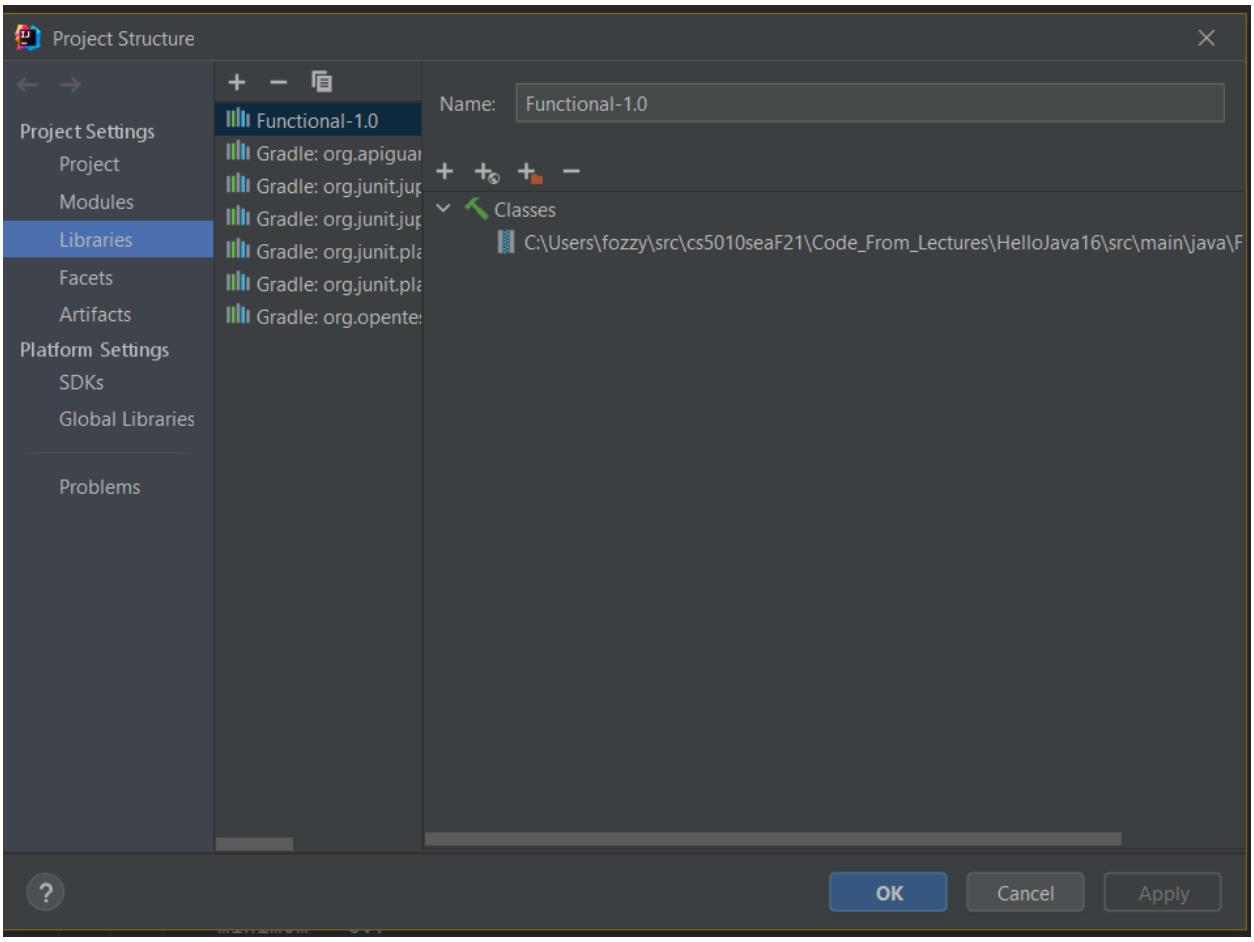
The way that our projects are set up, you should see a .jar file in any of your projects under the <root>\build\libs path.

The HelloJava16 project creates a file named: Java16-1.0-SNAPSHOT.jar
If you'd like to rename the jar file generated by your project, you can change the primary name (Java16 in the above example) by changing the name in the settings.gradle file of the project (A4 in this case). If you want to remove the SNAPSHOT and/or update the version, you can change that in the build.gradle file by changing the value of **version**.

Using the jar file in your A6 project

Once you have a jar file, copy it into your project you'd like to consume the jar.

1. Open the Project Structure settings for the project.
2. Click "Libraries":



3. Click the plus in the middle column to add a library. Choose "java"
4. Navigate the open file dialog to the jar file. Click ok.

At that point you should have added it and can start using it. Remember you'll need to start via the package name that was used.