

East London Science School

A-Level Computer Science Project

JarChat

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1: Analysis

1.1: Aims of JarChat

JarChat will aim to be a cross-platform IRC client which will support Windows, MacOS, Linux, and maybe more operating Systems not already listed. This will have the benefit of native cross-platform support as it is built-in to Java. Java's JDK version 8 (Java version 1.8) will be used to compile all binaries as most computers still run JDK version 8, even though Oracle has moved their LTS (Long Term Support) version to JDK 11.

1.2: Target Audience

I expect everyone who uses a computer to be able to take advantage of JarChat. While most services have moved their IM services to other platforms (Microsoft Teams, Skype, Discord, TeamSpeak, etc.), various FOSS (Free and Open-Sourced Software) still use IRC as their support protocol, taking advantage of IRC's decentralized nature.

JarChat can also expect to be popular with developers in any programming language, as there are still some programming help channels/servers hosted using IRC. The same will be true for new/existing users of most Linux distributions. Most of the time, if somebody has a question regarding Linux which can't be answered by Google, they can ask in the appropriate channel on [Libera.chat](https://libera.chat).

1.3: Research

1.3.1: Existing IRC Clients

1.3.1.1: Windows

Existing Windows clients include mIRC and XChat.

1.3.1.1.1: mIRC

mIRC is a paid and proprietary software which costs £17.94 (though it offers a 30-day free trial). It provides a slightly dated User Interface and was compiled in 32-bit form. This makes it compatible with 32- and 64-bit versions of Windows from Windows XP up to Windows 11. The UI makes use of a template too store different tabs as windows on a canvas. These windows cannot be moved or used in other parts of Windows. The settings menu leaves much to be desired and leaves few customization options. There is no option for IRC's VOIP feature included with the software.

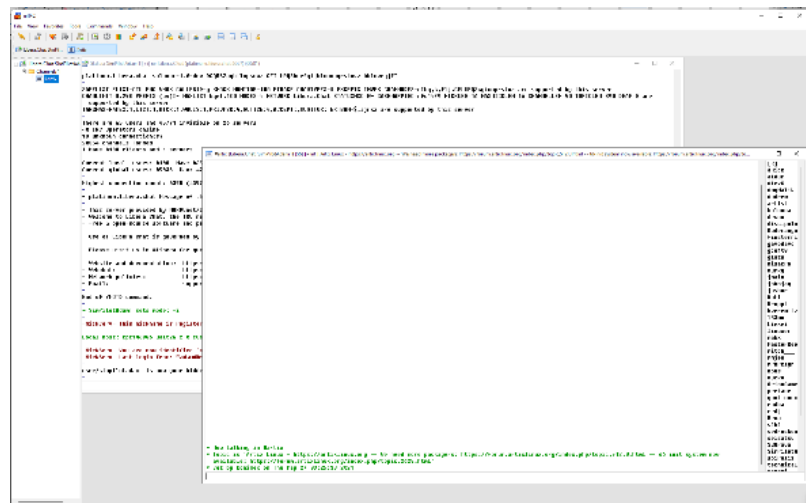


Figure 1: Default look of mIRC, running on Windows 11 build 22449.1000 (Dev Insider Preview).

I intend to take inspiration from mIRC's raw functionality as it just plain works (albeit only on Windows). I do plan, however, to expand this functionality to take advantage of all of the features that are included on IRC's feature set.

1.3.1.1.2: XChat

XChat is another IRC client. Written in C, the Linux version is free and open-sourced under the GNU GPLv2 license. The client is precompiled for Windows and Fedora GNU/Linux, with forks available for Arch Linux (in the AUR), and with a precompiled *.deb file in the official Debian and Ubuntu repositories. The Windows version of the software is closed-sourced and proprietary, costing users US\$19.99 (equivalent to £14.42 in September of 2021), though it offers a 30-day free trial. The Windows version officially supports all Windows versions from Windows 2000 up to Windows 10 (all in 32-bit).

I tried to use XChat to connect to my favorite IRC server, but the Windows version failed to do so on Windows Vista, 7, 8, 8.1, 10, and 11. This lack of ease of use is an issue that I would like to resolve with JarChat.

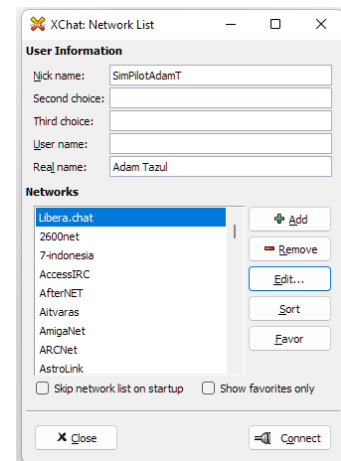


Figure 2: The first screen of the Windows version of XChat, running on Windows 11 build 22449.1000 (Dev Insider Preview).

1.3.1.2: Linux

Existing Linux IRC clients include Konversation, WeeChat, and HexChat.

1.3.1.2.1: Konversation

Konversation is a Linux IRC client which is tightly integrated with the KDE Plasma Desktop Environment. It is fully free & open-sourced under the GNU GPLv2 license. As a part of the KDE Applications suite. Konversation is precompiled for all major distributions of Linux & GNU/Linux, with source code hosted on the official KDE git repository (<https://invent.kde.org/network/konversation>).

I use Konversation myself frequently as my main desktop setup is Artix Linux with KDE Plasma, and its tight integration means accurate and appropriate theming in line with the global QT5 theme, no matter what theme is used. It also uses Kcolorchooser to allow for the user to create a custom colour for Konversation's theme, even if the user is not using a QT5-based theming engine.

Using Konversation, I found that it is a fully-featured client with support for every part of IRC, displayed in a user-friendly layout that is easy-to-use. I intent to take inspiration from this and remake these features in JarChat.

1.3.1.2.2: WeeChat

WeeChat is a Terminal User Interface IRC client for Linux which can be used on any Linux Distribution without the need for any Desktop Environment or Window Manager. It is also FOSS under the GNU GPL v3 license.

While strictly TUI and Keyboard Interaction only (unless the setting is changed), WeeChat still provides a fully-featured experience with support for every part and situation possible in IRC, with every customization as needed by anyone who would use it. Since WeeChat is TUI, it is aimed at people who are willing to learn how to use it, which can take some time. For this very reason, there are a lot of people who have installed it, tried to use it, and then immediately uninstalled it as they found it extremely difficult to get started in (even with the existing documentation provided by the developers). This is completely understandable as WeeChat was designed with minimalism at the forefront of the developers' minds.

1.3.1.2.3: HexChat

HexChat is a cross-platform IRC client which supports all Linux Distributions via a Flatpak, its source code, .deb file, the official Arch Linux repositories, and more. It is also FOSS under the GNU GPL v2 license and features full support for Windows 7, 8, 8.1, 10, and 11. While it has Windows support, I am testing it on my install of Artix Linux (my setup will allow for testing with tiling window managers, floating window managers, Xorg, Wayland, Pulseaudio, and Pipewire).

1.3.1.3: MacOS

Even though there are one or two IRC clients for MacOS, I do not have the means to test this. Creating virtual machines with MacOS installed on them have proved to create bugs at best, and hackintoshing (installing MacOS bare metal on computers not made by Apple) is also problematic, with stringent hardware requirements I do not meet. In any case, trying to do either will result in me breaking Apple's EULA, which is legally binding.

1.3.2: Features of JarChat

JarChat is intended to include:

- Basic functionality as an IRC Client
- Cross-compatibility between various different operating systems without compromising on features
- Vast configurability through an easy-to-use UI
- GNU GPLv3 Open-Sourced license to allow for the community to better help shape the future of JarChat

1.3.3: Limitations of JarChat

The main limitation of JarChat is the fact that it will be written in Java, which means that JarChat will require and expect the user to have a JVM compatible with Java version 1.8.0 already installed on their system. While Java is generally installed on millions of computer systems globally, it cannot be guaranteed that everyone will be able to use JarChat for lack of the ability to install the software.

1.4: Community input

I am already taking input from the community about the project. Since all source code and development will remain public under the GNU GPLv3 license, it is relatively easy to get community input at every stage in the development cycle. To start things off, I posted an anonymous survey in the *#libera* chat in the most popular IRC server, libera.chat.

The questions in this survey include:

1. Roughly how many hours per week do you spend actively logged onto an IRC server?
2. Which servers do you frequent?
3. Which channels do you frequent in those servers?
4. What do you mainly do when logged into IRC?
5. What do you look for in an IRC client?
6. Which IRC client do you use currently?

The most popular answers are as follows:

1. Between 30 and 40 hours
2. Freenode (before the change of ownership), Libera.chat
3. Various Linux Distribution/software development support channels
4. Ask for/provide support from/to other users of the channel
5. Usability, theming, FOSS

6. A mix of Konversation, HexChat, and WeeChat

1.5: Requirements

1.5.1: Software

- Windows:
 - Vista SP2/Server 2008 R2 SP1 (or newer)
 - At least Internet Explorer 9, or Firefox (a dependency of Java)
- Linux:
 - Any distribution which has Java JRE version 8 in its repositories
 - Firefox (a dependency of Java)
- MacOS
 - MacOS X 10.8.3 or newer (not compatible with Apple M1)
 - Any 64-bit web browser (a dependency of Java)
- Java version 1.8 (OpenJDK JRE version 8 in most Linux repositories)

1.5.2: Hardware

- Windows & Linux:
 - Pentium 2 266MHz CPU or better
 - 128MB RAM or better
 - 124MB free secondary storage or better
- MacOS
 - An Intel CPU
 - 124MB free secondary storage or better

1.6: Success Criteria

In order to be successful, JarChat will need to:

- Function as a fully working IRC client
- Be usable for everyone who would need to use it
- Be able to use SSL encryption for servers which use it
- Run on any OS that Java version 1.8.0 can be installed on

In order to check that each criterion is met, JarChat will need to

- Be tested in every aspect that is needed of any IRC client
- Be distributed to various users with various skill levels in computer usage
- Be tested on every OS JarChat is likely to be run on
- Be tested in connections with servers that use SSL encryption

2: Design

Most design will be happening after the core code of the program is written, as UI design takes time.

2.1: UI Design

2.1.1: Start-up Screen

On startup, I intend for JarChat to show the main window where server output will go, with a message in there if the user has not added any IRC servers. Alongside the main text area, there will be two other areas holding lists of connected servers/channels as well as active users in each channel.



Figure 3: First (rough) sketch of how the UI may look like.

3: Development & Testing: Part 1

3.1: Connection to IRC

The actual connection to IRC is going to be handled by some code I found on a [GitHub Gist](#) by [Kaecy](#), which seems to handle the connection decently and more stable than others I have found. I have made some edits to the code provided by Kaecy, ensuring it is well-commented, has static methods in line with my main class (called JarChat), has support for secure TLS connections, and has unnecessary parts removed. The code in the provided gist was originally created to be used in a bot, so did not need many of these features I deem required by JarChat.

The IRCMessageLoop class provided by Kaecy is an abstract superclass which JarChat needs to slightly extend on in order to be able to set up any kind of connection. To test the connection, I started to write the program in CLI form, in order to quickly set the server/user information and establish the connection. [Lines 38 and 39](#) of the source code (figure 10) as of the state of the code on 2022-05-02 at 23:17 currently create an instance of an object using the JarChat class, and then starts the connection. Using methods already declared in IRCMessageLoop, I was able to test and validate that the connection to the server was successful in this method.

```
1  /*
2   * JarChat IRC Client Source Code
3   * Free and Open-sourced under the GNU GPL v3 Licence
4   *
5   * Build using the latest JDK 8 to ensure compatibility with all
6   * modern devices. Will change JDK once more devices use JRE 11.
7   *
8   * Last Edited: 2022-05-05 16:47 by SimPilotAdamT
9   */
10
11 package com.AdamT;
12
13 // Imports
14 import java.net.InetAddress;
15 import java.net.UnknownHostException;
16 import java.util.Scanner;
17
18 // Main class
19 public class JarChat extends IRCMessageLoop {
20     JarChat(String server, int port) { super(server, port); }
21 }
```

Figure 4: The beginning of the main class file, showing the constructor of the JarChat class, as well as the necessary libraries being imported.

3.2: The code used in the “library”

The “library” used, as made by Kaecy, has several parts which have been edited by myself. For example, the extra code between [lines 27 and 35](#) of IRCMessageLoop.java (figure 5) includes a custom implementation of the javax.net.ssl.SSLSocket and javax.net.ssl.SSLSocketFactory classes, in order to allow for most servers’ main connection method. Lines 45 through 57 (Figure 6) were made compact to reduce the overall size of the source code file.

```
44  IRCMessageLoop(String serverName, int port) {
45      // Both outcomes of this if statement can throw exceptions, so need to be enclosed in a try-catch statement
46      try {
47          // These parts are exclusively used by encrypted TLS connections
48          if (port == 6697 || port == 6698 || port == 7777) {
49              // Initialize and extract the secure socket
50              SSLSocketFactory factory = (SSLSocketFactory)SSLSocketFactory.getDefault();
51              SSLSocket server = (SSLSocket)factory.createSocket(serverName, port);
52              server.startHandshake();
53              // Allow the program to read everything being received from the socket, as well as to send info back to the server
54              out = server.getOutputStream();
55              stream = server.getInputStream();
56          }
57          // Any other ports are going to be plaintext connections, so do not need SSL Sockets
58          socket = new Socket(serverName, port); // Initialize plaintext connection (this is automatically started)
59          // Allow the program to read everything being received from the socket, as well as to send info back to the server
60          out = socket.getOutputStream();
61          stream = socket.getInputStream();
62      } catch (Exception info) { info.printStackTrace(); } // Print information about the error to the terminal for debugging in case it's needed
63  }
```

Figure 5: The code which handles the actual Socket which connects to the IRC Server, with my own edits applied.


```

// Start the connection
try {
    client = new JarChatServer(Integer.parseInt(port));
    try {
        client.start();
    } catch (IOException e) {
        System.out.println("Error: " + e.getMessage());
        System.exit(1);
    }
} catch (Exception e) {
    System.out.println("Error: " + e.getMessage());
    System.exit(1);
}

// A loop if statement is used instead of a switch statement due to the String.startsWith() method being called, making a switch statement impossible
while (true) {
    // Get the next line of input
    String input = System.console().readLine();

    // If the input is empty, skip it
    if (input == null || input.isEmpty()) {
        continue;
    }

    // If the input starts with a slash, it's a command
    if (input.startsWith("/")) {
        // Remove the slash
        String command = input.substring(1);

        // If the command is "quit", exit the program
        if (command.equals("quit")) {
            System.out.println("JarChat Client Terminated");
            System.exit(0);
        }

        // If the command is "join", join the channel
        else if (command.equals("join")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Join the channel
            client.join(channelName);
        }

        // If the command is "msg", send a message
        else if (command.equals("msg")) {
            // Get the message
            String message = input.substring(1, input.indexOf(" "));

            // Send the message
            client.sendMessage(channelName, message);
        }

        // If the command is "me", send a message to the channel
        else if (command.equals("me")) {
            // Send the message
            client.sendMessage(channelName, input.substring(1));
        }

        // If the command is "nick", change the nickname
        else if (command.equals("nick")) {
            // Get the new nickname
            String newNick = input.substring(1, input.indexOf(" "));

            // Change the nickname
            client.setNick(newNick);
        }

        // If the command is "part", leave the channel
        else if (command.equals("part")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Leave the channel
            client.leave(channelName);
        }

        // If the command is "topic", get the channel topic
        else if (command.equals("topic")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the channel topic
            client.getChannelTopic(channelName);
        }

        // If the command is "users", get the list of users in the channel
        else if (command.equals("users")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the list of users
            client.getChannelUsers(channelName);
        }

        // If the command is "help", show the help message
        else if (command.equals("help")) {
            System.out.println("JarChat Client Help");
        }

        // If the command is "list", show the list of channels
        else if (command.equals("list")) {
            client.getChannelList();
        }

        // If the command is "whois", get the user info
        else if (command.equals("whois")) {
            // Get the username
            String username = input.substring(1, input.indexOf(" "));

            // Get the user info
            client.getUserInfo(username);
        }

        // If the command is "invite", invite a user to the channel
        else if (command.equals("invite")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to invite
            String username = input.substring(1, input.indexOf(" "));

            // Invite the user
            client.invite(channelName, username);
        }

        // If the command is "kick", kick a user from the channel
        else if (command.equals("kick")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to kick
            String username = input.substring(1, input.indexOf(" "));

            // Kick the user
            client.kick(channelName, username);
        }

        // If the command is "ban", ban a user from the channel
        else if (command.equals("ban")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to ban
            String username = input.substring(1, input.indexOf(" "));

            // Ban the user
            client.ban(channelName, username);
        }

        // If the command is "unban", unban a user from the channel
        else if (command.equals("unban")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to unban
            String username = input.substring(1, input.indexOf(" "));

            // Unban the user
            client.unban(channelName, username);
        }

        // If the command is "mode", change the channel mode
        else if (command.equals("mode")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the mode
            String mode = input.substring(1, input.indexOf(" "));

            // Change the mode
            client.setChannelMode(channelName, mode);
        }

        // If the command is "topic", get the channel topic
        else if (command.equals("topic")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the channel topic
            client.getChannelTopic(channelName);
        }

        // If the command is "users", get the list of users in the channel
        else if (command.equals("users")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the list of users
            client.getChannelUsers(channelName);
        }

        // If the command is "help", show the help message
        else if (command.equals("help")) {
            System.out.println("JarChat Client Help");
        }

        // If the command is "list", show the list of channels
        else if (command.equals("list")) {
            client.getChannelList();
        }

        // If the command is "whois", get the user info
        else if (command.equals("whois")) {
            // Get the username
            String username = input.substring(1, input.indexOf(" "));

            // Get the user info
            client.getUserInfo(username);
        }

        // If the command is "invite", invite a user to the channel
        else if (command.equals("invite")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to invite
            String username = input.substring(1, input.indexOf(" "));

            // Invite the user
            client.invite(channelName, username);
        }

        // If the command is "kick", kick a user from the channel
        else if (command.equals("kick")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to kick
            String username = input.substring(1, input.indexOf(" "));

            // Kick the user
            client.kick(channelName, username);
        }

        // If the command is "ban", ban a user from the channel
        else if (command.equals("ban")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to ban
            String username = input.substring(1, input.indexOf(" "));

            // Ban the user
            client.ban(channelName, username);
        }

        // If the command is "unban", unban a user from the channel
        else if (command.equals("unban")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to unban
            String username = input.substring(1, input.indexOf(" "));

            // Unban the user
            client.unban(channelName, username);
        }

        // If the command is "mode", change the channel mode
        else if (command.equals("mode")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the mode
            String mode = input.substring(1, input.indexOf(" "));

            // Change the mode
            client.setChannelMode(channelName, mode);
        }
    }
}

// Ensure everything closes gracefully
client.close();
System.exit(0);

```

Figure 6: The refactored code of the IRCMessageLoop Class.

process the input. The IRCMessageLoop class implements the Thread class and rewrites the [run\(\)](#) method (figure 7) in order to allow for it to read all outputs from the IRC server, and then calls the processMessage() method for each message.

```

// This class only parses messages it understands. If a message is not understood, the origin and command are extracted and parsing fails.
public void run() {
    try {
        MessageBuffer messageBuffer = new MessageBuffer();
        // Buffer
        byte[] buffer = new byte[4096];
        int count = 0;
        while (true) {
            // Read the next line of input
            count = stream.read(buffer, 0, buffer.length - count);
            // If the count is 0, the message is empty
            if (count == 0) {
                continue;
            }
            // If the count is greater than 0, the message is not empty
            while (messageBuffer.hasCompleteMessage()) {
                // Get the message
                String ircMessage = messageBuffer.getCompleteMessage();
                // System.out.println("ircMessage: " + ircMessage);
                processMessage(ircMessage);
            }
        }
    } catch (IOException e) {
        System.out.println("Error: " + e.getMessage());
        System.exit(1);
    }
}

```

Figure 7: The rewritten run() method.

The [Message](#) and [MessageBuffer](#) classes (figure 8) are used so that there is a buffer to store messages in and to ensure that each

```

// This class only parses messages it understands. If a message is not understood, the origin and command are extracted and parsing fails.
class Message {
    public String origin;
    public String command;
    public String target;
    public String content;
}

// This class only parses messages it understands. If a message is not understood, the origin and command are extracted and parsing fails.
class MessageBuffer {
    private byte[] buffer;
    private int count;
    private int spindex;
    public MessageBuffer() {
        buffer = new byte[4096];
        count = 0;
        spindex = 0;
    }
    public boolean hasCompleteMessage() {
        // If the count is 0, the message is empty
        if (count == 0) {
            return false;
        }
        // If the count is greater than 0, the message is not empty
        while (count > 0) {
            // Get the message
            String ircMessage = new String(buffer, spindex, count);
            // System.out.println("ircMessage: " + ircMessage);
            return true;
        }
    }
    public String getCompleteMessage() {
        // Get the message
        String ircMessage = new String(buffer, spindex, count);
        // System.out.println("ircMessage: " + ircMessage);
        return ircMessage;
    }
    public void setCompleteMessage(String ircMessage) {
        // Set the message
        count = ircMessage.length();
        spindex = 0;
    }
}

```

Figure 8: The Message and MessageBuffer classes.

The [MessageParser](#) class (figure 9, called by IRCMessageLoop.processMessage()) parses each message received from the server into a way better readable by IRCMessageLoop.processMessage(). It also slightly beautifies each message for when it gets put into STDOUT.

```

// This class only parses messages it understands. If a message is not understood, the origin and command are extracted and parsing fails.
class MessageParser {
    public Message parseMessage(String ircMessage) {
        Message message = new Message();
        // Get the origin
        int spindex = ircMessage.indexOf(" ");
        message.origin = ircMessage.substring(0, spindex);
        // Get the command
        int cpindex = ircMessage.indexOf(" ");
        message.command = ircMessage.substring(spindex + 1, cpindex);
        // Get the target
        int tpindex = ircMessage.indexOf(" ");
        message.target = ircMessage.substring(cpindex + 1, tpindex);
        // Get the content
        int cpindex = ircMessage.indexOf(" ");
        message.content = ircMessage.substring(tpindex + 1, cpindex);
        // Parse the message
        if (message.command.equals("ping")) {
            // Parse ping parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("pong")) {
            // Parse pong parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("quit")) {
            // Parse quit parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("join")) {
            // Parse join parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("msg")) {
            // Parse msg parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("me")) {
            // Parse me parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("nick")) {
            // Parse nick parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("part")) {
            // Parse part parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("topic")) {
            // Parse topic parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("users")) {
            // Parse users parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("help")) {
            // Parse help parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("list")) {
            // Parse list parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("whois")) {
            // Parse whois parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("invite")) {
            // Parse invite parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("kick")) {
            // Parse kick parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("ban")) {
            // Parse ban parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("unban")) {
            // Parse unban parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        } else if (message.command.equals("mode")) {
            // Parse mode parameters
            spindex = ircMessage.indexOf(" ");
            message.target = ircMessage.substring(0, spindex);
            message.content = ircMessage.substring(spindex + 1);
        }
    }
}

```

Figure 9: The MessageParser class.

```

// Start the connection
try {
    client = new JarChatServer(Integer.parseInt(port));
    try {
        client.start();
    } catch (IOException e) {
        System.out.println("Error: " + e.getMessage());
        System.exit(1);
    }
} catch (Exception e) {
    System.out.println("Error: " + e.getMessage());
    System.exit(1);
}

// A loop if statement is used instead of a switch statement due to the String.startsWith() method being called, making a switch statement impossible
while (true) {
    // Get the next line of input
    String input = System.console().readLine();

    // If the input is empty, skip it
    if (input == null || input.isEmpty()) {
        continue;
    }

    // If the input starts with a slash, it's a command
    if (input.startsWith("/")) {
        // Remove the slash
        String command = input.substring(1);

        // If the command is "quit", exit the program
        if (command.equals("quit")) {
            System.out.println("JarChat Client Terminated");
            System.exit(0);
        }

        // If the command is "join", join the channel
        else if (command.equals("join")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Join the channel
            client.join(channelName);
        }

        // If the command is "msg", send a message
        else if (command.equals("msg")) {
            // Get the message
            String message = input.substring(1, input.indexOf(" "));

            // Send the message
            client.sendMessage(channelName, message);
        }

        // If the command is "me", send a message to the channel
        else if (command.equals("me")) {
            // Send the message
            client.sendMessage(channelName, input.substring(1));
        }

        // If the command is "nick", change the nickname
        else if (command.equals("nick")) {
            // Get the new nickname
            String newNick = input.substring(1, input.indexOf(" "));

            // Change the nickname
            client.setNick(newNick);
        }

        // If the command is "part", leave the channel
        else if (command.equals("part")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Leave the channel
            client.leave(channelName);
        }

        // If the command is "topic", get the channel topic
        else if (command.equals("topic")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the channel topic
            client.getChannelTopic(channelName);
        }

        // If the command is "users", get the list of users in the channel
        else if (command.equals("users")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the list of users
            client.getChannelUsers(channelName);
        }

        // If the command is "help", show the help message
        else if (command.equals("help")) {
            System.out.println("JarChat Client Help");
        }

        // If the command is "list", show the list of channels
        else if (command.equals("list")) {
            client.getChannelList();
        }

        // If the command is "whois", get the user info
        else if (command.equals("whois")) {
            // Get the username
            String username = input.substring(1, input.indexOf(" "));

            // Get the user info
            client.getUserInfo(username);
        }

        // If the command is "invite", invite a user to the channel
        else if (command.equals("invite")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to invite
            String username = input.substring(1, input.indexOf(" "));

            // Invite the user
            client.invite(channelName, username);
        }

        // If the command is "kick", kick a user from the channel
        else if (command.equals("kick")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to kick
            String username = input.substring(1, input.indexOf(" "));

            // Kick the user
            client.kick(channelName, username);
        }

        // If the command is "ban", ban a user from the channel
        else if (command.equals("ban")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to ban
            String username = input.substring(1, input.indexOf(" "));

            // Ban the user
            client.ban(channelName, username);
        }

        // If the command is "unban", unban a user from the channel
        else if (command.equals("unban")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the username to unban
            String username = input.substring(1, input.indexOf(" "));

            // Unban the user
            client.unban(channelName, username);
        }

        // If the command is "mode", change the channel mode
        else if (command.equals("mode")) {
            // Get the channel name
            String channelName = input.substring(1, input.indexOf(" "));

            // Get the mode
            String mode = input.substring(1, input.indexOf(" "));

            // Change the mode
            client.setChannelMode(channelName, mode);
        }
    }
}

// Ensure everything closes gracefully
client.close();
System.exit(0);

```

Figure 10: The part of the JarChat class which handles the connection and the user's inputs to STDIN

sent to STDIN, the long if statement (used instead of a switch statement due to a [quirk in the way switch statements work](#)) checks for valid messages or commands, with an appropriate error message for anything invalid. So far everything can only take place in a single IRC text channel. The user is able to send direct messages to several users at a time, but can only be connected to a single channel at any given time. I hope to be able to make use of the Thread class within a javax.swing GUI in order to allow for the user to send/receive messages to/from multiple channels at once.

Lines 41 thru 60 of my code (figure 10) as of 2022-05-02 at 23:23 show a while loop which keeps going unless the program is exited (either by [issuing a /quit command to STDIN](#), or by [running into some kind of connection error](#)). For every thing

4: Testing, Review and Evaluation: Part 1

4.1: Achieved Success Criteria

So far, as of 2022-05-05 at 22:30, JarChat has achieved the following:

- Function as at least a semi-workable IRC Client
- Ability to use SSL encrypted connections
- Ability to be run on any given OS that has a JVM
- Ability to chat with multiple users directly at the same time

The most important parts of this project that are so far missing are the following:

- OP/Administrative commands
- javax.swing GUI
- Ability to join multiple channels
- Ability to join multiple servers

4.1.1: Proof of achieved Success Criteria

I have been able to connect to Libera.Chat's IRC server using JarChat in CLI (figures 11-12). The test shown here uses the TLS encrypted connection method and shows its success.

Figure 11: Collecting server/user info and connecting to the server.

Figure 12 shows the rest of the successful connection, with the login as managed by NickServ (a popular "login" bot used in IRC servers), with the password censored out.

Figure 12: Successful connection, with login.

Figures 13 & 14 show several messages being sent back and forth between my account

on Jar Chat and my main account on Libera.Chat's WebChat feature. Included there is a use of the /me command, which seems to fully work as intended.

Figures 13 & 14: Messages being sent back and forth in the test channel I created on Libera.Chat

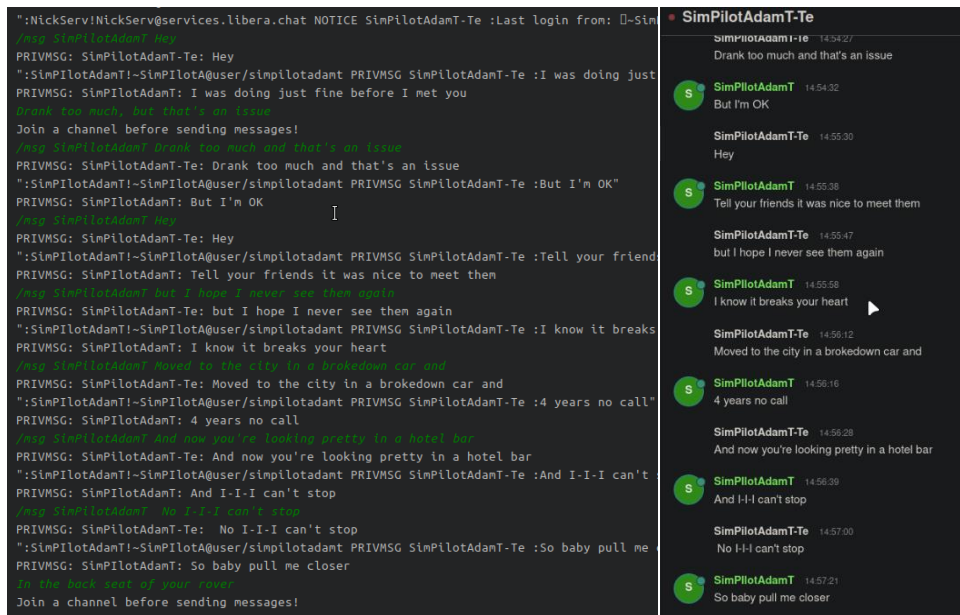


Figure 15 & 16: Testing direct messages between my accounts.

5: Final Code

5.1: IRCMessageLoop.java

```

1 // All of these classes are taken from Kaecy's gist at https://gist.github.com/kaecy/286f8ad334aec3fcb588516feb727772,
2 // with my own edits to ensure they better suited for use as an actual client, as well as to add comments to the code.
3
4 package com.AdamT;
5
6 // Imports
7 import com.sun.istack.internal.Nullable;
8 import java.io.IOException;
9 import java.io.InputStream;
10 import java.io.OutputStream;
11 import java.net.Socket;
12 import javax.net.ssl.SSLSocket;
13 import javax.net.ssl.SSLSocketFactory;
14 import java.util.ArrayList;
15 import java.util.Arrays;
16
17 abstract class IRCMessageLoop extends Thread {
18     // Variables (local to the class as many methods require them)
19     static OutputStream out;
20     ArrayList<String> channelList = new ArrayList<>();
21     boolean initial_setup_status;
22     InputStream stream;
23     IRCMessageLoop(String serverName, int port) {
24         // Both outcomes of this if statement can throw exceptions, so need to be encased in a try-catch statement
25         try {
26             // These ports are exclusively used by encrypted TLS connections
27             if (port == 6697 || port == 7000 || port == 7070) {
28                 // Initialise and start the secure socket
29                 SSLSocketFactory factory = (SSLSocketFactory)SSLSocketFactory.getDefault();
30                 SSLSocket server = (SSLSocket)factory.createSocket(serverName, port);
31                 server.startHandshake();
32                 // Allow the program to read everything being received from the socket, as well as to send info back to the server
33                 out = server.getOutputStream();
34                 stream = server.getInputStream();
35             }
36             // Any other ports are going to be plaintext connections, so do not need SSL Sockets
37             else {
38                 Socket server = new Socket(serverName, port); // Initialise plaintext connection (this is automatically started)
39                 // Allow the program to read everything being received from the socket, as well as to send info back to the server
40                 out = server.getOutputStream();
41                 stream = server.getInputStream();
42             }
43         }
44     }
45 }

```

~\JarChat\Client\src\com\AdamT\IRCMessageLoop.java [FORMAT=dos] [TYPE=JAVA] [POS=1,1][0%] [BUFFER=1] 06/05/2022 17:29:23

```

43     } catch (Exception info) { info.printStackTrace(); } // Print information about the error to the terminal for debugging in case it's needed
44 }
45 static void send(String text) {
46     byte[] bytes = (text + "\r\n").getBytes(); // Ensure the message being sent ends with a CRLF line break and not a LF line break
47     try { out.write(bytes); } catch (IOException info) { info.printStackTrace(); } // Try to send the message, and print out error info if it fails (without exiting the progr
48 }
49 void nick(String nickname) { String msg = "NICK " + nickname; send(msg); } // Set the nickname as seen by the server and other users
50 // Set the rest of the user's info
51 void user(String username, String hostname, String real_name) { String msg = "USER " + username + " " + hostname + " " + "null" + " " + real_name; send(msg); }
52 void join(String channel) { if (!initial_setup_status) { channelList.add(channel); return; } String msg = "JOIN " + channel; send(msg); } // Join the channel as requested by
53 the user
54 void part(String channel) { String msg = "PART " + channel; send(msg); } // Leave the channel as requested by the user, without disconnecting from the server
55 // Send messages, either directly or as a DM
56 static void privmsg(String to, String text, @Nullable String from) { String msg = "PRIVMSG " + to + " : " + text; send(msg); System.out.println("PRIVMSG: " + from + ": " + tex
57 t); }
58 void pong(String server) { String msg = "PONG " + server; send(msg); } // Respond back to the server every few minutes to ensure the connection isn't forcibly removed
59 static void quit(String reason) { String msg = "QUIT :Quit: " + reason; send(msg); } // Disconnect from the server as requested by the user
60 void initial_setup() {
61     initial_setup_status = true;
62     for (String channel: channelList) { join(channel); } // Now you can join the channels. You need to wait for message 001 before you join a channel.
63 }
64 // Method to call the other methods here as required depending on the message received from the server or other users.
65 void processMessage(String ircMessage) {
66     Message msg = MessageParser.message(ircMessage);
67     switch (msg.command) {
68         case "privmsg": if (msg.content.equals("\001VERSION\001")) { privmsg(msg.nickname, "JarChat", null); return; } // Reflect this client's name in the response
69         case "ping": if (msg.content.equals("PONG")) { pong(msg.server); return; } // Respond back to the server every few minutes to ensure the connection isn't forcibly removed
70         case "001": initial_setup(); break; // Initial message as sent by the server
71         case "ping": pong(msg.content); break; // see comment on line 53
72     }
73 }
74 public void run() {
75     try {
76         MessageBuffer messageBuffer = new MessageBuffer();
77         byte[] buffer = new byte[512];
78         int count;
79         while (true) {
80             count = stream.read(buffer);
81             if (count == -1) break; // There is nothing being sent by the server, so no need to continue the loop
82             messageBuffer.append(Arrays.copyOfRange(buffer, 0, count));
83             while (!messageBuffer.hasCompleteMessage()) {
84                 String ircMessage = messageBuffer.getNextMessage();
85                 System.out.println("\n" + ircMessage + "\n");
86                 processMessage(ircMessage);
87             }
88         }
89     } catch (IOException info) { quit("error in IRCMessageLoop"); info.printStackTrace(); System.exit(1); } // We cannot continue execution, so we disconnect and halt execution
90 }
91 }
92 }
93 // This class just sets all the attributes assigned to each message
94 class Message { public String origin; public String nickname; public String command; @SuppressWarnings("unused") public String target; public String content; }
95 // This class ensures the program can deal with every message one at a time
96 class MessageBuffer {
97     String buffer;
98     public MessageBuffer() { buffer = ""; } // At the start, there should be nothing in the buffer, data will be appended to this as the execution progresses
99     public void append(byte[] bytes) { buffer += new String(bytes); }
100     public boolean hasCompleteMessage() { return buffer.contains("\r\n"); } // The end of every complete message always has a CRLF line ending
101     public String getNextMessage() {
102         int index = buffer.indexOf("\r\n");
103         String message = "";
104         if (index > -1) { message = buffer.substring(0, index); buffer = buffer.substring(index + 2); }
105         return message;
106     }
107 }
108 }
109 }
110 // This class only parses messages it understands. If a message is not understood, the origin and command are extracted and parsing halts.
111 class MessageParser {
112     static Message message(String ircMessage) {
113         Message msg = new Message(); int spIndex;
114         if (ircMessage.startsWith(":")) {
115             spIndex = ircMessage.indexOf(' ');
116             if (spIndex > -1) {
117                 msg.origin = ircMessage.substring(1, spIndex);
118                 ircMessage = ircMessage.substring(spIndex + 1);
119                 int uIndex = msg.origin.indexOf(':');
120                 if (uIndex > -1) msg.nickname = msg.origin.substring(0, uIndex);
121             }
122         }
123     }
124 }

```

```

106     if (index > -1) { message = buffer.substring(0, index); buffer = buffer.substring(index + 2); }
107     return message;
108 }
109 }
110
111 // This class only parses messages it understands. If a message is not understood, the origin and command are extracted and parsing halts.
112 class MessageParser {
113     static Message message(String ircMessage) {
114         Message message = new Message(); int spIndex;
115         if (ircMessage.startsWith(":")) {
116             spIndex = ircMessage.indexOf(' ');
117             if (spIndex > -1) {
118                 message.origin = ircMessage.substring(1, spIndex);
119                 ircMessage = ircMessage.substring(spIndex + 1);
120                 int uIndex = message.origin.indexOf('!');
121                 if (uIndex > -1) message.nickname = message.origin.substring(0, uIndex);
122             }
123         }
124         spIndex = ircMessage.indexOf(' ');
125         if (spIndex == -1) { message.command = "null"; return message; }
126         message.command = ircMessage.substring(0, spIndex).toLowerCase();
127         ircMessage = ircMessage.substring(spIndex + 1);
128         // Parse privmsg parameters
129         if (message.command.equals("privmsg")) {
130             spIndex = ircMessage.indexOf(' '); message.target = ircMessage.substring(0, spIndex); ircMessage = ircMessage.substring(spIndex + 1);
131             if (ircMessage.startsWith(":")) message.content = ircMessage.substring(1);
132             else message.content = ircMessage;
133         }
134         // Parse quit/join
135         if (message.command.equals("quit") || message.command.equals("join")) {
136             if (ircMessage.startsWith(":")) message.content = ircMessage.substring(1);
137             else message.content = ircMessage;
138         }
139         // Parse ping parameters
140         if (message.command.equals("ping")) {
141             spIndex = ircMessage.indexOf(' ');
142             if (spIndex > -1) message.content = ircMessage.substring(0, spIndex);
143             else message.content = ircMessage;
144         }
145         return message;
146     }
147 }

```

~\JarChat\client\src\com\AdamT\IRCMessageLoop.java [FORMAT=dos] [TYPE=JAVA] [POS=146,1][99%] [BUFFER=1] 06/05/2022 17:33:23

5.2: JarChat.java

```

1 /*
2  * JarChat IRC Client Source Code
3  * Free and Open-sourced under the GNU GPL v3 Licence
4  *
5  * Build using the latest JDK 8 to ensure compatibility with all
6  * modern devices. Will change JDK once more devices use JRE 11.
7  *
8  * Last Edited: 2022-05-05 16:47 by SimPilotAdamT
9  */
10
11 package com.AdamT;
12
13 // Imports
14 import java.net.InetAddress;
15 import java.net.UnknownHostException;
16 import java.util.Scanner;
17
18 // Main class
19 public class JarChat extends IRCMessageLoop {
20
21     JarChat(String server, int port) { super(server, port); }
22
23     public static void main(String[] args) {
24         // Variables (local to this method instead of the class in case any variables with these names or similar are required elsewhere)
25         boolean exit; String input; String channel = ""; JarChat client; boolean valid; Scanner con; String server; String port; String nick; String uname; String name;
26
27         // Welcome and entering server details
28         System.out.println("\nHi!"); con = new Scanner(System.in); System.out.print("\nEnter server IP/Hostname: ");
29         server = con.nextLine(); System.out.print("Enter server port: "); port = con.nextLine();
30
31         // Check the port is valid (most servers use a port with 4 digits)
32         valid = false;
33         while(!valid) { if (isInteger(port) && port.length() == 4) valid=true; else { System.out.print("Error! Invalid port!\nEnter server port: "); port=con.nextLine(); } }
34
35         // Get user's details
36         System.out.print("\nEnter nickname: "); nick = con.nextLine(); System.out.print("Enter username (most of the time this is the same as the nickname): ");
37         uname = con.nextLine(); System.out.print("Enter real name: "); name = con.nextLine(); System.out.print("\n");
38
39         // Start the connection
40         client = new JarChat(server, Integer.parseInt(port)); client.nick(nick);
41         try { client.user(uname, InetAddress.getLocalHost().getHostName(), name); } catch (UnknownHostException ignored) { client.user(uname, "null", name); } client.start();
42

```

~\JarChat\client\src\com\AdamT\JarChat.java [FORMAT=dos] [TYPE=JAVA] [POS=1,1][1%] [BUFFER=1] 06/05/2022 17:35:24

```

27 // Welcome and entering server details
28 System.out.println("\nHi!"); con = new Scanner(System.in); System.out.print("\nEnter server IP/Hostname: ");
29 server = con.nextLine(); System.out.print("Enter server port: "); port = con.nextLine();
30
31 // Check the port is valid (most servers use a port with 4 digits
32 valid = false;
33 while(!valid) { if (isInteger(port) && port.length() == 4) valid=true; else { System.out.print("Error! Invalid port!\nEnter server port: "); port=con.nextLine(); } }
34
35 // Get user's details
36 System.out.print("\nEnter nickname: "); nick = con.nextLine(); System.out.print("Enter username (most of the time this is the same as the nickname): ");
37 uname = con.nextLine(); System.out.print("Enter real name: "); name = con.nextLine(); System.out.print("\n");
38
39 // Start the connection
40 client = new JarChat(server, Integer.parseInt(port)); client.nick(nick);
41 try { client.user(uname, InetAddress.getLocalHost().getHostName(), name); } catch (UnknownHostException ignored) { client.user(uname, "null", name); } client.start();
42
43 // String.equalsIgnoreCase() is used instead of String.equals() because this will save the user lots of hassle with typing commands
44 // A long if statement is used instead of a switch statement due to the String.startsWith() method being called, making a switch statement impossible
45 exit = false;
46 while (!exit) {
47     input = con.nextLine();
48     if (input.equalsIgnoreCase("/quit")) { exit=true; quit("JarChat Client Terminated"); } // Exit the program should the user send the command
49     else if (input.startsWith("/join ")) {
50         if (!channel.isEmpty()) client.part(channel); // Part from the current channel if joined
51         channel=input.substring(6); client.join(channel); // Remove the "/join " part of the command, then join the channel
52     }
53     else if (input.startsWith("/msg ")) {
54         input = input.substring(5); // Remove the "/msg " part of the command
55         String[] message = input.split(" ",2); // Split the command into username and message
56         privmsg(message[0],message[1],nick); // Send the DM
57     }
58     else if (input.startsWith("/me ") && !channel.isEmpty()) privmsg(channel,""+input.substring(4)+"",nick); // Fun command used in IRC RP
59     else if (input.equalsIgnoreCase("/leave") && !channel.isEmpty()) client.part(channel); // Core command
60     else if (!channel.isEmpty()) privmsg(channel,input,nick); // Send a message to the channel the user is in
61     else System.out.println("Join a channel before sending messages!"); // Suitable message to let the user know that they aren't in any channel
62 }
63 con.close(); System.exit(0); // Ensure everything closes gracefully
64 }
65
66 private static boolean isInteger(String input) { try { Integer.parseInt(input); return true; } catch (Exception ignored) { return false; } } // To check if the port is a valid number
67 }

```

C:\JarChat\src\com\AdamT\JarChat.java [FORMAT=dos] [TYPE=JAVA] [POS=55,1][82%] [BUFFER=1] 06/05/2022 17:36:39