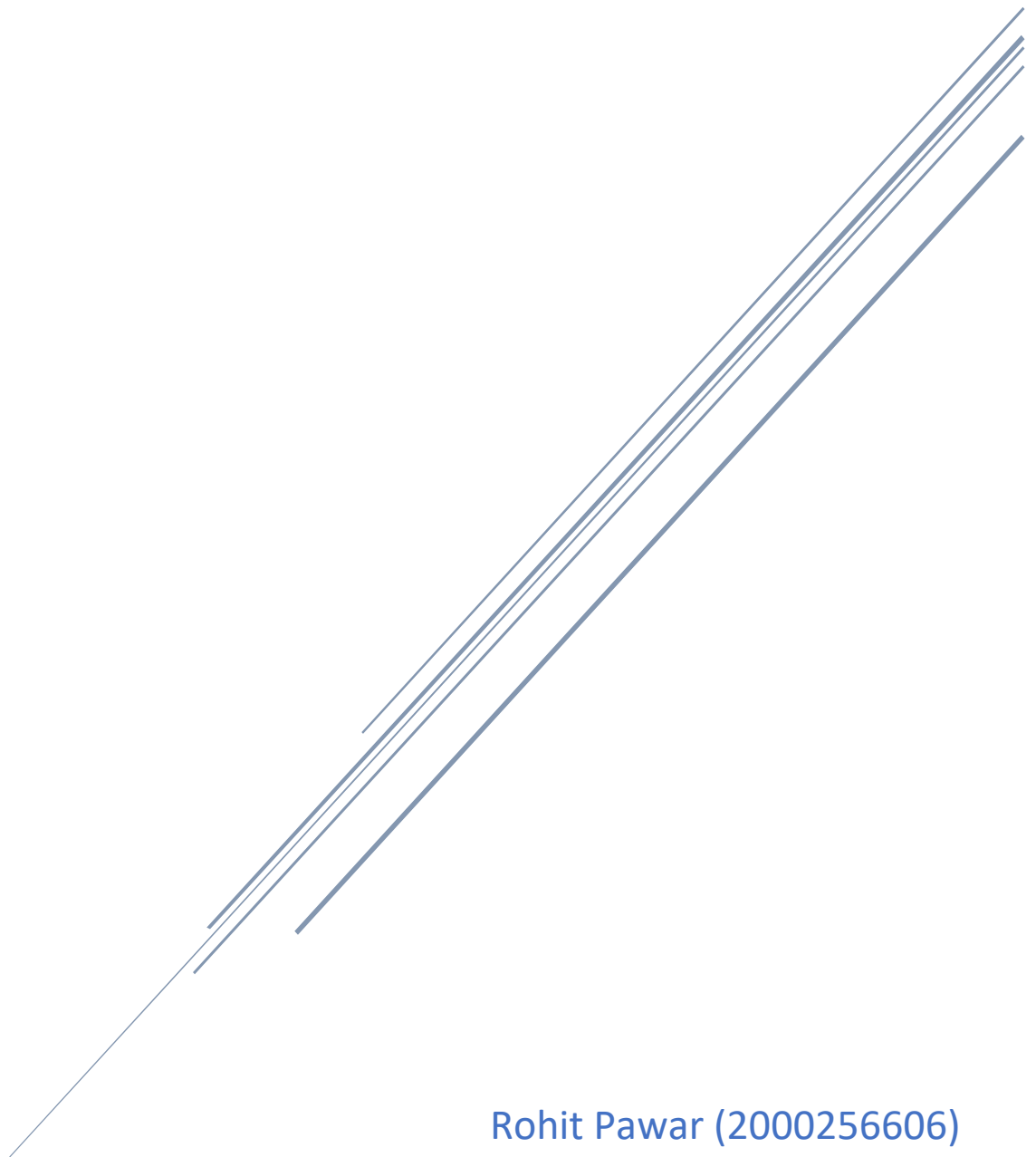


FIVE IN A ROW GAME

Data Communication and Computer Network Project



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Abstract:

Five in A Row is an abstract strategy board game often played with Go board and pieces. This paper write-up will introduce the implementation of a two player Five in a row game connected over web sockets. Furthermore, the goals, current accomplishments, successful demos, possible improvements and future plans of the project will also be introduced.

Introduction:

The project I have chosen to complete throughout my Fall 2017 semester is to create a two-player board game called Five In A Row. This program is implemented completely from scratch in the programming language of Java using web sockets. We have also used the cutting-edge technologies like HTML5, CSS3 and JavaScript. We have also added a broadcasting functionality and security using Ceaser cipher algorithm. The program currently could be against a human player. The goal of this project is to have hands on ability on system development using application layer protocol.

Background:

Five in A Row is a name translated directly from Chinese (五 子 棋 qí) for the board game. In English, the board game is usually called Gomoku or GoBang. It is a two-player board game often played on a Go board and pieces. It is more often seen in sizes of 15 by 15 or 19 by 19. The rule of this game is simple and is like Tic-Tac-Toe; the player who first obtains a consecutive five pieces on yxia3 the board is the winner. However, Five In A Row is considerably more difficult than Tic-Tac-Toe because of its huge searching space, and needs better pattern constructing strategies.

Since Five in A Row is one of those logic games and is played with open rules, which means both side of players know the available moves from a given point in the entire game. According to a previous paper, human players spend time to look for threat sequences. Humans use methods of optimistic search and verification.

Five-In-Row variants:

Five-in-row is a game with long history. Some professional players claim that this game is a won game for the player who moves first. Many variants of five-in-row exist. They all try to restrict Black's move to reduce the advantage of moving first. However, none players nor existing five-in-row programs can prove that this claim is true. Here we briefly introduce some of the variants to this game.

1. Non-standard boards:

People in early days play on a board bigger than the size of 15×15 . However, it's believed that larger board would increase the first player's advantage.

2. Standard Five-In-Row:

This is the most popular five in row these days. If a player creates a line of six or more consecutive markers, this line does not win. A line of five consecutive markers is the only winning pattern.

3. Renju:

Renju is the professional five-in-row. It restricts Black from winning with a line of six or more consecutive markers or double threats, while does not place any restriction on White.

We design our program to play the **non-restricted five-in-row** due to its simple rules.

Work Flow of Five In a Row Game:

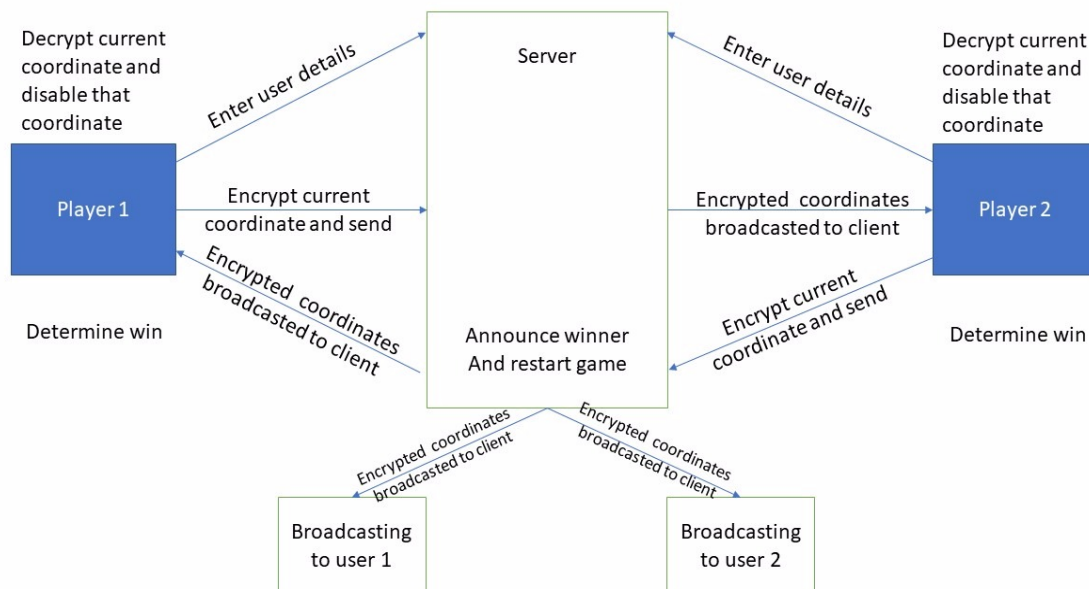


Figure 1: Workflow of Five in a row Game

Steps involved:

1. Client request server using URL.
2. Server acknowledge clients and establish connection.
3. Once connection is established client request for required files.
4. Server sends response and all the requested files like jsp,css and javascript files to client. [You can see details about step 1 to step 4 in wireshark analysis]
5. Client is connected to server and client has all the required files to start playing game.
6. Client provide its details to server and start playing game by making some moves.
7. Client encrypts its coordinate and send it to server. As per end to end argument, certain functionality can be implemented correctly with applications knowledge at ends hence we are performing encryption/ decryption at ends.

8. Once server receives json object from client it broadcast that coordinate to all the clients.
9. As soon as client receives the json object from server, first it decrypts the coordinate and disable that coordinate.
10. Now client determines whether its winning move or not. If it's a winning move then it again sends the winning status to server and server broadcast the status to all the clients and all the clients restart the game.

Algorithm used to determine win:

1. On click check count of current players colour
2. Count Function:
 Row: Checks the current position of the coordinates and matches the same colour horizontally. If the colours match and count ≥ 5 then function returns true.

 Column: Checks the current position of the coordinates and matches the same colour vertically. If the colours match and count ≥ 5 then function returns true.

 Diagonal: Checks the current position of the coordinates and matches the same colour diagonally. If the colours match and count ≥ 5 then function returns true.
3. When count function returns true then announce the winner and restart the game. else continue playing the game alternatively.

Additional Functionalities:

1. Broadcasting:

We have implemented a feature to broadcast the game. So other people who are willing to watch the game can do so. Broadcasting makes it easier for them to stream events. We have implemented broadcasting feature using session management, in it we have information of all the users. Once server receives the coordinates of the players, then it broadcasts their information to other users.

2. Security:

For better security to protect the user moves we have implemented the Ceaser Cipher algorithm which will protect the game from any cheats based on network sniffing. In this we are adding key to original coordinates for encryption and decryption.

Advantages of using Ceaser Cipher algorithm:

- a. Easy to implement.
- b. Protects users moves.
- c. Protects your game from any cheats based on network sniffing.

Execution:

1. Winner by horizontal or vertical:

Ro wins the game as he has completed the game horizontally.

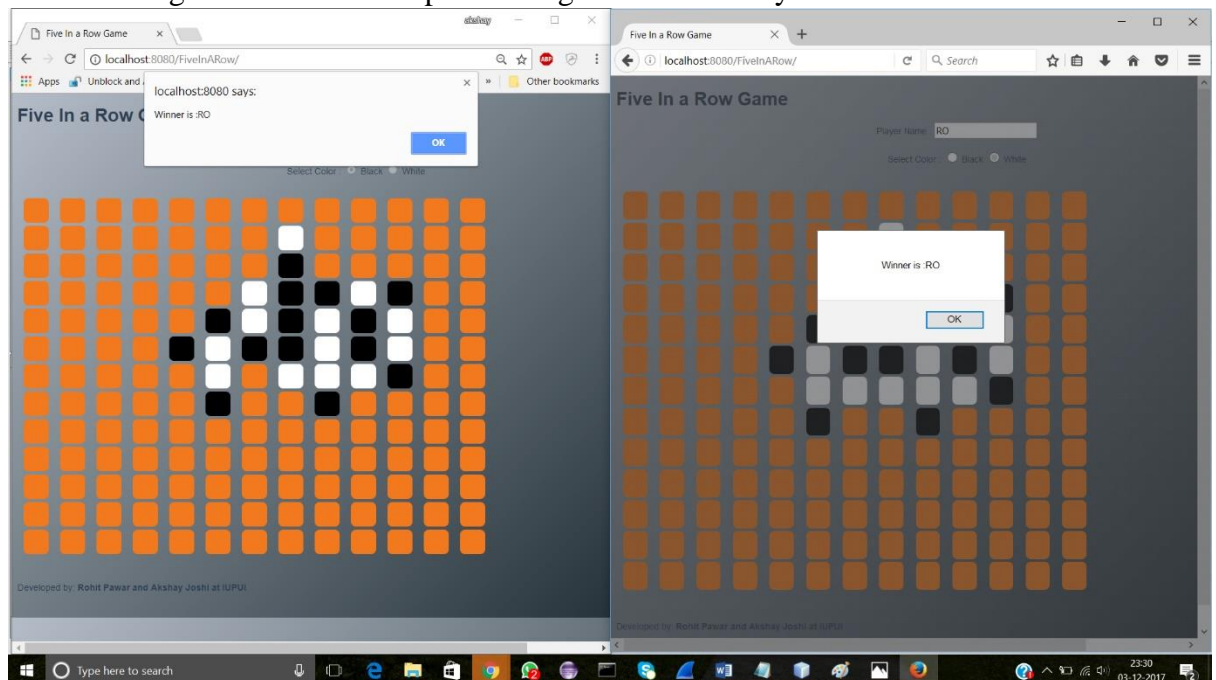


Figure 2: Horizontal win

2. Winner by diagonal:

Akshay wins the game as he has completed five in a row diagonally.

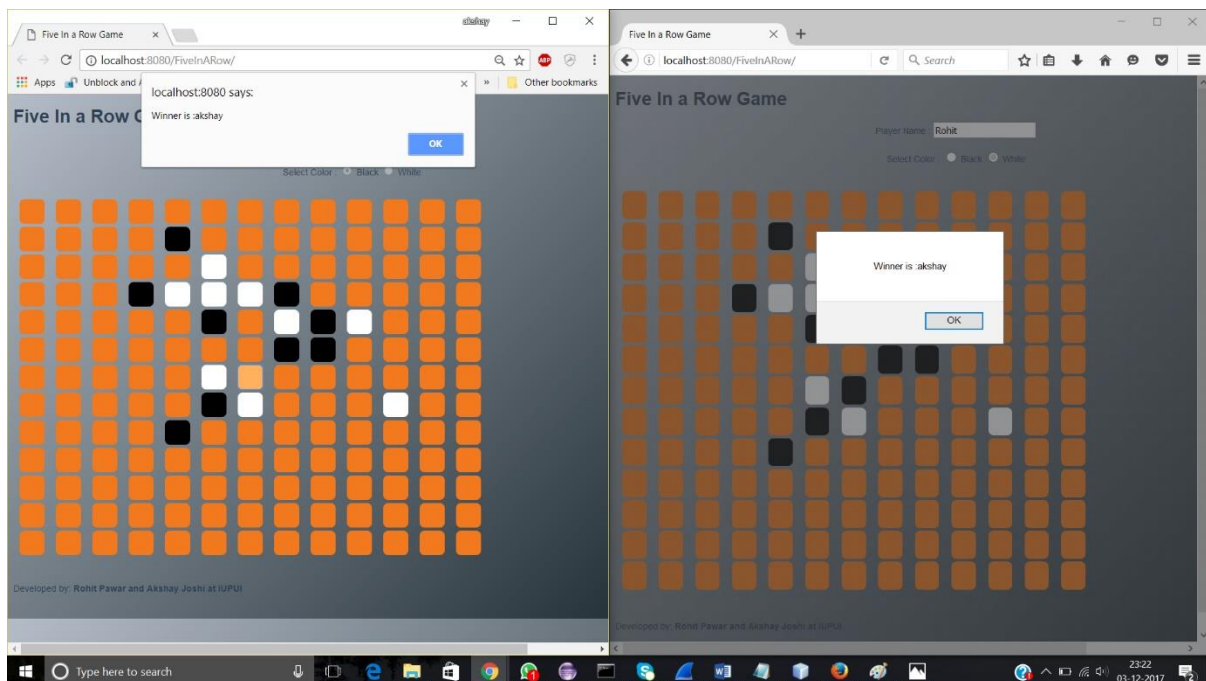


Figure 3: Winning Scenario by diagonal

Wireshark Analysis:

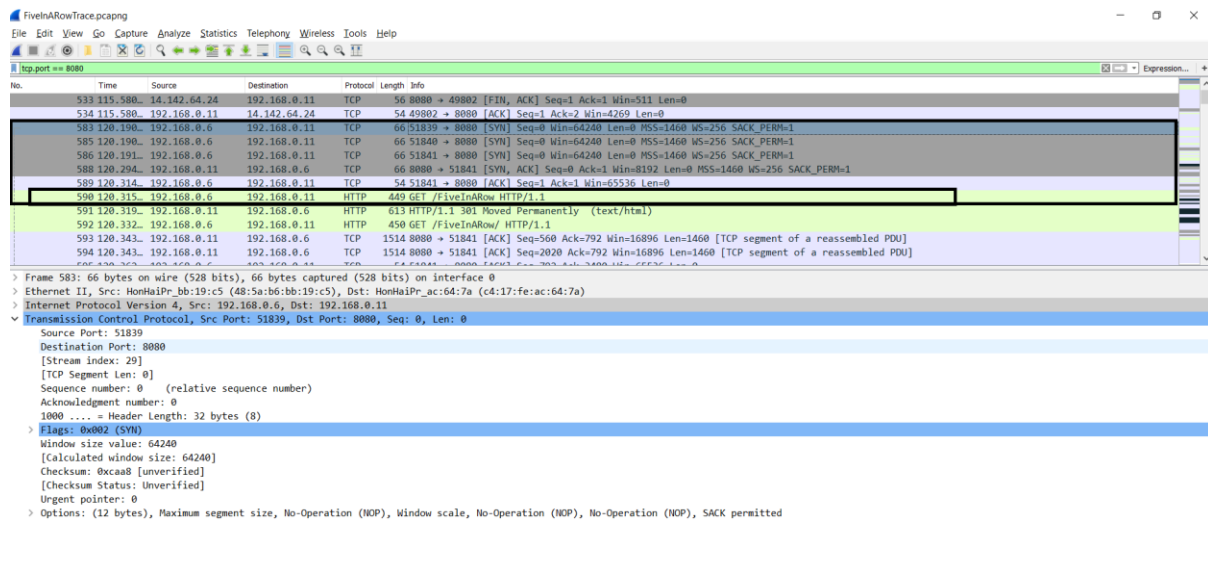


Figure 4: TCP connection establishment and http request for the game URL

In figure 4, The browser and the server both are running on HTTP version 1.1. The highlighted portion shows the establishment of TCP connection. The client TCP sends SYN=0 segment, which informs the server about the clients initial sequence number for the data that the client intends to send on the connection. The server then acknowledges the clients SYN with ACK=1 and sends its sequence number SYN=0. The client then acknowledges the servers SYN.

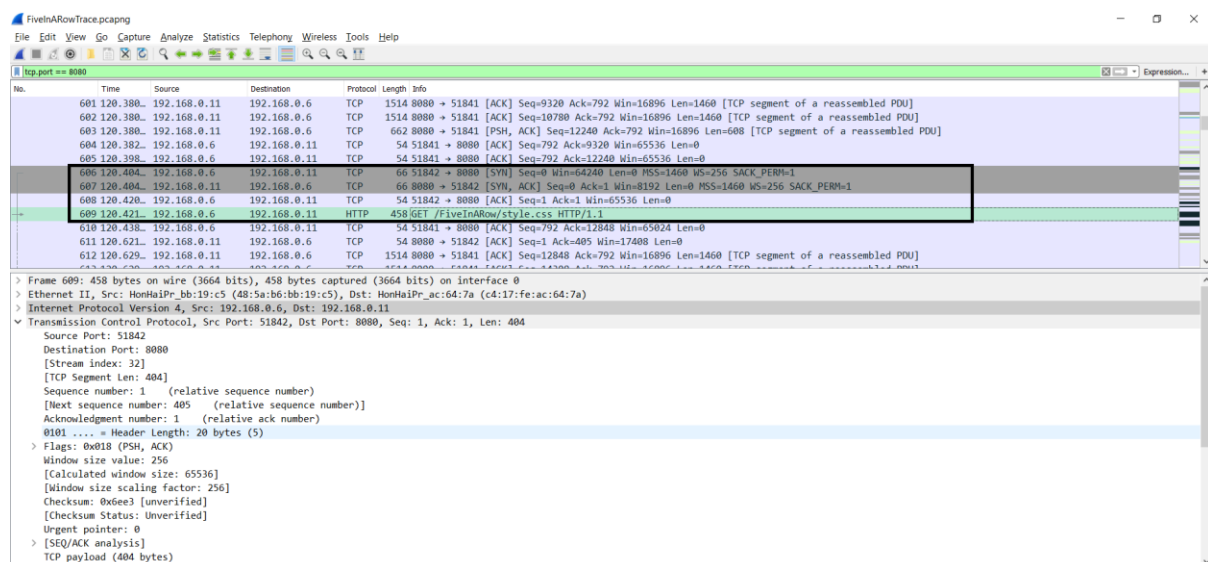


Figure 5. The client request for the CSS file.

In figure 5, The client after establishing connection asks the server for the css file. The server responds to the request with ACK=1 and sends the css file to the client.

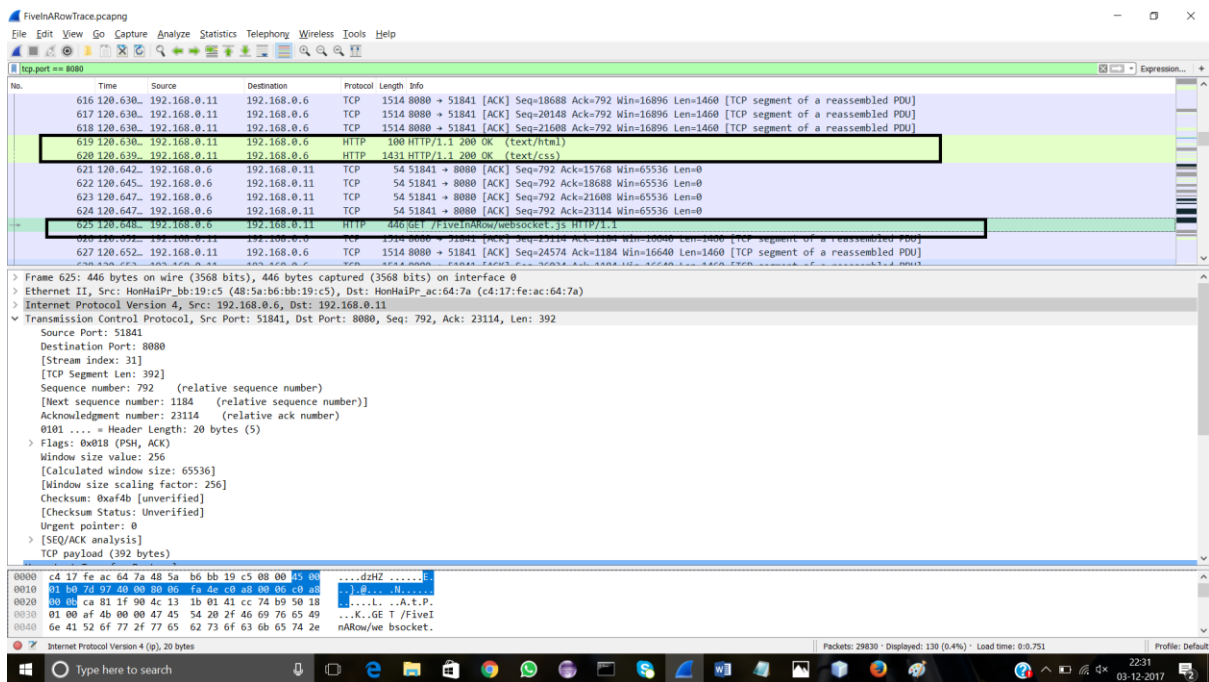


Figure 6: CSS and HTML files received. Clients request for .js file

In figure 6, the client receives the HTML and CSS file and then requests for the .js file. The server responds to this request with ACK=1 and sends the .js file to the client.

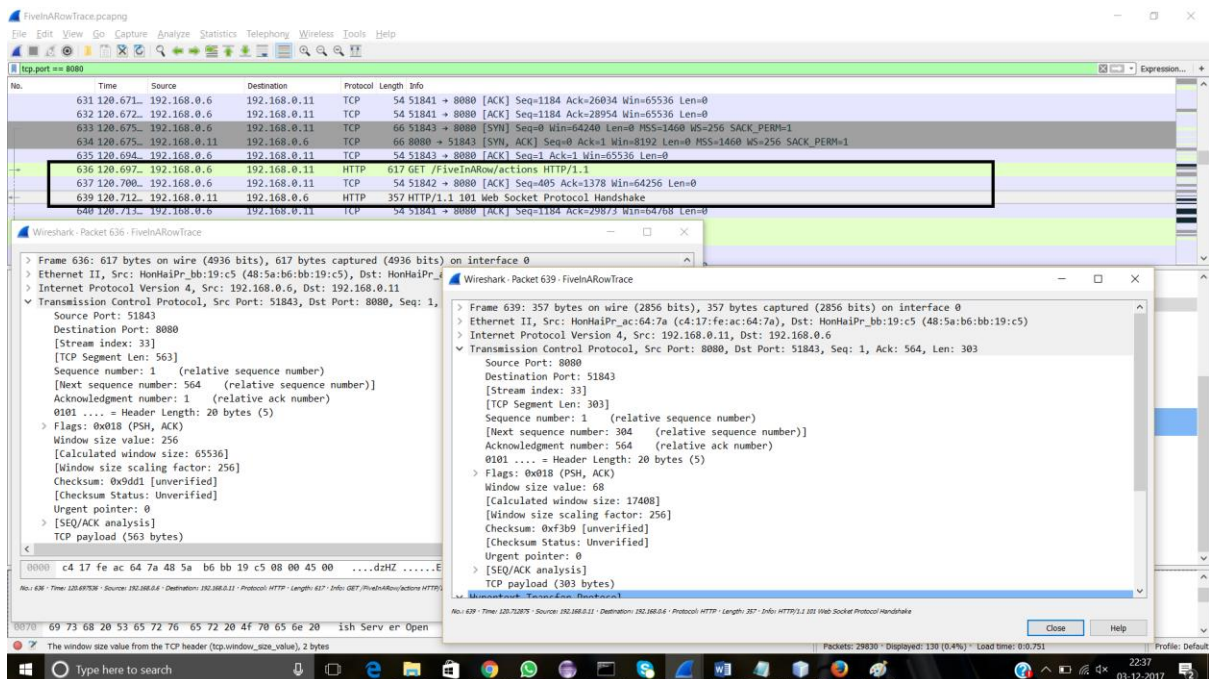


Figure 7: Action performed by the client and switching protocol

In figure 7, the player 1 clicks on the add button and performs “add” action. The highlighted portion shows how the action was sent from the client side and how the server switched to another protocol. The client here requested for an action in web socket, the server then responded with status 101 indicating that it is switching to another protocol.

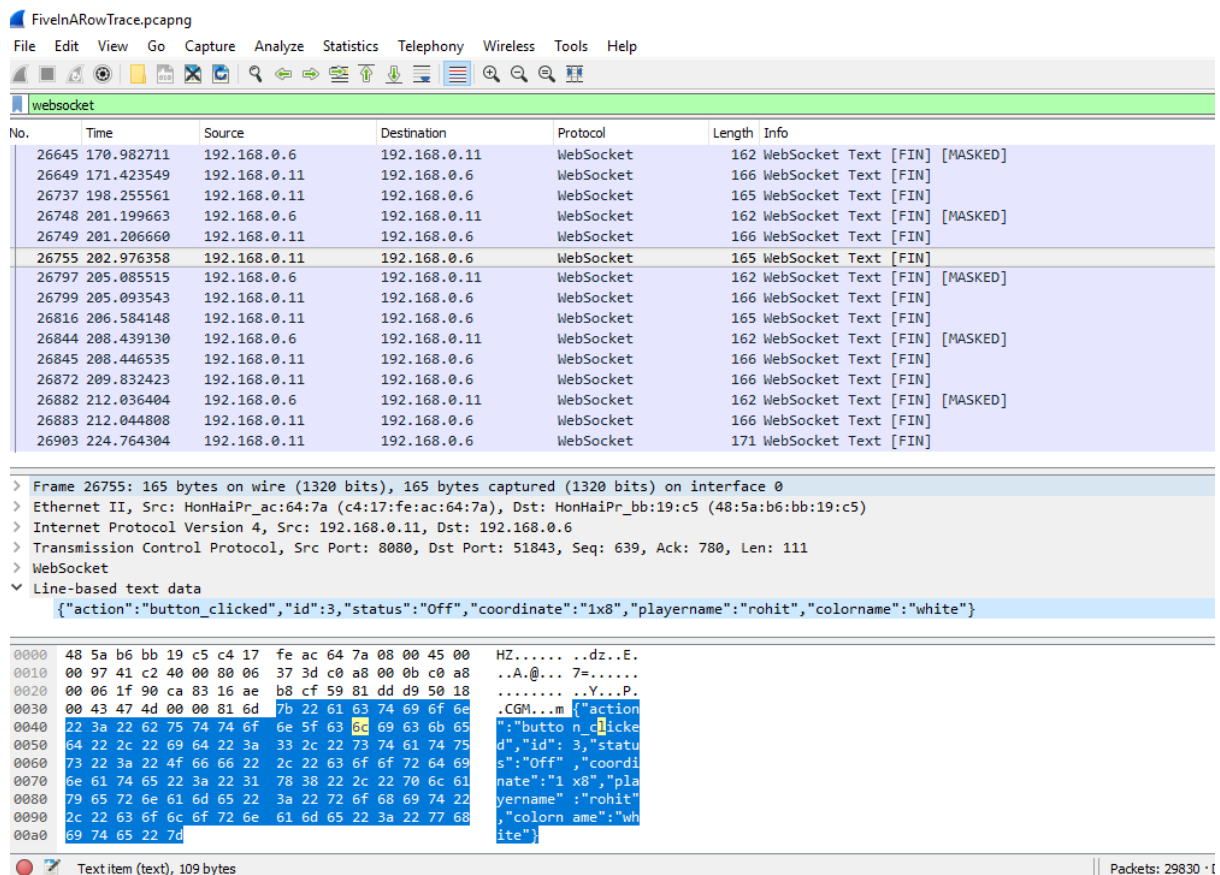


Figure 8: Move action performed by each player

In figure 8, Rohit performs a move and the server sends the details about this move to both the players and players send an acknowledgement for same. The highlighted portion in blue indicates the moves performed and acknowledgement by each player respectively. This is how the data of each move is sent and received on client side and server side simultaneously. Data visible in blue portion is not the actual coordinate as we have implemented Caesar cipher encryption technique.

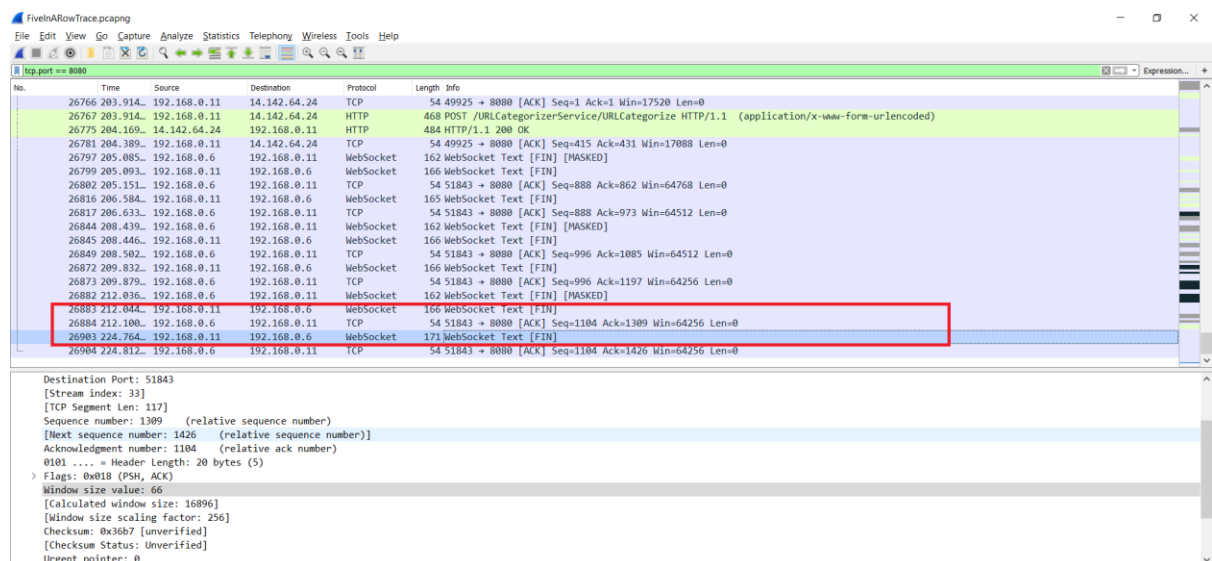


Figure 9: Winning Scenario

In figure 9, the player 1 performs a move which satisfies the winning condition. In such scenario the server prompts both player that player 1 wins and then the “restart” action is performed. In this the current session is closed and a new session is started, and we have a new board game.

Advantages of using WebSocket:

1. It supports full duplex communication
2. Faster than HTTP
3. Increased client and server communication efficiency

Disadvantages of using WebSocket:

1. Browser must be fully HTML5 compliant
2. Takes over the communications protocol between the client and the server for a connection.

Conclusion:

We have successfully implemented five in a row game using java’s websocket. We have also studied and analysed network protocol activities using wireshark.

References:

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