Computer Programming – CS 6011 Lecture 14: Web Sockets

Fall 2023

Topics

- Web Sockets
 - Web Calculator Application In Class

Recap: Client – Server Java implementation

Server side

- Server waits for client connections on a specific port Number
- Create a Server Socket and wait for the Client requests the constructor takes a port Number
- Use sockets I/O streams to perform communication with Client
- Close sockets

Client side

- Client connects to a server that needs an IP and port
- Create a **Socket** Object the constructor takes an IP address and a port Number
- Use sockets I/O streams to perform communication with the server
- Close the socket when done

Chat Client Communication Approach

- Each time a user enters a new message, how could we update the web page?
- Using AJAX / XMLHttpRequest?
 - For AJAX, you (the client) must make an *HTML* request...
 - Ask the server for any new messages...
 - How often? Every second? Every minute?
 - This method of communication is called polling.
 - Is there anything new?
 - Is there anything new?
 - Is there anything new?
 - •

Communication Method For Chat App...

- Can we do this with AJAX?
 - No AJAX is a client-side approach.
- In an ideal world, how would we know there are new messages?
 - The Server would tell us (because it knows when it receives a new message).
 - We need a method for **bi-direction** communication that allows two-way communication whenever either side wants to talk to the other.
 - Clients and Server can send messages back and forth whenever they want.
 - A connection that stays open until closed by one of the endpoints.
 - Built on top of HTTP (at least to start) So that all web servers are capable of at least receiving the request.

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Web Socket

- Provide a way to exchange data between browser and server
- To open a websocket connection, we need to create new WebSocket using the special protocol ws in the url:

```
let socket = new WebSocket("ws://serverURL");
```

Once the socket is created, there will be 4 events:

```
open
message
error
close
Then: socket.send(data) to send data.
```

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Web Socket Approach for the chat App

- Once a user types in a message and clicks send, we will send the message to the server.
- What do we expect will happen then (almost immediately)?
 - The Server should send back a message to us (and all other clients) with the message we just sent.
- Sending and receiving messages:

```
sendMessage( data ); // Send message to server.
msgData = receiveMessage( ); // Wait for the server's response
```

- When do we send a message?
 - When the user presses "enter" or clicks the "send" button. In other words, based on an event.
- When do we display a message?
 - onmessage // When the onmessage is called again based on the event of a message arriving.

Web Sockets – JavaScript Example

```
let ws = new WebSocket( "ws://localhost:8080" )
ws.onopen = handleConnect;
ws.onclose = handleClose;
ws.onerror = handleError;
ws.onmessage = handleMessage;
ws.send( message ) // To send the message to the server.
ws.close(); // When we are completely done.

    handleConnect, handle Close are just functions we write:

      function handleClose( ) { // clean up, etc }

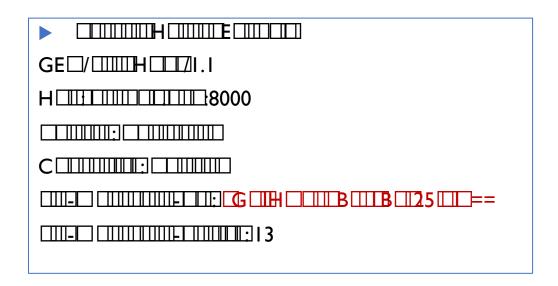
    URL: is the address of the server
```

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WebSocket Handshake



- WebSockets talk over port 80 (or 443) directly to the web server.
- They send header information (Similar to HTTP requests /responses).
- Then they switch to their own protocol ("language")



WebSocket Messages

- Once the initial WebSocket handshake has occurred (using standard HTTP headers / protocol / socket) the server switches to using an actual WebSocket and a different message protocol.
- Binary message format (binary data)
- Have to fit all header fields into the 2 byte header
 - Use bit manipulation like we have done previously.
- More on this later.



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Thursday Assignments

- HW 7 Server-side Calculator (In-class)
- Midterm Tomorrow (Friday)
 - 1 page Handwritten notes
- Have you turned in every lab (Up to Lab 8) / homework (Up to HW 7)?
 - If not, turn them in as soon as you can.
 - If so, do you have grades for them?

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Server-Side Calculator Client

- Read the assignment and think about how you might approach doing it.
 - 10 Minutes then we will implement the solution as a class.
- localhost:8080/calculate?x=5&y=9
 - Query string: Everything after the "?".
- Run curl to verify server is running and to see result.
- You can use WireShark to see the messages being sent.
- Cross-Origin Resource Sharing (CORS) Errors
 - You are not allowed to load new data from a different server then you loaded the page from.
 - By default, AJAX requests must go back to the server you are talking to.
- Using the class implementation as an example, you must implement your own Web Calculator Client and commit it to git.

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