CSE 331
Software Design & Implementation

Autumn 2021

HW9, JSON, Fetch

Administrivia

- HW8 due today (Thur. 12/2 @ 11:00pm)

- HW9 due a week later (Thurs. 12/9 @ 11:00pm)
  - Spec released soon. ☺
  - Plan ahead - this assignment can take a little longer than others.
  - Get creative! Lots of cool opportunities.
  - Make sure to watch the video!
    - It includes additional practice over today’s materials

- Any questions?

Agenda

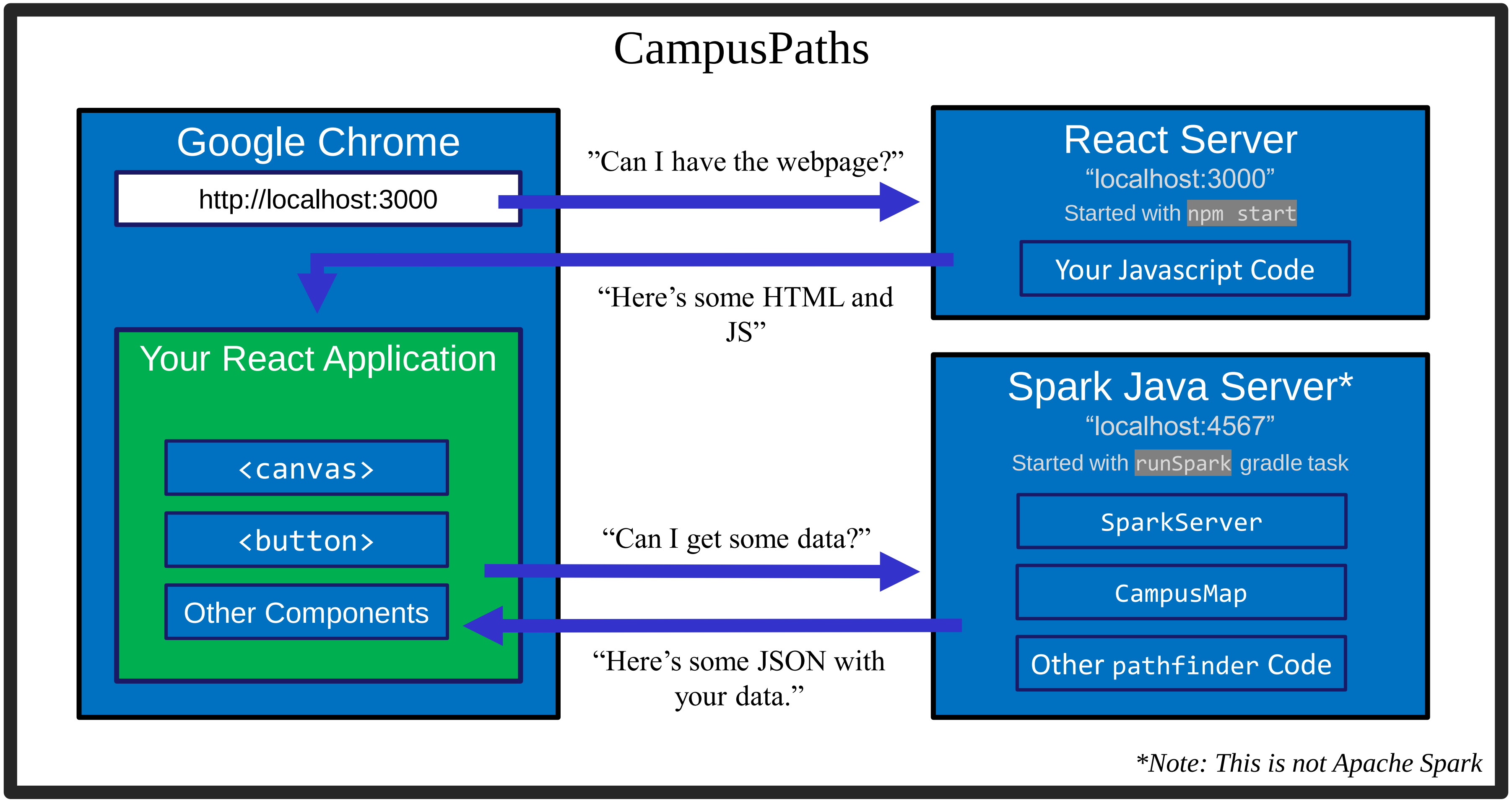
- HW9 Overview
- JSON
  - Brief overview
  - Helps share data between Java and JS.
- Fetch
  - How your JS sends requests to the Java server.

Homework 9 Overview

- Creating a new web GUI using React
  - Display a map and draw paths between two points on the map.
  - Works just like your React app in HW8 – but you get to design it!
  - Send requests to your Java server (new) to request building and path info.

- Creating a Java server as part of your previous HW5-7 code
  - Receives requests from the React app to calculate paths/send data.
  - Not much code to write here thanks to MVC.
    - Reuse your `CampusMap` class from HW7.

The Campus Paths Stack



Any Questions?

- Done:
  - HW9 Basic Overview
- Up Next:
  - JSON
  - Fetch

JSON

- We have a whole application written in Java so far:
  - Reads CSV data, manages a Graph data structure, manages building information, does Dijkstra's algorithm.
- We're writing a whole application in Javascript:
  - React web app to create a GUI for your users to interact with.
- Even if we get them to communicate (discussed later), we need to make sure they "speak the same language".
  - Javascript and Java store data *very* differently.
- JSON = <u>J</u>ava<u>S</u>cript <u>O</u>bject <u>N</u>otation
  - Can convert JS Object → String, and String → JS Object
  - Bonus: Strings are easy to send inside server requests/responses.

JSON ↔ JS

Javascript Object

```
let schoolInfo = {

  name: "U of Washington",
  location: "Seattle",
  founded: 1861,
  mascot: "Dubs II",
  isRainy: true,
  website: "www.uw.edu",
  colors: ["Purple","Gold"]

}
```

JSON String

```
{"name":"U of Washington","location":"Seattle","founded":1861,"mascot":"Dubs II","isRainy":true,"website":"www.uw.edu","colors":["Purple","Gold"]}
```

- Can convert between the two easily (we'll see how later)
- This means: if the server sent back a JSON String, it'd be easy to use the data inside of it – just turn it into a JS Object and read the fields out of the object.

JSON ↔ JS

Java Object

```
public class SchoolInfo {

  String name = "U of Washington";
  String location = "Seattle";
  int founded = 1861;
  String mascot = "Dubs II";
  boolean isRainy = true;
  String website = "www.uw.edu";
  String[] colors = new String[]
                  {"Purple", "Gold"};

}
```

JSON String

```
{"name":"U of Washington","location":"Seattle","founded":1861,"mascot":"Dubs II","isRainy":true,"website":"www.uw.edu","colors":["Purple","Gold"]}
```

- Use Gson (a library from Google) to convert between them.
  - Tricky (but possible) to go from JSON String to Java Object, but we don't need that for this assignment.

```
Gson gson = new Gson();
SchoolInfo sInfo = new SchoolInfo();
String json = gson.toJson(sInfo);
```

JSON – Key Ideas

- Use Gson to turn Java objects containing the data into JSON before we send it back.
  - The Java objects don't have to be simple, like in the example, Gson can handle complicated structures.
- Easy to turn a JSON string into a Javascript object so we can use the data (fetch can help us with that).

Any Questions?

- Done:
  - HW9 Basic Overview
  - JSON

- Up Next:
  - Fetch

Fetch

- Used by JS to send requests to servers to ask for info.
  - alternative to `XmlHttpRequest`

- Uses Promises:
  - Promises capture the idea of “it’ll be finished later.”
  - Asking a server for a response can be *slow*, so Promises allow the browser to keep working instead of stopping to wait.
  - Getting the data out is a little more complicated.

- Can use async/await syntax to deal with promises.

Creating a Request

- Recall from lecture:
  - When you type a URL into your browser, it makes a GET request to that URL, the response to that request is the website itself (HTML, JS, etc..).
    - A ”GET” request says “Hey server, can I get some info about _____?”
  - We’re going to make a request from inside Javascript to ask for data about paths on campus.
  - There are other kinds of requests, but we’re just using GET. (It’s the default for fetch).
- Each “place” that a request can be sent is called an “endpoint.”
  - Your Java server will provide multiple endpoints – one for each kind of request that your React app might want to make.
    - Find a path, get building info, etc...

Fetch Demo

- Let’s see how a request is handled in action.

Creating a Request

Server Address: `http://localhost:4567`

- Basic request with no extra data: “`http://localhost:4567/getSomeData`”
  - A request to the “`/getSomeData`” endpoint in the server at “`localhost:4567`”
  - “`localhost`” just means “on this same computer”
  - “`:4567`” specifies a port number – every computer has multiple ports so multiple things can be running at a given time.
- Sending extra information in a request is done with a query string:
  - Add a “`?`”, then a list of “`key=value`” pairs. Each pair is separated by “`&`“.
  - Query string might look like: “`?start=CSE&end=KNE`”
- Complete request looks like:

```
http://localhost:4567/findPath?start=CSE&end=KNE
```

- Sends a “/findPath” request to the server at “localhost:4567”, and includes two pieces of extra information, named “start” and “end”.
- You don’t need to name your endpoints or query string parameters anything specific, the above is just an example.

Sending the Request

```
let responsePromise = fetch(“http://localhost:4567/findPath?start=CSE&end=KNE”);
```

- The URL you pass to `fetch()` can include a query string if you need to send extra data.
- `responsePromise` is a Promise object
  - Once the Promise “resolves,” it’ll hold whatever is sent back from the server.
- How do we get the data out of the Promise?
  - We can `await` the promise’s resolution.
  - `await` tells the browser that it can pause the currently-executing function and go do other things. Once the promise resolves, it’ll resume where we left off.
  - Prevents the browser from freezing while the request is happening

Getting Useful Data

"This function is pause-able"

Will eventually resolve to an actual JS object based on the JSON string.

Once we have the data, store it in a useful place.

```
async sendRequest() {
    let responsePromise = fetch("...");
    let response = await responsePromise;
    let parsingPromise = response.json();
    let parsedObject = await parsingPromise;
    this.setState({
        importantData: parsedObject
    });
}
```

Error Checking

Every response has a ‘status code’ (404 = Not Found). This checks for 200 = OK

On a complete failure (i.e. server isn’t running) an error is thrown.

```
async sendRequest() {
    try {
        let response = await fetch(“...”);
        if (!response.ok) {
            alert(“Error!”);
            return;
        }
        let parsed = await response.json();
        this.setState({
            importantData: parsed
        });
    } catch (e) {
        alert(“Error!”);
    }
}
```

Things to Know

- Can only use the `await` keyword inside a function declared with the `async` keyword.
  - `async` keyword means that a function can be "paused" while `await`-ing
- `async` functions automatically return a Promise that (will eventually) contain(s) their return value.
  - This means that if you need a return value from the function you declared as `async`, you'll need to `await` the function call.
  - But that means that the caller also needs to be `async`.
  - Therefore: generally best to not have useful return values from `async` functions (in 331, there are lots of use cases outside of this course, but can get complicated fast).
  - Instead of returning, consider calling `setState` to store the result and trigger an update.

More Things to Know

- Error checking is important.
  - If you forget, the error most likely will disappear without actually causing your program to explode.
  - This is BAD! Silent errors can cause tricky bugs.
  - Happens because errors don’t bubble outside of promises, and the `async` function you’re inside is effectively “inside” a promise.
  - Means that if you don’t catch an exception, it’ll just disappear as soon as your function ends.

Any Questions?

- Done:
  - HW9 Basic Overview
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  - Fetch

Wrap-Up

- Don’t forget:
  - HW8 due today (Thur. 12/2 @ 11:00pm)
  - HW9 due a week later (Thur. 12/9 @ 11:00pm)

- Use your resources!
  - Office Hours
  - Links from HW specs
  - React Tips & Tricks Handout (See “Resources” page on web)
  - Other students (remember academic honesty policies: can’t share/show/copy code, but discussion is great!)
  - Google (carefully, always fully understand code you use)