Lecture #18: Ajax and JavaScript Libraries and Frameworks

CS106E Spring 2018, Young

In this lecture, we take a look at Ajax, one of the most important technologies associated with JavaScript. Ajax allows us to contact web servers and retrieve information from them without switching to another webpage. Instead we use JavaScript to modify the current webpage.

We also look at different JavaScript Libraries and Frameworks you may encounter including jQuery, Twitter Bootstrap, Angular, and React.

Ajax
- Ajax allows Client-Side JavaScript programs to make an HTTP request to a webserver.
    - o Normally, when we send a request to the server, the server responds with a new HTML file that replaces the current webpage. That's not how Ajax works.
    - o Instead, the server's response is stored in program memory, where our Client-Side program can access it.
    - o Our program analyzes the response and dynamically change the current webpage in response to the new information from the server.

- Ajax is a critical technology for making single-page applications (SPA).
    - o An SPA is a website consisting of a single page.
        - ▪ The user visits that page, interacts with the page, the page changes and responds to the user's interactions, but never switches to a new page.
        - ▪ Google Maps and Gmail are both examples of Single Page Applications
            - • If I type in an address, Google Maps does not switch to another webpage. Instead, it updates the current webpage.
            - • Similarly if I click on mail message in Gmail, I don't go to a different webpage. Instead the mail message is returned from the server and part of the webpage is updated to show that mail message.
    - o SPAs require Ajax's ability to get data from the server, without switching from one webpage to another webpage.

- There are several different data formats used to send information from the server to our client-side program.
    - o XML (Extensible Markup Language)
        - ▪ We previously encountered XML in Lecture 10. As you may recall XML allows us to define new languages that contain tags, attributes, and values, similar to how HTML works.
        - ▪ Ajax applications can define their own XML languages to convey data from the server to the client.

- XML was the original method used for data transfer with Ajax, and in fact, Ajax originally was an acronym standing for Asynchronous JavaScript and XML. However, as XML is no longer the only format used to transfer information, Ajax is no longer considered an acronym, but simply a proper name.
  - o JSON (JavaScript Object Notation)
    - JSON is essentially sending JavaScript object literals.
      - We've previously seen that JavaScript Objects give us a lot of flexibility to define attribute-value pairs.
      - JSON has a slightly more restrictive syntax, but is essentially the same as storing information as JavaScript object literals.
      - You may also recall from Lecture 13 on Databases, JSON is the storage format of the popular No-SQL MongoDB database.
    - Given that we're already planning to process the information on the client using JavaScript, JSON makes a very straightforward data format.

Vanilla JavaScript / JavaScript Libraries / JavaScript Frameworks
- JavaScript programs that just use the support provided by the web browser along with the standard JavaScript language libraries is sometimes referred to as *vanilla JavaScript*.

- Historically programming vanilla JavaScript has been somewhat challenging
  - o Unfortunately web browsers all acted differently, requiring vanilla JavaScript code to determine which features a web browser supported and which it didn't.
  - o Microsoft's Internet Explorer, in particular, did not follow standards, and vanilla JavaScript programs often had to have two sets of code in places, one for web browsers following the World Wide Web Consortium (W3C) standard, and one for Internet Explorer.
- This led to the rise of the very popular jQuery library, which we'll take a closer look at in a moment.
  - o jQuery handled cross-browser problems for the programmer.

- More recently, web browsers have done a better job of following the W3C standard, and the last few versions of Internet Explorer and Microsoft's new Edge web browser now support standard code.

- Recently more powerful, full featured frameworks have appeared.
  - o Frameworks often have a very specific view of the world and how programs should be written.
  - o If your project fits in with the framework's model, these can give tremendous advantages.

jQuery
- jQuery has become a very popular library since its introduction just over a decade ago.

- jQuery provided several important advantages over vanilla JavaScript.
  - o Foremost, as I mentioned previously, jQuery handled cross web browser issues. Programmers using jQuery were able to write just a single set of code, and jQuery would ensure that it ran on all web browsers.
  - o jQuery also supported more sophisticated ways of selecting elements on a webpage for processing.
    - jQuery users could use CSS style selectors to choose elements on the webpage for further processing.
  - o In addition, jQuery provided other advanced features such as easy animation of webpage elements.
- However, many of the advantages of jQuery are no longer applicable.

- As mentioned above, modern web browsers have become far more standardized. Ensuring a vanilla JavaScript program works across web browsers is no longer the chore it once was.
- Vanilla JavaScript now has the ability to choose elements for processing using CSS rules, just like jQuery.
- CSS Animation provides animation support.

- Plusses for using jQuery,
    - jQuery has a huge installed code base. At this point, if you're working on a legacy project, there's a good chance it will be using jQuery.
    - Some very popular and useful libraries are built on jQuery (most notably Twitter Bootstrap, which we'll explore further in a moment).

- Minuses for using jQuery
    - As previously mentioned, vanilla JavaScript has improved considerably; jQuery no longer provides the advantages it once did.
    - New powerful frameworks, such as Angular 4, React, and Vue have a very different view of the world from jQuery.
        - While it is often possible to combine jQuery with these frameworks, it is not recommended, as their world views and coding styles may clash with jQuery's, leading to code that is harder to understand and maintain.

jQuery UI
- jQuery UI provides a variety of user interface widgets built on top of jQuery.
- For example, if you need to create a fancy menu that includes sub menus on your webpage, it is possible to build one from scratch, but jQuery UI has one pre-built for you.
- jQuery UI also makes it easy to support a number of different commonly used abilities to your webpage elements such as making an element draggable or resizable.

Twitter Bootstrap
- Twitter Bootstrap is also built on jQuery and provides a set of user interface widgets similar to jQuery UI.
- In addition, however, Twitter Bootstrap provides pre-defined classes for CSS that allow us to easily layout a webpage into columns of different sizes.
- Twitter Bootstrap allows us to select different column rules depending on the size of the user's screen – easily setting up different webpage layouts for cell phones, tablets, and laptops or desktops with large monitors.

Angular
- Angular is a framework developed by Google.
- The first version of Angular uses JavaScript and is sometimes referred to as AngularJS.
- There are two newer versions of Angular – Angular 2 and Angular 4.
    - These are built for TypeScript, a superset of JavaScript that supports static typing.

- AngularJS provides support for a concept called Model View Controller (MVC)
    - Using MVC we distinguish between data (the model) and views of the data.
    - In AngularJS, I can associate different form elements on the webpage with underlying variables representing those form elements.
        - For example, I can associate a text field with a JavaScript variable.
        - If I change the variable, the text field automatically changes to match the variable. If the user changes the text field, the variable is automatically updated.
- AngularJS also allows provides the ability to auto-generate HTML based on JavaScript data structures.

- For example, I could have an array of patient names, and a <ul> unordered list element. I could instruct angular to take that list of patient names and automatically generate list items in the unordered list for me.
    - If the list later changes, what appears on the webpage will automatically change as well.

React
- React is a relatively new framework that has been gaining a lot of popularity.

- React has a very declarative style.
    - You can think of it as allowing us to define new types of HTML-like elements.
        - These elements can be parameterized to take display different data.
    - For example, if I had a news website, I could define the following elements:
        - NewsItem elements for displaying different news items
        - A WeatherBox element for displaying the current weather.

        - I can combine these elements in different ways to create different looking news webpages.
        - I can take an array of news stories and combine it with my NewsItem element to populate my webpage.

- React is from Facebook.