Serverless Single Page Web Apps, Part One

CSCI 5828: Foundations of Software Engineering
Lecture 20 — 10/27/2016

Goals

- Introduce our second textbook:
  - Serverless Single Page Web Apps by Ben Rady
  - Discuss what you need to do to use the example code in the book

Example Code (I)

- This book makes use of a "prepared environment"
  - A GitHub repo that contains software to help automate interactions with Amazon Web Services; *to allow us to focus on learning the content*
- The GitHub Repo is located here:
  - https://github.com/benrady/learnjs.git
- **Do NOT clone this repository directly**
  - Instead, the book asks you to fork it
- Let's work our way through that process…

Example Code (II)

- To fork a repository, visit it in your web browser:
  - https://github.com/benrady/learnjs.git
- Click on the Fork button in the upper right (and follow any instructions)
  - This will create a copy of the repository in your user account
- Now, clone your own copy of the forked repository to your computer
  - So, for me, I would go to my laptop, and do something like

```
$ cd Projects

$ git clone git@github.com:kenbod/learnjs.git
```

- You should execute similar commands on your machine but use the URL from your own account **NOT** my account

Example Code (III)

- Now, you need to configure your repository such that you can get updates from the original repository (if and when they appear)
- To do that, on your local machine, go to the learnjs directory and type
  - `$ git remote add upstream https://github.com/benrady/learnjs.git`
- Then verify that the remote has been set-up correctly:
  - `$ git remote -v`
- You should see something like:
  - `origin   git@github.com:kenbod/learnjs.git (fetch)`
  - `origin   git@github.com:kenbod/learnjs.git (push)`
  - `upstream https://github.com/benrady/learnjs.git (fetch)`
  - `upstream https://github.com/benrady/learnjs.git (push)`
- Your origin URL will point to your own forked copy of the repo, however

Example Code (IV)

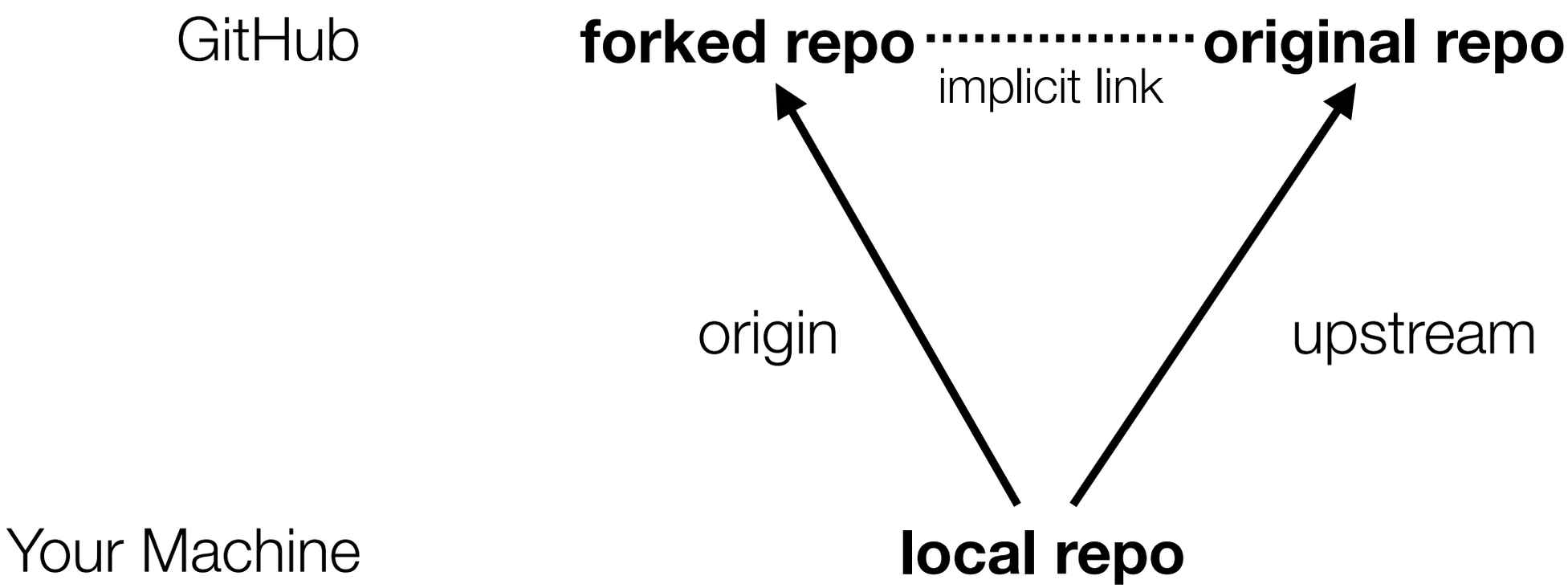
- We will be making changes to our local copy of the repository as we work through the chapters of this book
    - What should we do if the author publishes new commits to the original repository?
- The basic approach is the following
    - $ git stash
    - $ git fetch upstream
    - $ git checkout master
    - $ git merge upstream/master
    - $ git push
    - $ git stash apply
- What does this do?
    - (See next slide)

Example Code (V)

- Here's what the commands on the previous slide accomplish

1. **git stash:** Save your changes and set them aside; your repository goes back to the state stored in the HEAD of the current branch
2. **git fetch upstream:** Fetch the changes from the original repository; the changes are downloaded but NOT applied
3. **git checkout master:** Make sure you're on the master branch
4. **git merge upstream/master:** Merge the changes from the original repository to your local master branch; if you committed any changes to your local repository that conflict, you'll need to resolve the conflicts
5. **git push:** Assuming no conflicts, this command pushes the changes from the original repository to your forked repository on GitHub
6. **git stash apply:** Retrieve your changes saved in step 1 and apply them to the newly updated repository

Example Code (VI)



Example Code (VII)

- Contents of the example code
  - A shell script called `sspa` (used to automate various tasks)
  - A `public` folder that contains our initial website
  - Various support and configuration folders
- Dependencies
  - To run the shell script, you need to have python 2.7
  - You will also need to have the Amazon Web Services CLI
    - To do that, make use of Python's package manager, `pip`
      - `pip install awscli` or `sudo pip install awscli`
      - If you don't have pip, try: `(sudo) easy_install pip`

Serverless Web Applications

- Our goal is to look at a class of web applications known as "serverless" apps
    - These apps stand in contrast to most traditional web application frameworks: Ruby on Rails, Django, etc.
        - These frameworks help you develop web applications that live on the server and generate HTML/CSS/Javascript that executes on a client machine in response to HTTP GET/PUT/POST/DELETE requests
- With serverless apps, your first request to a server, downloads a set of HTML/CSS/Javascript that then handles all aspects of the web app ***within the browser on the client machine***
    - The server is used initially to get those files and then may be used to respond to requests made on web services hosted on the server
        - Or not… we might use web services hosted on OTHER servers

How is this possible?

- Web applications used to be located on the server side (and the vast majority still are) to handle things like
    - user credentials, storage of data, ability to make calls on 3rd party services
- But now, you can avoid the traditional n-tier architecture of web apps
    - client browser => load balancer => web server => app server => database
- and instead
    - use the web server as a delivery mechanism
    - all application logic lives in the browser
    - 3rd party web services handle everything else: user accounts, data, etc.
- All due primarily to the evolution of web standards: HTML5, ES6, CSS 3

Benefits of Serverless Design (I)

- **Avoid having to understand a complex web application framework**
- **No more servers! :-)**
  - You no longer have to worry about maintaining physical servers; you will instead host your app's files on a 3rd party service that simply delivers the app to the browser; someone else performs security updates, maintains file systems, etc.
- **Easy to Scale**
  - You can rely on cloud service providers to scale your application; our textbook looks at how AWS can help us scale up to large amounts of data and users if we need to

Benefits of Serverless Design (II)

- **Highly Available**
  - You don't have to bring your system down to upgrade it
  - You simply deploy a set of static files to the hosting service
    - Your users will see the update on the next full refresh on the client
- **Low Cost**
  - For small applications, your computational demands will typically stay in the range of a service's "free tier"; if you're at that level and your trial period expires, your costs are often "pennies per day"
    - When your needs go up, this approach still scales nicely; the book claims that its example app could scale to 1M users and still costs only "dollars per day"

Benefits of Serverless Design (III)

- **Microservice Friendly**
  - By running all your code in the browser, you can easily integrate new microservices or web services into your app
    - These services will follow OAuth workflows to "login" as a particular user and then be able to make calls on behalf of that user
      - You're not in the business of storing any of that data; the data is stored on the web service's computers
      - Your app might store some client-specific data but in the form of cookies on a client's machine or in a 3rd party service
- So, once again, you avoid the headaches that come with server side frameworks: how do I store client data in a safe and secure manner?

Benefits of Serverless Design (IV)

- **Less Code**
  - There is often a duplication of code that exists when using traditional web application frameworks
    - There's the HTML/CSS/Javascript in the client; it has logic about how to interoperate with the code on the server
    - There's framework code on the server that has to respond to those interactions
    - Change one, you need to change the other
- With serverless apps, all of this logic resides in one place: the client

Limitations

- *It's not all rainbows and butterflies*
  - adopting serverless web apps brings limitations and new techniques that are likely unfamiliar
- **Vendor Lock-In**
  - Our textbook makes use of AWS services; migrating to Google Compute Engine would not be trivial
- **Logging**
  - With traditional frameworks, all of your logging is done in one place; with serverless apps, your logs might be distributed across multiple services
- **Security and Identity Models**
  - Validating data becomes tricky with serverless apps; Identity/Logins makes use of 3rd party services that are initially unfamiliar
- **Big Money**: Usage spikes could impose BIG charges; you have to plan ahead

The Example App

- Our textbook is going to spend its time developing an application called LearnJS
    - It will be a quiz application that provides simple JavaScript questions to users who can submit answers and then see the results

Three Main Files

- Our app consists of three main files
  - index.html — content
  - app.js — logic
  - app_spec.js — tests
- In index.html, we can review the libraries that we depend on
  - Normalize, Skeleton, jQuery
  - vendor.js references JavaScript libraries that we need for AWS
- To run this on our local machine, head to the learnjs directory and type
  - $ ./sspa server
  - Then visit http://localhost:9292

DEMO

First Change

- Let's replace the boilerplate in index.html with the start of a landing page

```
<body>
  <div class='container'>
    <div class='row'>
      <div class='one-half column'>
        <h3>Learn JavaScript, one puzzle at a time.</h3>
        <a href='' class='button button-primary'>Start Now!</a>
      </div>
      <div class='one-half column'>
        <img src='/images/HeroImage.jpg'/>
      </div>
    </div>
  </div>
</body>
```

- We will learn about HTML, JavaScript, and CSS via osmosis

Let's Deploy

- Just like your semester projects, the first issue the book wants to tackle is deployment!
    - Since we don't need a server—just a place to deploy static files—we can get away with Amazon's S3 file service (Simple Storage Service)
- To make use of that, we need to create an account on Amazon.
    - What I did was I created a new e-mail account on Google
        - I then used that account to sign up for AWS at
            - https://console.aws.amazon.com
- Page 16 and 17 of the textbook step you through the process of then creating a user via the Identity & Access Management service
    - We use that "user" to generate the tokens we need to access AWS and to assign that user the rights to make use of those services

What will this cost?

- For the start of this project, we won't be taxing AWS in any way. We will stay within their "free tier" for quite a while.
- If/when our free tier expires, the size of the files that we're putting on S3 will only cost a few pennies per month
    - Nothing that will break the bank

Create a "bucket"

- Amazon S3 has the notion of a "bucket"
  - You create a bucket and then store things inside of it
  - Those items get referenced by things that look like file system paths
  - Those paths can then be combined with an "http" prefix and suddenly you have a URL that provides you with access to the data you put into the bucket
- To create the bucket, we use the sspa script:
  - `$ ./sspa create_bucket <bucket name>`
- I used:
  - `$ ./sspa create_bucket csci5828-f16-kena`
- You'll get back a URL like this:
  - `http://<bucket_name>.s3-website-us-east-1.amazonaws.com`
  - `http://csci5828-f16-kena.s3-website-us-east-1.amazonaws.com/`

Finally: Deploy the website

- We deploy our website to S3 using the `sspa` script
  - $ ./sspa deploy_bucket <bucket_name>
- Or, in my case,
  - $ ./sspa deploy_bucket csci5828-f16-kena
- You can then visit the URL on the previous slide to see your deployed website
- This initial work sets us up to explore the mechanics of single-page web apps next week!

Summary

- Introduced the notion of serverless single page web applications
  - Discussed benefits and limitations
  - Retrieved the "prepared workspace" and configured it
  - Took our first steps in developing and deploying our application

- Next week:
  - Chapter 2: Routing Views with Hash Events