IS216
Web
Application
Development II

Session 6

JavaScript – Part 3

(APIs, Axios, JSON)

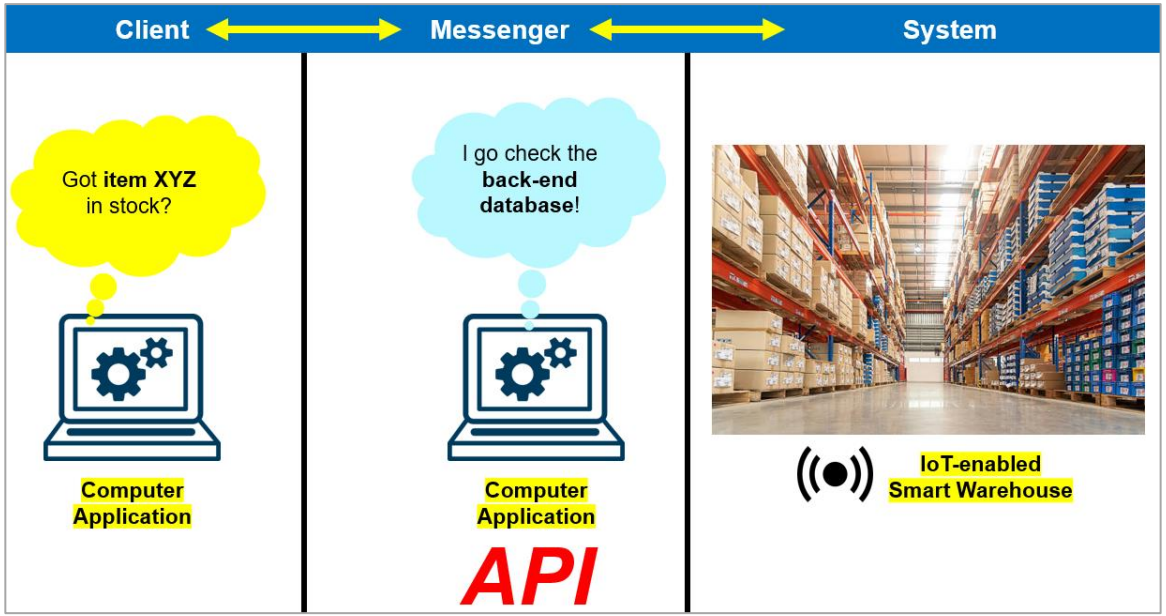
K. J. Shim

Sections: G1 / G2 / G3 / G11

Agenda

AXIOS {JSON}

APIs
- Axios & Async HTTP requests
- JSON Data Processing
- jQuery



Project (25%) - *Milestones*

- ***Initial*** **"Draft" Proposal Submission**
  - **(Week 8) 8-OCT-2021 (FRI) 12PM SG Time**
  - Fill out **ALL sections**
  - Teaching team will review and provide feedback by **Week 9 Monday 12PM SG Time**.

- ***Final*** **"Draft" Proposal Submission**
  - **(Week 9) 17-OCT-2021 (SUN) 12PM SG Time**
  - Address and resolve **ALL feedback comments/questions** by the teaching team.

- ***Consult Teaching Team*** (between **NOW** and **Initial Draft Proposal Submission**)
  - Look for us for ***discussion*** if you're UNSURE about any aspect of **proposal writing**.
  - You can add your **questions** as ***comments*** in your **Proposal Google Doc** – and simply **Slack DM** us to nudge us for help.
  - We can provide feedback/answers in the **Proposal Google Doc** or via online consultation.
  - Let us know how we can help you! Don't wait until the last minute please ~~

Source Code Files

eLearn → Content → Session 6 → In Class → **Week6.zip**

- **Unzip** it into your **webroot** (*any meaningful sub-directory), for example:*
  - (WAMP) C:\wamp64**www**\is216\…**Week6**
  - (MAMP) /Applications/MAMP/**htdocs**/is216/…/**Week6**

- You don't have to follow the above path – it's just an example.
  - But we DO strongly encourage you to keep source code files **organized** so that you can easily **search** them during **Lab Tests**

Things to Finish Before Session 7

1. Complete:
   - **JavaScript – Part 3 (API, JSON & AJAX) – Challenges 13, 14, 15**
   - **Resource files** (***Bootstrap 5.1 version !!!***) can be downloaded from **this link**
2. eLearn → Content → Session 7 → Before Class
   - Watch the video
   - Complete [Session 7] Pre-Class Quiz (Vue.js – Basics)

KrazyMatch

Business Problem

- *Singaporeans are **busy***. A 2020 news article showed that Singapore was world's 2nd most **overworked** city.

- *Singaporeans are **stressed***. A 2019 Straits Times article reported that **18%** of national healthcare expenditure was on stress-related illnesses annually.

Business Problem

- Recent studies have shown that **too many choices** exhaust people – making us **unhappy** and leading us to sometimes *abscond from making a decision all together*.
- In the 21st century, we have so many options that we get **stressed** every time we have to make a decision… because we're *worried about making the wrong decision*.

Solution

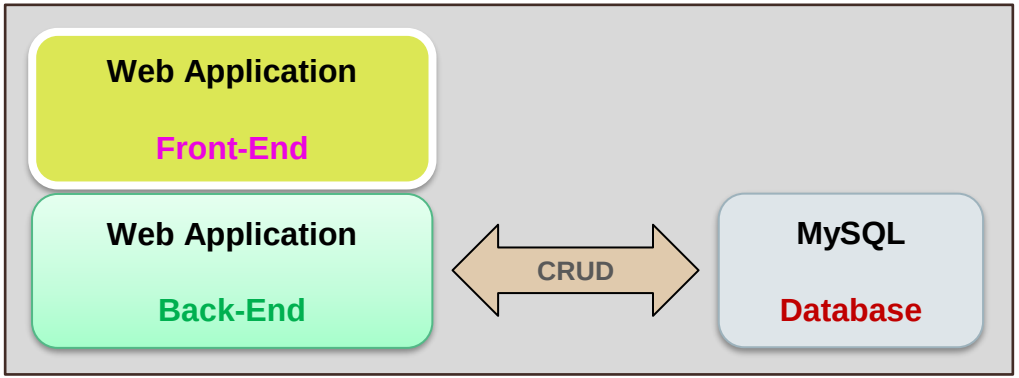
- Are you **busy**?
- Are you **stressed**?
- Are you **single** and looking for **the right someone**?

- Do you find yourself screaming
  "Goodness! ***Don't flood me*** with **choices**!
  Just **find me someone**!"

- **KrazyMatch** will *make that decision* ***FOR YOU***
- All you have to do is **Sign Up** today for **FREE**

Solution Architecture *(in IS113)*

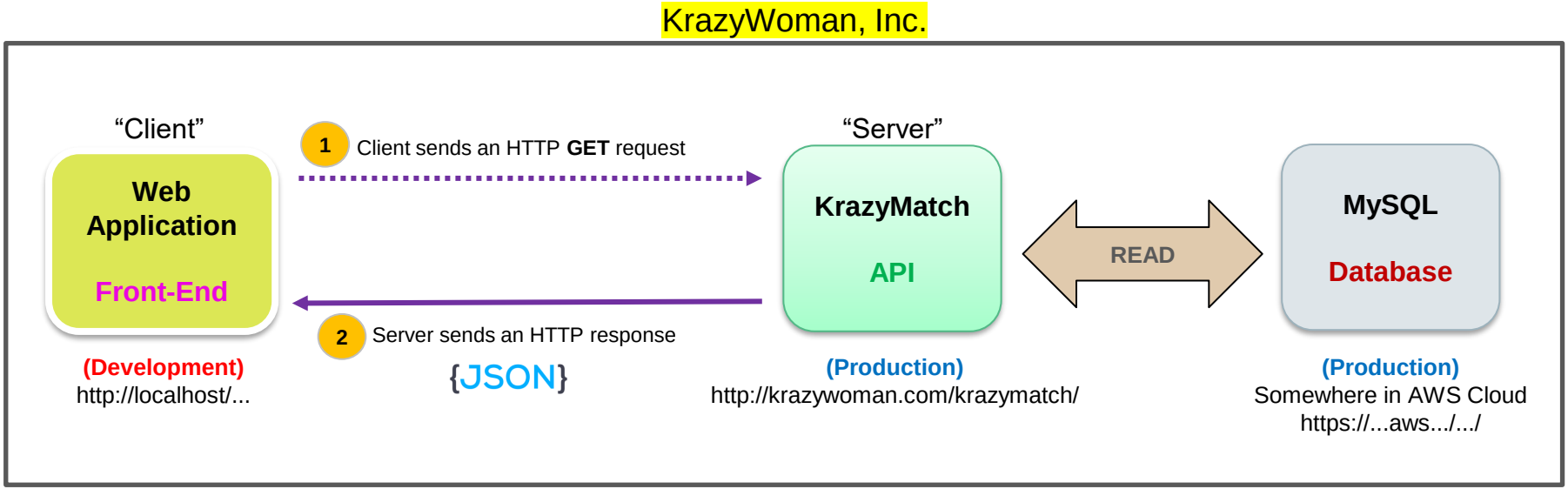
KrazyWoman, Inc.



(Development)
http://localhost/...

Front-End *&* ***Back-End*** *are* ***tightly coupled*** *(belong to the same code base)*
Web App *&* ***Database*** *reside on the same server* *(yikes! Single point of failure…)*

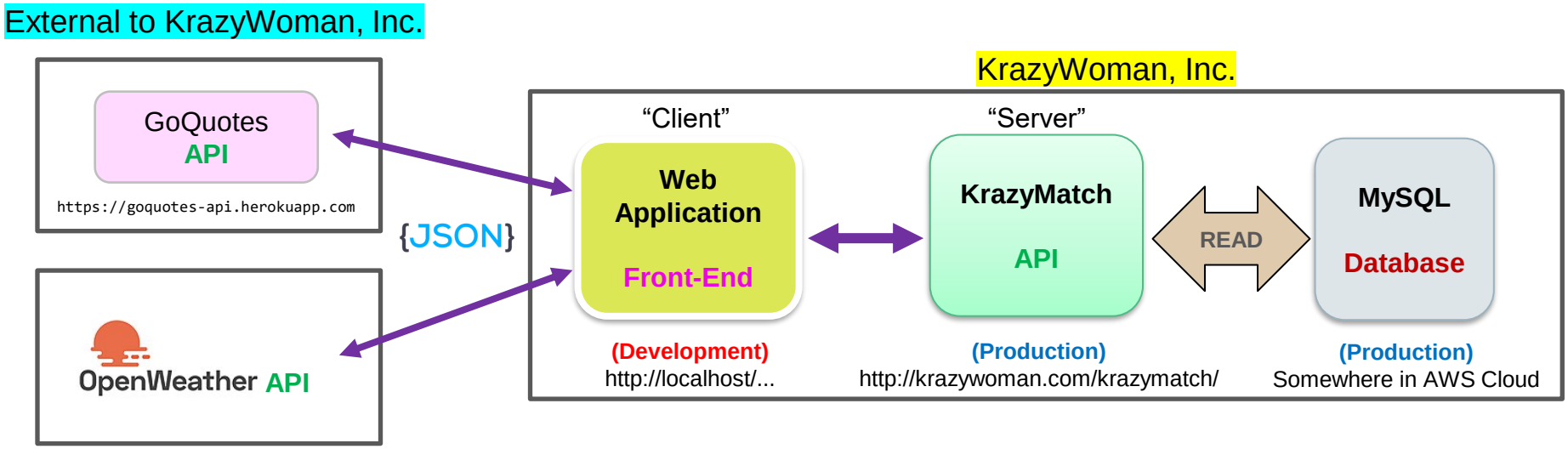
Solution Architecture *(Phase 1)*



Front-End Web App *&* ***API App*** *are* ***de-coupled***

Front-End Web App *&* ***API App*** *&* ***Database*** *are hosted in 3 different locations (no single point of failure)*

Solution Architecture *(Phase 2)*



KrazyMatch

(Phase 1)

Architecture Diagram

Tools & Dev Env Setup

- **Download & Install Postman**
  - https://www.postman.com/downloads/
  - **Sign Up** *(create an account)*
- **FollowMe → krazymatch**
  - Move **krazymatch** folder directly under your **Webroot**

Windows	`C:\wamp64\www\krazymatch`
Mac	`/Applications/MAMP/htdocs/krazymatch`

  - Follow me … to set up this **API** internally on **localhost**
    - **krazymatch → api → db → load.sql**
      - Go to http://localhost/phpmyadmin, log in, and import load.sql (or run the SQL statements inside the file by going to **SQL** tab)
    - **Krazymatch → api → config → database.php**
      - (If necessary) Change **username** / **password** / **port**
  - **Don't WORRY about the PHP code** – it's NOT tested in IS216. Treat it as a **black box** for the purposes of front-end web app development.
  - We WILL eventually make **KrazyMatchWebApp** (front-end app) call **krazymatch API** hosted **externally** at http://krazywoman.com/krazymatch/

(Mac) My MAMP won't start MySQL !!!

- Open Terminal
- Go to **/Applications/MAMP/conf/**
  cd **/Applications/MAMP/conf/**

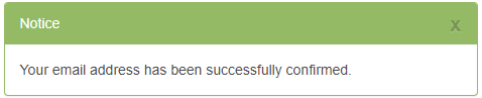
- Open **my.cnf**
- **sudo nano my.cnf**

- You will see a line that points to some **IS112** related folder path...
  - Go to the beginning of the line and put **#** (this will comment that line out)
  - You probably won't repeat IS112 so it's okay (or will you?)

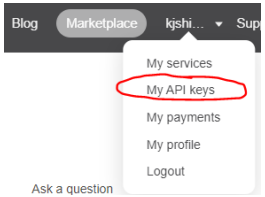
- Restart **MAMP**
  - You should see **Start** (GREEN) – indicating both Web Server & MySQL Server started successfully.

Tools & Dev Env Setup *(continued…)*

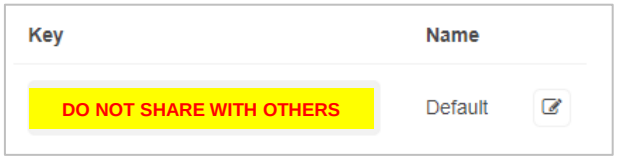
1. Go to https://openweathermap.org/ and **Sign Up** → ***Verify Your Email***



2. Sign In → (menu) → Click on your username → **My API keys**



3. You will see the **default key** → this is your **API Key**



It is NOT activated yet! It takes ~30 minutes to 1 hour.

LATER today… **You will need this API Key to programmatically CALL OpenWeatherMap.org's weather API endpoints**

Copy this API Key into a Sticky Note *(or somewhere on your computer for easy access – Do NOT share it with others)*

Follow Me (Code Together)

- **FollowMe → KrazyMatchWebApp**
  1. home.html → Click **Sign In**
  2. match.html
  3. match.js → code up
     - display_default()
     - call_krazymatch_api()
     - populate_today_pick_box()
     - process_not_my_type()
     - process_totally_my_type()

KrazyMatch

(Phase 2)

Architecture Diagram

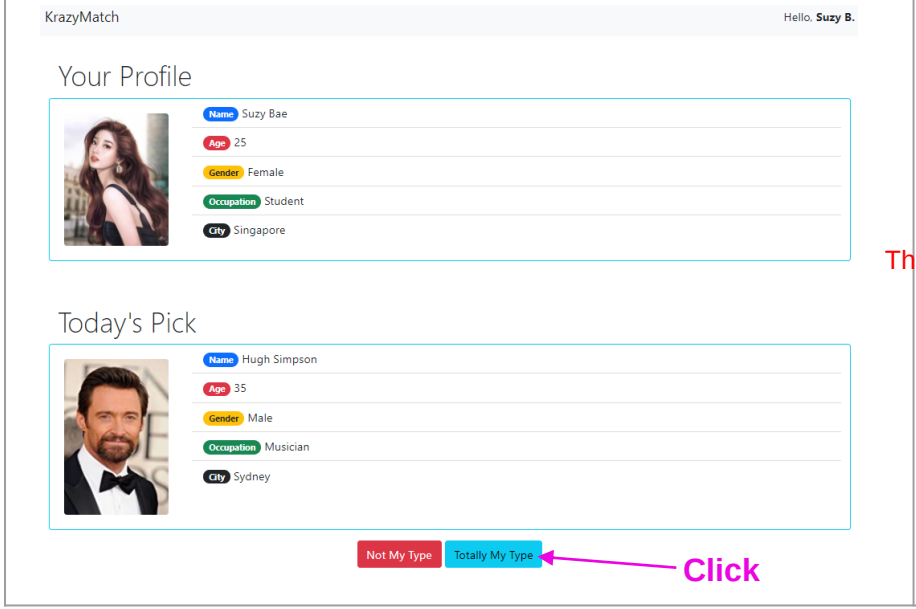
Follow Me (Code Together)

- **FollowMe → krazymatch**
  1. home.html → Click **Sign In**
  2. match.html
  3. match.js → code up:
     - display_default()
     - call_krazymatch_api()
     - populate_today_pick_box()
     - process_not_my_type()
     - process_totally_my_type()
     - call_quotes_api() → **Activity 1**
     - call_weather_api() → **Activity 2**

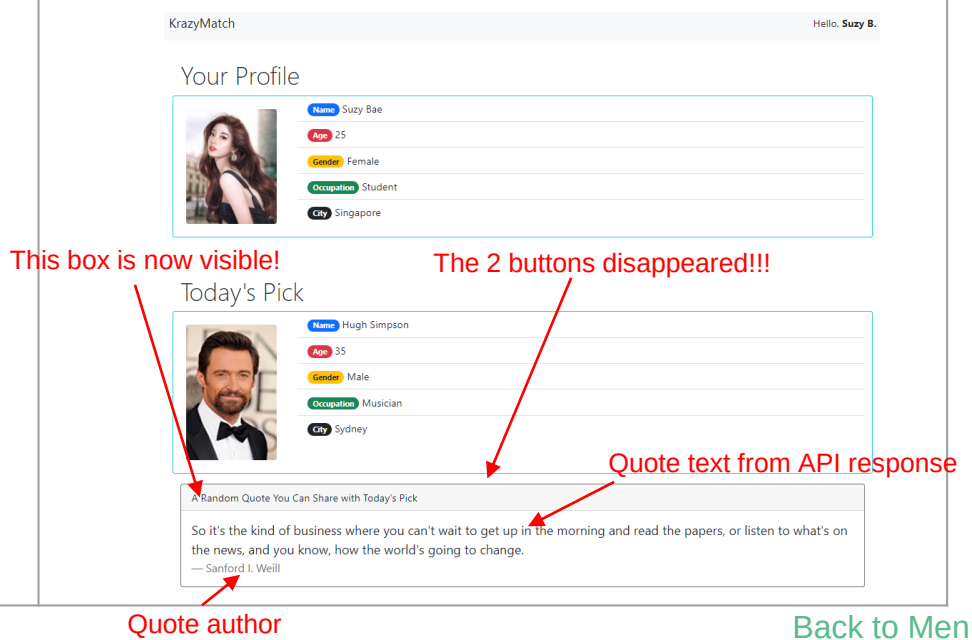
Activity 1: Quotes API (⭐⭐)

1. Complete `call_quotes_api()` such that it makes a request to the below **API endpoint**:
   `https://goquotes-api.herokuapp.com/api/v1/random?count=1`
2. Use **Postman** to ***test*** this API endpoint. Inspect the **response**. What does it have? What do you need to retrieve from the response?

match.html



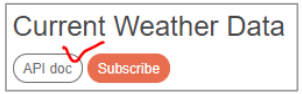
match.html
(**AFTER** clicking "Totally My Type" button)



Back to Menu

Activity 2: Weather API (⭐⭐)

1. Sign into https://openweathermap.org/
2. By now, you SHOULD have gotten your **API Key** and saved it on your local computer somewhere
3. Go to (menu) **API** → **Current Weather Data** → Click **API doc**



4. We will retrieve the **current weather info** for a certain **city** (e.g. **Singapore**).

API Endpoint

`http://api.openweathermap.org/data/2.5/weather?q=Singapore&appid=YOUR_API_KEY`

5. In **Postman**, test the above **API endpoint** with **city** "Singapore" and with **your own API Key**.
   - What **response** do you receive?

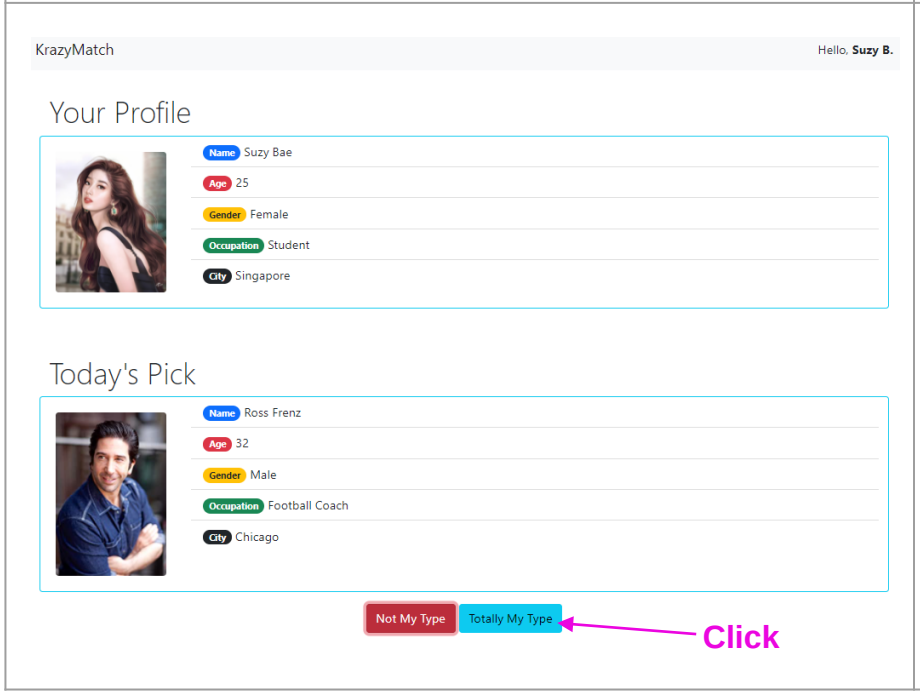
Go to the next slide for more instructions

Back to Menu

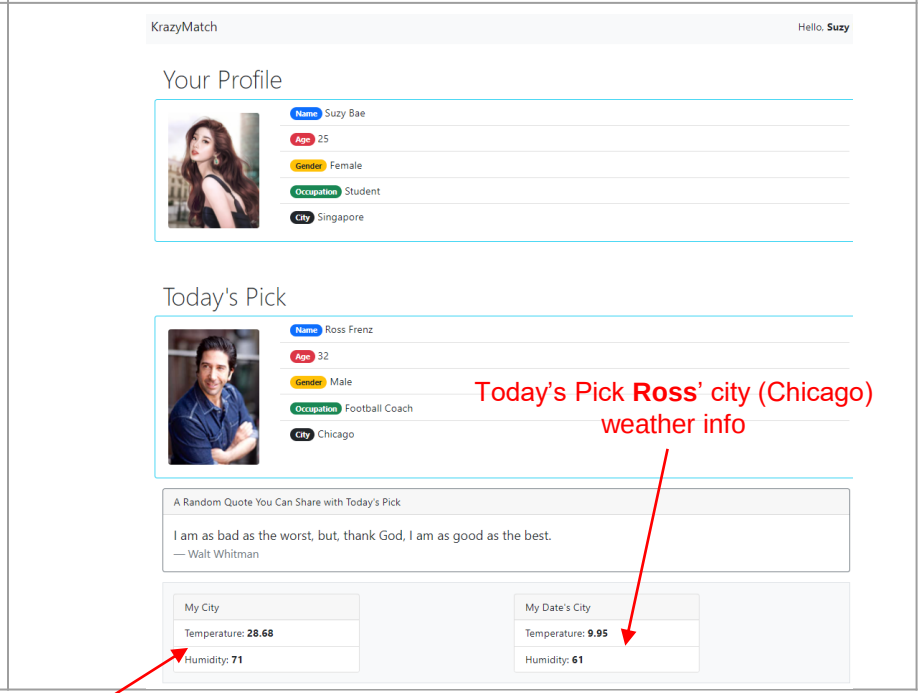
Activity 2: Weather API (⭐⭐)

Complete `call_weather_api()` such that it retrieves the **current weather info** of **Singapore** from OpenWeatherMap's API

match.html



match.html
(**AFTER** clicking "Totally My Type" button)



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Asynchronous HTTP Requests

What is Asynchronous Request?

- Asynchronous requests can be used to:
  - read data (e.g. JSON, XML, Text) from backend server - after the page has loaded
  - update a web page without reloading the page
  - send data to the server - in the background

- Compared to Synchronous requests (e.g. requests sent via HTML Forms),
  - less data usage, faster, more interactive

Axios

Promise based API for sending Asynchronous HTTP requests to backend server / REST endpoints and doing create/read/update/delete (CRUD) operations

Can be used with plain JavaScript or with frameworks like Vue.js

What is promise-based?
Shortly.

Basic Axios Methods

- Basic Axios Methods

  axios.get(url[, config])

  axios.post(url[, data[, config]])

- Axios Response Object
  - After sending an async. request, server returns a response.
  - Axios response object consists of:
    - data – payload
    - status – HTTP code (2xx, 3xx, 4xx)
    - statusText – HTTP status message (‘OK’, ‘Moved Permanently’, ‘Client Error’)
    - headers – information about the response, e.g. content type, cookies, etc.

How Does Axios Work?

1. import AXIOS library
2. execute GET/POST request to the endpoint of your backend server
3. Use the *then* method to act on the response result

Example: *wk6example1.html*

```
<script src="https://unpkg.com/axios/dist/axios.min.js"></script>
<button type="button" onclick="getAdvice()">Click Me!</button>
<script>
      function getAdvice() {
            axios.get(url)
            .then(response => {
                        // process response.data object
            })
            .catch(error => {
                        // process error object
            });
      }
</script>
```

How Does Axios Work?

Sending **GET requests with parameters**

Example: *wk6example2.html*

```
axios.get(url, {
                    params: {
                       name1 : value1,
                       name2 : value2
                    }
               }
)
.then(response => {
    // process response.data object
})
.catch(error => {
    // process error object
});
```

How Does Axios Work?

Sending **POST requests with parameters**

Example: *wk6example3.html*

```
axios.post(url, {
                    name1 : value1,
                    name2 : value2
                }
)
.then(response => {
    // process response.data object
})
.catch(error => {
    // process error object
});
```

JavaScript Arrow Functions

Arrow functions allow us to write shorter function syntax.

An arrow function is a function which has no name and is used once only.

Example

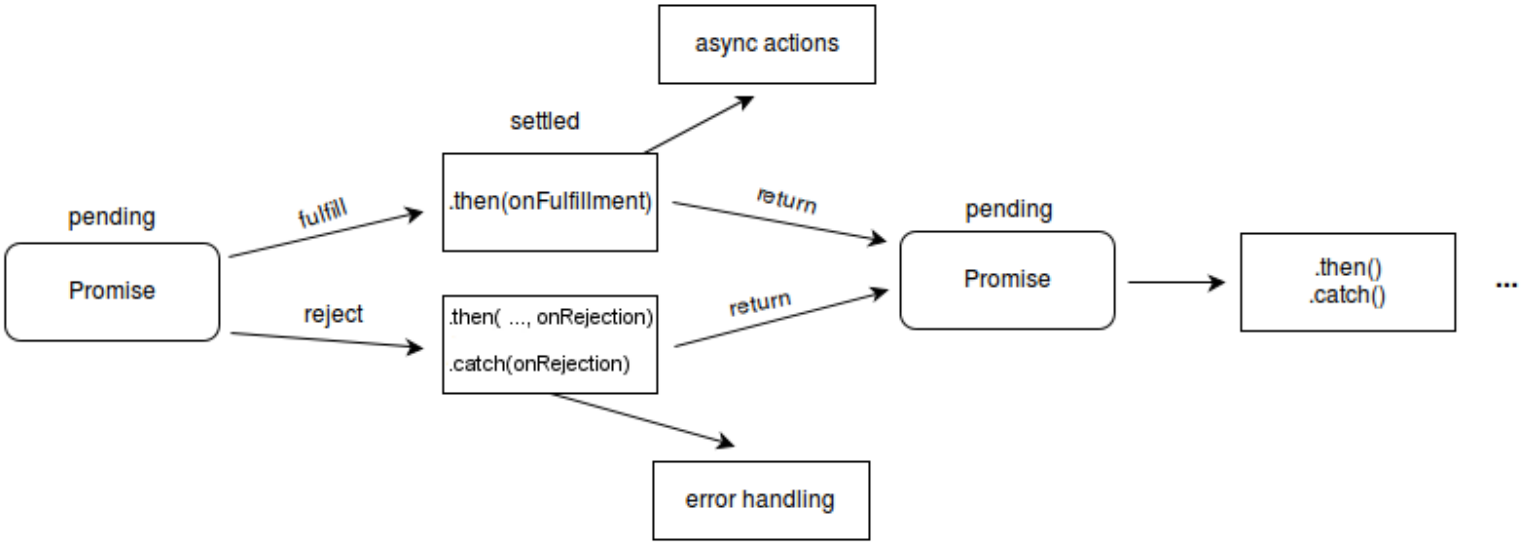
```
function onceFunc (msg) {
   return "Hello World!" + msg;
}
```

is equivalent to

```
msg => {
   return "Hello World!" + msg;
}
```

Promise

In JavaScript, a Promise is an object used as a proxy for a value not yet known (similar to Future in Java).



then() and catch()

Given a Promise object x,

x.then(fn) executes the function fn if the x is in a fulfilled state; and returns another Promise object; otherwise x is returned.

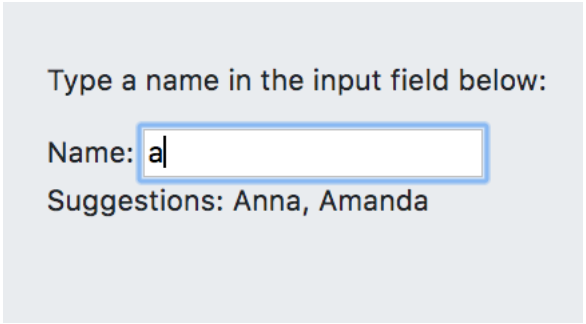
x.catch(fn) execute the function fn if x is in a rejected state; and returns another Promise object; otherwise x is returned.

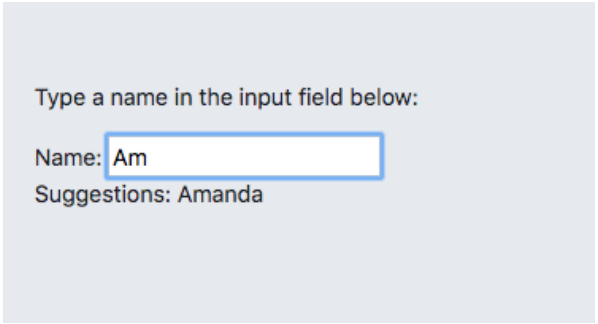
Example: *wk6example1.html*

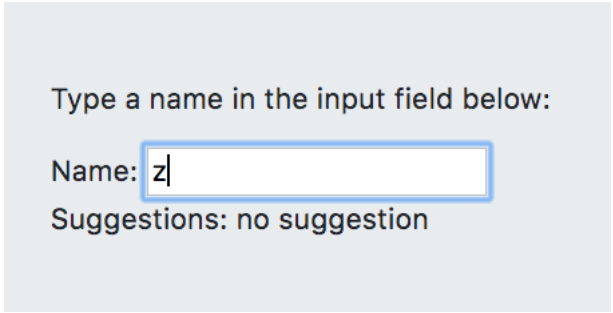
```
//returns a promise
axios.get('http://api.adviceslip.com/advice')

//call then to handle the good case
.then(response => {
    console.log(response.data.slip.advice)
  }
)

//call catch to handle the bad case
.catch(error => {
    console.log(error.message)
  }
)
```

Exercise 1: Search

- Given the resources: search.html, getHint.php (endpoint that returns Text data)
- Modify **search.html** such that when a user types a character in the input field (**onkeyup** event), a function called **showHint()** is executed, which suggests the possible names that the user is searching for.
- **showHint()** uses Asynchronous GET request to getHint.php to obtain those possible names

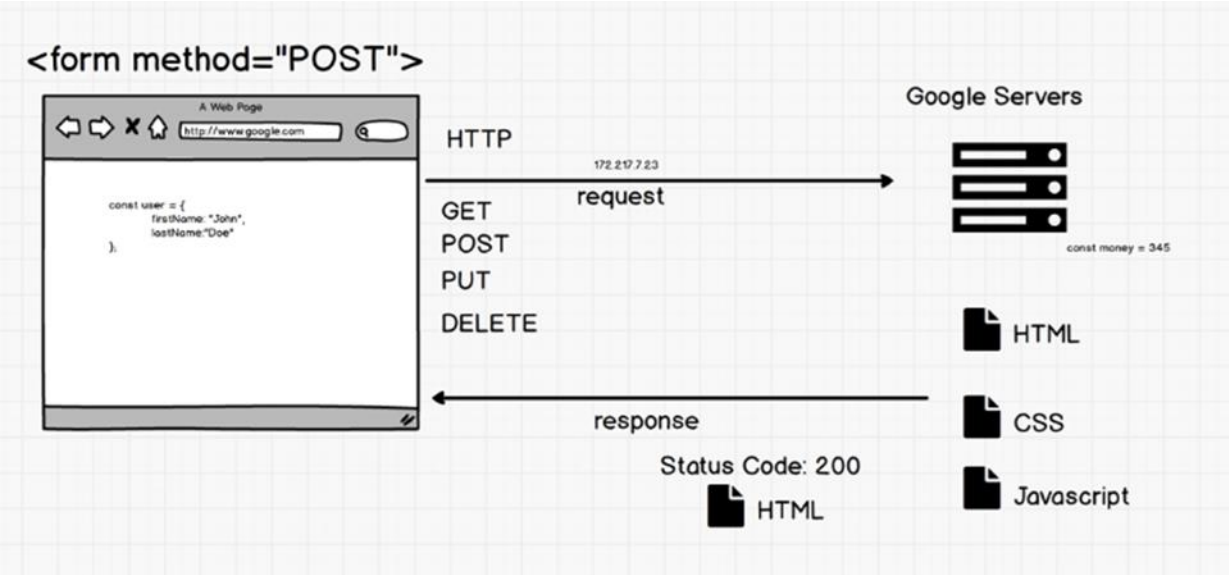






JSON

Why JSON?



You can’t just send JS objects directly to servers. Servers only understand Text. JSON or XML can be used to transfer data in text format.

JSON

What is JSON?

Lightweight data-interchange format for storing and exchanging data.

JSON has a JavaScript syntax but is text only.

JavaScript values/objects can be converted into JSON and send it to the server; JSON received from the server can be converted into JavaScript values/objects.

Language independent; can be used by any programming language.

Example:

```
{

   "coord": { "lon": 139, "lat": 35 },

   "weather": [
                  {
                     "id": 800,
                     "main": "Clear",
                     "description": "clear sky",
                     "icon": "01n"
                  }
               ],

    "base": "stations"

}
```

JSON Syntax

JSON objects are written in key/value pairs, separated by commas and surrounded by curly braces:

In JSON, keys must be strings, written with double quotes.

The file type for JSON files is ".json".

Example:

```
{
    "name" : "Mary",
    "age" : 26,
    "hobby" : [ "swimming", "badminton‟ ],
    "isMarried" : false
}
```

JSON Data Types

In JSON

There are 6 types: null, string, number, Boolean, JSON object, and array.

In Javascript

Function typeof returns 6 different values.

Object, boolean, function, number, string, and undefined

typeof([1,2,3]); // object!

Example: *wk6example4.html*

```
{
    "employee": {
        "name" : "Mary",
        "age" : 26,
        "hobby" : [ "swimming‟ ],
        "isMarried" : false
    }
}
```

```
"..." is string
26 is a number
[...] is an array
false / true: boolean
{ … }: object
```

Nested JSON

Nested Objects

```
person = {
            "name": "John",
            "age": 30,
            "cars": {
                        "car1": "Ford",
                        "car2": "BMW",
                        "car3": "Fiat"
                    }
        }
```

Nested Arrays

```
person = {
            "name": "John",
            "Age": 30,
            "cars": [
                        {  "name": "Ford",
                           "models": [ "Fiesta",
                                       "Mustang" ]
                        },
                        {  "name": "BMW",
                           "models": [ "320",
                                       "X3",
                                       "X5" ]
                        },
                        {
                           "name": "Fiat",
                           "models": [ "500",
                                       "Panda" ]
                        }
                    ]
        }
```

JSON vs Form Data

Form Data

Typically, we exchange data between client and server using forms (<form> tag) in HTML via POST or GET request

But this is a synchronous activity – request/response protocol

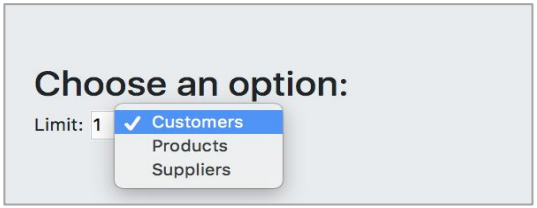
JSON

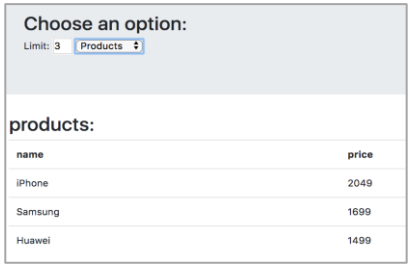
With JSON, we can also now grab the contents of the <input> in a form and submit those with JSON instead of form data

You can submit to server whenever you want through Asynchronous HTTP requests

Exercise 2: Dynamic Table

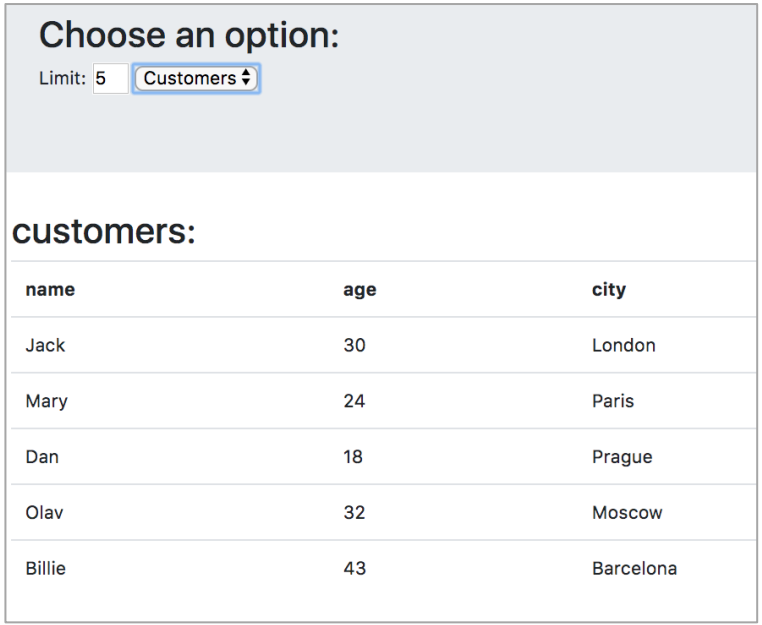
- Given the resources: info.html and getData.php (endpoint that returns JSON)
- Modify **info.html** so that it generates the HTML table dynamically based on the value of a drop down menu and the limit value
- Requirement: use Async. POST request to getData.php

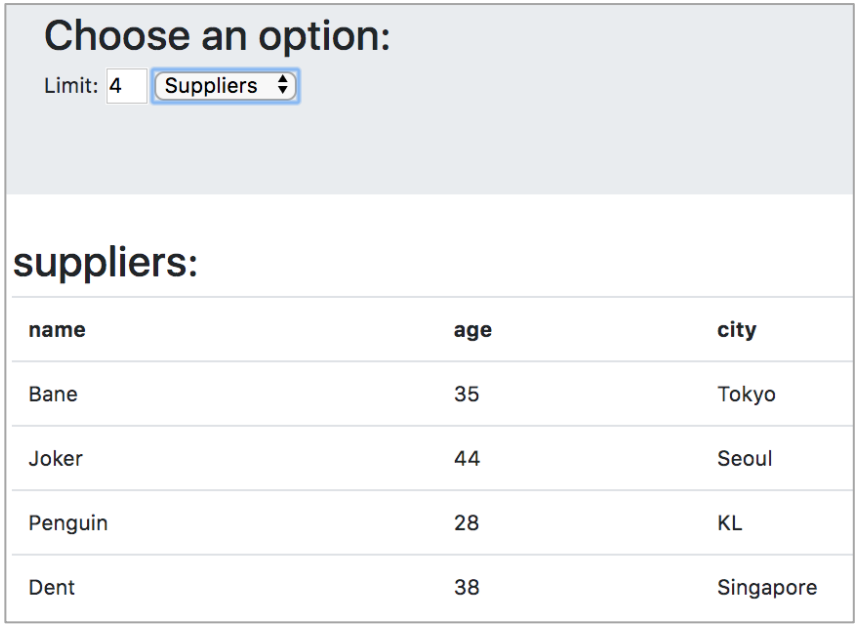




Exercise 2 ctd.

- Modify **info.html** so that it generates the HTML table dynamically based on the value of a dropdown menu and the limit value:





Extra Exercise (Optional): A Blog Service

In **Week6** folder, there is a sub-folder called **blog**.
- Copy this **blog** folder under your web server's **webroot**
- (Mac) **/Applications/MAMP/htdocs/blog**
- (Win) **C:\wamp64\www\blog**

Next, do the following:

1) Start your WAMP/MAMP server

2) Go to **http://localhost/phpmyadmin** and log in
- (Win) Username: root, Password: <empty>
- (Mac) Username: root, Password: root

3) After logging in, import **create.sql** into MySQL

4) Go to **ConnectionManager.php** and edit **password** and **port number** accordingly as per your local computer setup

Test Case

http://localhost/blog/getPosts.php

Go to the above URL in your web browser.

Make sure some JSON data is received.

Extra Exercise (Optional): A Blog Service ct.

Complete the TODO in extra-addpost.html so that it uses the service provided by addPost.php to add a new blog post.

Using Google Map APIs

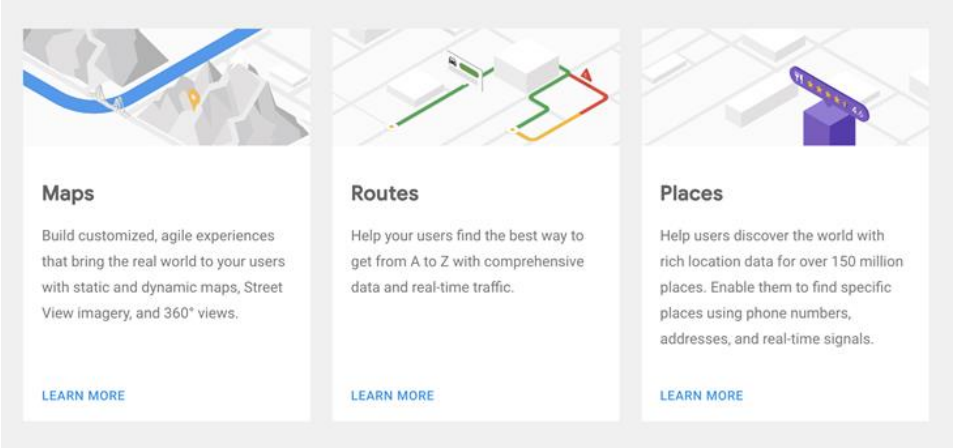
Google Map API

Google Map API

https://cloud.google.com/maps-platform/

API: Maps, Routes, Places, Gaming Solution and more

Google Maps JavaScript API V3 Reference



Google Map API

Have a look at this example.

Make sure you use your own Google Maps API key.

Given that you've keyed in a valid Google Maps API key, you should be able to see a map after the webpage has loaded in a web browser.

Example

wk6example5.html

Geolocation and Google Map

The HTML Geolocation API is used to locate a user's position.

HTML Geolocation API

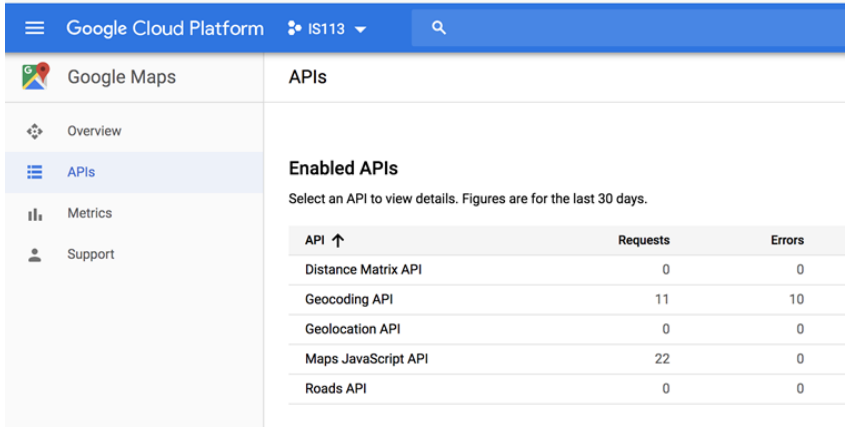
Geolocation API - Web APIs | MDN

Example: *wk6example6.html*

https://developers.google.com/maps/documentation/javascript/examples/map-geolocation#maps_map_geolocation-javascript

Exercise 3: Preparation

Enable Geocoding API.



Check your API key works using *wk6example6.html*

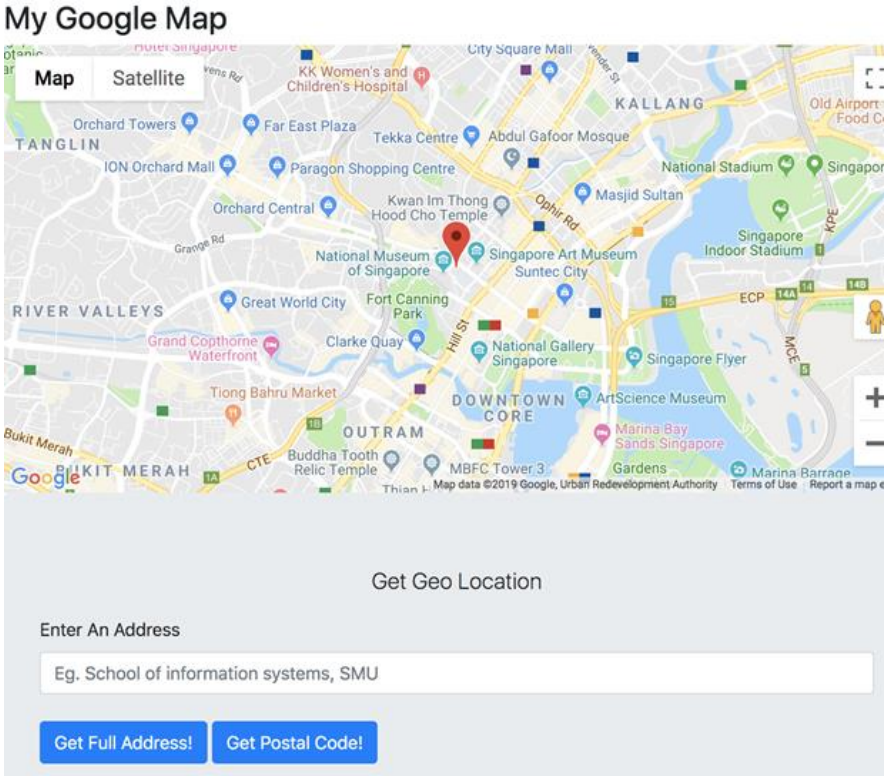
Try the following URL in your browser and make sure that some JSON data is received. Analyze the data a bit.

https://maps.googleapis.com/maps/api/geocode/json?address=1600+Amphitheatre+Parkway,+Mountain+View,+CA&key=**yourapikey**

Exercise 3

Given ex3.html, implement a client app (for geoencoding) such that given a street address, the app should show its geolocation on the map and put a mark.

The app should make use of Google's Geocoding API provided as web services.



Exercise 3 (Cont'd)

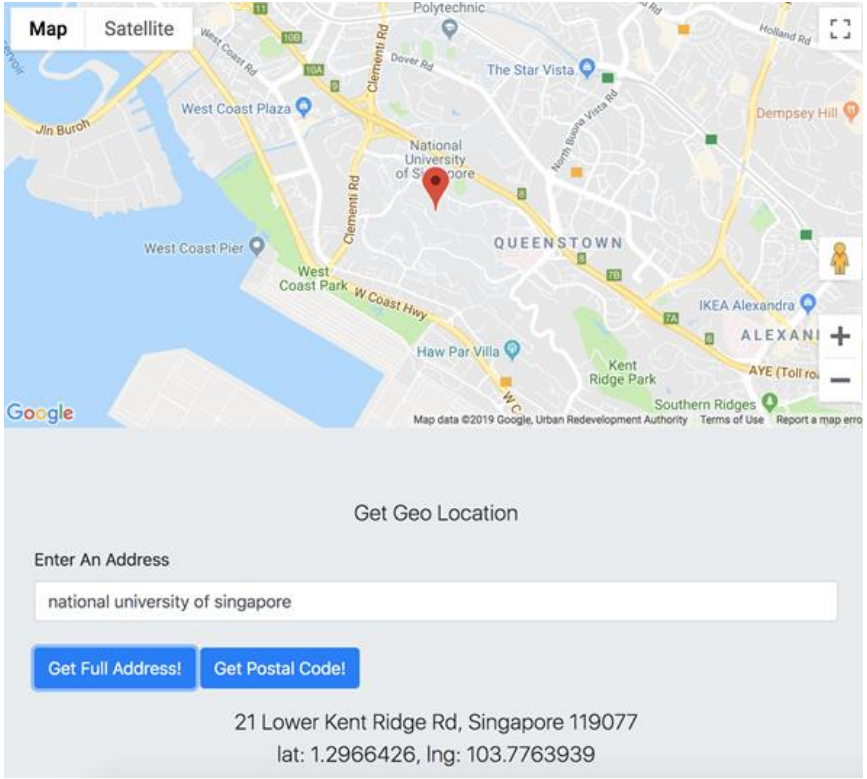
On page load, the app shows a map with a marker at a default address

It has an input field where the user can either enter a partial address or a postal code.

Upon clicking the button, the app shows the corresponding information.

Also the map automatically refreshes to the new address that the user just provided.

Your code should properly deal with invalid addresses.



Using Firebase Database

This topic is relevant to your **IS216 Project**
It will NOT be tested in Lab Tests/Final Exam

Firebase

Firebase

Firebase is a platform developed by Google for creating mobile and web applications.

It supports multiple databases.

Firebase Realtime Database

A realtime database which organizes data in the form of JSON.

One of the reasons for having a server is to have a database.

Firebase Realtime Database

No server required: Firebase Database can be accessed directly from a web browser; there's no need for an application server.

Realtime: data is synchronized across multiple devices efficiently.

Offline: Firebase database persists your data to disk when offline. Once connectivity is reestablished, the client device receives any changes it missed, synchronizing it with the current server state.

Firebase Realtime Database

Data are organized as a JSON tree

No table; no SQL.

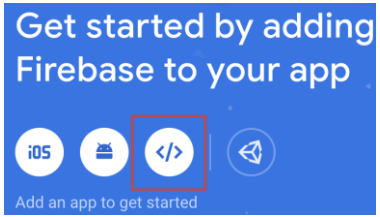
Add/delete/update data by modifying the JSON tree.

Retrieve data by retrieving one sub-tree at a time (so no mindful of the size of the subtree).

Firebase Realtime Database

Follow the steps here to enable Firebase Realtime Database

1. Sign-in Firebase using your Google account
2. Create a Firebase project
3. Register an APP

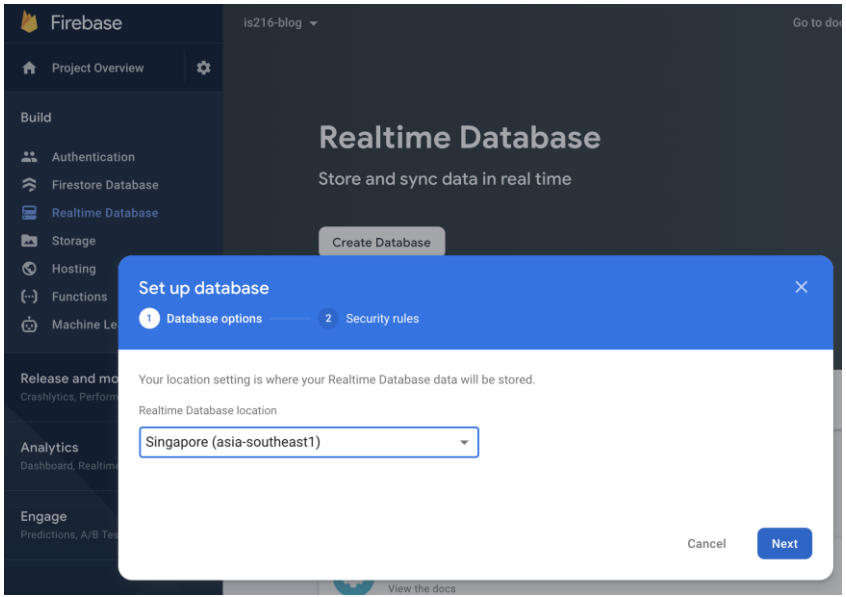


Now is a good time to set it up. Make sure that you are using a free plan (i.e., Spark plan)

Firebase Realtime Database ctd.

Build -> Real Time Database -> Create
Choose **test mode** instead of **locked mode**
(The Database URL will take a while to show up in your Firebase Config)

[Follow the instructions here to setup Firebase in your JavaScript]



Firebase Realtime Database

Store data

Add data into the database by growing the JSON tree with new nodes: using the set function.

API reference
https://firebase.google.com/docs/reference/js

Example: *wk6example7.html*

```
function writeUserDataWithCompletion(userId, name, email) {
  firebase.database().ref('users/' + userId).set({
     username: name, email: email
  }, function(error) {
     if (error) {
          ... //if error happens
     }
     else {
          ... //if no error
     }
  });
}
```

Firebase Realtime Database

Retrieve data

Retrieve data by obtaining a reference to the subtree and get a dataSnapShot **once**.

API reference
https://firebase.google.com/docs/reference/js

Example: *wk6example7.html*

```
function checkIfUserExists(userId) {
  var user = firebase.database().ref('users/' + userId);
  user.once('value').then((snapshot) => {
    if(snapshot.exists()) {
          ...
    }
    else {
          ...
    }
  });
}
```

Firebase Realtime Database

Retrieve data
React **on** certain data changes at a particular location.

API reference
https://firebase.google.com/docs/reference/js/firebase.database.Reference#on

Example: *wk6example7.html*

```
var users = firebase.database().ref('users');
users.on('child_added', (snapshot) =>{
    var today = new Date();
    var dd = String(today.getDate()).padStart(2, '0');
    var mm = String(today.getMonth() + 1).padStart(2, '0');
    var yyyy = today.getFullYear();
    today = mm + '/' + dd + '/' + yyyy;
    document.getElementById("latest").innerText = "Last user registered at " + today;
});
```

Firebase Realtime Database

Delete data

Delete data by obtaining a reference to the subtree and remove().

API reference

https://firebase.google.com/docs/reference/js

Example: *wk6example7.html*

```
function deregister(userId) {

  firebase.database().ref('users/' + userId).remove()
  .then(function() {
      ... //if success
  })
  .catch(function(error) {
      ... //if error occurs

  });

}
```

Firebase Realtime Database

Update data

Update data by obtaining a reference to the database and update().

API reference

https://firebase.google.com/docs/reference/js

Example

```
function updateEmail() {
   var userId = document.getElementById("id").value;
   var name = document.getElementById("name").value;
   var email = document.getElementById("email").value;
   var updates = {};

   updates['/users/' + userId + "/" + 'name'] = name;
   updates['/users/' + userId + "/" + 'email'] = email;
   firebase.database().ref().update(updates);
}
```

Exercise 4

Given *wk6example7.html*,

1. Update the project information to yours.
2. Enrich the page to display the total number of users who have registered. Note that the number should be updated accordingly when new users register or a user de-registers.

Hint: listen to database change through *reference.on(event, ...)*

Firebase Authentication

You should never store password in Firebase Realtime Database.

Use Firebase authentication instead.

Multiple authentication options are available.

https://firebase.google.com/docs/auth

Easiest option:
https://firebase.google.com/docs/auth/web/firebaseui

Example: *wk6example8.html*

Using Google authentication

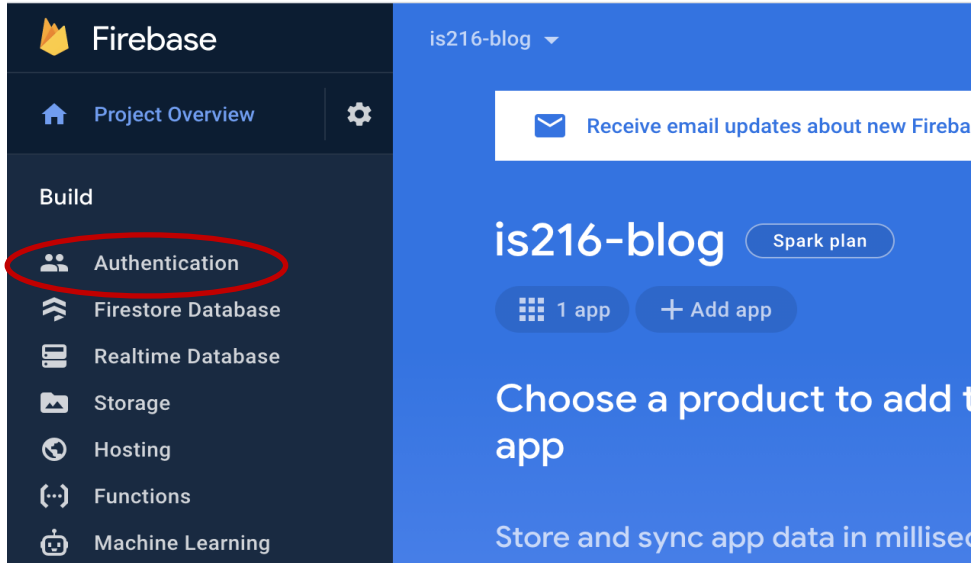
(To run the above file, start your WAMP server and access the file in your browser with the right URL, e.g., localhost/wk6example8.html)

Firebase Authentication

You need to enable “Authentication” in your firebase project

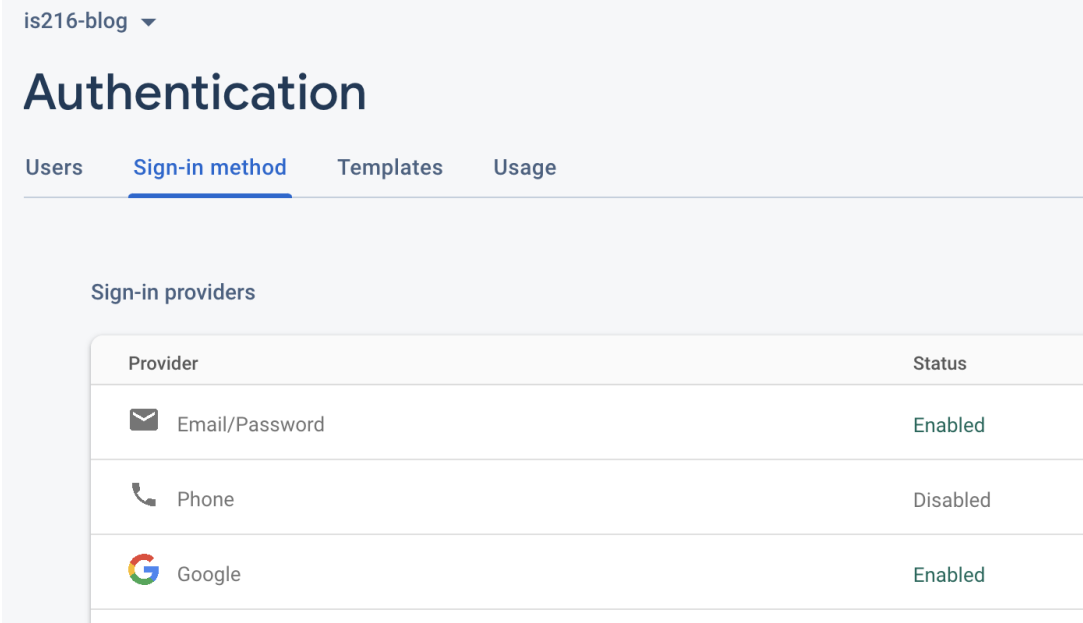
Go to your project console: https://console.firebase.google.com/u/0/

Select “Authentication”



Firebase Authentication

Choose your preferred “Authentication” option



Exercise 5

Given *wk6example8.html*,

1. Update the project information to yours.
2. Re-direct to the *wk6example7.html* page once the user logins in.

Hint: You will need to enable Firebase Authentication for Google Sign-in for this to work.

Firebase: More

Firestore

A newer version which is more scalable and reliable**.**

Firebase Realtime Database or Firebase?

https://firebase.google.com/docs/database/rtdb-vs-firestore

Or do we need to have a server?

Take-Away Message

JSON - a structured text for server-client communication

Axios – send asynchronous HTTP GET/POST requests

```
axios.get( url, { params: { ... } } )

.then( response => { ... } )

.catch( error => { ... } )
```