CS 572 Modern Web Applications

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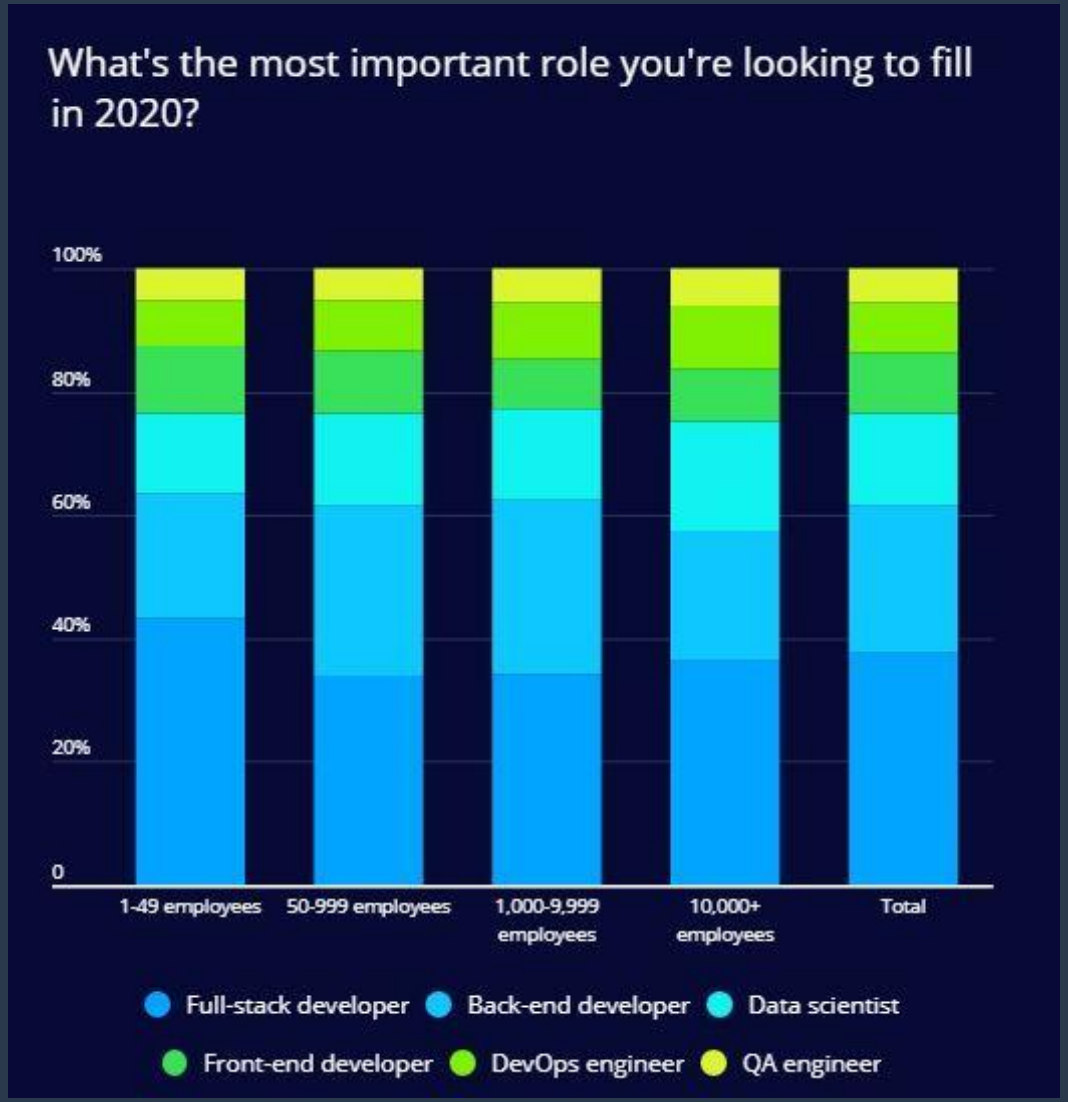
V3.0.0

Why Full Stack Development?

- The HackerRank Developers skills report 2020[1].
- Small companies hiring priority, 38% of hiring managers state full-stack as the number 1.



1- https://research.hackerrank.com/developer-skills/2020?

Full Stack Development

- Build the front end and back end of a website or web application.
- Front end: Interaction with browser.
- Back end: Interaction with database and server.
- Database driver application.

JavaScript Full Stack Development

- MongoDB
  - NoSQL database (document store)
  - Stores JSON documents
- Express
  - JavaScript web framework
  - On top of Node
- Angular
  - TypeScript UI framework
  - Single Page Applications
- Node
  - JavaScript server-side platform
  - Single threaded, fast and scalable

Introducing NodeJS & Express
Do Less Accomplish More

Wholeness

Writing everything from scratch is difficult and time-consuming. When you use a platform or a framework it performs most of the heavy lifting. You may only fully utilize a framework if you write code that is aligned with the framework expectations. You get the support of nature when your actions are aligned with the laws of nature, this results in actions being correct the first time, and there is no need to waste time correcting things.

No Frameworks

- We will start with nothing and build up.
- No opinionated frameworks (you are advised to investigate these in the future)
  - MEAN.io
  - MEANjs
  - Express Generator
  - Yeoman
- Frameworks are good for complex projects and for advanced users not good for learning and understanding for beginners.

Roadmap and Outcomes

- Node.js: write asynchronous (non-blocking) code. Understand node platform to start a project.
- Express: setup express and get requests and send back responses. REST API.
- MongoDB: what NoSQL DB looks like. Full API interacting with DB.
- Angular: Investigate Angular and the architecture of an Angular application. Build a single-page application.
- MEAN application: Learn by example. We will create a MEAN Games application.

Demo MEAN Games

Introducing Node & Express
Do Less Accomplish More

1. How to write a Node application?
2. How to write a web application in Node?
3. How to write an Express application?

Introducing Node & Express
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NodeJS

NodeJS and History

- Install Node from nodejs.org.
- Versions jumped from 0.x to 17.x
  - Due to the merge back from io.js to Node.js
  - Some original Node.js developers forked io.js why
    - community-driven development
    - Active release cycles
    - Use of semver for releases.
  - Node.js owned by Joyent had slow development, advisory board

Joyent Advisory Board

- Centralize Node.js to make development and future features faster.
- Board of large companies that use Node.js
- It moved Node.js from mailing lists and GitHub issues and developer's contribution to the power of the "big shots".
- Companies like Walmart, Yahoo, IBM, Microsoft, Joyent, Netflix, and PayPal were controlling things not the developer.
- The advisory board resulted in slower development and feature releases.

SEMVER

- Semantic Versioning
- MAJOR.MINOR.PATCH
- Major: incompatible API changes
- Minor: add backward compatible functionality
- Patch: add backward compatible bug fixes.

NodeJS

Check version

Run Node

Create and run node file

Install node from nodejs.org

node -v (or node --version)

v16.14.2

Check node package manager (npm)

npm -v

8.5.0

Start node

node

Print "Hello World!" from node

```
> console.log("Hello World!");
```

Hello World!

NodeJS

Check version

Run Node

Create and run node file

Start node

```
node
```

Write some JS

```
> var name = "Jack";
> console.log("Hello  "+ name);
Hello Jack
> name = 5;
> console.log("Hello  "+ name);
Hello 5
> .exit
```

NodeJS

Check version

Run Node

Create and run node file

vsCode (code.visualstudio.com has several MEAN plugins)

Create a file (instantHello.js)

```
let userName = "Jack";

console.log("Hello", userName);
```

Run file

```
node hello.js
```

```
Hello Jack
```

Modular Programming

- Best practice to have building blocks
  - You do not want everything running from a single file (hard to maintain).
- Separate the main application file from the modules you build.
- Separate loading from invocation.
- Each module exposes some functionality for other modules to use.

Modular Node

Multi files Node application
require to load file
Expose functionality using module.exports

Create app01.js file

```
require("./instantHello");
```

Run file

```
node app01.js
```

```
Hello Jack
```

Modular Node

Multi files Node application

require to load file

Expose functionality using module.exports

Create talk.js file

```
module.exports = function(){
  console.log("Goodbye");
}
```

app01.js file

```
require("./instantHello");
let goodbye = require("./talk");
goodbye();
```

Run file

```
node app01.js
```

```
Hello Jack
```

```
Goodbye
```

Exports

- Export more than one function.
- Encapsulation; reducing side effects, improve code maintainability.
- Avoid using .js in require. This will enable changing the structure of your modules in the future. If a file becomes complex, we can put it in a folder by itself as a module and make index.js backwards compatible.
- When require searches (require(name)):
  - Serach for name.js, if not found
  - Search for index.js in folder name
- Three ways to export
  - Single function
  - Multi functions
  - Return value

Module.exports

Single function

Multi functions

Return values

Create talk/index.js file

```
module.exports = function(){
  console.log("Goodbye");
}
```

app02.js file

```
require("./instantHello");
const goodbye = require("./talk");
goodbye();
```

Run file

```
node app02.js
```

```
Hello Jack
Goodbye
```

Module.exports

Single function

Multi functions

Return values

Create talk/index.js file

```
const filename = "index.js";
const hello = function(name){
  console.log("Hello", name);
}
const intro = function(){
   console.log("I'm a node file called", filename);
}
module.exports = {
   greeting : hello,
   intro
}
```

app02.js file

```
const talk= require("./talk");
talk.greeting("Jack");
talk.intro();
```

Run file

```
node app02.js
```

```
Hello Jack
I'm a node file called index.js
```

Module.exports

Single function

Multi functions

Return values

Create talk/question.js file

```
const answer = "This is a good question.";
module.exports.ask = function(question) {
    console.log(question);
    return answer;
}
```

app02.js file

```
const question= require("./talk/question");
const answer = question.ask("What is the meaning of life?");
console.log(answer);
```

Run file

```
node app02.js
```

```
What is the meaning of life?
That is a good question.
```

Single Threaded Node

- Node is single threaded.
  - One process to deal with all requests from all visitors.
- Node.js is designed to address I/O scalability (not computational scalability).
- I/O: reading files and working with DB.
- No user should wait for another users DB access.
- What if a user requests a computationally intense operation? (compute Fibonacci)
- Timers enable asynchronous code to run in separate threads. This enables scalable I/O operations. Perform file reading without everything else having to wait.

Async

setTimeout

readFileSync

readFileAsync

Named callback

app03.js file, setTimeout creates asynchronous code

```
console.log("1: Start app");
const laterWork = setTimeout( function(){
    console.log("2: In setTimeout");
}, 3000);
console.log("3: End app");
```

Run file

```
node app03.js
```

```
1: Start app
3: End app
2: In the setTimeout
```

Async

setTimeout

readFileSync

readFileAsync

Named callback

app04.js file

```
const fs= require("fs");
console.log("1: Get a file");
const buffer= fs.readFileSync("largeFile.txt");
console.log("2: Got the file", buffer.toString().substring(0, 21));
console.log("3: App continues...");
```

Run file, you notice a short delay between 1: ... and 2: ...

```
node app04.js
```

```
1: Get a file
2: Got the file This is a long file.
3: App continues...
```

Async

setTimeout

readFileSync

readFileAsync

Named callback

app05.js file

```
const fs= require("fs");
console.log("Going to get a file");
fs.readFile("shortFile.txt", function(err, buffer) {
   console.log("Got the file", buffer.toString().substring(0,
21));
});
console.log("App continues...");
```

Run file

```
node app05.js
```

```
Going to get a file
App continues...
Got the file This is a long file.
```

Async

setTimeout
readFileSync
readFileAsync
Named callback

app06.js file

```
const fs= require("fs");
const printFileFirstLine= function(err, file) {
   console.log("Got the file", buffer.toString().substring(0,
21));
}
console.log("1: Get a file");
fs.readFile("longFile.txt", printFileFirstLine);
console.log("3: App continues...");
```

Run file

```
node app06.js
```

```
Got the file
App continues...
Got the file This is a long file.
```

Benefits of Named Callbacks

- Readability
- Testability
- Maintainability

Intense Computations

- Avoid delays in a single threaded application server.
- If someone performs a task that takes too long to finish, it should not delay everyone else on a webserver.
- Computation is not I/O operations. Computations need a process to perform the operation.
- Spawn a child process to perform the computation. This will consume resources, but it will not block the main server.

Computation

Fibonacci

Blocking

Nonblocking

fibonacci.js file

```
const fibonacci= function(number) {
if (number <= 2) {
    return 1;
} else {
    return fibonacci(number-1) + fibonacci(number-2);
} } ;
console.log("Fibonacci of 42 is "+ fibonacci(42));
```

Run file, you will notice a delay (right)

```
node fibonacci.js
```

Fibonacci of 42 is 267914296

Computation
Fibonacci
Blocking
Nonblocking

app07.js file

```
console.log("1: Start");
require("./fibonacci");
console.log("2: End");
```

Run file

```
node app07.js
```

```
1: Start
Fibonacci of 42 is 267914296
2: End
```

Why is the dangerous and not a good idea?

Computation

Fibonacci

Blocking

Nonblocking

app08.js file

```
const child_process= require("child_process");
console.log("1: Start");
const newProcess= child_process.spawn("node",
["fibonacci.js"], {stdio : "inherit"});
console.log("2: End");
```

Run file

```
node app08.js
```

```
1: Start
2: End
Fibonacci of 42 is 267914296
```

Main Points
Introducing NodeJS & Express
Do Less Accomplish More

1. NodeJS is a single-threaded server-side JavaScript platform. We use modules in Node to write testable and maintainable code. We should be careful not to have computationally intense code blocking the Node platform. Science and Technology of Consciousness: The Unified Field is the ultimate platform. It is possible to experience it by anyone through the regular practice of Transcendental Meditation. Also, the most complex expressions in life do not block any other aspect of nature.

Introducing Node & Express
Do Less Accomplish More

1. How to write a Node application?
2. How to write a web application in Node?
3. How to write an Express application?

http Module

Modules

Written
Built-in
External

We can write out own modules, like talk module.

Built in modules are modules that come with node and are available for use. A built-in module can be used by simply requiring the model using "require(module_name)". The fs module is an example of built-in module.

External modules need to be downloaded then they can be used like built-in modules.

We will use the http Module to create a web application.

```
const http= require("http");
```

Is http a user, or built-in, or external module?

http

Setup

HelloWorld

HTML

JSON

app09.js file

```
const http= require("http");
const server= http.createServer();
server.listen(8080, "localhost", function(){
    console.log("Server is running on
http://localhost:8080");
});
```

Run file

```
node app09.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

Is the server running?

http

Setup

HelloWorld

HTML

JSON

app10.js file

```
...
const helloWorld= function(req, res) {
   res.writeHead(200);
   res.end("Hello World!");
}
const server= http.createServer(helloWorld);
...
```

Run file

```
node app10.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

Do you get a response?

http
Setup
HelloWorld
HTML
JSON

app11.js file

```
...
const helloWorldHtml= function(req, res) {
   res.setHeader("Content-Type", "text/html");
   res.writeHead(200);
   res.end("<HTML><BODY><H1>Hello
World!</H1></BODY></HTML>");
}
const server= http.createServer(helloWorld);
...
```

Run file

```
node app11.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

What is this response? How can you prove it?

http
Setup
HelloWorld
HTML
JSON

app12.js file

```
...
const helloWorldJson= function(req, res) {
   res.setHeader("Content-Type", "application/json");
   res.writeHead(200);
   res.end("{'message' : 'Hello World!'}");
}
const server= http.createServer(helloWorld);
...
```

Run file

```
node app12.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

What is this response? How can you prove it?

Web App

Serve Files

Better Serve

Error Handling

Routing

Create index.html (an html file)

app13.js file

```
const http= require("http");
const fs= require("fs");
const readIndexAndServe= function(req, res) {
   fs.readFile(__dirname + "\\index.html", function(err, buffer) {
      res.setHeader("Content-Type", "text/html");
      res.writeHead(200);
      res.end(buffer);
   });
}
const server= http.createServer(readIndexAndServe);
```

Run file

```
node app13.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

What type of server have we just created? Performance issue?

Web App

Serve Files

Better Serve

Error Handling

Routing

app14.js file

```
const http= require("http");
const fs= require("fs");
let indexFileBuffer;
const serveIndex= function(req, res) {
    res.setHeader("Content-Type", "text/html");
    res.writeHead(200);
    res.end(indexFileBuffer);
}
fs.readFile(__dirname + "\\index.html", function(err, buffer) {
    indexFileBuffer= buffer;
    server.listen(3000, "localhost", function() {
        console.log("Server is running on http://localhost:3000");
    });
});
const server= http.createServer(serveIndex);
```

Run file

```
node app14.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

Group Activity
Error Handling & Routing

- Split up in groups of 4 (at least one student should speak a different language than the rest of the group, more is better). Then attempt to answer the questions assigned to your group. After 5 minutes make sure you have 4 answers to share with the class.
- Even Group Number
  - What kind of errors should be handled?
  - How do we deal with each error?
- Odd Group Number
  - What is routing? What do we mean by routing in a web application?
  - Give two examples of different routings.

Students Answers

ERROR HANDLING

- File does not exists
  - Handel the error
    - Response with file not found (status 404)
- Error while read file
  - Yes handle
    - Response internal error (501)
- Empty file (content not html)
  - Do not handle

ROUTING

- Routing is finding a path for your data over a network.
- Providing different paths for a request/response.

Web App

Serve Files

Better Serve

Error Handling

Routing

app15.js file

```
…
let statusCode;
…
    res.writeHead(statusCode);
…
fs.readFile(__dirname + "\\index.html", function(err, buffer) {
    if (err) {
            indexFileBuffer= "File not found";
            statusCode= 404;
        } else {
            indexFileBuffer= buffer;
            statusCode= 200;
        }
    server.listen(3000, "localhost", function() {
        console.log("Server  is running on http://localhost:3000");
    });
});
```

Run file

```
node app15.js
```

```
Server is running on http://localhost:8080
```

Open your browser and enter http://localhost:8080

Change the name of inde.html and restart the application.

Web App

Serve Files

Better Serve

Error Handling

Routing

app16.js file

```
const http= require("http");
const fs= require("fs");
const serveAllRequests=  function(req,  res) {
  switch(req.url)  {
     case "/json"  :
       res.setHeader("Content-Type",  "application/json");
       res.writeHead(200);
       res.end("{'message'  : 'Hello  World!'}");
       break;
     case "/":
       res.setHeader("Content-Type",  "text/html");
       let statusCode;
       let fileBuffer;
       fs.readFile(__dirname  + "\\index.html",
function(err,  buffer) {
          if (err) {
            statusCode=  404;
            fileBuffer=  "File  not Found";
          } else  {
            statusCode=  200;
            fileBuffer=  buffer;
          }
          res.writeHead(statusCode);
          res.end(fileBuffer);
       });
       break;
  }
}
```

```
const server=
http.createServer(serveAllReq
uests);
server.listen(3000,  "localhost",
function() {
   console.log("Server  is
running on
http://localhost:3000");
});
```

...

Run file

```
node app16.js
```

Server is running on http://localhost:8080

Open your browser and enter http://localhost:8080

Main Points
Introducing NodeJS & Express
Do Less Accomplish More

1. NodeJS is a single-threaded server-side JavaScript platform. We use modules in Node to write testable and maintainable code. We should be careful not to have computationally intense code blocking the Node platform. Science and Technology of Consciousness: The Unified Field is the ultimate platform. It is possible to experience it by anyone through the regular practice of Transcendental Meditation. Also, the most complex expressions in life do not block any other aspect of nature.
2. We can write web applications with NodeJS using the built-in http module. The http module abstracts the web protocols and networking issues, enabling us to create a request-response-based application (page serving and routing). Science and Technology of Consciousness: The laws of nature govern all aspects of our life. We do not need to know all the details of all the laws to be able to gain the benefits. We focus on what is important to us and gain benefits. Water the root and enjoy the fruit.

Express

Introducing Node & Express
Do Less Accomplish More

1. How to write a Node application?
2. How to write a web application?
3. How to write an Express application?

Node Package Management (npm)

- Define and manage dependencies using npm.
- Using packages enables code reuse, and not writing things from scratch.
- Move code around and use latest versions of dependencies.

Using npm

- Creating package.json can be done with npm init
- Follow the steps npm gives you.
- Entry point: this is the file that will contain the application starting point (the file to run).
  - We use (app.js)
- This creates package.json having all the information you provided.
- Use it to add dependencies, installing packages, development vs testing dependencies, run scripts.
- Ignoring dependencies when uploading to git.

npm

Create

Add

Development

Install

Scripts

How to create package.json file

```
npm init
package name: (app17)
version: (1.0.0)
description: This is my first npm project
entry point: (index.js) app17.js
test command:
git repository:
keywords: MEAN
author: Najeeb Najeeb
license: (ISC)
Is this OK? (yes)
```

npm create package.json

package.json

npm

Create

Add

Development

Install

Scripts

Add dependency on Express (using npm command line)

```
npm install express
+ express@4.17.3
```

npm added express to package.json

ls or dir

node_modules

```
"license": "ISC",
"dependencies": {
   "express": "^4.17.3"
}
```

npm

Create

Add

Development

Install

Scripts

Add dependency on Express (using npm command line)

```
npm install mocha --save-dev
+ express@9.1.3
```

npm added mocha to package.json

```
...
"license": "ISC",
"dependencies": {
   "express": "^4.17.3"
},
"devDependencies": {
   "mocha": "^9.1.3"
}
```

^x.y.z: use x major and the latest minor and patch.

npm
Create
Add
Development
Install
Scripts

Dependencies are not uploaded to git
Dependencies should be installed after fetching code from git

npm install

Insall only production dependencies (on production server)

npm install --production

Create readme.md

"This repo contains the MEAN stack application that is built in CS572 Modern Web Applications course."

Ignore node_modules when pushing to git.
Create .gitignore file and fill it with

node_modules

npm

Create

Add

Development

Install

Scripts

Start script; shortcut to start your application.

```
"scripts": {
   "start": "node app17.js",
   "test": "echo \"Error: no test specified\" && exit 1"
}
```

Create file app17.js

To start the application:

```
npm start
```

```
> app17@1.0.0 start
> node app17.js
```

What is Express

- Web framework for MEAN stack.
- Listen to incoming requests and respond.
- Deliver static html files.
- Compile and deliver html.
- Return JSON.

Express Application

- Add dependency on Express.
- Require Express.
- Listen to requests (port) at URLs.
- Return HTTP status codes.
- Response HTML or JSON.

Express

Add

Listen

Application Variables

Callback

Create package.json

```
npm init
```

Add dependency on Express (using npm command line)

```
npm install express
```

app18.js file

```
const express= require("express");
const app= express();
```

Run the application:

```
npm start
```

The server terminates before we send a request!

Express

Add

Listen

Application

Variables

Callback

app18.js file

```
const express= require("express");
const app= express();
app.listen(3000); // Hardcoded more than one place :(
console.log("Listening to port 3000"); // Another place :(
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Nothing interesting, but we do have a server.

Express
Add
Listen
Application
Variables
Callback

app19.js file

```
const express= require("express");
const app= express();
app.set("port", 3000); // In one place
app.listen(app.get("port");
console.log("Listening to port "+ app.get("port");
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Same results but better software engineering, right? Why?

Express

Add

Listen

Application

Variables

Callback

app20.js file

```
const express= require("express");
const app= express();
app.set("port", 3000);
const server= app.listen(app.get("port"), function(){
   const port= server.address().port; // Get port from app
   console.log("Listening to port "+ port);
});
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Is this really a callback?

Environment Variables

- Hard coding values in code is bad.
  - Why?
- Best to have constants outside the program.
  - In Java we use property files.
  - In NodeJS we use environment variables.
- To read environment variables we use a package (dotenv).

dotenv

Install

Add

Use

Install dotenv package

```
npm install dotenv
+ dotenv@10.0.0
```

dotenv

Install

Add

Use

app21.js file

```
require("dotenv").config();
const express= require("express");
...
```

Create file .env and fill it with

```
PORT = 3000
```

dotenv

Install

Add

Use

app21.js file

```
require("dotenv").config();
const express= require("express");
const app= express();
app.set("port", process.env.PORT);
const server= app.listen(app.get("port"), function() {
   console.log("Listening to port", server.address().port);
});
```

Now you can change the port number outside of your program.

Don't forget to exclude the file from git (for security)

Update .gitignore (good idea to add lock file)

```
.env
package-lock.json
```

Routing using Express

- Routing is listening to requests on certain URLs and doing something on the server side then sending a response back.
- Route definition
  - HTTP method
  - Path
  - Function to run when route is matched

Routing

Define

HTTP Status

Data Response

File Response

app22.js file

```
require("dotenv").config();
const express= require("express");
const app= express();
app.get("/", function(req, res) {
    console.log("GET received");
});
const server= app.listen(process.env.PORT, function() {
    const port= server.address().port();
    console.log(process.env.MSG_SERVER_START, port);
});
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Are you getting a response? Is the server getting the request?

Routing

Define

HTTP Status

Data Response

File Response

app22.js file

```
require("dotenv").config();
const express= require("express");
const app= express();
app.get("/", function(req, res) {
    console.log("GET received");
    res.send("Received your GET request.");
});
const server= app.listen(process.env.PORT, function() {
    const port= server.address().port();
    console.log(process.env.MSG_SERVER_START, port);
});
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Routing
Define
HTTP Status
Data Response
File Response

app22.js file

```
require("dotenv").config();
const express= require("express");
const app= express();
app.get("/", function(req, res) {
    console.log("GET received");
    res.status(404).send("Received your GET request.");
});
const server= app.listen(process.env.PORT, function() {
    const port= server.address().port();
    console.log(process.env.MSG_SERVER_START, port);
});
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Routing
Define
HTTP Status
Data Response
File Response

app22.js file

```
...
app.get("/json", function(req, res) {
    console.log("JSON request received");
    res.status(200).json({"JSON_Data": true});
}
...
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000/json)

Routing

Define

HTTP Status

Data Response

File Response

app22.js file

```
const path= require("path");
…
app.get("/file", function(req, res) {
    console.log("File request received");
    res.status(200).sendFile(path.join(__dirname,
"app22.js"));
});
…
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000/file)

Express Serving Static Files

- Applications require foundations
  - HTML pages
  - CSS files
  - Images
  - JS libraries
- Easier to deliver static pages through Express directly.

Static Pages

Folder

Subset of routes

CSS

JQuery

IMG

app23.js file, after port definition and before routes we define the static folder (introduce middleware)

```
app.use(express.static(path.join(__dirname, "public")));
```

Create a public folder and add index.html into it.

Run the application

```
npm start
```

Check the browser (http://localhost:3000/index.html)

Check the browser (http://localhost:3000)

Static Pages

Folder

Subset of routes

CSS

JQuery

IMG

app23.js file

```
app.use("/public", express.static(path.join(__dirname, "public")));
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000/public/index.html)

Static Pages
Folder
Subset of routes
CSS
JQuery
IMG

CSS bootstrap Theam available from www.bootswatch.com/superhero (bootstrap.min.css)

Add the downloaded file to /public/css folder

Link CSS file to index.html file header section

```
<link href="css/bootstrap.min.css" rel="stylesheet" />
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Static Pages
Folder
Subset of routes
CSS
JQuery
IMG

JQuery from www.jquery.com/download/ (jquery-3.5.1.min.js)

Reference jquery in the page

```
<script src="jquery/jquery-3.5.1.min.js"/>
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

Static Pages
Folder
Subset of routes
CSS
JQuery
IMG

Create images folder

Go to (https://compro.miu.edu/) and obtain a copy of MIU logo, copy the image to the images folder

Add image to index.html

```
<a href="https://compro.miu.edu" target="_blank"><img src="/images/compro-web-logo-442x112.webp" height="60" alt="MIU Compro"></a>
```

Run the application

```
npm start
```

Check the browser (http://localhost:3000)

In class Exercise
Start Creating MEAN Games
Based on what we learned so far.

- Create a MEAN Games application (using npm init)
- Add dotenv
- Add Express
- Create a homepage (index.html), CSS, and image
  - Find index.html (in the resources folder)
  - Find custom.css (in the resources folder)