COMP 307
Principles of Web Development

MCGILL UNIVERSITY

COMP 307

Principles of Web Development

Lecture 14

Unit 4 – Servers

MERN (part 1)

Contents

MERN
Node.JS

Class Outline

- Introduction to MERN
- About single paged websites
  - And what Facebook needed to solve.
- Introduction to NodeJS

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Readings

- MyCourses Resource Folder
  - MERN Resources PDF
- Internet Resources
  - https://nodejs.dev/en/learn/how-to-install-nodejs/
  - https://nodejs.org/en/download
  - https://radixweb.com/blog/installing-npm-and-nodejs-on-windows-and-mac
  - https://www.geeksforgeeks.org/installation-of-node-js-on-windows/
  - https://www.w3schools.com/nodejs/

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Introduction to MERN

MERN (part 1)

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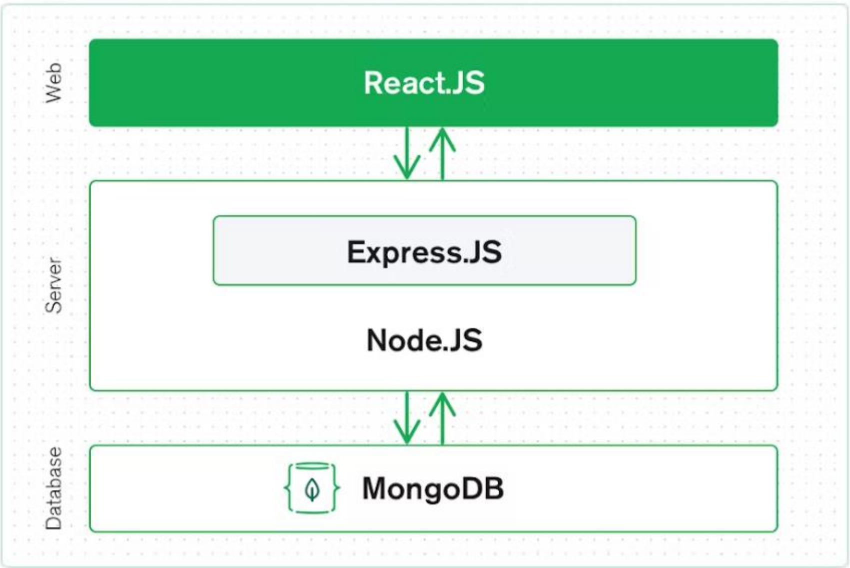
Mongo Express React Node

What is the MERN stack?

- Browser → React.JS library (like Vue.JS)
- Server:
  - Server → Node.JS
  - Tools → Express.JS (we will code in Node.JS)(optional)
- Database (optional) → MongoDB (not today)



The MERN Stack

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What is React?

- **React** (also known as **React.js** or **ReactJS**) is a free and open-source front-end JavaScript library[3] for building user interfaces based on UI components.
  - Maintained by Meta (formerly Facebook) and a community of individual developers and companies.[4][5][6]
  - React can be used as a base in the development of single-page or mobile applications.
  - However, React is only concerned with state management and rendering that state to the DOM, so creating React applications usually requires the use of additional libraries for routing, as well as certain client-side functionality.[7]
  - React was created by Jordan Walke, a software engineer at Facebook.

allows you to
do component
things easily

react is like an extra DOM

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Why React?

- Good question
  - HTML, CSS and JS does everything you want
- Benefits
  - Facilitates **single page applications**
  - Built-in call-back life cycle
  - JSX (extension to JS language using XML)
  - Can render to <canvas> and <DOM>
  - Combine with Flux and replace MVC with Observer Pattern
    - (Flex: chapter 18 from our textbook)
  - Unidirectional data flow (like in C and Java)

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What is a single page application?

- A website that exists within a single HTML file
- Requires deep connectivity with the server database
- The single page provides a skeleton
  - Branding, nav bar, contents, colors, style, and flow
  - Interactive, responsive and dynamic elements
- The contents of the skeleton is populated through queries with the server database.
- Since Browser JS can manipulate the DOM then a JavaScript-based solution is obvious
  - However, you can do equivalent with Python & PHP

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What did Facebook need to solve?

- Facebook was moving away from desktop interfaces to mobile since most users interacted with Facebook from their phones.
- Phones are not ideal platforms for multi-paged websites, but they do work well as an app.
- This led to the idea of a single webpage that behaves like an app.
- It permitted a common code-base for all platforms: desktop, tablet, and mobile.

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What is Node.JS?

- A webserver that executes JavaScript
- A collection of web services without a main()
- You provide the body of main()
  - i.e. you create the run-time environment you want
  - Unlike in Apache where you are given a run-time environment
  - Some people to do not want to create the run-time environment, so they install Express.js
- Why Node.JS?
  - Popularity of JavaScript
  - Community interest to learn fewer internet languages
  - MongoDB's new database design and its association to MERN

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Databases and MERN

- Node.js can connect to any database
  - Traditionally, Apache connects to SQL
  - Traditionally, Node.JS connects to MongoDB
  - But this is artificial, you can mix and match
- Servers require permanent storage otherwise they forget information about users.
  - File storage provides a means to store permanent information
  - Option 1: User creates directories and files (like in COMP 206)
    - Requires technical knowledge and directory access
  - Option 2: Server uses CSV
    - Very fast for small data sets or large simple data streams.
  - Option 3: Server uses Databases
    - Great for complex information and large data sets

Unit 5 & 6 for uses

Unit 5 for SQL & Mongo

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Introduction to Node.JS

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Getting Node.JS

- Install Node
  - https://nodejs.org/en/
- Use any IDE or text editor to write scripts

yes to
Change path, reboot
so you can type
node in any folder
to run the
server

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Setting up your first server

- Create a directory called Server
- Create the main() script for Node.js

packet coming in

packet that will go out at end of function

main →

```
var http = require('http');
var url  = require('url');

http.createServer(function (req, res) {
  res.writeHead(200, {'Content-Type': 'text/html'});
```

← goes to header

```
  var q  = url.parse(req.url, true);

  var txtURL = "URL: "            + req.url;
  var txtHOST= "<br>HOST: "   + q.host;
  var txtPATH= "<br>PATH: "   + q.pathname;
  var txtSRCH= "<br>SEARCH: " + q.search;
```

comes from string

```
  var qdata  = q.query;
  var txtQRY = "<br>QRY: "    + qdata.year + " " + qdata.month + "<br>";

  res.write(txtURL);
  res.write(txtQRY);
  res.write(txtHOST);
  res.write(txtPATH);
  res.write(txtSRCH);
```

} goes to payload

```
  res.end();
}).listen(8080);
```

port

myserver.js

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Running the server

- In command-line mode
  - CD to Server
  - Type: node myserver.js
  - The server runs under http://localhost:8080
    - Simply type above URL on the browser to see

```
URL: /                         /hello                         hello ?month...
QRY: undefined undefined       undefined undefined            2023 oct

HOST: null                     null
PATH: /                        hello
SEARCH: null                   null
```

- Try: http://localhost:8080/hello ←
  - What do you see?

cgi way of sending data

- Try: http://localhost:8080/hello?month=abc&year=def ←
  - What do you see? What is happening? Let us look at the code.

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Looking at the code

```
var http = require('http');
var url  = require('url');

http.createServer(function (req, res) {
  res.writeHead(200, {'Content-Type': 'text/html'});

  var q   = url.parse(req.url, true);

  var txtURL = "URL: "              + req.url;
  var txtHOST= "<br>HOST: "   + q.host;
  var txtPATH= "<br>PATH: "    + q.pathname;
  var txtSRCH= "<br>SEARCH: " + q.search;

  var qdata  = q.query;
  var txtQRY = "<br>QRY: "    + qdata.year + " " + qdata.month + "<br>";

  res.write(txtURL);
  res.write(txtQRY);
  res.write(txtHOST);
  res.write(txtPATH);
  res.write(txtSRCH);

  res.end();
}).listen(8080);
```

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A better server (no DB)

- See source files:
  - myserver2noDB.js
  - utils.js

on mycourses

Let’s break it down

- Notice how the code does:
  - Modularizes by functions & utility file
  - Notice main() and router() division
  - Notice GET and POST division
  - Notice internal to server functions to execute website
    - This is different from have PHP or Python or C programs on the server’s hard disk that need to be found by the OS and then launched in an OS shell.
    - Provides faster execution at the expense of keeping everything in RAM.

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A better server (no DB)

fs → file system

- Let us try it out
- Type, what does it do, where in the code:
  - http://localhost:8080 → get route not valid
  - http://localhost:8080/function → undefined undefined
  - http://localhost:8080/function?month=oct&year=2023 ↳ 2023 oct
  - http://localhost:8080/summer → summer
  - Now view & run the post.html file

only exported methods are public

Later we will look at server3.js with DB

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Prepare for Next Class

- Assignments
  - Mini 5 due
  - Mini 6 out
- Lab this week
  - Lab C
- Do on your own
  - Install Node.js and run the sample programs as shown in class.