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15CSE337
Cloud Computing and Services

Node.js

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MEAN STACK

- The Friendly & Fun Fullstack JavaScript framework

MongoDB is the leading NoSQL database, empowering businesses to be more agile and scalable

Express is a minimal and flexible node.js web application framework, providing a robust set of features for building single and multi-page, and hybrid web applications

React is a JavaScript library for building user interfaces

Node.js is a platform built on Chrome's JavaScript runtime for easily building fast, scalable network applications

Node.js

- Node.js is an open-source, cross-platform runtime environment used for development of server-side web applications
- Node.js applications are written in JavaScript and can be run on a wide variety of operating systems
- Node.js is based on an event-driven architecture and a non-blocking Input/Output API that is designed to optimize an application's throughput and scalability for real-time web applications

Features

Asynchronous event driven IO helps concurrent request handling

- This is probably the biggest selling points of Node.js
- This feature basically means that if a request is received by Node for some Input/Output operation, it will execute the operation in the background and continue with processing other requests

Asynchronous event driven IO helps concurrent request handling

- This code looks at reading a file called Sample.txt. In other languages, the next line of processing would only happen once the entire file is read

```
var fs = require('fs');
        fs.readFile("Sample.txt",function(error,data)
        {
            console.log("Reading Data completed");
    });
```

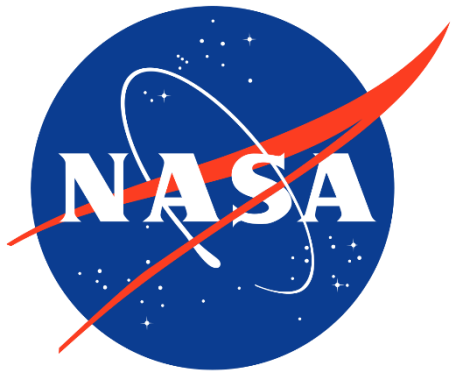
- But in Node.js the important fraction of code to notice is the declaration of the function ('function(error,data)'). This is known as a callback function
- What happens? → file reading operation will start in the background
- And other processing can happen simultaneously while the file is being read. Once the file read operation is completed, this anonymous function will be called and the text "Reading Data completed" will be written to the console log

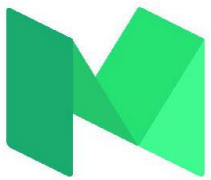
Features (cntd)

Node uses the V8 JavaScript Runtime engine	The one which is used by Google Chrome. Node has a wrapper over the JavaScript engine which makes the runtime engine much faster and hence processing of requests within Node also become faster.
Handling of concurrent requests	Another key functionality of Node is the ability to handle concurrent connections with a very minimal overhead on a single process.
The Node.js library used JavaScript	This is another important aspect of development in Node.js. A major part of the development community are already well versed in javascript, and hence, development in Node.js becomes easier for a developer who knows javascript.
There are an Active and vibrant community for the Node.js framework	Because of the active community, there are always keys updates made available to the framework. This helps to keep the framework always up-to-date with the latest trends in web development.

Words to describe node.js

https://nodejs.org/en/user-survey-report/





https://brainhub.eu/blog/9-famous-apps-using-node-js/

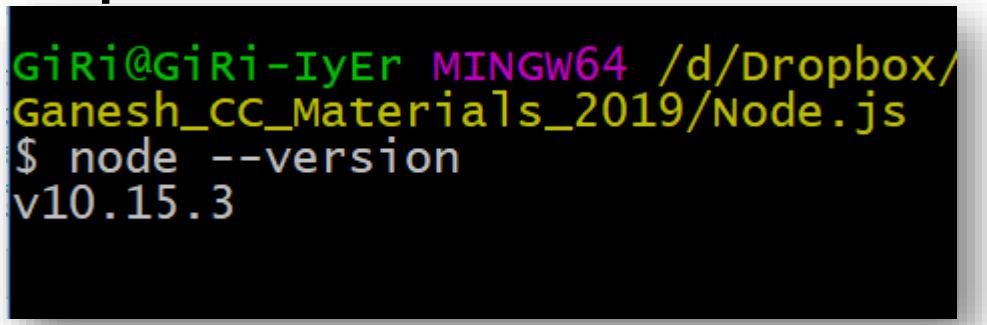
When to use Node.js

Best for usage in streaming or event-based real-time applications

- Chat applications
- Game servers – Fast and high-performance servers that need to processes thousands of requests at a time, then this is an ideal framework.
- Good for collaborative environment – This is good for environments which manage document. In document management environment you will have multiple people who post their documents and do constant changes by checking out and checking in documents. So Node.js is good for these environments because the event loop in Node.js can be triggered whenever documents are changed in a document managed environment.
- Advertisement servers – Again here you could have thousands of request to pull advertisements from the central server and Node.js can be an ideal framework to handle this.
- Streaming servers – Another ideal scenario to use Node is for multimedia streaming servers wherein clients have request's to pull different multimedia contents from this server

Installation and setup

- Installation must have been done as a prerequisite for React
- If not, visit http://node.js.org to install node.js
- You can check the installation by running the following command
- node –version in the command prompt

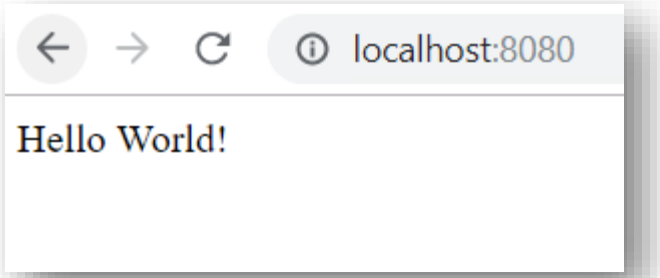


Running your first Hello world application in Node.js

- Create a folder (e.g. node) in your computer and copy this code into a file called firstprogram.js

```
1  var http = require('http');
2
3  http.createServer(function (req, res) {
4      res.writeHead(200, {'Content-Type': 'text/html'});
5      res.end('Hello World!');
6  }).listen(8080);
```

- In command prompt, run `node firstprogram.js`
- Open http://localhost:8080



Modules in node.js

- Consider modules to be the same as JavaScript libraries.
- A set of functions you want to include in your application.
- Node.js has a set of built-in modules which you can use without any further installation.
- To include a module, use the require() function with the name of the module:

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

- Now your application has access to the HTTP module, and is able to create a server:

createServer method

- HTTP server is created using the http module's createServer() method
- Like most Node.js functions, createServer() takes a callback function as an argument
- This callback function is executed each time the server receives a new request
- The http.createServer() method includes *request* and *response* parameters which is supplied by Node.js
- The request object can be used to get information about the current HTTP request e.g., url, request header, and data
- The response object can be used to send a response for a current HTTP request

createServer method

- The callback function begins by calling the res.writeHead() method
- This method sends an HTTP status code and a collection of response headers back to the client
- The status code is used to indicate the result of the request
- For example, everyone has encountered a 404 error before, indicating that a page could not be found
- The example server returns the code 200, which indicates success

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

createServer method

- Along with the status code, the server returns a number of HTTP headers which define the parameters of the response
- If you do not specify headers, Node.js will implicitly send them for you
- The example server specifies only the Content-Type header
- This particular header defines the MIME type of the response
- In the case of an HTML response, the MIME type is “text/html”.

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

Lets Modify the file a bit

```
1  var http = require('http');
2
3  http.createServer(function (req, res) {
4      res.writeHead(200, {'Content-Type': 'text/html'});
5      res.write('Welcome'+'<br/>');
6      res.end('Hello World!');
7  }).listen(8080);
8
9  console.log('Node.js web server at port 8080 is
   running.. Type https://localhost:8080 to verify the
   same ')
```

res.write

- Re-run the command `node firstprogram.js` and check the browser again
- Look at the line, the server res.write()
- This call is used to write the HTML page
- ‘
’ is used inside to break line after “Welcome”

res.write
Another sample

- Look at the lines, the server res.write()
- These calls are used to write the HTML page

```
var http = require("http");
var server = http.createServer(function(request, response) {
  response.writeHead(200, {"Content-Type": "text/html"});
  response.write("<!DOCTYPE "html">");
  response.write("<html>");
  response.write("<head>");
  response.write("<title>Hello World Page</title>");
  response.write("</head>");
  response.write("<body>");
  response.write("Hello World!");
  response.write("</body>");
  response.write("</html>");
  response.end();
});

server.listen(80);
console.log("Server is listening");
```

res.end

- After the HTML page has been written, the res.end() method is called
- By calling this method, we are telling the server that the response headers and body have been sent, and that the request has been fulfilled
- The example server call end() can be used with no parameters or like write(), assuming only one call is needed

listen

- The call to `listen()` causes the server to bind to a port and listen for incoming connections
- Computers have thousands of ports, which act as communication end points
- In order to connect to the server, clients must know exactly which port the server is listening on
- Ports are identified by port numbers, with HTTP servers typically listening to port 80
- In this slide deck, did you notice two ways of calling listen?

Node.js as a File server

Node.js as a File Server

- The Node.js file system module allows you to work with the file system on your computer
- To include the File System module, use the require() method:

```
var fs = require('fs');
```

- Common use for the File System module:
  - Read files
  - Create files
  - Update files
  - Delete files
  - Rename files

Read Files

- The fs.readFile() method is used to read files on your computer.
- Assume we have the following HTML file (located in the same folder as Node.js):

demofile1.html

```
<html>
<body>
<h1>My Header</h1>
<p>My paragraph.</p>
</body>
</html>
```

Read Files

Create a Node.js file that reads the HTML file, and return the content:

- demo_readfile.js

```
var http = require('http');
var fs = require('fs');
http.createServer(function (req, res) {
  fs.readFile('demofile1.html', function(err, data) {
    res.writeHead(200, {'Content-Type': 'text/html'});
    res.write(data);
    res.end();
  });
}).listen(8080);
```

Run the code and verify the output

- node demo_readfile.js
- http://localhost:8080

Create Files

- The File System module has methods for creating new files:
  - fs.appendFile()
  - fs.open()
  - fs.writeFile()

Append

- The fs.appendFile() method appends specified content to a file. If the file does not exist, the file will be created
- Create a new file using the appendFile() method

```
var fs = require('fs');

fs.appendFile('mynewfile1.txt', 'Hello content!', function (err) {
  if (err) throw err;
  console.log('Saved!');
});
```

Open

- The fs.open() method takes a "flag" as the second argument, if the flag is "w" for "writing", the specified file is opened for writing. If the file does not exist, an empty file is created:

```
var fs = require('fs');

fs.open('mynewfile2.txt', 'w', function (err, file) {
  if (err) throw err;
  console.log('Saved!');
});
```

Write File

- The fs.writeFile() method replaces the specified file and content if it exists. If the file does not exist, a new file, containing the specified content, will be created:

```
var fs = require('fs');

fs.writeFile('mynewfile3.txt', 'Hello content!', function (err) {
  if (err) throw err;
  console.log('Saved!');
});
```

Update Files

- The File System module has methods for updating files:
  - fs.appendFile()
  - fs.writeFile()
- The fs.appendFile() method appends the specified content at the end of the specified file:

```
var fs = require('fs');

fs.appendFile('mynewfile1.txt', ' This is my text.', function (err) {
  if (err) throw err;
  console.log('Updated!');
});
```

Update Files

- The fs.writeFile() method replaces the specified file and content:

```
var fs = require('fs');

fs.writeFile('mynewfile3.txt', 'This is my text', function (err) {
  if (err) throw err;
  console.log('Replaced!');
});
```

Delete Files

- To delete a file with the File System module, use the fs.unlink() method
- The fs.unlink() method deletes the specified file:
- Delete "mynewfile2.txt":

```
var fs = require('fs');

fs.unlink('mynewfile2.txt', function (err) {
  if (err) throw err;
  console.log('File deleted!');
});
```

Node.JS URL Module

URL Module

- The URL module splits up a web address into readable parts.

- To include the URL module, use the require() method:

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

url.parse()

Split a web address into readable parts:

```
var url = require('url');
var adr = 'http://localhost:8080/default.htm?year=2017&month=february';
var q = url.parse(adr, true);

console.log(q.host); //returns 'localhost:8080'
console.log(q.pathname); //returns '/default.htm'
console.log(q.search); //returns '?year=2017&month=february'

var qdata = q.query; //returns an object: { year: 2017, month: 'february' }
console.log(qdata.month); //returns 'february'
```

Node.js File Server

- Now we know how to parse the query string, and in the previous chapter we learned how to make Node.js behave as a file server
- Let us combine the two, and serve the file requested by the client.
- Create two html files and save them in the same folder as your node.js files.

Node.js File Server

summer.html

```
<!DOCTYPE html>
<html>
<body>
<h1>Summer</h1>
<p>I love the sun!</p>
</body>
</html>
```

winter.html

```
<!DOCTYPE html>
<html>
<body>
<h1>Winter</h1>
<p>I love the snow!</p>
</body>
</html>
```

demo_fileserver.js:

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

http.createServer(function (req, res) {
  var q = url.parse(req.url, true);
  var filename = "." + q.pathname;
  fs.readFile(filename, function(err, data) {
    if (err) {
      res.writeHead(404, {'Content-Type': 'text/html'});
      return res.end("404 Not Found");
    }
    res.writeHead(200, {'Content-Type': 'text/html'});
    res.write(data);
    return res.end();
  });
}).listen(8080);
```

- If you have followed the same steps on your computer, you should see two different results when opening these two addresses:
- http://localhost:8080/summer.html

- http://localhost:8080/winter.html

Thank you!

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