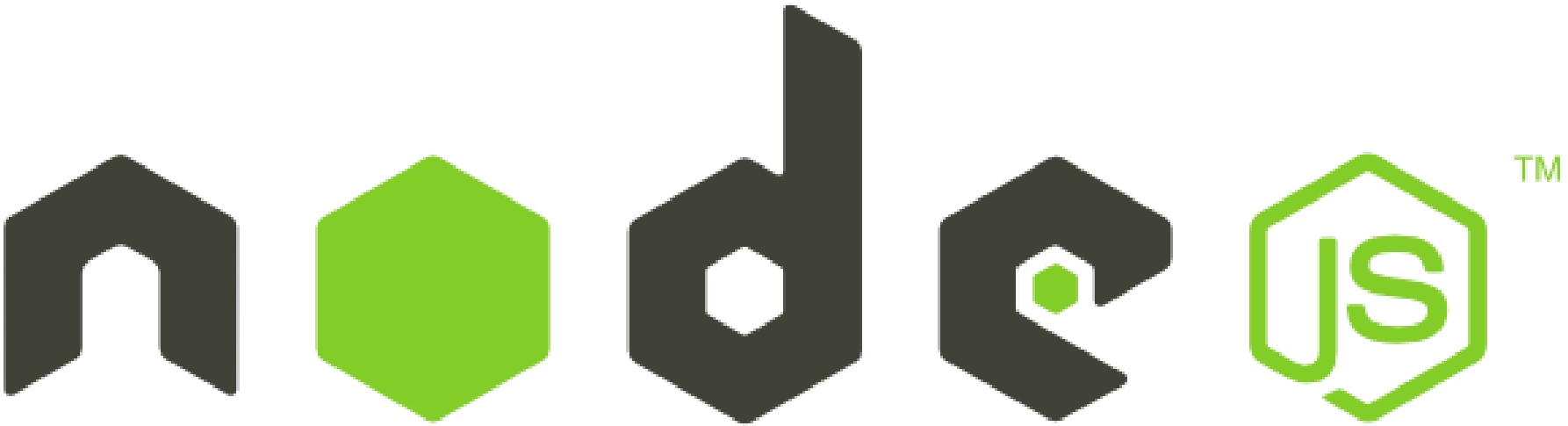

Introduction to Node.js

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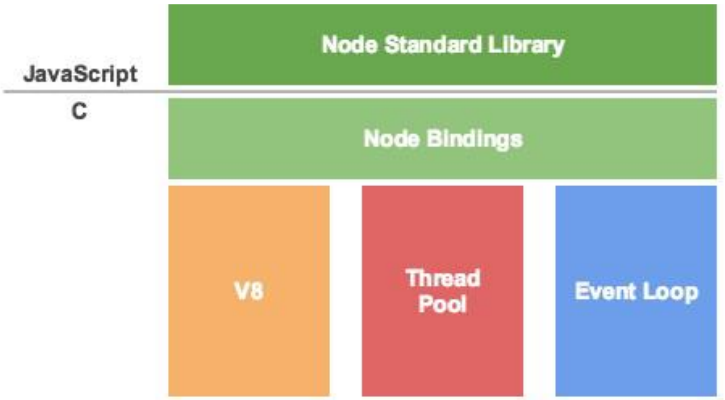
Agenda

- What is node.js
- Non Blocking and Blocking
- Event-based processes
- Callbacks in node
- Node Package Manager
- Creating a node app
- Introduction to Express

What's Node: Basics

- Put simply, Node.js is ‘server-side JavaScript’.
- More accurately, Node.js is a high performance network applications framework, well optimized for high concurrent environments.
- In ‘Node.js’ , ‘.js’ doesn’t mean that its solely written in JavaScript. It is 40% JS and 60% C++.
- From the official site: ‘Node's goal is to provide an easy way to build scalable network programs.



What’s Node, V8.

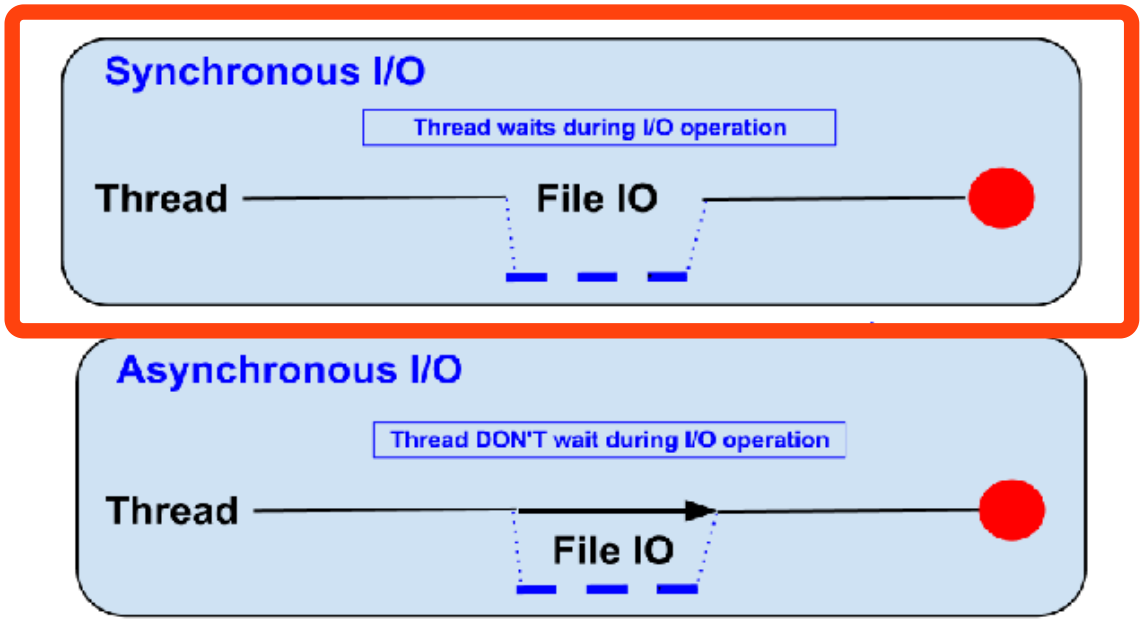
Embeddable C++ component
Can expose C++ objects to Javascript
Very fast and multi-platform
Find out a bit about it's history here: http://www.google.com/googlebooks/chrome/big_12.html

What's Node.js: Event-based

- Generally, input/output (io) is slow.
  - Reading/writing to data store, probably across a network.
- Calculations in cpu are fast.
  - 2+2=4
- Most time in programs spent waiting for io to complete.
  - In applications with lots of concurrent users (e.g. web servers), you can't stop everything and wait for io to complete.
- Solutions to deal with this are:
  - Blocking code with multiple threads of execution (e.g. Apache, IIS)
  - Non-blocking, event-based code in single thread (e.g. NGINX, Node.js)

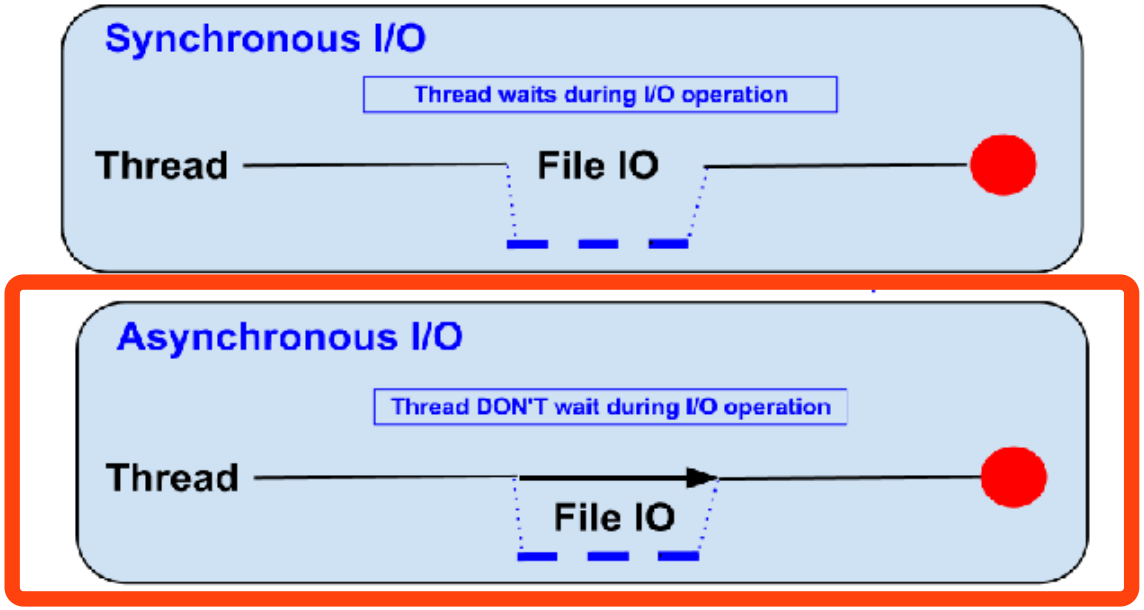
Blocking (Traditional)

- Traditional code waits for input before proceeding (Synchronous)
- The thread on a server "blocks" on io and resumes when it returns.



Non-blocking (Node)

- Node.js code runs in a Non-blocking, event-based Javascript thread
  - No overhead associated with threads
  - Good for high concurrency (i.e. lots of client requests at the same time)



Blocking/Non-blocking Example

Blocking

- Read from file and set equal to contents
- Print Contents
- Do Something Else...

Non-blocking

- Read from File
  - Whenever read is complete, print contents
- Do Something Else...

Blocking/Non-blocking Example

Blocking

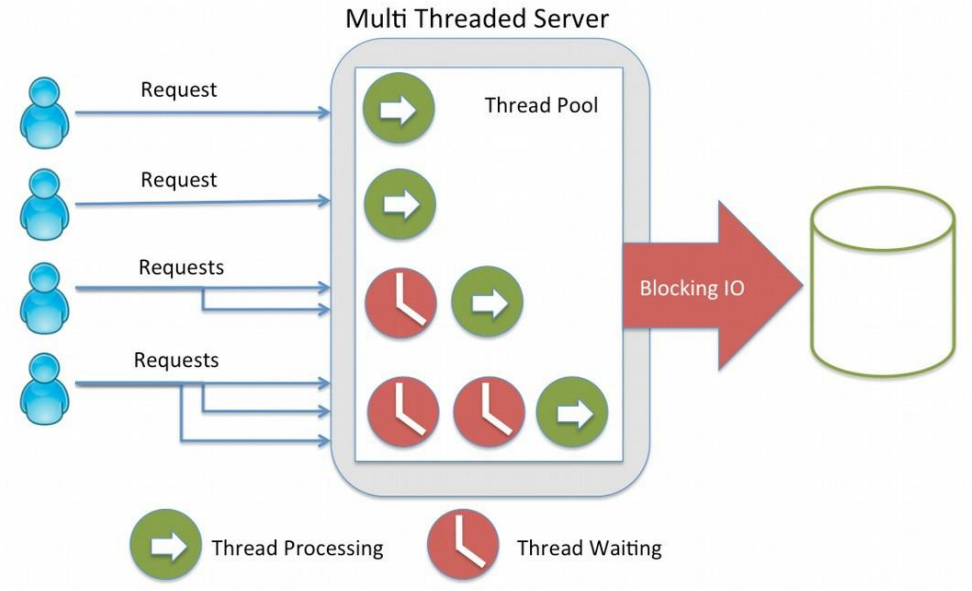
```
const contents = fs.readFileSync('./text.txt');
console.log(contents);
console.log('Doing something else');
```

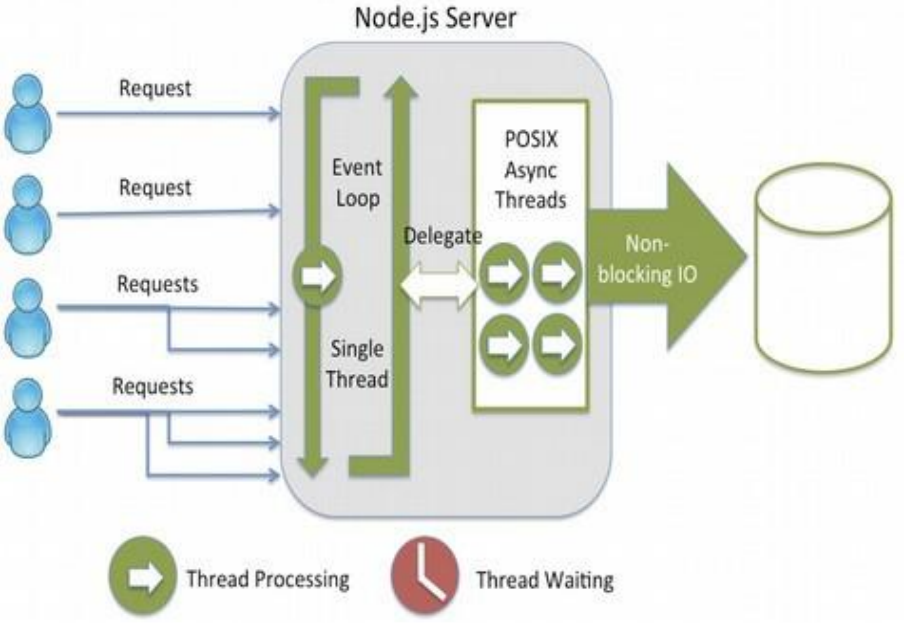
Non-blocking

```
fs.readFile('./text.txt', (err, contents)=>{ console.log(contents); });
console.log('Doing something else');
```

Blocking vs. Non-blocking

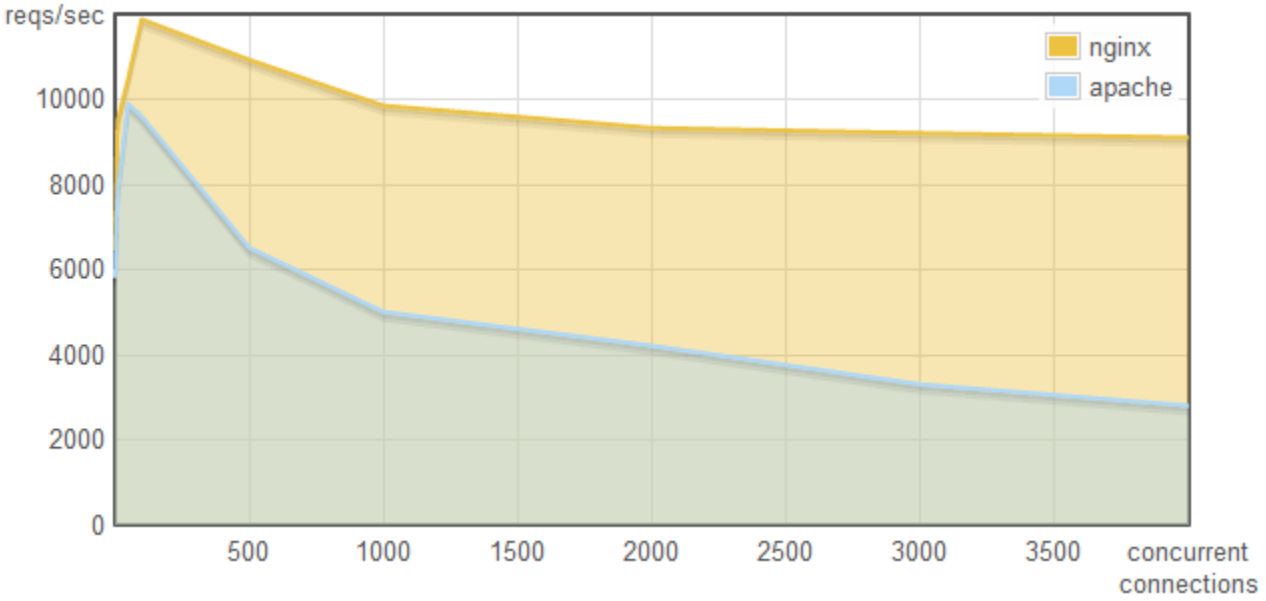
- Threads consume resources
  - Memory on stack
  - Processing time for context switching etc.
- No thread management on single threaded apps
  - Just execute “callbacks” when event occurs
  - Callbacks are usually in the form of anonamous functions.

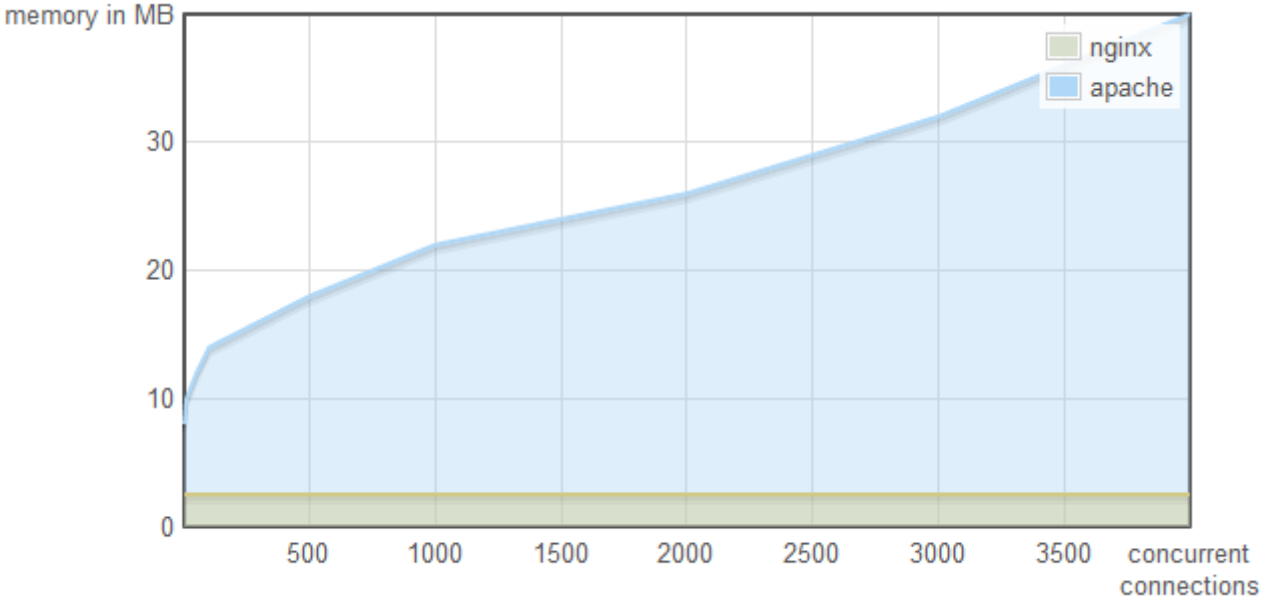




Why does it matter...

- This is why:





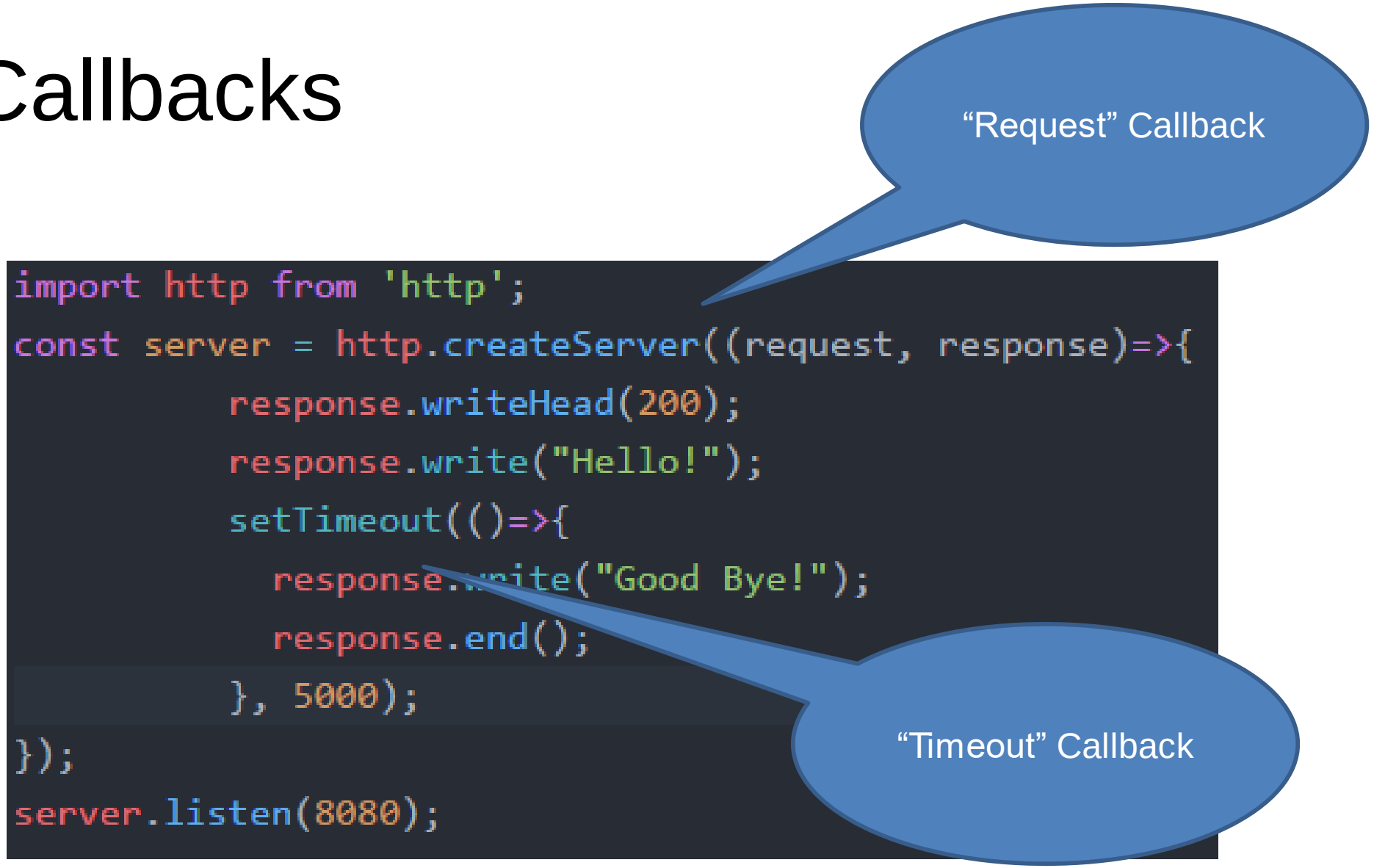
http://blog.webfaction.com/a-little-holiday-present

Node.js Event Loop

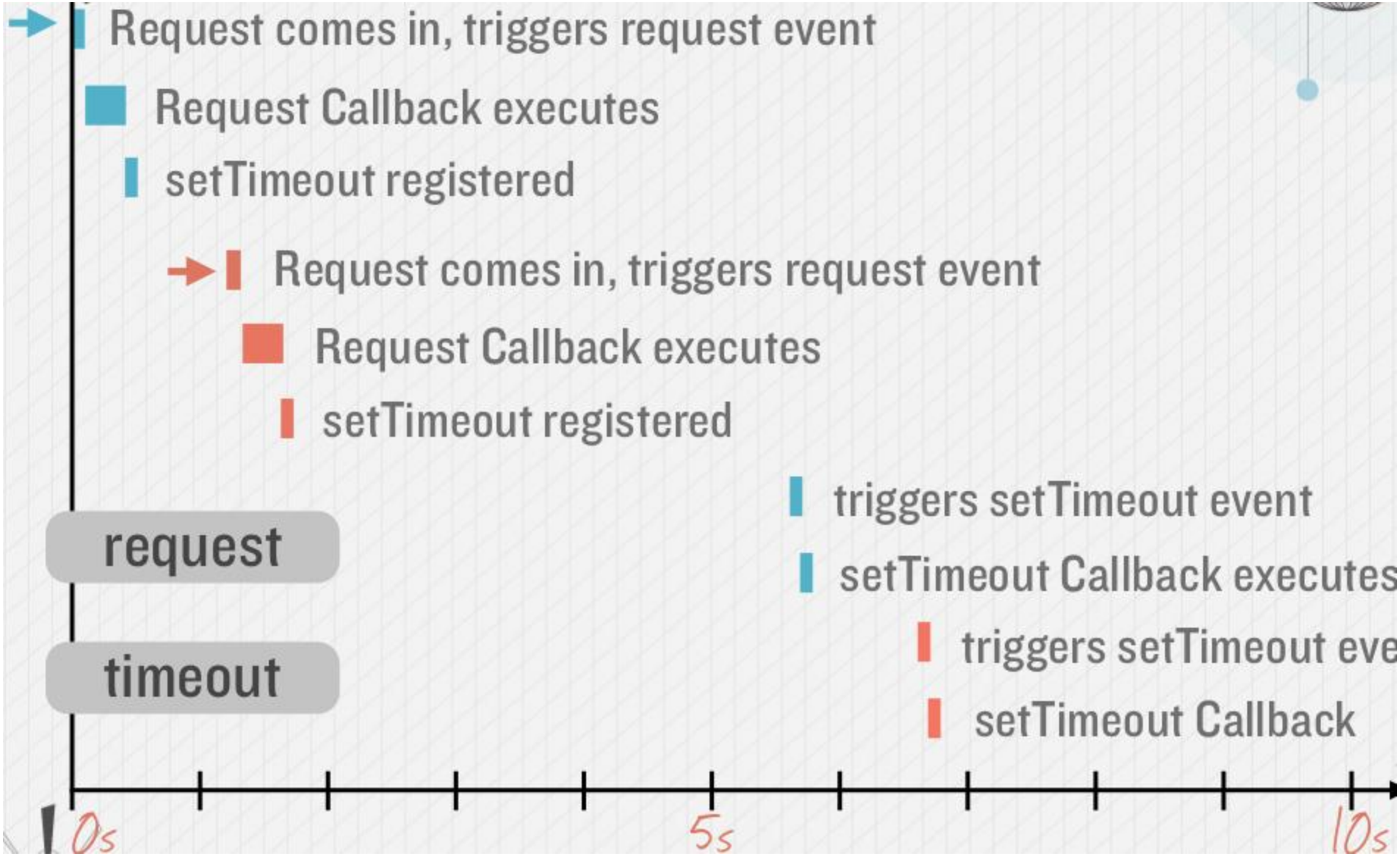
```
import http from 'http';
import config from './config';

// Configure our HTTP server to respond with Hello World t
const server = http.createServer((req, res) => {
  res.writeHead(200, {'Content-Type': 'text/plain'});
  res.end('Hello World!');
});

server.listen(config.port);

// Put a friendly message on the terminal
console.log("Server running at " + config.port);
```

EVENT LOOP STARTS WHEN FINISHED

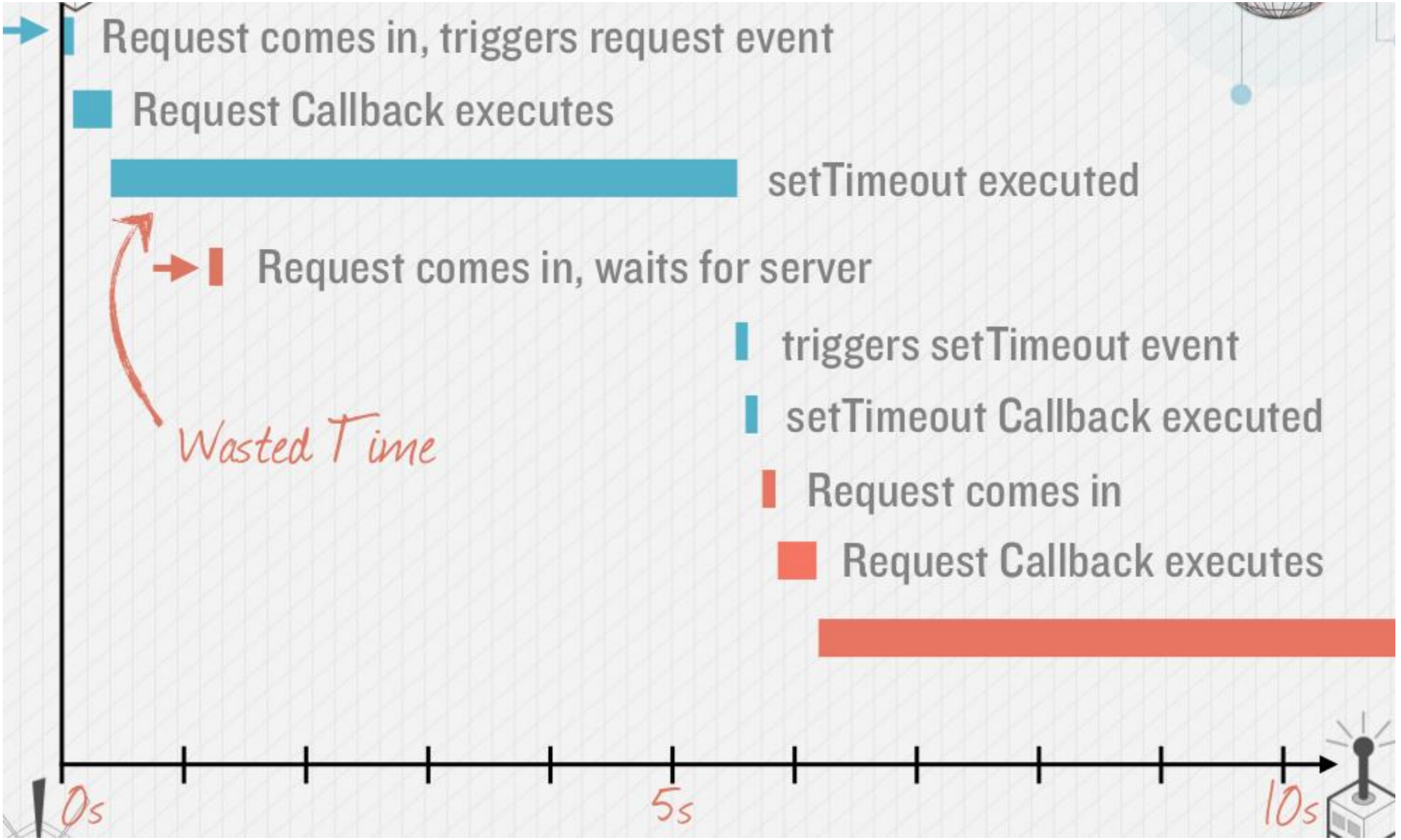
Callbacks


“Request” Callback
import http from 'http';
const server = http.createServer((request, response)=>{
response.writeHead(200);
response.write("Hello!");
setTimeout(()=>{
response.write("Good Bye!");
response.end();
}, 5000);
});
server.listen(8080);
“Timeout” Callback

Callback Timeline, Non Blocking

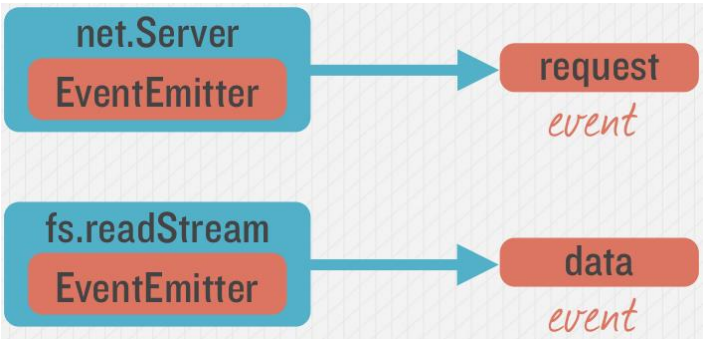


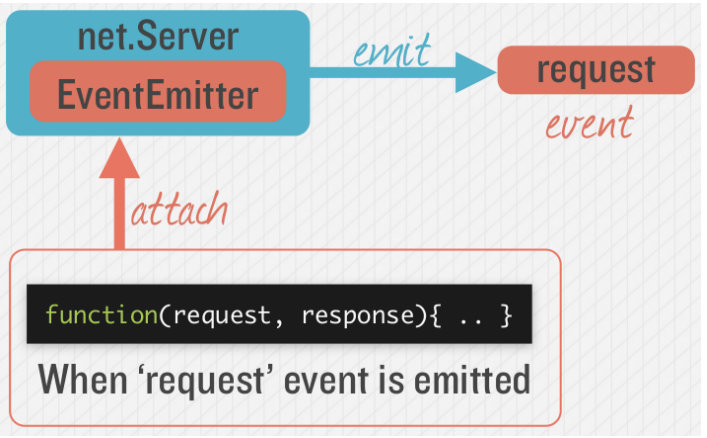
Callback Timeline, Blocking



Emitting Event in Node

- Many objects can emit events in node.





Node Callbacks

“If Google’s V8 Engine is the heart of your Node.js application, then callbacks are its veins”.

They enable a balanced, non-blocking flow of asynchronous control across modules and applications.

But for callbacks to work at scale you need a common, reliable protocol.

The “error-first” callback (also known as an “errorback”, “errback”, or “node-style callback”) was introduced to solve this problem, and is a standard for Node.js callbacks.

A callback is basically a function called at the completion of a given task. This prevents any blocking, and allows other code to be run in the meantime.

Error First Callbacks

- The first argument is error object.
- The second argument of the callback is reserved for any successful response data.
- If no error occurred, err will be set to null and any successful data will be returned in the second argument.

```
fs.readFile('/foo.txt', (err, data)=>{
  // If an error occurred, handle it (t
  if(err) {
    console.log('Unknown Error');
    return;
    }
  // Otherwise, log the file contents
  console.log(data);
});
```

Node: Caution!

- In node, event callback functions should execute fast
- Do not perform computationally expensive operations in the event callback function.
- Always use callback functions. Better for high concurrency.

Node Modules

Node Modules

- Node has a small core API
- Most applications depend on third party modules
- Curated in online registry called the Node Package Manager system (NPM)

- NPM downloads and installs modules, placing them into a **node_modules** folder in your current folder.

NPM init

- You can use NPM to manage your node projects
- Run the following in the root folder of your app/project:

  npm init
- This will ask you a bunch of questions, and then write a package.json for you.
- It attempts to make reasonable guesses about what you want things to be set to, and then writes a package.json file with the options you've selected.

Node Modules

- Navigate to the application folder and run:
  npm install express --save
- This installs into a "**node_module**" folder in the current folder.
- The --save bit updates your package.json with the dependency
- To use the module in your code, use:
  import express from 'express';
- This loads express from local **node_modules** folder.

Global Node Modules

- Sometimes you may want to access modules from the shell/command line.
- You can install modules that will execute globally by including the '-g'.
- Example, Grunt is a Node-based software management/build tool for Javascript.

npm install -g grunt-cli

- This puts the “grunt” command in the system path, allowing it to be run from any directory.

NPM Common Commands

Common npm commands:

– **npm init** *initialize a package.json file*

– **npm install <package name> -g** *install a package, if –g option is given package will be installed globally,* ***--save*** *and* ***--save-dev*** *will add package to your dependencies*

– **npm install** *install packages listed in package.json*

– **npm ls –g** *listed local packages (without –g) or global packages (with –g)*

– **npm update <package name>** *update a package*

Creating your own Node Modules

- We want to create the following module called **greeting.js:**

```
const hello = function() {
console.log("hello!");
}
export default hello;
```

Export defines what import returns

- To access in our application, **app.js:**

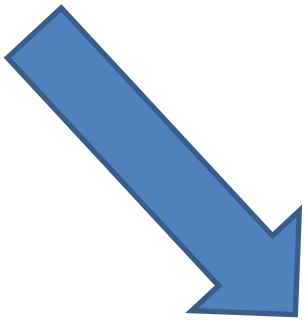
```
import hello from './custom_hello';
hello();
```

Creating your own Node Modules

- Exporting Multiple Properties

```
const env = process.env;

export const nodeEnv = env.NODE_ENV || 'development';

export const logStars = function(message) {
  console.info('**********');
  console.info(message);
  console.info('**********');
};

export default {
  port: env.PORT || 8080,
  host: env.HOST || '0.0.0.0',
  get serverUrl() {
    return `http://${this.host}:${this.port}`;
  }
};
```

- Accessing in other scripts



```
import config from './config';

......

server.listen(config.port, config.host, () => {
  console.info(`Contact api available at ${config.serverUrl}/api/contests`)
});
```

The import search

- Import searches for modules based on path specified:

```
import myMod from ('./myModule');  //current dir
import myMod from ('../myModule'); //parent dir
import myMod from ('../modules/myModule');
```

- Just providing the module name will search in node_modules folder

```
import myMod from ('myModule')
```

The Express Package

What is Express?

- Web application framework for Node
  - Built on the Connect middleware package
  - It's popular because it‘s
    - Minimalist,
    - Fast
    - Simple

What Express Gives Us...

- Parses arguments and headers
- Easy Routing
  - Route a URL to a Javascript callback function
- Views
  - Partials
  - Layouts
- Environment-based Configuration
- Sessions
- File Uploads

Simple Express App (index.js)

```
import config from './config';
import express from 'express';

const server = express();

server.use(express.static('public'));

server.listen(config.port, () => {
  console.info('Express listening on port', config.port);
});
```

Loads Express module

Instantiates Express server

Define static content for HTTP GET

Getting Started with Express

- Installing Express

```
[local install] C:\> npm install express
[global install] C:\> npm install express -g
```

Express Configuration

Express allows you to easily configure your web app behaviour...

```
// allow serving of static files from the public directory
app.use(express.static('/public'));
// configure to parse application/json
app.use(bodyParser.json());
// configure to parse application/x-www-form-urlencoded
app.use(bodyParser.urlencoded({ extended: true }));
```

Routing Examples

```
//Catch-all
app.all('/app(/*)?', requiresLogin);

// Routes
app.get('/', routes.index);
app.get('/about', routes.about);
app.get('/contact', routes.contact);
app.get('/app/list', routes.listapps);
app.get('/app/new', routes.newapp);
app.post('/app/new', routes.saveapp);
app.get('/app/:app', routes.getapp);
app.get('/app/:app/edit', routes.editapp);
```

Catch-all – works for all HTTP verbs

HTTP GET request

HTTP POST request

Accepts :app route argument

Syntax follows the pattern:

App.[verb](path, (req,res)=>{});

Node Applications Structure

Structuring Node Apps

- Node Server Code needs to be structured
  - Manage code base
  - Keeps code maintainable
  - Nodes packaging system supports this approach
- Typical Node.js application code:
  - main server code
  - api implementation code
  - helper code

Example Approach:

- Use a “project root” folder is the top level and contains the “entry point” or main server code
  - Always run npm in this folder to ensure just one node_modules folder
  - Use a **public** folder within the node folder for static content

Basic Project Structure