NODE.JS

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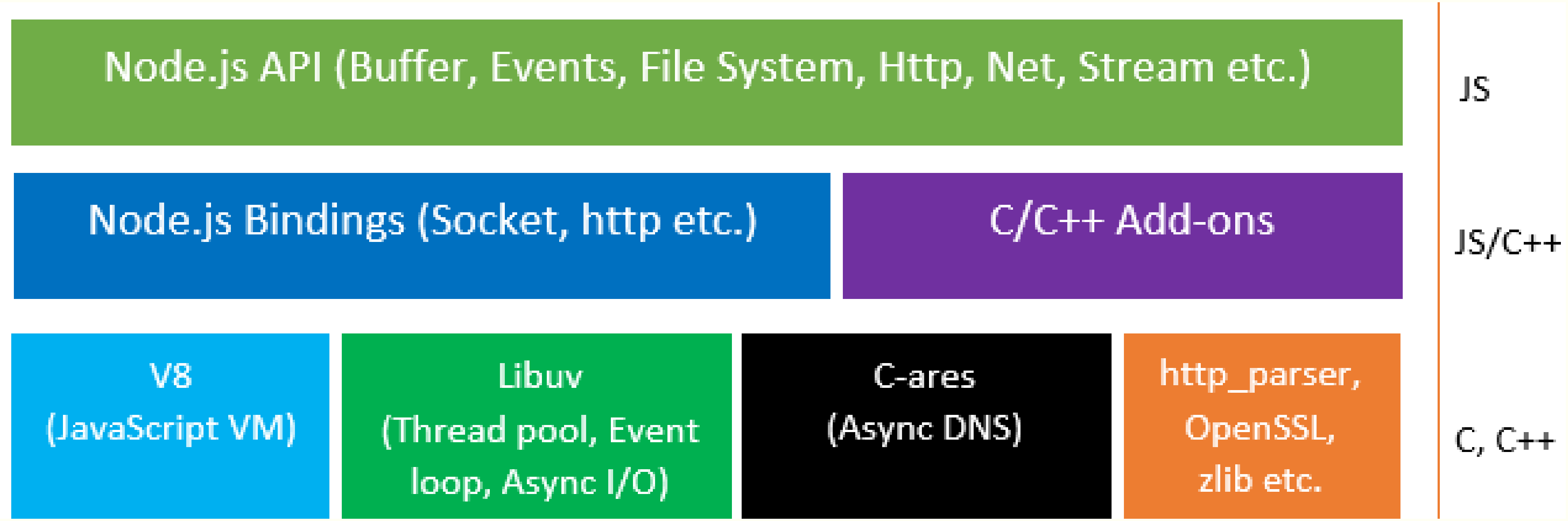
Node.js is a C++ program controlled via V8 JavaScript

- Google V8 is a JavaScript engine initially created for Google Chrome but it can also be used as a standalone.
- V8 compiles JavaScript down to native code and executes it.
- During execution it manages the allocation and freeing of memory as needed.
- Node.js is a platform built on V8 Engine runtime for easily building fast, scalable network applications.
- Node.js uses an **event-driven**, **non-blocking I/O model** that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices.
- Created by **Ray Daul** in 2009

Architecture



Node.js API (Buffer, Events, File System, Http, Net, Stream etc.)

Node.js Bindings (Socket, http etc.)

C/C++ Add-ons

V8
(JavaScript VM)

Libuv
(Thread pool, Event loop, Async I/O)

C-ares
(Async DNS)

http_parser, OpenSSL, zlib etc.

JS

JS/C++

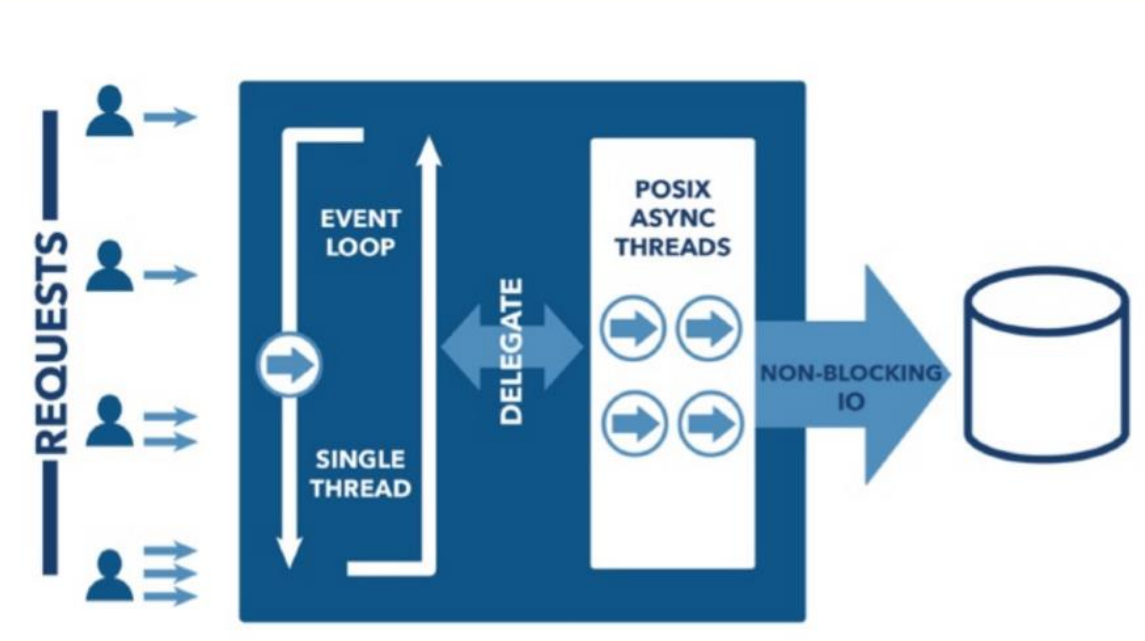
C, C++

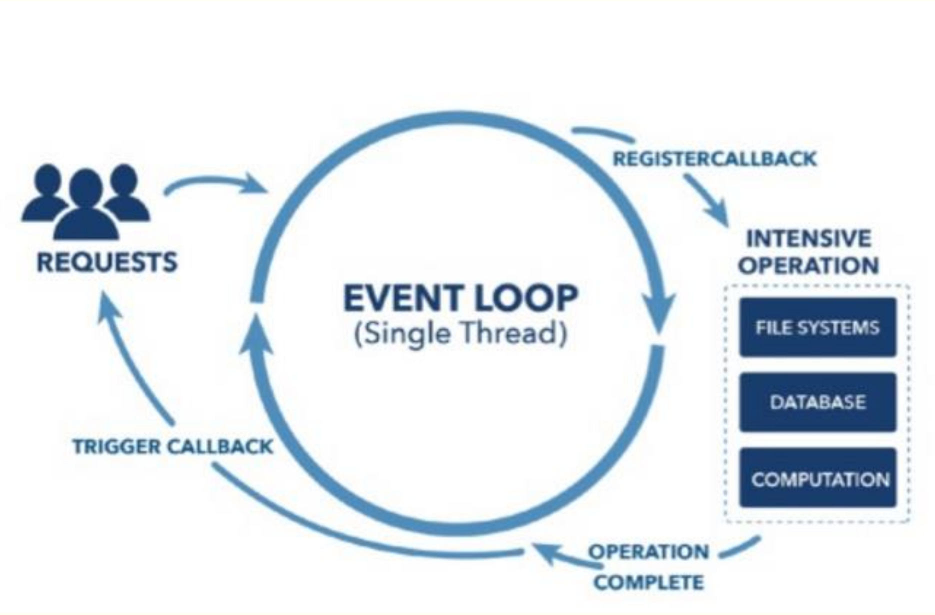
Architecture

- Node.js API
  - These are written in JavaScript and directly exposed to outer world to interact with Node.js internal components. Node.js Binding – These are Core API, which bind the JavaScript with C / C++ libraries.
- C/C++ Add-ons
  - You can also develop your Node.js Add-ons using C/C++ to work with Node.js.
- V8
  - It is Google’s open source JavaScript engine, written in C++
- Libuv
  - It is a multi-platform support C++ library which is responsible for handling thread pool, event loop and async I/O operations in Node.js. In Node.js, blocking I/O operations are delegated to Libuv modules which has a fixed size C++ thread pool to handle these operations. When these operations are completed, they are notified to Event loop.
- C-ares
  - It is a C library for handling async DNS request, name resolves and multiple DNS queries in parallel.

Event Loop and Non-Blocking IO

- Event loop delegates tasks to a thread allocated by the Libuv library and allows for an asynchronous solution



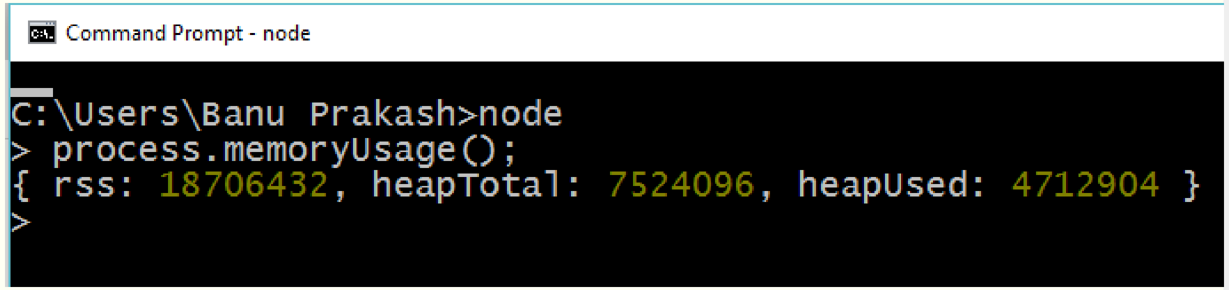


V8’s Memory Scheme

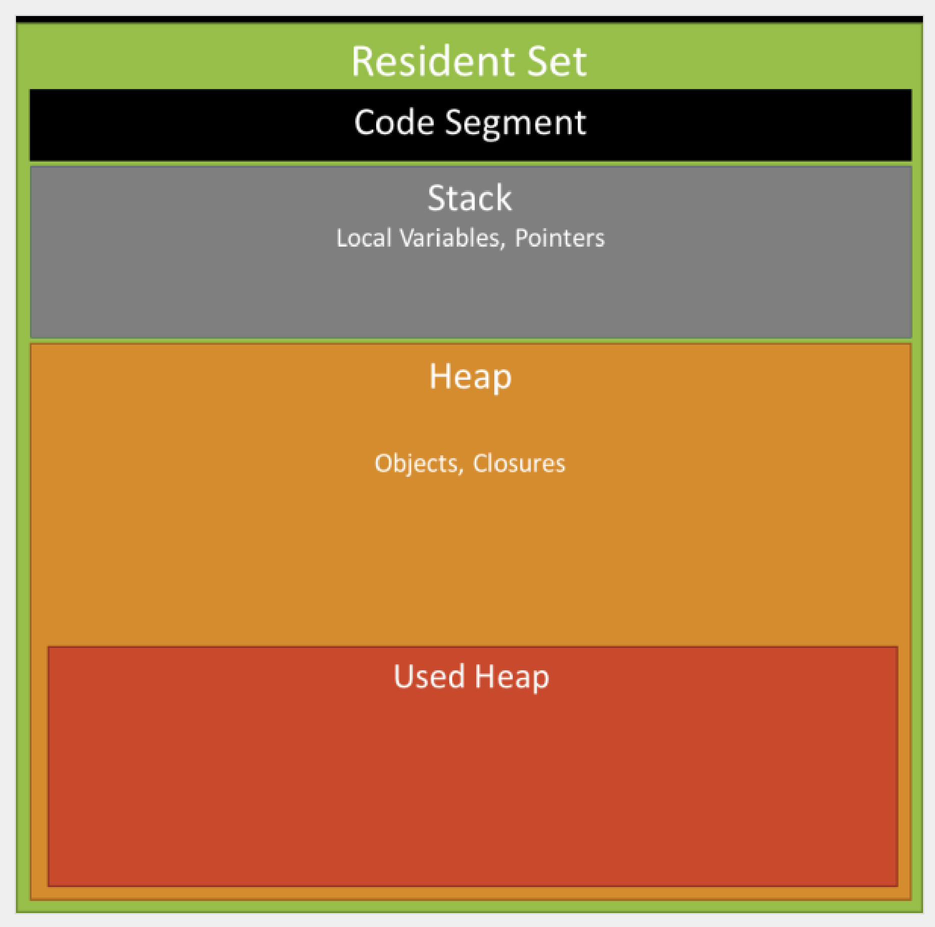
- A running program is always represented through some space allocated in memory. This space is called *Resident Set*.
- V8 uses a scheme similar the Java Virtual Machine and divides the memory into segments:
  - **Code:** the actual code being executed
  - **Stack:** contains all value types (primitives like integer or boolean) with pointers referencing objects on the heap and pointers defining the control flow of the program
  - **Heap:** a memory segment dedicated to storing reference types like objects, strings and closures.

V8 Memory Scheme

- The function **process.memoryUsage()** will return an object containing:
  - Resident Set Size
  - Total Size of the Heap
  - Heap actually Used



```
C:\Users\Banu Prakash>node
> process.memoryUsage();
{ rss: 18706432, heapTotal: 7524096, heapUsed: 4712904 }
>
```



Resident Set

Code Segment

Stack

Local Variables, Pointers

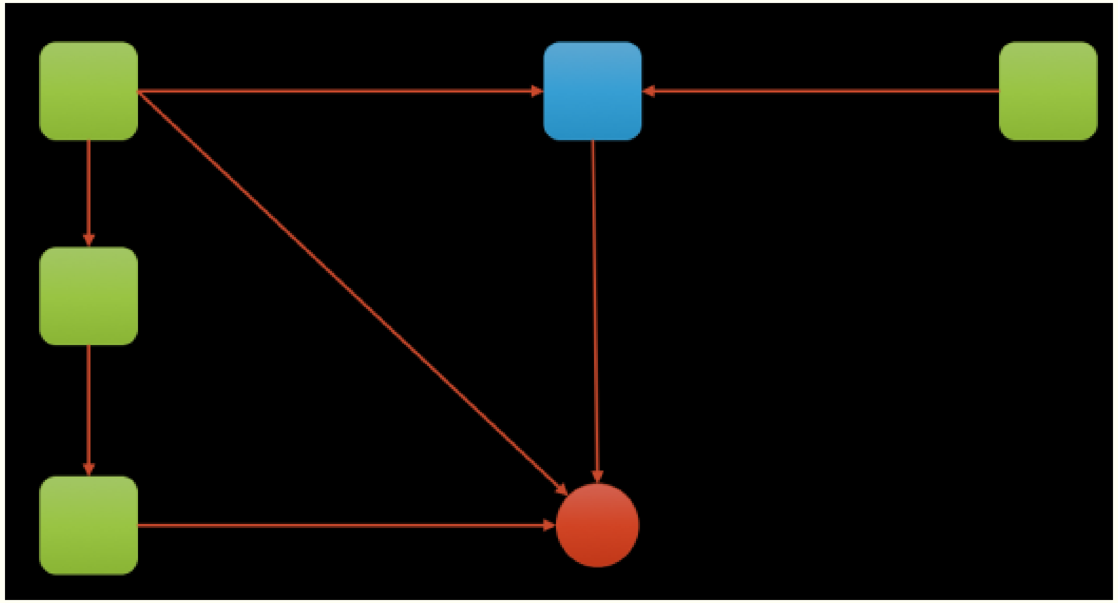
Heap

Objects, Closures

Used Heap

Garbage collection

- If a memory segment is not referenced from anywhere, we can assume that it is not used and, therefore, can be freed.
- However, retrieving and maintaining this information is quite complex as there may be chained references and indirections that form a complex graph structure



Garbage collection

- V8 divides the heap into several different spaces:
  - **New-space**: Most objects are allocated here. New-space is small and is designed to be garbage collected very quickly, independent of other spaces.
  - **Old-pointer-space**: Contains most objects which may have pointers to other objects. Most objects are moved here after surviving in new-space for a while.
  - **Old-data-space**: Contains objects which just contain raw data (no pointers to other objects). Strings, boxed numbers, and arrays of unboxed doubles are moved here after surviving in new-space for a while.
  - **Large-object-space**: This space contains objects which are larger than the size limits of other spaces. Each object gets its own mmap'ed region of memory. Large objects are never moved by the garbage collector.

Garbage collection

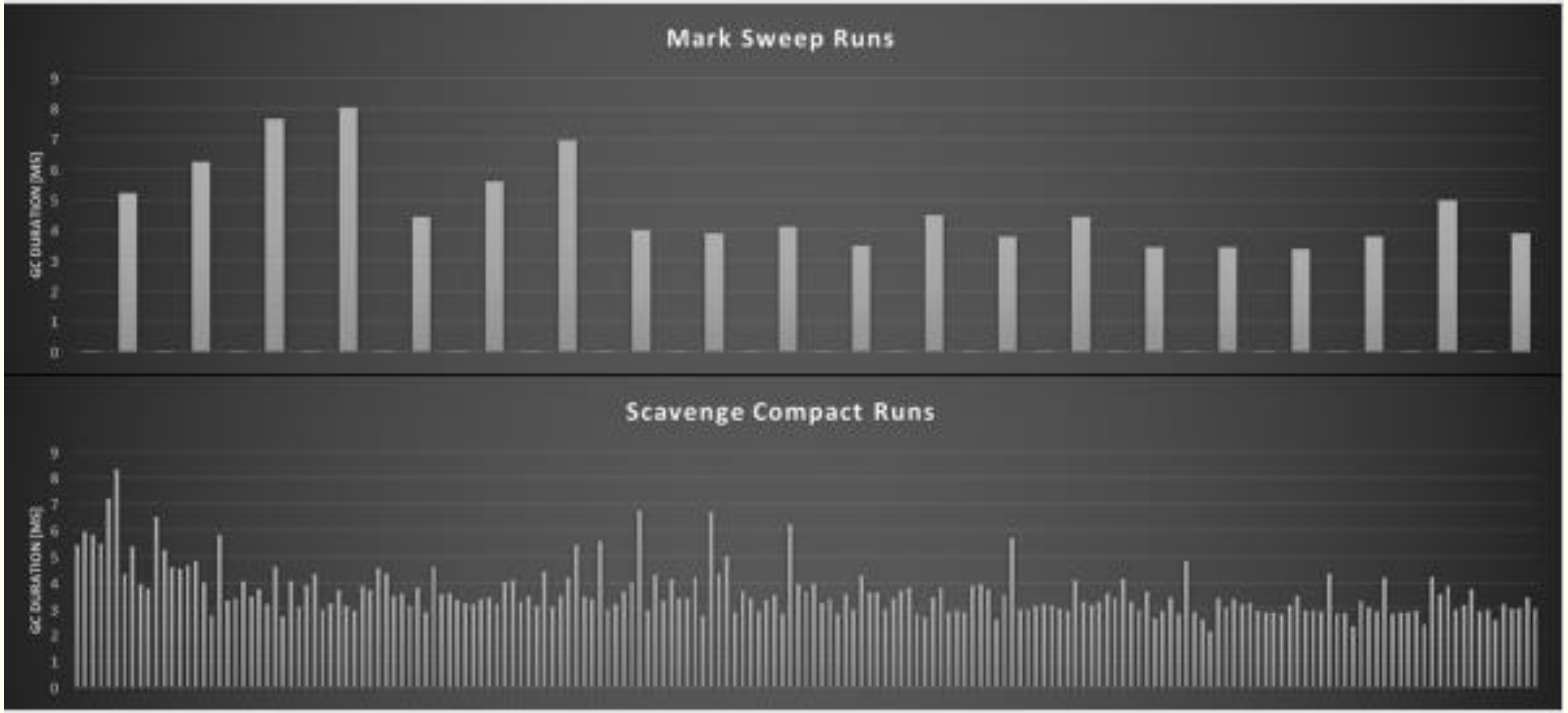
- V8 uses two types of garbage collection
  - Short GC / Scavenge
  - Full GC / mark-sweep & mark-compact

  - Short GC / Scavenge
    - Objects are allocated in ‘new-space’ (between 1 – 8 MB). Allocation in new space is very cheap; increment an allocation pointer when we want to reserve space for new object. When the pointer reaches the end of ‘new-space’, a scavenge is triggered, quickly removing the dead objects from ‘new-space’
    - But it has large space overhead, since we need physical memory backing both to-space and from-space.
    - This is acceptable as long as we keep new-space small, but it's impractical to use this approach for more than a few megabytes.

Garbage collection

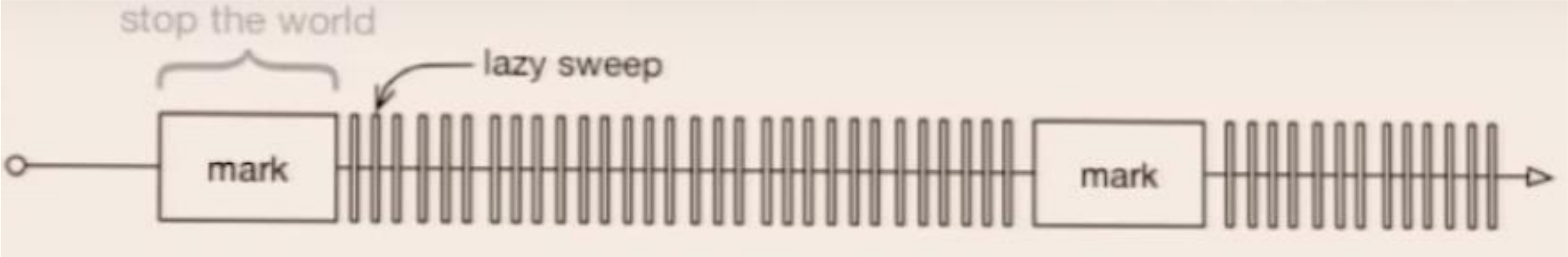
- Full GC / Mark-Sweep & Mark-Compact
  - Objects which have survived two minor garbage collections are promoted to ‘old-space’.
  - Old-space is garbage collected in full GC which is less frequent.
  - A full GC is triggered based on a memory threshold.
  - To collect old space, which may contain several hundred megabytes of data, V8 uses two closely related algorithms, *Mark-sweep* and *Mark-compact*.

Garbage collection



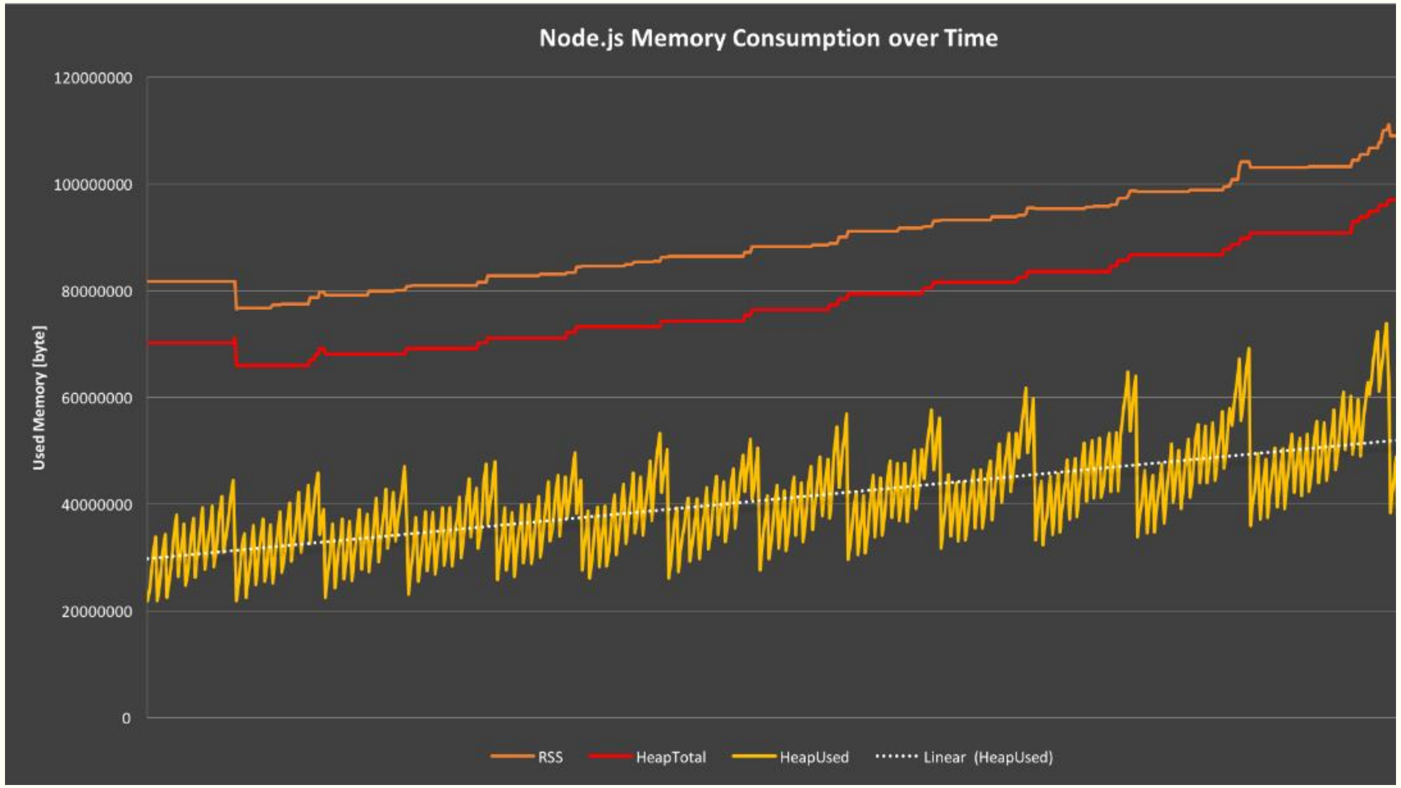
Garbage collection

- Incremental marking and lazy sweeping
  - Incremental marking allows to do a bit of marking, then let the JavaScript run a bit, then do another bit of marking work.
  - Short pauses in the order of 5-10ms each.
  - Lazy sweep cleans up set of objects at time eventually cleaning all pages.



Garbage collection

- Memory leak in progress
  - Garbage collection tries its best to free memory but for every run we see that consumption after a garbage collection run is constantly climbing, which is a clear indication of a leak



Non-blocking (Asynchronous)

- Synchronous
  - The waiter goes to a table and takes the order, goes to the chef and gives him the order that customer wants to have.
  - After that he sits and waits for the order to be ready, then takes the dishes and serves it to the customer.
- Asynchronous
  - So while the chef is cooking, the waiter is free and has nothing to do but in the mean time he can server other customers or do some other task a waiter does.
  - So the asynchronous methodology maximizes the usage of the processor and it's cheaper and efficient for computer processor.

BENEFITS OF USING NODE

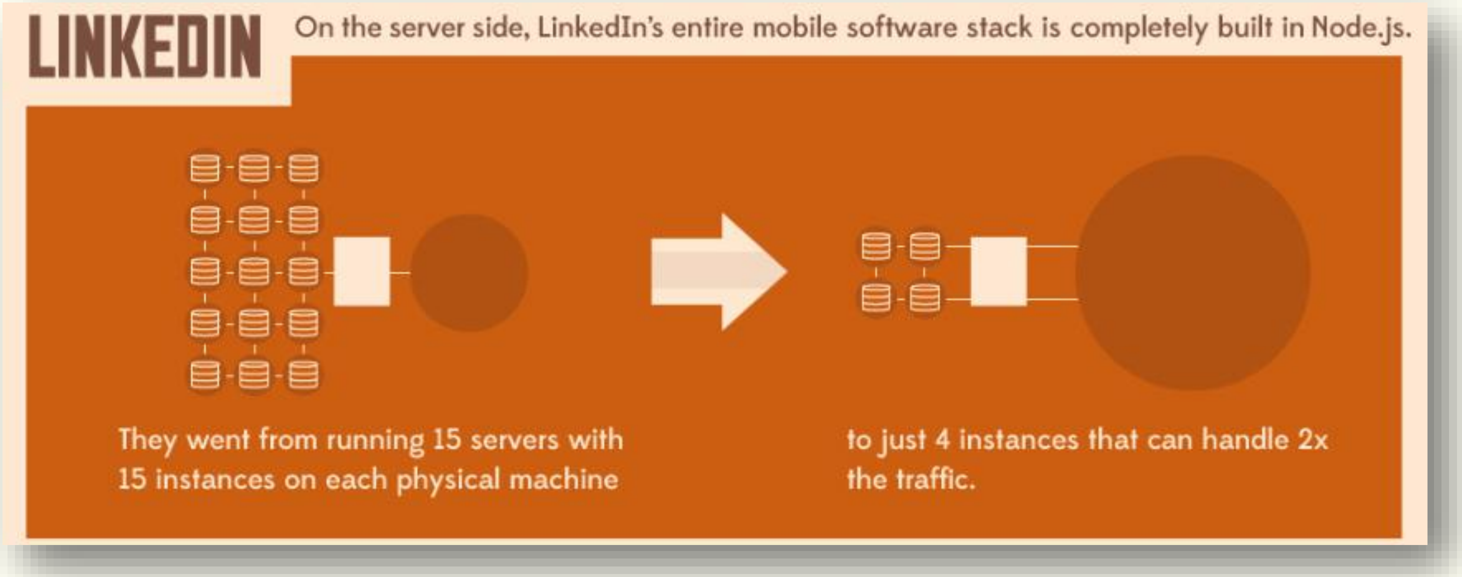
- PRODUCTIVITY
  - When PayPal started using Node.js, they reported a 100% increase in productivity compared to the previous Java stack.
  - How is that even possible?
    - The npm has an incredible amount of modules that can be used instantly. This saves a lot of development effort for you; there is no need to reinvent the wheel.
    - Node.js applications are written using JavaScript, frontend developers can also easily understand what is going on, and make changes if necessary. This saves valuable time, again, as developers will use the same language on the entire stack.
    - In addition to tools like Browserify or Webpack, you can use the very same modules in the frontend, as you use in the backend.

BENEFITS OF USING NODE

- PERFORMANCE
  - In 2014, on Black Friday, 1.5 billion dollars were spent online in the US on a single day. It is crucial to keep up with such traffic - Walmart, one of the biggest retailers using Node.js served 500 million page views on Black Friday, without a hitch.
  - PayPal had the same results when it came to performance.
  - *35% decrease in the average response time for the same page. This resulted in the pages being served 200ms faster — something users will definitely notice.*
- LONG-TERM SUPPORT
  - After the Node.js and io.js merged, something great happened: Node.js finally got a LTS (long-term support) working group.

BENEFITS OF USING NODE

- SUCCESSFUL ADOPTIONS IN THE ENTERPRISE
  - LinkedIn’s mobile application was originally powered by Ruby on Rails, but it is now one of their biggest Node.js applications in production.
  - The original application used to make several sequential calls for a single page, with every thread handling a single request.
  - Node.js enabled the team to move to a model where the client only makes a single request for a page. They also could simplify the code and move to stateless servers.



On the server side, LinkedIn’s entire mobile software stack is completely built in Node.js.

They went from running 15 servers with 15 instances on each physical machine

to just 4 instances that can handle 2x the traffic.

BENEFITS OF USING NODE

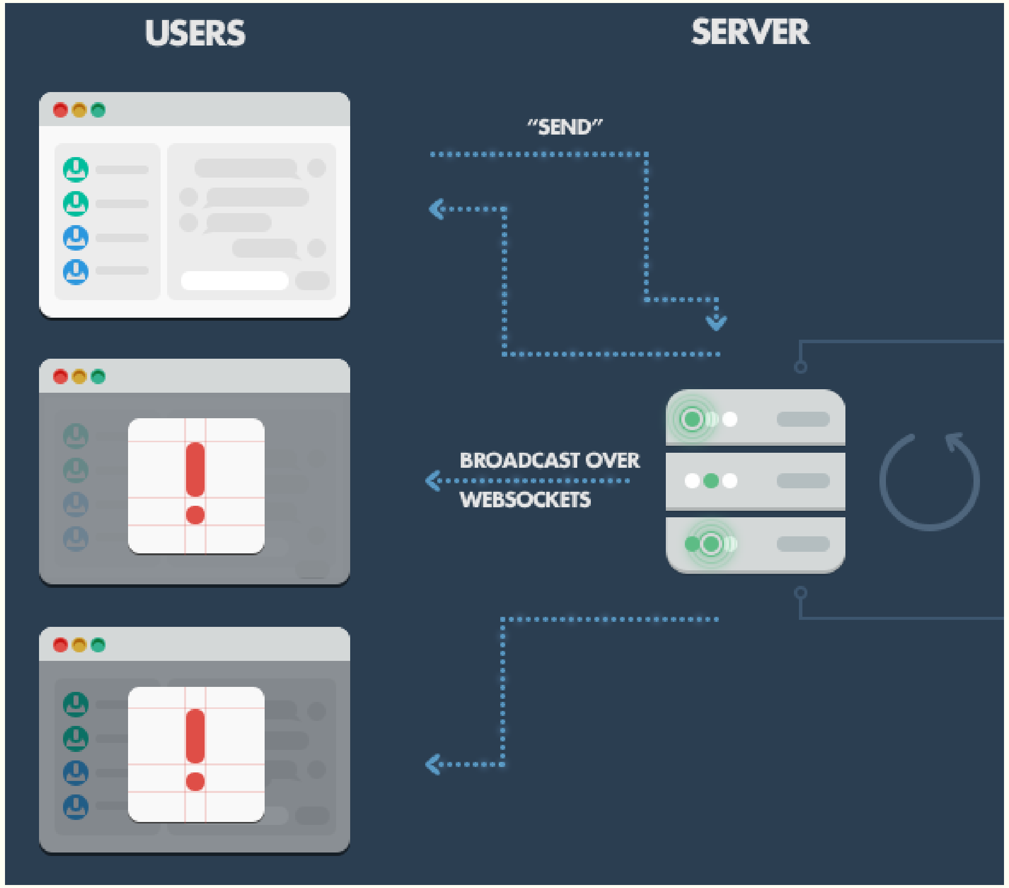
- NETFLIX
  - Netflix did not migrate everything to Node.js at first. Context switching between the UI and the backend was often difficult, because the backend infrastructure was based on Java. The UI team wanted to work with a language that was already familiar to them.
  - Using Node.js enabled quicker iterations, gave a productivity boost to the engineers and improved user experience for the customers.

BENEFITS OF USING NODE

- DOW JONES
  - Dow Jones was able to release 2x-4x faster, with around 1/10th the amount of code than before by transforming C# into JavaScript on node.js
- NEW YORK TIMES
  - The video team at the New York Times uses Node.js for both the video API and maintaining the videos.
  - There was no main internal API for consumption of video or playlist data when Times Video was created.
  - They needed to update the application every single time when an editor created or updated video or playlist metadata using JSON files.
  - The team tested Node.js for its non-blocking I/O Model capability and they experienced a huge performance boost compared to their PHP application

Examples of Where Node.js Should Be Used

- CHAT
  - Chat is the most typical real-time, multi-user application. The chat application is really the sweet-spot example for Node.js: it’s a lightweight, high traffic, data-intensive (but low processing / computation) application that runs across distributed devices.



Examples of Where Node.js Should Be Used

- **API ON TOP OF AN OBJECT DB**
  - It’s quite a natural fit for exposing the data from object DBs (e.g. MongoDB). JSON stored data allow Node.js to function without the impedance mismatch and data conversion.
- **QUEUED INPUTS**
  - If you’re receiving a high amount of concurrent data, your database can become a bottleneck. But because database access is a blocking operation, we run into trouble. The solution is to acknowledge the client’s behaviour before the data is truly written to the database.
  - With that approach, the system maintains its responsiveness under a heavy load, which is particularly useful when the client doesn’t need firm confirmation of a the successful data write.

Examples of Where Node.js Should Be Used

- **DATA STREAMING**
  - it’s possible to process files while they’re still being uploaded, as the data comes in through a stream and we can process it in an online fashion.
  - This could be done for real-time audio or video encoding
- **BROKERAGE - STOCK TRADER’S DASHBOARD**
  - used to track stocks prices, perform calculations/technical analysis, and create graphs/charts.
- **APPLICATION MONITORING DASHBOARD**
  - Node-with-web-sockets fits perfectly: tracking website visitors and visualizing their interactions in real-time.
  - Track every website visitor and all their activities including: page views, case-studies, products, downloads, videos viewed and more. [https://www.canddi.com/]

Examples of Where Node.js Should Be Used

- **SYSTEM MONITORING DASHBOARD**
    - With the Node.js event-loop, we can create a powerful web-based dashboard that checks the services' statuses in an asynchronous manner and pushes data to clients using websockets. [https://status.github.com/]
- **SERVER-SIDE WEB APPLICATIONS [Can be used]**
    - Node.js with Express.js can also be used to create classic web applications on the server-side.

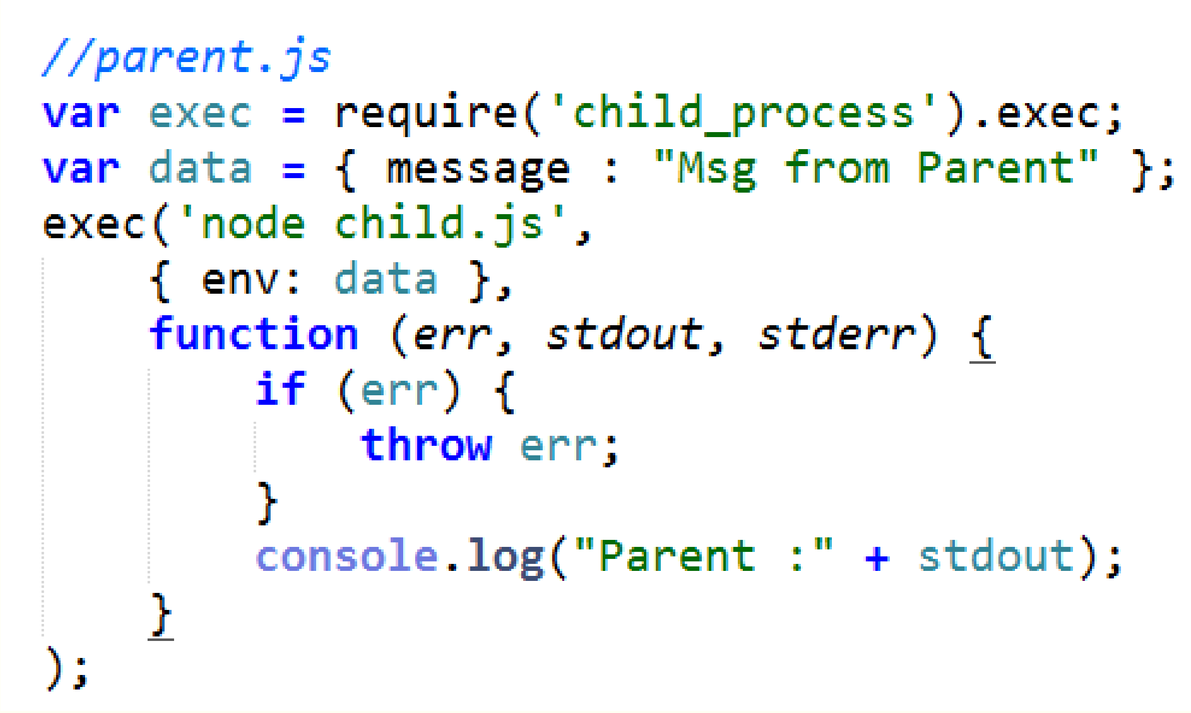
Where Node.js Shouldn’t Be Used

- **SERVER-SIDE WEB APPLICATION W/ A RELATIONAL DB BEHIND**
  - Relational DB tools for Node.js are still in their early stages; they’re rather immature and not as pleasant to work with
- **HEAVY SERVER-SIDE COMPUTATION/PROCESSING**
  - Any CPU intensive operation nullifies all the throughput benefits Node offers with its event-driven, non-blocking I/O model because any incoming requests will be blocked while the thread is occupied with your number-crunching.

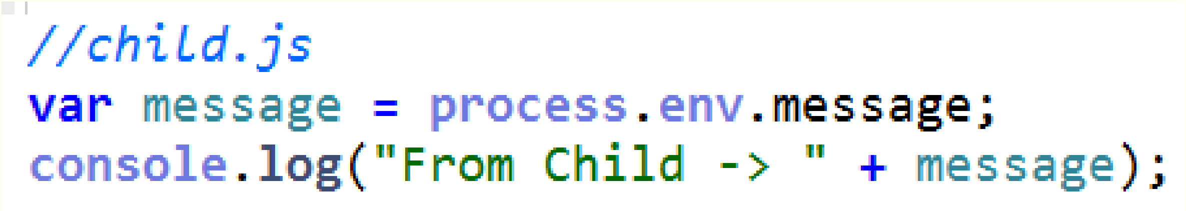
Child Process

- There are two methods for running child processes under Node.js - **exec** and **spawn**.
  - exec
    - Buffer, async, all data at once
    - child_process.exec returns the whole buffer output from the child process. By default the buffer size is set at 200k
    - Use it to run programs that return result statuses, instead of data.
    - child_process.exec is "synchronously asynchronous", meaning although the exec is asynchronous, it waits for the child process to end and tries to return all the buffered data at once.
    - If the buffer size of exec is not set big enough, it fails with a "maxBuffer exceeded" error.

Child Process [exec]



```
//parent.js
var exec = require('child_process').exec;
var data = { message : "Msg from Parent" };
exec('node child.js',
    { env: data },
    function (err, stdout, stderr) {
        if (err) {
            throw err;
        }
        console.log("Parent :" + stdout);
    }
);
```

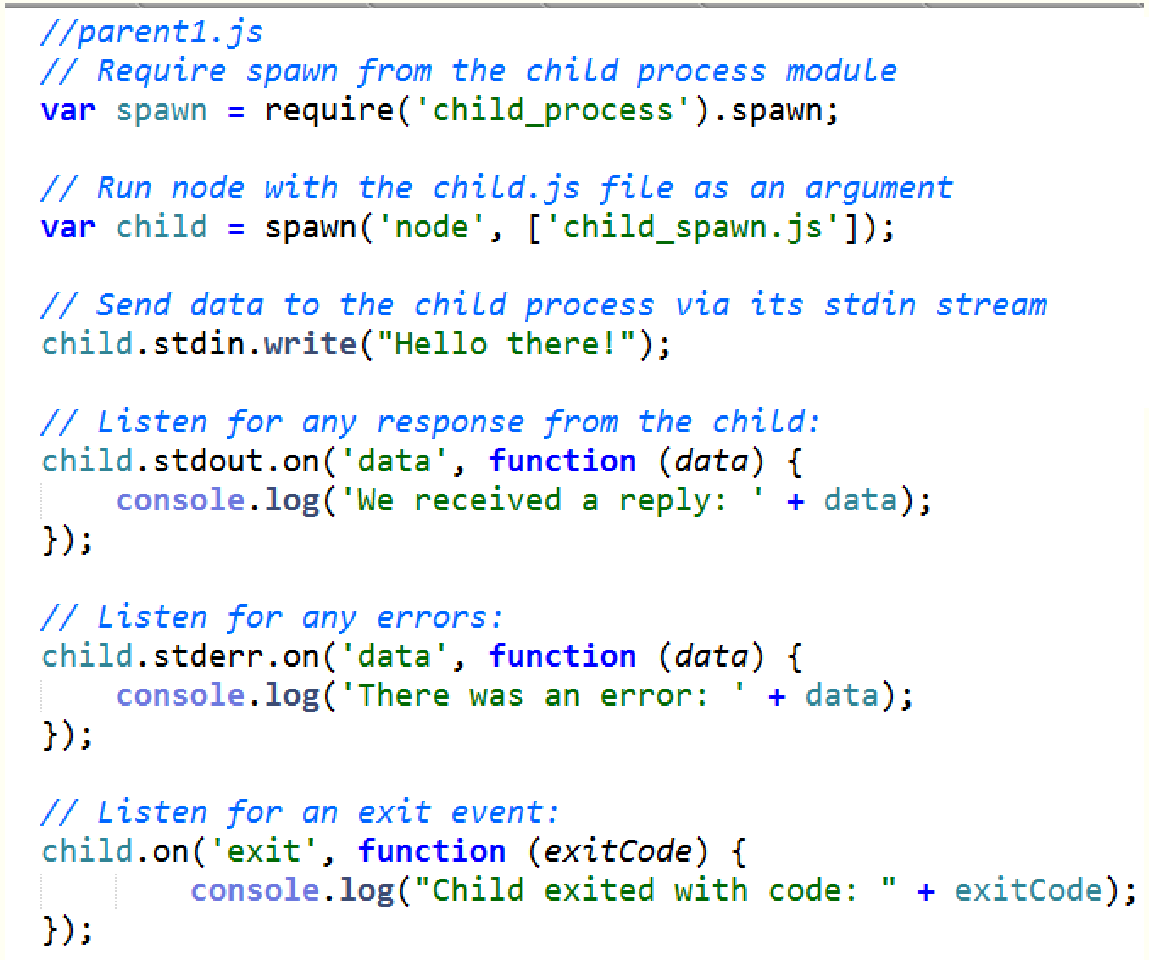


```
//child.js
var message = process.env.message;
console.log("From Child -> " + message);
```

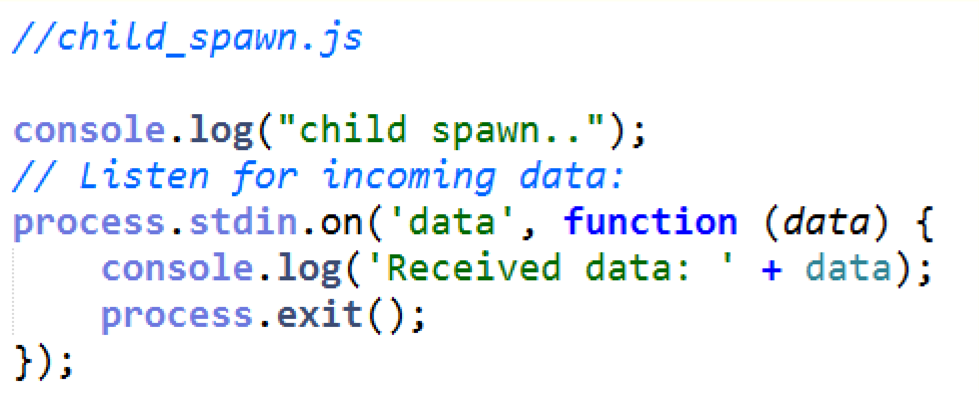
Child Process [spawn]

- Large Data, stream and no new V8 instance
- child_process.spawn returns an object with stdout and stderr streams.
- You can tap on the stdout stream to read data that the child process sends back to Node.
- stdout being a stream has the "data", "end", and other events that streams have.
- spawn is best used to when you want the child process to return a large amount of data to Node - image processing, reading binary data etc.

Child Process [spawn]



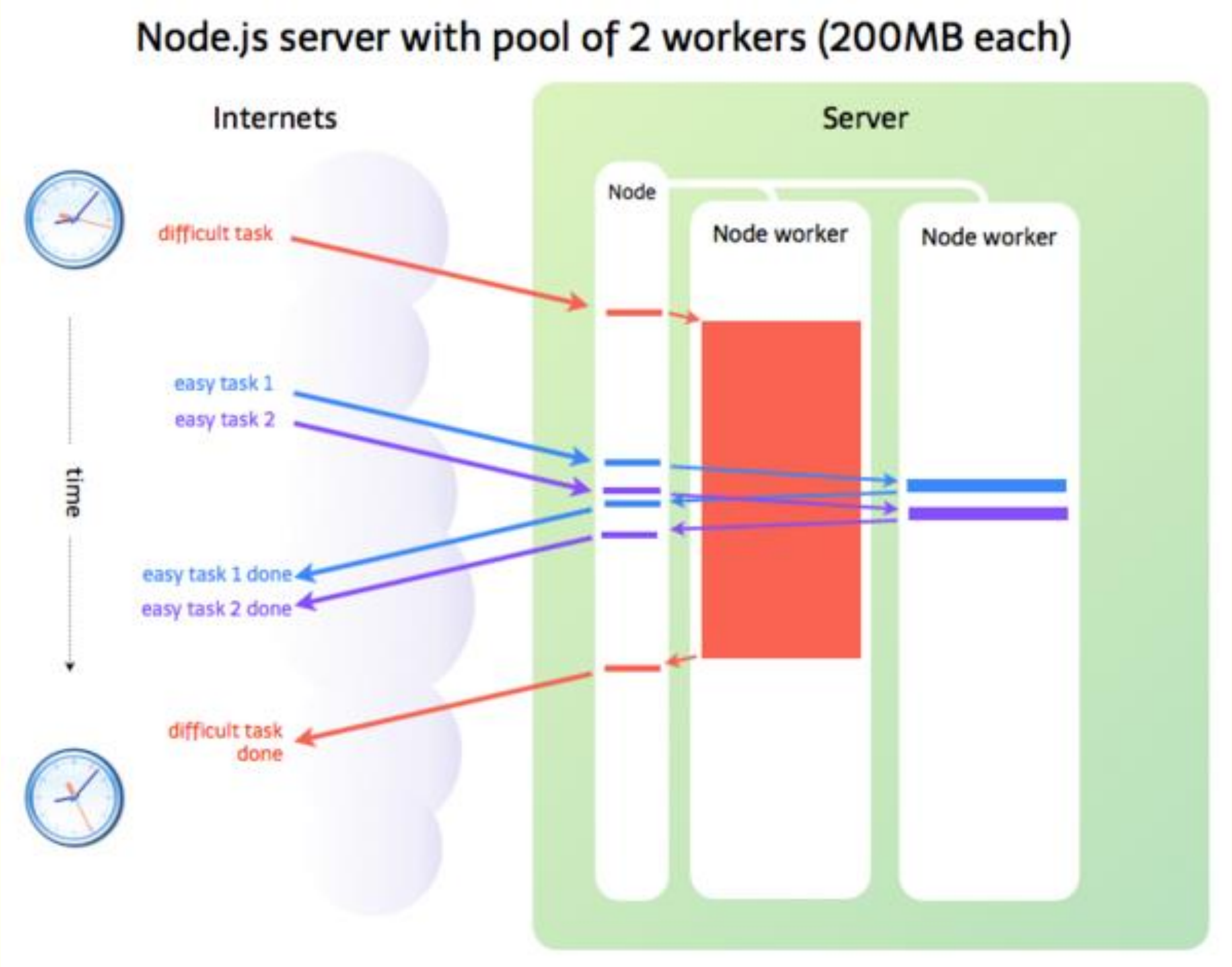
```
//parent1.js
// Require spawn from the child process module
var spawn = require('child_process').spawn;

// Run node with the child.js file as an argument
var child = spawn('node', ['child_spawn.js']);

// Send data to the child process via its stdin stream
child.stdin.write("Hello there!");

// Listen for any response from the child:
child.stdout.on('data', function (data) {
    console.log('We received a reply: ' + data);
});

// Listen for any errors:
child.stderr.on('data', function (data) {
    console.log('There was an error: ' + data);
});

// Listen for an exit event:
child.on('exit', function (exitCode) {
        console.log("Child exited with code: " + exitCode);
});
```



```
//child_spawn.js

console.log("child spawn..");
// Listen for incoming data:
process.stdin.on('data', function (data) {
    console.log('Received data: ' + data);
    process.exit();
});
```

Fork

- New V8 instance,
- Multiple workers



What is clustering ?

- If you run your single Node server on specific port, it runs on single thread.
- It take advantage of your Single core only.
- Clustering in Node.js allows you to create separate processes which can share same server port.
  - For example, if we run one HTTP server on Port 3000, it is one Server running on Single thread on single core of processor.
  - So i will cluster my application and run them on all cores. So if i run one server on Port 3000 by having 4 core of processor then actually i am running 4 server all are listening to Port 3000.

What is clustering ?

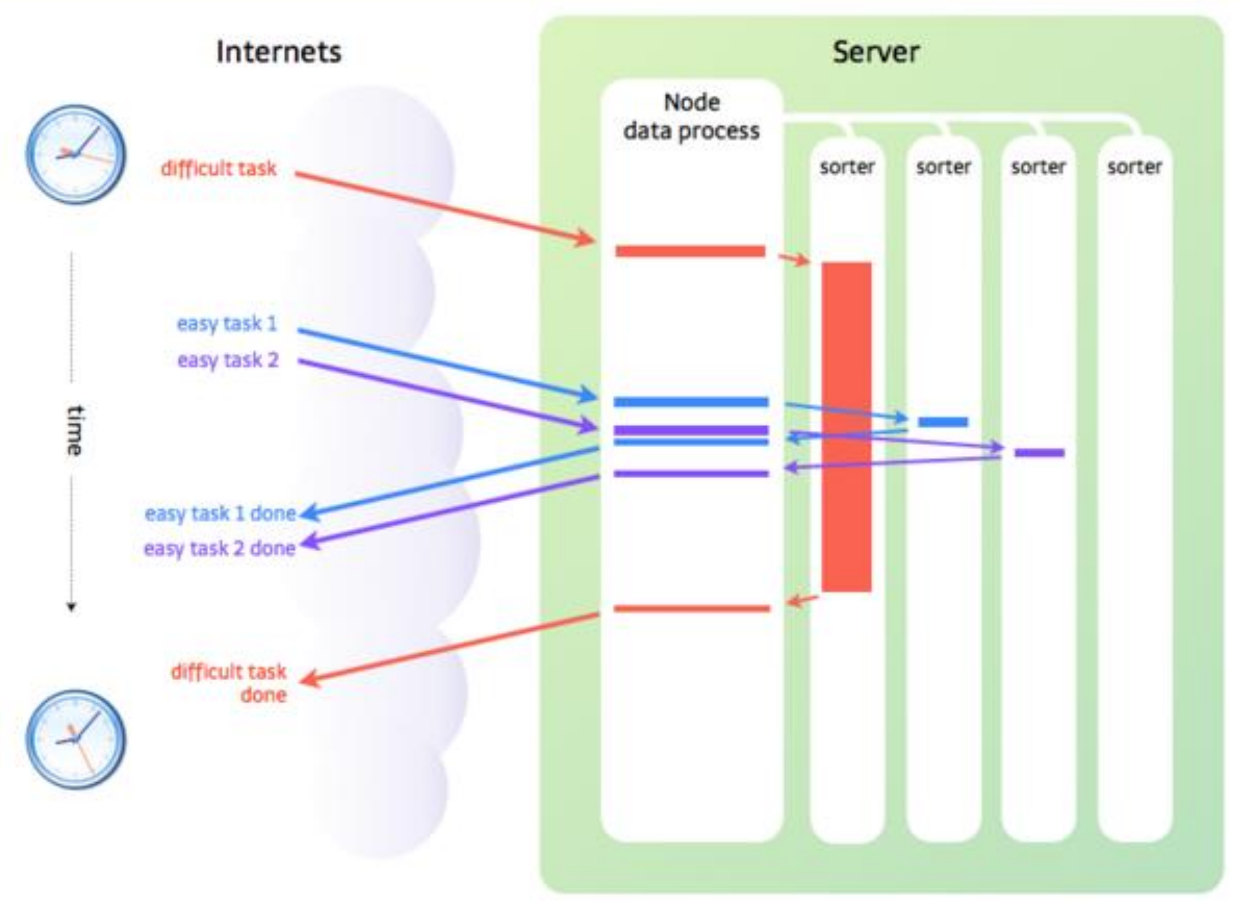
- So if one server goes down then other is there to take the place of it, also in peak load of traffic, Node will automatically allocate the worker to particular process so basically it does internal load balancing very efficiently.

Cluster [forks with shared memory]

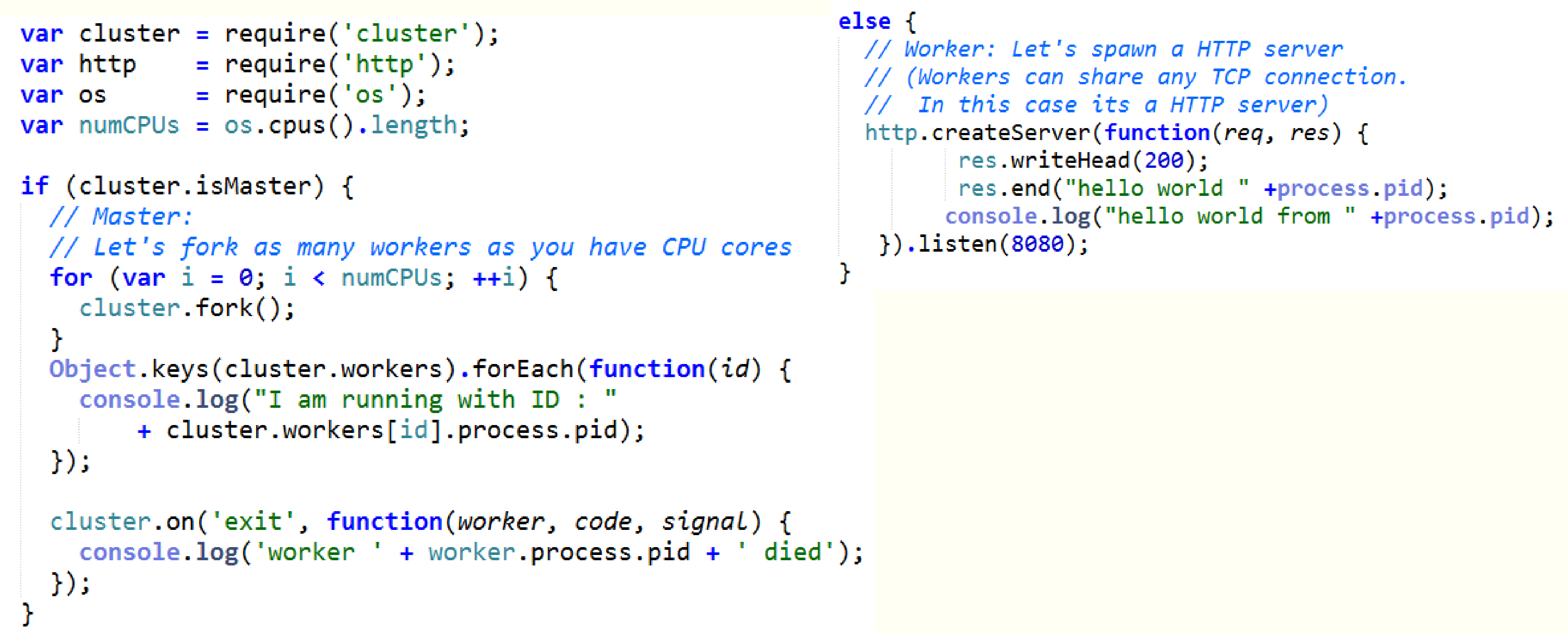
- Cluster module will set up a master and then fork your server (also called a worker).

- It communicates with workers via **IPC** channels and comes with an embedded load-balancer which uses **Round-robin algorithm** to better distribute load among the workers.

- When using Round-robin scheduling policy, the master **accepts()** all incoming connections and sends the TCP handle for that particular connection to the chosen worker (still via IPC).



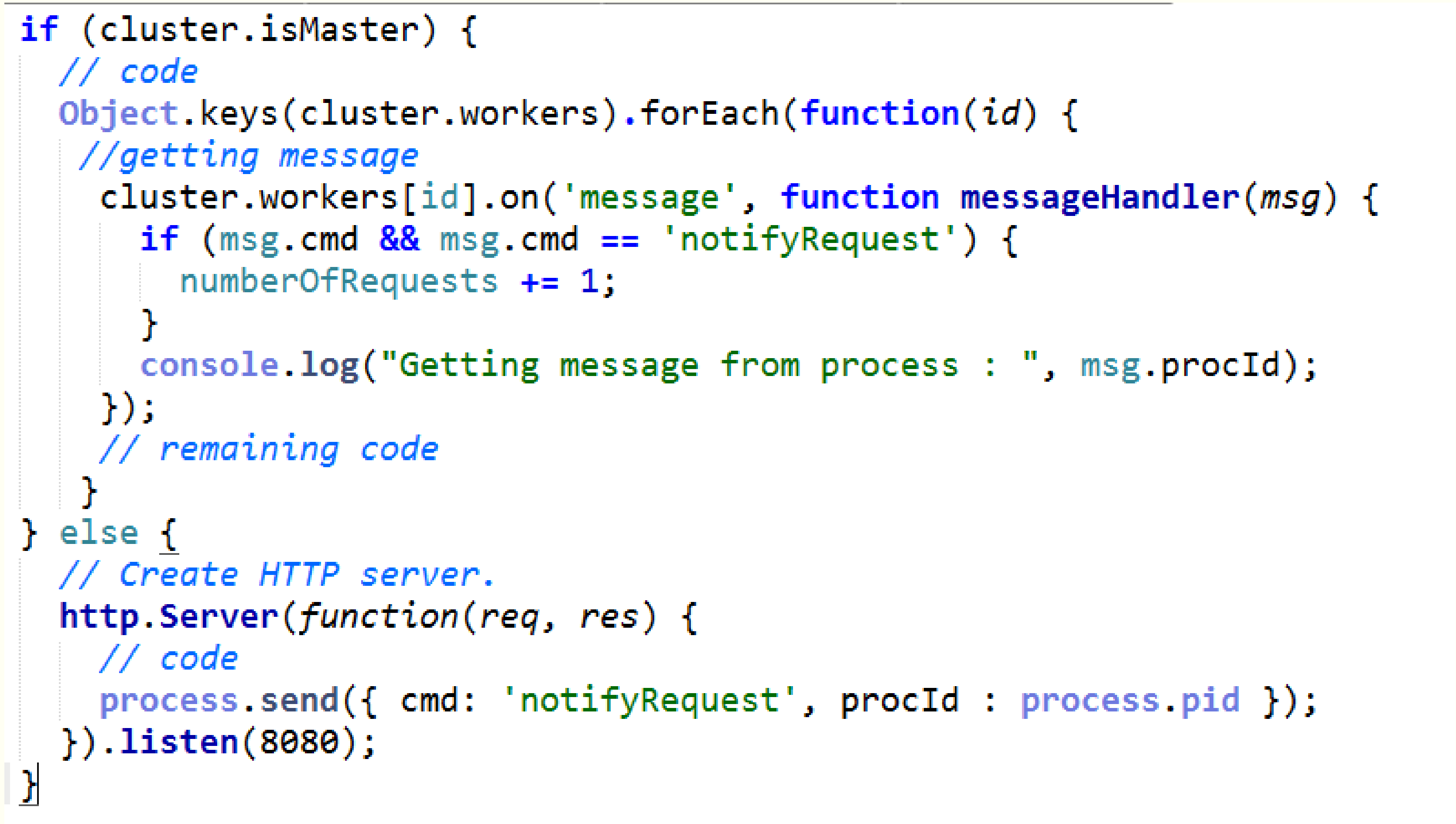
Cluster



```
var cluster = require('cluster');
var http    = require('http');
var os      = require('os');
var numCPUs = os.cpus().length;

if (cluster.isMaster) {
  // Master:
  // Let's fork as many workers as you have CPU cores
  for (var i = 0; i < numCPUs; ++i) {
    cluster.fork();
  }
  Object.keys(cluster.workers).forEach(function(id) {
    console.log("I am running with ID : "
        + cluster.workers[id].process.pid);
  });

  cluster.on('exit', function(worker, code, signal) {
    console.log('worker ' + worker.process.pid + ' died');
  });
}
```

```
else {
  // Worker: Let's spawn a HTTP server
  // (Workers can share any TCP connection.
  //  In this case its a HTTP server)
  http.createServer(function(req, res) {
           res.writeHead(200);
           res.end("hello world " +process.pid);
          console.log("hello world from " +process.pid);
   }).listen(8080);
}
```

Cluster [send a message from the "worker" to the "master“]



```
if (cluster.isMaster) {
  // code
  Object.keys(cluster.workers).forEach(function(id) {
   //getting message
    cluster.workers[id].on('message', function messageHandler(msg) {
      if (msg.cmd && msg.cmd == 'notifyRequest') {
        numberOfRequests += 1;
      }
      console.log("Getting message from process : ", msg.procId);
    });
    // remaining code
   }
} else {
  // Create HTTP server.
  http.Server(function(req, res) {
    // code
    process.send({ cmd: 'notifyRequest', procId : process.pid });
  }).listen(8080);
}
```

Cluster Libraries

- **Strong-cluster-control** (https://github.com/ strongloop/strong-cluster-control)
  - slc run
- **pm2** (https://github.com/Unitech/pm2):
- PM2 DEMO:
  - TYPICAL EXPRESS SERVER

```
var express = require('express')
var app = express()
app.get('*', function(req, res) {
        // handle req and res
}).listen(port)
```

- PM2 DEMO:

```
$ pm2 start server.js -i 4 // four instances
```

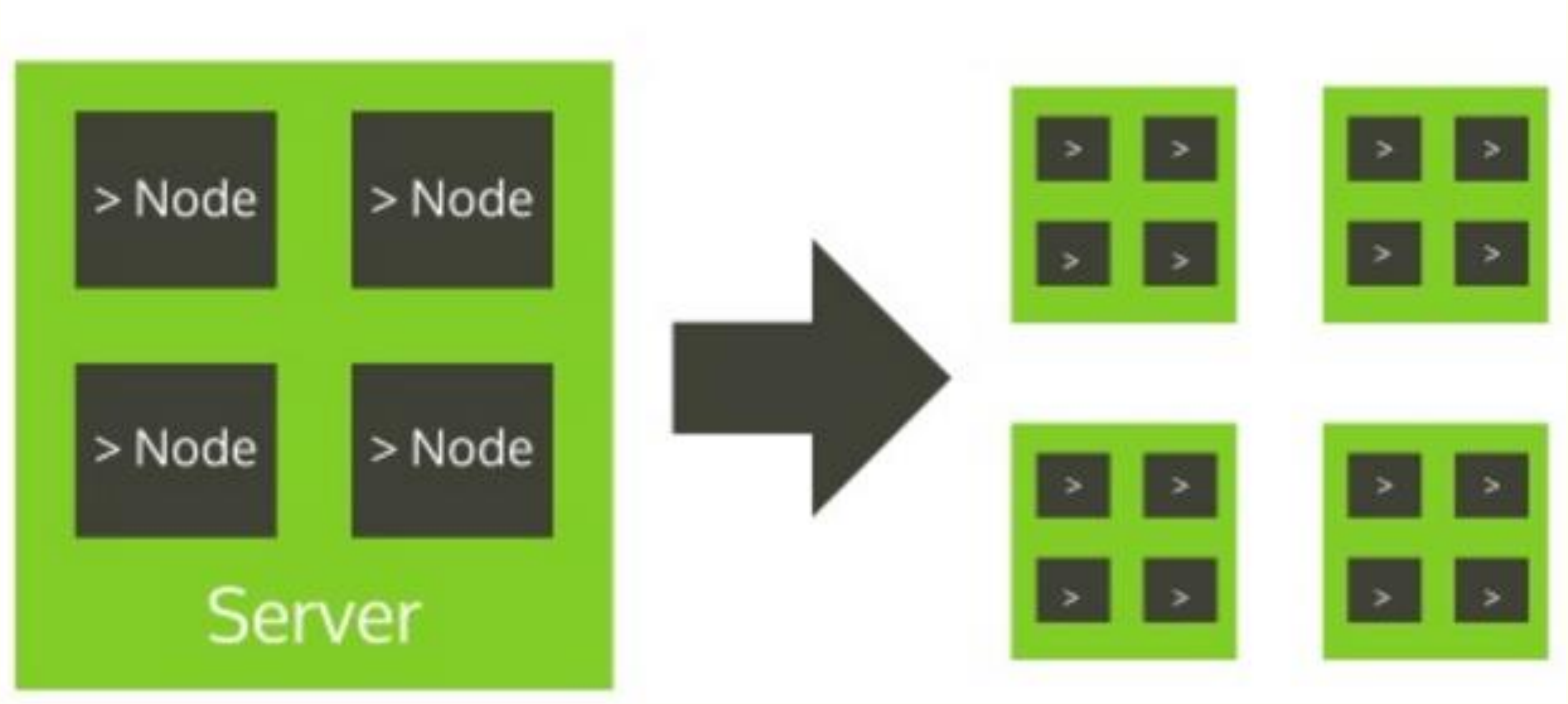
- In a new window:

```
$ loadtest http://localhost:3000 -t 20 -c 10
```

```
$  ab –n 1000 –c 100 http://127.0.0.1:8080 [ Apache Benchmark ]
```

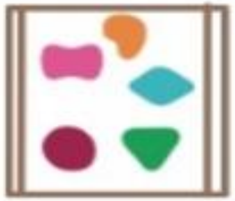
Container Clustering

- Distribute load over multiple machines(virtual or physical)

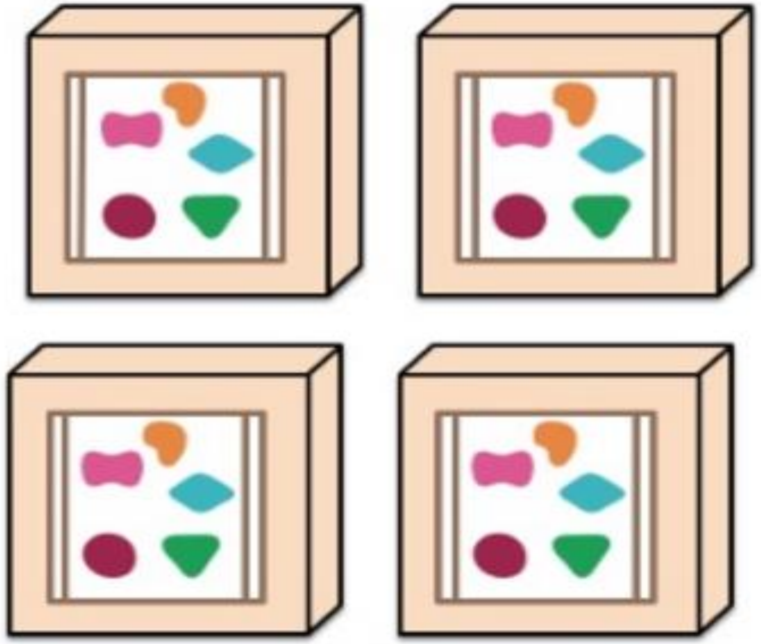


Monolithic

A monolithic application puts all its functionality into a single process...

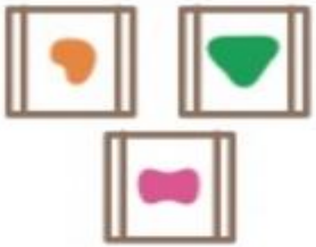


... and scales by replicating the monolith on multiple servers

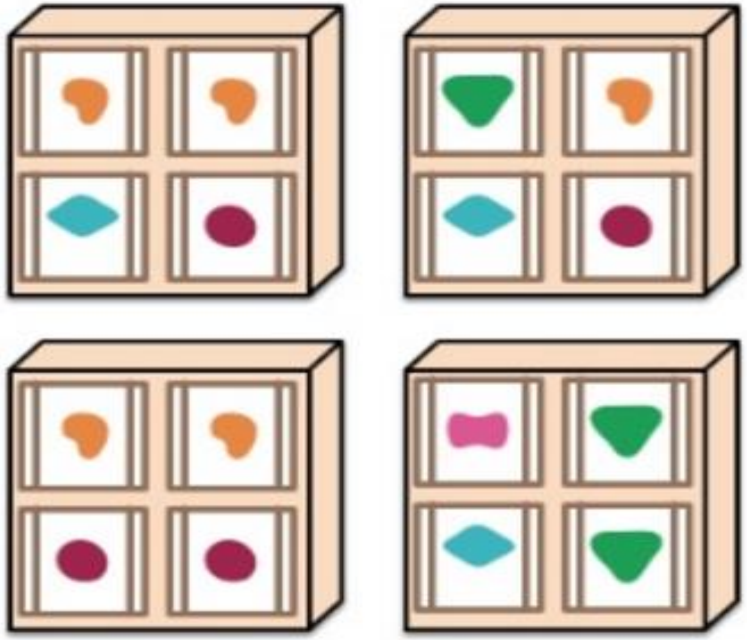


Microservices

A microservices architecture puts each element of functionality into a separate service...



... and scales by distributing these services across servers, replicating as needed.



Load Balancing

- Nginx
  - Nginx is an open source HTTP server, similar to Apache but much faster. It has built in load balancing
  - Nginx is actually a pretty darn solid choice for load balancing Node.js processes.
  - NGINX (http://nginx.com/), is an HTTP server like Apache, but instead of using the multithreaded approach with blocking I/O, it uses an event loop with asynchronous I/O.
  - Apache uses one thread per connection.
  - NGINX doesn’t use threads. It uses an **event loop**.

- HAProxy
  - HAProxy or "High Availability Proxy" is an open source Proxy server. It is pretty much built solely to load balance lots of machines. Unlike Nginx it cannot serve up static files. It comes with all the great load balancing features of Nginx - weighted processes, failover, horizontal scaling, plus loads more settings and features
  - It also offers some great monitoring options.

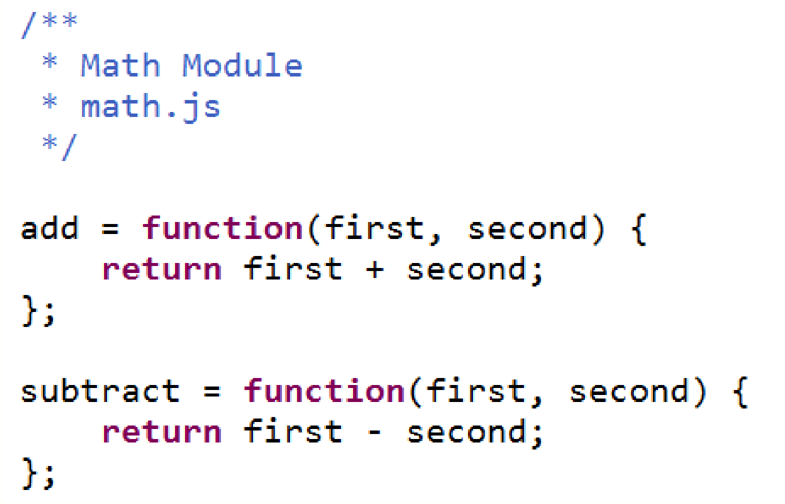
Node Globals

- **process** – object providing information and methods for the current process
  - process.versions
  - process.arch
  - process.argv
  - process.env
  - process.uptime()
  - process.memoryUsage( )
  - process.cwd()
  - process.exit( )
  - process.on( )
  - process.pid
- **console** – allows printing to stdout and stderr
- **require()** – function to load a module
- **module** – refers to the current module

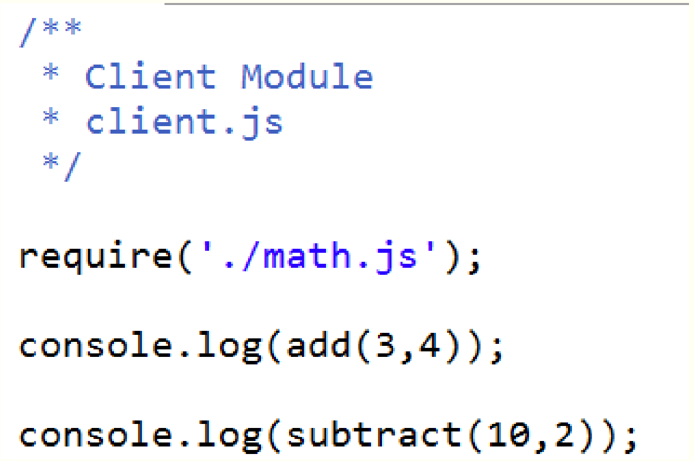
Node.js Modules

- Node.JS - a Common.JS Module Implementation
- Your code uses require to include modules.
- Modules use exports to make things available.

Pattern 1: Define a Global



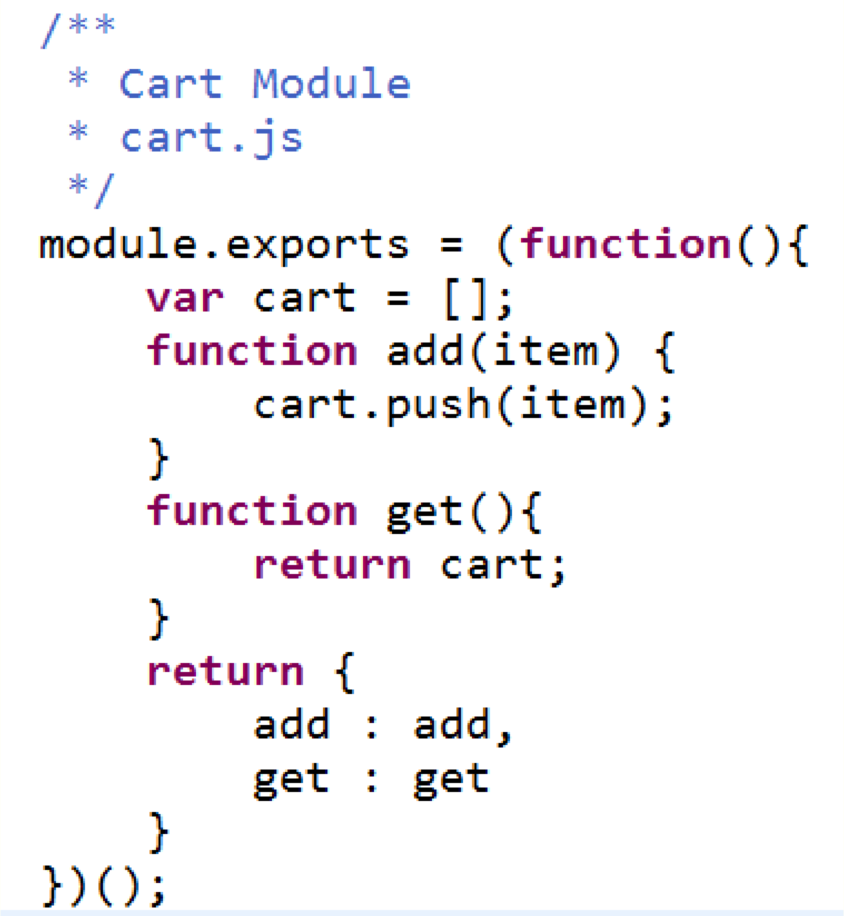
```
/**
 * Math Module
 * math.js
 */

add = function(first, second) {
    return first + second;
};

subtract = function(first, second) {
    return first - second;
};
```



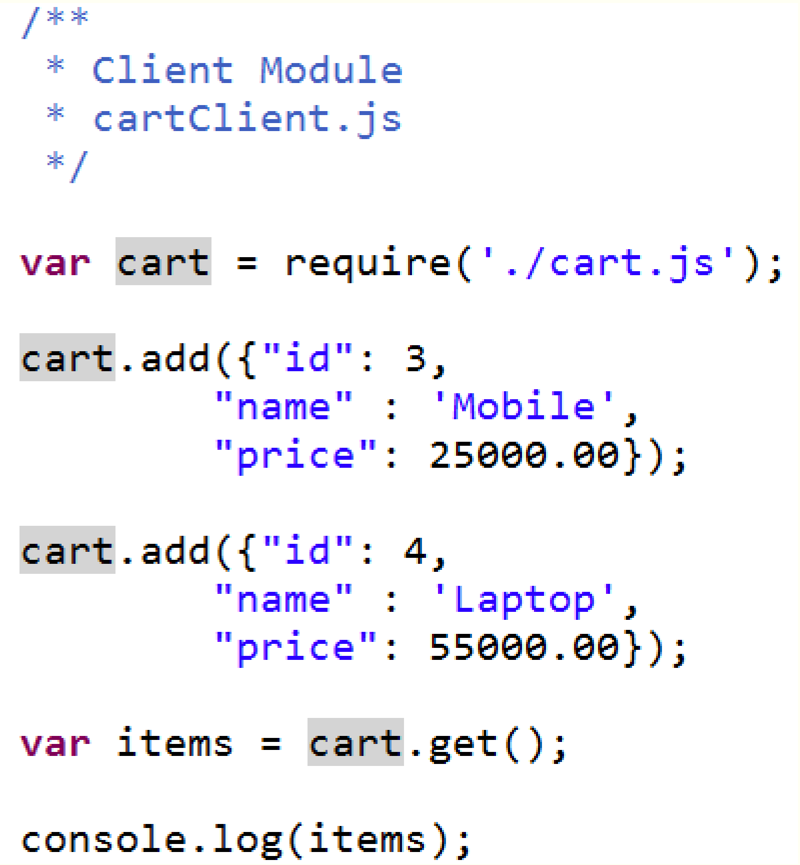
```
/**
 * Client Module
 * client.js
 */

require('./math.js');

console.log(add(3,4));

console.log(subtract(10,2));
```

don't pollute the global space

Pattern 2: Export an Anonymous Function

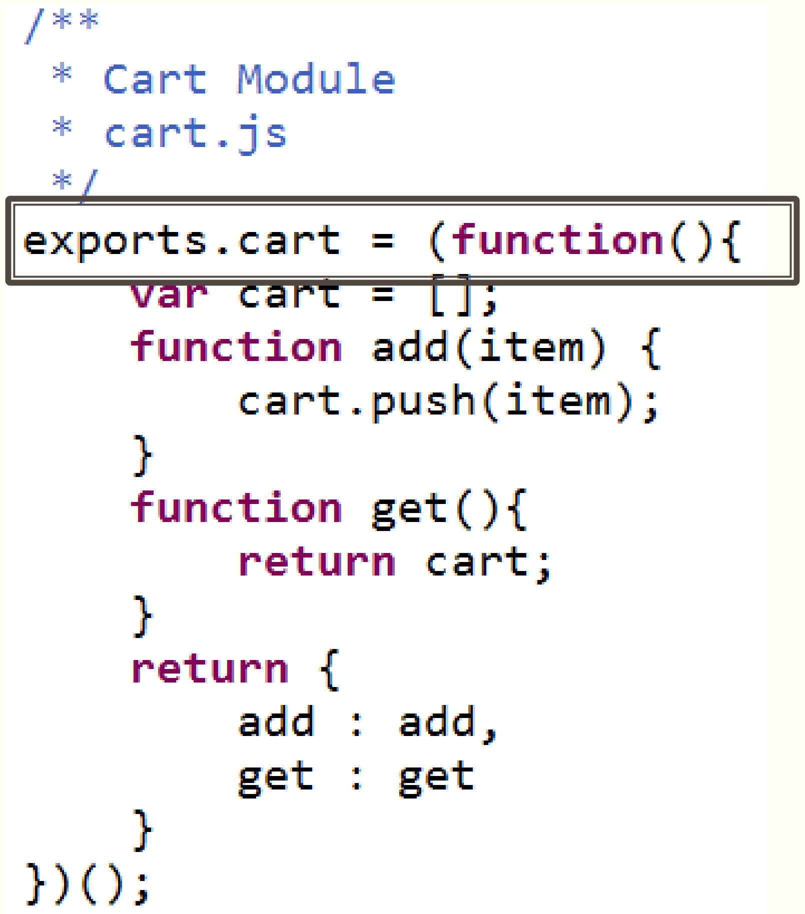


```
/**
 * Cart Module
 * cart.js
 */
module.exports = (function(){
    var cart = [];
    function add(item) {
        cart.push(item);
    }
    function get(){
        return cart;
    }
    return {
        add : add,
        get : get
    }
})();
```

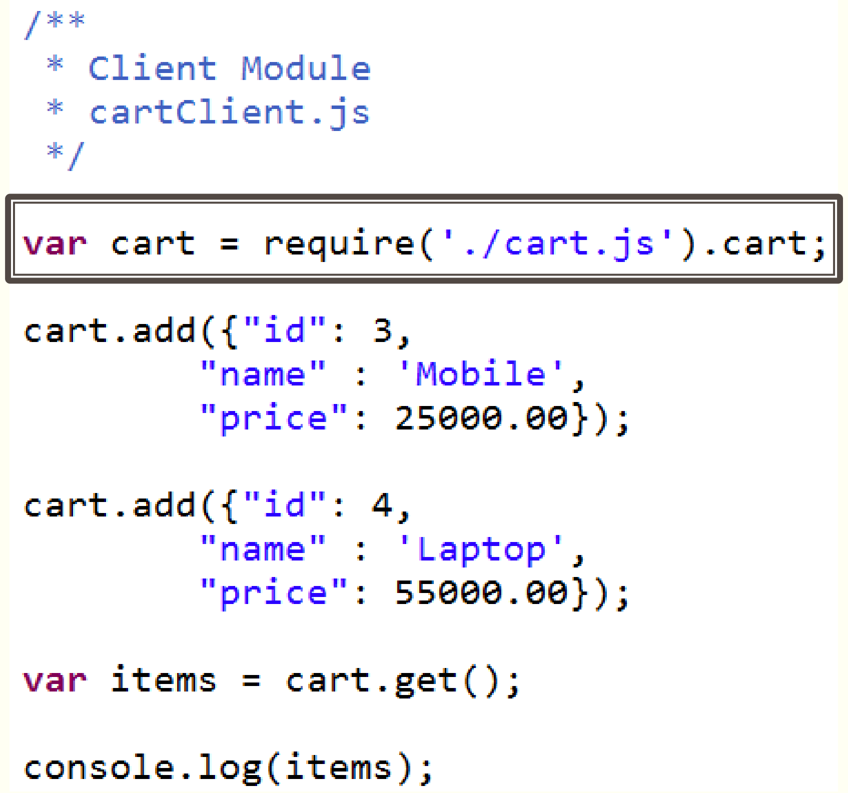


```
/**
 * Client Module
 * cartClient.js
 */

var cart = require('./cart.js');

cart.add({"id": 3,
        "name" : 'Mobile',
        "price": 25000.00});

cart.add({"id": 4,
        "name" : 'Laptop',
        "price": 55000.00});

var items = cart.get();

console.log(items);
```

Pattern 3: Export a Named Function



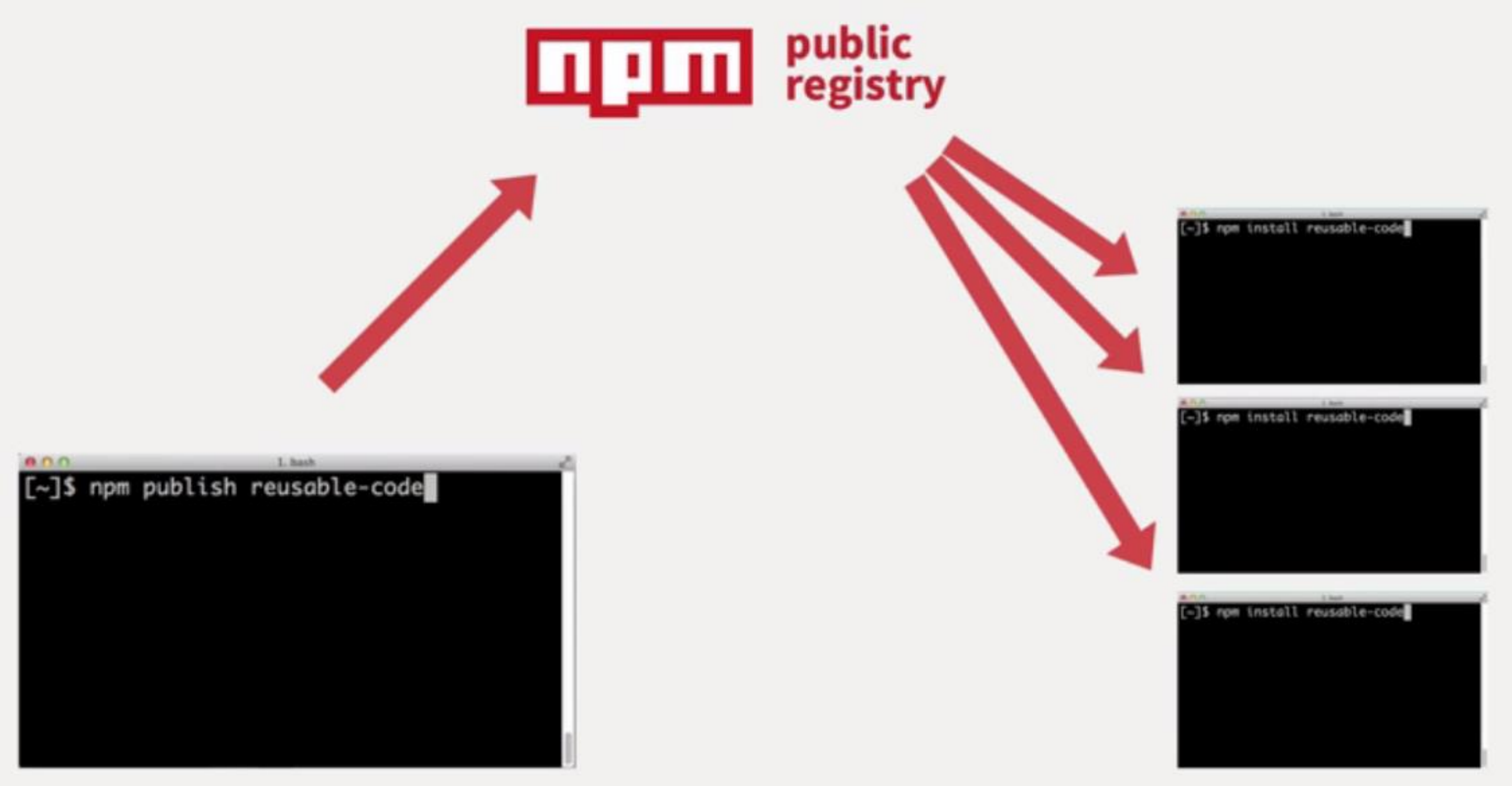
```
/**
 * Cart Module
 * cart.js
 */
exports.cart = (function(){
    var cart = [];
    function add(item) {
        cart.push(item);
    }
    function get(){
        return cart;
    }
    return {
        add : add,
        get : get
    }
})();
```



```
/**
 * Client Module
 * cartClient.js
 */

var cart = require('./cart.js').cart;

cart.add({"id": 3,
        "name" : 'Mobile',
        "price": 25000.00});

cart.add({"id": 4,
        "name" : 'Laptop',
        "price": 55000.00});

var items = cart.get();

console.log(items);
```

What is NPM?

- ➢ Node Package Manager (NPM) is a package manager for node
- ➢ Allows us to install packages from repo, and publish our own



```
[~]$ npm publish reusable-code
```

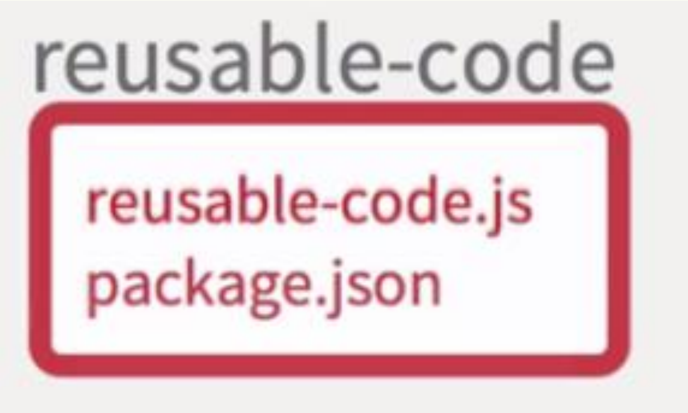
```
[~]$ npm install reusable-code
```

```
[~]$ npm install reusable-code
```

```
[~]$ npm install reusable-code
```

Node Packaged Modules

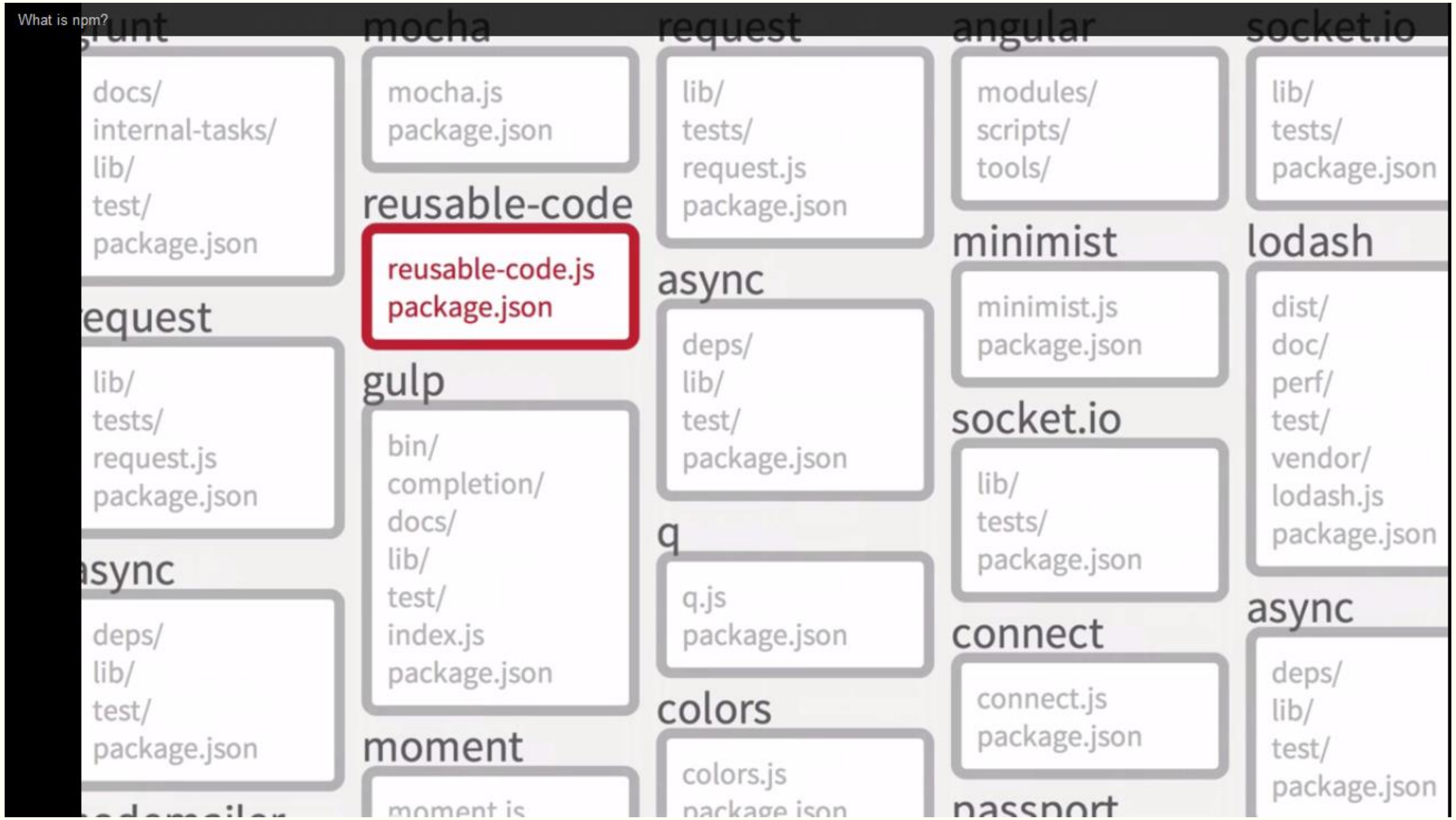
- Packages or Modules is just a director with one or more reusable-files in it along with a file called “package.json” in it.
- Packages are generally small and generally solve one problem



- Package.json contains metadata about the package

Node Packaged Modules

- A typical application like a web-site will depend on many packages



What is npm?

grunt
docs/
internal-tasks/
lib/
test/
package.json

equest
lib/
tests/
request.js
package.json

async
deps/
lib/
test/
package.json

mocha
mocha.js
package.json

reusable-code
reusable-code.js
package.json

gulp
bin/
completion/
docs/
lib/
test/
index.js
package.json

moment
moment.js

request
lib/
tests/
request.js
package.json

async
deps/
lib/
test/
package.json

q
q.js
package.json

colors
colors.js
package.json

angular
modules/
scripts/
tools/

minimist
minimist.js
package.json

socket.io
lib/
tests/
package.json

connect
connect.js
package.json

passport

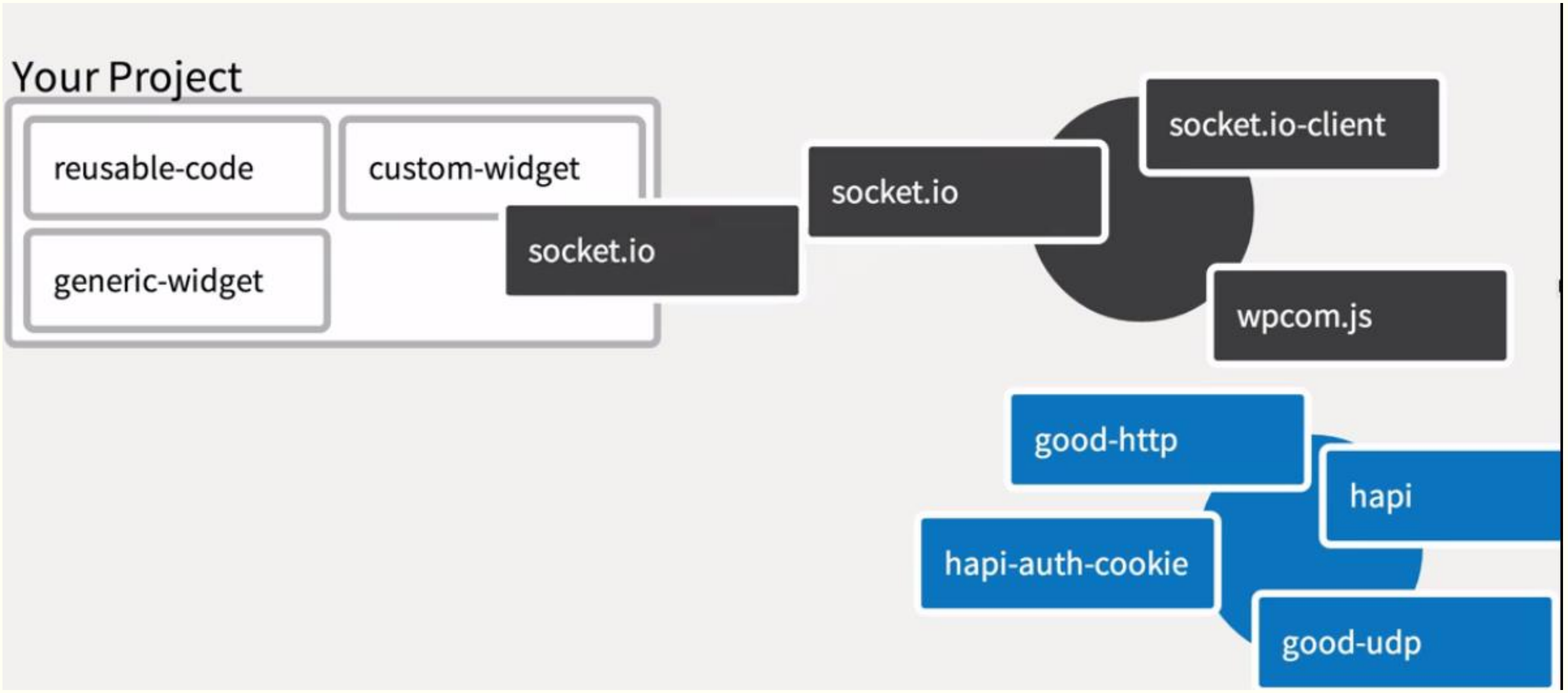
socket.io
lib/
tests/
package.json

lodash
dist/
doc/
perf/
test/
vendor/
lodash.js
package.json

async
deps/
lib/
test/
package.json

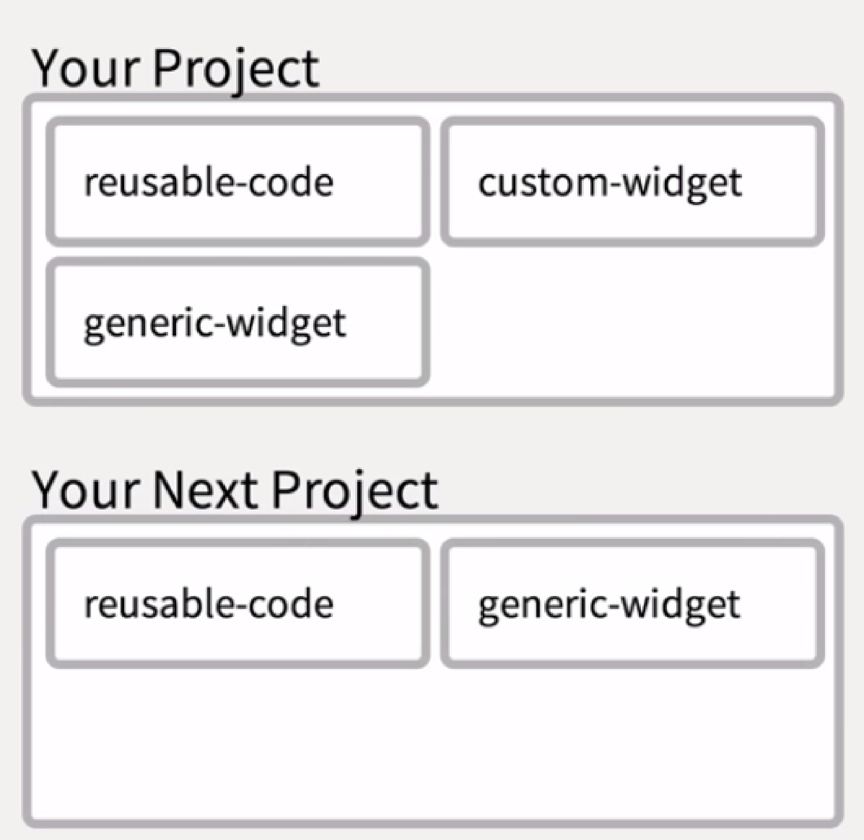
Node Packaged Modules

- Packages help in bringing in packages developed from people who have focussed on particular problem area



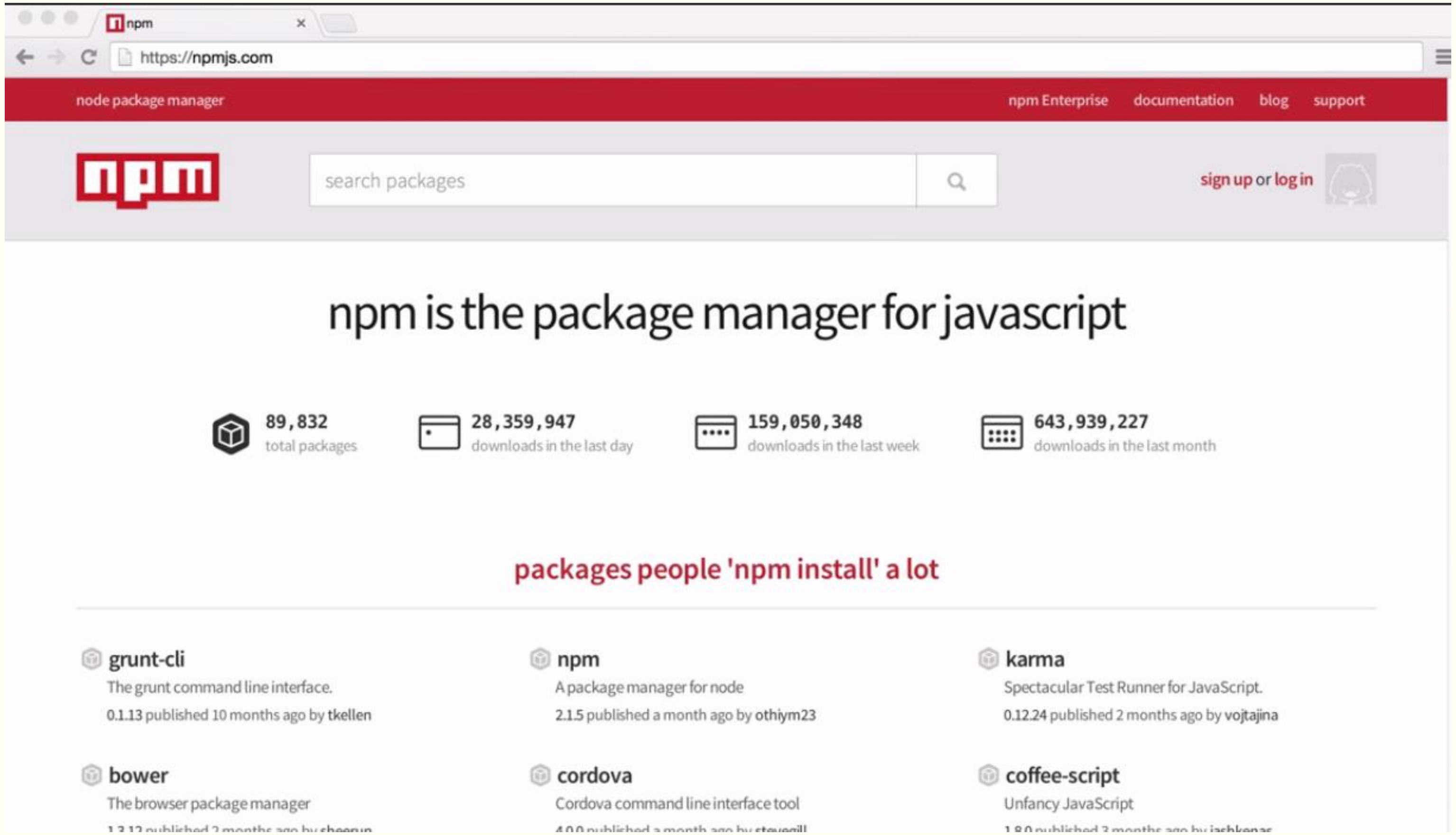
Node Packaged Modules

- Helps reuse code across projects



Node Packaged Modules

- You can browse node module packages in npm web site



npm is the package manager for javascript

89,832 total packages

28,359,947 downloads in the last day

159,050,348 downloads in the last week

643,939,227 downloads in the last month

packages people 'npm install' a lot

grunt-cli
The grunt command line interface.
0.1.13 published 10 months ago by tkellen

npm
A package manager for node
2.1.5 published a month ago by othiym23

karma
Spectacular Test Runner for JavaScript.
0.12.24 published 2 months ago by vojtajina

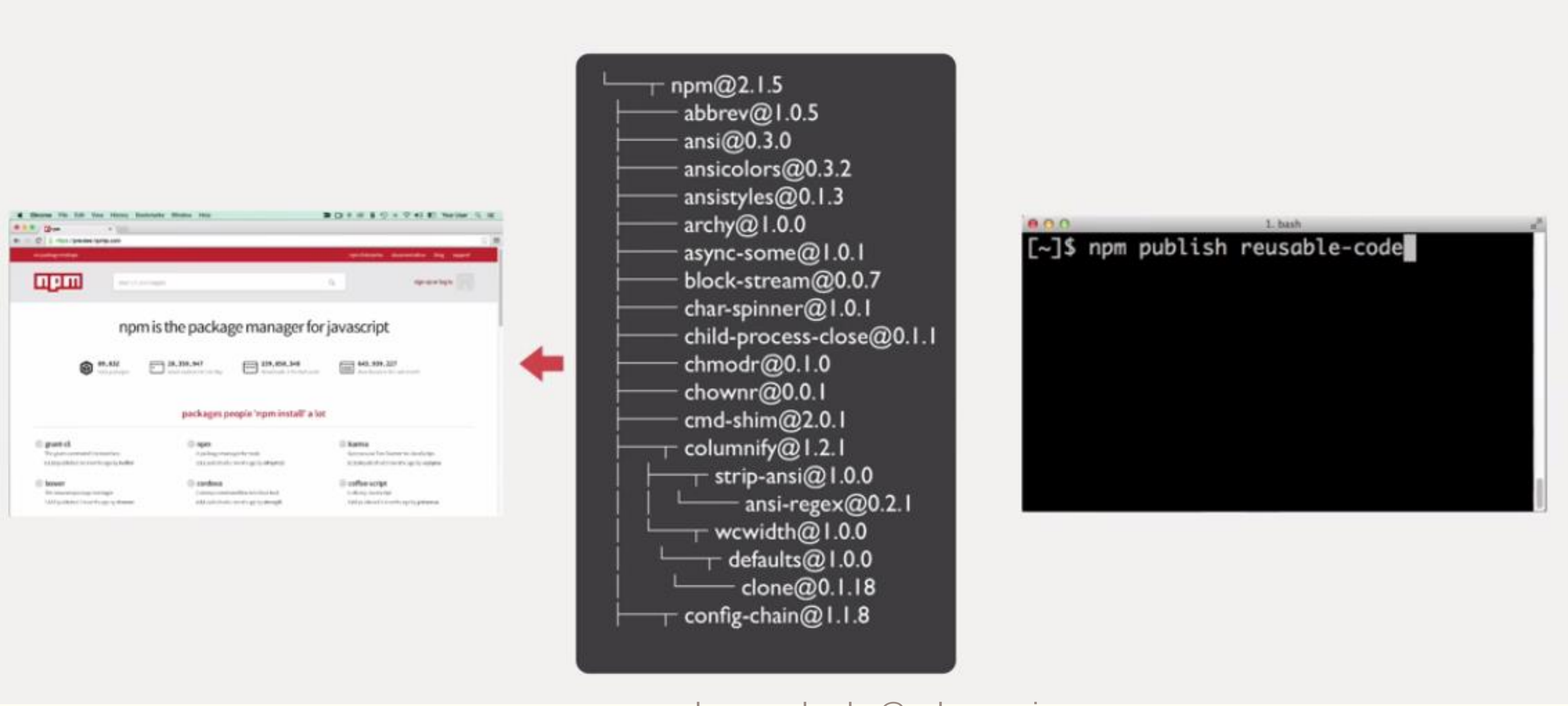
bower
The browser package manager
1.3.12 published 2 months ago by sheerun

cordova
Cordova command line interface tool
4.0.0 published a month ago by stevegill

coffee-script
Unfancy JavaScript
1.8.0 published 3 months ago by jashkenas

Node Packaged Modules

- Node modules can be published using npm client.
- Published modules are reflected in the registry and visible in the web site. Once it is available in registry other clients can install it using npm client


npm
npm is the package manager for javascript
packages people 'npm install' a lot

```
└─┬ npm@2.1.5
  ├── abbrev@1.0.5
  ├── ansi@0.3.0
  ├── ansicolors@0.3.2
  ├── ansistyles@0.1.3
  ├── archy@1.0.0
  ├── async-some@1.0.1
  ├── block-stream@0.0.7
  ├── char-spinner@1.0.1
  ├── child-process-close@0.1.1
  ├── chmodr@0.1.0
  ├── chownr@0.0.1
  ├── cmd-shim@2.0.1
  ├─┬ columnify@1.2.1
  │ ├─┬ strip-ansi@1.0.0
  │ │ └── ansi-regex@0.2.1
  │ └─┬ wcwidth@1.0.0
  │   └─┬ defaults@1.0.0
  │     └── clone@0.1.18
  ├─┬ config-chain@1.1.8
```

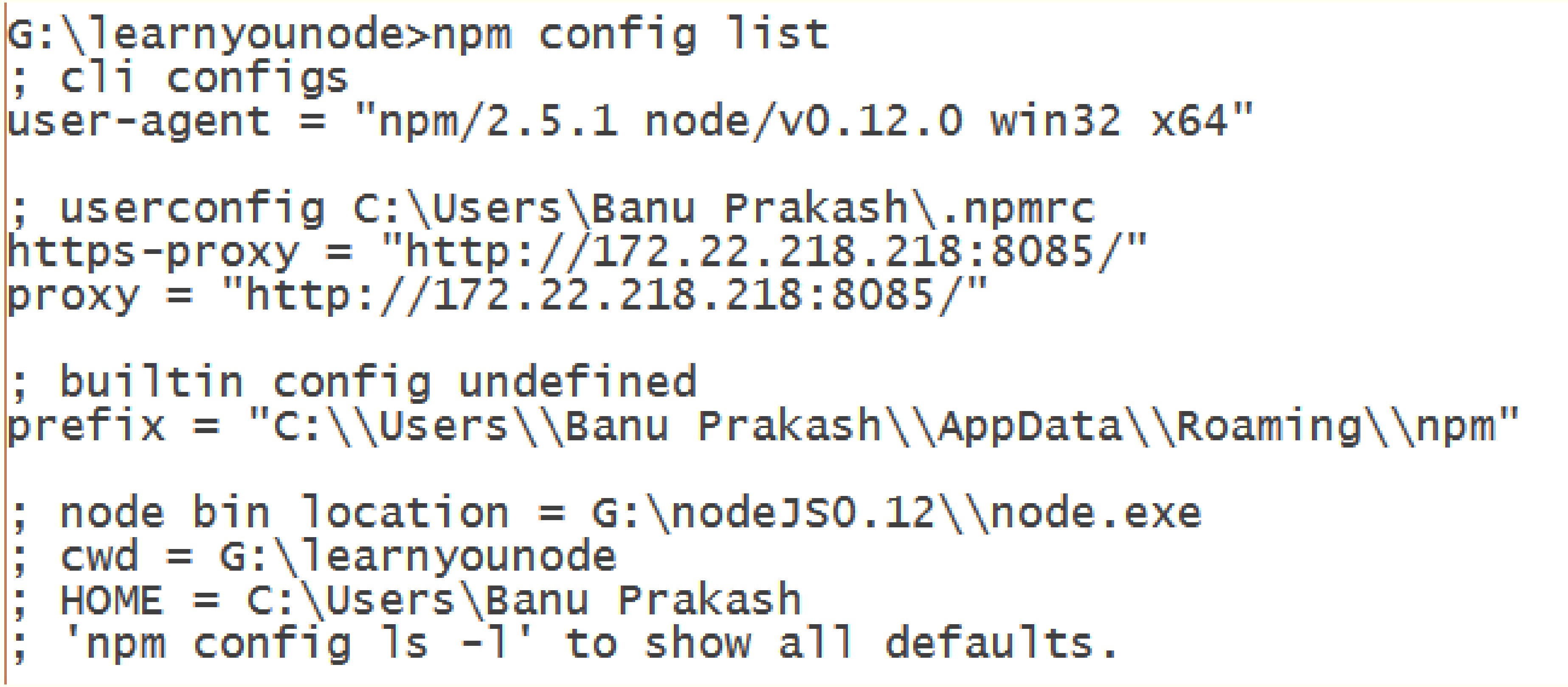
```
[~]$ npm publish reusable-code
```

Node Packaged Modules

- npm can install packages in local or global mode.
- In local mode it installs the package in a node_modules folder in your parent working directory. This location is owned by the current user.
- Global packages are installed in {prefix}/lib/node_modules/ which is owned by root (where {prefix} is usually /usr/ or /usr/local).

Changing the Location of Global Packages

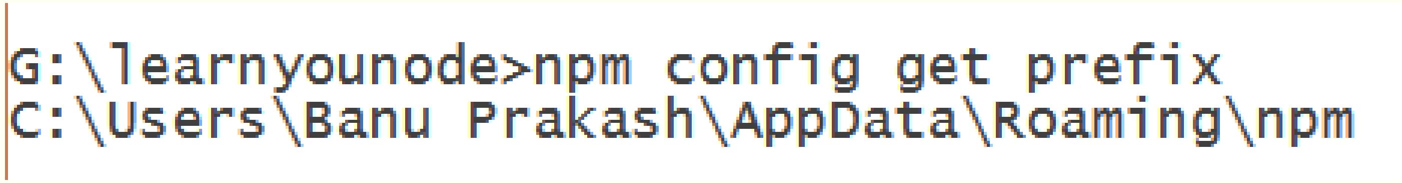
- Let’s see what output npm config gives us.



```
G:\learnyounode>npm config list
; cli configs
user-agent = "npm/2.5.1 node/v0.12.0 win32 x64"

; userconfig C:\Users\Banu Prakash\.npmrc
https-proxy = "http://172.22.218.218:8085/"
proxy = "http://172.22.218.218:8085/"

; builtin config undefined
prefix = "C:\\Users\\Banu Prakash\\AppData\\Roaming\\npm"

; node bin location = G:\nodeJS0.12\\node.exe
; cwd = G:\learnyounode
; HOME = C:\Users\Banu Prakash
; 'npm config ls -l' to show all defaults.
```

Changing the Location of Global Packages

- Get the current global location



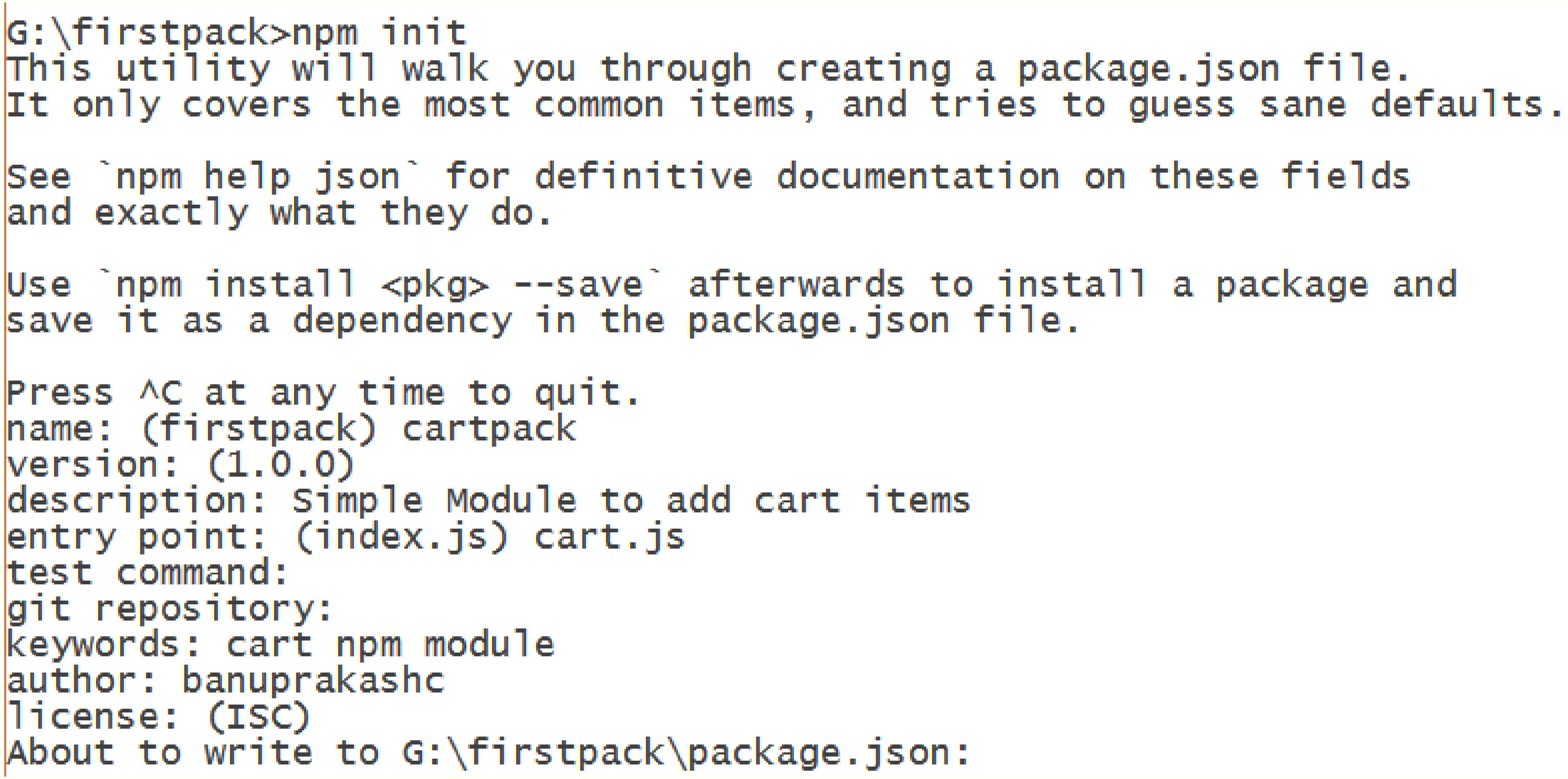
```
G:\learnyounode>npm config get prefix
C:\Users\Banu Prakash\AppData\Roaming\npm
```

- This is the prefix we want to change, so as to install global packages in our home directory. To do that create a new directory in your home folder.
    - npm config set prefix=$HOME/.node_modules_global
- we have altered the location to which global Node packages are installed.
- This also creates a .npmrc file in our home directory.
- npm config get prefix [/home/.node_modules_global]
- cat .npmrc
- prefix=/home/sitepoint/.node_modules_global

npm install global

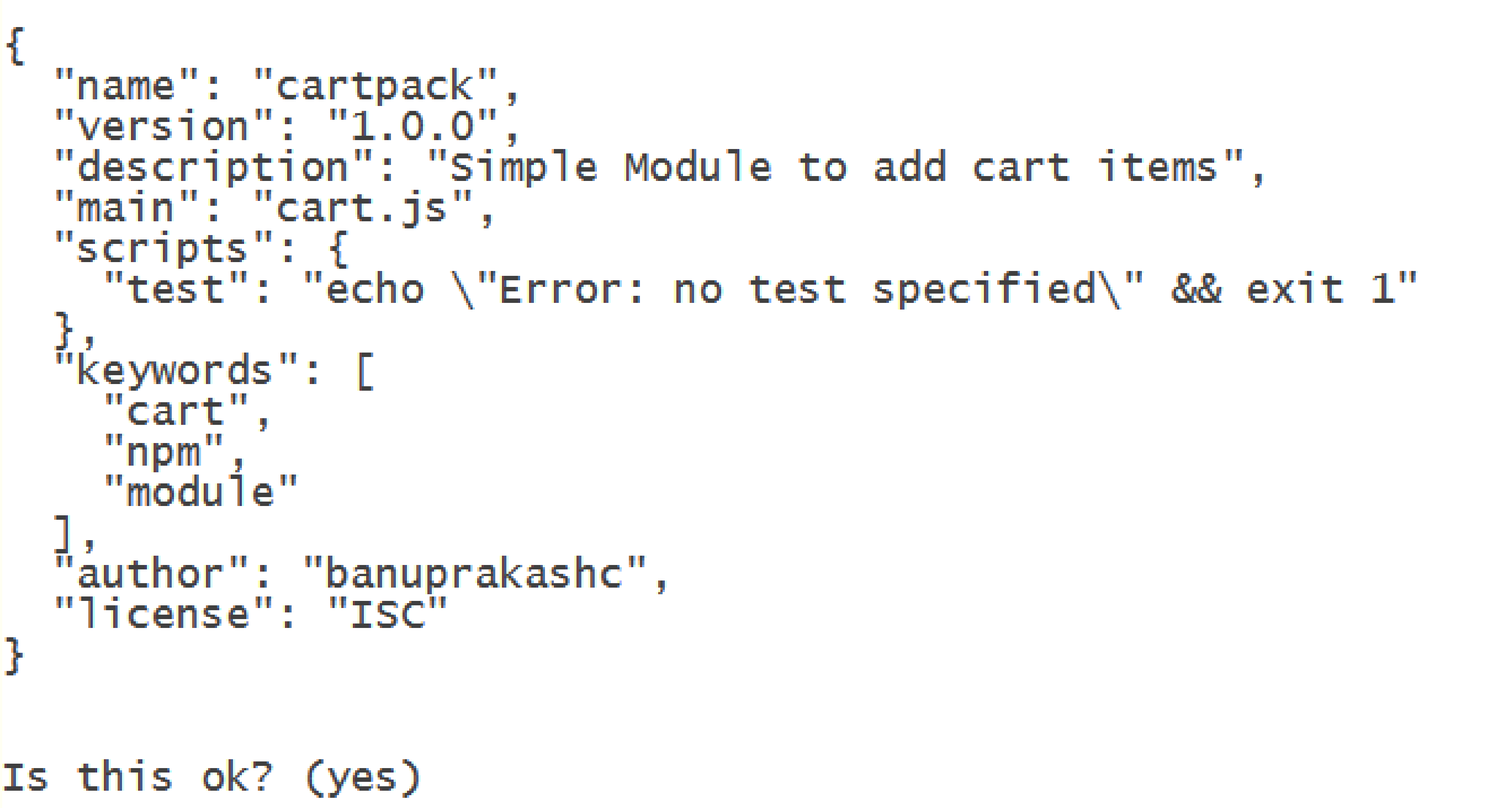
- We still have npm installed in a location owned by root. But because we changed our global package location we can take advantage of that. We need to install npm again, but this time in the new user-owned location. This will also install the latest version of npm.
  - $ npm install npm –global
- Finally, we need to add .node_modules_global/bin to our $PATH environment variable, so that we can run global packages from the command line.
- export PATH="$HOME/.node_modules_global/bin:$PATH"

Installing Packages in Global Mode



```
G:\firstpack>npm init
This utility will walk you through creating a package.json file.
It only covers the most common items, and tries to guess sane defaults.

See `npm help json` for definitive documentation on these fields
and exactly what they do.

Use `npm install <pkg> --save` afterwards to install a package and
save it as a dependency in the package.json file.

Press ^C at any time to quit.
name: (firstpack) cartpack
version: (1.0.0)
description: Simple Module to add cart items
entry point: (index.js) cart.js
test command:
git repository:
keywords: cart npm module
author: banuprakashc
license: (ISC)
About to write to G:\firstpack\package.json:
```

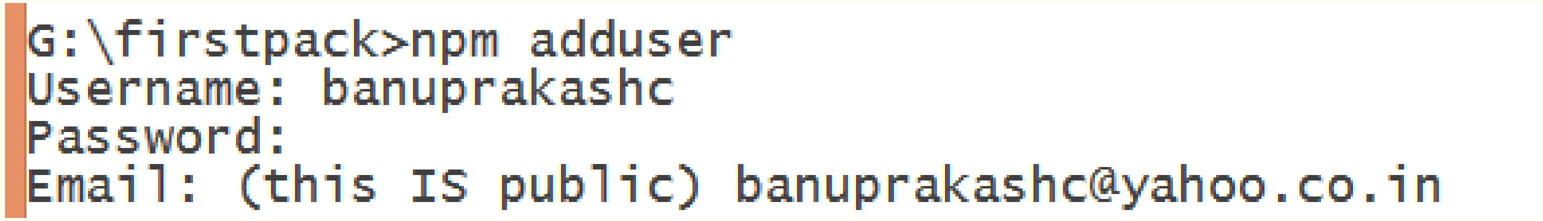
Installing Packages in Global Mode contd..



```
{
  "name": "cartpack",
  "version": "1.0.0",
  "description": "Simple Module to add cart items",
  "main": "cart.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "keywords": [
    "cart",
    "npm",
    "module"
  ],
  "author": "banuprakashc",
  "license": "ISC"
}


Is this ok? (yes)
```

Publish the package

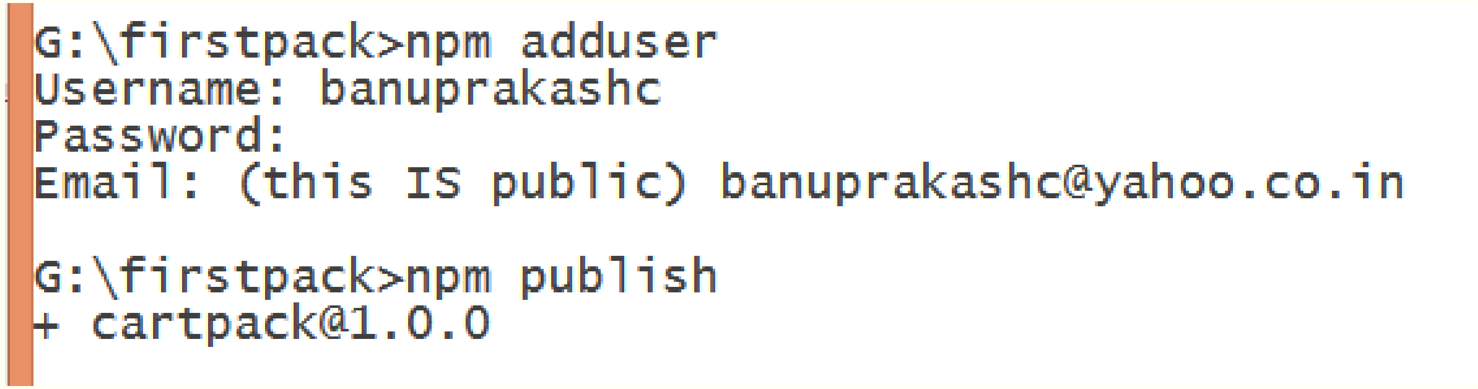
- You can publish any directory that has a package.json
- Creating a user
  - To publish, you must have a user on the npm registry. If you don't have one, create it with npm adduser.
  - If you created one on the site, use npm login to store the credentials on the client.



```
G:\firstpack>npm adduser
Username: banuprakashc
Password:
Email: (this IS public) banuprakashc@yahoo.co.in
```

Publish the package

- **Publishing the package**

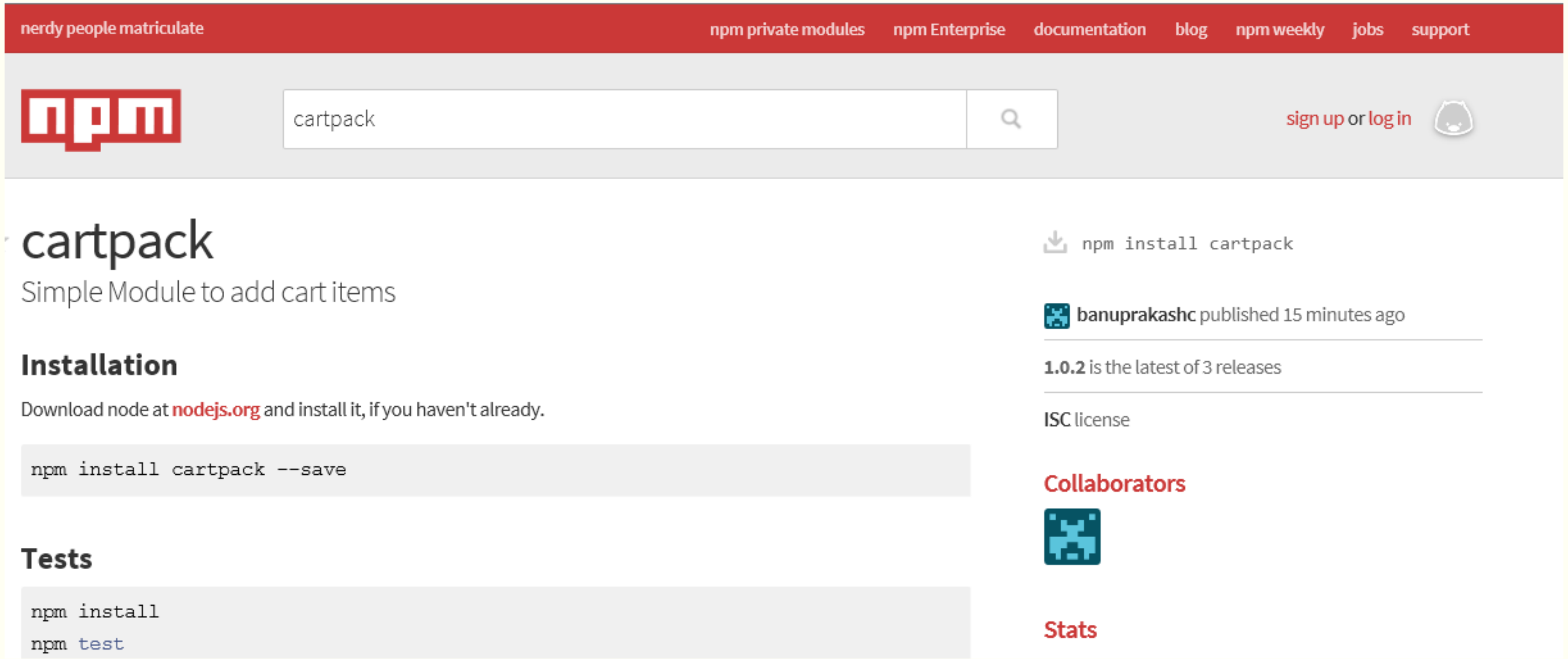


```
G:\firstpack>npm adduser
Username: banuprakashc
Password:
Email: (this IS public) banuprakashc@yahoo.co.in

G:\firstpack>npm publish
+ cartpack@1.0.0
```

- **Check published [https://www.npmjs.com/package/cartpack]**

View available packages

- **Check published [https://www.npmjs.com/package/cartpack]**



cartpack

Simple Module to add cart items

Installation

Download node at nodejs.org and install it, if you haven't already.

```
npm install cartpack --save
```

Tests

```
npm install
npm test
```

```
npm install cartpack
```

banuprakashc published 15 minutes ago

1.0.2 is the latest of 3 releases

ISC license

Collaborators

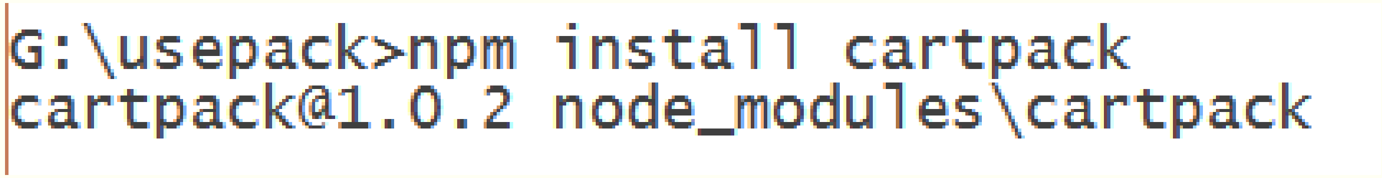
Stats

Updating the package

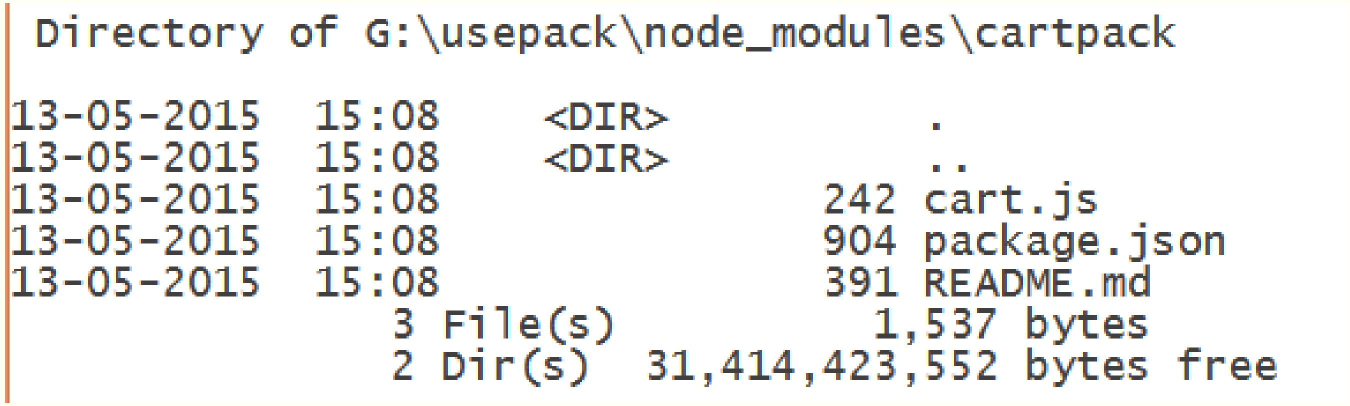
- When you make changes, you can update the package using
- npm version <update_type>,
  - where update_type is one of the semantic versioning release types, patch, minor, or major.
  - This command will change the version number in package.json.
  - Note that this will also add a tag with this release number to your git repository if you have one.
- After updating the version number, you can npm publish again.
- Test: Go to http://npmjs.com/package/<package>. The package number should be updated.

Using node modules

- Install module



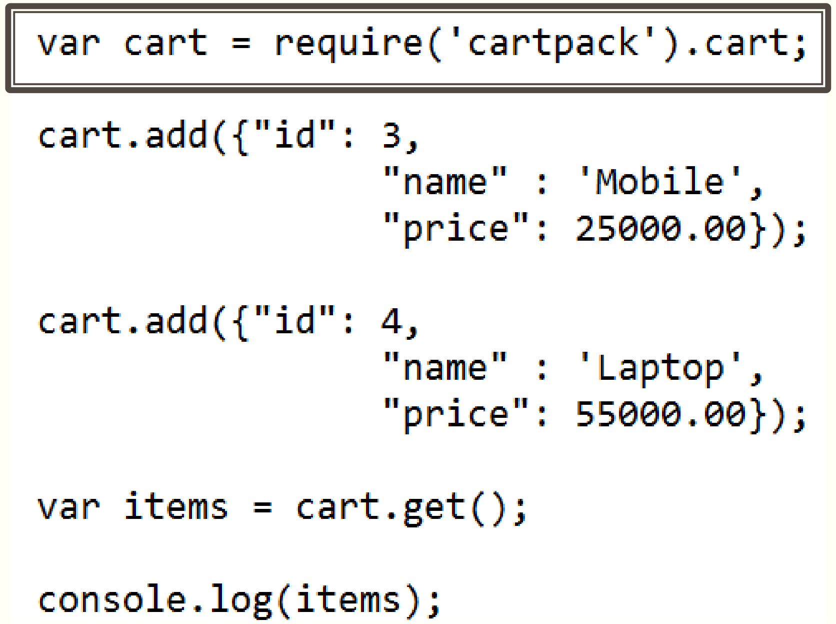
```
G:\usepack>npm install cartpack
cartpack@1.0.2 node_modules\cartpack
```



```
 Directory of G:\usepack\node_modules\cartpack

13-05-2015  15:08    <DIR>          .
13-05-2015  15:08    <DIR>          ..
13-05-2015  15:08               242 cart.js
13-05-2015  15:08               904 package.json
13-05-2015  15:08               391 README.md
               3 File(s)          1,537 bytes
               2 Dir(s)  31,414,423,552 bytes free
```

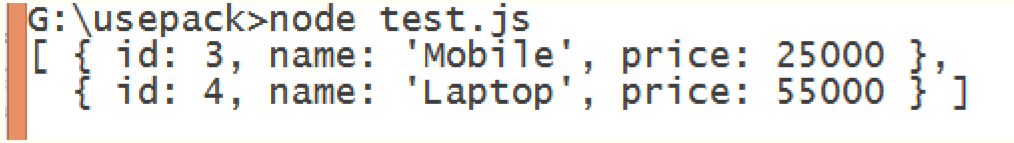
Using node modules

- Create test.js



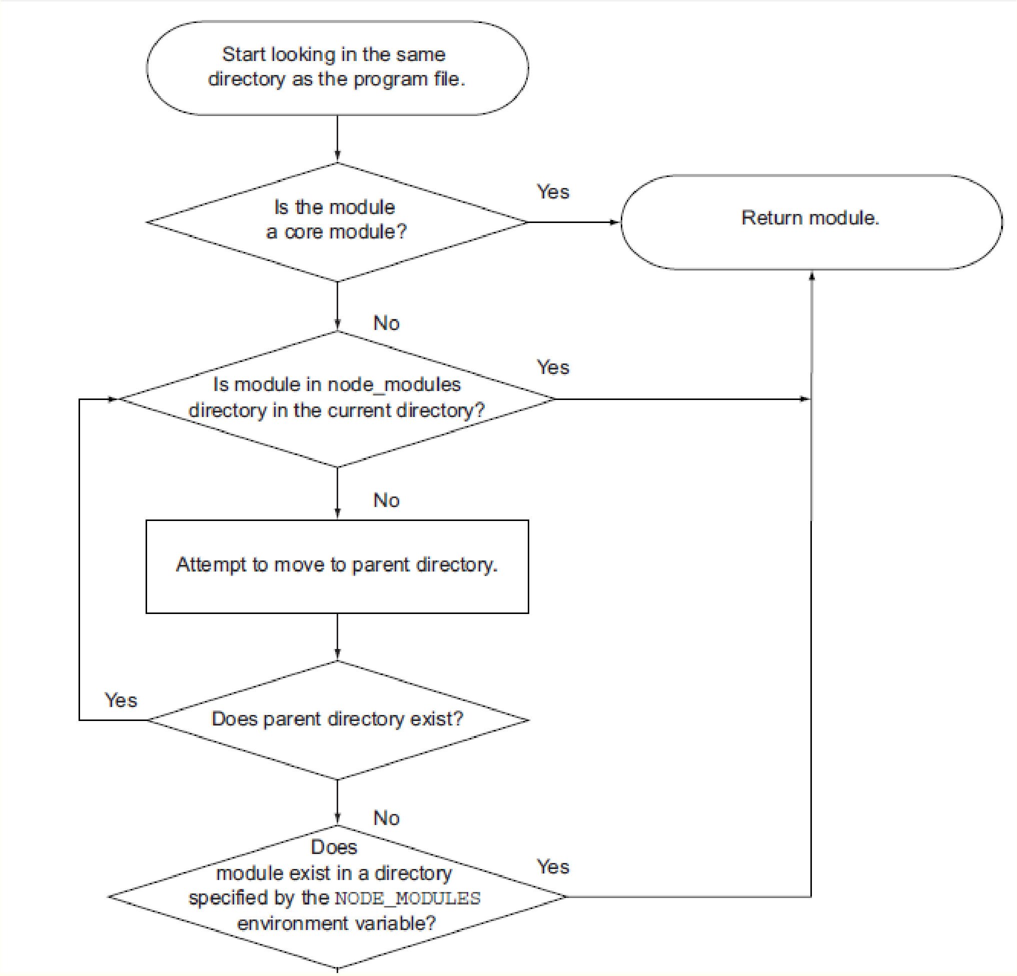
```
var cart = require('cartpack').cart;

cart.add({"id": 3,
                "name" : 'Mobile',
                "price": 25000.00});

cart.add({"id": 4,
                "name" : 'Laptop',
                "price": 55000.00});

var items = cart.get();

console.log(items);
```

- Invoke node



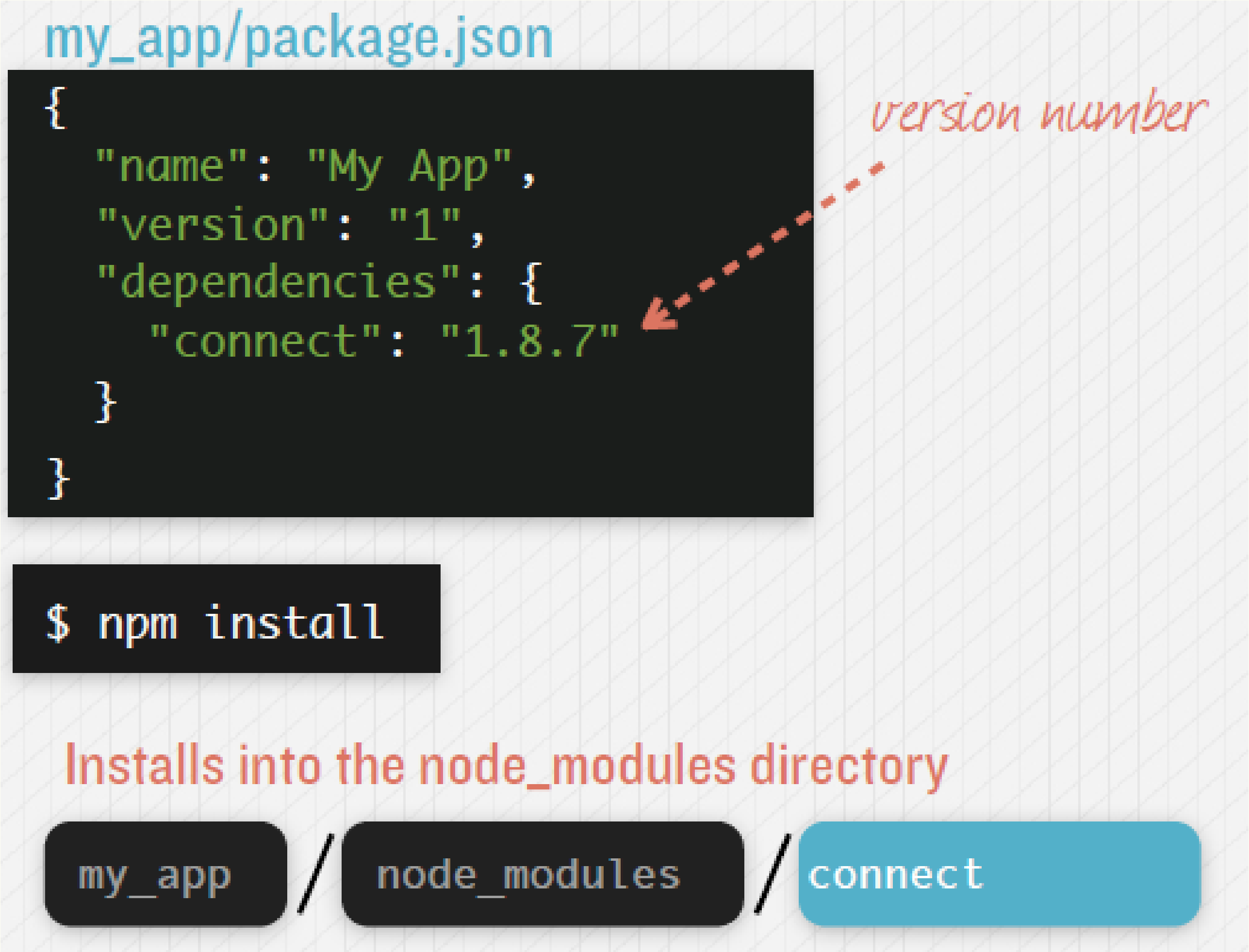
```
G:\usepack>node test.js
[ { id: 3, name: 'Mobile', price: 25000 },
  { id: 4, name: 'Laptop', price: 55000 } ]
```

Reusing modules using the node_modules folder


Start looking in the same directory as the program file.
Is the module a core module?
Yes
Return module.
No
Is module in node_modules directory in the current directory?
Yes
No
Attempt to move to parent directory.
Yes
Does parent directory exist?
No
Does module exist in a directory specified by the NODE_MODULES environment variable?
Yes

The NODE_PATH environmental variable provides a way to specify alternative locations for Node modules. If used, NODE_PATH should be set to a list of directories separated by semicolons in Windows or colons in other operating systems

DEFINING YOUR DEPENDENCIES



my_app/package.json

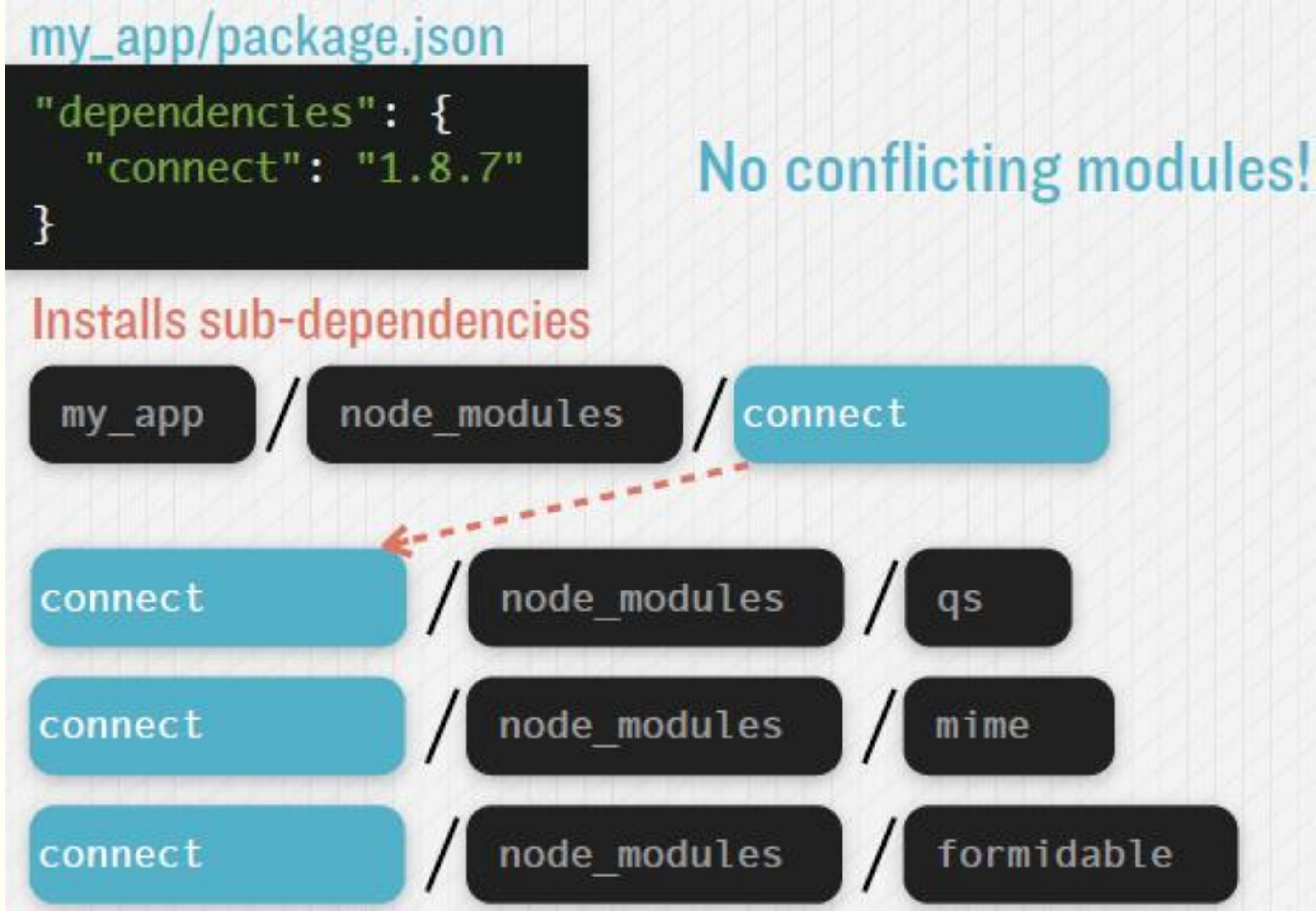
```
{
  "name": "My App",
  "version": "1",
  "dependencies": {
    "connect": "1.8.7"
  }
}
```

```
$ npm install
```

Installs into the node_modules directory

my_app / node_modules / connect

DEPENDENCIES



my_app/package.json

```
"dependencies": {
  "connect": "1.8.7"
}
```

No conflicting modules!

Installs sub-dependencies

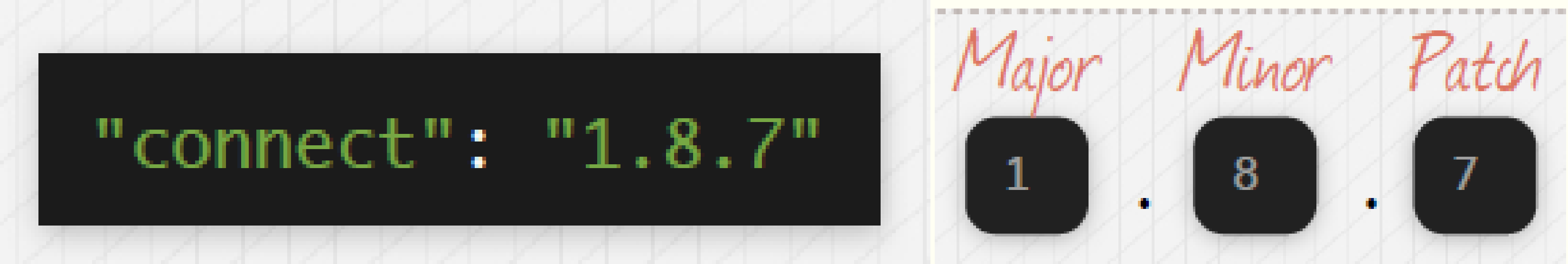
my_app / node_modules / connect

connect / node_modules / qs

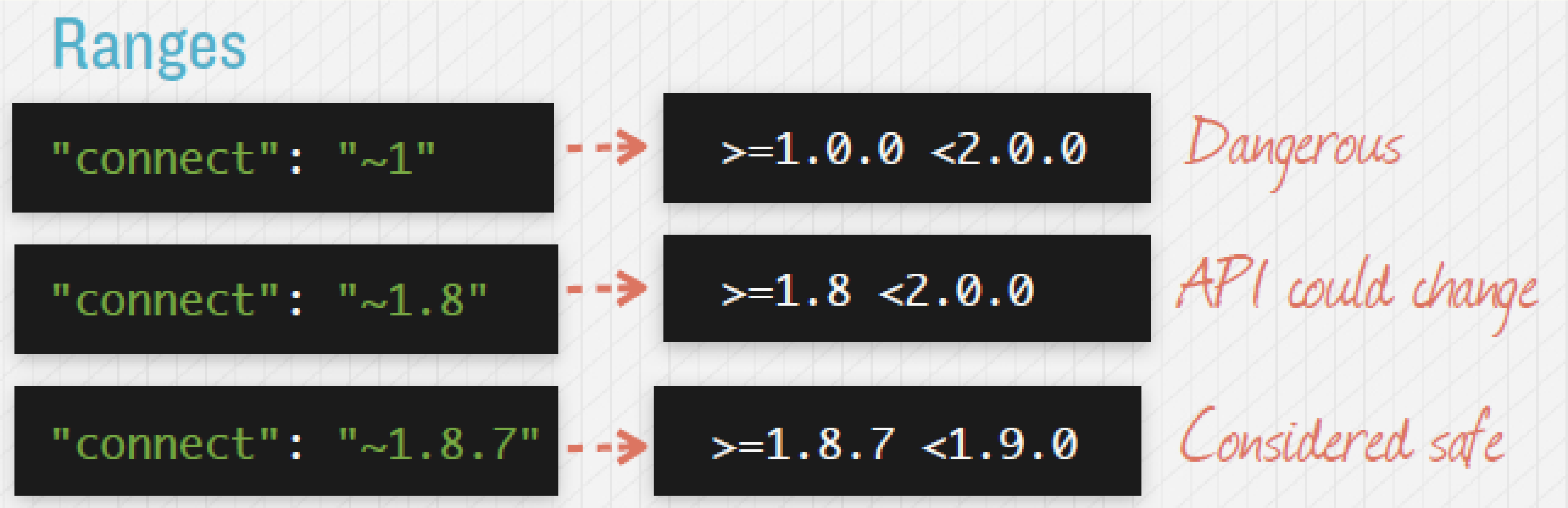
connect / node_modules / mime

connect / node_modules / formidable

SEMANTIC VERSIONING



```
"connect": "1.8.7"
```



Ranges

```
"connect": "~1"      -->  >=1.0.0 <2.0.0
"connect": "~1.8"    -->  >=1.8 <2.0.0
"connect": "~1.8.7"  -->  >=1.8.7 <1.9.0
```

Dangerous

API could change

Considered safe

Exercise

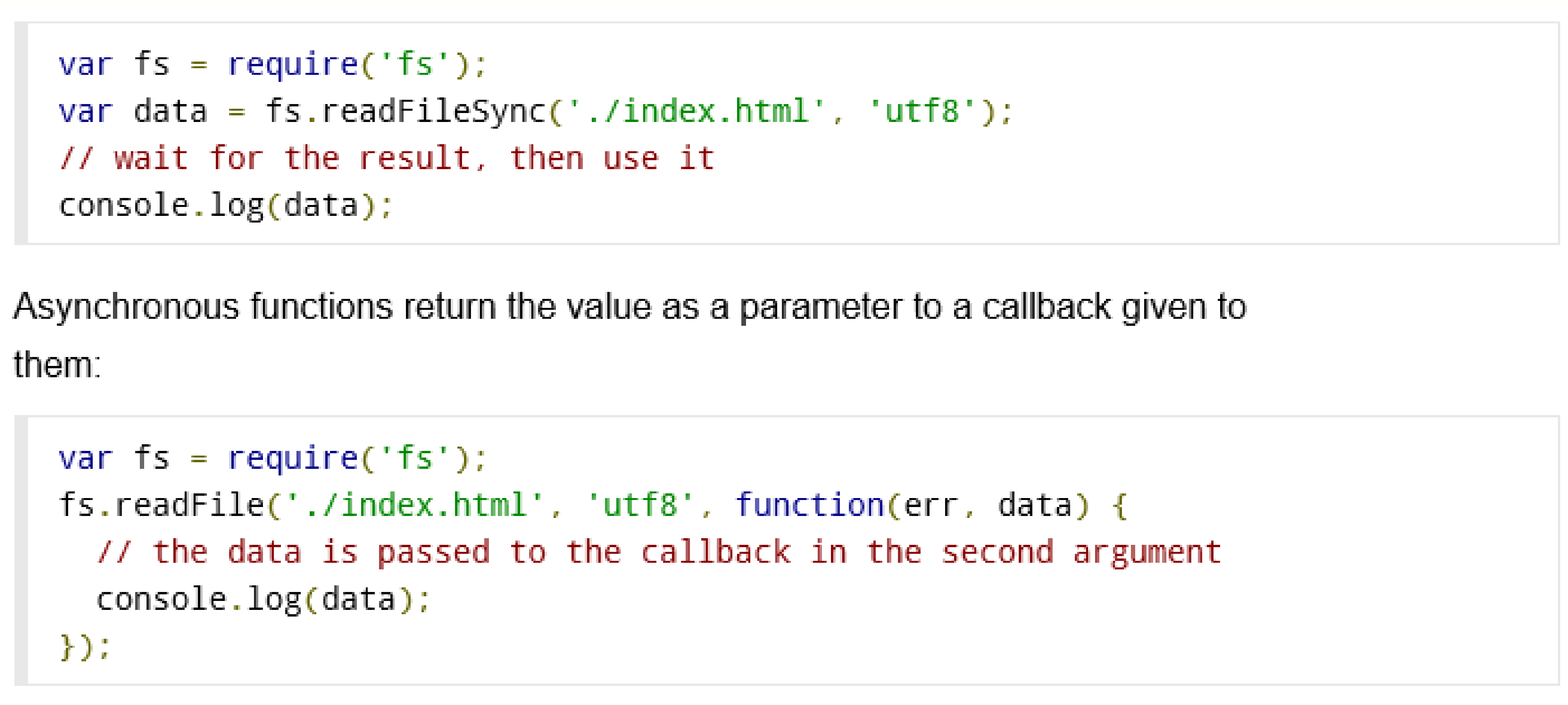
- **http://nodeschool.io/index.html#workshoppers**
  - How to npm
  - Learn how to use and create npm modules.
    - npm install -g how-to-npm

File system

- The file system functions consist of file I/O and directory I/O functions.
- All of the file system functions offer both synchronous (blocking) and asynchronous (non-blocking) versions.
  - The difference between these two is that the synchronous functions (which have “Sync” in their name) return the value directly and prevent Node from executing any code while the I/O operation is being performed

File System

- Blocking code Vs Non-blocking code



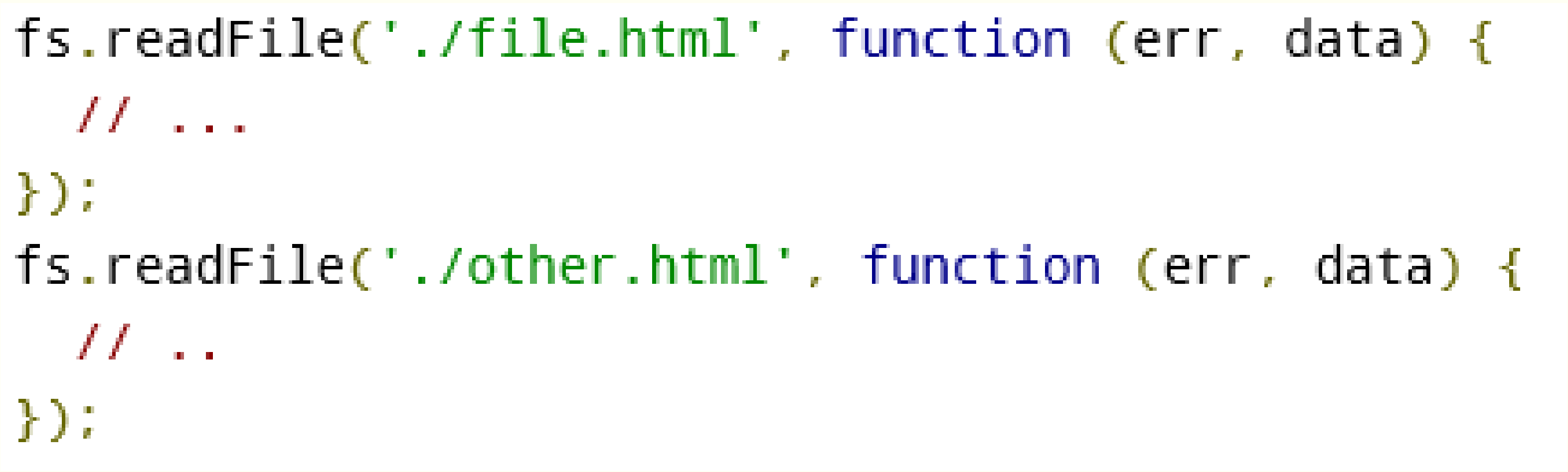
```
var fs = require('fs');
var data = fs.readFileSync('./index.html', 'utf8');
// wait for the result, then use it
console.log(data);
```

Asynchronous functions return the value as a parameter to a callback given to them:

```
var fs = require('fs');
fs.readFile('./index.html', 'utf8', function(err, data) {
  // the data is passed to the callback in the second argument
  console.log(data);
});
```

File System

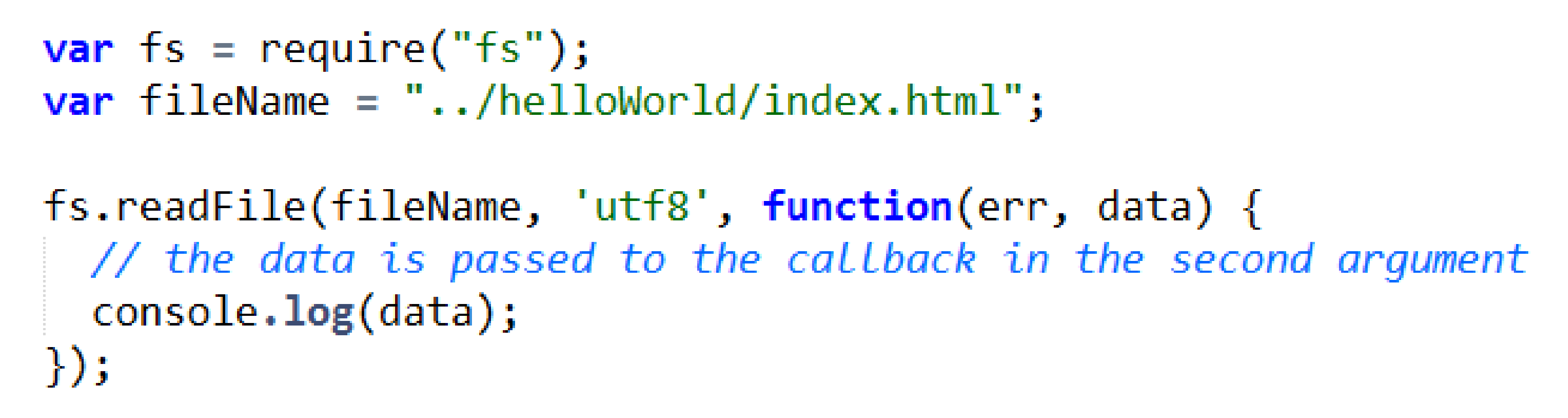
- You should use the asynchronous version in most cases, but in rare cases (e.g. reading configuration files when starting a server) the synchronous version is more appropriate.
- Note that the asynchronous versions require a bit more thought, since the operations are started immediately and may finish in any order



```
fs.readFile('./file.html', function (err, data) {
  // ...
});
fs.readFile('./other.html', function (err, data) {
  // ..
});
```

Files: Reading a file

- Fully buffered reads and writes are fairly straightforward: call the function and pass in a String or a Buffer to write, and then check the return value



```
var fs = require("fs");
var fileName = "../helloWorld/index.html";

fs.readFile(fileName, 'utf8', function(err, data) {
  // the data is passed to the callback in the second argument
  console.log(data);
});
```

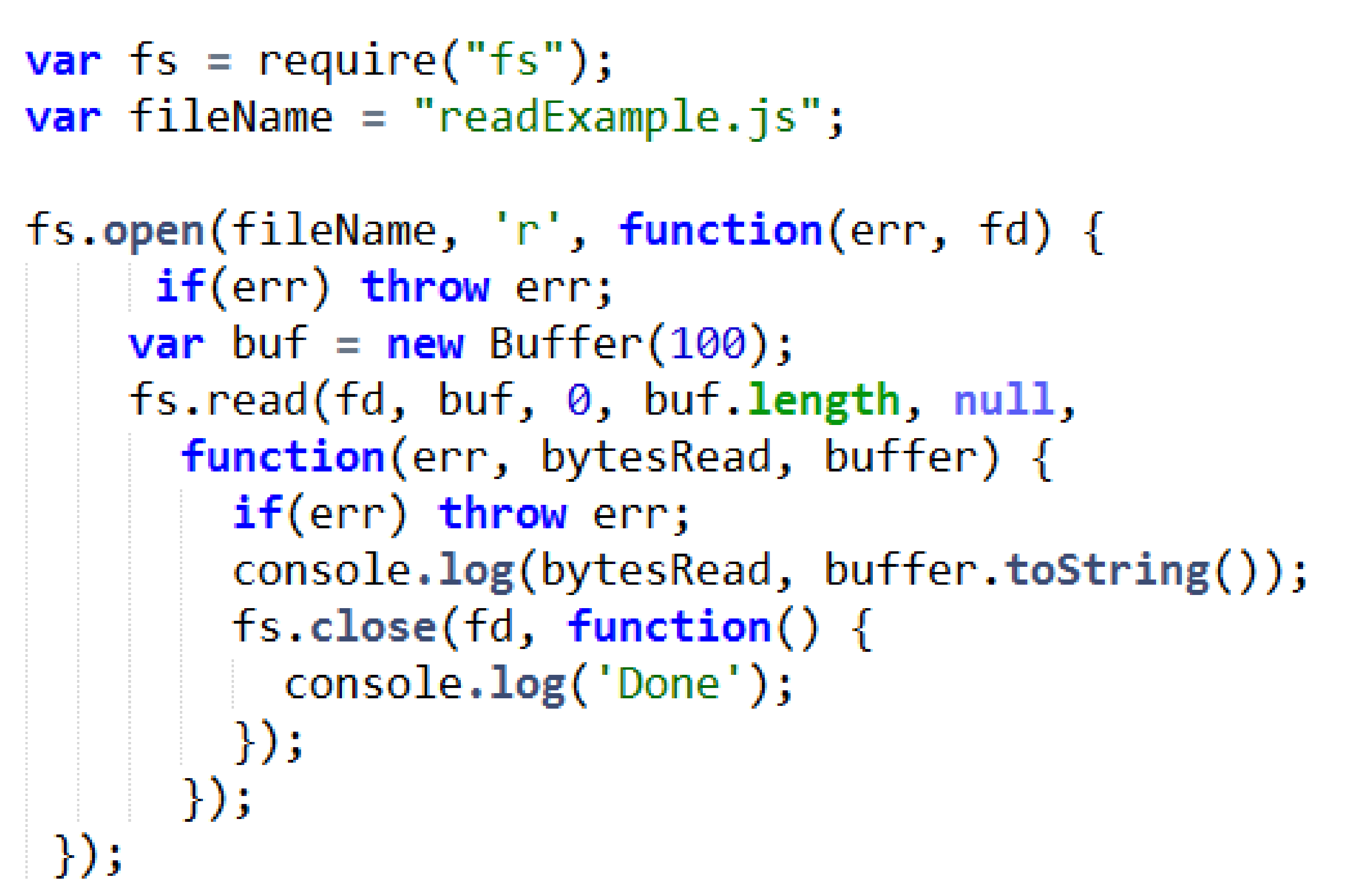
Files: Reading a file

- When we want to work with files in smaller parts, we need to open(), get a file descriptor and then work with that file descriptor.
- fs.open(path, flags, [mode], [callback])
- supports the following flags:
  - 'r' - Open file for reading. An exception occurs if the file does not exist.
  - 'r+' - Open file for reading and writing. An exception occurs if the file does not exist.
  - 'w' - Open file for writing. The file is created (if it does not exist) or truncated (if it exists).
  - 'w+' - Open file for reading and writing. The file is created (if it does not exist) or truncated (if it exists).
  - 'a' - Open file for appending. The file is created if it does not exist.
  - 'a+' - Open file for reading and appending. The file is created if it does not exist.

Files: Reading from a file

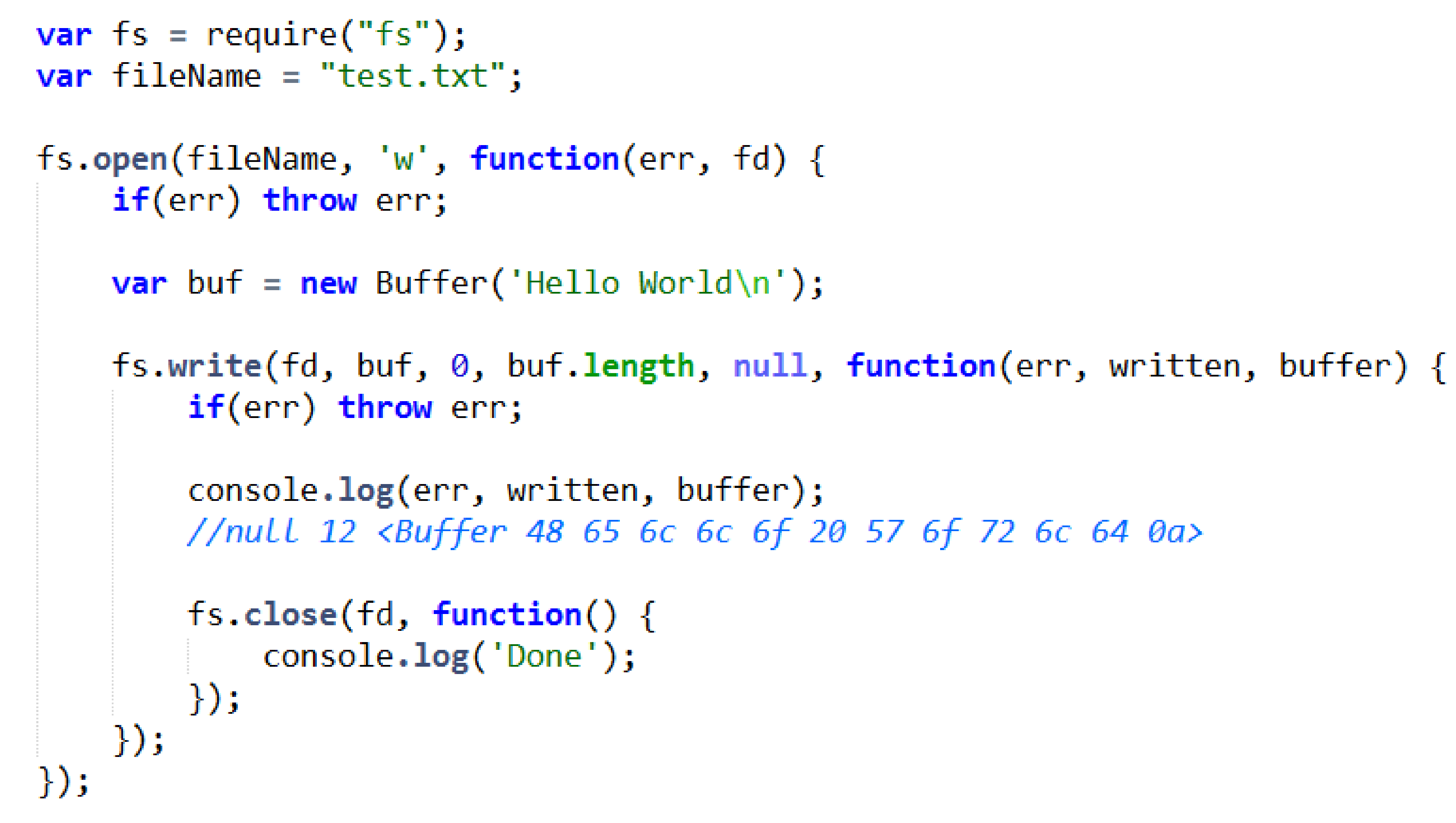
- **Reading File**
- Following is the syntax of one of the methods to read from a file:
  - **fs.read(fd, buffer, offset, length, position, callback)**
  - Here is the description of the parameters used:
    - fd - This is the file descriptor returned by file fs.open() method.
    - buffer - This is the buffer that the data will be written to.
    - offset - This is the offset in the buffer to start writing at.
    - length - This is an integer specifying the number of bytes to read.
    - position - This is an integer specifying where to begin reading from in the file. If position is null, data will be read from the current file position.
    - callback - This is the callback function which gets the three arguments, (err, bytesRead, buffer).

Files: Reading from a file example



```
var fs = require("fs");
var fileName = "readExample.js";

fs.open(fileName, 'r', function(err, fd) {
     if(err) throw err;
    var buf = new Buffer(100);
    fs.read(fd, buf, 0, buf.length, null,
      function(err, bytesRead, buffer) {
        if(err) throw err;
        console.log(bytesRead, buffer.toString());
        fs.close(fd, function() {
          console.log('Done');
        });
      });
 });
```

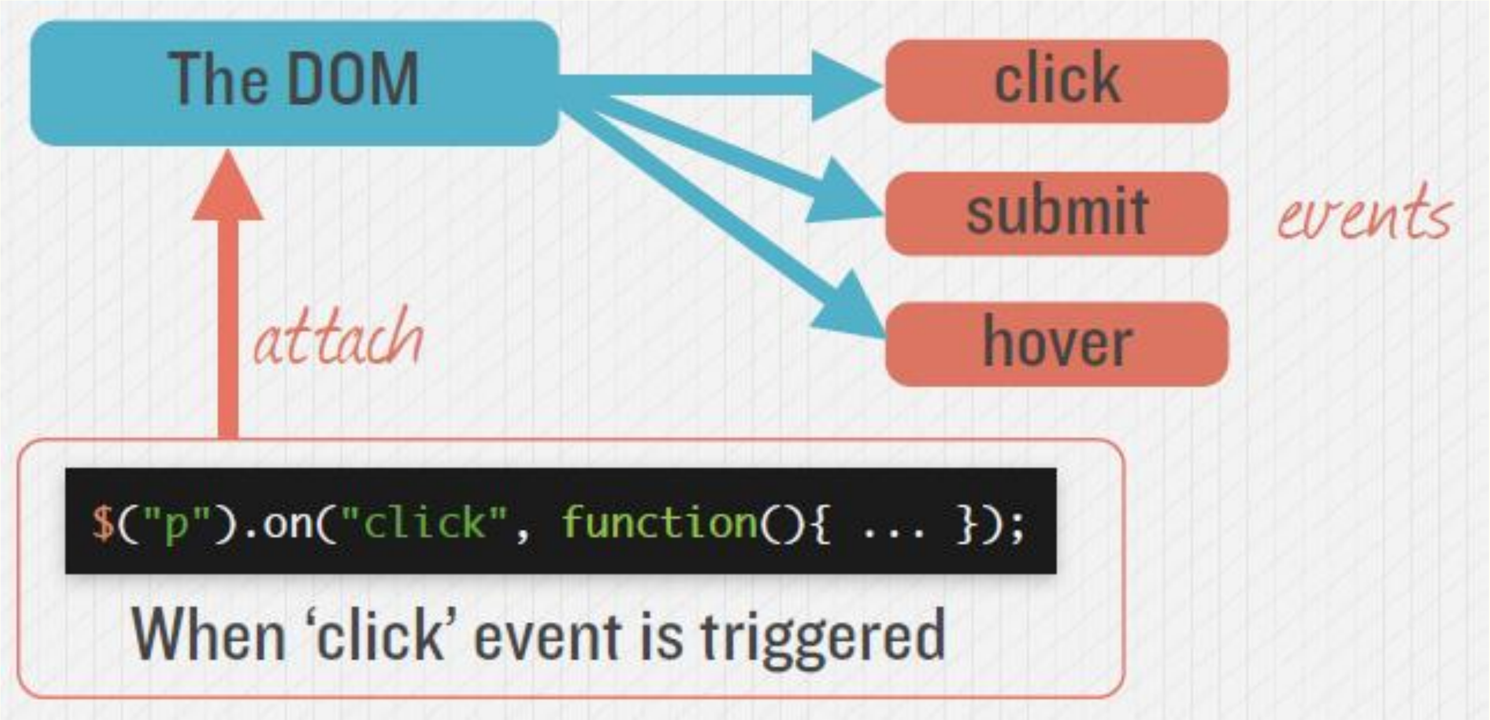
Files: Writing to a file



```
var fs = require("fs");
var fileName = "test.txt";

fs.open(fileName, 'w', function(err, fd) {
    if(err) throw err;

    var buf = new Buffer('Hello World\n');

    fs.write(fd, buf, 0, buf.length, null, function(err, written, buffer) {
        if(err) throw err;

        console.log(err, written, buffer);
        //null 12 <Buffer 48 65 6c 6c 6f 20 57 6f 72 6c 64 0a>

        fs.close(fd, function() {
            console.log('Done');
        });
    });
});
```

Events

- EVENTS IN THE DOM
- The DOM triggers Events; you can listen for those events

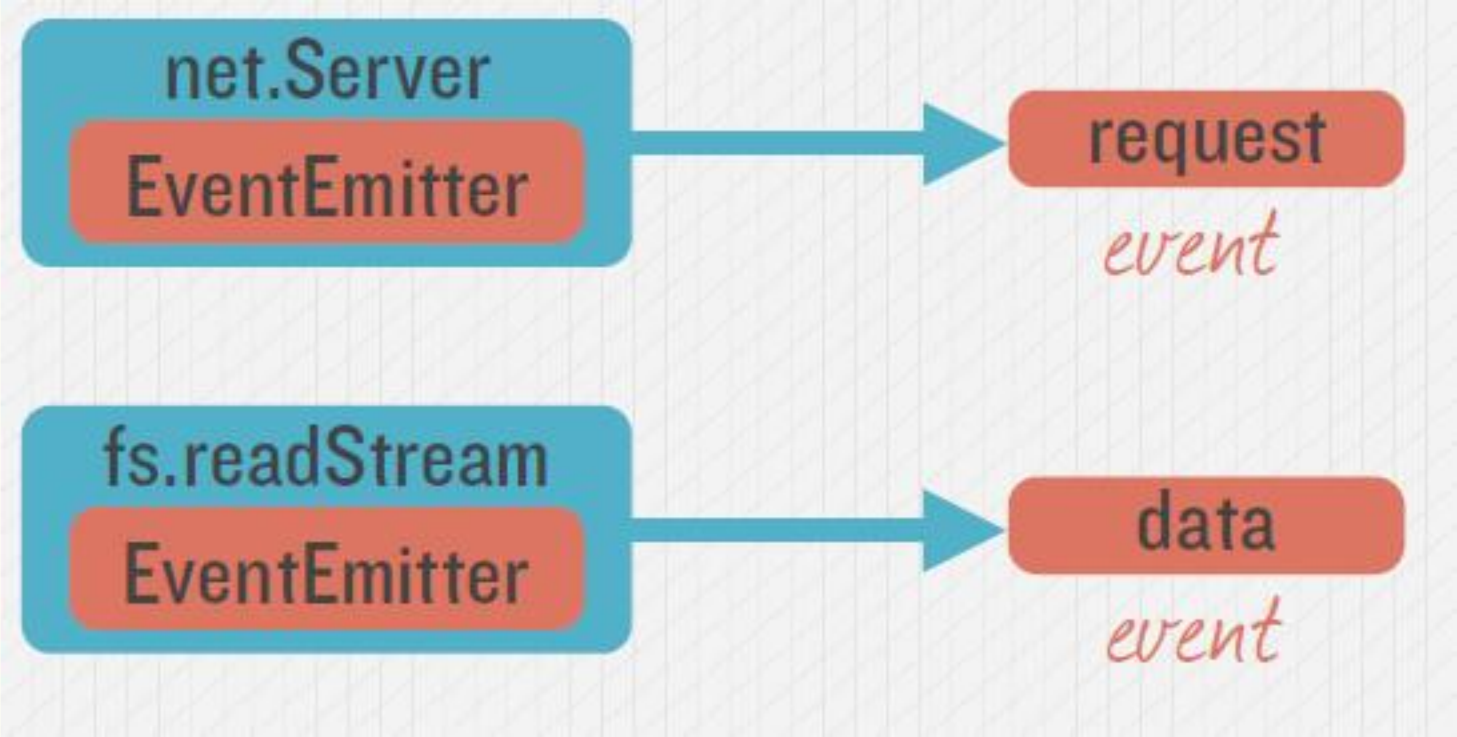


```
$("p").on("click", function(){ ... });
```

When ‘click’ event is triggered

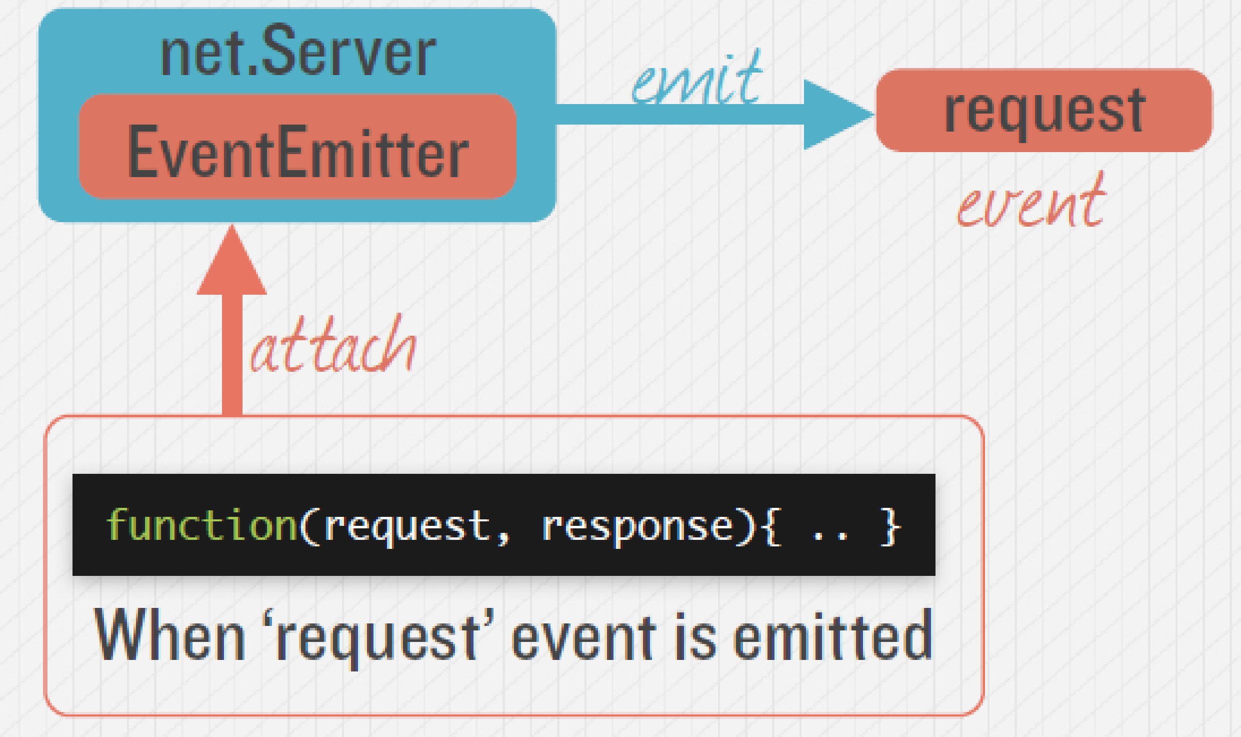
EVENTS IN NODE

- Many objects in Node emit events



EVENTS IN NODE

- Many objects in Node emit events



```
function(request, response){ .. }
```

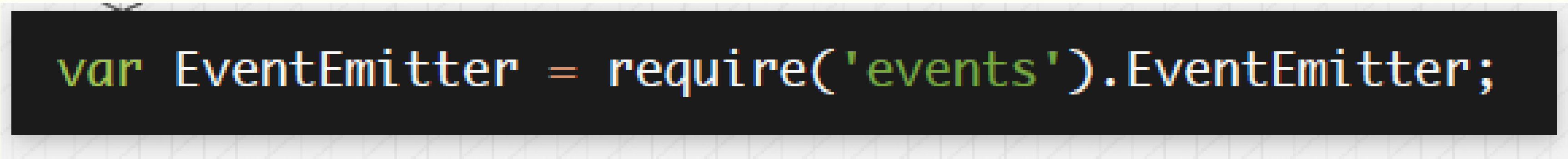
When ‘request’ event is emitted

CUSTOM EVENT EMITTERS

- **EventEmitter** class
  - It allows you to listen for "events" and assign actions to run when those events occur.
  - The principles EventEmitter is based on have been called the publish/subscribe model, because we can subscribe to events and then publish them.
  - In Node, it's an alternative to deeply nested callbacks.
  - A lot of Node methods are run asynchronously, which means that to run code after the method has finished, you need to pass a callback method to the function.
  - Eventually, your code will look like a giant funnel. To prevent this, many node classes emit events that you can listen for.
  - This allows you to organize your code the way you'd like to, and not use callbacks.

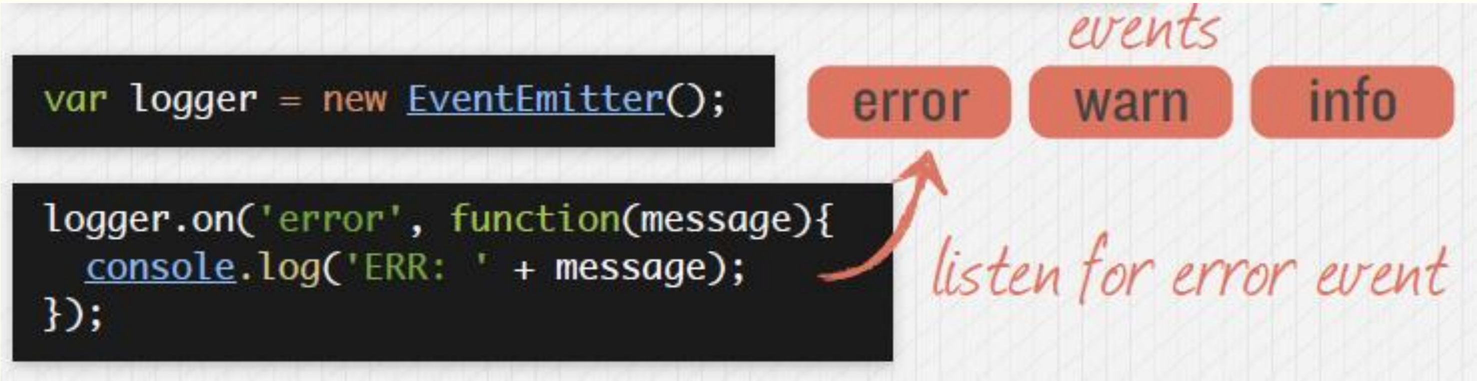
EventEmitter

- we require the events module:



```
var EventEmitter = require('events').EventEmitter;
```

- This "on" method takes two parameters:
- a) we start with the name of the event we're listening for:
- b) The second parameter is the function that will be called when the event occurs.



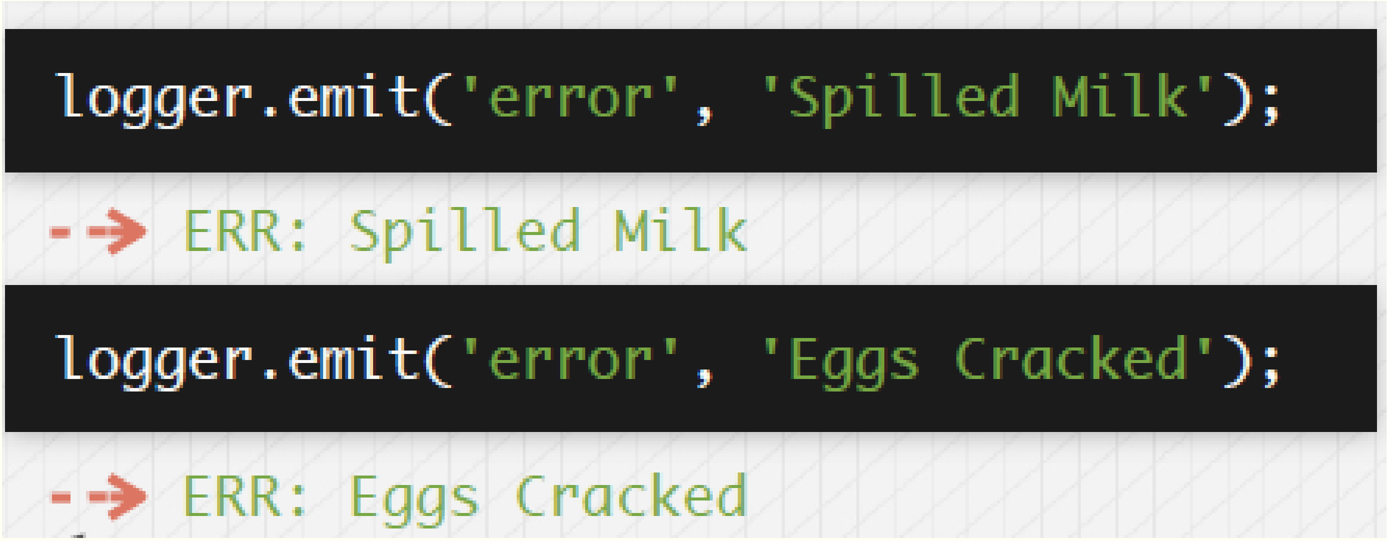
```
var logger = new EventEmitter();
```

```
logger.on('error', function(message){
  console.log('ERR: ' + message);
});
```

EventEmitter

- To fire the event, you pass the event name to the EventEmitter instance's **emit( )** method.

- You can pass data/info while firing events



```
logger.emit('error', 'Spilled Milk');
```

```
--> ERR: Spilled Milk
```

```
logger.emit('error', 'Eggs Cracked');
```

```
--> ERR: Eggs Cracked
```

EventEmitter

- Other EventEmitter Methods
- once.
  - It's just like the on method, except that it only works once. After being called for the first time, the listener is removed.
  - ee.once("firstConnection", function () {
    - console.log("You'll never see this again");

    });

  - ee.emit("firstConnection");
  - ee.emit("firstConnection"); // not picked up by any listeners

STREAMS

- Streams can be readable, writeable, or both.
- Streams are **EventEmitters**, they emit several events at various points
- Example:
  - In a Node.js based HTTP server, request is a readable stream and response is a writable stream.
  - the fs module which lets you work with both readable and writable file streams

Stream events

- Event: 'readable'

- When a chunk of data can be read from the stream, it will emit a 'readable' event

```
var readable = getReadableStreamSomehow();
readable.on('readable', function() {
  // there is some data to read now
});
```

Stream events

- Event: 'data'
- Attaching a data event listener to a stream that has not been explicitly paused will switch the stream into flowing mode.
- Data will then be passed as soon as it is available.

```
var readable = getReadableStreamSomehow();
readable.on('data', function(chunk) {
  console.log('got %d bytes of data', chunk.length);
});
```

Stream events

- Event: 'end'
  - This event fires when there will be no more data to read.
  - Note that the end event will not fire unless the data is completely consumed.
  - This can be done by switching into flowing mode, or by calling read() repeatedly until you get to the end.

```
readable.on('end', function() {
  console.log('there will be no more data.');
});
```

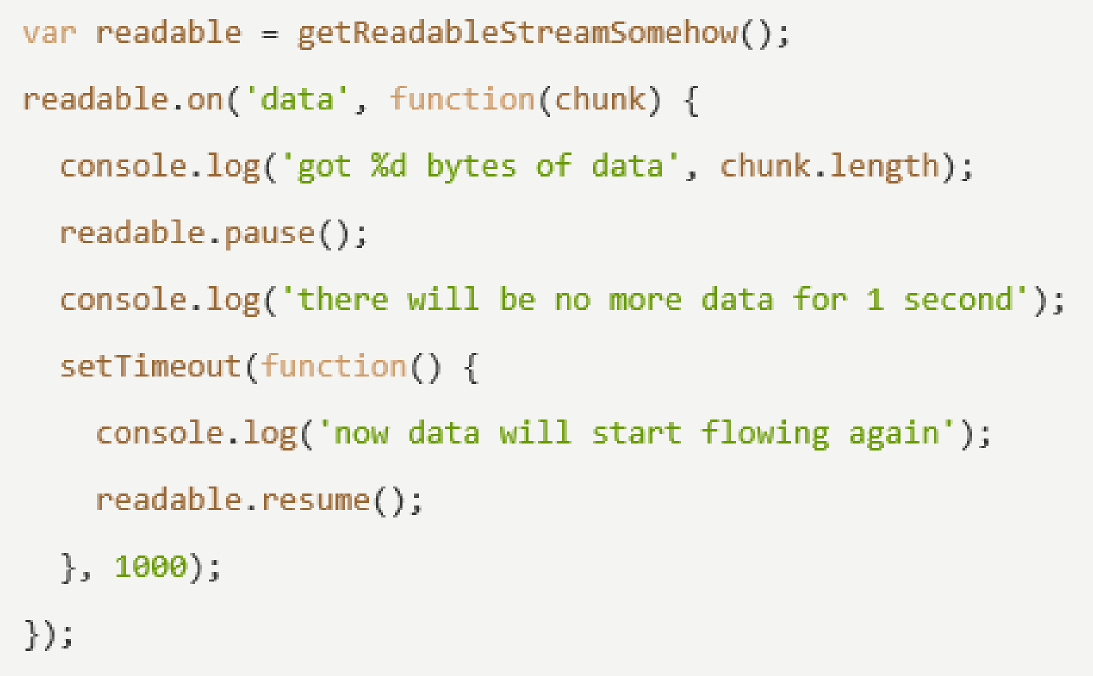
Stream events

- Event: 'close'
  - Emitted when the underlying resource has been closed. Not all streams will emit this.

- Event: 'error'
  - Emitted if there was an error receiving data.

Stream events

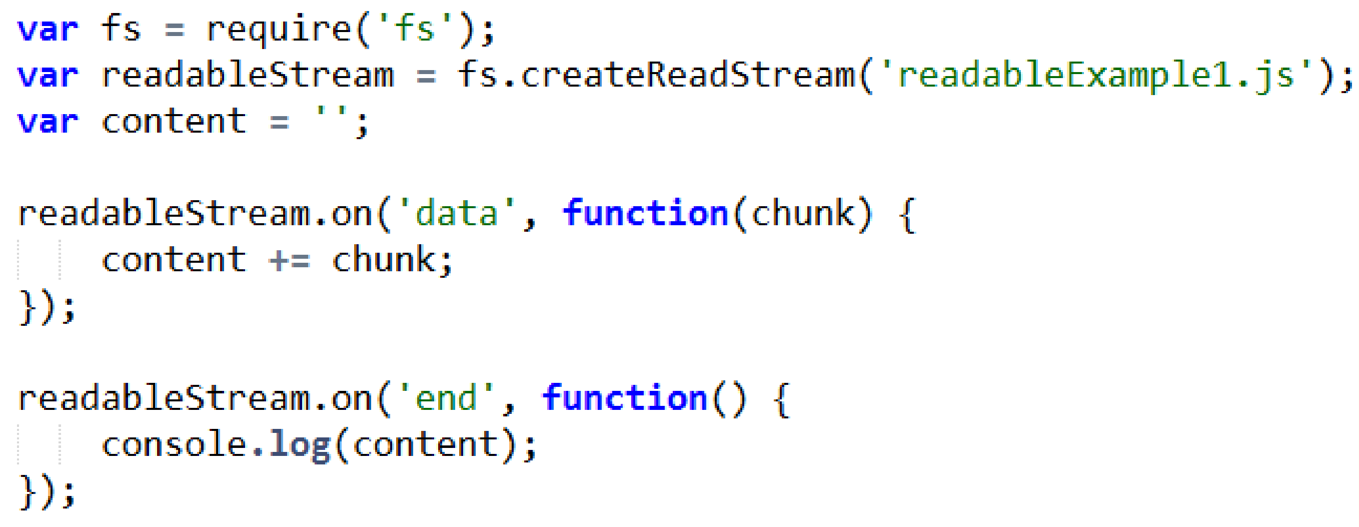
- readable.pause()
  - This method will cause a stream in flowing mode to stop emitting data events, switching out of flowing mode.
  - Any data that becomes available will remain in the internal buffer.
- readable.resume()
  - This method will
  - cause the readable
  - stream to resume
  - emitting data events.



```
var readable = getReadableStreamSomehow();
readable.on('data', function(chunk) {
  console.log('got %d bytes of data', chunk.length);
  readable.pause();
  console.log('there will be no more data for 1 second');
  setTimeout(function() {
    console.log('now data will start flowing again');
    readable.resume();
  }, 1000);
});
```

Readable Stream

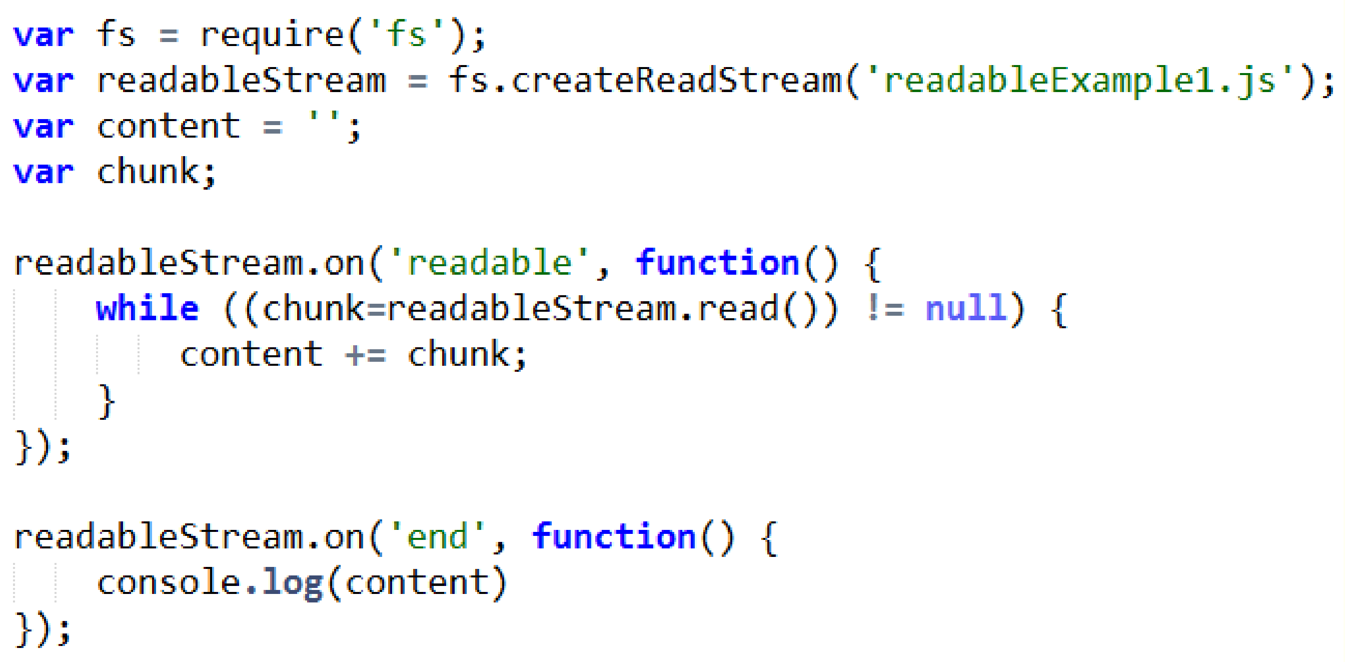
- The function call fs.createReadStream() gives you a readable stream.
- Initially, the stream is in a static state. As soon as you listen to data event and attach a callback it starts flowing.
  - After that, chunks of data are read and passed to your callback.
  - When there is no more data to read (end is reached), the stream emits an end event



```
var fs = require('fs');
var readableStream = fs.createReadStream('readableExample1.js');
var content = '';

readableStream.on('data', function(chunk) {
    content += chunk;
});

readableStream.on('end', function() {
    console.log(content);
});
```

Readable Stream

- The stream implementor decides how often data event is emitted.
- There is also another way to read from stream. You just need to call read() on the stream instance repeatedly until every chunk of data has been read.
- Note that the readable event is emitted when a chunk of data can be read from the stream.



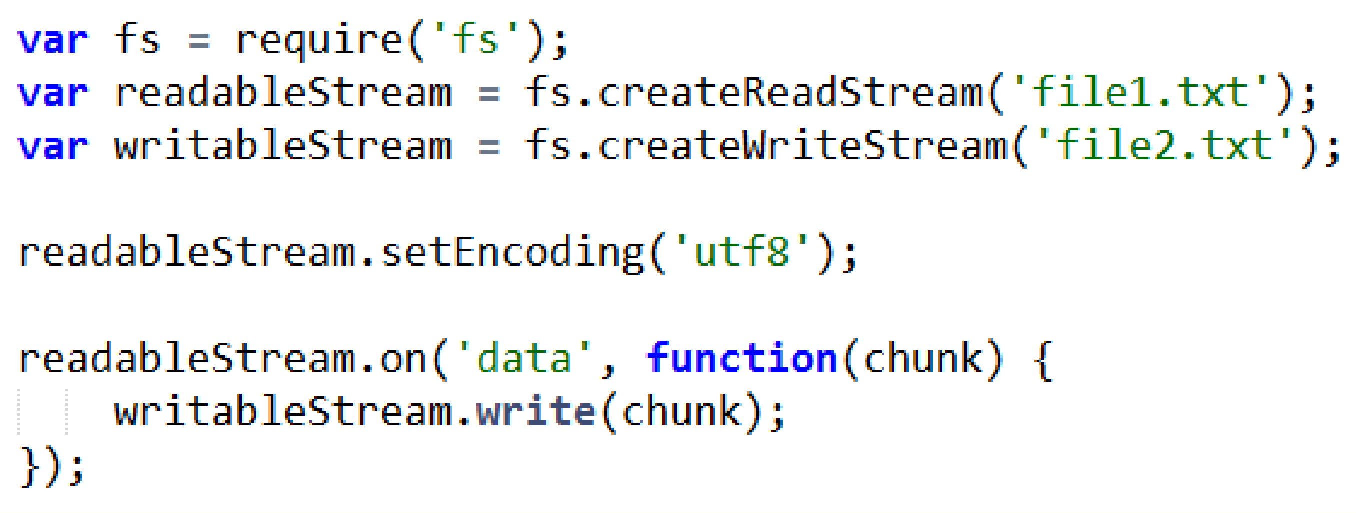
```
var fs = require('fs');
var readableStream = fs.createReadStream('readableExample1.js');
var content = '';
var chunk;

readableStream.on('readable', function() {
    while ((chunk=readableStream.read()) != null) {
        content += chunk;
    }
});

readableStream.on('end', function() {
    console.log(content)
});
```

Readable Stream

- Setting Encoding
  - By default the data you read from a stream is a Buffer object. If you are reading strings this may not be suitable for you
  - readableStream.setEncoding('utf8');
  - As a result, the data is interpreted as utf8 and passed to your callback as string.

Writable Streams

- Writable streams let you write data to a destination.
- Like readable streams, these are also EventEmitters and emit various events at various points.
- To write data to a writable stream you need to call write() on the stream instance. This function returns a Boolean value indicating if the operation was successful



```
var fs = require('fs');
var readableStream = fs.createReadStream('file1.txt');
var writableStream = fs.createWriteStream('file2.txt');

readableStream.setEncoding('utf8');

readableStream.on('data', function(chunk) {
    writableStream.write(chunk);
});
```

Writable Streams

- When you don’t have more data to write you can simply call end() to notify the stream that you have finished writing.
- Assuming res is an HTTP response object, you often do the following to send the response to browser:
  - res.write('Some Data!!');
  - res.end('End.');

Piping

- Piping is a mechanism in which you can read data from the source and write to destination without managing the flow yourself.

```
var fs = require('fs');
var readableStream = fs.createReadStream('file1.txt');
var writableStream = fs.createWriteStream('file2.txt');
readableStream.pipe(writableStream);
```

  - //pipe() function to write the content of file1 to file2

Chaining

- As pipe() manages the data flow for you, you should not worry about slow or fast data flow.
- This makes pipe() a neat tool to read and write data.
- You should also note that pipe() returns the destination stream. So, you can easily utilize this to chain multiple streams together.
- Assume that you have an archive and want to decompress it.

```
var fs = require('fs');
var zlib = require('zlib');
fs.createReadStream('input.txt.gz')              //read from the file input.txt.gz
  .pipe(zlib.createGunzip())                      //un-gzip the content
  .pipe(fs.createWriteStream('output.txt'));
//write the un-gzipped content to the file
```

Objectives

- Understand Handling HTTP requests with Node’s API
- Understand RESTful web service
- Understand Serving static files
- Understand how to accept user input from forms
- Understand how to secure applications with HTTPS

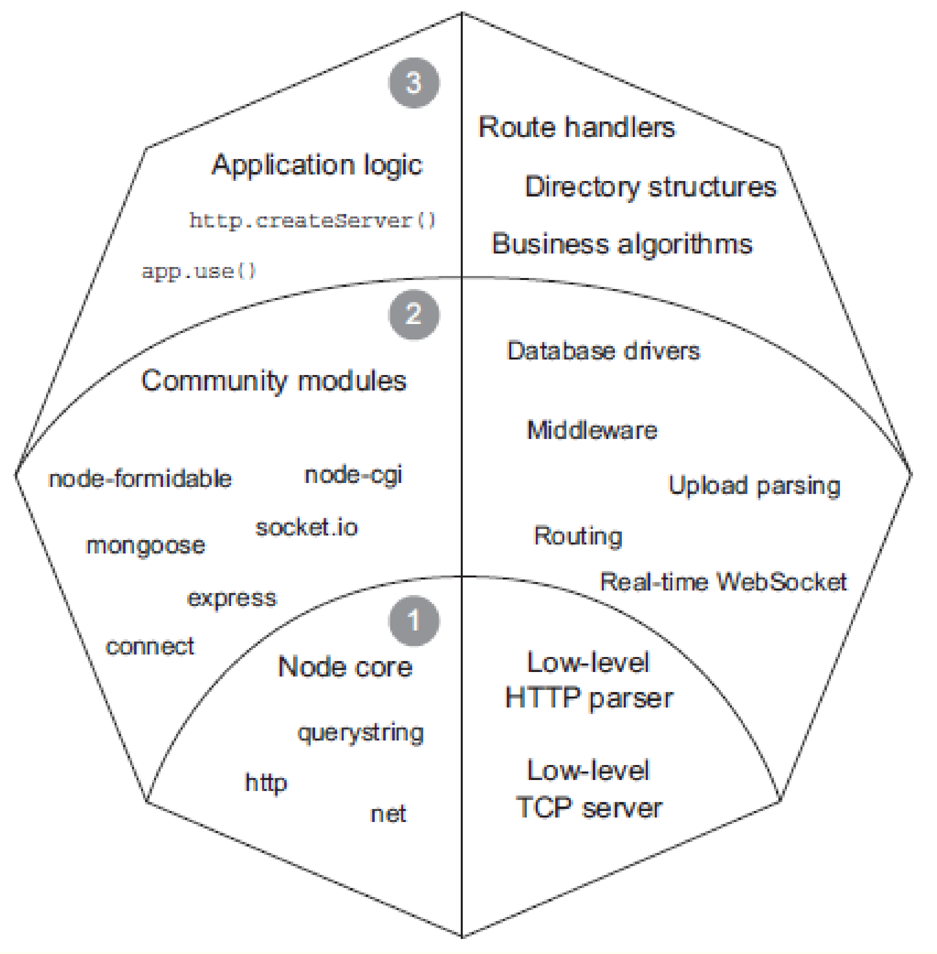
Node HTTP server fundamentals

- Node’s HTTP interface is low-level when compared with frameworks or languages
- such as PHP in order to keep it fast and flexible.

- High-level "sugar" APIs are left for third-party frameworks, such as Connect or Express, that greatly simplify the web application building process.

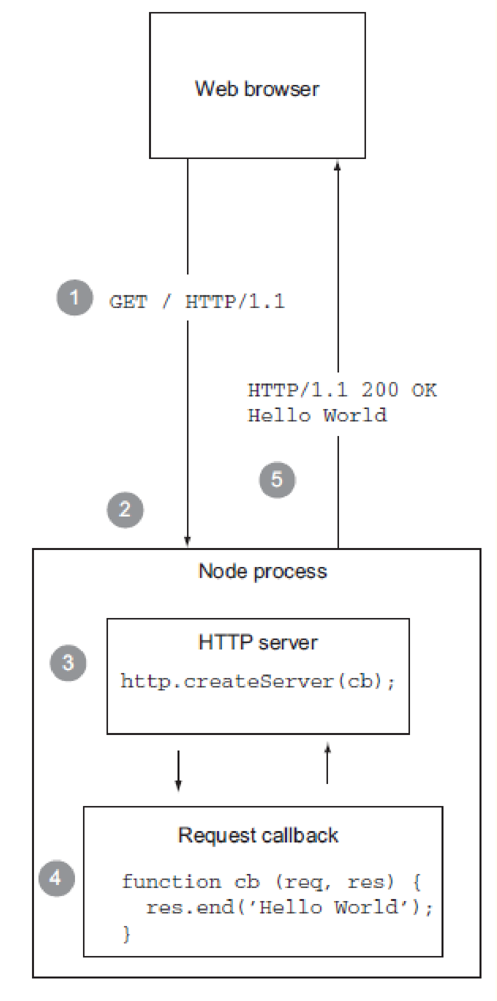
Layers that make up a Node web application

- Node’s core APIs are always lightweight and low-level.
- Community members take the low-level core APIs and create easy-to-use modules that allow you to get tasks done easily.
- The application logic layer is where your app is implemented.
  - The size of this layer depends on the number of community modules used and the complexity of the application.



Lifecycle of an HTTP request going through a Node HTTP server

1. An HTTP client, like a web browser, initiates an HTTP request.
2. Node accepts the connection, and incoming request data is given to the HTTP server.
3. The HTTP server parses up to the end of the HTTP headers and then hands control over to the request callback.
4. The request callback performs application logic, in this case responding immediately with the text “Hello World.”
5. The request is sent back through the HTTP server, which formats a proper HTTP response for the client.



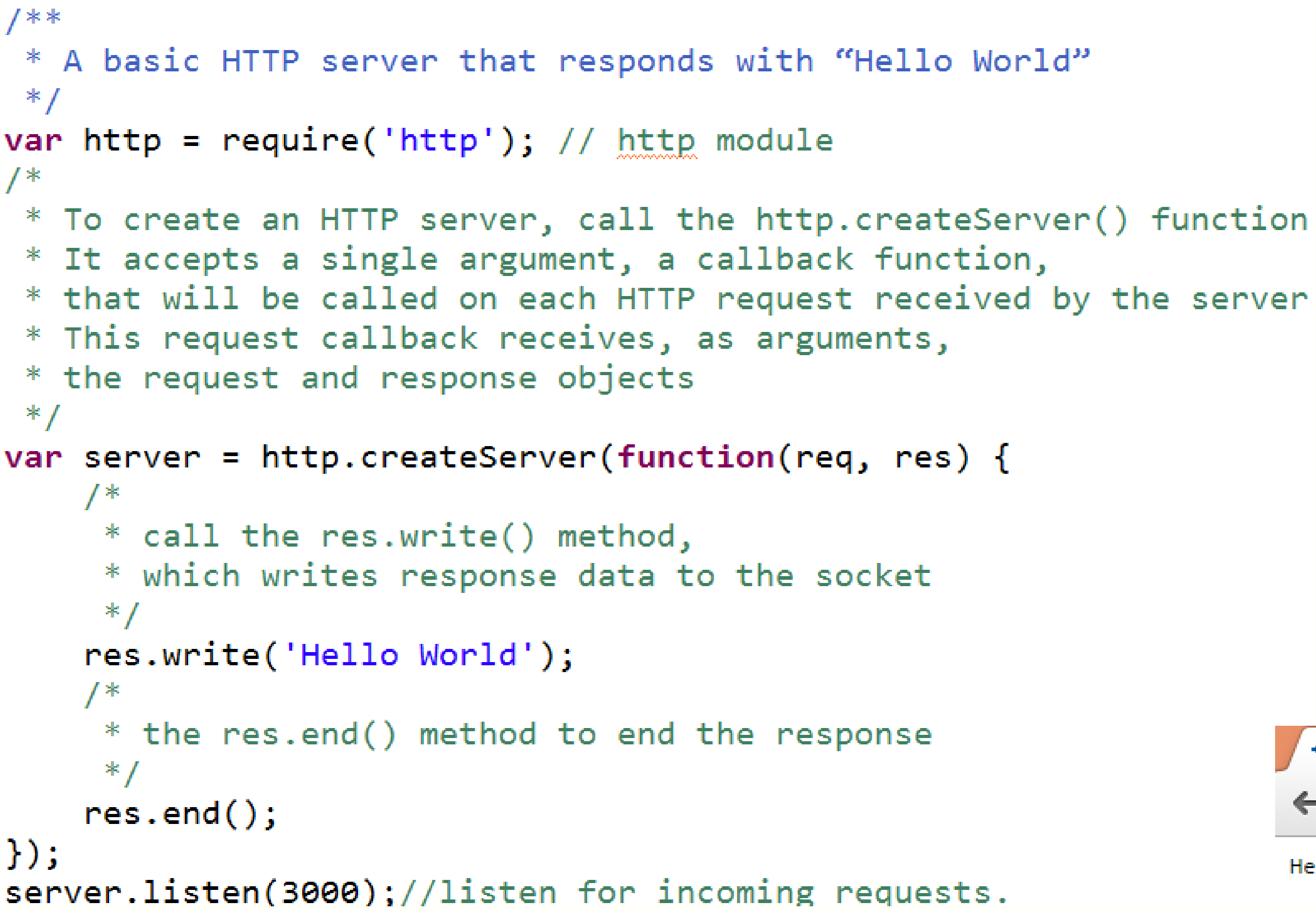
```
GET / HTTP/1.1
```

```
HTTP/1.1 200 OK
Hello World
```

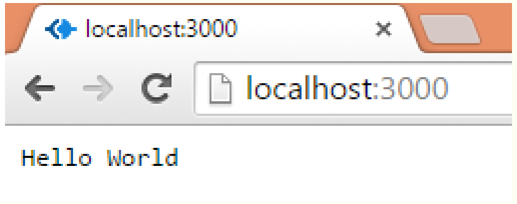
```
http.createServer(cb);
```

```
function cb (req, res) {
  res.end('Hello World');
}
```

Hello World HTTP server



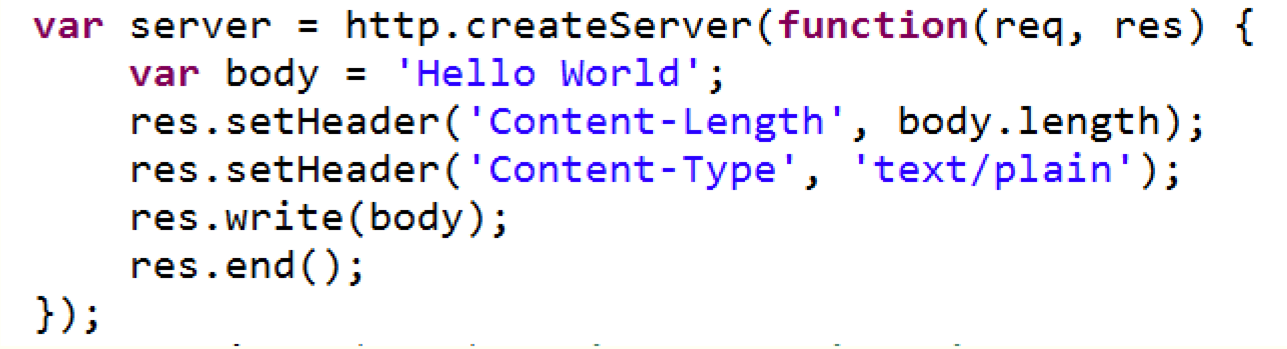
```
/**
 * A basic HTTP server that responds with “Hello World”
 */
var http = require('http'); // http module
/*
 * To create an HTTP server, call the http.createServer() function
 * It accepts a single argument, a callback function,
 * that will be called on each HTTP request received by the server
 * This request callback receives, as arguments,
 * the request and response objects
 */
var server = http.createServer(function(req, res) {
    /*
     * call the res.write() method,
     * which writes response data to the socket
     */
    res.write('Hello World');
    /*
     * the res.end() method to end the response
     */
    res.end();
});
server.listen(3000);//listen for incoming requests.
```



```
Hello World
```

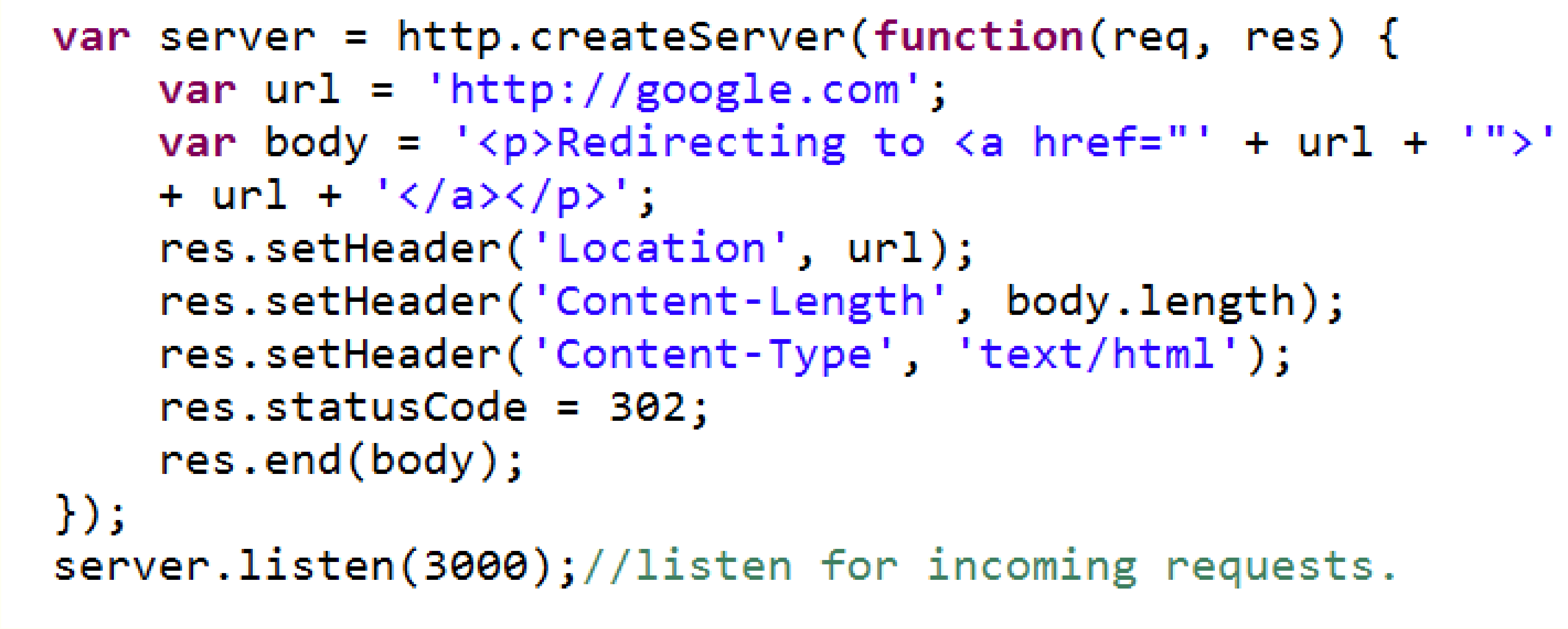
Response headers

- Setting response headers



```
var server = http.createServer(function(req, res) {
    var body = 'Hello World';
    res.setHeader('Content-Length', body.length);
    res.setHeader('Content-Type', 'text/plain');
    res.write(body);
    res.end();
});
```

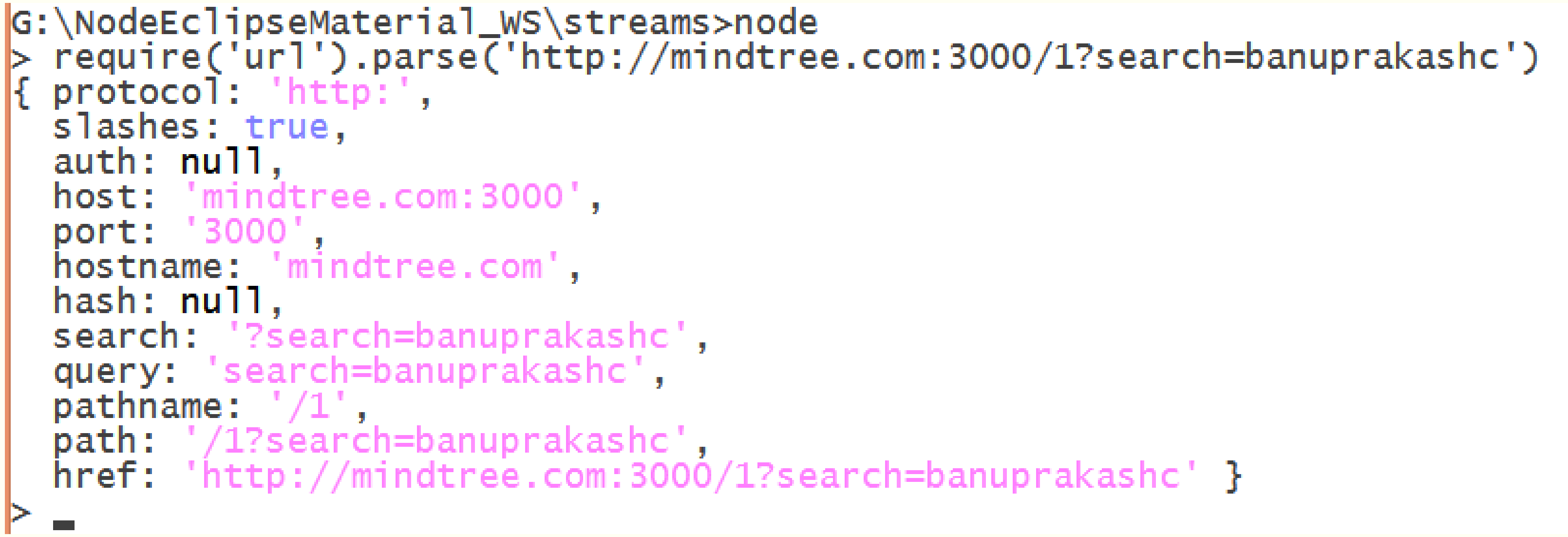
Setting the status code of an HTTP response



```
var server = http.createServer(function(req, res) {
    var url = 'http://google.com';
    var body = '<p>Redirecting to <a href="' + url + '">'
    + url + '</a></p>';
    res.setHeader('Location', url);
    res.setHeader('Content-Length', body.length);
    res.setHeader('Content-Type', 'text/html');
    res.statusCode = 302;
    res.end(body);
});
server.listen(3000);//listen for incoming requests.
```

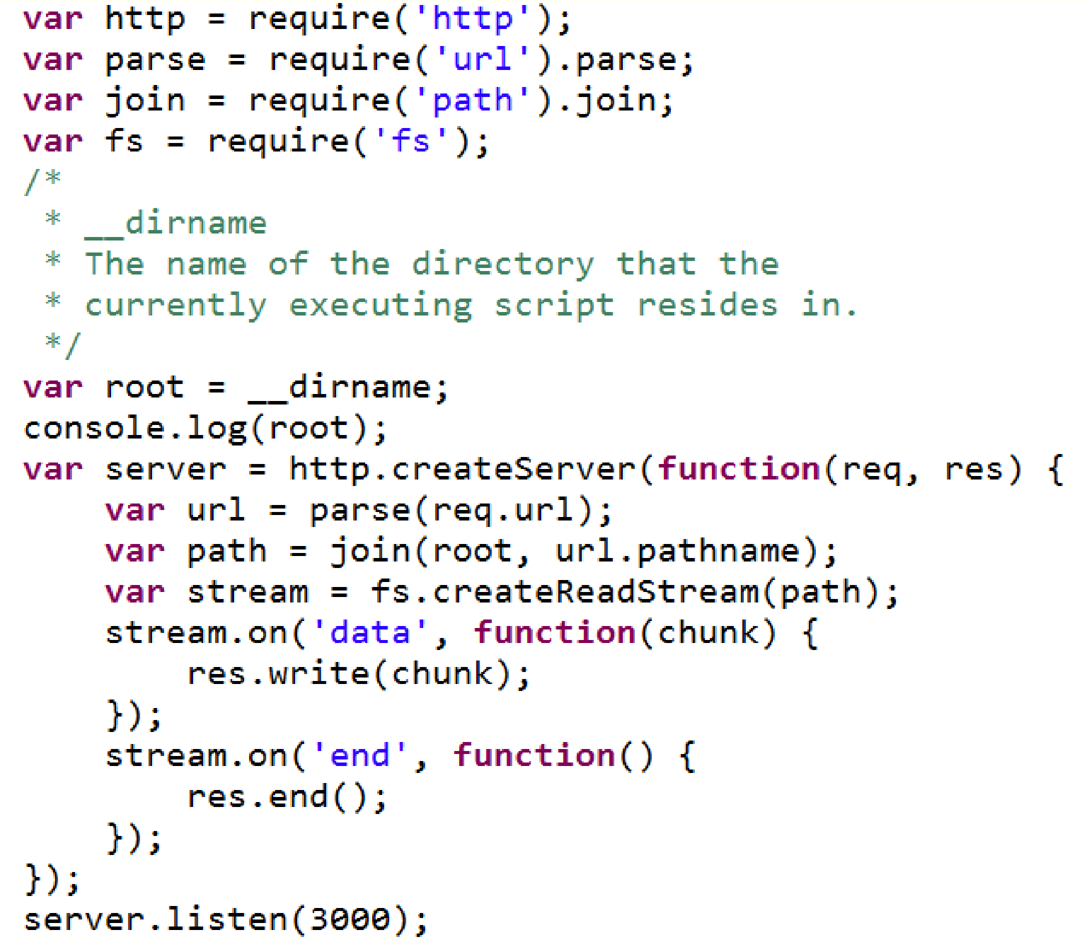
Request URL

- The requested URL can be accessed with the req.url property, which may contain several components depending on the request.
- To parse these sections, Node provides the url module, and specifically the **.parse() function**



```
G:\NodeEclipseMaterial_WS\streams>node
> require('url').parse('http://mindtree.com:3000/1?search=banuprakashc')
{ protocol: 'http:',
  slashes: true,
  auth: null,
  host: 'mindtree.com:3000',
  port: '3000',
  hostname: 'mindtree.com',
  hash: null,
  search: '?search=banuprakashc',
  query: 'search=banuprakashc',
  pathname: '/1',
  path: '/1?search=banuprakashc',
  href: 'http://mindtree.com:3000/1?search=banuprakashc' }
> _
```

Creating a static file server

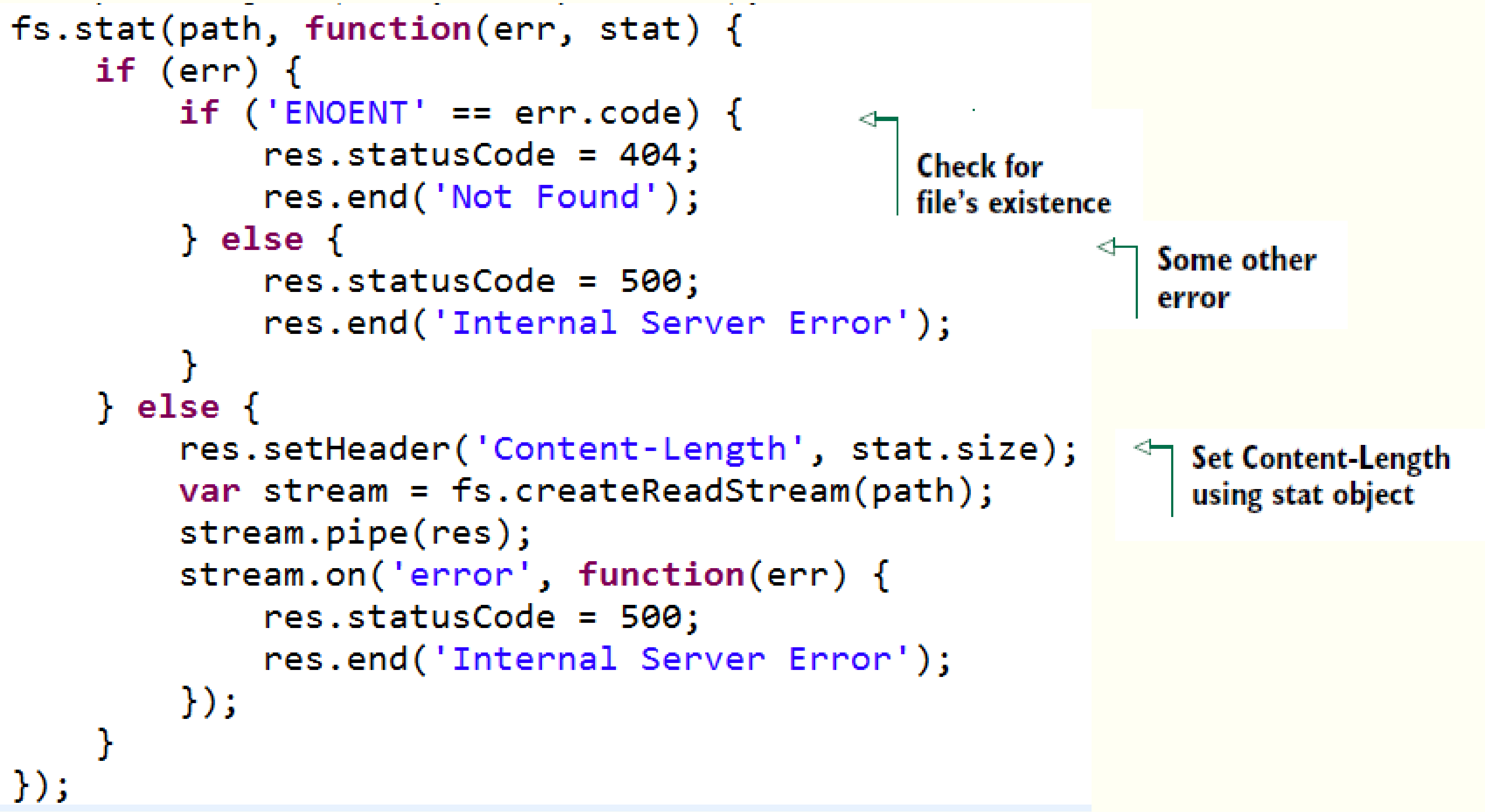


```
var http = require('http');
var parse = require('url').parse;
var join = require('path').join;
var fs = require('fs');
/*
 * __dirname
 * The name of the directory that the
 * currently executing script resides in.
 */
var root = __dirname;
console.log(root);
var server = http.createServer(function(req, res) {
    var url = parse(req.url);
    var path = join(root, url.pathname);
    var stream = fs.createReadStream(path);
    stream.on('data', function(chunk) {
        res.write(chunk);
    });
    stream.on('end', function() {
        res.end();
    });
});
server.listen(3000);
```

- Each static file server has a root directory, which is the base directory files are served from.

- In the server you’ll create, you’ll define a root variable, which will act as the static file server’s root directory

Checking for a file’s existence



```
fs.stat(path, function(err, stat) {
    if (err) {
        if ('ENOENT' == err.code) {
            res.statusCode = 404;
            res.end('Not Found');
        } else {
            res.statusCode = 500;
            res.end('Internal Server Error');
        }
    } else {
        res.setHeader('Content-Length', stat.size);
        var stream = fs.createReadStream(path);
        stream.pipe(res);
        stream.on('error', function(err) {
            res.statusCode = 500;
            res.end('Internal Server Error');
        });
    }
});
```

Check for file’s existence

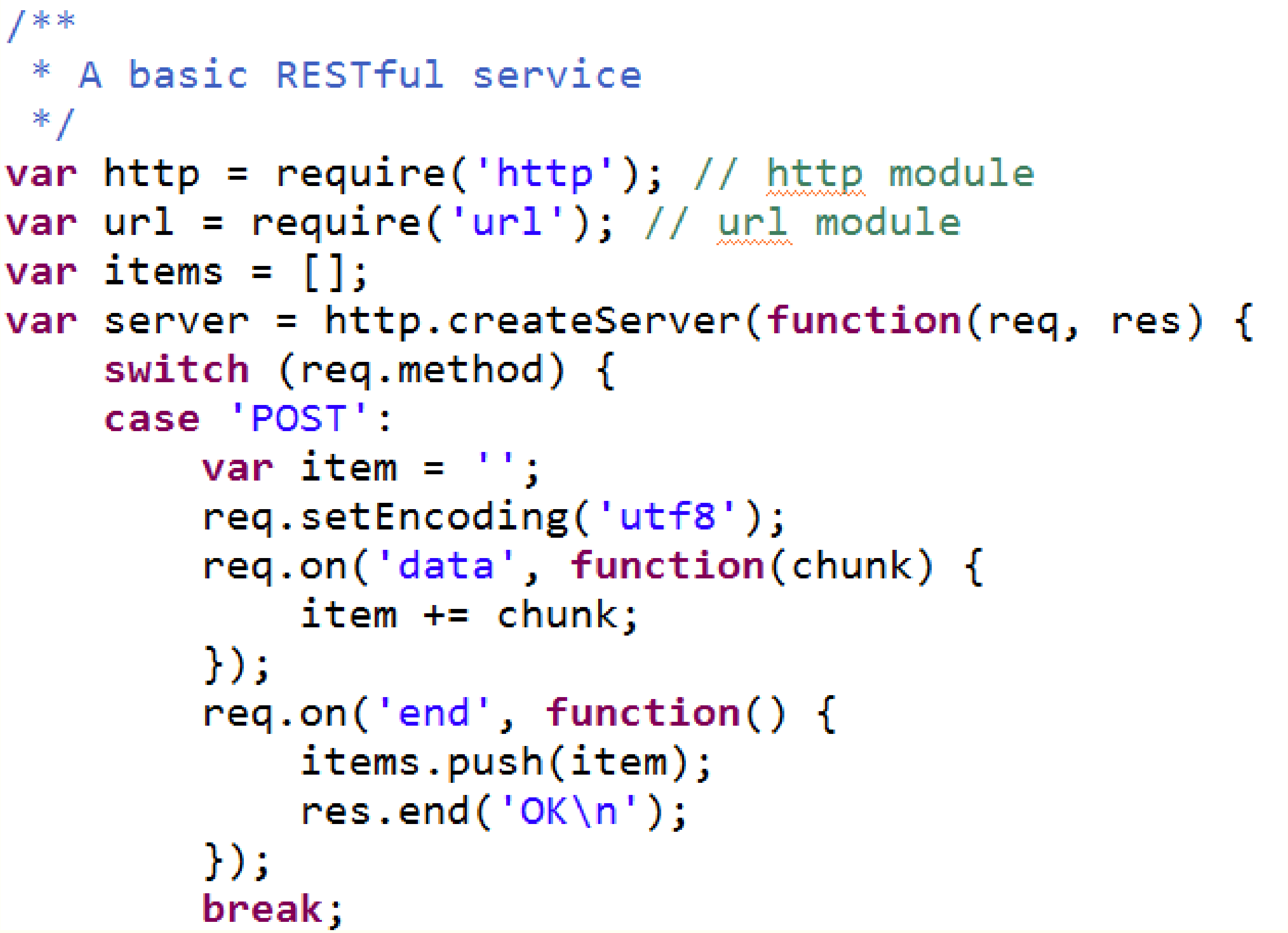
Some other error

Set Content-Length using stat object

Restful services

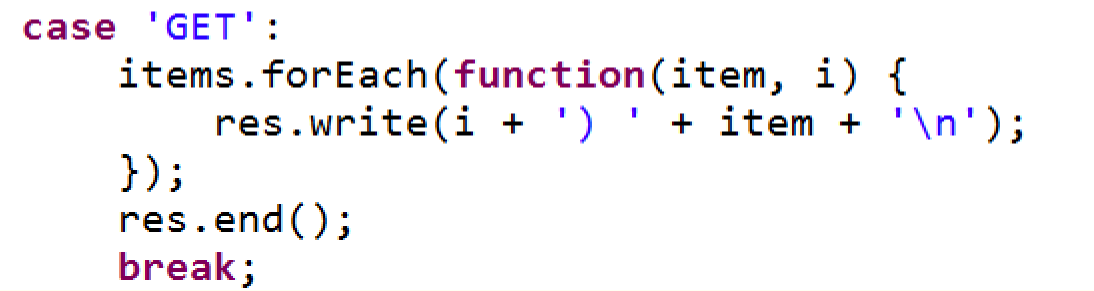
- Representational State Transfer (REST) is a software architecture style consisting of guidelines and best practices for creating scalable web services.
- REST is a coordinated set of constraints applied to the design of components in a distributed hypermedia system that can lead to a more performant and maintainable architecture.
- REST has gained widespread acceptance across the Web as a simpler alternative to SOAP and WSDL-based Web services.
- RESTful systems typically, but not always, communicate over the Hypertext Transfer Protocol with the same HTTP verbs (GET, POST, PUT, DELETE, etc.) used by web browsers to retrieve web pages and send data to remote servers.
- The REST architectural style was developed by W3C Technical Architecture Group (TAG) in parallel with HTTP 1.1, based on the existing design of HTTP 1.0.
- The World Wide Web represents the largest implementation of a system conforming to the REST architectural style

Restful services



```
/**
 * A basic RESTful service
 */
var http = require('http'); // http module
var url = require('url'); // url module
var items = [];
var server = http.createServer(function(req, res) {
    switch (req.method) {
    case 'POST':
        var item = '';
        req.setEncoding('utf8');
        req.on('data', function(chunk) {
            item += chunk;
        });
        req.on('end', function() {
            items.push(item);
            res.end('OK\n');
        });
        break;
```

Restful services



```
case 'GET':
    items.forEach(function(item, i) {
        res.write(i + ') ' + item + '\n');
    });
    res.end();
    break;
```

- To speed up responses, the Content-Length field should be sent with your response when possible.
- An optimized version of the GET handler could look something like this:

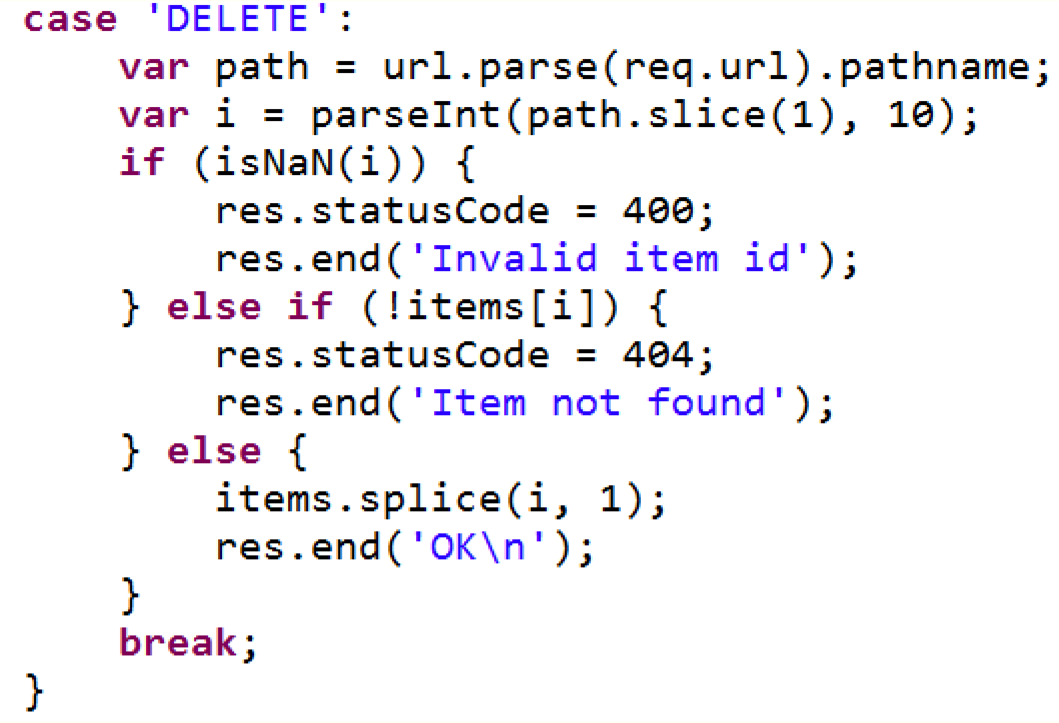
```
var body = items.map(function(item, i){
return i + ') ' + item;
}).join('\n');
res.setHeader('Content-Length', Buffer.byteLength(body));
res.setHeader('Content-Type', 'text/plain; charset="utf-8"');
res.end(body);
```

Restful services

- **Removing resources with DELETE requests**
  - To accomplish this, the app will need to check the requested URL, which is how the HTTP client will specify which item to remove. In this case, the identifier will be the array index in the items array;
    - for example, DELETE /1 or DELETE /5

Restful services

- Delete code

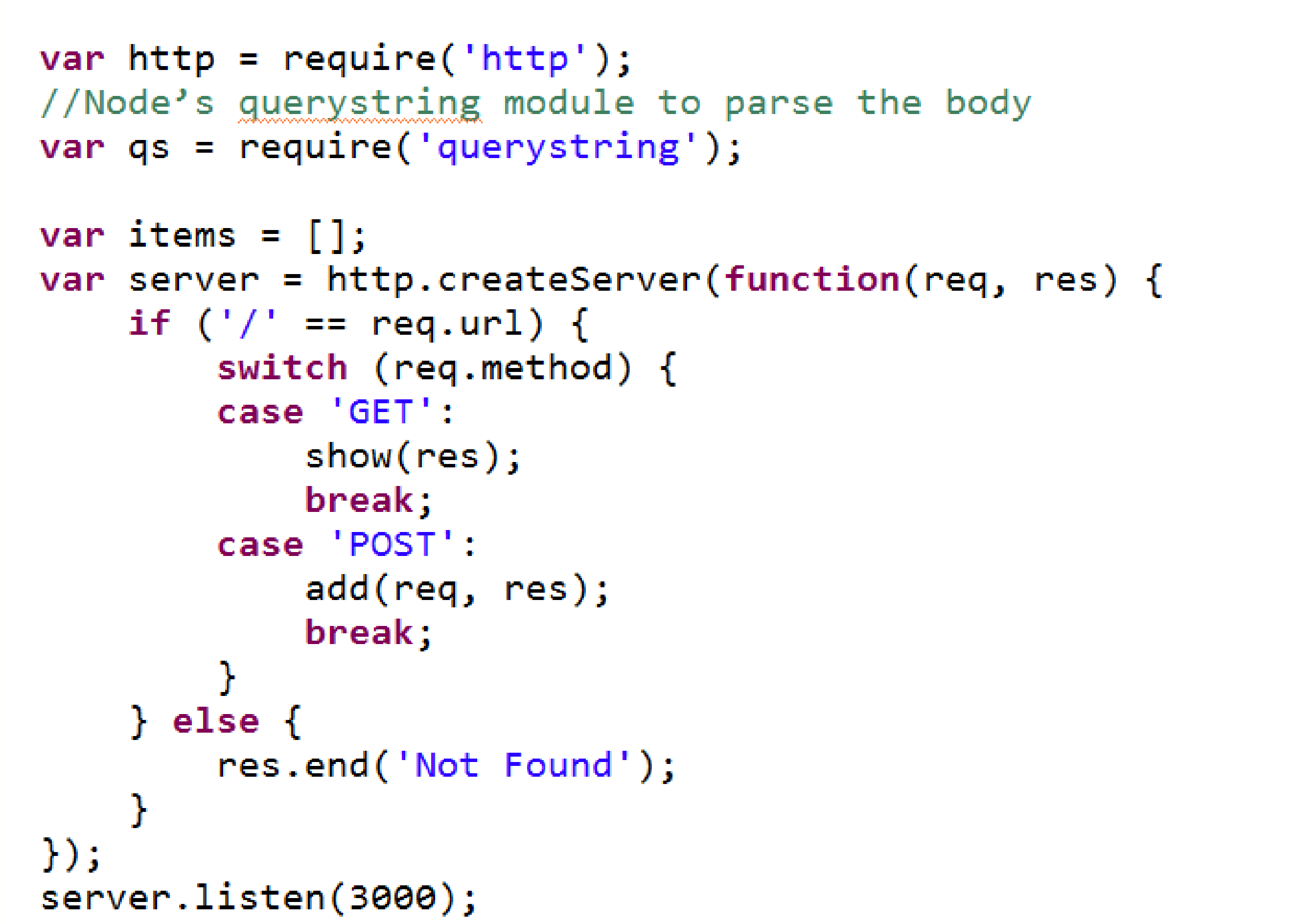


```
case 'DELETE':
    var path = url.parse(req.url).pathname;
    var i = parseInt(path.slice(1), 10);
    if (isNaN(i)) {
        res.statusCode = 400;
        res.end('Invalid item id');
    } else if (!items[i]) {
        res.statusCode = 404;
        res.end('Item not found');
    } else {
        items.splice(i, 1);
        res.end('OK\n');
    }
    break;
}
```

Handling submitted form fields

- Typically two Content-Type values are associated with form submission requests:
  - application/x-www-form-urlencoded
    - The default for HTML forms
  - multipart/form-data
    - Used when the form contains files, or non-ASCII or binary data

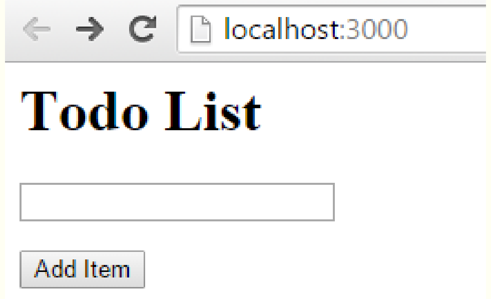
Handling submitted form fields

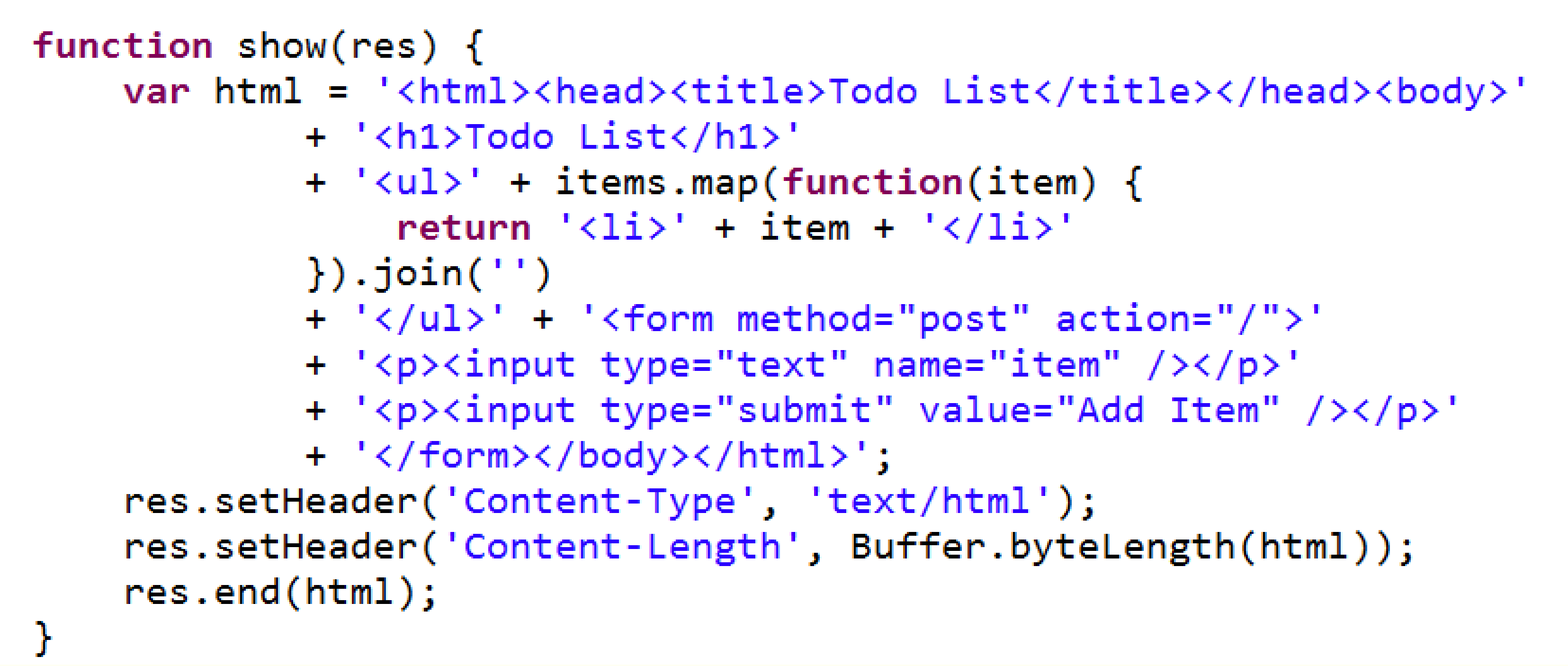


```
var http = require('http');
//Node’s querystring module to parse the body
var qs = require('querystring');

var items = [];
var server = http.createServer(function(req, res) {
    if ('/' == req.url) {
        switch (req.method) {
        case 'GET':
            show(res);
            break;
        case 'POST':
            add(req, res);
            break;
        }
    } else {
        res.end('Not Found');
    }
});
server.listen(3000);
```

Handling submitted form fields

- Handle get request
  - Display Form to accept user input

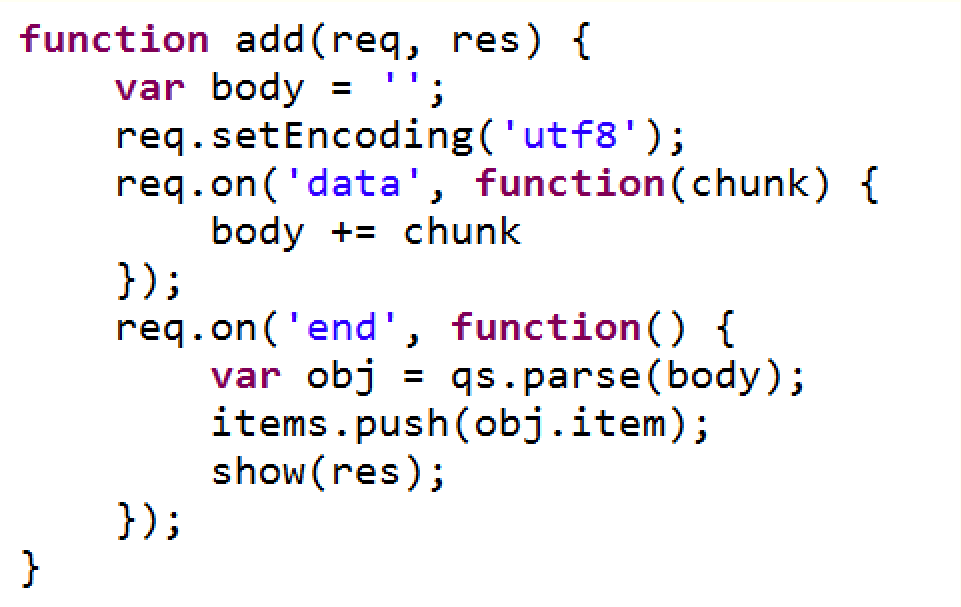




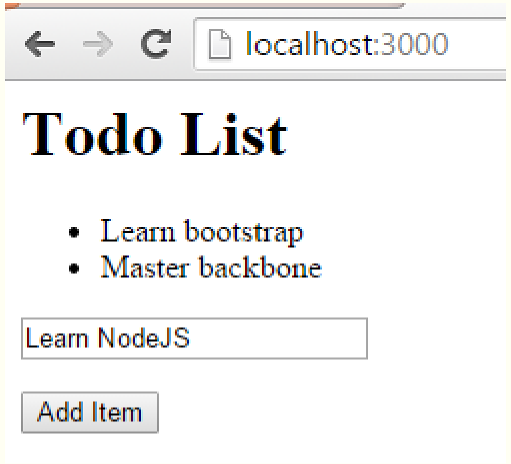
```
function show(res) {
    var html = '<html><head><title>Todo List</title></head><body>'
            + '<h1>Todo List</h1>'
            + '<ul>' + items.map(function(item) {
                return '<li>' + item + '</li>'
            }).join('')
            + '</ul>' + '<form method="post" action="/">'
            + '<p><input type="text" name="item" /></p>'
            + '<p><input type="submit" value="Add Item" /></p>'
            + '</form></body></html>';
    res.setHeader('Content-Type', 'text/html');
    res.setHeader('Content-Length', Buffer.byteLength(html));
    res.end(html);
}
```

Handling submitted form fields

- Handle form data
  - Use Node’s **querystring** module to parse the body



```
function add(req, res) {
    var body = '';
    req.setEncoding('utf8');
    req.on('data', function(chunk) {
        body += chunk
    });
    req.on('end', function() {
        var obj = qs.parse(body);
        items.push(obj.item);
        show(res);
    });
}
```



Todo List

- Learn bootstrap
- Master backbone

Learn NodeJS

HTTPS openSSL

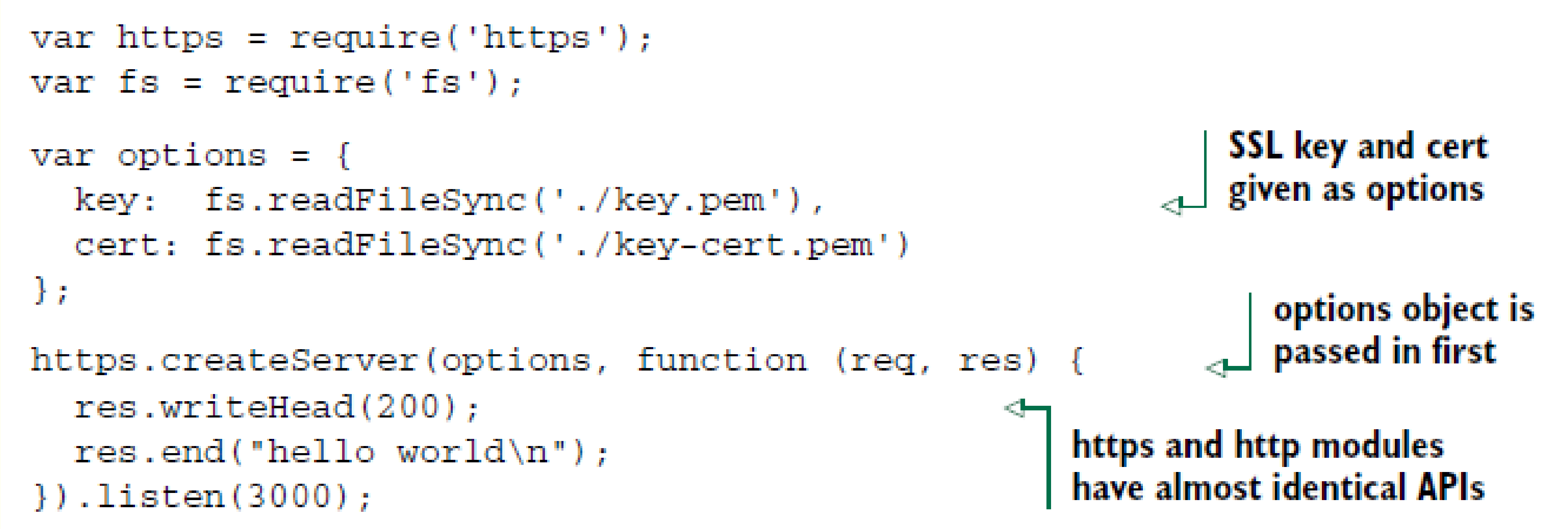
- To generate a private key, which we’ll call key.pem,
- open up a command-line prompt and enter the following:
  - openssl genrsa 1024 > key.pem

- The private key is used to create the certificate. Enter the following to generate a certificate called key-cert.pem:
  - openssl req -x509 -new -key key.pem > key-cert.pem

- Unlike a private key, a certificate can be shared with the world; it contains a public key and information about the certificate holder.
- The public key is used to encrypt traffic sent from the client to the server

HTTPS openSSL

- Need to use HTTPS



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

var options = {
  key:  fs.readFileSync('./key.pem'),
  cert: fs.readFileSync('./key-cert.pem')
};

https.createServer(options, function (req, res) {
  res.writeHead(200);
  res.end("hello world\n");
}).listen(3000);
```

SSL key and cert given as options

options object is passed in first

https and http modules have almost identical APIs

Objectives

- Understand how to bind node.js with mySql database
- Restful services using http and mysql module

Relational database management systems

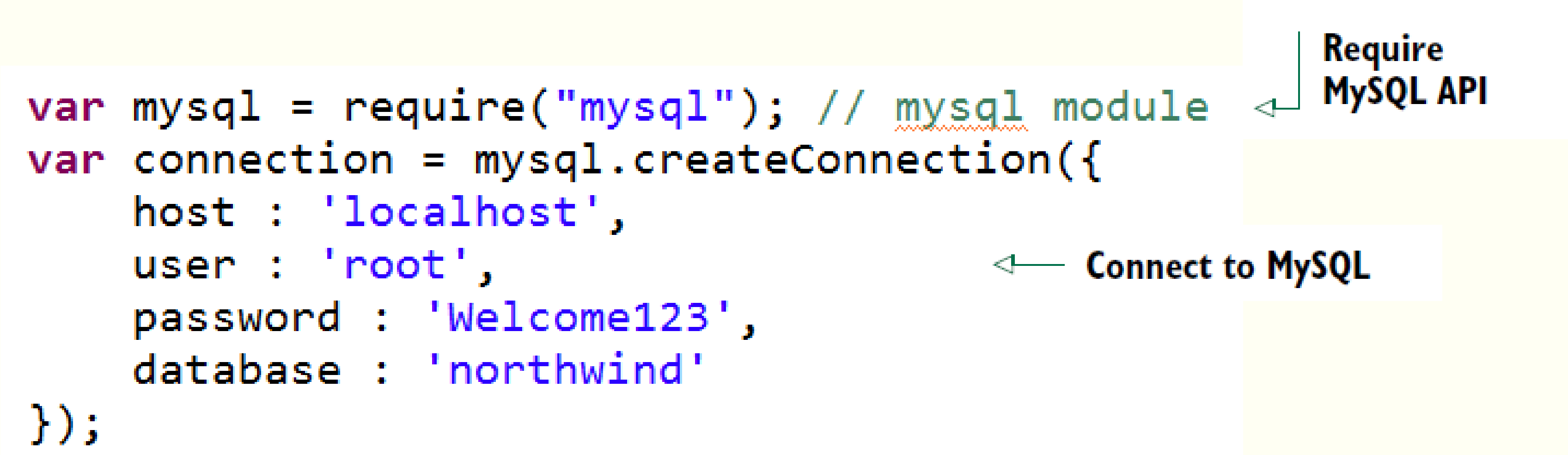
- Relational database management systems (RDBMSs) allow complex information to be stored and easily queried.
- RDBMSs have traditionally been used for relatively high-end applications, such as content management, customer relationship management, and shopping carts.
- Developers have many relational database options, but most choose open source databases, primarily because they’re well supported, they work well, and they don’t cost anything.
- MySQL and PostgreSQL have similar capabilities, and both are solid choices.
- MySQL is easier to set up and has a larger user base

The node.js driver for mysql

- Install
  - npm install mysql
  - This is a node.js driver for mysql.
  - It is written in JavaScript, does not require compiling, and is 100% MIT licensed

Connecting to MySQL

- Fill in the host, user, password, and database settings with those that correspond to your MySQL configuration



```
var mysql = require("mysql"); // mysql module
var connection = mysql.createConnection({
    host : 'localhost',
    user : 'root',
    password : 'Welcome123',
    database : 'northwind'
});
```

Require MySQL API

Connect to MySQL

Few important Connection Options

When establishing a connection, you can set the following options:

- host : The hostname of the database you are connecting to. (Default: localhost)
- port : The port number to connect to. (Default: 3306)
- user : The MySQL user to authenticate as.
- password : The password of that MySQL user.
- database : Name of the database to use for this connection
- connectTimeout : The milliseconds before a timeout occurs during the initial connection to the MySQL server. (Default: 10000)
- dateStrings : Force date types (TIMESTAMP, DATETIME, DATE) to be returned as strings rather then inflated into JavaScript Date objects. (Default: false)
- debug : Prints protocol details to stdout. (Default: false)

Performing queries

- The most basic way to perform a query is to call the .query() method on an object
- The simplest form of .query() is
  - .query(sqlString, callback) , where a SQL string is the first argument and the second is a callback:

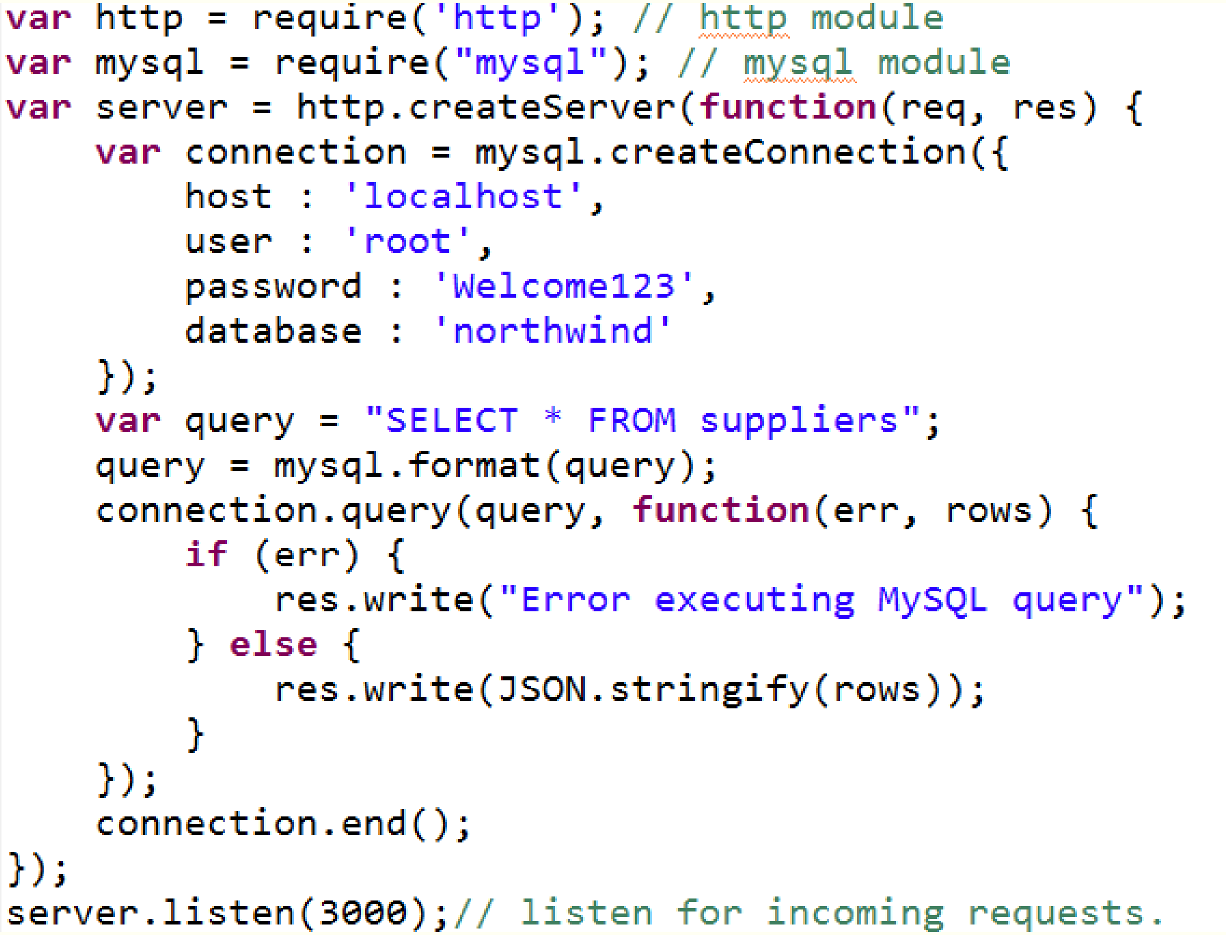
```
connection.query('SELECT * FROM books WHERE author = "David"',
 function (error, results, fields) {
          // error will be an Error if one occurred during the query
           // results will contain the results of the query
          // fields will contain information about the returned results fields (if any)
});
```

Performing queries

- Using IN parameters [Placeholders]
  - **.query(sqlString, values, callback)**

```
connection.query('SELECT * FROM books WHERE author = ?',
    ['David'],
    function (error, results, fields) {

    });
```

Sample code to get json data from “suppliers” table

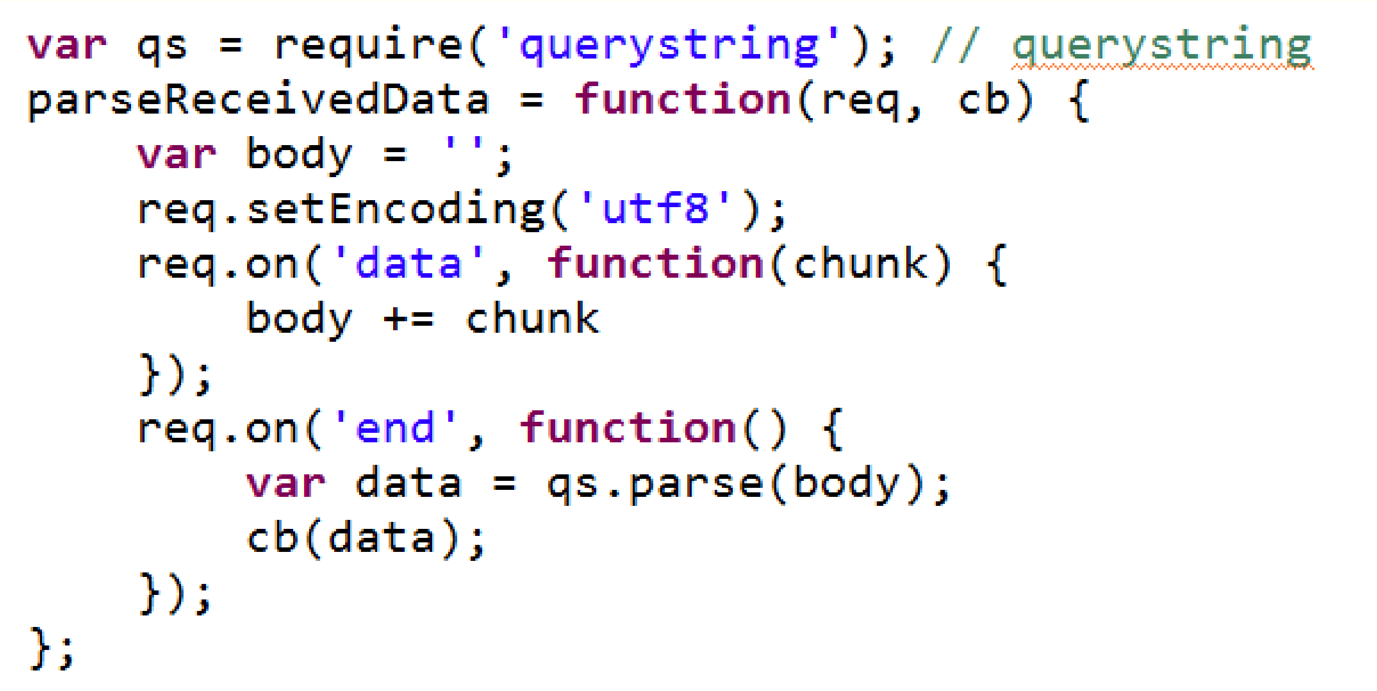


```
var http = require('http'); // http module
var mysql = require("mysql"); // mysql module
var server = http.createServer(function(req, res) {
    var connection = mysql.createConnection({
        host : 'localhost',
        user : 'root',
        password : 'Welcome123',
        database : 'northwind'
    });
    var query = "SELECT * FROM suppliers";
    query = mysql.format(query);
    connection.query(query, function(err, rows) {
        if (err) {
            res.write("Error executing MySQL query");
        } else {
            res.write(JSON.stringify(rows));
        }
    });
    connection.end();
});
server.listen(3000);// listen for incoming requests.
```

- Every method you invoke on a connection is queued and executed in sequence.
- Closing the connection is done using end() which makes sure all remaining queries are executed before sending a quit packet to the mysql server.

Sample code to insert form-data into table

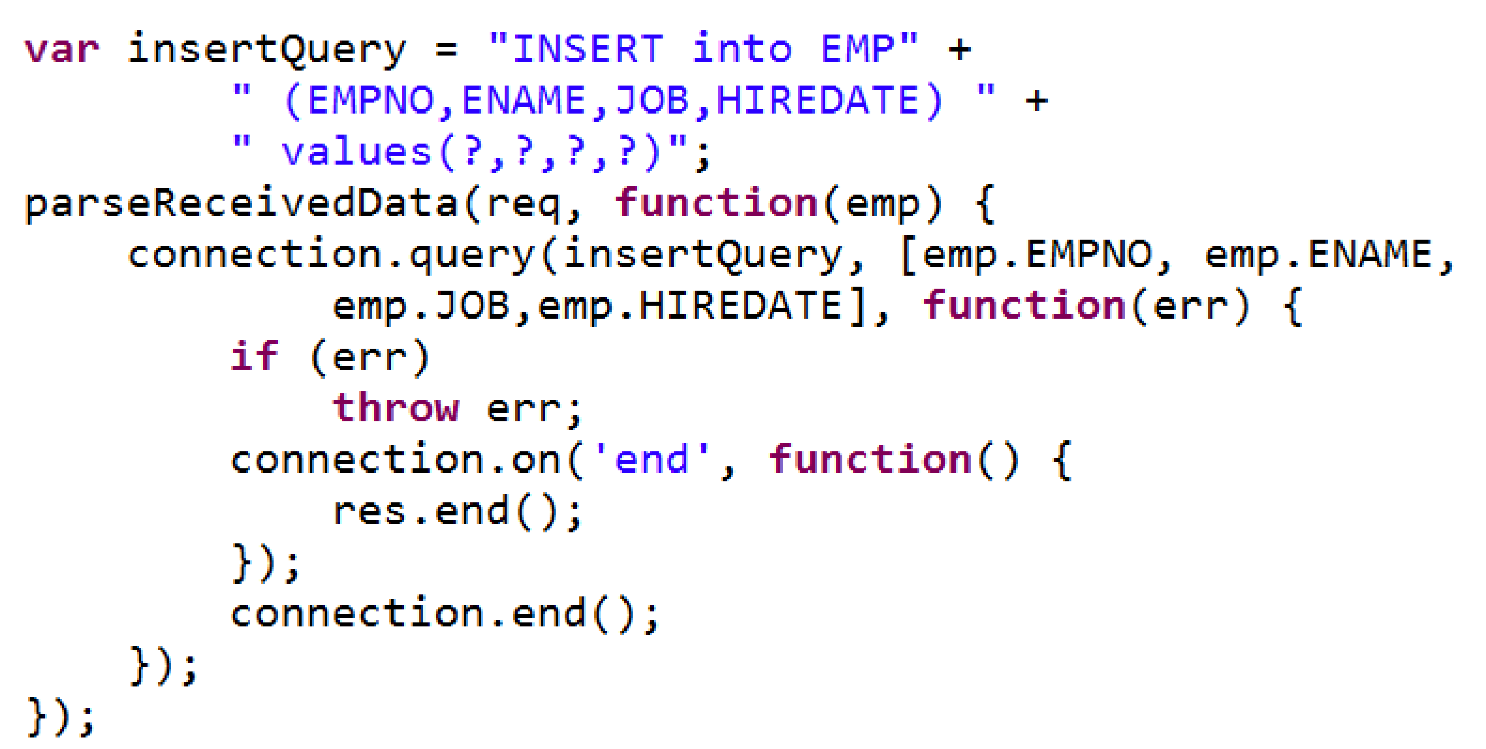
- Helper function to parse HTTP POST data
  - Converts form parameters into JSON data



```
var qs = require('querystring'); // querystring
parseReceivedData = function(req, cb) {
    var body = '';
    req.setEncoding('utf8');
    req.on('data', function(chunk) {
        body += chunk
    });
    req.on('end', function() {
        var data = qs.parse(body);
        cb(data);
    });
};
```

Sample code to insert form-data into table

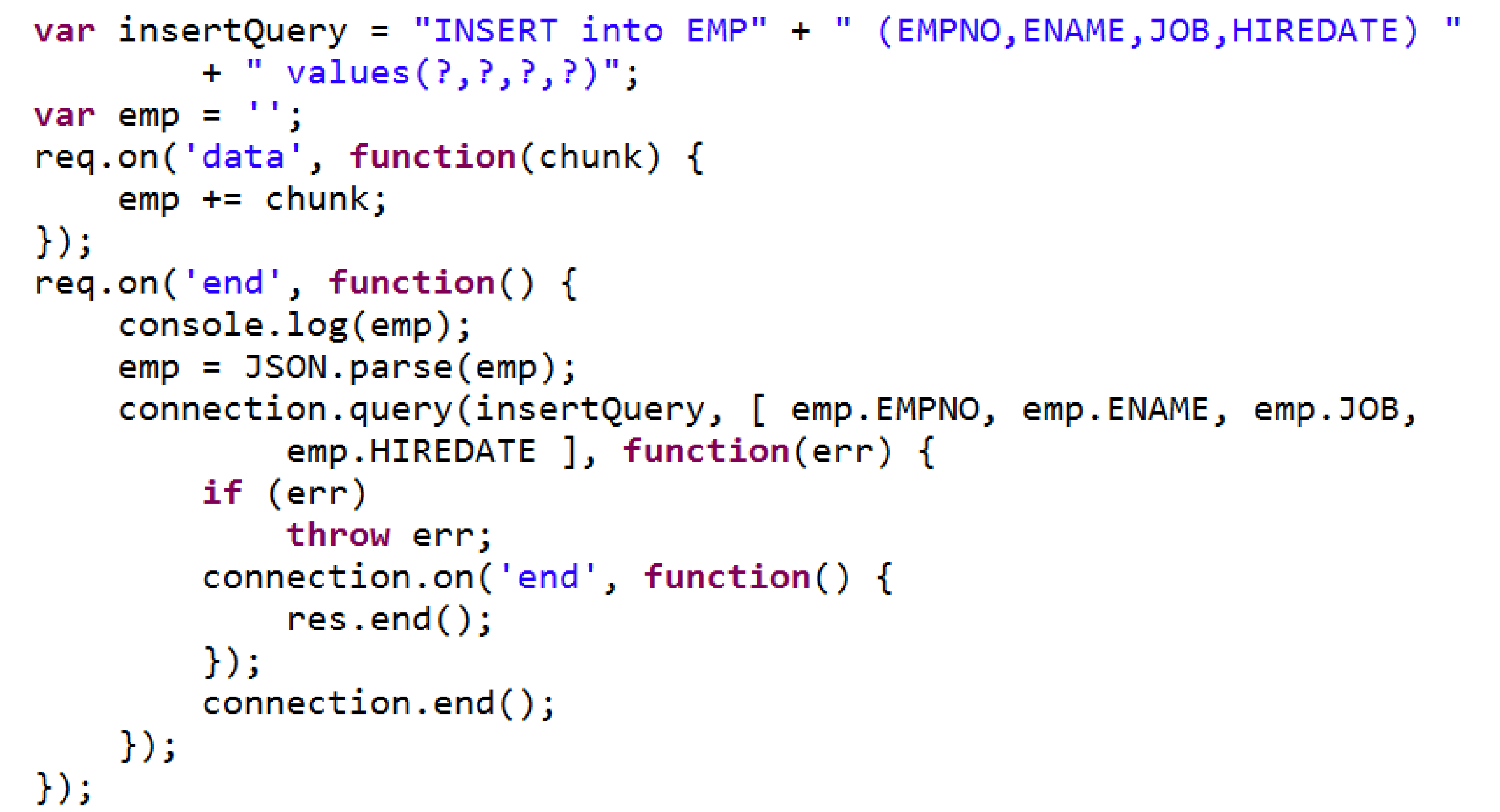
- Insert Data to EMP table



```
var insertQuery = "INSERT into EMP" +
        " (EMPNO,ENAME,JOB,HIREDATE) " +
        " values(?,?,?,?)";
parseReceivedData(req, function(emp) {
    connection.query(insertQuery, [emp.EMPNO, emp.ENAME,
            emp.JOB,emp.HIREDATE], function(err) {
        if (err)
            throw err;
        connection.on('end', function() {
            res.end();
        });
        connection.end();
    });
});
```

Sample code to insert json-data into table

- {"EMPNO":63,"ENAME":"T","HIREDATE":"2004-4-4"}



```
var insertQuery = "INSERT into EMP" + " (EMPNO,ENAME,JOB,HIREDATE) "
        + " values(?,?,?,?)";
var emp = '';
req.on('data', function(chunk) {
    emp += chunk;
});
req.on('end', function() {
    console.log(emp);
    emp = JSON.parse(emp);
    connection.query(insertQuery, [ emp.EMPNO, emp.ENAME, emp.JOB,
            emp.HIREDATE ], function(err) {
        if (err)
            throw err;
        connection.on('end', function() {
            res.end();
        });
        connection.end();
    });
});
```

Escaping query values

- In order to avoid SQL Injection attacks, you should always escape any user provided data before using it inside a SQL query.
- You can do so using the mysql.escape() , connection.escape() or pool.escape() methods
  - var sql = 'SELECT * FROM users WHERE id = ' + connection.escape(userId);
- Alternatively, you can use ? characters as placeholders for values you would like to have escaped like this:

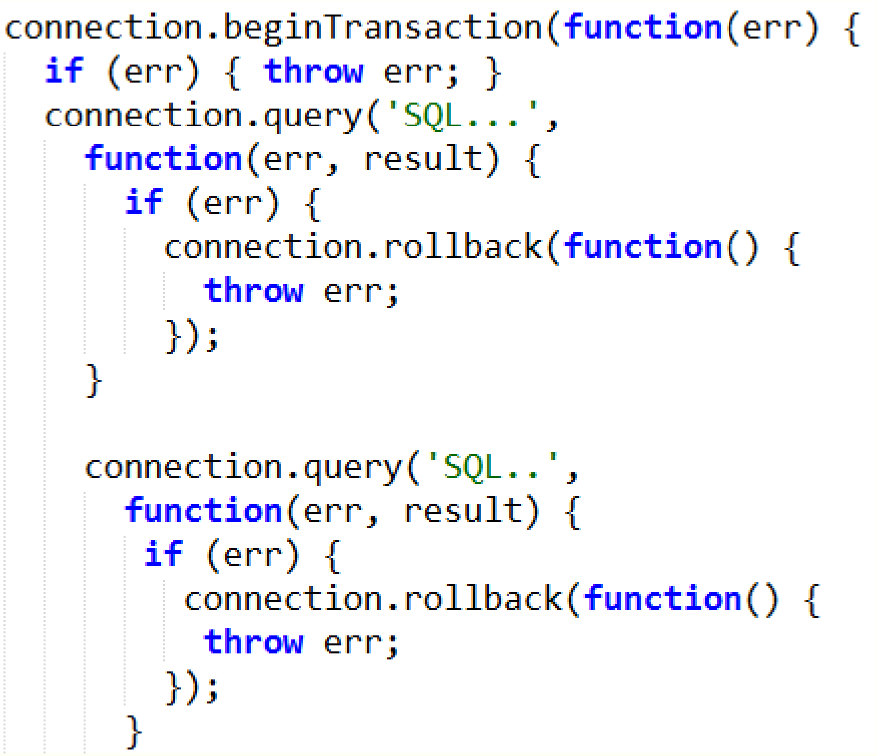
```
connection.query('SELECT * FROM users WHERE id = ?', [userId], function(err, results) {
  // ...
});
```

Escaping query values

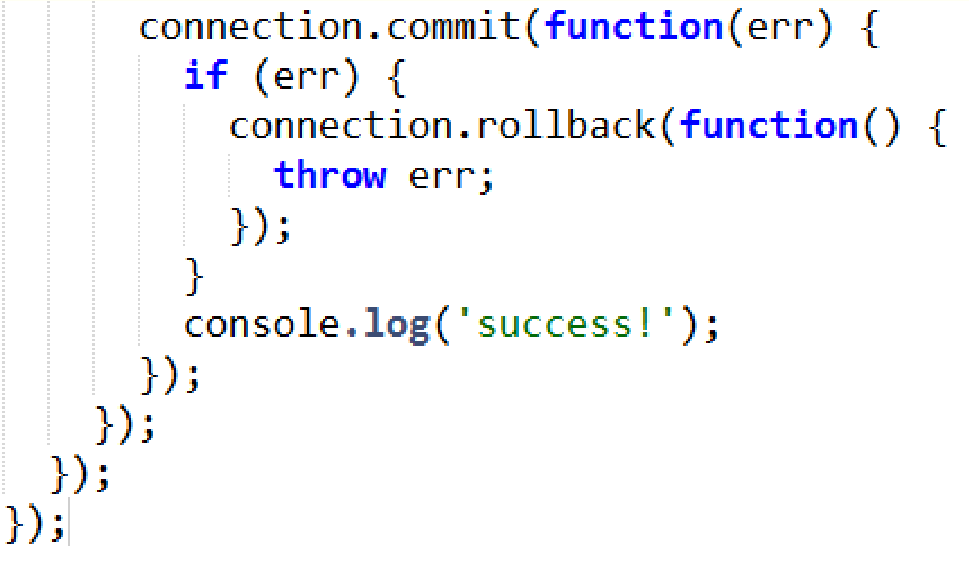
- Different value types are escaped differently, here is how:
  - Numbers are left untouched
  - Booleans are converted to true / false
  - Date objects are converted to 'YYYY-mm-dd HH:ii:ss' strings
  - Buffers are converted to hex strings, e.g. X'0fa5'
  - Strings are safely escaped
  - Arrays are turned into list, e.g. ['a', 'b'] turns into 'a', 'b'
  - Nested arrays are turned into grouped lists (for bulk inserts), e.g. [['a', 'b'], ['c', 'd']] turns into ('a', 'b'), ('c', 'd')
  - Objects are turned into key = 'val' pairs for each enumerable property on the object. If the property's value is a function, it is skipped; if the property's value is an object, toString() is called on it and the returned value is used.
  - undefined / null are converted to NULL
  - NaN / Infinity are left as-is. MySQL does not support these, and trying to insert them as values will trigger MySQL errors until they implement support.

Transactions

- beginTransaction(), commit() and rollback() are simply convenience functions that execute the START TRANSACTION, COMMIT, and ROLLBACK commands respectively



```
connection.beginTransaction(function(err) {
  if (err) { throw err; }
  connection.query('SQL...',
    function(err, result) {
      if (err) {
        connection.rollback(function() {
          throw err;
        });
    }

    connection.query('SQL..',
      function(err, result) {
       if (err) {
         connection.rollback(function() {
          throw err;
        });
      }
```



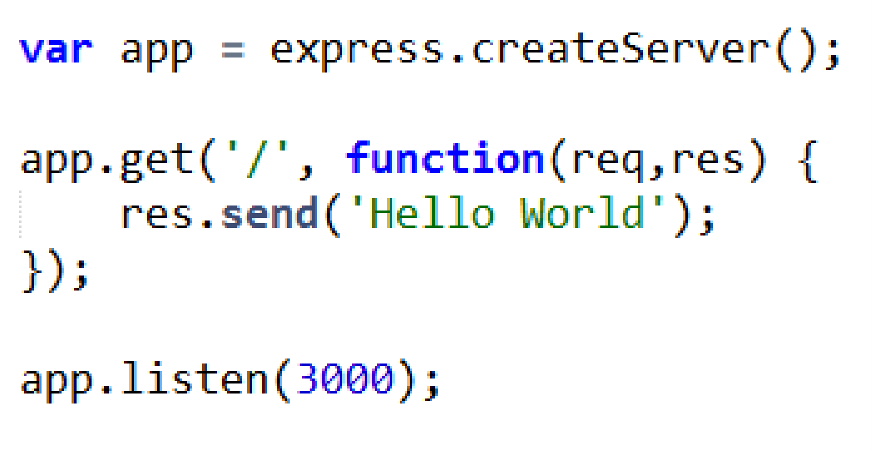
```
      connection.commit(function(err) {
        if (err) {
          connection.rollback(function() {
            throw err;
          });
        }
        console.log('success!');
      });
    });
  });
});
```

Objectives

- Understand NodeJS express-4 module
- Build RESTful application using node express

Express

- What’s Express?
  - NodeJS based web framework
  - Asynchronous

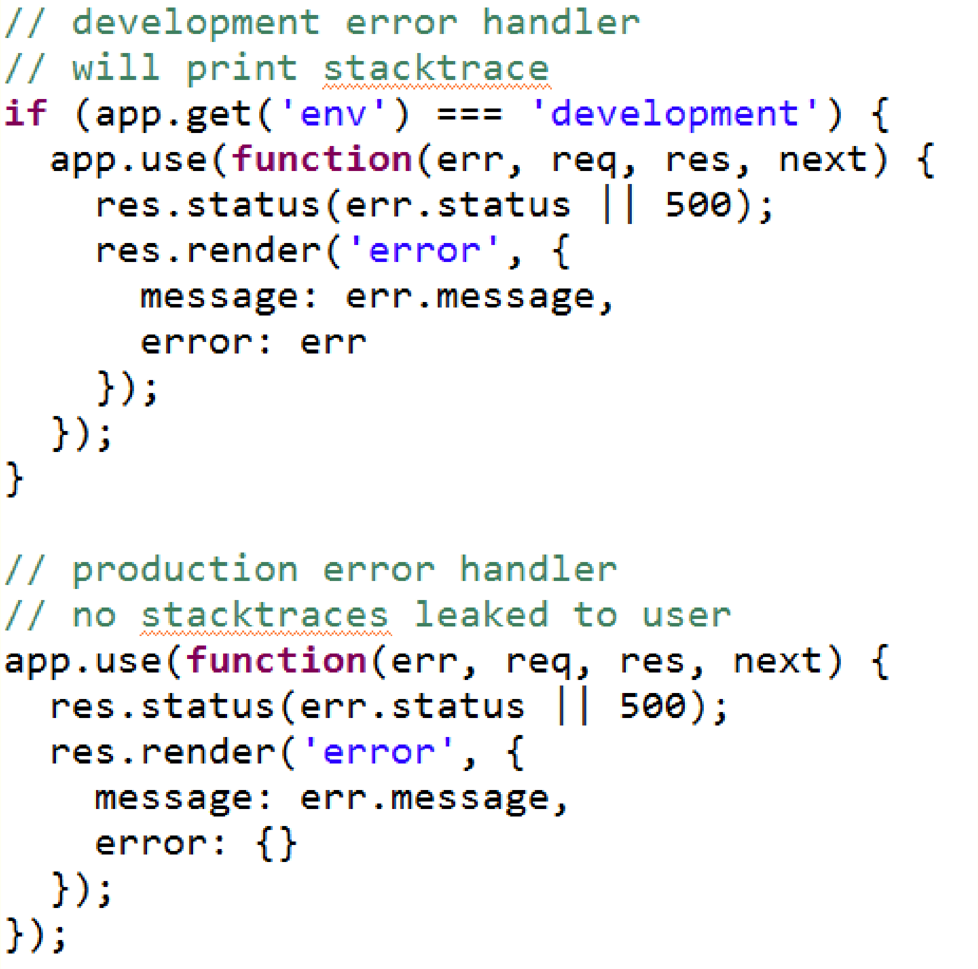


```
var app = express.createServer();

app.get('/', function(req,res) {
    res.send('Hello World');
});

app.listen(3000);
```

Express

- Installation
  - Install node
  - Install npm
  - npm install express

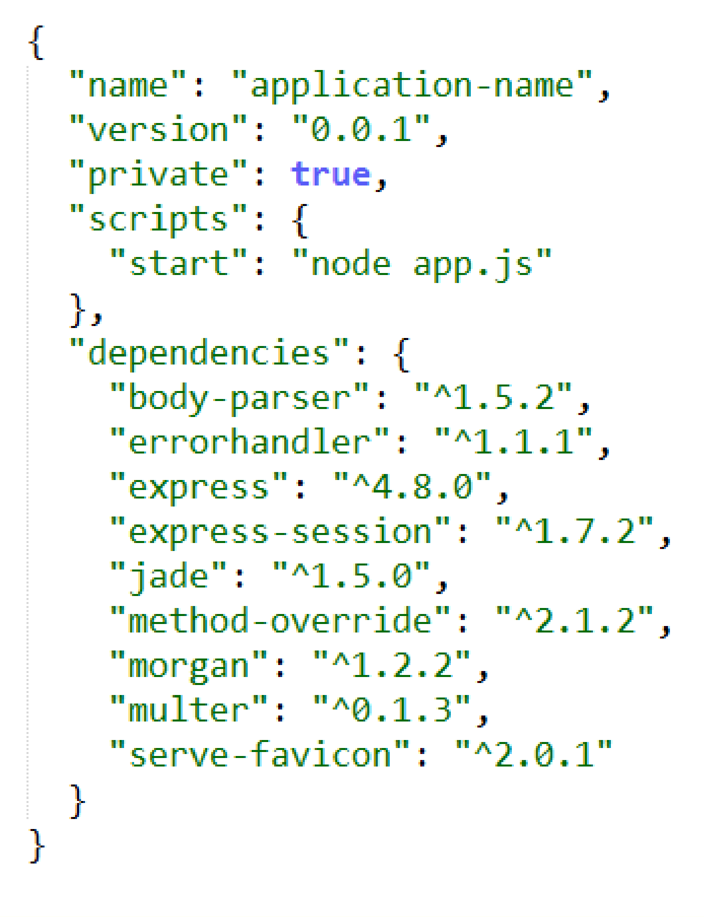
Configuration for Development and Production env



```
// development error handler
// will print stacktrace
if (app.get('env') === 'development') {
  app.use(function(err, req, res, next) {
    res.status(err.status || 500);
    res.render('error', {
      message: err.message,
      error: err
    });
  });
}

// production error handler
// no stacktraces leaked to user
app.use(function(err, req, res, next) {
  res.status(err.status || 500);
  res.render('error', {
    message: err.message,
    error: {}
  });
});
```

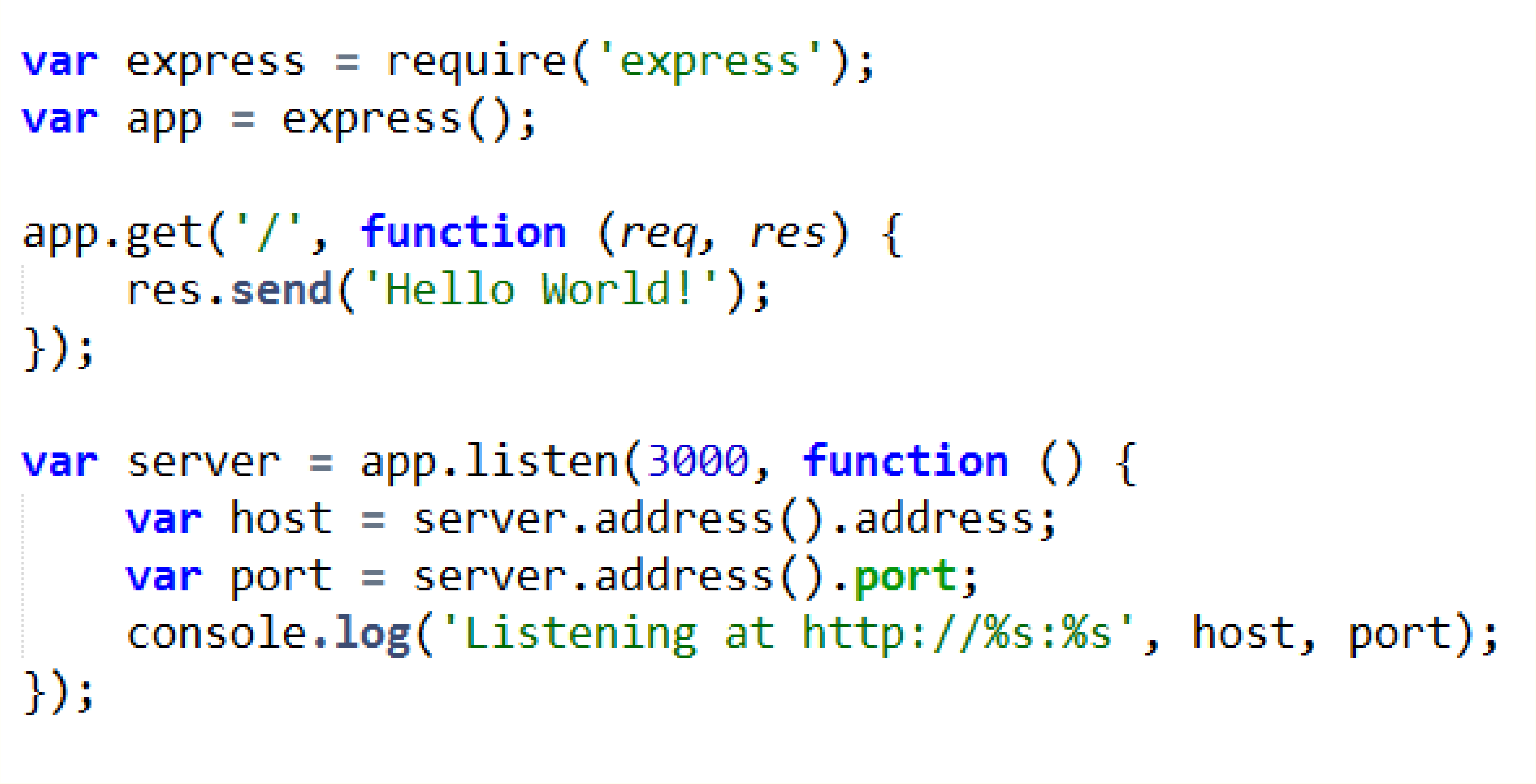
Setup Express project

- npm install serve-favicon morgan method-override express-session body-parser multer errorhandler express@latest jade@latest --save



```
{
  "name": "application-name",
  "version": "0.0.1",
  "private": true,
  "scripts": {
    "start": "node app.js"
  },
  "dependencies": {
    "body-parser": "^1.5.2",
    "errorhandler": "^1.1.1",
    "express": "^4.8.0",
    "express-session": "^1.7.2",
    "jade": "^1.5.0",
    "method-override": "^2.1.2",
    "morgan": "^1.2.2",
    "multer": "^0.1.3",
    "serve-favicon": "^2.0.1"
  }
}
```

Hello world example



```
var express = require('express');
var app = express();

app.get('/', function (req, res) {
    res.send('Hello World!');
});

var server = app.listen(3000, function () {
    var host = server.address().address;
    var port = server.address().port;
    console.log('Listening at http://%s:%s', host, port);
});
```

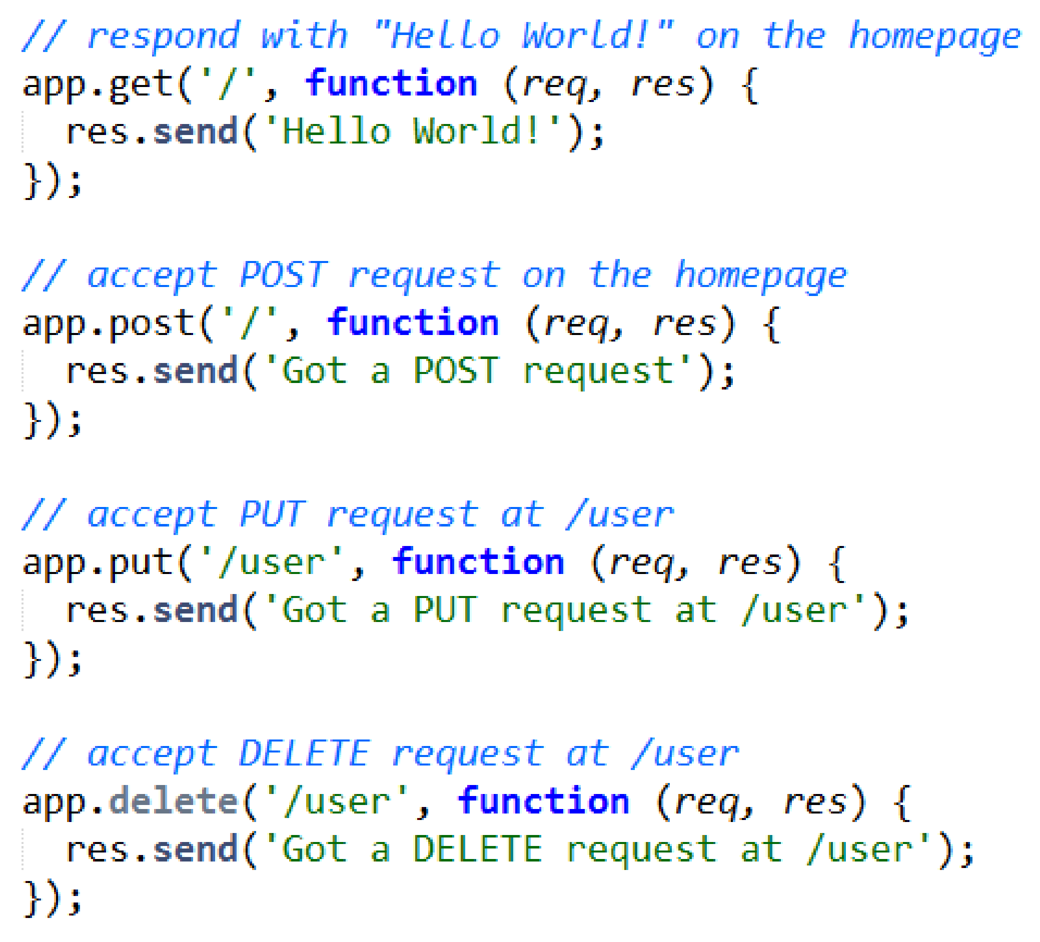
Routing

- Routing refers to determining how an application responds to a client request to a particular endpoint, which is a URI (or path) and a specific HTTP request method (GET, POST, and so on).

- Each route can have one or more handler functions, which is / are executed when the route is matched.

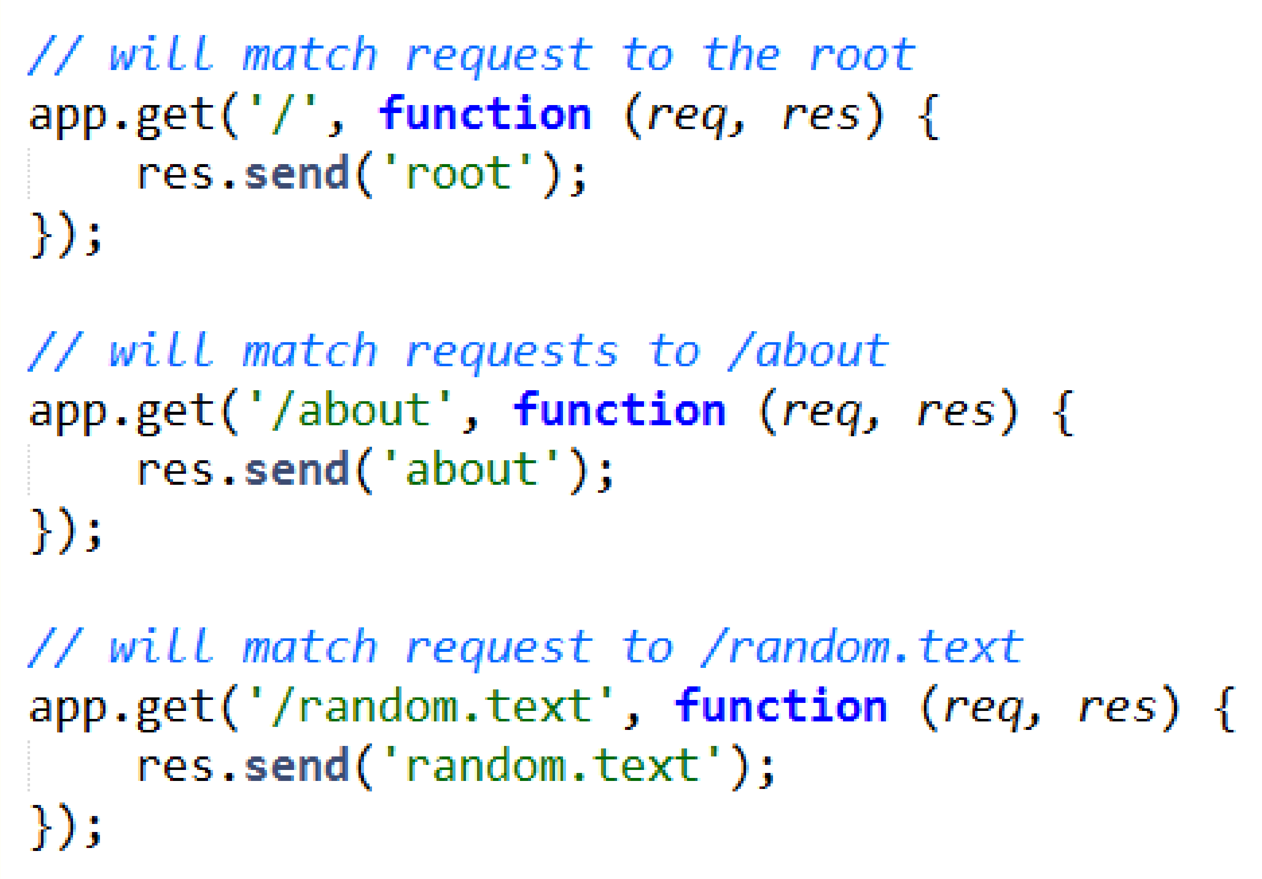
- Route definition takes the following structure app.METHOD (PATH, HANDLER), where app is an instance of express, METHOD is an HTTP request method, PATH is a path on the server, and HANDLER is the function executed when the route is matched.

Routing example



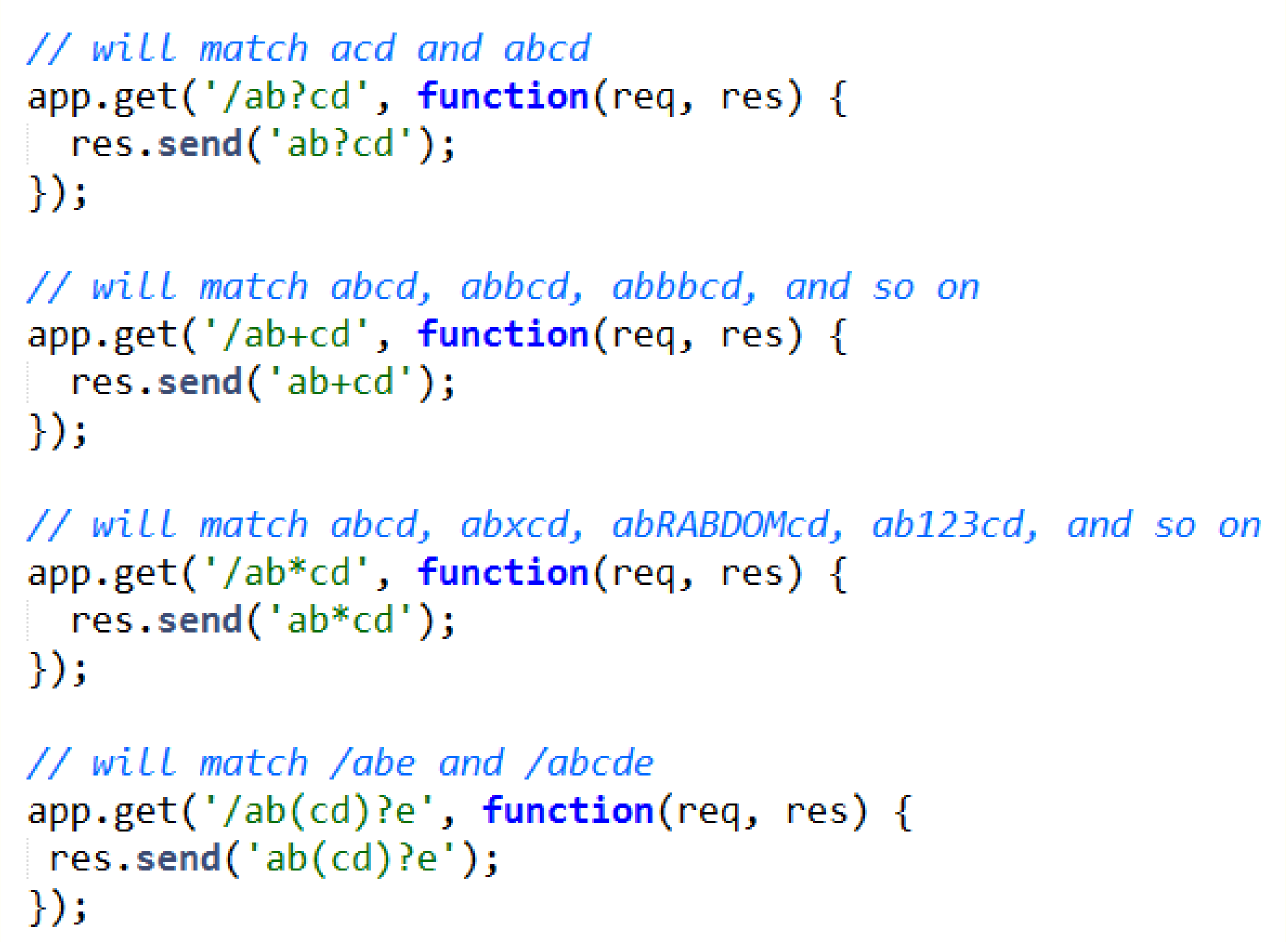
```
// respond with "Hello World!" on the homepage
app.get('/', function (req, res) {
  res.send('Hello World!');
});

// accept POST request on the homepage
app.post('/', function (req, res) {
  res.send('Got a POST request');
});

// accept PUT request at /user
app.put('/user', function (req, res) {
  res.send('Got a PUT request at /user');
});

// accept DELETE request at /user
app.delete('/user', function (req, res) {
  res.send('Got a DELETE request at /user');
});
```

Route paths



```
// will match request to the root
app.get('/', function (req, res) {
    res.send('root');
});

// will match requests to /about
app.get('/about', function (req, res) {
    res.send('about');
});

// will match request to /random.text
app.get('/random.text', function (req, res) {
    res.send('random.text');
});
```

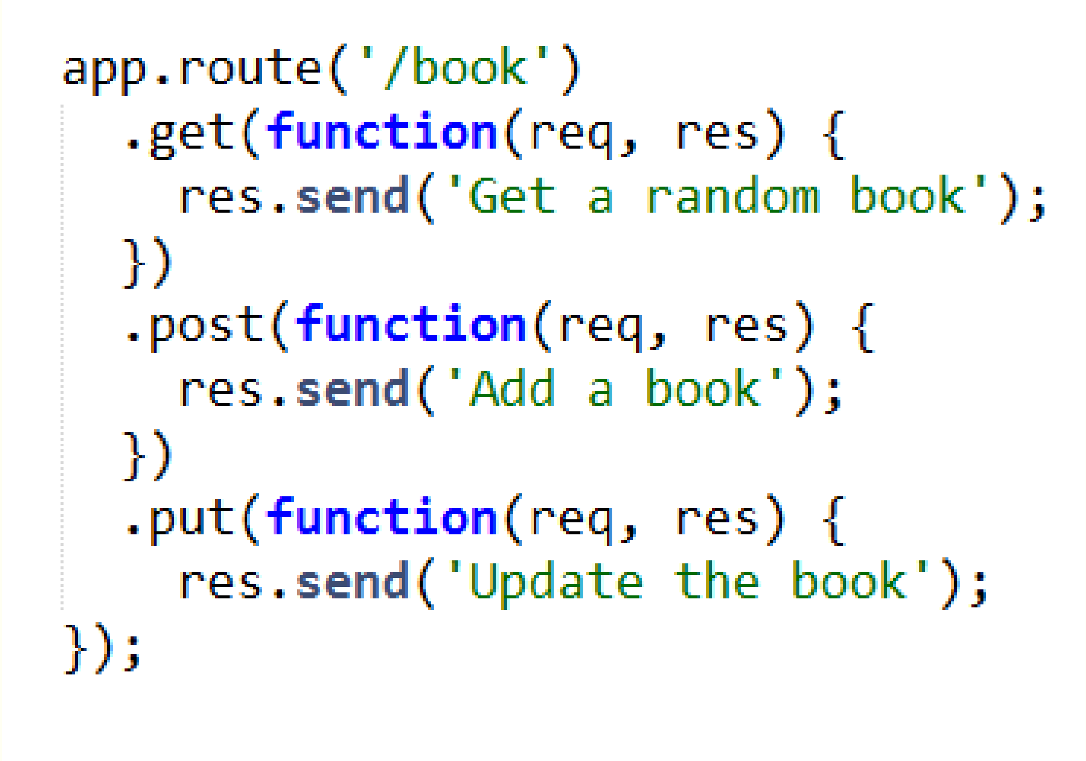
Route paths



```
// will match acd and abcd
app.get('/ab?cd', function(req, res) {
  res.send('ab?cd');
});

// will match abcd, abbcd, abbbcd, and so on
app.get('/ab+cd', function(req, res) {
  res.send('ab+cd');
});

// will match abcd, abxcd, abRABDOMcd, ab123cd, and so on
app.get('/ab*cd', function(req, res) {
  res.send('ab*cd');
});

// will match /abe and /abcde
app.get('/ab(cd)?e', function(req, res) {
 res.send('ab(cd)?e');
});
```

Create modular routes

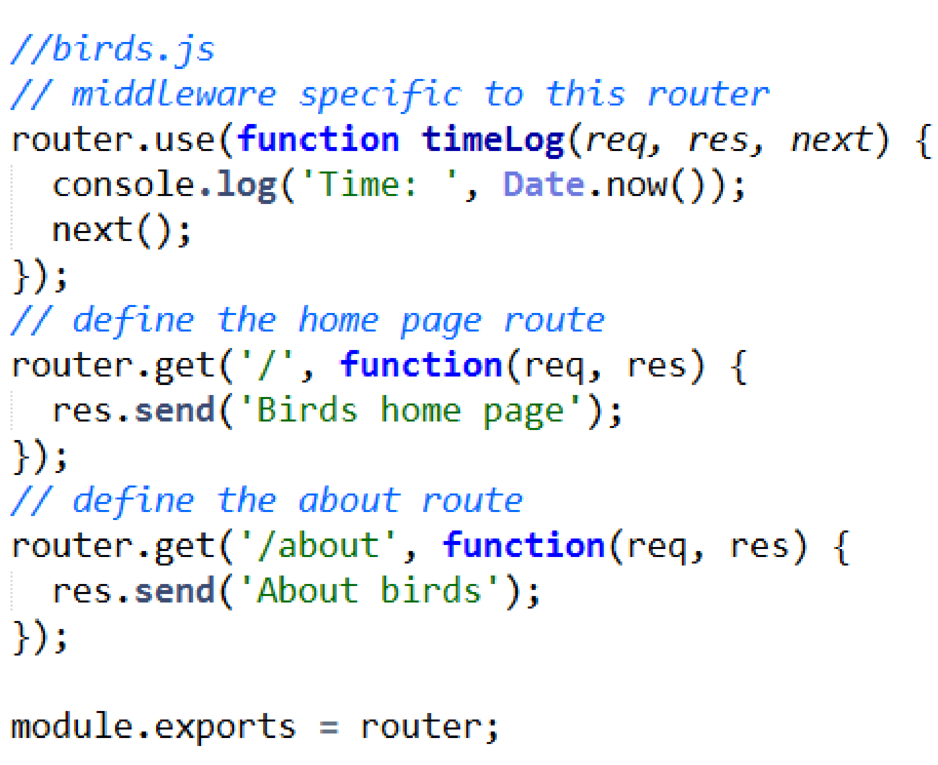
- Chainable route handlers for a route path can be created using app.route(). Since the path is specified at a single location, it helps to create modular routes and reduce redundancy and typos



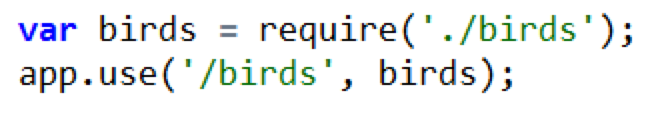
```
app.route('/book')
  .get(function(req, res) {
    res.send('Get a random book');
  })
  .post(function(req, res) {
    res.send('Add a book');
  })
  .put(function(req, res) {
    res.send('Update the book');
});
```

express.Router

- The express.Router class can be used to create modular mountable route handlers.
- A Router instance is a complete middleware and routing system; for this reason it is often referred to as a “mini-app”.



```
//birds.js
// middleware specific to this router
router.use(function timeLog(req, res, next) {
  console.log('Time: ', Date.now());
  next();
});
// define the home page route
router.get('/', function(req, res) {
  res.send('Birds home page');
});
// define the about route
router.get('/about', function(req, res) {
  res.send('About birds');
});

module.exports = router;
```



```
var birds = require('./birds');
app.use('/birds', birds);
```

Serving static files in Express

- Serving files, such as images, CSS, JavaScript and other static files is accomplished with the help of a built-in middleware in
  - Express - express.static.

- Pass the name of the directory, which is to be marked as the location of static assets, to the express.static middleware to start serving the files directly.

- For example, if you keep your images, CSS, and JavaScript files in a directory named public, you can do this:
  - app.use(express.static('public'));

Serving static files in Express

- If you want to use multiple directories as static assets directories, you can call the express.static middleware multiple times:
  - app.use(express.static('public'));
  - app.use(express.static('files'));

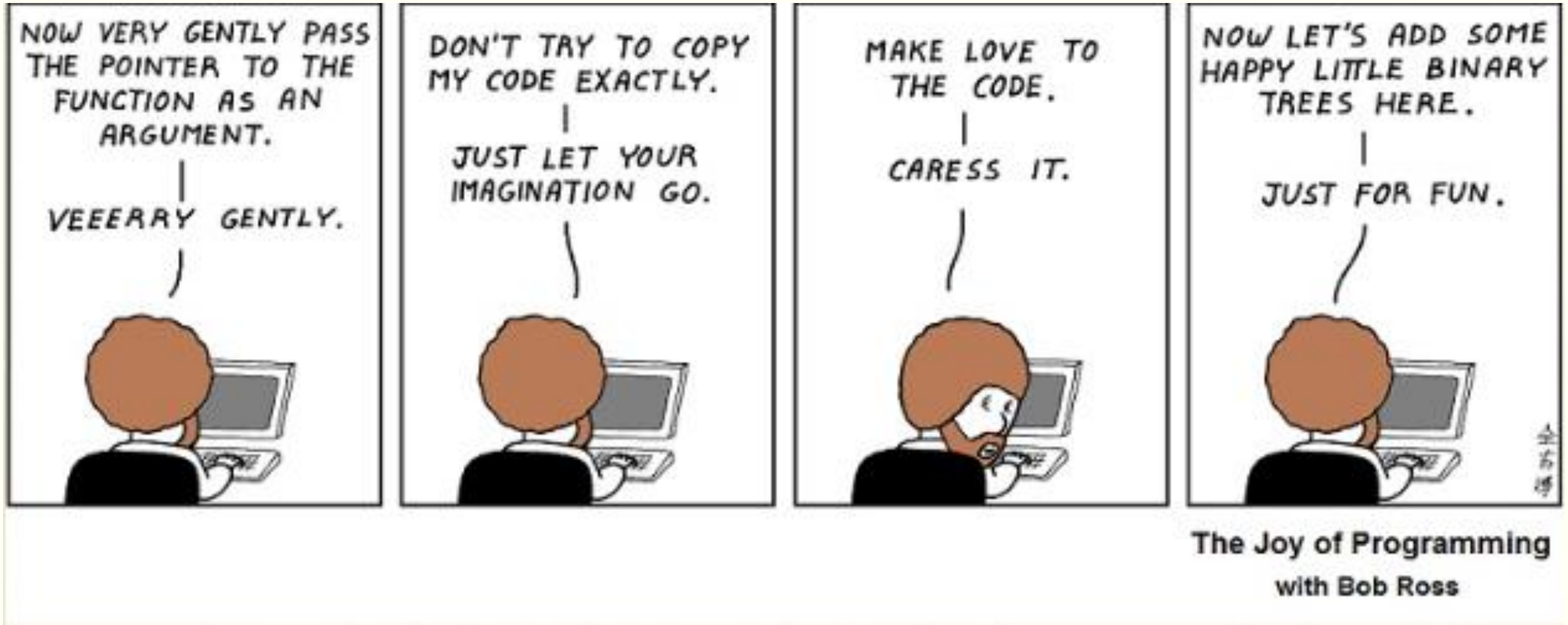
- The files will be looked up in the order the static directories were set using the express.static middleware.

Objectives

- Understand TDD and BDD
- Understand different Testing frameworks used to test NodeJS modules

Why Write Tests?

- The Joy of Programming


NOW VERY GENTLY PASS THE POINTER TO THE FUNCTION AS AN ARGUMENT.
VEEERRY GENTLY.
DON'T TRY TO COPY MY CODE EXACTLY.
JUST LET YOUR IMAGINATION GO.
MAKE LOVE TO THE CODE.
CARESS IT.
NOW LET'S ADD SOME HAPPY LITTLE BINARY TREES HERE.
JUST FOR FUN.
The Joy of Programming
with Bob Ross

Why Write Tests?

- Programming should not be frustrating

Why Write Tests?

The biggest Joy in programming is knowing **“What you write”** does **“What you intended”** to do, and it **doesn’t break** anything else.

Why Write Tests?

- Most common excuses to not write tests
  - Laziness: “Writing tests is such a unpleasant task!”
  - Perceived busyness: “We have too many things to do. We have targets to hit!!!”
  - Overconfidence: “This function is really easy. I can handle this.”
  - Ego: “It’ll definitely work. I’m a Programmer”.

Why Write Tests?

- What are the consequences?

Why Write Tests?

- What Programmers deal with?
  - Old code breaks when you write a new code
  - Your code just broke other people’s code
  - Code that you wrote is slow
  - Send hours debugging your code and other people’s code
  - What you’ve done is not what is supposed to do.
  - and ….

Why Write Tests?

- Whose fault is it?
  - Yours, of course

Why Write Tests?

- If you don’t want to deal with all that, write tests.

TDD (Test Driven Development)

- Test-driven development (TDD) is a software development process that relies on the repetition of a very short development cycle:
  - first the developer writes an (initially failing) automated test case that defines a desired improvement or new function, then produces the minimum amount of code to pass that test, and finally refactors the new code to acceptable standards.
  - Kent Beck, who is credited with having developed or 'rediscovered‘ the technique, stated in 2003 that TDD encourages simple designs and inspires confidence

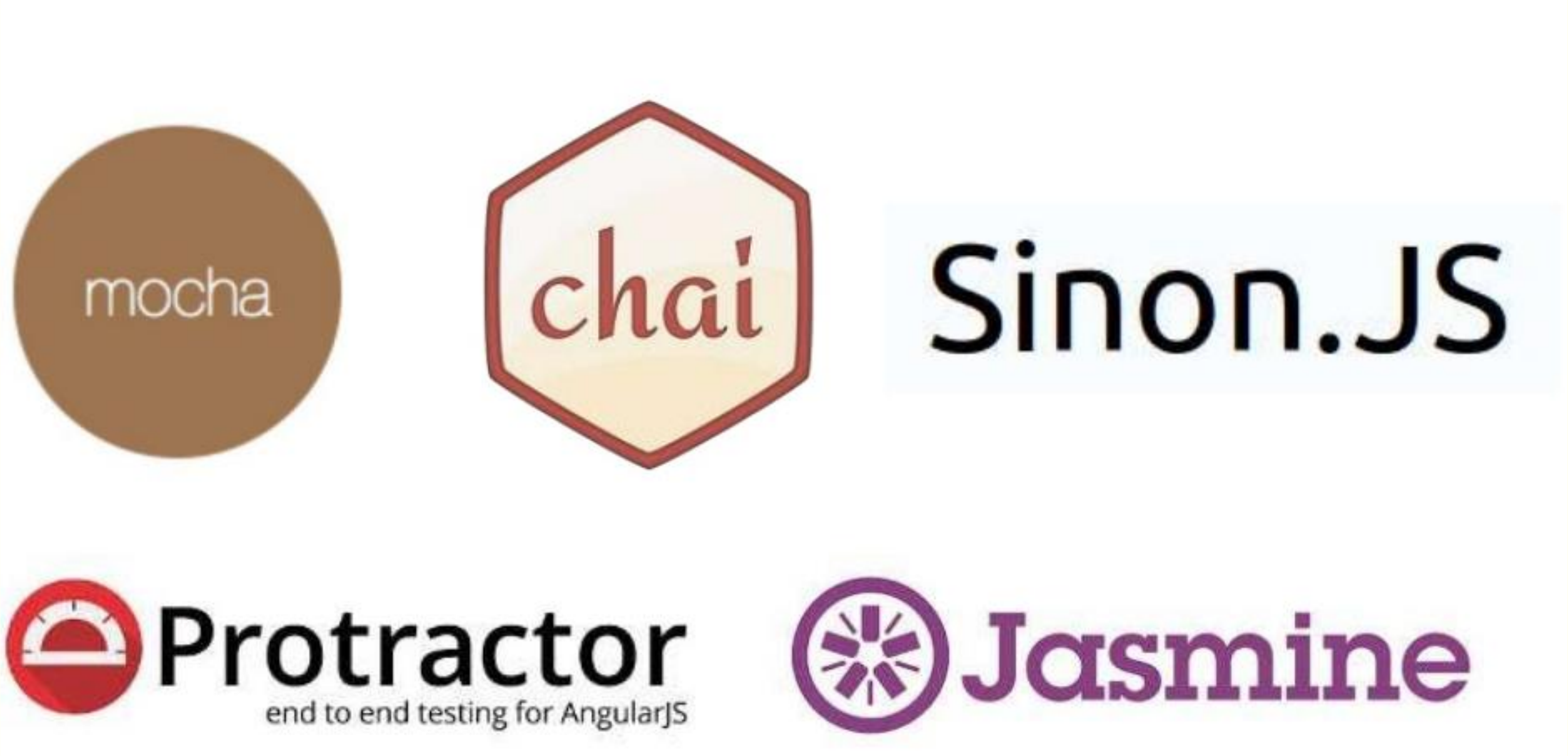
TDD (Test Driven Development)

- Step 1: Write Test
- Step 2: Run the test (It will fail, It’s Okay)
- Step 3: Write the code to make the test pass
- Step 4: Celebrate that your code works wonderfully.

BDD (Behaviour Driven Development)

- It includes the practice of writing tests first, but focuses on tests which describe behaviour, rather than tests which test a unit of implementation
    - Step 1: Gather requirements from the business side
    - Step 2: Write the test cases to meet the pre-defined business requirements
    - Step 3: Write the code to make the test pass
    - Step 4: Show it to your business partner

How to test JavaScript?

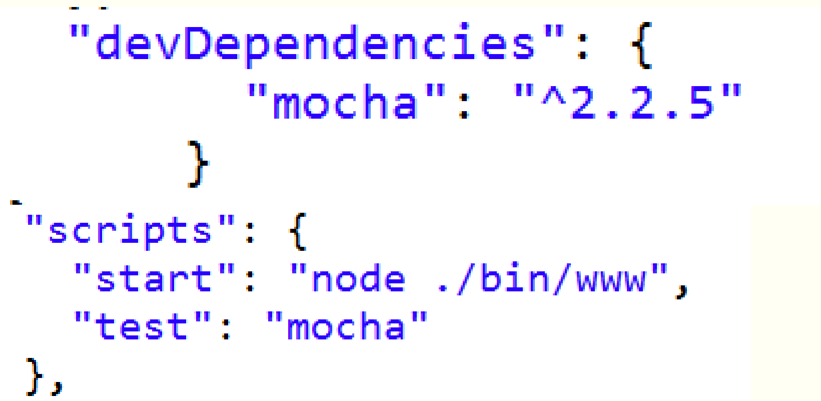


Mocha

- Mocha is a feature-rich JavaScript test framework running on node.js and the browser, making asynchronous testing simple and fun.
- Mocha tests run serially, allowing for flexible and accurate reporting, while mapping uncaught exceptions to the correct test cases.
  - Runs on nodeJS/ Browser
  - Supports TDD and BDD
  - Choose any assertion library
  - Choose any Mocking library
  - Async and Promise support
- Installation
  - npm install -g mocha

The Basics

- **The package.json**
- **devDependencies**
  - If someone is planning on downloading and using your module in their program, then they probably don't want or need to download and build the external test or documentation framework that you use.
  - In this case, it's best to map these additional items in a devDependencies object.



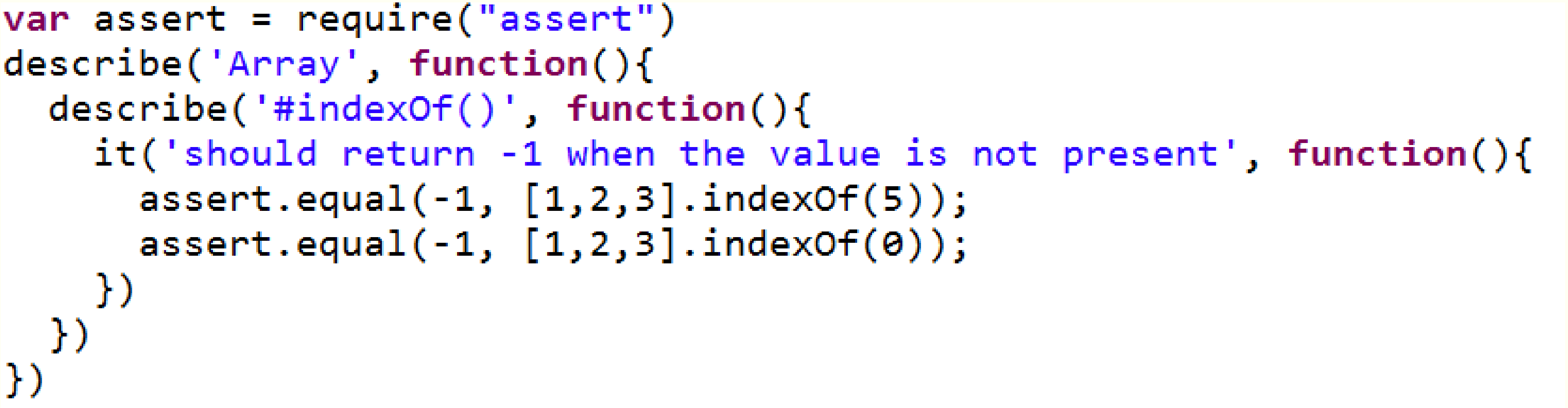
```
  "devDependencies": {
          "mocha": "^2.2.5"
      }
"scripts": {
  "start": "node ./bin/www",
  "test": "mocha"
},
```

The Basics

- Then run npm install and you're almost ready to use Mocha.
- The Mocha script will be in ./node_modules/.bin/mocha
- Create “test” folder. == > folder which contains all tests
- The "BDD" interface provides describe(), it(), before(), after(), beforeEach(), and afterEach().
- The "TDD" interface provides suite(), test(), setup(), and teardown().

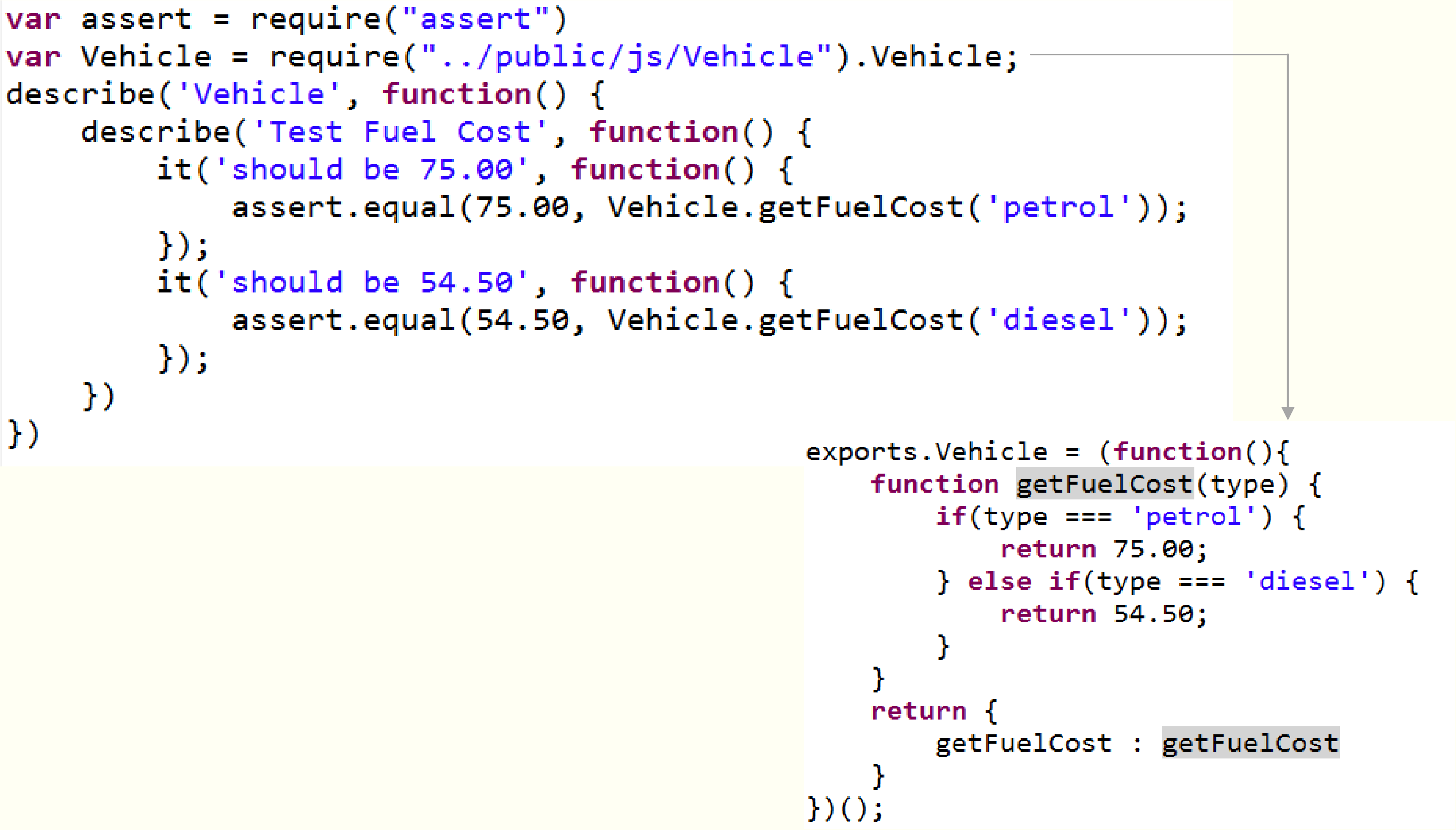
Example BDD

- test/arrayTest.js



```
var assert = require("assert")
describe('Array', function(){
  describe('#indexOf()', function(){
    it('should return -1 when the value is not present', function(){
      assert.equal(-1, [1,2,3].indexOf(5));
      assert.equal(-1, [1,2,3].indexOf(0));
    })
  })
})
```

Testing Synchronous Code

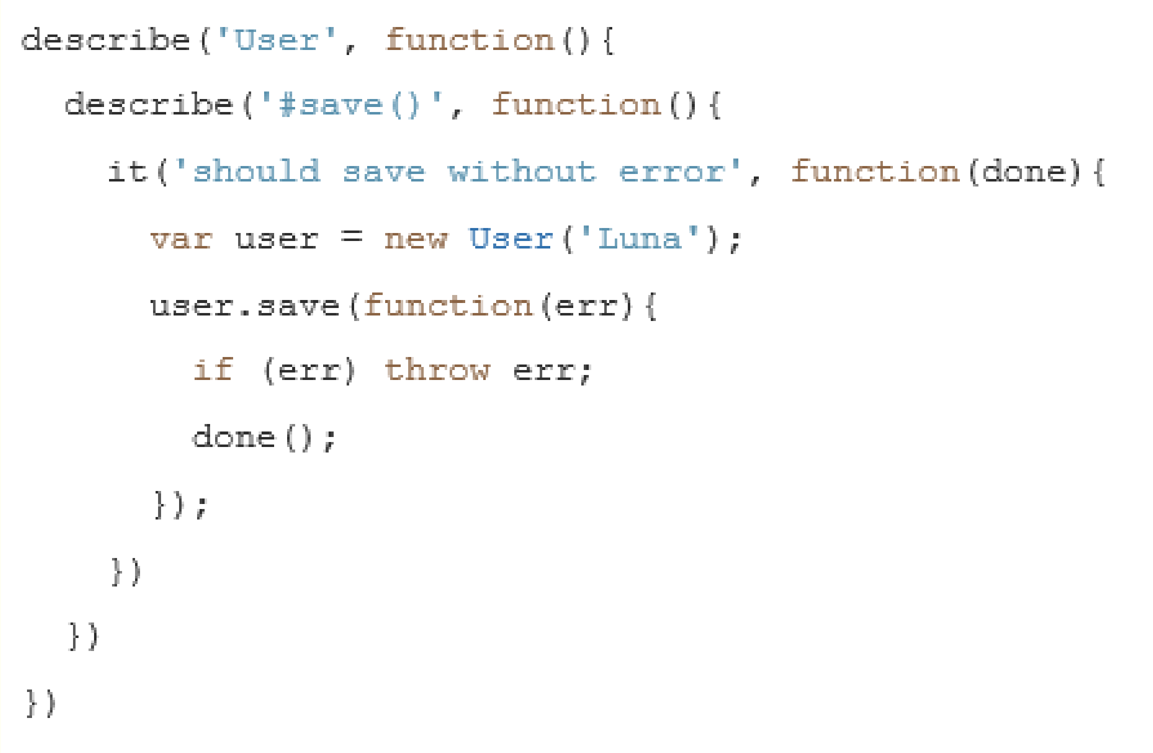


```
var assert = require("assert")
var Vehicle = require("../public/js/Vehicle").Vehicle;
describe('Vehicle', function() {
    describe('Test Fuel Cost', function() {
        it('should be 75.00', function() {
            assert.equal(75.00, Vehicle.getFuelCost('petrol'));
        });
        it('should be 54.50', function() {
            assert.equal(54.50, Vehicle.getFuelCost('diesel'));
        });
    })
})
```

```
exports.Vehicle = (function(){
    function getFuelCost(type) {
        if(type === 'petrol') {
            return 75.00;
        } else if(type === 'diesel') {
            return 54.50;
        }
    }
    return {
        getFuelCost : getFuelCost
    }
})();
```

Asynchronous code

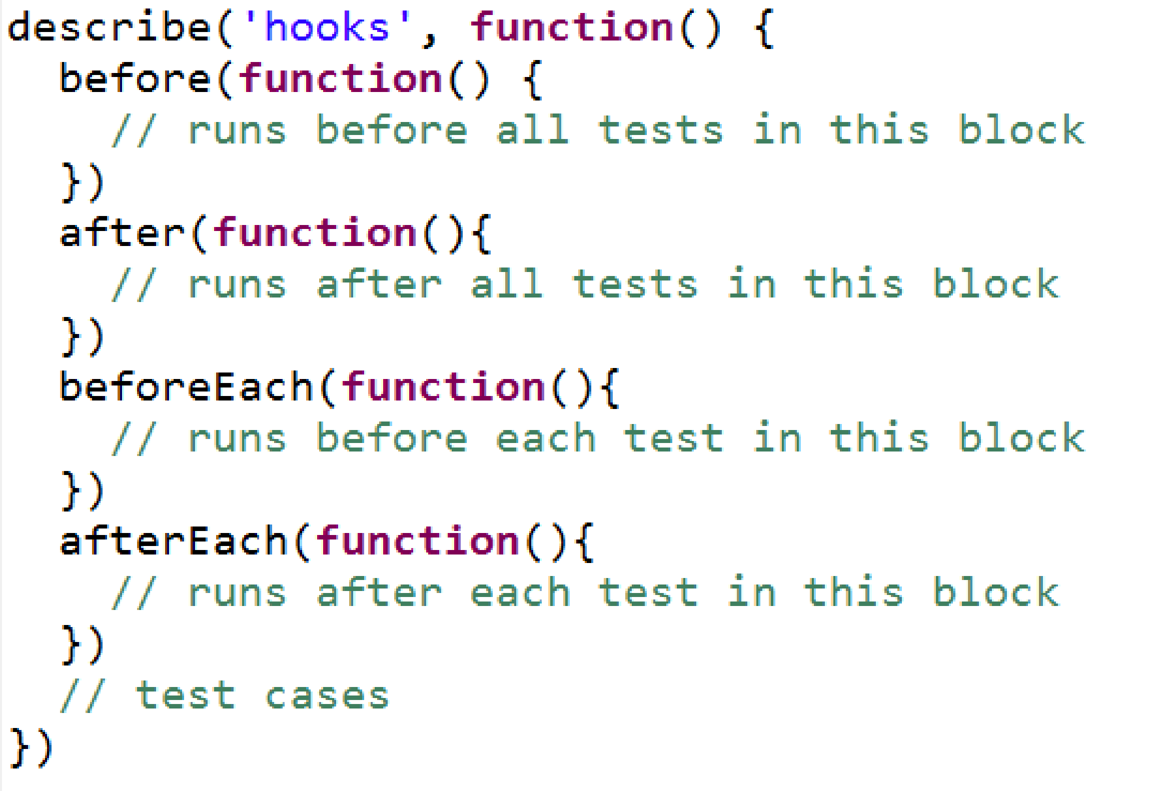
- Simply invoke the callback when your test is complete.
- By adding a callback (usually named done) to it() Mocha will know that it should wait for completion.



```
describe('User', function(){
  describe('#save()', function(){
    it('should save without error', function(done){
      var user = new User('Luna');
      user.save(function(err){
        if (err) throw err;
        done();
      });
    })
  })
})
```

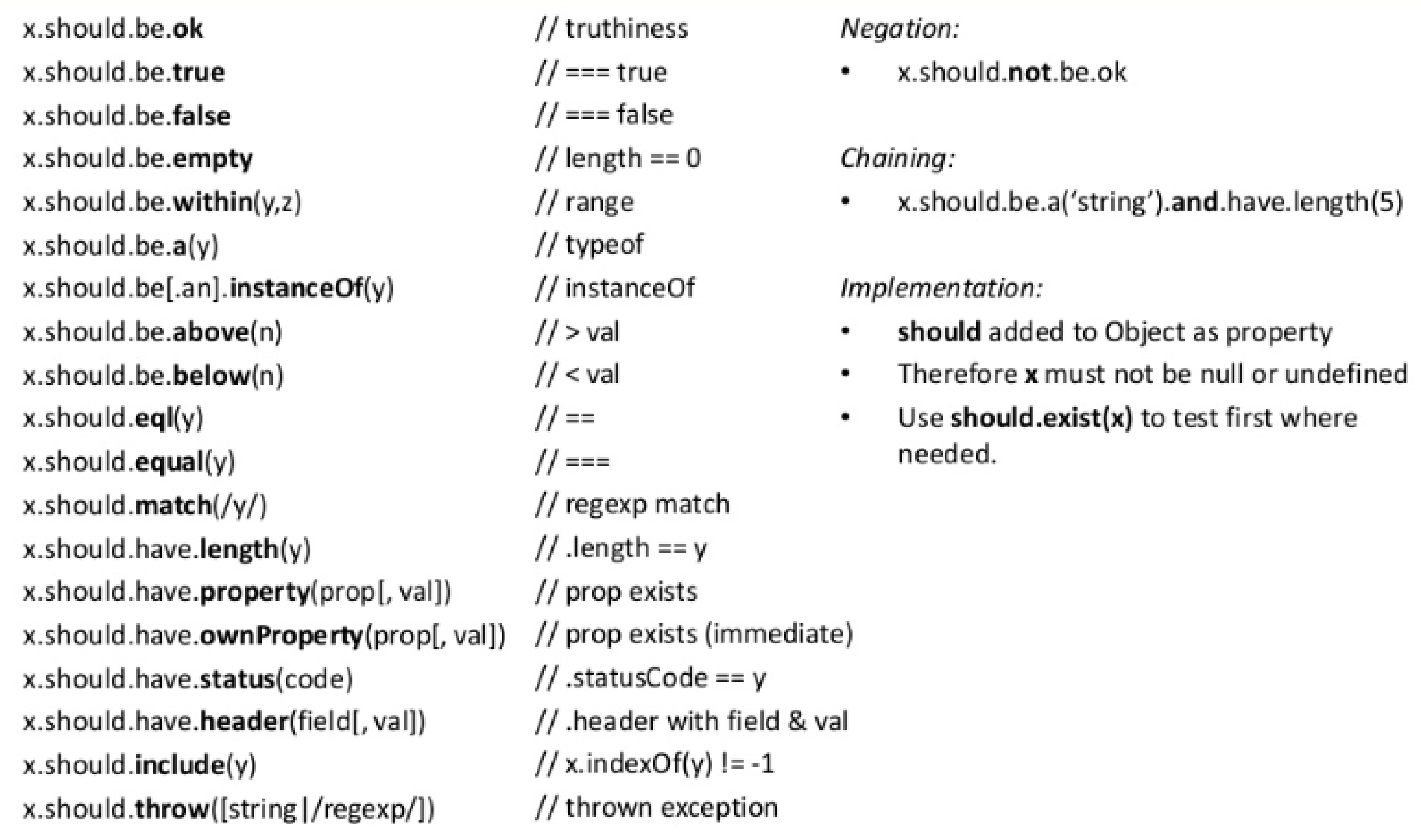
Hooks

- Mocha provides the hooks before(), after(), beforeEach(), afterEach(), that can be used to set up preconditions and clean up your tests



```
describe('hooks', function() {
  before(function() {
    // runs before all tests in this block
  })
  after(function(){
    // runs after all tests in this block
  })
  beforeEach(function(){
    // runs before each test in this block
  })
  afterEach(function(){
    // runs after each test in this block
  })
  // test cases
})
```

Should assertion library



x.should.be.**ok**	// truthiness
x.should.be.**true**	// === true
x.should.be.**false**	// === false
x.should.be.**empty**	// length == 0
x.should.be.**within**(y,z)	// range
x.should.be.**a**(y)	// typeof
x.should.be[.an].**instanceOf**(y)	// instanceOf
x.should.be.**above**(n)	// > val
x.should.be.**below**(n)	// < val
x.should.**eql**(y)	// ==
x.should.**equal**(y)	// ===
x.should.**match**(/y/)	// regexp match
x.should.have.**length**(y)	// .length == y
x.should.have.**property**(prop[, val])	// prop exists
x.should.have.**ownProperty**(prop[, val])	// prop exists (immediate)
x.should.have.**status**(code)	// .statusCode == y
x.should.have.**header**(field[, val])	// .header with field & val
x.should.**include**(y)	// x.indexOf(y) != -1
x.should.**throw**([string|/regexp/])	// thrown exception

Negation:

- x.should.**not**.be.ok

Chaining:

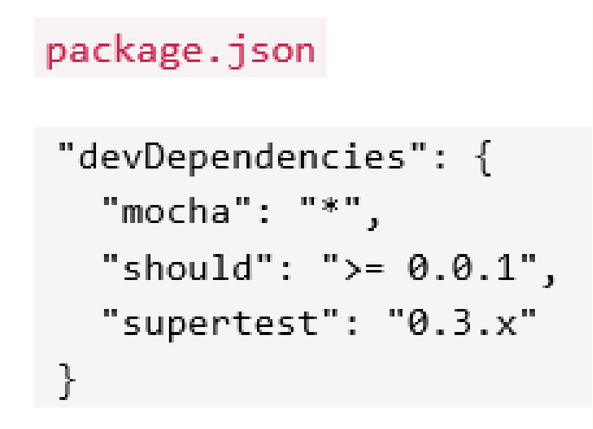
- x.should.be.a('string')**.and**.have.length(5)

Implementation:

- **should** added to Object as property
- Therefore **x** must not be null or undefined
- Use **should.exist(x)** to test first where needed.

Testing Express Code

- supertest is a Super-agent driven library for testing.
- supertest works by staring an express application and running test against it.
- This type of testing is often referred to as end-to-end testing or some times integration testing.
- This style of testing has the benefit of testing your public api where unit test test’s individual internal units.



package.json

```
"devDependencies": {
  "mocha": "*",
  "should": ">= 0.0.1",
  "supertest": "0.3.x"
}
```

Testing Express Code

- supertest takes the express app that it will be testing as an argument, therefore we must export our app from app.js

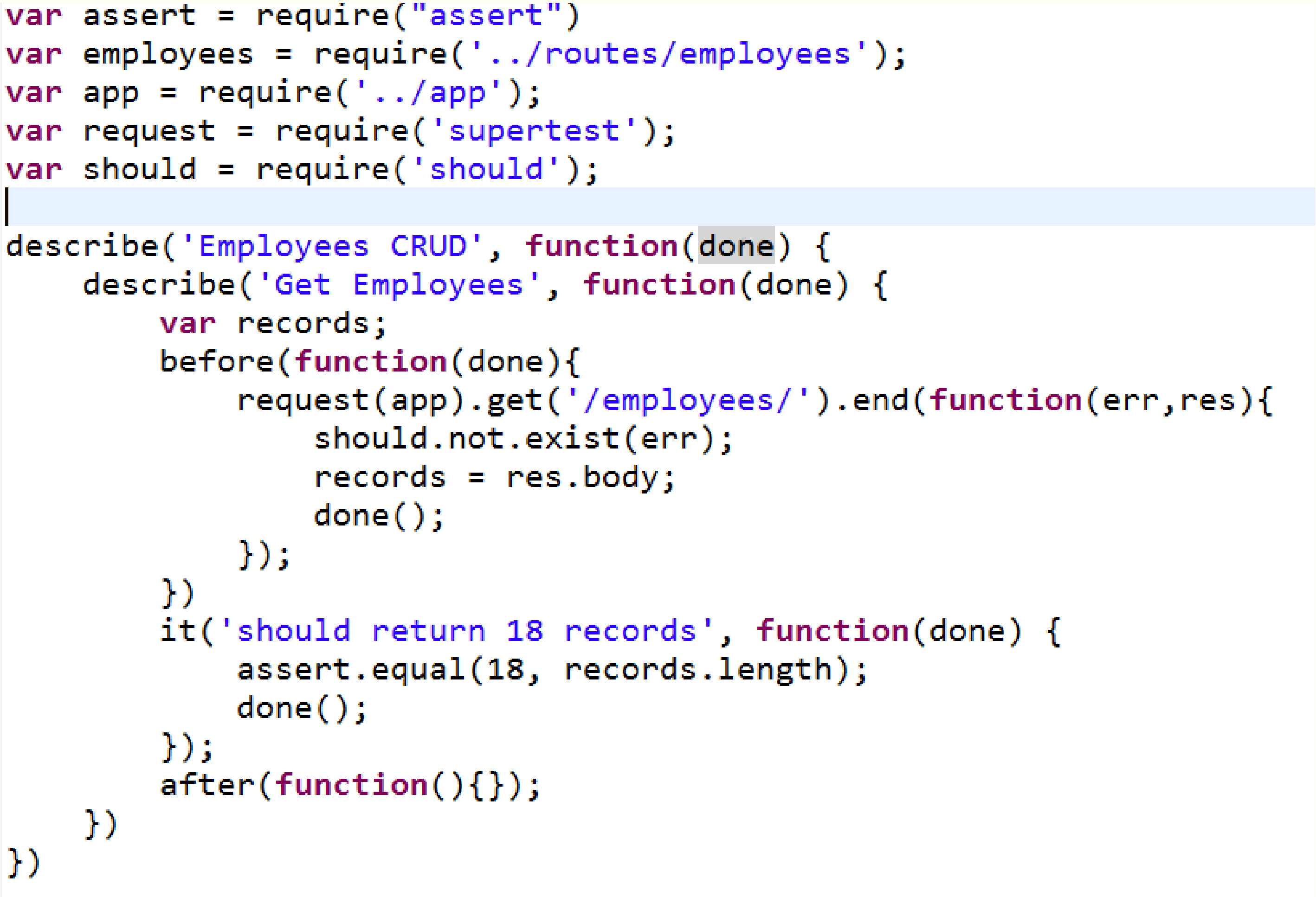
app.js

```
//...
module.exports = app;
```

test file:

```
var app = require('../app');
var request = require('supertest');
```

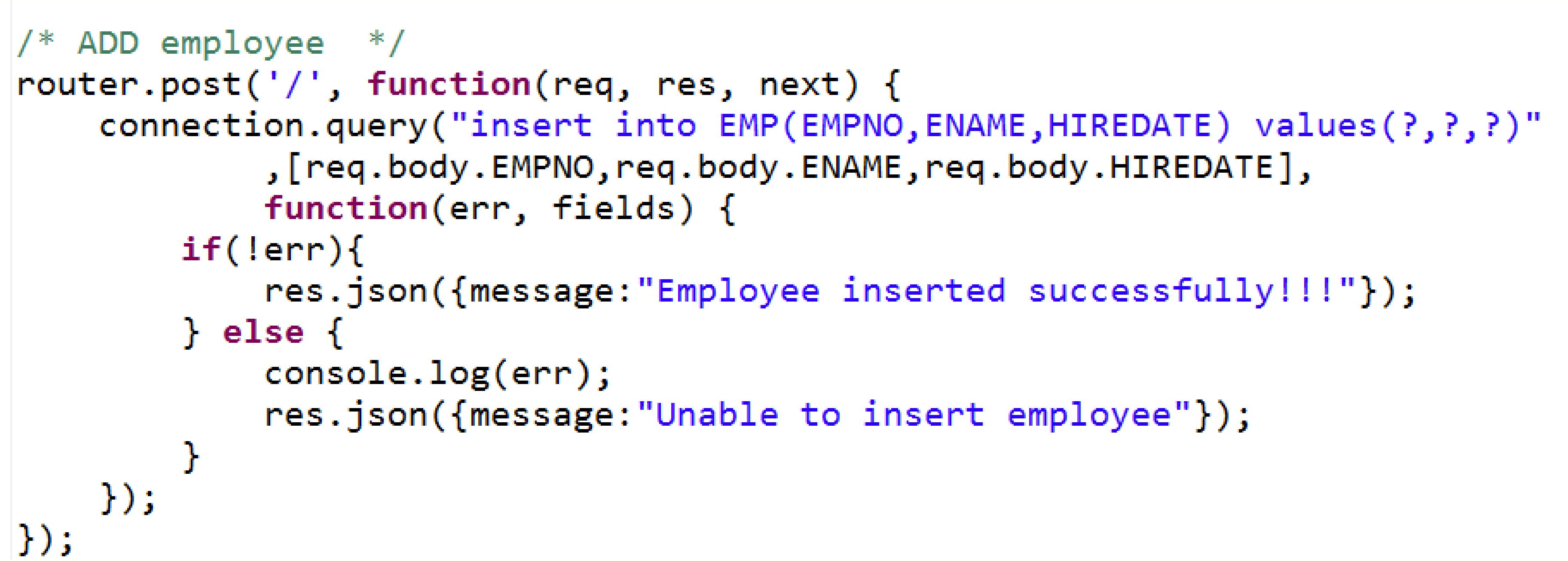
Testing Express Code



```
var assert = require("assert")
var employees = require('../routes/employees');
var app = require('../app');
var request = require('supertest');
var should = require('should');

describe('Employees CRUD', function(done) {
    describe('Get Employees', function(done) {
        var records;
        before(function(done){
            request(app).get('/employees/').end(function(err,res){
                should.not.exist(err);
                records = res.body;
                done();
            });
        })
        it('should return 18 records', function(done) {
            assert.equal(18, records.length);
            done();
        });
        after(function(){});
    })
})
```

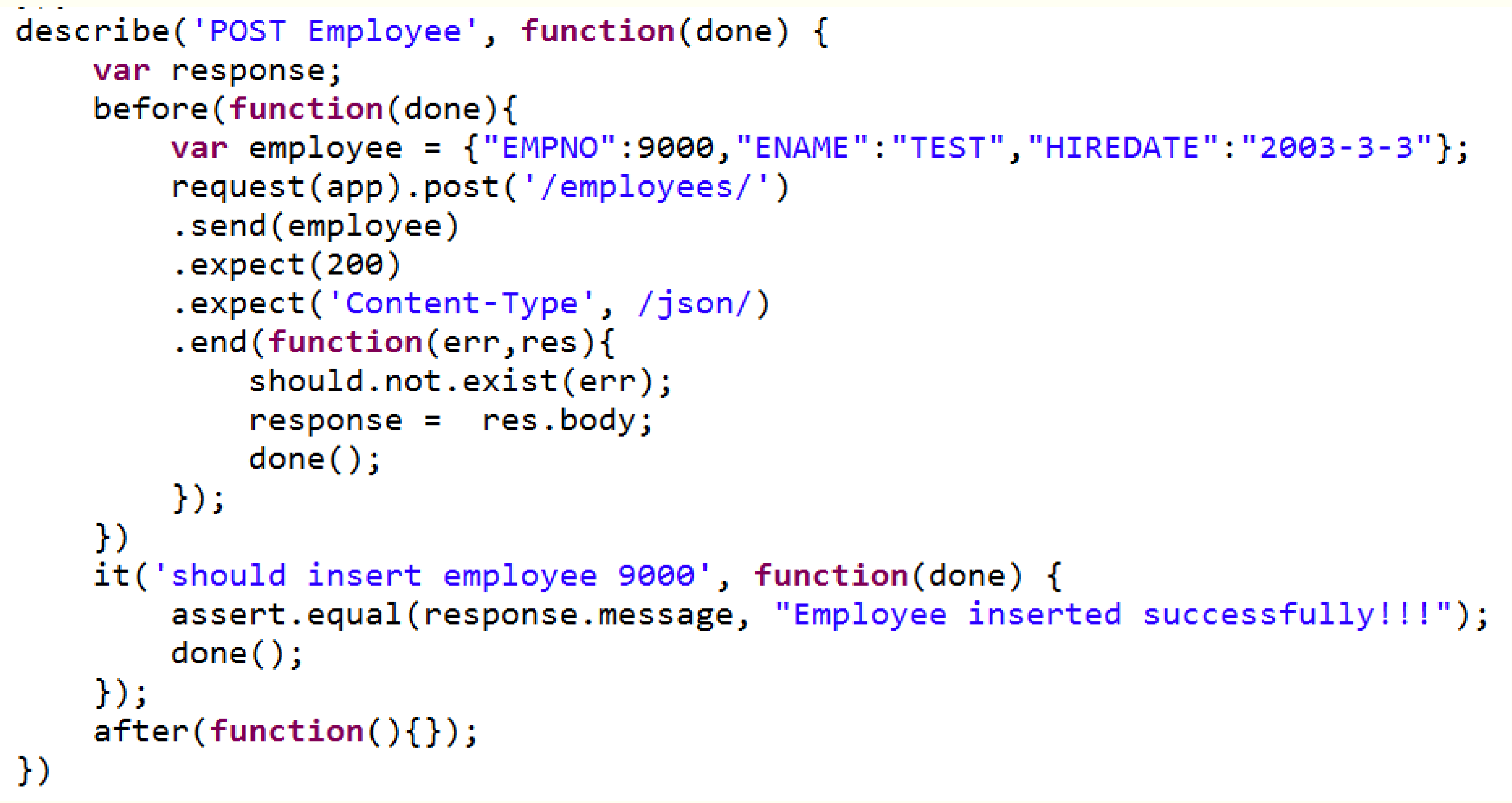
Testing Express Code

- POST Restful service



```
/* ADD employee  */
router.post('/', function(req, res, next) {
    connection.query("insert into EMP(EMPNO,ENAME,HIREDATE) values(?,?,?)"
            ,[req.body.EMPNO,req.body.ENAME,req.body.HIREDATE],
            function(err, fields) {
        if(!err){
            res.json({message:"Employee inserted successfully!!!"});
        } else {
            console.log(err);
            res.json({message:"Unable to insert employee"});
        }
    });
});
```

Testing Express Code



```
describe('POST Employee', function(done) {
    var response;
    before(function(done){
        var employee = {"EMPNO":9000,"ENAME":"TEST","HIREDATE":"2003-3-3"};
        request(app).post('/employees/')
        .send(employee)
        .expect(200)
        .expect('Content-Type', /json/)
        .end(function(err,res){
            should.not.exist(err);
            response =  res.body;
            done();
        });
    })
    it('should insert employee 9000', function(done) {
        assert.equal(response.message, "Employee inserted successfully!!!");
        done();
    });
    after(function(){});
})
```

References

- https://github.com/mochajs/mocha/

Objectives

- Understand Session Handling using NodeJS
- Understand Using Passport for Authentication
- Understand OAuth

HTTP Protocol

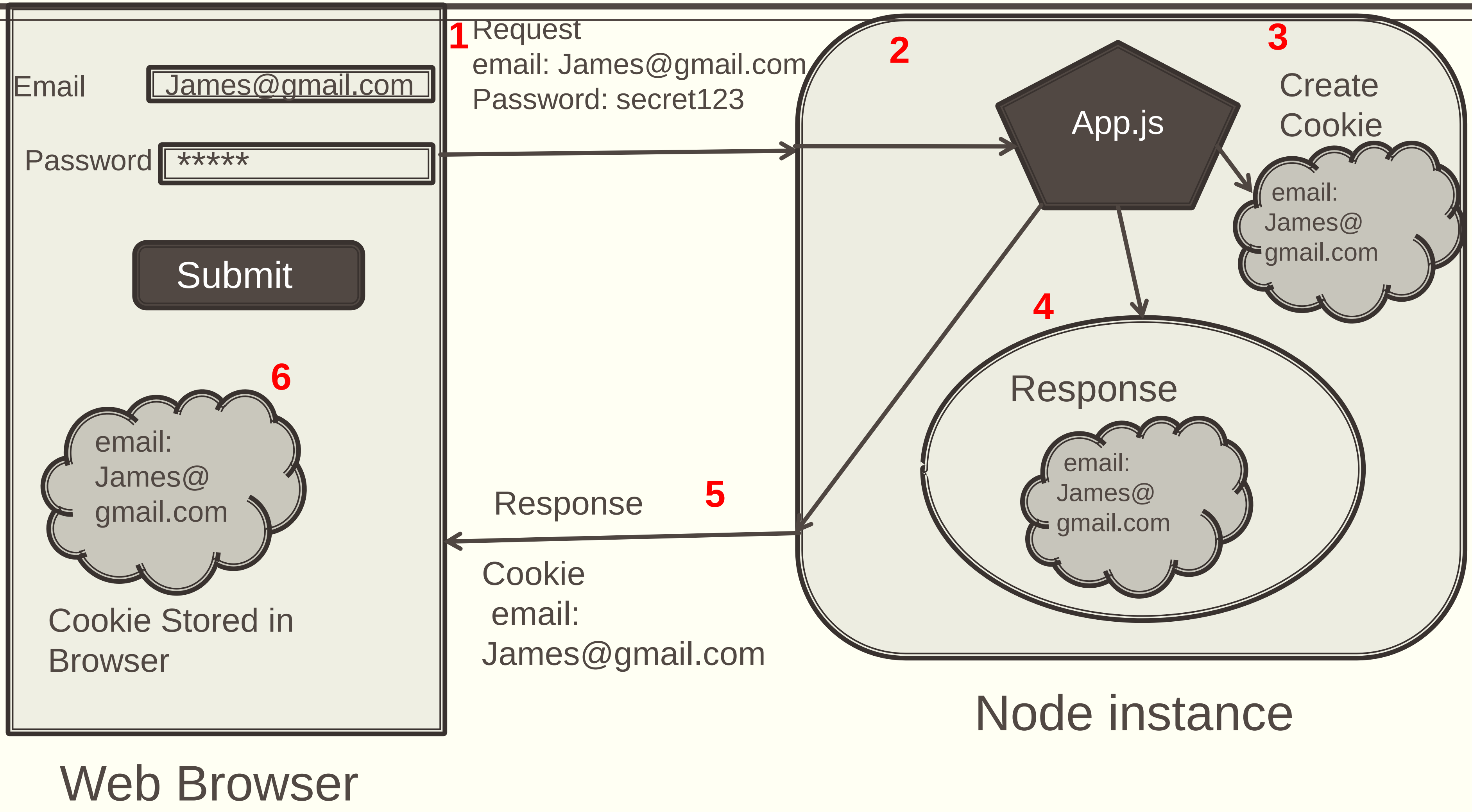
- HTTP Protocol is a stateless protocol which means that each page request is considered independent of any other request.
  - A web server does not understand if a page request comes from someone who has already requested a page or if the person is visiting the page for the first time.
  - It treats each request in the same way.

- In some scenarios, e.g. ecommerce and banking web applications this is inconvenient and we need some way to tie every page request together as a session of a single visitor.

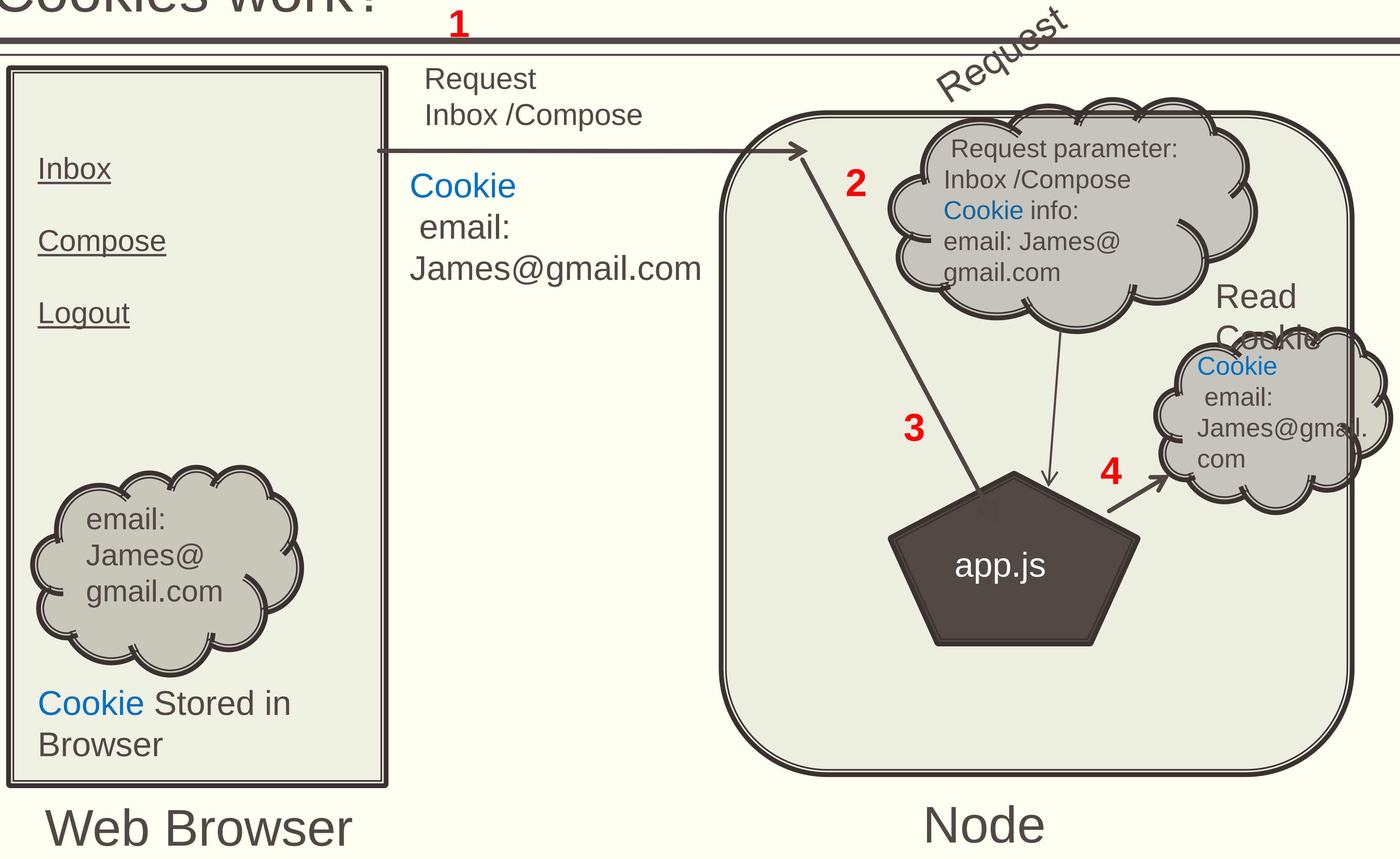
Session Tracking

- Session tracking is a mechanism which helps the servers to maintain the conversational state of a client.
  - Cookies can be used for session tracking.
  - A *cookie* is a bit of information sent by a web server to a browser that can later be read back from that browser.
  - Browser receives a cookie and it saves the cookie.
  - Browser sends the cookie back to the server each time it accesses a page on that server

How Cookie Works?

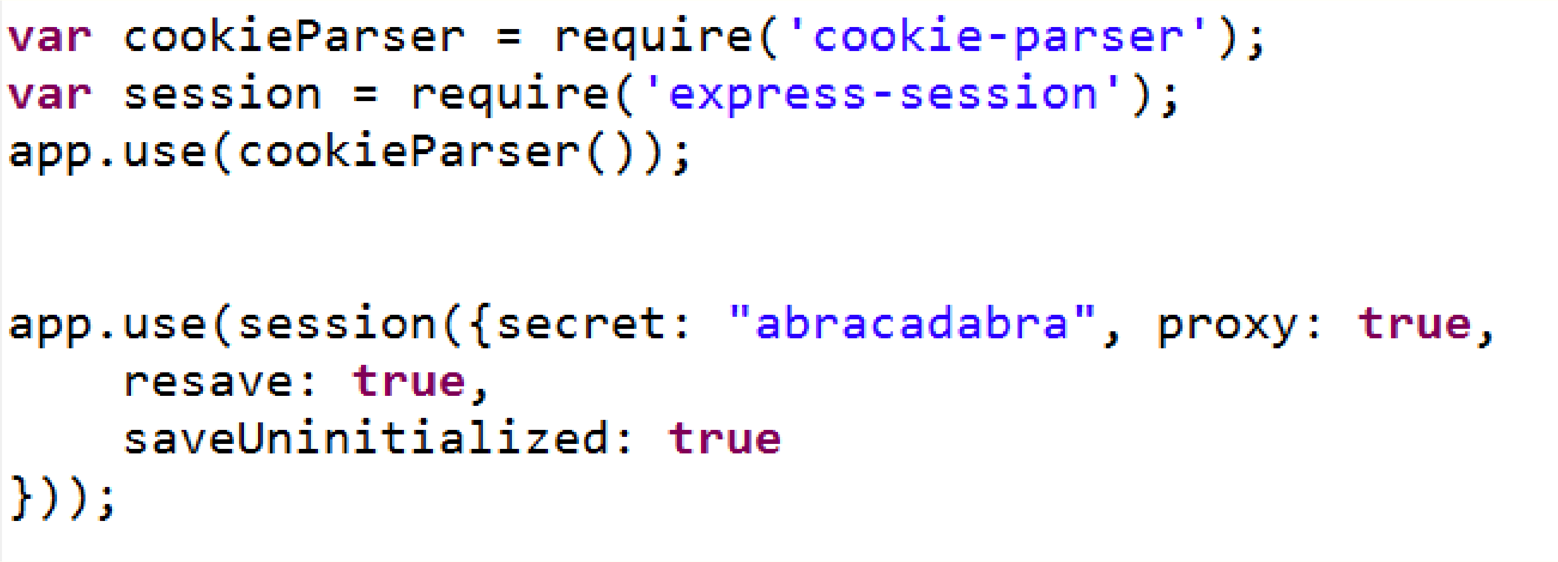


How Cookies work?



Express Session

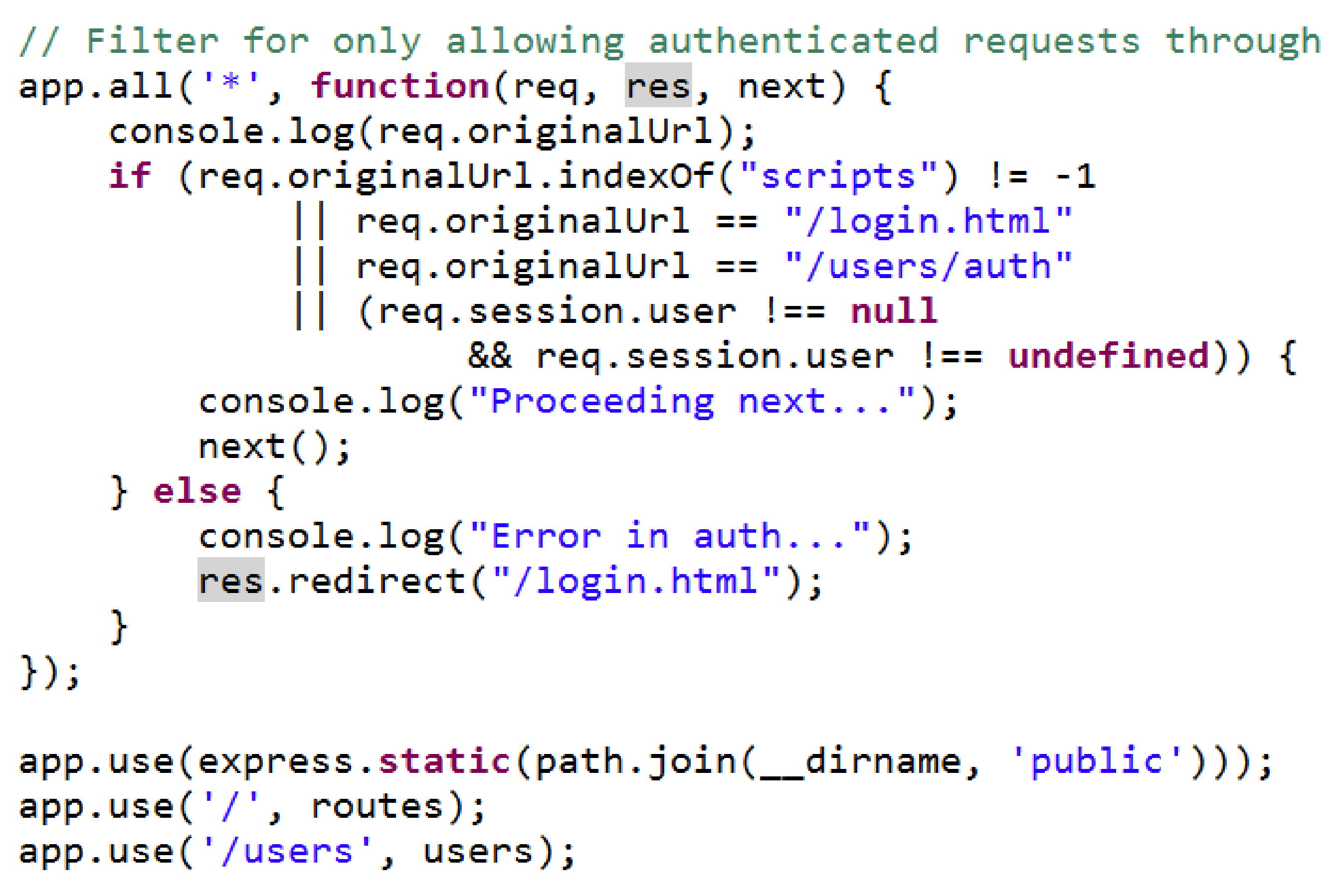
- Include “cookie-parser” and “express-session” modules
- Set secret for cookie-handling



```
var cookieParser = require('cookie-parser');
var session = require('express-session');
app.use(cookieParser());


app.use(session({secret: "abracadabra", proxy: true,
    resave: true,
    saveUninitialized: true
}));
```

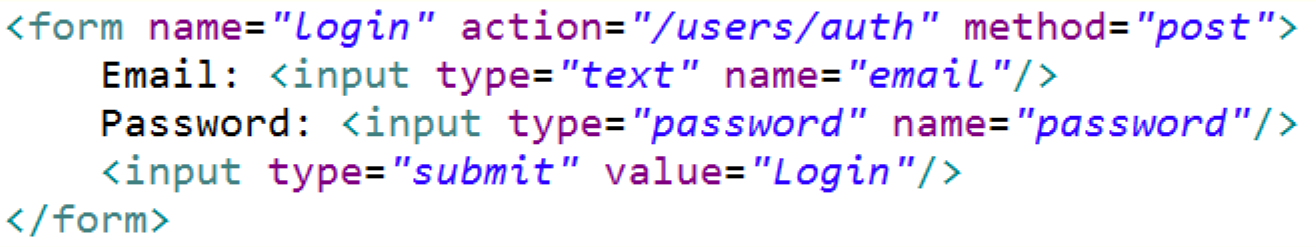
Express Session

- Set Filters before any Routers

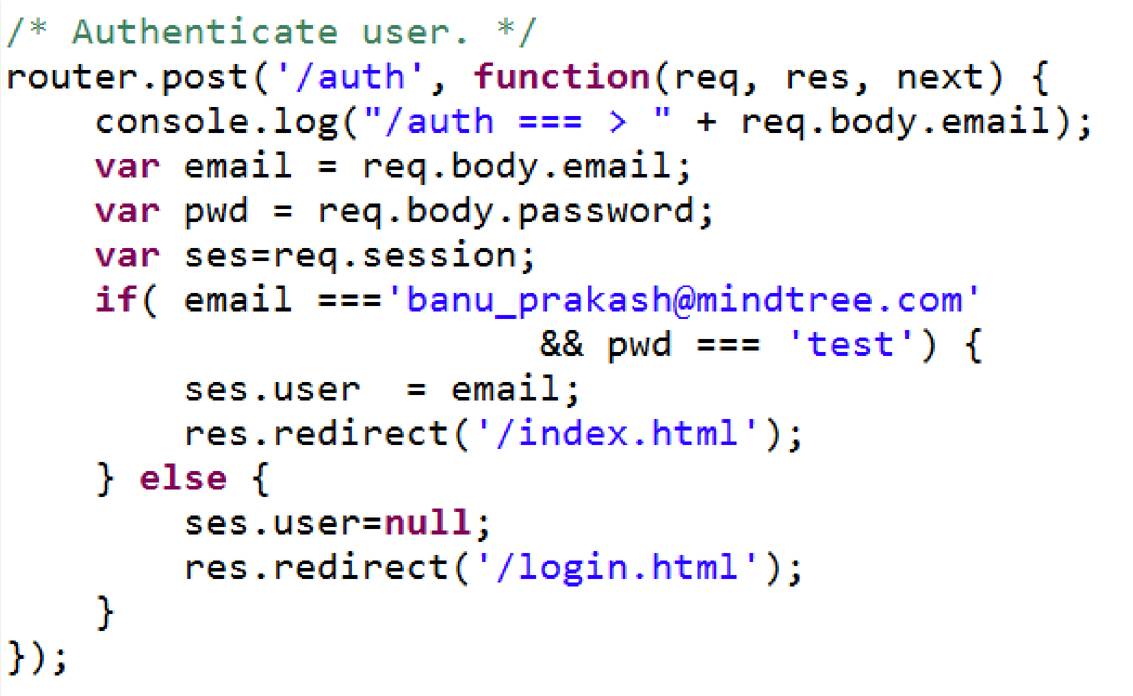


```
// Filter for only allowing authenticated requests through
app.all('*', function(req, res, next) {
    console.log(req.originalUrl);
    if (req.originalUrl.indexOf("scripts") != -1
            || req.originalUrl == "/login.html"
            || req.originalUrl == "/users/auth"
            || (req.session.user !== null
                    && req.session.user !== undefined)) {
        console.log("Proceeding next...");
        next();
    } else {
        console.log("Error in auth...");
        res.redirect("/login.html");
    }
});

app.use(express.static(path.join(__dirname, 'public')));
app.use('/', routes);
app.use('/users', users);
```

Express-Session [Handling Login and Logout]



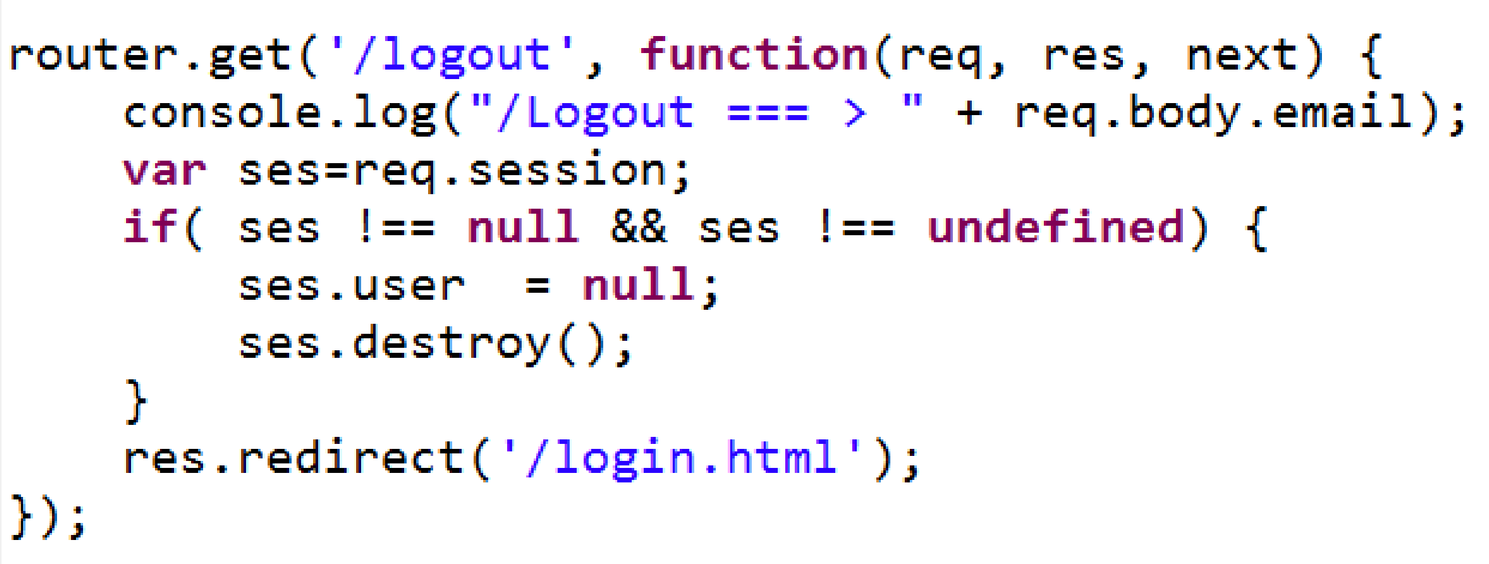
```
<form name="login" action="/users/auth" method="post">
    Email: <input type="text" name="email"/>
    Password: <input type="password" name="password"/>
    <input type="submit" value="Login"/>
</form>
```



```
/* Authenticate user. */
router.post('/auth', function(req, res, next) {
    console.log("/auth === > " + req.body.email);
    var email = req.body.email;
    var pwd = req.body.password;
    var ses=req.session;
    if( email ==='banu_prakash@mindtree.com'
                        && pwd === 'test') {
        ses.user  = email;
        res.redirect('/index.html');
    } else {
        ses.user=null;
        res.redirect('/login.html');
    }
});
```

Express-Session [Handling Login and Logout]

- Logout



```
router.get('/logout', function(req, res, next) {
    console.log("/Logout === > " + req.body.email);
    var ses=req.session;
    if( ses !== null && ses !== undefined) {
        ses.user  = null;
        ses.destroy();
    }
    res.redirect('/login.html');
});
```

- Refer: https://github.com/expressjs/session

Passport Authentication

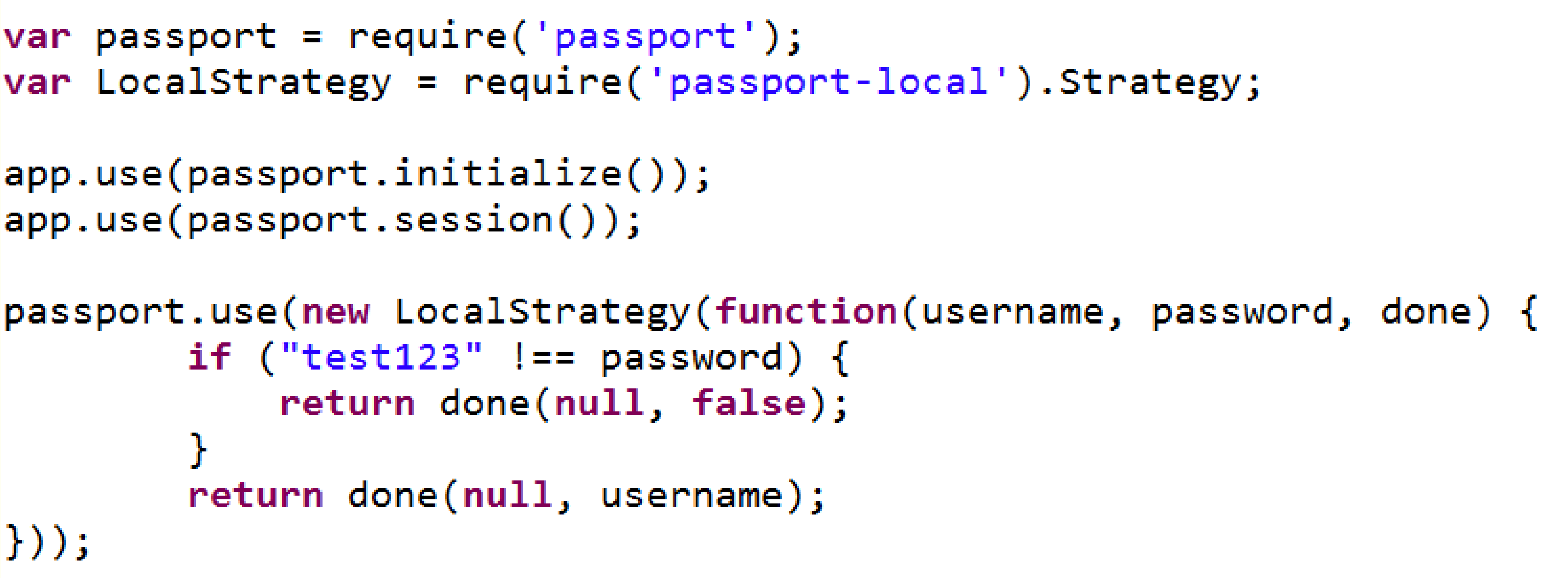
- **Implementing Facebook Authentication**
  - npm install passport –g
  - npm install -g passport-local
  - npm install passport-facebook

Passport

- Passport is authentication middleware for Node.js.
- Extremely flexible and modular, Passport can be unobtrusively dropped in to any Express-based web application.
- A comprehensive set of strategies support authentication using a username and password, Facebook, Twitter, and more.

Passport: Strategies

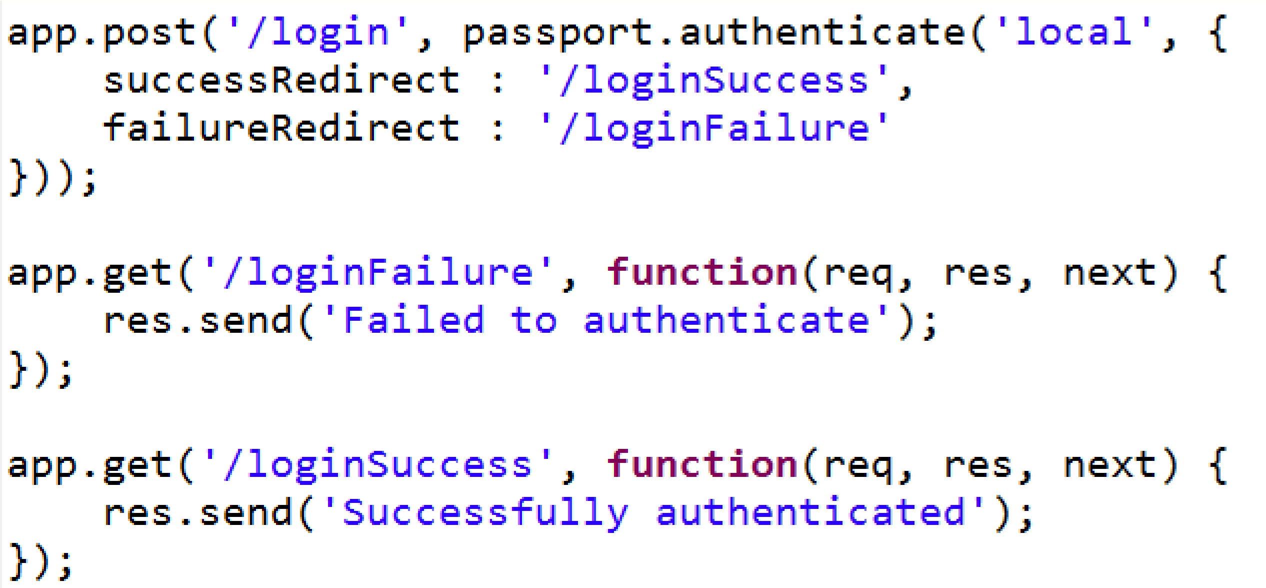
- Passport recognizes that each application has unique authentication requirements. Authentication mechanisms, known as *strategies*, are packaged as individual modules.
- Applications can choose which strategies to employ, without creating unnecessary dependencies



```
var passport = require('passport');
var LocalStrategy = require('passport-local').Strategy;

app.use(passport.initialize());
app.use(passport.session());

passport.use(new LocalStrategy(function(username, password, done) {
        if ("test123" !== password) {
            return done(null, false);
        }
        return done(null, username);
}));
```

Passport: Redirects

- Upon successful authentication, the user will be redirected to the home page.
- If authentication fails, the user will be redirected back to the login page for another attempt.
- In this case, the redirect options override the default behaviour.



```
app.post('/login', passport.authenticate('local', {
    successRedirect : '/loginSuccess',
    failureRedirect : '/loginFailure'
}));

app.get('/loginFailure', function(req, res, next) {
    res.send('Failed to authenticate');
});

app.get('/loginSuccess', function(req, res, next) {
    res.send('Successfully authenticated');
});
```

Passport :**Flash Messages**

- Redirects are often combined with flash messages in order to display status information to the user.

```
app.post('/login',
  passport.authenticate('local', { successRedirect: '/',
                                   failureRedirect: '/login',
                                   failureFlash: true })
);
```

- Setting the failureFlash option to true instructs Passport to flash an error message using the message given by the strategy's verify callback, if any.
- This is often the best approach, because the verify callback can make the most accurate determination of why authentication failed.
- the flash message can be set specifically.
- passport.authenticate('local', { failureFlash: 'Invalid username or password.' });

Passport : Sessions

- In a typical web application, the credentials used to authenticate a user will only be transmitted during the login request.
- If authentication succeeds, a session will be established and maintained via a cookie set in the user's browser.
- Each subsequent request will not contain credentials, but rather the unique cookie that identifies the session.
- In order to support login sessions, Passport will serialize and deserialize user instances to and from the session.

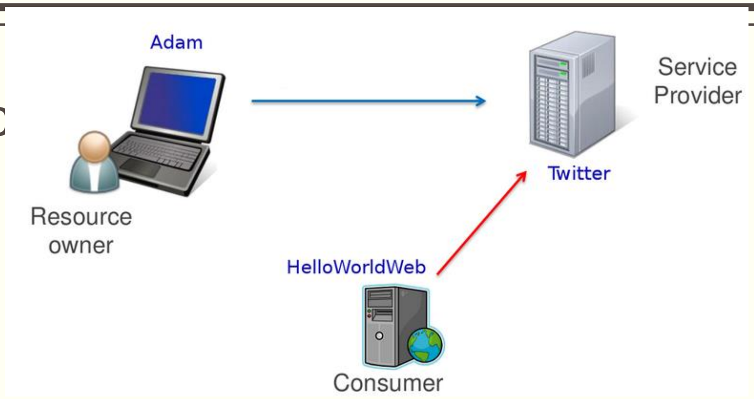
Passport : Sessions

```
passport.serializeUser(function(user, done) {
  done(null, user.id);
});
passport.deserializeUser(function(id, done) {
  User.findById(id, function(err, user) {
    done(err, user);
  });
});
```

- In this example, only the user ID is serialized to the session, keeping the amount of data stored within the session small.
- When subsequent requests are received, this ID is used to find the user, which will be restored to req.user.

OAuth

- OAuth is a specification that defines secure authentication model on behalf o another user.
- The first party represents a user, in our case Adam, who is called in the OAuth terminology a Resource Owner. Adam has an account on Twitter.



Twitter represents the second party. This party is called a Service Provider.

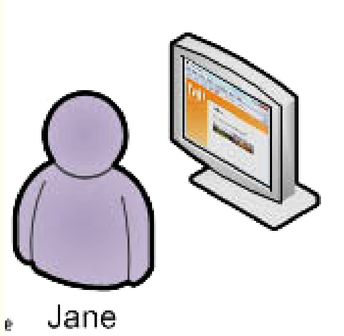
Twitter offers a web interface that Adam uses to create new tweets, read tweets of others etc. Now, Adam uses our new web site, HelloWorldWeb, that displays the last tweet of the logged in user.
To do so, web site needs to have access to the Twitter account of Adam.
HelloWorldWeb site is a 3rd party application that wants to connect to Twitter and get Adam's tweets.
In OAuth, such party is called Consumer.

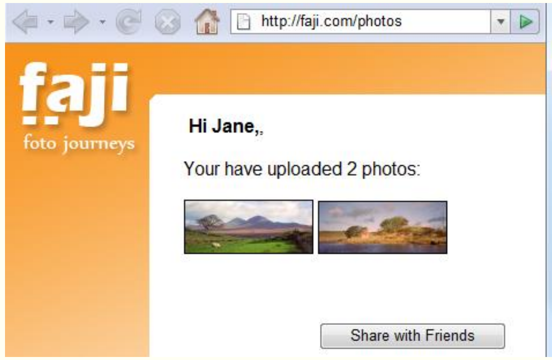
OAuth

- Two versions of OAuth exists at the moment
  - *OAuth 1* defined by OAuth 1.0 specification
  - *OAuth 2* defined by OAuth 2.0 specification.

OAuth example

- *Jane wants to share some of her vacation photos with her friends.*
- *Jane uses Faji, a photo sharing site, for sharing journey photos.*
- *She signs into her faji.com account, and uploads two photos which she marks private*
- In OAuth terminology, Jane is the resource owner and Faji the server. The 2 photos Jane uploaded are the protected resources



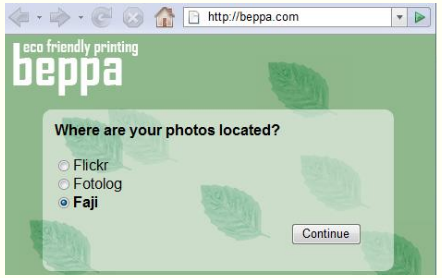


Hi Jane,,

Your have uploaded 2 photos:

OAuth example

- *Jane visits beppa.com and begins to order prints. Beppa supports importing images from many photo sharing sites, including Faji. Jane selects the photos source and clicks Continue.*



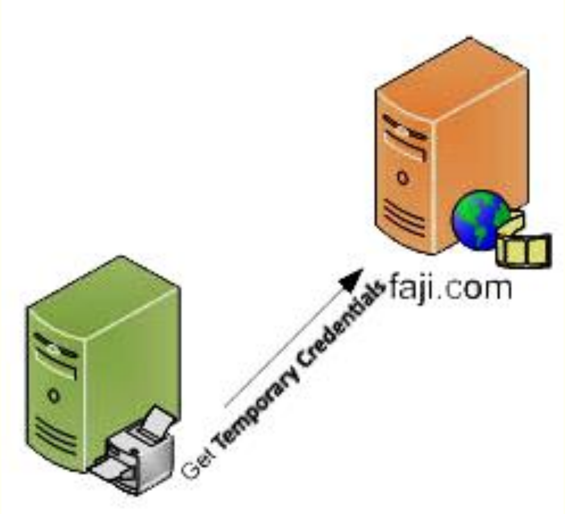
Where are your photos located?

○ Flickr
○ Fotolog
● **Faji**

- In OAuth terminology, Beppa is the client. When Beppa added support for Faji photo import, a Beppa developer known in OAuth as a client developer obtained a set of client credentials (client identifier and secret) from Faji to be used with Faji’s OAuth-enabled API.

OAuth example

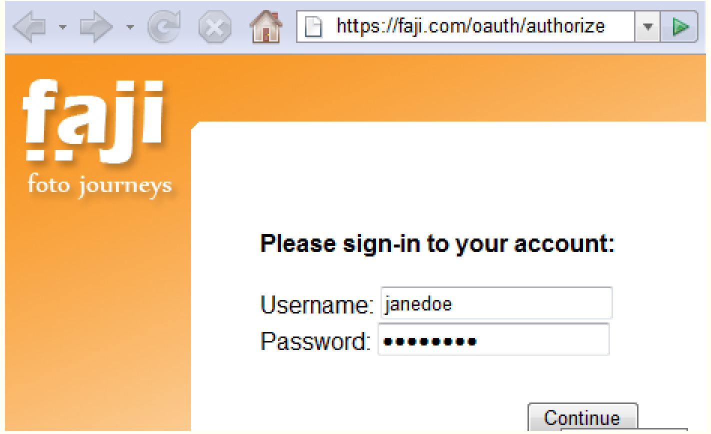
- After Jane clicks Continue, Beppa requests from Faji a set of temporary credentials.
- At this point, the temporary credentials are not resource-owner-specific, and can be used by Beppa to gain resource owner approval from Jane to access her photos.



OAuth example

- When Beppa receives the temporary credentials, it redirects Jane to the Faji OAuth User Authorization URL with the temporary credentials and asks Faji to redirect Jane back once approval has been granted to http://beppa.com/order.

- Jane has been redirected to Faji and is requested to sign into the site. OAuth requires that servers first authenticate the resource owner, and then ask them to grant access to the client.



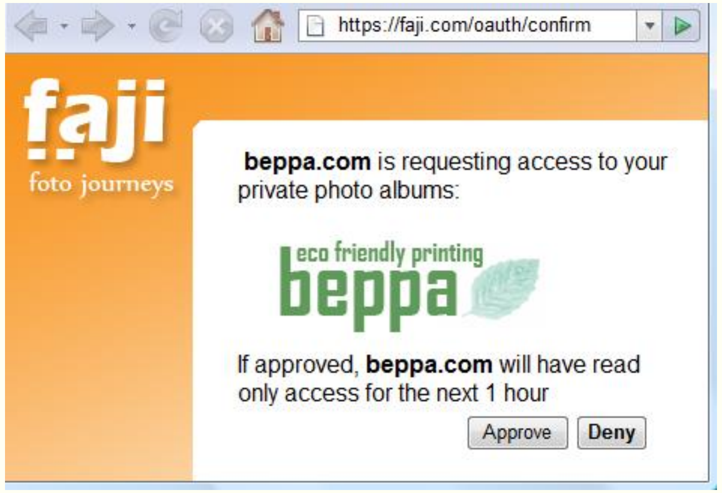
Please sign-in to your account:

Username: janedoe

Password: •••••••••

OAuth example

- After successfully logging into Faji, Jane is asked to grant access to Beppa, the client. Faji informs Jane of who is requesting access (in this case Beppa) and the type of access being granted. Jane can approve or deny access.

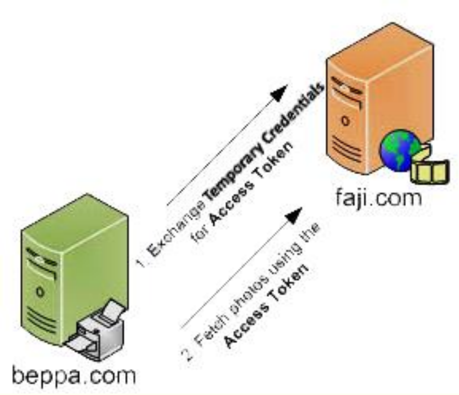


beppa.com is requesting access to your private photo albums:

If approved, **beppa.com** will have read only access for the next 1 hour

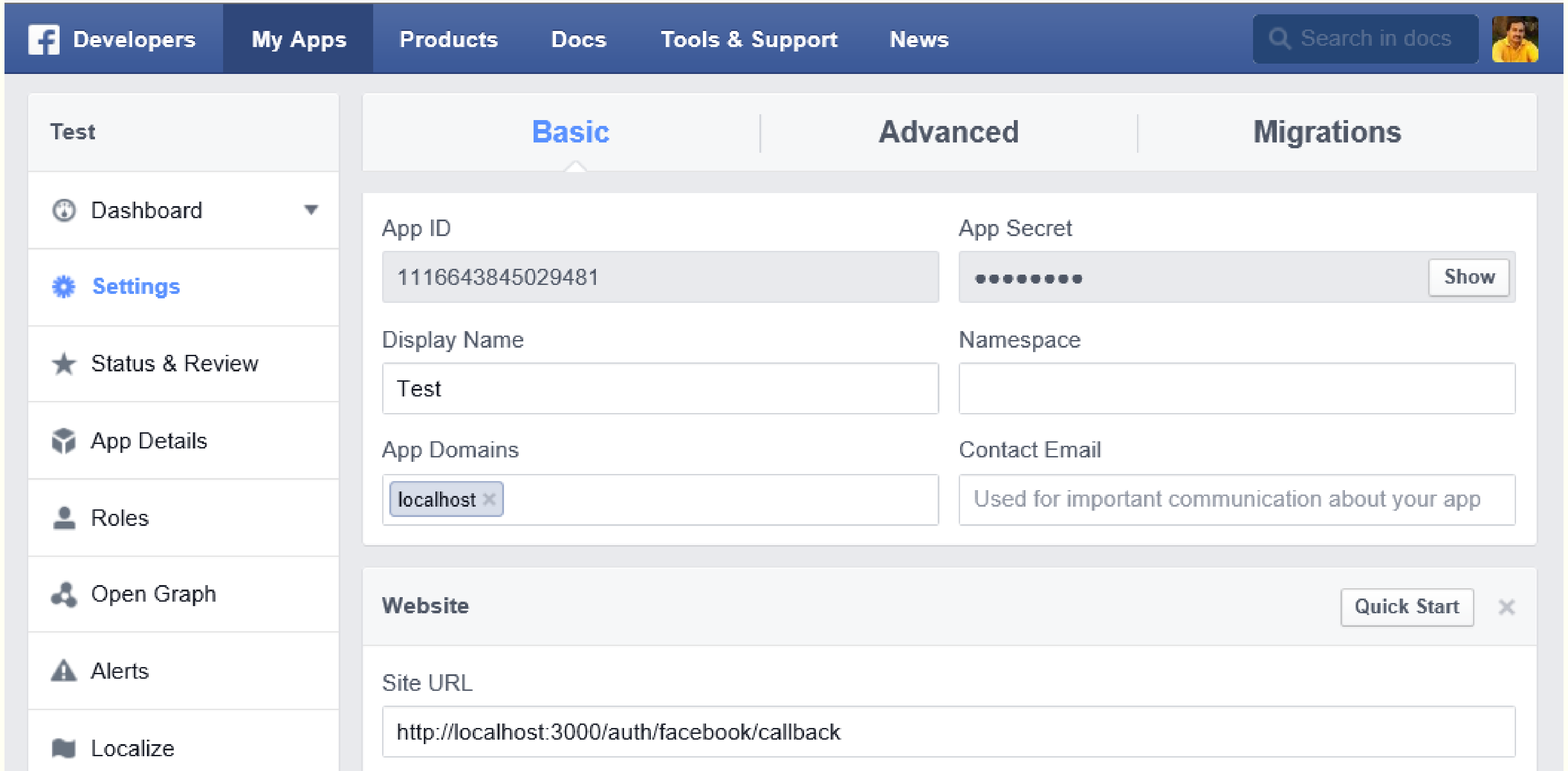
OAuth example

- Beppa uses the authorized Request Token and exchanges it for an Access Token. Request Tokens are only good for obtaining User approval, while Access Tokens are used to access Protected Resources, in this case Jane’s photos. In the first request, Beppa exchanges the Request Token for an Access Token and in the second request gets the photos.


1. Exchange **Temporary Credentials** for **Access Token**
2. Fetch photos using the **Access Token**
faji.com
beppa.com

Implementing Facebook authentication

- Register a new Facebook app. Note of the App ID and App Secret. Since we’re developing locally, set App Domains as localhost. Specify Site URL



App ID: 1116643845029481

App Secret: ●●●●●●●●●

Display Name: Test

Namespace:

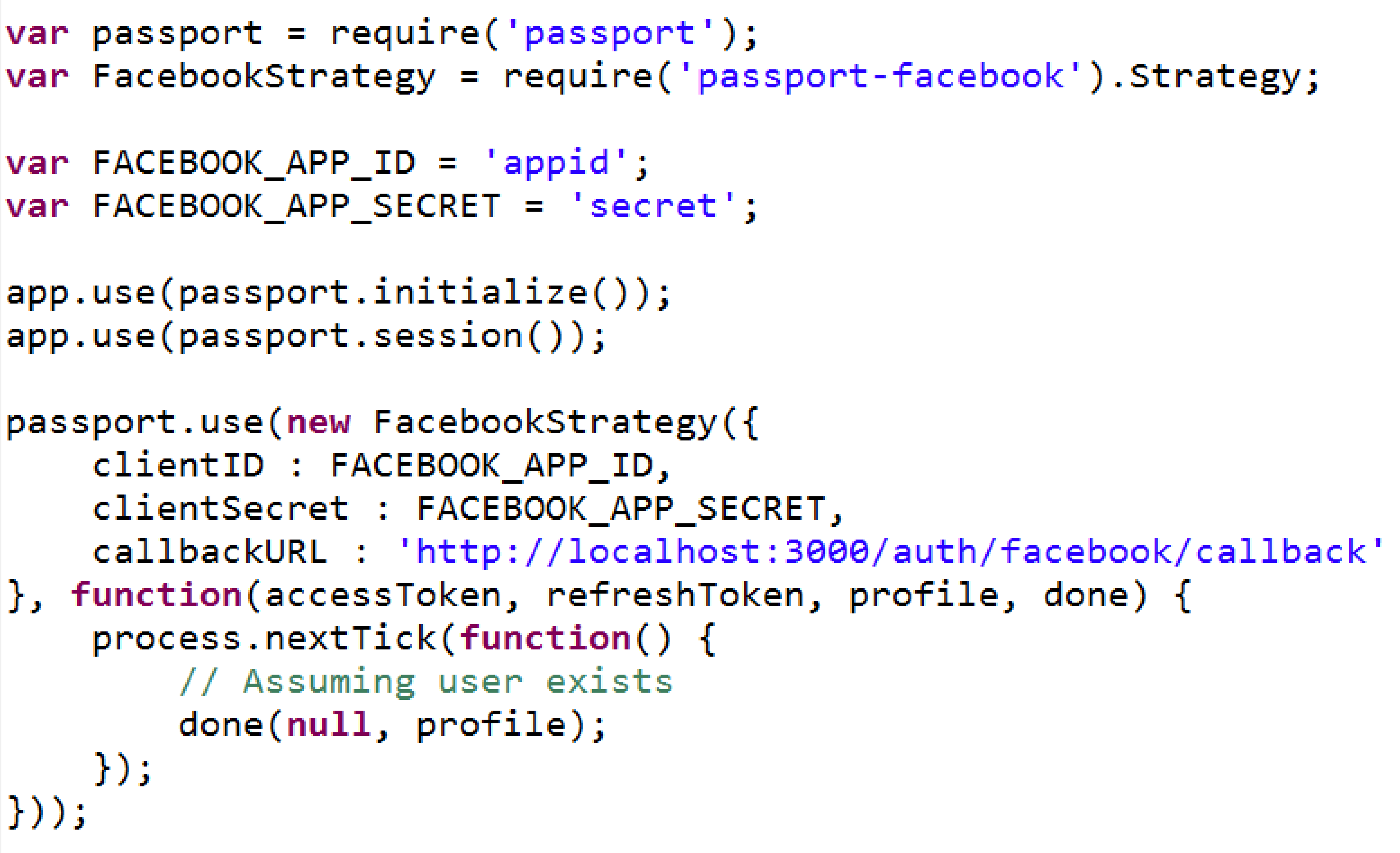
App Domains: localhost ×

Contact Email: Used for important communication about your app

Website

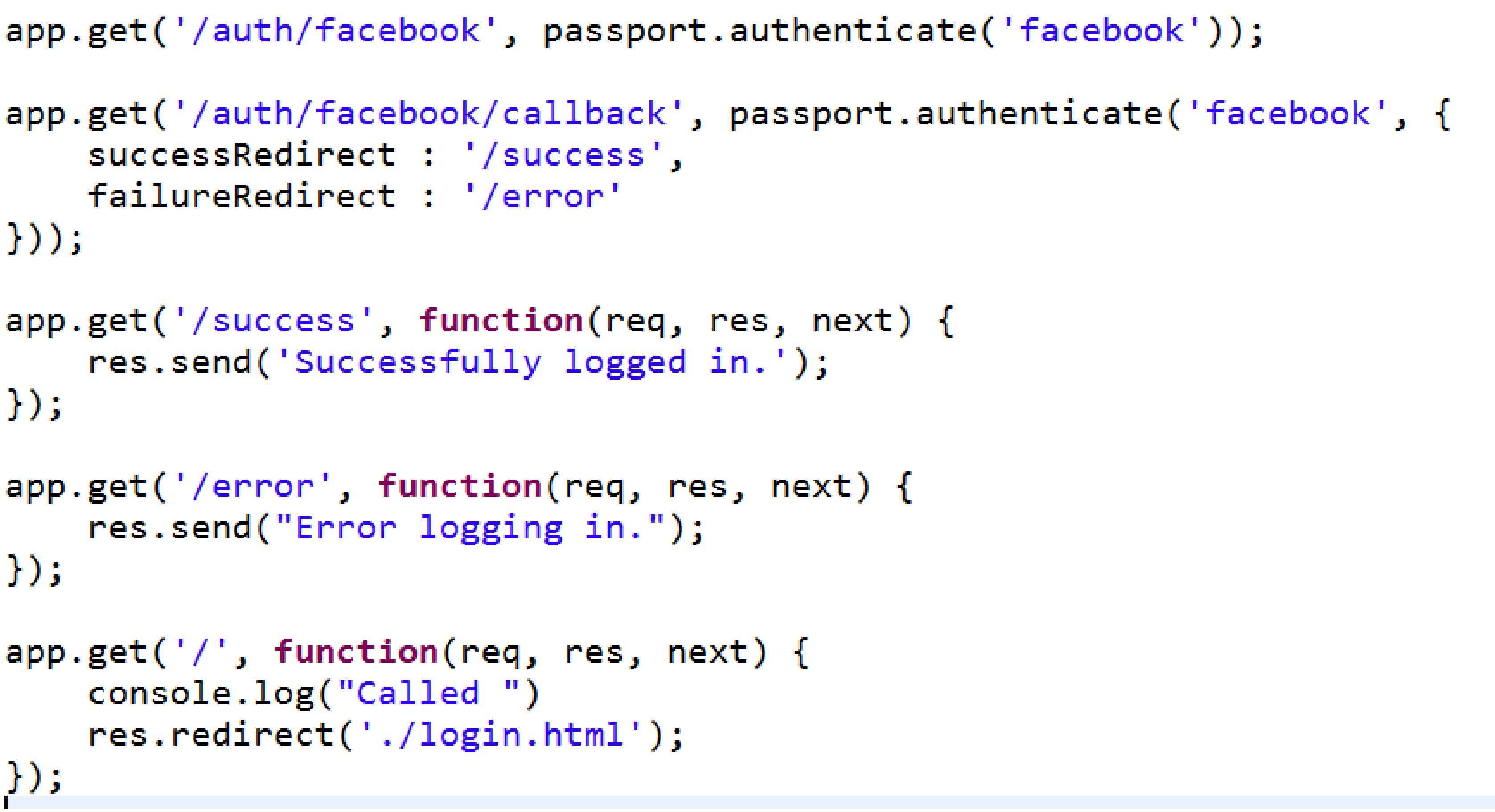
Site URL: http://localhost:3000/auth/facebook/callback

Implementing Facebook Authentication



```
var passport = require('passport');
var FacebookStrategy = require('passport-facebook').Strategy;

var FACEBOOK_APP_ID = 'appid';
var FACEBOOK_APP_SECRET = 'secret';

app.use(passport.initialize());
app.use(passport.session());

passport.use(new FacebookStrategy({
    clientID : FACEBOOK_APP_ID,
    clientSecret : FACEBOOK_APP_SECRET,
    callbackURL : 'http://localhost:3000/auth/facebook/callback'
}, function(accessToken, refreshToken, profile, done) {
    process.nextTick(function() {
        // Assuming user exists
        done(null, profile);
    });
}));
```

Implementing Facebook Authentication



```
app.get('/auth/facebook', passport.authenticate('facebook'));

app.get('/auth/facebook/callback', passport.authenticate('facebook', {
    successRedirect : '/success',
    failureRedirect : '/error'
}));

app.get('/success', function(req, res, next) {
    res.send('Successfully logged in.');
});

app.get('/error', function(req, res, next) {
    res.send("Error logging in.");
});

app.get('/', function(req, res, next) {
    console.log("Called ")
    res.redirect('./login.html');
});
```

Grunt

- Grunt.js is a Node.js JavaScript task runner that helps you perform repetitive tasks such as minification, compilation, unit testing or linting.

Why use a task runner?

- Enables to write consistent code
- Maintain coding standards within teams
- Automate build process
- Automate testing and deployment and release process

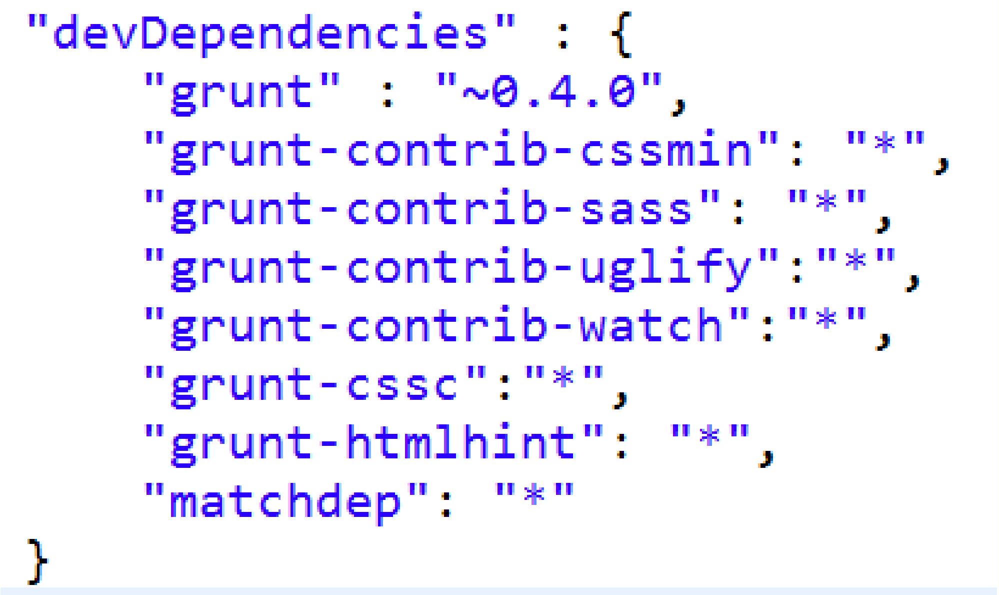
Setting Up

- The first thing to do in order to use Grunt is to set up Node.js.
- npm install -g grunt-cli

- To make sure Grunt has been properly installed, you can run the following command:
- grunt --version

Next Steps

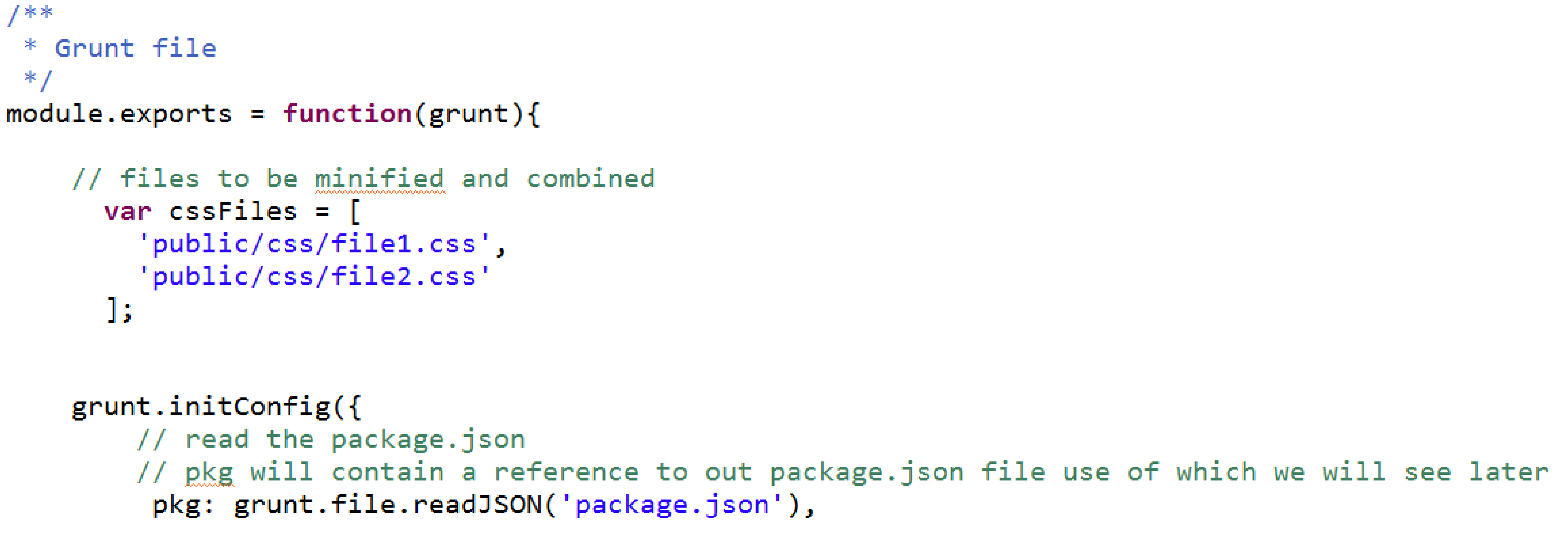
- The next step is to create a **package.json** and a **gruntfile.js** file in the root directory of your project.
- Creating the package.json File and execute [npm install]



```
"devDependencies" : {
    "grunt" : "~0.4.0",
    "grunt-contrib-cssmin": "*",
    "grunt-contrib-sass": "*",
    "grunt-contrib-uglify":"*",
    "grunt-contrib-watch":"*",
    "grunt-cssc":"*",
    "grunt-htmlhint": "*",
    "matchdep": "*"
}
```

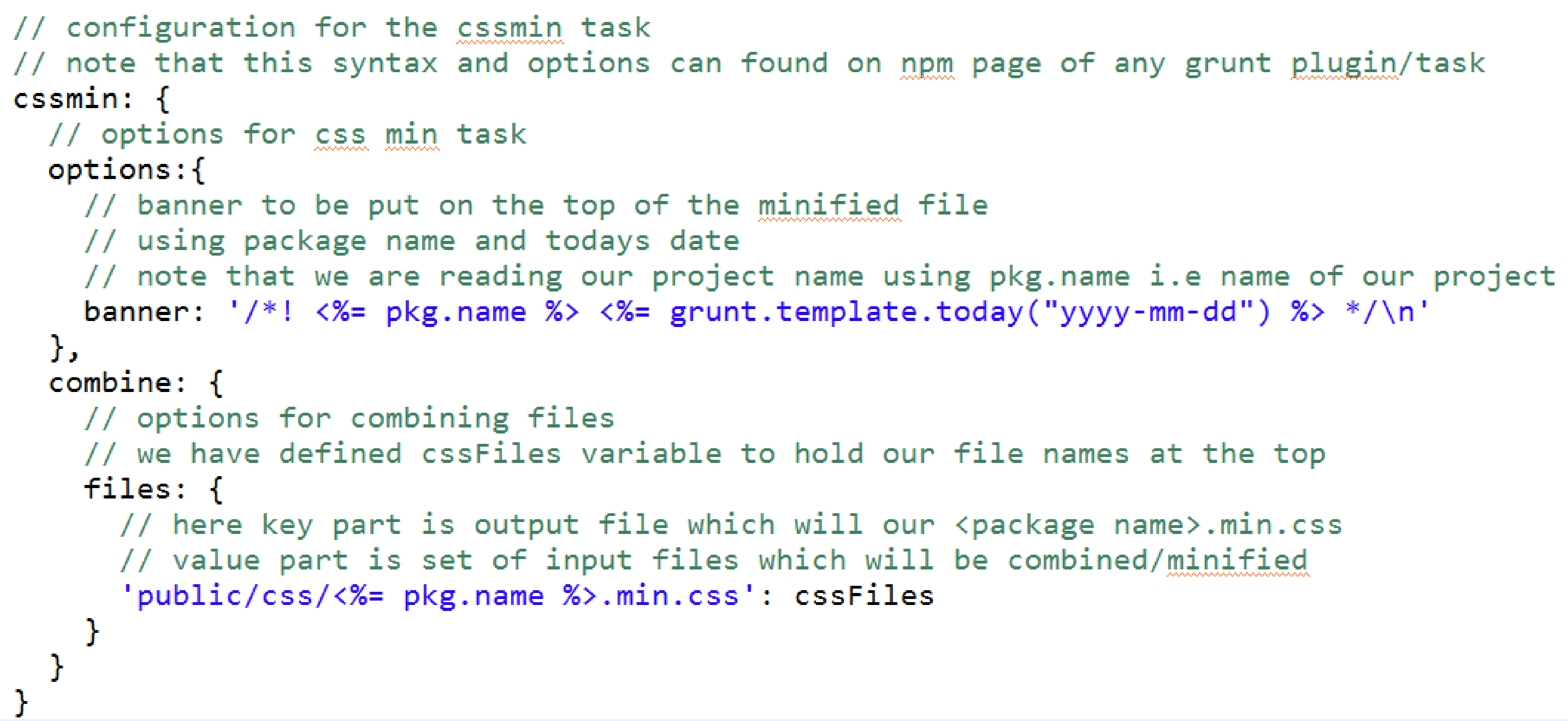
Creating the gruntfile.js File

- Gruntfile.js is essentially made up of a wrapper function that takes grunt as an argument.



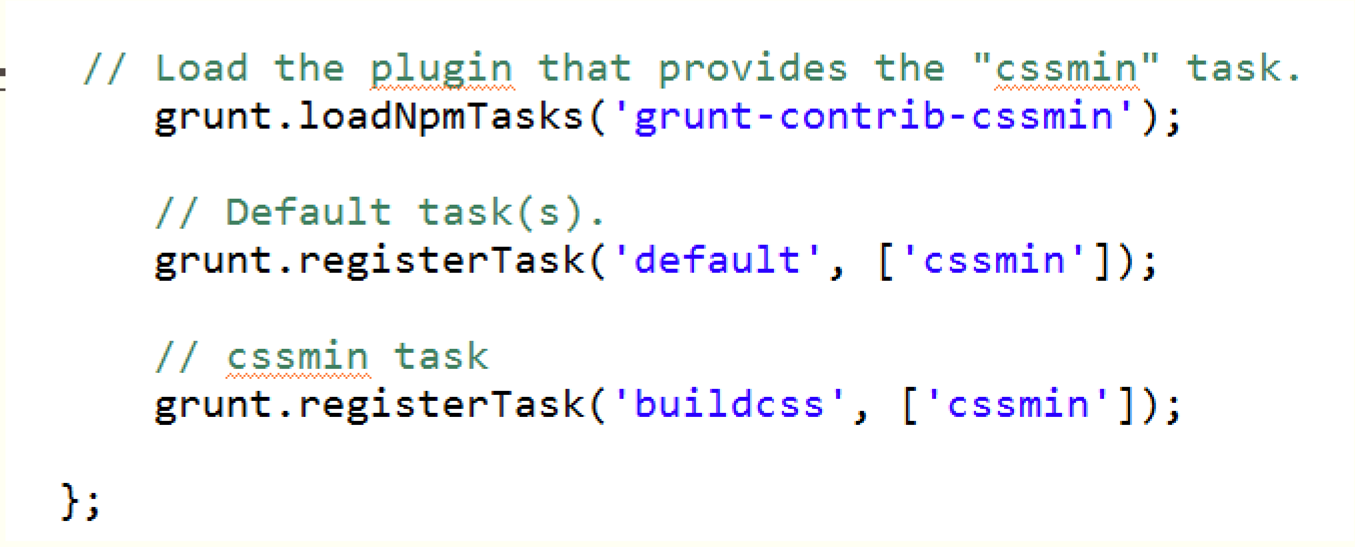
```
/**
 * Grunt file
 */
module.exports = function(grunt){

    // files to be minified and combined
      var cssFiles = [
        'public/css/file1.css',
        'public/css/file2.css'
      ];


    grunt.initConfig({
        // read the package.json
        // pkg will contain a reference to out package.json file use of which we will see later
         pkg: grunt.file.readJSON('package.json'),
```

Creating the gruntfile.js File



```
// configuration for the cssmin task
// note that this syntax and options can found on npm page of any grunt plugin/task
cssmin: {
  // options for css min task
  options:{
    // banner to be put on the top of the minified file
    // using package name and todays date
    // note that we are reading our project name using pkg.name i.e name of our project
    banner: '/*! <%= pkg.name %> <%= grunt.template.today("yyyy-mm-dd") %> */\n'
  },
  combine: {
    // options for combining files
    // we have defined cssFiles variable to hold our file names at the top
    files: {
      // here key part is output file which will our <package name>.min.css
      // value part is set of input files which will be combined/minified
      'public/css/<%= pkg.name %>.min.css': cssFiles
    }
  }
}
```

Creating the gruntfile.js File



```
 // Load the plugin that provides the "cssmin" task.
    grunt.loadNpmTasks('grunt-contrib-cssmin');

    // Default task(s).
    grunt.registerTask('default', ['cssmin']);

    // cssmin task
    grunt.registerTask('buildcss', ['cssmin']);

};
```

- grunt.loadNpmTasks - This is where we load the task/plugin.
- grunt.registerTask - This is where we register the task.
- grunt
  - Runs default grunt task defined with grunt.registerTask('default', [['cssmin','uglify']])
- grunt buildcss
  - Runs custom grunt task defined with grunt.registerTask('buildcss', ['cssmin'])

JSHint

- JSHint is a program that flags suspicious usage in programs written in JavaScript.
- JSHint comes with a default set of warnings but it was designed to be very configurable.
- There are three main ways to configure your copy of JSHint:
- you can either specify the configuration file manually via the --config flag,
- use a special file .jshintrc
- or put your config into your projects package.json file under the jshintConfig property

JSHint Options

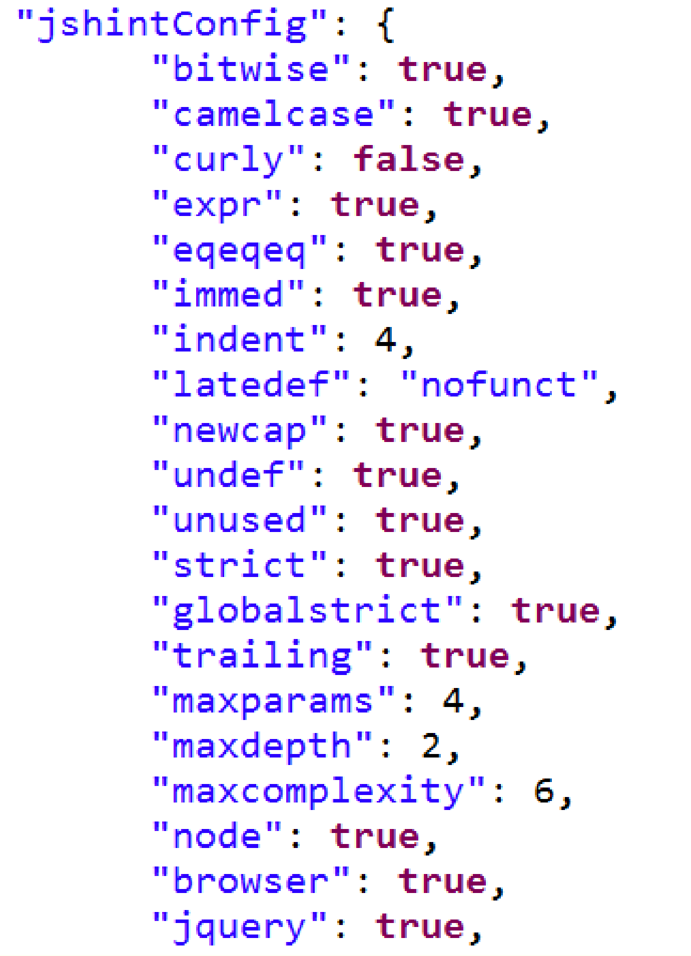
- Enforcing options
- When set to true, these options will make JSHint produce warnings about your code.

camelcase	**This option allows you to force all variable names to use either camelCase style or UPPER_CASE with underscores.**
bitwise	This option prohibits the use of bitwise operators such as ^ (XOR), | (OR) and others. Bitwise operators are very rare in JavaScript programs and quite often & is simply a mistyped &&.
curly	This option requires you to always put curly braces around blocks in loops and conditionals.
eqeqeq	This options prohibits the use of == and != in favor of === and !==

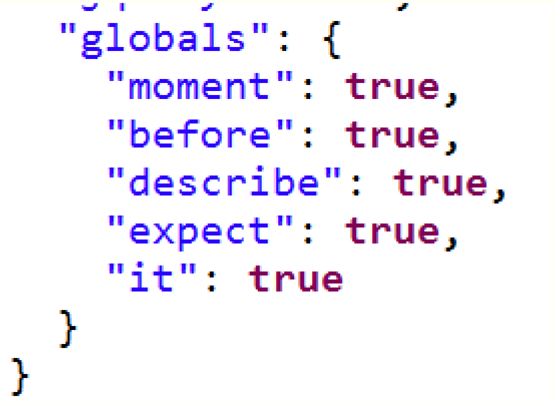
JSHint Options [More on http://jshint.com/docs/options/]

funcscope	**This option suppresses warnings about declaring variables inside of control structures while accessing them later from the outside. Even though JavaScript has only two real scopes—global and function—such practice leads to confusion among people new to the language and hard-to-debug bugs. This is why, by default, JSHint warns about variables that are used outside of their intended scope**
globals	Setting an entry to true enables reading and writing to that variable. Setting it to false will trigger JSHint to consider that variable read-only.
maxcomplexity	This option lets you control cyclomatic complexity throughout your code. Cyclomatic complexity measures the number of linearly independent paths through a program's source code
maxdepth	his option lets you control how nested do you want your blocks to be

"jshintConfig": config in package.json

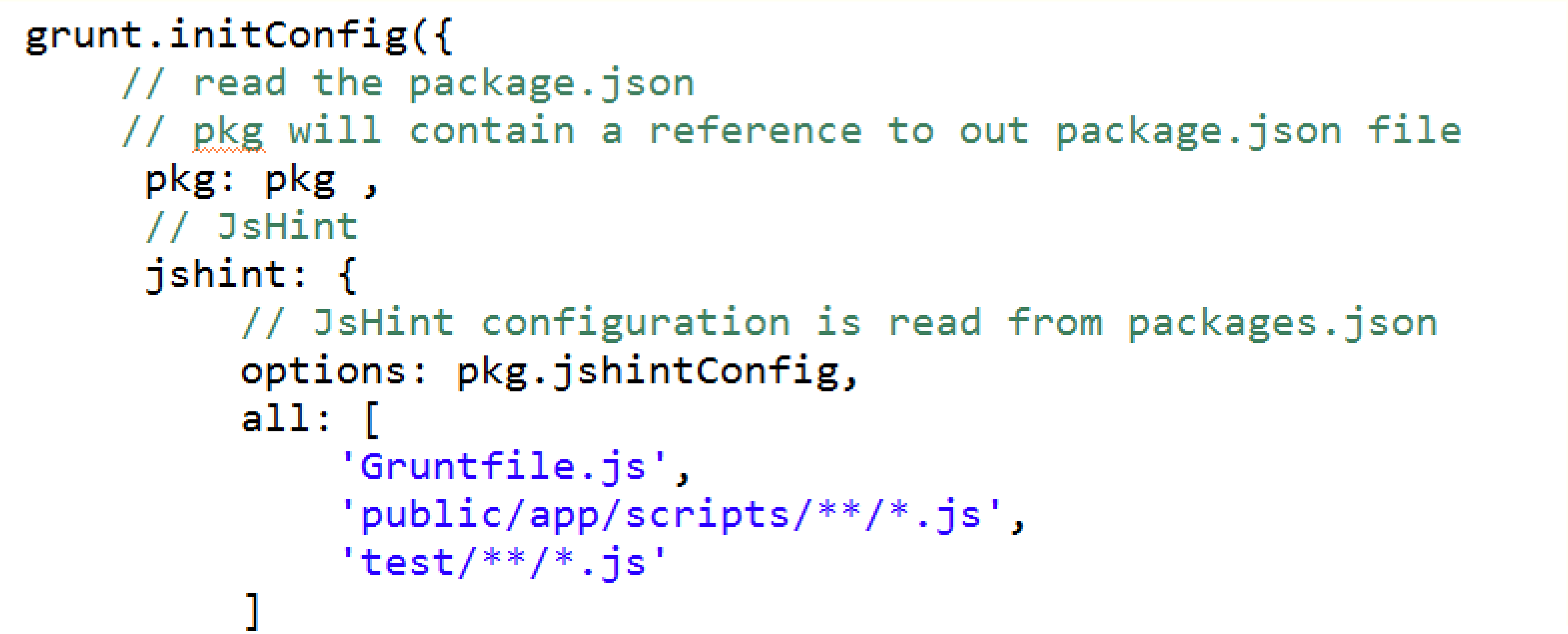


```
"jshintConfig": {
      "bitwise": true,
      "camelcase": true,
      "curly": false,
      "expr": true,
      "eqeqeq": true,
      "immed": true,
      "indent": 4,
      "latedef": "nofunct",
      "newcap": true,
      "undef": true,
      "unused": true,
      "strict": true,
      "globalstrict": true,
      "trailing": true,
      "maxparams": 4,
      "maxdepth": 2,
      "maxcomplexity": 6,
      "node": true,
      "browser": true,
      "jquery": true,
```

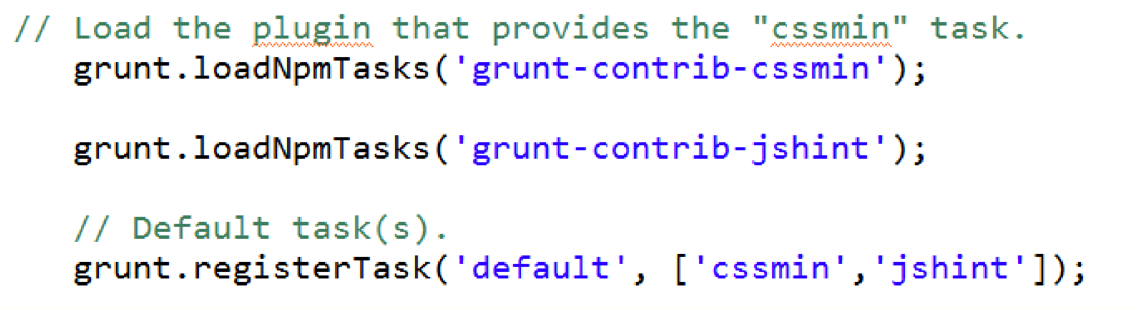


```
  "globals": {
    "moment": true,
    "before": true,
    "describe": true,
    "expect": true,
    "it": true
  }
}
```

Gruntfile Config



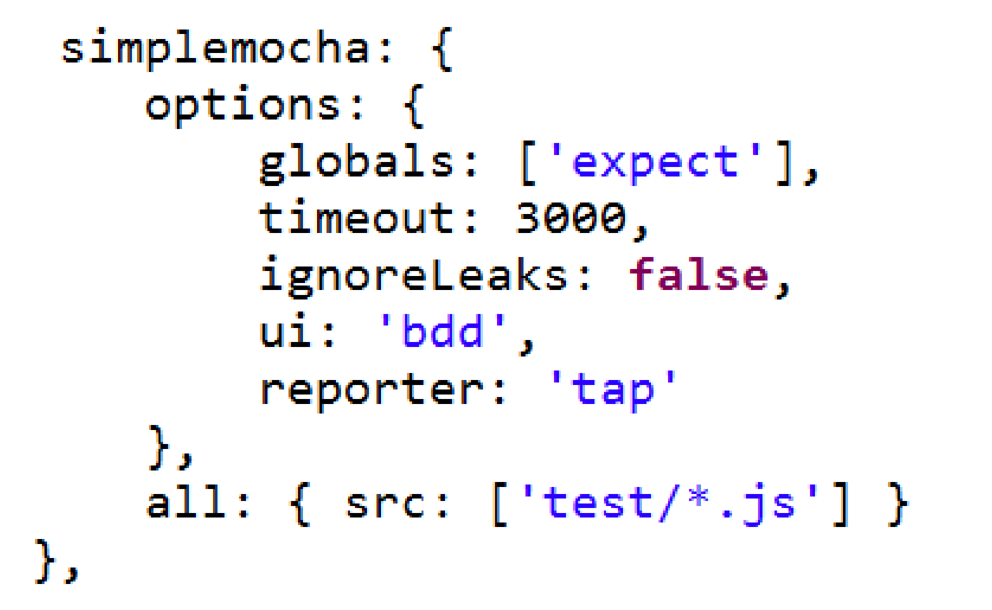
```
grunt.initConfig({
    // read the package.json
    // pkg will contain a reference to out package.json file
     pkg: pkg ,
     // JsHint
     jshint: {
         // JsHint configuration is read from packages.json
         options: pkg.jshintConfig,
         all: [
             'Gruntfile.js',
             'public/app/scripts/**/*.js',
             'test/**/*.js'
         ]
     },
```



```
// Load the plugin that provides the "cssmin" task.
   grunt.loadNpmTasks('grunt-contrib-cssmin');

   grunt.loadNpmTasks('grunt-contrib-jshint');

   // Default task(s).
   grunt.registerTask('default', ['cssmin','jshint']);
```

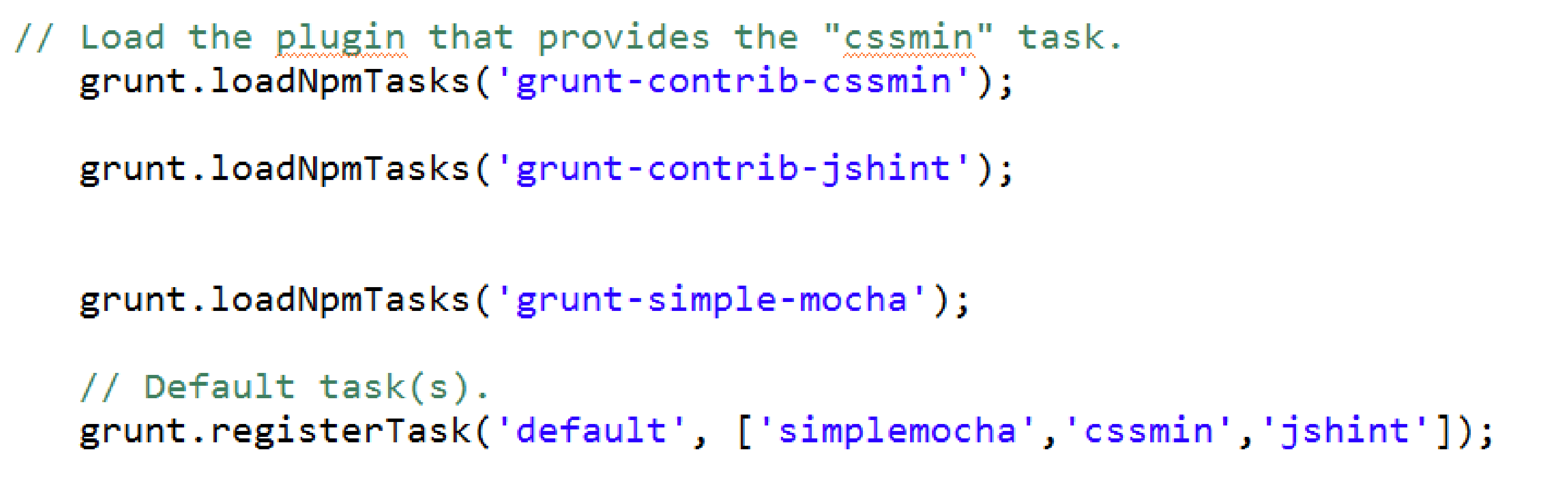
Simple Mocha

- Let’s configure Grunt to run these tests for us automatically.
- We’ll begin by installing the grunt-simple-mocha plugin using the --save-dev flag to keep package.json up to date.
  - npm install grunt-simple-mocha --save-dev
    - "grunt-simple-mocha": "^0.4.0“
    - Configure gruntfile.js

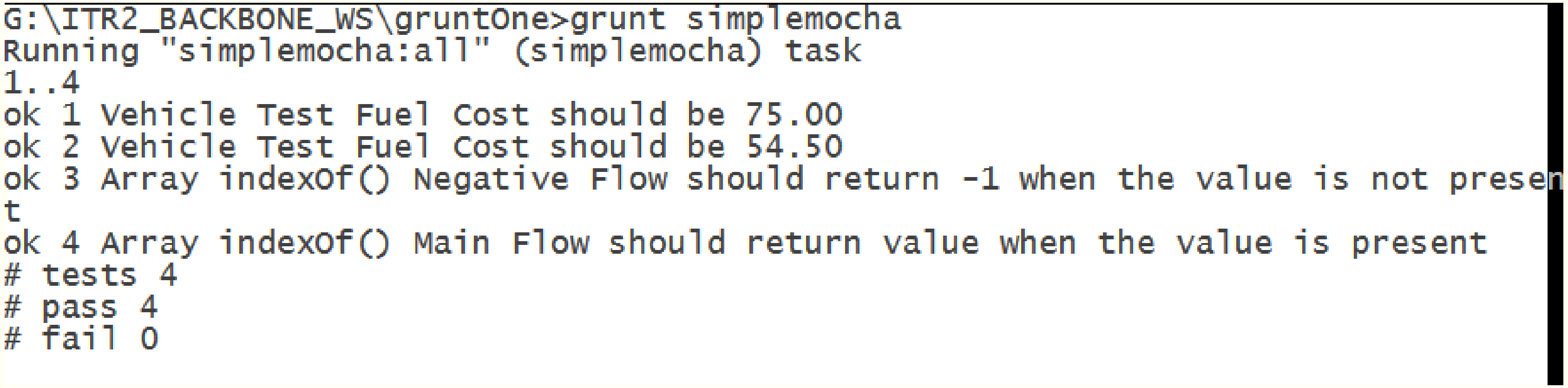


```
 simplemocha: {
    options: {
        globals: ['expect'],
        timeout: 3000,
        ignoreLeaks: false,
        ui: 'bdd',
        reporter: 'tap'
    },
    all: { src: ['test/*.js'] }
},
```

Configure gruntfile.js and run test



```
// Load the plugin that provides the "cssmin" task.
   grunt.loadNpmTasks('grunt-contrib-cssmin');

   grunt.loadNpmTasks('grunt-contrib-jshint');


   grunt.loadNpmTasks('grunt-simple-mocha');

   // Default task(s).
   grunt.registerTask('default', ['simplemocha','cssmin','jshint']);
```



```
G:\ITR2_BACKBONE_WS\gruntOne>grunt simplemocha
Running "simplemocha:all" (simplemocha) task
1..4
ok 1 Vehicle Test Fuel Cost should be 75.00
ok 2 Vehicle Test Fuel Cost should be 54.50
ok 3 Array indexOf() Negative Flow should return -1 when the value is not presen
t
ok 4 Array indexOf() Main Flow should return value when the value is present
# tests 4
# pass 4
# fail 0
```