FREE eBook

LEARNING Node.js

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#node.js

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About

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Chapter 1: Getting started with Node.js

Remarks

Node.js is an event-based, non-blocking, asynchronous I/O framework that uses Google's V8 JavaScript engine. It is used for developing applications that make heavy use of the ability to run JavaScript both on the client, as well as on server side and therefore benefit from the re-usability of code and the lack of context switching. It is open-source and cross-platform. Node.js applications are written in pure JavaScript and can be run within Node.js environment on Windows, Linux etc…

Versions

Version	Release Date
v8.2.1	2017-07-20
v8.2.0	2017-07-19
v8.1.4	2017-07-11
v8.1.3	2017-06-29
v8.1.2	2017-06-15
v8.1.1	2017-06-13
v8.1.0	2017-06-08
v8.0.0	2017-05-30
v7.10.0	2017-05-02
v7.9.0	2017-04-11
v7.8.0	2017-03-29
v7.7.4	2017-03-21
v7.7.3	2017-03-14
v7.7.2	2017-03-08
v7.7.1	2017-03-02
v7.7.0	2017-02-28

Version	Release Date
v7.6.0	2017-02-21
v7.5.0	2017-01-31
v7.4.0	2017-01-04
v7.3.0	2016-12-20
v7.2.1	2016-12-06
v7.2.0	2016-11-22
v7.1.0	2016-11-08
v7.0.0	2016-10-25
v6.11.0	2017-06-06
v6.10.3	2017-05-02
v6.10.2	2017-04-04
v6.10.1	2017-03-21
v6.10.0	2017-02-21
v6.9.5	2017-01-31
v6.9.4	2017-01-05
v6.9.3	2017-01-05
v6.9.2	2016-12-06
v6.9.1	2016-10-19
v6.9.0	2016-10-18
v6.8.1	2016-10-14
v6.8.0	2016-10-12
v6.7.0	2016-09-27
v6.6.0	2016-09-14
v6.5.0	2016-08-26
v6.4.0	2016-08-12

Version	Release Date
v6.3.1	2016-07-21
v6.3.0	2016-07-06
v6.2.2	2016-06-16
v6.2.1	2016-06-02
v6.2.0	2016-05-17
v6.1.0	2016-05-05
v6.0.0	2016-04-26
v5.12.0	2016-06-23
v5.11.1	2016-05-05
v5.11.0	2016-04-21
v5.10.1	2016-04-05
v5.10	2016-04-01
v5.9	2016-03-16
v5.8	2016-03-09
v5.7	2016-02-23
v5.6	2016-02-09
v5.5	2016-01-21
v5.4	2016-01-06
v5.3	2015-12-15
v5.2	2015-12-09
v5.1	2015-11-17
v5.0	2015-10-29
v4.4	2016-03-08
v4.3	2016-02-09
v4.2	2015-10-12

Version	Release Date
v4.1	2015-09-17
v4.0	2015-09-08
io.js v3.3	2015-09-02
io.js v3.2	2015-08-25
io.js v3.1	2015-08-19
io.js v3.0	2015-08-04
io.js v2.5	2015-07-28
io.js v2.4	2015-07-17
io.js v2.3	2015-06-13
io.js v2.2	2015-06-01
io.js v2.1	2015-05-24
io.js v2.0	2015-05-04
io.js v1.8	2015-04-21
io.js v1.7	2015-04-17
io.js v1.6	2015-03-20
io.js v1.5	2015-03-06
io.js v1.4	2015-02-27
io.js v1.3	2015-02-20
io.js v1.2	2015-02-11
io.js v1.1	2015-02-03
io.js v1.0	2015-01-14
v0.12	2016-02-09
v0.11	2013-03-28
v0.10	2013-03-11
v0.9	2012-07-20

Version	Release Date
v0.8	2012-06-22
v0.7	2012-01-17
v0.6	2011-11-04
v0.5	2011-08-26
v0.4	2011-08-26
v0.3	2011-08-26
v0.2	2011-08-26
v0.1	2011-08-26

Examples

Hello World HTTP server

First, install Node.js for your platform.

In this example we'll create an HTTP server listening on port 1337, which sends `Hello, World!` to the browser. Note that, instead of using port 1337, you can use any port number of your choice which is currently not in use by any other service.

The `http` module is a Node.js ***core module*** (a module included in Node.js's source, that does not require installing additional resources). The `http` module provides the functionality to create an HTTP server using the `http.createServer()` method. To create the application, create a file containing the following JavaScript code.

```
const http = require('http'); // Loads the http module

http.createServer((request, response) => {

    // 1. Tell the browser everything is OK (Status code 200), and the data is in plain text
    response.writeHead(200, {
        'Content-Type': 'text/plain'
    });

    // 2. Write the announced text to the body of the page
    response.write('Hello, World!\n');

    // 3. Tell the server that all of the response headers and body have been sent
    response.end();

}).listen(1337); // 4. Tells the server what port to be on
```

Save the file with any file name. In this case, if we name it `hello.js` we can run the application by going to the directory the file is in and using the following command:

```
node hello.js
```

The created server can then be accessed with the URL http://localhost:1337 or http://127.0.0.1:1337 in the browser.

A simple web page will appear with a “Hello, World!” text at the top, as shown in the screenshot below.

Editable online example.

Hello World command line

Node.js can also be used to create command line utilities. The example below reads the first argument from the command line and prints a Hello message.

To run this code on an Unix System:

1. Create a new file and paste the code below. The filename is irrelevant.
2. Make this file executable with `chmod 700 FILE_NAME`
3. Run the app with `./APP_NAME David`

On Windows you do step 1 and run it with `node APP_NAME David`

```
#!/usr/bin/env node

'use strict';

/*
    The command line arguments are stored in the `process.argv` array,
    which has the following structure:
    [0] The path of the executable that started the Node.js process
    [1] The path to this application
    [2-n] the command line arguments
```

```
    Example: [ '/bin/node', '/path/to/yourscript', 'arg1', 'arg2', ... ]
    src: https://nodejs.org/api/process.html#process_process_argv
 */

// Store the first argument as username.
var username = process.argv[2];

// Check if the username hasn't been provided.
if (!username) {

    // Extract the filename
    var appName = process.argv[1].split(require('path').sep).pop();

    //  Give the user an example on how to use the app.
    console.error('Missing argument! Example: %s YOUR_NAME', appName);

    // Exit the app (success: 0, error: 1).
    // An error will stop the execution chain. For example:
    //   ./app.js && ls       -> won't execute ls
    //   ./app.js David && ls -> will execute ls
    process.exit(1);
}

// Print the message to the console.
console.log('Hello %s!', username);
```

Installing and Running Node.js

To begin, install Node.js on your development computer.

Windows: Navigate to the download page and download/run the installer.

Mac: Navigate to the download page and download/run the installer. Alternatively, you can install Node via Homebrew using `brew install node`. Homebrew is a command-line package mananger for Macintosh, and more information about it can be found on the Homebrew website.

Linux: Follow the instructions for your distro on the command line installation page.

Running a Node Program

To run a Node.js program, simply run `node app.js` or `nodejs app.js`, where `app.js` is the filename of your node app source code. You do not need to include the `.js` suffix for Node to find the script you'd like to run.

Alternatively under UNIX-based operating systems, a Node program may be executed as a terminal script. To do so, it needs to begin with a shebang pointing to the Node interpreter, such as `#!/usr/bin/env node`. The file also has to be set as executable, which can be done using `chmod`. Now the script can be directly run from the command line.

Deploying your application online

When you deploy your app to a (Node.js-specific) hosted environment, this environment usually offers a `PORT`-environment variable that you can use to run your server on. Changing the port number to `process.env.PORT` allows you to access the application.

For example,

```
http.createServer(function(request, response) {
   // your server code
}).listen(process.env.PORT);
```

Also, if you would like to access this offline while debugging, you can use this:

```
http.createServer(function(request, response) {
  // your server code
}).listen(process.env.PORT || 3000);
```

where `3000` is the offline port number.

Debugging Your NodeJS Application

You can use the node-inspector. Run this command to install it via npm:

```
npm install -g node-inspector
```

Then you can debug your application using

```
node-debug app.js
```

The Github repository can be found here: https://github.com/node-inspector/node-inspector

---

Debugging natively

You can also debug node.js natively by starting it like this:

```
node debug your-script.js
```

To breakpoint your debugger exactly in a code line you want, use this:

```
debugger;
```

For more information see here.

In node.js 8 use the following command:

```
node --inspect-brk your-script.js
```

Then open `about://inspect` in a recent version of Google Chrome and select your Node script to get the debugging experience of Chrome's DevTools.

Hello World with Express

The following example uses Express to create an HTTP server listening on port 3000, which responds with "Hello, World!". Express is a commonly-used web framework that is useful for creating HTTP APIs.

First, create a new folder, e.g. `myApp`. Go into `myApp` and make a new JavaScript file containing the following code (let's name it `hello.js` for example). Then install the express module using `npm install --save express` from the command line. *Refer to this documentation for more information on how to install packages*.

```
// Import the top-level function of express
const express = require('express');

// Creates an Express application using the top-level function
const app = express();

// Define port number as 3000
const port = 3000;

// Routes HTTP GET requests to the specified path "/" with the specified callback function
app.get('/', function(request, response) {
  response.send('Hello, World!');
});

// Make the app listen on port 3000
app.listen(port, function() {
  console.log('Server listening on http://localhost:' + port);
});
```

From the command line, run the following command:

```
node hello.js
```

Open your browser and navigate to `http://localhost:3000` or `http://127.0.0.1:3000` to see the response.

For more information about the Express framework, you can check the Web Apps With Express section

Hello World basic routing

Once you understand how to create an HTTP Server with node, it's important to understand how to make it "do" things based on the path that a user has navigated to. This phenomenon is called, "routing".

The most basic example of this would be to check `if (request.url === 'some/path/here')`, and then call a function that responds with a new file.

An example of this can be seen here:

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

function index (request, response) {
    response.writeHead(200);
    response.end('Hello, World!');
}

http.createServer(function (request, response) {

    if (request.url === '/') {
        return index(request, response);
    }

    response.writeHead(404);
    response.end(http.STATUS_CODES[404]);

}).listen(1337);
```

If you continue to define your "routes" like this, though, you'll end up with one massive callback function, and we don't want a giant mess like that, so let's see if we can clean this up.

First, let's store all of our routes in an object:

```
var routes = {
    '/': function index (request, response) {
        response.writeHead(200);
        response.end('Hello, World!');
    },
    '/foo': function foo (request, response) {
        response.writeHead(200);
        response.end('You are now viewing "foo"');
    }
}
```

Now that we've stored 2 routes in an object, we can now check for them in our main callback:

```
http.createServer(function (request, response) {

    if (request.url in routes) {
        return routes[request.url](request, response);
    }

    response.writeHead(404);
    response.end(http.STATUS_CODES[404]);

}).listen(1337);
```

Now every time you try to navigate your website, it will check for the existence of that path in your routes, and it will call the respective function. If no route is found, the server will respond with a 404 (Not Found).

And there you have it--routing with the HTTP Server API is very simple.

TLS Socket: server and client

The only major differences between this and a regular TCP connection are the private Key and the public certificate that you'll have to set into an option object.

How to Create a Key and Certificate

The first step in this security process is the creation of a private Key. And what is this private key? Basically, it's a set of random noise that's used to encrypt information. In theory, you could create one key, and use it to encrypt whatever you want. But it is best practice to have different keys for specific things. Because if someone steals your private key, it's similar to having someone steal your house keys. Imagine if you used the same key to lock your car, garage, office, etc.

```
openssl genrsa -out private-key.pem 1024
```

Once we have our private key, we can create a CSR (certificate signing request), which is our request to have the private key signed by a fancy authority. That is why you have to input information related to your company. This information will be seen by the signing authority, and used to verify you. In our case, it doesn't matter what you type, since in the next step we're going to sign our certificate ourselves.

```
openssl req -new -key private-key.pem -out csr.pem
```

Now that we have our paper work filled out, it's time to pretend that we're a cool signing authority.

```
openssl x509 -req -in csr.pem -signkey private-key.pem -out public-cert.pem
```

Now that you have the private key and the public cert, you can establish a secure connection between two NodeJS apps. And, as you can see in the example code, it is a very simple process.

Important!

Since we created the public cert ourselves, in all honesty, our certificate is worthless, because we are nobodies. The NodeJS server won't trust such a certificate by default, and that is why we need to tell it to actually trust our cert with the following option rejectUnauthorized: false. **Very important**: never set this variable to true in a production environment.

TLS Socket Server

```
'use strict';

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

const PORT = 1337;
const HOST = '127.0.0.1'
```

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

var server = tls.createServer(options, function(socket) {

    // Send a friendly message
    socket.write("I am the server sending you a message.");

    // Print the data that we received
    socket.on('data', function(data) {

        console.log('Received: %s [it is %d bytes long]',
            data.toString().replace(/(\n)/gm,""),
            data.length);

    });

    // Let us know when the transmission is over
    socket.on('end', function() {

        console.log('EOT (End Of Transmission)');

    });

});

// Start listening on a specific port and address
server.listen(PORT, HOST, function() {

    console.log("I'm listening at %s, on port %s", HOST, PORT);

});

// When an error occurs, show it.
server.on('error', function(error) {

    console.error(error);

    // Close the connection after the error occurred.
    server.destroy();

});
```

TLS Socket Client

```
'use strict';

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

const PORT = 1337;
const HOST = '127.0.0.1'

// Pass the certs to the server and let it know to process even unauthorized certs.
var options = {
    key: fs.readFileSync('private-key.pem'),
```

```
    cert: fs.readFileSync('public-cert.pem'),
    rejectUnauthorized: false
};

var client = tls.connect(PORT, HOST, options, function() {

    // Check if the authorization worked
    if (client.authorized) {
        console.log("Connection authorized by a Certificate Authority.");
    } else {
        console.log("Connection not authorized: " + client.authorizationError)
    }

    // Send a friendly message
    client.write("I am the client sending you a message.");

});

client.on("data", function(data) {

    console.log('Received: %s [it is %d bytes long]',
        data.toString().replace(/(\n)/gm,""),
        data.length);

    // Close the connection after receiving the message
    client.end();

});

client.on('close', function() {

    console.log("Connection closed");

});

// When an error ocoures, show it.
client.on('error', function(error) {

    console.error(error);

    // Close the connection after the error occurred.
    client.destroy();

});
```

Hello World in the REPL

When called without arguments, Node.js starts a REPL (Read-Eval-Print-Loop) also known as the "*Node shell*".

At a command prompt type `node`.

```
$ node
>
```

At the Node shell prompt `>` type "Hello World!"

```
$ node
> "Hello World!"
'Hello World!'
```

Core modules

Node.js is a Javascript engine (Google's V8 engine for Chrome, written in C++) that allows to run Javascript outside the browser. While numerous libraries are available for extending Node's functionalities, the engine comes with a set of *core modules* implementing basic functionalities.

There's currently 34 core modules included in Node:

```
[ 'assert',
  'buffer',
  'c/c++_addons',
  'child_process',
  'cluster',
  'console',
  'crypto',
  'deprecated_apis',
  'dns',
  'domain',
  'Events',
  'fs',
  'http',
  'https',
  'module',
  'net',
  'os',
  'path',
  'punycode',
  'querystring',
  'readline',
  'repl',
  'stream',
  'string_decoder',
  'timers',
  'tls_(ssl)',
  'tracing',
  'tty',
  'dgram',
  'url',
  'util',
  'v8',
  'vm',
  'zlib' ]
```

This list was obtained from the Node documentation API https://nodejs.org/api/all.html (JSON file: https://nodejs.org/api/all.json).

All core modules at-a-glance

assert

The `assert` module provides a simple set of assertion tests that can be used to test invariants.

buffer

Prior to the introduction of `TypedArray` in ECMAScript 2015 (ES6), the JavaScript language had no mechanism for reading or manipulating streams of binary data. The `Buffer` class was introduced as part of the Node.js API to make it possible to interact with octet streams in the context of things like TCP streams and file system operations.

Now that `TypedArray` has been added in ES6, the `Buffer` class implements the `Uin t8Array` API in a manner that is more optimized and suitable for Node.js' use cases.

c/c++_addons

Node.js Addons are dynamically-linked shared objects, written in C or C++, that can be loaded into Node.js using the `require()` function , and used just as if they were an ordinary Node.js module. They are used primarily to provide an interface between JavaScript running in Node.js and C/C++ libraries.

child_process

The `child_process` module provides the ability to spawn child processes in a manner that is similar, but not identical, to popen(3).

cluster

A single instance of Node.js runs in a single thread. To take advantage of multi-core systems the user will sometimes want to launch a cluster of Node.js processes to handle the load. The cluster module allows you to easily create child processes that all share server ports.

console

The `console` module provides a simple debugging console that is similar to the JavaScript console mechanism provided by web browsers.

crypto

The `crypto` module provides cryptographic functionality that includes a set of wrappers for OpenSSL's hash, HMAC, cipher, decipher, sign and verify functions.

deprecated_apis

Node.js may deprecate APIs when either: (a) use of the API is considered to be unsafe, (b) an improved alternative API has been made available, or (c) breaking changes to the API are expected in a future major release.

dns

The `dns` module contains functions belonging to two different categories:

1. Functions that use the underlying operating system facilities to perform name resolution, and

that do not necessarily perform any network communication. This category contains only one function: `dns.lookup()`.
2. Functions that connect to an actual DNS server to perform name resolution, and that *always* use the network to perform DNS queries. This category contains all functions in the `dns` module *except* `dns.lookup()`.

domain

This module is pending deprecation. Once a replacement API has been finalized, this module will be fully deprecated. Most end users should **not** have cause to use this module. Users who absolutely must have the functionality that domains provide may rely on it for the time being but should expect to have to migrate to a different solution in the future.

Events

Much of the Node.js core API is built around an idiomatic asynchronous event-driven architecture in which certain kinds of objects (called "emitters") periodically emit named events that cause Function objects ("listeners") to be called.

fs

File I/O is provided by simple wrappers around standard POSIX functions. To use this module do `require('fs')`. All the methods have asynchronous and synchronous forms.

http

The HTTP interfaces in Node.js are designed to support many features of the protocol which have been traditionally difficult to use. In particular, large, possibly chunk-encoded, messages. The interface is careful to never buffer entire requests or responses--the user is able to stream data.

https

HTTPS is the HTTP protocol over TLS/SSL. In Node.js this is implemented as a separate module.

module

Node.js has a simple module loading system. In Node.js, files and modules are in one-to-one correspondence (each file is treated as a separate module).

net

The `net` module provides you with an asynchronous network wrapper. It contains functions for creating both servers and clients (called streams). You can include this module with `require('net');`.

os

The `os` module provides a number of operating system-related utility methods.

path

The `path` module provides utilities for working with file and directory paths.

punycode

The version of the punycode module bundled in Node.js is being deprecated.

querystring

The `querystring` module provides utilities for parsing and formatting URL query strings.

readline

The `readline` module provides an interface for reading data from a Readable stream (such as `process.stdin`) one line at a time.

repl

The `repl` module provides a Read-Eval-Print-Loop (REPL) implementation that is available both as a standalone program or includible in other applications.

stream

A stream is an abstract interface for working with streaming data in Node.js. The `stream` module provides a base API that makes it easy to build objects that implement the stream interface.

There are many stream objects provided by Node.js. For instance, a request to an HTTP server and `process.stdout` are both stream instances.

string_decoder

The `string_decoder` module provides an API for decoding `Buffer` objects into strings in a manner that preserves encoded multi-byte UTF-8 and UTF-16 characters.

timers

The `timer` module exposes a global API for scheduling functions to be called at some future period of time. Because the timer functions are globals, there is no need to call `require('timers')` to use the API.

The timer functions within Node.js implement a similar API as the timers API provided by Web Browsers but use a different internal implementation that is built around the Node.js Event Loop.

tls_(ssl)

The `tls` module provides an implementation of the Transport Layer Security (TLS) and Secure Socket Layer (SSL) protocols that is built on top of OpenSSL.

tracing

Trace Event provides a mechanism to centralize tracing information generated by V8, Node core, and userspace code.

Tracing can be enabled by passing the `--trace-events-enabled` flag when starting a Node.js application.

tty

The `tty` module provides the `tty.ReadStream` and `tty.WriteStream` classes. In most cases, it will not be necessary or possible to use this module directly.

dgram

The `dgram` module provides an implementation of UDP Datagram sockets.

url

The `url` module provides utilities for URL resolution and parsing.

util

The `util` module is primarily designed to support the needs of Node.js' own internal APIs. However, many of the utilities are useful for application and module developers as well.

v8

The `v8` module exposes APIs that are specific to the version of V8 built into the Node.js binary.

Note: The APIs and implementation are subject to change at any time.

vm

The `vm` module provides APIs for compiling and running code within V8 Virtual Machine contexts. JavaScript code can be compiled and run immediately or compiled, saved, and run later.

Note: The vm module is not a security mechanism. ***Do not use it to run untrusted code***.

zlib

The `zlib` module provides compression functionality implemented using Gzip and Deflate/Inflate.

How to get a basic HTTPS web server up and running!

Once you have node.js installed on your system, you can just follow the procedure below to get a basic web server running with support for both HTTP and HTTPS!

Step 1 : Build a Certificate Authority

1. create the folder where you want to store your key & certificate :

```
mkdir conf
```

---

2. go to that directory :

```
cd conf
```

---

3. grab this `ca.cnf` file to use as a configuration shortcut :

```
wget https://raw.githubusercontent.com/anders94/https-authorized-clients/master/keys/ca.cnf
```

---

4. create a new certificate authority using this configuration :

```
openssl req -new -x509 -days 9999 -config ca.cnf -keyout ca-key.pem -out ca-cert.pem
```

---

5. now that we have our certificate authority in `ca-key.pem` and `ca-cert.pem`, let's generate a private key for the server :

```
openssl genrsa -out key.pem 4096
```

---

6. grab this `server.cnf` file to use as a configuration shortcut :

```
wget https://raw.githubusercontent.com/anders94/https-authorized-
clients/master/keys/server.cnf
```

---

7. generate the certificate signing request using this configuration :

```
openssl req -new -config server.cnf -key key.pem -out csr.pem
```

---

8. sign the request :

```
openssl x509 -req -extfile server.cnf -days 999 -passin "pass:password" -in csr.pem -CA ca-
cert.pem -CAkey ca-key.pem -CAcreateserial -out cert.pem
```

Step 2 : Install your certificate as a root certificate

1. copy your certificate to your root certificates' folder :

```
sudo cp ca-crt.pem /usr/local/share/ca-certificates/ca-crt.pem
```

---

2. update CA store :

```
sudo update-ca-certificates
```

Step 3 : Starting your node server

First, you want to create a `server.js` file that contains your actual server code.

The minimal setup for an HTTPS server in Node.js would be something like this :

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

var httpsOptions = {
    key: fs.readFileSync('path/to/server-key.pem'),
    cert: fs.readFileSync('path/to/server-crt.pem')
};

var app = function (req, res) {
  res.writeHead(200);
  res.end("hello world\n");
}

https.createServer(httpsOptions, app).listen(4433);
```

If you also want to support http requests, you need to make just this small modification :

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

var httpsOptions = {
    key: fs.readFileSync('path/to/server-key.pem'),
    cert: fs.readFileSync('path/to/server-crt.pem')
};

var app = function (req, res) {
  res.writeHead(200);
  res.end("hello world\n");
}

http.createServer(app).listen(8888);
https.createServer(httpsOptions, app).listen(4433);
```

1. go to the directory where your `server.js` is located :

   ```
   cd /path/to
   ```

---

2. run `server.js` :

   ```
   node server.js
   ```

Read Getting started with Node.js online: https://riptutorial.com/node-js/topic/340/getting-started-with-node-js

Chapter 2: Arduino communication with nodeJs

Introduction

Way to show how Node.Js can communicate with Arduino Uno.

Examples

Node Js communication with Arduino via serialport

Node js code

Sample to start this topic is Node.js server communicating with Arduino via serialport.

```
npm install express --save
npm install serialport --save
```

Sample app.js:

```
const express = require('express');
const app = express();
var SerialPort = require("serialport");

var port = 3000;

var arduinoCOMPort = "COM3";

var arduinoSerialPort = new SerialPort(arduinoCOMPort, {
 baudrate: 9600
});

arduinoSerialPort.on('open',function() {
  console.log('Serial Port ' + arduinoCOMPort + ' is opened.');
});

app.get('/', function (req, res) {

    return res.send('Working');

})

app.get('/:action', function (req, res) {

   var action = req.params.action || req.param('action');

    if(action == 'led'){
        arduinoSerialPort.write("w");
        return res.send('Led light is on!');
    }
```

```
    if(action == 'off') {
        arduinoSerialPort.write("t");
        return res.send("Led light is off!");
    }

    return res.send('Action: ' + action);

});

app.listen(port, function () {
  console.log('Example app listening on port http://0.0.0.0:' + port + '!');
});
```

Starting sample express server:

```
node app.js
```

Arduino code

```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.

  Serial.begin(9600); // Begen listening on port 9600 for serial

  pinMode(LED_BUILTIN, OUTPUT);

  digitalWrite(LED_BUILTIN, LOW);
}

// the loop function runs over and over again forever
void loop() {

   if(Serial.available() > 0) // Read from serial port
    {
      char ReaderFromNode; // Store current character
      ReaderFromNode = (char) Serial.read();
      convertToState(ReaderFromNode); // Convert character to state
    }
  delay(1000);
}

void convertToState(char chr) {
  if(chr=='o'){
    digitalWrite(LED_BUILTIN, HIGH);
    delay(100);
  }
  if(chr=='f'){
    digitalWrite(LED_BUILTIN, LOW);
    delay(100);
  }
}
```

Starting Up

1. Connect the arduino to your machine.
2. Start the server

Control the build in led via node js express server.

To turn on the led:

```
http://0.0.0.0:3000/led
```

To turn off the led:

```
http://0.0.0.0:3000/off
```

Read Arduino communication with nodeJs online: https://riptutorial.com/node-js/topic/10509/arduino-communication-with-nodejs

Chapter 3: async.js

Syntax

- **Each callback must be written with this syntax:**
- function callback(err, result [, arg1[, ...]])
- **This way, you are forced to return the error first, and can't ignore handling them later on. `null` is the convention in absence of errors**
- callback(null, myResult);
- **Your callbacks can contain more arguments than *err* and *result*, but it's useful only for a specific set of functions (waterfall, seq, ...)**
- callback(null, myResult, myCustomArgument);
- **And, of course, send errors. You must do it, and handle errors (or at least log them).**
- callback(err);

Examples

Parallel : multi-tasking

async.parallel(tasks, afterTasksCallback) will execute a set of tasks in parallel and **wait the end of all tasks** (reported by the call of **callback** function).

When tasks are finished, *async* call the main callback with all errors and all results of tasks.

```
function shortTimeFunction(callback) {
  setTimeout(function() {
    callback(null, 'resultOfShortTime');
  }, 200);
}

function mediumTimeFunction(callback) {
  setTimeout(function() {
    callback(null, 'resultOfMediumTime');
  }, 500);
}

function longTimeFunction(callback) {
  setTimeout(function() {
    callback(null, 'resultOfLongTime');
  }, 1000);
}

async.parallel([
    shortTimeFunction,
```

```
    mediumTimeFunction,
    longTimeFunction
  ],
  function(err, results) {
    if (err) {
      return console.error(err);
    }

    console.log(results);
  });
```

Result : `["resultOfShortTime", "resultOfMediumTime", "resultOfLongTime"]`.

Call `async.parallel()` with an object

You can replace the *tasks* array parameter by an object. In this case, results will be also an object **with the same keys than tasks**.

It's very useful to compute some tasks and find easily each result.

```
async.parallel({
    short: shortTimeFunction,
    medium: mediumTimeFunction,
    long: longTimeFunction
  },
  function(err, results) {
    if (err) {
      return console.error(err);
    }

    console.log(results);
  });
```

Result : `{short: "resultOfShortTime", medium: "resultOfMediumTime", long: "resultOfLongTime"}`.

Resolving multiple values

Each parallel function is passed a callback. This callback can either return an error as the first argument or success values after that. If a callback is passed several success values, these results are returned as an array.

```
async.parallel({
    short: function shortTimeFunction(callback) {
      setTimeout(function() {
        callback(null, 'resultOfShortTime1', 'resultOfShortTime2');
      }, 200);
    },
    medium: function mediumTimeFunction(callback) {
      setTimeout(function() {
        callback(null, 'resultOfMediumTime1', 'resultOfMeiumTime2');
      }, 500);
    }
```

```
  },
  function(err, results) {
    if (err) {
      return console.error(err);
    }

    console.log(results);
  });
```

Result :

```
{
    short: ["resultOfShortTime1", "resultOfShortTime2"],
    medium: ["resultOfMediumTime1", "resultOfMediumTime2"]
}
```

.

Series : independent mono-tasking

async.series(tasks, afterTasksCallback) will execute a set of tasks. Each task are executed **after another**. **If a task fails, *async* stops immediately the execution and jump into the main callback**.

When tasks are finished successfully, *async* call the "master" callback with all errors and all results of tasks.

```
function shortTimeFunction(callback) {
  setTimeout(function() {
    callback(null, 'resultOfShortTime');
  }, 200);
}

function mediumTimeFunction(callback) {
  setTimeout(function() {
    callback(null, 'resultOfMediumTime');
  }, 500);
}

function longTimeFunction(callback) {
  setTimeout(function() {
    callback(null, 'resultOfLongTime');
  }, 1000);
}

async.series([
    mediumTimeFunction,
    shortTimeFunction,
    longTimeFunction
  ],
  function(err, results) {
    if (err) {
      return console.error(err);
    }

    console.log(results);
```

```
  });
```

Result : `["resultOfMediumTime", "resultOfShortTime", "resultOfLongTime"]`.

Call `async.series()` with an object

You can replace the *tasks* array parameter by an object. In this case, results will be also an object **with the same keys than tasks**.

It's very useful to compute some tasks and find easily each result.

```
async.series({
    short: shortTimeFunction,
    medium: mediumTimeFunction,
    long: longTimeFunction
  },
  function(err, results) {
    if (err) {
      return console.error(err);
    }

    console.log(results);
  });
```

Result : `{short: "resultOfShortTime", medium: "resultOfMediumTime", long: "resultOfLongTime"}`.

Waterfall : dependent mono-tasking

async.waterfall(tasks, afterTasksCallback) will execute a set of tasks. Each task are executed **after another, and the result of a task is passed to the next task**. As *async.series()*, if a task fails, *async* stop the execution and call immediately the main callback.

When tasks are finished successfully, *async* call the "master" callback with all errors and all results of tasks.

```
function getUserRequest(callback) {
  // We simulate the request with a timeout
  setTimeout(function() {
    var userResult = {
      name : 'Aamu'
    };

    callback(null, userResult);
  }, 500);
}

function getUserFriendsRequest(user, callback) {
  // Another request simulate with a timeout
  setTimeout(function() {
    var friendsResult = [];

    if (user.name === "Aamu"){
        friendsResult = [{
```

```
          name : 'Alice'
        }, {
          name: 'Bob'
        }];
    }

    callback(null, friendsResult);
  }, 500);
}

async.waterfall([
    getUserRequest,
    getUserFriendsRequest
  ],
  function(err, results) {
    if (err) {
      return console.error(err);
    }

    console.log(JSON.stringify(results));
  });
```

Result: `results` contains the second callback parameter of the last function of the waterfall, which is `friendsResult` in that case.

async.times(To handle for loop in better way)

To execute a function within a loop in node.js, it's fine to use a `for` loop for short loops. But the loop is long, using `for` loop will increase the time of processing which might cause the node process to hang. In such scenarios, you can use: **asycn.times**

```
function recursiveAction(n, callback)
{
    //do whatever want to do repeatedly
    callback(err, result);
}
async.times(5, function(n, next) {
    recursiveAction(n, function(err, result) {
        next(err, result);
    });
}, function(err, results) {
    // we should now have 5 result
});
```

This is called in parallel. When we want to call it one at a time, use: **async.timesSeries**

async.each(To handle array of data efficiently)

When we want to handle array of data, its better to use **async.each**. When we want to perform something with all data & want to get the final callback once everything is done, then this method will be useful. This is handled in parallel way.

```
function createUser(userName, callback)
{
```

```
    //create user in db
    callback(null)//or error based on creation
}

var arrayOfData = ['Ritu', 'Sid', 'Tom'];
async.each(arrayOfData, function(eachUserName, callback) {

    // Perform operation on each user.
    console.log('Creating user '+eachUserName);
    //Returning callback is must. Else it wont get the final callback, even if we miss to
return one callback
    createUser(eachUserName, callback);

}, function(err) {
    //If any of the user creation failed may throw error.
    if( err ) {
      // One of the iterations produced an error.
      // All processing will now stop.
      console.log('unable to create user');
    } else {
      console.log('All user created successfully');
    }
});
```

To do one at a time can use **async.eachSeries**

async.series(To handle events one by one)

/In async.series,all the functions are executed in series and the consolidated outputs of each function is passed to the final callback. e.g/

var async = require('async'); async.series([function (callback) { console.log('First Execute..'); callback(null, 'userPersonalData'); }, function (callback) { console.log('Second Execute.. '); callback(null, 'userDependentData'); }], function (err, result) { console.log(result); });

//Output:

First Execute.. Second Execute.. ['userPersonalData','userDependentData'] //result

Read async.js online: https://riptutorial.com/node-js/topic/3972/async-js

Chapter 4: Async/Await

Introduction

Async/await is a set of keywords that allows writing of asynchronous code in a procedural manner without having to rely on callbacks (*callback hell*) or promise-chaining (`.then().then().then()`).

This works by using the `await` keyword to suspend the state of an async function, until the resolution of a promise, and using the `async` keyword to declare such async functions, which return a promise.

Async/await is available from node.js 8 by default or 7 using the flag `--harmony-async-await`.

Examples

Async Functions with Try-Catch Error Handling

One of the best features of async/await syntax is that standard try-catch coding style is possible, just like you were writing synchronous code.

```
const myFunc = async (req, res) => {
  try {
    const result = await somePromise();
  } catch (err) {
    // handle errors here
  }
});
```

Here's an example with Express and promise-mysql:

```
router.get('/flags/:id', async (req, res) => {

  try {

    const connection = await pool.createConnection();

    try {
      const sql = `SELECT f.id, f.width, f.height, f.code, f.filename
                   FROM flags f
                   WHERE f.id = ?
                   LIMIT 1`;
      const flags = await connection.query(sql, req.params.id);
      if (flags.length === 0)
        return res.status(404).send({ message: 'flag not found' });

      return res.send({ flags[0] });

    } finally {
      pool.releaseConnection(connection);
    }
```

```
  } catch (err) {
    // handle errors here
  }
});
```

Comparison between Promises and Async/Await

Function using promises:

```
function myAsyncFunction() {
    return aFunctionThatReturnsAPromise()
           // doSomething is a sync function
           .then(result => doSomething(result))
           .catch(handleError);
}
```

So here is when Async/Await enter in action in order to get cleaner our function:

```
async function myAsyncFunction() {
  let result;

  try {
      result = await aFunctionThatReturnsAPromise();
  } catch (error) {
      handleError(error);
  }

  // doSomething is a sync function
  return doSomething(result);
}
```

So the keyword `async` would be similar to write `return new Promise((resolve, reject) => {...}`.

And `await` similar to get your result in `then` callback.

Here I leave a pretty brief gif that will not left any doubt in mind after seeing it:

GIF

Progression from Callbacks

In the beginning there were callbacks, and callbacks were ok:

```
const getTemperature = (callback) => {
  http.get('www.temperature.com/current', (res) => {
    callback(res.data.temperature)
  })
}

const getAirPollution = (callback) => {
  http.get('www.pollution.com/current', (res) => {
    callback(res.data.pollution)
  });
}
```

```
getTemperature(function(temp) {
  getAirPollution(function(pollution) {
    console.log(`the temp is ${temp} and the pollution is ${pollution}.`)
    // The temp is 27 and the pollution is 0.5.
  })
})
```

But there were a few really frustrating issues with callbacks so we all started using promises.

```
const getTemperature = () => {
  return new Promise((resolve, reject) => {
    http.get('www.temperature.com/current', (res) => {
      resolve(res.data.temperature)
    })
  })
}

const getAirPollution = () => {
  return new Promise((resolve, reject) => {
    http.get('www.pollution.com/current', (res) => {
      resolve(res.data.pollution)
    })
  })
}

getTemperature()
.then(temp => console.log(`the temp is ${temp}`))
.then(() => getAirPollution())
.then(pollution => console.log(`and the pollution is ${pollution}`))
// the temp is 32
// and the pollution is 0.5
```

This was a bit better. Finally, we found async/await. Which still uses promises under the hood.

```
const temp = await getTemperature()
const pollution = await getAirPollution()
```

Stops execution at await

If the promise doesn't return anything, the async task can be completed using `await`.

```
try{
    await User.findByIdAndUpdate(user._id, {
        $push: {
            tokens: token
        }
    }).exec()
}catch(e){
    handleError(e)
}
```

Read Async/Await online: https://riptutorial.com/node-js/topic/6729/async-await

Chapter 5: Asynchronous programming

Introduction

Node is a programming language where everything could run on an asynchronous way. Below you could find some examples and the typical things of asynchronous working.

Syntax

- doSomething([args], function([argsCB]) { /* do something when done */});
- doSomething([args], ([argsCB]) => { /* do something when done */ });

Examples

Callback functions

Callback functions in JavaScript

Callback functions are common in JavaScript. Callback functions are possible in JavaScript because functions are first-class citizens.

Synchronous callbacks.

Callback functions can be synchronous or asynchronous. Since Asynchronous callback functions may be more complex here is a simple example of a synchronous callback function.

```
// a function that uses a callback named `cb` as a parameter
function getSyncMessage(cb) {
    cb("Hello World!");
}

console.log("Before getSyncMessage call");
// calling a function and sending in a callback function as an argument.
getSyncMessage(function(message) {
    console.log(message);
});
console.log("After getSyncMessage call");
```

The output for the above code is:

```
> Before getSyncMessage call
> Hello World!
> After getSyncMessage call
```

First we will step through how the above code is executed. This is more for those who do not

already understand the concept of callbacks if you do already understand it feel free to skip this paragraph. First the code is parsed and then the first interesting thing to happen is line 6 is executed which outputs `Before getSyncMessage call` to the console. Then line 8 is executed which calls the function `getSyncMessage` sending in an anonymous function as an argument for the parameter named `cb` in the `getSyncMessage` function. Execution is now done inside the `getSyncMessage` function on line 3 which executes the function `cb` which was just passed in, this call sends an argument string "Hello World" for the param named `message` in the passed in anonymous function. Execution then goes to line 9 which logs `Hello World!` to the console. Then the execution goes through the process of exiting the callstack (see also) hitting line 10 then line 4 then finally back to line 11.

Some information to know about callbacks in general:

- The function you send in to a function as a callback may be called zero times, once, or multiple times. It all depends on implementation.
- The callback function may be called synchronously or asynchronously and possibly both synchronously and asynchronously.
- Just like normal functions the names you give parameters to your function are not important but the order is. So for example on line 8 the parameter `message` could have been named `statement`, `msg`, or if you're being nonsensical something like `jellybean`. So you should know what parameters are sent into your callback so you can get them in the right order with proper names.

Asynchronous callbacks.

One thing to note about JavaScript is it is synchronous by default, but there are APIs given in the environment (browser, Node.js, etc.) that could make it asynchronous (there's more about that here).

Some common things that are asynchronous in JavaScript environments that accept callbacks:

- Events
- setTimeout
- setInterval
- the fetch API
- Promises

Also any function that uses one of the above functions may be wrapped with a function that takes a callback and the callback would then be an asynchronous callback (although wrapping a promises with a function that takes a callback would likely be considered an anti-pattern as there are more preferred ways to handle promises).

So given that information we can construct an asynchronous function similar to the above synchronous one.

```
// a function that uses a callback named `cb` as a parameter
function getAsyncMessage(cb) {
    setTimeout(function () { cb("Hello World!") }, 1000);
```

```
}

console.log("Before getSyncMessage call");
// calling a function and sending in a callback function as an argument.
getAsyncMessage(function(message) {
    console.log(message);
});
console.log("After getSyncMessage call");
```

Which prints the following to the console:

```
> Before getSyncMessage call
> After getSyncMessage call
// pauses for 1000 ms with no output
> Hello World!
```

Line execution goes to line 6 logs "Before getSyncMessage call". Then execution goes to line 8 calling getAsyncMessage with a callback for the param `cb`. Line 3 is then executed which calls setTimeout with a callback as the first argument and the number 300 as the second argument. `setTimeout` does whatever it does and holds on to that callback so that it can call it later in 1000 milliseconds, but following setting up the timeout and before it pauses the 1000 milliseconds it hands execution back to where it left off so it goes to line 4, then line 11, and then pauses for 1 second and setTimeout then calls its callback function which takes execution back to line 3 where `getAsyncMessages` callback is called with value "Hello World" for its parameter `message` which is then logged to the console on line 9.

Callback functions in Node.js

NodeJS has asynchronous callbacks and commonly supplies two parameters to your functions sometimes conventionally called `err` and `data`. An example with reading a file text.

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

fs.readFile("./test.txt", "utf8", function(err, data) {
    if(err) {
        // handle the error
    } else {
        // process the file text given with data
    }
});
```

This is an example of a callback that is called a single time.

It's good practice to handle the error somehow even if your just logging it or throwing it. The else is not necessary if you throw or return and can be removed to decrease indentation so long as you stop execution of the current function in the if by doing something like throwing or returning.

Though it may be common to see `err`, `data` it may not always be the case that your callbacks will use that pattern it's best to look at documentation.

Another example callback comes from the express library (express 4.x):

```
// this code snippet was on http://expressjs.com/en/4x/api.html
const express = require('express');
const app = express();

// this app.get method takes a url route to watch for and a callback
// to call whenever that route is requested by a user.
app.get('/', function(req, res){
  res.send('hello world');
});

app.listen(3000);
```

This example shows a callback that is called multiple times. The callback is provided with two objects as params named here as `req` and `res` these names correspond to request and response respectively, and they provide ways to view the request coming in and set up the response that will be sent to the user.

As you can see there are various ways a callback can be used to execute sync and async code in JavaScript and callbacks are very ubiquitous throughout JavaScript.

Code example

Question: What is the output of code below and why?

```
setTimeout(function() {
    console.log("A");
}, 1000);

setTimeout(function() {
    console.log("B");
}, 0);

getDataFromDatabase(function(err, data) {
    console.log("C");
    setTimeout(function() {
        console.log("D");
    }, 1000);
});

console.log("E");
```

Output: This is known for sure: `EBAD`. `C` is unknown when it will be logged.

Explanation: The compiler will not stop on the `setTimeout` and the `getDataFromDatabase` methodes. So the first line he will log is `E`. The callback functions *(first argument of `setTimeout`)* will run after the set timeout on a asynchronous way!

More details:

1. `E` has no `setTimeout`
2. `B` has a set timeout of 0 milliseconds
3. `A` has a set timeout of 1000 milliseconds

4. `D` must request a database, after it must `D` wait 1000 milliseconds so it comes after `A`.
5. `C` is unknown because it is unknown when the data of the database is requested. It could be before or after `A`.

Async error handling

Try catch

Errors must always be handled. If you are using synchronous programming you could use a `try catch`. But this does not work if you work asynchronous! Example:

```
try {
    setTimeout(function() {
        throw new Error("I'm an uncaught error and will stop the server!");
    }, 100);
}
catch (ex) {
    console.error("This error will not be work in an asynchronous situation: " + ex);
}
```

Async errors will only be handled inside the callback function!

Working possibilities

v0.8

Event handlers

The first versions of Node.JS got an event handler.

```
process.on("UncaughtException", function(err, data) {
    if (err) {
        // error handling
    }
});
```

v0.8

Domains

Inside a domain, the errors are release via the event emitters. By using this are all errors, timers, callback methodes implicitly only registrated inside the domain. By an error, be an error event send and didn't crash the application.

```
var domain = require("domain");
var d1 = domain.create();
var d2 = domain.create();
```

```
d1.run(function() {
    d2.add(setTimeout(function() {
        throw new Error("error on the timer of domain 2");
    }, 0));
});

d1.on("error", function(err) {
    console.log("error at domain 1: " + err);
});

d2.on("error", function(err) {
    console.log("error at domain 2: " + err);
});
```

Callback hell

Callback hell (also a pyramid of doom or boomerang effect) arises when you nest too many callback functions inside a callback function. Here is an example to read a file (in ES6).

```
const fs = require('fs');
let filename = `${__dirname}/myfile.txt`;

fs.exists(filename, exists => {
    if (exists) {
        fs.stat(filename, (err, stats) => {
            if (err) {
                throw err;
            }
            if (stats.isFile()) {
                fs.readFile(filename, null, (err, data) => {
                    if (err) {
                        throw err;
                    }
                    console.log(data);
                });
            }
            else {
                throw new Error("This location contains not a file");
            }
        });
    }
    else {
        throw new Error("404: file not found");
    }
});
```

How to avoid "Callback Hell"

It is recommended to nest no more than 2 callback functions. This will help you maintain code readability and will me much easier to maintain in the future. If you have a need to nest more than 2 callbacks, try to make use of distributed events instead.

There also exists a library called async that helps manage callbacks and their execution available on npm. It increases the readability of callback code and gives you more control over your callback code flow, including allowing you to run them in parallel or in series.

Native Promises

v6.0.0

Promises are a tool for async programming. In JavaScript promises are known for their `then` methods. Promises have two main states 'pending' and 'settled'. Once a promise is 'settled' it cannot go back to 'pending'. This means that promises are mostly good for events that only occur once. The 'settled' state has two states as well 'resolved' and 'rejected'. You can create a new promise using the `new` keyword and passing a function into the constructor `new Promise(function (resolve, reject) {})`.

The function passed into the Promise constructor always receives a first and second parameter usually named `resolve` and `reject` respectively. The naming of these two parameters is convention, but they will put the promise into either the 'resolved' state or the 'rejected' state. When either one of these is called the promise goes from being 'pending' to 'settled'. `resolve` is called when the desired action, which is often asynchronous, has been performed and `reject` is used if the action has errored.

In the below timeout is a function that returns a Promise.

```
function timeout (ms) {
  return new Promise(function (resolve, reject) {
    setTimeout(function () {
      resolve("It was resolved!");
    }, ms)
  });
}

timeout(1000).then(function (dataFromPromise) {
  // logs "It was resolved!"
  console.log(dataFromPromise);
})

console.log("waiting...");
```

console output

```
waiting...
// << pauses for one second>>
It was resolved!
```

When timeout is called the function passed to the Promise constructor is executed without delay. Then the setTimeout method is executed and its callback is set to fire in the next `ms` milliseconds, in this case `ms=1000`. Since the callback to the setTimeout isn't fired yet the timeout function returns control to the calling scope. The chain of `then` methods are then stored to be called later when/if the Promise has resolved. If there were `catch` methods here they would be stored as well, but would be fired when/if the promise 'rejects'.

The script then prints 'waiting...'. One second later the setTimeout calls its callback which calls the resolve function with the string "It was resolved!". That string is then passed into the `then` method's callback and is then logged to the user.

In the same sense you can wrap the asynchronous setTimeout function which requires a callback you can wrap any singular asynchronous action with a promise.

Read more about promises in the JavaScript documentation Promises.

Read Asynchronous programming online: https://riptutorial.com/node-js/topic/8813/asynchronous-programming

Chapter 6: Autoreload on changes

Examples

Autoreload on source code changes using nodemon

The nodemon package makes it possible to automatically reload your program when you modify any file in the source code.

Installing nodemon globally

`npm install -g nodemon` (or `npm i -g nodemon`)

Installing nodemon locally

In case you don't want to install it globally

`npm install --save-dev nodemon` (or `npm i -D nodemon`)

Using nodemon

Run your program with `nodemon entry.js` (or `nodemon entry`)

This replaces the usual use of `node entry.js` (or `node entry`).

You can also add your nodemon startup as an npm script, which might be useful if you want to supply parameters and not type them out every time.

Add **package.json:**

```
  "scripts": {
    "start": "nodemon entry.js -devmode -something 1"
  }
```

This way you can just use `npm start` from your console.

Browsersync

Overview

Browsersync is a tool that allows for live file watching and browser reloading. It's available as a NPM package.

Installation

To install Browsersync you'll first need to have Node.js and NPM installed. For more information see the SO documentation on Installing and Running Node.js.

Once your project is set up you can install Browsersync with the following command:

```
$ npm install browser-sync -D
```

This will install Browsersync in the local `node_modules` directory and save it to your developer dependencies.

If you'd rather install it globally use the `-g` flag in place of the `-D` flag.

Windows Users

If you're having trouble installing Browsersync on Windows you may need to install Visual Studio so you can access the build tools to install Browsersync. You'll then need to specify the version of Visual Studio you're using like so:

```
$ npm install browser-sync --msvs_version=2013 -D
```

This command specifies the 2013 version of Visual Studio.

Basic Usage

To automatically reload your site whenever you change a JavaScript file in your project use the following command:

```
$ browser-sync start --proxy "myproject.dev" --files "**/*.js"
```

Replace `myproject.dev` with the web address that you are using to access your project. Browsersync will output an alternate address that can be used to access your site through the proxy.

Advanced Usage

Besides the command line interface that was described above Browsersync can also be used with Grunt.js and Gulp.js.

Grunt.js

Usage with Grunt.js requires a plugin that can be installed like so:

```
$ npm install grunt-browser-sync -D
```

Then you'll add this line to your `gruntfile.js`:

```
grunt.loadNpmTasks('grunt-browser-sync');
```

Gulp.js

Browsersync works as a CommonJS module, so there's no need for a Gulp.js plugin. Simply require the module like so:

```
var browserSync = require('browser-sync').create();
```

You can now use the Browsersync API to configure it to your needs.

API

The Browsersync API can be found here: https://browsersync.io/docs/api

Read Autoreload on changes online: https://riptutorial.com/node-js/topic/1743/autoreload-on-changes

Chapter 7: Avoid callback hell

Examples

Async module

The source is available for download from GitHub. Alternatively, you can install using npm:

$ npm install --save async

As well as using Bower:

$ bower install async

Example:

```
var async = require("async");
async.parallel([
    function(callback) { ... },
    function(callback) { ... }
], function(err, results) {
    // optional callback
});
```

Async Module

Thankfully, libraries like Async.js exist to try and curb the problem. Async adds a thin layer of functions on top of your code, but can greatly reduce the complexity by avoiding callback nesting.

Many helper methods exist in Async that can be used in different situations, like series, parallel, waterfall, etc. Each function has a specific use-case, so take some time to learn which one will help in which situations.

As good as Async is, like anything, its not perfect. Its very easy to get carried away by combining series, parallel, forever, etc, at which point you're right back to where you started with messy code. Be careful not to prematurely optimize. Just because a few async tasks can be run in parallel doesn't always mean they should. In reality, since Node is only single-threaded, running tasks in parallel on using Async has little to no performance gain.

The source is available for download from https://github.com/caolan/async . Alternatively, you can install using npm:

$ npm install --save async

As well as using Bower:

$ bower install async

Async's waterfall Example:

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

var myFile = '/tmp/test';

async.waterfall([
    function(callback) {
        fs.readFile(myFile, 'utf8', callback);
    },
    function(txt, callback) {
        txt = txt + '\nAppended something!';
        fs.writeFile(myFile, txt, callback);
    }
], function (err, result) {
    if(err) return console.log(err);
    console.log('Appended text!');
});
```

Read Avoid callback hell online: https://riptutorial.com/node-js/topic/10045/avoid-callback-hell

Chapter 8: Bluebird Promises

Examples

Converting nodeback library to Promises

```
const Promise = require('bluebird'),
      fs = require('fs')

Promise.promisifyAll(fs)

// now you can use promise based methods on 'fs' with the Async suffix
fs.readFileAsync('file.txt').then(contents => {
  console.log(contents)
}).catch(err => {
  console.error('error reading', err)
})
```

Functional Promises

Example of map:

```
Promise.resolve([ 1, 2, 3 ]).map(el => {
   return Promise.resolve(el * el) // return some async operation in real world
})
```

Example of filter:

```
Promise.resolve([ 1, 2, 3 ]).filter(el => {
  return Promise.resolve(el % 2 === 0) // return some async operation in real world
}).then(console.log)
```

Example of reduce:

```
Promise.resolve([ 1, 2, 3 ]).reduce((prev, curr) => {
  return Promise.resolve(prev + curr) // return some async operation in real world
}).then(console.log)
```

Coroutines (Generators)

```
const promiseReturningFunction = Promise.coroutine(function* (file) {
  const data = yield fs.readFileAsync(file) // this returns a Promise and resolves to the file
contents

  return data.toString().toUpperCase()
})

promiseReturningFunction('file.txt').then(console.log)
```

Automatic Resource Disposal (Promise.using)

```
function somethingThatReturnsADisposableResource() {
  return getSomeResourceAsync(...).disposer(resource => {
    resource.dispose()
  })
}

Promise.using(somethingThatReturnsADisposableResource(), resource => {
  // use the resource here, the disposer will automatically close it when Promise.using exits
})
```

Executing in series

```
Promise.resolve([1, 2, 3])
  .mapSeries(el => Promise.resolve(el * el)) // in real world, use Promise returning async
function
  .then(console.log)
```

Read Bluebird Promises online: https://riptutorial.com/node-js/topic/6728/bluebird-promises

Chapter 9: Callback to Promise

Examples

Promisifying a callback

Callback-based:

```
db.notification.email.find({subject: 'promisify callback'}, (error, result) => {
   if (error) {
       console.log(error);
   }

   // normal code here
});
```

This uses bluebird's promisifyAll method to promisify what is conventionally callback-based code like above. bluebird will make a promise version of all the methods in the object, those promise-based methods names has Async appended to them:

```
let email = bluebird.promisifyAll(db.notification.email);

email.findAsync({subject: 'promisify callback'}).then(result => {

    // normal code here
})
.catch(console.error);
```

If only specific methods need to be promisified, just use its promisify:

```
let find = bluebird.promisify(db.notification.email.find);

find({locationId: 168}).then(result => {

    // normal code here
});
.catch(console.error);
```

There are some libraries (e.g., MassiveJS) that can't be promisified if the immediate object of the method is not passed on second parameter. In that case, just pass the immediate object of the method that need to be promisified on second parameter and enclosed it in context property.

```
let find = bluebird.promisify(db.notification.email.find, { context: db.notification.email });

find({locationId: 168}).then(result => {

    // normal code here
});
.catch(console.error);
```

Manually promisifying a callback

Sometimes it might be necessary to manually promisify a callback function. This could be for a case where the callback does not follow the standard error-first format or if additional logic is needed to promisify:

Example with fs.exists(path, callback):

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

var existsAsync = function(path) {
  return new Promise(function(resolve, reject) {
    fs.exists(path, function(exists) {
      // exists is a boolean
      if (exists) {
        // Resolve successfully
        resolve();
      } else {
        // Reject with error
        reject(new Error('path does not exist'));
      }
    });
});

// Use as a promise now
existsAsync('/path/to/some/file').then(function() {
  console.log('file exists!');
}).catch(function(err) {
  // file does not exist
  console.error(err);
});
```

setTimeout promisified

```
function wait(ms) {
    return new Promise(function (resolve, reject) {
        setTimeout(resolve, ms)
    })
}
```

Read Callback to Promise online: https://riptutorial.com/node-js/topic/2346/callback-to-promise

Chapter 10: Cassandra Integration

Examples

Hello world

For accessing Cassandra `cassandra-driver` module from DataStax can be used. It supports all the features and can be easily configured.

```
const cassandra = require("cassandra-driver");
const clientOptions = {
    contactPoints: ["host1", "host2"],
    keyspace: "test"
};

const client = new cassandra.Client(clientOptions);

const query = "SELECT hello FROM world WHERE name = ?";
client.execute(query, ["John"], (err, results) => {
    if (err) {
      return console.error(err);
    }

    console.log(results.rows);
});
```

Read Cassandra Integration online: https://riptutorial.com/node-js/topic/5949/cassandra-integration

Chapter 11: CLI

Syntax

- node [options] [v8 options] [script.js | -e "script"] [arguments]

Examples

Command Line Options

```
-v, --version
```

Added in: v0.1.3 Print node's version.

```
-h, --help
```

Added in: v0.1.3 Print node command line options. The output of this option is less detailed than this document.

```
-e, --eval "script"
```

Added in: v0.5.2 Evaluate the following argument as JavaScript. The modules which are predefined in the REPL can also be used in script.

```
-p, --print "script"
```

Added in: v0.6.4 Identical to -e but prints the result.

```
-c, --check
```

Added in: v5.0.0 Syntax check the script without executing.

```
-i, --interactive
```

Added in: v0.7.7 Opens the REPL even if stdin does not appear to be a terminal.

```
-r, --require module
```

Added in: v1.6.0 Preload the specified module at startup.

Follows require()'s module resolution rules. module may be either a path to a file, or a node module name.

```
--no-deprecation
```

Added in: v0.8.0 Silence deprecation warnings.

```
--trace-deprecation
```

Added in: v0.8.0 Print stack traces for deprecations.

```
--throw-deprecation
```

Added in: v0.11.14 Throw errors for deprecations.

```
--no-warnings
```

Added in: v6.0.0 Silence all process warnings (including deprecations).

```
--trace-warnings
```

Added in: v6.0.0 Print stack traces for process warnings (including deprecations).

```
--trace-sync-io
```

Added in: v2.1.0 Prints a stack trace whenever synchronous I/O is detected after the first turn of the event loop.

```
--zero-fill-buffers
```

Added in: v6.0.0 Automatically zero-fills all newly allocated Buffer and SlowBuffer instances.

```
--preserve-symlinks
```

Added in: v6.3.0 Instructs the module loader to preserve symbolic links when resolving and caching modules.

By default, when Node.js loads a module from a path that is symbolically linked to a different on-disk location, Node.js will dereference the link and use the actual on-disk "real path" of the module as both an identifier and as a root path to locate other dependency modules. In most cases, this default behavior is acceptable. However, when using symbolically linked peer dependencies, as illustrated in the example below, the default behavior causes an exception to be thrown if moduleA attempts to require moduleB as a peer dependency:

```
{appDir}
 ├── app
 │   ├── index.js
 │   └── node_modules
 │       ├── moduleA -> {appDir}/moduleA
 │       └── moduleB
 │           ├── index.js
 │           └── package.json
 └── moduleA
     ├── index.js
```

```
    └── package.json
```

The --preserve-symlinks command line flag instructs Node.js to use the symlink path for modules as opposed to the real path, allowing symbolically linked peer dependencies to be found.

Note, however, that using --preserve-symlinks can have other side effects. Specifically, symbolically linked native modules can fail to load if those are linked from more than one location in the dependency tree (Node.js would see those as two separate modules and would attempt to load the module multiple times, causing an exception to be thrown).

```
--track-heap-objects
```

Added in: v2.4.0 Track heap object allocations for heap snapshots.

```
--prof-process
```

Added in: v6.0.0 Process v8 profiler output generated using the v8 option --prof.

```
--v8-options
```

Added in: v0.1.3 Print v8 command line options.

Note: v8 options allow words to be separated by both dashes (-) or underscores (_).

For example, --stack-trace-limit is equivalent to --stack_trace_limit.

```
--tls-cipher-list=list
```

Added in: v4.0.0 Specify an alternative default TLS cipher list. (Requires Node.js to be built with crypto support. (Default))

```
--enable-fips
```

Added in: v6.0.0 Enable FIPS-compliant crypto at startup. (Requires Node.js to be built with ./configure --openssl-fips)

```
--force-fips
```

Added in: v6.0.0 Force FIPS-compliant crypto on startup. (Cannot be disabled from script code.) (Same requirements as --enable-fips)

```
--icu-data-dir=file
```

Added in: v0.11.15 Specify ICU data load path. (overrides NODE_ICU_DATA)

```
Environment Variables
```

```
NODE_DEBUG=module[,…]
```

Added in: v0.1.32 ','-separated list of core modules that should print debug information.

```
NODE_PATH=path[:…]
```

Added in: v0.1.32 ':'-separated list of directories prefixed to the module search path.

Note: on Windows, this is a ';'-separated list instead.

```
NODE_DISABLE_COLORS=1
```

Added in: v0.3.0 When set to 1 colors will not be used in the REPL.

```
NODE_ICU_DATA=file
```

Added in: v0.11.15 Data path for ICU (Intl object) data. Will extend linked-in data when compiled with small-icu support.

```
NODE_REPL_HISTORY=file
```

Added in: v5.0.0 Path to the file used to store the persistent REPL history. The default path is ~/.node_repl_history, which is overridden by this variable. Setting the value to an empty string ("" or " ") disables persistent REPL history.

Read CLI online: https://riptutorial.com/node-js/topic/6013/cli

Chapter 12: Client-server communication

Examples

/w Express, jQuery and Jade

```
//'client.jade'

//a button is placed down; similar in HTML
button(type='button', id='send_by_button') Modify data

    #modify Lorem ipsum Sender

    //loading jQuery; it can be done from an online source as well
    script(src='./js/jquery-2.2.0.min.js')

    //AJAX request using jQuery
    script
        $(function () {
            $('#send_by_button').click(function (e) {
                e.preventDefault();

                //test: the text within brackets should appear when clicking on said button
                //window.alert('You clicked on me.  - jQuery');

                //a variable and a JSON initialized in the code
                var predeclared = "Katamori";
                var data = {
                    Title: "Name_SenderTest",
                    Nick: predeclared,
                    FirstName: "Zoltan",
                    Surname: "Schmidt"
                };

                //an AJAX request with given parameters
                $.ajax({
                    type: 'POST',
                    data: JSON.stringify(data),
                    contentType: 'application/json',
                    url: 'http://localhost:7776/domaintest',

                    //on success, received data is used as 'data' function input
                    success: function (data) {
                        window.alert('Request sent; data received.');

                        var jsonstr = JSON.stringify(data);
                        var jsonobj = JSON.parse(jsonstr);

                        //if the 'nick' member of the JSON does not equal to the predeclared
string (as it was initialized), then the backend script was executed, meaning that
communication has been established
                        if(data.Nick != predeclared){
                            document.getElementById("modify").innerHTML = "JSON changed!\n" +
jsonstr;
                        };

                    }
```

```
                });
            });
            });

//'domaintest_route.js'

var express = require('express');
var router = express.Router();

//an Express router listening to GET requests - in this case, it's empty, meaning that nothing
is displayed when you reach 'localhost/domaintest'
router.get('/', function(req, res, next) {
});

//same for POST requests - notice, how the AJAX request above was defined as POST
router.post('/', function(req, res) {
    res.setHeader('Content-Type', 'application/json');

    //content generated here
    var some_json = {
        Title: "Test",
        Item: "Crate"
    };

    var result = JSON.stringify(some_json);

    //content got 'client.jade'
    var sent_data = req.body;
    sent_data.Nick = "ttony33";

    res.send(sent_data);

});


module.exports = router;
```

//based on a personally used gist: https://gist.github.com/Katamori/5c9850f02e4baf6e9896

Read Client-server communication online: https://riptutorial.com/node-js/topic/6222/client-server-communication

Chapter 13: Cluster Module

Syntax

- const cluster = require("cluster")
- cluster.fork()
- cluster.isMaster
- cluster.isWorker
- cluster.schedulingPolicy
- cluster.setupMaster(settings)
- cluster.settings
- cluster.worker // in worker
- cluster.workers // in master

Remarks

Note that `cluster.fork()` spawns a child process that begins executing the current script from the beginning, in contrast to the `fork()` system call in *C* which clones the current process and continues from the instruction after the system call in both parent and child process.

The Node.js Documentation has a more complete guide to clusters here

Examples

Hello World

This is your `cluster.js`:

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

if (cluster.isMaster) {
  // Fork workers.
  for (let i = 0; i < numCPUs; i++) {
    cluster.fork();
  }

  cluster.on('exit', (worker, code, signal) => {
    console.log(`worker ${worker.process.pid} died`);
  });
} else {
  // Workers can share any TCP connection
  // In this case it is an HTTP server
  require('./server.js')();
}
```

This is your main `server.js`:

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

function startServer() {
    const server = http.createServer((req, res) => {
      res.writeHead(200);
      res.end('Hello Http');
    });

    server.listen(3000);
}

if(!module.parent) {
    // Start server if file is run directly
    startServer();
} else {
    // Export server, if file is referenced via cluster
    module.exports = startServer;
}
```

In this example, we host a basic web server, however, we spin up workers (child processes) using the built-in **cluster** module. The number of processes forker depend on the number of CPU cores available. This enables a Node.js application to take advantage of multi-core CPUs, since a single instance of Node.js runs in a single thread. The application will now share the port 8000 across all the processes. Loads will automatically be distributed between workers using the Round-Robin method by default.

Cluster Example

A single instance of `Node.js` runs in a single thread. To take advantage of multi-core systems, application can be launched in a cluster of Node.js processes to handle the load.

The `cluster` module allows you to easily create child processes that all share server ports.

Following example create the worker child process in main process that handles the load across multiple cores.

Example

```
const cluster = require('cluster');
const http = require('http');
const numCPUs = require('os').cpus().length; //number of CPUS

if (cluster.isMaster) {
  // Fork workers.
  for (var i = 0; i < numCPUs; i++) {
    cluster.fork();    //creating child process
  }

  //on exit of cluster
  cluster.on('exit', (worker, code, signal) => {
      if (signal) {
        console.log(`worker was killed by signal: ${signal}`);
      } else if (code !== 0) {
        console.log(`worker exited with error code: ${code}`);
      } else {
```

```
        console.log('worker success!');
      }
  });
} else {
  // Workers can share any TCP connection
  // In this case it is an HTTP server
  http.createServer((req, res) => {
    res.writeHead(200);
    res.end('hello world\n');
  }).listen(3000);
}
```

Read Cluster Module online: https://riptutorial.com/node-js/topic/2817/cluster-module

Chapter 14: Connect to Mongodb

Introduction

MongoDB is a free and open-source cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schemas.

For more details go to https://www.mongodb.com/

Syntax

- MongoClient.connect('mongodb://127.0.0.1:27017/crud',function (err,db) {//do womething here});

Examples

Simple example to Connect mongoDB from Node.JS

```
MongoClient.connect('mongodb://localhost:27017/myNewDB',function (err,db) {
    if(err)
        console.log("Unable to connect DB. Error: " + err)
    else
        console.log('Connected to DB');

    db.close();
});
```

myNewDB is DB name, if it does not exists in database then it will create automatically with this call.

Simple way to Connect mongoDB with core Node.JS

```
  var MongoClient = require('mongodb').MongoClient;

    //connection with mongoDB
    MongoClient.connect("mongodb://localhost:27017/MyDb", function (err, db) {
          //check the connection
 if(err){
           console.log("connection failed.");
}else{
                    console.log("successfully connected to mongoDB.");
    });
```

Read Connect to Mongodb online: https://riptutorial.com/node-js/topic/6280/connect-to-mongodb

Chapter 15: Creating a Node.js Library that Supports Both Promises and Error-First Callbacks

Introduction

Many people like working with promises and/or async/await syntax, but when writing a module it would be useful to some programmers to support classic callback style methods as well. Rather than creating two modules, or two sets of functions, or having the programmer promisify your module, your module can support both programming methods at one using bluebird's asCallback() or Q's nodeify().

Examples

Example Module and Corresponding Program using Bluebird

math.js

```
'use strict';

const Promise = require('bluebird');

module.exports = {

  // example of a callback-only method
  callbackSum: function(a, b, callback) {
    if (typeof a !== 'number')
      return callback(new Error('"a" must be a number'));
    if (typeof b !== 'number')
      return callback(new Error('"b" must be a number'));

    return callback(null, a + b);
  },

  // example of a promise-only method
  promiseSum: function(a, b) {
    return new Promise(function(resolve, reject) {
      if (typeof a !== 'number')
        return reject(new Error('"a" must be a number'));
      if (typeof b !== 'number')
        return reject(new Error('"b" must be a number'));
      resolve(a + b);
    });
  },

  // a method that can be used as a promise or with callbacks
  sum: function(a, b, callback) {
    return new Promise(function(resolve, reject) {
      if (typeof a !== 'number')
        return reject(new Error('"a" must be a number'));
```

```
      if (typeof b !== 'number')
        return reject(new Error('"b" must be a number'));
      resolve(a + b);
    }).asCallback(callback);
  },

};
```

index.js

```
'use strict';

const math = require('./math');


// classic callbacks

math.callbackSum(1, 3, function(err, result) {
  if (err)
    console.log('Test 1: ' + err);
  else
    console.log('Test 1: the answer is ' + result);
});

math.callbackSum(1, 'd', function(err, result) {
  if (err)
    console.log('Test 2: ' + err);
  else
    console.log('Test 2: the answer is ' + result);
});


// promises

math.promiseSum(2, 5)
.then(function(result) {
  console.log('Test 3: the answer is ' + result);
})
.catch(function(err) {
  console.log('Test 3: ' + err);
});

math.promiseSum(1)
.then(function(result) {
  console.log('Test 4: the answer is ' + result);
})
.catch(function(err) {
  console.log('Test 4: ' + err);
});


// promise/callback method used like a promise

math.sum(8, 2)
.then(function(result) {
  console.log('Test 5: the answer is ' + result);
})
.catch(function(err) {
  console.log('Test 5: ' + err);
});
```

```
// promise/callback method used with callbacks

math.sum(7, 11, function(err, result) {
  if (err)
    console.log('Test 6: ' + err);
  else
    console.log('Test 6: the answer is ' + result);
});


// promise/callback method used like a promise with async/await syntax

(async () => {

  try {
    let x = await math.sum(6, 3);
    console.log('Test 7a: ' + x);

    let y = await math.sum(4, 's');
    console.log('Test 7b: ' + y);

  } catch(err) {
    console.log(err.message);
  }

})();
```

Read Creating a Node.js Library that Supports Both Promises and Error-First Callbacks online: https://riptutorial.com/node-js/topic/9874/creating-a-node-js-library-that-supports-both-promises-and-error-first-callbacks

Chapter 16: Creating API's with Node.js

Examples

GET api using Express

`Node.js` apis can be easily constructed in `Express` web framework.

Following example creates a simple `GET` api for listing all users.

Example

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

var users =[{
        id: 1,
        name: "John Doe",
        age : 23,
        email: "john@doe.com"
    }];

// GET /api/users
app.get('/api/users', function(req, res){
    return res.json(users);    //return response as JSON
});

app.listen('3000', function(){
    console.log('Server listening on port 3000');
});
```

POST api using Express

Following example create `POST` api using `Express`. This example is similar to `GET` example except the use of `body-parser` that parses the post data and add it to `req.body`.

Example

```
var express = require('express');
var app = express();
// for parsing the body in POST request
var bodyParser = require('body-parser');

var users =[{
    id: 1,
    name: "John Doe",
    age : 23,
    email: "john@doe.com"
}];

app.use(bodyParser.urlencoded({ extended: false }));
app.use(bodyParser.json());
```

```
// GET /api/users
app.get('/api/users', function(req, res){
    return res.json(users);
});


/* POST /api/users
    {
        "user": {
           "id": 3,
            "name": "Test User",
            "age" : 20,
            "email": "test@test.com"
        }
    }
*/
app.post('/api/users', function (req, res) {
    var user = req.body.user;
    users.push(user);

    return res.send('User has been added successfully');
});

app.listen('3000', function(){
    console.log('Server listening on port 3000');
});
```

Read Creating API's with Node.js online: https://riptutorial.com/node-js/topic/5991/creating-api-s-with-node-js

Chapter 17: csv parser in node js

Introduction

Reading data in from a csv can be handled in many ways. One solution is to read the `csv` file into an array. From there you can do work on the array.

Examples

Using FS to read in a CSV

fs is the File System API in node. We can use the method readFile on our fs variable, pass it a `data.csv` file, format and function that reads and splits the `csv` for further processing.

This assumes you have a file named `data.csv` in the same folder.

```
'use strict'

const fs = require('fs');

fs.readFile('data.csv', 'utf8', function (err, data) {
  var dataArray = data.split(/\r?\n/);
  console.log(dataArray);
});
```

You can now use the array like any other to do work on it.

Read csv parser in node js online: https://riptutorial.com/node-js/topic/9162/csv-parser-in-node-js

Chapter 18: Database (MongoDB with Mongoose)

Examples

Mongoose connection

Make sure to have mongodb running first! `mongod --dbpath data/`

package.json

```
"dependencies": {
    "mongoose": "^4.5.5",
}
```

server.js (ECMA 6)

```
import mongoose from 'mongoose';

mongoose.connect('mongodb://localhost:27017/stackoverflow-example');
const db = mongoose.connection;
db.on('error', console.error.bind(console, 'DB connection error!'));
```

server.js (ECMA 5.1)

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

mongoose.connect('mongodb://localhost:27017/stackoverflow-example');
var db = mongoose.connection;
db.on('error', console.error.bind(console, 'DB connection error!'));
```

Model

Define your model(s):

app/models/user.js (ECMA 6)

```
import mongoose from 'mongoose';

const userSchema = new mongoose.Schema({
    name: String,
    password: String
});

const User = mongoose.model('User', userSchema);

export default User;
```

app/model/user.js (ECMA 5.1)

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

var userSchema = new mongoose.Schema({
    name: String,
    password: String
});

var User = mongoose.model('User', userSchema);

module.exports = User
```

Insert data

ECMA 6:

```
const user = new User({
   name: 'Stack',
   password: 'Overflow',
   }) ;

user.save((err) => {
    if (err) throw err;

    console.log('User saved!');
});
```

ECMA5.1:

```
var user = new User({
   name: 'Stack',
   password: 'Overflow',
   }) ;

user.save(function (err) {
    if (err) throw err;

    console.log('User saved!');
});
```

Read data

ECMA6:

```
User.findOne({
    name: 'stack'
}, (err, user) => {
    if (err) throw err;

    if (!user) {
        console.log('No user was found');
    } else {
        console.log('User was found');
    }
```

```
});
```

ECMA5.1:

```
User.findOne({
    name: 'stack'
}, function (err, user) {
    if (err) throw err;

    if (!user) {
        console.log('No user was found');
    } else {
        console.log('User was found');
    }
});
```

Read Database (MongoDB with Mongoose) online: https://riptutorial.com/node-js/topic/6411/database--mongodb-with-mongoose-

Chapter 19: Debugging Node.js application

Examples

Core node.js debugger and node inspector

Using core debugger

Node.js provides a build in non graphical debugging utility. To start the build in the debugger, start the application with this command:

```
node debug filename.js
```

Consider the following simple Node.js application contained in the `debugDemo.js`

```
'use strict';

function addTwoNumber(a, b){
// function returns the sum of the two numbers
debugger
  return a + b;
}

var result = addTwoNumber(5, 9);
console.log(result);
```

The keyword `debugger` will stop the debugger at that point in the code.

Command reference

1. Stepping

```
cont, c - Continue execution
next, n - Step next
step, s - Step in
out, o - Step out
```

2. Breakpoints

```
setBreakpoint(), sb() - Set breakpoint on current line
setBreakpoint(line), sb(line) - Set breakpoint on specific line
```

To Debug the above code run the following command

```
node debug debugDemo.js
```

Once the above commands runs you will see the following output. To exit from the debugger interface, type `process.exit()`

```
ankuranand:~/workspace/nodejs/nodejsDebugging $ node debug debugDemo.js
< Debugger listening on port 5858
debug> . ok
break in debugDemo.js:3
  1 // A Demo Code Showing the basic capabilities of the nodejs  debugging module
  2
> 3 'use strict';
  4
  5 function addTwoNumber(a, b){
debug> n
break in debugDemo.js:11
  9 }
 10
>11 let result = addTwoNumber(5, 9);
 12 console.log(result);
 13
debug> c
break in debugDemo.js:7
  5 function addTwoNumber(a, b){
  6 // function returns the sum of the two numbers
> 7 debugger
  8   return a + b;
  9 }
debug> c
< 14
debug> process.exit()
ankuranand:~/workspace/nodejs/nodejsDebugging $
```

Use `watch(expression)` command to add the variable or expression whose value you want to watch and `restart` to restart the app and debugging.

Use `repl` to enter code interactively. The repl mode has the same context as the line you are debugging. This allows you to examine the contents of variables and test out lines of code. Press `Ctrl+C` to leave the debug repl.

Using Built-in Node inspector

v6.3.0

You can run node's built in v8 inspector! The node-inspector plug-in is not needed anymore.

Simply pass the inspector flag and you'll be provided with a URL to the inspector

```
node --inspect server.js
```

Using Node inspector

Install the node inspector:

```
npm install -g node-inspector
```

Run your app with the node-debug command:

```
node-debug filename.js
```

After that, hit in Chrome:

```
http://localhost:8080/debug?port=5858
```

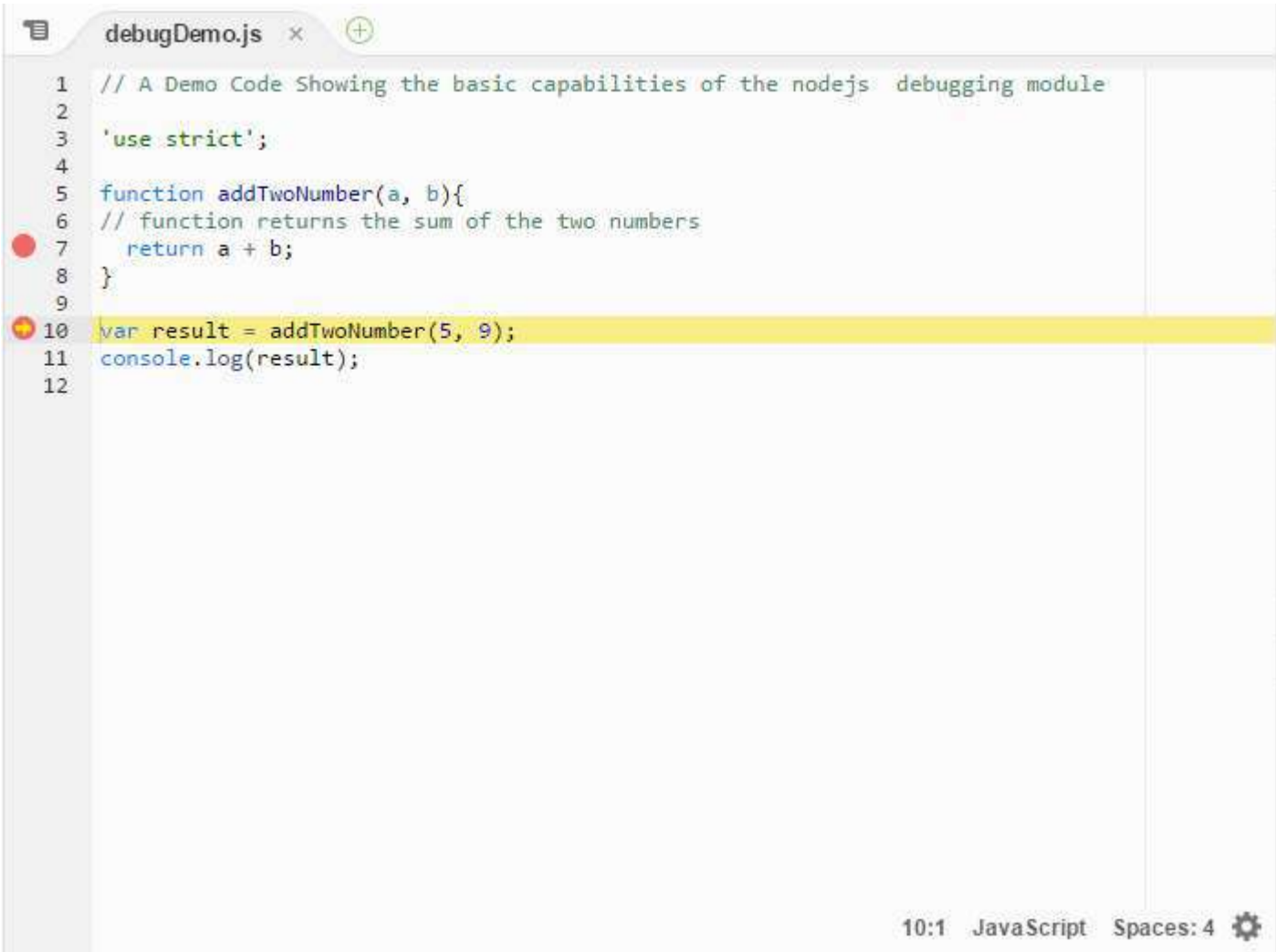
Sometimes port 8080 might not be available on your computer. You may get the following error:

> Cannot start the server at 0.0.0.0:8080. Error: listen EACCES.

In this case, start the node inspector on a different port using the following command.

```
$node-inspector --web-port=6500
```

You will see something like this:



Read Debugging Node.js application online: https://riptutorial.com/node-js/topic/5900/debugging-node-js-application

Chapter 20: Deliver HTML or any other sort of file

Syntax

- response.sendFile(fileName, options, function (err) {});

Examples

Deliver HTML at specified path

Here's how to create an Express server and serve `index.html` by default (empty path `/`), and `page1.html` for `/page1` path.

Folder structure

```
project root
|    server.js
|____views
     |    index.html
     |    page1.html
```

server.js

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

// deliver index.html if no file is requested
app.get("/", function (request, response) {
  response.sendFile(path.join(__dirname, 'views/index.html'));
});

// deliver page1.html if page1 is requested
app.get('/page1', function(request, response) {
    response.sendFile(path.join(__dirname, 'views', 'page1.html', function(error) {
        if (error) {
            // do something in case of error
            console.log(err);
            response.end(JSON.stringify({error:"page not found"}));
        }
    });
});

app.listen(8080);
```

Note that `sendFile()` just streams a static file as response, offering no opportunity to modify it. If

you are serving an HTML file and want to include dynamic data with it, then you will need to use a *template engine* such as Pug, Mustache, or EJS.

Read Deliver HTML or any other sort of file online: https://riptutorial.com/node-js/topic/6538/deliver-html-or-any-other-sort-of-file

Chapter 21: Dependency Injection

Examples

Why Use Dependency Injection

1. **Fast Development process**
2. **Decoupling**
3. **Unit test writing**

Fast Development process
When using dependency injection node developer can faster their development proceess because after DI there is less code conflict and easy to manage all module.

Decoupling
Modules becomes less couple then it is easy to maintain.

Unit test writing
Hardcoded dependencies can pass them into the module then easy to write unit test for each module.

Read Dependency Injection online: https://riptutorial.com/node-js/topic/7681/dependency-injection

Chapter 22: Deploying Node.js application without downtime.

Examples

Deployment using PM2 without downtime.

`ecosystem.json`

```
{
    "name": "app-name",
    "script": "server",
    "exec_mode": "cluster",
    "instances": 0,
    "wait_ready": true
    "listen_timeout": 10000,
    "kill_timeout": 5000,
}
```

```
wait_ready
```

Instead of reload waiting for listen event, wait for process.send('ready');

```
listen_timeout
```

Time in ms before forcing a reload if app not listening.

```
kill_timeout
```

Time in ms before sending a final SIGKLL.

`server.js`

```
const http = require('http');
const express = require('express');

const app = express();
const server = http.Server(app);
const port = 80;

server.listen(port, function() {
    process.send('ready');
});

process.on('SIGINT', function() {
    server.close(function() {
        process.exit(0);
    });
});
```

You might need to wait for your application to have etablished connections with your DBs/caches/workers/whatever. PM2 needs to wait before considering your application as online. To do this, you need to provide `wait_ready: true` in a process file. This will make PM2 listen for that event. In your application you will need to add `process.send('ready');` when you want your application to be considered as ready.

When a process is stopped/restarted by PM2, some system signals are sent to your process in a given order.

First a `SIGINT` a signal is sent to your processes, signal you can catch to know that your process is going to be stopped. If your application does not exit by itself before 1.6s (customizable) it will receive a `SIGKILL` signal to force the process exit. So if your application need to clean-up something states or jobs you can catch the `SIGINT` signal to prepare your application to exit.

Read Deploying Node.js application without downtime. online: https://riptutorial.com/node-js/topic/9752/deploying-node-js-application-without-downtime-

Chapter 23: Deploying Node.js applications in production

Examples

Setting NODE_ENV="production"

Production deployments will vary in many ways, but a standard convention when deploying in production is to define an environment variable called `NODE_ENV` and set its value to *"production"*.

Runtime flags

Any code running in your application (including external modules) can check the value of `NODE_ENV`:

```
if(process.env.NODE_ENV === 'production') {
    // We are running in production mode
} else {
   // We are running in development mode
}
```

Dependencies

When the `NODE_ENV` environment variable is set to *'production'* all `devDependencies` in your *package.json* file will be completely ignored when running `npm install`. You can also enforce this with a `--production` flag:

```
npm install --production
```

For setting `NODE_ENV` you can use any of these methods

method 1: set NODE_ENV for all node apps

Windows :

```
set NODE_ENV=production
```

Linux or other unix based system :

```
export NODE_ENV=production
```

This sets `NODE_ENV` for current bash session thus any apps started after this statement will have `NODE_ENV` set to `production`.

method 2: set NODE_ENV for current app

```
NODE_ENV=production node app.js
```

This will set `NODE_ENV` for the current app only. This helps when we want to test our apps on different environments.

method 3: create `.env` file and use it

This uses the idea explained here. Refer this post for more detailed explanation.

Basically you create `.env` file and run some bash script to set them on environment.

To avoid writing a bash script, the env-cmd package can be used to load the environment variables defined in the `.env` file.

```
env-cmd .env node app.js
```

method 4: Use `cross-env` package

This package allows environment variables to be set in one way for every platform.

After installing it with npm, you can just add it to your deployment script in `package.json` as follows:

```
"build:deploy": "cross-env NODE_ENV=production webpack"
```

Manage app with process manager

It's a good practice to run NodeJS apps controlled by process managers. Process manager helps to keep application alive forever, restart on failure, reload without downtime and simplifies administrating. Most powerful of them (like PM2) have a built-in load balancer. PM2 also enables you to manage application logging, monitoring, and clustering.

PM2 process manager

Installing PM2:

```
npm install pm2 -g
```

Process can be started in cluster mode involving integrated load balancer to spread load between processes:

`pm2 start app.js -i 0 --name "api"` (*-i* is to specify number of processes to spawn. If it is 0, then process number will be based on CPU cores count)

While having multiple users in production, its must to have a single point for PM2. Therefore pm2 command must be prefixed with a location (for PM2 config) else it will spawn a new pm2 process for every user with config in respective home directory. And it will be inconsistent.

Usage: `PM2_HOME=/etc/.pm2 pm2 start app.js`

Deployment using PM2

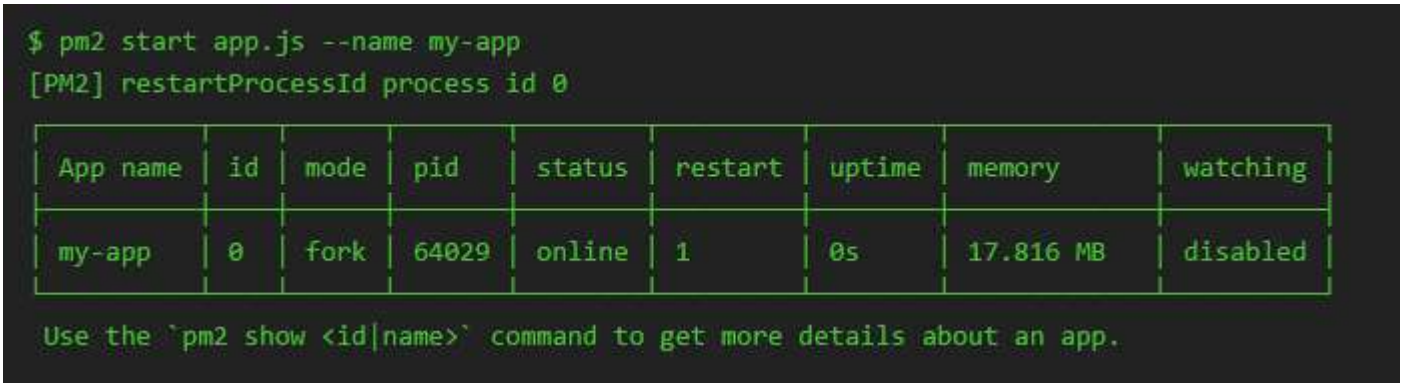
`PM2` is a production process manager for `Node.js` applications, that allows you to keep applications alive forever and reload them without downtime. PM2 also enables you to manage application logging, monitoring, and clustering.

Install `pm2` globally.

```
npm install -g pm2
```

Then, run the `node.js` app using `PM2`.

```
pm2 start server.js --name "my-app"
```



Following commands are useful while working with `PM2`.

List all running processes:

```
pm2 list
```

Stop an app:

```
pm2 stop my-app
```

Restart an app:

```
pm2 restart my-app
```

To view detailed information about an app:

```
pm2 show my-app
```

To remove an app from PM2's registry:

```
pm2 delete my-app
```

Deployment using process manager

Process manager is generally used in production to deploy a nodejs app. The main functions of a process manager are restarting the server if it crashes, checking resource consumption, improving runtime performance, monitoring etc.

Some of the popular process managers made by the node community are forever, pm2, etc.

Forvever

`forever` is a command-line interface tool for ensuring that a given script runs continuously. `forever` 's simple interface makes it ideal for running smaller deployments of `Node.js` apps and scripts.

`forever` monitors your process and restarts it if it crashes.

Install `forever` globally.

```
$ npm install -g forever
```

Run application :

```
$ forever start server.js
```

This starts the server and gives an id for the process(starts from 0).

Restart application :

```
$ forever restart 0
```

Here `0` is the id of the server.

Stop application :

```
$ forever stop 0
```

Similar to restart, `0` is the id the server. You can also give process id or script name in place of the id given by the forever.

For more commands : https://www.npmjs.com/package/forever

Using different Properties/Configuration for different environments like dev, qa, staging etc.

Large scale applications often need different properties when running on different environments. we can achieve this by passing arguments to NodeJs application and using same argument in node process to load specific environment property file.

Suppose we have two property files for different environment.

- dev.json

```
{
    "PORT": 3000,
    "DB": {
        "host": "localhost",
        "user": "bob",
        "password": "12345"
    }
}
```

- qa.json

```
{
    "PORT": 3001,
    "DB": {
        "host": "where_db_is_hosted",
        "user": "bob",
        "password": "54321"
    }
}
```

Following code in application will export respective property file which we want to use.

```
process.argv.forEach(function (val) {
    var arg = val.split("=");
    if (arg.length > 0) {
        if (arg[0] === 'env') {
            var env = require('./' + arg[1] + '.json');
            exports.prop = env;
        }
    }
});
```

We give arguments to the application like following

```
node app.js env=dev
```

if we are using process manager like *forever* than it as simple as

```
forever start app.js env=dev
```

Taking advantage of clusters

A single instance of Node.js runs in a single thread. To take advantage of multi-core systems the user will sometimes want to launch a cluster of Node.js processes to handle the load.

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

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

       if (cluster.isMaster) {
         // In real life, you'd probably use more than just 2 workers,
         // and perhaps not put the master and worker in the same file.
         //
         // You can also of course get a bit fancier about logging, and
         // implement whatever custom logic you need to prevent DoS
         // attacks and other bad behavior.
         //
         // See the options in the cluster documentation.
         //
         // The important thing is that the master does very little,
         // increasing our resilience to unexpected errors.
           console.log('your server is working on ' + numCPUs + ' cores');

            for (var i = 0; i < numCPUs; i++) {
                   cluster.fork();
                 }

         cluster.on('disconnect', function(worker) {
           console.error('disconnect!');
           //clearTimeout(timeout);
           cluster.fork();
         });


       } else {
           require('./app.js');

       }
```

Read Deploying Node.js applications in production online: https://riptutorial.com/node-js/topic/2975/deploying-node-js-applications-in-production

Chapter 24: ECMAScript 2015 (ES6) with Node.js

Examples

const/let declarations

Unlike `var`, `const`/`let` are bound to lexical scope rather than function scope.

```
{
  var x = 1 // will escape the scope
  let y = 2 // bound to lexical scope
  const z = 3 // bound to lexical scope, constant
}

console.log(x) // 1
console.log(y) // ReferenceError: y is not defined
console.log(z) // ReferenceError: z is not defined
```

Run in RunKit

Arrow functions

Arrow functions automatically bind to the 'this' lexical scope of the surrounding code.

```
performSomething(result => {
  this.someVariable = result
})
```

vs

```
performSomething(function(result) {
  this.someVariable = result
}.bind(this))
```

Arrow Function Example

Let's consider this example, that outputs the squares of the numbers 3, 5, and 7:

```
let nums = [3, 5, 7]
let squares = nums.map(function (n) {
  return n * n
})
console.log(squares)
```

Run in RunKit

The function passed to `.map` can also be written as arrow function by removing the `function`

keyword and instead adding the arrow `=>`:

```
let nums = [3, 5, 7]
let squares = nums.map((n) => {
  return n * n
})
console.log(squares)
```

Run in RunKit

However, this can be written even more concise. If the function body consists of only one statement and that statement computes the return value, the curly braces of wrapping the function body can be removed, as well as the `return` keyword.

```
let nums = [3, 5, 7]
let squares = nums.map(n => n * n)
console.log(squares)
```

Run in RunKit

destructuring

```
    let [x,y, ...nums] = [0, 1, 2, 3, 4, 5, 6];
console.log(x, y, nums);

let {a, b, ...props} = {a:1, b:2, c:3, d:{e:4}}
console.log(a, b, props);

let dog = {name: 'fido', age: 3};
let {name:n, age} = dog;
console.log(n, age);
```

flow

```
/* @flow */

function product(a: number, b: number){
  return a * b;
}

const b = 3;
let c = [1,2,3,,{}];
let d = 3;

import request from 'request';

request('http://dev.markitondemand.com/MODApis/Api/v2/Quote/json?symbol=AAPL', (err, res,
payload)=>{
  payload = JSON.parse(payload);
  let {LastPrice} = payload;
  console.log(LastPrice);
});
```

ES6 Class

```
class Mammel {
  constructor(legs){
    this.legs = legs;
  }
  eat(){
    console.log('eating...');
  }
  static count(){
    console.log('static count...');
  }
}

class Dog extends Mammel{
  constructor(name, legs){
    super(legs);
    this.name = name;
  }
  sleep(){
    super.eat();
    console.log('sleeping');
  }
}

let d = new Dog('fido', 4);
d.sleep();
d.eat();
console.log('d', d);
```

Read ECMAScript 2015 (ES6) with Node.js online: https://riptutorial.com/node-js/topic/6732/ecmascript-2015--es6--with-node-js

Chapter 25: Environment

Examples

Accessing environment variables

The `process.env` property returns an object containing the user environment.

It returns an object like this one :

```
{
  TERM: 'xterm-256color',
  SHELL: '/usr/local/bin/bash',
  USER: 'maciej',
  PATH: '~/.bin/:/usr/bin:/bin:/usr/sbin:/sbin:/usr/local/bin',
  PWD: '/Users/maciej',
  EDITOR: 'vim',
  SHLVL: '1',
  HOME: '/Users/maciej',
  LOGNAME: 'maciej',
  _: '/usr/local/bin/node'
}
```

```
process.env.HOME // '/Users/maciej'
```

If you set environment variable `FOO` to `foobar`, it will be accessible with:

```
process.env.FOO // 'foobar'
```

process.argv command line arguments

process.argv is an array containing the command line arguments. The first element will be `node`, the second element will be the name of the JavaScript file. The next elements will be any additional command line arguments.

Code Example:

Output sum of all command line arguments

`index.js`

```
var sum = 0;
for (i = 2; i < process.argv.length; i++) {
    sum += Number(process.argv[i]);
}

console.log(sum);
```

Usage Exaple:

```
node index.js 2 5 6 7
```

Output will be `20`

A brief explanation of the code:

Here in for loop `for (i = 2; i < process.argv.length; i++)` loop begins with 2 because first two elements in process.argv array **always** is `['path/to/node.exe', 'path/to/js/file', ...]`

Converting to number `Number(process.argv[i])` because elements in process.argv array **always** is string

Using different Properties/Configuration for different environments like dev, qa, staging etc.

Large scale applications often need different properties when running on different environments. we can achieve this by passing arguments to NodeJs application and using same argument in node process to load specific environment property file.

Suppose we have two property files for different environment.

- dev.json

```
{
    PORT : 3000,
    DB : {
        host : "localhost",
        user : "bob",
        password : "12345"
    }
}
```

- qa.json

```
{
        PORT : 3001,
        DB : {
            host : "where_db_is_hosted",
            user : "bob",
            password : "54321"
        }
}
```

Following code in application will export respective property file which we want to use.

Suppose the code is in environment.js

```
process.argv.forEach(function (val, index, array) {
```

```
    var arg = val.split("=");
    if (arg.length > 0) {
        if (arg[0] === 'env') {
            var env = require('./' + arg[1] + '.json');
            module.exports = env;
        }
    }
});
```

We give arguments to the application like following

```
node app.js env=dev
```

if we are using process manager like *forever* than it as simple as

```
forever start app.js env=dev
```

How to use the configuration file

```
 var env= require("environment.js");
```

Loading environment properties from a "property file"

- Install properties reader:

```
npm install properties-reader --save
```

- Create a **directory env** to store your properties files:

```
mkdir env
```

- Create **environments.js**:

```
process.argv.forEach(function (val, index, array) {
    var arg = val.split("=");
    if (arg.length > 0) {
        if (arg[0] === 'env') {
            var env = require('./env/' + arg[1] + '.properties');
            module.exports = env;
        }
    }
});
```

- Sample **development.properties** properties file:

```
# Dev properties
[main]
# Application port to run the node server
app.port=8080

[database]
```

```
# Database connection to mysql
mysql.host=localhost
mysql.port=2500
...
```

- Sample usage of the loaded properties:

```
var enviorment = require('./environments');
var PropertiesReader = require('properties-reader');
var properties = new PropertiesReader(enviorment);

var someVal = properties.get('main.app.port');
```

- Starting the express server

```
npm start env=development
```

or

```
npm start env=production
```

Read Environment online: https://riptutorial.com/node-js/topic/2340/environment

Chapter 26: Event Emitters

Remarks

When an event "fires" (which means the same as "publishing an event" or "emitting an event"), each listener will be called synchronously (source), along with any accompanying data that was passed in to `emit()`, no matter how many arguments you pass in:

```
myDog.on('bark', (howLoud, howLong, howIntense) => {
  // handle the event
})
myDog.emit('bark', 'loudly', '5 seconds long', 'fiercely')
```

The listeners will be called in the order they were registered:

```
myDog.on('urinate', () => console.log('My first thought was "Oh-no"'))
myDog.on('urinate', () => console.log('My second thought was "Not my lawn :)"'))
myDog.emit('urinate')
// The console.logs will happen in the right order because they were registered in that order.
```

But if you need a listener to fire first, before all of the other listeners that have already been added, you can use `prependListener()` like so:

```
myDog.prependListener('urinate', () => console.log('This happens before my first and second
thoughts, even though it was registered after them'))
```

If you need to listen to an event, but you only want to hear about it once, you can use `once` instead of `on`, or `prependOnceListener` instead of `prependListener`. After the event is fired and the listener gets called, the listener will automatically be removed, and won't be called again the next time the event is fired.

Finally, if you want to remove all of the listeners and start over, feel free to do just that:

```
myDog.removeAllListeners()
```

Examples

HTTP Analytics through an Event Emitter

In the HTTP server code (e.g. `server.js`):

```
const EventEmitter = require('events')
const serverEvents = new EventEmitter()

// Set up an HTTP server
const http = require('http')
const httpServer = http.createServer((request, response) => {
```

```
  // Handler the request...
  // Then emit an event about what happened
  serverEvents.emit('request', request.method, request.url)
});

// Expose the event emitter
module.exports = serverEvents
```

In supervisor code (e.g. `supervisor.js`):

```
const server = require('./server.js')
// Since the server exported an event emitter, we can listen to it for changes:
server.on('request', (method, url) => {
  console.log(`Got a request: ${method} ${url}`)
})
```

Whenever the server gets a request, it will emit an event called `request` which the supervisor is listening for, and then the supervisor can react to the event.

Basics

Event Emitters are built into Node, and are for pub-sub, a pattern where a *publisher* will emit events, which *subscribers* can listen and react to. In Node jargon, publishers are called *Event Emitters*, and they emit events, while subscribers are called *listeners*, and they react to the events.

```
// Require events to start using them
const EventEmitter = require('events').EventEmitter;
// Dogs have events to publish, or emit
class Dog extends EventEmitter {};
class Food {};

let myDog = new Dog();

// When myDog is chewing, run the following function
myDog.on('chew', (item) => {
  if (item instanceof Food) {
    console.log('Good dog');
  } else {
    console.log(`Time to buy another ${item}`);
  }
});

myDog.emit('chew', 'shoe'); // Will result in console.log('Time to buy another shoe')
const bacon = new Food();
myDog.emit('chew', bacon); // Will result in console.log('Good dog')
```

In the above example, the dog is the publisher/EventEmitter, while the function that checks the item was the subscriber/listener. You can make more listeners too:

```
myDog.on('bark', () => {
  console.log('WHO\'S AT THE DOOR?');
  // Panic
});
```

There can also be multiple listeners for a single event, and even remove listeners:

```
myDog.on('chew', takeADeepBreathe);
myDog.on('chew', calmDown);
// Undo the previous line with the next one:
myDog.removeListener('chew', calmDown);
```

If you want to listen to a event only once, you can use:

```
myDog.once('chew', pet);
```

Which will remove the listener automatically without race conditions.

Get the names of the events that are subscribed to

The function **EventEmitter.eventNames()** will return an array containing the names of the events currently subscribed to.

```
const EventEmitter = require("events");
class MyEmitter extends EventEmitter{}

var emitter = new MyEmitter();

emitter
.on("message", function(){ //listen for message event
    console.log("a message was emitted!");
})
.on("message", function(){ //listen for message event
    console.log("this is not the right message");
})
.on("data", function(){ //listen for data event
    console.log("a data just occured!!");
});

console.log(emitter.eventNames()); //=> ["message","data"]
emitter.removeAllListeners("data");//=> removeAllListeners to data event
console.log(emitter.eventNames()); //=> ["message"]
```

Run in RunKit

Get the number of listeners registered to listen for a specific event

The function Emitter.listenerCount(eventName) will return the number of listeners that are currently listening for the event provided as argument

```
const EventEmitter = require("events");
class MyEmitter extends EventEmitter{}
var emitter = new MyEmitter();

emitter
.on("data", ()=>{ // add listener for data event
    console.log("data event emitter");
});
```

```
console.log(emitter.listenerCount("data"))    // => 1
console.log(emitter.listenerCount("message")) // => 0

emitter.on("message", function mListener(){ //add listener for message event
    console.log("message event emitted");
});
console.log(emitter.listenerCount("data"))    // => 1
console.log(emitter.listenerCount("message")) // => 1

emitter.once("data", (stuff)=>{ //add another listener for data event
    console.log(`Tell me my ${stuff}`);
})

console.log(emitter.listenerCount("data"))   // => 2
console.log(emitter.listenerCount("message"))// => 1
```

Read Event Emitters online: https://riptutorial.com/node-js/topic/1623/event-emitters

Chapter 27: Eventloop

Introduction

In this post we are going to discuss how the concept of Eventloop emerged and how it can be used for high performance servers and event driven applications like GUIs.

Examples

How the concept of event loop evolved.

Eventloop in pseudo code

An event loop is a loop that waits for events and then reacts to those events

```
while true:
    wait for something to happen
    react to whatever happened
```

Example of a single-threaded HTTP server with no event loop

```
    while true:
    socket = wait for the next TCP connection
    read the HTTP request headers from (socket)
    file_contents = fetch the requested file from disk
    write the HTTP response headers to (socket)
    write the (file_contents) to (socket)
    close(socket)
```

Here's a simple form of a HTTP server which is a single threaded but no event loop. The problem here is that it waits until each request is finished before starting to process the next one. If it takes a while to read the HTTP request headers or to fetch the file from disk, we should be able to start processing the next request while we wait for that to finish.

The most common solution is to make the program multi-threaded.

Example of a multi-threaded HTTP server with no event loop

```
function handle_connection(socket):
    read the HTTP request headers from (socket)
    file_contents = fetch the requested file from disk
    write the HTTP response headers to (socket)
    write the (file_contents) to (socket)
    close(socket)
while true:
    socket = wait for the next TCP connection
    spawn a new thread doing handle_connection(socket)
```

Now we have made our little HTTP server multi threaded. This way, we can immediately move on to the next request because the current request is running in a background thread. Many servers, including Apache, use this approach.

But it's not perfect. One limitation is that you can only spawn so many threads. For workloads where you have a huge number of connections, but each connection only requires attention every once in a while, the multi-threaded model won't perform very well. The solution for those cases is to use an event loop:

Example of a HTTP server with event loop

```
while true:
    event = wait for the next event to happen
    if (event.type == NEW_TCP_CONNECTION):
        conn = new Connection
        conn.socket = event.socket
        start reading HTTP request headers from (conn.socket) with userdata = (conn)
    else if (event.type == FINISHED_READING_FROM_SOCKET):
        conn = event.userdata
        start fetching the requested file from disk with userdata = (conn)
    else if (event.type == FINISHED_READING_FROM_DISK):
        conn = event.userdata
        conn.file_contents = the data we fetched from disk
        conn.current_state = "writing headers"
        start writing the HTTP response headers to (conn.socket) with userdata = (conn)
    else if (event.type == FINISHED_WRITING_TO_SOCKET):
        conn = event.userdata
        if (conn.current_state == "writing headers"):
            conn.current_state = "writing file contents"
            start writing (conn.file_contents) to (conn.socket) with userdata = (conn)
        else if (conn.current_state == "writing file contents"):
            close(conn.socket)
```

Hopefully this pseudocode is intelligible. Here's what's going on: We wait for things to happen. Whenever a new connection is created or an existing connection needs our attention, we go deal with it, then go back to waiting. That way, we perform well when there are many connections and each one only rarely requires attention.

In a real application (not pseudocode) running on Linux, the "wait for the next event to happen" part would be implemented by calling the poll() or epoll() system call. The "start reading/writing something to a socket" parts would be implemented by calling the recv() or send() system calls in non-blocking mode.

Reference:

[1]. "How does an event loop work?" [Online]. Available : https://www.quora.com/How-does-an-event-loop-work

Read Eventloop online: https://riptutorial.com/node-js/topic/8652/eventloop

Chapter 28: Exception handling

Examples

Handling Exception In Node.Js

Node.js has 3 basic ways to handle exceptions/errors:

1. **try-catch** block
2. **error** as the first argument to a `callback`
3. `emit` an **error** event using eventEmitter

try-catch is used to catch the exceptions thrown from the synchronous code execution. If the caller (or the caller's caller, ...) used try/catch, then they can catch the error. If none of the callers had try-catch than the program crashes.
If using try-catch on an async operation and exception was thrown from callback of async method than it will not get caught by try-catch. To catch an exception from async operation callback, it is preferred to use *promises*.
Example to understand it better

```
// ** Example - 1  **
function doSomeSynchronousOperation(req, res) {
    if(req.body.username === ''){
        throw new Error('User Name cannot be empty');
    }
    return true;
}

// calling the method above
try {
    // synchronous code
    doSomeSynchronousOperation(req, res)
catch(e) {
    //exception handled here
    console.log(e.message);
}

// ** Example - 2 **
function doSomeAsynchronousOperation(req, res, cb) {
    // imitating async operation
    return setTimeout(function(){
        cb(null, []);
    },1000);
}

try {
    // asynchronous code
    doSomeAsynchronousOperation(req, res, function(err, rs){
        throw new Error("async operation exception");
    })
} catch(e) {
     // Exception will not get handled here
     console.log(e.message);
```

```
}
// The exception is unhandled and hence will cause application to break
```

callbacks are mostly used in Node.js as callback delivers an event asynchronously. The user passes you a function (the callback), and you invoke it sometime later when the asynchronous operation completes.
The usual pattern is that the callback is invoked as a *callback(err, result)*, where only one of err and result is non-null, depending on whether the operation succeeded or failed.

```
function doSomeAsynchronousOperation(req, res, callback) {
   setTimeout(function(){
        return callback(new Error('User Name cannot be empty'));
   }, 1000);
   return true;
}

doSomeAsynchronousOperation(req, res, function(err, result) {
   if (err) {
       //exception handled here
       console.log(err.message);
   }

   //do some stuff with valid data
});
```

emit For more complicated cases, instead of using a callback, the function itself can return an EventEmitter object, and the caller would be expected to listen for error events on the emitter.

```
const EventEmitter = require('events');

function doSomeAsynchronousOperation(req, res) {
    let myEvent = new EventEmitter();

    // runs asynchronously
    setTimeout(function(){
        myEvent.emit('error', new Error('User Name cannot be empty'));
    }, 1000);

    return myEvent;
}

// Invoke the function
let event = doSomeAsynchronousOperation(req, res);

event.on('error', function(err) {
    console.log(err);
});

event.on('done', function(result) {
    console.log(result); // true
});
```

Unhanded Exception Management

Because Node.js runs on a single process uncaught exceptions are an issue to be aware of when

developing applications.

Silently Handling Exceptions

Most of the people let node.js server(s) silently swallow up the errors.

- Silently handling the exception

```
process.on('uncaughtException', function (err) {
  console.log(err);
});
```

This is bad, it will work but:

- Root cause will remains unknown, as such will not contribute to resolution of what caused the Exception (Error).
- In case of database connection (pool) gets closed for some reason this will result in constant propagation of errors, meaning that server will be running but it will not reconnect to db.

Returning to Initial state

In case of an " uncaughtException " it is good to restart the server and return it to its **initial state**, where we know it will work. Exception is logged, application is terminated but since it will be running in a container that will make sure that the server is running we will achieve restarting of the server (returning to the initial working state) .

- Installing the forever (or other CLI tool to make sure that node server runs continuously)

```
npm install forever -g
```

- Starting the server in forever

```
forever start app.js
```

  Reason why is it started and why we use forever is after the server is **terminated** forever process will start the server again.

- Restarting the server

```
process.on('uncaughtException', function (err) {
    console.log(err);

    // some logging mechanisam
    // ....

    process.exit(1); // terminates process
```

```
});
```

On a side note there was a way also to handle exceptions with **Clusters and Domains**.

Domains are deprecated more information here.

Errors and Promises

Promises handle errors differently to synchronous or callback-driven code.

```
const p = new Promise(function (resolve, reject) {
    reject(new Error('Oops'));
});

// anything that is `reject`ed inside a promise will be available through catch
// while a promise is rejected, `.then` will not be called
p
    .then(() => {
        console.log("won't be called");
    })
    .catch(e => {
        console.log(e.message); // output: Oops
    })
    // once the error is caught, execution flow resumes
    .then(() => {
        console.log('hello!'); // output: hello!
    });
```

currently, errors thrown in a promise that are not caught results in the error being swallowed, which can make it difficult to track down the error. This can be solved using linting tools like eslint or by ensuring you always have a `catch` clause.

This behaviour is deprecated in node 8 in favour of terminating the node process.

Read Exception handling online: https://riptutorial.com/node-js/topic/2819/exception-handling

Chapter 29: Executing files or commands with Child Processes

Syntax

- child_process.exec(command[, options][, callback])
- child_process.execFile(file[, args][, options][, callback])
- child_process.fork(modulePath[, args][, options])
- child_process.spawn(command[, args][, options])
- child_process.execFileSync(file[, args][, options])
- child_process.execSync(command[, options])
- child_process.spawnSync(command[, args][, options])

Remarks

When dealing with child processes, all of the asynchronous methods will return an instance of `ChildProcess`, while all the synchronous versions will return the output of whatever was run. Like other synchronous operations in Node.js, if an error occurs, it *will* throw.

Examples

Spawning a new process to execute a command

To spawn a new process in which you need *unbuffered* output (e.g. long-running processes which might print output over a period of time rather than printing and exiting immediately), use `child_process.spawn()`.

This method spawns a new process using a given command and an array of arguments. The return value is an instance of `ChildProcess`, which in turn provides the `stdout` and `stderr` properties. Both of those streams are instances of `stream.Readable`.

The following code is equivalent to using running the command `ls -lh /usr`.

```
const spawn = require('child_process').spawn;
const ls = spawn('ls', ['-lh', '/usr']);

ls.stdout.on('data', (data) => {
  console.log(`stdout: ${data}`);
});

ls.stderr.on('data', (data) => {
  console.log(`stderr: ${data}`);
});

ls.on('close', (code) => {
  console.log(`child process exited with code ${code}`);
```

```
});
```

Another example command:

```
zip -0vr "archive" ./image.png
```

Might be written as:

```
spawn('zip', ['-0vr', '"archive"', './image.png']);
```

Spawning a shell to execute a command

To run a command in a shell, in which you required buffered output (i.e. it is not a stream), use `child_process.exec`. For example, if you wanted to run the command `cat *.js file | wc -l`, with no options, that would look like this:

```
const exec = require('child_process').exec;
exec('cat *.js file | wc -l', (err, stdout, stderr) => {
  if (err) {
    console.error(`exec error: ${err}`);
    return;
  }

  console.log(`stdout: ${stdout}`);
  console.log(`stderr: ${stderr}`);
});
```

The function accepts up to three parameters:

```
child_process.exec(command[, options][, callback]);
```

The command parameter is a string, and is required, while the options object and callback are both optional. If no options object is specified, then `exec` will use the following as a default:

```
{
  encoding: 'utf8',
  timeout: 0,
  maxBuffer: 200*1024,
  killSignal: 'SIGTERM',
  cwd: null,
  env: null
}
```

The options object also supports a `shell` parameter, which is by default `/bin/sh` on UNIX and `cmd.exe` on Windows, a `uid` option for setting the user identity of the process, and a `gid` option for the group identity.

The callback, which is called when the command is done executing, is called with the three arguments `(err, stdout, stderr)`. If the command executes successfully, `err` will be `null`, otherwise it will be an instance of `Error`, with `err.code` being the exit code of the process and `err.signal`

being the signal that was sent to terminate it.

The `stdout` and `stderr` arguments are the output of the command. It is decoded with the encoding specified in the options object (default: `string`), but can otherwise be returned as a `Buffer` object.

There also exists a synchronous version of `exec`, which is `execSync`. The synchronous version does not take a callback, and will return `stdout` instead of an instance of `ChildProcess`. If the synchronous version encounters an error, it *will* throw and halt your program. It looks like this:

```
const execSync = require('child_process').execSync;
const stdout = execSync('cat *.js file | wc -l');
console.log(`stdout: ${stdout}`);
```

Spawning a process to run an executable

If you are looking to run a file, such as an executable, use `child_process.execFile`. Instead of spawning a shell like `child_process.exec` would, it will directly create a new process, which is slightly more efficient than running a command. The function can be used like so:

```
const execFile = require('child_process').execFile;
const child = execFile('node', ['--version'], (err, stdout, stderr) => {
  if (err) {
    throw err;
  }

  console.log(stdout);
});
```

Unlike `child_process.exec`, this function will accept up to four parameters, where the second parameter is an array of arguments you'd like to supply to the executable:

```
child_process.execFile(file[, args][, options][, callback]);
```

Otherwise, the options and callback format are otherwise identical to `child_process.exec`. The same goes for the synchronous version of the function:

```
const execFileSync = require('child_process').execFileSync;
const stdout = execFileSync('node', ['--version']);
console.log(stdout);
```

Read Executing files or commands with Child Processes online: https://riptutorial.com/node-js/topic/2726/executing-files-or-commands-with-child-processes

Chapter 30: Exporting and Consuming Modules

Remarks

While everything in Node.js is generally done asynchronously, `require()` is not one of those things. Since modules in practice only need to be loaded once, it is a blocking operation and should be used properly.

Modules are cached after the first time they are loaded. Should you be editing a module in development, you will need to delete its entry in the module cache in order to use new changes. That being said, even if a module is cleared out of the module cache, the module itself is not garbage collected, so care should be taken for its use in production environments.

Examples

Loading and using a module

A module can be "imported", or otherwise "required" by the `require()` function. For example, to load the `http` module that ships with Node.js, the following can be used:

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

Aside from modules that are shipped with the runtime, you can also require modules that you have installed from npm, such as express. If you had already installed express on your system via `npm install express`, you could simply write:

```
const express = require('express');
```

You can also include modules that you have written yourself as part of your application. In this case, to include a file named `lib.js` in the same directory as current file:

```
const mylib = require('./lib');
```

Note that you can omit the extension, and `.js` will be assumed. Once you load a module, the variable is populated with an object that contains the methods and properties published from the required file. A full example:

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

// The `http` module has the property `STATUS_CODES`
console.log(http.STATUS_CODES[404]); // outputs 'Not Found'

// Also contains `createServer()`
http.createServer(function(req, res) {
```

```
  res.writeHead(200, {'Content-Type': 'text/html'});
  res.write('<html><body>Module Test</body></html>');
  res.end();
}).listen(80);
```

Creating a hello-world.js module

Node provides the `module.exports` interface to expose functions and variables to other files. The most simple way to do so is to export only one object (function or variable), as shown in the first example.

hello-world.js

```
module.exports = function(subject) {
    console.log('Hello ' + subject);
};
```

If we don't want the entire export to be a single object, we can export functions and variables as properties of the `exports` object. The three following examples all demonstrate this in slightly different ways :

- hello-venus.js : the function definition is done separately then added as a property of `module.exports`
- hello-jupiter.js : the functions definitions are directly put as the value of properties of `module.exports`
- hello-mars.js : the function definition is directly declared as a property of `exports` which is a short version of `module.exports`

hello-venus.js

```
function hello(subject) {
    console.log('Venus says Hello ' + subject);
}

module.exports = {
    hello: hello
};
```

hello-jupiter.js

```
module.exports = {
    hello: function(subject) {
      console.log('Jupiter says hello ' + subject);
    },

    bye: function(subject) {
      console.log('Jupiter says goodbye ' + subject);
    }
};
```

hello-mars.js

```
exports.hello = function(subject) {
    console.log('Mars says Hello ' + subject);
};
```

Loading module with directory name

We have a directory named `hello` which includes the following files:

index.js

```
// hello/index.js
module.exports = function(){
    console.log('Hej');
};
```

main.js

```
// hello/main.js
// We can include the other files we've defined by using the `require()` method
var hw = require('./hello-world.js'),
    hm = require('./hello-mars.js'),
    hv = require('./hello-venus.js'),
    hj = require('./hello-jupiter.js'),
    hu = require('./index.js');

// Because we assigned our function to the entire `module.exports` object, we
// can use it directly
hw('World!'); // outputs "Hello World!"

// In this case, we assigned our function to the `hello` property of exports, so we must
// use that here too
hm.hello('Solar System!'); // outputs "Mars says Hello Solar System!"

// The result of assigning module.exports at once is the same as in hello-world.js
hv.hello('Milky Way!'); // outputs "Venus says Hello Milky Way!"

hj.hello('Universe!'); //  outputs "Jupiter says hello Universe!"
hj.bye('Universe!'); // outputs "Jupiter says goodbye Universe!"

hu(); //output 'hej'
```

Invalidating the module cache

In development, you may find that using `require()` on the same module multiple times always returns the same module, even if you have made changes to that file. This is because modules are cached the first time they are loaded, and any subsequent module loads will load from the cache.

To get around this issue, you will have to `delete` the entry in the cache. For example, if you loaded a module:

```
var a = require('./a');
```

You could then delete the cache entry:

```
var rpath = require.resolve('./a.js');
delete require.cache[rpath];
```

And then require the module again:

```
var a = require('./a');
```

Do note that this is not recommended in production because the `delete` will only delete the reference to the loaded module, not the loaded data itself. The module is not garbage collected, so improper use of this feature could lead to leaking memory.

Building your own modules

You can also reference an object to publicly export and continuously append methods to that object:

```
const auth = module.exports = {}
const config = require('../config')
const request = require('request')

auth.email = function (data, callback) {
  // Authenticate with an email address
}

auth.facebook = function (data, callback) {
  // Authenticate with a Facebook account
}

auth.twitter = function (data, callback) {
  // Authenticate with a Twitter account
}

auth.slack = function (data, callback) {
  // Authenticate with a Slack account
}

auth.stack_overflow = function (data, callback) {
  // Authenticate with a Stack Overflow account
}
```

To use any of these, just require the module as you normally would:

```
const auth = require('./auth')

module.exports = function (req, res, next) {
  auth.facebook(req.body, function (err, user) {
    if (err) return next(err)

    req.user = user
    next()
  })
}
```

Every module injected only once

NodeJS executes the module only the first time you require it. Any further require functions will re-use the same Object, thus not executing the code in the module another time. Also Node caches the modules first time they are loaded using require. This reduces the number of file reads and helps to speed up the application.

myModule.js

```
console.log(123) ;
exports.var1 = 4 ;
```

index.js

```
var a=require('./myModule') ; // Output 123
var b=require('./myModule') ; // No output
console.log(a.var1) ; // Output 4
console.log(b.var1) ; // Output 4
a.var2 = 5 ;
console.log(b.var2) ; // Output 5
```

Module loading from node_modules

Modules can be `require`d without using relative paths by putting them in a special directory called `node_modules`.

For example, to `require` a module called `foo` from a file `index.js`, you can use the following directory structure:

```
index.js
 \- node_modules
  \- foo
   |- foo.js
   \- package.json
```

Modules should be placed inside a directory, along with a `package.json` file. The `main` field of the `package.json` file should point to the entry point for your module--this is the file that is imported when users do `require('your-module')`. `main` defaults to `index.js` if not provided. Alternatively, you can refer to files relative to your module simply by appending the relative path to the `require` call: `require('your-module/path/to/file')`.

Modules can also be `require`d from `node_modules` directories up the file system hierarchy. If we have the following directory structure:

```
my-project
\- node_modules
 |- foo   // the foo module
  \- ...
 \- baz   // the baz module
  \- node_modules
   \- bar   // the bar module
```

we will be able to `require` the module `foo` from any file within `bar` using `require('foo')`.

Note that node will only match the module that is closest to the file in the filesystem hierarchy, starting from (the file's current directory/node_modules). Node matches directories this way up to the file system root.

You can either install new modules from the npm registry or other npm registries, or make your own.

Folder as a module

Modules can be split across many .js files in the same folder. An example in a *my_module* folder:

function_one.js

```
module.exports = function() {
  return 1;
}
```

function_two.js

```
module.exports = function() {
  return 2;
}
```

index.js

```
exports.f_one = require('./function_one.js');
exports.f_two = require('./function_two.js');
```

A module like this one is used by referring to it by the folder name:

```
var split_module = require('./my_module');
```

Please note that if you required it by omitting `./` or any indication of a path to a folder from the require function argument, Node will try to load a module from the *node_modules* folder.

Alternatively you can create in the same folder a `package.json` file with these contents:

```
{
    "name": "my_module",
    "main": "./your_main_entry_point.js"
}
```

This way you are not required to name the main module file "index".

Read Exporting and Consuming Modules online: https://riptutorial.com/node-js/topic/547/exporting-and-consuming-modules

Chapter 31: Exporting and Importing Module in node.js

Examples

Using a simple module in node.js

What is a node.js module (link to article):

> A module encapsulates related code into a single unit of code. When creating a module, this can be interpreted as moving all related functions into a file.

Now lets see an example. Imagine all files are in same directory:

File: `printer.js`

```
"use strict";

exports.printHelloWorld = function (){
    console.log("Hello World!!!");
}
```

Another way of using modules:

File `animals.js`

```
"use strict";

module.exports = {
    lion: function() {
        console.log("ROAARR!!!");
    }

};
```

File: `app.js`

Run this file by going to your directory and typing: `node app.js`

```
"use strict";

//require('./path/to/module.js') node which module to load
var printer = require('./printer');
var animals = require('./animals');

printer.printHelloWorld(); //prints "Hello World!!!"
animals.lion(); //prints "ROAARR!!!"
```

Using Imports In ES6

Node.js is built against modern versions of V8. By keeping up-to-date with the latest releases of this engine, we ensure new features from the JavaScript ECMA-262 specification are brought to Node.js developers in a timely manner, as well as continued performance and stability improvements.

All ECMAScript 2015 (ES6) features are split into three groups for shipping, staged, and in progress features:

All shipping features, which V8 considers stable, are turned on by default on Node.js and do NOT require any kind of runtime flag. Staged features, which are almost-completed features that are not considered stable by the V8 team, require a runtime flag: --harmony. In progress features can be activated individually by their respective harmony flag, although this is highly discouraged unless for testing purposes. Note: these flags are exposed by V8 and will potentially change without any deprecation notice.

Currently ES6 supports import statements natively Refer here

So if we have a file called `fun.js`…

```
export default function say(what){
  console.log(what);
}

export function sayLoud(whoot) {
  say(whoot.toUpperCase());
}
```

…and if there was another file named `app.js` where we want to put our previously defined functions to use, there are three ways how to import them.

Import default

```
import say from './fun';
say('Hello Stack Overflow!!');  // Output: Hello Stack Overflow!!
```

Imports the `say()` function because it is marked as the default export in the source file (`export default …`)

Named imports

```
import { sayLoud } from './fun';
sayLoud('JS modules are awesome.'); // Output: JS MODULES ARE AWESOME.
```

Named imports allow us to import exactly the parts of a module we actually need. We do this by explicitly naming them. In our case by naming `sayLoud` in curly brackets within the import statement.

Bundled import

```
import * as i from './fun';
```

```
i.say('What?'); // Output: What?
i.sayLoud('Whoot!'); // Output: WHOOT!
```

If we want to have it all, this is the way to go. By using the syntax `* as i` we have the `import` statement provide us with an object `i` that holds all exports of our `fun` module as correspondingly named properties.

Paths

Keep in mind that you have to explicitly mark your import paths as *relative paths* even if the file to be imported resided in the same directory like the file you are importing into by using `./`. Imports from unprefixed paths like

```
import express from 'express';
```

will be looked up in the local and global `node_modules` folders and will throw an error if no matching modules are found.

Exporting with ES6 syntax

This is the equivalent of the other example but using ES6 instead.

```
export function printHelloWorld() {
  console.log("Hello World!!!");
}
```

Read Exporting and Importing Module in node.js online: https://riptutorial.com/node-js/topic/1173/exporting-and-importing-module-in-node-js

Chapter 32: File upload

Examples

Single File Upload using multer

Remember to

- create folder for upload (`uploads` in example).
- install multer `npm i -S multer`

`server.js`:

```
var express =   require("express");
var multer  =   require('multer');
var app         =   express();
var fs = require('fs');

app.get('/',function(req,res){
      res.sendFile(__dirname + "/index.html");
});

var storage =   multer.diskStorage({
  destination: function (req, file, callback) {
    fs.mkdir('./uploads', function(err) {
        if(err) {
            console.log(err.stack)
        } else {
            callback(null, './uploads');
        }
    })
  },
  filename: function (req, file, callback) {
    callback(null, file.fieldname + '-' + Date.now());
  }
});

app.post('/api/file',function(req,res){
    var upload = multer({ storage : storage}).single('userFile');
    upload(req,res,function(err) {
        if(err) {
            return res.end("Error uploading file.");
        }
        res.end("File is uploaded");
    });
});

app.listen(3000,function(){
    console.log("Working on port 3000");
});
```

`index.html`:

```
<form id        =  "uploadForm"
```

```
      enctype   =  "multipart/form-data"
      action    =  "/api/file"
      method    =  "post"
>
<input type="file" name="userFile" />
<input type="submit" value="Upload File" name="submit">
</form>
```

Note:

To upload file with extension you can use Node.js path built-in library

For that just require `path` to `server.js` file:

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

and change:

```
callback(null, file.fieldname + '-' + Date.now());
```

adding a file extension in the following way:

```
callback(null, file.fieldname + '-' + Date.now() + path.extname(file.originalname));
```

How to filter upload by extension:

In this example, view how to upload files to allow only certain extensions.

For example only images extensions. Just add to `var upload = multer({ storage : storage}).single('userFile');` fileFilter condition

```
var upload = multer({
    storage: storage,
    fileFilter: function (req, file, callback) {
        var ext = path.extname(file.originalname);
        if(ext !== '.png' && ext !== '.jpg' && ext !== '.gif' && ext !== '.jpeg') {
            return callback(new Error('Only images are allowed'))
        }
        callback(null, true)
    }
}).single('userFile');
```

Now you can upload only image files with `png`, `jpg`, `gif` or `jpeg` extensions

Using formidable module

Install module and read **docs**

```
npm i formidable@latest
```

Example of server on 8080 port

```
var formidable = require('formidable'),
    http = require('http'),
    util = require('util');

http.createServer(function(req, res) {
  if (req.url == '/upload' && req.method.toLowerCase() == 'post') {
    // parse a file upload
    var form = new formidable.IncomingForm();

    form.parse(req, function(err, fields, files) {
      if (err)
          do-smth; // process error

      // Copy file from temporary place
      // var fs = require('fs');
      // fs.rename(file.path, <targetPath>, function (err) { ... });

      // Send result on client
      res.writeHead(200, {'content-type': 'text/plain'});
      res.write('received upload:\n\n');
      res.end(util.inspect({fields: fields, files: files}));
    });

    return;
  }

  // show a file upload form
  res.writeHead(200, {'content-type': 'text/html'});
  res.end(
    '<form action="/upload" enctype="multipart/form-data" method="post">'+
    '<input type="text" name="title"><br>'+
    '<input type="file" name="upload" multiple="multiple"><br>'+
    '<input type="submit" value="Upload">'+
    '</form>'
  );
}).listen(8080);
```

Read File upload online: https://riptutorial.com/node-js/topic/4080/file-upload

Chapter 33: Filesystem I/O

Remarks

In Node.js, resource intensive operations such as I/O are performed *asynchronously*, but have a *synchronous* counterpart (e.g. there exists a `fs.readFile` and its counterpart is `fs.readFileSync`). Since Node is single-threaded, you should be careful when using *synchronous* operations, because they will block the entire process.

If a process is blocked by a synchronous operation, the entire execution cycle (including the event loop) is halted. That means other asynchronous code, including events and event handlers, will not run and your program will continue to wait until the single blocking operation has completed.

There are appropriate uses for both synchronous and asynchronous operations, but care must be taken that they are utilized properly.

Examples

Writing to a file using writeFile or writeFileSync

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

// Save the string "Hello world!" in a file called "hello.txt" in
// the directory "/tmp" using the default encoding (utf8).
// This operation will be completed in background and the callback
// will be called when it is either done or failed.
fs.writeFile('/tmp/hello.txt', 'Hello world!', function(err) {
  // If an error occurred, show it and return
  if(err) return console.error(err);
  // Successfully wrote to the file!
});

// Save binary data to a file called "binary.txt" in the current
// directory. Again, the operation will be completed in background.
var buffer = new Buffer([ 0x48, 0x65, 0x6c, 0x6c, 0x6f ]);
fs.writeFile('binary.txt', buffer, function(err) {
  // If an error occurred, show it and return
  if(err) return console.error(err);
  // Successfully wrote binary contents to the file!
});
```

`fs.writeFileSync` behaves similarly to `fs.writeFile`, but does not take a callback as it completes synchronously and therefore blocks the main thread. Most node.js developers prefer the asynchronous variants which will cause virtually no delay in the program execution.

Note: Blocking the main thread is bad practice in node.js. Synchronous function should only be used when debugging or when no other options are availables.

```
// Write a string to another file and set the file mode to 0755
```

```
try {
  fs.writeFileSync('sync.txt', 'anni', { mode: 0o755 });
} catch(err) {
  // An error occurred
  console.error(err);
}
```

Asynchronously Read from Files

Use the filesystem module for all file operations:

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

With Encoding

In this example, read `hello.txt` from the directory `/tmp`. This operation will be completed in the background and the callback occurs on completion or failure:

```
fs.readFile('/tmp/hello.txt', { encoding: 'utf8' }, (err, content) => {
  // If an error occurred, output it and return
  if(err) return console.error(err);

  // No error occurred, content is a string
  console.log(content);
});
```

Without Encoding

Read the binary file `binary.txt` from the current directory, asynchronously in the background. Note that we do not set the 'encoding' option - this prevents Node.js from decoding the contents into a string:

```
fs.readFile('binary', (err, binaryContent) => {
  // If an error occurred, output it and return
  if(err) return console.error(err);

  // No error occurred, content is a Buffer, output it in
  // hexadecimal representation.
  console.log(content.toString('hex'));
});
```

Relative paths

Keep in mind that, in general case, your script could be run with an arbitrary current working directory. To address a file relative to the current script, use `__dirname` or `__filename`:

```
fs.readFile(path.resolve(__dirname, 'someFile'), (err, binaryContent) => {
  //Rest of Function
```

```
}
```

Listing Directory Contents with readdir or readdirSync

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

// Read the contents of the directory /usr/local/bin asynchronously.
// The callback will be invoked once the operation has either completed
// or failed.
fs.readdir('/usr/local/bin', (err, files) => {
  // On error, show it and return
  if(err) return console.error(err);

  // files is an array containing the names of all entries
  // in the directory, excluding '.' (the directory itself)
  // and '..' (the parent directory).

  // Display directory entries
  console.log(files.join(' '));
});
```

A synchronous variant is available as `readdirSync` which blocks the main thread and therefore prevents execution of asynchronous code at the same time. Most developers avoid synchronous IO functions in order to improve performance.

```
let files;

try {
  files = fs.readdirSync('/var/tmp');
} catch(err) {
  // An error occurred
  console.error(err);
}
```

Using a generator

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

// Iterate through all items obtained via
// 'yield' statements
// A callback is passed to the generator function because it is required by
// the 'readdir' method
function run(gen) {
  var iter = gen((err, data) => {
    if (err) { iter.throw(err); }

    return iter.next(data);
  });

  iter.next();
}

const dirPath = '/usr/local/bin';

// Execute the generator function
```

```
run(function* (resume) {
  // Emit the list of files in the directory from the generator
  var contents = yield fs.readdir(dirPath, resume);
  console.log(contents);
});
```

Reading from a file synchronously

For any file operations, you will need the filesystem module:

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

Reading a String

`fs.readFileSync` behaves similarly to `fs.readFile`, but does not take a callback as it completes synchronously and therefore blocks the main thread. Most node.js developers prefer the asynchronous variants which will cause virtually no delay in the program execution.

If an `encoding` option is specified, a string will be returned, otherwise a `Buffer` will be returned.

```
// Read a string from another file synchronously
let content;
try {
  content = fs.readFileSync('sync.txt', { encoding: 'utf8' });
} catch(err) {
  // An error occurred
  console.error(err);
}
```

Deleting a file using unlink or unlinkSync

Delete a file asynchronously:

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

fs.unlink('/path/to/file.txt', function(err) {
  if (err) throw err;

  console.log('file deleted');
});
```

You can also delete it synchronously*:

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

fs.unlinkSync('/path/to/file.txt');
console.log('file deleted');
```

* avoid synchronous methods because they block the entire process until the execution finishes.

Reading a file into a Buffer using streams

While reading content from a file is already asynchronous using the `fs.readFile()` method, sometimes we want to get the data in a Stream versus in a simple callback. This allows us to pipe this data to other locations or to process it as it comes in versus all at once at the end.

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

// Store file data chunks in this array
let chunks = [];
// We can use this variable to store the final data
let fileBuffer;

// Read file into stream.Readable
let fileStream = fs.createReadStream('text.txt');

// An error occurred with the stream
fileStream.once('error', (err) => {
    // Be sure to handle this properly!
    console.error(err);
});

// File is done being read
fileStream.once('end', () => {
    // create the final data Buffer from data chunks;
    fileBuffer = Buffer.concat(chunks);

    // Of course, you can do anything else you need to here, like emit an event!
});

// Data is flushed from fileStream in chunks,
// this callback will be executed for each chunk
fileStream.on('data', (chunk) => {
    chunks.push(chunk); // push data chunk to array

    // We can perform actions on the partial data we have so far!
});
```

Check Permissions of a File or Directory

`fs.access()` determines whether a path exists and what permissions a user has to the file or directory at that path. `fs.access` doesn't return a result rather, if it doesn't return an error, the path exists and the user has the desired permissions.

The permission modes are available as a property on the `fs` object, `fs.constants`

- `fs.constants.F_OK` - Has read/write/execute permissions (If no mode is provided, this is the default)
- `fs.constants.R_OK` - Has read permissions
- `fs.constants.W_OK` - Has write permissions
- `fs.constants.X_OK` - Has execute permissions (Works the same as `fs.constants.F_OK` on Windows)

Asynchronously

```
var fs = require('fs');
var path = '/path/to/check';

// checks execute permission
fs.access(path, fs.constants.X_OK, (err) => {
    if (err) {
        console.log("%s doesn't exist", path);
    } else {
        console.log('can execute %s', path);
    }
});
// Check if we have read/write permissions
// When specifying multiple permission modes
// each mode is separated by a pipe : `|`
fs.access(path, fs.constants.R_OK | fs.constants.W_OK, (err) => {
    if (err) {
        console.log("%s doesn't exist", path);
    } else {
        console.log('can read/write %s', path);
    }
});
```

Synchronously

`fs.access` also has a synchronous version `fs.accessSync`. When using `fs.accessSync` you must enclose it within a try/catch block.

```
// Check write permission
try {
    fs.accessSync(path, fs.constants.W_OK);
    console.log('can write %s', path);
}
catch (err) {
    console.log("%s doesn't exist", path);
}
```

Avoiding race conditions when creating or using an existing directory

Due to Node's asynchronous nature, creating or using a directory by first:

1. checking for its existence with `fs.stat()`, then
2. creating or using it depending of the results of the existence check,

can lead to a race condition if the folder is created between the time of the check and the time of the creation. The method below wraps `fs.mkdir()` and `fs.mkdirSync()` in error-catching wrappers that let the exception pass if its code is `EEXIST` (already exists). If the error is something else, like `EPERM` (pemission denied), throw or pass an error like the native functions do.

Asynchronous version with `fs.mkdir()`

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

function mkdir (dirPath, callback) {
  fs.mkdir(dirPath, (err) => {
    callback(err && err.code !== 'EEXIST' ? err : null);
  });
}

mkdir('./existingDir', (err) => {

  if (err)
    return console.error(err.code);

  // Do something with `./existingDir` here

});
```

Synchronous version with `fs.mkdirSync()`

```
function mkdirSync (dirPath) {
  try {
    fs.mkdirSync(dirPath);
  } catch(e) {
    if ( e.code !== 'EEXIST' ) throw e;
  }
}

mkdirSync('./existing-dir');
// Do something with `./existing-dir` now
```

Checking if a file or a directory exists

Asynchronously

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

fs.stat('path/to/file', function(err) {
    if (!err) {
        console.log('file or directory exists');
    }
    else if (err.code === 'ENOENT') {
        console.log('file or directory does not exist');
    }
});
```

Synchronously

here, we must wrap the function call in a `try/catch` block to handle error.

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

try {
    fs.statSync('path/to/file');
    console.log('file or directory exists');
```

```
}
catch (err) {
  if (err.code === 'ENOENT') {
    console.log('file or directory does not exist');
  }
}
```

Cloning a file using streams

This program illustrates how one can copy a file using readable and writable streams using the `createReadStream()`, and `createWriteStream()` functions provided by the file system module.

```
//Require the file System module
var fs = require('fs');

/*
  Create readable stream to file in current directory (__dirname) named 'node.txt'
  Use utf8 encoding
  Read the data in 16-kilobyte chunks
*/
var readable = fs.createReadStream(__dirname + '/node.txt', { encoding: 'utf8', highWaterMark:
16 * 1024 });

// create writable stream
var writable = fs.createWriteStream(__dirname + '/nodeCopy.txt');

// Write each chunk of data to the writable stream
readable.on('data', function(chunk) {
    writable.write(chunk);
});
```

Copying files by piping streams

This program copies a file using readable and a writable stream with the `pipe()` function provided by the stream class

```
// require the file system module
var fs = require('fs');

/*
    Create readable stream to file in current directory named 'node.txt'
    Use utf8 encoding
    Read the data in 16-kilobyte chunks
*/
var readable = fs.createReadStream(__dirname + '/node.txt', { encoding: 'utf8', highWaterMark:
16 * 1024 });

// create writable stream
var writable = fs.createWriteStream(__dirname + '/nodePipe.txt');

// use pipe to copy readable to writable
readable.pipe(writable);
```

Changing contents of a text file

Example. It will be replacing the word `email` to a `name` in a text file `index.txt` with simple RegExp `replace(/email/gim, 'name')`

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

fs.readFile('index.txt', 'utf-8', function(err, data) {
    if (err) throw err;

    var newValue = data.replace(/email/gim, 'name');

    fs.writeFile('index.txt', newValue, 'utf-8', function(err, data) {
        if (err) throw err;
        console.log('Done!');
    })
})
```

Determining the line count of a text file

app.js

```
const readline = require('readline');
const fs = require('fs');

var file = 'path.to.file';
var linesCount = 0;
var rl = readline.createInterface({
    input: fs.createReadStream(file),
    output: process.stdout,
    terminal: false
});
rl.on('line', function (line) {
    linesCount++; // on each linebreak, add +1 to 'linesCount'
});
rl.on('close', function () {
    console.log(linesCount); // print the result when the 'close' event is called
});
```

Usage:

```
node app
```

Reading a file line by line

app.js

```
const readline = require('readline');
const fs = require('fs');

var file = 'path.to.file';
var rl = readline.createInterface({
    input: fs.createReadStream(file),
    output: process.stdout,
```

```
    terminal: false
});

rl.on('line', function (line) {
    console.log(line) // print the content of the line on each linebreak
});
```

Usage:

```
node app
```

Read Filesystem I/O online: https://riptutorial.com/node-js/topic/489/filesystem-i-o

Chapter 34: Getting started with Nodes profiling

Introduction

The aim of this post is to get started with profiling nodejs application and how to make sense of this results to capture a bug or a memory leak. A nodejs running application is nothing but a v8 engine processes which is in many terms similar to a website running on a browser and we can basically capture all the metrics which are related to a website process for a node application.

The tool of my preference is chrome devtools or chrome inspector coupled with the node-inspector.

Remarks

The node-inspector fails to attach to the node bebug process sometimes in which case you will not be able to get the debug breakpoint in devtools .Try refreshing the devtools tab multiple times and wait for some seconds to see if it is in debug mode.

If not restart the node-inspector from command line.

Examples

Profiling a simple node application

Step 1 : Install the node-inspector package using npm globally on you machine

```
$ npm install -g node-inspector
```

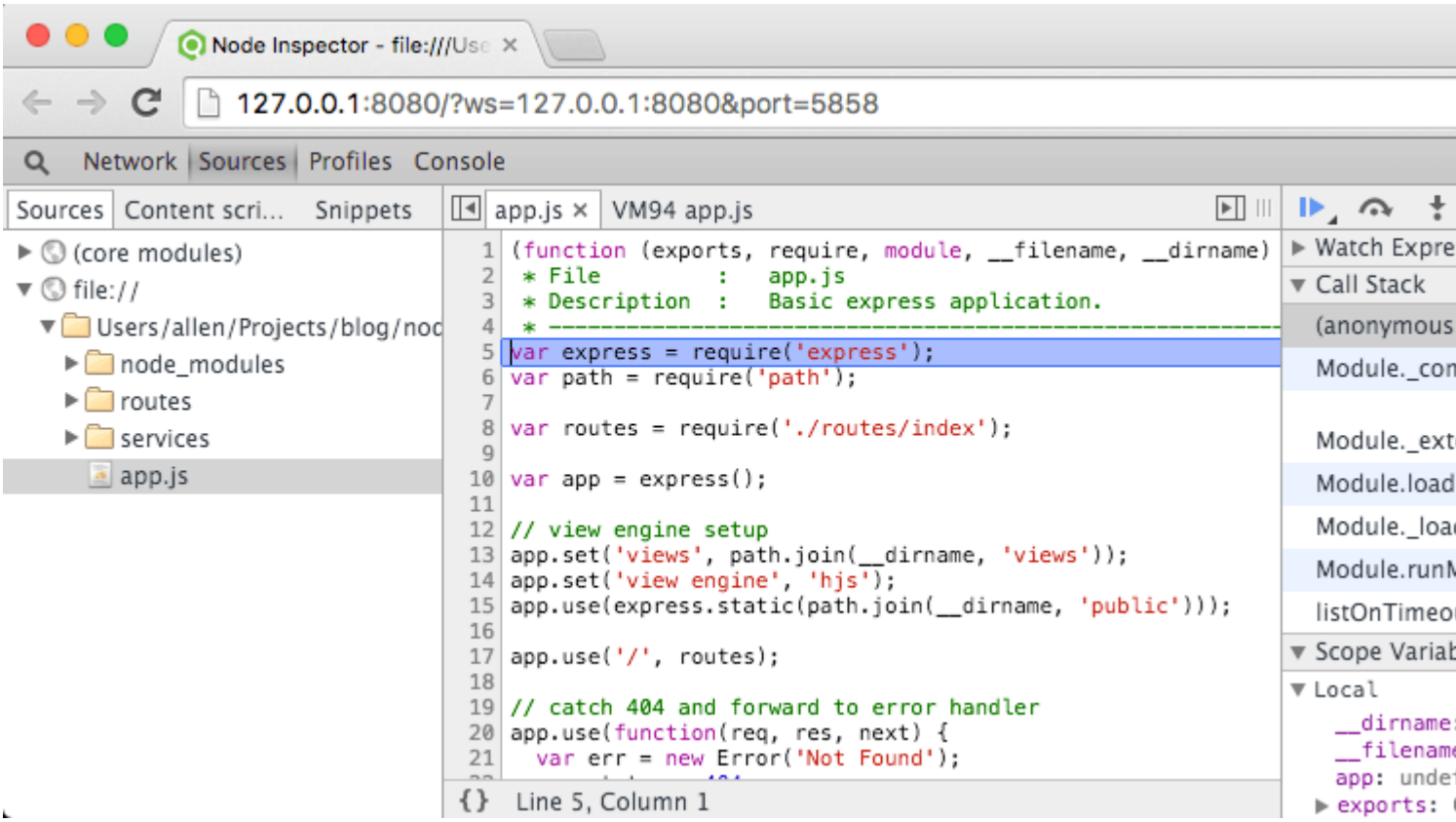
Step 2 : Start the node-inspector server

```
$ node-inspector
```

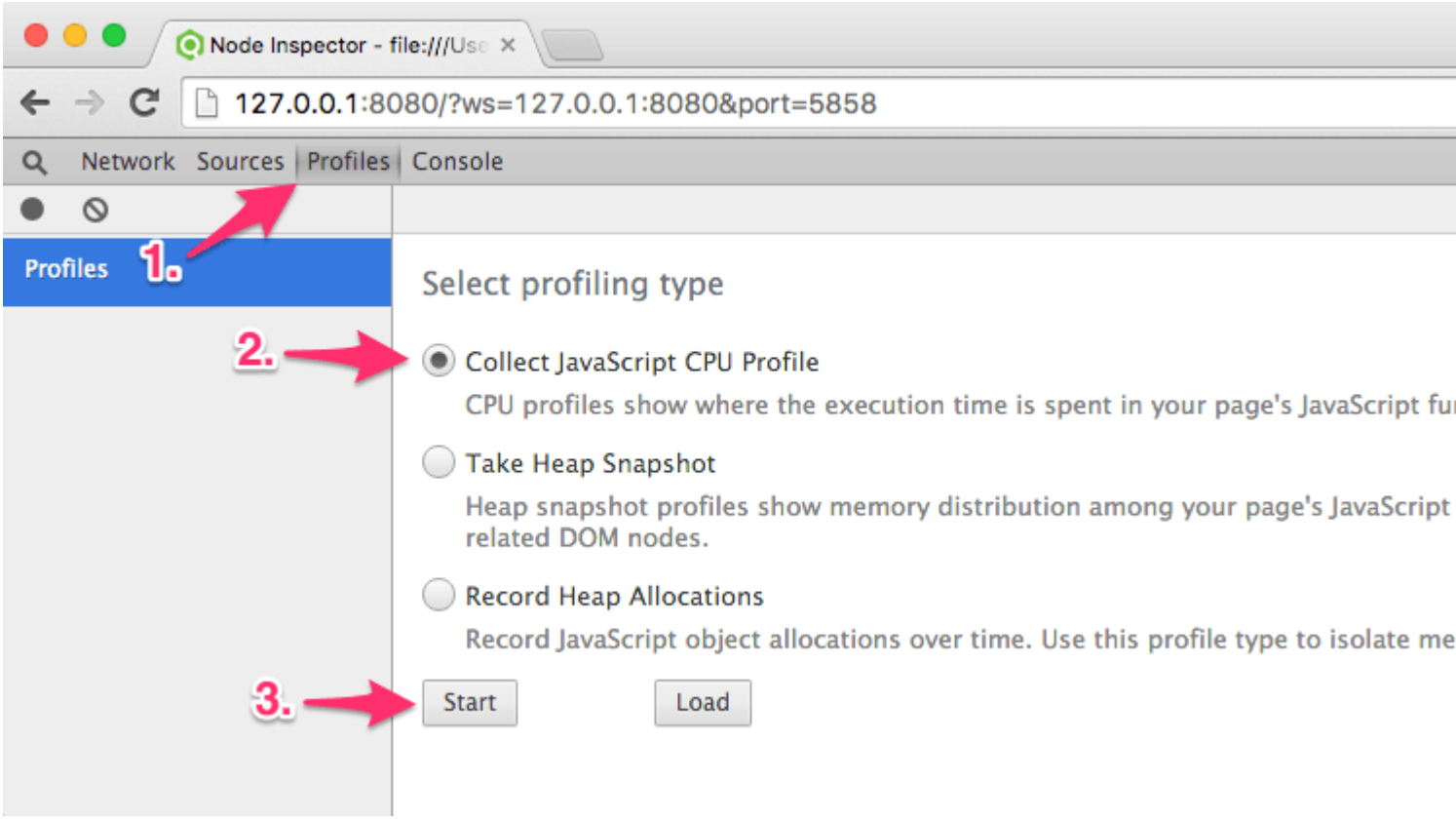
Step 3 : Start debugging your node application

```
$ node --debug-brk your/short/node/script.js
```

Step 4 : Open http://127.0.0.1:8080/?port=5858 in the Chrome browser. And you will see a chrom-dev tools interface with your nodejs application source code in left panel . And since we have used debug break option while debugging the application the code execution will stop at the first line of code.



Step 5 : This is the easy part where you switch to the profiling tab and start profiling the application . In case you want get the profile for a particular method or flow make sure the code execution is break-pointed just before that piece of code is executed.



Step 6 : Once you have recorded your CPU profile or heap dump/snapshot or heap allocation you can then view the results in the same window or save them to local drive for later analysis or

comparison with other profiles.

You can use this articles to know how to read the profiles :

- Reading CPU Profiles
- Chrome CPU profiler and Heap profiler

Read Getting started with Nodes profiling online: https://riptutorial.com/node-js/topic/9347/getting-started-with-nodes-profiling

Chapter 35: Good coding style

Remarks

I would recommend to a beginner to start with this style of coding. And if anybody can suggest a better way(p.s i opted this technique and is working efficiently for me in an app used by more then 100k users), feel free for any suggestions. TIA.

Examples

Basic program for signup

Through this example, it will be explained to divide the **node.js** code into different **modules/folders** for better undertandibility. Following this technique makes it easier for other developers to understand the code as he can directly refer to concerned file instead of going through whole code. The major use is when you are working in a team and a new developer joins at a later stage, it will get easier for him to gel up with the code itself.

index.js :- This file will manage server connection.

```
//Import Libraries
var express = require('express'),
    session = require('express-session'),
    mongoose = require('mongoose'),
    request = require('request');

//Import custom modules
var userRoutes = require('./app/routes/userRoutes');
var config = require('./app/config/config');

//Connect to Mongo DB
mongoose.connect(config.getDBString());

//Create a new Express application and Configure it
var app = express();

//Configure Routes
app.use(config.API_PATH, userRoutes());

//Start the server
app.listen(config.PORT);
console.log('Server started at - '+ config.URL+ ":" +config.PORT);
```

config.js:-This file will manage all the configuration related params which will remain same throughout.

```
var config = {
VERSION: 1,
BUILD: 1,
URL: 'http://127.0.0.1',
```

```
API_PATH : '/api',
PORT : process.env.PORT || 8080,
DB : {
    //MongoDB configuration
    HOST : 'localhost',
    PORT : '27017',
    DATABASE : 'db'
},

/*
 * Get DB Connection String for connecting to MongoDB database
 */
getDBString : function(){
    return 'mongodb://'+ this.DB.HOST +':'+ this.DB.PORT +'/'+ this.DB.DATABASE;
},

/*
 * Get the http URL
 */
getHTTPUrl : function(){
    return 'http://' + this.URL + ":" + this.PORT;
}

module.exports = config;
```

user.js:- Model file where schema is defined

```
var mongoose = require('mongoose');
var Schema = mongoose.Schema;

//Schema for User
var UserSchema = new Schema({
    name: {
        type: String,
    //    required: true
    },
    email: {
        type: String
    },
    password: {
        type: String,
        //required: true
    },
    dob: {
        type: Date,
        //required: true
    },
    gender: {
        type: String, // Male/Female
    //    required: true
    }
});

//Define the model for User
var User;
if(mongoose.models.User)
    User = mongoose.model('User');
else
    User = mongoose.model('User', UserSchema);
```

```
//Export the User Model
module.exports = User;
```

userController:- This file contains the function for user signUp

```
var User = require('../models/user');
var crypto = require('crypto');

//Controller for User
var UserController = {

    //Create a User
    create: function(req, res){
        var repassword = req.body.repassword;
        var password = req.body.password;
        var userEmail = req.body.email;

        //Check if the email address already exists
        User.find({"email": userEmail}, function(err, usr){
            if(usr.length > 0){
                //Email Exists

                res.json('Email already exists');
                return;
            }
            else
            {
                //New Email

                //Check for same passwords
                if(password != repassword){
                    res.json('Passwords does not match');
                    return;
                }

                //Generate Password hash based on sha1
                var shasum = crypto.createHash('sha1');
                shasum.update(req.body.password);
                var passwordHash = shasum.digest('hex');

                //Create User
                var user = new User();
                user.name = req.body.name;
                user.email = req.body.email;
                user.password = passwordHash;
                user.dob = Date.parse(req.body.dob) || "";
                user.gender = req.body.gender;

                //Validate the User
                user.validate(function(err){
                    if(err){
                        res.json(err);
                        return;
                    }else{
                        //Finally save the User
                        user.save(function(err){
                            if(err)
                            {
                                res.json(err);
                                return;
```

```
                            }

                            //Remove Password before sending User details
                            user.password = undefined;
                            res.json(user);
                            return;
                        });
                    }
                });
            }
        });
    }

}

module.exports = UserController;
```

userRoutes.js:- This the route for userController

```
var express = require('express');
var UserController = require('../controllers/userController');

//Routes for User
var UserRoutes = function(app)
{
    var router = express.Router();

router.route('/users')
    .post(UserController.create);

return router;

}

module.exports = UserRoutes;
```

The above example may appear too big but if a beginner at node.js with a little blend of express knowledge tries to go through this will find it easy and really helpful.

Read Good coding style online: https://riptutorial.com/node-js/topic/6489/good-coding-style

Chapter 36: Graceful Shutdown

Examples

Graceful Shutdown - SIGTERM

By using **server.close()** and **process.exit()**, we can catch the server exception and do a graceful shutdown.

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

var server = http.createServer(function (req, res) {
  setTimeout(function () { //simulate a long request
    res.writeHead(200, {'Content-Type': 'text/plain'});
    res.end('Hello World\n');
  }, 4000);
}).listen(9090, function (err) {
  console.log('listening http://localhost:9090/');
  console.log('pid is ' + process.pid);
});

process.on('SIGTERM', function () {
  server.close(function () {
    process.exit(0);
  });
});
```

Read Graceful Shutdown online: https://riptutorial.com/node-js/topic/5996/graceful-shutdown

Chapter 37: grunt

Remarks

Further reading:

The Installing grunt guide has detailed information about installing specific, production or in-development, versions of Grunt and grunt-cli.

The Configuring Tasks guide has an in-depth explanation on how to configure tasks, targets, options and files inside the Gruntfile, along with an explanation of templates, globbing patterns and importing external data.

The Creating Tasks guide lists the differences between the types of Grunt tasks and shows a number of sample tasks and configurations.

Examples

Introduction To GruntJs

Grunt is a JavaScript Task Runner, used for automation of repetitive tasks like minification, compilation, unit testing, linting, etc.

In order to get started, you'll want to install Grunt's command line interface (CLI) globally.

```
npm install -g grunt-cli
```

Preparing a new Grunt project: A typical setup will involve adding two files to your project: package.json and the Gruntfile.

package.json: This file is used by npm to store metadata for projects published as npm modules. You will list grunt and the Grunt plugins your project needs as devDependencies in this file.

Gruntfile: This file is named Gruntfile.js and is used to configure or define tasks and load Grunt plugins.

```
Example package.json:

{
  "name": "my-project-name",
  "version": "0.1.0",
  "devDependencies": {
    "grunt": "~0.4.5",
    "grunt-contrib-jshint": "~0.10.0",
    "grunt-contrib-nodeunit": "~0.4.1",
    "grunt-contrib-uglify": "~0.5.0"
  }
}
```

Example gruntfile:

```
module.exports = function(grunt) {

  // Project configuration.
  grunt.initConfig({
    pkg: grunt.file.readJSON('package.json'),
    uglify: {
      options: {
        banner: '/*! <%= pkg.name %> <%= grunt.template.today("yyyy-mm-dd") %> */\n'
      },
      build: {
        src: 'src/<%= pkg.name %>.js',
        dest: 'build/<%= pkg.name %>.min.js'
      }
    }
  });

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

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

};
```

Installing gruntplugins

Adding dependcy

To use a gruntplugin, you first need to add it as a dependency to your project. Let's use the jshint plugin as an example.

```
npm install grunt-contrib-jshint --save-dev
```

The `--save-dev` option is used to add the plugin in the `package.json`, this way the plugin is always installed after a `npm install`.

Loading the plugin

You can load your plugin in the gruntfile file using `loadNpmTasks`.

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

Configuring the task

You configure the task in the gruntfile adding a property called `jshint` to the object passed to `grunt.initConfig`.

```
grunt.initConfig({
  jshint: {
    all: ['Gruntfile.js', 'lib/**/*.js', 'test/**/*.js']
  }
```

```
});
```

Don't forget you can have other properties for other plugins you are using.

Running the task

To just run the task with the plugin you can use the command line.

```
grunt jshint
```

Or you can add `jshint` to another task.

```
grunt.registerTask('default', ['jshint']);
```

The default task runs with the grunt command in the terminal without any options.

Read grunt online: https://riptutorial.com/node-js/topic/6059/grunt

Chapter 38: Hack

Examples

Add new extensions to require()

You can add new extensions to `require()` by extending `require.extensions`.

For a **XML** example:

```
// Add .xml for require()
require.extensions['.xml'] = (module, filename) => {
    const fs = require('fs')
    const xml2js = require('xml2js')

    module.exports = (callback) => {
        // Read required file.
        fs.readFile(filename, 'utf8', (err, data) => {
            if (err) {
                callback(err)
                return
            }
            // Parse it.
            xml2js.parseString(data, (err, result) => {
                callback(null, result)
            })
        })
    }
}
```

If the content of `hello.xml` is following:

```
<?xml version="1.0" encoding="UTF-8"?>
<foo>
    <bar>baz</bar>
    <qux />
</foo>
```

You can read and parse it through `require()`:

```
require('./hello')((err, xml) {
    if (err)
        throw err;
    console.log(err);
})
```

It prints `{ foo: { bar: [ 'baz' ], qux: [ '' ] } }`.

Read Hack online: https://riptutorial.com/node-js/topic/6645/hack

Chapter 39: Handling POST request in Node.js

Remarks

Node.js uses streams to handle incoming data.

Quoting from the docs,

> A stream is an abstract interface for working with streaming data in Node.js. The stream module provides a base API that makes it easy to build objects that implement the stream interface.

To handle in request body of a POST request, use the `request` object, which is a readable stream. Data streams are emitted as `data` events on the `request` object.

```
request.on('data', chunk => {
  buffer += chunk;
});
request.on('end', () => {
  // POST request body is now available as `buffer`
});
```

Simply create an empty buffer string and append the buffer data as it received via `data` events.

NOTE

1. Buffer data received on `data` events is of type Buffer
2. Create new buffer string to collect buffered data from data events **for every request** i.e. create `buffer` string inside the request handler.

Examples

Sample node.js server that just handles POST requests

```
'use strict';

const http = require('http');

const PORT = 8080;
const server = http.createServer((request, response) => {
  let buffer = '';
  request.on('data', chunk => {
    buffer += chunk;
  });
  request.on('end', () => {
    const responseString = `Received string ${buffer}`;
    console.log(`Responding with: ${responseString}`);
```

```
    response.writeHead(200, "Content-Type: text/plain");
    response.end(responseString);
  });
}).listen(PORT, () => {
  console.log(`Listening on ${PORT}`);
});
```

Read Handling POST request in Node.js online: https://riptutorial.com/node-js/topic/5676/handling-post-request-in-node-js

Chapter 40: How modules are loaded

Examples

Global Mode

If you installed Node using the default directory, while in the global mode, NPM installs packages into `/usr/local/lib/node_modules`. If you type the following in the shell, NPM will search for, download, and install the latest version of the package named sax inside the directory `/usr/local/lib/node_modules/express`:

```
$ npm install -g express
```

Make sure that you have sufficient access rights to the folder. These modules will be available for all node process which will be running in that machine

In local mode installation. Npm will down load and install modules in the current working folders by creating a new folder called `node_modules` for example if you are in `/home/user/apps/my_app` a new folder will be created called `node_modules /home/user/apps/my_app/node_modules` if its not already exist

Loading modules

When we refer the module in the code, node first looks up the `node_module` folder inside the referenced folder in required statement If the module name is not relative and is not a core module, Node will try to find it inside the `node_modules` folder in the current directory. For instance, if you do the following, Node will try to look for the file `./node_modules/myModule.js`:

```
var myModule = require('myModule.js');
```

If Node fails to find the file, it will look inside the parent folder called `../node_modules/myModule.js`. If it fails again, it will try the parent folder and keep descending until it reaches the root or finds the required module.

You can also omit the `.js` extension if you like to, in which case node will append the `.js` extension and will search for the file.

Loading a Folder Module

You can use the path for a folder to load a module like this:

```
var myModule = require('./myModuleDir');
```

If you do so, Node will search inside that folder. Node will presume this folder is a package and will try to look for a package definition. That package definition should be a file named `package.json`. If

that folder does not contain a package definition file named `package.json`, the package entry point will assume the default value of `index.js`, and Node will look, in this case, for a file under the path `./myModuleDir/index.js`.

The last resort if module is not found in any of the folders is the global module installation folder.

Read How modules are loaded online: https://riptutorial.com/node-js/topic/7738/how-modules-are-loaded

Chapter 41: http

Examples

http server

A basic example of HTTP server.

write following code in http_server.js file:

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

var httpPort = 80;

http.createServer(handler).listen(httpPort, start_callback);

function handler(req, res) {

    var clientIP = req.connection.remoteAddress;
    var connectUsing = req.connection.encrypted ? 'SSL' : 'HTTP';
    console.log('Request received: '+ connectUsing + ' ' + req.method + ' ' + req.url);
    console.log('Client IP: ' + clientIP);

    res.writeHead(200, "OK", {'Content-Type': 'text/plain'});
    res.write("OK");
    res.end();
    return;
}

function start_callback(){
    console.log('Start HTTP on port ' + httpPort)
}
```

then from your http_server.js location run this command:

```
node http_server.js
```

you should see this result:

```
> Start HTTP on port 80
```

now you need to test your server, you need to open your internet browser and navigate to this url:

```
http://127.0.0.1:80
```

if your machine running Linux server you can test it like this:

```
curl 127.0.0.1:80
```

you should see following result:

```
ok
```

in your console, that running the app, you will see this results:

```
> Request received: HTTP GET /
> Client IP: ::ffff:127.0.0.1
```

http client

a basic example for http client:

write the follwing code in http_client.js file:

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

var options = {
  hostname: '127.0.0.1',
  port: 80,
  path: '/',
  method: 'GET'
};

var req = http.request(options, function(res) {
    console.log('STATUS: ' + res.statusCode);
    console.log('HEADERS: ' + JSON.stringify(res.headers));
    res.setEncoding('utf8');
    res.on('data', function (chunk) {
        console.log('Response: ' + chunk);
    });
    res.on('end', function (chunk) {
        console.log('Response ENDED');
    });
});

req.on('error', function(e) {
    console.log('problem with request: ' + e.message);
});


req.end();
```

then from your http_client.js location run this command:

```
node http_client.js
```

you should see this result:

```
> STATUS: 200
> HEADERS: {"content-type":"text/plain","date":"Thu, 21 Jul 2016 11:27:17
GMT","connection":"close","transfer-encoding":"chunked"}
> Response: OK
> Response ENDED
```

note: this example depend on http server example.

Read http online: https://riptutorial.com/node-js/topic/2973/http

Chapter 42: Installing Node.js

Examples

Install Node.js on Ubuntu

Using the apt package manager

```
sudo apt-get update
sudo apt-get install nodejs
sudo apt-get install npm
sudo ln -s /usr/bin/nodejs /usr/bin/node

# the node & npm versions in apt are outdated. This is how you can update them:
sudo npm install -g npm
sudo npm install -g n
sudo n stable # (or lts, or a specific version)
```

Using the latest of specific version (e.g. LTS 6.x) directly from nodesource

```
curl -sL https://deb.nodesource.com/setup_6.x | sudo -E bash -
apt-get install -y nodejs
```

Also, for the right way to install global npm modules, set the personal directory for them (eliminates the need for sudo and avoids EACCES errors):

```
mkdir ~/.npm-global
echo "export PATH=~/.npm-global/bin:$PATH" >> ~/.profile
source ~/.profile
npm config set prefix '~/.npm-global'
```

Installing Node.js on Windows

Standard installation

All Node.js binaries, installers, and source files can be downloaded here.

You can download just the `node.exe` runtime or use the Windows installer (`.msi`), which will also install `npm`, the recommended package manager for Node.js, and configure paths.

Installation by package manager

You can also install by package manager *Chocolatey* (Software Management Automation).

```
# choco install nodejs.install
```

More information about current version, you can find in the choco repository here.

Using Node Version Manager (nvm)

Node Version Manager, otherwise known as nvm, is a bash script that simplifies the management of multiple Node.js versions.

To install nvm, use the provided install script:

```
$ curl -o- https://raw.githubusercontent.com/creationix/nvm/v0.31.3/install.sh | bash
```

For windows there is a nvm-windows package with an installer. This GithHub page has the details for installing and using the nvm-windows package.

After installing nvm, run "nvm on" from command line. This enables nvm to control the node versions.

Note: You may need to restart your terminal for it to recognize the newly installed `nvm` command.

Then install the latest Node version:

```
$ nvm install node
```

You can also install a specific Node version, by passing the major, minor, and/or patch versions:

```
$ nvm install 6
$ nvm install 4.2
```

To list the versions available for install:

```
$ nvm ls-remote
```

You can then switch versions by passing the version the same way you do when installing:

```
$ nvm use 5
```

You can set a specific version of Node that you installed to be the **default version** by entering:

```
$ nvm alias default 4.2
```

To display a list of Node versions that are installed on your machine, enter:

```
$ nvm ls
```

To use project-specific node versions, you can save the version in .nvmrc file. This way, starting to

work with another project will be less error-prone after fetching it from its repository.

```
$ echo "4.2" > .nvmrc
$ nvm use
Found '/path/to/project/.nvmrc' with version <4.2>
Now using node v4.2 (npm v3.7.3)
```

When Node is installed via nvm we don't have to use `sudo` to install global packages since they are installed in home folder. Thus `npm i -g http-server` works without any permission errors.

Install Node.js From Source with APT package manager

Prerequisites

```
sudo apt-get install build-essential
sudo apt-get install python

[optional]
sudo apt-get install git
```

Get source and build

```
cd ~
git clone https://github.com/nodejs/node.git
```

OR For the latest LTS Node.js version 6.10.2

```
cd ~
wget https://nodejs.org/dist/v6.3.0/node-v6.10.2.tar.gz
tar -xzvf node-v6.10.2.tar.gz
```

Change to the source directory such as in `cd ~/node-v6.10.2`

```
./configure
make
sudo make install
```

Installing Node.js on Mac using package manager

Homebrew

You can install Node.js using the Homebrew package manager.

Start by updating brew:

```
brew update
```

You may need to change permissions or paths. It's best to run this before proceeding:

```
brew doctor
```

Next you can install Node.js by running:

```
brew install node
```

Once Node.js is installed, you can validate the version installed by running:

```
node -v
```

Macports

You can also install node.js through Macports.

First update it to make sure the lastest packages are referenced:

```
sudo port selfupdate
```

Then install nodejs and npm

```
sudo port install nodejs npm
```

You can now run node through CLI directly by invoking `node`. Also, you can check your current node version with

```
node -v
```

Installing using MacOS X Installer

You can find the installers on Node.js download page. Normally, Node.js recommends two versions of Node, the LTS version (long term support) and the current version (latest release). If you are new to Node, just go for the LTS and then click the `Macintosh Installer` button to download the package.

If you want to find other NodeJS releases, go here, choose your release then click download. From the download page, look for a file with extension `.pkg`.

Once you downloaded the file (with extension `.pkg` ofcourse), double click it to install. The installer packed with `Node.js` and `npm`, by default, the package will install both but you can customize which one to install by clicking the `customize` button in the `Installation Type` step. Other than that, just follow the installation instructions, it's pretty straightforward.

Check if Node is installed

Open `terminal` (if you don't know how to open your terminal, look at this wikihow). In the terminal type `node --version` then enter. Your terminal will look like this if Node is installed:

```
$ node --version
v7.2.1
```

The `v7.2.1` is your Node.js version, if you receive the message `command not found: node` instead of that, then it's mean there is a problem with your installation.

Installing Node.js on Raspberry PI

To install v6.x update the packages

```
curl -sL https://deb.nodesource.com/setup_6.x | sudo -E bash -
```

Using the apt package manager

```
sudo apt-get install -y nodejs
```

Installing with Node Version Manager under Fish Shell with Oh My Fish!

Node Version Manager (`nvm`) greatly simplifies the management of Node.js versions, their installation, and removes the need for `sudo` when dealing with packages (e.g. `npm install ...`). Fish Shell (`fish`) "*is a smart and user-friendly command line shell for OS X, Linux, and the rest of the family*" that is a popular alternative among programmers to common shells such as `bash`. Lastly, Oh My Fish (`omf`) allows for customizing and installing packages within Fish shell.

This guide assumes you are already using Fish as your shell.

Install nvm

```
curl -o- https://raw.githubusercontent.com/creationix/nvm/v0.31.4/install.sh | bash
```

Install Oh My Fish

```
curl -L https://github.com/oh-my-fish/oh-my-fish/raw/master/bin/install | fish
```

(Note: You will be prompted to restart your terminal at this point. Go ahead and do so now.)

Install plugin-nvm for Oh My Fish

We will install plugin-nvm via Oh My Fish to expose `nvm` capabilities within the Fish shell:

```
omf install nvm
```

Install Node.js with Node Version Manager

You are now ready to use `nvm`. You may install and use the version of Node.js of your liking. Some examples:

- Install the most recent Node version: `nvm install node`
- Install 6.3.1 specifically: `nvm install 6.3.1`
- List installed verisons: `nvm ls`
- Switch to a previously installed 4.3.1: `nvm use 4.3.1`

Final Notes

Remember again, that we no longer need `sudo` when dealing with Node.js using this method! Node versions, packages, and so on are installed in your home directory.

Install Node.js from source on Centos, RHEL and Fedora

Prerequisites

- git
- `clang` and `clang++` 3.4^ or `gcc` and `g++` 4.8^
- Python 2.6 or 2.7
- GNU Make 3.81^

Get source

Node.js v6.x LTS

```
git clone -b v6.x https://github.com/nodejs/node.git
```

Node.js v7.x

```
git clone -b v7.x https://github.com/nodejs/node.git
```

Build

```
cd node
./configure
make -jX
su -c make install
```

X - the number of processor cores, greatly speeds up the build

Cleanup [Optional]

```
cd
rm -rf node
```

Installing Node.js with n

First, there is a really nice wrapper for setting up `n` on your system. Just run:

```
curl -L https://git.io/n-install | bash
```

to install `n`. Then install binaries in a variety of ways:

latest

```
n latest
```

stable

```
n stable
```

lts

```
n lts
```

Any other version

```
n <version>
```

e.g. `n 4.4.7`

If this version is already installed, this command will activate that version.

Switching versions

`n` by itself will produce a selection list of installed binaries. Use up and down to find the one you want and Enter to activate it.

Read Installing Node.js online: https://riptutorial.com/node-js/topic/1294/installing-node-js

Chapter 43: Interacting with Console

Syntax

- console.log([data][, ...])
- console.error([data][, ...])
- console.time(label)
- console.timeEnd(label)

Examples

Logging

Console Module

Similar to the browser environment of JavaScript node.js provides a **console** module which provides simple logging and debugging possibilities.

The most important methods provided by the console module are `console.log`, `console.error` and `console.time`. But there are several others like `console.info`.

console.log

The parameters will be printed to the standard output (`stdout`) with a new line.

```
console.log('Hello World');
```

```
> console.log('Hello World')
Hello World
```

console.error

The parameters will be printed to the standard error (`stderr`) with a new line.

```
console.error('Oh, sorry, there is an error.');
```

```
> console.error("Oh, sorry, error");
Oh, sorry, error
```

console.time, console.timeEnd

`console.time` starts a timer with an unique lable that can be used to compute the duration of an operation. When you call `console.timeEnd` with the same label, the timer stops and it prints the elapsed time in milliseconds to `stdout`.

```
> console.time("label");
undefined
> console.timeEnd("label");
label: 9297.320ms
```

Process Module

It is possible to use the **process** module to write **directly** into the standard output of the console. Therefore it exists the method `process.stdout.write`. Unlike `console.log` this method does not add a new line before your output.

So in the following example the method is called two times, but no new line is added in between their outputs.

```
> process.stdout.write("123");process.stdout.write("456");
123456true
```

Formatting

One can use **terminal (control) codes** to issue specific commands like switching colors or positioning the cursor.

```
> console.log("\033[31mThis will be red");
This will be red
```

General

Effect	Code
Reset	`\033[0m`
Hicolor	`\033[1m`
Underline	`\033[4m`
Inverse	`\033[7m`

Font Colors

Effect	Code
Black	`\033[30m`
Red	`\033[31m`
Green	`\033[32m`

Effect	Code
Yellow	`\033[33m`
Blue	`\033[34m`
Magenta	`\033[35m`
Cyan	`\033[36m`
White	`\033[37m`

Background Colors

Effect	Code
Black	`\033[40m`
Red	`\033[41m`
Green	`\033[42m`
Yellow	`\033[43m`
Blue	`\033[44m`
Magenta	`\033[45m`
Cyan	`\033[46m`
White	`\033[47m`

Read Interacting with Console online: https://riptutorial.com/node-js/topic/5935/interacting-with-console

Chapter 44: Keep a node application constantly running

Examples

Use PM2 as a process manager

PM2 lets you run your nodejs scripts forever. In the event that your application crashes, PM2 will also restart it for you.

Install PM2 globally to manager your nodejs instances

```
npm install pm2 -g
```

Navigate to the directory in which your nodejs script resides and run the following command each time you want to start a nodejs instance to be monitored by pm2:

```
pm2 start server.js --name "app1"
```

Useful commands for monitoring the process

1. List all nodejs instances managed by pm2

   ```
   pm2 list
   ```

2. Stop a particular nodejs instance

   ```
   pm2 stop <instance named>
   ```

3. Delete a particular nodejs instance

```
pm2 delete <instance name>
```

4. Restart a particular nodejs instance

```
pm2 restart <instance name>
```

5. Monitoring all nodejs instances

```
pm2 monit
```

6. Stop pm2

```
pm2 kill
```

7. As opposed to restart, which kills and restarts the process, reload achieves a 0-second-downtime reload

```
pm2 reload <instance name>
```

8. View logs

```
pm2 logs <instance_name>
```

Running and stopping a Forever daemon

To start the process:

```
$ forever start index.js
warn:    --minUptime not set. Defaulting to: 1000ms
warn:    --spinSleepTime not set. Your script will exit if it does not stay up for at least
1000ms
info:    Forever processing file: index.js
```

List running Forever instances:

```
$ forever list
info:    Forever processes running

|data: | index | uid | command          | script      |forever pid|id    | logfile
|uptime        |
|------|-------|-----|------------------|-------------|-----------|-----|--------------------
---|--------------|
|data: | [0]   |f4Kt |/usr/bin/nodejs   | src/index.js|2131       |
2146|/root/.forever/f4Kt.log | 0:0:0:11.485 |
```

Stop the first process:

```
$ forever stop 0

$ forever stop 2146

$ forever stop --uid f4Kt

$ forever stop --pidFile 2131
```

Continuous running with nohup

An alternative to forever on Linux is nohup.

To start a nohup instance

1. cd to the location of `app.js` or `www`folder
2. run `nohup nodejs app.js &`

To kill the process

1. run `ps -ef|grep nodejs`
2. `kill -9 <the process number>`

Process Mangement with Forever

Installation

```
npm install forever -g
cd /node/project/directory
```

Usages

```
forever start app.js
```

Read Keep a node application constantly running online: https://riptutorial.com/node-js/topic/2820/keep-a-node-application-constantly-running

Chapter 45: Koa Framework v2

Examples

Hello World example

```
const Koa = require('koa')

const app = new Koa()

app.use(async ctx => {
   ctx.body = 'Hello World'
})

app.listen(8080)
```

Handling errors using middleware

```
app.use(async (ctx, next) => {
  try {
    await next() // attempt to invoke the next middleware downstream
  } catch (err) {
    handleError(err, ctx) // define your own error handling function
  }
})
```

Read Koa Framework v2 online: https://riptutorial.com/node-js/topic/6730/koa-framework-v2

Chapter 46: Lodash

Introduction

Lodash is a handy JavaScript utility library.

Examples

Filter a collection

The code snippet below shows the various ways you can filter on an array of objects using lodash.

```
let lodash = require('lodash');

var countries = [
    {"key": "DE", "name": "Deutschland", "active": false},
    {"key": "ZA", "name": "South Africa", "active": true}
];

var filteredByFunction = lodash.filter(countries, function (country) {
    return country.key === "DE";
});
// => [{"key": "DE", "name": "Deutschland"}];

var filteredByObjectProperties = lodash.filter(countries, { "key": "DE" });
// => [{"key": "DE", "name": "Deutschland"}];

var filteredByProperties = lodash.filter(countries, ["key", "ZA"]);
// => [{"key": "ZA", "name": "South Africa"}];

var filteredByProperty = lodash.filter(countries, "active");
// => [{"key": "ZA", "name": "South Africa"}];
```

Read Lodash online: https://riptutorial.com/node-js/topic/9161/lodash

Chapter 47: Loopback - REST Based connector

Introduction

Rest based connectors and how to deal with them. We all know Loopback does not provide elegance to REST based connections

Examples

Adding a web based connector

```
//This example gets the response from iTunes
{
  "rest": {
    "name": "rest",
    "connector": "rest",
    "debug": true,
    "options": {
      "useQuerystring": true,
      "timeout": 10000,
      "headers": {
        "accepts": "application/json",
        "content-type": "application/json"
      }
    },
    "operations": [
      {
        "template": {
          "method": "GET",
          "url": "https://itunes.apple.com/search",
          "query": {
            "term": "{keyword}",
            "country": "{country=IN}",
            "media": "{itemType=music}",
            "limit": "{limit=10}",
            "explicit": "false"
          }
        },
        "functions": {
          "search": [
            "keyword",
            "country",
            "itemType",
            "limit"
          ]
        }
      },
      {
        "template": {
          "method": "GET",
          "url": "https://itunes.apple.com/lookup",
          "query": {
```

```
            "id": "{id}"
          }
        },
        "functions": {
          "findById": [
            "id"
          ]
        }
      }
    ]
  }
}
```

Read Loopback - REST Based connector online: https://riptutorial.com/node-js/topic/9234/loopback---rest-based-connector

Chapter 48: metalsmith

Examples

Build a simple blog

Assuming that you have node and npm installed and available, create a project folder with a valid `package.json`. Install the necessary dependencies:

```
npm install --save-dev metalsmith metalsmith-in-place handlebars
```

Create a file called `build.js` at the root of your project folder, containing the following:

```
var metalsmith = require('metalsmith');
var handlebars = require('handlebars');
var inPlace = require('metalsmith-in-place');

Metalsmith(__dirname)
  .use(inPlace('handlebars'))
  .build(function(err) {
    if (err) throw err;
    console.log('Build finished!');
  });
```

Create a folder called `src` at the root of your project folder. Create `index.html` in `src`, containing the following:

```
---
title: My awesome blog
---
<h1>{{ title }}</h1>
```

Running `node build.js` will now build all files in `src`. After running this command, you'll have `index.html` in your build folder, with the following contents:

```
<h1>My awesome blog</h1>
```

Read metalsmith online: https://riptutorial.com/node-js/topic/6111/metalsmith

Chapter 49: Mongodb integration

Syntax

- db.*collection*.insertOne(*document*, *options(w, wtimeout, j, serializeFuntions, forceServerObjectId, bypassDocumentValidation)*, *callback*)
- db.*collection*.insertMany(*[documents]*, *options(w, wtimeout, j, serializeFuntions, forceServerObjectId, bypassDocumentValidation)*, *callback*)
- db.*collection*.find(*query*)
- db.*collection*.updateOne(*filter*, *update*, *options(upsert, w, wtimeout, j, bypassDocumentValidation)*, *callback*)
- db.*collection*.updateMany(*filter*, *update*, *options(upsert, w, wtimeout, j)*, *callback*)
- db.*collection*.deleteOne(*filter*, *options(upsert, w, wtimeout, j)*, *callback*)
- db.*collection*.deleteMany(*filter*, *options(upsert, w, wtimeout, j)*, *callback*)

Parameters

Parameter	Details
document	A javascript object representing a document
documents	An array of documents
query	An object defining a search query
filter	An object defining a search query
callback	Function to be called when the operation is done
options	*(optional)* Optional settings *(default: null)*
w	*(optional)* The write concern
wtimeout	*(optional)* The write concern timeout. *(default: null)*
j	*(optional)* Specify a journal write concern *(default: false)*
upsert	*(optional)* Update operation *(default: false)*
multi	*(optional)* Update one/all documents *(default: false)*
serializeFunctions	*(optional)* Serialize functions on any object *(default: false)*
forceServerObjectId	*(optional)* Force server to assign _id values instead of driver *(default: false)*
bypassDocumentValidation	*(optional)* Allow driver to bypass schema validation in MongoDB

Parameter	Details
	3.2 or higher *(default: false)*

Examples

Connect to MongoDB

Connect to MongoDB, print 'Connected!' and close the connection.

```
const MongoClient = require('mongodb').MongoClient;

var url = 'mongodb://localhost:27017/test';

MongoClient.connect(url, function(err, db) { // MongoClient method 'connect'
    if (err) throw new Error(err);
    console.log("Connected!");
    db.close(); // Don't forget to close the connection when you are done
});
```

MongoClient method `Connect()`

MongoClient.connect(*url*, *options*, *callback*)

Argument	Type	Description
`url`	string	A string specifying the server ip/hostname, port and database
`options`	object	*(optional)* Optional settings *(default: null)*
`callback`	Function	Function to be called when the connection attempt is done

The `callback` function takes two arguments

- `err` : Error - If an error occurs the `err` argument will be defined
- `db` : object - The MongoDB instance

Insert a document

Insert a document called 'myFirstDocument' and set **2** properties, `greetings` and `farewell`

```
const MongoClient = require('mongodb').MongoClient;

const url = 'mongodb://localhost:27017/test';

MongoClient.connect(url, function (err, db) {
  if (err) throw new Error(err);
  db.collection('myCollection').insertOne({ // Insert method 'insertOne'
    "myFirstDocument": {
      "greetings": "Hellu",
```

```
      "farewell": "Bye"
    }
  }, function (err, result) {
    if (err) throw new Error(err);
    console.log("Inserted a document into the myCollection collection!");
    db.close(); // Don't forget to close the connection when you are done
  });
});
```

Collection method `insertOne()`

db.collection(*collection*).insertOne(*document*, *options*, *callback*)

Argument	Type	Description
`collection`	string	A string specifying the collection
`document`	object	The document to be inserted into the collection
`options`	object	*(optional)* Optional settings *(default: null)*
`callback`	Function	Function to be called when the insert operation is done

The `callback` function takes two arguments

- `err` : Error - If an error occurs the `err` argument will be defined
- `result` : object - An object containing details about the insert operation

Read a collection

Get all documents in the collection 'myCollection' and print them to the console.

```
const MongoClient = require('mongodb').MongoClient;

const url = 'mongodb://localhost:27017/test';

MongoClient.connect(url, function (err, db) {
  if (err) throw new Error(err);
  var cursor = db.collection('myCollection').find(); // Read method 'find'
  cursor.each(function (err, doc) {
    if (err) throw new Error(err);
    if (doc != null) {
      console.log(doc); // Print all documents
    } else {
      db.close(); // Don't forget to close the connection when you are done
    }
  });
});
```

Collection method `find()`

db.collection(*collection*).find()

Argument	Type	Description
`collection`	string	A string specifying the collection

Update a document

Find a document with the property `{ greetings: 'Hellu' }` and change it to `{ greetings: 'Whut?' }`

```
const MongoClient = require('mongodb').MongoClient;

const url = 'mongodb://localhost:27017/test';

MongoClient.connect(url, function (err, db) {
    if (err) throw new Error(err);
    db.collection('myCollection').updateOne({ // Update method 'updateOne'
        greetings: "Hellu" },
        { $set: { greetings: "Whut?" }},
        function (err, result) {
            if (err) throw new Error(err);
            db.close(); // Don't forget to close the connection when you are done
        });
});
```

Collection method `updateOne()`

db.collection(*collection*).updateOne(*filter*, *update*, *options*. *callback*)

Parameter	Type	Description
`filter`	object	Specifies the selection critera
`update`	object	Specifies the modifications to apply
`options`	object	*(optional)* Optional settings *(default: null)*
`callback`	Function	Function to be called when the operation is done

The `callback` function takes two arguments

- `err` : Error - If an error occurs the err argument will be defined
- `db` : object - The MongoDB instance

Delete a document

Delete a document with the property `{ greetings: 'Whut?' }`

```
const MongoClient = require('mongodb').MongoClient;
```

```
const url = 'mongodb://localhost:27017/test';

MongoClient.connect(url, function (err, db) {
    if (err) throw new Error(err);
    db.collection('myCollection').deleteOne(// Delete method 'deleteOne'
        { greetings: "Whut?" },
        function (err, result) {
            if (err) throw new Error(err);
            db.close(); // Don't forget to close the connection when you are done
    });
});
```

Collection method `deleteOne()`

db.collection(*collection*).deleteOne(*filter*, *options*, *callback*)

Parameter	Type	Description
`filter`	object	A document specifying the selection critera
`options`	object	*(optional)* Optional settings *(default: null)*
`callback`	Function	Function to be called when the operation is done

The `callback` function takes two arguments

- `err` : Error - If an error occurs the err argument will be defined
- `db` : object - The MongoDB instance

Delete multiple documents

Delete ALL documents with a 'farewell' property set to 'okay'.

```
const MongoClient = require('mongodb').MongoClient;

const url = 'mongodb://localhost:27017/test';

MongoClient.connect(url, function (err, db) {
    if (err) throw new Error(err);
    db.collection('myCollection').deleteMany(// MongoDB delete method 'deleteMany'
        { farewell: "okay" }, // Delete ALL documents with the property 'farewell: okay'
        function (err, result) {
            if (err) throw new Error(err);
            db.close(); // Don't forget to close the connection when you are done
    });
});
```

Collection method `deleteMany()`

db.collection(*collection*).deleteMany(*filter*, *options*, *callback*)

Parameter	Type	Description
`filter`	document	A document specifying the selection critera
`options`	object	*(optional)* Optional settings *(default: null)*
`callback`	function	Function to be called when the operation is done

The `callback` function takes two arguments

- `err` : Error - If an error occurs the err argument will be defined
- `db` : object - The MongoDB instance

Simple connect

```
MongoDB.connect('mongodb://localhost:27017/databaseName', function(error, database) {
   if(error) return console.log(error);
   const collection = database.collection('collectionName');
   collection.insert({key: 'value'}, function(error, result) {
      console.log(error, result);
   });
});
```

Simple connect, using promises

```
const MongoDB = require('mongodb');

MongoDB.connect('mongodb://localhost:27017/databaseName')
    .then(function(database) {
        const collection = database.collection('collectionName');
        return collection.insert({key: 'value'});
    })
    .then(function(result) {
        console.log(result);
    });
    ```
```

Read Mongodb integration online: https://riptutorial.com/node-js/topic/5002/mongodb-integration
```

Chapter 50: MongoDB Integration for Node.js/Express.js

Introduction

MongoDB is one of the most popular NoSQL databases, thanks to the help of the MEAN stack. Interfacing with a Mongo database from an Express app is quick and easy, once you understand the kinda-wonky query syntax. We'll use Mongoose to help us out.

Remarks

More information can be found here: http://mongoosejs.com/docs/guide.html

Examples

Installing MongoDB

```
npm install --save mongodb
npm install --save mongoose //A simple wrapper for ease of development
```

In your server file (normally named index.js or server.js)

```
const express = require('express');
const mongodb = require('mongodb');
const mongoose = require('mongoose');
const mongoConnectString = 'http://localhost/database name';

mongoose.connect(mongoConnectString, (err) => {
  if (err) {
    console.log('Could not connect to the database');
  }
});
```

Creating a Mongoose Model

```
const Schema = mongoose.Schema;
const ObjectId = Schema.Types.ObjectId;

const Article = new Schema({
  title: {
    type: String,
    unique: true,
    required: [true, 'Article must have title']
  },
  author: {
    type: ObjectId,
    ref: 'User'
```

```
  }
});

module.exports = mongoose.model('Article, Article);
```

Let's dissect this. MongoDB and Mongoose use JSON(actually BSON, but that's irrelevant here) as the data format. At the top, I've set a few variables to reduce typing.

I create a `new Schema` and assign it to a constant. It's simple JSON, and each attribute is another Object with properties that help enforce a more consistent schema. Unique forces new instances being inserted in the database to, obviously, be unique. This is great for preventing a user creating multiple accounts on a service.

Required is another, declared as an array. The first element is the boolean value, and the second the error message should the value being inserted or updated fail to exist.

ObjectIds are used for relationships between Models. Examples might be 'Users have many Comments`. Other attributes can be used instead of ObjectId. Strings like a username is one example.

Lastly, exporting the model for use with your API routes provides access to your schema.

Querying your Mongo Database

A simple GET request. Let's assume the Model from the example above is in the file `./db/models/Article.js`.

```
const express = require('express');
const Articles = require('./db/models/Article');

module.exports = function (app) {
  const routes = express.Router();

  routes.get('/articles', (req, res) => {
    Articles.find().limit(5).lean().exec((err, doc) => {
      if (doc.length > 0) {
        res.send({ data: doc });
      } else {
        res.send({ success: false, message: 'No documents retrieved' });
      }
    });
  });

app.use('/api', routes);
};
```

We can now get the data from our database by sending an HTTP request to this endpoint. A few key things, though:

1. Limit does exactly what it looks like. I'm only getting 5 documents back.
2. Lean strips away some stuff from the raw BSON, reducing complexity and overhead. Not required. But useful.

3. When using `find` instead of `findOne`, confirm that the `doc.length` is greater than 0. This is because `find` always returns an array, so an empty array will not handle your error unless it is checked for length
4. I personally like to send the error message in that format. Change it to suit your needs. Same thing for the returned document.
5. The code in this example is written under the assumption that you have placed it in another file and not directly on the express server. To call this in the server, include these lines in your server code:

```
const app = express();
require('./path/to/this/file')(app) //
```

Read MongoDB Integration for Node.js/Express.js online: https://riptutorial.com/node-js/topic/9020/mongodb-integration-for-node-js-express-js

Chapter 51: Mongoose Library

Examples

Connect to MongoDB Using Mongoose

First, install Mongoose with:

```
npm install mongoose
```

Then, add it to `server.js` as dependencies:

```
var mongoose = require('mongoose');
var Schema = mongoose.Schema;
```

Next, create the database schema and the name of the collection:

```
var schemaName = new Schema({
    request: String,
    time: Number
}, {
    collection: 'collectionName'
});
```

Create a model and connect to the database:

```
var Model = mongoose.model('Model', schemaName);
mongoose.connect('mongodb://localhost:27017/dbName');
```

Next, start MongoDB and run `server.js` using `node server.js`

To check if we have successfully connected to the database, we can use the events `open`, `error` from the `mongoose.connection` object.

```
var db = mongoose.connection;
db.on('error', console.error.bind(console, 'connection error:'));
db.once('open', function() {
  // we're connected!
});
```

Save Data to MongoDB using Mongoose and Express.js Routes

Setup

First, install the necessary packages with:

```
npm install express cors mongoose
```

Code

Then, add dependencies to your `server.js` file, create the database schema and the name of the collection, create an Express.js server, and connect to MongoDB:

```
var express = require('express');
var cors = require('cors'); // We will use CORS to enable cross origin domain requests.
var mongoose = require('mongoose');
var Schema = mongoose.Schema;

var app = express();

var schemaName = new Schema({
    request: String,
    time: Number
}, {
    collection: 'collectionName'
});

var Model = mongoose.model('Model', schemaName);
mongoose.connect('mongodb://localhost:27017/dbName');

var port = process.env.PORT || 8080;
app.listen(port, function() {
    console.log('Node.js listening on port ' + port);
});
```

Now add Express.js routes that we will use to write the data:

```
app.get('/save/:query', cors(), function(req, res) {
    var query = req.params.query;

    var savedata = new Model({
        'request': query,
        'time': Math.floor(Date.now() / 1000) // Time of save the data in unix timestamp
format
    }).save(function(err, result) {
        if (err) throw err;

        if(result) {
            res.json(result)
        }
    })
})
```

Here the `query` variable will be the `<query>` parameter from the incoming HTTP request, which will be saved to MongoDB:

```
var savedata = new Model({
    'request': query,
    //...
```

If an error occurs while trying to write to MongoDB, you will receive an error message on the console. If all is successful, you will see the saved data in JSON format on the page.

```
//...
}).save(function(err, result) {
    if (err) throw err;

    if(result) {
        res.json(result)
    }
})
//...
```

Now, you need to start MongoDB and run your `server.js` file using `node server.js`.

Usage

To use this to save data, go to the following URL in your browser:

```
http://localhost:8080/save/<query>
```

Where `<query>` is the new request you wish to save.

Example:

```
http://localhost:8080/save/JavaScript%20is%20Awesome
```

Output in JSON format:

```
{
    __v: 0,
    request: "JavaScript is Awesome",
    time: 1469411348,
    _id: "57957014b93bc8640f2c78c4"
}
```

Find Data in MongoDB Using Mongoose and Express.js Routes

Setup

First, install the necessary packages with:

```
npm install express cors mongoose
```

Code

Then, add dependencies to `server.js`, create the database schema and the name of the collection, create an Express.js server, and connect to MongoDB:

```
var express = require('express');
var cors = require('cors'); // We will use CORS to enable cross origin domain requests.
var mongoose = require('mongoose');
var Schema = mongoose.Schema;

var app = express();

var schemaName = new Schema({
    request: String,
    time: Number
}, {
    collection: 'collectionName'
});

var Model = mongoose.model('Model', schemaName);
mongoose.connect('mongodb://localhost:27017/dbName');

var port = process.env.PORT || 8080;
app.listen(port, function() {
    console.log('Node.js listening on port ' + port);
});
```

Now add Express.js routes that we will use to query the data:

```
app.get('/find/:query', cors(), function(req, res) {
    var query = req.params.query;

    Model.find({
        'request': query
    }, function(err, result) {
        if (err) throw err;
        if (result) {
            res.json(result)
        } else {
            res.send(JSON.stringify({
                error : 'Error'
            }))
        }
    })
})
```

Assume that the following documents are in the collection in the model:

```
{
        "_id" : ObjectId("578abe97522ad414b8eeb55a"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710551
}
{
        "_id" : ObjectId("578abe9b522ad414b8eeb55b"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710555
}
{
        "_id" : ObjectId("578abea0522ad414b8eeb55c"),
```

```
        "request" : "JavaScript is Awesome",
        "time" : 1468710560
}
```

And the goal is to find and display all the documents containing `"JavaScript is Awesome"` under the `"request"` key.

For this, start MongoDB and run `server.js` with `node server.js`:

Usage

To use this to find data, go to the following URL in a browser:

```
http://localhost:8080/find/<query>
```

Where `<query>` is the search query.

Example:

```
http://localhost:8080/find/JavaScript%20is%20Awesome
```

Output:

```
[{
    _id: "578abe97522ad414b8eeb55a",
    request: "JavaScript is Awesome",
    time: 1468710551,
    __v: 0
},
{
    _id: "578abe9b522ad414b8eeb55b",
    request: "JavaScript is Awesome",
    time: 1468710555,
    __v: 0
},
{
    _id: "578abea0522ad414b8eeb55c",
    request: "JavaScript is Awesome",
    time: 1468710560,
    __v: 0
}]
```

Find Data in MongoDB Using Mongoose, Express.js Routes and $text Operator

Setup

First, install the necessary packages with:

```
npm install express cors mongoose
```

Code

Then, add dependencies to `server.js`, create the database schema and the name of the collection, create an Express.js server, and connect to MongoDB:

```
var express = require('express');
var cors = require('cors'); // We will use CORS to enable cross origin domain requests.
var mongoose = require('mongoose');
var Schema = mongoose.Schema;

var app = express();

var schemaName = new Schema({
    request: String,
    time: Number
}, {
    collection: 'collectionName'
});

var Model = mongoose.model('Model', schemaName);
mongoose.connect('mongodb://localhost:27017/dbName');

var port = process.env.PORT || 8080;
app.listen(port, function() {
    console.log('Node.js listening on port ' + port);
});
```

Now add Express.js routes that we will use to query the data:

```
app.get('/find/:query', cors(), function(req, res) {
    var query = req.params.query;

    Model.find({
        'request': query
    }, function(err, result) {
        if (err) throw err;
        if (result) {
            res.json(result)
        } else {
            res.send(JSON.stringify({
                error : 'Error'
            }))
        }
    })
})
```

Assume that the following documents are in the collection in the model:

```
{
        "_id" : ObjectId("578abe97522ad414b8eeb55a"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710551
}
```

```
{
        "_id" : ObjectId("578abe9b522ad414b8eeb55b"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710555
}
{
        "_id" : ObjectId("578abea0522ad414b8eeb55c"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710560
}
```

And that the goal is to find and display all the documents containing only `"JavaScript"` word under the `"request"` key.

To do this, first create a *text index* for `"request"` in the collection. For this, add the following code to `server.js`:

```
schemaName.index({ request: 'text' });
```

And replace:

```
    Model.find({
        'request': query
    }, function(err, result) {
```

With:

```
Model.find({
    $text: {
        $search: query
    }
}, function(err, result) {
```

Here, we are using `$text` and `$search` MongoDB operators for find all documents in collection `collectionName` which contains at least one word from the specified find query.

Usage

To use this to find data, go to the following URL in a browser:

```
http://localhost:8080/find/<query>
```

Where `<query>` is the search query.

Example:

```
http://localhost:8080/find/JavaScript
```

Output:

```
[{
    _id: "578abe97522ad414b8eeb55a",
    request: "JavaScript is Awesome",
    time: 1468710551,
    __v: 0
},
{
    _id: "578abe9b522ad414b8eeb55b",
    request: "JavaScript is Awesome",
    time: 1468710555,
    __v: 0
},
{
    _id: "578abea0522ad414b8eeb55c",
    request: "JavaScript is Awesome",
    time: 1468710560,
    __v: 0
}]
```

Indexes in models.

MongoDB supports secondary indexes. In Mongoose, we define these indexes within our schema. Defining indexes at schema level is necessary when we need to create compound indexes.

Mongoose Connection

```
var strConnection = 'mongodb://localhost:27017/dbName';
var db = mongoose.createConnection(strConnection)
```

Creating a basic schema

```
var Schema = require('mongoose').Schema;
var usersSchema = new Schema({
    username: {
        type: String,
        required: true,
        unique: true
    },
    email: {
        type: String,
        required: true
    },
    password: {
        type: String,
        required: true
    },
    created: {
        type: Date,
        default: Date.now
    }
});

var usersModel = db.model('users', usersSchema);
module.exports = usersModel;
```

By default, mongoose adds two new fields into our model, even when those are not defined in the

model. Those fields are:

_id

Mongoose assigns each of your schemas an _id field by default if one is not passed into the Schema constructor. The type assigned is an ObjectId to coincide with MongoDB's default behavior. If you don't want an _id added to your schema at all, you may disable it using this option.

```
var usersSchema = new Schema({
    username: {
        type: String,
        required: true,
        unique: true
    }, {
        _id: false
});
```

__v or versionKey

The versionKey is a property set on each document when first created by Mongoose. This keys value contains the internal revision of the document. The name of this document property is configurable.

You can easy disable this field in the model configuration:

```
var usersSchema = new Schema({
    username: {
        type: String,
        required: true,
        unique: true
    }, {
    versionKey: false
});
```

Compound indexes

We can create another indexes besides those Mongoose creates.

```
usersSchema.index({username: 1 });
usersSchema.index({email: 1 });
```

In these case our model have two more indexes, one for the field username and another for email field. But we can create compound indexes.

```
usersSchema.index({username: 1, email: 1 });
```

Index performance impact

By default, mongoose always call the ensureIndex for each index sequentially and emit an 'index' event on the model when all the ensureIndex calls succeeded or when there was an error.

In MongoDB ensureIndex is deprecated since 3.0.0 version, now is an alias for createIndex.

Is recommended disable the behavior by setting the autoIndex option of your schema to false, or globally on the connection by setting the option config.autoIndex to false.

```
usersSchema.set('autoIndex', false);
```

Useful Mongoose functions

Mongoose contains some built in functions that build on the standard `find()`.

```
doc.find({'some.value':5},function(err,docs){
    //returns array docs
});

doc.findOne({'some.value':5},function(err,doc){
    //returns document doc
});

doc.findById(obj._id,function(err,doc){
    //returns document doc
});
```

find data in mongodb using promises

Setup

First, install the necessary packages with:

```
npm install express cors mongoose
```

Code

Then, add dependencies to `server.js`, create the database schema and the name of the collection, create an Express.js server, and connect to MongoDB:

```
var express = require('express');
var cors = require('cors'); // We will use CORS to enable cross origin domain requests.
var mongoose = require('mongoose');
var Schema = mongoose.Schema;

var app = express();

var schemaName = new Schema({
    request: String,
    time: Number
}, {
    collection: 'collectionName'
});

var Model = mongoose.model('Model', schemaName);
mongoose.connect('mongodb://localhost:27017/dbName');
```

```
var port = process.env.PORT || 8080;
app.listen(port, function() {
    console.log('Node.js listening on port ' + port);
});

app.use(function(err, req, res, next) {
  console.error(err.stack);
  res.status(500).send('Something broke!');
});

app.use(function(req, res, next) {
  res.status(404).send('Sorry cant find that!');
});
```

Now add Express.js routes that we will use to query the data:

```
app.get('/find/:query', cors(), function(req, res, next) {
    var query = req.params.query;

    Model.find({
        'request': query
    })
    .exec() //remember to add exec, queries have a .then attribute but aren't promises
    .then(function(result) {
        if (result) {
            res.json(result)
        } else {
            next() //pass to 404 handler
        }
    })
    .catch(next) //pass to error handler
})
```

Assume that the following documents are in the collection in the model:

```
{
        "_id" : ObjectId("578abe97522ad414b8eeb55a"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710551
}
{
        "_id" : ObjectId("578abe9b522ad414b8eeb55b"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710555
}
{
        "_id" : ObjectId("578abea0522ad414b8eeb55c"),
        "request" : "JavaScript is Awesome",
        "time" : 1468710560
}
```

And the goal is to find and display all the documents containing `"JavaScript is Awesome"` under the `"request"` key.

For this, start MongoDB and run `server.js` with `node server.js`:

Usage

To use this to find data, go to the following URL in a browser:

```
http://localhost:8080/find/<query>
```

Where `<query>` is the search query.

Example:

```
http://localhost:8080/find/JavaScript%20is%20Awesome
```

Output:

```
[{
    _id: "578abe97522ad414b8eeb55a",
    request: "JavaScript is Awesome",
    time: 1468710551,
    __v: 0
},
{
    _id: "578abe9b522ad414b8eeb55b",
    request: "JavaScript is Awesome",
    time: 1468710555,
    __v: 0
},
{
    _id: "578abea0522ad414b8eeb55c",
    request: "JavaScript is Awesome",
    time: 1468710560,
    __v: 0
}]
```

Read Mongoose Library online: https://riptutorial.com/node-js/topic/3486/mongoose-library

Chapter 52: MSSQL Intergration

Introduction

To integrate any database with nodejs you need a driver package or you can call it a npm module which will provide you with basic API to connect with the database and perform interactions . Same is true with mssql database , here we will integrate mssql with nodejs and perform some basic queries on SQL tabels.

Remarks

We have assumed that we will have a local instance of mssql database server running on local machine . You can refer this document to do the same .

Also make sure you appropriate user created with privileges added as well.

Examples

Connecting with SQL via. mssql npm module

We will start with creating a simple node application with a basic structure and then connecting with local sql server database and performing some queries on that database.

Step 1: Create a directory/folder by the name of project which you intent to create. Initialize a node application using *npm init* command which will create a package.json in current directory .

```
mkdir mySqlApp
//folder created
cd mwSqlApp
//change to newly created directory
npm init
//answer all the question ..
npm install
//This will complete quickly since we have not added any packages to our app.
```

Step 2: Now we will create a App.js file in this directory and install some packages which we are going to need to connect to sql db.

```
sudo gedit App.js
//This will create App.js file , you can use your fav. text editor :)
npm install --save mssql
//This will install the mssql package to you app
```

Step 3: Now we will add a basic configuration variable to our application which will be used by mssql module to establish a connection .

```
console.log("Hello world, This is an app to connect to sql server.");
```

```
var config = {
        "user": "myusername", //default is sa
        "password": "yourStrong(!)Password",
        "server": "localhost", // for local machine
        "database": "staging", // name of database
        "options": {
            "encrypt": true
        }
      }

sql.connect(config, err => {
    if(err){
        throw err ;
    }
    console.log("Connection Successful !");

    new sql.Request().query('select 1 as number', (err, result) => {
        //handle err
        console.dir(result)
        // This example uses callbacks strategy for getting results.
    })

});

sql.on('error', err => {
    // ... error handler
    console.log("Sql database connection error " ,err);
})
```

Step 4: This is the easiest step ,where we start the application and the application will connect to the sql server and print out some simple results .

```
node App.js
// Output :
// Hello world, This is an app to connect to sql server.
// Connection Successful !
// 1
```

> To use promises or async for query execution refer the official documents of the mssql package :
>
> - Promises
> - Async/Await

Read MSSQL Intergration online: https://riptutorial.com/node-js/topic/9884/mssql-intergration

Chapter 53: Multithreading

Introduction

Node.js has been designed to be single threaded. So for all practical purposes, applications that launch with Node will run on a single thread.

However, Node.js itself runs multi-threaded. I/O operations and the like will run from a thread pool. Further will any instance of a node application run on a different thread, therefore to run multi-threaded applications one launches multiple instances.

Remarks

Understanding the Event Loop is important to understand how and why to use multiple threads.

Examples

Cluster

The `cluster` module allows one to start the same application multiple times.

Clustering is desirable when the different instances have the same flow of execution and don't depend on one another. In this scenario, you have one master that can start forks and the forks (or children). The children work independently and have their one space of Ram and Event Loop.

Setting up clusters can be beneficial for websites / APIs. Any thread can serve any customer, as it doesn't depend on other threads. A Database (like Redis) would be used to share Cookies, as **variables can't be shared!** between the threads.

```
// runs in each instance
var cluster = require('cluster');
var numCPUs = require('os').cpus().length;

console.log('I am always called');

if (cluster.isMaster) {
    // runs only once (within the master);
    console.log('I am the master, launching workers!');
    for(var i = 0; i < numCPUs; i++) cluster.fork();

} else {
    // runs in each fork
    console.log('I am a fork!');

    // here one could start, as an example, a web server

}

console.log('I am always called as well');
```

Child Process

Child Processes are the way to go when one wants to run processes independently with different initialization and concerns. Like forks in clusters, a `child_process` runs in its thread, but unlike forks, it has a way to communicate with its parent.

The communication goes both ways, so parent and child can listen for messages and send messages.

Parent (../parent.js)

```
var child_process = require('child_process');
console.log('[Parent]', 'initalize');

var child1 = child_process.fork(__dirname + '/child');
child1.on('message', function(msg) {
    console.log('[Parent]', 'Answer from child: ', msg);
});

// one can send as many messages as one want
child1.send('Hello'); // Hello to you too :)
child1.send('Hello'); // Hello to you too :)

// one can also have multiple children
var child2 = child_process.fork(__dirname + '/child');
```

Child (../child.js)

```
// here would one initialize this child
// this will be executed only once
console.log('[Child]', 'initalize');

// here one listens for new tasks from the parent
process.on('message', function(messageFromParent) {

    //do some intense work here
    console.log('[Child]', 'Child doing some intense work');

    if(messageFromParent == 'Hello') process.send('Hello to you too :)');
    else process.send('what?');

})
```

Next to message one can listen to many events like 'error', 'connected' or 'disconnect'.

Starting a child process has a certain cost associated with it. One would want to spawn as few of them as possible.

Read Multithreading online: https://riptutorial.com/node-js/topic/10592/multithreading

Chapter 54: Mysql Connection Pool

Examples

Using a connection pool without database

Achieving multitenancy on database server with multiple databases hosted on it.

Multitenancy is common requirement of enterprise application nowadays and creating connection pool for each database in database server is not recommended. so, what we can do instead is create connection pool with database server and than switch between databases hosted on database server on demand.

Suppose our application has different databases for each firm hosted on database server. We will connect to respective firm database when user hits the application. here is the example on how to do that:-

```
var pool  = mysql.createPool({
      connectionLimit : 10,
      host            : 'example.org',
      user            : 'bobby',
      password        : 'pass'
    });

pool.getConnection(function(err, connection){
    if(err){
        return cb(err);
    }
    connection.changeUser({database : "firm1"});
    connection.query("SELECT * from history", function(err, data){
        connection.release();
        cb(err, data);
    });
});
```

Let me break down the example:-

When defining pool configuration i did not gave the database name but only gave database server i.e

```
{
  connectionLimit : 10,
  host            : 'example.org',
  user            : 'bobby',
  password        : 'pass'
}
```

so when we want to use the specific database on database server, we ask the connection to hit database by using:-

```
    connection.changeUser({database : "firm1"});
```

you can refer the official documentation here

Read Mysql Connection Pool online: https://riptutorial.com/node-js/topic/6353/mysql-connection-pool

Chapter 55: MySQL integration

Introduction

In this topic you will learn how to integrate with Node.js using MYSQL database management tool. You will learn various ways to connect and interact with data residing in mysql using a nodejs program and script.

Examples

Query a connection object with parameters

When you want to use user generated content in the SQL, it with done with parameters. For example for searching user with the name `aminadav` you should do:

```
var username = 'aminadav';
var querystring = 'SELECT name, email from users where name = ?';
connection.query(querystring, [username], function(err, rows, fields) {
  if (err) throw err;
  if (rows.length) {
    rows.forEach(function(row) {
      console.log(row.name, 'email address is', row.email);
    });
  } else {
    console.log('There were no results.');
  }
});
```

Using a connection pool

a. Running multiple queries at same time

All queries in MySQL connection are done one after another. It means that if you want to do 10 queries and each query takes 2 seconds then it will take 20 seconds to complete whole execution. The solution is to create 10 connection and run each query in a different connection. This can be done automatically using connection pool

```
var pool  = mysql.createPool({
  connectionLimit : 10,
  host            : 'example.org',
  user            : 'bobby',
  password        : 'pass',
  database        : 'schema'
});

for(var i=0;i<10;i++){
  pool.query('SELECT ` as example', function(err, rows, fields) {
    if (err) throw err;
    console.log(rows[0].example); //Show 1
```

```
  });
 }
```

It will run all the 10 queries in parallel.

When you use `pool` you don't need the connection anymore. You can query directly the pool. MySQL module will search for the next free connection to execute your query.

b. Achieving multi-tenancy on database server with different databases hosted on it.

Multitenancy is a common requirement of enterprise application nowadays and creating connection pool for each database in database server is not recommended. so, what we can do instead is create connection pool with database server and then switch them between databases hosted on database server on demand.

Suppose our application has different databases for each firm hosted on database server. We will connect to respective firm database when user hits the application. Here is the example on how to do that:-

```
var pool  = mysql.createPool({
      connectionLimit : 10,
      host            : 'example.org',
      user            : 'bobby',
      password        : 'pass'
    });

pool.getConnection(function(err, connection){
    if(err){
        return cb(err);
    }
    connection.changeUser({database : "firm1"});
    connection.query("SELECT * from history", function(err, data){
        connection.release();
        cb(err, data);
    });
});
```

Let me break down the example:-

When defining pool configuration i did not gave the database name but only gave database server i.e

```
{
  connectionLimit : 10,
  host            : 'example.org',
  user            : 'bobby',
  password        : 'pass'
}
```

so when we want to use the specific database on database server, we ask the connection to hit database by using:-

```
    connection.changeUser({database : "firm1"});
```

you can refer the official documentation here

Connect to MySQL

One of the easiest ways to connect to MySQL is by using `mysql` module. This module handles the connection between Node.js app and MySQL server. You can install it like any other module:

```
npm install --save mysql
```

Now you have to create a mysql connection, which you can later query.

```
const mysql      = require('mysql');
const connection = mysql.createConnection({
  host     : 'localhost',
  user     : 'me',
  password : 'secret',
  database : 'database_schema'
});

connection.connect();

// Execute some query statements
// I.e. SELECT * FROM FOO

connection.end();
```

In the next example you will learn how to query the `connection` object.

Query a connection object without parameters

You send the query as a string and in response callback with the answer is received. The callback gives you `error`, array of `rows` and fields. Each row contains all the column of the returned table. Here is a snippet for the following explanation.

```
connection.query('SELECT name,email from users', function(err, rows, fields) {
  if (err) throw err;

  console.log('There are:', rows.length,' users');
  console.log('First user name is:',rows[0].name)
});
```

Run a number of queries with a single connection from a pool

There may be situations where you have setup a pool of MySQL connections, but you have a number of queries you would like to run in sequence:

```
SELECT 1;
SELECT 2;
```

You *could* just run then using `pool.query` as seen elsewhere, however if you only have one free connection in the pool you must wait until a connection becomes available before you can run the second query.

You can, however, retain an active connection from the pool and run as many queries as you would like using a single connection using `pool.getConnection`:

```
pool.getConnection(function (err, conn) {
  if (err) return callback(err);

  conn.query('SELECT 1 AS seq', function (err, rows) {
    if (err) throw err;

    conn.query('SELECT 2 AS seq', function (err, rows) {
      if (err) throw err;

      conn.release();
      callback();
    });
  });
});
```

Note: You must remember to `release` the connection, otherwise there is one less MySQL connection available to the rest of the pool!

For more information on pooling MySQL connections check out the MySQL docs.

Return the query when an error occurs

You can attach the query executed to your `err` object when an error occurs:

```
var q = mysql.query('SELECT `name` FROM `pokedex` WHERE `id` = ?', [ 25 ], function (err,
result) {
  if (err) {
    // Table 'test.pokedex' doesn't exist
    err.query = q.sql; // SELECT `name` FROM `pokedex` WHERE `id` = 25
    callback(err);
  }
  else {
    callback(null, result);
  }
});
```

Export Connection Pool

```
// db.js

const mysql = require('mysql');

const pool = mysql.createPool({
  connectionLimit : 10,
  host            : 'example.org',
  user            : 'bob',
  password        : 'secret',
```

```
  database        : 'my_db'
});

module.export = {
  getConnection: (callback) => {
    return pool.getConnection(callback);
  }
}
```

```
// app.js

const db = require('./db');

db.getConnection((err, conn) => {
  conn.query('SELECT something from sometable', (error, results, fields) => {
    // get the results
    conn.release();
  });
});
```

Read MySQL integration online: https://riptutorial.com/node-js/topic/1406/mysql-integration

Chapter 56: N-API

Introduction

The N-API is a new and better way for creating native module for NodeJS. N-API is in early stage so it may have inconsistent documentation.

Examples

Hello to N-API

This module register hello function on hello module. hello function prints Hello world on console with `printf` and return `1373` from native function into javascript caller.

```
#include <node_api.h>
#include <stdio.h>


napi_value say_hello(napi_env env, napi_callback_info info)
{
    napi_value retval;

    printf("Hello world\n");

    napi_create_number(env, 1373, &retval);

    return retval;
}

void init(napi_env env, napi_value exports, napi_value module, void* priv)
{
    napi_status status;
    napi_property_descriptor desc = {
        /*
         * String describing the key for the property, encoded as UTF8.
         */
        .utf8name = "hello",
        /*
         * Set this to make the property descriptor object's value property
         * to be a JavaScript function represented by method.
         * If this is passed in, set value, getter and setter to NULL (since these members
won't be used).
         */
        .method = say_hello,
        /*
         * A function to call when a get access of the property is performed.
         * If this is passed in, set value and method to NULL (since these members won't be
used).
         * The given function is called implicitly by the runtime when the property is
accessed
         * from JavaScript code (or if a get on the property is performed using a N-API call).
         */
        .getter = NULL,
        /*
```

```
         * A function to call when a set access of the property is performed.
         * If this is passed in, set value and method to NULL (since these members won't be
used).
         * The given function is called implicitly by the runtime when the property is set
         * from JavaScript code (or if a set on the property is performed using a N-API call).
         */
        .setter = NULL,
        /*
         * The value that's retrieved by a get access of the property if the property is a
data property.
         * If this is passed in, set getter, setter, method and data to NULL (since these
members won't be used).
         */
        .value = NULL,
        /*
         * The attributes associated with the particular property. See
napi_property_attributes.
         */
        .attributes = napi_default,
        /*
         * The callback data passed into method, getter and setter if this function is
invoked.
         */
        .data = NULL
    };
    /*
     * This method allows the efficient definition of multiple properties on a given object.
     */
    status = napi_define_properties(env, exports, 1, &desc);

    if (status != napi_ok)
        return;
}


NAPI_MODULE(hello, init)
```

Read N-API online: https://riptutorial.com/node-js/topic/10539/n-api

Chapter 57: Node JS Localization

Introduction

Its very easy to maintain localization nodejs express

Examples

using i18n module to maintains localization in node js app

Lightweight simple translation module with dynamic json storage. Supports plain vanilla node.js apps and should work with any framework (like express, restify and probably more) that exposes an app.use() method passing in res and req objects. Uses common __('...') syntax in app and templates. Stores language files in json files compatible to webtranslateit json format. Adds new strings on-the-fly when first used in your app. No extra parsing needed.

express + i18n-node + cookieParser and avoid concurrency issues

```
// usual requirements
var express = require('express'),
    i18n = require('i18n'),
    app = module.exports = express();

i18n.configure({
  // setup some locales - other locales default to en silently
  locales: ['en', 'ru', 'de'],

  // sets a custom cookie name to parse locale settings from
  cookie: 'yourcookiename',

  // where to store json files - defaults to './locales'
  directory: __dirname + '/locales'
});

app.configure(function () {
  // you will need to use cookieParser to expose cookies to req.cookies
  app.use(express.cookieParser());

  // i18n init parses req for language headers, cookies, etc.
  app.use(i18n.init);

});

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

// starting server
if (!module.parent) {
  app.listen(3000);
}
```

Read Node JS Localization online: https://riptutorial.com/node-js/topic/9594/node-js-localization

Chapter 58: Node server without framework

Remarks

Though Node has many framework to help you getting your server up and running, mainly:

Express: The most used framework

Total: The ALL-IN-ONE UNITY framework, that have everything and do not depend on any other framework or module.

But, there is always no one size fits all, so developer may need to build his/her own server, without any other dependency.

If the app i accessed through external server, CORS could be an issue, a code to avoid it had been provided.

Examples

Framework-less node server

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

http.createServer(function (request, response) {
console.log('request ', request.url);

var filePath = '.' + request.url;
if (filePath == './')
    filePath = './index.html';

var extname = String(path.extname(filePath)).toLowerCase();
var contentType = 'text/html';
var mimeTypes = {
    '.html': 'text/html',
    '.js': 'text/javascript',
    '.css': 'text/css',
    '.json': 'application/json',
    '.png': 'image/png',
    '.jpg': 'image/jpg',
    '.gif': 'image/gif',
    '.wav': 'audio/wav',
    '.mp4': 'video/mp4',
    '.woff': 'application/font-woff',
    '.ttf': 'applilcation/font-ttf',
    '.eot': 'application/vnd.ms-fontobject',
    '.otf': 'application/font-otf',
    '.svg': 'application/image/svg+xml'
};

contentType = mimeTypes[extname] || 'application/octect-stream';
```

```
fs.readFile(filePath, function(error, content) {
    if (error) {
        if(error.code == 'ENOENT'){
            fs.readFile('./404.html', function(error, content) {
                response.writeHead(200, { 'Content-Type': contentType });
                response.end(content, 'utf-8');
            });
        }
        else {
            response.writeHead(500);
            response.end('Sorry, check with the site admin for error: '+error.code+' ..\n');
            response.end();
        }
    }
    else {
        response.writeHead(200, { 'Content-Type': contentType });
        response.end(content, 'utf-8');
    }
 });

}).listen(8125);
console.log('Server running at http://127.0.0.1:8125/');
```

Overcoming CORS Issues

```
// Website you wish to allow to connect to
response.setHeader('Access-Control-Allow-Origin', '*');

// Request methods you wish to allow
response.setHeader('Access-Control-Allow-Methods', 'GET, POST, OPTIONS, PUT, PATCH, DELETE');

// Request headers you wish to allow
response.setHeader('Access-Control-Allow-Headers', 'X-Requested-With,content-type');

// Set to true if you need the website to include cookies in the requests sent
// to the API (e.g. in case you use sessions)
response.setHeader('Access-Control-Allow-Credentials', true);
```

Read Node server without framework online: https://riptutorial.com/node-js/topic/5910/node-server-without-framework

Chapter 59: Node.js (express.js) with angular.js Sample code

Introduction

This example shows how to create a basic express app and then serve AngularJS.

Examples

Creating our project.

We're good to go so, we run, again from console:

```
mkdir our_project
cd our_project
```

Now we're in the place where our code will live. To create the main archive of our project you can run

Ok, but how we create the express skeleton project?

It's simple:

```
npm install -g express express-generator
```

Linux distros and Mac should use **sudo** to install this because they're installed in the nodejs directory which is only accessible by the **root** user. If everything went fine we can, finally, create the express-app skeleton, just run

```
express
```

This command will create inside our folder an express example app. The structure is as follow:

```
bin/
public/
routes/
views/
app.js
package.json
```

Now if we run **npm start** an go to http://localhost:3000 we'll see the express app up and running, fair enough we've generated an express app without too much trouble, but how can we mix this with AngularJS?.

How express works, briefly?

Express is a framework built on top of **Nodejs**, you can see the official documentation at the Express Site. But for our purpose we need to know that **Express** is the responsible when we type, for example, http://localhost:3000/home of rendering the home page of our application. From the recently created app created we can check:

```
FILE: routes/index.js
var express = require('express');
var router = express.Router();

/* GET home page. */
router.get('/', function(req, res, next) {
  res.render('index', { title: 'Express' });
});

module.exports = router;
```

What this code is telling us is that when the user goes to http://localhost:3000 it must render the **index** view and pass a **JSON** with a title property and value Express. But when we check the views directory and open index.jade we can see this:

```
extends layout
block content
    h1= title
    p Welcome to #{title}
```

This is another powerful Express feature, **template engines**, they allow you to render content in the page by passing variables to it or inherit another template so your pages are more compact and better understandable by others. The file extension is **.jade** as far as I know **Jade** changed the name for **Pug**, basically is the same template engine but with some updates and core modifications.

Installing Pug and updating Express template engine.

Ok, to start using Pug as the template engine of our project we need to run:

```
npm install --save pug
```

This will install Pug as a dependency of our project and save it to **package.json**. To use it we need to modify the file **app.js**:

```
var app = express();
// view engine setup
app.set('views', path.join(__dirname, 'views'));
app.set('view engine', 'pug');
```

And replace the line of view engine with pug and that's all. We can run again our project with **npm start** and we'll see that everything is working fine.

How AngularJS fits in all of this?

AngularJS is an Javascript **MVW**(Model-View-Whatever) Framework mainly used to create **SPA** (Simple Page Application) installing is fairly simple, you can go to AngularJS website and download the latest version which is **v1.6.4**.

After we downloaded AngularJS when should copy the file to our **public/javascripts** folder inside our project, a little explanation, this is the folder that serves the static assets of our site, images, css, javacript files and so on. Of course this is configurable through the **app.js** file, but we'll keep it simple. Now we create a file named **ng-app.js**, the file where our application will live, inside our javascripts public folder, just where AngularJS lives. To bring AngularJS up we need to modify the content of **views/layout.pug** as follow:

```
doctype html
html(ng-app='first-app')
  head
    title= title
    link(rel='stylesheet', href='/stylesheets/style.css')
  body(ng-controller='indexController')
    block content

  script(type='text-javascript', src='javascripts/angular.min.js')
  script(type='text-javascript', src='javascripts/ng-app.js')
```

What are we doing here?, well, we're including AngularJS core and our recently created file **ng-app.js** so when the template is rendered it will bring AngularJS up, notice the use of the **ng-app** directive, this is telling AngularJS that this is our application name and it should stick to it.
So, the content of our **ng-app.js** will be:

```
angular.module('first-app', [])
       .controller('indexController', ['$scope', indexController]);

function indexController($scope) {
    $scope.name = 'sigfried';
}
```

We're using the most basic AngularJS feature here, **two-way data binding**, this allows us to refresh the content of our view and controller instantly, this is a very simple explanation, but you can make a research in Google or StackOverflow to see how it really works.

So, we have the basic blocks of our AngularJS application, but there is something we got to do, we need to update our index.pug page to see the changes of our angular app, let's do it:

```
extends layout
block content
  div(ng-controller='indexController')
    h1= title
    p Welcome {{name}}
    input(type='text' ng-model='name')
```

Here we're just binding the input to our defined property name in the AngularJS scope inside our

controller:

```
$scope.name = 'sigfried';
```

The purpose of this is that whenever we change the text in the input the paragraph above will update it content inside the {{name}}, this is called **interpolation**, again another AngularJS feature to render our content in the template.

So, all is setup, we can now run **npm start** go to http://localhost:3000 and see our express application serving the page and AngularJS managing the application frontend.

Read Node.js (express.js) with angular.js Sample code online: https://riptutorial.com/node-js/topic/9757/node-js--express-js--with-angular-js-sample-code

Chapter 60: Node.JS and MongoDB.

Remarks

These are the basic CRUD operations for using mongo db with nodejs.

Question: Are there other ways you can do what is done here ??

Answer : Yes, there are numerous way to do this.

Question: Is using mongoose necessary ??

Answer : No. There are other packages available which can help you.

Question: Where can I get full documentation of mongoose ??

Answer: Click Here

Examples

Connecting To a Database

To connect to a mongo database from node application we require mongoose.

Installing Mongoose Go to the toot of your application and install mongoose by

```
npm install mongoose
```

Next we connect to the database.

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

//connect to the test database running on default mongod port of localhost
mongoose.connect('mongodb://localhost/test');



//Connecting with custom credentials
mongoose.connect('mongodb://USER:PASSWORD@HOST:PORT/DATABASE');


//Using Pool Size to define the number of connections opening
//Also you can use a call back function for error handling
mongoose.connect('mongodb://localhost:27017/consumers',
                 {server: { poolSize: 50 }},
                 function(err) {
                    if(err) {
                        console.log('error in this')
                        console.log(err);
                        // Do whatever to handle the error
                    } else {
```

```
                        console.log('Connected to the database');
                    }
                });
```

Creating New Collection

With Mongoose, everything is derived from a Schema. Lets create a schema.

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

var Schema = mongoose.Schema;

var AutoSchema = new Schema({
    name : String,
    countOf: Number,
});
// defining the document structure

// by default the collection created in the db would be the first parameter we use (or the
plural of it)
module.exports = mongoose.model('Auto', AutoSchema);

// we can over write it and define the collection name by specifying that in the third
parameters.
module.exports = mongoose.model('Auto', AutoSchema, 'collectionName');


// We can also define methods in the models.
AutoSchema.methods.speak = function () {
  var greeting = this.name
    ? "Hello this is  " + this.name+ " and I have counts of "+ this.countOf
    : "I don't have a name";
  console.log(greeting);
}
mongoose.model('Auto', AutoSchema, 'collectionName');
```

Remember methods must be added to the schema before compiling it with mongoose.model() like done above ..

Inserting Documents

For inserting a new document in the collection, we create a object of the schema.

```
var Auto = require('models/auto')
var autoObj = new Auto({
    name: "NewName",
    countOf: 10
});
```

We save it like the following

```
autoObj.save(function(err, insertedAuto) {
    if (err) return console.error(err);
    insertedAuto.speak();
    // output: Hello this is NewName and I have counts of 10
```

```
});
```

This will insert a new document in the collection

Reading

Reading Data from the collection is very easy. Getting all data of the collection.

```
var Auto = require('models/auto')
Auto.find({}, function (err, autos) {
      if (err) return console.error(err);
       // will return a json array of all the documents in the collection
      console.log(autos);
})
```

Reading data with a condition

```
Auto.find({countOf: {$gte: 5}}, function (err, autos) {
      if (err) return console.error(err);
       // will return a json array of all the documents in the collection whose count is
greater than 5
      console.log(autos);
})
```

You can also specify the second parameter as object of what all fields you need

```
Auto.find({},{name:1}, function (err, autos) {
      if (err) return console.error(err);
       // will return a json array of name field of all the documents in the collection
      console.log(autos);
})
```

Finding one document in a collection.

```
Auto.findOne({name:"newName"}, function (err, auto) {
      if (err) return console.error(err);
     //will return the first object of the document whose name is "newName"
      console.log(auto);
})
```

Finding one document in a collection by id .

```
Auto.findById(123, function (err, auto) {
      if (err) return console.error(err);
     //will return the first json object of the document whose id is 123
      console.log(auto);
})
```

Updating

For updating collections and documents we can use any of these methods:

Methods

- update()
- updateOne()
- updateMany()
- replaceOne()

Update()

The update() method modifies one or many documents (update parameters)

```
db.lights.update(
   { room: "Bedroom" },
   { status: "On" }
)
```

This operation searches the 'lights' collection for a document where `room` is **Bedroom** *(1st parameter)*. It then updates the matching documents `status` property to **On** *(2nd parameter)* and returns a WriteResult object that looks like this:

```
{ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 }
```

UpdateOne

The UpdateOne() method modifies ONE document (update parameters)

```
db.countries.update(
   { country: "Sweden" },
   { capital: "Stockholm" }
)
```

This operation searches the 'countries' collection for a document where `country` is **Sweden** *(1st parameter)*. It then updates the matching documents property `capital` to **Stockholm** *(2nd parameter)* and returns a WriteResult object that looks like this:

```
{ "acknowledged" : true, "matchedCount" : 1, "modifiedCount" : 1 }
```

UpdateMany

The UpdateMany() method modifies multible documents (update parameters)

```
db.food.updateMany(
   { sold: { $lt: 10 } },
   { $set: { sold: 55 } }
)
```

This operation updates all documents *(in a 'food' collection)* where `sold` is **lesser than 10** *(1st parameter) by setting `sold` to **55**. It then returns a WriteResult object that looks like this:

```
{ "acknowledged" : true, "matchedCount" : a, "modifiedCount" : b }
```

a = Number of matched documents
b = Number of modified documents

ReplaceOne

Replaces the first matching document (replacement document)

This example collection called **countries** contains 3 documents:

```
{ "_id" : 1, "country" : "Sweden" }
{ "_id" : 2, "country" : "Norway" }
{ "_id" : 3, "country" : "Spain" }
```

The following operation replaces the document `{ country: "Spain" }` with document `{ country: "Finland" }`

```
db.countries.replaceOne(
   { country: "Spain" },
   { country: "Finland" }
)
```

And returns:

```
{ "acknowledged" : true, "matchedCount" : 1, "modifiedCount" : 1 }
```

The example collection **countries** now contains:

```
{ "_id" : 1, "country" : "Sweden" }
{ "_id" : 2, "country" : "Norway" }
{ "_id" : 3, "country" : "Finland" }
```

Deleting

Deleting documents from a collection in mongoose is done in the following manner.

```
Auto.remove({_id:123}, function(err, result){
    if (err) return console.error(err);
```

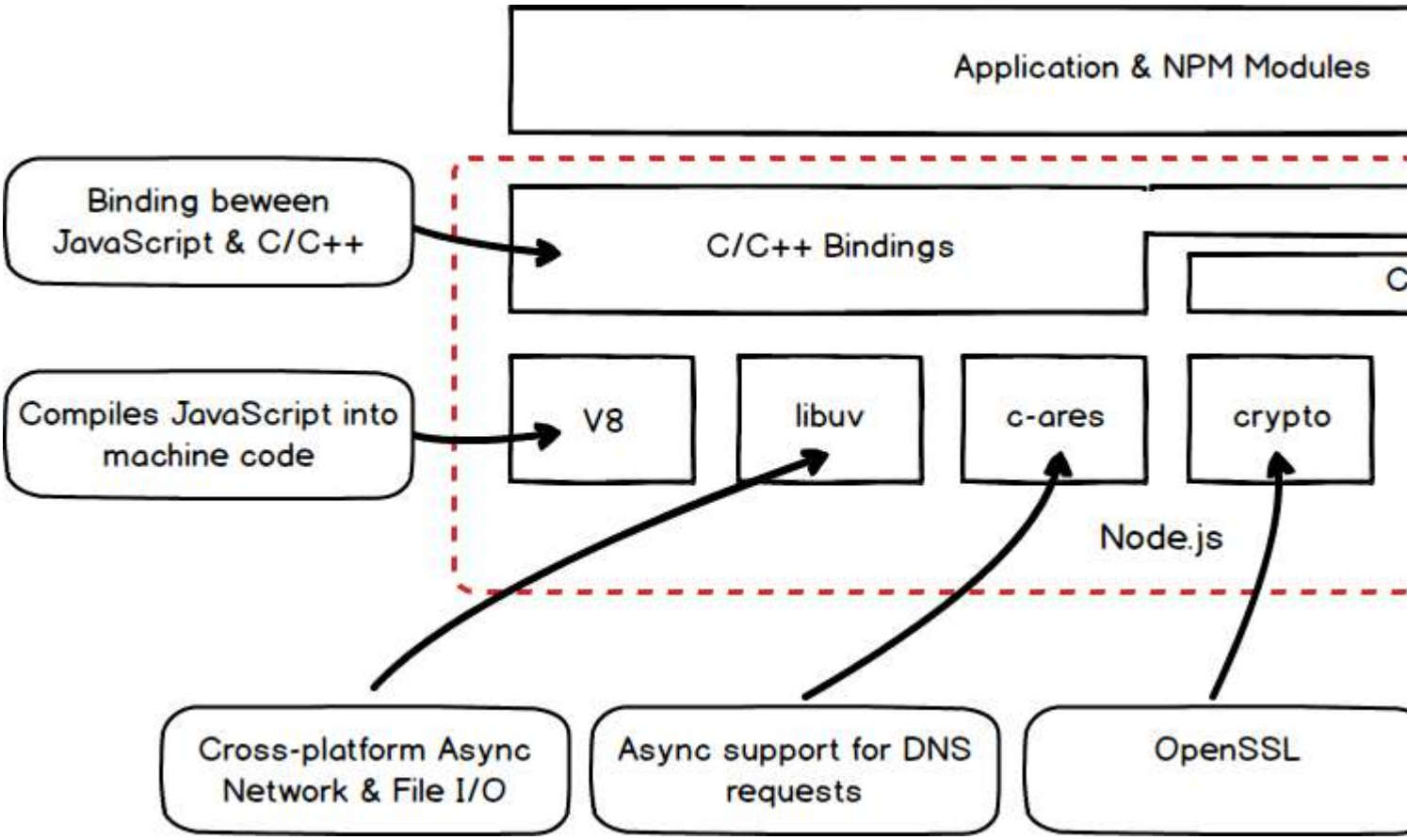
```
    console.log(result); // this will specify the mongo default delete result.
});
```

Read Node.JS and MongoDB. online: https://riptutorial.com/node-js/topic/7505/node-js-and-mongodb-

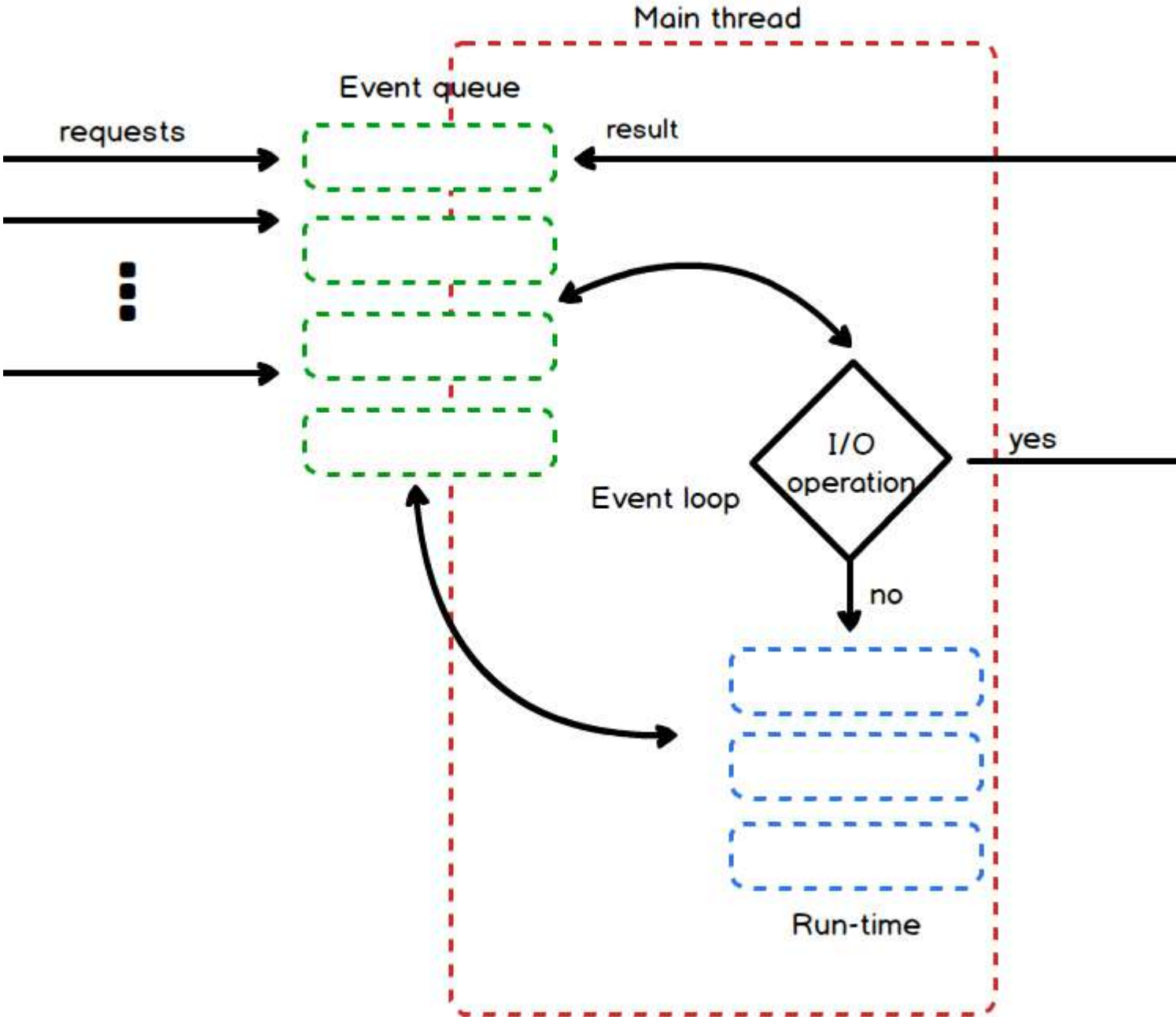
Chapter 61: Node.js Architecture & Inner Workings

Examples

Node.js - under the hood



Node.js - in motion



Read Node.js Architecture & Inner Workings online: https://riptutorial.com/node-js/topic/5892/node-js-architecture---inner-workings

Chapter 62: Node.js code for STDIN and STDOUT without using any library

Introduction

This is a simple program in node.js to which takes input from the user and prints it to the console.

The **process** object is a global that provides information about, and control over, the current Node.js process. As a global, it is always available to Node.js applications without using require().

Examples

Program

The **process.stdin** property returns a Readable stream equivalent to or associated with stdin.

The **process.stdout** property returns a Writable stream equivalent to or associated with stdout.

```
process.stdin.resume()
console.log('Enter the data to be displayed ');
process.stdin.on('data', function(data) { process.stdout.write(data) })
```

Read Node.js code for STDIN and STDOUT without using any library online: https://riptutorial.com/node-js/topic/8961/node-js-code-for-stdin-and-stdout-without-using--any-library

Chapter 63: Node.js Design Fundamental

Examples

The Node.js philosophy

Small Core, **Small Module** :-

Build small and single purpose modules not in term of code size only, but also in term of scope that serves a single purpose

```
    a - "Small is beautiful"
    b - "Make each program do one thing well."
```

The Reactor Pattern

The Reactor Pattern is the heart of the `node.js` asynchronous nature. Allowed the system to be implemented as a single-threaded process with a series of event generators and event handlers, with the help of event loop that runs continuously.

The non-blocking I/O engine of Node.js – libuv -

The Observer Pattern(EventEmitter) maintains a list of dependents/observers and notifies them

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

var ringBell = function ringBell()
{
  console.log('tring tring tring');
}
eventEmitter.on('doorOpen', ringBell);

eventEmitter.emit('doorOpen');
```

Read Node.js Design Fundamental online: https://riptutorial.com/node-js/topic/6274/node-js-design-fundamental

Chapter 64: Node.js Error Management

Introduction

We will learn how to create Error objects and how to throw & handle errors in Node.js

Future edits related to best practices in error handling.

Examples

Creating Error object

new Error(message)

Creates new error object, where the value `message` is being set to `message` property of the created object. Usually the `message` arguments are being passed to Error constructor as a string. However if the `message` argument is object not a string then Error constructor calls `.toString()` method of the passed object and sets that value to `message` property of the created error object.

```
var err = new Error("The error message");
console.log(err.message); //prints: The error message
console.log(err);
//output
//Error: The error message
//    at ...
```

Each error object has stack trace. Stack trace contains the information of error message and shows where the error happened (the above output shows the error stack). Once error object is created the system captures the stack trace of the error on current line. To get the stack trace use stack property of any created error object. Below two lines are identical:

```
console.log(err);
console.log(err.stack);
```

Throwing Error

Throwing error means exception if any exception is not handled then the node server will crash.

The following line throws error:

```
throw new Error("Some error occurred");
```

or

```
var err = new Error("Some error occurred");
throw err;
```

or

```
throw "Some error occurred";
```

The last example (throwing strings) is not good practice and is not recommended (always throw errors which are instances of Error object).

Note that if you `throw` an error in your, then the system will crash on that line (if there is no exception handlers), no any code will be executed after that line.

```
var a = 5;
var err = new Error("Some error message");
throw err; //this will print the error stack and node server will stop
a++; //this line will never be executed
console.log(a); //and this one also
```

But in this example:

```
var a = 5;
var err = new Error("Some error message");
console.log(err); //this will print the error stack
a++;
console.log(a); //this line will be executed and will print 6
```

try...catch block

try...catch block is for handling exceptions, remember exception means the thrown error not the error.

```
try {
    var a = 1;
    b++; //this will cause an error because be is undefined
    console.log(b); //this line will not be executed
} catch (error) {
    console.log(error); //here we handle the error caused in the try block
}
```

In the `try` block `b++` cause an error and that error passed to `catch` block which can be handled there or even can be thrown the same error in catch block or make little bit modification then throw. Let's see next example.

```
try {
    var a = 1;
    b++;
    console.log(b);
} catch (error) {
    error.message = "b variable is undefined, so the undefined can't be incremented"
    throw error;
}
```

In the above example we modified the `message` property of `error` object and then throw the modified `error`.

You can through any error in your try block and handle it in the catch block:

```
try {
    var a = 1;
    throw new Error("Some error message");
    console.log(a); //this line will not be executed;
} catch (error) {
    console.log(error); //will be the above thrown error
}
```

Read Node.js Error Management online: https://riptutorial.com/node-js/topic/8590/node-js-error-management

Chapter 65: Node.js Performance

Examples

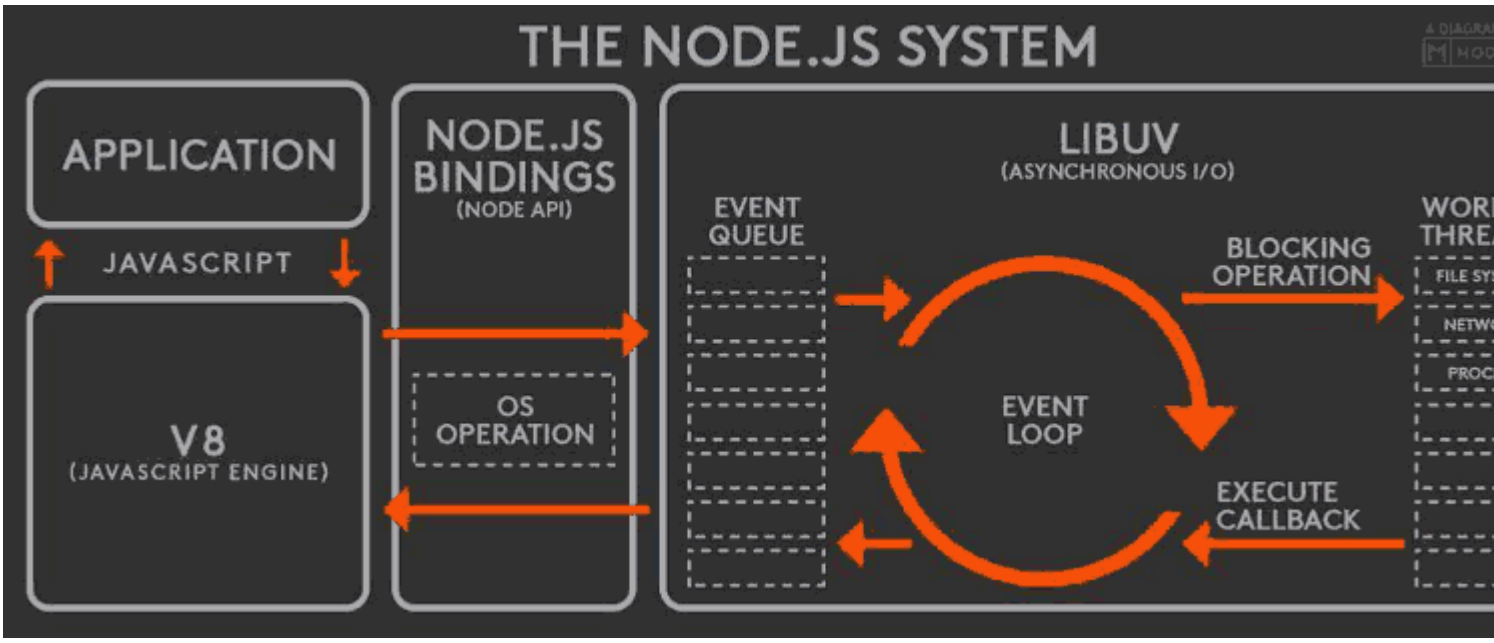
Event Loop

Blocking Operation Example

```
let loop = (i, max) => {
  while (i < max) i++
  return i
}

// This operation will block Node.js
// Because, it's CPU-bound
// You should be careful about this kind of code
loop(0, 1e+12)
```

Non-Blocking IO Operation Example

```
let i = 0

const step = max => {
  while (i < max) i++
  console.log('i = %d', i)
}

const tick = max => process.nextTick(step, max)

// this will postpone tick run step's while-loop to event loop cycles
// any other IO-bound operation (like filesystem reading) can take place
// in parallel
tick(1e+6)
tick(1e+7)
console.log('this will output before all of tick operations. i = %d', i)
console.log('because tick operations will be postponed')
tick(1e+8)
```



In simpler terms, Event Loop is a single-threaded queue mechanism which executes your CPU-bound code until end of its execution and IO-bound code in a non-blocking fashion.

However, Node.js under the carpet uses multi-threading for some of its operations through libuv Library.

Performance Considerations

- Non-blocking operations will not block the queue and will not effect the performance of the loop.
- However, CPU-bound operations will block the queue, so you should be careful not to do CPU-bound operations in your Node.js code.

Node.js non-blocks IO because it offloads the work to the operating system kernel, and when the IO operation supplies data (*as an event*), it will notify your code with your supplied callbacks.

Increase maxSockets

Basics

```
require('http').globalAgent.maxSockets = 25

// You can change 25 to Infinity or to a different value by experimenting
```

Node.js by default is using `maxSockets = Infinity` at the same time (since v0.12.0). Until Node v0.12.0, the default was `maxSockets = 5` (see v0.11.0). So, after more than 5 requests they will be queued. If you want concurrency, increase this number.

Setting your own agent

`http` API is using a "**Global Agent**". You can supply your own agent. Like this:

```
const http = require('http')
const myGloriousAgent = new http.Agent({ keepAlive: true })
myGloriousAgent.maxSockets = Infinity

http.request({ ..., agent: myGloriousAgent }, ...)
```

Turning off Socket Pooling entirely

```
const http = require('http')
const options = {.....}

options.agent = false

const request = http.request(options)
```

Pitfalls

- You should do the same thing for `https` API if you want the same effects
- Beware that, for example, AWS will use 50 instead of `Infinity`.

Enable gzip

```
const http = require('http')
const fs   = require('fs')
const zlib = require('zlib')

http.createServer((request, response) => {
  const stream          = fs.createReadStream('index.html')
  const acceptsEncoding = request.headers['accept-encoding']

  let encoder = {
    hasEncoder     : false,
    contentEncoding: {},
    createEncoder  : () => throw 'There is no encoder'
  }

  if (!acceptsEncoding) {
    acceptsEncoding = ''
  }

  if (acceptsEncoding.match(/\bdeflate\b/)) {
    encoder = {
      hasEncoder     : true,
      contentEncoding: { 'content-encoding': 'deflate' },
      createEncoder  : zlib.createDeflate
```

```
    }
  } else if (acceptsEncoding.match(/\bgzip\b/)) {
    encoder = {
      hasEncoder     : true,
      contentEncoding: { 'content-encoding': 'gzip' },
      createEncoder  : zlib.createGzip
    }
  }

  response.writeHead(200, encoder.contentEncoding)

  if (encoder.hasEncoder) {
    stream = stream.pipe(encoder.createEncoder())
  }

  stream.pipe(response)

}).listen(1337)
```

Read Node.js Performance online: https://riptutorial.com/node-js/topic/9410/node-js-performance

Chapter 66: Node.js v6 New Features and Improvement

Introduction

With node 6 becoming the new LTS version of node. We can see an number of improvements to the language through the new ES6 standards introduces. We'll be walking through some of the new features introduced and examples of how to implement them.

Examples

Default Function Parameters

```
function addTwo(a, b = 2) {
    return a + b;
}

addTwo(3) // Returns the result 5
```

With the addition of default function parameters you can now make arguments optional and have them default to a value of your choice.

Rest Parameters

```
function argumentLength(...args) {
    return args.length;
}

argumentLength(5) // returns 1
argumentLength(5, 3) //returns 2
argumentLength(5, 3, 6) //returns 3
```

By prefacing the last argument of your function with ... all arguments passed to the function are read as an array. In this example we get pass in multiple arguments and get the length of the array created from those arguments.

Spread Operator

```
function myFunction(x, y, z) { }
var args = [0, 1, 2];
myFunction(...args);
```

The spread syntax allows an expression to be expanded in places where multiple arguments (for function calls) or multiple elements (for array literals) or multiple variables are expected. Just like the rest parameters simply preface your array with ...

Arrow Functions

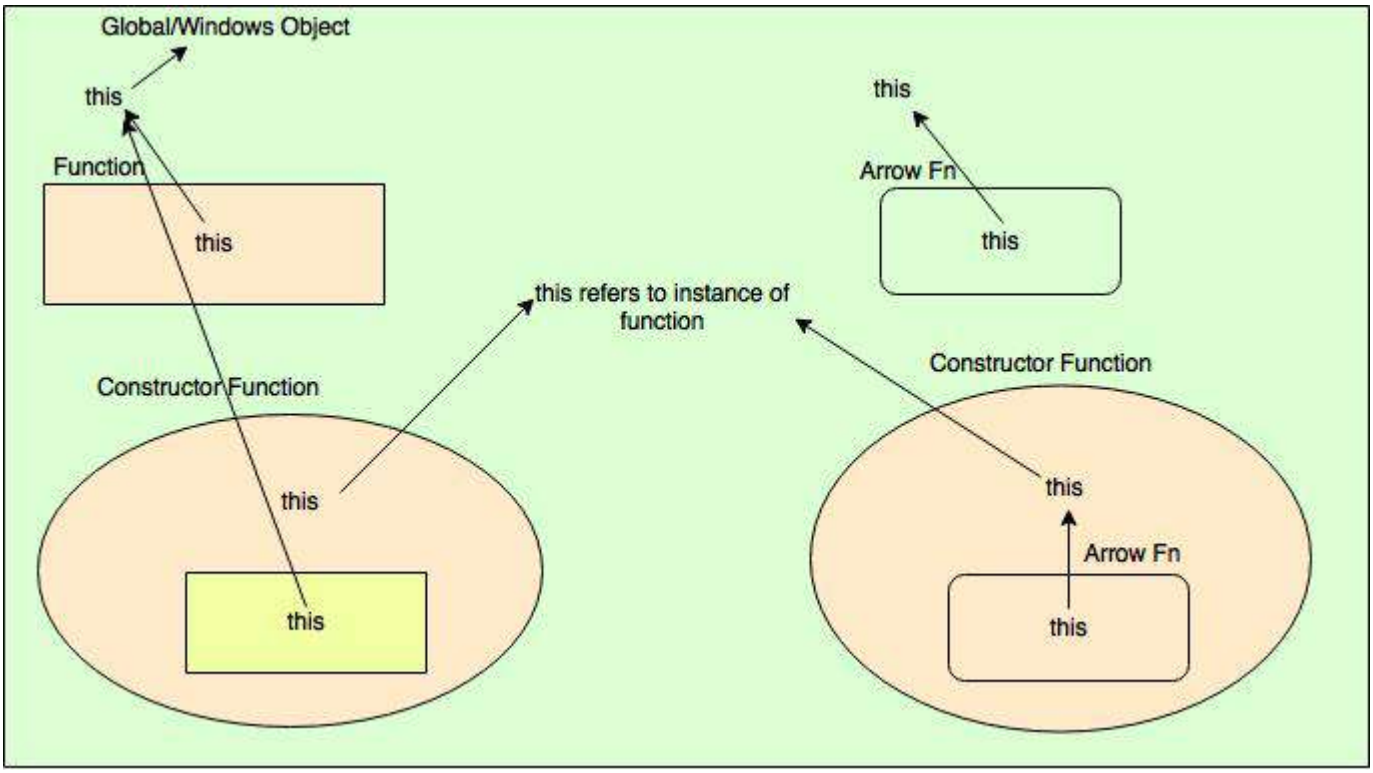
Arrow function is the new way of defining a function in ECMAScript 6.

```
// traditional way of declaring and defining function
var sum = function(a,b)
{
    return a+b;
}

// Arrow Function
let sum = (a, b)=> a+b;

//Function defination using multiple lines
let checkIfEven = (a) => {
    if( a % 2 == 0 )
        return true;
    else
        return false;
}
```

"this" in Arrow Function

this in function refers to instance object used to call that function but ***this*** in arrow function is equal to *this* of function in which arrow function is defined.

Let's understand using diagram



Understanding using examples.

```
var normalFn = function(){
   console.log(this) // refers to global/window object.
```

```
}

var arrowFn = () => console.log(this); // refers to window or global object as function is
defined in scope of global/window object

var service = {

    constructorFn : function(){

        console.log(this); //  refers to service as service object used to call method.

        var nestedFn = function(){
            console.log(this); // refers window or global object because no instance object
was used to call this method.
        }
        nestedFn();
    },

    arrowFn : function(){
        console.log(this); // refers to service as service object was used to call method.
        let fn = () => console.log(this); // refers to service object as arrow function
defined in function which is called using instance object.
        fn();
    }
}

// calling defined functions
constructorFn();
arrowFn();
service.constructorFn();
service.arrowFn();
```

In arrow function, *this* is lexical scope which is the scope of function where arrow function is defined.
The first example is the traditional way of defining functions and hence, *this* refers to *global/window* object.
In the second example *this* is used inside arrow function hence *this* refers to the scope where it is defined(which is windows or global object). In the third example *this* is service object as service object is used to call the function.
In fourth example, arrow function in defined and called from the function whose scope is *service*, hence it prints *service* object.

Note: - global object is printed in Node.Js and windows object in browser.

Read Node.js v6 New Features and Improvement online: https://riptutorial.com/node-js/topic/8593/node-js-v6-new-features-and-improvement

Chapter 67: Node.js with CORS

Examples

Enable CORS in express.js

As node.js is often used to build API, proper CORS setting can be a life saver if you want to be able to request the API from different domains.

In the exemple, we'll set it up for the wider configuration (authorize all request types from any domain.

In your server.js after initializing express:

```
// Create express server
const app = express();

app.use((req, res, next) => {
    res.header('Access-Control-Allow-Origin', '*');

    // authorized headers for preflight requests
    // https://developer.mozilla.org/en-US/docs/Glossary/preflight_request
    res.header('Access-Control-Allow-Headers', 'Origin, X-Requested-With, Content-Type,
Accept');
    next();

    app.options('*', (req, res) => {
        // allowed XHR methods
        res.header('Access-Control-Allow-Methods', 'GET, PATCH, PUT, POST, DELETE, OPTIONS');
        res.send();
    });
});
```

Usually, node is ran behind a proxy on production servers. Therefore the reverse proxy server (such as Apache or Nginx) will be responsible for the CORS config.

To conveniently adapt this scenario, it's possible to only enable node.js CORS when it's in development.

This is easily done by checking `NODE_ENV`:

```
const app = express();

if (process.env.NODE_ENV === 'development') {
    // CORS settings
}
```

Read Node.js with CORS online: https://riptutorial.com/node-js/topic/9272/node-js-with-cors

Chapter 68: Node.JS with ES6

Introduction

ES6, ECMAScript 6 or ES2015 is the latest specification for JavaScript which introduces some syntactic sugar to the language. It's a big update to the language and introduces a lot of new features

More details on Node and ES6 can be found on their site https://nodejs.org/en/docs/es6/

Examples

Node ES6 Support and creating a project with Babel

The whole ES6 spec is not yet implemented in its entirety so you will only be able to use some of the new features. You can see a list of the current supported ES6 features at http://node.green/

Since NodeJS v6 there has been pretty good support. So if you using NodeJS v6 or above you can enjoy using ES6. However, you may also want to use some of the unreleased features and some from beyond. For this you will need to use a transpiler

It is possible to run a transpiler at run time and build, to use all of the ES6 features and more. The most popular transpiler for JavaScript is called Babel

Babel allows you to use all of the features from the ES6 specification and some additional not-in-spec features with 'stage-0' such as `import thing from 'thing` instead of `var thing = require('thing')`

If we wanted to create a project where we use 'stage-0' features such as import we would need to add Babel as a transpiler. You'll see projects using react and Vue and other commonJS based patterns implement stage-0 quite often.

create a new node project

```
mkdir my-es6-app
cd my-es6-app
npm init
```

Install babel the ES6 preset and stage-0

```
npm install --save-dev babel-preset-es2015 babel-preset-stage-2 babel-cli babel-register
```

Create a new file called `server.js` and add a basic HTTP server.

```
import http from 'http'

http.createServer((req, res) => {
  res.writeHead(200, {'Content-Type': 'text/plain'})
```

```
  res.end('Hello World\n')
}).listen(3000, '127.0.0.1')

console.log('Server running at http://127.0.0.1:3000/')
```

Note that we use an `import http from 'http'` this is a stage-0 feature and if it works it means we've got the transpiler working correctly.

If you run `node server.js` it will fail not knowing how to handle the import.

Creating a .babelrc file in the root of your directory and add the following settings

```
{
  "presets": ["es2015", "stage-2"],
  "plugins": []
}
```

you can now run the server with `node src/index.js --exec babel-node`

Finishing off it is not a good idea to run a transpiler at runtime on a production app. We can however implement some scripts in our package.json to make it easier to work with.

```
"scripts": {
    "start": "node dist/index.js",
    "dev": "babel-node src/index.js",
    "build": "babel src -d dist",
    "postinstall": "npm run build"
  },
```

The above will on `npm install` build the transpiled code to the dist directory allow `npm start` to use the transpiled code for our production app.

`npm run dev` will boot the server and babel runtime which is fine and preferred when working on a project locally.

Going one further you could then install nodemon `npm install nodemon --save-dev` to watch for changes and then reboot the node app.

This really speeds up working with babel and NodeJS. In you package.json just update the "dev" script to use nodemon

```
"dev": "nodemon src/index.js --exec babel-node",
```

Use JS es6 on your NodeJS app

JS es6 (also known as es2015) is a set of new features to JS language aim to make it more intuitive when using OOP or while facing modern development tasks.

Prerequisites:

1. Check out the new es6 features at http://es6-features.org - it may clarify to you if you really intend to use it on your next NodeJS app
2. Check the compatibility level of your node version at http://node.green
3. If all is ok - let's code on!

Here is a very short sample of a simple `hello world` app with JS es6

```
'use strict'

class Program
{
    constructor()
    {
        this.message = 'hello es6 :)';
    }

    print()
    {
        setTimeout(() =>
        {
            console.log(this.message);

            this.print();

        }, Math.random() * 1000);
    }
}

new Program().print();
```

You can run this program and observe how it print the same message over and over again.

Now.. let break it down line by line:

```
'use strict'
```

This line is actually required if you intend to use js es6. `strict` mode, intentionally, has different semantics from normal code (please read more about it on MDN - https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Strict_mode)

```
class Program
```

Unbelievable - a `class` keyword! Just for a quick reference - before es6 the only way do define a class in js was with the... `function` keyword!

```
function MyClass() // class definition
{

}

var myClassObject = new MyClass(); // generating a new object with a type of MyClass
```

When using OOP, a class is a very fundamental ability which assist the developer to represent a specific part of a system (breaking down code is crucial when the code is getting larger.. for instance: when writing server-side code)

```
constructor()
{
    this.message = 'hello es6 :)';
}
```

You got to admit - this is pretty intuitive! This is the c'tor of my class - this unique "function" will occur every time an object is created from this particular class (in our program - only once)

```
print()
{
    setTimeout(() => // this is an 'arrow' function
    {
        console.log(this.message);

        this.print(); // here we call the 'print' method from the class template itself (a
recursion in this particular case)

    }, Math.random() * 1000);
}
```

Because print is defined in the class scope - it is actually a method - which can be invoked from either the object of the class or from within the class itself!

So.. till now we defined our class.. time to use it:

```
new Program().print();
```

Which is truly equals to:

```
var prog = new Program(); // define a new object of type 'Program'

prog.print(); // use the program to print itself
```

In conclusion: JS es6 can simplify your code - make it more intuitive and easy to understand (comparing with the previous version of JS).. you may try to re-write an existing code of yours and see the difference for yourself

ENJOY :)

Read Node.JS with ES6 online: https://riptutorial.com/node-js/topic/5934/node-js-with-es6

Chapter 69: Node.js with Oracle

Examples

Connect to Oracle DB

A very easy way to connect to an ORACLE database is by using `oracledb` module. This module handles the connection between your Node.js app and Oracle server. You can install it like any other module:

```
npm install oracledb
```

Now you have to create an ORACLE connection, which you can later query.

```
const oracledb = require('oracledb');

oracledb.getConnection(
  {
    user          : "oli",
    password      : "password",
    connectString : "ORACLE_DEV_DB_TNS_NAME"
  },
  connExecute
);
```

The connectString "ORACLE_DEV_DB_TNA_NAME" may live in a tnsnames.org file in the same directory or where your oracle instant client is installed.

If you don't have any oracle instant client installed on you development machine you may follow the `instant client installation guide` for your operating system.

Query a connection object without parameters

Use may now use the connExecute-Function for executing a query. You have the option to get the query result as an object or array. The result ist printed to console.log.

```
function connExecute(err, connection)
{
    if (err) {
        console.error(err.message);
        return;
    }
    sql = "select 'test' as c1, 'oracle' as c2 from dual";
    connection.execute(sql, {}, { outFormat: oracledb.OBJECT }, // or oracledb.ARRAY
        function(err, result)
        {
            if (err) {
                console.error(err.message);
                connRelease(connection);
                return;
```

```
            }
            console.log(result.metaData);
            console.log(result.rows);
            connRelease(connection);
        });
}
```

Since we used a non-pooling connection, we have to release our connection again.

```
function connRelease(connection)
{
  connection.close(
    function(err) {
      if (err) {
        console.error(err.message);
      }
    });
}
```

The output for an object will be

```
[ { name: 'C1' }, { name: 'C2' } ]
[ { C1: 'test', C2: 'oracle' } ]
```

and the output for an array will be

```
[ { name: 'C1' }, { name: 'C2' } ]
[ [ 'test', 'oracle' ] ]
```

Using a local module for easier querying

To simplify your querying from ORACLE-DB, you may want to call your query like this:

```
const oracle = require('./oracle.js');

const sql = "select 'test' as c1, 'oracle' as c2 from dual";
oracle.queryObject(sql, {}, {})
    .then(function(result) {
        console.log(result.rows[0]['C2']);
    })
    .catch(function(err) {
        next(err);
    });
```

Building up the connection and executing is included in this oracle.js file with content as follows:

```
'use strict';
const oracledb = require('oracledb');

const oracleDbRelease = function(conn) {
  conn.release(function (err) {
    if (err)
      console.log(err.message);
  });
```

```
};

function queryArray(sql, bindParams, options) {
    options.isAutoCommit = false; // we only do SELECTs

    return new Promise(function(resolve, reject) {
        oracledb.getConnection(
                  {
                    user          : "oli",
                    password      : "password",
                    connectString : "ORACLE_DEV_DB_TNA_NAME"
                })
        .then(function(connection){
            //console.log("sql log: " + sql + " params " + bindParams);
            connection.execute(sql, bindParams, options)
            .then(function(results) {
                resolve(results);
                process.nextTick(function() {
                    oracleDbRelease(connection);
                });
            })
            .catch(function(err) {
                reject(err);

                process.nextTick(function() {
                    oracleDbRelease(connection);
                        });
                    });
            })
            .catch(function(err) {
                reject(err);
            });
    });
}

function queryObject(sql, bindParams, options) {
    options['outFormat'] = oracledb.OBJECT; // default is oracledb.ARRAY
    return queryArray(sql, bindParams, options);
}

module.exports = queryArray;
module.exports.queryArray = queryArray;
module.exports.queryObject = queryObject;
```

Note that you have both methods queryArray and queryObject to call on your oracle object.

Read Node.js with Oracle online: https://riptutorial.com/node-js/topic/8248/node-js-with-oracle

Chapter 70: NodeJS Beginner Guide

Examples

Hello World !

Place the following code into a file name `helloworld.js`

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

Save the file, and execute it through Node.js:

```
node helloworld.js
```

Read NodeJS Beginner Guide online: https://riptutorial.com/node-js/topic/7693/nodejs-beginner-guide

Chapter 71: NodeJS Frameworks

Examples

Web Server Frameworks

Express

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

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

app.listen(3000, function () {
  console.log('Example app listening on port 3000!');
});
```

Koa

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

app.use(function *(next){
  var start = new Date;
  yield next;
  var ms = new Date - start;
  console.log('%s %s - %s', this.method, this.url, ms);
});

app.use(function *(){
  this.body = 'Hello World';
});

app.listen(3000);
```

Command Line Interface Frameworks

Commander.js

```
var program = require('commander');

program
  .version('0.0.1')

program
  .command('hi')
  .description('initialize project configuration')
  .action(function(){
```

```
        console.log('Hi my Friend!!!');
});

program
  .command('bye [name]')
  .description('initialize project configuration')
  .action(function(name){
        console.log('Bye ' + name + '. It was good to see you!');
});

program
  .command('*')
  .action(function(env){
    console.log('Enter a Valid command');
    terminate(true);
});

program.parse(process.argv);
```

Vorpal.js

```
const vorpal = require('vorpal')();

vorpal
  .command('foo', 'Outputs "bar".')
  .action(function(args, callback) {
    this.log('bar');
    callback();
  });

vorpal
  .delimiter('myapp$')
  .show();
```

Read NodeJS Frameworks online: https://riptutorial.com/node-js/topic/6042/nodejs-frameworks

Chapter 72: Nodejs History

Introduction

Here we are going to discuss about the history of Node.js, version information and it's current status.

Examples

Key events in each year

2009

- 3rd March : The project was named as "node"
- 1st October : First very early preview of npm, the Node package manager
- 8th November : Ryan Dahl's (Creator of Node.js) Original Node.js Talk at JSConf 2009

2010

- Express: A Node.js web development framework
- Socket.io initial release
- 28th April : Experimental Node.js Support on Heroku
- 28th July : Ryan Dahl's Google Tech Talk on Node.js
- 20th August : Node.js 0.2.0 released

2011

- 31st March : Node.js Guide
- 1st May : npm 1.0: Released
- 1st May : Ryan Dahl's AMA on Reddit
- 10th July : The Node Beginner Book, an introduction to Node.js, is completed.
    - A comprehensive Node.js tutorial for beginners.
- 16th August : LinkedIn uses Node.js
    - LinkedIn launched its completely overhauled mobile app with new features and new parts under the hood.
- 5th October : Ryan Dahl talks about the history of Node.js and why he created it
- 5th December : Node.js in production at Uber
    - Uber Engineering Manager Curtis Chambers explains why his company completely re-engineered their application using Node.js to increase efficiency and improve the partner and customer experience.

2012

- 30th January : Node.js creator Ryan Dahl steps away from Node's day-to-day
- 25th June : Node.js v0.8.0 [stable] is out
- 20th December : Hapi, a Node.js framework is released

2013

- 30th April : The MEAN Stack: MongoDB, ExpressJS, AngularJS and Node.js
- 17th May : How We Built eBay's First Node.js Application
- 15th November : PayPal releases Kraken, a Node.js framework
- 22nd November : Node.js Memory Leak at Walmart
    - Eran Hammer of Wal-Mart labs came to the Node.js core team complaining of a memory leak he had been tracking down for months.
- 19th December : Koa - Web framework for Node.js

2014

- 15th January : TJ Fontaine takes over Node project
- 23rd October : Node.js Advisory Board
    - Joyent and several members of the Node.js community announced a proposal for a Node.js Advisory Board as a next step towards a fully open governance model for the Node.js open source project.
- 19th November : Node.js in Flame Graphs - Netflix
- 28th November : IO.js – Evented I/O for V8 Javascript

2015

Q1

- 14th January : IO.js 1.0.0
- 10th Febraury : Joyent Moves to Establish Node.js Foundation
    - Joyent, IBM, Microsoft, PayPal, Fidelity, SAP and The Linux Foundation Join Forces to Support Node.js Community With Neutral and Open Governance
- 27th Febraury : IO.js and Node.js reconciliation proposal

Q2

- 14th April : npm Private Modules
- 28th May : Node lead TJ Fontaine is stepping down and leaving Joyent
- 13th May : Node.js and io.js are merging under the Node Foundation

Q3

- 2nd August : Trace - Node.js performance monitoring and debugging
    - Trace is a visualized microservice monitoring tool that gets you all the metrics you need when operating microservices.
- 13th August : 4.0 is the new 1.0

Q4

- 12th October : Node v4.2.0, first Long Term Support release
- 8th December : Apigee, RisingStack and Yahoo join the Node.js Foundation
- 8th & 9th December : Node Interactive
    - The first annual Node.js conference by the Node.js Foundation

2016

Q1

- 10th February : Express becomes an incubated project
- 23rd March : The leftpad incident
- 29th March : Google Cloud Platform joins the Node.js Foundation

Q2

- 26th April : npm has 210.000 users

Q3

- 18th July : CJ Silverio becomes the CTO of npm
- 1st August : Trace, the Node.js debugging solution becomes generally available
- 15th September : The first Node Interactive in Europe

Q4

- 11th October : The yarn package manager got released
- 18th October : Node.js 6 becomes the LTS version

Reference

1. "History of Node.js on a Timeline" [Online]. Available : [https://blog.risingstack.com/history-of-node-js]

Read Nodejs History online: https://riptutorial.com/node-js/topic/8653/nodejs-history

Chapter 73: NodeJs Routing

Introduction

How to set up basic Express web server under the node js and Exploring the Express router.

Remarks

At last, Using Express Router you can use routing facility in you application and it is easy to implement.

Examples

Express Web Server Routing

Creating Express Web Server

Express server came handy and it deeps through many user and community. It is getting popular.

Lets create a Express Server. For Package Management and Flexibility for Dependency We will use NPM(Node Package Manager).

1. Go to the Project directory and create package.json file. ***package.json*** { "name": "expressRouter", "version": "0.0.1", "scripts": { "start": "node Server.js" }, "dependencies": { "express": "^4.12.3" } }
2. Save the file and install the express dependency using following command *npm install*. This will create node_modules in you project directory along with required dependency.
3. Let's create Express Web Server. Go to the Project directory and create server.js file. ***server.js***

   var express = require("express"); var app = express();

//Creating Router() object

var router = express.Router();

// Provide all routes here, this is for Home page.

```
router.get("/",function(req,res){
res.json({"message" : "Hello World"});
```

});

app.use("/api",router);

// Listen to this Port

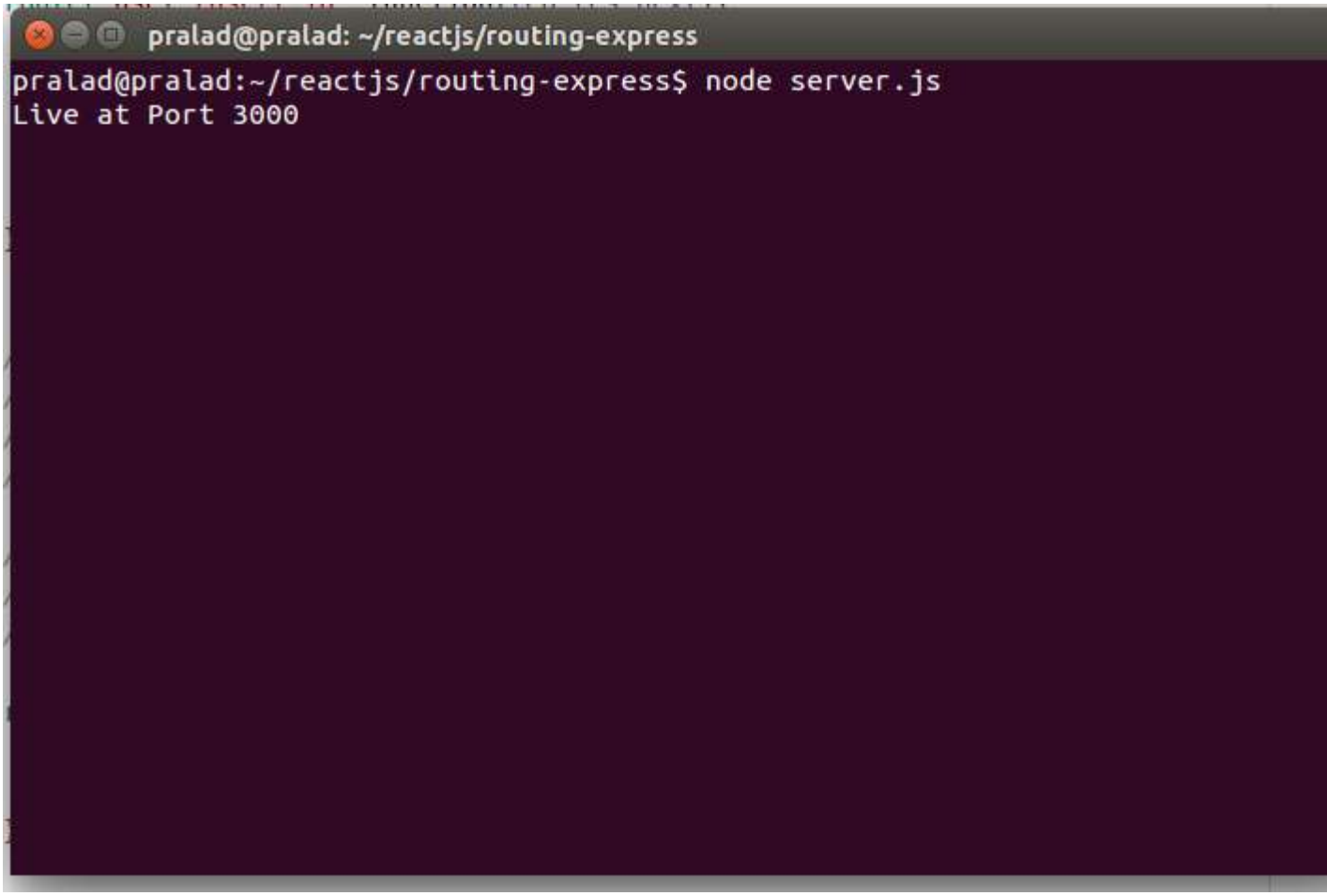
app.listen(3000,function(){ console.log("Live at Port 3000"); });

```
For more detail on setting node server you can see [here][1].
```

4. Run the server by typing following command.

   node server.js

   If Server runs successfully, you will se something like this.



   .

5. Now go to the browser or postman and made a request

   http://localhost:3000/api/

   The output will be

.

That is all, the basic of Express routing.

Now let's handle the GET,POST etc.

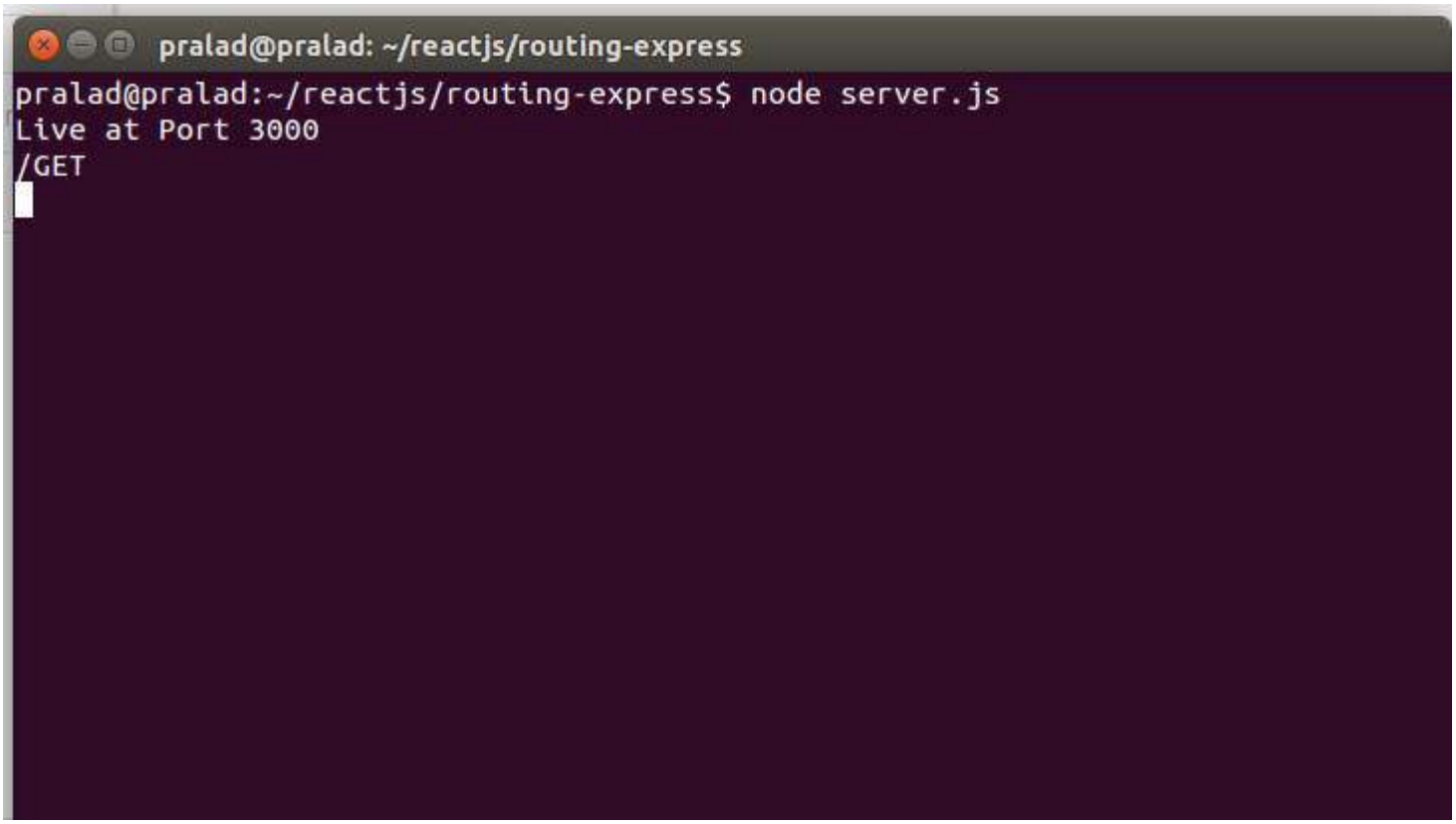
Change yous server.js file like

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

//Creating Router() object

var router = express.Router();

// Router middleware, mentioned it before defining routes.

router.use(function(req,res,next) {
  console.log("/" + req.method);
  next();
});

// Provide all routes here, this is for Home page.

router.get("/",function(req,res){
  res.json({"message" : "Hello World"});
});


app.use("/api",router);


app.listen(3000,function(){
  console.log("Live at Port 3000");
});
```

Now if you restart the server and made the request to

```
http://localhost:3000/api/
```

You Will see something like

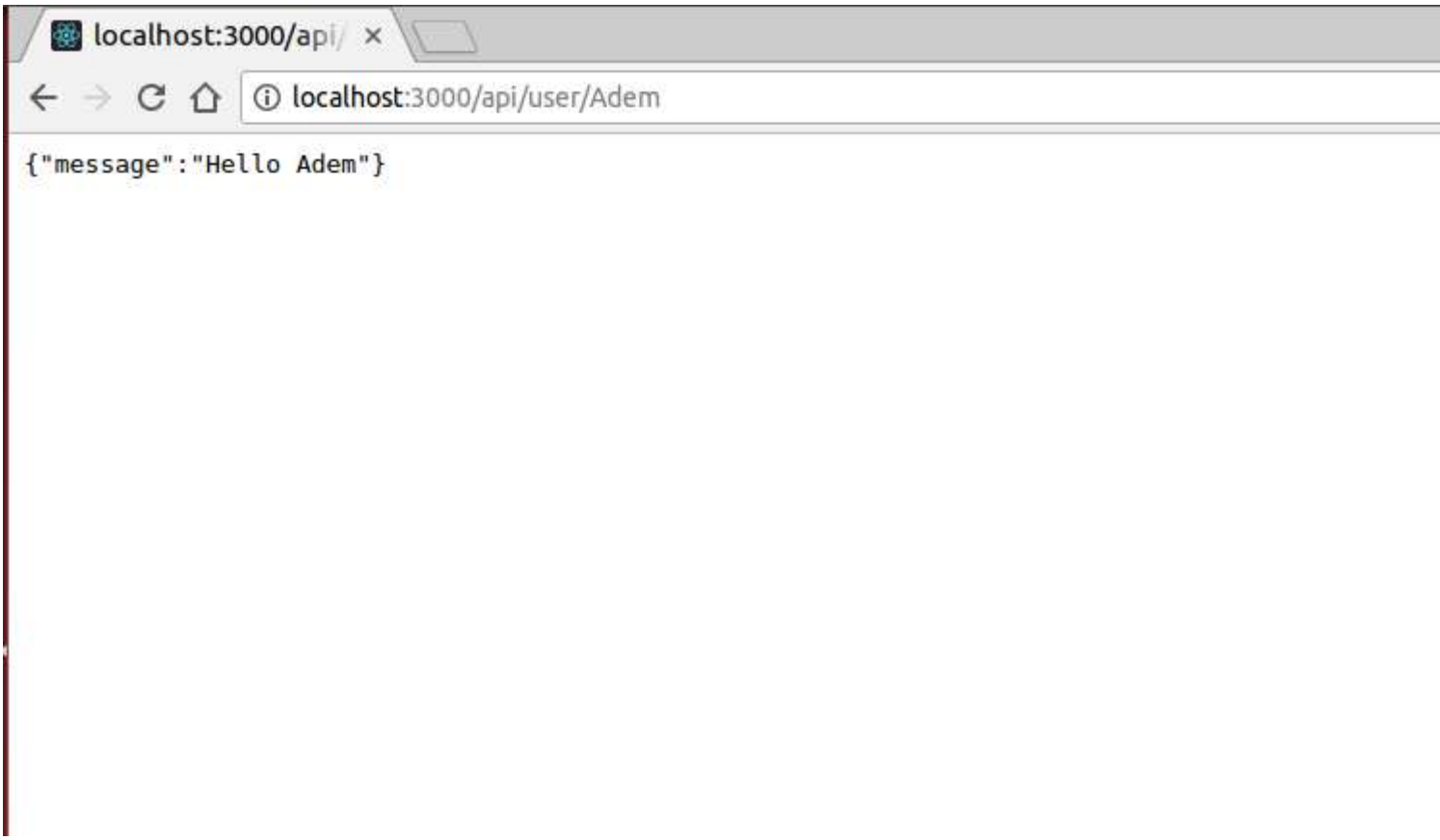


Accessing Parameter in Routing

You can access the parameter from url also, Like *http://example.com/api/:name/*. So name parameter can be access. Add the following code into your server.js

```
router.get("/user/:id",function(req,res){
  res.json({"message" : "Hello "+req.params.id});
});
```

Now restart server and go to [http://localhost:3000/api/user/Adem][4], the output will be like



.

Read NodeJs Routing online: https://riptutorial.com/node-js/topic/9846/nodejs-routing

Chapter 74: NodeJS with Redis

Remarks

We have covered the basic and most commonly used operations in node_redis. You can use this module to leverage the full power of Redis and create really sophisticated Node.js apps. You can build many interesting things with this library such as a strong caching layer, a powerful Pub/Sub messaging system and more. To know more about the library check out their documentation.

Examples

Getting Started

node_redis, as you may have guessed, is the Redis client for Node.js. You can install it via npm using the following command.

```
npm install redis
```

Once you have installed node_redis module you are good to go. Let's create a simple file, app.js, and see how to connect with Redis from Node.js.

app.js

```
var redis = require('redis');
client = redis.createClient(); //creates a new client
```

By default, redis.createClient() will use 127.0.0.1 and 6379 as the hostname and port respectively. If you have a different host/port you can supply them as following:

```
var client = redis.createClient(port, host);
```

Now, you can perform some action once a connection has been established. Basically, you just need to listen for connect events as shown below.

```
client.on('connect', function() {
    console.log('connected');
});
```

So, the following snippet goes into app.js:

```
var redis = require('redis');
var client = redis.createClient();

client.on('connect', function() {
    console.log('connected');
});
```

Now, type node app in the terminal to run the app. Make sure your Redis server is up and running before running this snippet.

Storing Key-Value Pairs

Now that you know how to connect with Redis from Node.js, let's see how to store key-value pairs in Redis storage.

Storing Strings

All the Redis commands are exposed as different functions on the client object. To store a simple string use the following syntax:

```
client.set('framework', 'AngularJS');
```

Or

```
client.set(['framework', 'AngularJS']);
```

The above snippets store a simple string AngularJS against the key framework. You should note that both the snippets do the same thing. The only difference is that the first one passes a variable number of arguments while the later passes an args array to `client.set()` function. You can also pass an optional callback to get a notification when the operation is complete:

```
client.set('framework', 'AngularJS', function(err, reply) {
  console.log(reply);
});
```

If the operation failed for some reason, the `err` argument to the callback represents the error. To retrieve the value of the key do the following:

```
client.get('framework', function(err, reply) {
    console.log(reply);
});
```

`client.get()` lets you retrieve a key stored in Redis. The value of the key can be accessed via the callback argument reply. If the key doesn't exist, the value of reply will be empty.

Storing Hash

Many times storing simple values won't solve your problem. You will need to store hashes (objects) in Redis. For that you can use `hmset()` function as following:

```
client.hmset('frameworks', 'javascript', 'AngularJS', 'css', 'Bootstrap', 'node', 'Express');

client.hgetall('frameworks', function(err, object) {
    console.log(object);
});
```

The above snippet stores a hash in Redis that maps each technology to its framework. The first argument to `hmset()` is the name of the key. Subsequent arguments represent key-value pairs. Similarly, `hgetall()` is used to retrieve the value of the key. If the key is found, the second argument to the callback will contain the value which is an object.

Note that Redis doesn't support nested objects. All the property values in the object will be coerced into strings before getting stored. You can also use the following syntax to store objects in Redis:

```
client.hmset('frameworks', {
    'javascript': 'AngularJS',
    'css': 'Bootstrap',
    'node': 'Express'
});
```

An optional callback can also be passed to know when the operation is completed.

All the functions (commands) can be called with uppercase/lowercase equivalents. For example, `client.hmset()` and `client.HMSET()` are the same. Storing Lists

If you want to store a list of items, you can use Redis lists. To store a list use the following syntax:

```
client.rpush(['frameworks', 'angularjs', 'backbone'], function(err, reply) {
    console.log(reply); //prints 2
});
```

The above snippet creates a list called frameworks and pushes two elements to it. So, the length of the list is now two. As you can see I have passed an `args` array to `rpush`. The first item of the array represents the name of the key while the rest represent the elements of the list. You can also use `lpush()` instead of `rpush()` to push the elements to the left.

To retrieve the elements of the list you can use the `lrange()` function as following:

```
client.lrange('frameworks', 0, -1, function(err, reply) {
    console.log(reply); // ['angularjs', 'backbone']
});
```

Just note that you get all the elements of the list by passing -1 as the third argument to `lrange()`. If you want a subset of the list, you should pass the end index here.

Storing Sets

Sets are similar to lists, but the difference is that they don't allow duplicates. So, if you don't want any duplicate elements in your list you can use a set. Here is how we can modify our previous snippet to use a set instead of list.

```
client.sadd(['tags', 'angularjs', 'backbonejs', 'emberjs'], function(err, reply) {
    console.log(reply); // 3
});
```

As you can see, the `sadd()` function creates a new set with the specified elements. Here, the length of the set is three. To retrieve the members of the set, use the `smembers()` function as following:

```
client.smembers('tags', function(err, reply) {
    console.log(reply);
});
```

This snippet will retrieve all the members of the set. Just note that the order is not preserved while retrieving the members.

This was a list of the most important data structures found in every Redis powered app. Apart from strings, lists, sets, and hashes, you can store sorted sets, hyperLogLogs, and more in Redis. If you want a complete list of commands and data structures, visit the official Redis documentation. Remember that almost every Redis command is exposed on the client object offered by the node_redis module.

Some more important operations supported by node_redis.

Checking the Existence of Keys

Sometimes you may need to check if a key already exists and proceed accordingly. To do so you can use `exists()` function as shown below:

```
client.exists('key', function(err, reply) {
    if (reply === 1) {
        console.log('exists');
    } else {
        console.log('doesn\'t exist');
    }
});
```

Deleting and Expiring Keys

At times you will need to clear some keys and reinitialize them. To clear the keys, you can use del command as shown below:

```
client.del('frameworks', function(err, reply) {
    console.log(reply);
});
```

You can also give an expiration time to an existing key as following:

```
client.set('key1', 'val1');
client.expire('key1', 30);
```

The above snippet assigns an expiration time of 30 seconds to the key key1.

Incrementing and Decrementing

Redis also supports incrementing and decrementing keys. To increment a key use `incr()` function as shown below:

```
client.set('key1', 10, function() {
    client.incr('key1', function(err, reply) {
        console.log(reply); // 11
    });
});
```

The `incr()` function increments a key value by 1. If you need to increment by a different amount, you can use `incrby()` function. Similarly, to decrement a key you can use the functions like `decr()` and `decrby()`.

Read NodeJS with Redis online: https://riptutorial.com/node-js/topic/7107/nodejs-with-redis

Chapter 75: npm

Introduction

Node Package Manager (npm) provides following two main functionalities: Online repositories for node.js packages/modules which are searchable on search.nodejs.org. Command line utility to install Node.js packages, do version management and dependency management of Node.js packages.

Syntax

- npm <command> where <command> is one of:
  - add-user
  - adduser
  - apihelp
  - author
  - bin
  - bugs
  - c
  - cache
  - completion
  - config
  - ddp
  - dedupe
  - deprecate
  - docs
  - edit
  - explore
  - faq
  - find
  - find-dupes
  - get
  - help
  - help-search
  - home
  - i
  - install
  - info
  - init
  - isntall
  - issues
  - la
  - link
  - list

- ll
- ln
- login
- ls
- outdated
- owner
- pack
- prefix
- prune
- publish
- r
- rb
- rebuild
- remove
- repo
- restart
- rm
- root
- run-script
- s
- se
- search
- set
- show
- shrinkwrap
- star
- stars
- start
- stop
- submodule
- tag
- test
- tst
- un
- uninstall
- unlink
- unpublish
- unstar
- up
- update
- v
- version
- view
- whoami

Parameters

Parameter	Example
access	`npm publish --access=public`
bin	`npm bin -g`
edit	`npm edit connect`
help	`npm help init`
init	`npm init`
install	`npm install`
link	`npm link`
prune	`npm prune`
publish	`npm publish ./`
restart	`npm restart`
start	`npm start`
stop	`npm start`
update	`npm update`
version	`npm version`

Examples

Installing packages

Introduction

Package is a term used by npm to denote tools that developers can use for their projects. This includes everything from libraries and frameworks such as jQuery and AngularJS to task runners such as Gulp.js. The packages will come in a folder typically called `node_modules`, which will also contain a `package.json` file. This file contains information regarding all the packages including any dependencies, which are additional modules needed to use a particular package.

Npm uses the command line to both install and manage packages, so users attempting to use npm should be familiar with basic commands on their operating system i.e.: traversing directories as well as being able to see the contents of directories.

Installing NPM

Note that in order to install packages, you must have NPM installed.

The recommended way to install NPM is to use one of the installers from the Node.js download page. You can check to see if you already have node.js installed by running either the `npm -v` or the `npm version` command.

After installing NPM via the Node.js installer, be sure to check for updates. This is because NPM gets updated more frequently than the Node.js installer. To check for updates run the following command:

```
npm install npm@latest -g
```

How to install packages

To install one or more packages use the following:

```
npm install <package-name>
# or
npm i <package-name>...

# e.g. to install lodash and express
npm install lodash express
```

> **Note**: This will install the package in the directory that the command line is currently in, thus it is important to check whether the appropriate directory has been chosen

If you already have a `package.json` file in your current working directory and dependencies are defined in it, then `npm install` will automatically resolve and install all dependencies listed in the file. You can also use the shorthand version of the `npm install` command which is: `npm i`

If you want to install a specific version of a package use:

```
npm install <name>@<version>

# e.g. to install version 4.11.1 of the package lodash
npm install lodash@4.11.1
```

If you want to install a version which matches a specific version range use:

```
npm install <name>@<version range>

# e.g. to install a version which matches "version >= 4.10.1" and "version < 4.11.1"
# of the package lodash
npm install lodash@">=4.10.1 <4.11.1"
```

If you want to install the latest version use:

```
npm install <name>@latest
```

The above commands will search for packages in the central `npm` repository at npmjs.com. If you are not looking to install from the `npm` registry, other options are supported, such as:

```
# packages distributed as a tarball
npm install <tarball file>
npm install <tarball url>

# packages available locally
npm install <local path>

# packages available as a git repository
npm install <git remote url>

# packages available on GitHub
npm install <username>/<repository>

# packages available as gist (need a package.json)
npm install gist:<gist-id>

# packages from a specific repository
npm install --registry=http://myreg.mycompany.com <package name>

# packages from a related group of packages
# See npm scope
npm install @<scope>/<name>(@<version>)

# Scoping is useful for separating private packages hosted on private registry from
# public ones by setting registry for specific scope
npm config set @mycompany:registry http://myreg.mycompany.com
npm install @mycompany/<package name>
```

Usually, modules will be installed locally in a folder named `node_modules`, which can be found in your current working directory. This is the directory `require()` will use to load modules in order to make them available to you.

If you already created a `package.json` file, you can use the `--save` (shorthand `-S`) option or one of its variants to automatically add the installed package to your `package.json` as a dependency. If someone else installs your package, `npm` will automatically read dependencies from the `package.json` file and install the listed versions. Note that you can still add and manage your dependencies by editing the file later, so it's usually a good idea to keep track of dependencies, for example using:

```
npm install --save <name> # Install dependencies
# or
npm install -S <name> # shortcut version --save
# or
npm i -S <name>
```

In order to install packages and save them only if they are needed for development, not for running them, not if they are needed for the application to run, follow the following command:

```
npm install --save-dev <name> # Install dependencies for development purposes
# or
npm install -D <name> # shortcut version --save-dev
# or
npm i -D <name>
```

Installing dependencies

Some modules do not only provide a library for you to use, but they also provide one or more binaries which are intended to be used via the command line. Although you can still install those packages locally, it is often preferred to install them globally so the command-line tools can be enabled. In that case, `npm` will automatically link the binaries to appropriate paths (e.g. `/usr/local/bin/<name>`) so they can be used from the command line. To install a package globally, use:

```
npm install --global <name>
# or
npm install -g <name>
# or
npm i -g <name>

# e.g. to install the grunt command line tool
npm install -g grunt-cli
```

If you want to see a list of all the installed packages and their associated versions in the current workspace, use:

```
npm list
npm list <name>
```

Adding an optional name argument can check the version of a specific package.

Note: If you run into permission issues while trying to install an npm module globally, resist the temptation to issue a `sudo npm install -g ...` to overcome the issue. Granting third-party scripts to run on your system with elevated privileges is dangerous. The permission issue might mean that you have an issue with the way `npm` itself was installed. If you're interested in installing Node in sandboxed user environments, you might want to try using nvm.

If you have build tools, or other development-only dependencies (e.g. Grunt), you might not want to have them bundled with the application you deploy. If that's the case, you'll want to have it as a development dependency, which is listed in the `package.json` under `devDependencies`. To install a package as a development-only dependency, use `--save-dev` (or `-D`).

```
npm install --save-dev <name> // Install development dependencies which is not included in
production
# or
npm install -D <name>
```

You will see that the package is then added to the `devDependencies` of your `package.json`.

To install dependencies of a downloaded/cloned node.js project, you can simply use

```
npm install
# or
npm i
```

npm will automatically read the dependencies from `package.json` and install them.

NPM Behind A Proxy Server

If your internet access is through a proxy server, you might need to modify npm install commands that access remote repositories. npm uses a configuration file which can be updated via command line:

```
npm config set
```

You can locate your proxy settings from your browser's settings panel. Once you have obtained the proxy settings (server URL, port, username and password); you need to configure your npm configurations as follows.

```
$ npm config set proxy http://<username>:<password>@<proxy-server-url>:<port>
$ npm config set https-proxy http://<username>:<password>@<proxy-server-url>:<port>
```

`username`, `password`, `port` fields are optional. Once you have set these, your `npm install`, `npm i -g` etc. would work properly.

Scopes and repositories

```
# Set the repository for the scope "myscope"
npm config set @myscope:registry http://registry.corporation.com

# Login at a repository and associate it with the scope "myscope"
npm adduser --registry=http://registry.corporation.com --scope=@myscope

# Install a package "mylib" from the scope "myscope"
npm install @myscope/mylib
```

If the name of your own package starts with `@myscope` and the scope "myscope" is associated with a different repository, `npm publish` will upload your package to that repository instead.

You can also persist these settings in a `.npmrc` file:

```
@myscope:registry=http://registry.corporation.com
//registry.corporation.com/:_authToken=xxxxxxxx-xxxx-xxxx-xxxxxxxxxxxxxxx
```

This is useful when automating the build on a CI server f.e.

Uninstalling packages

To uninstall one or more locally installed packages, use:

```
npm uninstall <package name>
```

The uninstall command for npm has five aliases that can also be used:

```
npm remove <package name>
npm rm <package name>
npm r <package name>

npm unlink <package name>
npm un <package name>
```

If you would like to remove the package from the `package.json` file as part of the uninstallation, use the `--save` flag (shorthand: `-S`):

```
npm uninstall --save <package name>
npm uninstall -S <package name>
```

For a development dependency, use the `--save-dev` flag (shorthand: `-D`):

```
npm uninstall --save-dev <package name>
npm uninstall -D <package name>
```

For an optional dependency, use the `--save-optional` flag (shorthand: `-O`):

```
npm uninstall --save-optional <package name>
npm uninstall -O <package name>
```

For packages that are installed globally use the `--global` flag (shorthand: `-g`):

```
npm uninstall -g <package name>
```

Basic semantic versioning

Before publishing a package you have to version it. npm supports semantic versioning, this means there are **patch, minor and major** releases.

For example, if your package is at version 1.2.3 to change version you have to:

1. patch release: `npm version patch` => 1.2.4
2. minor release: `npm version minor` => 1.3.0
3. major release: `npm version major` => 2.0.0

You can also specify a version directly with:

`npm version 3.1.4` => 3.1.4

When you set a package version using one of the npm commands above, npm will modify the version field of the package.json file, commit it, and also create a new Git tag with the version prefixed with a "v", as if you've issued the command:

`git tag v3.1.4`

Unlike other package managers like Bower, the npm registry doesn't rely on Git tags being created for every version. But, if you like using tags, you should remember to push the newly created tag after bumping the package version:

`git push origin master` (to push the change to package.json)

`git push origin v3.1.4` (to push the new tag)

Or you can do this in one swoop with:

`git push origin master --tags`

Setting up a package configuration

Node.js package configurations are contained in a file called `package.json` that you can find at the root of each project. You can setup a brand new configuration file by calling:

```
npm init
```

That will try to read the current working directory for Git repository information (if it exists) and environment variables to try and autocomplete some of the placeholder values for you. Otherwise, it will provide an input dialog for the basic options.

If you'd like to create a `package.json` with default values use:

```
npm init --yes
# or
npm init -y
```

If you're creating a `package.json` for a project that you are not going to be publishing as an npm package (i.e. solely for the purpose of rounding up your dependencies), you can convey this intent in your `package.json` file:

1. Optionally set the `private` property to true to prevent accidental publishing.
2. Optionally set the `license` property to "UNLICENSED" to deny others the right to use your package.

To install a package and automatically save it to your `package.json`, use:

```
npm install --save <package>
```

The package and associated metadata (such as the package version) will appear in your dependencies. If you save if as a development dependency (using `--save-dev`), the package will instead appear in your `devDependencies`.

With this bare-bones `package.json`, you will encounter warning messages when installing or upgrading packages, telling you that you are missing a description and the repository field. While it is safe to ignore these messages, you can get rid of them by opening the package.json in any text editor and adding the following lines to the JSON object:

```
[...]
"description": "No description",
"repository": {
  "private": true
},
[...]
```

Publishing a package

First, make sure that you have configured your package (as said in Setting up a package configuration). Then, you have to be logged in to npmjs.

If you already have a npm user

```
npm login
```

If you don't have a user

```
npm adduser
```

To check that your user is registered in the current client

```
npm config ls
```

After that, when your package is ready to be published use

```
npm publish
```

And you are done.

If you need to publish a new version, ensure that you update your package version, as stated in Basic semantic versioning. Otherwise, `npm` will not let you publish the package.

```
{
    name: "package-name",
    version: "1.0.4"
}
```

Running scripts

You may define scripts in your `package.json`, for example:

```
{
  "name": "your-package",
```

```
  "version": "1.0.0",
  "description": "",
  "main": "index.js",
  "author": "",
  "license": "ISC",
  "dependencies": {},
  "devDependencies": {},
  "scripts": {
    "echo": "echo hello!"
  }
}
```

To run the `echo` script, run `npm run echo` from the command line. Arbitrary scripts, such as `echo` above, have to be be run with `npm run <script name>`. npm also has a number of official scripts that it runs at certain stages of the package's life (like `preinstall`). See here for the entire overview of how npm handles script fields.

npm scripts are used most often for things like starting a server, building the project, and running tests. Here's a more realistic example:

```
  "scripts": {
    "test": "mocha tests",
    "start": "pm2 start index.js"
  }
```

In the `scripts` entries, command-line programs like `mocha` will work when installed either globally or locally. If the command-line entry does not exist in the system PATH, npm will also check your locally installed packages.

If your scripts become very long, they can be split into parts, like this:

```
  "scripts": {
    "very-complex-command": "npm run chain-1 && npm run chain-2",
    "chain-1": "webpack",
    "chain-2": "node app.js"
  }
```

Removing extraneous packages

To remove extraneous packages (packages that are installed but not in dependency list) run the following command:

```
npm prune
```

To remove all `dev` packages add `--production` flag:

```
npm prune --production
```

More on it

Listing currently installed packages

To generate a list (tree view) of currently installed packages, use

```
npm list
```

ls, **la** and **ll** are aliases of **list** command. la and ll commands shows extended information like description and repository.

Options

The response format can be changed by passing options.

```
npm list --json
```

- **json** - Shows information in json format
- **long** - Shows extended information
- **parseable** - Shows parseable list instead of tree
- **global** - Shows globally installed packages
- **depth** - Maximum display depth of dependency tree
- **dev**/**development** - Shows devDependencies
- **prod**/**production** - Shows dependencies

If you want, you can also go to the package's home page.

```
npm home <package name>
```

Updating npm and packages

Since npm itself is a Node.js module, it can be updated using itself.

If OS is Windows must be running command prompt as Admin

```
npm install -g npm@latest
```

If you want to check for updated versions you can do:

```
npm outdated
```

In order to update a specific package:

```
npm update <package name>
```

> This will update the package to the latest version according to the restrictions in package.json

In case you also want to lock the updated version in package.json:

```
npm update <package name> --save
```

Locking modules to specific versions

By default, npm installs the latest available version of modules according to each dependencies' semantic version. This can be problematic if a module author doesn't adhere to semver and introduces breaking changes in a module update, for example.

To lock down each dependencies' version (and the versions of their dependencies, etc) to the specific version installed locally in the `node_modules` folder, use

```
npm shrinkwrap
```

This will then create a `npm-shrinkwrap.json` alongside your `package.json` which lists the specific versions of dependancies.

Setting up for globally installed packages

You can use `npm install -g` to install a package "globally." This is typically done to install an executable that you can add to your path to run. For example:

```
npm install -g gulp-cli
```

If you update your path, you can call `gulp` directly.

On many OSes, `npm install -g` will attempt to write to a directory that your user may not be able to write to such as `/usr/bin`. You should **not** use `sudo npm install` in this case since there is a possible security risk of running arbitrary scripts with `sudo` and the root user may create directories in your home that you cannot write to which makes future installations more difficult.

You can tell `npm` where to install global modules to via your configuration file, `~/.npmrc`. This is called the `prefix` which you can view with `npm prefix`.

```
prefix=~/.npm-global-modules
```

This will use the prefix whenever you run `npm install -g`. You can also use `npm install --prefix ~/.npm-global-modules` to set the prefix when you install. If the prefix is the same as your configuration, you don't need to use `-g`.

In order to use the globally installed module, it needs to be on your path:

```
export PATH=$PATH:~/.npm-global-modules/bin
```

Now when you run `npm install -g gulp-cli` you will be able to use `gulp`.

Note: When you `npm install` (without `-g`) the prefix will be the directory with `package.json` or the current directory if none is found in the hierarchy. This also creates a directory `node_modules/.bin`

that has the executables. If you want to use an executable that is specific to a project, it's not necessary to use `npm install -g`. You can use the one in `node_modules/.bin`.

Linking projects for faster debugging and development

Building project dependencies can sometimes be a tedious task. Instead of publishing a package version to NPM and installing the dependency to test the changes, use `npm link`. `npm link` creates a symlink so the latest code can be tested in a local environment. This makes testing global tools and project dependencies easier by allowing the latest code run before making a published version.

Help text

```
NAME
       npm-link - Symlink a package folder

SYNOPSIS
         npm link (in package dir)
         npm link [<@scope>/]<pkg>[@<version>]

         alias: npm ln
```

Steps for linking project dependencies

When creating the dependency link, note that the package name is what is going to be referenced in the parent project.

1. CD into a dependency directory (ex: `cd ../my-dep`)
2. `npm link`
3. CD into the project that is going to use the dependency
4. `npm link my-dep` or if namespaced `npm link @namespace/my-dep`

Steps for linking a global tool

1. CD into the project directory (ex: `cd eslint-watch`)
2. `npm link`
3. Use the tool
4. `esw --quiet`

Problems that may arise

Linking projects can sometimes cause issues if the dependency or global tool is already installed. `npm uninstall (-g) <pkg>` and then running `npm link` normally resolves any issues that may arise.

Read npm online: https://riptutorial.com/node-js/topic/482/npm

Chapter 76: nvm - Node Version Manager

Remarks

The urls used in the above examples reference a specific version of Node Version Manager. It is most likely that the latest version is different to what's being referenced. To install nvm using the latest version, click here to access nvm on GitHub, which will provide you with latest urls.

Examples

Install NVM

You can use `curl`:

```
curl -o- https://raw.githubusercontent.com/creationix/nvm/v0.31.3/install.sh | bash
```

Or you can use `wget`:

```
wget -qO- https://raw.githubusercontent.com/creationix/nvm/v0.31.3/install.sh | bash
```

Check NVM version

To verify that nvm has been installed, do:

```
command -v nvm
```

which should output 'nvm' if the installation was successful.

Installing an specific Node version

Listing available remote versions for installation

```
nvm ls-remote
```

Installing a remote version

```
nvm install <version>
```

For example

```
nvm install 0.10.13
```

Using an already installed node version

To list available local versions of node through NVM:

```
nvm ls
```

For example, if `nvm ls` returns:

```
$ nvm ls
     v4.3.0
     v5.5.0
```

You can switch to `v5.5.0` with:

```
nvm use v5.5.0
```

Install nvm on Mac OSX

INSTALLATION PROCESS

You can install Node Version Manager using git, curl or wget. You run these commands in **Terminal** on **Mac OSX**.

curl example:

```
curl -o- https://raw.githubusercontent.com/creationix/nvm/v0.31.3/install.sh | bash
```

wget example:

```
wget -qO- https://raw.githubusercontent.com/creationix/nvm/v0.31.3/install.sh | bash
```

TEST THAT NVM WAS PROPERLY INSTALLED

To test that nvm was properly installed, close and re-open Terminal and enter `nvm`. If you get a **nvm: command not found** message, your OS may not have the necessary **.bash_profile** file. In Terminal, enter `touch ~/.bash_profile` and run the above install script again.

If you still get **nvm: command not found**, try the following:

- In Terminal, enter `nano .bashrc`. You should see an export script almost identical to the following:

  export NVM_DIR=”/Users/johndoe/.nvm” [-s “$NVM_DIR/nvm.sh”] && . “$NVM_DIR/nvm.sh”

- Copy the export script and remove it from **.bashrc**
- Save and Close the .bashrc file (CTRL+O – Enter – CTRL+X)
- Next, enter `nano .bash_profile` to open the Bash Profile
- Paste the export script you copied into the Bash Profile on a new line

- Save and Close the Bash Profile (CTRL+O – Enter – CTRL+X)
- Finally enter `nano .bashrc` to re-open the **.bashrc** file
- Paste the following line into the file:

  source ~/.nvm/nvm.sh

- Save and Close (CTRL+O – Enter – CTRL+X)
- Restart Terminal and enter `nvm` to test if it's working

Setting alias for node version

If you want to set some alias name to installed node version, do:

```
nvm alias <name> <version>
```

Similary to unalias, do:

```
nvm unalias <name>
```

A proper usecase would be, if you want to set some other version than stable version as default alias. `default` aliased versions are loaded on console by default.

Like:

```
nvm alias default 5.0.1
```

Then every time **console**/**terminal** starts 5.0.1 would be present by default.

Note:

```
nvm alias # lists all aliases created on nvm
```

Run any arbitrary command in a subshell with the desired version of node

List all the node versions installed

```
nvm ls
    v4.5.0
    v6.7.0
```

Run command using any node installed version

```
nvm run 4.5.0 --version or nvm exec 4.5.0 node --version
Running node v4.5.0 (npm v2.15.9)
v4.5.0
```

```
nvm run 6.7.0 --version or nvm exec 6.7.0 node --version
Running node v6.7.0 (npm v3.10.3)
```

```
v6.7.0
```

---

using alias

```
nvm run default --version or nvm exec default node --version
Running node v6.7.0 (npm v3.10.3)
v6.7.0
```

To install node LTS version

```
nvm install --lts
```

Version Switching

```
nvm use v4.5.0 or nvm use stable ( alias )
```

Read nvm - Node Version Manager online: https://riptutorial.com/node-js/topic/2823/nvm---node-version-manager

Chapter 77: OAuth 2.0

Examples

OAuth 2 with Redis Implementation - grant_type: password

In this example I will be using oauth2 in rest api with redis database

> **Important:** You will need to install redis database on your machine, Download it from here for linux users and from here to install windows version, and we will be using redis manager desktop app, install it from here.

Now we have to set our node.js server to use redis database.

- **Creating Server file: app.js**

```
    var express = require('express'),
  bodyParser = require('body-parser'),
  oauthserver = require('oauth2-server'); // Would be: 'oauth2-server'

var app = express();

app.use(bodyParser.urlencoded({ extended: true }));

app.use(bodyParser.json());

app.oauth = oauthserver({
  model: require('./routes/Oauth2/model'),
  grants: ['password', 'refresh_token'],
  debug: true
});

// Handle token grant requests
app.all('/oauth/token', app.oauth.grant());

app.get('/secret', app.oauth.authorise(), function (req, res) {
  // Will require a valid access_token
  res.send('Secret area');
});

app.get('/public', function (req, res) {
  // Does not require an access_token
  res.send('Public area');
});

// Error handling
app.use(app.oauth.errorHandler());

app.listen(3000);
```

- **Create Oauth2 model in routes/Oauth2/model.js**

```
 var model = module.exports,
  util = require('util'),
  redis = require('redis');

var db = redis.createClient();

var keys = {
  token: 'tokens:%s',
  client: 'clients:%s',
  refreshToken: 'refresh_tokens:%s',
  grantTypes: 'clients:%s:grant_types',
  user: 'users:%s'
};

model.getAccessToken = function (bearerToken, callback) {
  db.hgetall(util.format(keys.token, bearerToken), function (err, token) {
    if (err) return callback(err);

    if (!token) return callback();

    callback(null, {
      accessToken: token.accessToken,
      clientId: token.clientId,
      expires: token.expires ? new Date(token.expires) : null,
      userId: token.userId
    });
  });
};

model.getClient = function (clientId, clientSecret, callback) {
  db.hgetall(util.format(keys.client, clientId), function (err, client) {
    if (err) return callback(err);

    if (!client || client.clientSecret !== clientSecret) return callback();

    callback(null, {
      clientId: client.clientId,
      clientSecret: client.clientSecret
    });
  });
};

model.getRefreshToken = function (bearerToken, callback) {
  db.hgetall(util.format(keys.refreshToken, bearerToken), function (err, token) {
    if (err) return callback(err);

    if (!token) return callback();

    callback(null, {
      refreshToken: token.accessToken,
      clientId: token.clientId,
      expires: token.expires ? new Date(token.expires) : null,
      userId: token.userId
    });
  });
};

model.grantTypeAllowed = function (clientId, grantType, callback) {
  db.sismember(util.format(keys.grantTypes, clientId), grantType, callback);
};
```

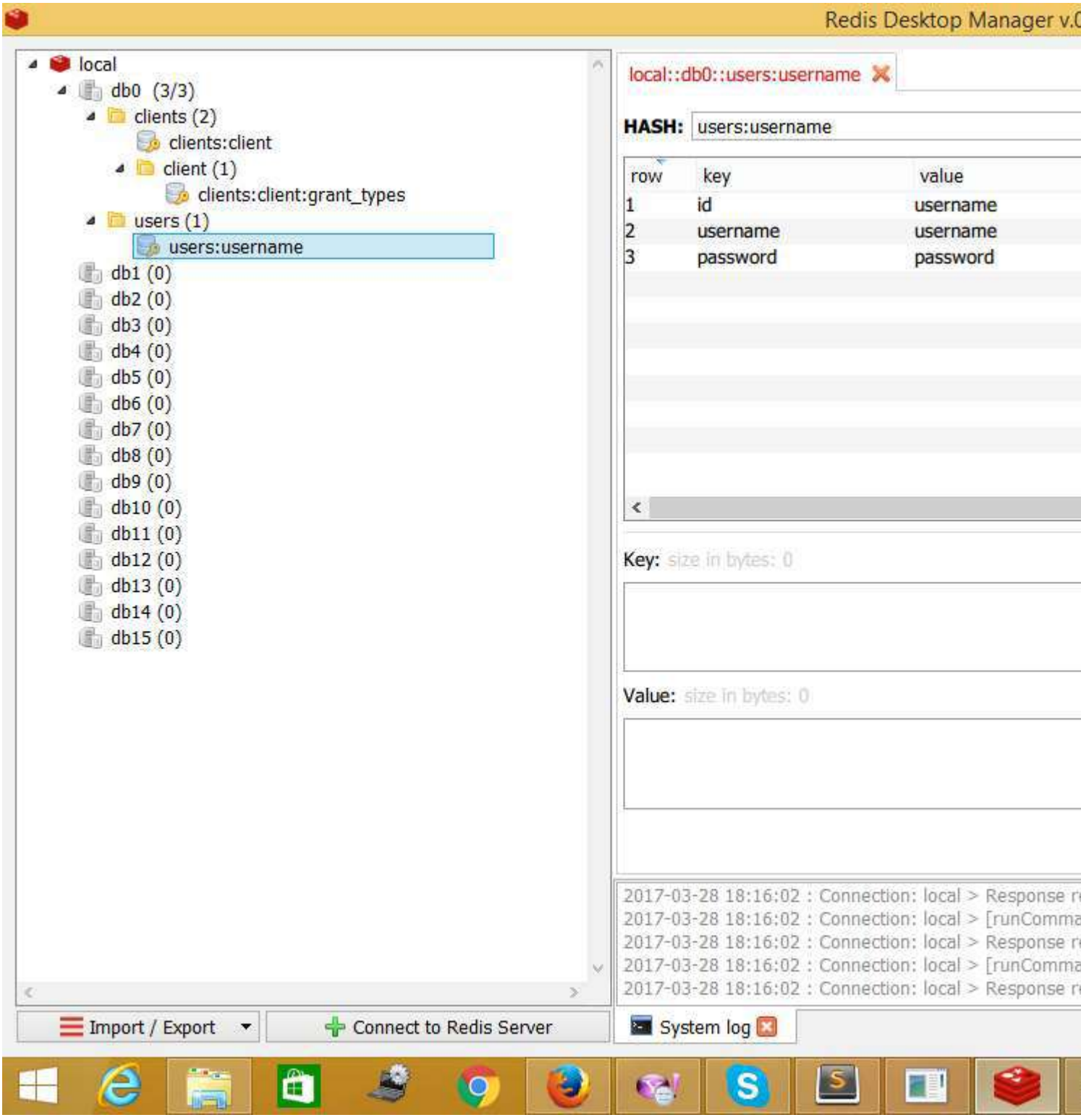
```
model.saveAccessToken = function (accessToken, clientId, expires, user, callback) {
  db.hmset(util.format(keys.token, accessToken), {
    accessToken: accessToken,
    clientId: clientId,
    expires: expires ? expires.toISOString() : null,
    userId: user.id
  }, callback);
};

model.saveRefreshToken = function (refreshToken, clientId, expires, user, callback) {
  db.hmset(util.format(keys.refreshToken, refreshToken), {
    refreshToken: refreshToken,
    clientId: clientId,
    expires: expires ? expires.toISOString() : null,
    userId: user.id
  }, callback);
};

model.getUser = function (username, password, callback) {
  db.hgetall(util.format(keys.user, username), function (err, user) {
    if (err) return callback(err);

    if (!user || password !== user.password) return callback();

    callback(null, {
      id: username
    });
  });
};
```

You only need to install redis on your machine and run the following node file

```
  #! /usr/bin/env node

var db = require('redis').createClient();

db.multi()
  .hmset('users:username', {
    id: 'username',
    username: 'username',
    password: 'password'
  })
  .hmset('clients:client', {
    clientId: 'client',
    clientSecret: 'secret'
  })//clientId + clientSecret to base 64 will generate Y2xpZW50OnNlY3JldA==
  .sadd('clients:client:grant_types', [
    'password',
    'refresh_token'
  ])
  .exec(function (errs) {
    if (errs) {
      console.error(errs[0].message);
      return process.exit(1);
    }

    console.log('Client and user added successfully');
    process.exit();
  });
```

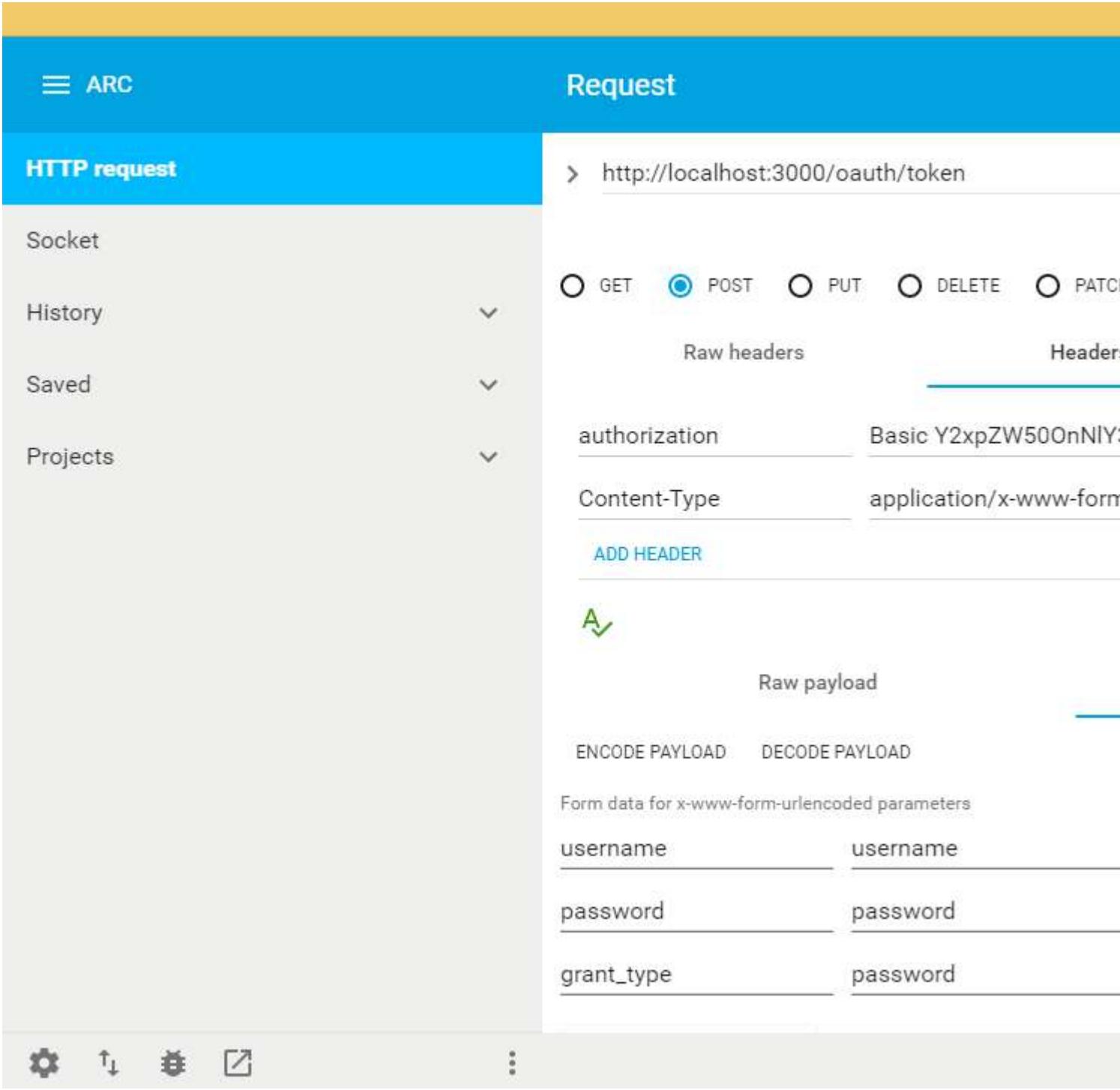
Note: This file will set credentials for your frontend to request token So your request from

Sample redis database after calling the above file:



Request will be as follows:

Sample Call to api



Header:

1. authorization: Basic followed by the password set when you first setup redis:

    a. clientId + secretId to base64

2. Data form:

    username: user that request token

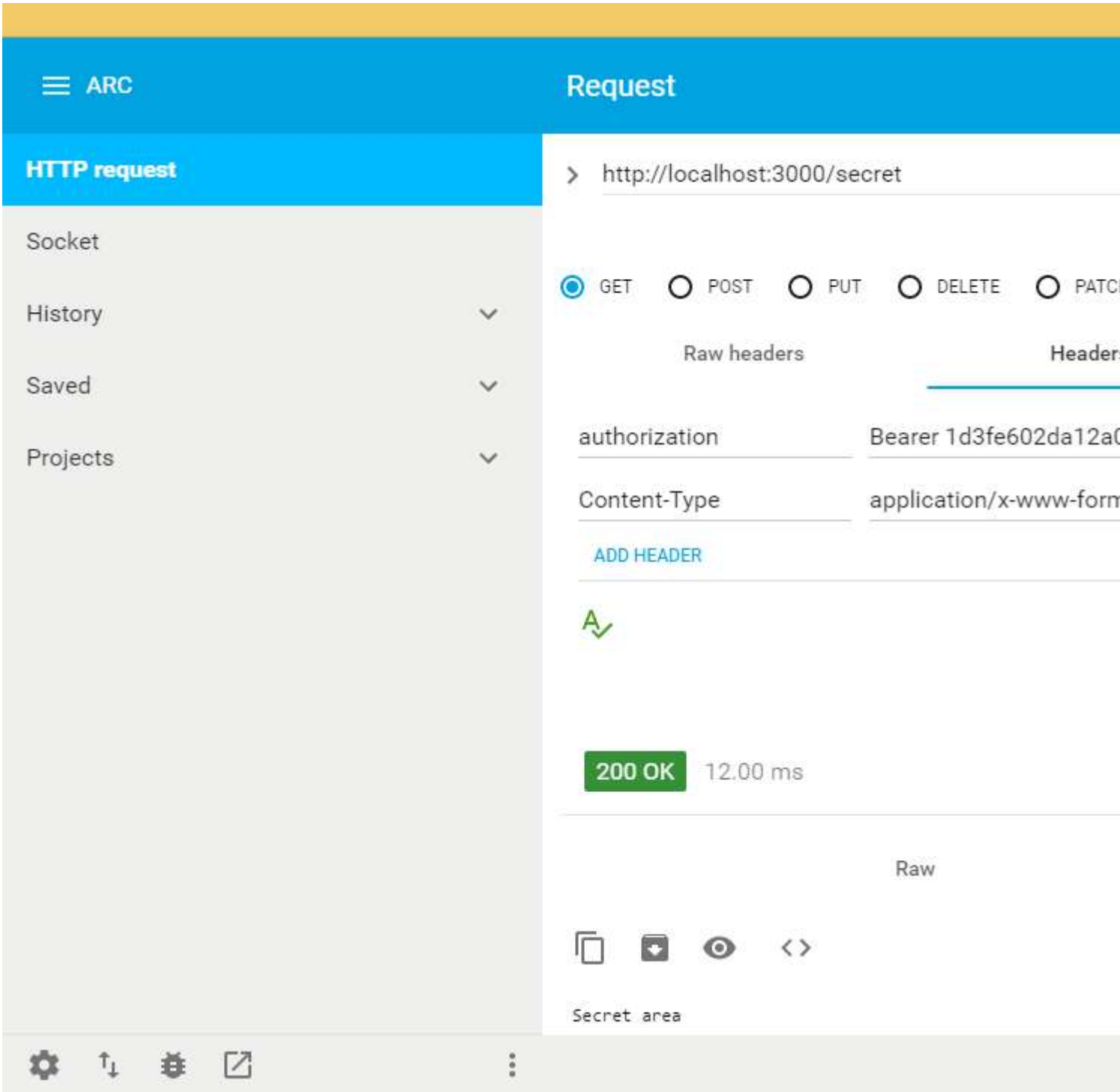
    password: user password

    grant_type: depends on what options do you want, I choose passwod which

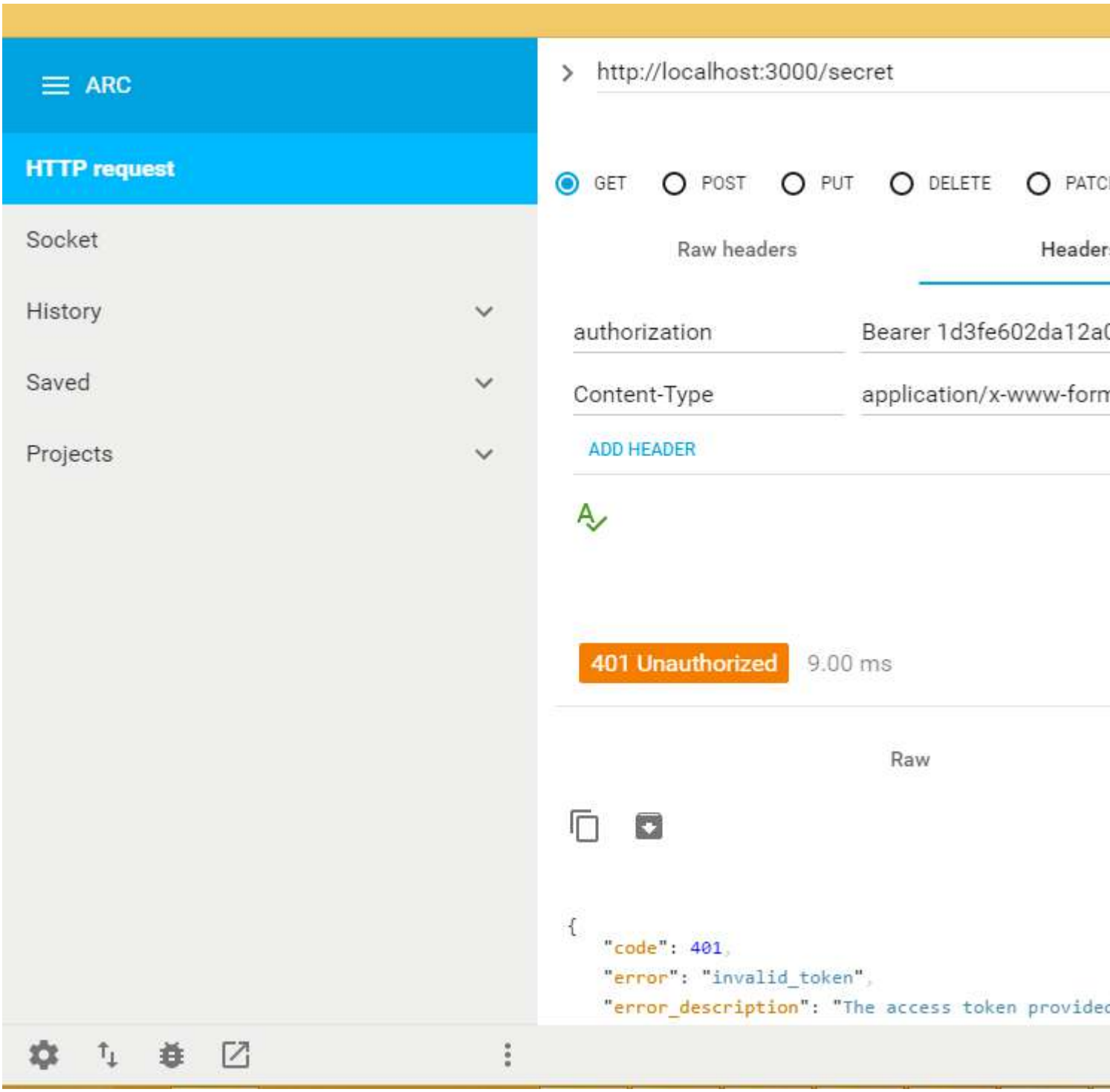
takes only username and password to be created in redis, Data on redis will be as below:

```
{
  "access_token":"1d3fe602da12a086ecb2b996fd7b7ae874120c4f",
  "token_type":"bearer", // Will be used to access api + access+token e.g. bearer
1d3fe602da12a086ecb2b996fd7b7ae874120c4f
  "expires_in":3600,
  "refresh_token":"b6ad56e5c9aba63c85d7e21b1514680bbf711450"
}
```

So We need to call our api and grab some secured data with our access token we have just created, see below:

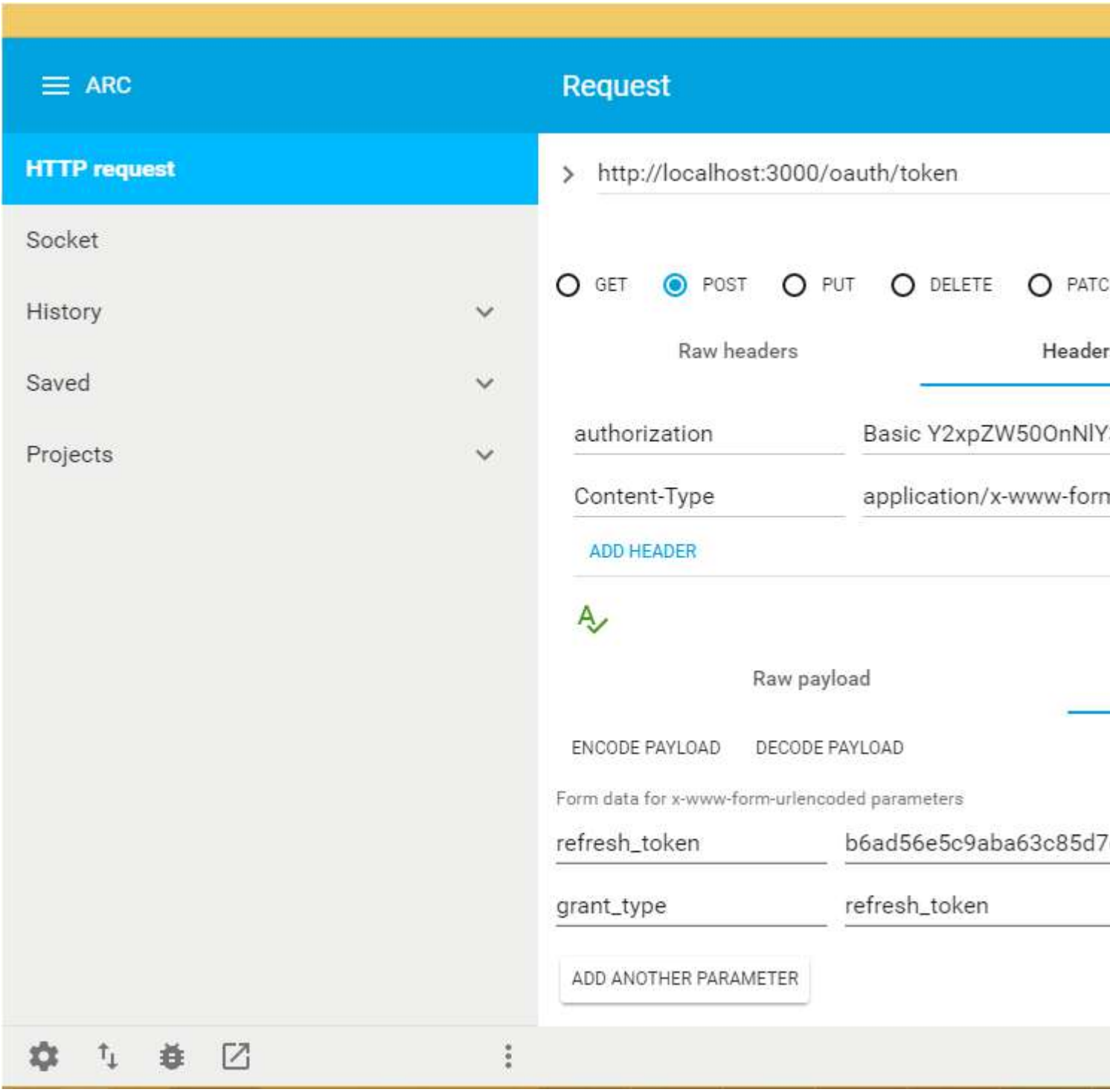


when token expires api will throw an error that the token expires and you cannot have access to any of the api calls, see image below :



> Lets see what to do if the token expires, Let me first explain it to you, if access token expires a refresh_token exists in redis that reference the expired access_token So what we need is to call oauth/token again with the refresh_token grant_type and set the authorization to the Basic clientId:clientsecret (to base 64 !) and finally send the refresh_token, this will generate a new access_token with a new expiry data.

The following picture shows how to get a new access token:



Hope to Help!

Read OAuth 2.0 online: https://riptutorial.com/node-js/topic/9566/oauth-2-0

Chapter 78: package.json

Remarks

You can create `package.json` with

```
npm init
```

which will ask you about basic facts about your projects, including license identifier.

Examples

Basic project definition

```
{
    "name": "my-project",
    "version": "0.0.1",
    "description": "This is a project.",
    "author": "Someone <someone@example.com>",
    "contributors": [{
        "name": "Someone Else",
        "email": "else@example.com"
    }],
    "keywords": ["improves", "searching"]
}
```

Field	Description
name	a **required** field for a package to install. Needs to be lowercase, single word without spaces. (Dashes and underscores allowed)
version	a **required** field for the package version using semantic versioning.
description	a short description of the project
author	specifies the author of the package
contributors	an array of objects, one for each contributor
keywords	an array of strings, this will help people finding your package

Dependencies

"dependencies": { "module-name": "0.1.0" }

- **exact**: `0.1.0` will install that specific version of the module.
- **newest minor version**: `^0.1.0` will install the newest minor version, for example `0.2.0`, but

won't install a module with a higher major version e.g. `1.0.0`

- **newest patch**: `0.1.x` or `~0.1.0` will install the newest patch version available, for example `0.1.4`, but won't install a module with higher major or minor version, e.g. `0.2.0` or `1.0.0`.
- **wildcard**: `*` will install the latest version of the module.
- **git repository**: the following will install a tarball from the master branch of a git repo. A `#sha`, `#tag` or `#branch` can also be provided:
  - **GitHub**: `user/project` or `user/project#v1.0.0`
  - **url**: `git://gitlab.com/user/project.git` or `git://gitlab.com/user/project.git#develop`
- **local path**: `file:../lib/project`

After adding them to your package.json, use the command `npm install` in your project directory in terminal.

devDependencies

```
"devDependencies": {
    "module-name": "0.1.0"
}
```

For dependencies required only for development, like testing styling proxies ext. Those dev-dependencies won't be installed when running "npm install" in production mode.

Scripts

You can define scripts that can be executed or are triggered before or after another script.

```
{
  "scripts": {
    "pretest": "scripts/pretest.js",
    "test": "scripts/test.js",
    "posttest": "scripts/posttest.js"
  }
}
```

In this case, you can execute the script by running either of these commands:

```
$ npm run-script test
$ npm run test
$ npm test
$ npm t
```

Pre-defined scripts

Script Name	Description
prepublish	Run before the package is published.

Script Name	Description
publish, postpublish	Run after the package is published.
preinstall	Run before the package is installed.
install, postinstall	Run after the package is installed.
preuninstall, uninstall	Run before the package is uninstalled.
postuninstall	Run after the package is uninstalled.
preversion, version	Run before bump the package version.
postversion	Run after bump the package version.
pretest, test, posttest	Run by the `npm test` command
prestop, stop, poststop	Run by the `npm stop` command
prestart, start, poststart	Run by the `npm start` command
prerestart, restart, postrestart	Run by the `npm restart` command

User-defined scripts

You can also define your own scripts the same way you do with the pre-defined scripts:

```
{
  "scripts": {
    "preci": "scripts/preci.js",
    "ci": "scripts/ci.js",
    "postci": "scripts/postci.js"
  }
}
```

In this case, you can execute the script by running either of these commands:

```
$ npm run-script ci
$ npm run ci
```

User-defined scripts also supports *pre* and *post* scripts, as shown in the example above.

Extended project definition

Some of the additional attributes are parsed by the npm website like `repository`, `bugs` or `homepage` and shown in the infobox for this packages

```
{
```

```
  "main": "server.js",
  "repository" :  {
    "type": "git",
    "url": "git+https://github.com/<accountname>/<repositoryname>.git"
  },
  "bugs": {
    "url": "https://github.com/<accountname>/<repositoryname>/issues"
  },
  "homepage": "https://github.com/<accountname>/<repositoryname>#readme",
  "files": [
    "server.js", // source files
    "README.md", // additional files
    "lib" // folder with all included files
  ]
}
```

Field	Description
main	Entry script for this package. This script is returned when a user requires the package.
repository	Location and type of the public repository
bugs	Bugtracker for this package (e.g. github)
homepage	Homepage for this package or the general project
files	List of files and folders which should be downloaded when a user does a `npm install <packagename>`

Exploring package.json

A `package.json` file, usually present in the project root, contains metadata about your app or module as well as the list of dependencies to install from npm when running `npm install`.

To initialize a `package.json` type `npm init` in your command prompt.

To create a `package.json` with default values use:

```
npm init --yes
# or
npm init -y
```

To install a package and save it to `package.json` use:

```
npm install {package name} --save
```

You can also use the shorthand notation:

```
 npm i -S {package name}
```

NPM aliases `-S` to `--save` and `-D` to `--save-dev` to save in your production or development dependencies respectively.

The package will appear in your dependencies; if you use `--save-dev` instead of `--save`, the package will appear in your devDependencies.

Important properties of `package.json`:

```
{
  "name": "module-name",
  "version": "10.3.1",
  "description": "An example module to illustrate the usage of a package.json",
  "author": "Your Name <your.name@example.org>",
  "contributors": [{
    "name": "Foo Bar",
    "email": "foo.bar@example.com"
  }],
  "bin": {
    "module-name": "./bin/module-name"
  },
  "scripts": {
    "test": "vows --spec --isolate",
    "start": "node index.js",
    "predeploy": "echo About to deploy",
    "postdeploy": "echo Deployed",
    "prepublish": "coffee --bare --compile --output lib/foo src/foo/*.coffee"
  },
  "main": "lib/foo.js",
  "repository": {
    "type": "git",
    "url": "https://github.com/username/repo"
  },
  "bugs": {
    "url": "https://github.com/username/issues"
  },
  "keywords": [
    "example"
  ],
  "dependencies": {
    "express": "4.2.x"
  },
  "devDependencies": {
    "assume": "<1.0.0 || >=2.3.1 <2.4.5 || >=2.5.2 <3.0.0"
  },
  "peerDependencies": {
    "moment": ">2.0.0"
  },
  "preferGlobal": true,
  "private": true,
  "publishConfig": {
    "registry": "https://your-private-hosted-npm.registry.domain.com"
  },
  "subdomain": "foobar",
  "analyze": true,
  "license": "MIT",
  "files": [
    "lib/foo.js"
  ]
}
```

Information about some important properties:

```
name
```

The unique name of your package and should be down in lowercase. This property is required and your package will not install without it.

1. The name must be less than or equal to 214 characters.
2. The name can't start with a dot or an underscore.
3. New packages must not have uppercase letters in the name.

```
version
```

The version of the package is specified by Semantic Versioning (semver). Which assumes that a version number is written as MAJOR.MINOR.PATCH and you increment the:

1. MAJOR version when you make incompatible API changes
2. MINOR version when you add functionality in a backwards-compatible manner
3. PATCH version when you make backwards-compatible bug fixes

```
description
```

The description of the project. Try to keep it short and concise.

```
author
```

The author of this package.

```
bin
```

An object which is used to expose binary scripts from your package. The object assumes that the key is the name of the binary script and the value a relative path to the script.

This property is used by packages that contain a CLI (command line interface).

```
script
```

A object which exposes additional npm commands. The object assumes that the key is the npm command and the value is the script path. These scripts can get executed when you run `npm run {command name}` or `npm run-script {command name}`.

Packages that contain a command line interface and are installed locally can be called without a relative path. So instead of calling `./node-modules/.bin/mocha` you can directly call `mocha`.

```
main
```

The main entry point to your package. When calling `require('{module name}')` in node, this will be

actual file that is required.

It's highly advised that requiring the main file does not generate any side affects. For instance, requiring the main file should not start up a HTTP server or connect to a database. Instead, you should create something like `exports.init = function () {...}` in your main script.

```
keywords
```

An array of keywords which describe your package. These will help people find your package.

```
devDependencies
```

These are the dependencies that are only intended for development and testing of your module. The dependencies will be installed automatically unless the `NODE_ENV=production` environment variable has been set. If this is the case you can still these packages using `npm install --dev`

```
peerDependencies
```

If you are using this module, then peerDependencies lists the modules you must install alongside this one. For example, `moment-timezone` must be installed alongside `moment` because it is a plugin for moment, even if it doesn't directly `require("moment")`.

```
preferGlobal
```

A property that indicates that this page prefers to be installed globally using `npm install -g {module-name}`. This property is used by packages that contain a CLI (command line interface).

In all other situations you should NOT use this property.

```
publishConfig
```

The publishConfig is an object with configuration values that will be used for publishing modules. The configuration values that are set override your default npm configuration.

The most common use of the `publishConfig` is to publish your package to a private npm registry so you still have the benefits of npm but for private packages. This is done by simply setting URL of your private npm as value for the registry key.

```
files
```

This is an array of all the files to include in the published package. Either a file path or folder path can be used. All the contents of a folder path will be included. This reduces the total size of your package by only including the correct files to be distributed. This field works in conjunction with a `.npmignore` rules file.

Source

Read package.json online: https://riptutorial.com/node-js/topic/1515/package-json

Chapter 79: Parsing command line arguments

Examples

Passing action (verb) and values

```
const options = require("commander");

options
  .option("-v, --verbose", "Be verbose");

options
  .command("convert")
  .alias("c")
  .description("Converts input file to output file")
  .option("-i, --in-file <file_name>", "Input file")
  .option("-o, --out-file <file_name>", "Output file")
  .action(doConvert);

options.parse(process.argv);

if (!options.args.length) options.help();

function doConvert(options){
    //do something with options.inFile and options.outFile
};
```

Passing boolean switches

```
const options = require("commander");

options
  .option("-v, --verbose")
  .parse(process.argv);

if (options.verbose){
  console.log("Let's make some noise!");
}
```

Read Parsing command line arguments online: https://riptutorial.com/node-js/topic/6174/parsing-command-line-arguments

Chapter 80: Passport integration

Remarks

Password must **always** be hashed. A simple way to secure passwords using **NodeJS** would be to use **bcrypt-nodejs** module.

Examples

Getting started

Passport must be initialized using `passport.initialize()` middleware. To use login sessions, `passport.session()` middleware is required.

Note that `passport.serialize()` and `passport.deserializeUser()` methods must be defined. **Passport** will serialize and deserialize user instances to and from the session

```
const express = require('express');
const session = require('express-session');
const passport = require('passport');
const cookieParser = require('cookie-parser');
const app = express();

// Required to read cookies
app.use(cookieParser());

passport.serializeUser(function(user, next) {
    // Serialize the user in the session
    next(null, user);
});

passport.deserializeUser(function(user, next) {
    // Use the previously serialized user
        next(null, user);
});

// Configuring express-session middleware
app.use(session({
    secret: 'The cake is a lie',
    resave: true,
    saveUninitialized: true
}));

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

// Starting express server on port 3000
app.listen(3000);
```

Local authentication

The **passport-local** module is used to implement a local authentication.

> This module lets you authenticate using a username and password in your Node.js applications.

Registering the user :

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

// A named strategy is used since two local strategy are used :
// one for the registration and the other to sign-in
passport.use('localSignup', new LocalStrategy({
    // Overriding defaults expected parameters,
    // which are 'username' and 'password'
    usernameField: 'email',
    passwordField: 'password',
    passReqToCallback: true // allows us to pass back the entire request to the callback    .
},
function(req, email, password, next) {
    // Check in database if user is already registered
    findUserByEmail(email, function(user) {
        // If email already exists, abort registration process and
        // pass 'false' to the callback
        if (user) return next(null, false);
        // Else, we create the user
        else {
            // Password must be hashed !
            let newUser = createUser(email, password);

            newUser.save(function() {
                // Pass the user to the callback
                return next(null, newUser);
            });
        }
    });
});
```

Logging in the user :

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

passport.use('localSignin', new LocalStrategy({
    usernameField : 'email',
    passwordField : 'password',
},
function(email, password, next) {
    // Find the user
    findUserByEmail(email, function(user) {
        // If user is not found, abort signing in process
        // Custom messages can be provided in the verify callback
        // to give the user more details concerning the failed authentication
        if (!user)
            return next(null, false, {message: 'This e-mail address is not associated with any
account.'});
        // Else, we check if password is valid
        else {
```

```
            // If password is not correct, abort signing in process
            if (!isPasswordValid(password)) return next(null, false);
            // Else, pass the user to callback
            else return next(null, user);
        }
    });
});
```

Creating routes :

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

// Sign-in route
// Passport strategies are middlewares
app.post('/login', passport.authenticate('localSignin', {
    successRedirect: '/me',
    failureRedirect: '/login'
});

// Sign-up route
app.post('/register', passport.authenticate('localSignup', {
    successRedirect: '/',
    failureRedirect: '/signup'
});

// Call req.logout() to log out
app.get('/logout', function(req, res) {
    req.logout();
    res.redirect('/');
});

app.listen(3000);
```

Facebook authentication

The **passport-facebook** module is used to implement a **Facebook** authentication. In this example, if the user does not exist on sign-in, he is created.

Implementing strategy :

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

// Strategy is named 'facebook' by default
passport.use({
    clientID: 'yourclientid',
    clientSecret: 'yourclientsecret',
    callbackURL: '/auth/facebook/callback'
},
// Facebook will send a token and user's profile
function(token, refreshToken, profile, next) {
    // Check in database if user is already registered
    findUserByFacebookId(profile.id, function(user) {
        // If user exists, returns his data to callback
        if (user) return next(null, user);
```

```
        // Else, we create the user
        else {
            let newUser = createUserFromFacebook(profile, token);

            newUser.save(function() {
                // Pass the user to the callback
                return next(null, newUser);
            });
        }
    });
});
```

Creating routes :

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

// Authentication route
app.get('/auth/facebook', passport.authenticate('facebook', {
    // Ask Facebook for more permissions
    scope : 'email'
}));

// Called after Facebook has authenticated the user
app.get('/auth/facebook/callback',
    passport.authenticate('facebook', {
        successRedirect : '/me',
        failureRedirect : '/'
}));


//...

app.listen(3000);
```

Simple Username-Password Authentication

In your routes/index.js

Here `user` is the model for the userSchema

```
router.post('/login', function(req, res, next) {
    if (!req.body.username || !req.body.password) {
        return res.status(400).json({
            message: 'Please fill out all fields'
        });
    }

    passport.authenticate('local', function(err, user, info) {
        if (err) {
            console.log("ERROR : " + err);
            return next(err);
        }

        if(user) (
```

```
            console.log("User Exists!")
            //All the data of the user can be accessed by user.x
            res.json({"success" : true});
            return;
        } else {
            res.json({"success" : false});
            console.log("Error" + errorResponse());
            return;
        }
    })(req, res, next);
});
```

Google Passport authentication

We have simple module available in npm for goggle authetication name **passport-google-oauth20**

Consider the following example In this example have created a folder namely config having the passport.js and google.js file in the root directory. In your app.js include the following

```
var express = require('express');
var session = require('express-session');
var passport = require('./config/passport'); // path where the passport file placed
var app = express();
passport(app);
```

// other code to initailize the server , error handle

In the passport.js file in the config folder include the following code

```
var passport = require  ('passport'),
google = require('./google'),
User = require('./../model/user'); // User is the  mongoose model

module.exports = function(app){
  app.use(passport.initialize());
  app.use(passport.session());
  passport.serializeUser(function(user, done){
      done(null, user);
  });
  passport.deserializeUser(function (user, done) {
     done(null, user);
  });
  google();
};
```

In the google.js file in the same config folder include following

```
var passport = require('passport'),
GoogleStrategy = require('passport-google-oauth20').Strategy,
User = require('./../model/user');
module.exports = function () {
passport.use(new GoogleStrategy({
        clientID: 'CLIENT ID',
        clientSecret: 'CLIENT SECRET',
```

```
        callbackURL: "http://localhost:3000/auth/google/callback"
    },
    function(accessToken, refreshToken, profile, cb) {
        User.findOne({ googleId : profile.id }, function (err, user) {
            if(err){
                return cb(err, false, {message : err});
            }else {
                if (user != '' && user != null) {
                    return cb(null, user, {message : "User "});
                } else {
                    var username  = profile.displayName.split(' ');
                    var userData = new User({
                        name : profile.displayName,
                        username : username[0],
                        password : username[0],
                        facebookId : '',
                        googleId : profile.id,
                    });
                    // send email to user just in case required to send the newly created
                    // credentails to user for future login without using google login
                    userData.save(function (err, newuser) {
                        if (err) {
                            return cb(null, false, {message : err + " !!! Please try again"});
                        }else{
                            return cb(null, newuser);
                        }
                    });
                }
            }
        });
      }
  ));
};
```

Here in this example, if user is not in DB then creating a new user in DB for local reference using the field name googleId in user model.

Read Passport integration online: https://riptutorial.com/node-js/topic/7666/passport-integration

Chapter 81: passport.js

Introduction

Passport is a popular authorisation module for node. In simple words it handles all the authorisation requests on your app by users. Passport supports over 300 strategies so that you can easily integrate login with Facebook / Google or any other social network using it. The strategy that we will discuss here is the Local where you authenticate an user using your own database of registered users(using username and password).

Examples

Example of LocalStrategy in passport.js

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

passport.serializeUser(function(user, done) { //In serialize user you decide what to store in
the session. Here I'm storing the user id only.
  done(null, user.id);
});

passport.deserializeUser(function(id, done) { //Here you retrieve all the info of the user
from the session storage using the user id stored in the session earlier using serialize user.
  db.findById(id, function(err, user) {
    done(err, user);
    });
});

passport.use(new LocalStrategy(function(username, password, done) {
    db.findOne({'username':username},function(err,student){
        if(err)return done(err,{message:message});//wrong roll_number or password;
        var pass_retrieved = student.pass_word;
        bcrypt.compare(password, pass_retrieved, function(err3, correct) {
          if(err3){
            message = [{"msg": "Incorrect Password!"}];
            return done(null,false,{message:message});  // wrong password
          }
          if(correct){
              return done(null,student);
          }
        });
    });
}));

app.use(session({ secret: 'super secret' })); //to make passport remember the user on other
pages too.(Read about session store. I used express-sessions.)
app.use(passport.initialize());
app.use(passport.session());

app.post('/',passport.authenticate('local',{successRedirect:'/users' failureRedirect: '/'}),
    function(req,res,next){
});
```

Read passport.js online: https://riptutorial.com/node-js/topic/8812/passport-js

Chapter 82: Performance challenges

Examples

Processing long running queries with Node

Since Node is single-threaded, there is a need of workaround if it comes to a long-running calculations.

Note: this is "ready to run" example. Just, don't forget to get jQuery and install the required modules.

Main logic of this example:

1. Client sends request to the server.
2. Server starts the routine in separate node instance and sends immediate response back with related task ID.
3. Client continiously sends checks to a server for status updates of the given task ID.

Project structure:

```
project
|   package.json
|   index.html
|
├──js
|      main.js
|      jquery-1.12.0.min.js
|
└──srv
    |    app.js
    ├── models
    |     task.js
    └── tasks
          data-processor.js
```

app.js:

```
var express     = require('express');
var app         = express();
var http        = require('http').Server(app);
var mongoose    = require('mongoose');
var bodyParser  = require('body-parser');

var childProcess= require('child_process');

var Task        = require('./models/task');

app.use(bodyParser.urlencoded({ extended: true }));
app.use(bodyParser.json());

app.use(express.static(__dirname + '/../'));
```

```
app.get('/', function(request, response){
    response.render('index.html');
});

//route for the request itself
app.post('/long-running-request', function(request, response){
    //create new task item for status tracking
    var t = new Task({ status: 'Starting ...' });

    t.save(function(err, task){
        //create new instance of node for running separate task in another thread
        taskProcessor = childProcess.fork('./srv/tasks/data-processor.js');

        //process the messages comming from the task processor
        taskProcessor.on('message', function(msg){
            task.status = msg.status;
            task.save();
        }.bind(this));

        //remove previously openned node instance when we finished
        taskProcessor.on('close', function(msg){
            this.kill();
        });

        //send some params to our separate task
        var params = {
            message: 'Hello from main thread'
        };

        taskProcessor.send(params);
        response.status(200).json(task);
    });
});

//route to check is the request is finished the calculations
app.post('/is-ready', function(request, response){
    Task
        .findById(request.body.id)
        .exec(function(err, task){
            response.status(200).json(task);
        });
});

mongoose.connect('mongodb://localhost/test');
http.listen('1234');
```

task.js:

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

var taskSchema = mongoose.Schema({
    status: {
        type: String
    }
});

mongoose.model('Task', taskSchema);

module.exports  = mongoose.model('Task');
```

data-processor.js:

```
process.on('message', function(msg){
    init = function(){
        processData(msg.message);
    }.bind(this)();

    function processData(message){
        //send status update to the main app
        process.send({ status: 'We have started processing your data.' });

        //long calculations ..
        setTimeout(function(){
            process.send({ status: 'Done!' });

            //notify node, that we are done with this task
            process.disconnect();
        }, 5000);
    }
});

process.on('uncaughtException',function(err){
    console.log("Error happened: " + err.message + "\n" + err.stack + ".\n");
    console.log("Gracefully finish the routine.");
});
```

index.html:

```
<!DOCTYPE html>
<html>
    <head>
        <script src="./js/jquery-1.12.0.min.js"></script>
        <script src="./js/main.js"></script>
    </head>
    <body>
        <p>Example of processing long-running node requests.</p>
        <button id="go" type="button">Run</button>

        <br />

        <p>Log:</p>
        <textarea id="log" rows="20" cols="50"></textarea>
    </body>
</html>
```

main.js:

```
$(document).on('ready', function(){

    $('#go').on('click', function(e){
        //clear log
        $("#log").val('');

        $.post("/long-running-request", {some_params: 'params' })
            .done(function(task){
                $("#log").val( $("#log").val() + '\n' + task.status);

                //function for tracking the status of the task
```

```
                function updateStatus(){
                    $.post("/is-ready", {id: task._id })
                        .done(function(response){
                            $("#log").val( $("#log").val() + '\n' + response.status);

                            if(response.status != 'Done!'){
                                checkTaskTimeout = setTimeout(updateStatus, 500);
                            }
                        });
                }

                //start checking the task
                var checkTaskTimeout = setTimeout(updateStatus, 100);
            });
    });
});
```

package.json:

```
{
  "name": "nodeProcessor",
  "dependencies": {
    "body-parser": "^1.15.2",
    "express": "^4.14.0",
    "html": "0.0.10",
    "mongoose": "^4.5.5"
  }
}
```

Disclaimer: this example is intended to give you basic idea. To use it in production environment, it needs improvements.

Read Performance challenges online: https://riptutorial.com/node-js/topic/6325/performance-challenges

Chapter 83: PostgreSQL integration

Examples

Connect To PostgreSQL

Using `PostgreSQL`npm module.

install dependency from npm

```
npm  install pg --save
```

Now you have to create a PostgreSQL connection, which you can later query.

Assume you Database_Name = students, Host = localhost and DB_User= postgres

```
var pg = require("pg")
var connectionString = "pg://postgres:postgres@localhost:5432/students";
var client = new pg.Client(connectionString);
client.connect();
```

Query with Connection Object

If you want to use connection object for query database you can use this sample code.

```
var queryString = "SELECT name, age FROM students " ;
var query = client.query(queryString);

query.on("row", (row, result)=> {
result.addRow(row);
});

query.on("end", function (result) {
//LOGIC
});
```

Read PostgreSQL integration online: https://riptutorial.com/node-js/topic/7706/postgresql-integration

Chapter 84: Project Structure

Introduction

The structure of nodejs project is influenced by the personal preferences, project's architecture and module injection strategy being used.Also on event based arc' which uses dynamic module instantiation mechanism. To have a MVC structure it is imperative to separate out the server side and client side source code as the client side code will probably be minimized and sent to browser and is public in its basic nature. And the server side or back-end will provide API to perform CRUD operations

Remarks

The project above uses browserify and vue.js modules as application base view and minification libs. So the project structure may changes minutely based on which mvc framework you use e.g. The build directory in public will need to contain all the mvc code. You can have a task which does this for you .

Examples

A simple nodejs application with MVC and API

- The first major distinction is between the dynamically generated directories which will be used for hosting and source directories.
- The source directories will have a config file or folder depending on the amount of configuration you may have . This includes the environment configuration and business logic configuration which you may choose to put inside config directory.

```
|-- Config
       |-- config.json
       |-- appConfig
           |-- pets.config
           |-- payment.config
```

- Now the most vital directories where we distinguish between the server side/backend and the frontend modules . The 2 directories *server* and *webapp* represent the backend and frontend respectively which we can choose to put inside a source directory viz. *src*.

  > You can go with different names as per personal choice for server or webapp depending on what makes sense for you. Make sure you dont want to make it too long or to complex as it is in the end internal project structure.

- Inside the *server* directory you can have the controller ,the App.js/index.js which will be you main nodejs file and start point .The server dir. can also have the *dto* dir which holds all the data transfer objects which will be usd by API controllers.

```
|-- server
     |-- dto
         |-- pet.js
         |-- payment.js
     |-- controller
         |-- PetsController.js
         |-- PaymentController.js
     |-- App.js
```

- The webapp directory can be divided into two major parts *public* and *mvc* , this is again influenced by what build strategy you want to use. We are using browserfiy the build the MVC part of webapp and minimize the contents from *mvc* directory simply put.

  |-- webapp |-- public |-- mvc

- Now the public directory can contain all the static resources,images,css(you can have saas files as well) and most importantly the HTML files .

```
|-- public
    |-- build  // will contianed minified scripts(mvc)
    |-- images
        |-- mouse.jpg
        |-- cat.jpg
    |-- styles
        |-- style.css
    |-- views
        |-- petStore.html
        |-- paymentGateway.html
        |-- header.html
        |-- footer.html
    |-- index.html
```

- The *mvc* directory will contain the front-end logic including the *models*,the *view controllers* and any other *utils* modules you may need as part of UI. Also the index.js or shell.js whichever may suite you is part of this directory as well.

```
|-- mvc
    |-- controllers
        |-- Dashborad.js
        |-- Help.js
        |-- Login.js
    |-- utils
    |-- index.js
```

So in conclusion the entire project structure will look like below.And a simple build task like *gulp browserify* will minify the mvc scripts and publish in *public* directory. We can then provide this public directory as static resource via ***express.use(satic('public'))*** api.

```
    |-- node_modules
    |-- src
        |-- server
            |-- controller
            |-- App.js   // node app
        |-- webapp
```

```
            |-- public
                |-- styles
                |-- images
                |-- index.html
            |-- mvc
                |-- controller
                |-- shell.js  // mvc shell
    |-- config
    |-- Readme.md
    |-- .gitignore
    |-- package.json
```

Read Project Structure online: https://riptutorial.com/node-js/topic/9935/project-structure

Chapter 85: Push notifications

Introduction

So if you wanna make web app notification I suggest you to use Push.js or SoneSignal framework for Web/mobile app.

Push is the fastest way to get up and running with Javascript notifications. A fairly new addition to the official specification, the Notification API allows modern browsers such as Chrome, Safari, Firefox, and IE 9+ to push notifications to a user's desktop.

You will have to use Socket.io and some backend framework, I will user Express for this example.

Parameters

module/framework	description
node.js/express	Simple backe-end framework for Node.js application, very easy to use and extremely powerful
Socket.io	Socket.IO enables real-time bidirectional event-based communication. It works on every platform, browser or device, focusing equally on reliability and speed.
Push.js	The world's most versatile desktop notifications framework
OneSignal	Just another form off push notifications for Apple devices
Firebase	Firebase is Google's mobile platform that helps you quickly develop high-quality apps and grow your business.

Examples

Web notification

First, you will need to install Push.js module.

```
$ npm install push.js --save
```

Or import it to your front-end app through CDN

```
<script src="./push.min.js"></script> <!-- CDN link -->
```

After you are done with that, you should be good to go. This is how it should look like if u wanna

make simple notification:

```
Push.create('Hello World!')
```

I will assume that you know how to setup Socket.io with your app. Here is some code example of my backend app with express:

```
var app = require('express')();
var server = require('http').Server(app);
var io = require('socket.io')(server);

server.listen(80);

app.get('/', function (req, res) {
  res.sendfile(__dirname + '/index.html');
});

io.on('connection', function (socket) {

  socket.emit('pushNotification', { success: true, msg: 'hello' });

});
```

After your server is all set up, you should be able to move on to front-end stuff. Now all we have to do is import Socket.io CDN and add this code to my *index.html* file:

```
<script src="../socket.io.js"></script> <!-- CDN link -->
<script>
  var socket = io.connect('http://localhost');
  socket.on('pushNotification', function (data) {
    console.log(data);
    Push.create("Hello world!", {
        body: data.msg, //this should print "hello"
        icon: '/icon.png',
        timeout: 4000,
        onClick: function () {
            window.focus();
            this.close();
        }
    });
  });
</script>
```

There you go, now you should be able to display your notification, this also works on any Android device, and if u wanna use Firebase cloud messaging, you can use it with this module, Here is link for that example written by Nick (creator of Push.js)

Apple

Keep in mind that this will not work on Apple devices (I didnt test them all), but if you want to make push notifications check OneSignal plugin.

Read Push notifications online: https://riptutorial.com/node-js/topic/10892/push-notifications

Chapter 86: Readline

Syntax

- const readline = require('readline')
- readline.close()
- readline.pause()
- readline.prompt([preserveCursor])
- readline.question(query, callback)
- readline.resume()
- readline.setPrompt(prompt)
- readline.write(data[, key])
- readline.clearLine(stream, dir)
- readline.clearScreenDown(stream)
- readline.createInterface(options)
- readline.cursorTo(stream, x, y)
- readline.emitKeypressEvents(stream[, interface])
- readline.moveCursor(stream, dx, dy)

Examples

Line-by-line file reading

```
const fs = require('fs');
const readline = require('readline');

const rl = readline.createInterface({
    input: fs.createReadStream('text.txt')
});

// Each new line emits an event - every time the stream receives \r, \n, or \r\n
rl.on('line', (line) => {
    console.log(line);
});

rl.on('close', () => {
    console.log('Done reading file');
});
```

Prompting user input via CLI

```
const readline = require('readline');

const rl = readline.createInterface({
    input: process.stdin,
    output: process.stdout
});

rl.question('What is your name?', (name) => {
```

```
    console.log(`Hello ${name}!`);

    rl.close();
});
```

Read Readline online: https://riptutorial.com/node-js/topic/1431/readline

Chapter 87: Remote Debugging in Node.JS

Examples

NodeJS run configuration

To set up Node remote debugging, simply run the node process with the `--debug` flag. You can add a port on which the debugger should run using `--debug=<port>`.

When your node process starts up you should see the message

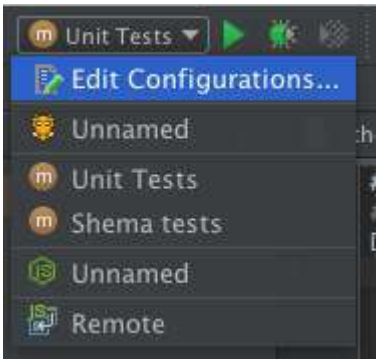
```
Debugger listening on port <port>
```

Which will tell you that everything is good to go.

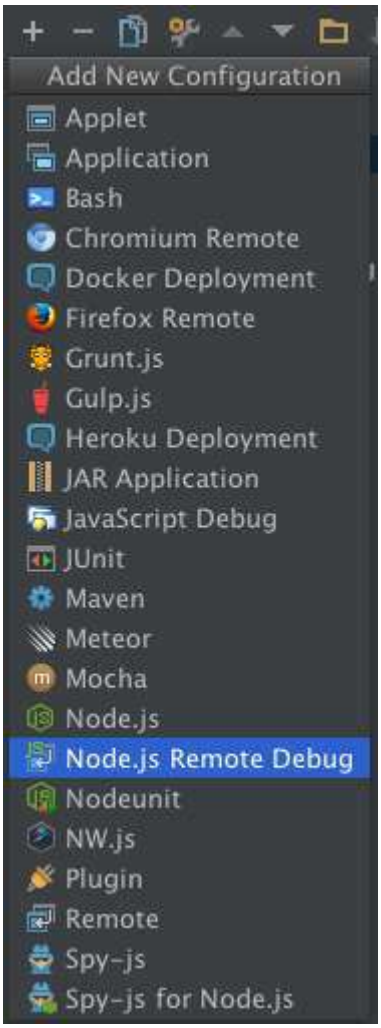
Then you set up the remote debugging target in your specific IDE.

IntelliJ/Webstorm Configuration

1. Make sure that the NodeJS plugin is enabled
2. Select your run configurations (screen)



3. Select **+** > **Node.js Remote Debug**



4. Make sure you enter the port selected above as well as the correct host

Once those are configured simply run the debug target as you normally would and it will stop on your breakpoints.

Use the proxy for debugging via port on Linux

If you start your application on Linux, use the proxy for debugging via port, for example:

```
socat TCP-LISTEN:9958,fork TCP:127.0.0.1:5858 &
```

Use port 9958 for remote debugging then.

Read Remote Debugging in Node.JS online: https://riptutorial.com/node-js/topic/6335/remote-debugging-in-node-js

Chapter 88: Require()

Introduction

This documentation focuses on explaining the uses and of the `require()` statement that NodeJS includes in their language.

Require is an import of certain files or packages used with NodeJS's modules. It is used to improve code structure and uses. `require()` is used on files that are installed locally, with a direct route from the file that is `require`'ing.

Syntax

- module.exports = {testFunction: testFunction};
- var test_file = require('./testFile.js'); //Let us have a file named `testFile`
- test_file.testFunction(our_data); //Let `testFile` have function `testFunction`

Remarks

Using `require()` allows code to be structured in a way similar to Java's use of classes and public methods. If a function is `.export`'ed, it can be `require`'ed in another file to be used. If a file is not `.export`'ed, it cannot be used in another file.

Examples

Beginning require() use with a function and file

Require is a statement that Node interprets as, in some sense, a `getter` function. For example, say you have a file named `analysis.js`, and the inside of your file looks like this,

```
function analyzeWeather(weather_data) {
  console.log('Weather information for ' + weather_data.time + ': ');
  console.log('Rainfall: ' + weather_data.precip);
  console.log('Temperature: ' + weather_data.temp);
  //More weather_data analysis/printing...
}
```

This file contains only the method, `analyzeWeather(weather_data)`. If we want to use this function, it must be either used inside of this file, or copied to the file it wants to be used by. However, Node has included a very useful tool to help with code and file organization, which is modules.

In order to utilize our function, we must first `export` the function through a statement at the beginning. Our new file looks like this,

```
module.exports = {
```

```
  analyzeWeather: analyzeWeather
}
function analyzeWeather(weather_data) {
  console.log('Weather information for ' + weather_data.time + ': ');
  console.log('Rainfall: ' + weather_data.precip);
  console.log('Temperature: ' + weather_data.temp);
  //More weather_data analysis/printing...
}
```

With this small `module.exports` statement, our function is now ready for use outside of the file. All that is left to do is to use `require()`.

When `require`'ing a function or file, the syntax is very similar. It is usually done at the beginning of the file and set to `var`'s or `const`'s for use throughout the file. For example, we have another file (on the same level as `analyze.js` named `handleWeather.js` that looks like this,

```
const analysis = require('./analysis.js');

weather_data = {
  time: '01/01/2001',
  precip: 0.75,
  temp: 78,
  //More weather data...
};
analysis.analyzeWeather(weather_data);
```

In this file, we are using `require()` to grab our `analysis.js` file. When used, we just call the variable or constant assigned to this `require` and use whatever function inside that is exported.

Beginning require() use with an NPM package

Node's `require` is also very helpful when used in tandem with an NPM package. Say, for example, you would like to use the NPM package `require` in a file named `getWeather.js`. After NPM installing your package through your command line (`git install request`), you are ready to use it. Your `getWeather.js` file might like look this,

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

//Construct your url variable...
https.get(url, function(error, response, body) {
  if (error) {
    console.log(error);
  } else {
    console.log('Response => ' + response);
    console.log('Body => ' + body);
  }
});
```

When this file is run, it first `require`'s (imports) the package you just installed called `request`. Inside of the `request` file, there are many functions you now have access to, one of which is called `get`. In the next couple lines, the function is used in order to make an HTTP GET request.

Read Require() online: https://riptutorial.com/node-js/topic/10742/require--

Chapter 89: Restful API Design: Best Practices

Examples

Error Handling: GET all resources

How do you handle errors, rather then log them to the console?

Bad way:

```
Router.route('/')
  .get((req, res) => {
    Request.find((err, r) => {
      if(err){
        console.log(err)
      } else {
        res.json(r)
      }
    })
  })
  .post((req, res) => {
    const request = new Request({
      type: req.body.type,
      info: req.body.info
    });
    request.info.user = req.user._id;
    console.log("ABOUT TO SAVE REQUEST", request);
    request.save((err, r) => {
      if (err) {
        res.json({ message: 'there was an error saving your r' });
      } else {
        res.json(r);
      }
    });
  });
```

Better way:

```
Router.route('/')
 .get((req, res) => {
  Request.find((err, r) => {
   if(err){
    console.log(err)
  } else {
    return next(err)
  }
})
})
.post((req, res) => {
const request = new Request({
  type: req.body.type,
  info: req.body.info
```

```
});
request.info.user = req.user._id;
console.log("ABOUT TO SAVE REQUEST", request);
request.save((err, r) => {
  if (err) {
    return next(err)
  } else {
    res.json(r);
  }
});
});
```

Read Restful API Design: Best Practices online: https://riptutorial.com/node-js/topic/6490/restful-api-design--best-practices

Chapter 90: Route-Controller-Service structure for ExpressJS

Examples

Model-Routes-Controllers-Services Directory Structure

```
├──models
|   ├──user.model.js
├──routes
|   ├──user.route.js
├──services
|   ├──user.service.js
├──controllers
|   ├──user.controller.js
```

For modular code structure the logic should be divided into these directories and files.

Models - The schema definition of the Model

Routes - The API routes maps to the Controllers

Controllers - The controllers handles all the logic behind validating request parameters, query, Sending Responses with correct codes.

Services - The services contains the database queries and returning objects or throwing errors

This coder will end up writing more codes. But at the end the codes will be much more maintainable and seperated.

Model-Routes-Controllers-Services Code Structure

user.model.js

```
var mongoose = require('mongoose')

const UserSchema  = new mongoose.Schema({
    name: String
})

const User = mongoose.model('User', UserSchema)

module.exports = User;
```

user.routes.js

```
var express = require('express');
var router = express.Router();

var UserController = require('../controllers/user.controller')

router.get('/', UserController.getUsers)

module.exports = router;
```

user.controllers.js

```
var UserService = require('../services/user.service')

exports.getUsers = async function (req, res, next) {
    // Validate request parameters, queries using express-validator

    var page = req.params.page ? req.params.page : 1;
    var limit = req.params.limit ? req.params.limit : 10;
    try {
        var users = await UserService.getUsers({}, page, limit)
        return res.status(200).json({ status: 200, data: users, message: "Succesfully Users
Retrieved" });
    } catch (e) {
        return res.status(400).json({ status: 400, message: e.message });
    }
}
```

user.services.js

```
var User = require('../models/user.model')

exports.getUsers = async function (query, page, limit) {

    try {
        var users = await User.find(query)
        return users;
    } catch (e) {
        // Log Errors
        throw Error('Error while Paginating Users')
    }
}
```

Read Route-Controller-Service structure for ExpressJS online: https://riptutorial.com/node-js/topic/10785/route-controller-service-structure-for-expressjs

Chapter 91: Routing ajax requests with Express.JS

Examples

A simple implementation of AJAX

You should have the basic express-generator template

In app.js, add(you can add it anywhere after `var app = express.app()`):

```
app.post(function(req, res, next){
    next();
});
```

Now in your index.js file (or its respective match), add:

```
router.get('/ajax', function(req, res){
    res.render('ajax', {title: 'An Ajax Example', quote: "AJAX is great!"});
});
router.post('/ajax', function(req, res){
    res.render('ajax', {title: 'An Ajax Example', quote: req.body.quote});
});
```

Create an `ajax.jade` / `ajax.pug` or `ajax.ejs` file in `/views` directory, add:

For Jade/PugJS:

```
extends layout
script(src="http://code.jquery.com/jquery-3.1.0.min.js")
script(src="/magic.js")
h1 Quote: !{quote}
form(method="post" id="changeQuote")
    input(type='text', placeholder='Set quote of the day', name='quote')
    input(type="submit", value="Save")
```

For EJS:

```
<script src="http://code.jquery.com/jquery-3.1.0.min.js"></script>
<script src="/magic.js"></script>
<h1>Quote: <%=quote%> </h1>
<form method="post" id="changeQuote">
    <input type="text" placeholder="Set quote of the day" name="quote"/>
    <input type="submit" value="Save">
</form>
```

Now, create a file in `/public` called `magic.js`

```
$(document).ready(function(){
```

```
    $("form#changeQuote").on('submit', function(e){
        e.preventDefault();
        var data = $('input[name=quote]').val();
        $.ajax({
            type: 'post',
            url: '/ajax',
            data: data,
            dataType: 'text'
        })
        .done(function(data){
            $('h1').html(data.quote);
        });
    });
});
```

And there you have it! When you click Save the quote will change!

Read Routing ajax requests with Express.JS online: https://riptutorial.com/node-js/topic/6738/routing-ajax-requests-with-express-js

Chapter 92: Running node.js as a service

Introduction

Unlike many web servers, Node isn't installed as a service out of the box. But in production, it's better to have it run as a dæmon, managed by an init system.

Examples

Node.js as a systemd dæmon

systemd is the *de facto* init system in most Linux distributions. After Node has been configured to run with systemd, it's possible to use the `service` command to manage it.

First of all, it needs a config file, let's create it. For Debian based distros, it will be in `/etc/systemd/system/node.service`

```
[Unit]
Description=My super nodejs app

[Service]
# set the working directory to have consistent relative paths
WorkingDirectory=/var/www/app

# start the server file (file is relative to WorkingDirectory here)
ExecStart=/usr/bin/node serverCluster.js

# if process crashes, always try to restart
Restart=always

# let 500ms between the crash and the restart
RestartSec=500ms

# send log tot syslog here (it doesn't compete with other log config in the app itself)
StandardOutput=syslog
StandardError=syslog

# nodejs process name in syslog
SyslogIdentifier=nodejs

# user and group starting the app
User=www-data
Group=www-data

# set the environement (dev, prod…)
Environment=NODE_ENV=production


[Install]
# start node at multi user system level (= sysVinit runlevel 3)
WantedBy=multi-user.target
```

It's now possible to respectively start, stop and restart the app with:

```
service node start
service node stop
service node restart
```

To tell systemd to automatically start node on boot, just type: `systemctl enable node`.

That's all, node now runs as a dæmon.

Read Running node.js as a service online: https://riptutorial.com/node-js/topic/9258/running-node-js-as-a-service

Chapter 93: Securing Node.js applications

Examples

Preventing Cross Site Request Forgery (CSRF)

CSRF is an attack which forces end user to execute unwanted actions on a web application in which he/she is currently authenticated.

It can happen because cookies are sent with every request to a website - even when those requests come from a different site.

We can use `csurf` module for creating csrf token and validating it.

Example

```
var express = require('express')
var cookieParser = require('cookie-parser')    //for cookie parsing
var csrf = require('csurf')    //csrf module
var bodyParser = require('body-parser')    //for body parsing

// setup route middlewares
var csrfProtection = csrf({ cookie: true })
var parseForm = bodyParser.urlencoded({ extended: false })

// create express app
var app = express()

// parse cookies
app.use(cookieParser())

app.get('/form', csrfProtection, function(req, res) {
  // generate and pass the csrfToken to the view
  res.render('send', { csrfToken: req.csrfToken() })
})

app.post('/process', parseForm, csrfProtection, function(req, res) {
  res.send('data is being processed')
})
```

So, when we access `GET /form`, it will pass the csrf token `csrfToken` to the view.

Now, inside the view, set the csrfToken value as the value of a hidden input field named `_csrf`.

e.g. for `handlebar` templates

```
<form action="/process" method="POST">
    <input type="hidden" name="_csrf" value="{{csrfToken}}">
    Name: <input type="text" name="name">
    <button type="submit">Submit</button>
</form>
```

e.g. for `jade` templates

```
form(action="/process" method="post")
    input(type="hidden", name="_csrf", value=csrfToken)

    span Name:
    input(type="text", name="name", required=true)
    br

    input(type="submit")
```

e.g. for `ejs` templates

```
<form action="/process" method="POST">
    <input type="hidden" name="_csrf" value="<%= csrfToken %>">
    Name: <input type="text" name="name">
    <button type="submit">Submit</button>
</form>
```

SSL/TLS in Node.js

If you choose to handle SSL/TLS in your Node.js application, consider that you are also responsible for maintaining SSL/TLS attack prevention at this point. In many server-client architectures, SSL/TLS terminates on a reverse proxy, both to reduce application complexity and reduce the scope of security configuration.

If your Node.js application should handle SSL/TLS, it can be secured by loading the key and cert files.

If your certificate provider requires a certificate authority (CA) chain, it can be added in the `ca` option as an array. A chain with multiple entries in a single file must be split into multiple files and entered in the same order into the array as Node.js does not currently support multiple ca entries in one file. An example is provided in the code below for files `1_ca.crt` and `2_ca.crt`. If the `ca` array is required and not set properly, client browsers may display messages that they could not verify the authenticity of the certificate.

Example

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

const options = {
  key: fs.readFileSync('privatekey.pem'),
  cert: fs.readFileSync('certificate.pem'),
  ca: [fs.readFileSync('1_ca.crt'), fs.readFileSync('2_ca.crt')]
};

https.createServer(options, (req, res) => {
  res.writeHead(200);
  res.end('hello world\n');
}).listen(8000);
```

Using HTTPS

The minimal setup for an HTTPS server in Node.js would be something like this :

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

const httpsOptions = {
    key: fs.readFileSync('path/to/server-key.pem'),
    cert: fs.readFileSync('path/to/server-crt.pem')
};

const app = function (req, res) {
  res.writeHead(200);
  res.end("hello world\n");
}

https.createServer(httpsOptions, app).listen(4433);
```

If you also want to support http requests, you need to make just this small modification:

```
const http = require('http');
const https = require('https');
const fs = require('fs');

const httpsOptions = {
    key: fs.readFileSync('path/to/server-key.pem'),
    cert: fs.readFileSync('path/to/server-crt.pem')
};

const app = function (req, res) {
  res.writeHead(200);
  res.end("hello world\n");
}

http.createServer(app).listen(8888);
https.createServer(httpsOptions, app).listen(4433);
```

Setting up an HTTPS server

Once you have node.js installed on your system, just follow the procedure below to get a basic web server running with support for both HTTP and HTTPS!

Step 1 : Build a Certificate Authority

1. create the folder where you want to store your key & certificate :

   ```
   mkdir conf
   ```

---

2. go to that directory :

   ```
   cd conf
   ```

---

3. grab this `ca.cnf` file to use as a configuration shortcut :

```
wget https://raw.githubusercontent.com/anders94/https-authorized-clients/master/keys/ca.cnf
```

---

4. create a new certificate authority using this configuration :

```
openssl req -new -x509 -days 9999 -config ca.cnf -keyout ca-key.pem -out ca-cert.pem
```

---

5. now that we have our certificate authority in `ca-key.pem` and `ca-cert.pem`, let's generate a private key for the server :

```
openssl genrsa -out key.pem 4096
```

---

6. grab this `server.cnf` file to use as a configuration shortcut :

```
wget https://raw.githubusercontent.com/anders94/https-authorized-
clients/master/keys/server.cnf
```

---

7. generate the certificate signing request using this configuration :

```
openssl req -new -config server.cnf -key key.pem -out csr.pem
```

---

8. sign the request :

```
openssl x509 -req -extfile server.cnf -days 999 -passin "pass:password" -in csr.pem -CA ca-
cert.pem -CAkey ca-key.pem -CAcreateserial -out cert.pem
```

Step 2 : Install your certificate as a root certificate

1. copy your certificate to your root certificates' folder :

```
sudo cp ca-crt.pem /usr/local/share/ca-certificates/ca-crt.pem
```

---

2. update CA store :

```
sudo update-ca-certificates
```

Secure express.js 3 Application

The configuration to make a secure connection using express.js (Since version 3):

```
var fs = require('fs');
var http = require('http');
var https = require('https');
var privateKey  = fs.readFileSync('sslcert/server.key', 'utf8');
var certificate = fs.readFileSync('sslcert/server.crt', 'utf8');

// Define your key and cert
```

```
var credentials = {key: privateKey, cert: certificate};
var express = require('express');
var app = express();

// your express configuration here

var httpServer = http.createServer(app);
var httpsServer = https.createServer(credentials, app);

// Using port 8080 for http and 8443 for https

httpServer.listen(8080);
httpsServer.listen(8443);
```

In that way you provide express middleware to the native http/https server

If you want your app running on ports below 1024, you will need to use sudo command (not recommended) or use a reverse proxy (e.g. nginx, haproxy).

Read Securing Node.js applications online: https://riptutorial.com/node-js/topic/3473/securing-node-js-applications

Chapter 94: Send Web Notification

Examples

Send Web notification using GCM (Google Cloud Messaging System)

Such Example is knowing wide spreading among **PWAs** (Progressive Web Applications) and in this example we're going to send a simple Backend like notification using **NodeJS** and **ES6**

1. Install Node-GCM Module : `npm install node-gcm`
2. Install Socket.io : `npm install socket.io`
3. Create a GCM Enabled application using Google Console.
4. Grabe your GCM Application Id (we will need it later on)
5. Grabe your GCM Application Secret code.
6. Open Your favorite code editor and add the following code :

```
'use strict';

const express = require('express');
const app = express();
const gcm = require('node-gcm');
app.io = require('socket.io')();

// [*] Configuring our GCM Channel.
const sender = new gcm.Sender('Project Secret');
const regTokens = [];
let message = new gcm.Message({
    data: {
        key1: 'msg1'
    }
});

// [*] Configuring our static files.
app.use(express.static('public/'));

// [*] Configuring Routes.
app.get('/', (req, res) => {
    res.sendFile(__dirname + '/public/index.html');
});

// [*] Configuring our Socket Connection.
app.io.on('connection', socket => {
    console.log('we have a new connection ...');
    socket.on('new_user', (reg_id) => {
        // [*] Adding our user notification registration token to our list typically
hided in a secret place.
        if (regTokens.indexOf(reg_id) === -1) {
            regTokens.push(reg_id);
```

```
            // [*] Sending our push messages
            sender.send(message, {
                registrationTokens: regTokens
            }, (err, response) => {
                if (err) console.error('err', err);
                else console.log(response);
            });
        }
    })
});

module.exports = app
```

PS : I'm using here a special hack in order to make Socket.io works with Express because simply it doesn't work outside of the box.

Now Create a **.json** file and name it : **Manifest.json**, open it and past the following :

```
{
    "name": "Application Name",
    "gcm_sender_id": "GCM Project ID"
}
```

Close it and save in your application **ROOT** directory.

PS : the Manifest.json file needs to be in root directory or it won't work.

In the code above I'm doing the following :

1. I seted up and sent a normal index.html page that will use socket.io also.
2. I'm listening on a **connection** event fired from the **front-end** aka my **index.html page** (it will be fired once a new client successfully connected to our pre-defined link)
3. I'm sending a special token know's as the **registration token** from my index.html via socket.io **new_user** event, such token will be our user unique passcode and each code is generated usually from a supporting browser for the **Web notification API** (read more here.
4. I'm simply using the **node-gcm** module to send my notification which will be handled and shown later on using **Service Workers**`.

This is from **NodeJS** point of view. in other examples I will show how we can send custom data, icons ..etc in our push message.

PS : you can find the full working demo over here.

Read Send Web Notification online: https://riptutorial.com/node-js/topic/6333/send-web-notification

Chapter 95: Sending a file stream to client

Examples

Using fs And pipe To Stream Static Files From The Server

A good VOD (Video On Demand) service should start with the basics. Lets say you have a directory on your server that is not publicly accessible, yet through some sort of portal or paywall you want to allow users to access your media.

```
var movie = path.resolve('./public/' + req.params.filename);

        fs.stat(movie, function (err, stats) {

            var range = req.headers.range;

            if (!range) {

                return res.sendStatus(416);

            }

            //Chunk logic here
            var positions = range.replace(/bytes=/, "").split("-");
            var start = parseInt(positions[0], 10);
            var total = stats.size;
            var end = positions[1] ? parseInt(positions[1], 10) : total - 1;
            var chunksize = (end - start) + 1;

            res.writeHead(206, {

                'Transfer-Encoding': 'chunked',

                "Content-Range": "bytes " + start + "-" + end + "/" + total,

                "Accept-Ranges": "bytes",

                "Content-Length": chunksize,

                "Content-Type": mime.lookup(req.params.filename)

            });

            var stream = fs.createReadStream(movie, { start: start, end: end, autoClose: true
})

                .on('end', function () {

                    console.log('Stream Done');

                })

                .on("error", function (err) {

                    res.end(err);
```

```
            })
            .pipe(res, { end: true });
    });
```

The above snippet is a basic outline for how you would like to stream your video to a client. The chunk logic depends on a variety of factors, including network traffic and latency. It is important to balance chuck size vs. quantity.

Finally, the .pipe call lets node.js know to keep a connection open with the server and to send additional chunks as needed.

Streaming Using fluent-ffmpeg

You can also use flent-ffmpeg to convert .mp4 files to .flv files, or other types:

res.contentType('flv');

```
    var pathToMovie = './public/' + req.params.filename;
    var proc = ffmpeg(pathToMovie)
        .preset('flashvideo')
        .on('end', function () {
            console.log('Stream Done');
        })
        .on('error', function (err) {
            console.log('an error happened: ' + err.message);
            res.send(err.message);
        })
        .pipe(res, { end: true });
```

Read Sending a file stream to client online: https://riptutorial.com/node-js/topic/6994/sending-a-file-stream-to-client

Chapter 96: Sequelize.js

Examples

Installation

Make sure that you first have Node.js and npm installed. Then install sequelize.js with npm

```
npm install --save sequelize
```

You will also need to install supported database Node.js modules. You only need to install the one you are using

For `MYSQL` and `Mariadb`

```
npm install --save mysql
```

For `PostgreSQL`

```
npm install --save pg pg-hstore
```

For `SQLite`

```
 npm install --save sqlite
```

For `MSSQL`

```
npm install --save tedious
```

Once you have you set up installed you can include and create a new Sequalize instance like so.

ES5 syntax

```
var Sequelize = require('sequelize');
var sequelize = new Sequelize('database', 'username', 'password');
```

ES6 stage-0 Babel syntax

```
import Sequelize from 'sequelize';
const sequelize = new Sequelize('database', 'username', 'password');
```

You now have an instance of sequelize available. You could if you so feel inclined call it a different name such as

```
var db = new Sequelize('database', 'username', 'password');
```

or

```
var database = new Sequelize('database', 'username', 'password');
```

that part is your prerogative. Once you have this installed you can use it inside of your application as per the API documentation http://docs.sequelizejs.com/en/v3/api/sequelize/

Your next step after install would be to set up your own model

Defining Models

There are two ways to define models in sequelize; with `sequelize.define(...)`, or `sequelize.import(...)`. Both functions return a sequelize model object.

1. sequelize.define(modelName, attributes, [options])

This is the way to go if you'd like to define all your models in one file, or if you want to have extra control of your model definition.

```
/* Initialize Sequelize */
const config = {
    username: "database username",
    password: "database password",
    database: "database name",
    host: "database's host URL",
    dialect: "mysql" // Other options are postgres, sqlite, mariadb and mssql.
}
var Sequelize = require("sequelize");
var sequelize = new Sequelize(config);

/* Define Models */
sequelize.define("MyModel", {
    name: Sequelize.STRING,
    comment: Sequelize.TEXT,
    date: {
        type: Sequelize.DATE,
        allowNull: false
    }
});
```

For the documentation and more examples, check out the doclets documentation, or sequelize.com's documentation.

---

2. sequelize.import(path)

If your model definitions are broken into a file for each, then `import` is your friend. In the file where

you initialize Sequelize, you need to call import like so:

```
/* Initialize Sequelize */
// Check previous code snippet for initialization

/* Define Models */
sequelize.import("./models/my_model.js"); // The path could be relative or absolute
```

Then in your model definition files, your code will look something like this:

```
module.exports = function(sequelize, DataTypes) {
    return sequelize.define("MyModel", {
        name: DataTypes.STRING,
        comment: DataTypes.TEXT,
        date: {
            type: DataTypes.DATE,
            allowNull: false
        }
    });
};
```

For more information on how to use `import`, check out sequelize's express example on GitHub.

Read Sequelize.js online: https://riptutorial.com/node-js/topic/7705/sequelize-js

Chapter 97: Simple REST based CRUD API

Examples

REST API for CRUD in Express 3+

```
var express = require("express"),
    bodyParser = require("body-parser"),
    server = express();

//body parser for parsing request body
server.use(bodyParser.json());
server.use(bodyParser.urlencoded({ extended: true }));

//temperary store for `item` in memory
var itemStore = [];

//GET all items
server.get('/item', function (req, res) {
    res.json(itemStore);
});

//GET the item with specified id
server.get('/item/:id', function (req, res) {
    res.json(itemStore[req.params.id]);
});

//POST new item
server.post('/item', function (req, res) {
    itemStore.push(req.body);
    res.json(req.body);
});

//PUT edited item in-place of item with specified id
server.put('/item/:id', function (req, res) {
    itemStore[req.params.id] = req.body
    res.json(req.body);
});

//DELETE item with specified id
server.delete('/item/:id', function (req, res) {
    itemStore.splice(req.params.id, 1)
    res.json(req.body);
});

//START SERVER
server.listen(3000, function () {
    console.log("Server running");
})
```

Read Simple REST based CRUD API online: https://riptutorial.com/node-js/topic/5850/simple-rest-based-crud-api

Chapter 98: Socket.io communication

Examples

"Hello world!" with socket messages.

Install node modules

```
npm install express
npm install socket.io
```

Node.js server

```
const express = require('express');
const app = express();
const server = app.listen(3000,console.log("Socket.io Hello World server started!"));
const io = require('socket.io')(server);

io.on('connection', (socket) => {
    //console.log("Client connected!");
    socket.on('message-from-client-to-server', (msg) => {
        console.log(msg);
    })
    socket.emit('message-from-server-to-client', 'Hello World!');
});
```

Browser client

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8">
    <title>Hello World with Socket.io</title>
  </head>
  <body>
    <script src="https://cdn.socket.io/socket.io-1.4.5.js"></script>
    <script>
      var socket = io("http://localhost:3000");
      socket.on("message-from-server-to-client", function(msg) {
          document.getElementById('message').innerHTML = msg;
      });
      socket.emit('message-from-client-to-server', 'Hello World!');
    </script>
    <p>Socket.io Hello World client started!</p>
    <p id="message"></p>
  </body>
</html>
```

Read Socket.io communication online: https://riptutorial.com/node-js/topic/4261/socket-io-communication

Chapter 99: Synchronous vs Asynchronous programming in nodejs

Examples

Using async

The async package provides functions for asynchronous code.

Using the auto function you can define asynchronous relations between two or more functions:

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

async.auto({
    get_data: function(callback) {
        console.log('in get_data');
        // async code to get some data
        callback(null, 'data', 'converted to array');
    },
    make_folder: function(callback) {
        console.log('in make_folder');
        // async code to create a directory to store a file in
        // this is run at the same time as getting the data
        callback(null, 'folder');
    },
    write_file: ['get_data', 'make_folder', function(results, callback) {
        console.log('in write_file', JSON.stringify(results));
        // once there is some data and the directory exists,
        // write the data to a file in the directory
        callback(null, 'filename');
    }],
    email_link: ['write_file', function(results, callback) {
        console.log('in email_link', JSON.stringify(results));
        // once the file is written let's email a link to it...
        // results.write_file contains the filename returned by write_file.
        callback(null, {'file':results.write_file, 'email':'user@example.com'});
    }]
}, function(err, results) {
    console.log('err = ', err);
    console.log('results = ', results);
});
```

This code could have been made synchronously, by just calling the `get_data`, `make_folder`, `write_file` and `email_link` in the correct order. Async keeps track of the results for you, and if an error occurred (first parameter of `callback` unequal to `null`) it stops the execution of the other functions.

Read Synchronous vs Asynchronous programming in nodejs online: https://riptutorial.com/node-js/topic/8287/synchronous-vs-asynchronous-programming-in-nodejs

Chapter 100: TCP Sockets

Examples

A simple TCP server

```
// Include Nodejs' net module.
const Net = require('net');
// The port on which the server is listening.
const port = 8080;

// Use net.createServer() in your code. This is just for illustration purpose.
// Create a new TCP server.
const server = new Net.Server();
// The server listens to a socket for a client to make a connection request.
// Think of a socket as an end point.
server.listen(port, function() {
    console.log(`Server listening for connection requests on socket localhost:${port}`.);
});

// When a client requests a connection with the server, the server creates a new
// socket dedicated to that client.
server.on('connection', function(socket) {
    console.log('A new connection has been established.');

    // Now that a TCP connection has been established, the server can send data to
    // the client by writing to its socket.
    socket.write('Hello, client.');

    // The server can also receive data from the client by reading from its socket.
    socket.on('data', function(chunk) {
        console.log(`Data received from client: ${chunk.toString()`.});
    });

    // When the client requests to end the TCP connection with the server, the server
    // ends the connection.
    socket.on('end', function() {
        console.log('Closing connection with the client');
    });

    // Don't forget to catch error, for your own sake.
    socket.on('error', function(err) {
        console.log(`Error: ${err}`);
    });
});
```

A simple TCP client

```
// Include Nodejs' net module.
const Net = require('net');
// The port number and hostname of the server.
const port = 8080;
const host = 'localhost';

// Create a new TCP client.
```

```
const client = new Net.Socket();
// Send a connection request to the server.
client.connect({ port: port, host: host }), function() {
    // If there is no error, the server has accepted the request and created a new
    // socket dedicated to us.
    console.log('TCP connection established with the server.');

    // The client can now send data to the server by writing to its socket.
    client.write('Hello, server.');
});

// The client can also receive data from the server by reading from its socket.
client.on('data', function(chunk) {
    console.log(`Data received from the server: ${chunk.toString()}.`);

    // Request an end to the connection after the data has been received.
    client.end();
});

client.on('end', function() {
    console.log('Requested an end to the TCP connection');
});
```

Read TCP Sockets online: https://riptutorial.com/node-js/topic/6545/tcp-sockets

Chapter 101: Template frameworks

Examples

Nunjucks

Server-side engine with block inheritance, autoescaping, macros, asynchronous control, and more. Heavily inspired by jinja2, very similar to Twig (php).

Docs - http://mozilla.github.io/nunjucks/
Install - `npm i nunjucks`

Basic usage with *Express* below.

app.js

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

var app = express();
app.use(express.static('/public'));

// Apply nunjucks and add custom filter and function (for example).
var env = nunjucks.configure(['views/'], { // set folders with templates
    autoescape: true,
    express: app
});
env.addFilter('myFilter', function(obj, arg1, arg2) {
    console.log('myFilter', obj, arg1, arg2);
    // Do smth with obj
    return obj;
});
env.addGlobal('myFunc', function(obj, arg1) {
    console.log('myFunc', obj, arg1);
    // Do smth with obj
    return obj;
});

app.get('/', function(req, res){
    res.render('index.html', {title: 'Main page'});
});

app.get('/foo', function(req, res){
    res.locals.smthVar = 'This is Sparta!';
    res.render('foo.html', {title: 'Foo page'});
});

app.listen(3000, function() {
    console.log('Example app listening on port 3000...');
});
```

/views/index.html

```
<html>
<head>
    <title>Nunjucks example</title>
</head>
<body>
{% block content %}
{{title}}
{% endblock %}
</body>
</html>
```

/views/foo.html

```
{% extends "index.html" %}

{# This is comment #}
{% block content %}
    <h1>{{title}}</h1>
    {# apply custom function and next build-in and custom filters #}
    {{ myFunc(smthVar) | lower | myFilter(5, 'abc') }}
{% endblock %}
```

Read Template frameworks online: https://riptutorial.com/node-js/topic/5885/template-frameworks

Chapter 102: Uninstalling Node.js

Examples

Completely uninstall Node.js on Mac OSX

In Terminal on your Mac operating system, enter the following 2 commands:

```
lsbom -f -l -s -pf /var/db/receipts/org.nodejs.pkg.bom | while read f; do  sudo rm
/usr/local/${f}; done

sudo rm -rf /usr/local/lib/node /usr/local/lib/node_modules /var/db/receipts/org.nodejs.*
```

Uninstall Node.js on Windows

To uninstall Node.js on Windows, use Add or Remove Programs like this:

1. Open `Add or Remove Programs` from the start menu.
2. Search for `Node.js`.

Windows 10:

3. Click Node.js.
4. Click Uninstall.
5. Click the new Uninstall button.

Windows 7-8.1:

3. Click the Uninstall button under Node.js.

Read Uninstalling Node.js online: https://riptutorial.com/node-js/topic/2821/uninstalling-node-js

Chapter 103: Unit testing frameworks

Examples

Mocha synchronous

```
describe('Suite Name', function() {
  describe('#method()', function() {
    it('should run without an error', function() {
      expect([ 1, 2, 3 ].length).to.be.equal(3)
    })
  })
})
```

Mocha asynchronous (callback)

```
var expect = require("chai").expect;
describe('Suite Name', function() {
  describe('#method()', function() {
    it('should run without an error', function(done) {
      testSomething(err => {
        expect(err).to.not.be.equal(null)
        done()
      })
    })
  })
})
```

Mocha asynchronous (Promise)

```
describe('Suite Name', function() {
  describe('#method()', function() {
    it('should run without an error', function() {
      return doSomething().then(result => {
         expect(result).to.be.equal('hello world')
      })
    })
  })
})
```

Mocha Asynchronous (async/await)

```
const { expect } = require('chai')

describe('Suite Name', function() {
  describe('#method()', function() {
    it('should run without an error', async function() {
      const result = await answerToTheUltimateQuestion()
      expect(result).to.be.equal(42)
    })
  })
```

```
})
```

Read Unit testing frameworks online: https://riptutorial.com/node-js/topic/6731/unit-testing-frameworks

Chapter 104: Use Cases of Node.js

Examples

HTTP server

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

console.log('Starting server...');
var config = {
    port: 80,
    contentType: 'application/json; charset=utf-8'
};
// JSON-API server on port 80

var server = http.createServer();
server.listen(config.port);
server.on('error', (err) => {
    if (err.code == 'EADDRINUSE') console.error('Port '+ config.port +' is already in use');
    else console.error(err.message);
});
server.on('request', (request, res) => {
    var remoteAddress = request.headers['x-forwarded-for'] ||
request.connection.remoteAddress; // Client address
    console.log(remoteAddress +' '+ request.method +' '+ request.url);

    var out = {};
    // Here you can change output according to `request.url`
    out.test = request.url;
    res.writeHead(200, {
        'Content-Type': config.contentType
    });
    res.end(JSON.stringify(out));
});
server.on('listening', () => {
    c.info('Server is available: http://localhost:'+ config.port);
});
```

Console with command prompt

```
const process = require('process');
const rl = require('readline').createInterface(process.stdin, process.stdout);

rl.pause();
console.log('Something long is happening here...');

var cliConfig = {
    promptPrefix: ' > '
}

/*
    Commands recognition
    BEGIN
*/
var commands = {
```

```
    eval: function(arg) { // Try typing in console: eval 2 * 10 ^ 3 + 2 ^ 4
        arg = arg.join(' ');
        try { console.log(eval(arg)); }
        catch (e) { console.log(e); }
    },
    exit: function(arg) {
        process.exit();
    }
};
rl.on('line', (str) => {
    rl.pause();
    var arg = str.trim().match(/([^"]+)|("(?:[^"\\]|\\.)+")/g); // Applying regular expression
for removing all spaces except for what between double quotes:
http://stackoverflow.com/a/14540319/2396907
    if (arg) {
        for (let n in arg) {
            arg[n] = arg[n].replace(/^\"|\"$/g, '');
        }
        var commandName = arg[0];
        var command = commands[commandName];
        if (command) {
            arg.shift();
            command(arg);
        }
        else console.log('Command "'+ commandName +'" doesn\'t exist');
    }
    rl.prompt();
});
/*
    END OF
    Commands recognition
*/

rl.setPrompt(cliConfig.promptPrefix);
rl.prompt();
```

Read Use Cases of Node.js online: https://riptutorial.com/node-js/topic/7703/use-cases-of-node-js

Chapter 105: Using Browserfiy to resolve 'required' error with browsers

Examples

Example - file.js

In this example we have a file called **file.js**.

Let's assume that you have to parse an URL using JavaScript and NodeJS querystring module.

To accomplish this all you have to do is to insert the following statement in your file:

```
const querystring = require('querystring');
var ref = querystring.parse("foo=bar&abc=xyz&abc=123");
```

What is this snippet doing?

Well, first, we create a querystring module which provides utilities for parsing and formatting URL query strings. It can be accessed using:

```
const querystring = require('querystring');
```

Then, we parse a URL using the .parse() method. It parses a URL query string (str) into a collection of key and value pairs.

For example, the query string `'foo=bar&abc=xyz&abc=123'` is parsed into:

```
{  foo: 'bar',  abc: ['xyz', '123']   }
```

Unfortunately, Browsers don't have the *require* method defined, but Node.js does.

Install Browserfy

With Browserify you can write code that uses *require* in the same way that you would use it in Node. So, how do you solve this? It's simple.

1. First install node, which ships with npm. Then do:

   npm install -g **browserify**

2. Change into the directory in which your file.js is and Install our *querystring* module with npm:

npm install **querystring**

Note: If you don't change in the specific directory the command will fail because it can't find the file which contains the module.

3. Now recursively bundle up all the required modules starting at file.js into a single file called bundle.js (or whatever you like to name it) with the **browserify command**:

   browserify file.js -o bundle.js

Browserify parses the Abstract Syntax Tree for *require()* calls to traverse the entire dependency graph of your

4. FinallyDrop a single tag into your html and you're done!

```
<script src="bundle.js"></script>
```

What happens is that you get a combination of your old .js file (**file.js** that is) and your newly created **bundle.js** file. Those two files are merged into one single file.

Important

Please keep in mind that if you want to make any changes to your file.js and will not affect the behaviour of your program. **Your changes will only take effect if you edit the newly created bundle.js**

What does that mean?

This means that if you want to edit **file.js** for any reasons, the changes will not have any effects. You really have to edit **bundle.js** since it is a merge of **bundle.js** and **file.js**.

Read Using Browserfiy to resolve 'required' error with browsers online: https://riptutorial.com/node-js/topic/7123/using-browserfiy-to-resolve--required--error-with-browsers

Chapter 106: Using IISNode to host Node.js Web Apps in IIS

Remarks

Virtual Directory / Nested Application with Views Pitfall

If you're going to be using Express to render views using a View Engine, you'll need to pass the `virtualDirPath` value in to your views

```
`res.render('index', { virtualDirPath: virtualDirPath });`
```

The reason for doing this is to make your hyperlinks to other views host by your app and static resource paths to know where the site is being hosted without needing to modify all views after deployment. This is one of the more annoying and tedious pitfalls of using Virtual Directories with IISNode.

Versions

All of the examples above work with

- Express v4.x
- IIS 7.x/8.x
- Socket.io v1.3.x or greater

Examples

Getting Started

IISNode allows Node.js Web Apps to be hosted on IIS 7/8 just like a .NET application would. Of course, you can self host your `node.exe` process on Windows but why do that when you can just run your app in IIS.

IISNode will handle scaling over multiple cores, process manageement of `node.exe`, and auto-recycle your IIS Application whenever your app is updated, just to name a few of its benefits.

Requirements

IISNode does have a few requirements before you can host your Node.js app in IIS.

1. Node.js must be installed on the IIS host, 32-bit or 64-bit, either are supported.
2. IISNode installed x86 or x64, this should match the bitness of your IIS Host.
3. The Microsoft URL-Rewrite Module for IIS installed on your IIS host.
    - This is key, otherwise requests to your Node.js app won't function as expected.
4. A `Web.config` in the root folder of your Node.js app.
5. IISNode configuration via an `iisnode.yml` file or an `<iisnode>` element within your `Web.config`.

Basic Hello World Example using Express

To get this example working, you'll need to create an IIS 7/8 app on your IIS host and add the directory containing the Node.js Web App as the Physical Directory. Ensure that your Application/Application Pool Identity can access the Node.js install. This example uses the Node.js 64-bit installation.

Project Strucure

This is the basic project structure of a IISNode/Node.js Web app. It looks almost identical to any non-IISNode Web App except for the addition of the `Web.config`.

```
- /app_root
  - package.json
  - server.js
  - Web.config
```

server.js - Express Application

```
const express = require('express');
const server = express();

// We need to get the port that IISNode passes into us
// using the PORT environment variable, if it isn't set use a default value
const port = process.env.PORT || 3000;

// Setup a route at the index of our app
server.get('/', (req, res) => {
    return res.status(200).send('Hello World');
});

server.listen(port, () => {
    console.log(`Listening on ${port}`);
});
```

Configuration & Web.config

The `Web.config` is just like any other IIS `Web.config` except the following two things must be present, URL `<rewrite><rules>` and an IISNode `<handler>`. Both of these elements are children of the `<system.webServer>` element.

Configuration

You can configure IISNode by using a `iisnode.yml` file or by adding the `<iisnode>` element as a child of `<system.webServer>` in your `Web.config`. Both of these configuration can be used in conjunction with one another however, in this case, `Web.config` will need to specify the `iisnode.yml` file **AND** any configuration conflicts will be take from the `iisnode.yml` file instead. This configuration overriding cannot happen the other way around.

IISNode Handler

In order for IIS to know that `server.js` contains our Node.js Web App we need to explicitly tell it that. We can do this by adding the IISNode `<handler>` to the `<handlers>` element.

```
<handlers>
  <add name="iisnode" path="server.js" verb="*" modules="iisnode"/>
</handlers>
```

URL-Rewrite Rules

The final part of the configuration is ensuring that traffic intended for our Node.js app coming into our IIS instance is being directed to IISNode. Without URL rewrite rules, we would need to visit our app by going to `http://<host>/server.js` and even worse, when trying to request a resource supplied by `server.js` you'll get a `404`. This is why URL rewriting is necessary for IISNode web apps.

```
<rewrite>
    <rules>
        <!-- First we consider whether the incoming URL matches a physical file in the /public
folder -->
        <rule name="StaticContent" patternSyntax="Wildcard">
            <action type="Rewrite" url="public/{R:0}" logRewrittenUrl="true"/>
            <conditions>
                <add input="{REQUEST_FILENAME}" matchType="IsFile" negate="true"/>
            </conditions>
            <match url="*.*"/>
        </rule>

        <!-- All other URLs are mapped to the Node.js application entry point -->
        <rule name="DynamicContent">
            <conditions>
                <add input="{REQUEST_FILENAME}" matchType="IsFile" negate="True"/>
            </conditions>
            <action type="Rewrite" url="server.js"/>
        </rule>
    </rules>
</rewrite>
```

This is a working `Web.config` file for this example, setup for a 64-bit Node.js install.

That's it, now visit your IIS Site and see your Node.js application working.

Using an IIS Virtual Directory or Nested Application via

Using a Virtual Directory or Nested Application in IIS is a common scenario and most likely one that you'll want to take advantage of when using IISNode.

IISNode doesn't provide direct support for Virtual Directories or Nested Applications via configuration so to achieve this we'll need to take advantage of a feature of IISNode that isn't part of the configuration and is much lesser known. All children of the `<appSettings>` element with the `Web.config` are added to the `process.env` object as properties using the appSetting key.

Lets create a Virtual Directory in our `<appSettings>`

```
<appSettings>
  <add key="virtualDirPath" value="/foo" />
</appSettings>
```

Within our Node.js App we can access the `virtualDirPath` setting

```
console.log(process.env.virtualDirPath); // prints /foo
```

Now that we can use the `<appSettings>` element for configuration, lets take advantage of that and use it in our server code.

```
// Access the virtualDirPath appSettings and give it a default value of '/'
// in the event that it doesn't exist or isn't set
var virtualDirPath = process.env.virtualDirPath || '/';

// We also want to make sure that our virtualDirPath
// always starts with a forward slash
if (!virtualDirPath.startsWith('/', 0))
  virtualDirPath = '/' + virtualDirPath;

// Setup a route at the index of our app
server.get(virtualDirPath, (req, res) => {
    return res.status(200).send('Hello World');
});
```

We can use the virtualDirPath with our static resources as well

```
// Public Directory
server.use(express.static(path.join(virtualDirPath, 'public')));
// Bower
server.use('/bower_components', express.static(path.join(virtualDirPath,
'bower_components')));
```

Lets put all of that together

```
const express = require('express');
const server = express();

const port = process.env.PORT || 3000;
```

```
// Access the virtualDirPath appSettings and give it a default value of '/'
// in the event that it doesn't exist or isn't set
var virtualDirPath = process.env.virtualDirPath || '/';

// We also want to make sure that our virtualDirPath
// always starts with a forward slash
if (!virtualDirPath.startsWith('/', 0))
  virtualDirPath = '/' + virtualDirPath;

// Public Directory
server.use(express.static(path.join(virtualDirPath, 'public')));
// Bower
server.use('/bower_components', express.static(path.join(virtualDirPath,
'bower_components')));

// Setup a route at the index of our app
server.get(virtualDirPath, (req, res) => {
    return res.status(200).send('Hello World');
});

server.listen(port, () => {
    console.log(`Listening on ${port}`);
});
```

Using Socket.io with IISNode

To get Socket.io working with IISNode, the only changes necessary when not using a Virtual Directory/Nested Application are within the `Web.config`.

Since Socket.io sends requests starting with `/socket.io`, IISNode needs to communicate to IIS that these should also be handled IISNode and aren't just static file requests or other traffic. This requires a different `<handler>` than standard IISNode apps.

```
<handlers>
    <add name="iisnode-socketio" path="server.js" verb="*" modules="iisnode" />
</handlers>
```

In addition to the changes to the `<handlers>` we also need to add an additional URL rewrite rule. The rewrite rule sends all `/socket.io` traffic to our server file where the Socket.io server is running.

```
<rule name="SocketIO" patternSyntax="ECMAScript">
    <match url="socket.io.+"/>
    <action type="Rewrite" url="server.js"/>
</rule>
```

If you are using IIS 8, you'll need to disable your webSockets setting in your `Web.config` in addition to adding the above handler and rewrite rules. This is unnecessary in IIS 7 since there is no webSocket support.

```
<webSocket enabled="false" />
```

Read Using IISNode to host Node.js Web Apps in IIS online: https://riptutorial.com/node-js/topic/6003/using-iisnode-to-host-node-js-web-apps-in-iis

Chapter 107: Using Streams

Parameters

Parameter	Definition
Readable Stream	type of stream where data can be read from
Writable Stream	type of stream where data can be written to
Duplex Stream	type of stream that is both readable and writeable
Transform Stream	type of duplex stream that can transform data as it is being read and then written

Examples

Read Data from TextFile with Streams

I/O in node is asynchronous, so interacting with the disk and network involves passing callbacks to functions. You might be tempted to write code that serves up a file from disk like this:

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

var server = http.createServer(function (req, res) {
    fs.readFile(__dirname + '/data.txt', function (err, data) {
        res.end(data);
    });
});
server.listen(8000);
```

This code works but it's bulky and buffers up the entire data.txt file into memory for every request before writing the result back to clients. If data.txt is very large, your program could start eating a lot of memory as it serves lots of users concurrently, particularly for users on slow connections.

The user experience is poor too because users will need to wait for the whole file to be buffered into memory on your server before they can start receiving any contents.

Luckily both of the (req, res) arguments are streams, which means we can write this in a much better way using fs.createReadStream() instead of fs.readFile():

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

var server = http.createServer(function (req, res) {
```

```
    var stream = fs.createReadStream(__dirname + '/data.txt');
    stream.pipe(res);
});
server.listen(8000);
```

Here .pipe() takes care of listening for 'data' and 'end' events from the fs.createReadStream(). This code is not only cleaner, but now the data.txt file will be written to clients one chunk at a time immediately as they are received from the disk.

Piping streams

Readable streams can be "piped," or connected, to writable streams. This makes data flow from the source stream to the destination stream without much effort.

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

var readable = fs.createReadStream('file1.txt')
var writable = fs.createWriteStream('file2.txt')

readable.pipe(writable) // returns writable
```

When writable streams are also readable streams, i.e. when they're *duplex* streams, you can continue piping it to other writable streams.

```
var zlib = require('zlib')

fs.createReadStream('style.css')
  .pipe(zlib.createGzip()) // The returned object, zlib.Gzip, is a duplex stream.
  .pipe(fs.createWriteStream('style.css.gz')
```

Readable streams can also be piped into multiple streams.

```
var readable = fs.createReadStream('source.css')
readable.pipe(zlib.createGzip()).pipe(fs.createWriteStream('output.css.gz'))
readable.pipe(fs.createWriteStream('output.css')
```

Note that you must pipe to the output streams synchronously (at the same time) before any data 'flows'. Failure to do so might lead to incomplete data being streamed.

Also note that stream objects can emit `error` events; be sure to responsibly handle these events on *every* stream, as needed:

```
var readable = fs.createReadStream('file3.txt')
var writable = fs.createWriteStream('file4.txt')
readable.pipe(writable)
readable.on('error', console.error)
writable.on('error', console.error)
```

Creating your own readable/writable stream

We will see stream objects being returned by modules like fs etc but what if we want to create our

own streamable object.

To create Stream object we need to use the stream module provided by NodeJs

```
    var fs = require("fs");
    var stream = require("stream").Writable;

    /*
     *  Implementing the write function in writable stream class.
     *  This is the function which will be used when other stream is piped into this
     *  writable stream.
     */
    stream.prototype._write = function(chunk, data){
        console.log(data);
    }

    var customStream = new stream();

    fs.createReadStream("am1.js").pipe(customStream);
```

This will give us our own custom writable stream. we can implement anything within the *_write* function. Above method works in NodeJs 4.x.x version but in NodeJs 6.x **ES6** introduced classes therefore syntax have changed. Below is the code for 6.x version of NodeJs

```
    const Writable = require('stream').Writable;

    class MyWritable extends Writable {
      constructor(options) {
        super(options);
      }

      _write(chunk, encoding, callback) {
        console.log(chunk);
      }
    }
```

Why Streams?

Lets examine the following two examples for reading a file's contents:

The first one, which uses an async method for reading a file, and providing a callback function which is called once the file is fully read into the memory:

```
fs.readFile(`${__dirname}/utils.js`, (err, data) => {
  if (err) {
    handleError(err);
  } else {
    console.log(data.toString());
  }
})
```

And the second, which uses `streams` in order to read the file's content, piece by piece:

```
var fileStream = fs.createReadStream(`${__dirname}/file`);
```

```
var fileContent = '';
fileStream.on('data', data => {
  fileContent += data.toString();
})

fileStream.on('end', () => {
  console.log(fileContent);
})

fileStream.on('error', err => {
  handleError(err)
})
```

It's worth mentioning that both examples do the **exact same thing**. What's the difference then?

- The first one is shorter and looks more elegant
- The second lets you do some processing on the file **while** it is being read (!)

When the files you deal with are small then there is no real effect when using `streams`, but what happens when the file is big? (so big that it takes 10 seconds to read it into memory)

Without `streams` you'll be waiting, doing absolutely nothing (unless your process does other stuff), until the 10 seconds pass and the file is **fully read**, and only then you can start processing the file.

With `streams`, you get the file's contents piece by piece, **right when they're available** - and that lets you process the file **while** it is being read.

The above example does not illustrate how `streams` can be utilized for work that cannot be done when going the callback fashion, so lets look at another example:

I would like to download a `gzip` file, unzip it and save its content to the disk. Given the file's `url` this is what's need to be done:

- Download the file
- Unzip the file
- Save it to disk

Here's a [small file][1], which is stored in my `S3` storage. The following code does the above in the callback fashion.

```
var startTime = Date.now()
s3.getObject({Bucket: 'some-bucket', Key: 'tweets.gz'}, (err, data) => {
  // here, the whole file was downloaded

  zlib.gunzip(data.Body, (err, data) => {
    // here, the whole file was unzipped

    fs.writeFile(`${__dirname}/tweets.json`, data, err => {
      if (err) console.error(err)

      // here, the whole file was written to disk
      var endTime = Date.now()
      console.log(`${endTime - startTime} milliseconds`) // 1339 milliseconds
```

```
    })
  })
})

// 1339 milliseconds
```

This is how it looks using `streams`:

```
s3.getObject({Bucket: 'some-bucket', Key: 'tweets.gz'}).createReadStream()
  .pipe(zlib.createGunzip())
  .pipe(fs.createWriteStream(`${__dirname}/tweets.json`));

// 1204 milliseconds
```

Yep, it's not faster when dealing with small files - the tested file weights `80KB`. Testing this on a bigger file, `71MB` gzipped (`382MB` unzipped), shows that the `streams` version is much faster

- It took 20925 milliseconds to download `71MB`, unzip it and then write `382MB` to disk - **using the callback fashion**.
- In comparison, it took 13434 milliseconds to do the same when using the `streams` version (35% faster, for a not-so-big file)

Read Using Streams online: https://riptutorial.com/node-js/topic/2974/using-streams

Chapter 108: Using WebSocket's with Node.JS

Examples

Installing WebSocket's

There are a few way's to install WebSocket's to your project. Here are some example's:

```
npm install --save ws
```

or inside your package.json using:

```
"dependencies": {
  "ws": "*"
},
```

Adding WebSocket's to your file's

To add ws to your file's simply use:

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

Using WebSocket's and WebSocket Server's

To open a new WebSocket, simply add something like:

```
var WebSocket = require("ws");
var ws = new WebSocket("ws://host:8080/OptionalPathName);
// Continue on with your code...
```

Or to open a server, use:

```
var WebSocketServer = require("ws").Server;
var ws = new WebSocketServer({port: 8080, path: "OptionalPathName"});
```

A Simple WebSocket Server Example

```
var WebSocketServer = require('ws').Server
, wss = new WebSocketServer({ port: 8080 }); // If you want to add a path as well, use path:
"PathName"

wss.on('connection', function connection(ws) {
  ws.on('message', function incoming(message) {
    console.log('received: %s', message);
  });
```

```
  ws.send('something');
});
```

Read Using WebSocket's with Node.JS online: https://riptutorial.com/node-js/topic/6106/using-websocket-s-with-node-js

Chapter 109: Web Apps With Express

Introduction

Express is a minimal and flexible Node.js web application framework, providing a robust set of features for building web applications.

The official website of Express is expressjs.com. The source can be found on GitHub.

Syntax

- app.get(path [, middleware], callback[, callback...])
- app.put(path [, middleware], callback[, callback...])
- app.post(path [, middleware], callback[, callback...])
- app['delete'](path [, middleware], callback[, callback...])
- app.use(path [, middleware], callback[, callback...])
- app.use(callback)

Parameters

Parameter	Details
`path`	Specifies the path portion or the URL that the given callback will handle.
`middleware`	One or more functions which will be called before the callback. Essentially a chaining of multiple `callback` functions. Useful for more specific handling for example authorization or error handling.
`callback`	A function that will be used to handle requests to the specified `path`. It will be called like `callback(request, response, next)`, where `request`, `response`, and `next` are described below.
callback `request`	An object encapsulating details about the HTTP request that the callback is being called to handle.
`response`	An object that is used to specify how the server should respond to the request.
`next`	A callback that passes control on to the next matching route. It accepts an optional error object.

Examples

Getting Started

You will first need to create a directory, access it in your shell and install Express using npm by running `npm install express --save`

Create a file and name it `app.js` and add the following code which creates a new Express server and adds one endpoint to it (`/ping`) with the `app.get` method:

```
const express = require('express');

const app = express();

app.get('/ping', (request, response) => {
    response.send('pong');
});

app.listen(8080, 'localhost');
```

To run your script use the following command in your shell:

```
> node app.js
```

Your application will accept connections on localhost port 8080. If the hostname argument to `app.listen` is omitted, then server will accept connections on the machine's IP address as well as localhost. If port value is 0, the operating system will assign an available port.

Once your script is running, you can test it in a shell to confirm that you get the expected response, "pong", from the server:

```
> curl http://localhost:8080/ping
pong
```

You can also open a web browser, navigate to the url http://localhost:8080/ping to view the output

Basic routing

First create an express app:

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

Then you can define routes like this:

```
app.get('/someUri', function (req, res, next) {})
```

That structure works for all HTTP methods, and expects a path as the first argument, and a handler for that path, which receives the request and response objects. So, for the basic HTTP methods, these are the routes

```
// GET www.domain.com/myPath
app.get('/myPath', function (req, res, next) {})
```

```
// POST www.domain.com/myPath
app.post('/myPath', function (req, res, next) {})

// PUT www.domain.com/myPath
app.put('/myPath', function (req, res, next) {})

// DELETE www.domain.com/myPath
app.delete('/myPath', function (req, res, next) {})
```

You can check the complete list of supported verbs here. If you want to define the same behavior for a route and all HTTP methods, you can use:

```
app.all('/myPath', function (req, res, next) {})
```

or

```
app.use('/myPath', function (req, res, next) {})
```

or

```
app.use('*', function (req, res, next) {})

// * wildcard will route for all paths
```

You can chain your route definitions for a single path

```
app.route('/myPath')
  .get(function (req, res, next) {})
  .post(function (req, res, next) {})
  .put(function (req, res, next) {})
```

You can also add functions to any HTTP method. They will run before the final callback and take the parameters (req, res, next) as arguments.

```
// GET www.domain.com/myPath
app.get('/myPath', myFunction, function (req, res, next) {})
```

Your final callbacks can be stored in an external file to avoid putting too much code in one file:

```
// other.js
exports.doSomething = function(req, res, next) {/* do some stuff */};
```

And then in the file containing your routes:

```
const other = require('./other.js');
app.get('/someUri', myFunction, other.doSomething);
```

This will make your code much cleaner.

Getting info from the request

To get info from the requesting url (notice that `req` is the request object in the handler function of routes). Consider this route definition **`/settings/:user_id`** and this particular example **`/settings/32135?field=name`**

```
// get the full path
req.originalUrl // => /settings/32135?field=name

// get the user_id param
req.params.user_id // => 32135

// get the query value of the field
req.query.field // => 'name'
```

You can also get headers of the request, like this

```
req.get('Content-Type')
// "text/plain"
```

To simplify getting other info you can use middlewares. For example, to get the body info of the request, you can use the body-parser middleware, which will transform raw request body into usable format.

```
var app = require('express')();
var bodyParser = require('body-parser');

app.use(bodyParser.json()); // for parsing application/json
app.use(bodyParser.urlencoded({ extended: true })); // for parsing application/x-www-form-
urlencoded
```

Now suppose a request like this

```
PUT /settings/32135
{
  "name": "Peter"
}
```

You can access the posted name like this

```
req.body.name
// "Peter"
```

In a similar way, you can access cookies from the request, you also need a middleware like cookie-parser

```
req.cookies.name
```

Modular express application

To make express web application modular use router factories:

Module:

```
// greet.js
const express = require('express');

module.exports = function(options = {}) { // Router factory
    const router = express.Router();

    router.get('/greet', (req, res, next) => {
        res.end(options.greeting);
    });

    return router;
};
```

Application:

```
// app.js
const express = require('express');
const greetMiddleware = require('./greet.js');

express()
    .use('/api/v1/', greetMiddleware({ greeting:'Hello world' }))
    .listen(8080);
```

This will make your application modular, customisable and your code reusable.

When accessing `http://<hostname>:8080/api/v1/greet` the output will be `Hello world`

More complicated example

Example with services that shows middleware factory advantages.

Module:

```
// greet.js
const express = require('express');

module.exports = function(options = {}) { // Router factory
    const router = express.Router();
    // Get controller
    const {service} = options;

    router.get('/greet', (req, res, next) => {
        res.end(
            service.createGreeting(req.query.name || 'Stranger')
        );
    });

    return router;
};
```

Application:

```
// app.js
const express = require('express');
```

```
const greetMiddleware = require('./greet.js');

class GreetingService {
    constructor(greeting = 'Hello') {
        this.greeting = greeting;
    }

    createGreeting(name) {
        return `${this.greeting}, ${name}!`;
    }
}

express()
    .use('/api/v1/service1', greetMiddleware({
        service: new GreetingService('Hello'),
    }))
    .use('/api/v1/service2', greetMiddleware({
        service: new GreetingService('Hi'),
    }))
    .listen(8080);
```

When accessing `http://<hostname>:8080/api/v1/service1/greet?name=World` the output will be `Hello, World` and accessing `http://<hostname>:8080/api/v1/service2/greet?name=World` the output will be `Hi, World`.

Using a Template Engine

Using a Template Engine

The following code will setup Jade as template engine. (Note: Jade has been renamed to `pug` as of December 2015.)

```
const express = require('express');  //Imports the express module
const app = express();  //Creates an instance of the express module

const PORT = 3000; //Randomly chosen port

app.set('view engine','jade'); //Sets jade as the View Engine / Template Engine
app.set('views','src/views'); //Sets the directory where all the views (.jade files) are
stored.

//Creates a Root Route
app.get('/',function(req, res){
    res.render('index');  //renders the index.jade file into html and returns as a response.
The render function optionally takes the data to pass to the view.
});

//Starts the Express server with a callback
app.listen(PORT, function(err) {
    if (!err) {
        console.log('Server is running at port', PORT);
    } else {
        console.log(JSON.stringify(err));
    }
});
```

Similarly, other Template Engines could be used too such as `Handlebars`(`hbs`) or `ejs`. Remember to `npm install` the Template Engine too. For Handlebars we use `hbs` package, for Jade we have a `jade` package and for EJS, we have an `ejs` package.

EJS Template Example

With EJS (like other express templates), you can run server code and access your server variables from you HTML.
In EJS it's done using "`<%`" as start tag and "`%>`" as end tag, variables passed as the render params can be accessed using `<%=var_name%>`
For instance, if you have supplies array in your server code
you can loop over it using

```
<h1><%= title %></h1>
   <ul>
<% for(var i=0; i<supplies.length; i++) { %>
    <li>
        <a href='supplies/<%= supplies[i] %>'>
            <%= supplies[i] %>
        </a>
    </li>
<% } %>
```

As you can see in the example every time you switch between server side code and HTML you need to close the current EJS tag and open a new one later, here we wanted to create `li` inside the `for` command so we needed to close our EJS tag at the end of the `for` and create new tag just for the curly brackets
another example
if we want to put input default version to be a variable from the server side we use `<%=`
for example:

```
 Message:<br>
<input type="text" value="<%= message %>" name="message" required>
```

Here the message variable passed from your server side will be the default value of your input, please be noticed that if you didn't pass message variable from your server side, EJS will throw an exception. You can pass parameters using `res.render('index', {message: message});` (for ejs file called index.ejs).

In the EJS tags you can also use `if` , `while` or any other javascript command you want.

JSON API with ExpressJS

```
var express = require('express');
var cors = require('cors'); // Use cors module for enable Cross-origin resource sharing

var app = express();
app.use(cors()); // for all routes
```

```
var port = process.env.PORT || 8080;

app.get('/', function(req, res) {
    var info = {
        'string_value': 'StackOverflow',
        'number_value': 8476
    }
    res.json(info);

    // or
    /* res.send(JSON.stringify({
        string_value: 'StackOverflow',
        number_value: 8476
    })) */

  //you can add a status code to the json response
   /* res.status(200).json(info) */
})

app.listen(port, function() {
    console.log('Node.js listening on port ' + port)
})
```

On `http://localhost:8080/` output object

```
{
    string_value: "StackOverflow",
    number_value: 8476
}
```

Serving static files

When building a webserver with Express it's often required to serve a combination of dynamic content and static files.

For example, you may have index.html and script.js which are static files kept in the file system.

It is common to use folder named 'public' to have static files. In this case the folder structure may look like:

```
project root
├── server.js
├── package.json
└── public
    ├── index.html
    └── script.js
```

This is how to configure Express to serve static files:

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

app.use(express.static('public'));
```

Note: once the folder is configured, index.html, script.js and all the files in the "public" folder will be available in at the root path (you must not specify `/public/` in the url). This is because, express looks up for the files relative to the static folder configured. You can specify *virtual path prefix* as shown below:

```
app.use('/static', express.static('public'));
```

will make the resources available under the `/static/` prefix.

Multiple folders

It is possible to define multiple folders at the same time:

```
app.use(express.static('public'));
app.use(express.static('images'));
app.use(express.static('files'));
```

When serving the resources Express will examine the folder in definition order. In case of files with the same name, the one in the first matching folder will be served.

Named routes in Django-style

One big problem is that valuable named routes is not supported by Express out of the box. Solution is to install supported third-party package, for example express-reverse:

```
npm install express-reverse
```

Plug it in your project:

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

Then use it like:

```
app.get('test', '/hello', function(req, res) {
  res.end('hello');
});
```

The downside of this approach is that you cant use `route` Express module as shown in Advanced router usage. The workaround is to pass your `app` as a parameter to you router factory:

```
require('./middlewares/routing')(app);
```

And use it like:

```
module.exports = (app) => {
    app.get('test', '/hello', function(req, res) {
      res.end('hello');
```

```
    });
};
```

You can figure it out from now on, how define functions to merge it with specified custom namespaces and point at appropriate controllers.

Error Handling

Basic Error Handling

By default, Express will look for an 'error' view in the `/views` directory to render. Simply create the 'error' view and place it in the views directory to handle errors. Errors are written with the error message, status and stack trace, for example:

views/error.pug

```
html
  body
      h1= message
      h2= error.status
      p= error.stack
```

Advanced Error Handling

Define your error-handling middleware functions at the very end of the middleware function stack. These have four arguments instead of three `(err, req, res, next)` for example:

app.js

```
// catch 404 and forward to error handler
app.use(function(req, res, next) {
    var err = new Error('Not Found');
    err.status = 404;

    //pass error to the next matching route.
    next(err);
});

// handle error, print stacktrace
app.use(function(err, req, res, next) {
    res.status(err.status || 500);

    res.render('error', {
        message: err.message,
        error: err
    });
});
```

You can define several error-handling middleware functions, just as you would with regular middleware functions.

Using middleware and the next callback

Express passes a `next` callback to every route handler and middleware function that can be used to break logic for single routes across multiple handlers. Calling `next()` with no arguments tells express to continue to the next matching middleware or route handler. Calling `next(err)` with an error will trigger any error handler middleware. Calling `next('route')` will bypass any subsequent middleware on the current route and jump to the next matching route. This allows domain logic to be decoupled into reusable components that are self-contained, simpler to test, and easier to maintain and change.

Multiple matching routes

Requests to `/api/foo` or to `/api/bar` will run the initial handler to look up the member and then pass control to the actual handler for each route.

```
app.get('/api', function(req, res, next) {
  // Both /api/foo and /api/bar will run this
  lookupMember(function(err, member) {
    if (err) return next(err);
    req.member = member;
    next();
  });
});

app.get('/api/foo', function(req, res, next) {
  // Only /api/foo will run this
  doSomethingWithMember(req.member);
});

app.get('/api/bar', function(req, res, next) {
  // Only /api/bar will run this
  doSomethingDifferentWithMember(req.member);
});
```

Error handler

Error handlers are middleware with the signature `function(err, req, res, next)`. They could be set up per route (e.g. `app.get('/foo', function(err, req, res, next)`) but typically, a single error handler that renders an error page is sufficient.

```
app.get('/foo', function(req, res, next) {
  doSomethingAsync(function(err, data) {
    if (err) return next(err);
    renderPage(data);
  });
});

// In the case that doSomethingAsync return an error, this special
// error handler middleware will be called with the error as the
// first parameter.
app.use(function(err, req, res, next) {
  renderErrorPage(err);
});
```

Middleware

Each of the functions above is actually a middleware function that is run whenever a request matches the route defined, but any number of middleware functions can be defined on a single route. This allows middleware to be defined in separate files and common logic to be reused across multiple routes.

```
app.get('/bananas', function(req, res, next) {
  getMember(function(err, member) {
    if (err) return next(err);
    // If there's no member, don't try to look
    // up data. Just go render the page now.
    if (!member) return next('route');
    // Otherwise, call the next middleware and fetch
    // the member's data.
    req.member = member;
    next();
  });
}, function(req, res, next) {
  getMemberData(req.member, function(err, data) {
    if (err) return next(err);
    // If this member has no data, don't bother
    // parsing it. Just go render the page now.
    if (!data) return next('route');
    // Otherwise, call the next middleware and parse
    // the member's data. THEN render the page.
    req.member.data = data;
    next();
  });
}, function(req, res, next) {
  req.member.parsedData = parseMemberData(req.member.data);
  next();
});

app.get('/bananas', function(req, res, next) {
  renderBananas(req.member);
});
```

In this example, each middleware function would be either in it's own file or in a variable elsewhere in the file so that it could be reused in other routes.

Error handling

Basic docs can be found **here**

```
app.get('/path/:id(\\d+)', function (req, res, next) { // please note: "next" is passed
    if (req.params.id == 0) // validate param
        return next(new Error('Id is 0')); // go to first Error handler, see below

    // Catch error on sync operation
    var data;
    try {
        data = JSON.parse('/file.json');
    } catch (err) {
        return next(err);
    }

    // If some critical error then stop application
    if (!data)
```

```
        throw new Error('Smth wrong');

    // If you need send extra info to Error handler
    // then send custom error (see Appendix B)
    if (smth)
        next(new MyError('smth wrong', arg1, arg2))

    // Finish request by res.render or res.end
    res.status(200).end('OK');
});

// Be sure: order of app.use have matter
// Error handler
app.use(function(err, req, res, next)) {
    if (smth-check, e.g. req.url != 'POST')
        return next(err); // go-to Error handler 2.

    console.log(req.url, err.message);

    if (req.xhr) // if req via ajax then send json else render error-page
        res.json(err);
    else
        res.render('error.html', {error: err.message});
});

// Error handler 2
app.use(function(err, req, res, next)) {
    // do smth here e.g. check that error is MyError
    if (err instanceof MyError) {
        console.log(err.message, err.arg1, err.arg2);
    }
    ...
    res.end();
});
```

Appendix A

```
// "In Express, 404 responses are not the result of an error,
// so the error-handler middleware will not capture them."
// You can change it.
app.use(function(req, res, next) {
    next(new Error(404));
});
```

Appendix B

```
// How to define custom error
var util = require('util');
...
function MyError(message, arg1, arg2) {
    this.message = message;
    this.arg1 = arg1;
    this.arg2 = arg2;
    Error.captureStackTrace(this, MyError);
}
util.inherits(MyError, Error);
MyError.prototype.name = 'MyError';
```

Hook: How to execute code before any req and after any res

`app.use()` and middleware can be used for "before" and a combination of the close and finish events can be used for "after".

```
app.use(function (req, res, next) {
    function afterResponse() {
        res.removeListener('finish', afterResponse);
        res.removeListener('close', afterResponse);

        // actions after response
    }
    res.on('finish', afterResponse);
    res.on('close', afterResponse);

    // action before request
    // eventually calling `next()`
    next();
});
...
app.use(app.router);
```

An example of this is the logger middleware, which will append to the log after the response by default.

Just make sure this "middleware" is used before `app.router` as order does matter.

Original post is **here**

Handling POST Requests

Just like you handle get requests in Express with app.get method, you can use app.post method to handle post requests.

But before you can handle POST requests, you will need to use the `body-parser` middleware. It simply parses the body of `POST`, `PUT`, `DELETE` and other requests.

`Body-Parser` middleware parses the body of the request and turns it into an object available in `req.body`

```
var bodyParser = require('body-parser');

const express = require('express');

const app = express();

// Parses the body for POST, PUT, DELETE, etc.
app.use(bodyParser.json());

app.use(bodyParser.urlencoded({ extended: true }));

app.post('/post-data-here', function(req, res, next){

    console.log(req.body); // req.body contains the parsed body of the request.
```

```
});

app.listen(8080, 'localhost');
```

Setting cookies with cookie-parser

The following is an example for setting and reading cookies using the cookie-parser module:

```
var express = require('express');
var cookieParser = require('cookie-parser'); // module for parsing cookies
var app = express();
app.use(cookieParser());

app.get('/setcookie', function(req, res){
    // setting cookies
    res.cookie('username', 'john doe', { maxAge: 900000, httpOnly: true });
    return res.send('Cookie has been set');
});

app.get('/getcookie', function(req, res) {
    var username = req.cookies['username'];
    if (username) {
        return res.send(username);
    }

    return res.send('No cookie found');
});

app.listen(3000);
```

Custom middleware in Express

In Express, you can define middlewares that can be used for checking requests or setting some headers in response.

```
app.use(function(req, res, next){ });    // signature
```

Example

The following code adds `user` to the request object and pass the control to the next matching route.

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

//each request will pass through it
app.use(function(req, res, next){
    req.user = 'testuser';
    next();    // it will pass the control to next matching route
});

app.get('/', function(req, res){
    var user = req.user;
```

```
    console.log(user); // testuser
    return res.send(user);
});

app.listen(3000);
```

Error handling in Express

In Express, you can define unified error handler for handling errors occurred in application. Define then handler at the end of all routes and logic code.

Example

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

//GET /names/john
app.get('/names/:name', function(req, res, next){
    if (req.params.name == 'john'){
        return res.send('Valid Name');
    } else{
        next(new Error('Not valid name'));    //pass to error handler
    }
});

//error handler
app.use(function(err, req, res, next){
    console.log(err.stack);    // e.g., Not valid name
    return res.status(500).send('Internal Server Occured');
});

app.listen(3000);
```

Adding Middleware

Middleware functions are functions that have access to the request object (req), the response object (res), and the next middleware function in the application's request-response cycle.

Middleware functions can execute any code, make changes to `res` and `req` objects, end response cycle and call next middleware.

Very common example of middleware is `cors` module. To add CORS support, simply install it, require it and put this line:

```
app.use(cors());
```

before any routers or routing functions.

Hello World

Here we create a basic hello world server using Express. Routes:

- '/'
- '/wiki'

And for rest will give "404" , i.e. page not found.

```
'use strict';

const port = process.env.PORT || 3000;

var app = require('express')();
    app.listen(port);

app.get('/',(req,res)=>res.send('HelloWorld!'));
app.get('/wiki',(req,res)=>res.send('This is wiki page.'));
app.use((req,res)=>res.send('404-PageNotFound'));
```

Note: We have put 404 route as the last route as Express stacks routes in order and processes them for each request sequentially.

Read Web Apps With Express online: https://riptutorial.com/node-js/topic/483/web-apps-with-express

Chapter 110: Windows authentication under node.js

Remarks

There are several other Active Directory APIS, such as `activedirectory2` and `adldap`.

Examples

Using activedirectory

The example below is taken from the full docs, available here (GitHub) or here (NPM).

Installation

```
npm install --save activedirectory
```

Usage

```
// Initialize
var ActiveDirectory = require('activedirectory');
var config = {
    url: 'ldap://dc.domain.com',
    baseDN: 'dc=domain,dc=com'
};
var ad = new ActiveDirectory(config);
var username = 'john.smith@domain.com';
var password = 'password';
// Authenticate
ad.authenticate(username, password, function(err, auth) {
    if (err) {
        console.log('ERROR: '+JSON.stringify(err));
        return;
    }
    if (auth) {
        console.log('Authenticated!');
    }
    else {
        console.log('Authentication failed!');
    }
});
```

Read Windows authentication under node.js online: https://riptutorial.com/node-js/topic/10612/windows-authentication-under-node-js

Chapter 111: Yarn Package Manager

Introduction

Yarn is a package manager for Node.js, similar to npm. While sharing a lot of common ground, there are some key differences between Yarn and npm.

Examples

Yarn Installation

This example explains the different methods to install Yarn for your OS.

macOS

Homebrew

```
brew update
brew install yarn
```

MacPorts

```
sudo port install yarn
```

Adding Yarn to your PATH

Add the following to your preferred shell profile (`.profile`, `.bashrc`, `.zshrc` etc)

```
export PATH="$PATH:`yarn global bin`"
```

Windows

Installer

First, install Node.js if it is not already installed.

Download the Yarn installer as an `.msi` from the Yarn website.

Chocolatey

```
choco install yarn
```

Linux

Debian / Ubuntu

Ensure Node.js is installed for your distro, or run the following

```
curl -sL https://deb.nodesource.com/setup_6.x | sudo -E bash -
sudo apt-get install -y nodejs
```

Configure the YarnPkg repository

```
curl -sS https://dl.yarnpkg.com/debian/pubkey.gpg | sudo apt-key add -
echo "deb https://dl.yarnpkg.com/debian/ stable main" | sudo tee
/etc/apt/sources.list.d/yarn.list
```

Install Yarn

```
sudo apt-get update && sudo apt-get install yarn
```

CentOS / Fedora / RHEL

Install Node.js if not already installed

```
curl --silent --location https://rpm.nodesource.com/setup_6.x | bash -
```

Install Yarn

```
sudo wget https://dl.yarnpkg.com/rpm/yarn.repo -O /etc/yum.repos.d/yarn.repo
sudo yum install yarn
```

Arch

Install Yarn via AUR.

Example using yaourt:

```
yaourt -S yarn
```

Solus

```
sudo eopkg install yarn
```

All Distributions

Add the following to your preferred shell profile (`.profile`, `.bashrc`, `.zshrc` etc)

```
export PATH="$PATH:`yarn global bin`"
```

Alternative Method of Installation

Shell script

```
curl -o- -L https://yarnpkg.com/install.sh | bash
```

or specify a version to install

```
curl -o- -L https://yarnpkg.com/install.sh | bash -s -- --version [version]
```

Tarball

```
cd /opt
wget https://yarnpkg.com/latest.tar.gz
tar zvxf latest.tar.gz
```

Npm

If you already have npm installed, simply run

```
npm install -g yarn
```

Post Install

Check the installed version of Yarn by running

```
yarn --version
```

Creating a basic package

The `yarn init` command will walk you through the creation of a `package.json` file to configure some information about your package. This is similar to the `npm init` command in npm.

Create and navigate to a new directory to hold your package, and then run `yarn init`

```
mkdir my-package && cd my-package
yarn init
```

Answer the questions that follow in the CLI

```
question name (my-package): my-package
question version (1.0.0):
question description: A test package
question entry point (index.js):
question repository url:
question author: StackOverflow Documentation
question license (MIT):
success Saved package.json
✨  Done in 27.31s.
```

This will generate a `package.json` file similar to the following

```
{
  "name": "my-package",
  "version": "1.0.0",
  "description": "A test package",
  "main": "index.js",
  "author": "StackOverflow Documentation",
  "license": "MIT"
}
```

Now lets try adding a dependency. The basic syntax for this is `yarn add [package-name]`

Run the following to install ExpressJS

```
yarn add express
```

This will add a `dependencies` section to your `package.json`, and add ExpressJS

```
"dependencies": {
    "express": "^4.15.2"
}
```

Install package with Yarn

Yarn uses the same registry that npm does. That means that every package that is a available on npm is the same on Yarn.

To install a package, run `yarn add package`.

If you need a specific version of the package, you can use `yarn add package@version`.

If the version you need to install has been tagged, you can use `yarn add package@tag`.

Read Yarn Package Manager online: https://riptutorial.com/node-js/topic/9441/yarn-package-manager

Credits

S. No	Chapters	Contributors
1	Getting started with Node.js	4444, Abdelaziz Mokhnache, Abhishek Jain, Adam, Aeolingamenfel, Alessandro Trinca Tornidor, Aljoscha Meyer, Amila Sampath, Ankit Gomkale, Ankur Anand, arcs, Aule, B Thuy, baranskistad, Bundit J., Chandra Sekhar, Chezzwizz, Christopher Ronning, Community, Craig Ayre, David Gatti, Djizeus, Florian Hämmerle, Franck Dernoncourt, ganesshkumar, George Aidonidis, Harangue, hexacyanide, Iain Reid, Inanc Gumus, Jason, Jasper, Jeremy Banks, John Slegers, JohnnyCoder, Joshua Kleveter, KolesnichenkoDS, krishgopinath, Léo Martin, Majid, Marek Skiba, Matt Bush, Meinkraft, Michael Irigoyen, Mikhail, Milan Laslop, ndugger, Nick, olegzhermal, Peter Mortensen, RamenChef, Reborn, Rishikesh Chandra, Shabin Hashim, Shiven, Sibeesh Venu, sigfried, SteveLacy, Susanne Oberhauser, thefourtheye, theunexpected1, Tomás Cañibano, user2314737, Volodymyr Sichka, xam, zurfyx
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111	Yarn Package Manager	Andrew Brooke, skiilaa