# Comp 324/424 - Client-side Web Design

Spring Semester 2017 - Week 10

Dr Nick Hayward

# Contents

# JS Server-side considerations - save data

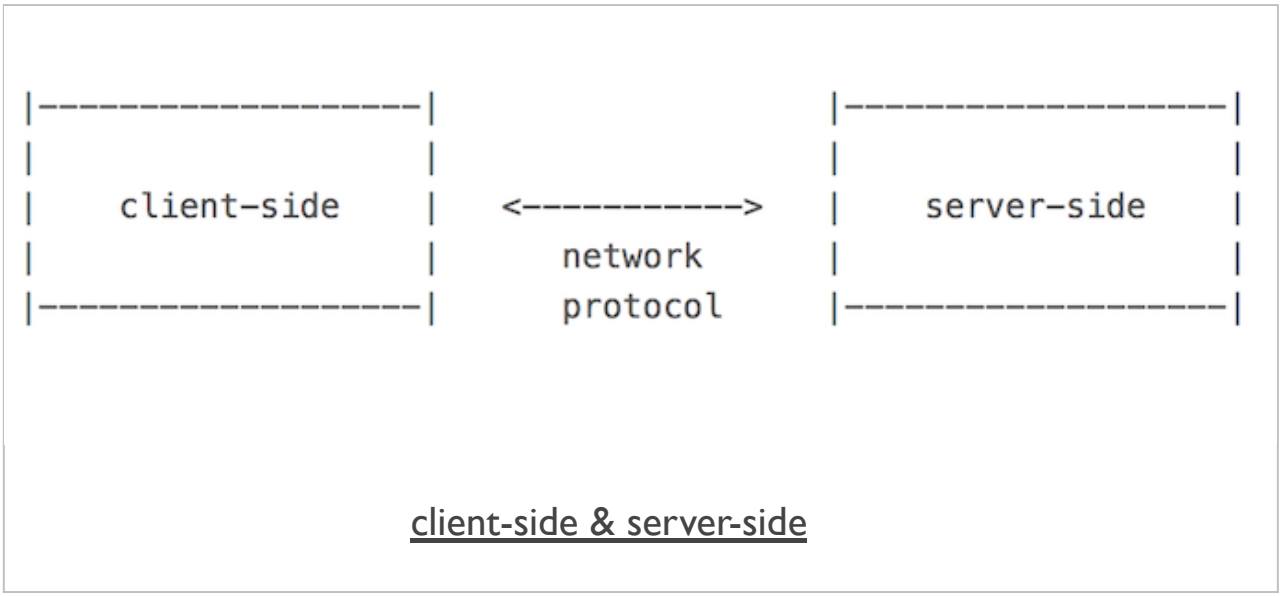
***save JSON in travel notes app***

- need to be able to save our simple notes
- now load from a JSON file as the app starts
  - *also we can add new notes, delete existing notes...*
- not as simple as writing to our existing JSON file direct from JS
  - *security implications if that was permitted directly from the browser*
- need to consider a few server-side options
- could use a combination of PHP on the server-side
  - *with AJAX jQuery on the client-side*
  - *traditional option with a simple ajax post to a PHP file on the server-side*
- consider JavaScript options on the client and server-side
- brief overview of working with **Node.js**

# Server-side considerations - intro

- normally define computer programs as either client-side or server-side programs
- server-side programs normally abstract a resource over a network
  - *enabling many client-side programs to access at the same time*
  - *a common example is file requests and transfers*
- we can think of the client as the web browser
- a web server as the remote machine abstracting resources
- abstracts them via **hypertext transfer protocol**
  - *HTTP for short*
- designed to help with the transfer of HTML documents
  - *HTTP now used as an abstracted wrapper for many different types of resources*
  - *may include documents, media, databases...*

# Image - Client-side and server-side computing




client-side & server-side

# Server-side considerations - Node.js

***intro - what is Node.js?***

- Node.js is, in essence, a JavaScript runtime environment
  - *designed to be run outside of the browser*
- designed as a general purpose utility
- can be used for many different tasks including
  - *asset compilation*
  - *monitoring*
  - *scripting*
  - *web servers*
- with Node.js, role of JS is changing
  - *moving from client-side to a support role in back-end development*

# Server-side considerations - Node.js

***intro - speed of Node.js***

- a key advantage touted for Node.js is its speed
- many companies have noted the performance benefits of implementing Node.js
  - *including PayPal, Walmart, LinkedIn...*
- a primary reason for this speed boost is the underlying architecture of Node.js
- Node.js uses an **event-based** architecture
- instead of a threading model popular in compiled languages
- Node.js uses a single event thread by default
- all I/O is asynchronous

# Server-side considerations - Node.js

***intro - conceptual model for processing in Node.js***

- how does Node.js, and its underlying processing model, actually work?
- client sends a hypertext transfer protocol, HTTP, request
  - *request or requests sent to Node.js server*
- event loop is then informed by the host OS
  - *passes applicable request and response objects as JavaScript closures*
  - *passed to associated worker functions with callbacks*
- long running jobs continue to run on various assigned worker threads
- responses are sent from the non-blocking workers back to the main event loop
  - *returned via a callback*
- event loop returns any results back to the client
  - *effectively when they're ready*

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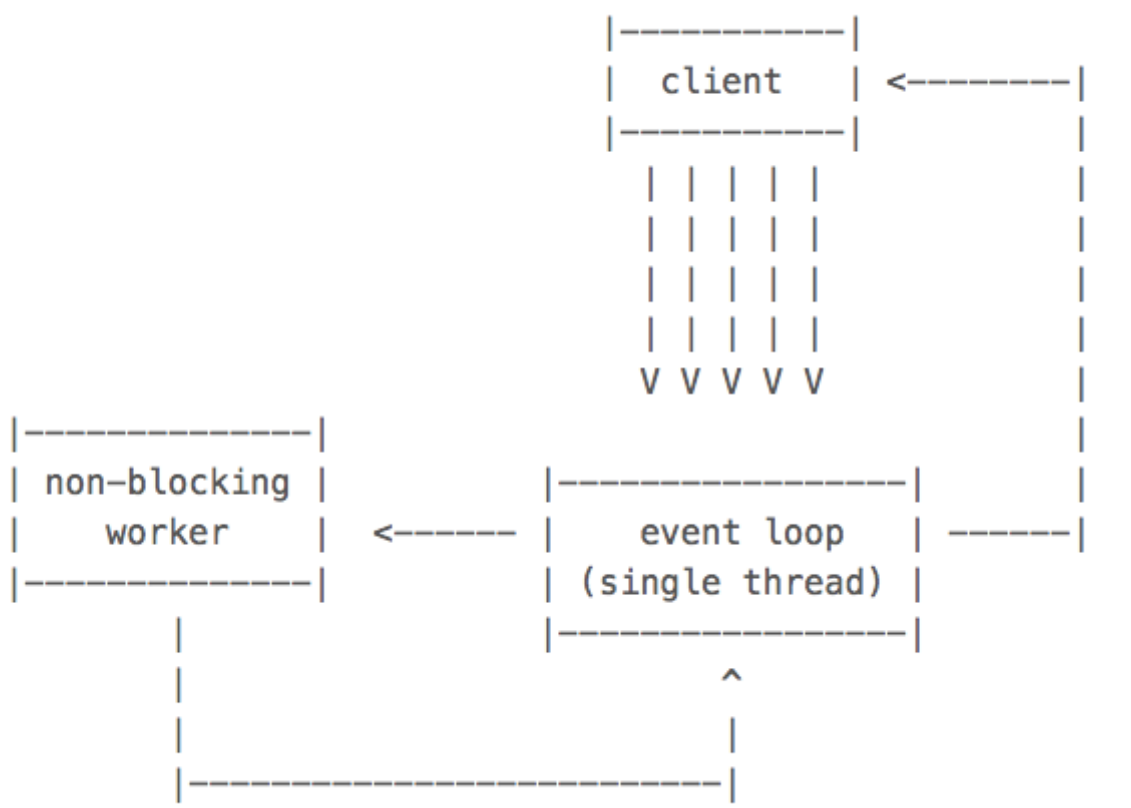



Node.js - conceptual model for processing

# Server-side considerations - Node.js

***intro - threaded architecture***

- concurrency allows multiple things to happen at the same time
- common practice on servers due to the nature of multiple user queries
- Java, for example, will create a new thread on each connection
  - *threading is inherently resource expensive*
- size of a thread is normally around 4MB of memory
- naturally limits the number of threads that can run at the same time
- also inherently more complicated to develop platforms that are thread-safe
  - *thereby allowing for such functionality*
- due to this complexity
  - *many languages, eg: Ruby, Python, and PHP, do not have threads that allow for real concurrency*
  - *without custom binaries*
- JavaScript is similarly single-threaded
  - *able to run multiple code paths in parallel due to* ***events***

# Server-side considerations - Node.js

***intro - event-driven architecture***

- JavaScript originally designed to work within the confines of the web browser
- had to handle restrictive nature of a single thread and single process for the whole page
- synchronous blocking in code would lock up a web page from all actions
  - *JavaScript was built with this in mind*
- due to this style of I/O handling
  - *Node.js is able to handle millions of concurrent requests on a single process*
- added, using libraries, to many other existing languages
  - *Akka for Java*
  - *EventMachine for Ruby*
  - *Twisted for Python*
  - ...
- JavaScript syntax already assumes events through its use of callbacks
- **NB:** if a query etc is CPU intensive instead of I/O intensive
  - *thread will be tied up*
  - *everything will be blocked as it waits for it to finish*

# Server-side considerations - Node.js

***intro - callbacks***

- in most languages
  - *send an I/O query & wait until result is returned*
  - *wait before you can continue your code procedure*
- for example, submit a query to a database for a user ID
  - *server will pause that thread/process until database returns result for ID query*
- in JS, this concept is rarely implemented as standard
- in JS, more common to pass the I/O call a **callback**
- in JS, this **callback** will need to run when task is completed
  - *eg: find a user ID and then do something, such as output to a HTML element*
- biggest difference in these approaches
  - *whilst the database is fetching the user ID query*
  - *thread is free to do whatever else might be useful*
  - *eg: accept another web request, listen to a different event...*
- this is one of the reasons that Node.js returns good benchmarks and is easily scaled
- **NB:** makes Node.js well suited for I/O heavy and intensive scenarios

# Server-side considerations - Node.js

***install Node.js***

- a number of different ways to install **Node.js**, **npm**, and the lightweight, customisable web framework **Express**
- run and test Node.js on a local Mac OS X or Windows machine
- download and install a package from the following URL
  - *Node.js - download*
- install the Node module, **Express**
- Express is a framework for web applications built upon Node.js
  - *minimal, flexible, & easily customised server*
- use *npm* to install the Express module

```
npm install -g express
```

- –g option sets a global flag for Express instead of limited local install
- installs Express command line tool
  - *allows us to start building our basic web application*
- now also necessary to install Express application generator

```
npm install -g express-generator
```

# Server-side considerations - Node.js

### *NPM - intro*

- **npm** is a package manager for Node.js
- Developers can use **npm** to share and reuse modules in Node.js applications
- **npm** can also be used to share complete Node.js applications
- example modules might include
  - *Markup, YAML etc parsers*
  - *database connectors*
  - *Express server*
  - ...
- **npm** is included with the default installers available at the Node.js website
- test whether **npm** is installed, simply issue the following command

```
npm
```

- should output some helpful information if **npm** is currently installed
- **NB:** on a Unix system, such as OS X or Linux
  - *best to avoid installing **npm** modules with `sudo` privileges*

# Server-side considerations - Node.js

***NPM - installing modules***

- install existing **npm** modules, use the following type of command

```
npm install express
```

- this command installs module named `express` in the current directory
- it will act as a local installation within the current directory
- installing in a folder called `node_modules`
  - *this is the default behaviour for current installs*
- we can also specify a global install for modules
  - *eg: we may wish to install the **express** module with global scope*

```
npm install -g express
```

- again, the `-g` flag specifies the required global install

# Server-side considerations - Node.js

***NPM - importing modules***

- import, or effectively add, modules in our Node.js code
  - *use the following declaration*

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

- when we run this application
  - *Node.js looks for the required module library and its source code*

# Server-side considerations - Node.js

***NPM - finding modules***

- official online search tool for **npm** can be found at
  - *npmjs*
- top packages include options such as
  - *browserify*
  - *express*
  - *grunt*
  - *bower*
  - *karma*
  - ...
- also search for Node modules directly
  - *search from the command line using the following command*

```
npm search express
```

- returns results for module names and descriptions

# Server-side considerations - Node.js

***NPM - specifying dependencies***

- ease Node.js app installation
  - *specify any required dependencies in an associated `package.json` file*
- allows us as developers to specify modules to install for our application
  - *which can then be run using the following command*

```
npm install
```

- helps reduce the need to install each module individually
- helps other users install an application as quickly as possible
- our application's dependencies are stored in one place
- example `package.json`

```
{
"name": "app",
"version": "0.0.1",
"dependencies": {
  "express": "4.2.x",
  "underscore": "-1.2.1"
}
}
```

# Server-side considerations - Node.js

***initial Express usage***

- now use Express to start building our initial basic web application
- Express creates a basic shell for our web application
  - *cd to working directory and use the following command*

```
express /node/test-project
```

- command makes a new directory
  - *populates with required basic web application directories and files*
- cd to this directory and install any required dependencies,

```
npm install
```

- then run our new app,

```
npm start
```

- or run and monitor our app,

```
nodemon start
```

# Server-side considerations - Node.js

***initial Express server - setup***

- we've now tested **npm**, and installed our first module with **Express**
- test **Express**, and build our first, simple server
- initial directory structure

```
|- .
   |- 424-node
      |- node_modules
```

- need to do is create a JS file to store our server code, so we'll add `server.js`

```
|- .
   |- 424-node
      |- node_modules
      |- server.js
```

- start adding our Node.js code to create a simple server

# Server-side considerations - Node.js

***initial Express server - server.js - part 1***

- add some initial code to get our server up and running

```
/* a simple Express server for Node.js*/
var express = require("express"),
    http = require("http"),
    appTest;

// create our server - listen on port 3030
appTest = express();
http.createServer(appTest).listen(3030);

// set up routes
appTest.get("/test", function(req, res) {
  res.send("welcome to the 424 test app.");
});
```

- then start and test this server as follows at the command line

```
node server.js
```

# Server-side considerations - Node.js

***initial Express server - server.js - part 2***

- open our web browser, and use the following URL

```
http://localhost:3030
```

- this is the route of our new server
  - *to get our newly created route use the following URL*

```
http://localhost:3030/test
```

- this will now return our specified route, and output message
- update our `server.js` file to support root directory level routes

```
appTest.get("/", function(req, res) {
  res.send("Welcome to the 424 server.")
});
```

- now load our server at the root URL

```
http://localhost:3030
```

- stop server from command line using `CTRL` and `c`

# Server-side considerations - Node.js

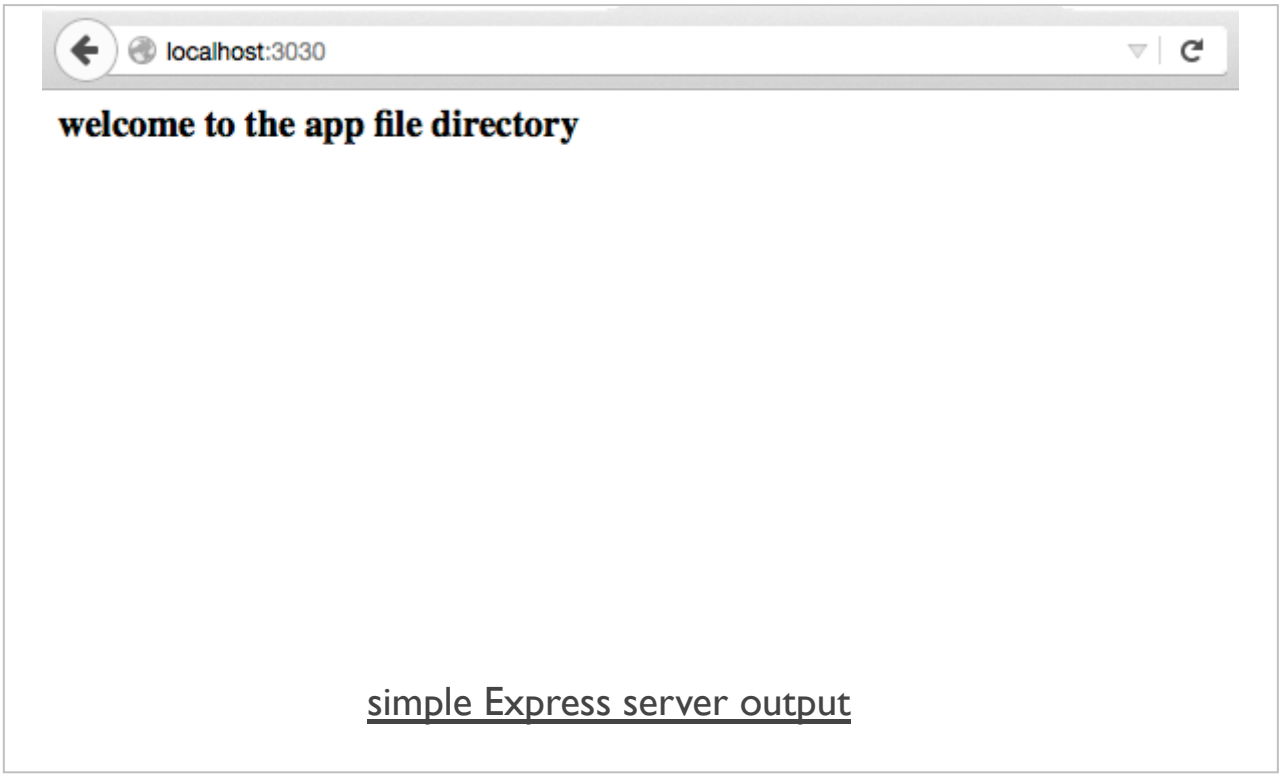
***initial Express server - server.js - part 3***

- currently, initial Express server is managing some static routes for loading content
  - *we simply tell the server how to react when a given route is requested*
- what if we now want to serve some HTML pages?
  - *Express allows us to set up routes for static files*

```
//set up static file directory - default route for server
appTest.use(express.static(__dirname + "/app"));
```

- now defining Express as a static file server
  - *enabling us to publish our HTML, CSS, and JS files*
  - *published from our default directory, `/app`*
- if requested file not available
  - *server will check other available routes*
  - *or report error to browser if nothing found*
- DEMO - 424-node

# Image - Client-side and server-side computing




simple Express server output

# Server-side considerations - Node.js

***working with data - JSON***

- let us now work our way through a basic Node.js app
- serve our JSON, then read and load from a standard web app
- create our initial `server.js` file

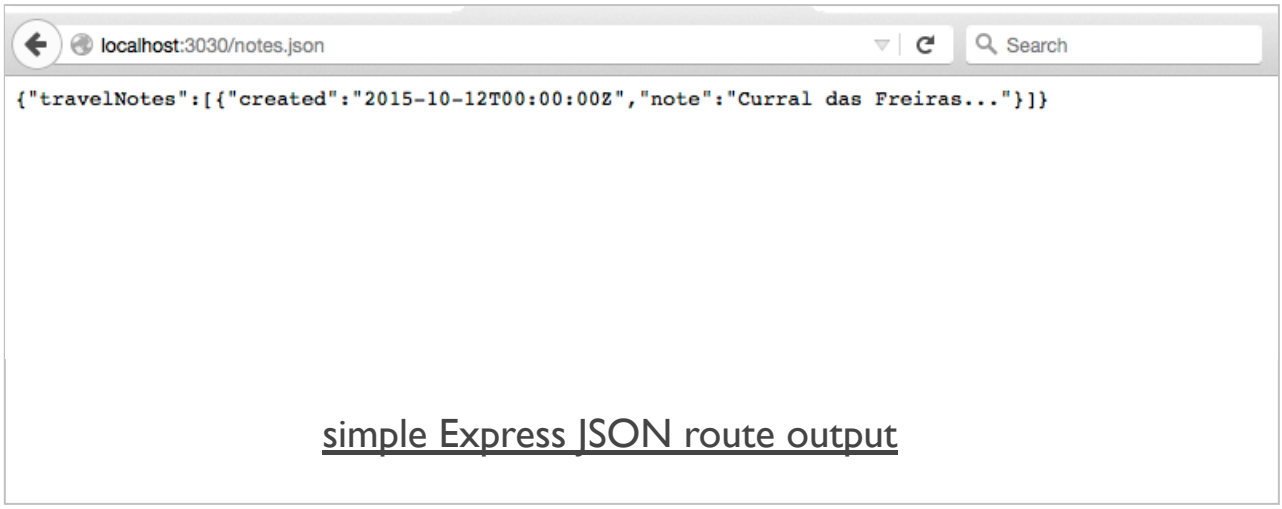
```
var express = require('express'),
    http = require("http"),
    jsonApp = express(),
    notes = {
      "travelNotes": [{
      "created": "2015-10-12T00:00:00Z",
      "note": "Curral das Freiras..."
      }]
    };

jsonApp.use(express.static(__dirname + "/app"));

http.createServer(jsonApp).listen(3030);

//json route
jsonApp.get("notes.json", function(req, res) {
  res.json(notes);
});
```

# Image - Client-side and server-side computing




simple Express JSON route output

# Server-side considerations - Node.js

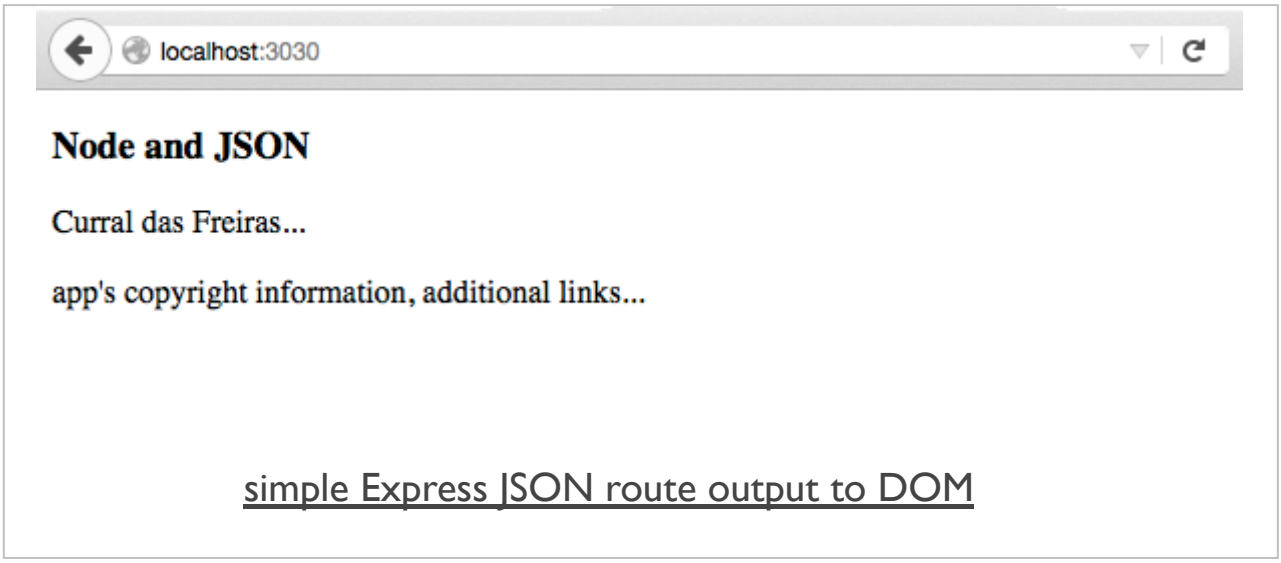
***working with data - JSON***

- now have our `get` routes setup for JSON
- now add some client-side logic to read that route
- render to the browser
- same basic patterns we've seen before
  - *using jQuery's `.getJSON()` function*

```
...
  $.getJSON("notes.json", function (response) {
    console.log("response = "+response.toSource());
    buildNote(response);
  })
...
```

- response object from our JSON
  - *this time from the server and not a file or API*
- use our familiar functions to create and render each note
  - *call our normal `buildNote()` function*
- DEMO - 424-node-json1

# Image - Client-side and server-side computing



# Server-side considerations - Node.js

***working with data - post data***

- we've seen examples that load JSON data
  - *using jQuery's `.getJSON()` function*
- now consider jQuery's `post` function
  - *allow us to easily send JSON data to the server*
  - *simply called `post`*
- begin our updates by creating a new route in our Express server
  - *one that will handle the `post` route*

```
jsonApp.post("/notes", function(req, res) {
  //return simple JSON object
  res.json({
    "message": "post complete to server"
  });
});
```

# Server-side considerations - Node.js

***working with data - post data***

- may look similar to our earlier `get` routes
  - *difference due to browser restrictions*
  - *can't simply request direct route using our browser*
  - *as we did with `get` routes*
- need to change JS we use for the client-side
  - *allows us to post new route*
  - *then enables view of the returned message*
- update our test app to store data on the server
  - *then initialise our client with this stored data*

# Server-side considerations - Node.js

***working with data - post data***

- start with a simple check that the post route is working correctly
  - *add a button, submit a request to the post route, and then wait for the response*
  - *add event handler for a button*

```
$("#post").on("click", function() {
  $.post("notes", {}, function (response) {
    console.log("server post response returned..." + response.toSource());
  })
});
```

- submit a `post` request
  - *specify the route for the post to the Node.js server*
  - *then specify the data to post - an empty object in this example*
  - *the specify a callback for the server's response*
- test returns the following output to the browser's console,

```
server post response returned...({message:"post complete to server"})
```

# Server-side considerations - Node.js

***working with data - post data***

- now send some data to the server
  - *add new note to our object*
- update the server to handle this incoming object
  - *process the submitted jQuery JSON into a JavaScript object*
  - *ready for use with the server*
- use the **Express** module's `body-parser` plugin
- update `server.js` as follows

```
//add body-parser for JSON parsing etc...
var bodyParser = require("body-parser");
...
//Express will parse incoming JSON objects
jsonApp.use(bodyParser.urlencoded({ extended: false }));
...
```

- as server receives new JSON object
  - *it will now parse, or process, this object*
  - *ensures it can be stored on the server for future use*

# Server-side considerations - Node.js

***working with data - post data***

- now update our test button's event handler
  - *send a new note as a JSON object*
- note will retrieve its new content from the input field
  - *gets the current time from the node server*

```
$(".note-input button").on("click", function() {
  //get values for new note
  var note_text = $(".note-input input").val();
  var created = new Date();
  //create new note
  var newNote = {"created":created, "note":note_text};
  //post new note to server
  $.post("notes", newNote, function (response) {
    console.log("server post response returned..." + response.toSource());
  })
});
```

- input field and button follow the same pattern as previous examples

```
<!-- note input -->
<section class="note-input col-6">
    <h5>add note</h5>
    <input><button>add</button>
</section>
```

- DEMO - 424-node-json2

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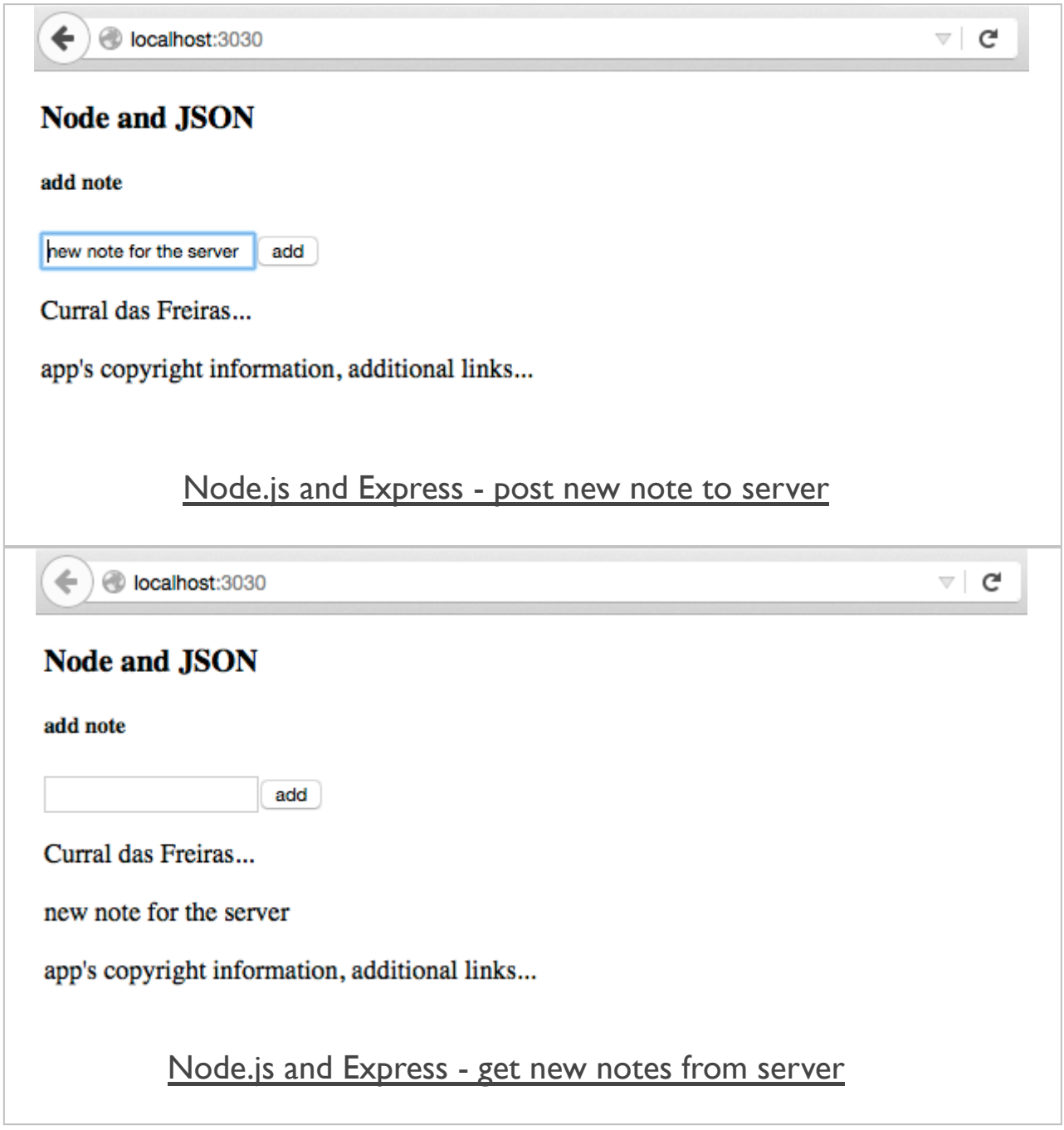

# Demos

## Node.js

- 424-node
- 424-node-json1
- 424-node-json2

# References

- Node.js
  - *Node.js home*
  - *Node.js - download*
  - *ExpressJS*
  - *ExpressJS body-parser*