Comp 324/424 - Client-side Web Design - Slides

Fall Semester 2017 - Week 13

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Contents

Server-side considerations - data storage

Redis and Node.js setup

- test Redis with our Node.js app
- new test app called `424-node-redis1`

```
|- 424-node-redis1
   |- app
      |- assets
   |- node_modules
   |- package.json
   |- server.js
```

- create new file, `package.json` to track project
  - *eg: dependencies, name, description, version...*

Server-side considerations - data storage

Redis and Node.js - package.json

```
{
  "name": "424-node-redis1",
  "version": "1.0.0",
  "description": "test app for node and redis",
  "main": "server.js",
  "dependencies": {
    "body-parser": "^1.14.1",
    "express": "^4.13.3",
    "redis": "^2.3.0"
  },
  "author": "ancientlives",
  "license": "ISC"
}
```

- we can write the `package.json` file ourselves or use the interactive option

```
npm init
```

- then add extra dependencies, eg: Redis, using

```
npm install redis --save
```

- use `package.json` to help with app management and abstraction...

Server-side considerations - data storage

Redis and Node.js - set notes value

- add Redis to our earlier test app
- import and use Redis in the `server.js` file

```
...
var express = require("express"),
    http = require("http"),
    bodyParser = require("body-parser"),
    jsonApp = express(),
    redis = require("redis");
...
```

- create client to connect to Redis from Node.js

```
//create client to connect to Redis
redisConnect = redis.createClient();
```

- then use Redis, for example, to store access total for notes on server

```
redisConnect.incr("notes");
```

- check Redis command line for change in `notes` value

```
get notes
```

Server-side considerations - data storage

Redis and Node.js - get notes value

- now set the counter value for our notes
  - *add our counter to the application to record access count for notes*
- use the `get` command with Redis to retrieve the incremented values for the `notes` key

```
redisConnect.get("notes", function(error, notesCounter) {
  //set counter to int of value in Redis or start at 0
  notesTotal.notes = parseInt(notesCounter,10) || 0;
});
```

- `get` accepts two parameters - `error` and return value
- Redis stores values and strings
  - *convert string to integer using `parseInt()`*
  - *two parameters - return value and `base-10` value of the specified number*
- value is now being stored in a global variable `notesTotal`
  - *declared in `server.js`*

```
var express = require("express"),
    http = require("http"),
    bodyParser = require("body-parser"),
    jsonApp = express(),
    redis = require("redis"),
    notesTotal = {};
```

Server-side considerations - data storage

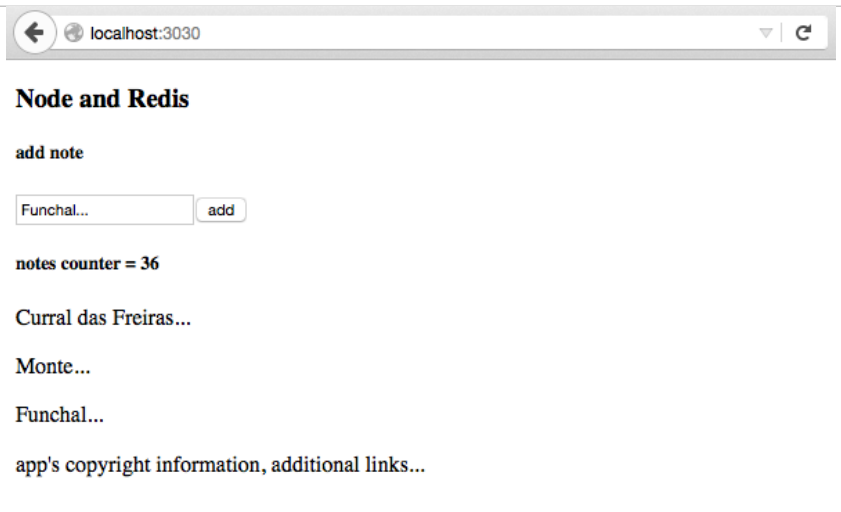
Redis and Node.js - get notes value

- store notes counter value in Redis
- create new route in `server.js`
  - *monitor the returned JSON for the counter*

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

- start using it with our application
  - *load by default, within event handler...*
- render to DOM
- store as a internal log record
- link to create note event handler...
- DEMO - 424-node-redis I

Image - Client-side and server-side computing



Node and Redis - 424-node-redis I

Server-side considerations - data storage

MongoDB - intro

- MongoDB is another example of a NoSQL based data store
  - *a database that enables us to store our data on disk*
- unlike MySQL, for example, it is not in a relational format
- MongoDB is best characterised as a **document-oriented** database
- conceptually may be considered as storing objects in collections
- stores its data using the BSON format
  - *consider similar to JSON*
  - *use JavaScript for working with MongoDB*

Server-side considerations - data storage

MongoDB - document oriented

- SQL database, data is stored in tables and rows
- MongoDB, by contrast, uses **collections** and **documents**
- comparison often made between a collection and a table
- **NB:** a document is quite different from a table
- a document can contain a lot more data than a table
- a noted concern with this document approach is duplication of data
- one of the trade-offs between NoSQL (MongoDB) and SQL
- SQL - goal of data structuring is to normalise as much as possible
- thereby avoiding duplicated information
- NoSQL (MongoDB) - provision a data store, as easy as possible for the application to use

Server-side considerations - data storage

MongoDB - BSON

- BSON is the format used by MongoDB to store its data
- effectively, JSON stored as binary with a few notable differences
  - *eg: `ObjectId` values - data type used in MongoDB to uniquely identify documents*
  - *created automatically on each document in the database*
  - *often considered as analogous to a primary key in a SQL database*
- `ObjectId` is a large pseudo-random number
- for nearly all practical occurrences, assume number will be unique
- might cease to be unique if server can't keep pace with number generation...
- other interesting aspect of `ObjectId`
  - *they are partially based on a timestamp*
  - *helps us determine when they were created*

Server-side considerations - data storage

MongoDB - general hierarchy of data

- in general, MongoDB has a three tiered data hierarchy
  1. database
     - *normally one database per app*
     - *possible to have multiple per server*
     - *same basic role as DB in SQL*
  2. collection
     - *a grouping of similar pieces of data*
     - *documents in a collection*
     - *name is usually a noun*
     - *resembles in concept a table in SQL*
     - *documents do not require the same schema*
  3. document
     - *a single item in the database*
     - *data structure of field and value pairs*
     - *similar to objects in JSON*
     - *eg: an individual user record*

Server-side considerations - data storage

MongoDB - install and setup

- install on Linux
- install on Mac OS X
  - *again, we can use* ***Homebrew*** *to install MongoDB*

```
// update brew packages
brew update
// install MongoDB
brew install mongodb
```

- then follow the above OS X install instructions to set paths...
- install on Windows

Server-side considerations - data storage

MongoDB - a few shell commands

- issue following commands at command line to get started - OS X etc

```
// start MongoDB server - terminal window 1
mongod
// connect to MongoDB - terminal window 2
mongo
```

- switch to, create a new DB (if not available), and drop a current DB as follows

```
// list available databases
show dbs
// switch to specified db
use 424db1
// show current database
db
// drop current database
db.dropDatabase();
```

- DB is not created permanently until data is created and saved
  - *insert a record and save to current DB*
- only permanent DB is the local `test` DB, until new DBs created...

Server-side considerations - data storage

MongoDB - a few shell commands

- add an initial record to a new `424db1` database.

```
// select/create db
use 424db1
// insert data to collection in current db
db.notes.insert({
...    "travelNotes": [{
...    "created": "2015-10-12T00:00:00Z",
...    "note": "Curral das Freiras..."
...    }]
... })
```

- our new DB `424db1` will now be saved in Mongo
- we've created a new collection, `notes`

```
// show databases
show dbs
// show collections
show collections
```

Server-side considerations - data storage

MongoDB - test app

- now create a new test app for use with MongoDB
- create and setup app as before
  - *eg: same setup pattern as Redis test app*
- add **Mongoose** to our app
  - *use to connect to MongoDB*
  - *helps us create a schema for working with DB*
- update our `package.json` file
  - *add dependency for Mongoose*

```
// add mongoose to app and save dependency to package.json
npm install mongoose --save
```

- test server and app as usual from app's working directory

```
node server.js
```

Server-side considerations - data storage

MongoDB - Mongoose schema

- use **Mongoose** as a type of bridge between Node.js and MongoDB
- works as a client for MongoDB from Node.js applications
- serves as a useful data modeling tool
  - *represent our documents as objects in the application*
- a data model
  - *object representation of a document collection within data store*
  - *helps specify required fields for each collection's document*
  - *known as a schema in Mongoose, eg: `NoteSchema`*

```
var NoteSchema = mongoose.Schema({
  "created": Date,
  "note": String
});
```

- using schema, build a model
  - *by convention, use first letter uppercase for name of data model object*

```
var Note = mongoose.model("Note", NoteSchema);
```

- now start creating objects of this model type using JavaScript

```
var funchalNote = new Note({
"created": "2015-10-12T00:00:00Z",
"note": "Curral das Freiras..."
});
```

- then use the Mongoose object to interact with the MongoDB
  - *using functions such as `save` and `find`*

Server-side considerations - data storage

MongoDB - test app

- with our new DB setup, our schema created
  - *now start to add notes to our DB, `424db1`, in MongoDB*
- in our `server.js` file
  - *need to connect Mongoose to `424db1` in MongoDB*
  - *define our schema for our notes*
  - *then model a note*
  - *use model to create a note for saving to `424db1`*

```
...
//connect to 424db1 DB in MongoDB
mongoose.connect('mongodb://localhost/424db1');
//define Mongoose schema for notes
var NoteSchema = mongoose.Schema({
  "created": Date,
  "note": String
});
//model note
var Note = mongoose.model("Note", NoteSchema);
...
```

Server-side considerations - data storage

MongoDB - test app

- then update app's `post` route to save note to `424db1`

```
//json post route - update for MongoDB
jsonApp.post("/notes", function(req, res) {
  var newNote = new Note({
    "created":req.body.created,
    "note":req.body.note
  });
  newNote.save(function (error, result) {
    if (error !== null) {
      console.log(error);
      res.send("error reported");
    } else {
      Note.find({}, function (error, result) {
        res.json(result);
      })
    }
  });
});
```

Server-side considerations - data storage

MongoDB - test app

- update our app's `get` route for serving these notes

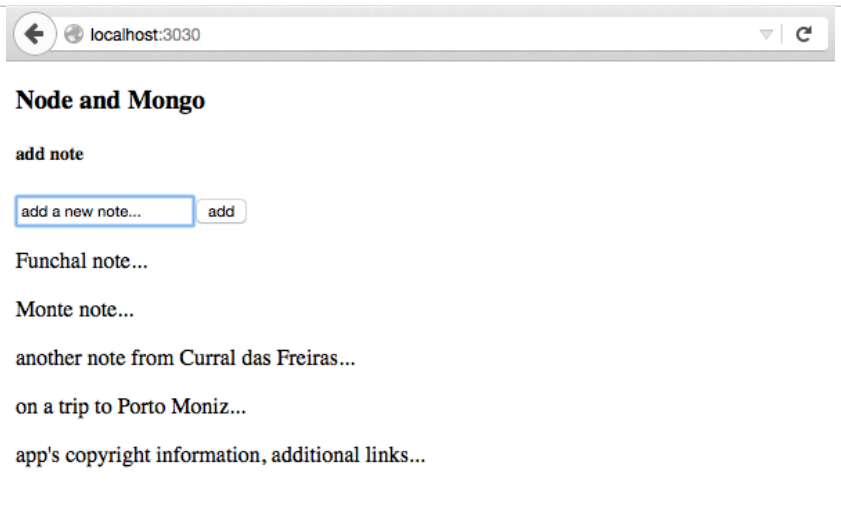
```
//json get route - update for mongo
jsonApp.get("/notes.json", function(req, res) {
  Note.find({}, function (error, notes) {
   //add some error checking...
   res.json(notes);
  });
});
```

- modify `buildNotes()` function in `json_app.js` to get return correctly

```
...
//get travelNotes
var $travelNotes = response;
...
```

- now able to enter, save, read notes for app
- notes data is stored in the `424db1` database in MongoDB
- notes are loaded from DB on page load
- notes are updated from DB for each new note addition
- DEMO - 424-node-mongo1

Image - Client-side and server-side computing



Node and MongoDB - 424-node-mongo1

Data visualisation

intro - part 1

- data visualisation - study of how to visually communicate and analyse data
- covers many disparate aspects
  - *including infographics, exploratory tools, dashboards...*
- already some notable definitions of data visualisation
- one of the better known examples,

> "*Data visualisation is the representation and presentation of data that exploits our visual perception in order to amplify cognition.*"
>
> *(Kirk, A. "Data Visualisation: A successful design process." Packt Publishing. 2012.)*

- several variants of this general theme exist
  - *the underlying premise remains the same*
- simply, data visualisation is a visual representation of the underlying data
- visualisation aims to impart a better understanding of this data
  - *by association, its relevant context*

Data visualisation

intro - part 2

- an inherent flip-side to data visualisation
- without a correct understanding of its application
  - *it can simply impart a false perception, and understanding, on the dataset*
- run the risk of creating many examples of standard **areal unit** problem
  - *perception often based on creator's base standard and potential bias*
- inherently good at seeing what we want to see
- without due care and attention visualisations may provide false summations of the data

Data visualisation

types - part 1

- many different ways to visualise datasets
  - *many ways to customise a standard infographic*
- some standard examples that allow us to consider the nature of visualisations
  - *infographics*
  - *exploratory visualisations*
  - *dashboards*
- perceived that data visualisation is simply a variation between
  - *infographics, exploratory tools, charts, and some data art*

1. infographics
   - *well suited for representing large datasets of contextual information*
   - *often used in projects more inclined to exploratory data analysis,*
   - *tend to be more interactive for the user*
   - *data science can perceive infographics as improper data visualisation because*
   - *they are designed to guide a user through a story*
   - *the main facts are often already highlighted*
   - ***NB:** such classifications often still only provide tangible reference points*

Data visualisation

types - part 2

2. exploratory visualisations
   - *more interested in the provision of tools to explore and interpret datasets*
   - *visualisations can be represented either static or interactive*
   - *from a user perspective these charts can be viewed*
   - *either carefully*
   - *simply become interactive representations*
   - *both perspectives help a user discover new and interesting concepts*
   - *interactivity may include*
   - *option for the user to filter the dataset*
   - *interact with the visualisation via manipulation of the data*
   - *modify the resultant information represented from the data*
   - *often perceived as more objective and data oriented than other forms*
3. dashboards
   - *dense displays of charts*
   - *represent and understand a given issue, domain...*
   - *as quickly and effectively as possible*
   - *examples of dashboards*
   - *display of server logs, website users, business data...*

Data visualisation

Dashboards - intro

- dashboards are dense displays of charts
- allow us to represent and understand the key **metrics** of a given issue
  - *as quickly and effective as possible*
  - *eg: consider display of server logs, website users, and business data...*
- one definition of a dashboard is as follows,

> *"A dashboard is a visual display of the most important information needed to achieve one or more objective; consolidated and arranged on a single screen so the information can be monitored at a glance."*
>
> *Few, Stephen. Information Dashboard Design: The Effective Visual Communication of Data. O'Reilly Media. 2006.*

- dashboards are visual displays of information
  - *can contain text elements*
  - *primarily a visual display of data rendered as meaningful information*

Data visualisation

Dashboards - intro

- information needs to be consumed quickly
- often simply no available time to read long annotations or repeatedly click controls
- information needs to be visible, and ready to be consumed
- dashboards are normally presented as a complementary environment
- an option to other tools and analytical/exploratory options
- design issues presented by dashboards include effective distribution of available space
- compact charts that permit quick data retrieval are normally preferred
- dashboards should be designed with a purpose in mind
- generalised information within a dashboard is rarely useful
- display most important information necessary to achieve their defined purpose
- a dashboard becomes a central view for collated data
- represented as meaningful information

Data visualisation

Dashboards - good practices

- to help promote our information
  - *need to design the dashboard to fully exploit available screen space*
- need to use this space to help users absorb as much information as possible
- some visual elements more easily perceived and absorbed by users than others
- some naturally convey and communicate information more effectively than others
- such attributes are known as **pre-attentive attributes of visual perception**
- for example,
  - *colour*
  - *form*
  - *position*

Data visualisation

Dashboards - visual perception

- pre-attentive attributes of visual perception

1. *Colour*
   - *many different colour models currently available*
   - *most useful relevant to dashboard design is the HSL model*
   - *this model describes colour in terms of three attributes*
     - *hue*
     - *saturation*
     - *lightness*
   - *perception of colour often depends upon context*
2. *Form*
   - *correct use of length, width, and general size can convey quantitative dimensions*
   - *each with varying degrees of precision*
   - *use the Laws of Prägnanz to manipulate groups of similar shapes and designs*
   - *thereby easily grouping like data and information for the user*
3. *Position*
   - *relative positioning of elements helps communicate dashboard information*
   - *laws of Prägnanz teach us*
   - *position can often infer a perception of relationship and similarity*
   - *higher items are often perceived as being better*
   - *items on the left of the screen traditionally seen first by a western user*

Demos

Redis

- 424-node-redis I

MongoDB

- 424-node-mongo I

References - JS & Libraries

- MongoDB
- MongoDB - For Giant Ideas
- MongoDB - Getting Started (Node.js driver edition)
- MongoDB - Getting Started (shell edition)
- Mongoose
- MongooseJS Docs
- Redis
- redis.io
- redis commands
- redis - npm
- try redis
- Windows support