Individual Programming Project - Part 2

Due: 23:59 Sunday 23 September 2018

Submission: Please submit a short report, your curl test commands, and a zip of your project directory (source code for the website and the RESTful web service) through the online submission portal (https://apps.ecs.vuw.ac.nz/submit/NWEN304)

This project is worth 15%

Overview

You are required to extend Part 1 of this project by creating a RESTful web service that provides your website with content. Using Node.js and Express.js, two industry standards, you will design and implement a web service with a RESTful interface. You will need to modify your Part 1 solution to use Ajax calls to communicate with the service. The service should be supported by a postgresql database.

This project will take place in four parts:

1. Create and run a Node.js service locally to serve your website content.
2. Connect your website with your server via appropriate Ajax calls.
3. Construct a Postgresql database to maintain the state of the service.
4. Host the service on the cloud service, Heroku.

Marking

The project will be marked out of 100. The following describes the distribution of marks.

Core (65%)

- (20%) Define an appropriate RESTful interface for your server for the Todo list application.
- (20%) Implement a Node.js service with the RESTful interface for the Todo list application.
- (20%) Implement Ajax calls to send and receive data from your RESTful web service
- (5%) Define a set of test cases (using the curl command) that demonstrate the correct operation of your RESTful web service.

Completion (25%)

- (10%) Create a postgresql database to support your web service. The database can be either created locally or hosted on Heroku. You are recommended to use the postgresql database service provided by Heroku.
- (10%) Use the database to enable persistent information storage in your RESTful web service.
- (5%) Implement appropriate error catching for database transaction/query handling in your RESTful web service. Your implementation should be supported by clear and sufficient comments to make your code easily maintainable and extensible.

Challenge (10%)

- (5%) Deploy the service successfully to Heroku so your RESTful service can be accessed anywhere in the Internet.
- (5%) Conduct performance test on your web application hosted on Heroku to determine the average response time of creating one todo item, updating one todo item, and deleting one todo item.

Background

Node.js is an open source runtime environment for developing web applications. It is optimised for scalability and throughput. Node.js is used extensively by industry leaders, including Netflix and Linkedin.

More information and documentation can be found at: https://nodejs.org/en/

Express.js is a Node.js framework for building web applications. It is the defacto standard for building Node.js applications and provides utility methods for accelerating their creation. In this project, you will use Express.js to build a RESTful web service.

More information and documentation can be found at: http://expressjs.com/

Postgresql is an object-oriented relational database management system. It is primarily used as a database server to store data securely and enables retrieval of data through SQL. It is designed to handle workloads ranging from a single user to enterprise level web applications. Using SQL you can create, insert, delete, and query data in a postgresql database.

Heroku is Platform as a Service (PaaS) cloud provider. It allows you to host web applications developed in various programming languages. You can use Heroku as a git repository to upload your content. It also provides the capability of hosting a postgresql database.

Core – create a Node.js service

Design and implement a simple RESTful web service on your local machine. The lab machines have Node.js installed on them. If you are running this from home, you will need to install Node.js before running your service.

1.1 Building the service

Create a working directory for the Node.js service and use npm init to perform the initial setup. It will ask you for configuration settings, either set these or press enter to use the default options.

```
> npm init
```

Now install Express.js in the directory (this may already be done by the lab machines):

```
> npm install express --save
```

1.2 Create an index.js file for your service

Enter the following:

```
var express = require('express');
var app = express();
var port = process.env.PORT || 8080;

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

app.listen(port, function () {
  console.log('Example app listening on port 8080!');
});
```

1.3 Run the service with node

```
> node index.js
```

That should bring up your service with the console log saying it is listening on port 8080.

1.4 Testing and debugging your service

There are a few ways that you can test to see if your service is working as intended. Web based approaches may be easy to start with, but as you start posting data to your service it becomes more complicated to accurately and reliably test. Curl is a command line tool that you can use to generate HTTP requests and pass data to your service.

Web based:
http://localhost:8080/

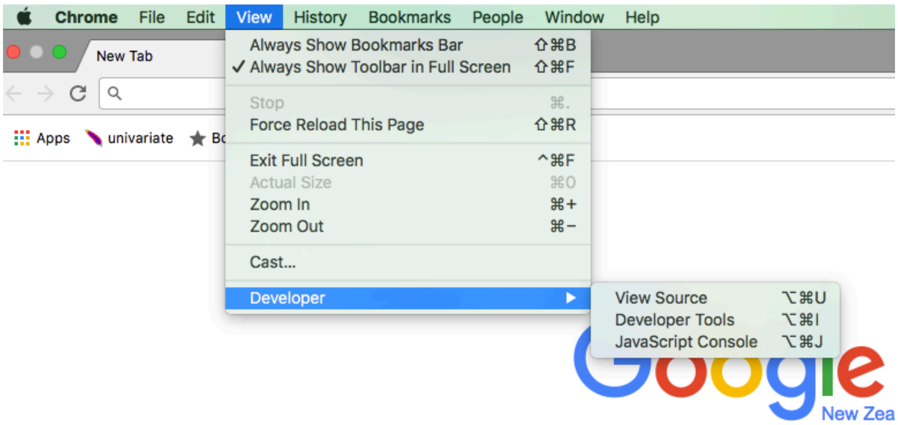
Curl:

```
> curl localhost:8080
```

Curl can also be used to perform other HTTP operations, such as POST and PUT. E.g.,

```
> curl -H "Content-Type: application/json" -X POST -d '{"username":"xyz","password":"xyz"}'
http://localhost:3000/api/login
```

To debug errors you can consider using the console.log() function. You may also consider using your browser's development tools. You can bring up the development tools in Google Chrome as shown below.



1.5 Define an appropriate REST interface

This should conform to a RESTful architecture, making use of appropriate resource identifiers (i.e. URLs) and suitable operations (i.e. HTTP request methods).

1.6 Define test cases

Define a set of curl-based test cases to demonstrate that your service is working correctly. There should be at least one curl command for each of your API function according to your RESTful interface design. These must be submitted and will be used for marking.

1.7 Create Ajax calls to utilize your RESTful web service

Implement appropriate Ajax calls to send and receive data between your web page and your REST service.

Here is an example of posting JSON data with Ajax:

```
var ERROR_LOG = console.error.bind(console);
$.Ajax({
        method: 'POST',
        url: 'http://localhost:8080/my_post_function/',
        data: JSON.stringify({
            task: task.find('.task').html()
        }),
        contentType: "application/json",
        dataType: "json"
    }).then(my_next_function, ERROR_LOG);
```

NOTE:
You may experience a problem with cross-site scripting, where you will not be allowed to invoke functions on a service hosted in a different location (e.g. if you do not rely on your Node.js server to serve the web page that makes the above Ajax call). One way to get around this problem is to add the following to your RESTful web service.

```
// Add headers
app.use(function (req, res, next) {
   // Website you wish to allow to connect
   res.setHeader('Access-Control-Allow-Origin', '*')

   // // Request methods you wish to allow
   res.setHeader('Access-Control-Allow-Methods', 'GET, POST, OPTIONS, PUT, PATCH, 
DELETE');

   // Request headers you wish to allow ,
   res.setHeader('Access-Control-Allow-Headers', 'Content-Type, Access-Control-Allow-
Headers');

   // Pass to next layer of middleware
   next();
});
```

Completion – support the service with a PostgreSQL database

RESTful web services should be stateless, meaning it should not have user data stored in variables etc. Instead, it should rely on a database to maintain the state of the service. You are required to build a small postgresql database and have the service read and write data from it.

Instructions on how to set up a local postgresql database on the lab machines can be found on the projects page.

However, a quick summary is:

1. On a lab machine you need to type ‘need postgres’. The databases are stored on a machine called Depot (not your local host). This is important to know when connecting your service to the database.
2. You can then create a database with ‘createdb <username>_jdbc’
3. Then you can connect to it with the ‘psql <dbname>’, e.g. ‘psql <username>_jdbc’.
4. You should change your database password (to something other than your ecs account password) with: ‘alter user <username> with password 'XyZZy';’
5. To exit the postgres interpreter type ‘\q’.
6. To list tables in your database use \dt or \d <table name>.

2.1 Create a simple database

Your database does not need to be very complex. Connect to your database and create a single table with an id and a task. This can be extended later if necessary.

```
> create table todo (id serial primary key, item varchar(255));
```

Insert a value into the table:

```
> insert into todo (item) values ('first todo item');
```

Query the table to check it is now in there:

```
> select * from todo;
```

You will later need to modify your table to store the status of a job, i.e. completed or in-progress. This is done with an SQL update command.

2.2 Use your database in your service

The code snippet below demonstrates how to work with your database in your node.js application:

```
const express = require('express')
const path = require('path')
const PORT = process.env.PORT || 5000

const { Pool } = require('pg');
const pool = new Pool({
  connectionString: process.env.DATABASE_URL,
  ssl: true
});

var app = express();

app
  .use(express.static(path.join(__dirname, 'public')))
  .set('views', path.join(__dirname, 'views'))
  .set('view engine', 'ejs')

app.get('/db', async (req, res) => {
  try {
    const client = await pool.connect()
    var result = await client.query('SELECT * FROM test_table');

    if (!result) {
      return res.send('No data found');
      }else{
      result.rows.forEach(row=>{
      console.log(row);
      });
      }

  res.render('pages/db', {'data': result.rows});
  client.release();

  } catch (err) {
    console.error(err);
    res.send("Error " + err);
  }
});

app.get('/', (req, res) => res.render('pages/index')).listen(PORT, () => console.log('Listening on ${ PORT }'))
```

2.3 Use your database in the service

Implement appropriate database calls for each API function of your RESTful web service.

2.4 Implement appropriate error checking

Ensure both your web page and service are robust by performing error checking and handling throughout them. You should consider invalid database transactions, invalid Ajax requests, invalid Ajax responses, etc. You should also provide clear and sufficient comments to ensure that your code is easy to maintain and extend.

Challenge – host your TODO service in the cloud

3.1 Host your service on Heroku

A live demo will be given in week 5 with regard to using Heroku to host your web application and using Postgresql database service provided by Heroku.

Sign up for Heroku and use the free tier to host your web application. You will need to read the Heroku documentation (linked below) to work out how to do this.

https://www.heroku.com/

Things for submission

You should submit the following through the online portal (https://apps.ecs.vuw.ac.nz/submit/NWEN304):

1. A short report explaining:
   a. How to use your system.
   b. The design of your RESTful web service interface with good explanation of each API function.
   c. What error handling has been conducted and why.

    d. Performance evaluation results with respect to key API functions, e.g. functions for creating new todo items, updating existing todo items, and deleting existing todo items.
    e. The test cases that you defined in Section 1.6. There should be at least one curl command for each of your API function according to your RESTful service interface design. For each test case (or curl command), provide evidence in the form of screenshot that you can obtain correct response from your RESTful web service.
2. A zip of your entire project directory (or a link to your Github repository), including the source code for the web page and the RESTful web service.

NOTE: your report must be submitted in PDF format. Reports submitted in other formats will NOT be marked.