Practical Course: Web Development

REST APIs with NodeJS

Winter Semester 2016/17

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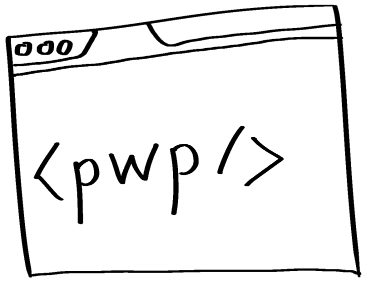


Today's Agenda

- APIs
  - What is it?
  - REST
  - Access Control
- APIs with NodeJS
  - Express
  - StrongLoop / Loopback
  - Adding a datasource
- Hands-On

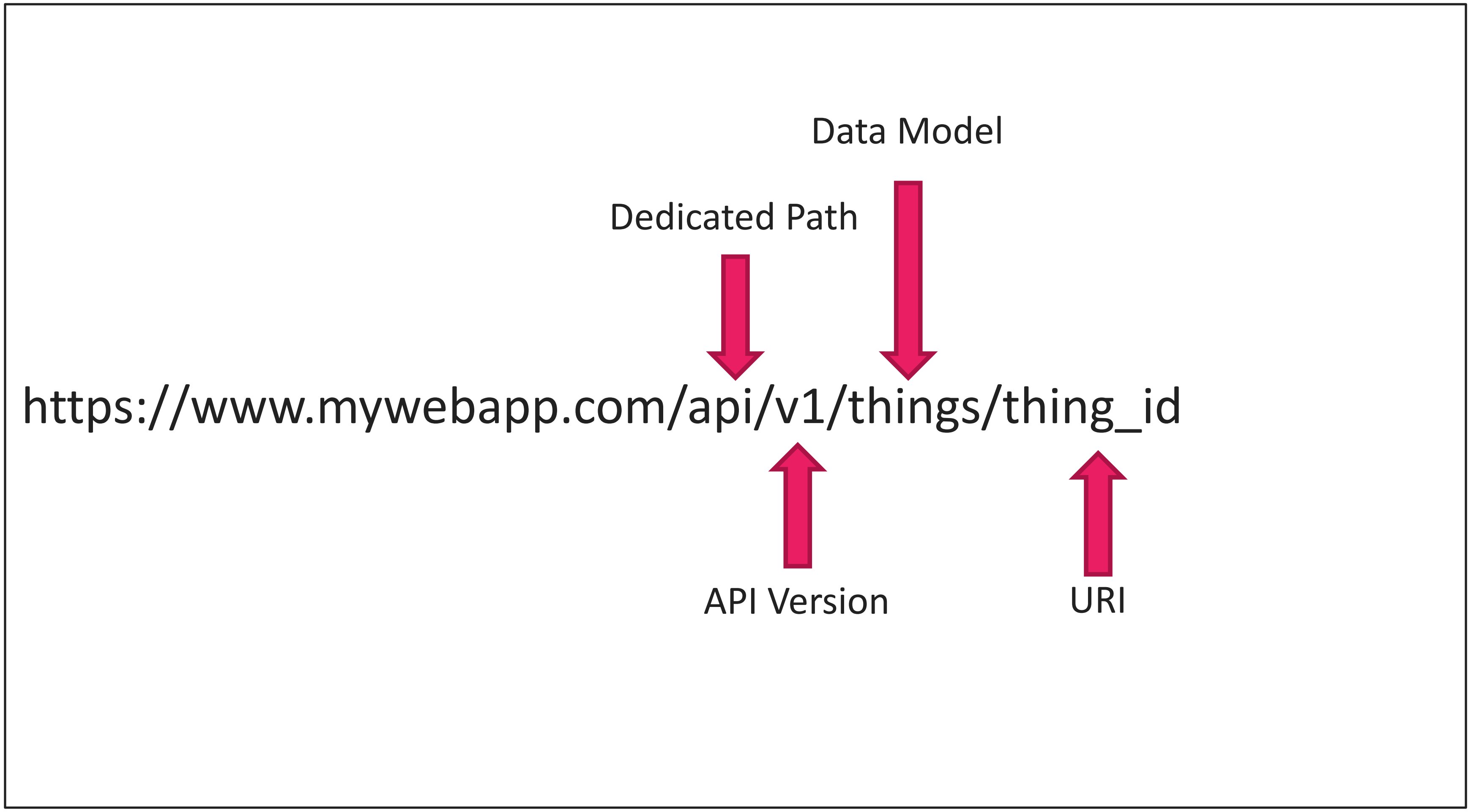
What is an API

- “Application Programming Interface”
- Interface: Allow other services to use program logic
- Goal: Allow pieces of software to talk to each other
- Characteristics of a Great API:
  - Make it easy for others to use your software.
  - “A Good API needs to appeal to laziness” Kevin Lackner
  - **Intuitive** (make it trivial)
  - **Documented** (if something is not trivial)
  - **Opinionated** (do it the way the API encourages you)

REST API

- Representational State Transfer
- Provide clients access to **resources**
- Your app manages the states of the resources, but lets other software access the state through the API
- Reasons for using REST APIs [5]:
  - Scalability
  - Generality by using HTTP
  - Independence from other parts of the app
  - Reduced Latency with caching
  - Security with HTTP headers
  - Encapsulation - APIs do not need to expose everything
- Most common format these days: JSON

A Typical API URL



REST API Quick Glance

- Go and look for a REST API
- Examples
  - Spotify
  - Google Maps
  - Flickr
  - Facebook Graph API
- Questions:
  - What do you think makes it a good / bad API?
  - What kind of access control does it have?
  - What kind of restrictions are there?

API Paradigm: CRUD

- **Create**
  ≈ INSERT INTO myData VALUES (....)
- **Read**
  ≈ SELECT * FROM myData WHERE ...
- **Update**
  ≈ UPDATE myData WHERE ...
- **Delete**
  ≈ DELETE FROM myData WHERE ...

REST APIS WITH NODEJS

You should know Express

- One of the most popular NodeJS frameworks.
- Characteristics:
  - minimalistic
  - easy to use API
  - many utility methods and middleware functionalities
  - thin layer on top of NodeJS
  - Supports multiple template engines (Pug/Jade, Handlebars, EJS)
- Find the documentation here: http://expressjs.com/
- Package:
  ```
  npm install --save express
  ```
- Express generator:
  ```
  npm install -g express
  ```

Simple Express App

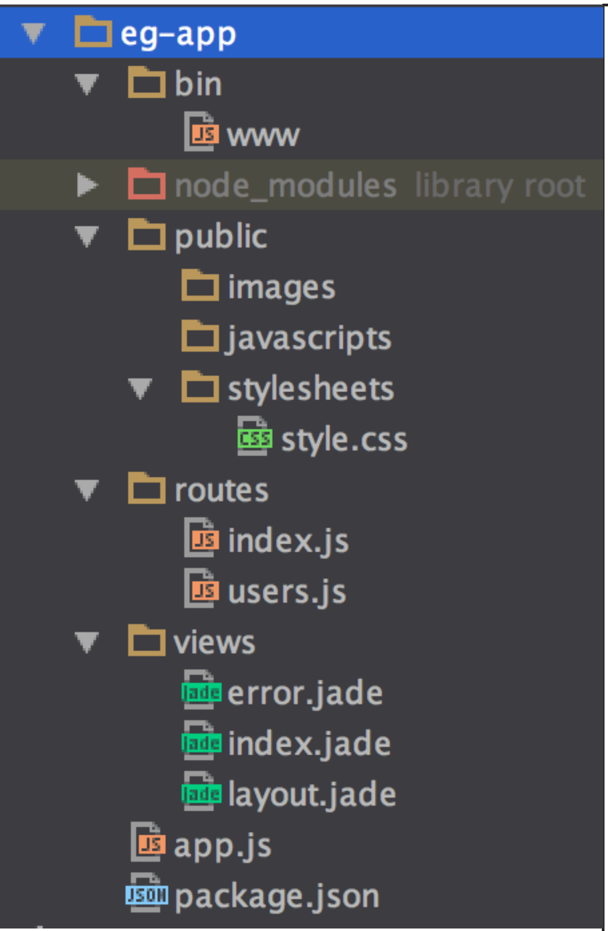
basics/app.js

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

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

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

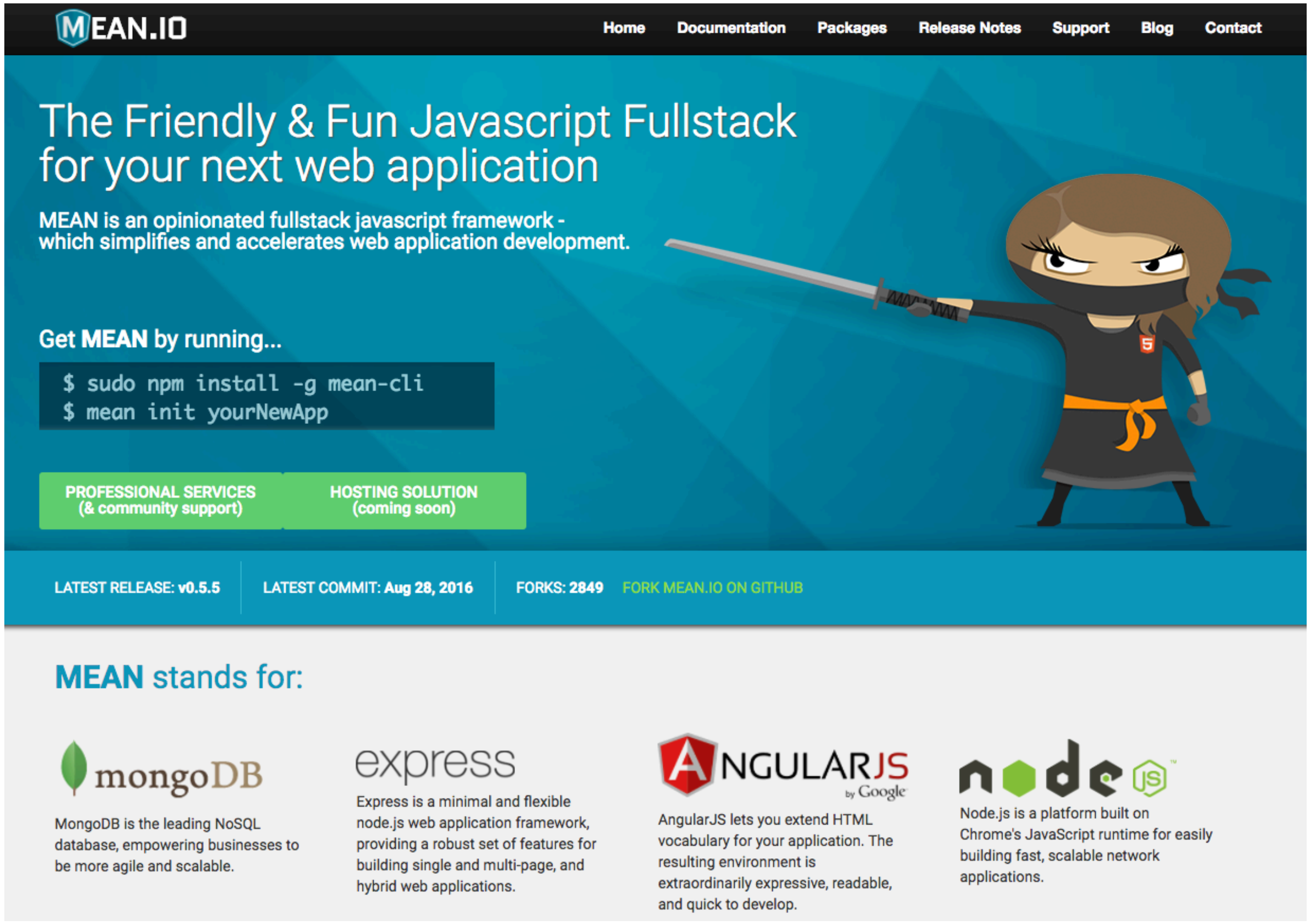
Express Generator


```
eg-app
  bin
    www
  node_modules  library root
  public
    images
    javascripts
    stylesheets
      style.css
  routes
    index.js
    users.js
  views
    error.jade
    index.jade
    layout.jade
  app.js
  package.json
```

- Goal: automatically generate the basic structure
  of an express app that includes
  views, routes, common dependencies
- Requirements: Install the generator globally:
  ```
  $ npm install -g express-generator
  $ express eg-app
  ```
- Documentation:
  http://expressjs.com/starter/generator.html
- You still have to install the dependencies manually:
  ```
  $ cd eg-app && npm install
  ```

Full Stack Solutions

mean.io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The Friendly & Fun Javascript Fullstack for your next web application

MEAN is an opinionated fullstack javascript framework - which simplifies and accelerates web application development.

Get **MEAN** by running...

```
$ sudo npm install -g mean-cli
$ mean init yourNewApp
```

PROFESSIONAL SERVICES (& community support)
HOSTING SOLUTION (coming soon)

LATEST RELEASE: **v0.5.5** LATEST COMMIT: **Aug 28, 2016** FORKS: **2849** FORK MEAN.IO ON GITHUB

MEAN stands for:

mongoDB

MongoDB is the leading NoSQL database, empowering businesses to be more agile and scalable.

express

Express is a minimal and flexible node.js web application framework, providing a robust set of features for building single and multi-page, and hybrid web applications.

ANGULARJS by Google

AngularJS lets you extend HTML vocabulary for your application. The resulting environment is extraordinarily expressive, readable, and quick to develop.

node js

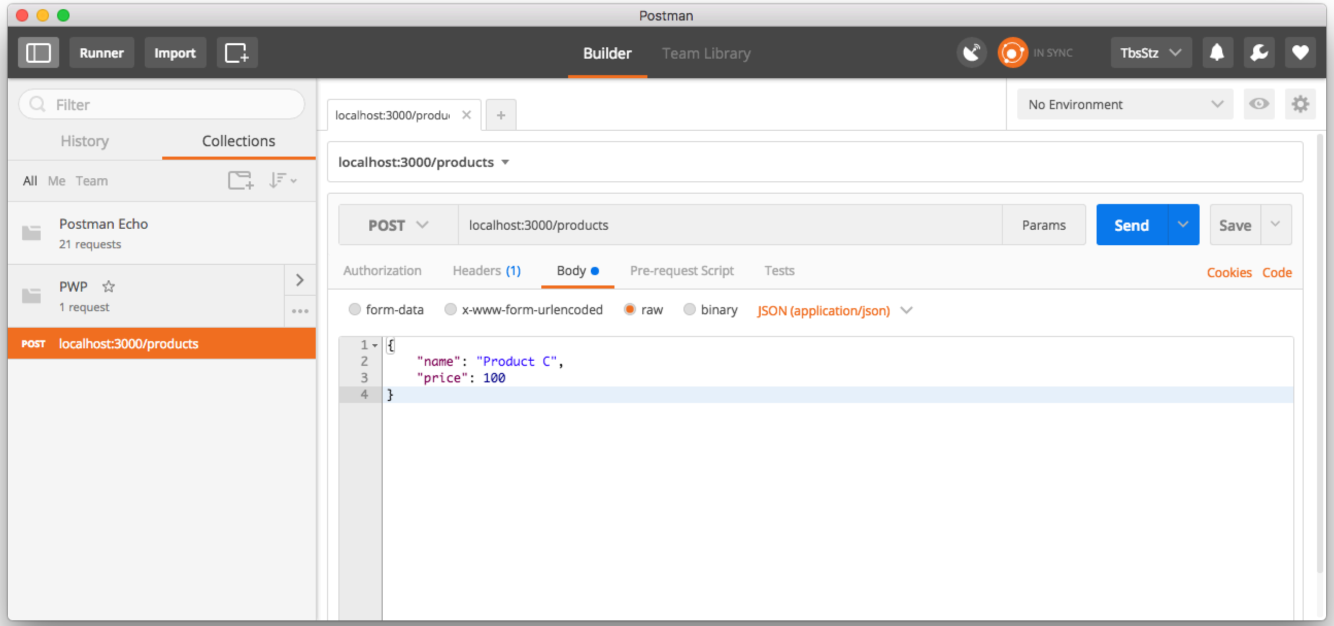
Node.js is a platform built on Chrome's JavaScript runtime for easily building fast, scalable network applications.

CRUD with Express

- Example API that manages products.
- Create a new product:
  `POST /products`
- Retrieve all products:
  `GET /products`
- Retrieve a particular product:
  `GET /product/:id`
- Replace a product:
  `PUT /product/:id`
- Update a product
  `PATCH /product/:id`
- Delete a product
  `DELETE /product/:id`

Testing POST / PUT / DELETE

- Recommended Tool: Postman https://www.getpostman.com/
- Don't forget the headers, e.g. Content-type: application/json
- Make sure your JSON only uses double quotes



localhost:3000/products

POST localhost:3000/products

Body: raw, JSON (application/json)

```
{
    "name": "Product C",
    "price": 100
}
```

Dummy database: JavaScript Object.

```
var products = {
  'id_A': {
    name: 'Product A',
    price: 30
  },
  'id_B': {
    name: 'Product B',
    price: 50
  }
};
```

GET /products

```
router.get('/', function(req, res) {
  var productArray =
    Object.keys(products).map(function(key) {
      var entry = products[key];
      entry.id = key;
      return entry;
    });
  var response = {
    code: 200,
    products: productArray
  };
  res.json(response);
});
```

Response with all products

```
{
  "code": 200,
  "products": [
    {
      "name": "Product A",
      "price": 30,
      "id": "id_A"
    },
    {
      "name": "Product B",
      "price": 50,
      "id": "id_B"
 ]
}
```

Opinionated:
Products is an Array,
instead of an Object literal.

POST /products

```
router.post('/', function(req, res) {
  var entry, id, response;
  if (req.body.name && req.body.price) {
    id = uuid.v1();
    entry = {};
    entry[id] = {
      id : id,
      name: req.body.name,
      price: req.body.price
    };
    products[id] = entry[id];
    response = {
      code: 201,
      message: 'created product',
      products: [entry]
    };
  } else {
    response = {
      code: 1000,
      message: 'missing parameter. required: name, price.'
    }
  }
  res.json(response);
});
```

Intuitive:

Follow API standards

≈ POST creates objects

Response: Product was created

```
{
  "code": 201,
  "message": "created product",
  "products": [
    {
      "182348e0-abfd-11e6-92a7-4fdc0c2e84f9": {
        "id": "182348e0-abfd-11e6-92a7-4fdc0c2e84f9",
        "name": "Product C",
        "price": 100
      }
    }
  ]
}
```

Intuitive:
Respond with the entire created document, so clients can update their views.

What’s up with this?

- Look at the file /routes/products.js
- Can you think of potential problems for your API?
- How would you solve them?

API Frameworks

- Goal: Simpler, faster creation of APIs and CRUD paradigm for resources
- Often with an abstraction layer
- Popular examples:
  - loopback.io - https://loopback.io/
  - hapi.js - http://hapijs.com/
  - Restify - http://restify.com/
- Comparison: https://strongloop.com/strongblog/compare-express-restify-hapi-loopback/

LoopBack

- Now part of StrongLoop Arc (IBM)
- Installation:
  `npm install -g strongloop`
- Getting started wizard:
  `slc loopback`
  - api-server: already contains authentication methods
  - empty-server: most basic setup
  - hello-world: small working sample
  - notes-app: full working example for a note-taking api

Step 1: Set up the project

```
spengler:04-apis Tobi$ slc loopback

     _-----_
    |       |    ╭──────────────────────────╮
    |--(o)--|    │  Let's create a LoopBack │
   `---------´   │       application!       │
    ( _´U`_ )    ╰──────────────────────────╯
    /___A___\   /
     |  ~  |
   __'.___.'__
 ´   `  |° ´ Y `

? What's the name of your application? loopback-api
? Enter name of the directory to contain the project: loopback-api
   create loopback-api/
     info change the working directory to loopback-api

? Which version of LoopBack would you like to use? 2.x (stable)
? What kind of application do you have in mind? hello-world
Generating .yo-rc.json …
```

Step 2: Create a model

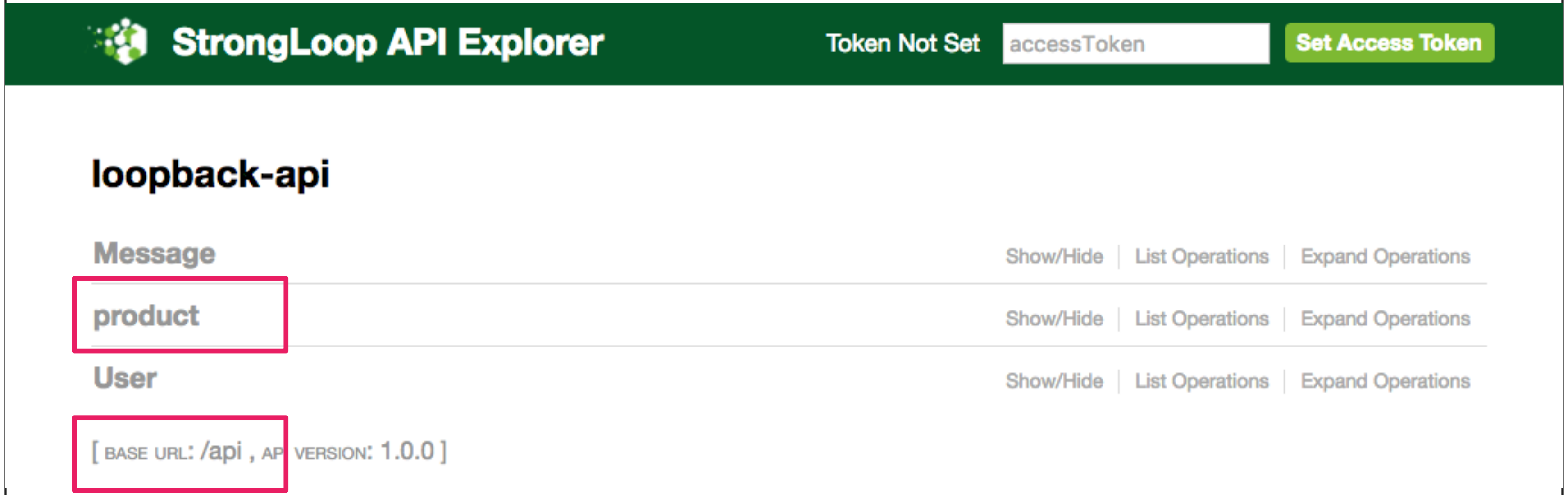
```
spengler:loopback-api Tobi$ slc loopback:model
? Enter the model name: product
? Select the data-source to attach product to: db (memory)
? Select model's base class PersistedModel
? Expose product via the REST API? Yes
? Custom plural form (used to build REST URL): products
? Common model or server only? common
Let's add some product properties now.
```

Step 3: Add properties

```
Enter an empty property name when done.
? Property name: name
   invoke   loopback:property
? Property type: string
? Required? Yes
? Default value[leave blank for none]:

Let's add another product property.
...
```

Step 4: Run the app

```
spengler:loopback-api Tobi$ node .
Web server listening at: http://0.0.0.0:3000
Browse your REST API at http://0.0.0.0:3000/explorer
```


StrongLoop API Explorer

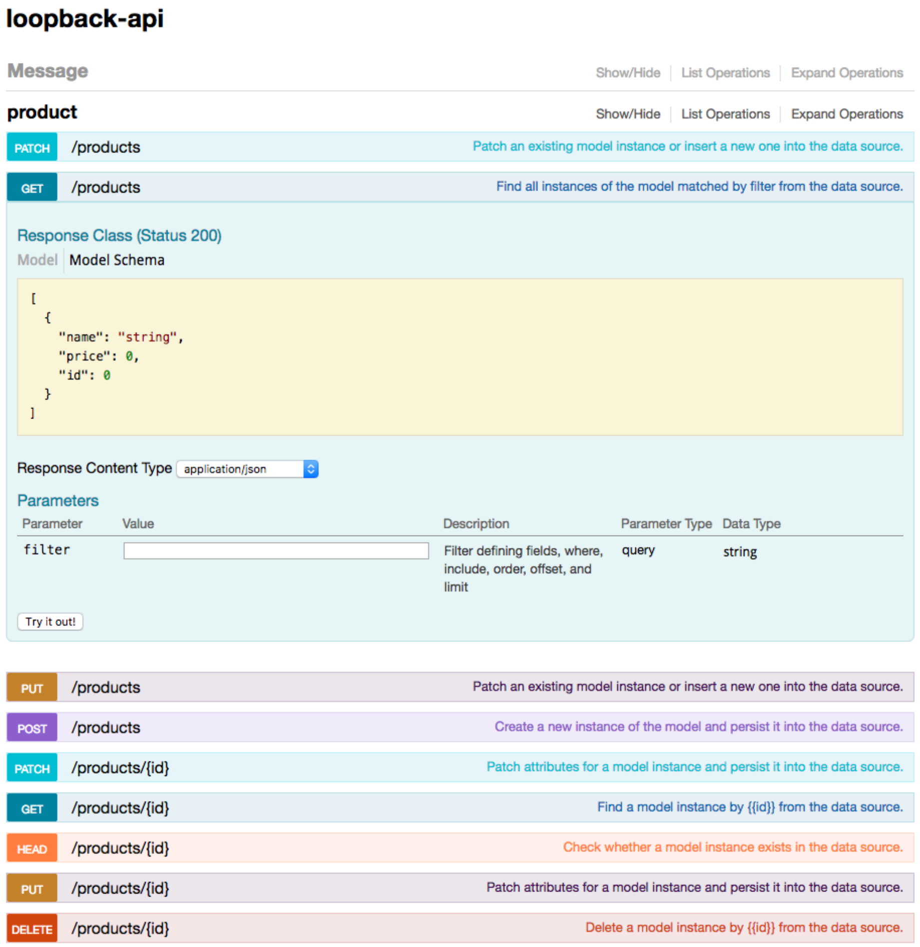
Token Not Set | accessToken | Set Access Token

loopback-api

Message	Show/Hide	List Operations	Expand Operations
product	Show/Hide	List Operations	Expand Operations
User	Show/Hide	List Operations	Expand Operations

[BASE URL: /api , API VERSION: 1.0.0]

Supported Methods


loopback-api

Message — Show/Hide | List Operations | Expand Operations

product — Show/Hide | List Operations | Expand Operations

PATCH /products — Patch an existing model instance or insert a new one into the data source.

GET /products — Find all instances of the model matched by filter from the data source.

Response Class (Status 200)

Model | Model Schema

```
[
  {
    "name": "string",
    "price": 0,
    "id": 0
  }
]
```

Response Content Type: application/json

Parameters

Parameter	Value	Description	Parameter Type	Data Type
filter		Filter defining fields, where, include, order, offset, and limit	query	string

Try it out!

PUT /products — Patch an existing model instance or insert a new one into the data source.

POST /products — Create a new instance of the model and persist it into the data source.

PATCH /products/{id} — Patch attributes for a model instance and persist it into the data source.

GET /products/{id} — Find a model instance by {{id}} from the data source.

HEAD /products/{id} — Check whether a model instance exists in the data source.

PUT /products/{id} — Patch attributes for a model instance and persist it into the data source.

DELETE /products/{id} — Delete a model instance by {{id}} from the data source.

localhost:3000/api/products

Use Postman to add some data...

Response:

```
{
  "name": "Product A",
  "price": 10,
  "id": 1
}
```

Persisting Models to a Database

- Loopback allows using “connectors” for various databases
- MySQL connector:
  ```
  npm install --save loopback-datasource-
  juggler loopback-connector-mysql
  ```
- Getting started:
  ```
  slc loopback:datasource
  ```
- This is not a trivial step, so you really need to try this yourself.
- Links:
  - http://loopback.io/doc/en/lb2/Connecting-to-MySQL.html
  - http://loopback.io/doc/en/lb2/MySQL-connector.html
  - http://loopback.io/doc/en/lb2/Data-source-generator.html
  - https://github.com/strongloop/loopback-connector-mysql

Add a MySQL Datasource

```
spengler:loopback-api Tobi$ slc loopback:datasource
? Enter the data-source name: mysql
? Select the connector for mysql: MySQL (supported by StrongLoop)
Connector-specific configuration:
? Connection String url to override other settings (eg:
mysql://user:pass@host/db):
? host: localhost
? port: 3306
? user: pwp
? password: *************
? database: pwp
```

This will add a new entry to server/datasources.json

server/model-config.json

```
{
  ...
  "product": {
    "dataSource": "mysql",
    "public": true
  }
}
```

Things to note at this point

- If you try to run the app now, you will get an error.
- **Problem**: There is no table “products” in your database
- **Goal**: You want LoopBack to generate this table for you.
- **Solution**: Automigration.
- Automigration also works, if you want to switch the database (e.g. replace MySQL with Cloudant)

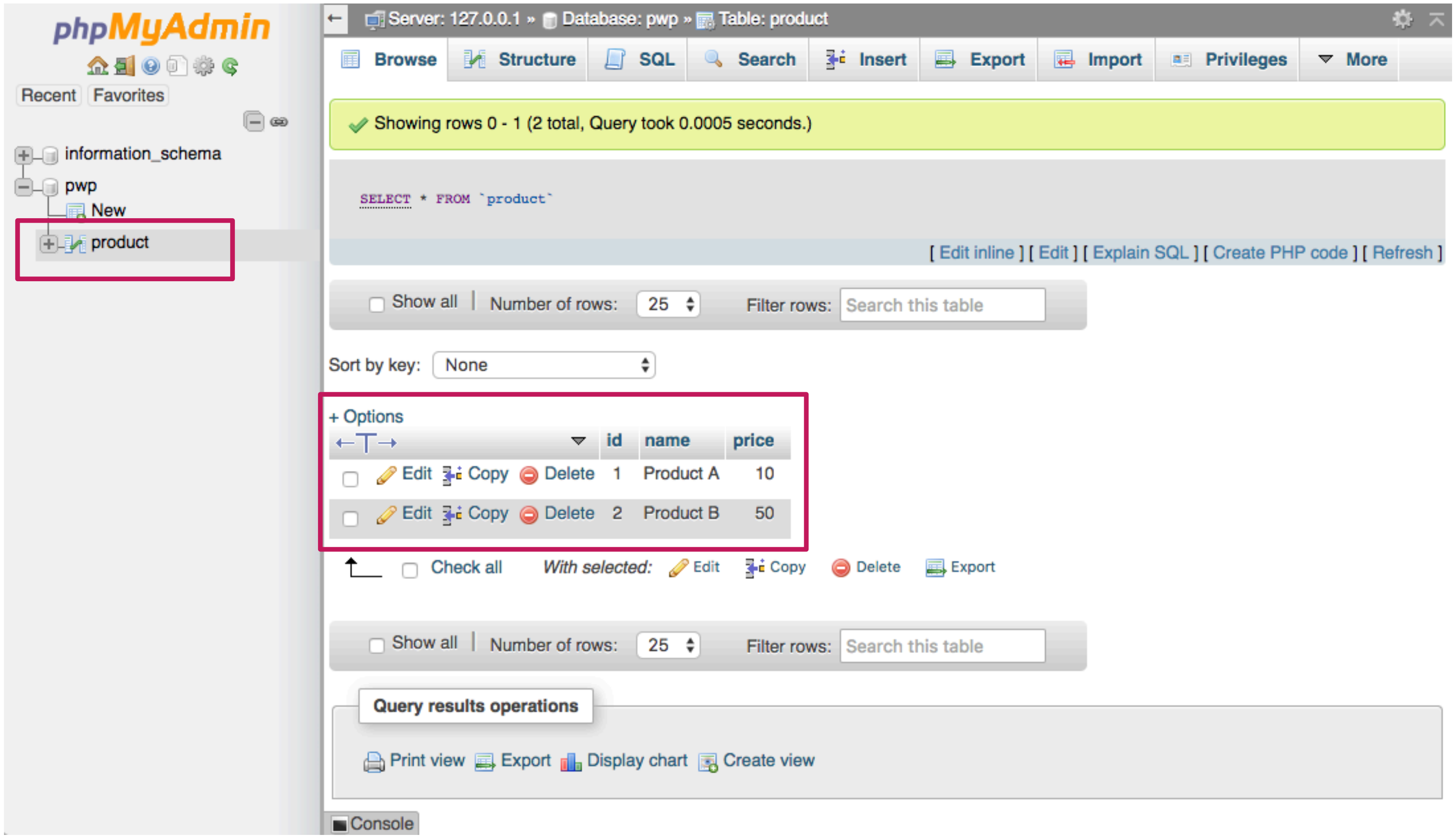
Automigration

```javascript
var path = require('path');
var app = require(path.resolve(__dirname, '../server/server'));

var ds = app.datasources.mysql;
ds.automigrate('product', function(err) {
  if (err) throw err;
  var products = [
    {
      name: 'Product A',
      price: 10
    },
    {
      name: 'Product B',
      price: 50
    }
  ];

  products.forEach(function(product, i) {
    app.models.product.create(product, function(err, model) {
      if (err) throw err;
      console.log('Created: ', model);
      if (i === products.length - 1) {
        ds.disconnect();
      }
    });
  });
});
```

Perform Automigration

```
spengler:loopback-api Tobi$ node bin/automigrate.js
Created:  { name: 'Product A', price: 10, id: 1 }
Created:  { name: 'Product B', price: 50, id: 2 }
```

After Automigration: We have a table!



Showing rows 0 - 1 (2 total, Query took 0.0005 seconds.)

```
SELECT * FROM `product`
```

[Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]
Show all
Number of rows: 25
Filter rows: Search this table
Sort by key: None
+ Options

				id	name	price
☐	Edit	Copy	Delete	1	Product A	10
☐	Edit	Copy	Delete	2	Product B	50

API for your project

- Think of a Resource that is going to be accessible through your project API
- Try to model it
  - properties
  - datatypes
- Perform all steps with loopback

Things that we couldn’t cover

- Autodiscovery of Schemas (LoopBack)
- Securing an API
- Manual Deployment and Configuration
- Process Management and Proxies
- Dockerizing a NodeJS app
- .... and much more.

- ==> We’ll get there, when we need them during the project phase.

Personal Experiences

- Put a lot of work into designing and specifying your API. API changes can break much of the applications using the interface.
- You don’t want to maintain a lot of different versions of the API, so it’s better to plan ahead.
- Make sure to bundle API calls on the front end ➔ Only one module contains API information. The module then exports methods to use the API across the entire front end.

Links 'n' Stuff

Must read:

1. http://www.restapitutorial.com/

Should read:

1. https://geemus.gitbooks.io/http-api-design/content/en/

Wouldn't do any harm:

1. https://www.toptal.com/api-developers/5-golden-rules-for-designing-a-great-web-api
2. https://www.youtube.com/watch?v=heh4OeB9A-c
3. https://www.youtube.com/watch?v=qCdpTji8nxo
4. https://www.youtube.com/watch?v=hdSrT4yjS1g
5. https://stormpath.com/blog/fundamentals-rest-api-design
6. http://web.archive.org/web/20151229055009/http://lcsd05.cs.tamu.edu/slides/keynote.pdf

Links 'n' Stuff

- http://blog.mwaysolutions.com/2014/06/05/10-best-practices-for-better-restful-api/
- http://www.vinaysahni.com/best-practices-for-a-pragmatic-restful-api
- https://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html
- https://github.com/RestCheatSheet/api-cheat-sheet#api-design-cheat-sheet