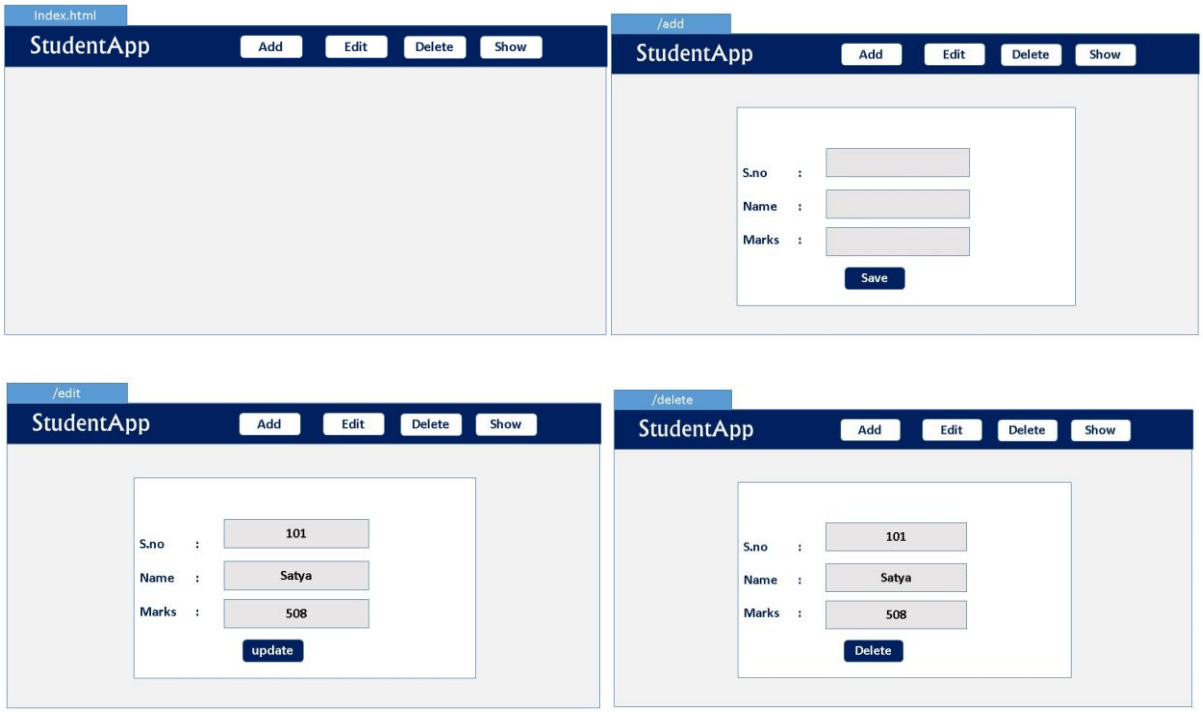
AngularJS with SpringBoot

AngularJs is a Single page application. That means we have only index.html file, but we can change the views in single page.

Index.html

```
<body ng-app="">

   ….

    <div ng-view="">
          // we can change the views as per controller logic display view
     </div>

   ….

<body>
```

SpringBoot App UI



Before going to the implementation, we need to know Basics once.

Basics

AngularJS extends HTML attributes with **Directives**, and binds data to HTML with **Expressions**.

AngularJS is distributed as a JavaScript file, and can be added to a web page with a script tag:

```
<script src="https://ajax.googleapis.com/ajax/libs/angularjs/1.6.9/angular.min.js"></script>
```

- The **ng-app** directive defines an AngularJS application.
- The **ng-model** directive binds the value of HTML controls (input, select, textarea) to application data.
- The **ng-bind** directive binds application data to the HTML view
- **{{ expression }}**. expressions bind AngularJS data to HTML the same way as the **ng-bind** directive

```
<div ng-app="">
  <p>Name: <input type="text" ng-model="name"></p>
  <p ng-bind="name"></p>

 <p>{{name}} </p> //will print the same
</div>
```

Understand with Example

AngularJS Example : index.html

```
<div ng-app="myApp" ng-controller="myCtrl">

First Name: <input type="text" ng-model="firstName"><br> //binds input with model
Last Name: <input type="text" ng-model="lastName"><br> ////binds input with model
Full Name: {{firstName + " " + lastName}}           //Prints the model values
</div>

<script>
var app = angular.module('myApp', []);
app.controller('myCtrl', function($scope) {
    $scope.firstName= "John";
    $scope.lastName= "Doe";
});
</script>
```

1.ng-app

- The `ng-app` directive tells AngularJS that this is the root element of the AngularJS application.
- All AngularJS applications must have a root element.
- You can only have one `ng-app` directive in your HTML document. If more than one `ng-app` directive appears, the first appearance will be used

In index.html. We will have to tell Angular in which part of the application it should be active.

You saw that when declaring the angular module, we named it **app**. To tell it where it should be active we add the attribute **ng-app="app"** in the tag and everything inside of it turns into an AngularJS application.

In our case, as the whole page will be an ngapp it is better to place the attribute in the <html> tag or in the <body> tag.

only one AngularJS application can be auto-bootstrapped per HTML document. The first `ngApp` found in the document will be used to define the root element to auto-bootstrap as an application. To run multiple applications in an HTML document you must manually bootstrap them using `angular.bootstrap` instead.

2.ng-controller

The `ngController` directive specifies a Controller class; the class contains business logic behind the application to decorate the scope with functions and values.

In above '**myCtrl**'has following business logic

```
app.controller('myCtrl', function($scope) {
    $scope.firstName= "John";
    $scope.lastName= "Doe";
});
```

3.angular.module

The `angular.module` is a global place for creating, registering and retrieving AngularJS modules. All modules (AngularJS core or 3rd party) that should be available to an application must be registered using this mechanism.

```
var app = angular.module('myApp', []);
```

in this line we registred the module with variable 'app'. Now we can access this module in whole application with variable name to perform any kind of operations.

A module is a collection of services, directives, controllers, filters, and configuration information. `angular.module` is used to configure the $injector.

```
// Create a new module
var myModule = angular.module('myModule', []);

// register a new service
myModule.value('appName', 'MyCoolApp');

// configure existing services inside initialization blocks.
myModule.config(['$locationProvider', function($locationProvider) {
  // Configure existing providers
  $locationProvider.hashPrefix('!');
}]);
```

3.$scope

- $scope is a Global Object which can accessed by both view and controller.
- When adding properties to the `$scope` object in the controller, the view (HTML) gets access to these properties
- All applications have a `$rootScope` which is the scope created on the HTML element that contains the `ng-app` directive.
- The rootScope is available in the entire application.

AngularJs internal working

Now you will take a look at the architecture concepts of AngularJS. When an HTML document is loaded into the browser and is evaluated by the browser, the following happens:

1. The **AngularJS JavaScript** file is loaded, and the Angular global object`$scope` is created. The JavaScript file that registers the controller functions is executed.

2. AngularJS scans the HTML to look for **AngularJS apps and views** and finds **a controller function corresponding to the view.**

3. AngularJS **executes the controller functions and updates the views** with data from the model populated by the controller.

4. AngularJS listens for browser events, such as button clicked, mouse moved, input field being changed, and so on. If any of these events happen, then AngularJS will update the view accordingly

Bootstrapping AngularJS by Adding ng-app in an HTML Page

```
<html lang="en" ng-app="userregistrationsystem">...</html>
```

This is also known as automatic initialization. So, when AngularJS finds the **ng-app** directive after analyzing the **index.html** file, it loads the associated modules and then compiles the DOM.

Few More Examples

AngularJS Example : ng-init, {{ expression }} = ng-bind

```
<div ng-app="" ng-init="firstName='John';lastName='Doe'">
        <p>The name is {{ firstName + " " + lastName }}</p>
        <p>The name is <span ng-bind="firstName + ' ' + lastName"></span></p>
</div>
```

AngularJS Objects

AngularJS objects are like JavaScript objects:

```
<div ng-app="" ng-init="person={firstName:'John',lastName:'Doe'}">
       <p>The name is {{ person.lastName }}</p> //or
      <p>The name is <span ng-bind="person.lastName"></span></p>
</div>
```

AngularJS Arrays

AngularJS arrays are like JavaScript arrays:

```
<div ng-app="" ng-init="points=[1,15,19,2,40]">
     <p>The third result is {{ points[2] }}</p>
</div>
```

AngularJS Module

- Creating a Module

```
<div ng-app="myApp">...</div>
<script>
     var app = angular.module("myApp", []);
</script>
```

- Adding a Controller

```
<script>

var app = angular.module("myApp", []);

app.controller("myCtrl", function($scope) {
  $scope.firstName = "John";
  $scope.lastName = "Doe";
});

</script>
```

AngularJs Validation

The `ng-model` directive can provide type validation for application data (number, e-mail, required):

```
<form ng-app="" name="myForm">
  Email:
  <input type="email" name="myAddress" ng-model="text">
  <span ng-show="myForm.myAddress.$error.email">Not a valid e-mail address</span>
</form>
```

AngularJs Controllers – with Different Data

- Inside another function

```
<script>
var app = angular.module('myApp', []);
app.controller('personCtrl', function($scope) {
  $scope.firstName = "John";
  $scope.lastName = "Doe";
  $scope.fullName = function() {
    return $scope.firstName + " " + $scope.lastName;
  };
});
</script>
```

- With Array data

```
File : namesController.js
angular.module('myApp', []).controller('namesCtrl', function($scope) {
  $scope.names = [
    {name:'Jani',country:'Norway'},
    {name:'Hege',country:'Sweden'},
    {name:'Kai',country:'Denmark'}
  ];
});
```

```
<div ng-app="myApp" ng-controller="namesCtrl">
<ul>
  <li ng-repeat="x in names">
    {{ x.name + ', ' + x.country }}
  </li>
</ul>
</div>
<script src="namesController.js"></script>
```

AngularJS Filters

AngularJS provides filters to transform data:

- `uppercase` Format a string to upper case.

```
<p>The name is {{ lastName | uppercase }}</p>
```

- `lowercase` Format a string to lower case.

```
<p>The name is {{ lastName | lowercase }}</p>
```

- `currency` Format a number to a currency format.

```
<h1>Price: {{ price | currency }}</h1> //output is : Price: $58.00
```

- `filter` Select a subset of items from an array.

  This example displays only the names containing the letter "i".

```
<ul>
  <li ng-repeat="x in names | filter : 'i'">
    {{ x }}
  </li>
</ul>
```

- `orderBy` Orders an array by an expression.

```
<ul>
  <li ng-repeat="x in names | orderBy:'country'">
    {{ x.name + ', ' + x.country }}
  </li>
</ul>
```

- `json` Format an object to a JSON string.
- `date` Format a date to a specified format.
- `number` Format a number to a string.
- `limitTo` Limits an array/string, into a specified number of elements/characters.

AngularJS Services

- In AngularJS, a service is a **function, or object**, that is available for your AngularJS application.
- AngularJS has about 30 built-in services. One of them is the `$location` service.

1.$location

returns information about the location of the current web page:

```
var app = angular.module('myApp', []);
app.controller('customersCtrl', function($scope, $location) {
    $scope.myUrl = $location.absUrl();
});
```

```
{{myUrl}} //prints
https://www.w3schools.com/angular/tryit.asp?filename=try_ng_services
```

$2.$http

$http is an AngularJS service for reading data from remote servers. The AngularJS `$http` service makes a request to the server, and returns a response.

```
var app = angular.module('myApp', []);
app.controller('myCtrl', function($scope, $http) {
  $http.get("welcome.htm").then(function (response) {
    $scope.myWelcome = response.data;
  });
});
```

More on Http

The example above uses the `.get` method of the `$http` service.

The `.get` method is a shortcut method of the `$http` service. There are several shortcut methods:

- `.get()`
- `.post()`
- `.put()`
- `.delete()`
- `.head()`
- `.jsonp()`
- `.patch()`

```
var app = angular.module('myApp', []);
app.controller('myCtrl', function($scope, $http) {
  $http({
    method : "GET",
      url : "welcome.htm"
  }).then(function mySuccess(response) {
    $scope.myWelcome = response.data;
  }, function myError(response) {
    $scope.myWelcome = response.statusText;
  });
});
```

Responnse Types

- `.config` the object used to generate the request.
- `.data` a string, or an object, carrying the response from the server.
- `.headers` a function to use to get header information.
- `.status` a number defining the HTTP status.
- `.statusText` a string defining the HTTP status.

```
<div ng-app="myApp" ng-controller="myCtrl">
  <p>Data : {{content}}</p>
  <p>Status : {{statuscode}}</p>
  <p>StatusText : {{statustext}}</p>
</div>

var app = angular.module('myApp', []);
app.controller('myCtrl', function($scope, $http) {
  $http.get("welcome.htm")
  .then(function(response) {
    $scope.content = response.data;
    $scope.statuscode = response.status;
    $scope.statustext = response.statusText;
  });
});
```

```
Data : Hello AngularJS Students
Status : 200
StatusText :
```

`$timeout`

The `$timeout` service is AngularJS' version of the `window.setTimeout` function.

```
var app = angular.module('myApp', []);
app.controller('myCtrl', function($scope, $timeout) {
  $scope.myHeader = "Hello World!";
  $timeout(function () {
    $scope.myHeader = "How are you today?";
  }, 2000);
});
```

AngularJs DOM Elements

Like in JavaScript we can hide,show,disable DOM elements

```
<button disabled>Click Me!</button>     //to Disable button
```

- Hide/show

```
<p ng-show="true">I am visible.</p>
<p ng-show="false">I am not visible.</p>

<p ng-hide="true">I am not visible.</p>
<p ng-hide="false">I am visible.</p>
```

AngularJS Events

You can add AngularJS event listeners to your HTML elements by using one or more of these directives:

- `ng-blur`
- `ng-change`
- `ng-click`
- `ng-copy`
- `ng-cut`
- `ng-dblclick`
- `ng-focus`
- `ng-keydown`
- `ng-keypress`
- `ng-keyup`
- `ng-mousedown`
- `ng-mouseenter`
- `ng-mouseleave`
- `ng-mousemove`
- `ng-mouseover`
- `ng-mouseup`
- `ng-paste`

Increase the count variable when the mouse clicked.

```
<div ng-app="myApp" ng-controller="myCtrl">
  <button ng-click="count = count + 1">Click me!</button>
  <p>{{ count }}</p>
</div>

//At Start count is 0 once Js load
<script>
var app = angular.module('myApp', []);
```

```
app.controller('myCtrl', function($scope) {
  $scope.count = 0;
});
</script>
```

Same, replace with function call

```
<div ng-app="myApp" ng-controller="myCtrl">

<button ng-click="myFunction()">Click me!</button>

<p>{{ count }}</p>

</div>
<script>
var app = angular.module('myApp', []);
app.controller('myCtrl', function($scope) {
  $scope.count = 0;
  $scope.myFunction = function() {
    $scope.count++;
  }
});
</script>
```

AngularJS Includes

With **ng-include** directive, you can include HTML from an external file.

```
<div ng-include="'myFile.htm'"></div>
```

AngularJS Routing

The `ngRoute` module helps your application to become a Single Page Application.

- If you want to navigate to different pages in your application, but you also want the application to be a SPA (Single Page Application), with no page reloading, you can use the `ngRoute` module.
- The `ngRoute` module *routes* your application to different pages without reloading the entire application.

For doing this

- you must include the AngularJS Route module JS

```
<script src="https://ajax.googleapis.com/angular-route.js"></script>
```

- Then you must add the `ngRoute` as a dependency in the application module:

```
var app = angular.module("myApp", ["ngRoute"]);
```

- Now your application has access to the route module, which provides the `$routeProvider`. Use the `$routeProvider` to **configure(`app.config`)** different routes in your application:

```
app.config(function($routeProvider) {
  $routeProvider
  .when("/", {
    templateUrl : "main.htm"
  })
  .when("/red", {
    templateUrl : "red.htm"
  })
  .when("/green", {
    templateUrl : "green.htm"
  })
  .when("/blue", {
    templateUrl : "blue.htm"
  });
});
```

Example

```
<body ng-app="myApp">
<a href="#/!">Main</a></p>
<a href="#!red">Red</a>
<a href="#!green">Green</a>
<a href="#!blue">Blue</a>

<div ng-view>
      <! –HERE CONTENT CHANGES -->
</div>

<script>
var app = angular.module("myApp", ["ngRoute"]);
```

```
app.config(function($routeProvider) {
  $routeProvider
  .when("/", {
    templateUrl : "main.htm"
  })
  .when("/red", {
    templateUrl : "red.htm"
  })
  .when("/green", {
    templateUrl : "green.htm"
  })
  .when("/blue", {
    templateUrl : "blue.htm"
  });
});
</script>
</body>
```

1.ng-view

Your application needs a container to put the **content** provided by the routing.This container is the `ng-view` directive. There are three different ways to include the ng-view directive in your application:

1. `<div ng-view></div>`
2. `<div class="ng-view"></div>`
3. `<ng-view></ng-view>`

Applications can only have one `ng-view` directive, and this will be the placeholder for all views provided by the route.

2.routeProvider

With the `$routeProvider` you can also define a controller for each "view".

```
var app = angular.module("myApp", ["ngRoute"]);
app.config(function($routeProvider) {
  $routeProvider
  .when("/", {
    templateUrl : "main.htm"
  })
  .when("/london", {
    templateUrl : "london.htm",
    controller : "londonCtrl"
```

```
  })
  .when("/paris", {
    templateUrl : "paris.htm",
    controller : "parisCtrl"
  });
});
app.controller("londonCtrl", function ($scope) {
  $scope.msg = "I love London";
});
app.controller("parisCtrl", function ($scope) {
  $scope.msg = "I love Paris";
});
```

3.template

In the previous examples we have used the `templateUrl` property in the `$routeProvider.when` method. You can also use the `template` property, which allows you to **write HTML directly in the property value**, and not refer to a page.

```
var app = angular.module("myApp", ["ngRoute"]);
app.config(function($routeProvider) {
  $routeProvider
  .when("/", {
    template : "<h1>Main</h1><p>Click on the links to change this content</p>"
  })
  .when("/banana", {
    template : "<h1>Banana</h1><p>Bananas contain around 75% water.</p>"
  })
  .when("/tomato", {
    template : "<h1>Tomato</h1><p>Tomatoes contain around 95% water.</p>"
  });
});
```

4. otherwise

In the previous examples we have used the `when` method of the `$routeProvider`.You can also use the `otherwise` method, which is the default route when none of the others get a match.

If use not clicked **/banana,/tamoto** for example user clicks **/apple** then otherwise will do the job.

```
var app = angular.module("myApp", ["ngRoute"]);
app.config(function($routeProvider) {
  $routeProvider
  .when("/banana", {
```

```
    template : "<h1>Banana</h1><p>Bananas contain around 75% water.</p>"
  })
  .when("/tomato", {
    template : "<h1>Tomato</h1><p>Tomatoes contain around 95% water.</p>"
  })
  .otherwise({
    template : "<h1>None</h1><p>Nothing has been selected</p>"
  });
});
```

AngularJS Architecture Concepts

Now you will take a look at the architecture concepts of AngularJS. When an HTML document is loaded into the browser and is evaluated by the browser, the following happens:

1. The **AngularJS JavaScript** file is loaded, and the Angular global object `$scope` is created. The JavaScript file that registers the controller functions is executed.

2. AngularJS scans the HTML to look for **AngularJS apps and views** and finds **a controller function corresponding to the view.**

3. AngularJS **executes the controller functions and updates the views** with data from the model populated by the controller.

4. AngularJS listens for browser events, such as button clicked, mouse moved, input field being changed, and so on. If any of these events happen, then AngularJS will update the view accordingly

Bootstrapping AngularJS by Adding ng-app in an HTML Page

```
<html lang="en" ng-app="userregistrationsystem">...</html>
```

This is also known as automatic initialization. So, when AngularJS finds the **ng-app** directive after analyzing the **index.html** file, it loads the associated modules and then compiles the DOM.

The AngularJS application **UserRegistrationSystem** is defined as the AngularJS module (**angular.module**) in app.js, which is the entry point into the application.

```
var app = angular.module('userregistrationsystem', ['ngRoute', 'ngResource']);
```

As you can see, the two dependencies have been defined in **app.js** as needed by **userregistrationsystem** at startup. The two dependencies in the previous code are defined in an array in the module definition.

- **ngRoute:** The first dependency is the AngularJS **ngRoute** module, which provides routing to the application. The ngRoute module is used for deep-linking URLs to controllers and views.
- **ngResource:** The second dependency is the AngularJS **ngResource** module, which provides interaction support with RESTful services

AngularJS Routes

AngularJS routes are configured using them **$routeProvider** API. Routes are dependent on the ngRoute module, which is why its dependency is defined in an array in the module definition.

app.js. You will define four routes in your AngularJS application.

- The first is /list-all-users.
- The second one is /register-new-user
- The third one is /update-user/:id
- The fourth one is different from the other three

```
var app = angular.module('userregistrationsystem', [ 'ngRoute', 'ngResource' ]);

app.config(function($routeProvider) {
   $routeProvider.when('/list-all-users', {
          templateUrl : '/template/listuser.html',
          controller : 'listUserController'
   }).when('/register-new-user',{
          templateUrl : '/template/userregistration.html',
          controller : 'registerUserController'
   }).when('/update-user/:id',{
          templateUrl : '/template/userupdation.html' ,
          controller : 'usersDetailsController'
   }).otherwise({
          redirectTo : '/home',
          templateUrl : '/template/home.html',
   });
});
```

- When the user clicks the link in the application specified at http://localhost:8080/#/list-all-users, the /list-all-users route will be followed, and the content associated with the /list-all-users URL will be displayed

in app.config , each route is mapped to a template and controller (optional).

- The controller listUserController will be called when you navigate to the URL /list-all-users
- controller registerUserController will be called when you navigate to the URL /register-new-user

AngularJS Templates

- AngularJS templates, also known as HTML partials, are HTML code that are bound to the <div ng-view> tag shown in the index.html file. If you look at the code from the
- app.js file, you can see that different templateUrl values are defined for different routes, as shown in above code
- The listuser.html, userregistration.html , userupdation.html , and home.html pages are four different partials or templates, which contain HTML code and AngularJS's built-in template language to display dynamic data in your template.

```
<html lang="en" ng-app="userregistrationsystem">
<head>
<title>Full Stack Development</title>
<link rel="stylesheet" href="/css/app.css">
</head>
<body>
	<div class="page-header text-center">
		<h2>User Registration System</h2>
	</div>
<nav class="navbar navbar-default">
   <div class="container-fluid">
	<a href="#/" class=" navbar-btn" role="button">Home</a>
	<a href="#/register-new-user" role="button">  Register New User</a>
	<a href="#/list-all-users" class="" role="button">List All Users</a>
  </div>
</nav>
	<div ng-view></div>
	<script src="/webjars/angularjs/1.4.9/angular.js"></script>
	<script src="/webjars/angularjs/1.4.9/angular-resource.js"></script>
	<script src="/webjars/angularjs/1.4.9/angular-route.js"></script>
	<script src="/js/app.js"></script>
	<script src="/js/controller.js"></script>
	<link rel="stylesheet"
		href="/webjars/bootstrap/3.3.6/css/bootstrap.css">
</body>
</html>
```

You have included a separate app.js, which is where you will be defining the application behavior.

Let's create four view pages in the template folder inside the src/main/resources/static directory.

•Home page :src/main/resources/template/home.html

•Register New User page :src/main/resources/template/userregistration.html

```
<form ng-submit="submitUserForm()" name="myForm" class="form-horizontal">

	<input type="text" ng-model="user.name" id="uname" />
	<input type="text" ng-model="user.address" id="address"/>
	<input type="email" ng-model="user.email" id="email" />

	<input type="submit" value="Register User"/>
	<button type="button" ng-click="resetForm()">Reset Form</button>
</form>
```

•List Of User page :**src/main/resources/template/listuser.html**

```
<table class="table table-hover table-bordered ">
	<thead>
		<tr>
			<th>Name</th>
			<th>Email</th>
			<th>Address</th>
			<th width="100">Edit</th>
			<th width="100">Delete</th>
		</tr>
	</thead>
	<tbody>
		<tr ng-repeat="user in users">
			<td>{{user.name}}</td>
			<td>{{user.email}}</td>
			<td>{{user.address}}</td>
			<td>
	<button type="button" ng-click="editUser(user.id)">	Edit</button>
			</td>
		<td>
	<button type="button" ng-click="deleteUser(user.id)"> Delete</button></td>
	</tr>
	</tbody>
</table>
```

AngularJS Controller

controller.js file defined in the **src/main/resources/static/js** folder contains the implementation of AngularJS controllers

- -On a successful POST call, it will redirect to list-all-users
- -$scope is used to set up dynamic content for the UI elements that this controller is responsible for
- -$http: The $http service is the core feature provided by AngularJS and is used to consume the REST

```
app.controller('registerUserController', function($scope, $http, $location,
		$route) {

	$scope.submitUserForm = function() {
		$http({
			method : 'POST',
			url : 'http://localhost:8080/api/user/',
			data : $scope.user,
		}).then(function(response) {
			$location.path("/list-all-users");
			$route.reload();
		}, function(errResponse) {
			$scope.errorMessage = errResponse.data.errorMessage;
		});
	}

	$scope.resetForm = function() {
		$scope.user = null;
	};
});
```

AngularJs + SpringBoot Example implementation

Index.html

- Create index.html & add all Anuglar related jars
- Declare body ng-app="*stApp*"> which will be the Startig point of our AngularJs App
- Create module

  ```
  var app = angular.module("myApp", []);
  ```

  if no dependencies are there [ ] will be empty

```
<body ng-app="stApp">

<nav class="navbar navbar-inverse">
ADD, EDIT, DELETE etc
</nav>

<div class="container">
 <h1>Student Application</h1>
</div>

</body>
</html>
```

References

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JUNIT

1.JUNIT Introduction

Testing is the process of checking the functionality of an application to ensure it runs as per requirements. **Unit testing** comes into picture at the developers' level; it is the testing of single entity **(class or method).** Unit testing can be done in two ways –**manual testing & automated testing**

1. Manual Testing: If you execute the test cases manually without any tool support, it is known as manual testing. It is time consuming and less reliable.

2. Automated Testing: If you execute the test cases by tool support, it is known as automated testing. It is fast and more reliable.

XUnit architecture **introduced automated unit testing**. There are many unit testing frame works for different programming. Few of the unit testing frame works are:

- JAVA - **JUnit**,
- C - **CUnit**,
- C++ - **CPPUnit**,
- .NET - .**NUnit** etc..

XUnit architecture was first implemented for java.**It is known as JUnit**

JUnit

It is an open-source testing framework for java programmers. The java programmer can create test cases and test his/her own code.It is one of the unit testing framework. Current version is **junit 5**.you can download it from **JUnit website (github)** or use below maven dependency in your **pom.xml**

```
<dependency>
  <groupId>junit</groupId>
  <artifactId>junit</artifactId>
  <version>4.12</version>
  <scope>test</scope>
</dependency>
```

The Junit 4.x framework is annotation based. Here're some basic JUnit annotations

- **@Test -**Given method is the test method.= `public void`
- **@Test(timeout=1000)** -method will be failed if it takes more then 1000 milliseconds (1 sec).
- **@BeforeClass** - method will be invoked only once, before starting all the tests. `public static void`
- **@AfterClass** -method will be invoked only once, after finishing all the tests `public static void`
- **@Before** -method will be invoked before each test. Run before @Test, `public void`
- **@After** - method will be invoked after each test. Run after @Test, `public void`

The most important package in JUnit is **junit.framework**, which contains all the core classes. Some of the most important classes are given below

1.Assert - set of assert methods.
2.TestCase - It is the testing of single entity (class or method)
3.TestSuite - A test suite bundles a few unit test cases and runs them together.
3.TestResult - Contains methods to collect the results of executing a test case.

REMEMBER: If Junit tests not Running means

By default Maven uses the following naming conventions when looking for tests to run:

- **Test***
- ***Test**
- ***TestCase**

1.Assert

The org.junit.Assert class provides methods to assert the program logic. Assert methods are usually used to **compare the actual value with the expected value**. All assert methods are static methods. Return type of all assert methods are void

1. **void assertEquals(boolean expected,boolean actual)**: checks that two primitives/objects are equal. It is overloaded.
2. **void assertTrue(boolean condition)**: checks that a condition is true.
3. **void assertFalse(boolean condition)**: checks that a condition is false.
4. **void assertNull(Object obj)**: checks that object is null.
5. **void assertNotNull(Object obj)**: checks that object is not null.

2.Test Case

It is the testing of single entity (class or method)

```
public class TestJunit1 {

   String message = "Robert";
   MessageUtil messageUtil = new MessageUtil(message);

   @Test
   public void testPrintMessage() {
      System.out.println("Inside testPrintMessage()");
      assertEquals(message, messageUtil.printMessage());
   }
}
```

3.Test Suites

A test suite bundles a few unit test cases and runs them together.

```
import org.junit.runner.RunWith;
import org.junit.runners.Suite;

//JUnit Suite Test
@RunWith(Suite.class)

@Suite.SuiteClasses({
   TestJunit1.class ,TestJunit2.class
})

public class JunitTestSuite {
}
```

4.Test Runners

Test runner is used for executing the test cases.

```
public class TestRunner {
```

```
   public static void main(String[] args) {
      Result result = JUnitCore.runClasses(TestJunit.class);

      for (Failure failure : result.getFailures()) {
         System.out.println(failure.toString());
      }

      System.out.println(result.wasSuccessful());
   }
}
```

TestResult(`Result`**)** – Contains methods to collect the results of executing a test case.

Example 1 : Testing Annotations Working

```
package basic;
import org.junit.*;
public class AnnotationsTest {
        // Run once, e.g. Database connection, connection pool
    @BeforeClass
    public static void runOnceBeforeClass() {
        System.out.println("@BeforeClass - runOnceBeforeClass");
    }

    // Run once, e.g close connection, cleanup
    @AfterClass
    public static void runOnceAfterClass() {
        System.out.println("@AfterClass - runOnceAfterClass");
    }

    // Should rename to @BeforeTestMethod
    // e.g. Creating an similar object and share for all @Test
    @Before
    public void runBeforeTestMethod() {
        System.out.println("@Before - runBeforeTestMethod");
    }

    // Should rename to @AfterTestMethod
    @After
    public void runAfterTestMethod() {
        System.out.println("@After - runAfterTestMethod");
    }

    @Test
    public void TestMethod1() {
        System.out.println("@Test - TestMethod1");
    }

    @Test
    public void TestMethod2() {
        System.out.println("@Test - TestMethod2");
    }
}
```

```
@BeforeClass – runOnceBeforeClass

@Before - runBeforeTestMethod
@Test - TestMethod1
@After – runAfterTestMethod

@Before - runBeforeTestMethod
@Test - TestMethod2
@After – runAfterTestMethod
```

```
@AfterClass - runOnceAfterClass
```

Note: All sources of production code commonly reside in the src/main/java directory, while all test source files are kept at src/test/java

2. JUnit Hello World!

To write testcases we must figute out below points

1. ***Class to be tested***
2. ***Write Testcases for selected class***
3. ***Run the Test (Commandline / TestRunner class)***

1. Class to be tested

```
package junit;
public class Calculator {
public int square(int x){
        return x*x;
}
}
```

2. Write Testcases for selected class

```
package junit;
import static org.junit.Assert.*;
import org.junit.Test;
public class CalculatorTest {
        @Test
          public void squareTest() {
            Calculator calculator = new Calculator();
            int sqr = calculator.square(2);
            //Checking for 2
            assertEquals("2*2=4 Passed",4, sqr);//pass
            assertEquals("2*2=4 Passed",6, sqr); //Fail
          }
}
```

3. Run the Test (Commandline / TestRunner class)

Using command line

```
java -cp .;junit-4.XX.jar;hamcrest-core-1.3.jar org.junit.runner.JUnitCore CalculatorTest
```

Using TestRunner class

```
package junit;
import org.junit.runner.*;
public class TestRunner {
        public static void main(String[] args) {
                Result result = JUnitCore.runClasses(CalculatorTest.class);

                for (Failure failure : result.getFailures()) {
                        System.out.println("Failure : " + failure.toString());
                }
                System.out.println("Success : " + result.wasSuccessful());
        }
}
```

```
Failure : squareTest(junit.CalculatorTest): 2*2=4 Passed expected:<6> but
was:<4>
Success : false  //for assertEquals("2*2=4 Passed",6, sqr); //Fail

Success : true //for assertEquals("2*2=4 Passed",4, sqr);//pass
```

4. JUnit Examples

4.1 Assert all Methods Example

```java
import static org.hamcrest.CoreMatchers.*;
import static org.junit.Assert.*;
import java.util.Arrays;
import org.hamcrest.core.CombinableMatcher;
import org.junit.Test;

public class AssertTests {
  @Test
  public void testAssertArrayEquals() {
    byte[] expected = "trial".getBytes();
    byte[] actual = "trial".getBytes();
    assertArrayEquals("failure - byte arrays not same", expected, actual);
  }

  @Test  public void testAssertEquals() {
    assertEquals("failure - strings are not equal", "text", "text");
  }

  @Test  public void testAssertFalse() {
    assertFalse("failure - should be false", false);
  }

  @Test  public void testAssertNotNull() {
    assertNotNull("should not be null", new Object());
  }

  @Test  public void testAssertNotSame() {
    assertNotSame("should not be same Object", new Object(), new Object());
  }

  @Test  public void testAssertNull() {
    assertNull("should be null", null);
  }

  @Test  public void testAssertSame() {
    Integer aNumber = Integer.valueOf(768);
    assertSame("should be same", aNumber, aNumber);
  }

  // JUnit Matchers assertThat
  @Test  public void testAssertThatBothContainsString() {
    assertThat("albumen", both(containsString("a")).and(containsString("b")));
  }

  @Test  public void testAssertThatHasItems() {
    assertThat(Arrays.asList("one", "two", "three"), hasItems("one", "three"));
  }

  @Test  public void testAssertThatEveryItemContainsString() {
    assertThat(Arrays.asList(new String[] { "fun", "ban", "net" }), everyItem(containsString("n")));
  }

  // Core Hamcrest Matchers with assertThat
  @Test  public void testAssertThatHamcrestCoreMatchers() {
    assertThat("good", allOf(equalTo("good"), startsWith("good")));
    assertThat("good", not(allOf(equalTo("bad"), equalTo("good"))));
```

```
    assertThat("good", anyOf(equalTo("bad"), equalTo("good")));
    assertThat(7, not(CombinableMatcher.<Integer> either(equalTo(3)).or(equalTo(4))));
    assertThat(new Object(), not(sameInstance(new Object())));
  }

  @Test  public void testAssertTrue() {
    assertTrue("failure - should be true", true);
  }
}
```

4.2 Test Suite

Test suite is used to bundle a few unit test cases and run them together. **@RunWith and @Suite** annotations are used to run the suite tests.

In below Example we are running Test1 & Test2 together using Test Suite.

1. Class to be tested

```
package testsuite;

public class Calculator {
        public int square(int x) {
                return x * x;
        }

        public int sum(int x, int y) {
                return x + y;
        }
}
```

2. Write Testcases for selected class

```
//1.Test1.java
package testsuite;

import static org.junit.Assert.assertEquals;
import org.junit.Test;

public class Test1 {
        @Test
          public void squareTest() {
            Calculator calculator = new Calculator();
            int sqr = calculator.square(2);
            assertEquals("2*2=4 Passed",4, sqr);
          }
}
-----------------------------------------------------------------------------------------------------
//2.Test2.java
package testsuite;

import static org.junit.Assert.assertEquals;
import org.junit.Test;

public class Test2 {
        @Test
          public void addTest() {
            Calculator calculator = new Calculator();
            int sum = calculator.sum(8,2);
            assertEquals("8+2=10 Passed",10, sum);
          }
}
```

3.Create Test Suite Class

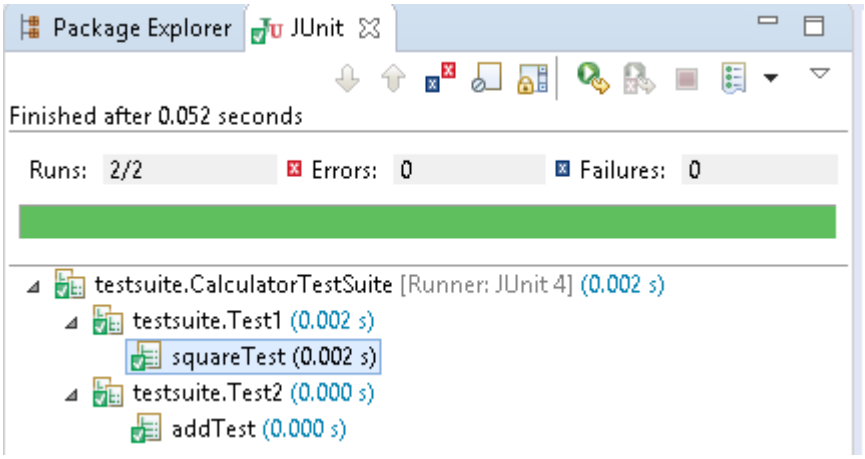
```
package testsuite;
import org.junit.runner.RunWith;
```

```
import org.junit.runners.Suite;

@RunWith(Suite.class)
@Suite.SuiteClasses({
   Test1.class,
   Test2.class
})
public class CalculatorTestSuite {
}
```

4. Run the Test (Commandline / TestRunner class)

Remember, TestRunner class is same for all Examples

```
package testsuite;

import org.junit.runner.JUnitCore;
import org.junit.runner.Result;
import org.junit.runner.notification.Failure;

public class TestRunner {
        public static void main(String[] args) {
                Result result = JUnitCore.runClasses(CalculatorTestSuite.class);

                for (Failure failure : result.getFailures()) {
                        System.out.println("Failure : " + failure.toString());
                }
                System.out.println("Success : " + result.wasSuccessful());
        }
}
```



4.3 Ignore Test

@Ignore annotation is used to create Ignore test. We use @ignore in two cases

1. **At Method Level** : if a method annotated with @Ignore, **that method will not be executed.**
2. **At Class Level Level** : if a class annotated with @Ignore**, all its methods will not be executed.**

1. Class to be tested

```
package ignoretest;
public class IgnoreTestClassLevel {
        private String str1;
        private String str2;
        private String str3;
```

```
        public IgnoreTestClassLevel(String str1, String str2) {
                this.str1 = str1;
                this.str2 = str2;
        }

        public String addStrings() {
                str3 = str1 + str2;
                System.out.println("addStrings : " + str3);
                return str1 + str2;
        }

        public String upperCase() {
                str3 = (str1 + str2).toUpperCase();
                System.out.println("upperCase : " + str3);
                return str1 + str2;
        }
}
```

2. Ignore Test at Method Level

```
package ignoretest;
import org.junit.Test;
import org.junit.Ignore;
import static org.junit.Assert.assertEquals;

public class IgnoreTestMethodLevel {
        StringUtil util = new StringUtil("a", "b");
        String res = "";

        @Ignore
        @Test
        public void testAddStrings() {
                System.out.println("Inside testAddStrings()");
                res = "ab";
                assertEquals(res, util.addStrings());
        }

        @Test
        public void testUpperCase() {
                System.out.println("Inside testUpperCase()");
                res = "AB";
                assertEquals(res, util.upperCase());
        }
}
```

```
Inside testUpperCase()
upperCase : AB
Success : true
```

3. Ignore Test at Class Level

```
package ignoretest;
import org.junit.Test;
import org.junit.Ignore;
import static org.junit.Assert.assertEquals;

@Ignore
public class IgnoreTestClassLevel {
        StringUtil util = new StringUtil("a", "b");
        String res = "";

        @Test
        public void testAddStrings() {
                System.out.println("Inside testAddStrings()");
                res = "ab";
                assertEquals(res, util.addStrings());
        }
```

```
        @Test
        public void testUpperCase() {
                System.out.println("Inside testUpperCase()");
                res = "AB";
                assertEquals(res, util.upperCase());
        }
}
```

Empty Output, because none of its test methods will be executed.

4.4 Time Test

`@Test(timeout)-` timeout parameter along with @Test annotation as used for Time Test.If a test case takes more time than the specified number of milliseconds, then JUnit will automatically mark it as failed.

Example: Time Test example for above StringUtil.java Class

```
package ignoretest;
import org.junit.Test;
import org.junit.Ignore;
import static org.junit.Assert.assertEquals;

public class StringUtilTimeTest {
        StringUtil util = new StringUtil("a", "b");
        String res = "";

        @Test(timeout = 1000)
        public void testAddStrings() {
                System.out.println("Inside testAddStrings()");
                res = "ab";
                assertEquals(res, util.addStrings());
        }

        @Test
        public void testUpperCase() {
                System.out.println("Inside testUpperCase()");
                res = "AB";
                assertEquals(res, util.upperCase());
        }
}
```

4.5 Exceptions Test

`@Test(expected)-` expected parameter along with @Test annotation as used for Exceptions Test. we can test whether our code throws an expected exception or not

Example: ExceptionsTest

```
package junit;

public class Calculator {
        public int square(int x) {
                return x * x;
        }
        public int div(int a, int b) {
                return a / b;
        }
}
```

```
package junit;
import static org.junit.Assert.*;
import org.junit.Test;

public class CaluculatorExceptionTest {
```

```
        @Test(expected = ArithmeticException.class)
         public void divTest() {
           Calculator calculator = new Calculator();
           int res = calculator.div(12,0);      //success
          // int res = calculator.div(12,0);    //error
           assertEquals(4, res);
        }
}
```

4.6 Parameterized Test

Parameterized tests allow a developer to run the same test over and over again using different values.we use **`@RunWith(Parameterized.class)`** to achive this type of tests.

Example

```
public class EvenNumbers {
        public Boolean checkEven(final Integer num) {

                for (int i = 1; i <= num; i++) {
                        if (i % 2 == 0) {
                                return true;
                        }
                }
                return false;
        }
}
```

```
package parameterizedtest;

import java.util.*;
import org.junit.*;
import static org.junit.Assert.assertEquals;

@RunWith(Parameterized.class)
public class PrimeNumberCheckerTest {
   private Integer inum;
   private Boolean res;
   private EvenNumbers evenObj;

   @Before
   public void initialize() {
      evenObj = new EvenNumbers();
   }


   public PrimeNumberCheckerTest(Integer inum, Boolean res) {
      this.inum = inum;
      this.res = res;
   }

   @Parameterized.Parameters
   public static Collection evenNumbers() {
      return Arrays.asList(new Object[][] {
         { 2, true },
         { 6, true },
         { 18, true },
         { 19, false },
         { 48, true }
      });
   }

   @Test
   public void testPrimeNumberChecker() {
```

```
      System.out.println("Parameterized Number is : " + inum);
      assertEquals(res, evenObj.checkEven(inum));
   }
}
```

```
Parameterized Number is : 2
Parameterized Number is : 6
Parameterized Number is : 18
Parameterized Number is : 19
Parameterized Number is : 48
```

4.7 JUnit List Example

```
package other;

import org.junit.Test;

import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;
import org.hamcrest.collection.IsEmptyCollection;
import static org.hamcrest.CoreMatchers.*;
import static org.hamcrest.collection.IsCollectionWithSize.hasSize;
import static org.hamcrest.collection.IsIterableContainingInAnyOrder.containsInAnyOrder;
import static org.hamcrest.collection.IsIterableContainingInOrder.contains;
import static org.hamcrest.number.OrderingComparison.greaterThanOrEqualTo;
import static org.hamcrest.number.OrderingComparison.lessThan;
import static org.hamcrest.MatcherAssert.assertThat;

public class ListExample{

    @Test
    public void testAssertList() {

        List<Integer> actual = Arrays.asList(1, 2, 3, 4, 5);
        List<Integer> expected = Arrays.asList(1, 2, 3, 4, 5);

        //All passed / true

        //1. Test equal.
        assertThat(actual, is(expected));

        //2. Check List has this value
        assertThat(actual, hasItems(2));

        //3. Check List Size
        assertThat(actual, hasSize(4));

        assertThat(actual.size(), is(5));

        //4.  List order

        // Ensure Correct order
        assertThat(actual, contains(1, 2, 3, 4, 5));

        // Can be any order
        assertThat(actual, containsInAnyOrder(5, 4, 3, 2, 1));

        //5. check empty list
        assertThat(actual, not(IsEmptyCollection.empty()));

        assertThat(new ArrayList<>(), IsEmptyCollection.empty());

                //6. Test numeric comparisons
        assertThat(actual, everyItem(greaterThanOrEqualTo(1)));

        assertThat(actual, everyItem(lessThan(10)));

    }
```

```
}
```

4.8 JUnit Map Example

```
public class MapExample {
        @Test
    public void testAssertMap() {

        Map<String, String> map = new HashMap<>();
        map.put("j", "java");
        map.put("c", "c++");
        map.put("p", "python");
        map.put("n", "node");

        Map<String, String> expected = new HashMap<>();
        expected.put("n", "node");
        expected.put("c", "c++");
        expected.put("j", "java");
        expected.put("p", "python");

        //All passed / true

        //1. Test equal, ignore order
        assertThat(map, is(expected));

        //2. Test size
        assertThat(map.size(), is(4));

        //3. Test map entry, best!
        assertThat(map, IsMapContaining.hasEntry("n", "node"));

        assertThat(map, not(IsMapContaining.hasEntry("r", "ruby")));

        //4. Test map key
        assertThat(map, IsMapContaining.hasKey("j"));

        //5. Test map value
        assertThat(map, IsMapContaining.hasValue("node"));

    }
}
```

4.9 JUnit Tools

Following are the JUnit Tools used for Testing −

1. Cactus
2. JWebUnit
3. XMLUnit
4. MockObject

References

http://junit.org/junit4/

https://www.tutorialspoint.com/junit/

http://www.javatpoint.com/junit-tutorial

http://www.mkyong.com/tutorials/junit-tutorials/

Mockito

Mockito facilitates creating mock objects(sample , similar Objects). Mock objects are nothing but proxy for actual implementations.

1.Creating Mock Objects

1.Normal way

```
      StockService stockServiceMock = mock(StockService.class);
```

2.Using Annotation

```
@Mock
 StockService stockServiceMock
```

2.Methods & Usage

All trhese methods are **static,** import provided by Mockito

```
import static org.mockito.Mockito.*;
```

when(...).thenReturn(...); - adds a functionality to a mock object using the methods when(). Then()

```
when(...).thenReturn(...);
```

// mock the behavior of stock service to return the value of various stocks

```
      when(stockServiceMock.getPrice(googleStock)).thenReturn(50.00);

      when(stockServiceMock.getPrice(microsoftStock)).thenReturn(1000.00);
```

```
// @RunWith attaches a runner with the test class to initialize the test data
@RunWith(MockitoJUnitRunner.class)
public class MathApplicationTester {

   //@InjectMocks annotation is used to create and inject the mock object
   @InjectMocks //main Object
   MathApplication mathApplication = new MathApplication();

   //@Mock annotation is used to create the dependent mock object
   @Mock //Calculator object id decalted inside MathApplication
   CalculatorService calcService;

   @Test
   public void testAdd(){
      //add the behavior of calc service to add two numbers
      when(calcService.add(10.0,20.0)).thenReturn(30.00);

      //test the add functionality
      Assert.assertEquals(mathApplication.add(10.0, 20.0),30.0,0);
   }
}
```

verify() method is ensure whether a mock method is being called with reequired arguments or not

```
//verify call to calcService is made or not with same arguments
verify(calcService).add(20.0, 30.0);
```

Times() method - Suppose MathApplication should call the CalculatorService.serviceUsed() method only once

```
      //check if add function is called three times
      verify(calcService, times(3)).add(10.0, 20.0);

      //verify that method was never called on a mock
      verify(calcService, never()).multiply(10.0,20.0)
```

Mockito provides the following additional methods to vary the expected call counts

```
      //check a minimum 1 call count
      verify(calcService, atLeastOnce()).subtract(20.0, 10.0);

      //check if add function is called minimum 2 times
      verify(calcService, atLeast(2)).add(10.0, 20.0);

      //check if add function is called maximum 3 times
      verify(calcService, atMost(3)).add(10.0,20.0);
```

Exception

```
@Test(expected = RuntimeException.class)
   public void testAdd(){
      //add the behavior to throw exception
      doThrow(new RuntimeException("Add operation not implemented"))
         .when(calcService).add(10.0,20.0);
}
```

InOrder class - takes care of the order of method calls

```
      //create an inOrder verifier for a single mock
      InOrder inOrder = inOrder(calcService);

      //following will make sure that add is first called then subtract is called.
      inOrder.verify(calcService).subtract(20.0,10.0);
      inOrder.verify(calcService).add(20.0,10.0);
```

reset - reset a mock so that it can be reused later

```
//reset the mock
      reset(calcService);
```

spy()/@Spy: partial mocking, real methods are invoked but still can be verified and stubbed

Hamcrest Matchers

Hamcrest provides a more readable, declarative approach to asserting and matching your test results.

Hamcrest has the target to make tests as readable as possible. For example, the `is` method is a thin wrapper for `equalTo(value)`.

```
import static org.hamcrest.MatcherAssert.assertThat;
import static org.hamcrest.Matchers.is;
import static org.hamcrest.Matchers.equalTo;

boolean a;
boolean b;

// all statements test the same
assertThat(a, equalTo(b));
assertThat(a, is(equalTo(b)));
assertThat(a, is(b));
```

The following snippets compare pure JUnit 4 assert statements with Hamcrest matchers.

```
    // JUnit 4 for equals check
       assertEquals(expected, actual);
       // Hamcrest for equals check
       assertThat(actual, is(equalTo(expected)));

       // JUnit 4 for not equals check
       assertNotEquals(expected, actual)
       // Hamcrest for not equals check
       assertThat(actual, is(not(equalTo(expected))));
```

The following are the most important Hamcrest matchers:

- `allOf` - matches if all matchers match (short circuits)
- `anyOf` - matches if any matchers match (short circuits)
- `not` - matches if the wrapped matcher doesn't match and vice
- `equalTo` - test object equality using the equals method
- `is` - decorator for equalTo to improve readability
- `hasToString` - test Object.toString
- `instanceOf`, `isCompatibleType` - test type
- `notNullValue`, `nullValue` - test for null
- `sameInstance` - test object identity
- `hasEntry`, `hasKey`, `hasValue` - test a map contains an entry, key or value
- `hasItem`, `hasItems` - test a collection contains elements
- `hasItemInArray` - test an array contains an element
- `closeTo` - test floating point values are close to a given value
- `greaterThan`, `greaterThanOrEqualTo`, `lessThan`, `lessThanOrEqualTo`
- `equalToIgnoringCase` - test string equality ignoring case
- `equalToIgnoringWhiteSpace` - test string equality ignoring differences in runs of whitespace

- `containsString`, `endsWith`, `startsWith` - test string matching

Integration Testing

Integration testing is all about testing all pieces of an application working together as they would in a live or production environment

To convert any JUnit test into a proper integration test, there are really two basic things that you need to do.

- The first is you need to annotate your tests with the `@RunWith` annotation and specify that you want to run it with the `SpringJUnit4ClassRunner.class`

- The second is you need to add the `@SpringApplicationConfiguration` annotation and provide your main Spring Boot class for your application.

```
@RunWith(SpringJUnit4ClassRunner.class)
@SpringApplicationConfiguration(Demo.class)
public class UserRepoIntegrationTest {
    @Autowired
    private UserRepository userRepository;

    @Test
    public void testFindAll() {
        List<User> users = userRepository.findAll();
        assertThat(users.size(), is(greaterThanOrEqualTo(0)));
    }
}
```

Regardless of the test result - successful or unsuccessful, open your IDE Console tab and you should notice that it looks like your application started (Spring logo, info etc). This happens because our application actually starts with integration tests

MockMvc

Spring MockMVC to perform **integration testing** of spring webmvc controllers

MockMVC class is part of Spring MVC test framework which helps in testing the controllers explicitly starting a Servlet container.

```
@RunWith(SpringRunner.class)
@WebMvcTest(StudentController.class)
public class StudentIntegrationTests {

        @Autowired
         private MockMvc mvc;
}
```

- `SpringRunner` is an alias for the `SpringJUnit4ClassRunner`.
- `@WebMvcTest` annotation is used for Spring MVC tests. It disables full auto-configuration and instead apply only configuration relevant to MVC tests.
- `StudentController.class` means initialize only this controller and provide dependent Mock object of this controller.

MockMvcRequestBuilders -hit the APIs & passing the path parameters and verify the status response codes

MockMvcResultMatchers – get the response content & matches with expected content

Types of Authentication

A servlet-based web application can choose from the following types of authentication, from least secure to most:

- Basic authentication
- Form-based authentication
- Digest authentication
- SSL and client certificate authentication

"Authentication" and "Authorization". Authentication can be defined as the process of verifying someone's identity by using pre-required details (Commonly username and password). Authorization is the process of allowing an authenticated user to access a specified resource (eg:-right to access a file).

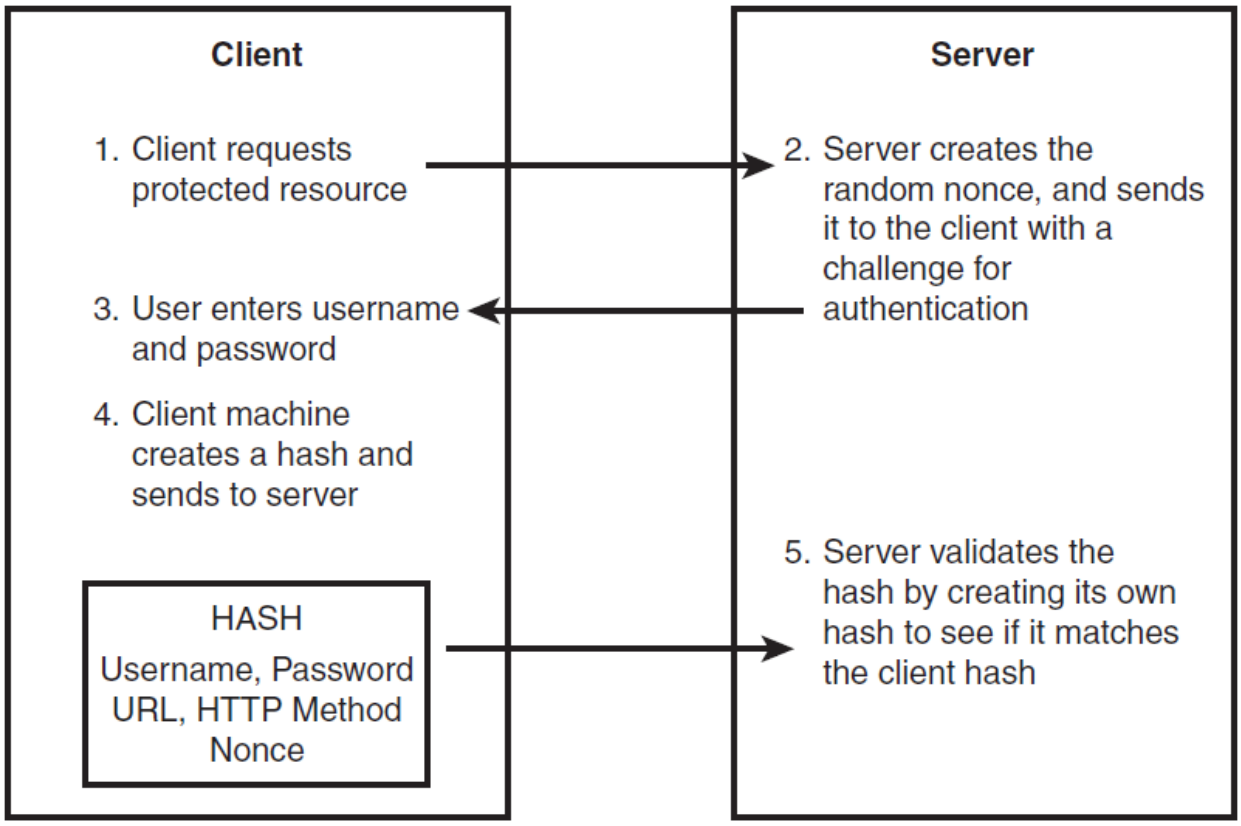
HTTP Basic Authentication

- One solution is that of **HTTP Basic Authentication**. In this approach, an HTTP user agent simply provides a **username**and **password** to prove their authentication.
- This approach does not require cookies, session IDs, login pages, and other such specialty solutions, and because it uses the **HTTP header** itself, there's no need to handshakes or other complex response systems.
- HTTP is not encrypted in any way. It is encapsulated in base64, and is often erroneously proclaimed as encrypted due to this

Digest authentication

The difference between digest authentication and basic authentication is that in digest authentication, the username and password are never sent over the wire. Instead, a hash is created made up of the following pieces of information:

- The username
- The password
- The URL
- The randomly generated string (the nonce)
- The HTTP method being used



API Keys : for Developer Quickstart

- To access Bitbucket in Hygieia, we will generate API key, and we will place that key in properties file.

- API Keys can be used as Basic HTTP Authentication credentials and provide a substitute for the account's actual username and password.

- The best thing about an API key is its simplicity. You merely log in to a service, find your API key (often in the settings screen), and copy it to use in an application, test in the browser, or use with one of these API request tools

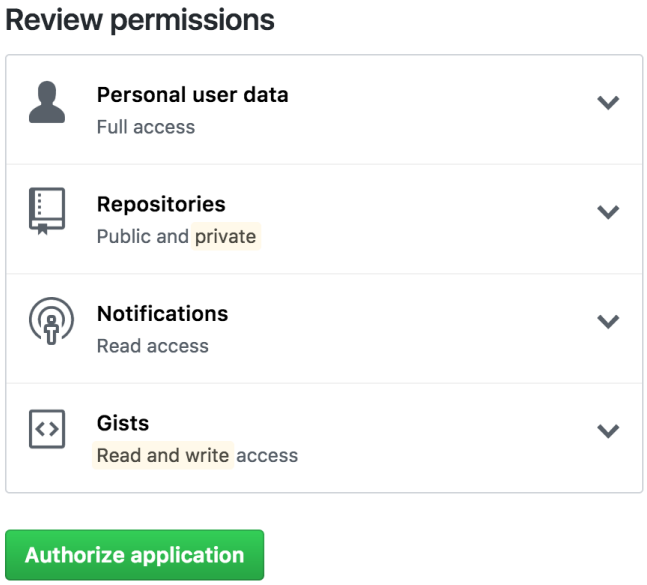
- Typically, an API key gives full access to every operation an API can perform, including writing new data or deleting existing data. If you use the same API key in multiple apps, a broken app could destroy your users' data without an easy way to stop just that one app.

- Many API keys are sent in the query string as part of the URL, which makes it easier to discover for someone who should not have access to it. A better option is to put the API key in the Authorization header. In fact, that's the proposed standard:
  Authorization: Apikey 1234567890abcdef

OAuth Tokens: Great for Accessing User Data

- OAuth is the answer to accessing user data with APIs.

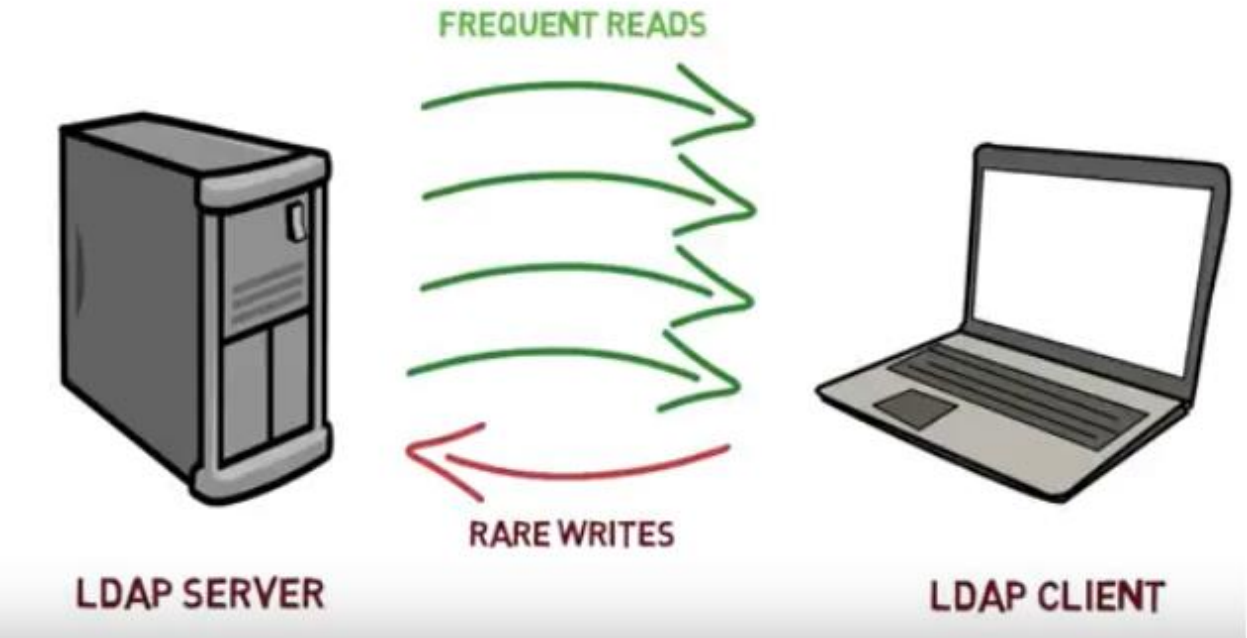
- users simply click a button to allow an application to access their accounts.

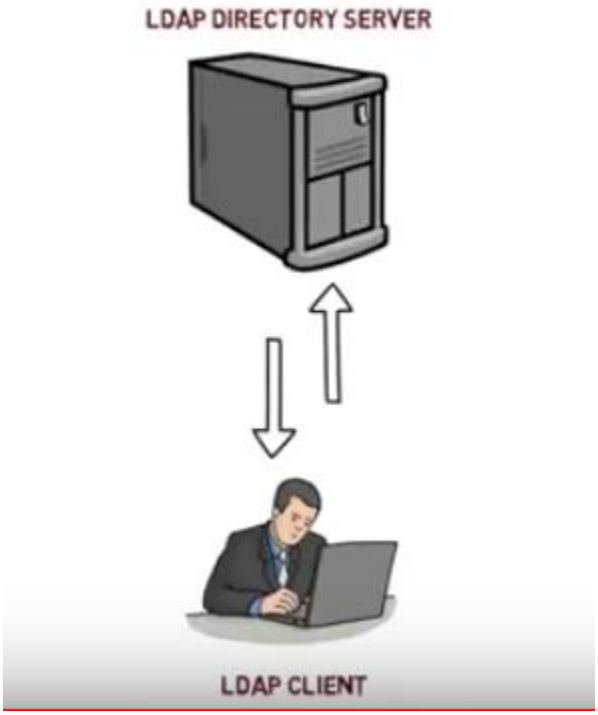


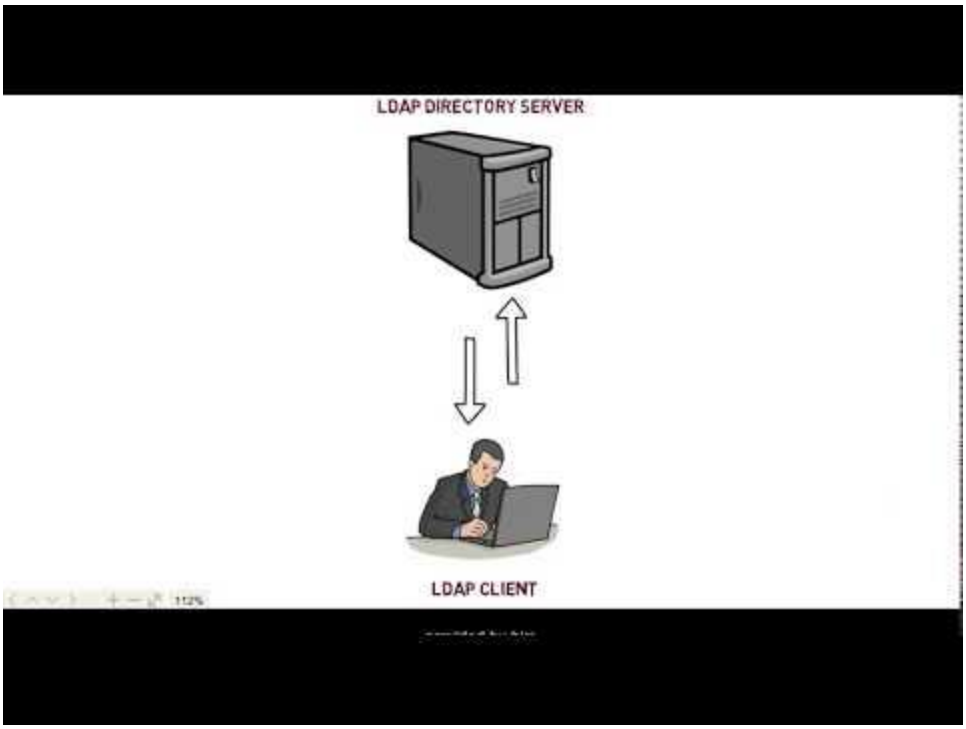
LDAP


L → LIGHTWEIGHTED
D → DIRECTORY
A → ACCESS
P → PROTOCOL


LDAP
RESOURCES


FREQUENT READS
RARE WRITES
LDAP SERVER
LDAP CLIENT


LDAP DIRECTORY SERVER
LDAP CLIENT



https://www.youtube.com/watch?v=lp5z8HQGAH8

```
import javax.naming.*;
import javax.naming.directory.*;
import java.util.Hashtable;

class Simple {
    public static void main(String[] args) {
        Hashtable authEnv = new Hashtable(11);
        String userName = "johnlennon";
        String passWord = "sushi974";
        String base = "ou=People,dc=example,dc=com";
        String dn = "uid=" + userName + "," + base;
        String ldapURL = "ldap://ldap.example.com:389";

        authEnv.put(Context.INITIAL_CONTEXT_FACTORY,"com.sun.jndi.ldap.LdapCtxFactory");
           authEnv.put(Context.PROVIDER_URL, ldapURL);
           authEnv.put(Context.SECURITY_AUTHENTICATION, "simple");
           authEnv.put(Context.SECURITY_PRINCIPAL, dn);
           authEnv.put(Context.SECURITY_CREDENTIALS, passWord);

        try {
            DirContext authContext = new InitialDirContext(authEnv);
            System.out.println("Authentication Success!");
        } catch (AuthenticationException authEx) {
            System.out.println("Authentication failed!");
        } catch (NamingException namEx) {
            System.out.println("Something went wrong!");
            namEx.printStackTrace();
        }
    }
}
```

SSH – Only for LINUX Server / CommadLine(git) related Access

- SSH, or secure shell, is an encrypted protocol used to administer and communicate with servers. When working with a Linux server, chances are, you will spend most of your time in a terminal session connected to your server through SSH.

- An SSH server can authenticate clients using a variety of different methods. The most basic of these is password authentication, which is easy to use, but not the most secure.

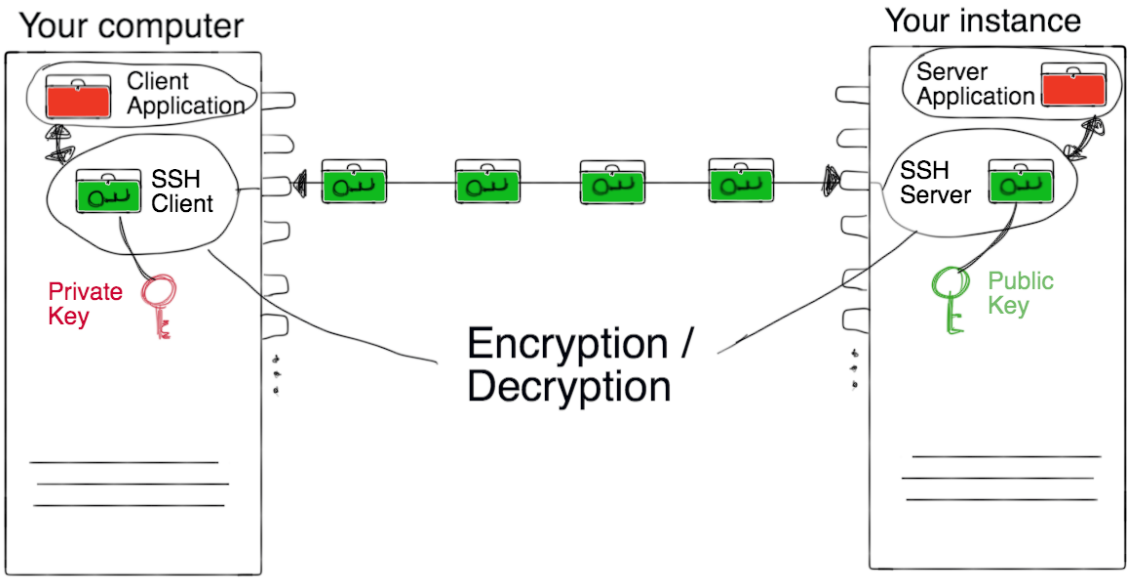
- SSH key pairs are two cryptographically secure keys that can be used to authenticate a client to an SSH server. Each key pair consists of a public key and a private key.

- The **private key** is retained by the client and should be kept absolutely secret. Any compromise of the private key will allow the attacker to log into servers that are configured with the associated public key without additional authentication. As an additional precaution, the key can be encrypted on disk with a passphrase.

- The associated public key can be shared freely without any negative consequences. The public key can be used to encrypt messages that only the private key can decrypt. This property is employed as a way of authenticating using the key pair.

- The public key is uploaded to a remote server that you want to be able to log into with SSH. The key is added to a special file within the user account you will be logging into called ~/.ssh/authorized_keys.

- When a client attempts to authenticate using SSH keys, the server can test the client on whether they are in possession of the private key. If the client can prove that it owns the private key, a shell session is spawned or the requested command is executed.



Base64 – not Authentication

represent binary data in an ASCII string format

Each Base64 digit represents exactly 6 bits of data.

Steps:

- take three ASCII numbers 155, 162, and 233
- Convert into binary stream formate 100110111010001011101001
- groupings of six characters: 100110 111010 001011 101001.
- The binary string 100110 converts to the decimal number 38: 0*2^01 + 1*2^1 + 1*2^2 + 0*2^3 + 0*2^4 + 1*2^5 = 0+2+4+0+0+32.
- Base64 6-bit values 38, 58, 11 and 41.
- Using the Base64 conversion table:
    - 38 is m
    - 58 is 6
    - 11 is L
    - 41 is p

Help.html

StudentApp Document

StudentApp + AngularJs+ CurdRepository+MockMVC References

CURD + POSTMAN

https://www.callicoder.com/spring-boot-rest-api-tutorial-with-mysql-jpa-hibernate/

AngularJS+Templates

https://examples.javacodegeeks.com/enterprise-java/spring/boot/spring-boot-and-angularjs-integration-tutorial/

Spring+AngularJS Controllers

https://java2blog.com/spring-boot-angularjs-example/

SpringBoot MockMVC Tutorial

- Mokito : https://howtodoinjava.com/spring-boot2/spring-boot-mockito-junit-example/
- MOCK MVC : https://howtodoinjava.com/spring-boot2/spring-boot-mockmvc-example/

StudentApp MongoRepository

Example App : https://www.journaldev.com/18156/spring-boot-mongodb

1. Add Maven Dependency: spring-boot-starter-data-mongodb

2.Create Sudent Collection

```
>use student
>db.createCollection("student");
>db.student.insert(
   {
      sno: 501,
      name: "Satya Kaveti",
      city:"Vijayawada",
```

```
      marks:508
   }
)
```

3.in **application.propertis** , add Mongo DB details

```
spring.data.mongodb.database=student
spring.data.mongodb.port=27017
spring.data.mongodb.host=localhost
```

2.Create **StudentModel**.java with **@Document & Id** annotations

3.create **StudentMongoRepository** extends **MongoRepository**

4.Create **StudentMongoController.java**

How can Spring Boot work without driver configuration?

Spring Boot gives you defaults on all things, the default in database is **H2**, so when you want to change this and use any other database you must define the connection attributes in the **application.properties** file.

- H2 is one of the popular in memory databases. Spring Boot has default integration for H2
- is live only during the time of execution of the application, not for real world applications
- The h2-*.jar is just an engine (the code) of the database. It is read-only and it does not store any information. The data in H2 can be stored either in memory or on disk in a specified file. You are actually specifying one:

In our Application we are using MySQL, so we provided details with out Driver detilas

```
spring.datasource.url = jdbc:mysql://localhost:3306/student?useSSL=false
spring.datasource.username = root
spring.datasource.password = root
```

```
        <dependency>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-starter-data-jpa</artifactId>
        </dependency>

        <dependency>
            <groupId>mysql</groupId>
            <artifactId>mysql-connector-java</artifactId>
            <scope>runtime</scope>
        </dependency>
```

- **@EnableAutoConfiguration** : This annotation tells Spring to automatically configure your application based on the dependencies that you have added in the **pom.xml** file.

- For example, If **spring-data-jpa** or **spring-jdbc** is in the classpath, then it automatically tries to configure a **DataSource** by reading the database properties from **application.properties** file.

- So,in above we just have to add the configuration and Spring Boot will take care of the rest.

- In the above properties file, the last two properties are for hibernate. Spring Boot uses Hibernate as the default JPA implementation.

- If you remove mysql-connector-java from pom.xml, SpringBoot unable to find the MySQL related java classes in insert application.propeties values to create datasource, it will throw below error.

```
Failed to bind properties under '' to com.zaxxer.hikari.HikariDataSource:
    Property: driverclassname
    Value: com.mysql.cj.jdbc.Driver
    Origin: "driverClassName" from property source "source"
Reason: Failed to load driver class com.mysql.cj.jdbc.Driver in either of HikariConfig
class loader or Thread context classloader

Action:
Update your application's configuration
```

So finally, SpringBoot uses Drivers & all normal stuff though @EnableAutoConfiguration to do the job

Spring Boot with multiple databases

In Our StudentApp we have multiple Databases.

1.if we use only one Database :MySQL we can use default `spring.data.*`properties. Spring @EnableAutoConfiguration will create Datasource by reading these properties

```
spring.datasource.url = jdbc:mysql://localhost:3306/student?useSSL=false
spring.datasource.username = root
spring.datasource.password = root
```

2.if we use two databases :MySQL, Mongo we can use default `spring.data.*`properties of therir respective databases. Spring @EnableAutoConfiguration will create two different Datasource by reading these properties

```
spring.data.mongodb.database=student
spring.data.mongodb.port=27017
spring.data.mongodb.host=localhost
```

3.If we use two DB's with our own Config properties we need to Ovveride DataSource Manually

```
#----------- MySQL -------------
own.spring.mysql.datasource.url = jdbc:mysql://localhost:3306/student?useSSL=false
own.spring.mysql.datasource.username = root
own.spring.mysql.datasource.password = root

#----------- MongoDB -------------
own.spring.mongo.datasource.database=student
own.spring.mongo.datasource.port=27017
```

```
own.spring.mongo.datasource.host=localhost
```

Because we want the Spring Boot autoconfiguration to pick up those different properties (and actually instantiate two different DataSources), we need to instantiate our DataSource beans manually in a configuration class

```
@Configuration
public class MultipleDataSourceConfiguration {

    @Bean
    @Primary
    @ConfigurationProperties(prefix="own.spring.mysql.datasource")
    public DataSource primaryDataSource() {
        return DataSourceBuilder.create().build();
    }

    @Bean
    @ConfigurationProperties(prefix="own.spring.mongo.datasource")
    public DataSource secondaryDataSource() {
        return DataSourceBuilder.create().build();
    }
}
```

- https://medium.com/@joeclever/using-multiple-datasources-with-spring-boot-and-spring-data-6430b00c02e7
- http://www.java2novice.com/spring-boot/configure-multiple-datasources/
- https://www.infoq.com/articles/Multiple-Databases-with-Spring-Boot

@Conditional & @Profilers

While developing Spring based applications we may come across a need to register beans conditionally.

For example, you may want to register a DataSource bean pointing to the **dev** database abd different **production database** while running in production.

To address this problem, Spring 3.1 introduced the concept of **Profiles**. When you run the application you can activate the desired profiles ,and only those beans of that profiles will be registered.

```
@Configuration
public class AppConfig
{
 @Bean
 @Profile("DEV")
 public DataSource devDataSource() {
 ...
 }
 @Bean
 @Profile("PROD")
 public DataSource prodDataSource() {
 ...
 }
}
```

Then you can specify the active profile using System Property **-Dspring.profiles.active=DEV**

Now we can configure both **JdbcUserDAO** and **MongoUserDAO** beans conditionally using **@Conditional**as follows:

```
@Configuration
public class AppConfig
{
 @Bean
 @Conditional(MySQLDatabaseTypeCondition.class)
 public UserDAO jdbcUserDAO(){
 return new JdbcUserDAO();
 }
 @Bean
 @Conditional(MongoDBDatabaseTypeCondition.class)
 public UserDAO mongoUserDAO(){
 return new MongoUserDAO();
 }
}
```

How EnableAutoConfiguration implemented?

auto-configuration is implemented with standard `@Configuration` classes.

Additional `@Conditional` annotations are used to constrain when the auto-configuration should apply.

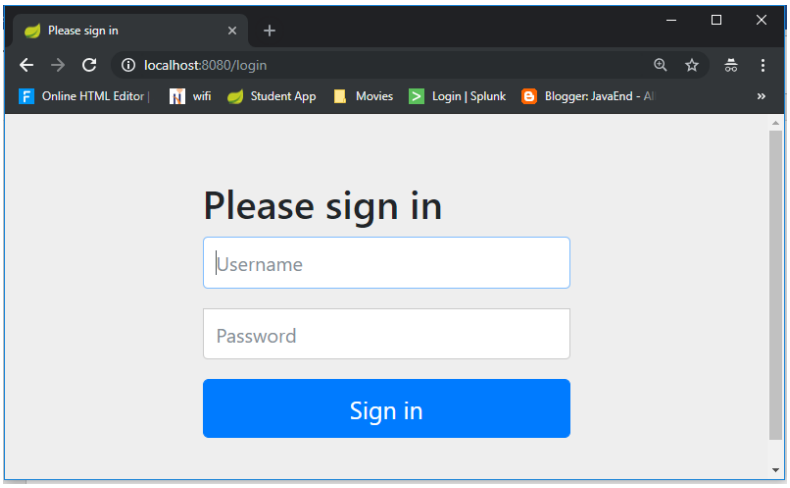
SpringBoot Security

`spring-boot-starter-security`: take care of all the required dependencies related to spring security.

```
<dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-security</artifactId>
</dependency>
```

This will include the *SecurityAutoConfiguration* class – containing the initial/default security configuration.

Just Run the project & see the magic



We never created this login form, but from where it came from?

SpringSecurity default comes with login page & you can login with generated password which is already printed in the console

```
Using generated security password: 8b4667a4-cc3a-47fd-b51f-b6f5e83745df
Def.user name is : user
```

You can change the password by providing a `security.user.password`. This and other useful properties are externalized via `SecurityProperties` (properties prefix "security").

```
security.user.name=user
security.user.name=password
security.basic.enabled=true
```

To discard the security auto-configuration and add our own configuration, we need to exclude the ***SecurityAutoConfiguration*** class.

```
@SpringBootApplication(exclude = { SecurityAutoConfiguration.class })
public class SpringBootSecurityApplication {
    public static void main(String[] args) {
        SpringApplication.run(SpringBootSecurityApplication.class, args);
    }
}
```

Or by adding some configuration into the *application.properties* file:

```
spring.autoconfigure.exclude=org.springframework.boot.autoconfigure.security.SecurityAutoConfiguration
```

If we disabling security auto-configuration, we need to provide our own configuration, by `extends WebSecurityConfigurerAdapter`

```
@Configuration
@EnableWebSecurity
public class SecurityConfig extends WebSecurityConfigurerAdapter {
```

```
        @Override
        public void configure(HttpSecurity http) throws Exception {
                // It allows configuring web based security for specific http requests
                http
        .authorizeRequests()
            .anyRequest().authenticated()
            .and()
        .formLogin()
            .and()
        .httpBasic();


        /* ============ Custom login Page URL ==========
        http
          .authorizeRequests()
          .antMatchers("/admin/**").hasRole("ADMIN")
          .antMatchers("/anonymous*").anonymous()
          .antMatchers("/login*").permitAll()
          .anyRequest().authenticated()
          .and()
          .formLogin()
          .loginPage("/login.html")
          .loginProcessingUrl("/perform_login")
          .defaultSuccessUrl("/homepage.html", true)
          //.failureUrl("/login.html?error=true")
          .failureHandler(authenticationFailureHandler())
          .and()
          .logout()
          .logoutUrl("/perform_logout")
          .deleteCookies("JSESSIONID")
          .logoutSuccessHandler(logoutSuccessHandler());
                */
        }

    @Bean
    @Override
    public UserDetailsService userDetailsService() {
        UserDetails user =
             User.withDefaultPasswordEncoder()
                .username("user")
                .password("user")
                .roles("USER")
                .build();

        return new InMemoryUserDetailsManager(user);
    }

}
```

Let's summarize what we did in order to add Spring Boot Security to his web app. To secure his web app,

- we added Spring Boot Security to the classpath.
- Once it was in the classpath, Spring Boot Security was enabled by default.
- Then customized the security by extending `WebSecurityConfigurerAdapter` and added his own `configure` and `userDetailsService` implementation.
- http://localhost:8080/login?logout
- https://docs.spring.io/spring-security/site/docs/current/guides/html5/form-javaconfig.html
- https://examples.javacodegeeks.com/enterprise-java/spring/boot/spring-boot-security-example/

SpringBoot AOP

Actually we don't have Spring AOP starter in Springboot, but we can integrate using traditional Spring Framework

```
<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-aop</artifactId>
  <version>5.0.1.RELEASE</version>
  <scope>compile</scope>
</dependency>
<dependency>
  <groupId>org.aspectj</groupId>
  <artifactId>aspectjweaver</artifactId>
  <version>1.8.12</version>
  <scope>compile</scope>
</dependency>
```

Applications are generally developed with multiple layers. A typical Java application has

- Web Layer - Exposing the services to outside world using REST or a web application
- Business Layer - Business Logic
- Data Layer - Persistence Logic

While the responsibilities of each of these layers are different, there are a few common aspects that apply to all layers

- Logging
- Security

In this example we are implementing Logging – we are trying to Log the all the Application flow like, what controller is calling, what method is executing on performing certain operation.

```
package app.aop;

@Aspect
@Configuration
public class StudentAOP {

private Logger logger = LoggerFactory.getLogger(this.getClass());

        //What kind of method calls I would intercept
        //execution(* PACKAGE.*.*(..))
        //Weaving & Weaver
        @Before("execution(* app.repository.*.*(..))")
        public void before(JoinPoint joinPoint){
                //Advice
                logger.info(" \n \n====== @Before===== \t  app.repository");
                logger.info(" Allowed execution for {}", joinPoint);
                logger.info(" ====== @Before=====  \n \n");
        }


        @AfterReturning(value = "execution(* app.controller.*.*(..))",
                        returning = "result")
        public void afterReturning(JoinPoint joinPoint, Object result) {
                logger.info("\n \n ====== @AfterReturning ===== \t : app.controller ");
                logger.info("{} returned with value {}", joinPoint, result);
                logger.info(" ====== @AfterReturning =====  \n \n");
```

```
        }

        @After(value = "execution(* app.security.*.*(..))")
        public void after(JoinPoint joinPoint) {
                logger.info("\n \n ====== @After =====  \t : app.security");
                logger.info("after execution of {}", joinPoint);
                logger.info(" ====== @After =====  \n \n");
        }

}
```

```
====== @After =====       : app.security
2019-02-10 22:50:12.232  INFO 8152 --- [           main] dentAOP$$EnhancerBySpringCGLIB$$bb027782 : after
execution of execution(UserDetailsService app.security.SecurityConfig.userDetailsService())
2019-02-10 22:50:12.236  INFO 8152 --- [           main] dentAOP$$EnhancerBySpringCGLIB$$bb027782 :
====== @After =====

 ====== @AfterReturning =====     : app.controller
2019-02-10 22:43:58.212  INFO 2440 --- [nio-8080-exec-7] dentAOP$$EnhancerBySpringCGLIB$$45dcbfee :
execution(List app.controller.StudentMongoController.getAllStudents()) returned with value [Student
[sno=501, name=vinay, city=karnool, marks=545], Student [sno=502, name=VINOD, city=BNHGG, marks=456]]
2019-02-10 22:43:58.212  INFO 2440 --- [nio-8080-exec-7] dentAOP$$EnhancerBySpringCGLIB$$45dcbfee :
====== @AfterReturning =====


Getting all users.2019-02-10 22:43:58.248  INFO 2440 --- [nio-8080-exec-9]
dentAOP$$EnhancerBySpringCGLIB$$45dcbfee :

 ====== @AfterReturning =====     : app.controller
2019-02-10 22:43:58.248  INFO 2440 --- [nio-8080-exec-9] dentAOP$$EnhancerBySpringCGLIB$$45dcbfee :
execution(List app.controller.StudentMongoController.getAllStudents()) returned with value [Student
[sno=501, name=vinay, city=karnool, marks=545], Student [sno=502, name=VINOD, city=BNHGG, marks=456]]
2019-02-10 22:43:58.248  INFO 2440 --- [nio-8080-exec-9] dentAOP$$EnhancerBySpringCGLIB$$45dcbfee :
====== @AfterReturning =====
```

Pointcut - Pointcut is the **expression** used to define when a call to a method should be intercepted. In the above example, `"execution(* app.repository.*.*(..))"` is the pointcut.

Advice - It is the **logic that you would want to exceute** when you intercept a method. In the above example, it is the code inside the `before(JoinPoint joinPoint)`method.

Aspect – is the Class we defiend, combination of on which method **(Pointcut)** and what to do **(Advice)** is called an Aspect.

Join Point - When the code is executed and the condition for pointcut is met, the advice is executed. The Join Point is a specific execution instance of an advice.

Weaver - Weaver is the framework which implements AOP - AspectJ or Spring AOP.

- http://www.springboottutorial.com/spring-boot-and-aop-with-spring-boot-starter-aop
- https://www.javainuse.com/spring/spring-boot-aop

SpringBoot Acuator - Health check, Auditing, Metrics,Monitoring

Actuator brings production-ready features to our application.

Monitoring our app, gathering metrics, understanding traffic or the state of our database becomes trivial with this dependency.

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```

Once above maven dependency is included in the POM file, **16 different actuator REST endpoints**, such as actuator, beans, dump, info, loggers, and metrics are exposed

Some of important and widely used actuator endpoints are given below:

ENDPOINT	USAGE
/env	Returns list of properties in current environment
/health	Returns application health information.
/auditevents	Returns all auto-configuration candidates and the reason why they 'were' or 'were not' applied.
/beans	Returns a complete list of all the Spring beans in your application.
/trace	Returns trace logs (by default the last 100 HTTP requests).
/dump	It performs a thread dump.
/metrics	It shows metrics information like JVM memory used, system CPU usage, open files, and much more.

You can access all avaible endpoint by this URL: **http://localhost:8080/actuator**


```
{
        "_links": {
                "self": {
                        "href": "http://localhost:8080/actuator",
                        "templated": false
                },
                "health": {
                        "href": "http://localhost:8080/actuator/health",
                        "templated": false
                },
                "health-component-instance": {
                        "href": "http://localhost:8080/actuator/health/{component}/{instance}",
                        "templated": true
                },
                "health-component": {
                        "href": "http://localhost:8080/actuator/health/{component}",
                        "templated": true
```

```
                },
                "info": {
                        "href": "http://localhost:8080/actuator/info",
                        "templated": false
                }
        }
}
```

If you see we have only 2 endpoints showing (health, info) out of 16 endpoints

By default, all the actuator endpoints are exposed over **JMX** but only the health and info endpoints are exposed over **HTTP**.

Here is how you can expose actuator endpoints over HTTP and JMX using application properties -

Exposing Actuator endpoints over HTTP

```
# Use "*" to expose all endpoints, or a comma-separated list to expose selected ones
management.endpoints.web.exposure.include=*
management.endpoints.web.exposure.exclude=
```

Exposing Actuator endpoints over JMX

```
# Use "*" to expose all endpoints, or a comma-separated list to expose selected ones
management.endpoints.jmx.exposure.include=*
management.endpoints.jmx.exposure.exclude=
```

Securing Actuator Endpoints with Spring Security

Actuator endpoints are sensitive and must be secured from unauthorized access. you can add spring security to your application using the following dependency -

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-security</artifactId>
</dependency>
```

we can override the default spring security configuration and define our own access rules.

Creating a Custom Actuator Endpoint

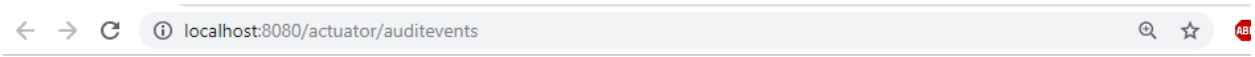
To customize the endpoint and define your own endpoint, simply Create a classs annotate with @Endpoint URL :

```
import org.springframework.boot.actuate.endpoint.annotation.Endpoint;
import org.springframework.boot.actuate.endpoint.annotation.ReadOperation;
import org.springframework.stereotype.Component;

@Endpoint(id="helloEndpoint")
@Component
public class ListEndPoints {
    @ReadOperation
```

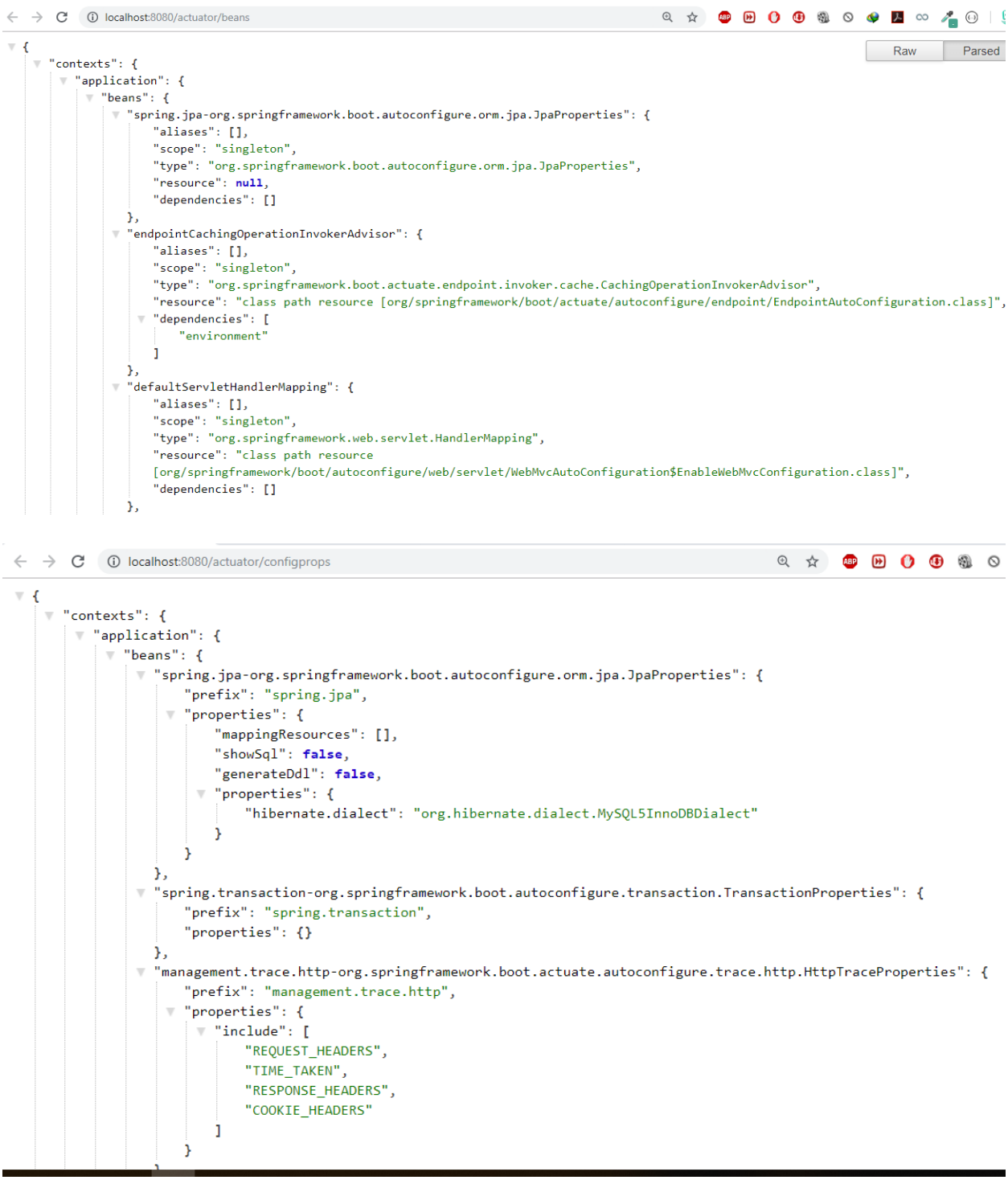
```
    public String mypoint(){
        return "Hello" ;
    }
}
```

Hello

Few more Endpoints




```
{
  "events": [
    {
      "timestamp": "2019-02-10T18:21:46.464Z",
      "principal": "anonymousUser",
      "type": "AUTHORIZATION_FAILURE",
      "data": {
        "details": {
          "remoteAddress": "0:0:0:0:0:0:0:1",
          "sessionId": null
        },
        "type": "org.springframework.security.access.AccessDeniedException",
        "message": "Access is denied"
      }
    },
    {
      "timestamp": "2019-02-10T18:22:45.986Z",
      "principal": "user",
      "type": "AUTHENTICATION_SUCCESS",
      "data": {
        "details": {
          "remoteAddress": "0:0:0:0:0:0:0:1",
          "sessionId": "ADF23C6CD682F9FFAD445C497F61D38B"
        }
      }
    }
  ]
}
```


localhost:8080/actuator/beans
Raw
Parsed
{
"contexts": {
"application": {
"beans": {
"spring.jpa-org.springframework.boot.autoconfigure.orm.jpa.JpaProperties": {
"aliases": [],
"scope": "singleton",
"type": "org.springframework.boot.autoconfigure.orm.jpa.JpaProperties",
"resource": null,
"dependencies": []
},
"endpointCachingOperationInvokerAdvisor": {
"aliases": [],
"scope": "singleton",
"type": "org.springframework.boot.actuate.endpoint.invoker.cache.CachingOperationInvokerAdvisor",
"resource": "class path resource [org/springframework/boot/actuate/autoconfigure/endpoint/EndpointAutoConfiguration.class]",
"dependencies": [
"environment"
]
},
"defaultServletHandlerMapping": {
"aliases": [],
"scope": "singleton",
"type": "org.springframework.web.servlet.HandlerMapping",
"resource": "class path resource
[org/springframework/boot/autoconfigure/web/servlet/WebMvcAutoConfiguration$EnableWebMvcConfiguration.class]",
"dependencies": []
},
localhost:8080/actuator/configprops
{
"contexts": {
"application": {
"beans": {
"spring.jpa-org.springframework.boot.autoconfigure.orm.jpa.JpaProperties": {
"prefix": "spring.jpa",
"properties": {
"mappingResources": [],
"showSql": false,
"generateDdl": false,
"properties": {
"hibernate.dialect": "org.hibernate.dialect.MySQL5InnoDBDialect"
}
}
},
"spring.transaction-org.springframework.boot.autoconfigure.transaction.TransactionProperties": {
"prefix": "spring.transaction",
"properties": {}
},
"management.trace.http-org.springframework.boot.actuate.autoconfigure.trace.http.HttpTraceProperties": {
"prefix": "management.trace.http",
"properties": {
"include": [
"REQUEST_HEADERS",
"TIME_TAKEN",
"RESPONSE_HEADERS",
"COOKIE_HEADERS"
]
}


localhost:8080/actuator/loggers
{
"levels": […], // 6 items
"loggers": {
"ROOT": {
"configuredLevel": "INFO",
"effectiveLevel": "INFO"
},
"app": {
"configuredLevel": null,
"effectiveLevel": "INFO"
},
"app.StudentAppApplication": {
"configuredLevel": null,
"effectiveLevel": "INFO"
},
"app.aop": {
"configuredLevel": null,
"effectiveLevel": "INFO"
},
"app.aop.StudentAOP": {
"configuredLevel": null,
"effectiveLevel": "INFO"
},
"app.aop.StudentAOP$": {
"configuredLevel": null,
"effectiveLevel": "INFO"
},

https://dzone.com/articles/spring-boot-actuator-a-complete-guide

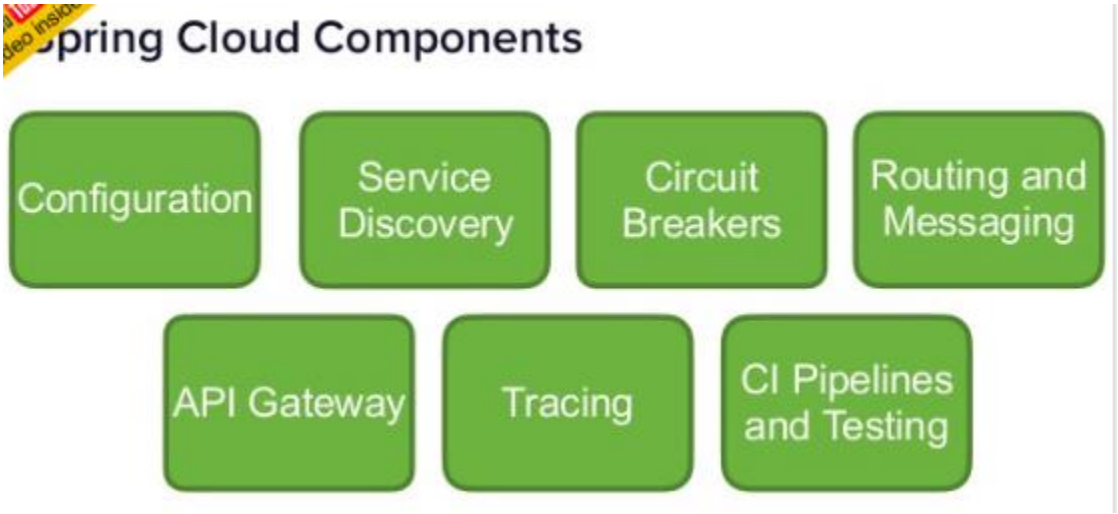
https://www.callicoder.com/spring-boot-actuator/

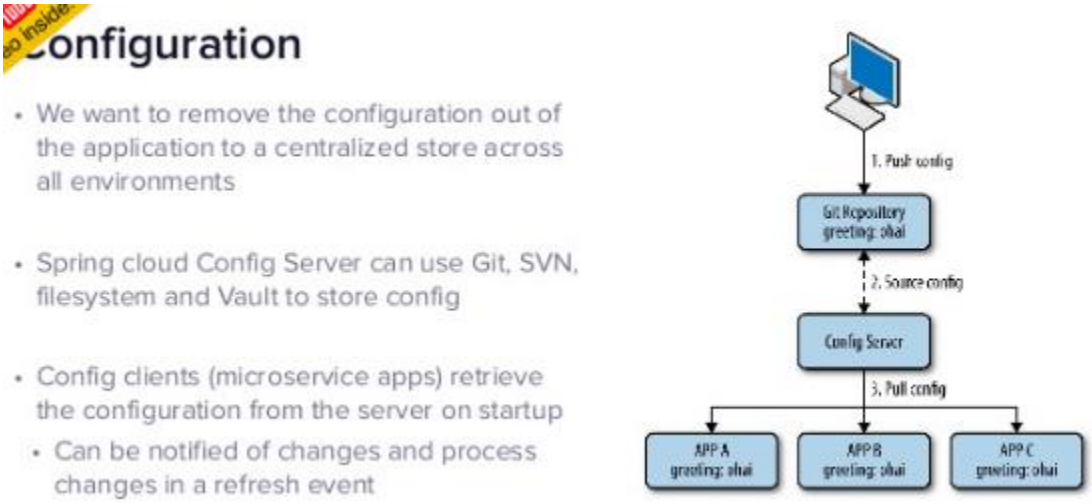
Spring cloud

Spring Cloud focuses on providing good out of box experience for typical use cases and extensibility mechanism to cover others.

- Distributed/versioned configuration
- Service registration and discovery
- Routing
- Service-to-service calls
- Load balancing
- Circuit Breakers
- Global locks
- Leadership election and cluster state
- Distributed messaging

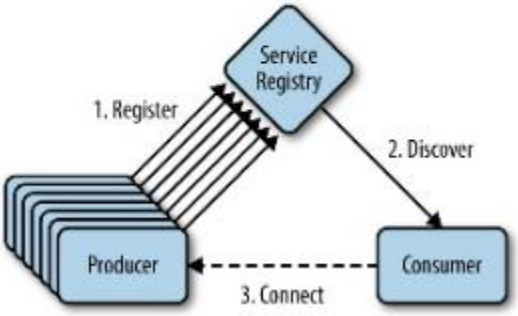
https://github.com/Debesh1234/DemoSpringBootProjects





Service Discovery

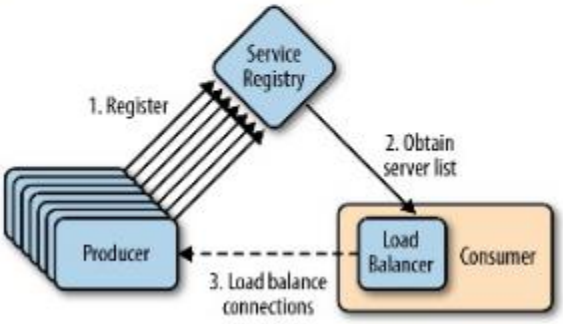
- With the dynamic nature of any cloud native application, depending on things like URLs can be problematic
- Service Discovery allows micro services to easily discover the routes to the services it needs to use
- Netflix Eureka
- Zookeeper
- Consul



Routing and Messaging

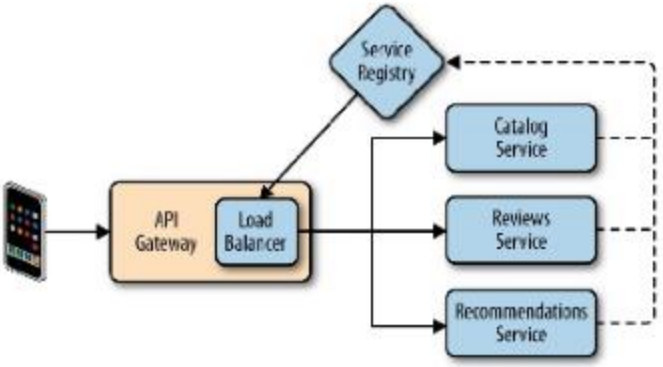
- Your cloud native app will be composed of many microservices so communication will be critical
- Spring Cloud supports communication via HTTP requests or via messaging

- Routing and Load Balancing:
  - Netflix Ribbon and Open Feign
- Messaging:
  - RabbitMQ or Kafka



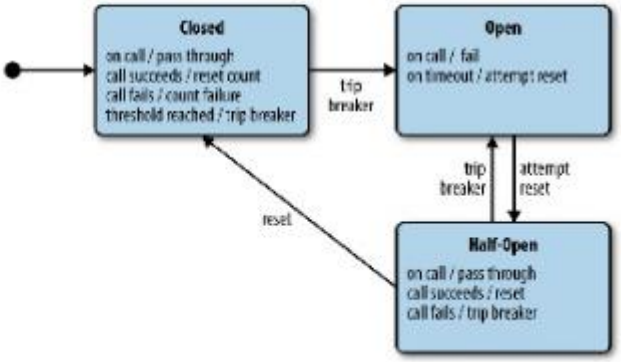
API Gateway

- API Gateways allow you to route API requests (internal or external) to the correct service
- Netflix Zuul
  - Leverages service discovery and load balancer
- Spring Cloud Gateway



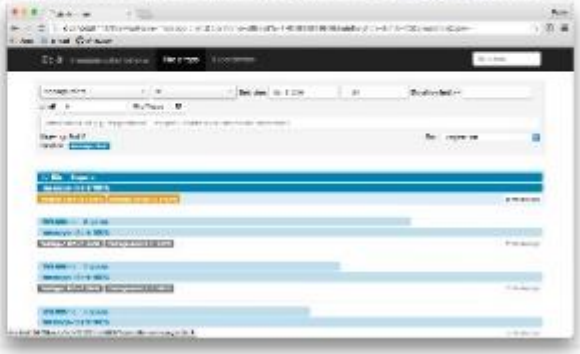
Circuit Breakers

- Failure is inevitable, but your user's don't need to know
- Circuit breakers can help an application function in the face of failure
- Netflix Hystrix



Tracing

- A single request to get data from your application may result in an exponentially larger number of requests to various microservices
- Tracing these requests through the application is critical when debugging issues
- Spring Cloud Sleuth and Zipkin



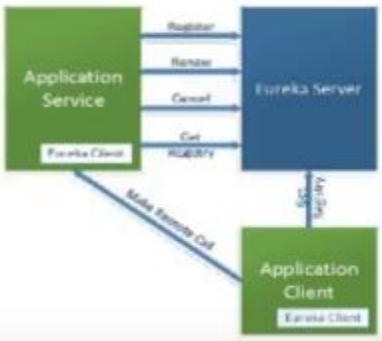
CI Pipelines and Testing

- Building, testing, and deploying the various services is critical to having a successful cloud native application
- Spring Cloud Pipelines is an opinionated pipeline for Jenkins or Concourse that will automatically create pipelines for your apps
- Spring Cloud Contract allows you to accurately mock dependencies between services using published contracts

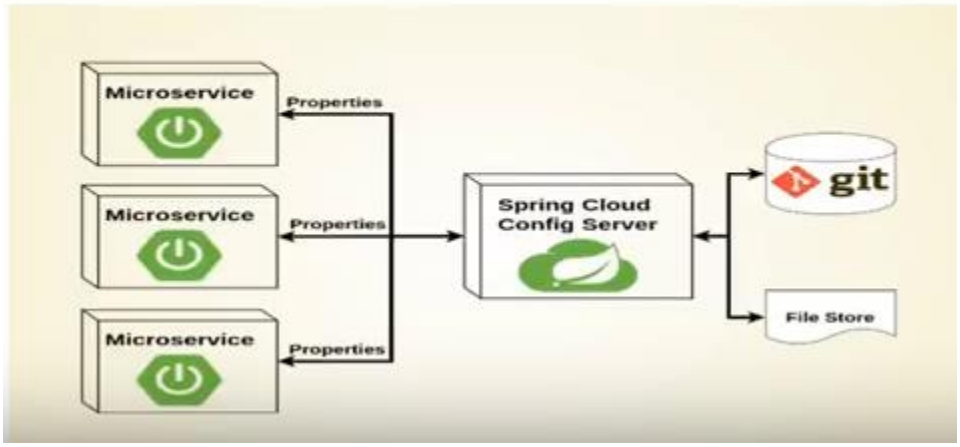
SpringOne Platform by Pivotal

Eureka Service Discovery

- Each service has unique serviced
- Service uses Eureka Client to interact with Eureka Server:
  - Register: serviceId, host, port
  - Renew: using heartbeats to check status
  - Get Registry: return list host:port of services by serviceId



CONFIG SERVER

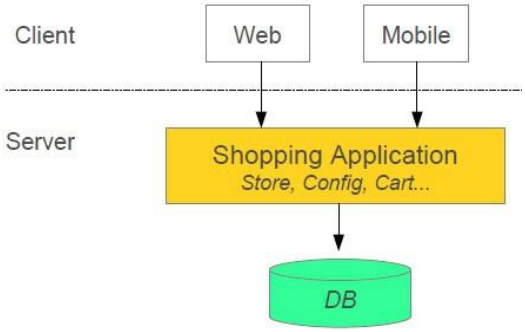


Read it Enough : http://www.optisolbusiness.com/Micro-Services-Architecture-Spring-Boot-and-Netflix-Infrastructure.pdf

SpringBoot MicroServices

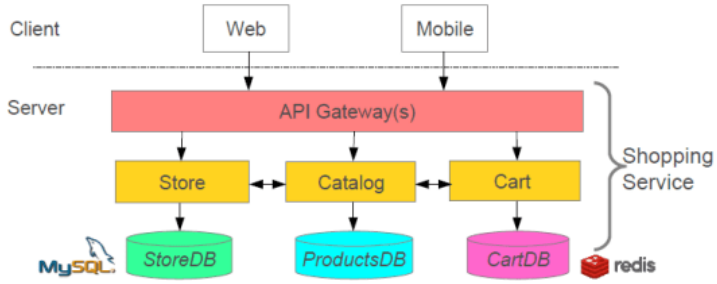
Microservices allows us **to break our large system into the number of independent** collaborating processes.

Shopping system without Microservices (Monolith architecture)



Shopping system with Microservices

In this architecture style, the main application divided into a set of sub-applications called microservices. One large Application divided into multiple collaborating processes as below.



Microservices Benefits

- The smaller code base is easy to maintain.
- Easy to scale as an individual component.
- Technology diversity i.e. we can mix libraries, databases, frameworks etc.
- Fault isolation i.e. a process failure should not bring the whole system down.
- Better support for smaller and parallel team.
- Independent deployment
- Deployment time reduce

Microservices Challenges

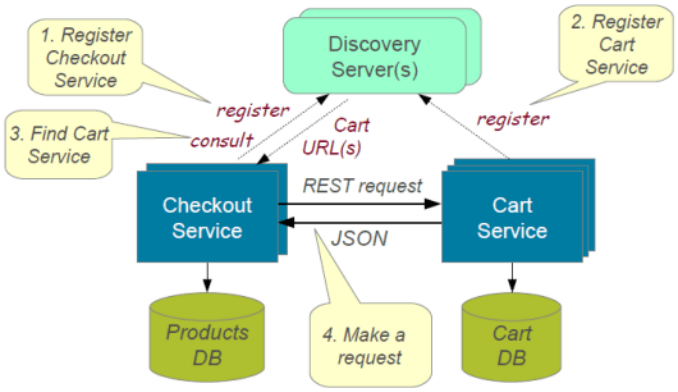
- Distributed System so hard to debug and trace the issues
- Greater need for an end to end testing
- Required cultural changes in across teams like Dev and Ops working together even in the same team.

Microservices Tooling Supports

1. Use Spring for creating Microservices

- Setup new service by using Spring Boot
- Expose resources via a RestController
- Consume remote services using RestTemplat

2.Service Discovery



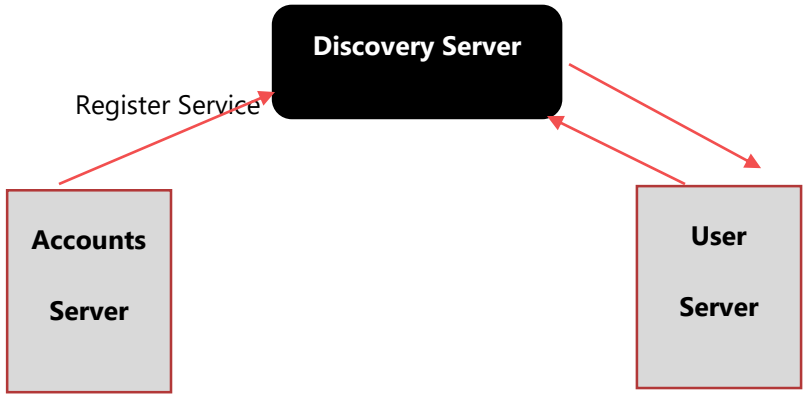
To build a simple microservices system following steps required

1. **Creating Discovery Service (Creating Eureka Discovery Service)**
2. **Creating MicroService (the Producer),** Register itself with Discovery Service with logical service.
3. **Create Microservice Consumers** find Service registered with Discovery ServiceDiscovery client using a smart **RestTemplate** to find microservice.

Example:

In this Example we have 3 Micro services should communicate each other.

Each micrpservice could have seprate Server & Separate DB



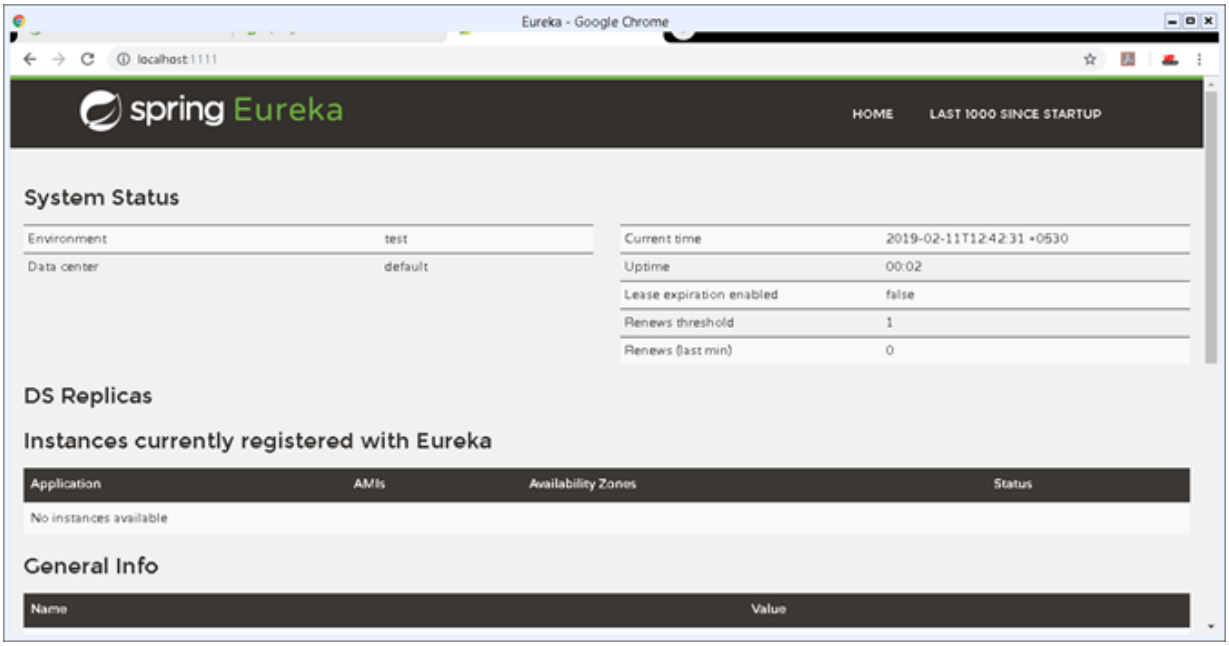
1**. Discovery Microservice server** – To register microservice URLS

https://github.com/dineshonjava/discovery-microservice-server

@EnableEurekaServer –EurekaServer Acts as a Discovery Server. To Make our class as Discovery server use @EnableEurekaServer on the top of Spring Application class

```
@SpringBootApplication
@EnableEurekaServer
public class DiscoveryMicroserviceServerApplication {

	public static void main(String[] args) {
		SpringApplication.run(DiscoveryMicroserviceServerApplication.class, args);
	}
}
```

Run this Eureka Server application with right click and run as Spring Boot Application and open in browser **http://localhost:1111/**



2. Accounts Microservice Server – It conatins Bank Account Deatils

https://github.com/dineshonjava/accounts-microservice-server

Account.java – for Account details

```
public class Account implements Serializable{

	private static final long serialVersionUID = 1L;
	private Long amount;
	private String number;
	private String name;
//Setter and getters
}
```

AccountController – all these Controller urs are Registers with Discovery Service

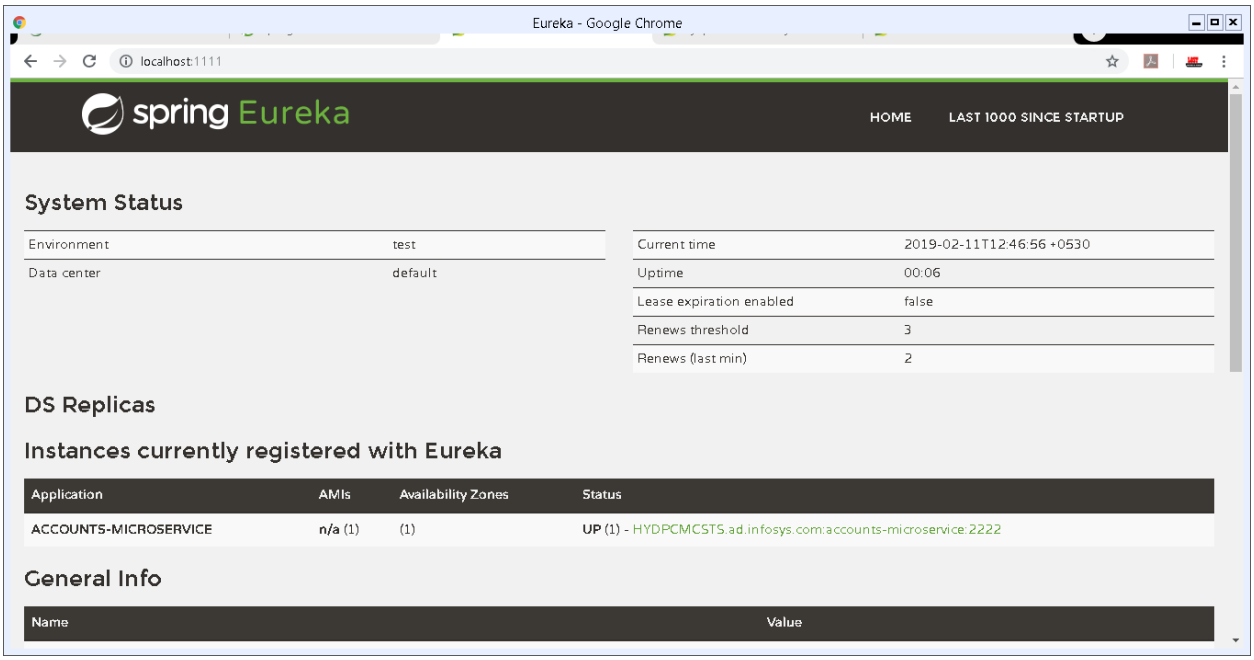
```
@RestController
public class AccountController {

	protected Logger logger = Logger
			.getLogger(AccountController.class.getName());

	@Autowired
	AccountRepository accountRepository;

	@RequestMapping("/accounts")
	public Account[] all() {
		logger.info("accounts-microservice all() invoked");
		List<Account> accounts = accountRepository.getAllAccounts();
		logger.info("accounts-microservice all() found: " + accounts.size());
		return accounts.toArray(new Account[accounts.size()]);
	}

	@RequestMapping("/accounts/{id}")
	public Account byId(@PathVariable("id") String id) {
		logger.info("accounts-microservice byId() invoked: " + id);
		Account account = accountRepository.getAccount(id);
		logger.info("accounts-microservice byId() found: " + account);
		return account;
	}
}
```

To make all our controller URLS register with Discovery server, we need to annotate our main Spring Application class with ***@EnableDiscoveryClient***

```
@SpringBootApplication
@EnableDiscoveryClient
public class AccountsMicroserviceServerApplication {

	public static void main(String[] args) {
		SpringApplication.run(AccountsMicroserviceServerApplication.class, args);
	}

}
```

Now run this account service application as **Spring Boot application** and after few seconds refresh the browser to the home page of **Eureka Discovery Server** at **http://localhost:1111/** .

Now one Service registered to the Eureka registered instances with Service Name "**ACCOUNT-MICROSERVICE**" as below



3. Webclient Mroservice server – User will ask for Specific Account details with AccNo

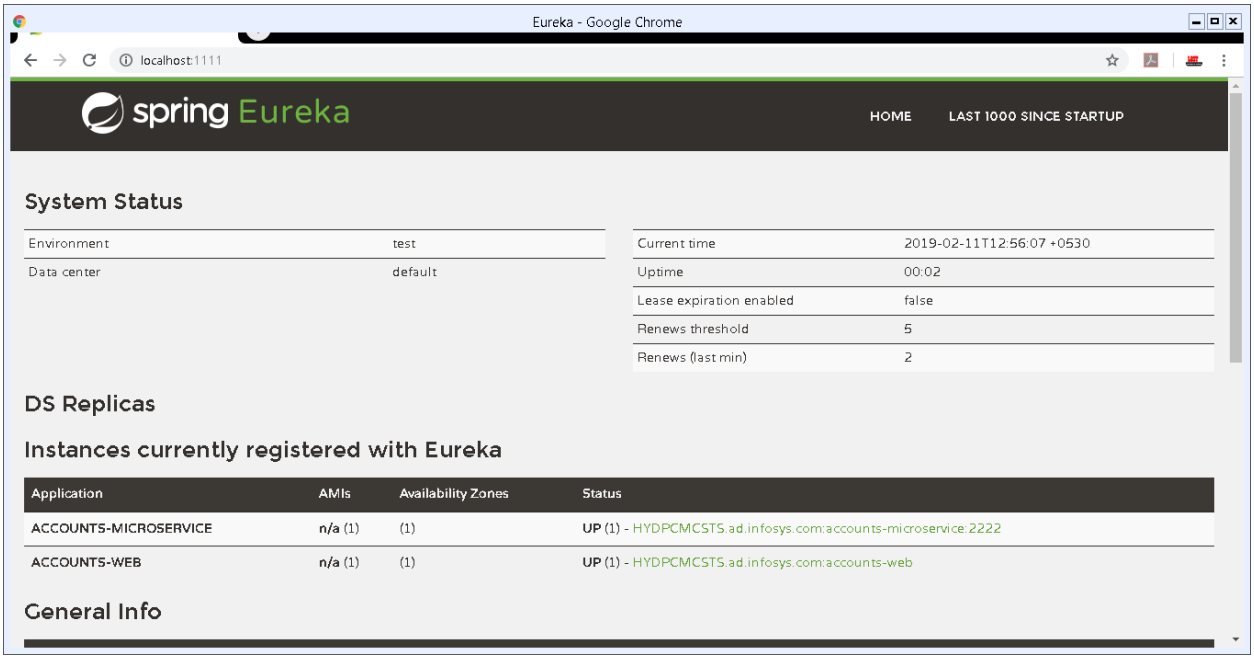
https://github.com/dineshonjava/webclient-microservice-server

Create users to find the Producer Service registered with Discovery Service by adding ***@EnableDiscoveryClient***. This annotation also allows us to query Discovery server to find microservices

```
@SpringBootApplication
@EnableDiscoveryClient
public class WebclientMicroserviceServerApplication {

	public static final String ACCOUNTS_SERVICE_URL = "http://ACCOUNTS-MICROSERVICE";

	public static void main(String[] args) {
		SpringApplication.run(WebclientMicroserviceServerApplication.class, args);
	}

	@Bean
	@LoadBalanced
	public RestTemplate restTemplate() {
		return new RestTemplate();
	}
	@Bean
	public AccountRepository accountRepository(){
		return new RemoteAccountRepository(ACCOUNTS_SERVICE_URL);
	}
}
```

Now run this consumer service application as **Spring Boot application** and after few seconds refresh the browser to the home page of **Eureka Discovery Server** at **http://localhost:1111**

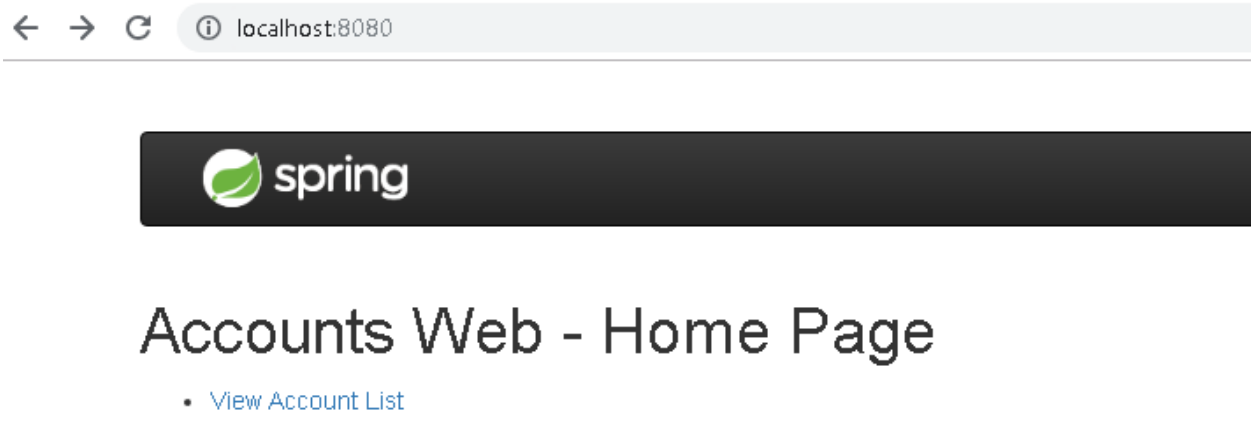
Now one more Service registered to the Eureka registered instances with Service Name "**ACCOUNTS-WEB**" as below

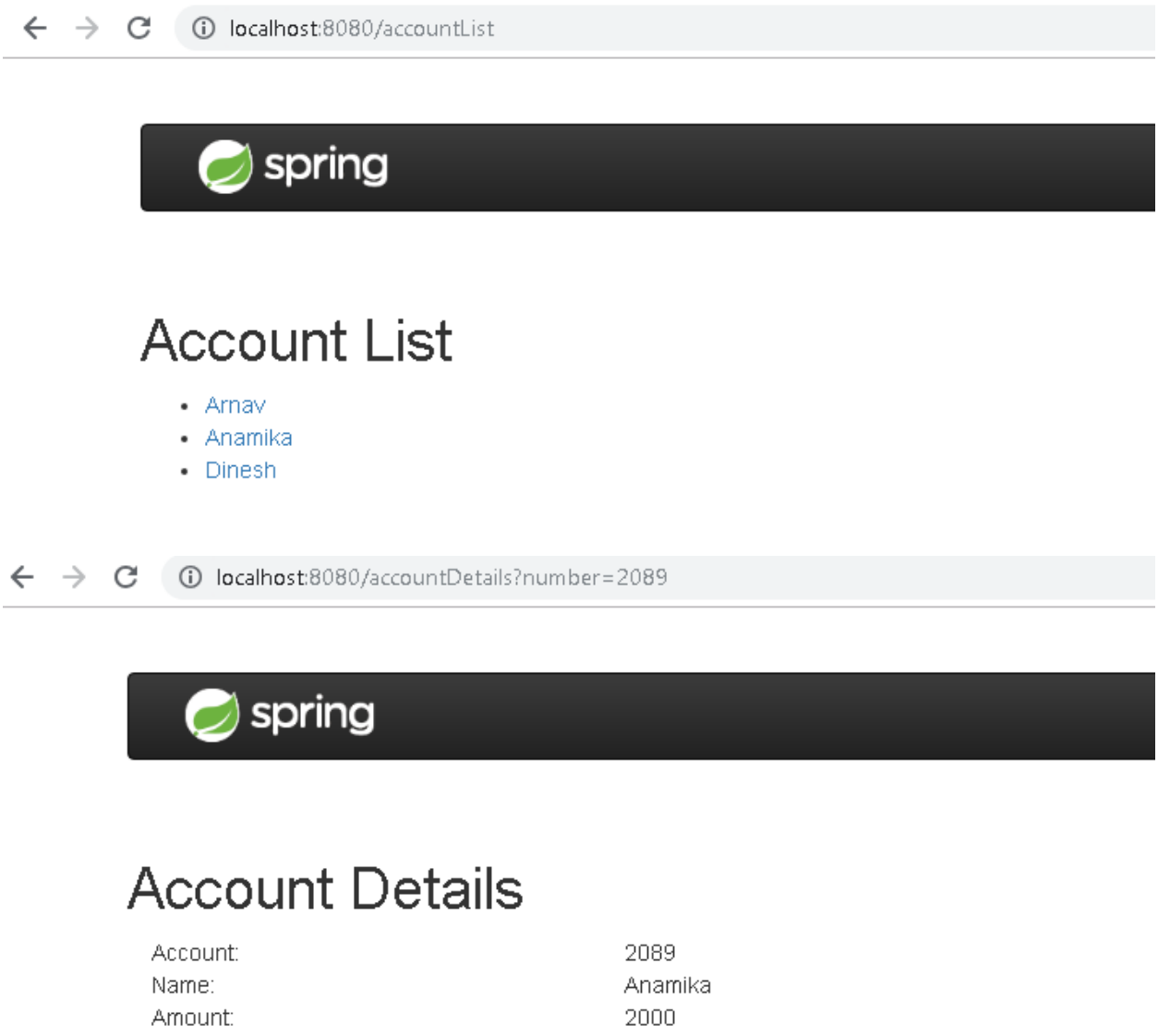


4.Access URL Through Web Application

We already created a Web Application in **Webclient Mroservice server** to call registred Discovery Server URLs.which is running on

http://localhost:8080/





https://www.dineshonjava.com/microservices-with-spring-boot/

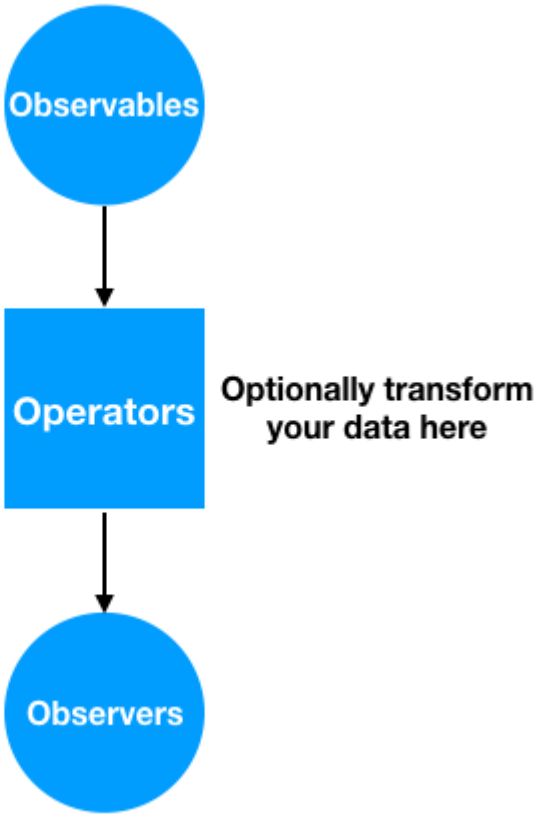
https://spring.io/blog/2015/07/14/microservices-with-spring

Reactive JavaRx

- Reactive comes from the word react, which means to **react to changes** in the state instead of actually doing the state change.
- The reactive model listens to changes in the event and runs the relevant code accordingly.
- **observer/subscriber** attached listening to the stream would receive the data.

The basic building blocks of RxJava are:

- **Observables**: That emits data streams
- **Observers and Subscribers**: That consume the data stream. The only difference between an Observer and a Subscriber is that a Subscriber class has the methods to unsubscribe/resubscribe independently without the need of the observerable methods.
- **Operators**: That transform the data stream



https://cdn.journaldev.com/wp-content/uploads/2018/02/rxjava-basics-flow.png

SpringBoot – Reactive Programming

Spring WebFlux framework is part of Spring 5 and provides reactive programming support for web applications

Spring WebFlux internally uses **Project Reactor** and its publisher implementations – ***Flux*** and ***Mono***.

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-webflux</artifactId>
    <version>2.0.3.RELEASE</version>
</dependency>
```

We'll now build a very simple Reactive REST *EmployeeManagement* application – using Spring WebFlux:

- We'll use a simple domain model – *Employee* with an *id* and a *name* field
- We'll build REST APIs for publishing and retrieve Single as well as Collection *Employee*resources using *RestController* and *WebClient*
- And we will also be creating a secured reactive endpoint using WebFlux and Spring Security

```
@RestController
@RequestMapping("/employees")
public class EmployeeReactiveController {

    private final EmployeeRepository employeeRepository;

@GetMapping("/{id}")
private Mono<Employee> getEmployeeById(@PathVariable String id) {
    return employeeRepository.findEmployeeById(id);
}

@GetMapping
private Flux<Employee> getAllEmployees() {
    return employeeRepository.findAllEmployees();
}

}
```

Reactive Web Client

WebClient introduced in Spring 5 is a non-blocking client with support for Reactive Streams.

On the client side, we use *WebClient* to retrieve data from our endpoints created in*EmployeeController*.

```
public class EmployeeWebClient {

    WebClient client = WebClient.create("http://localhost:8080");

  Mono<Employee> employeeMono = client.get()
```

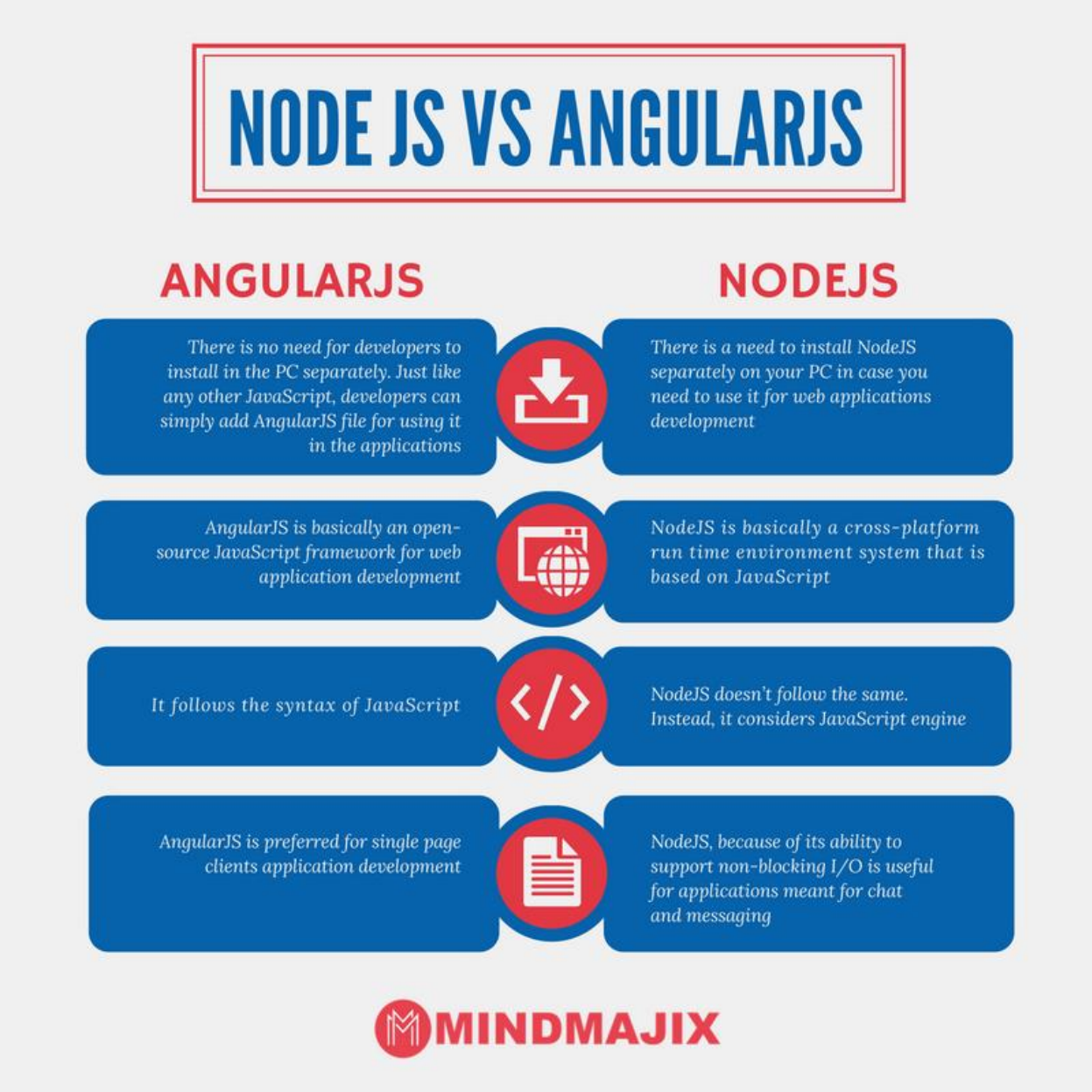
```
  .uri("/employees/{id}", "1")
  .retrieve()
  .bodyToMono(Employee.class);

employeeMono.subscribe(System.out::println);


Flux<Employee> employeeFlux = client.get()
  .uri("/employees")
  .retrieve()
  .bodyToFlux(Employee.class);

employeeFlux.subscribe(System.out::println);

}
```

https://www.baeldung.com/spring-webflux

https://www.journaldev.com/20763/spring-webflux-reactive-programming

AngularJs(Angular 1) vs Angular (Angular 2)

Technology	React	AngularJS	Angular 2
Author	Facebook community	Google	Google
Type	Open source JS library	Fully-featured MVC framework	Fully-featured MVC framework
Toolchain	High	Low	High
Language	JSX	JavaScript, HTML	TypeScript
Learning Curve	Low	High	Medium
Packaging	Strong	Weak	Medium
Rendering	Server Side	Client Side	Server Side
App Architecture	None, combined with Flux	MVC	Component-based
Data Binding	Uni-directional	Bi-directional	Bi-directional
DOM	Virtual DOM	Regular DOM	Regular DOM
Latest Version	15.4.0 (November 2016)	1.6.0	2.2.0 (November 2016)



What exactly node.js is?

Is it a web server or a programming language for server-side scripts?

- So here's how it is, how it's always been: a browser sends a request to a website. The site's server receives the request, tracks down the requested file, performs any database queries as needed, and sends a response to the browser. In traditional web servers, such as Apache, each request causes the server to create a new system process to handle that request

- Now think about what that means for a traditional web server like Apache. For each and every user connected to the site, your server has to keep a connection open. Each connection requires a process, and each of those processes will spend most of its time either sitting idle (consuming memory) or waiting on a database query to complete. This means that it's hard to scale up to high numbers of connections without grinding to a near halt and using up all your resources.

- So what's the solution? Here's where some of that jargon from before comes into play: specifically **non-blocking** and **event-driven**

- Think of **a non-blocking** server as a loop: it just keeps going round and round. A request comes in, the loop grabs it, passes it along to some other process (like a database query), sets up a callback, and keeps going round, ready for the next request. It doesn't just sit there, waiting for the database to come back with the requested info.

- If the database query comes back — fine, we'll deal with that the same way: throw a response back to the client and keep looping around. There's theoretically no limit on how many database queries you can be waiting on, or how many clients have open requests, because you're not spending any time waiting for them. You deal with them all in their own time

- **event-driven means**: the server only reacts when an event occurs. That could be a request, a file being loaded, or a query being executed — it really doesn't matter.

How to host node.js applications?

You need to Host AWS or Google Cloud or any other cloud platform because it needs Node.js to be installed.

Npm, bower packges

Let's understand by Example

I used the complete **MEAN** stack for this series

MEAN is a set of Open Source components that together, provide an end-to-end framework for building dynamic web applications;

- **M**ongoDB : Document database – used by your back-end application to store its data as JSON (JavaScript Object Notation) documents
- **E**xpress (sometimes referred to as Express.js): Back-end web application framework running on top of Node.js
- **A**ngular (formerly Angular.js): Front-end web app framework; runs your JavaScript code in the user's browser, allowing your application UI to be dynamic
- **N**ode.js : JavaScript runtime environment – lets you implement your application back-end in JavaScript

1.create **package.json** to install some Node packages.(like maven, here we can see **express.js** dependency)

```
//package.json
{
  "name": "node-rest-auth",
  "main": "server.js",
  "dependencies": {
    "bcrypt": "^0.8.5",
    "body-parser": "~1.9.2",
    "express": "~4.9.8",
    "jwt-simple": "^0.3.1",
    "mongoose": "~4.2.4",
    "morgan": "~1.5.0",
    "passport": "^0.3.0",
    "passport-jwt": "^1.2.1"
  }
}
```

To install pacakges Run

```
npm install
```

This will install all our modules to **node_modules/**.

We can also install one by one without package.json as below, it will get latest version of it

```
npm install mongojs
npm install express
```

2.create **server.js**, here we import all the needed elements and create our server with url localhost:9090

```
var express     = require('express');
var app         = express();
var bodyParser  = require('body-parser');
var morgan      = require('morgan');
var mongoose    = require('mongoose');
var passport = require('passport');
var config      = require('./config/database'); // get db config file
var User        = require('./app/models/user'); // get the mongoose model
var port        = process.env.PORT || 9090;
var jwt         = require('jwt-simple');

// get our request parameters
app.use(bodyParser.urlencoded({ extended: false }));
```

```
app.use(bodyParser.json());

// log to console
app.use(morgan('dev'));

// Use the passport package in our application
app.use(passport.initialize());

// demo Route (GET http://localhost:9090)
app.get('/', function(req, res) {
  res.send('Hello! The API is at http://localhost:' + port + '/api');
});

// Start the server
app.listen(port);
console.log('There will be dragons: http://localhost:' + port);
```

3.config/database.js

```
module.exports = {
  'secret': 'devdacticIsAwesome',
  'database': 'mongodb://localhost/node-rest-auth'
};
```

4. user model for our user authentication

```
//app/models/user.js
var mongoose = require('mongoose');
var Schema = mongoose.Schema;
var bcrypt = require('bcrypt');

// Thanks to http://blog.matoski.com/articles/jwt-express-node-mongoose/

// set up a mongoose model
var UserSchema = new Schema({
  name: {
        type: String,
        unique: true,
        required: true
    },
  password: {
        type: String,
        required: true
    }
});

UserSchema.pre('save', function (next) {
    var user = this;
    if (this.isModified('password') || this.isNew) {
        bcrypt.genSalt(10, function (err, salt) {
            if (err) {
                return next(err);
            }
            bcrypt.hash(user.password, salt, function (err, hash) {
                if (err) {
                    return next(err);
                }
                user.password = hash;
                next();
            });
        });
    } else {
        return next();
    }
});

UserSchema.methods.comparePassword = function (passw, cb) {
```

```
    bcrypt.compare(passw, this.password, function (err, isMatch) {
        if (err) {
            return cb(err);
        }
        cb(null, isMatch);
    });
};

module.exports = mongoose.model('User', UserSchema);
```

Now the basics are set up, and you can start our server from now on just with

```
node server.js
```

https://devdactic.com/restful-api-user-authentication-1/

Now NPM vs Bower

Npm and Bower are both **dependency management tools**. But the main difference between both is

- **npm is used for installing Node js modules**
- **bower is used for managing front end components like html, css, js etc**

running `bower install` will fetch the package and put it in `/vendor` directory,
running `npm install` it will fetch it and put it into `/node_modules` directory.

Grunt is quite different from Npm and Bower. Grunt is a javascript task runner tool. You can do a lot of things using grunt which you had to do manually otherwise

There are grunt plugins for **compilation, uglifying your javascript, copy files/folders, minifying javascript etc.**

References

OnlineHTML - https://www.froala.com/online-html-editor