AngularJS Testing

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Testing

- The most popular tool for running automated tests for AngularJS applications is Karma
  - runs unit tests and “end-to-end” tests in real browsers and PhantomJS
  - can use many testing frameworks, but Jasmine seems to supported best
- Create test directory with subdirectories **`unit`** and **`e2e`**
  - in unit directory, create subdirectories **`controllers`** and **`services`**

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Installing Karma

- To install **Karma**
  - **`npm install -g karma`**
  - cd to top directory of project
  - **`karma init`** (answer questions; creates **`karma.config.js`**)
    - in Windows, this didn't work from Cygwin but did from a Command Prompt

maybe because **`node`** and **`npm`** for Windows don't work in Cygwin

  - edit **`karma.config.js`**
    - add to **`files`** array passed to **`config.set`** the paths to **`angular.min.js`**, **`angular-mocks.js`** and the JavaScript files being tested

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Browser Support

- To use Google **Chrome**
  - karma-chrome-launcher is installed automatically when karma is installed
  - on Windows, set **`CHROME_BIN`** environment variable to point to **`chrome.exe`**
- To use **Firefox**
  - karma-firefox-launcher is installed automatically when karma is installed
  - on Windows, set **`FIREFOX_BIN`** environment variable to point to **`firefox.exe`**
- To use **IE** (Windows-only)
  - **`npm install -g karma-ie-launcher`**
- To use **Safari** (Mac-only)
  - **`npm install -g karma-safari-launcher`**
- To use **PhantomJS**
  - karma-phantomjs-launcher is installed automatically when karma is installed; includes PhantomJS
  - set **`PHANTOMJS_BIN`** environment variable to point to **`phantomjs`** executable (not needed on Windows)
  - executable is in **``` `npm root -g`/karma-phantomjs-launcher/node_modules/phantomjs/bin ```**

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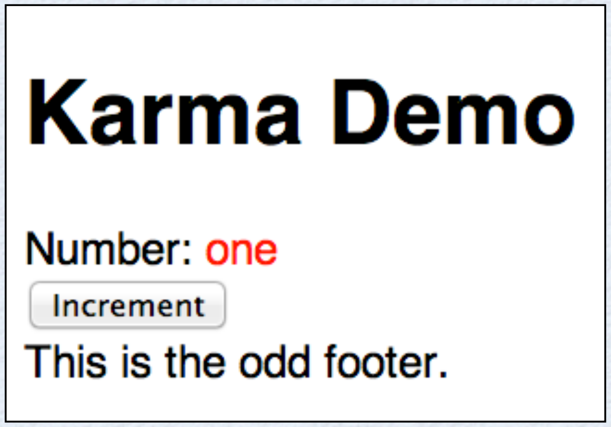
Sample Application

- We will walk through writing tests for a simple application
- The application has
  - one service
  - three controllers
  - one custom filter
  - one custom directive
  - routing
- Pressing the "Increment" button increments the number
  - the controller calls a service method to increment it - keeping things simple!
- A filter formats the numbers 1, 2 and 3 as words
- A directive applies different CSS classes to the number based on whether it is even or odd
- Routes cause different footers to be displayed based on whether the number is even or odd


Karma Demo

Number: one

This is the odd footer.

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HTML and CSS

index.html

```html
<!DOCTYPE html>
<html ng-app="KarmaDemo">
  <head>
    <link rel="stylesheet" href="karma-demo.css"/>
    <script src="lib/angular.min.js"></script>
    <script src="scripts/karma-demo.js"></script>
  </head>
  <body>
    <h1>Karma Demo</h1>
    <div ng-controller="DemoCtrl">
      <div>
        Number:
        <span even-odd-class="foo,bar">{{number | asWord}}</span>
      </div>
      <button ng-click="increment()">Increment</button>
    </div>
    <div ng-view="footer"></div>
  </body>
</html>
```

karma-demo.css

```css
body {
  font-family: sans-serif;
}

.foo {
  color: green;
}

.bar {
  color: red;
}
```

JavaScript ...

scripts/karma-demo.js

```
(function () {
  'use strict';

  // Create a module just to use for testing module dependencies.
  angular.module('OtherModule', []);

  var app = angular.module('KarmaDemo', ['OtherModule']);

  app.factory('demoSvc', function () {
    var svc = {};
    svc.increment = function (number) {
      return number + 1;
    };
    return svc;
  });

  app.controller('DemoCtrl', function ($scope, $location, demoSvc) {
    $scope.number = 1;
    $scope.increment = function () {
      $scope.number = demoSvc.increment($scope.number);
      var isEven = $scope.number % 2 === 0;
      $location.path('/' + (isEven ? 'even' : 'odd'));
    };
  });

  // These empty controllers are only used to test that routes
  // associated the correct controller with a view.
  app.controller('EvenFooterCtrl', function () {});
  app.controller('OddFooterCtrl', function () {});
```

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... JavaScript ...

scripts/
karma-demo.js

```
app.directive('evenOddClass', function () {
  var evenClass, oddClass;

  function evaluate(number, element) {
    if (number % 2 === 0) {
      element.removeClass(oddClass);
      element.addClass(evenClass);
    } else {
      element.removeClass(evenClass);
      element.addClass(oddClass);
    }
  }

  return {
    restrict: 'A',
    link: function (scope, element, attrs) {
      var classNames = attrs.evenOddClass.split(',');
      evenClass = classNames[0];
      oddClass = classNames[1];
      scope.$watch('number', function (newValue, oldValue) {
        evaluate(newValue, element);
      });
      evaluate(scope.number, element);
    }
  };
});
```

```
app.filter('asWord', function () {
  return function (number) {
    return number === 1 ? 'one' :
      number === 2 ? 'two' :
      number === 3 ? 'three' :
      number;
  };
});
```

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... JavaScript

```
  app.config(function ($routeProvider) {
    $routeProvider
      .when('/even', {
        'controller': 'EvenFooterCtrl',
        'templateUrl': 'views/evenFooter.html',
        'view': 'footer'
      })
      .when('/odd', {
        'controller': 'OddFooterCtrl',
        'templateUrl': 'views/oddFooter.html',
        'view': 'footer'
      })
      .otherwise({
        redirectTo: '/odd'
      });
  });
})();
```

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Module Tests

```
describe('KarmaDemo module', function () {
  var module = angular.module('KarmaDemo');

  it('should exist', function () {
    expect(module).not.toBeNull();
  });

  it('should have one dependency', function () {
    expect(module.requires.length).toBe(1);
    expect(module.requires).toContain('OtherModule');
  });
});
```

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Service Tests

```
describe('demoSvc service', function () {
  var svc;

  beforeEach(module('KarmaDemo'));

  it('should have demoSvc service', inject(function ($injector) {
    svc = $injector.get('demoSvc');
    expect(svc).not.toBeNull();
  }));

  it('should increment properly', function () {
    expect(svc.increment(2)).toBe(3);
  });
});
```

The method `angular.mock.module` is added to `window` as `module`.

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Controller Tests

```
describe('DemoCtrl controller', function () {
  var scope;

  beforeEach(function () {
    module('KarmaDemo');
    inject(function ($rootScope, $controller) {
      scope = $rootScope.$new(); // create a scope for DemoCtrl to use
      $controller('DemoCtrl', {$scope: scope}); // give scope to DemoCtrl
    });
  });

  it('should have number in scope', function () {
    expect(scope.number).not.toBeNull();
    expect(scope.number).toBe(1);
  });

  it('should increment properly', function () {
    scope.increment();
    expect(scope.number).toBe(2);
    scope.increment();
    expect(scope.number).toBe(3);
  });
});
```

The method `angular.mock.inject` is added to `window` as `inject`.

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Filter Tests

```
describe('asWord filter', function () {
  var filter;

  beforeEach(module('KarmaDemo'));

  it('should have asWord filter', inject(function ($filter) {
    filter = $filter('asWord');
    expect(filter).not.toBeNull();
  }));

  it('should translate 2', function () {
    expect(filter(2)).toBe('two');
  });
});
```

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Directive Tests

```
describe('evenOddClass directive', function () {
  var directive;

  beforeEach(module('KarmaDemo'));

  // TODO: Is there a way to test that a directive with a given name
  // TODO: exists in a module?

  it('should add the correct CSS class to an element',
    inject(function ($compile, $rootScope) {

    $rootScope.number = 1;
    // The directive should add the CSS class "bar"
    // to the element because number is odd.
    var element =
      $compile('<span even-odd-class="foo,bar"></span>')($rootScope);
    expect(element.hasClass('bar')).toBe(true);

    $rootScope.number = 2;
    // The directive should add the CSS class "foo"
    // to the element because number is even.
    element =
      $compile('<span even-odd-class="foo,bar"></span>')($rootScope);
    expect(element.hasClass('foo')).toBe(true);
  }));
});
```

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Route Tests

```
describe('footer routes', function () {
  it('should change path', function () {
    module('KarmaDemo'); // must do before inject

    inject(function ($route) {
      var route = $route.routes['/even'];
      expect(route.controller).toBe('EvenFooterCtrl');
      expect(route.templateUrl).toBe('views/evenFooter.html');
      expect(route.view).toBe('footer');

      route = $route.routes['/odd'];
      expect(route.controller).toBe('OddFooterCtrl');
      expect(route.templateUrl).toBe('views/oddFooter.html');
      expect(route.view).toBe('footer');
    });
  });
});
```

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karma.conf.js

```
module.exports = function (config) {
  config.set({
    basePath: '', // used to resolve relative file paths
    frameworks: ['jasmine'],
    files: [
      'lib/angular.min.js',
      'lib/angular-mocks.js',
      'scripts/*.js',
      'test/unit/*Spec.js'
    ],
    exclude: [],

    // options: 'dots', 'progress', 'junit', 'growl', 'coverage'
    reporters: ['progress'],

    port: 9876, // web server port
    colors: true, // in output of reporters and logs
    logLevel: config.LOG_INFO,
    autoWatch: true, // watch files and execute tests when any change
    // options: Chrome, ChromeCanary, Firefox, Opera,
    //          Safari (Mac-only), IE (Windows-only), PhantomJS
    browsers: ['Chrome'],

    // if browser doesn't capture output in given timeout(ms), kill it
    captureTimeout: 60000,

    // if true, it capture browsers, runs tests and exits
    singleRun: false
  });
};
```

for running unit tests, not e2e tests

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Running Unit Tests

- For a single run
  - edit **`karma.conf.js`** and verify that in the object passed to **`config.set`** **`auto-watch`** is **`false`** and **`singleRun`** is **`true`**
- For repeated runs every time a watched file is modified
  - edit **`karma.conf.js`** and verify that in the object passed to **`config.set`** **`auto-watch`** is **`true`** and **`singleRun`** is **`false`**
- To run unit tests
  - **`karma start`**
  - starts its own server and configured browsers
  - runs tests
  - exits if configured for a single run

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Mock Dependency Injection

- In unit test code, mock implementations of services can be used in place of real implementations
- One way to do this
  - create an object that has all the methods of the service
  - register that object under the name of the service to be replaced
    - `app.value(svcName, mockSvcObject);`
- Other ways?

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End-to-End Tests

- Old approach - Angular Scenario Runner
  - used with Karma
  - **`npm install -g karma-ng-scenario`**
  - must start a server that serves all static content
    - can use Grunt with the connect plugin
    - must do a local **`npm install`** of grunt, grunt-contrib-connect and grunt-karma (takes a LONG time!)
  - being phased out in favor of Protractor
- New approach - Protractor
  - https://github.com/angular/protractor
  - based on Selenium WebDriverJS
  - designed for AngularJS, but not restricted to that
  - can use Jasmine or Mocha test frameworks
  - a test runner; doesn't require using Karma
  - can use Selenium Grid to test in multiple browsers simultaneously and run mulitple instances of the same browser for load testing

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Protractor ...

- To install
  - **`npm install -g protractor`**
  - cd to top project directory
  - determine directory where global node modules are installed by running **`npm root -g`**
  - install standalone Selenium server
    - `./`***`that-dir`***`/protractor/bin/install_selenium_standalone`
    - on Windows, `node /`***`that-dir`***`/protractor/bin/install_selenium_standalone`

  not needed if using an existing Selenium server

  - copy `/`***`that-dir`***`/protractor/referenceConf.js` to **`protractor.conf.js`**
- Edit **`protractor.conf.js`**
  - modify **`specs`** property to include directory where tests will be stored (ex. **`test/e2e`**)
  - modify **`capabilities.browserName`** property to the name of the browser to be used
    - common choices are **`android`**, **`chrome`**, **`firefox`**, **`internet explorer`**, **`iPhone`**, **`iPad`** and **`safari`**
  - modify **`baseUrl`** property to to be URL where web app is served

for a detailed description of options, see https://code.google.com/p.selenium/wiki/DesiredCapabilities

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... Protractor

- To run tests
  - cd to top project directory
  - start Web server that servers static files and processes Ajax calls
  - **`protractor protractor.conf.js`**
    - starts Selenium server, runs tests, reports results, shuts down Selenium server, and exits
    - **`console.log`** output in tests will go to stdout

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Working With Page Elements

- Get Protractor instance and load a page

```
var ptor;

beforeEach(function () {
  ptor = protractor.getInstance();
  ptor.get('some-url');
});
```

- Get element objects
  by calling `ptor.findElement` or `ptor.findElements`
  with a “locator”
  - `findElement` returns the first matching element
  - `findElements` returns an array of all matching elements.
  - locators are `protractor.By.x('some-string')` where `x` is one of `className`, `css`, `id`, `linkText`, `partialLinkText`, `name`, `tagName` or `xpath`
  - AngularJS-specific values for `x` include `binding`, `select`, `selectedOption`, `input` and `repeater`
  - throws if no matching elements are found, causing test to fail

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Element Methods

- Can call many methods on these "element" objects
  - `clear()`, `click()`, `getAttribute(`*`name`*`)`, `getCssValue(`*`propertyName`*`)`, `getLocation()`, `getSize()`, `getTagName()`, `getText()`, `isDisplayed()`, `isEnabled()`, `isSelected()`, `sendKeys(`*`text`*`)`
- Typically want to call `clear()` on `input` elements before calling `sendKeys(`*`text`*`)`
- Methods that return data such as `getText` actually return a promise
- When a promise is passed to `expect`, it waits until the promise is resolved or rejected to evaluate it

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Protractor Sugar

- Directly using Protractor methods can be verbose
- Here are some utility methods to make Protractor tests less verbose
- This is used in the example test on the next slide

protractorSugar.js

```
module.exports = function (ptor) {
  var obj = {};

  obj.click = function (id) {
    this.getElementById(id).click();
  };

  obj.getElementById = function (id) {
    return ptor.findElement(protractor.By.id(id));
  };

  obj.getText = function (id) {
    return this.getElementById(id).getText();
  };

  obj.setInputValue = function (id, value) {
    var input = this.getElementById(id);
    input.clear();
    input.sendKeys(value);
  };

  return obj;
};
```

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Example Protractor Test

loginSpec.js

```
var protractorSugar = require('./protractorSugar');

describe('login', function () {
  var ps, ptor;

  beforeEach(function () {
    ptor = protractor.getInstance();
    ps = protractorSugar(ptor);
    ptor.get('/');
  });

  it('should fail on bad username/password', function () {
    ps.setInputValue('userId', 'foo');
    ps.setInputValue('password', 'bar');
    ps.click('login');
    expect(ps.getText('loginError')).toBe(
      'The user id or password is incorrect.');
  }, 5000); // five second timeout

  it('should get password hint', function () {
    ps.setInputValue('userId', 'gumby');
    ps.click('passwordHintLink');
    expect(ps.getText('passwordHint')).toBe('my horse');
  }, 5000); // five second timeout
});
```

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