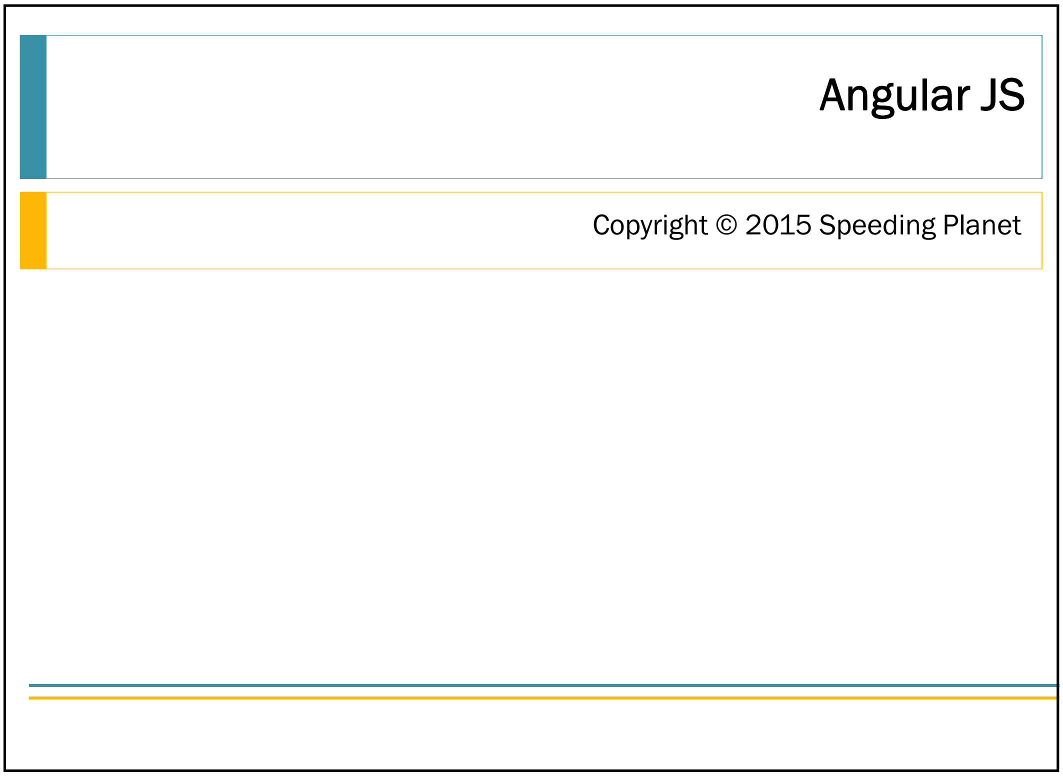
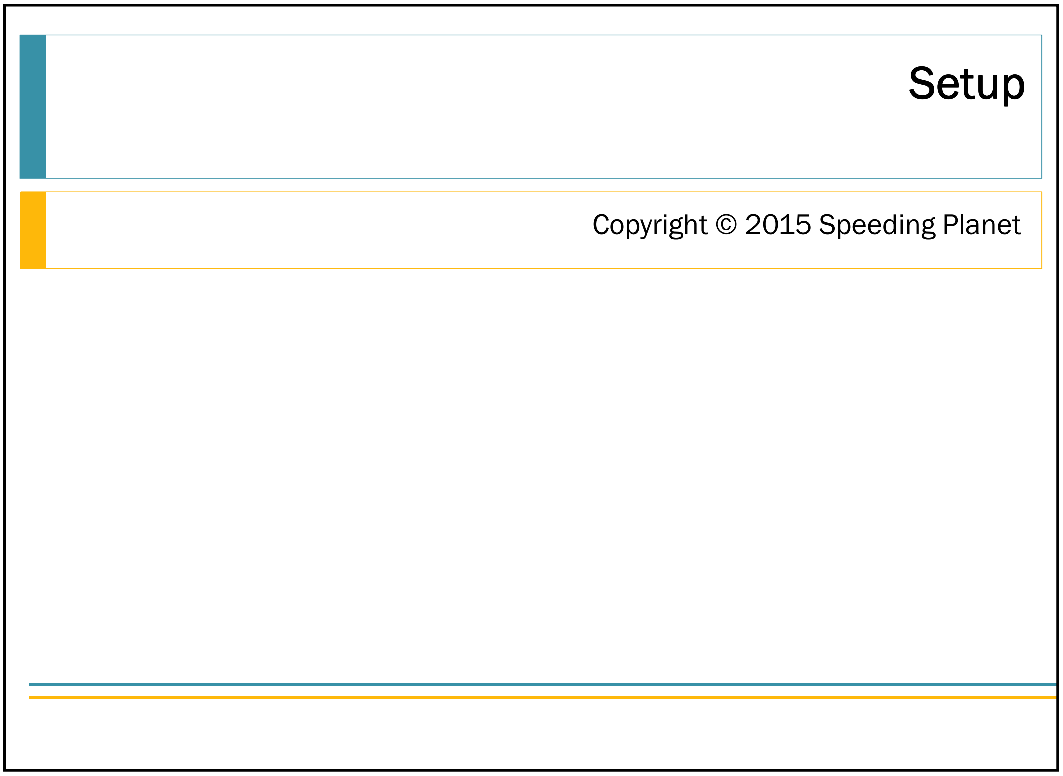
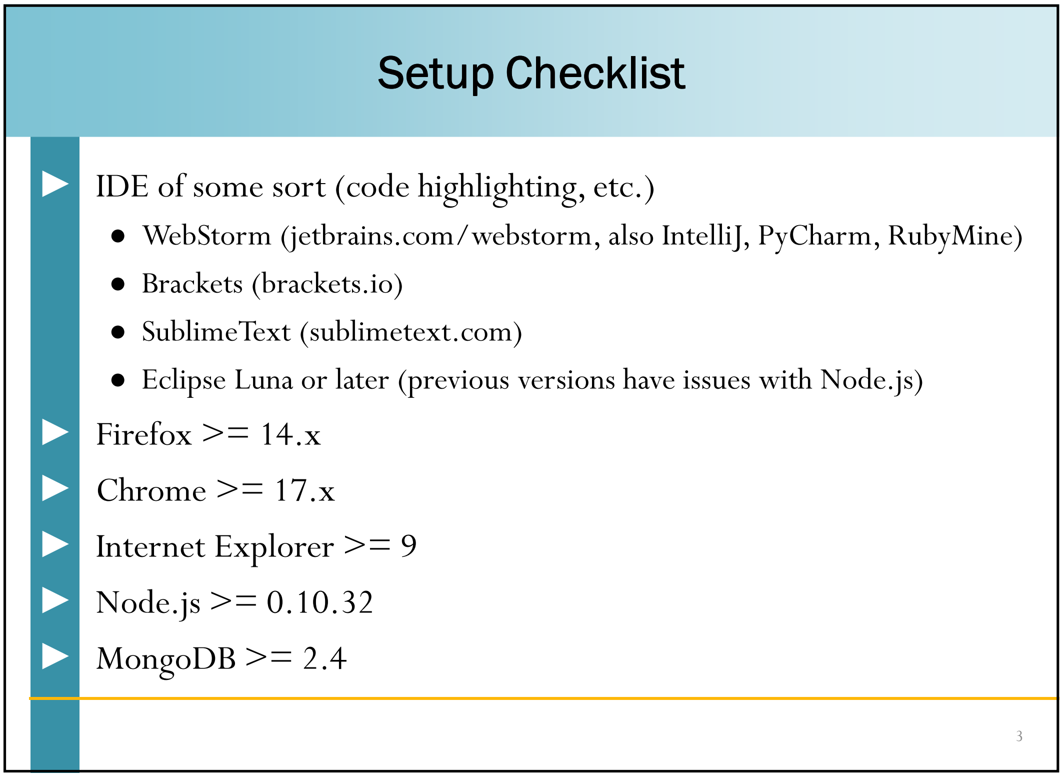


Angular JS

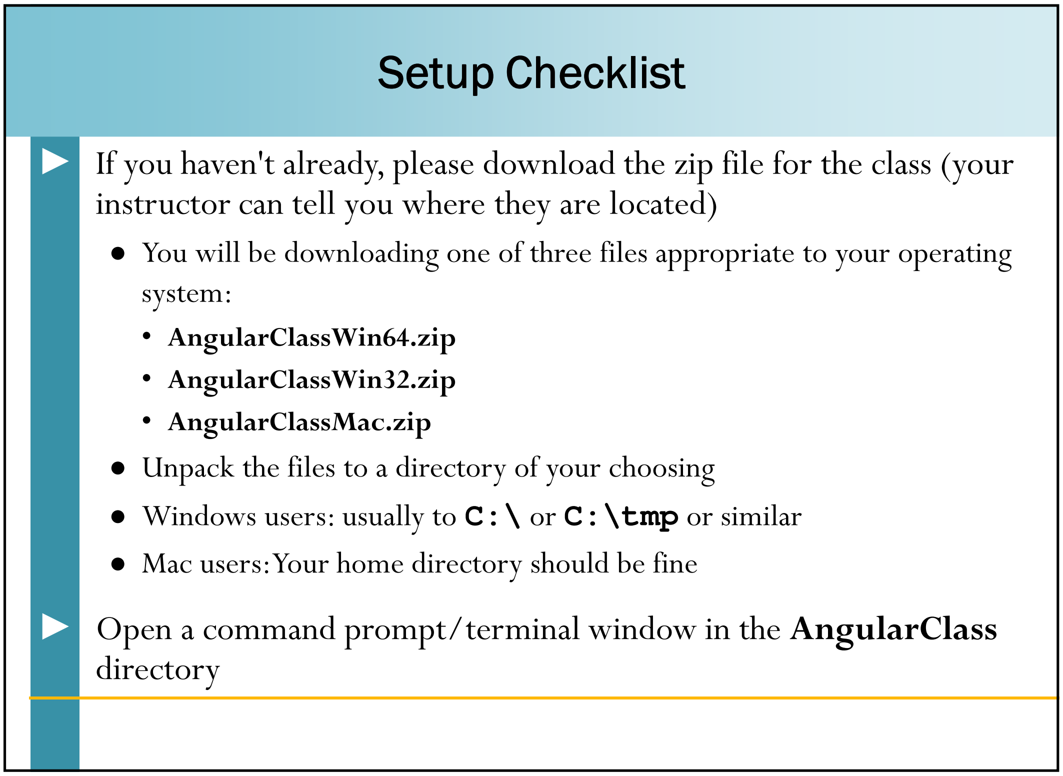


Setup



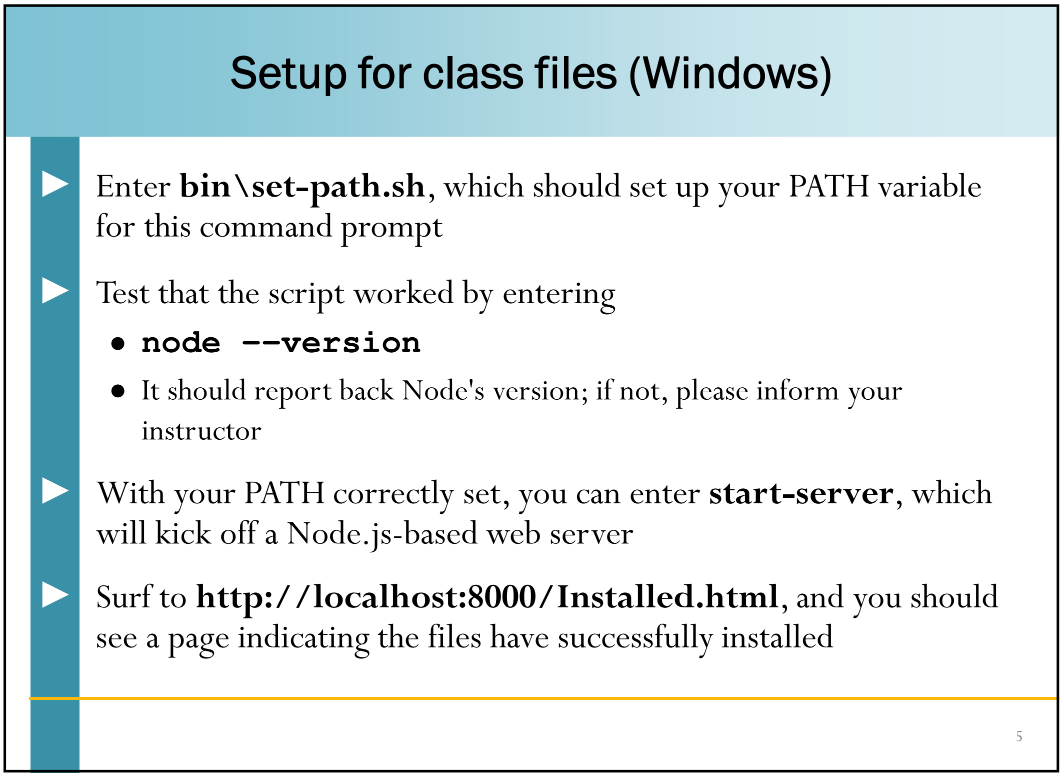
Setup Checklist

- IDE of some sort (code highlighting, etc.)
  - WebStorm (jetbrains.com/webstorm, also IntelliJ, PyCharm, RubyMine)
  - Brackets (brackets.io)
  - SublimeText (sublimetext.com)
  - Eclipse Luna or later (previous versions have issues with Node.js)
- Firefox >= 14.x
- Chrome >= 17.x
- Internet Explorer >= 9
- Node.js >= 0.10.32
- MongoDB >= 2.4



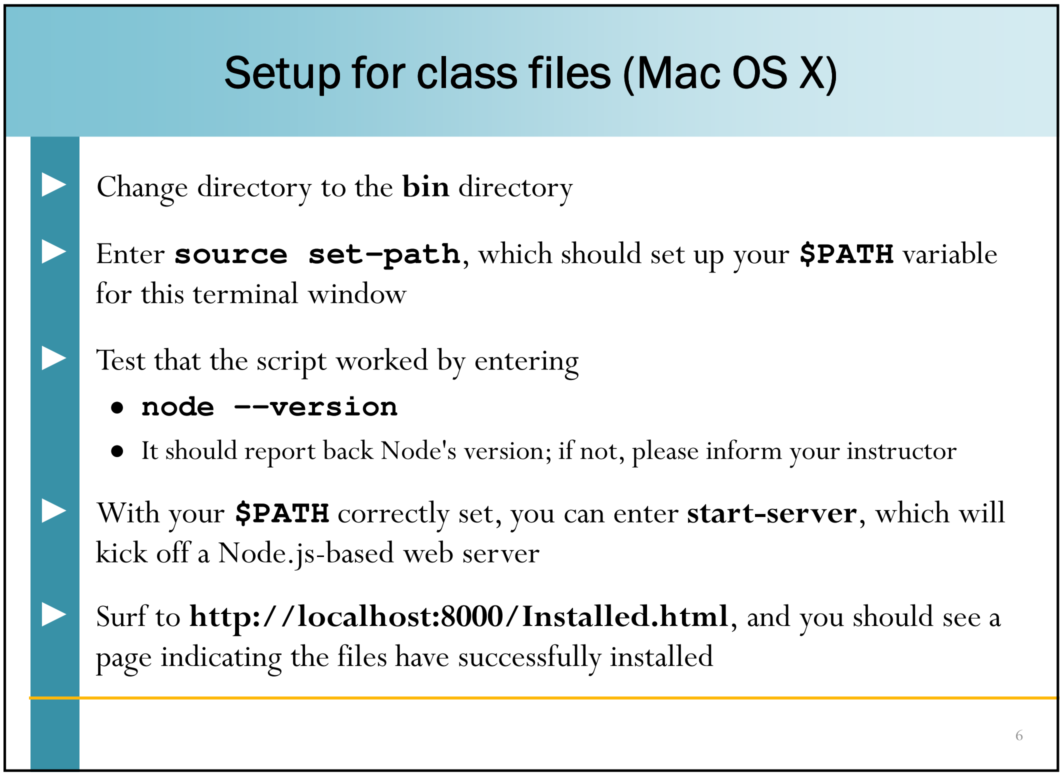
Setup Checklist

- If you haven't already, please download the zip file for the class (your instructor can tell you where they are located)
  - You will be downloading one of three files appropriate to your operating system:
    - **AngularClassWin64.zip**
    - **AngularClassWin32.zip**
    - **AngularClassMac.zip**
  - Unpack the files to a directory of your choosing
  - Windows users: usually to **`C:\`** or **`C:\tmp`** or similar
  - Mac users: Your home directory should be fine
- Open a command prompt/terminal window in the **AngularClass** directory



Setup for class files (Windows)

- Enter **bin\set-path.sh**, which should set up your PATH variable for this command prompt
- Test that the script worked by entering
  - **`node --version`**
  - It should report back Node's version; if not, please inform your instructor
- With your PATH correctly set, you can enter **start-server**, which will kick off a Node.js-based web server
- Surf to **http://localhost:8000/Installed.html**, and you should see a page indicating the files have successfully installed



Setup for class files (Mac OS X)

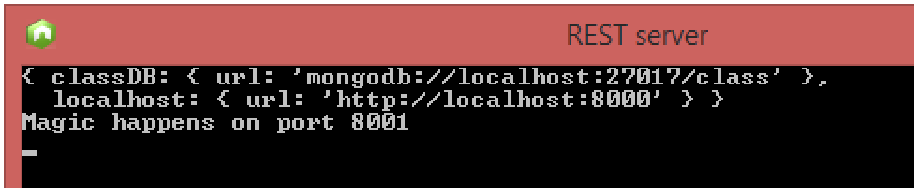
- Change directory to the **bin** directory
- Enter **`source set-path`**, which should set up your **`$PATH`** variable for this terminal window
- Test that the script worked by entering
  - **`node --version`**
  - It should report back Node's version; if not, please inform your instructor
- With your **`$PATH`** correctly set, you can enter **start-server**, which will kick off a Node.js-based web server
- Surf to **http://localhost:8000/Installed.html**, and you should see a page indicating the files have successfully installed

Database setup

- Test that your PATH has been correctly set by entering **`mongo --version`**
  - This should report back `MongoDB shell version: 2.6.7` or later
  - Or something similar, depending on the version
- Enter **`mongo-start`**, which will kick off an instance of the MongoDB database
- Enter **`mongo-load-class`**, which will load the class data into the Mongo database

REST setup scripts

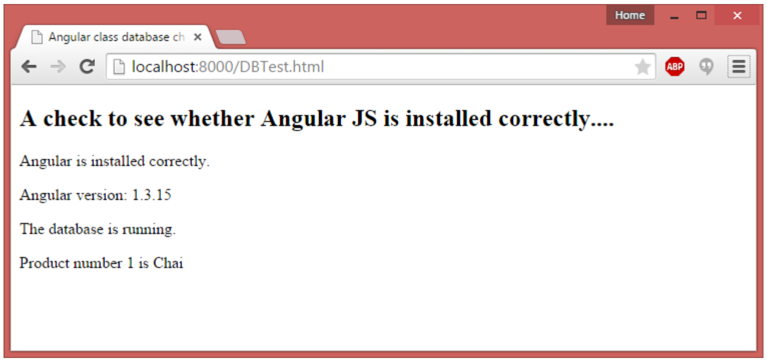
- Enter **start-rest**, which will kick off a RESTful interface to the Mongo database
- You should see a message like this:



```
{ classDB: { url: 'mongodb://localhost:27017/class' },
  localhost: { url: 'http://localhost:8000' } }
Magic happens on port 8001
_
```

RESTful check

- Surf to **http://localhost:8000/DBTest.html**
- You should see a page indicating that the web server and the RESTful server are both running



A check to see whether Angular JS is installed correctly....

Angular is installed correctly.

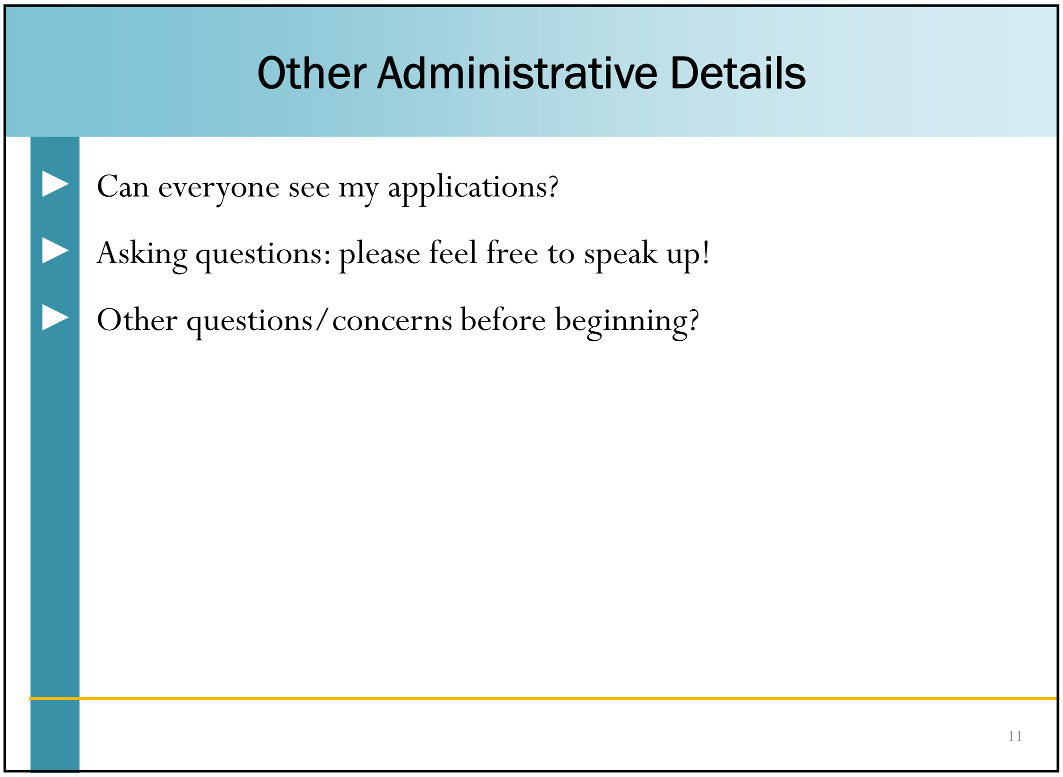
Angular version: 1.3.15

The database is running.

Product number 1 is Chai

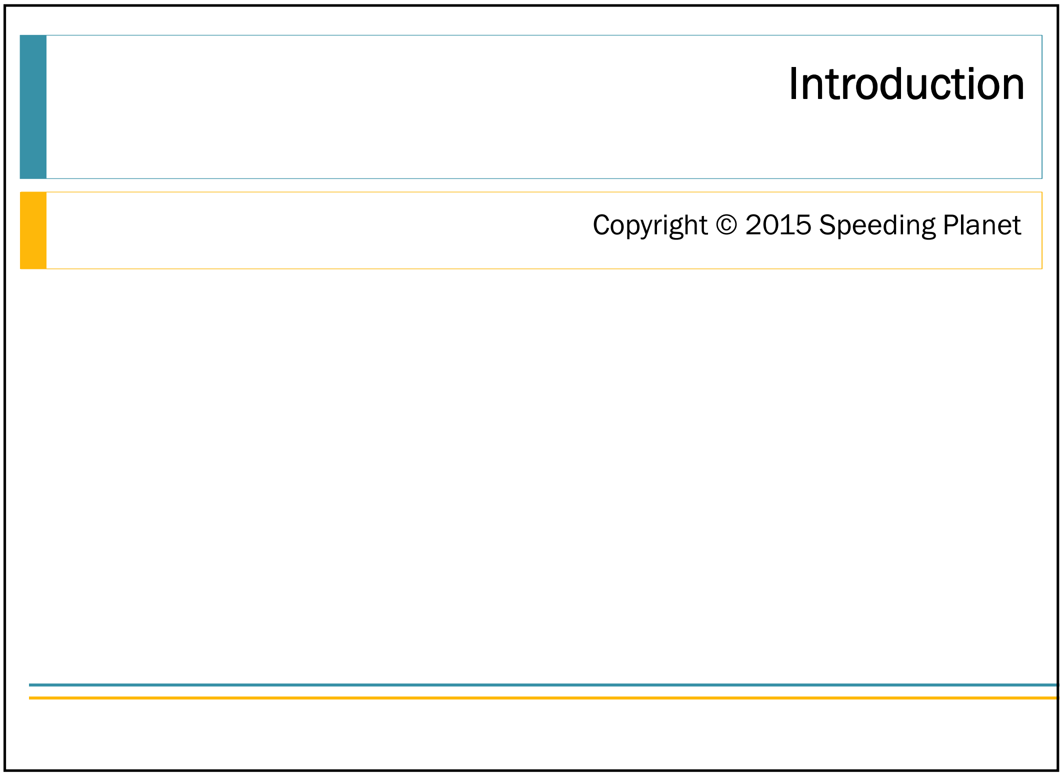
Assumptions

- You are familiar with basic HTML and CSS
  - HTML file structure, spans, divs, tables, etc.
  - CSS in-line styles, classes, in-document styles, linking separate CSS files
- You are familiar with JavaScript, particularly with functions and object literals
  - Of course, the basics of the language, variables, control-structures and so on help as well!
- You are conversant with the Model-View-Controller (MVC) design pattern

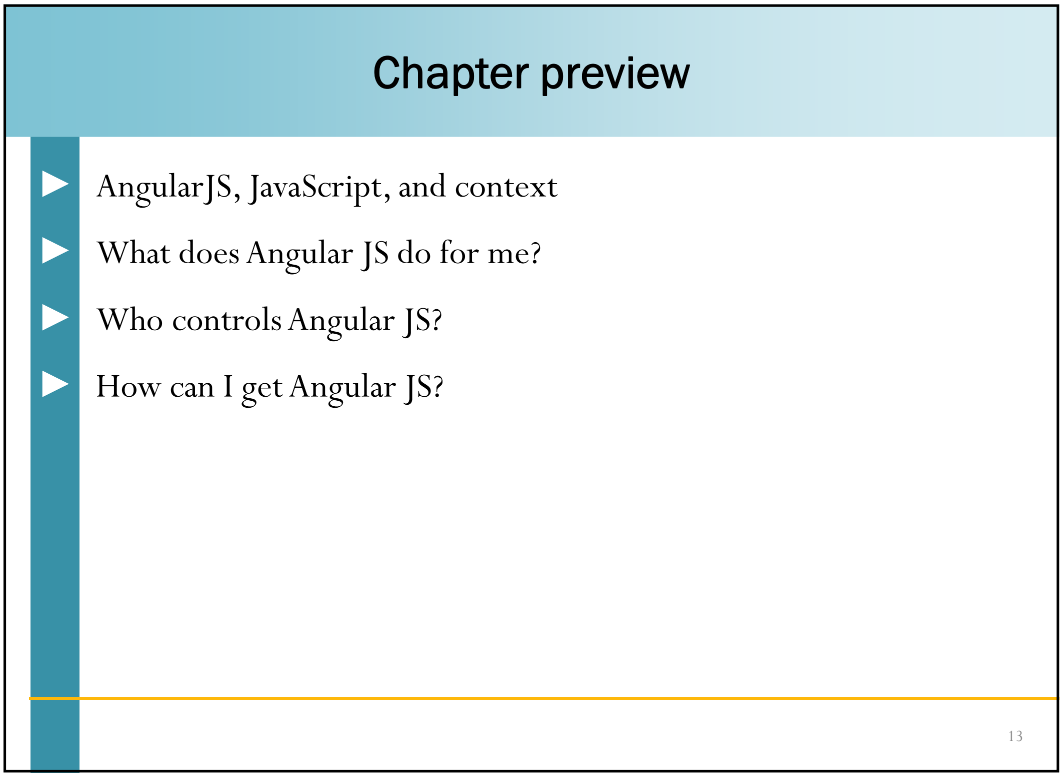


Other Administrative Details

- Can everyone see my applications?
- Asking questions: please feel free to speak up!
- Other questions/concerns before beginning?



Introduction



Chapter preview

- AngularJS, JavaScript, and context
- What does Angular JS do for me?
- Who controls Angular JS?
- How can I get Angular JS?

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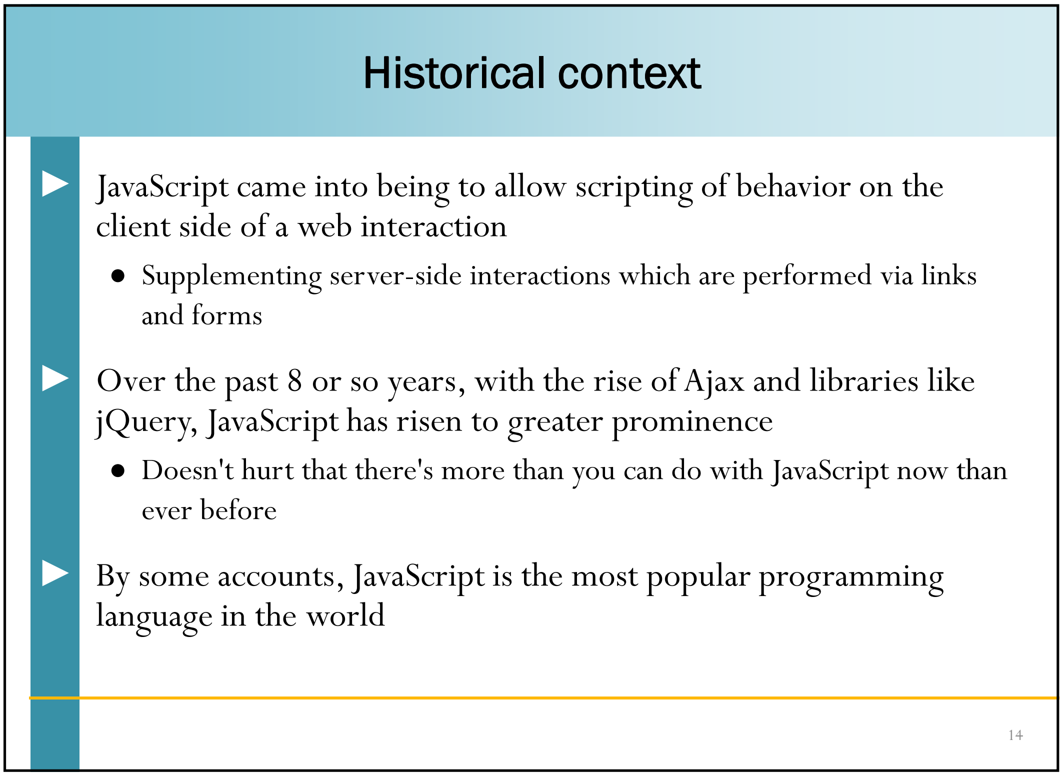

Historical context

- JavaScript came into being to allow scripting of behavior on the client side of a web interaction
  - Supplementing server-side interactions which are performed via links and forms
- Over the past 8 or so years, with the rise of Ajax and libraries like jQuery, JavaScript has risen to greater prominence
  - Doesn't hurt that there's more than you can do with JavaScript now than ever before
- By some accounts, JavaScript is the most popular programming language in the world

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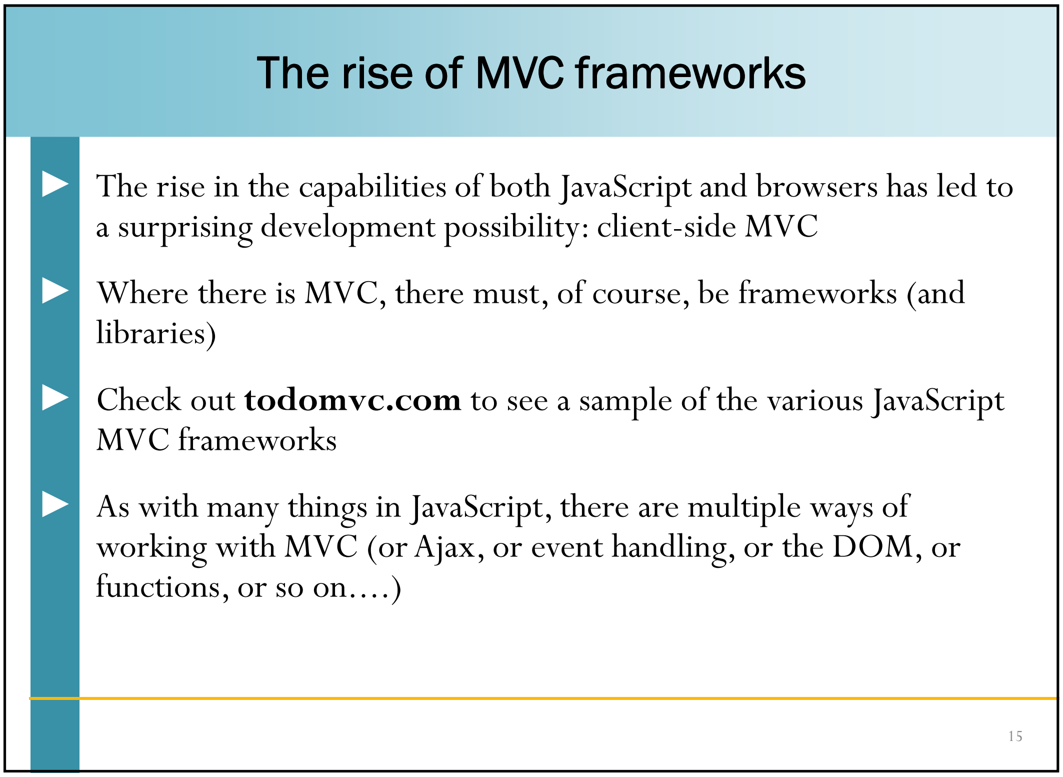

The rise of MVC frameworks

- The rise in the capabilities of both JavaScript and browsers has led to a surprising development possibility: client-side MVC
- Where there is MVC, there must, of course, be frameworks (and libraries)
- Check out **todomvc.com** to see a sample of the various JavaScript MVC frameworks
- As with many things in JavaScript, there are multiple ways of working with MVC (or Ajax, or event handling, or the DOM, or functions, or so on….)

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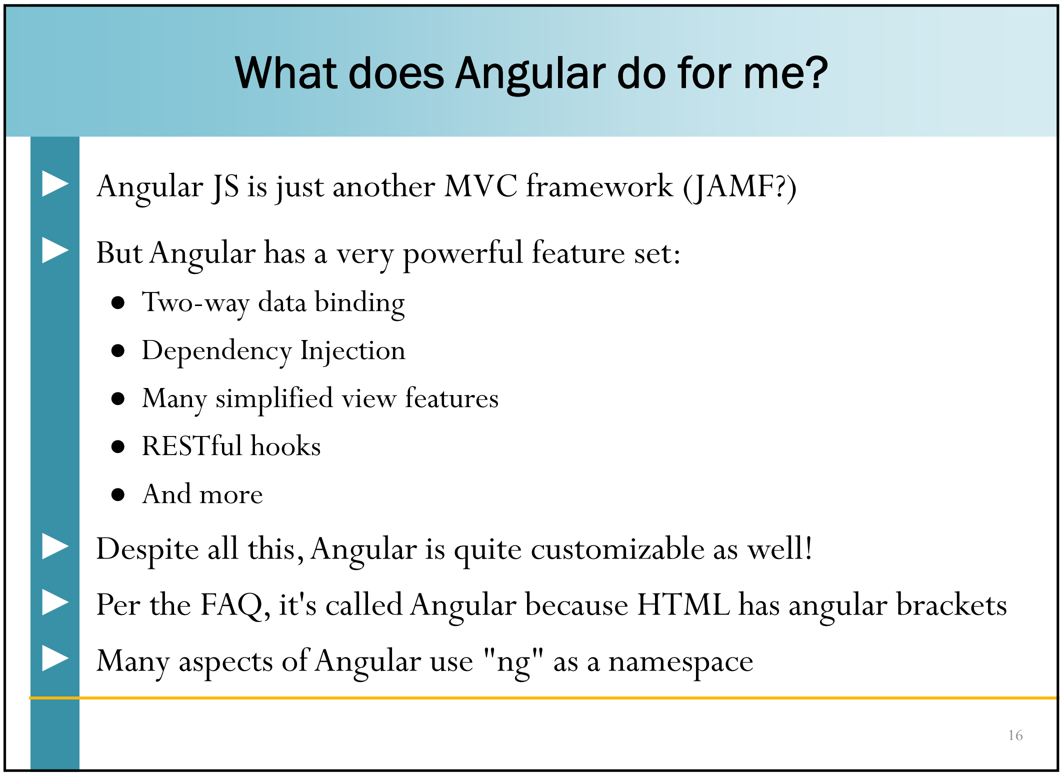

What does Angular do for me?

- Angular JS is just another MVC framework (JAMF?)
- But Angular has a very powerful feature set:
  - Two-way data binding
  - Dependency Injection
  - Many simplified view features
  - RESTful hooks
  - And more
- Despite all this, Angular is quite customizable as well!
- Per the FAQ, it's called Angular because HTML has angular brackets
- Many aspects of Angular use "ng" as a namespace

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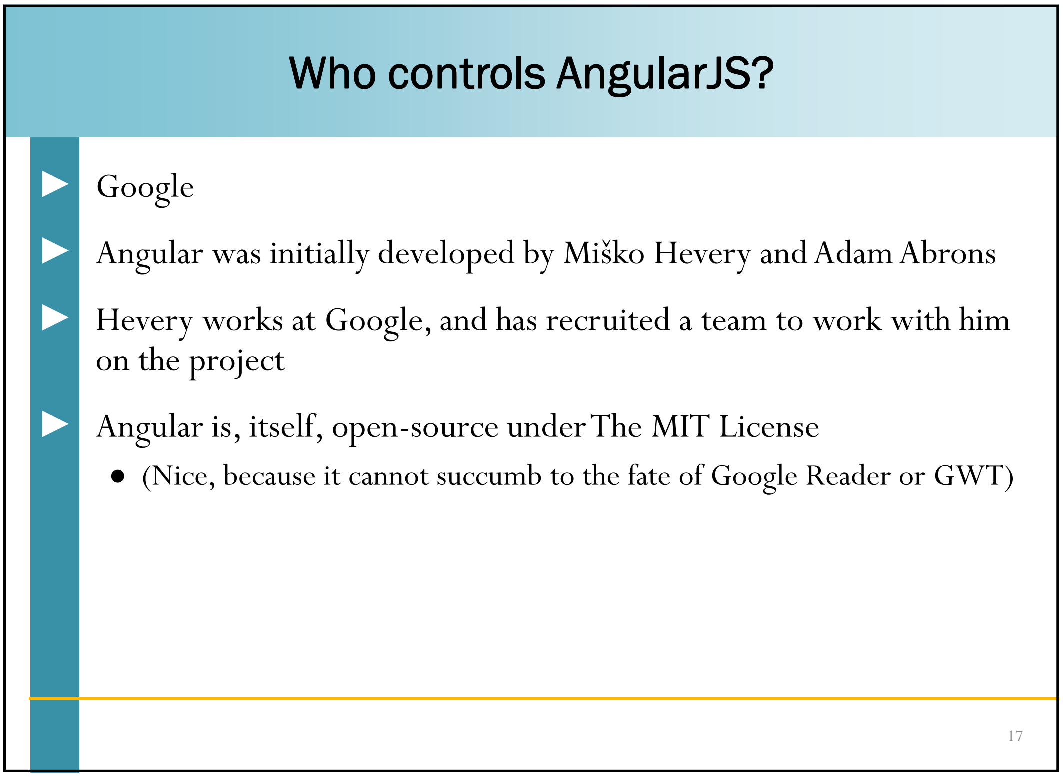
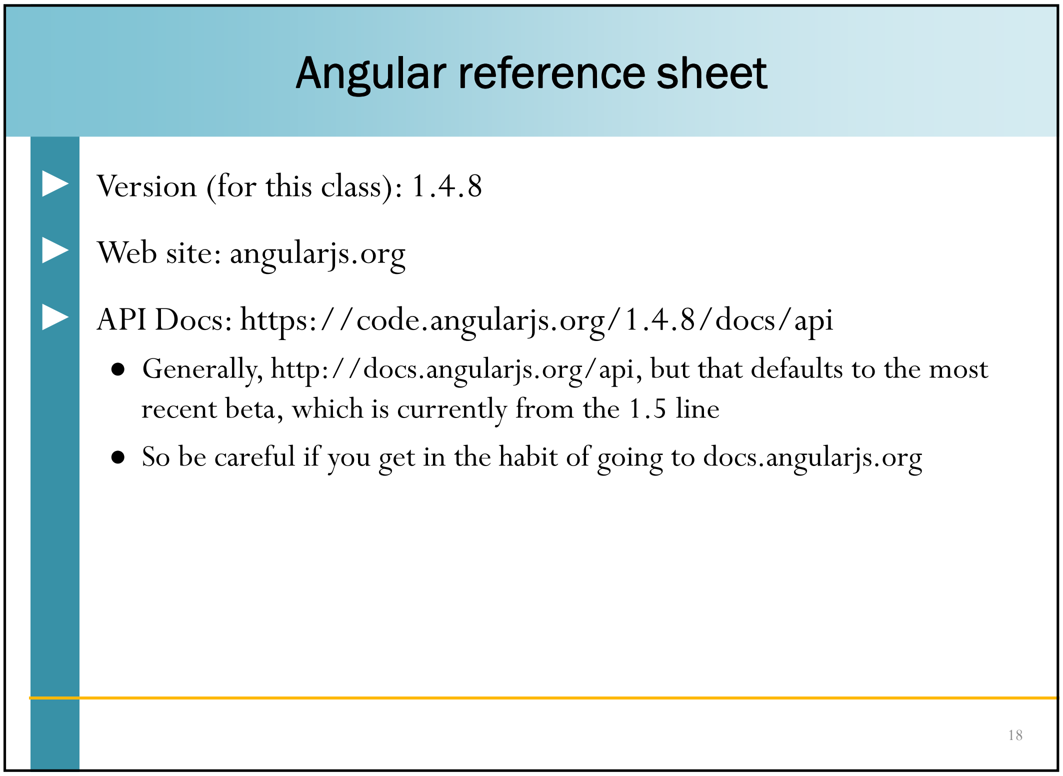


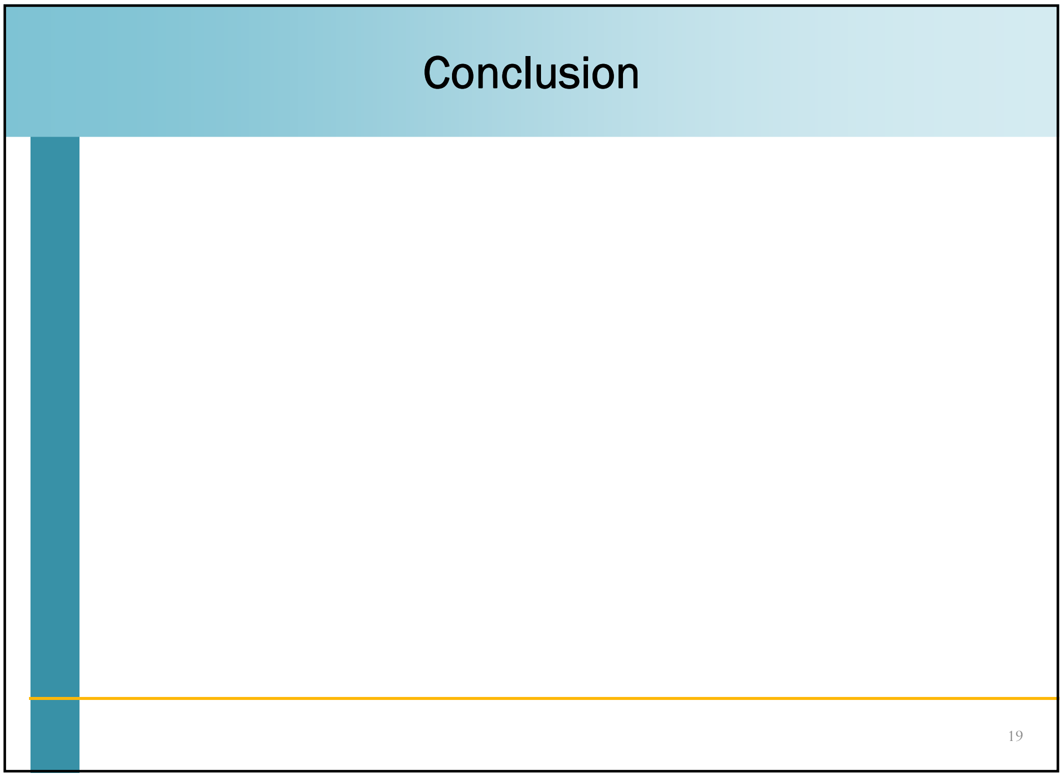
Who controls AngularJS?

- Google
- Angular was initially developed by Miško Hevery and Adam Abrons
- Hevery works at Google, and has recruited a team to work with him on the project
- Angular is, itself, open-source under The MIT License
  - (Nice, because it cannot succumb to the fate of Google Reader or GWT)

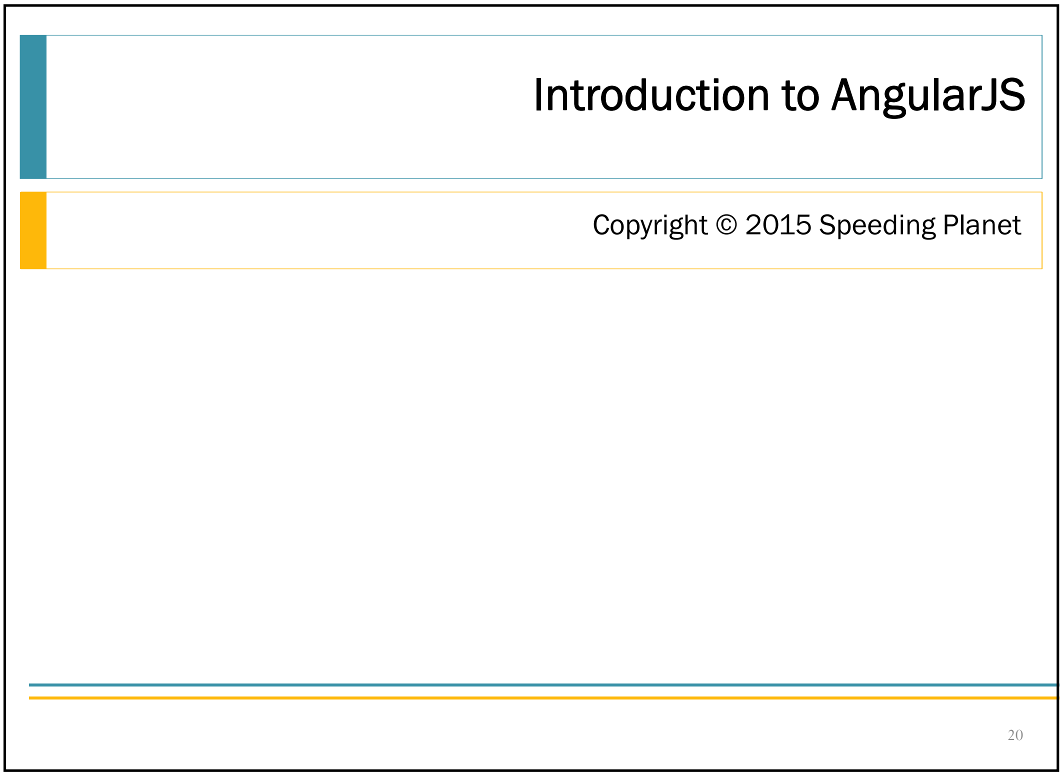


Angular reference sheet

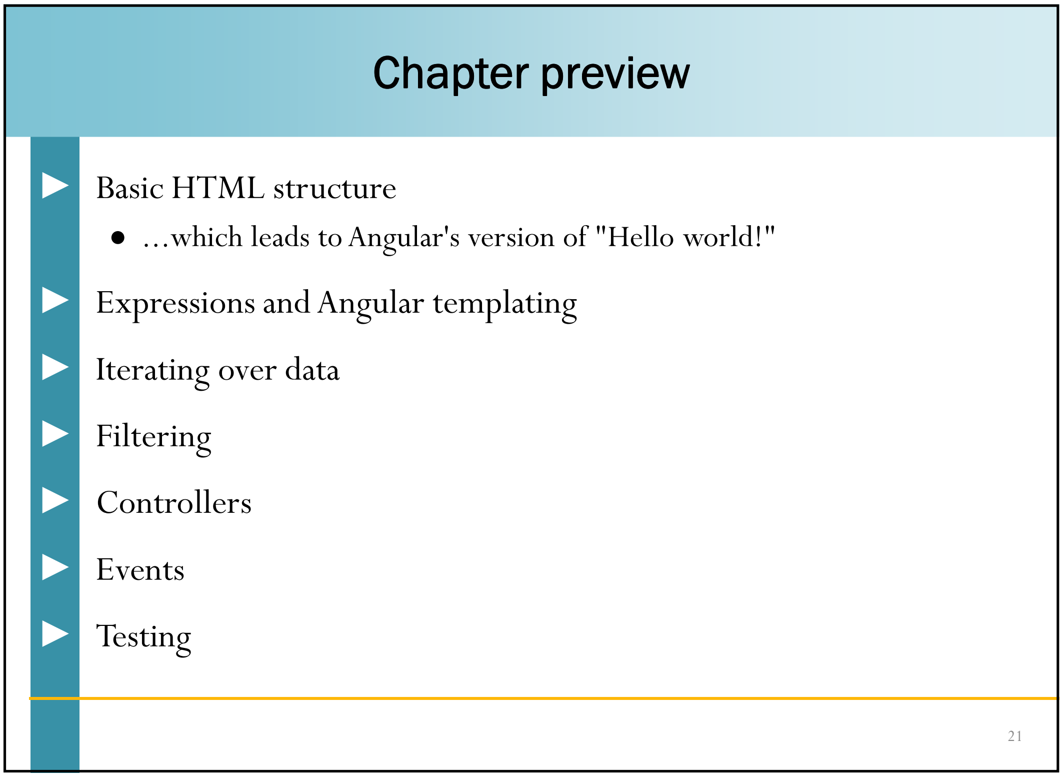
- Version (for this class): 1.4.8
- Web site: angularjs.org
- API Docs: https://code.angularjs.org/1.4.8/docs/api
  - Generally, http://docs.angularjs.org/api, but that defaults to the most recent beta, which is currently from the 1.5 line
  - So be careful if you get in the habit of going to docs.angularjs.org



Conclusion



Introduction to AngularJS



Chapter preview

- Basic HTML structure
  - …which leads to Angular's version of "Hello world!"
- Expressions and Angular templating
- Iterating over data
- Filtering
- Controllers
- Events
- Testing

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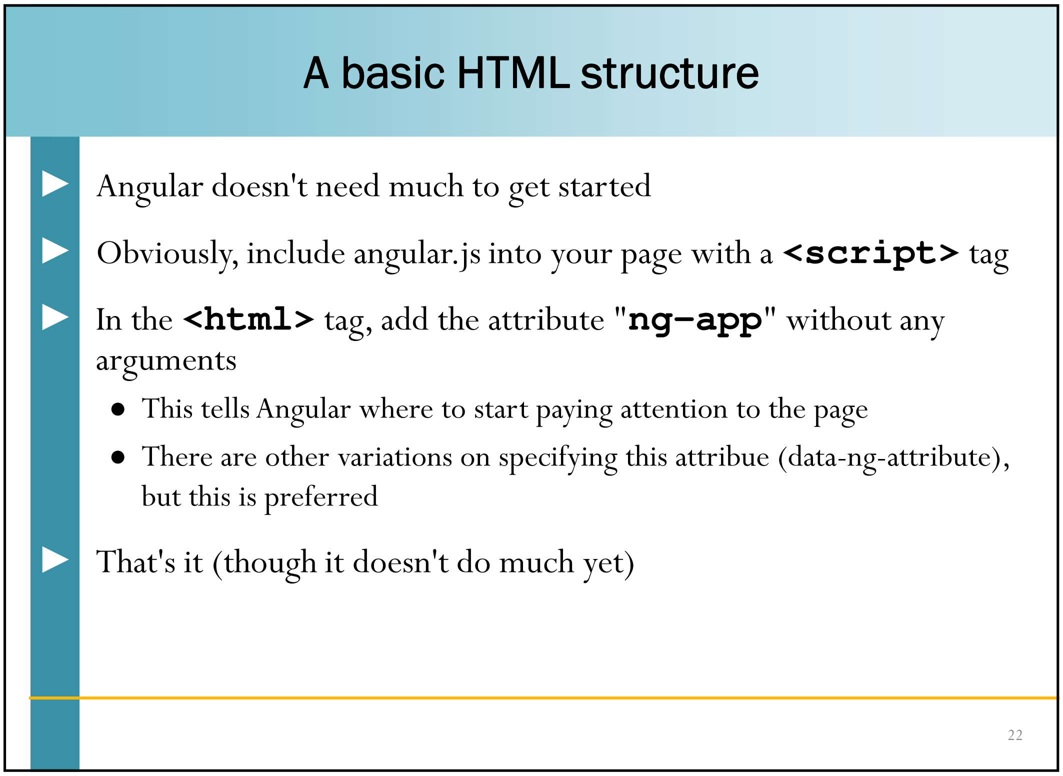

A basic HTML structure

- Angular doesn't need much to get started
- Obviously, include angular.js into your page with a **`<script>`** tag
- In the **`<html>`** tag, add the attribute "**`ng-app`**" without any arguments
  - This tells Angular where to start paying attention to the page
  - There are other variations on specifying this attribue (data-ng-attribute), but this is preferred
- That's it (though it doesn't do much yet)

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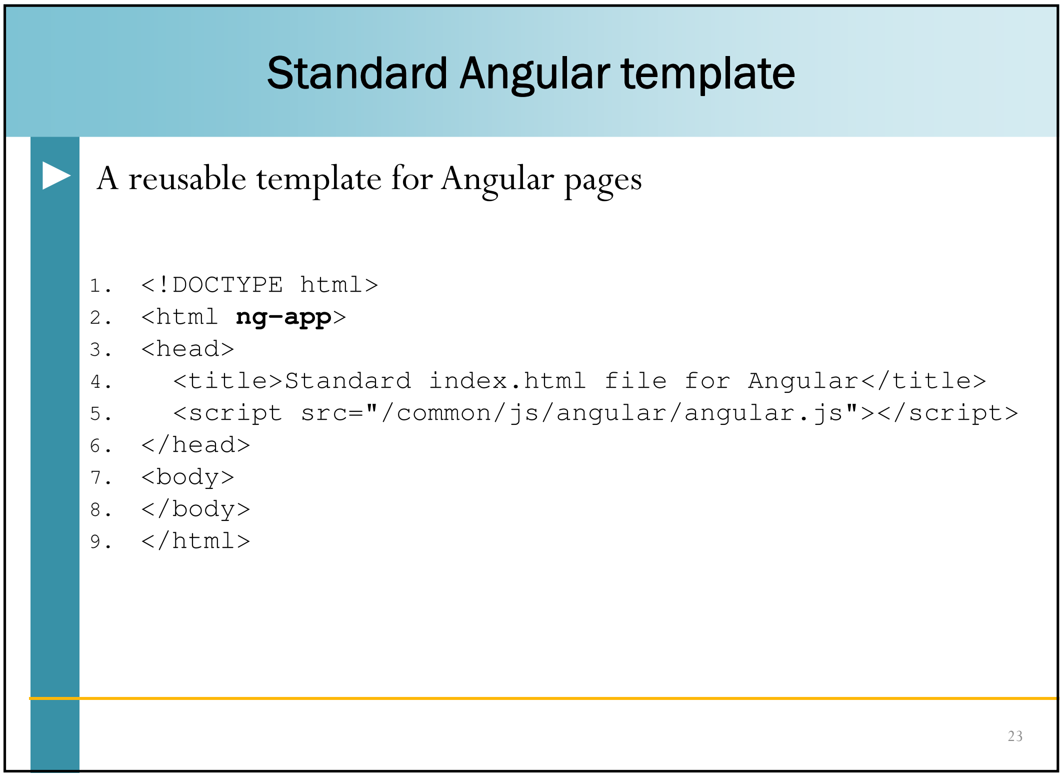
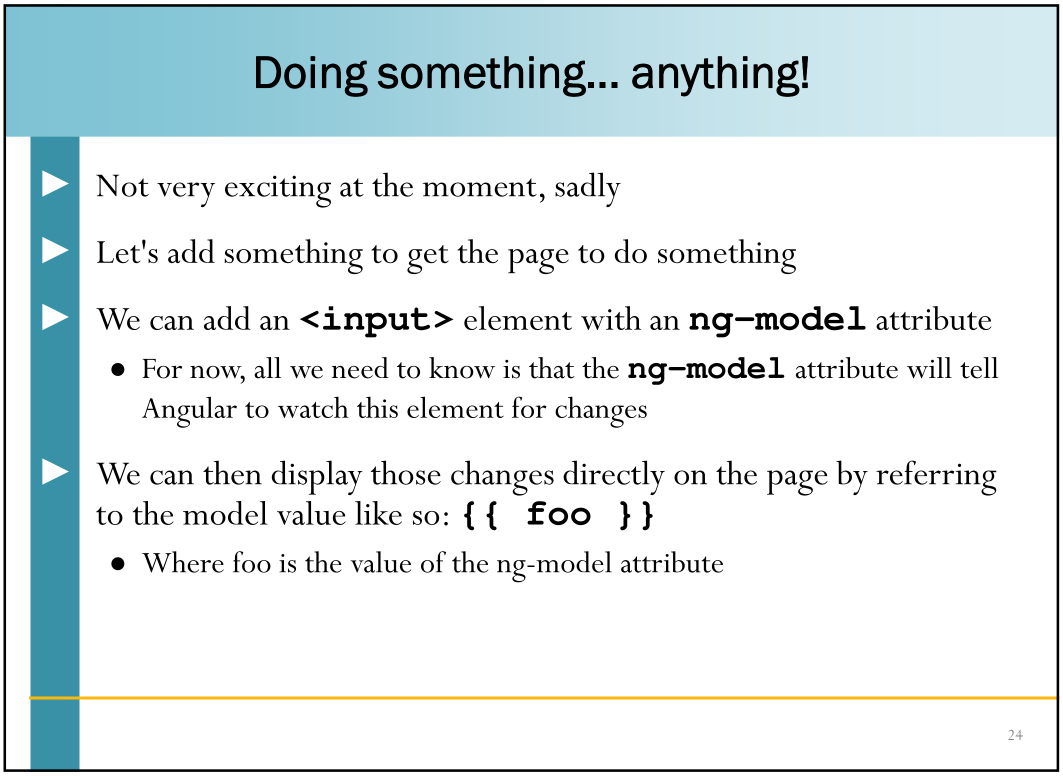


Standard Angular template

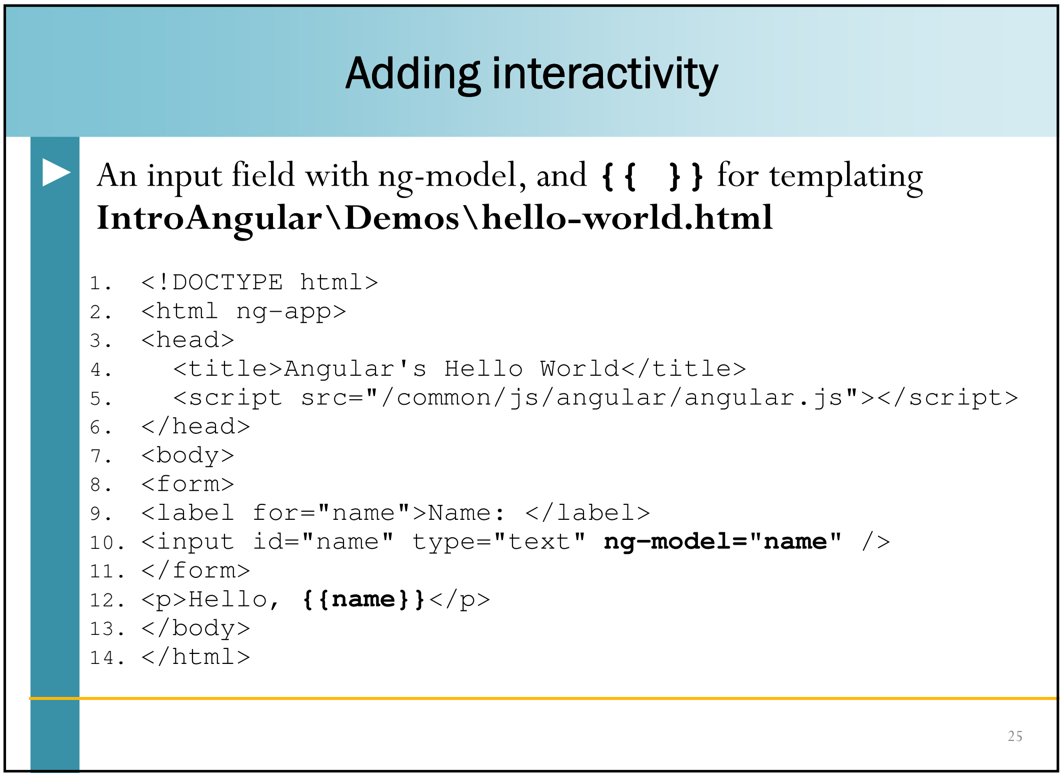
- A reusable template for Angular pages

```
<!DOCTYPE html>
<html ng-app>
<head>
  <title>Standard index.html file for Angular</title>
  <script src="/common/js/angular/angular.js"></script>
</head>
<body>
</body>
</html>
```



Doing something... anything!

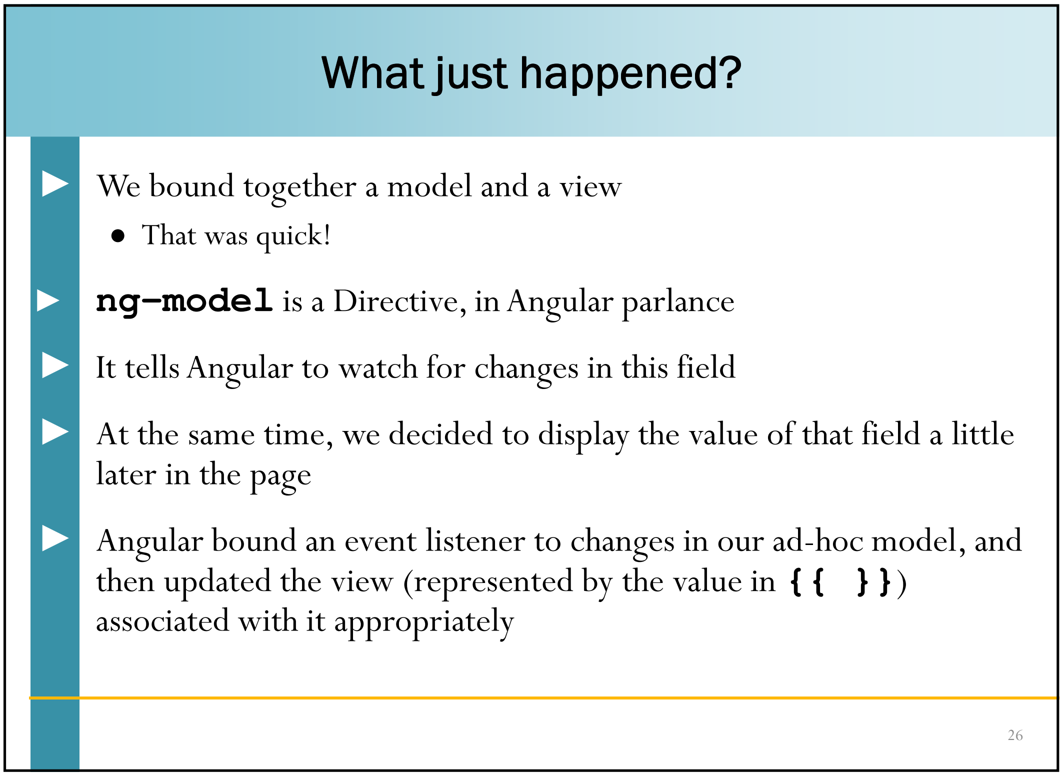
- Not very exciting at the moment, sadly
- Let's add something to get the page to do something
- We can add an **`<input>`** element with an **`ng-model`** attribute
  - For now, all we need to know is that the **`ng-model`** attribute will tell Angular to watch this element for changes
- We can then display those changes directly on the page by referring to the model value like so: **`{{ foo }}`**
  - Where foo is the value of the ng-model attribute



Adding interactivity

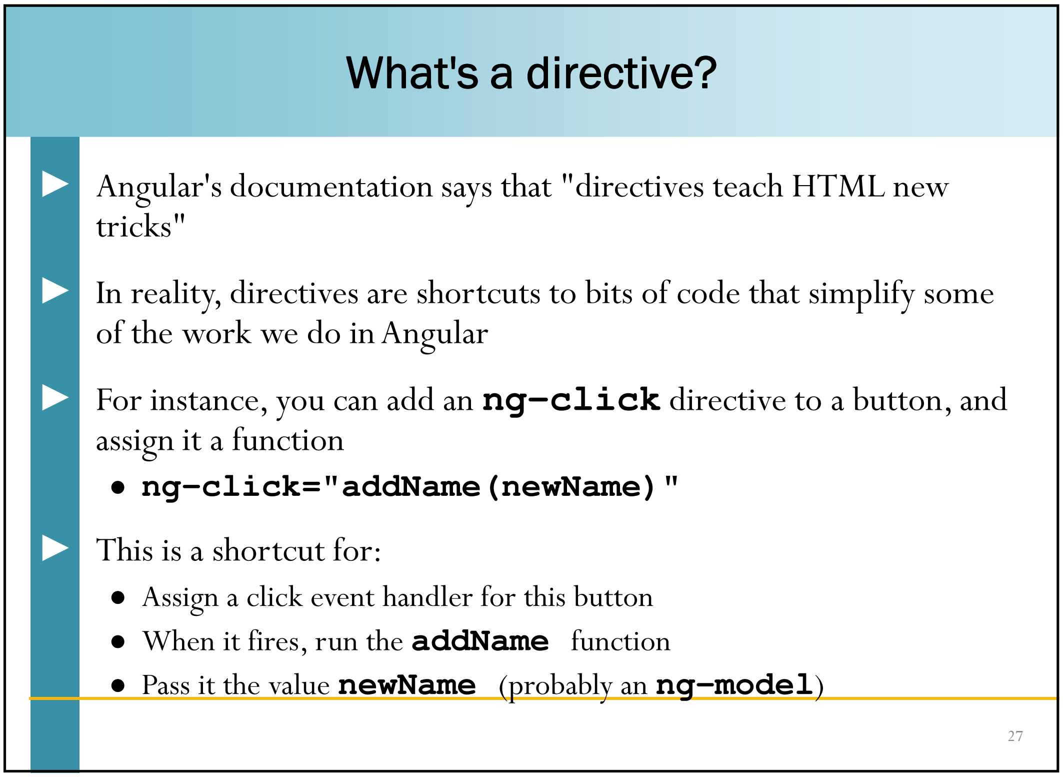
- An input field with ng-model, and **{{ }}** for templating **IntroAngular\Demos\hello-world.html**

```
<!DOCTYPE html>
<html ng-app>
<head>
  <title>Angular's Hello World</title>
  <script src="/common/js/angular/angular.js"></script>
</head>
<body>
<form>
<label for="name">Name: </label>
<input id="name" type="text" ng-model="name" />
</form>
<p>Hello, {{name}}</p>
</body>
</html>
```



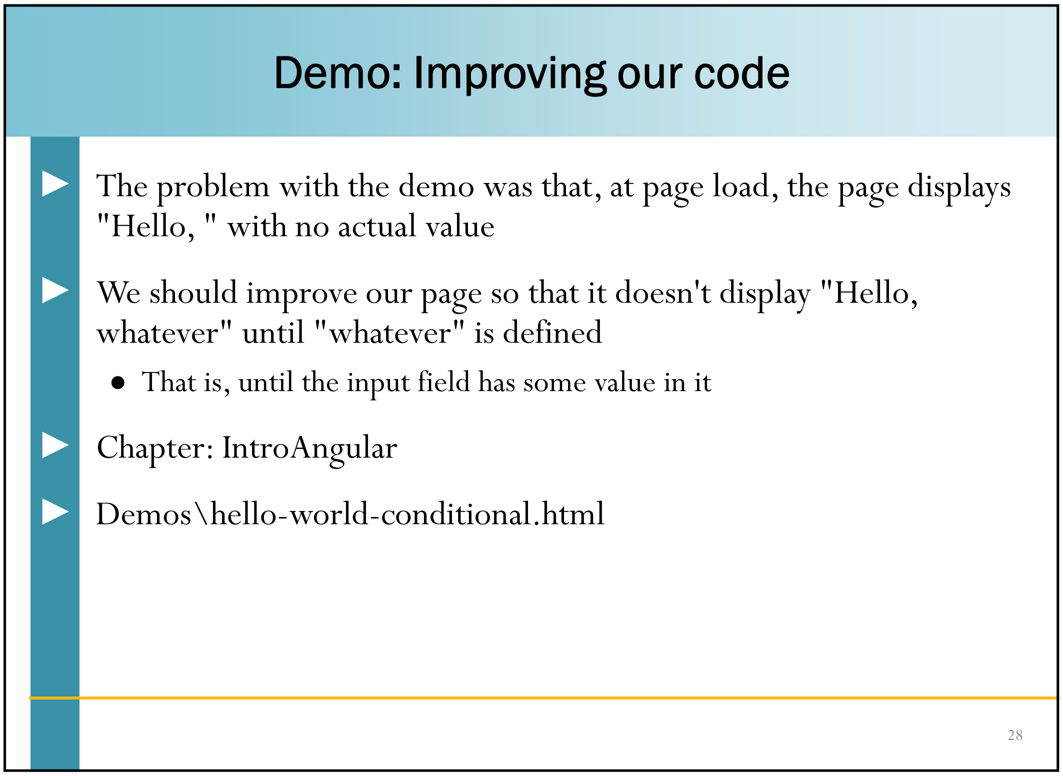
What just happened?

- We bound together a model and a view
  - That was quick!
- **`ng-model`** is a Directive, in Angular parlance
- It tells Angular to watch for changes in this field
- At the same time, we decided to display the value of that field a little later in the page
- Angular bound an event listener to changes in our ad-hoc model, and then updated the view (represented by the value in **{{ }}**) associated with it appropriately



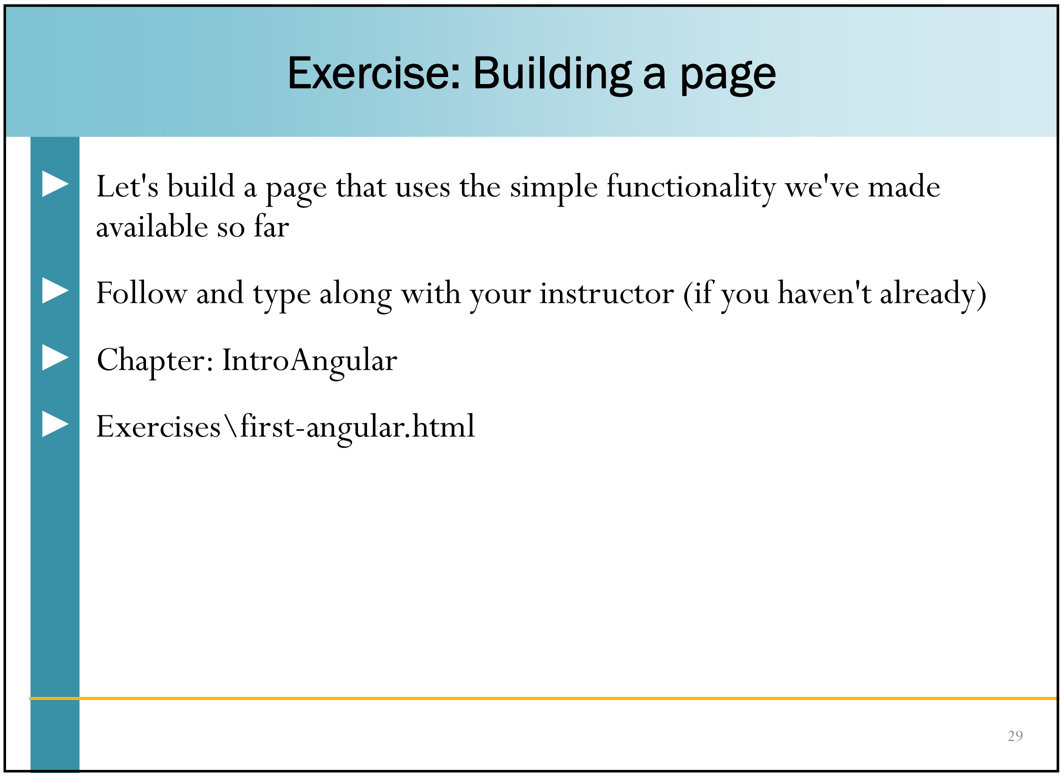
What's a directive?

- Angular's documentation says that "directives teach HTML new tricks"
- In reality, directives are shortcuts to bits of code that simplify some of the work we do in Angular
- For instance, you can add an **`ng-click`** directive to a button, and assign it a function
  - **`ng-click="addName(newName)"`**
- This is a shortcut for:
  - Assign a click event handler for this button
  - When it fires, run the **`addName`** function
  - Pass it the value **`newName`** (probably an **`ng-model`**)



Demo: Improving our code

- The problem with the demo was that, at page load, the page displays "Hello, " with no actual value
- We should improve our page so that it doesn't display "Hello, whatever" until "whatever" is defined
  - That is, until the input field has some value in it
- Chapter: IntroAngular
- Demos\hello-world-conditional.html



Exercise: Building a page

- Let's build a page that uses the simple functionality we've made available so far
- Follow and type along with your instructor (if you haven't already)
- Chapter: IntroAngular
- Exercises\first-angular.html

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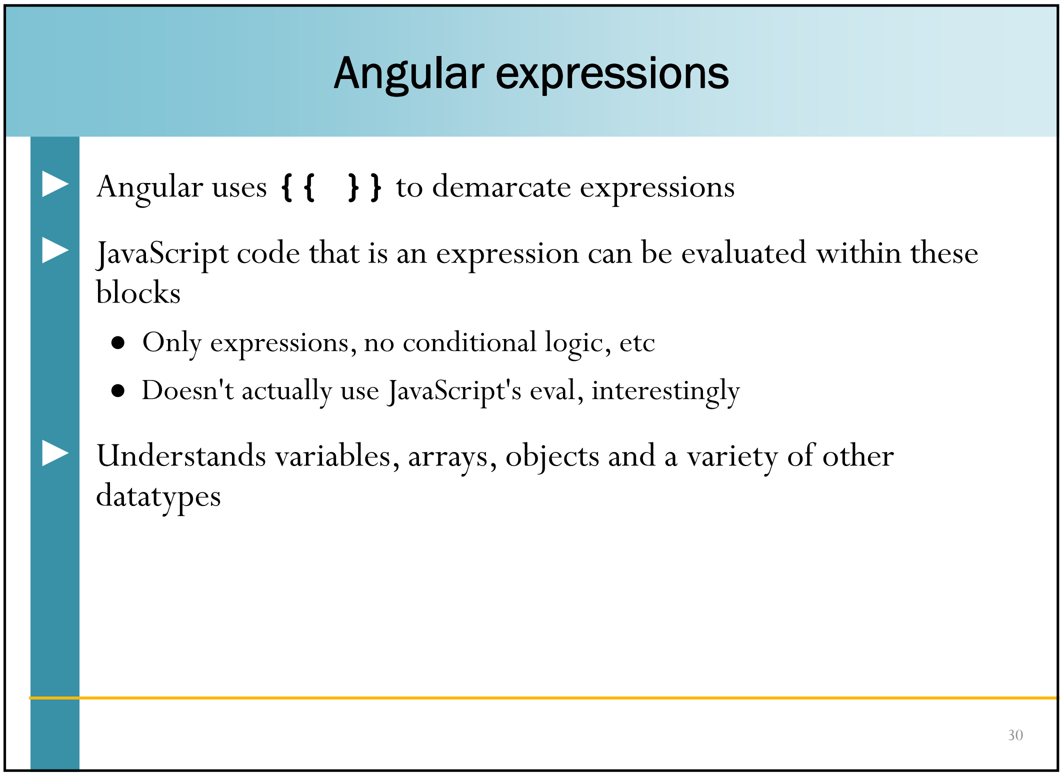

Angular expressions

- Angular uses **{{ }}** to demarcate expressions
- JavaScript code that is an expression can be evaluated within these blocks
  - Only expressions, no conditional logic, etc
  - Doesn't actually use JavaScript's eval, interestingly
- Understands variables, arrays, objects and a variety of other datatypes

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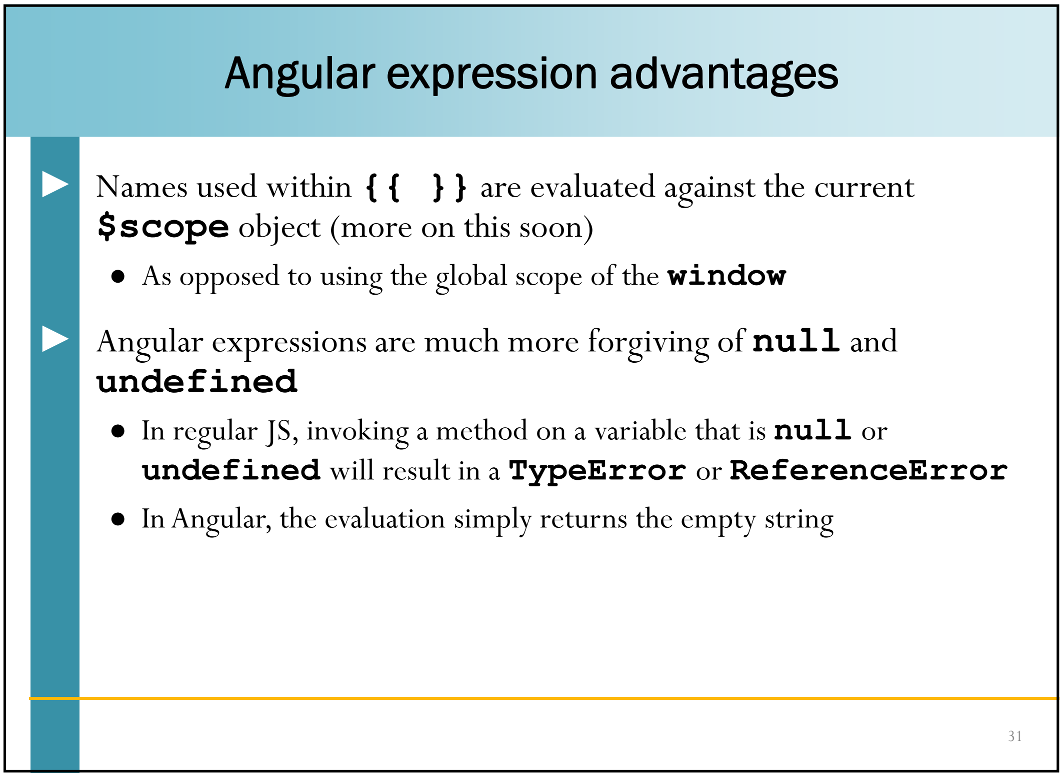

Angular expression advantages

- Names used within **`{{ }}`** are evaluated against the current **`$scope`** object (more on this soon)
  - As opposed to using the global scope of the **`window`**
- Angular expressions are much more forgiving of **`null`** and **`undefined`**
  - In regular JS, invoking a method on a variable that is **`null`** or **`undefined`** will result in a **`TypeError`** or **`ReferenceError`**
  - In Angular, the evaluation simply returns the empty string

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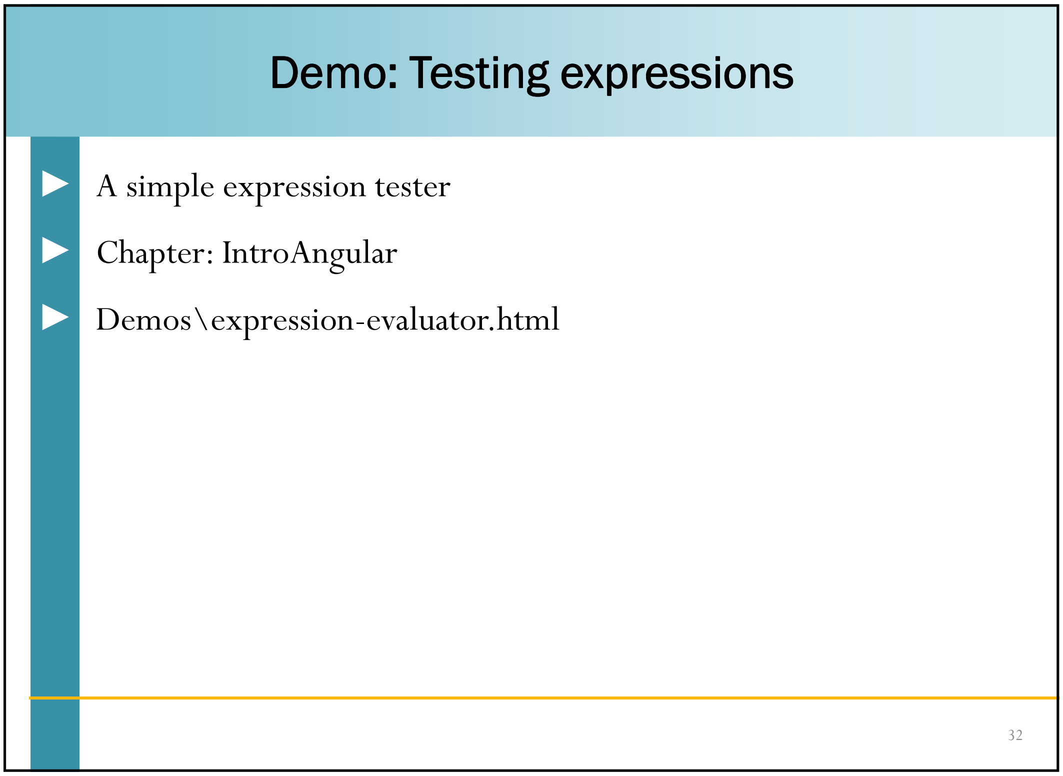

Demo: Testing expressions

- A simple expression tester
- Chapter: IntroAngular
- Demos\expression-evaluator.html

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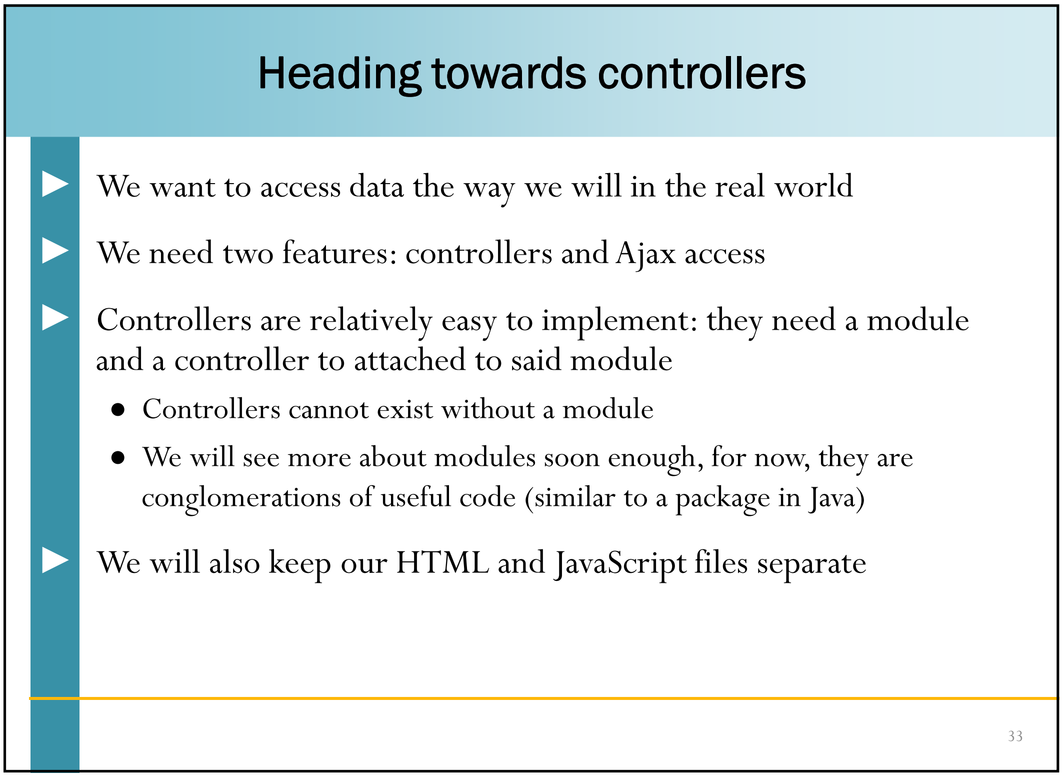
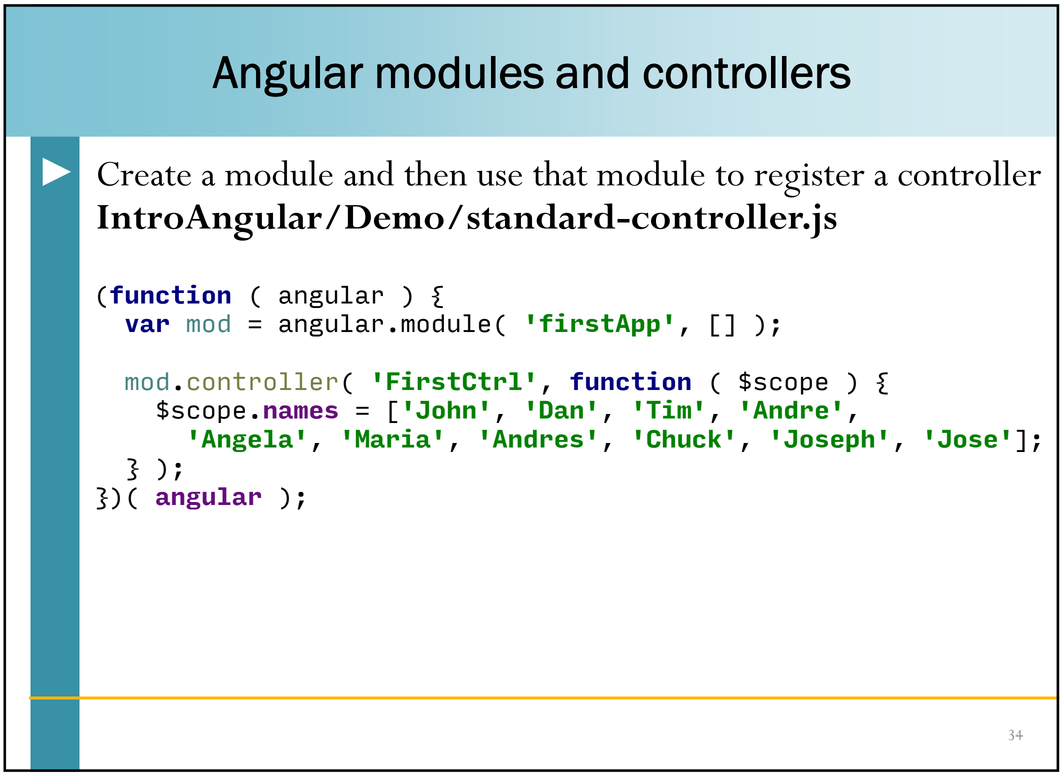


Heading towards controllers

- We want to access data the way we will in the real world
- We need two features: controllers and Ajax access
- Controllers are relatively easy to implement: they need a module and a controller to attached to said module
  - Controllers cannot exist without a module
  - We will see more about modules soon enough, for now, they are conglomerations of useful code (similar to a package in Java)
- We will also keep our HTML and JavaScript files separate

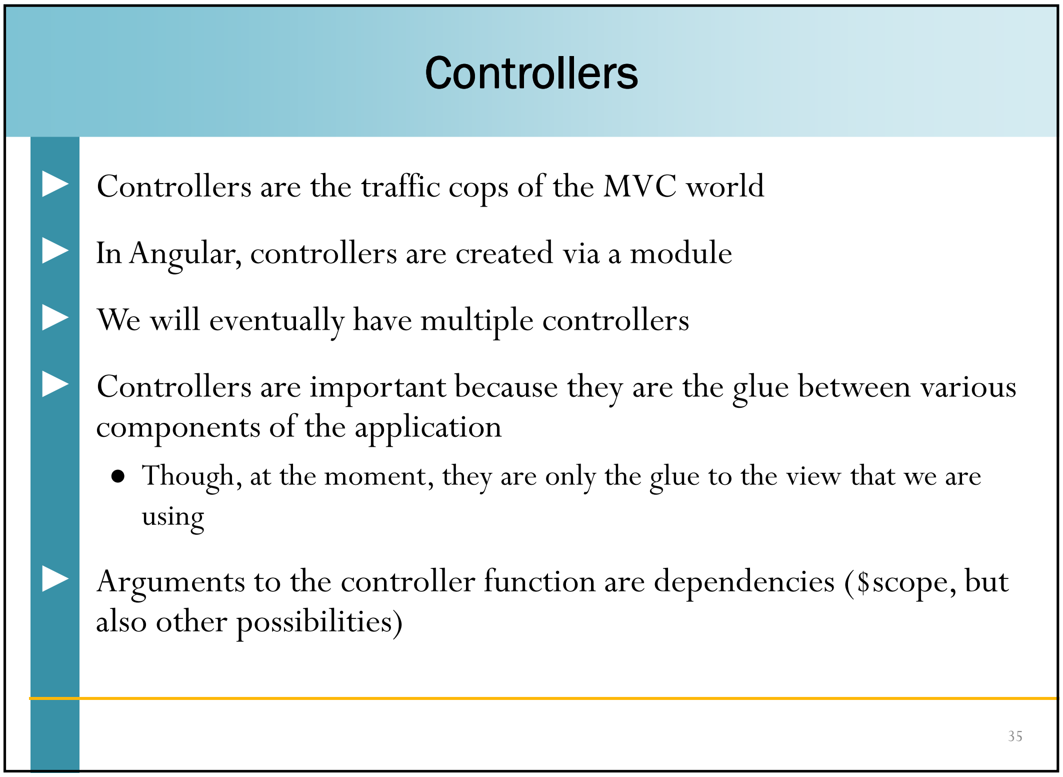


Angular modules and controllers

- Create a module and then use that module to register a controller **IntroAngular/Demo/standard-controller.js**

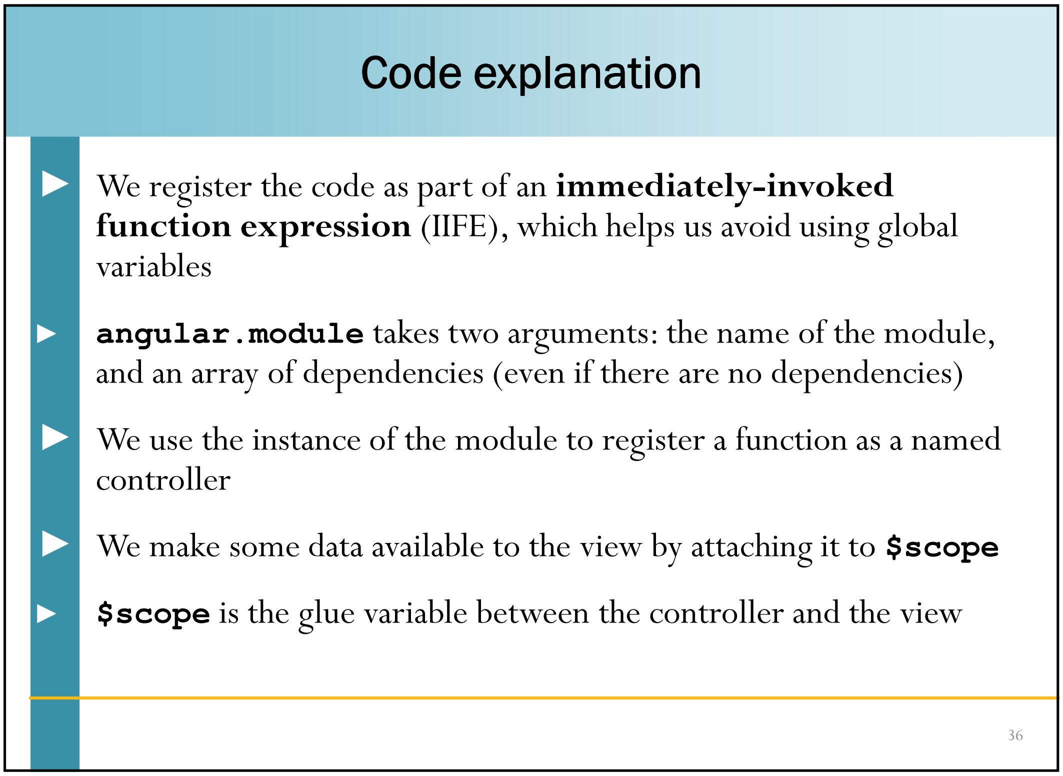
```
(function ( angular ) {
  var mod = angular.module( 'firstApp', [] );

  mod.controller( 'FirstCtrl', function ( $scope ) {
    $scope.names = ['John', 'Dan', 'Tim', 'Andre',
      'Angela', 'Maria', 'Andres', 'Chuck', 'Joseph', 'Jose'];
  } );
})( angular );
```



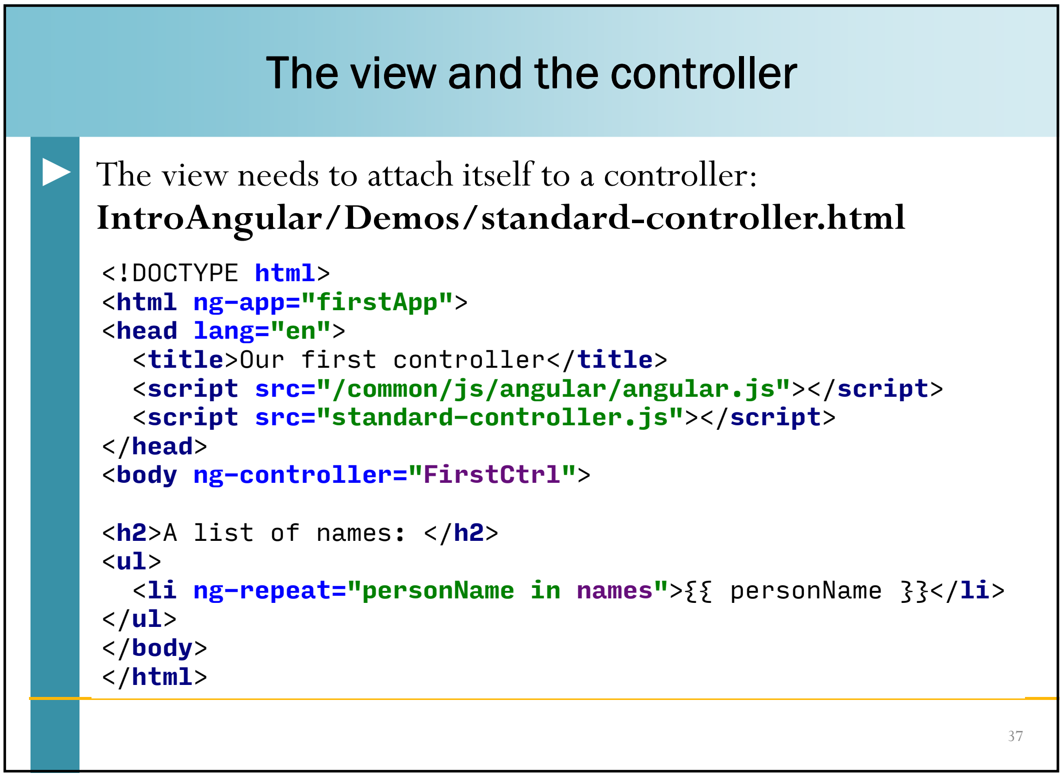
Controllers

- Controllers are the traffic cops of the MVC world
- In Angular, controllers are created via a module
- We will eventually have multiple controllers
- Controllers are important because they are the glue between various components of the application
  - Though, at the moment, they are only the glue to the view that we are using
- Arguments to the controller function are dependencies ($scope, but also other possibilities)



Code explanation

- We register the code as part of an **immediately-invoked function expression** (IIFE), which helps us avoid using global variables
- **`angular.module`** takes two arguments: the name of the module, and an array of dependencies (even if there are no dependencies)
- We use the instance of the module to register a function as a named controller
- We make some data available to the view by attaching it to **`$scope`**
- **`$scope`** is the glue variable between the controller and the view

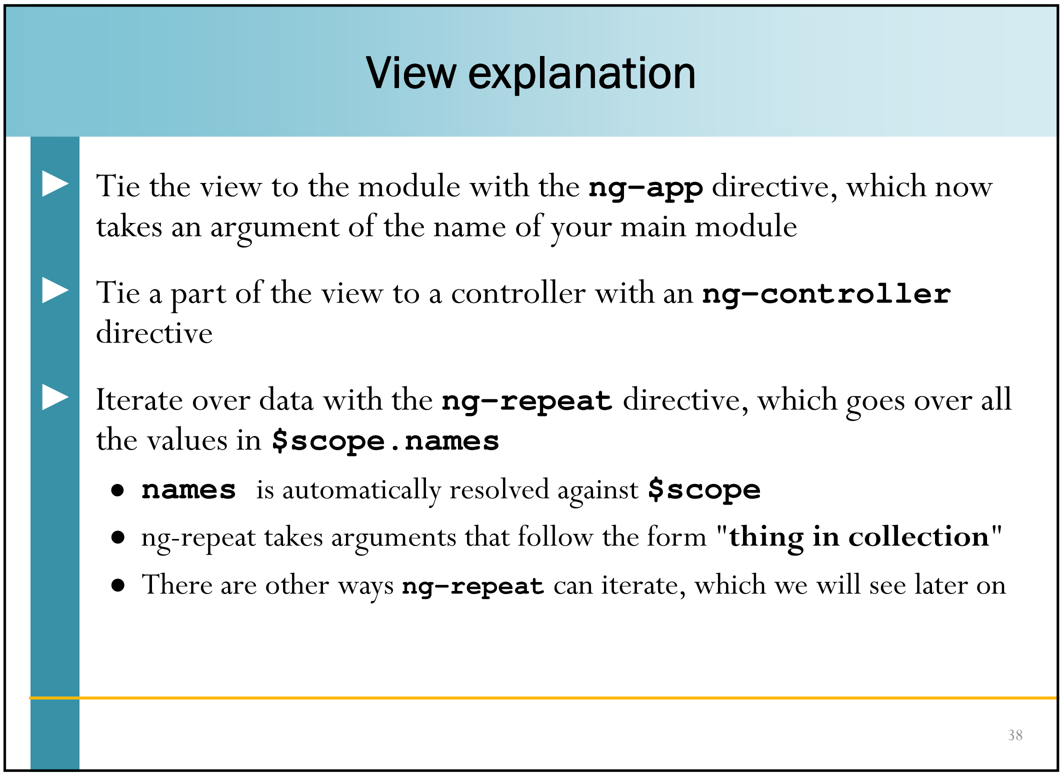


The view and the controller

- The view needs to attach itself to a controller: **IntroAngular/Demos/standard-controller.html**

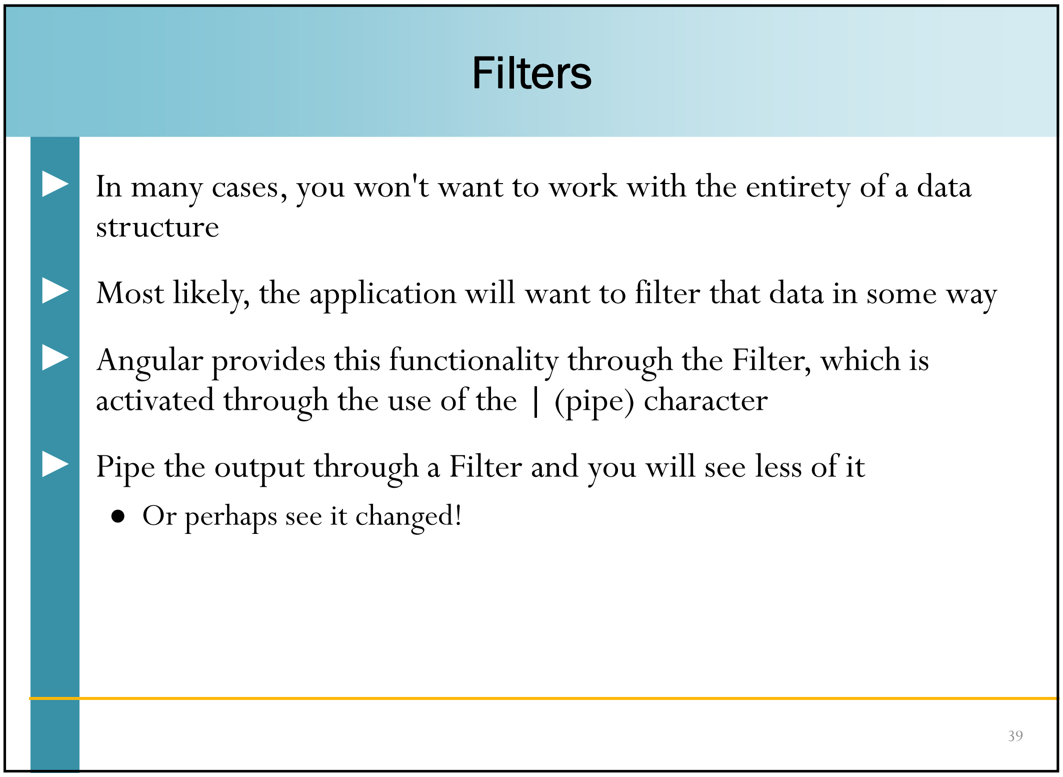
```
<!DOCTYPE html>
<html ng-app="firstApp">
<head lang="en">
  <title>Our first controller</title>
  <script src="/common/js/angular/angular.js"></script>
  <script src="standard-controller.js"></script>
</head>
<body ng-controller="FirstCtrl">

<h2>A list of names: </h2>
<ul>
  <li ng-repeat="personName in names">{{ personName }}</li>
</ul>
</body>
</html>
```



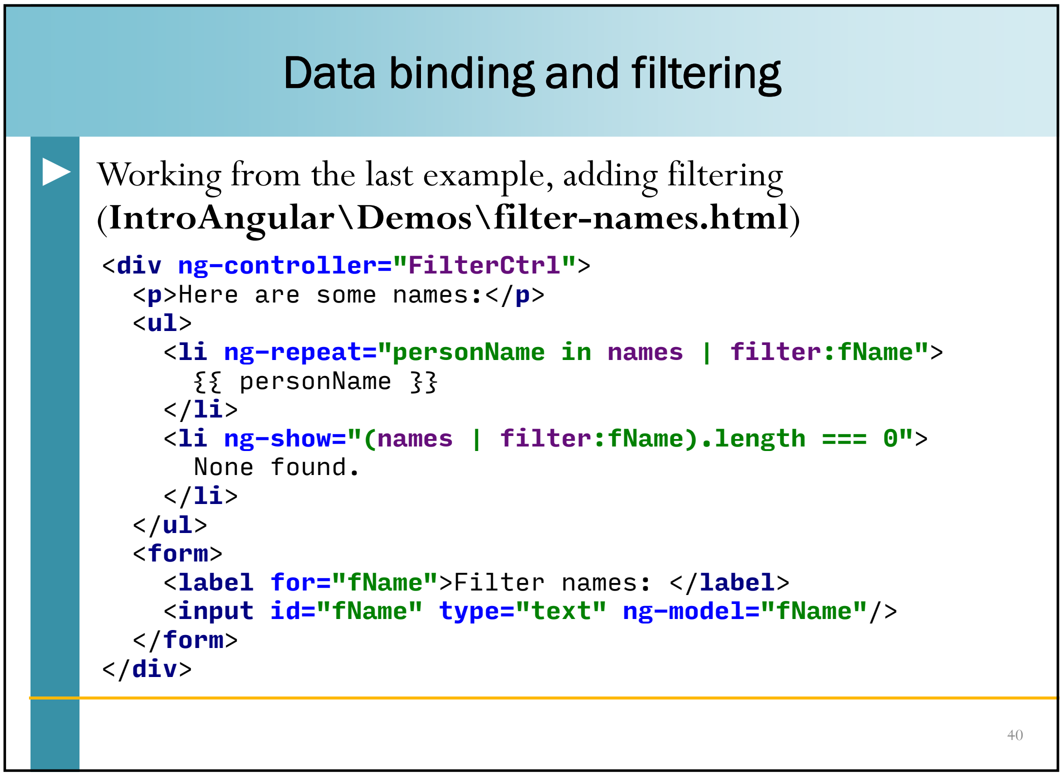
View explanation

- Tie the view to the module with the **`ng-app`** directive, which now takes an argument of the name of your main module
- Tie a part of the view to a controller with an **`ng-controller`** directive
- Iterate over data with the **`ng-repeat`** directive, which goes over all the values in **`$scope.names`**
  - **`names`** is automatically resolved against **`$scope`**
  - ng-repeat takes arguments that follow the form "**thing in collection**"
  - There are other ways **`ng-repeat`** can iterate, which we will see later on



Filters

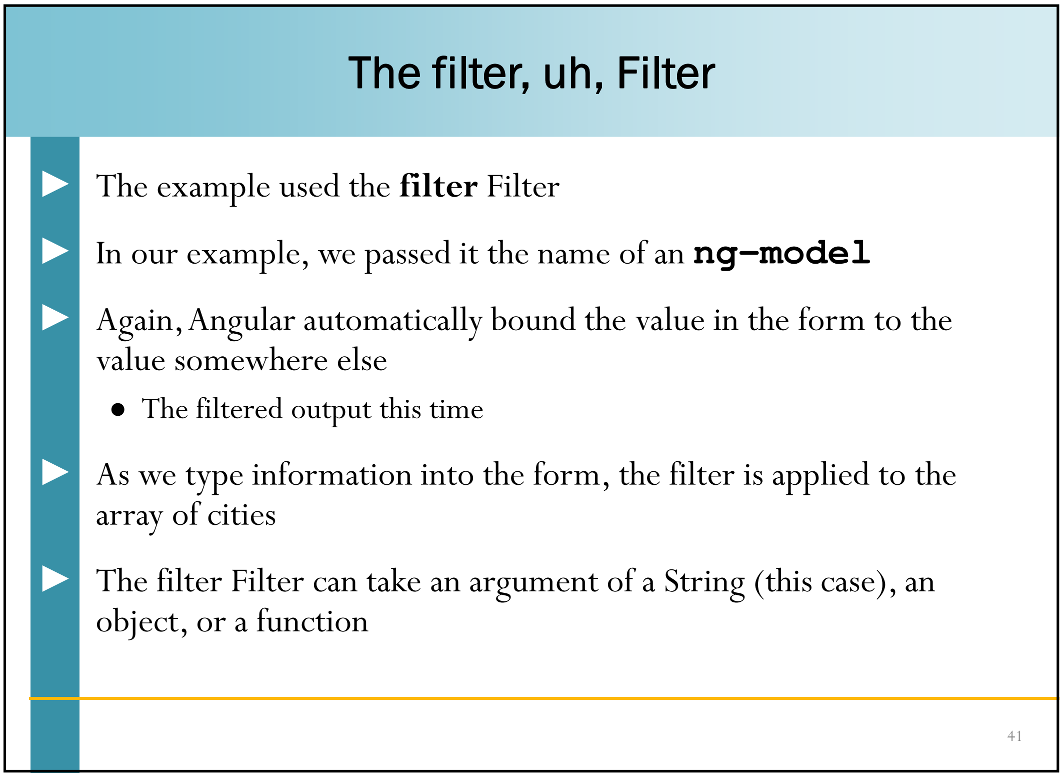
- In many cases, you won't want to work with the entirety of a data structure
- Most likely, the application will want to filter that data in some way
- Angular provides this functionality through the Filter, which is activated through the use of the | (pipe) character
- Pipe the output through a Filter and you will see less of it
  - Or perhaps see it changed!



Data binding and filtering

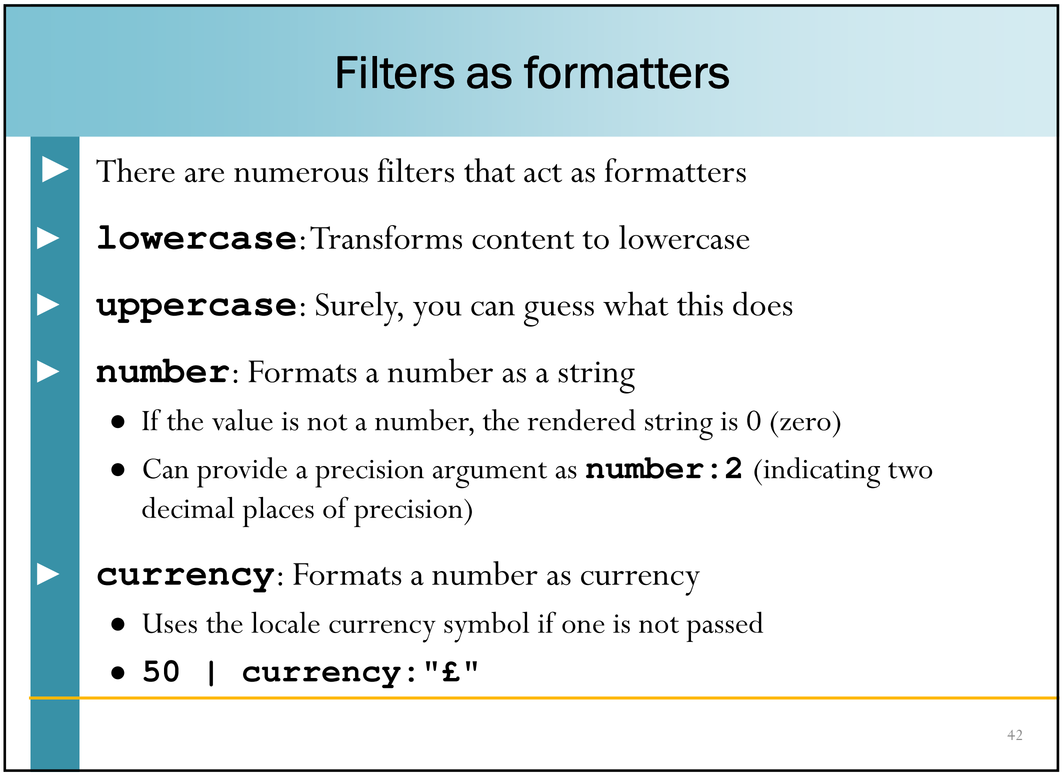
- Working from the last example, adding filtering (**IntroAngular\Demos\filter-names.html**)

```
<div ng-controller="FilterCtrl">
  <p>Here are some names:</p>
  <ul>
    <li ng-repeat="personName in names | filter:fName">
      {{ personName }}
    </li>
    <li ng-show="(names | filter:fName).length === 0">
      None found.
    </li>
  </ul>
  <form>
    <label for="fName">Filter names: </label>
    <input id="fName" type="text" ng-model="fName"/>
  </form>
</div>
```



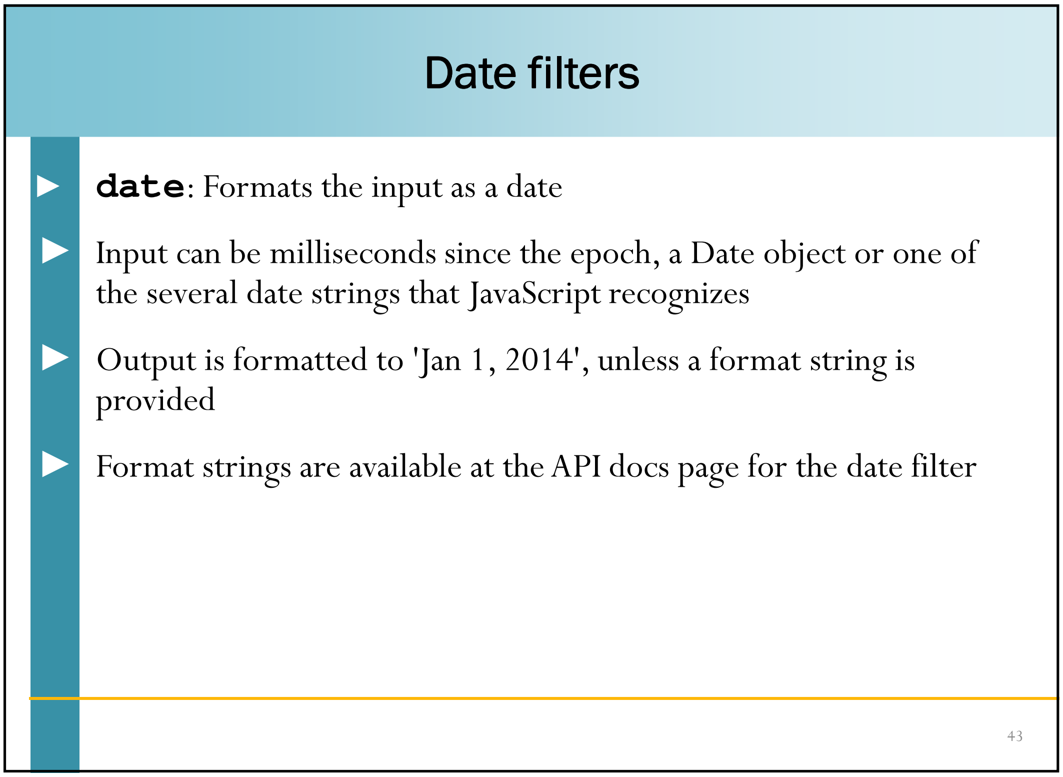
The filter, uh, Filter

- The example used the **filter** Filter
- In our example, we passed it the name of an **`ng-model`**
- Again, Angular automatically bound the value in the form to the value somewhere else
  - The filtered output this time
- As we type information into the form, the filter is applied to the array of cities
- The filter Filter can take an argument of a String (this case), an object, or a function



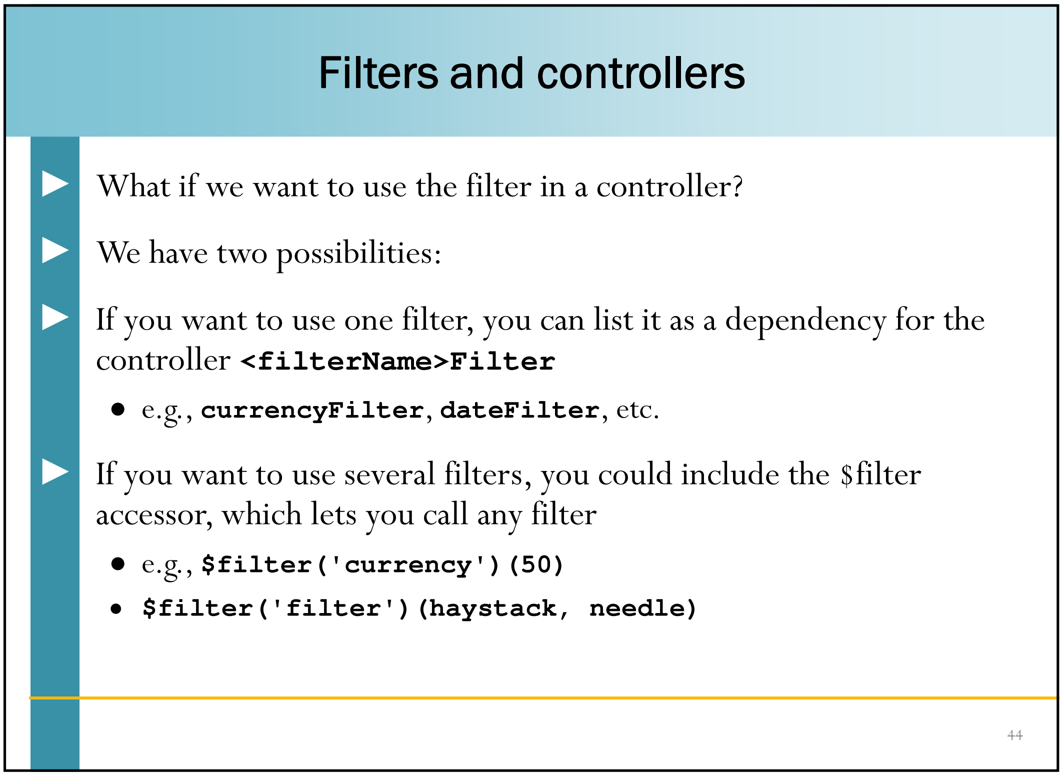
Filters as formatters

- There are numerous filters that act as formatters
- **`lowercase`**: Transforms content to lowercase
- **`uppercase`**: Surely, you can guess what this does
- **`number`**: Formats a number as a string
  - If the value is not a number, the rendered string is 0 (zero)
  - Can provide a precision argument as **`number:2`** (indicating two decimal places of precision)
- **`currency`**: Formats a number as currency
  - Uses the locale currency symbol if one is not passed
  - **`50 | currency:"£"`**



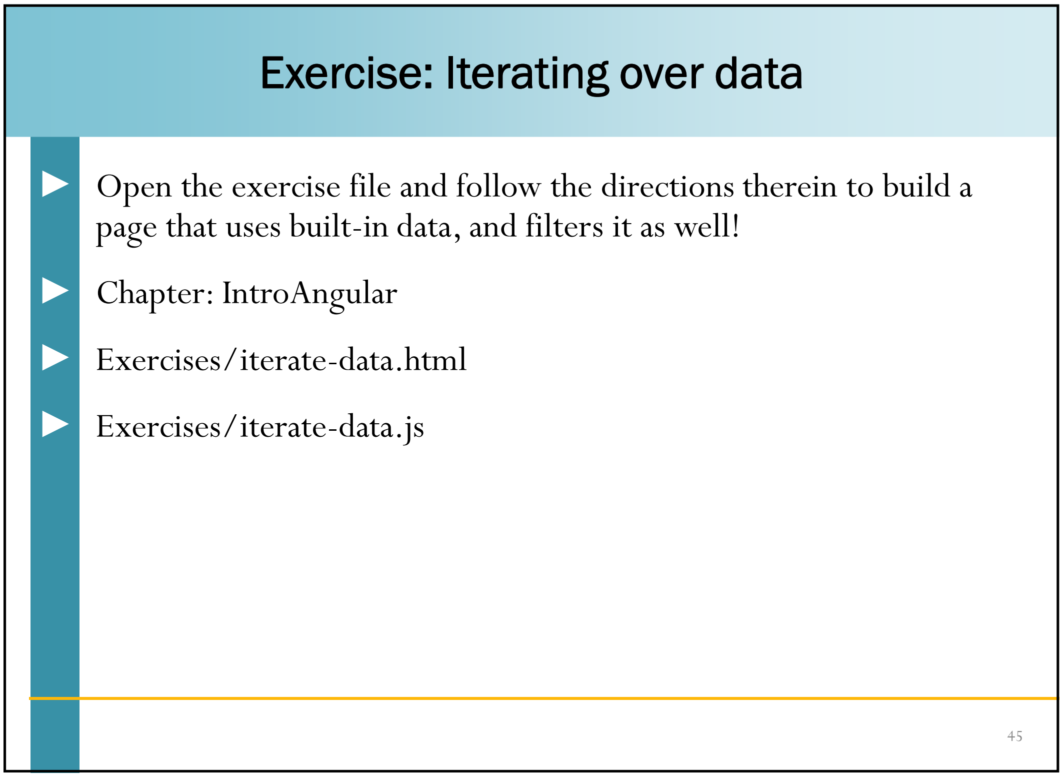
Date filters

- **`date`**: Formats the input as a date
- Input can be milliseconds since the epoch, a Date object or one of the several date strings that JavaScript recognizes
- Output is formatted to 'Jan 1, 2014', unless a format string is provided
- Format strings are available at the API docs page for the date filter



Filters and controllers

- What if we want to use the filter in a controller?
- We have two possibilities:
- If you want to use one filter, you can list it as a dependency for the controller **`<filterName>Filter`**
  - e.g., **`currencyFilter`**, **`dateFilter`**, etc.
- If you want to use several filters, you could include the $filter accessor, which lets you call any filter
  - e.g., **`$filter('currency')(50)`**
  - **`$filter('filter')(haystack, needle)`**



Exercise: Iterating over data

- Open the exercise file and follow the directions therein to build a page that uses built-in data, and filters it as well!
- Chapter: IntroAngular
- Exercises/iterate-data.html
- Exercises/iterate-data.js

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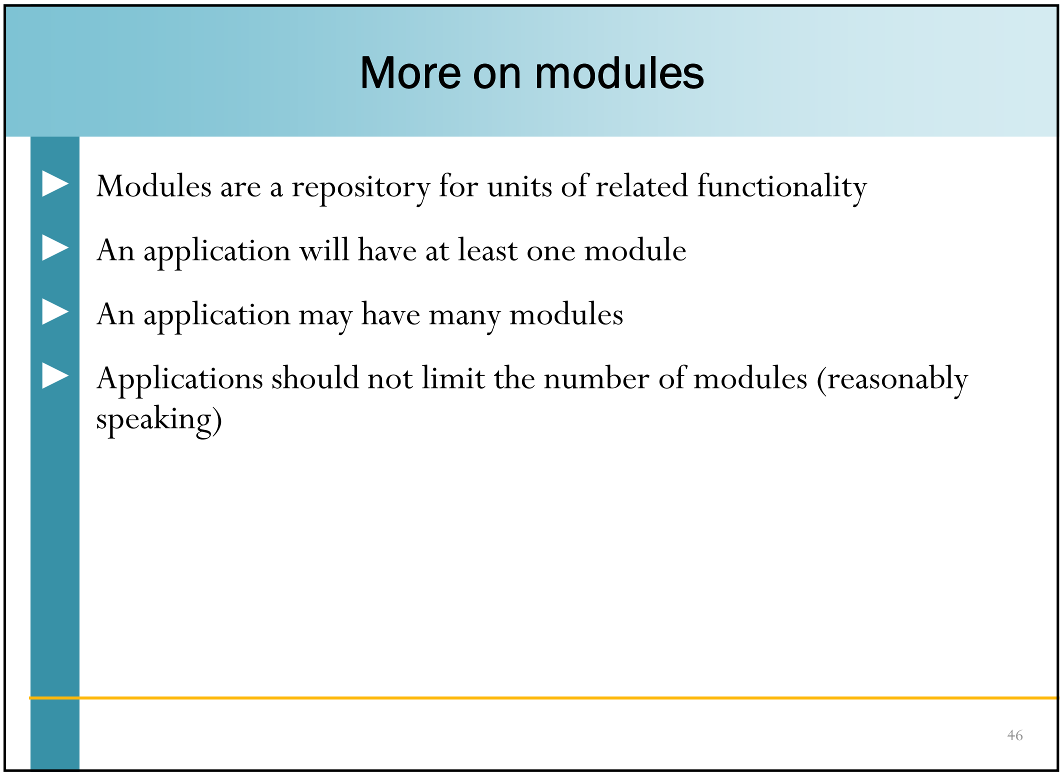

More on modules

- Modules are a repository for units of related functionality
- An application will have at least one module
- An application may have many modules
- Applications should not limit the number of modules (reasonably speaking)

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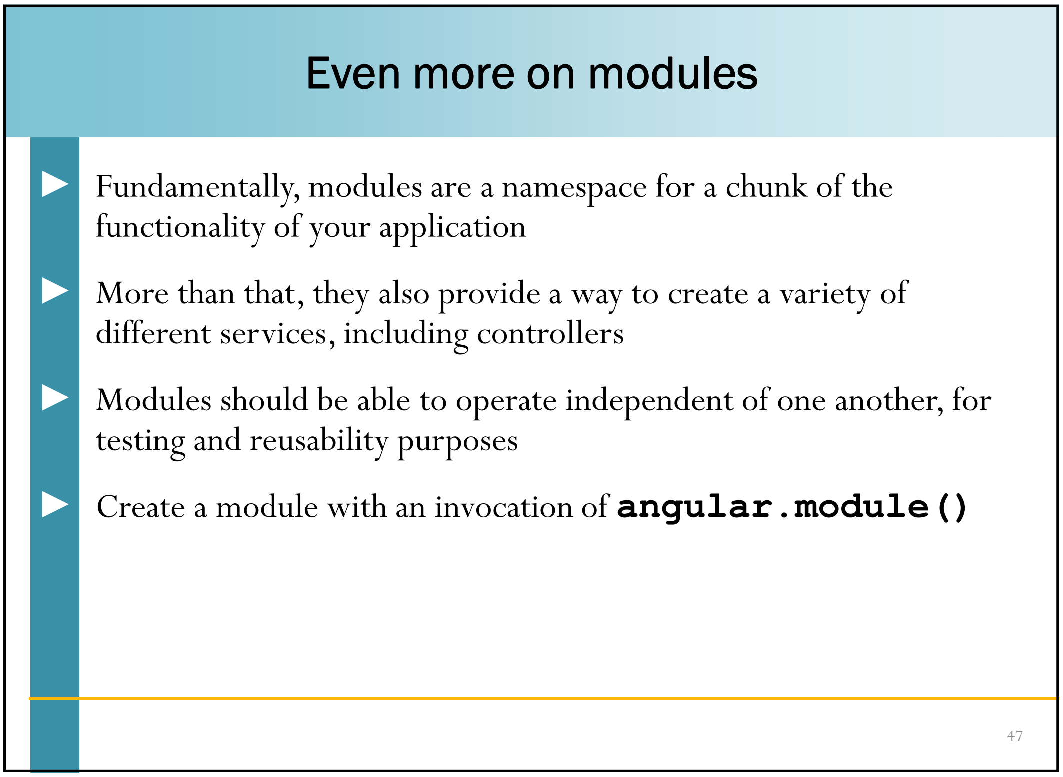
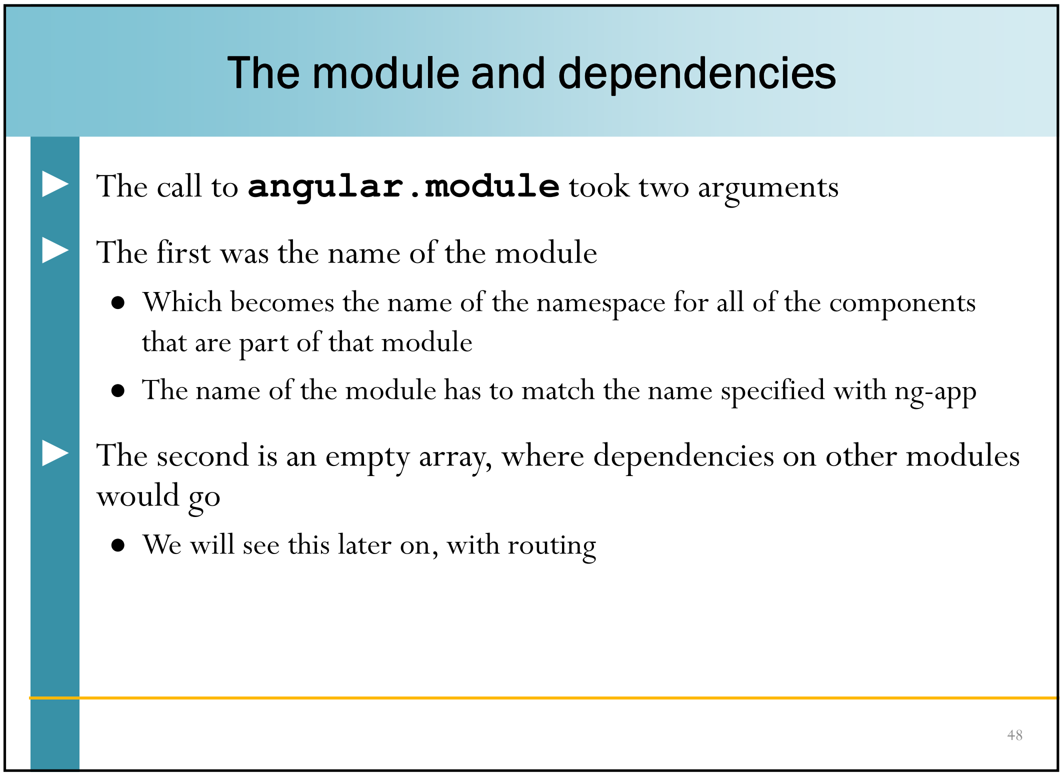


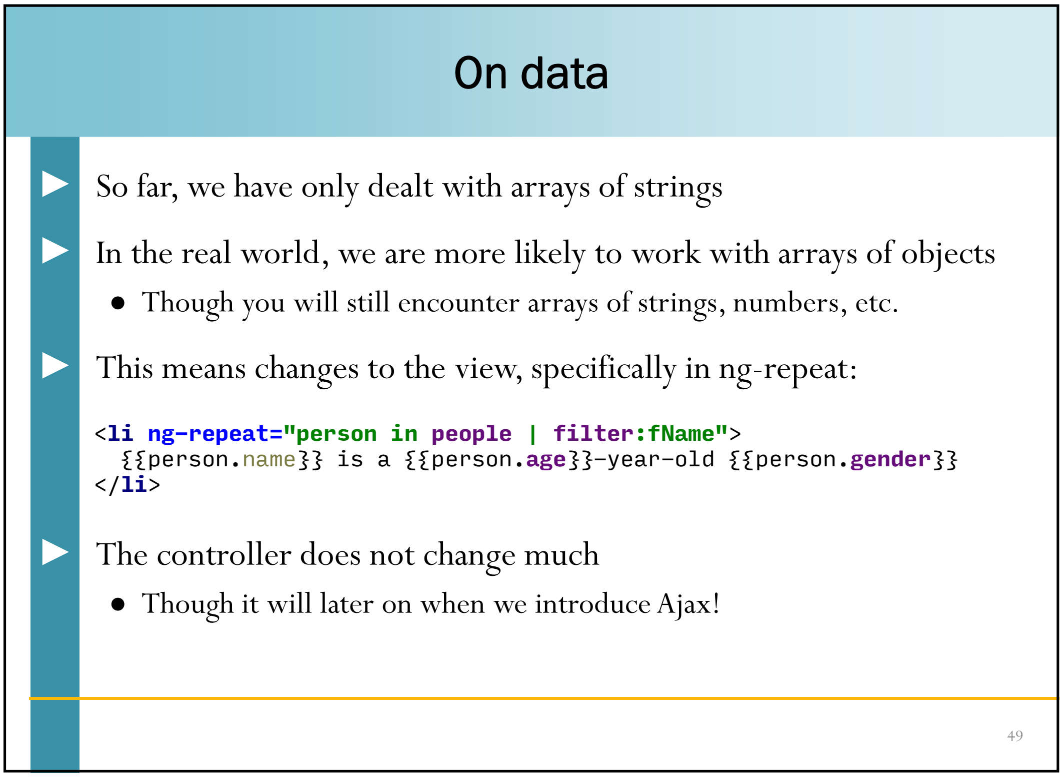
Even more on modules

- Fundamentally, modules are a namespace for a chunk of the functionality of your application
- More than that, they also provide a way to create a variety of different services, including controllers
- Modules should be able to operate independent of one another, for testing and reusability purposes
- Create a module with an invocation of **`angular.module()`**



The module and dependencies

- The call to **`angular.module`** took two arguments
- The first was the name of the module
  - Which becomes the name of the namespace for all of the components that are part of that module
  - The name of the module has to match the name specified with ng-app
- The second is an empty array, where dependencies on other modules would go
  - We will see this later on, with routing

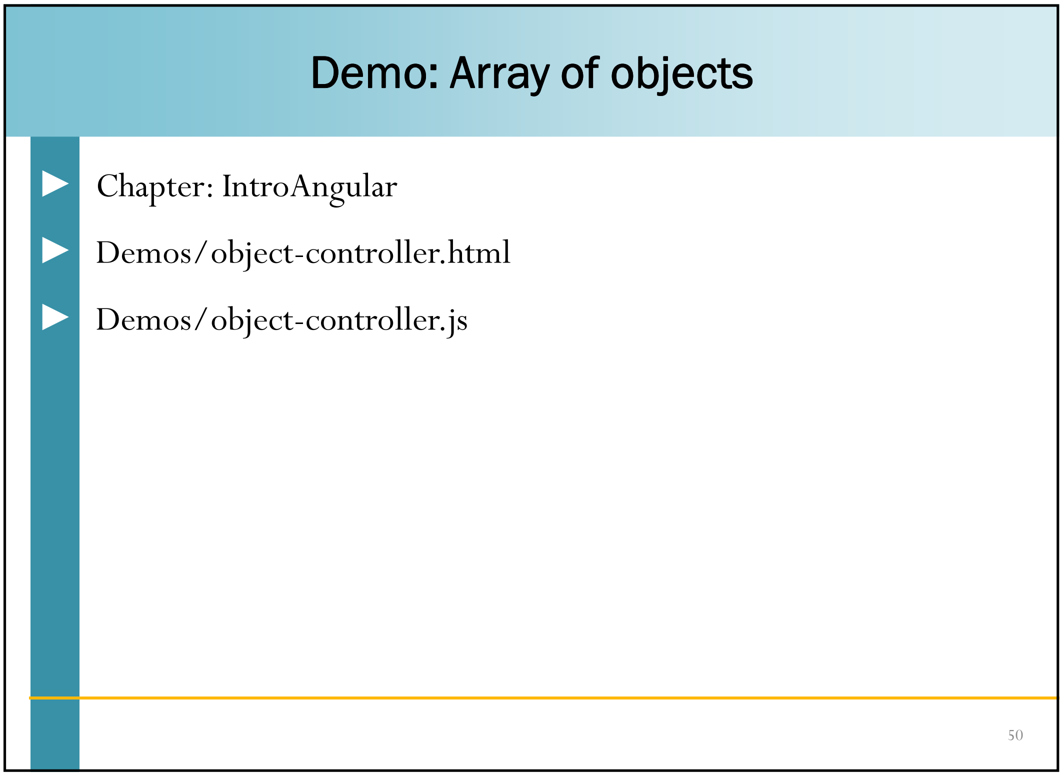


On data

- So far, we have only dealt with arrays of strings
- In the real world, we are more likely to work with arrays of objects
  - Though you will still encounter arrays of strings, numbers, etc.
- This means changes to the view, specifically in ng-repeat:

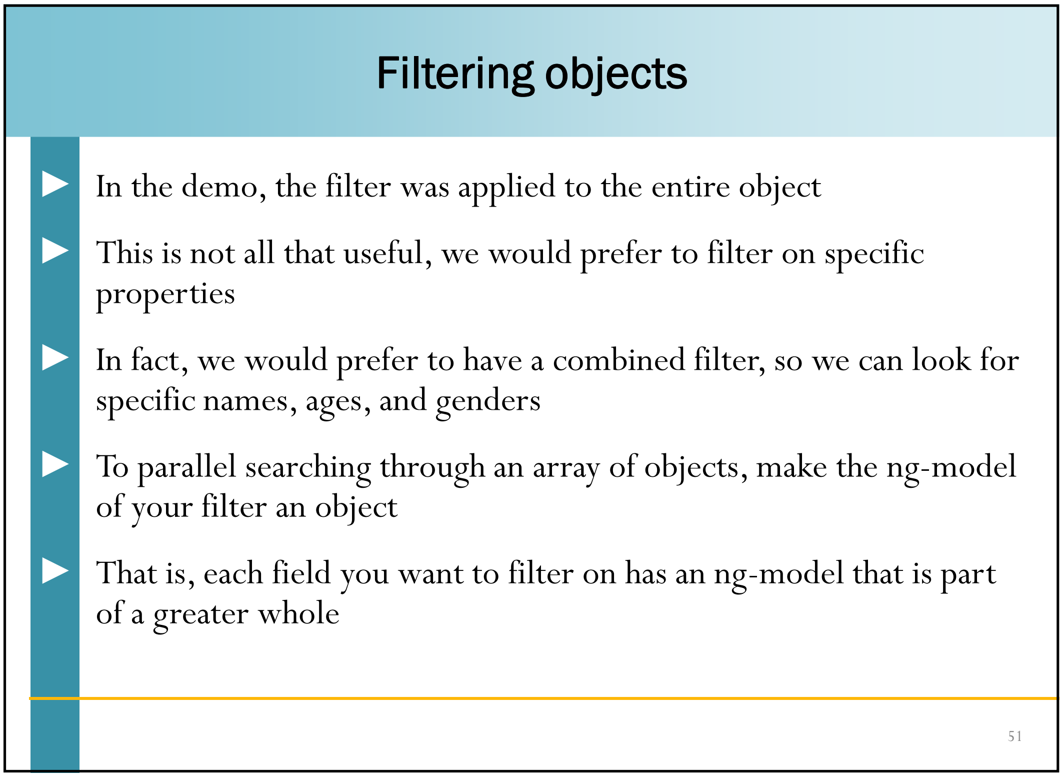
```
<li ng-repeat="person in people | filter:fName">
  {{person.name}} is a {{person.age}}-year-old {{person.gender}}
</li>
```

- The controller does not change much
  - Though it will later on when we introduce Ajax!



Demo: Array of objects

- Chapter: IntroAngular
- Demos/object-controller.html
- Demos/object-controller.js



Filtering objects

- In the demo, the filter was applied to the entire object
- This is not all that useful, we would prefer to filter on specific properties
- In fact, we would prefer to have a combined filter, so we can look for specific names, ages, and genders
- To parallel searching through an array of objects, make the ng-model of your filter an object
- That is, each field you want to filter on has an ng-model that is part of a greater whole

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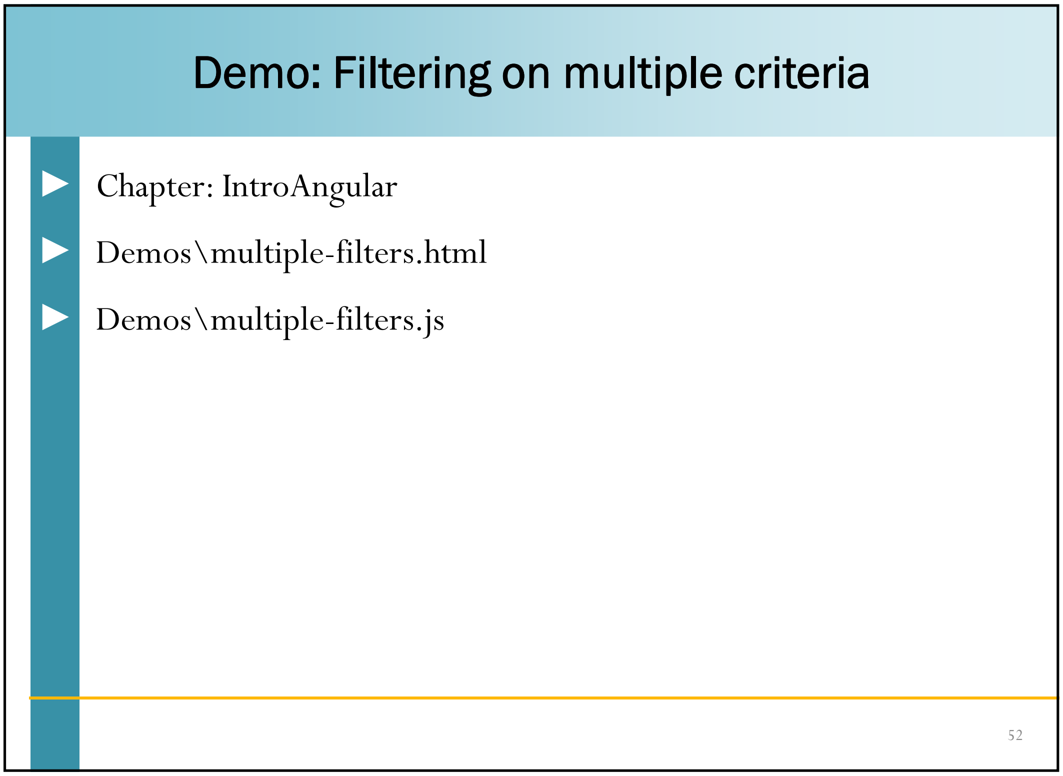

Demo: Filtering on multiple criteria

- Chapter: IntroAngular
- Demos\multiple-filters.html
- Demos\multiple-filters.js

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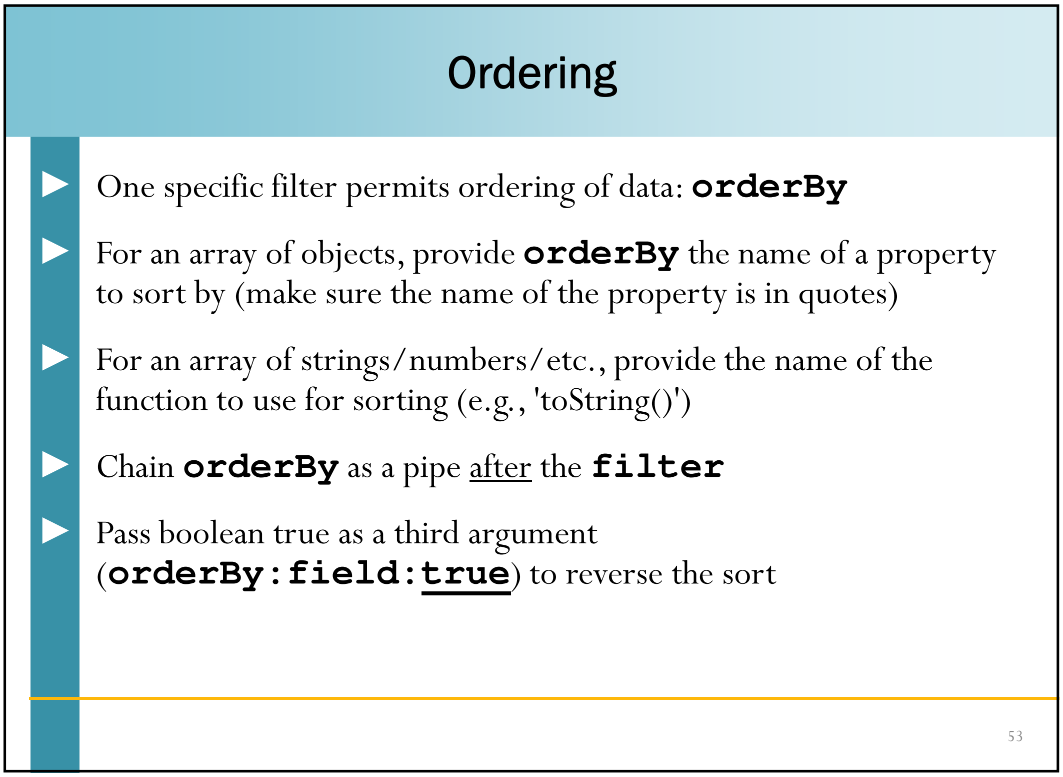

Ordering

- One specific filter permits ordering of data: **`orderBy`**
- For an array of objects, provide **`orderBy`** the name of a property to sort by (make sure the name of the property is in quotes)
- For an array of strings/numbers/etc., provide the name of the function to use for sorting (e.g., 'toString()')
- Chain **`orderBy`** as a pipe after the **`filter`**
- Pass boolean true as a third argument (**`orderBy:field:true`**) to reverse the sort

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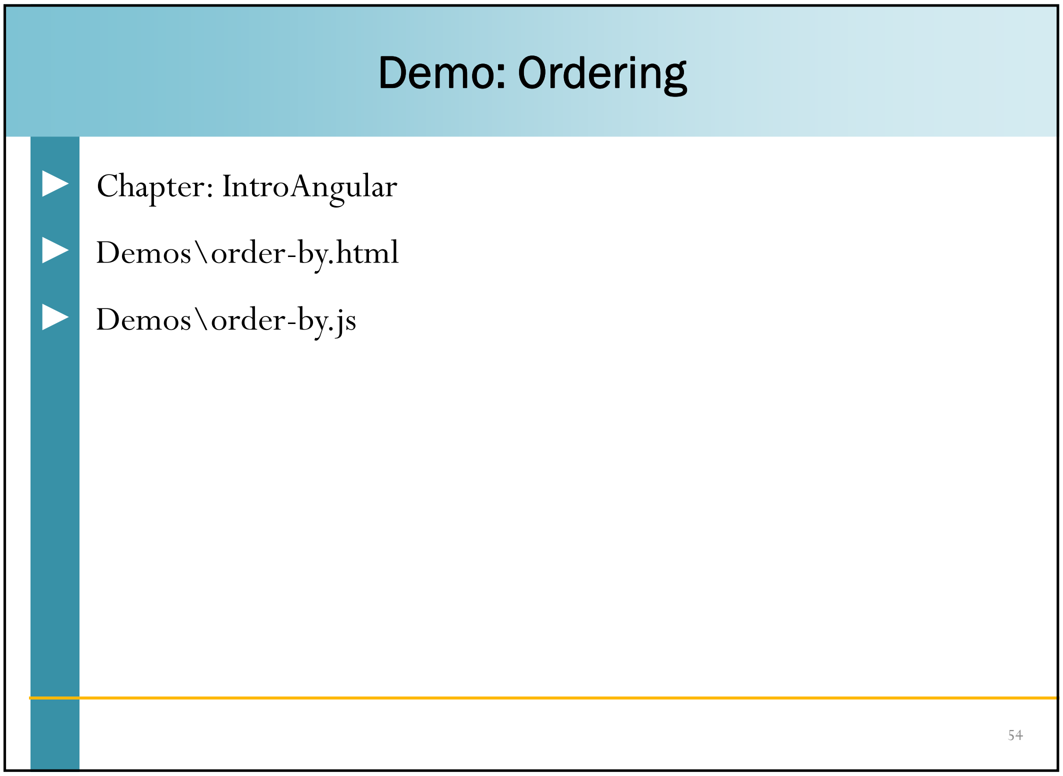

Demo: Ordering

- Chapter: IntroAngular
- Demos\order-by.html
- Demos\order-by.js

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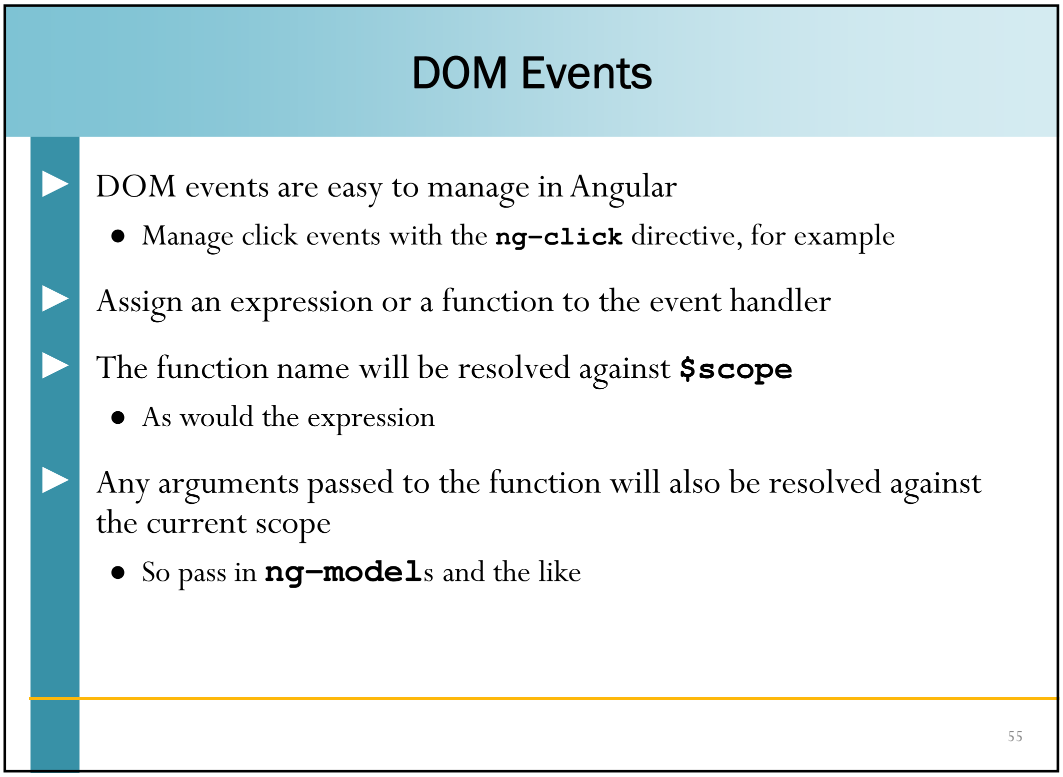
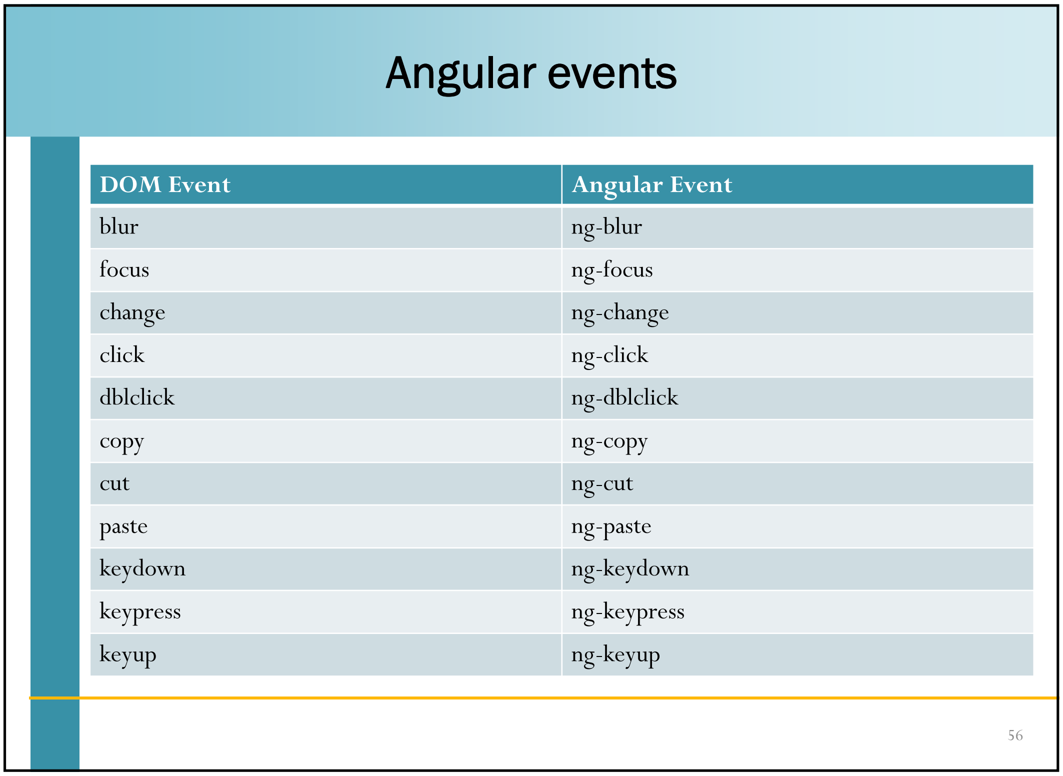


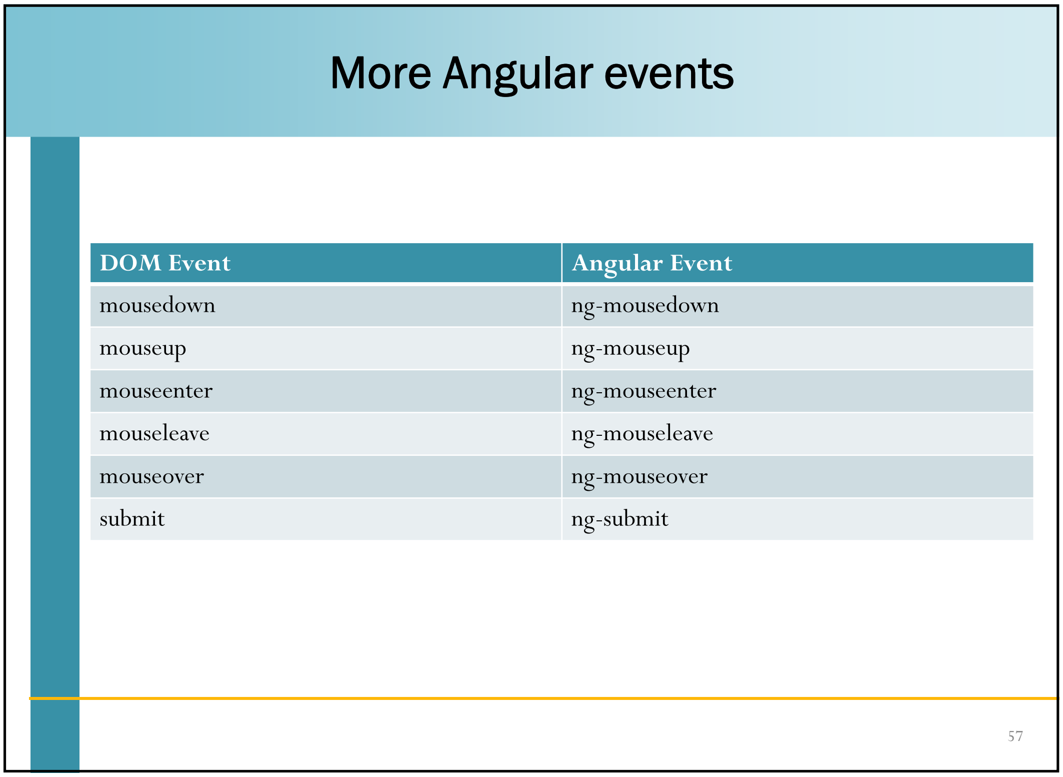
DOM Events

- DOM events are easy to manage in Angular
  - Manage click events with the **`ng-click`** directive, for example
- Assign an expression or a function to the event handler
- The function name will be resolved against **`$scope`**
  - As would the expression
- Any arguments passed to the function will also be resolved against the current scope
  - So pass in **`ng-model`**s and the like



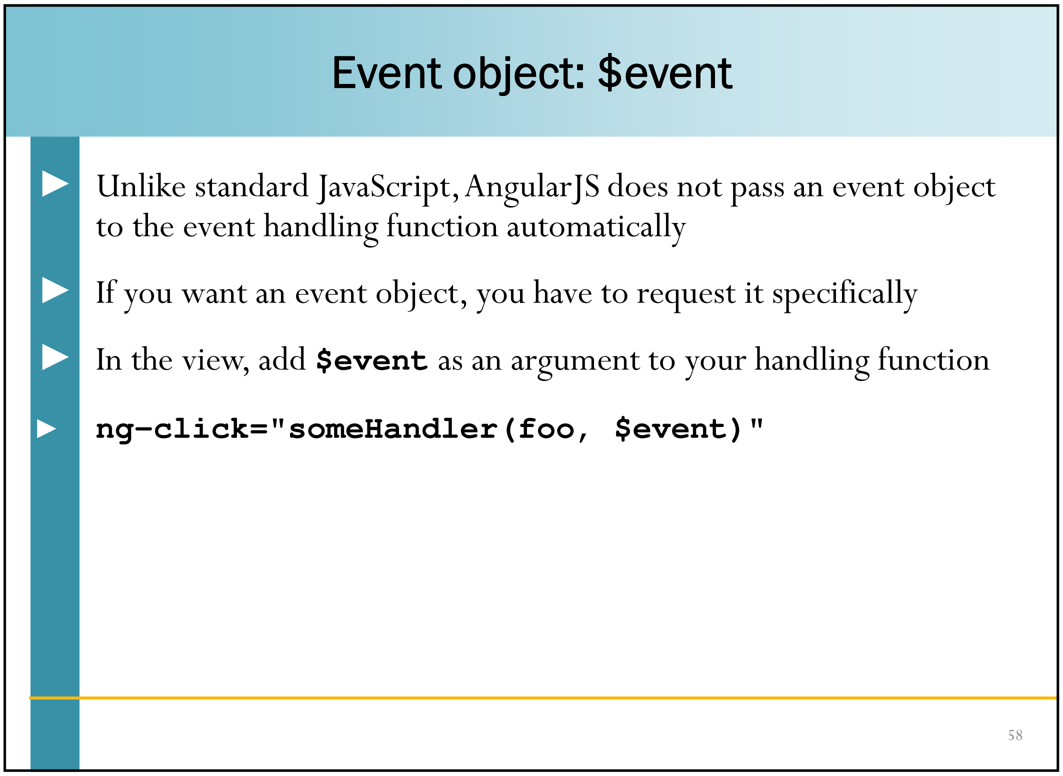
Angular events

DOM Event	Angular Event
blur	ng-blur
focus	ng-focus
change	ng-change
click	ng-click
dblclick	ng-dblclick
copy	ng-copy
cut	ng-cut
paste	ng-paste
keydown	ng-keydown
keypress	ng-keypress
keyup	ng-keyup



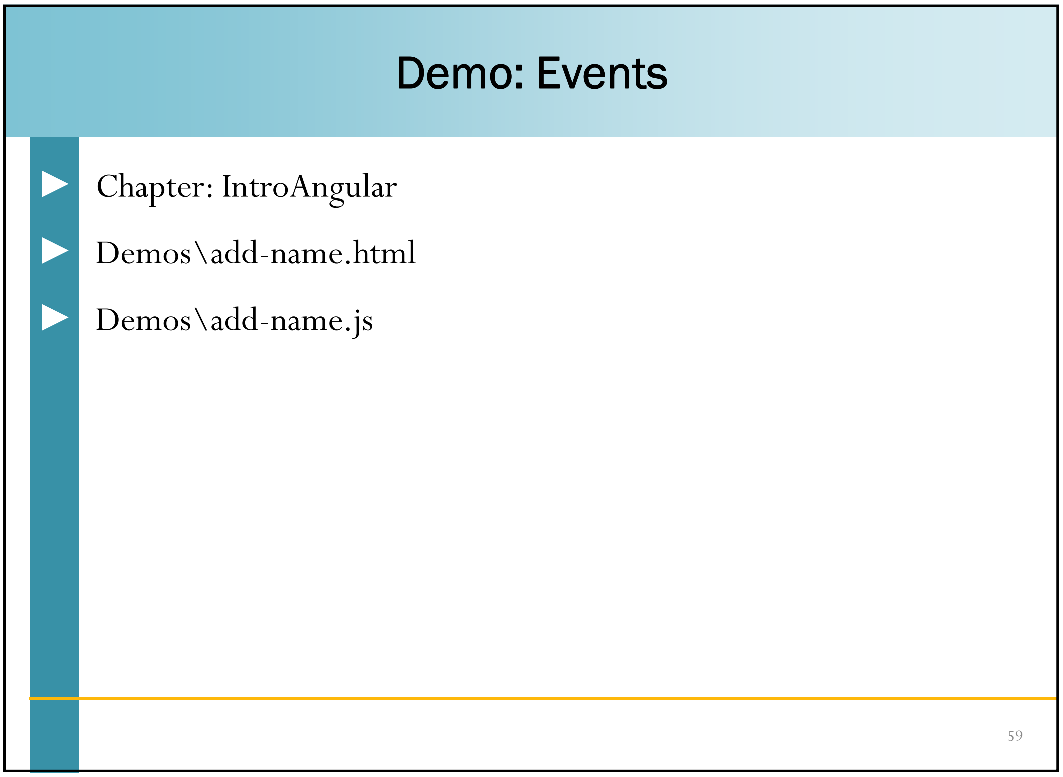
More Angular events

DOM Event	Angular Event
mousedown	ng-mousedown
mouseup	ng-mouseup
mouseenter	ng-mouseenter
mouseleave	ng-mouseleave
mouseover	ng-mouseover
submit	ng-submit



Event object: $event

- Unlike standard JavaScript, AngularJS does not pass an event object to the event handling function automatically
- If you want an event object, you have to request it specifically
- In the view, add **`$event`** as an argument to your handling function
- **`ng-click="someHandler(foo, $event)"`**



Demo: Events

- Chapter: IntroAngular
- Demos\add-name.html
- Demos\add-name.js

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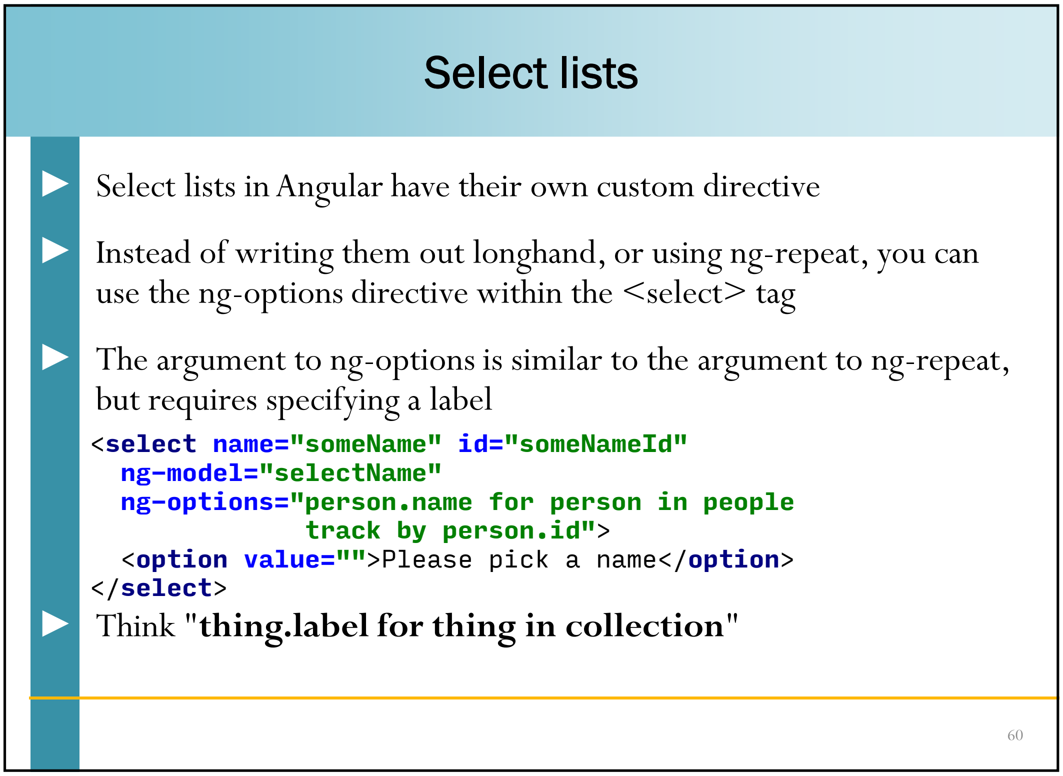

Select lists

- Select lists in Angular have their own custom directive
- Instead of writing them out longhand, or using ng-repeat, you can use the ng-options directive within the <select> tag
- The argument to ng-options is similar to the argument to ng-repeat, but requires specifying a label

```
<select name="someName" id="someNameId"
  ng-model="selectName"
  ng-options="person.name for person in people
              track by person.id">
  <option value="">Please pick a name</option>
</select>
```

- Think "**thing.label for thing in collection**"

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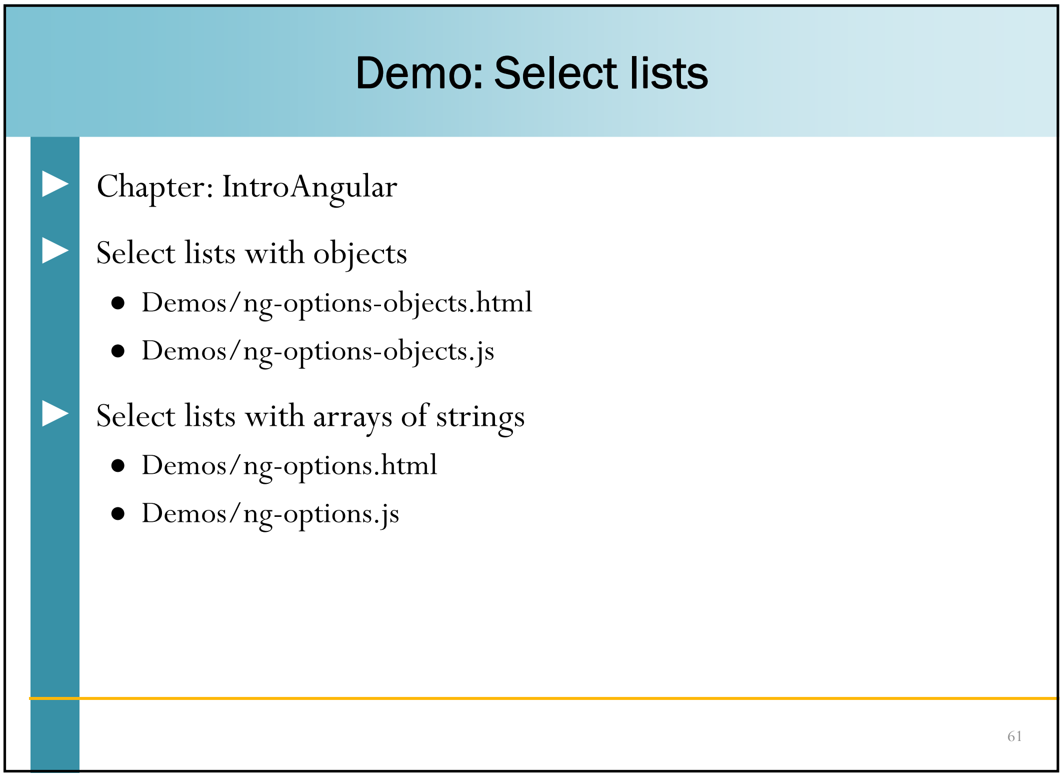

Demo: Select lists

- Chapter: IntroAngular
- Select lists with objects
  - Demos/ng-options-objects.html
  - Demos/ng-options-objects.js
- Select lists with arrays of strings
  - Demos/ng-options.html
  - Demos/ng-options.js

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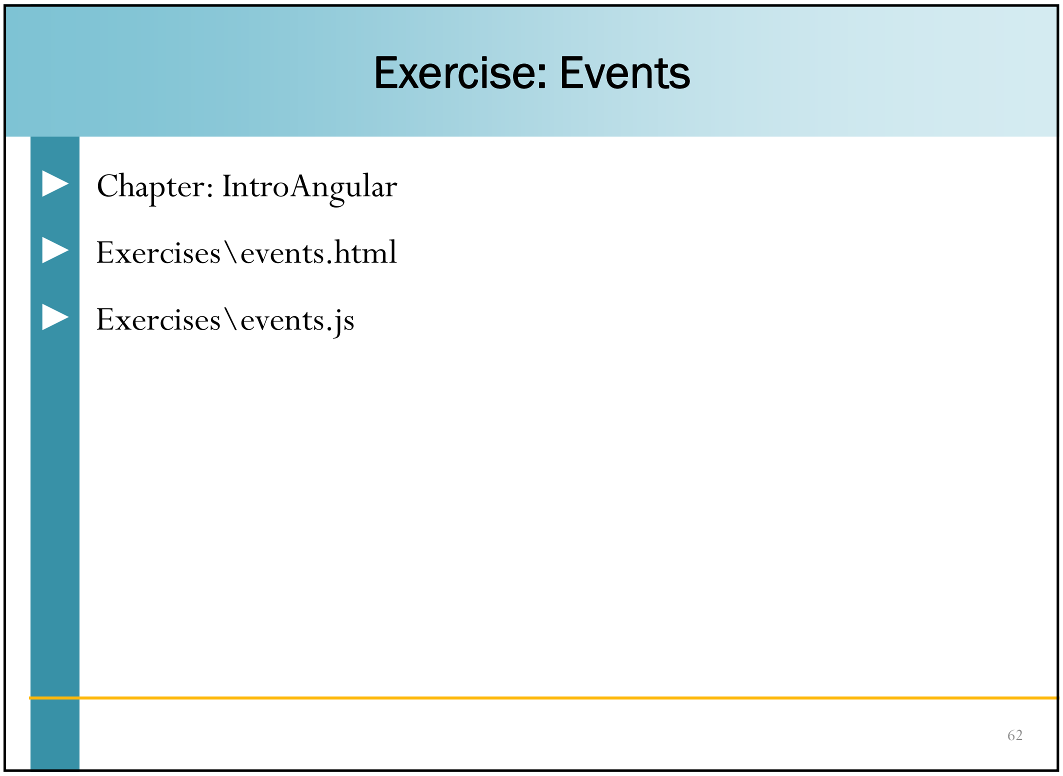

Exercise: Events

- Chapter: IntroAngular
- Exercises\events.html
- Exercises\events.js

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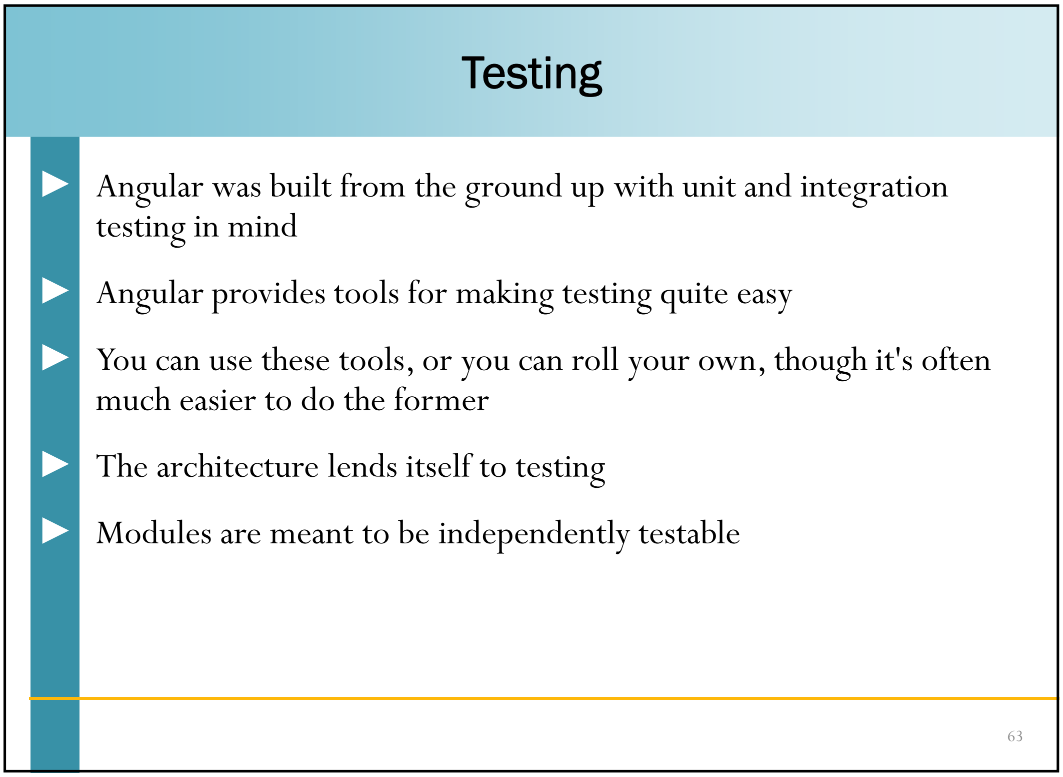
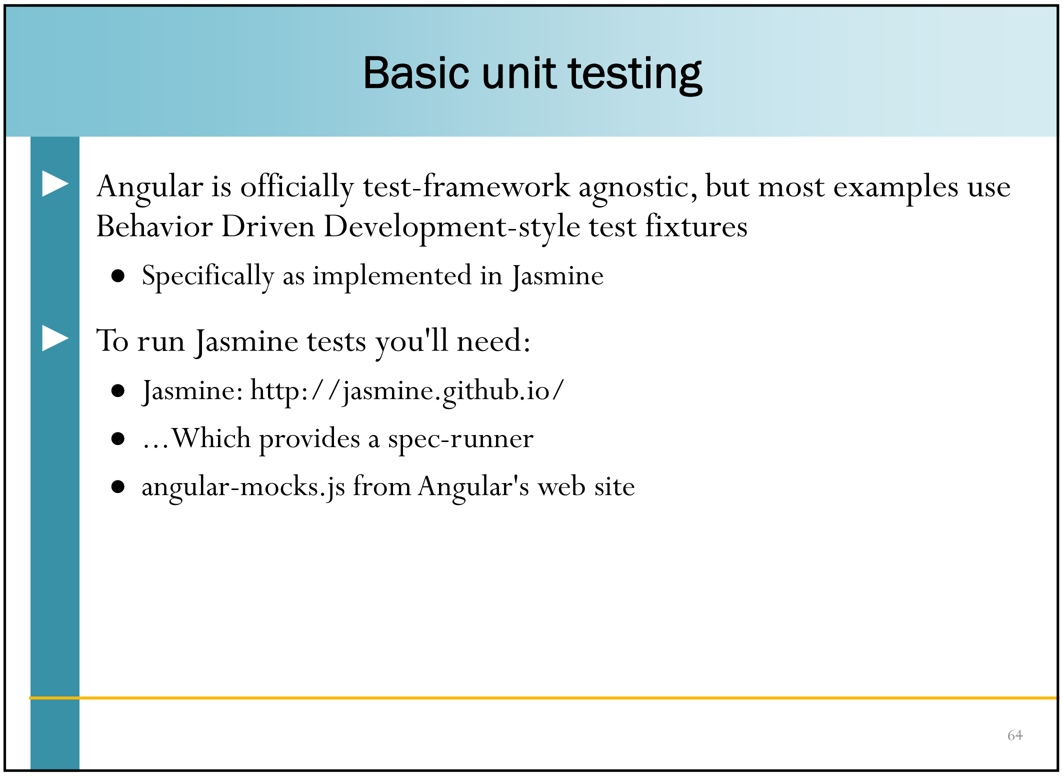


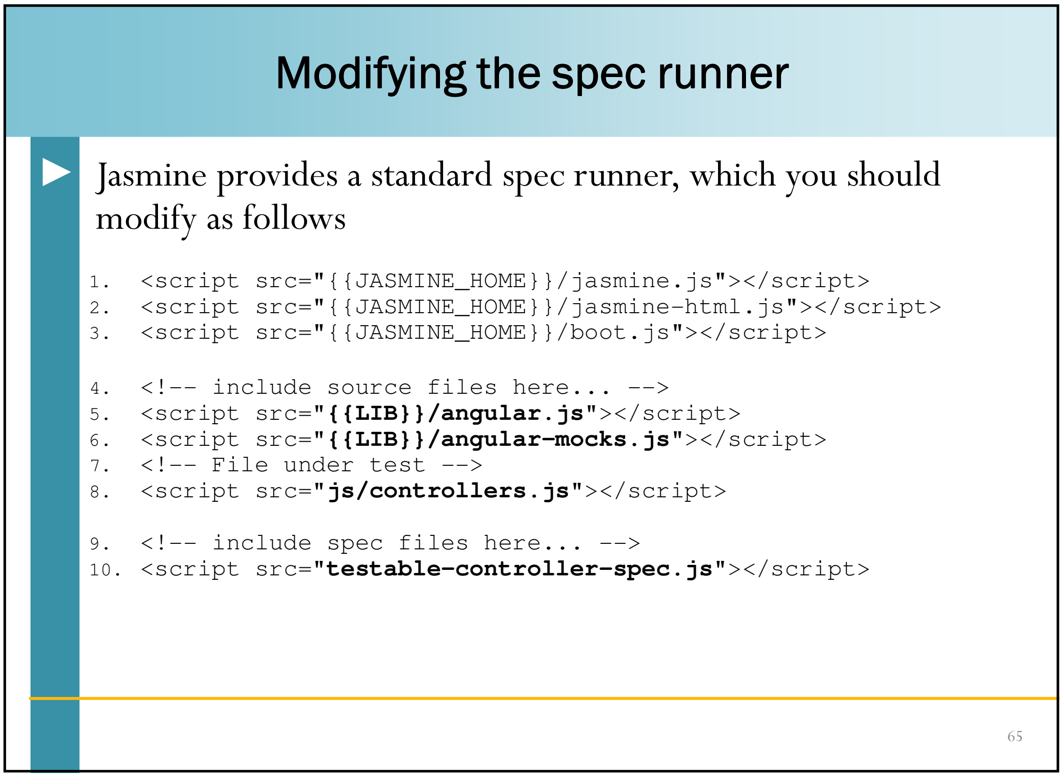
Testing

- Angular was built from the ground up with unit and integration testing in mind
- Angular provides tools for making testing quite easy
- You can use these tools, or you can roll your own, though it's often much easier to do the former
- The architecture lends itself to testing
- Modules are meant to be independently testable



Basic unit testing

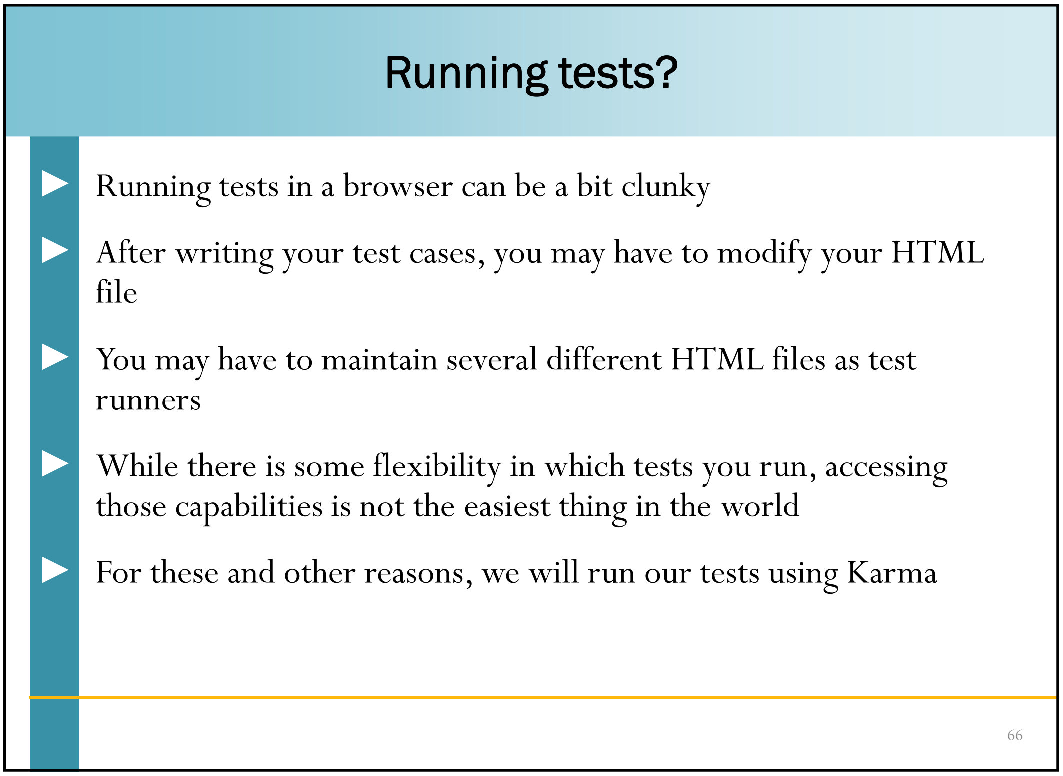
- Angular is officially test-framework agnostic, but most examples use Behavior Driven Development-style test fixtures
  - Specifically as implemented in Jasmine
- To run Jasmine tests you'll need:
  - Jasmine: http://jasmine.github.io/
  - …Which provides a spec-runner
  - angular-mocks.js from Angular's web site



Modifying the spec runner

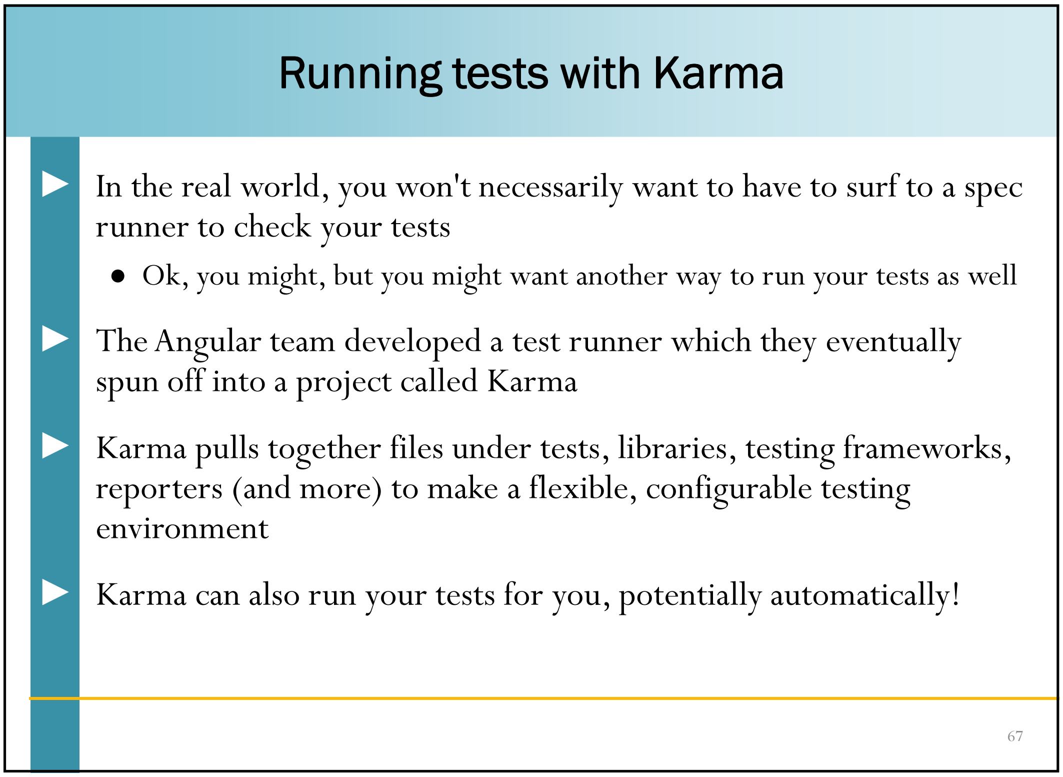
- Jasmine provides a standard spec runner, which you should modify as follows

```
<script src="{{JASMINE_HOME}}/jasmine.js"></script>
<script src="{{JASMINE_HOME}}/jasmine-html.js"></script>
<script src="{{JASMINE_HOME}}/boot.js"></script>

<!-- include source files here... -->
<script src="{{LIB}}/angular.js"></script>
<script src="{{LIB}}/angular-mocks.js"></script>
<!-- File under test -->
<script src="js/controllers.js"></script>

<!-- include spec files here... -->
<script src="testable-controller-spec.js"></script>
```



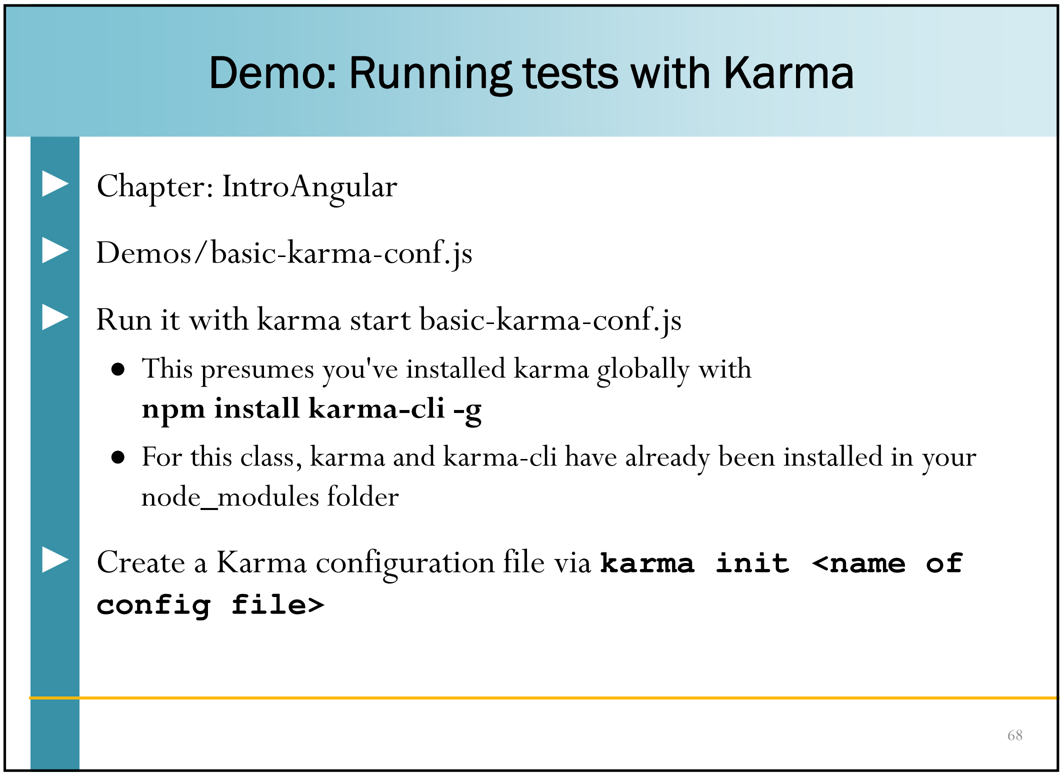
Running tests?

- Running tests in a browser can be a bit clunky
- After writing your test cases, you may have to modify your HTML file
- You may have to maintain several different HTML files as test runners
- While there is some flexibility in which tests you run, accessing those capabilities is not the easiest thing in the world
- For these and other reasons, we will run our tests using Karma



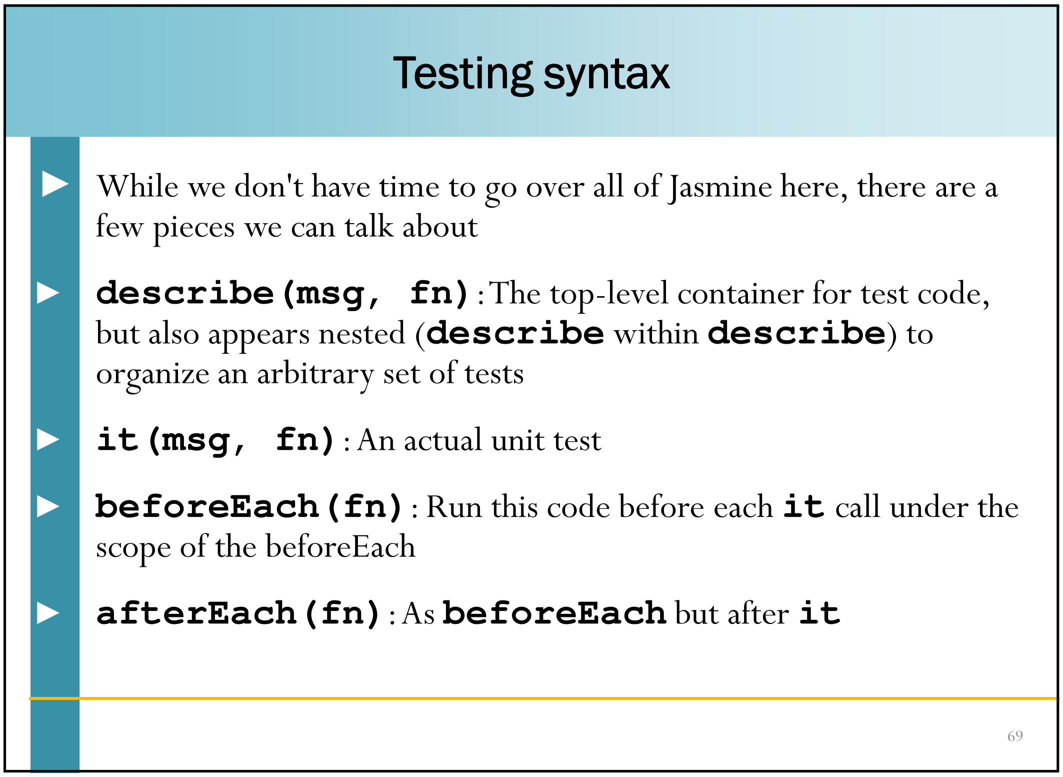
Running tests with Karma

- In the real world, you won't necessarily want to have to surf to a spec runner to check your tests
  - Ok, you might, but you might want another way to run your tests as well
- The Angular team developed a test runner which they eventually spun off into a project called Karma
- Karma pulls together files under tests, libraries, testing frameworks, reporters (and more) to make a flexible, configurable testing environment
- Karma can also run your tests for you, potentially automatically!



Demo: Running tests with Karma

- Chapter: IntroAngular
- Demos/basic-karma-conf.js
- Run it with karma start basic-karma-conf.js
  - This presumes you've installed karma globally with **npm install karma-cli -g**
  - For this class, karma and karma-cli have already been installed in your node_modules folder
- Create a Karma configuration file via **`karma init <name of config file>`**



Testing syntax

- While we don't have time to go over all of Jasmine here, there are a few pieces we can talk about
- **`describe(msg, fn)`** : The top-level container for test code, but also appears nested (**`describe`** within **`describe`**) to organize an arbitrary set of tests
- **`it(msg, fn)`** : An actual unit test
- **`beforeEach(fn)`** : Run this code before each **`it`** call under the scope of the beforeEach
- **`afterEach(fn)`** : As **`beforeEach`** but after **`it`**

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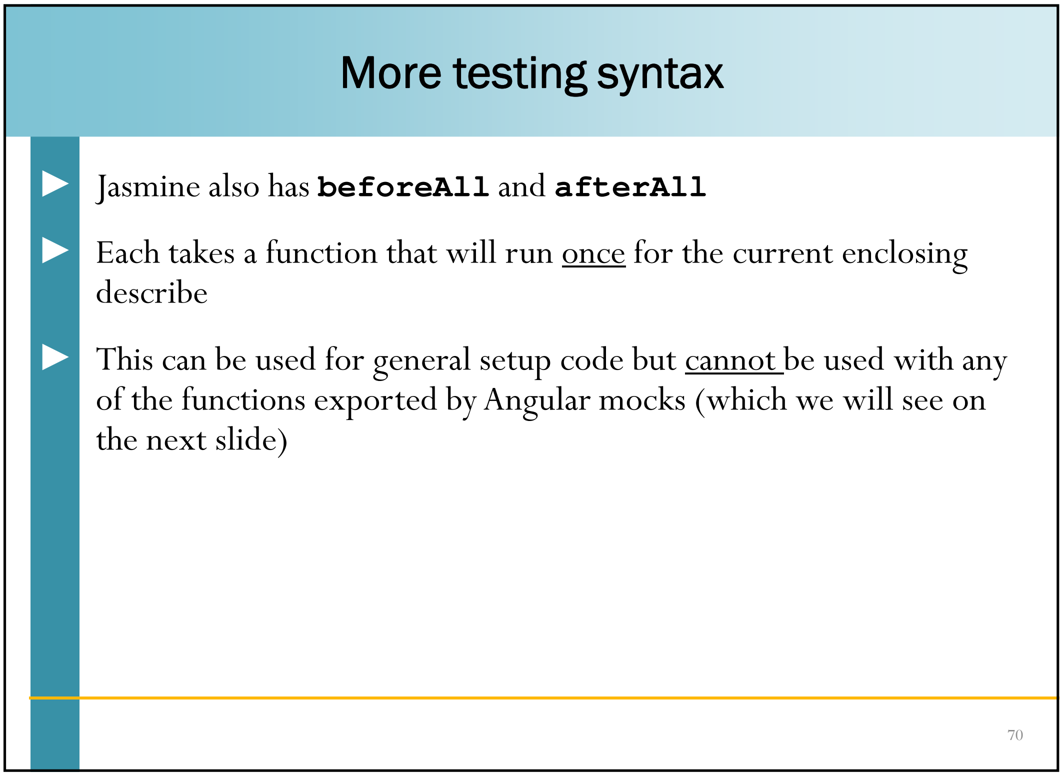

More testing syntax

- Jasmine also has **`beforeAll`** and **`afterAll`**
- Each takes a function that will run once for the current enclosing describe
- This can be used for general setup code but cannot be used with any of the functions exported by Angular mocks (which we will see on the next slide)

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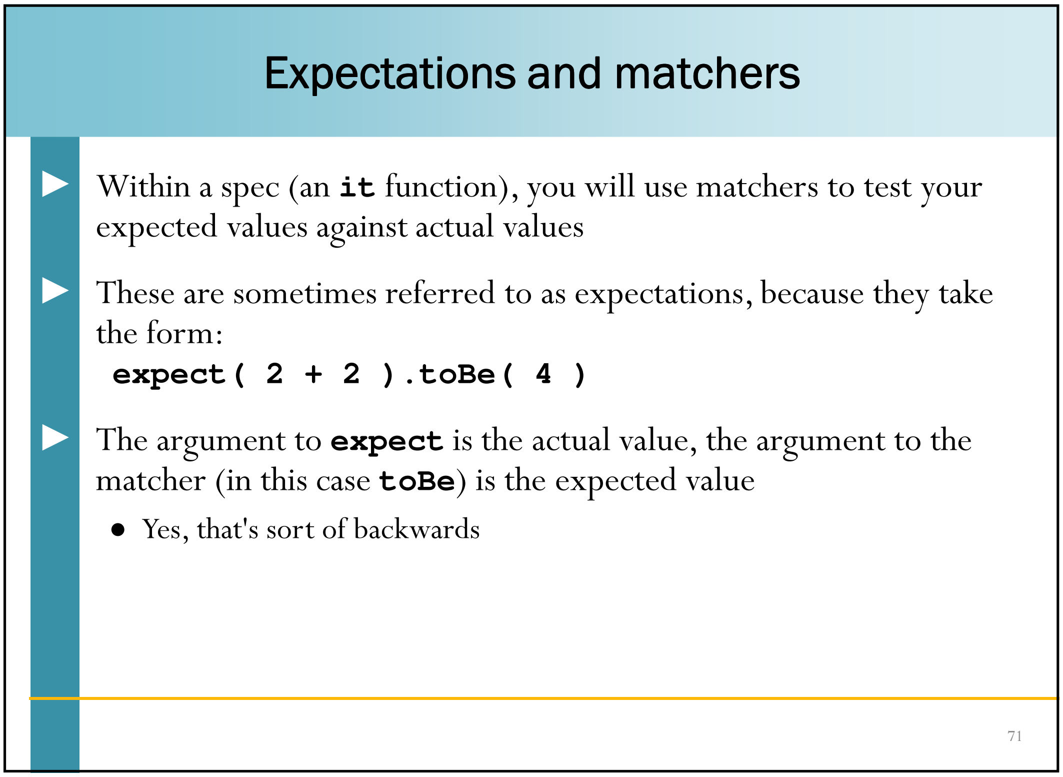
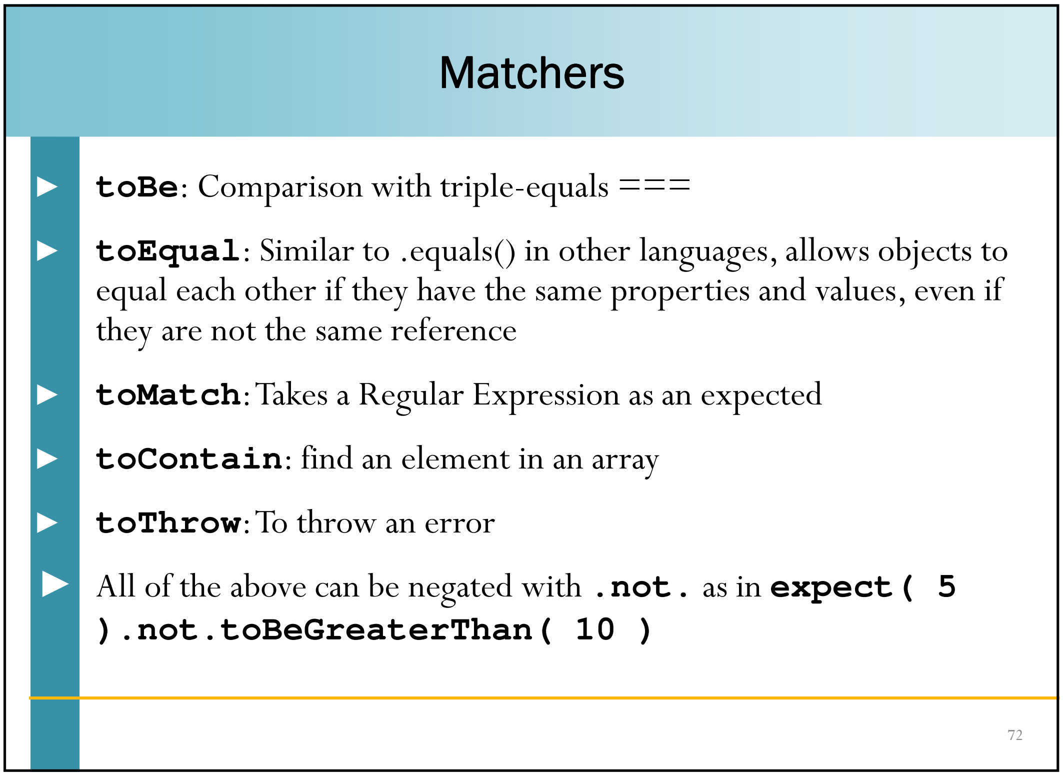


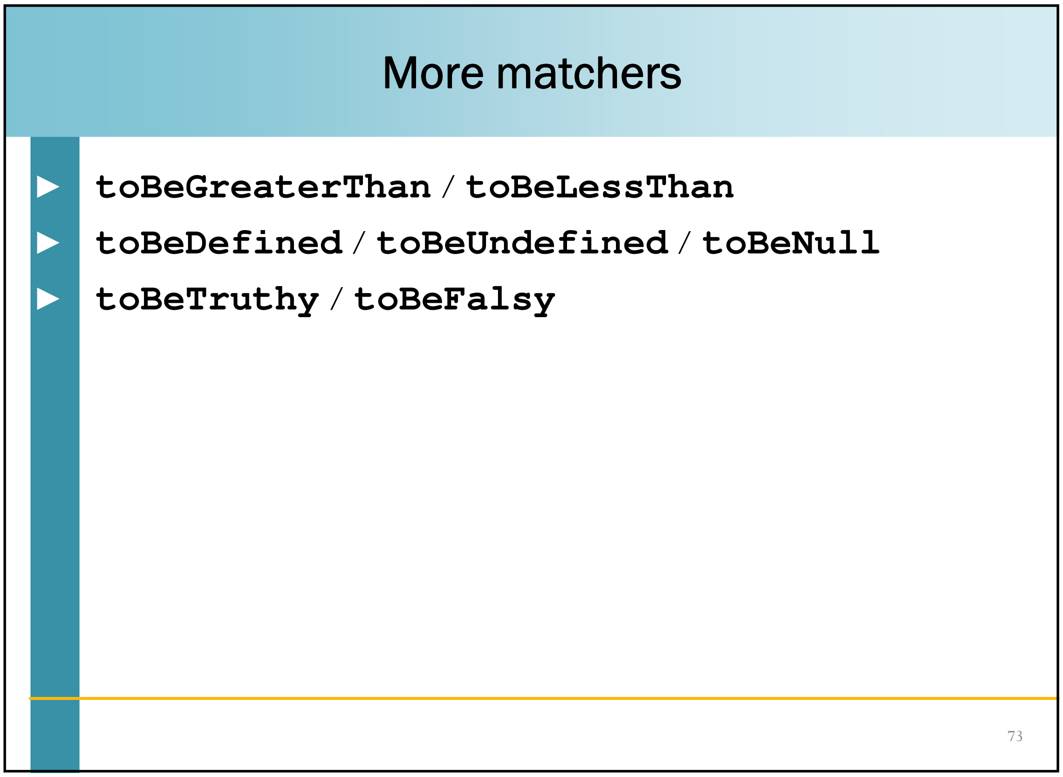
Expectations and matchers

- Within a spec (an **`it`** function), you will use matchers to test your expected values against actual values
- These are sometimes referred to as expectations, because they take the form:
  `expect( 2 + 2 ).toBe( 4 )`
- The argument to **`expect`** is the actual value, the argument to the matcher (in this case **`toBe`**) is the expected value
  - Yes, that's sort of backwards



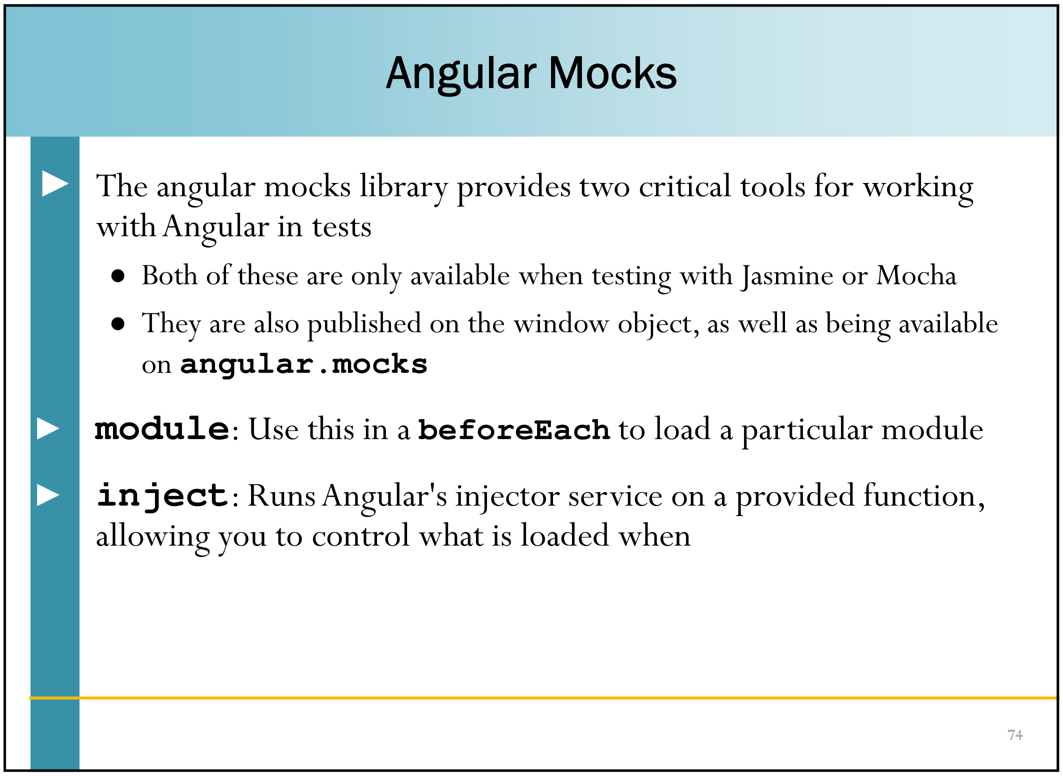
Matchers

- **`toBe`**: Comparison with triple-equals ===
- **`toEqual`**: Similar to .equals() in other languages, allows objects to equal each other if they have the same properties and values, even if they are not the same reference
- **`toMatch`**: Takes a Regular Expression as an expected
- **`toContain`**: find an element in an array
- **`toThrow`**: To throw an error
- All of the above can be negated with **`.not.`** as in **`expect( 5 ).not.toBeGreaterThan( 10 )`**



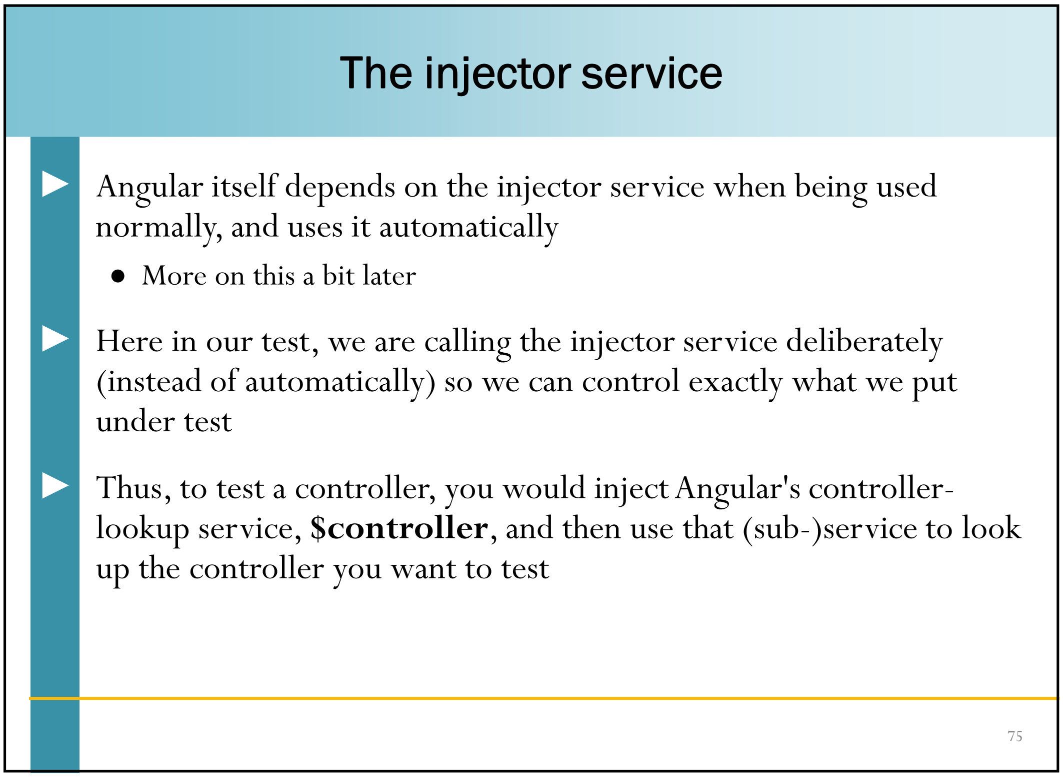
More matchers

- **`toBeGreaterThan`** / **`toBeLessThan`**
- **`toBeDefined`** / **`toBeUndefined`** / **`toBeNull`**
- **`toBeTruthy`** / **`toBeFalsy`**



Angular Mocks

- The angular mocks library provides two critical tools for working with Angular in tests
  - Both of these are only available when testing with Jasmine or Mocha
  - They are also published on the window object, as well as being available on **`angular.mocks`**
- **`module`**: Use this in a **`beforeEach`** to load a particular module
- **`inject`**: Runs Angular's injector service on a provided function, allowing you to control what is loaded when



The injector service

- Angular itself depends on the injector service when being used normally, and uses it automatically
  - More on this a bit later
- Here in our test, we are calling the injector service deliberately (instead of automatically) so we can control exactly what we put under test
- Thus, to test a controller, you would inject Angular's controller-lookup service, **$controller**, and then use that (sub-)service to look up the controller you want to test

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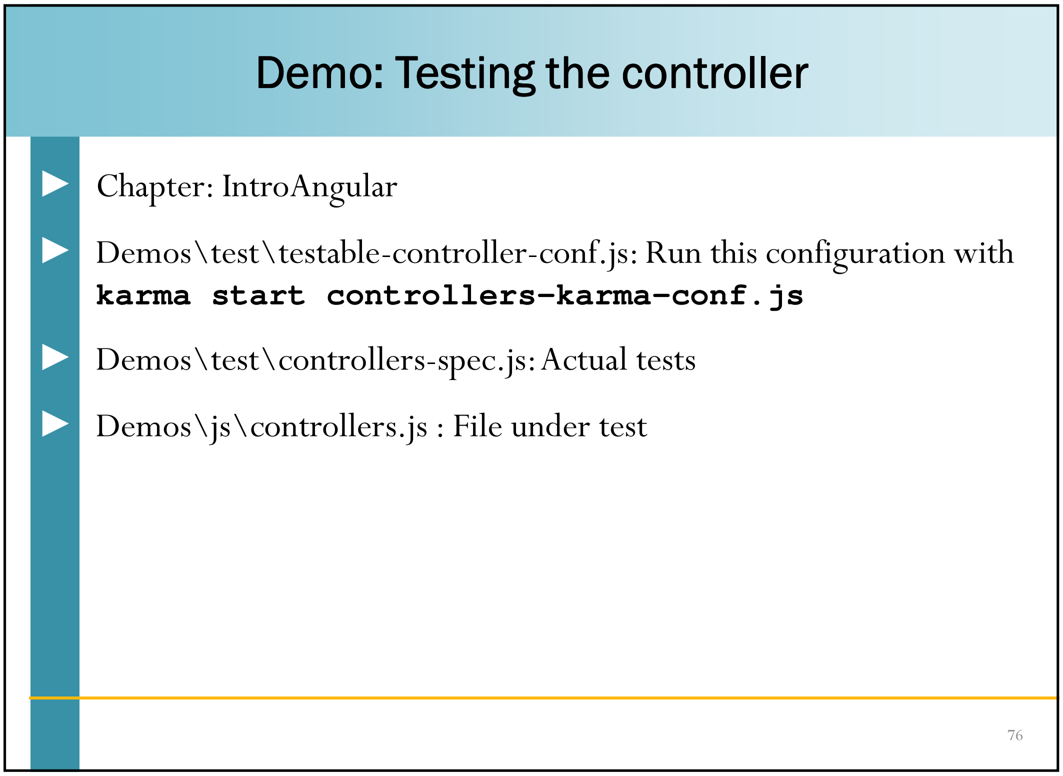

Demo: Testing the controller

- Chapter: IntroAngular
- Demos\test\testable-controller-conf.js: Run this configuration with **`karma start controllers-karma-conf.js`**
- Demos\test\controllers-spec.js: Actual tests
- Demos\js\controllers.js : File under test

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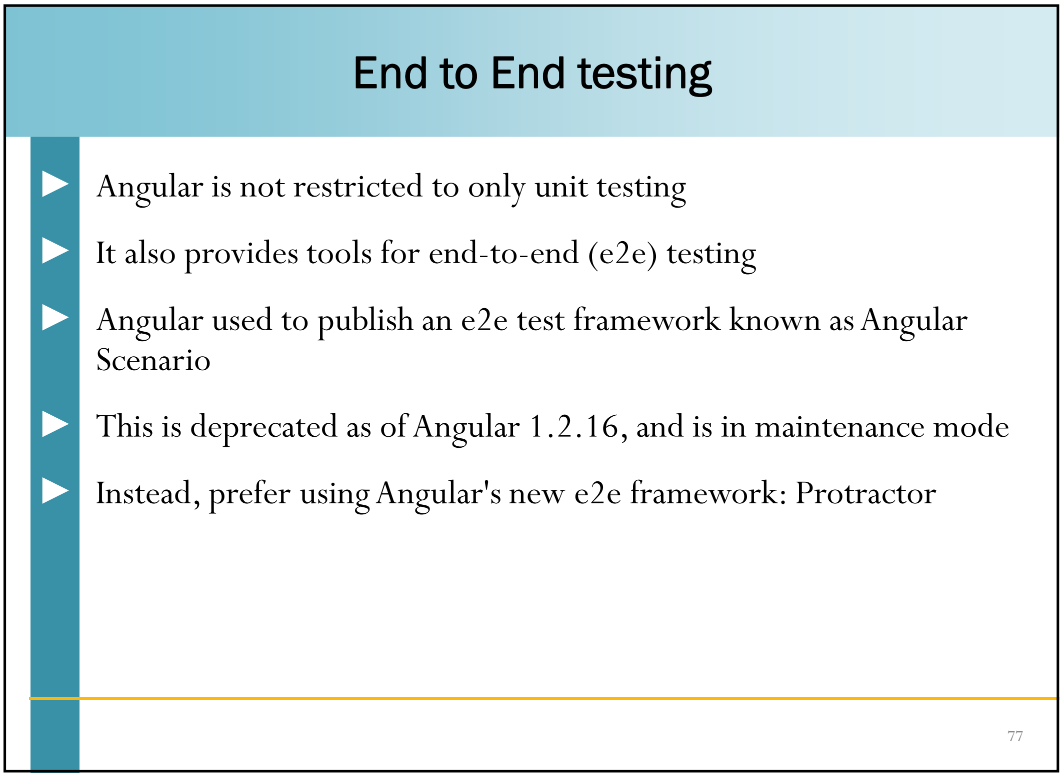
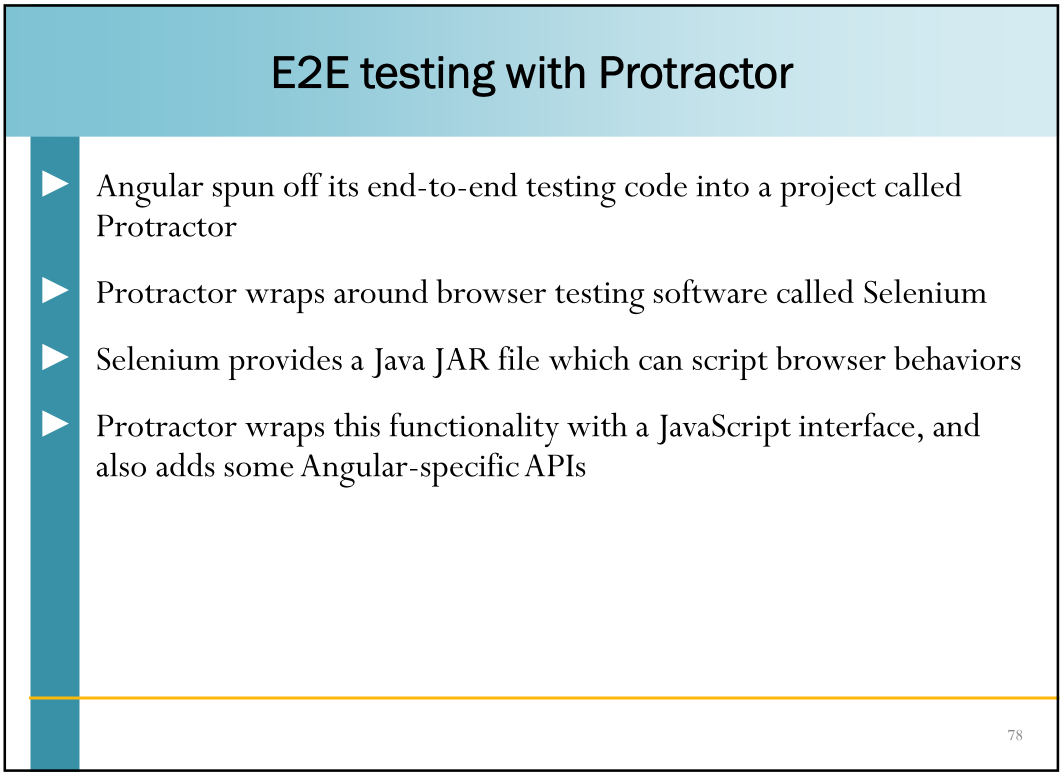


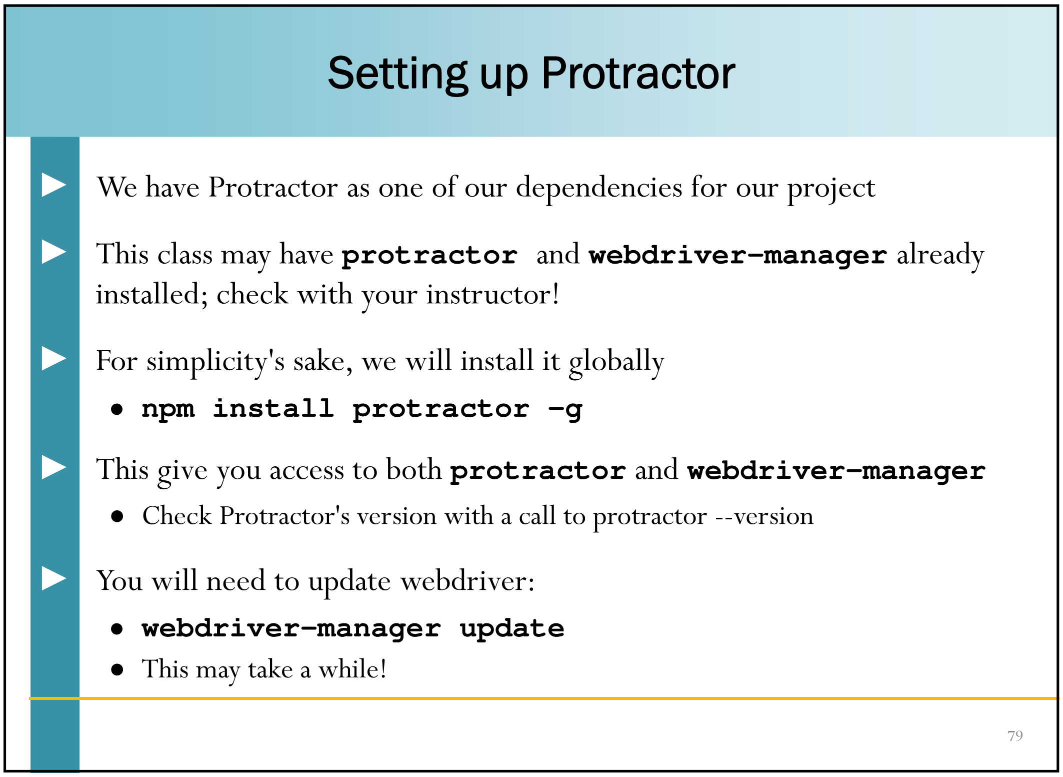
End to End testing

- Angular is not restricted to only unit testing
- It also provides tools for end-to-end (e2e) testing
- Angular used to publish an e2e test framework known as Angular Scenario
- This is deprecated as of Angular 1.2.16, and is in maintenance mode
- Instead, prefer using Angular's new e2e framework: Protractor



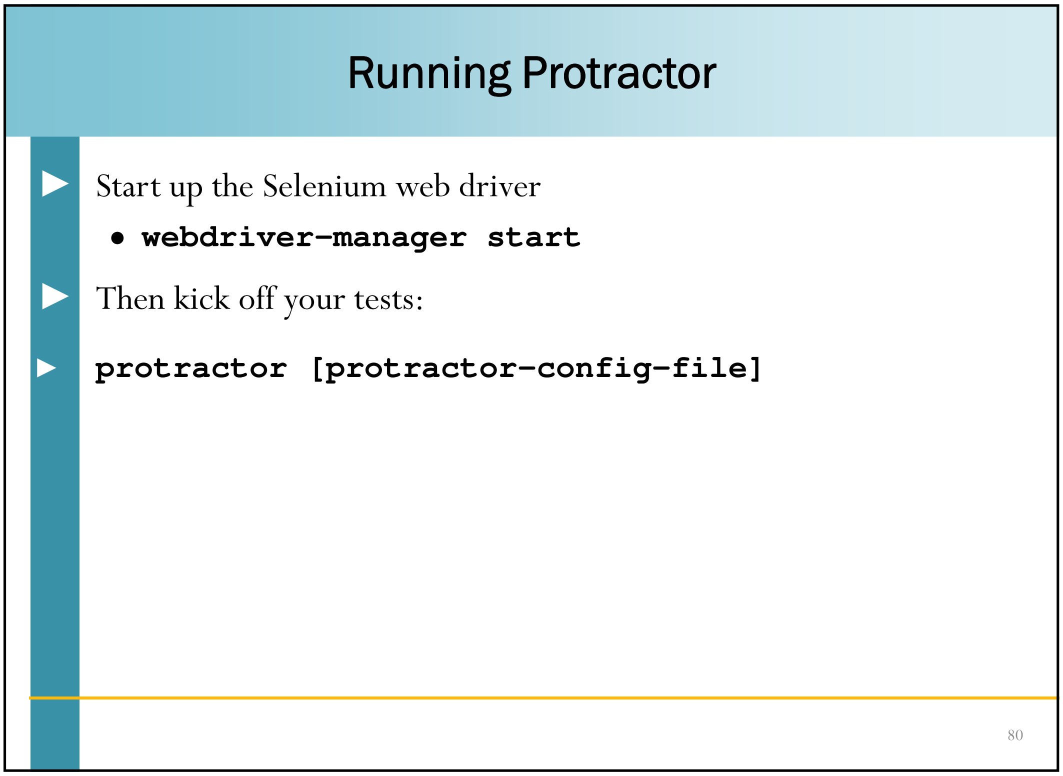
E2E testing with Protractor

- Angular spun off its end-to-end testing code into a project called Protractor
- Protractor wraps around browser testing software called Selenium
- Selenium provides a Java JAR file which can script browser behaviors
- Protractor wraps this functionality with a JavaScript interface, and also adds some Angular-specific APIs



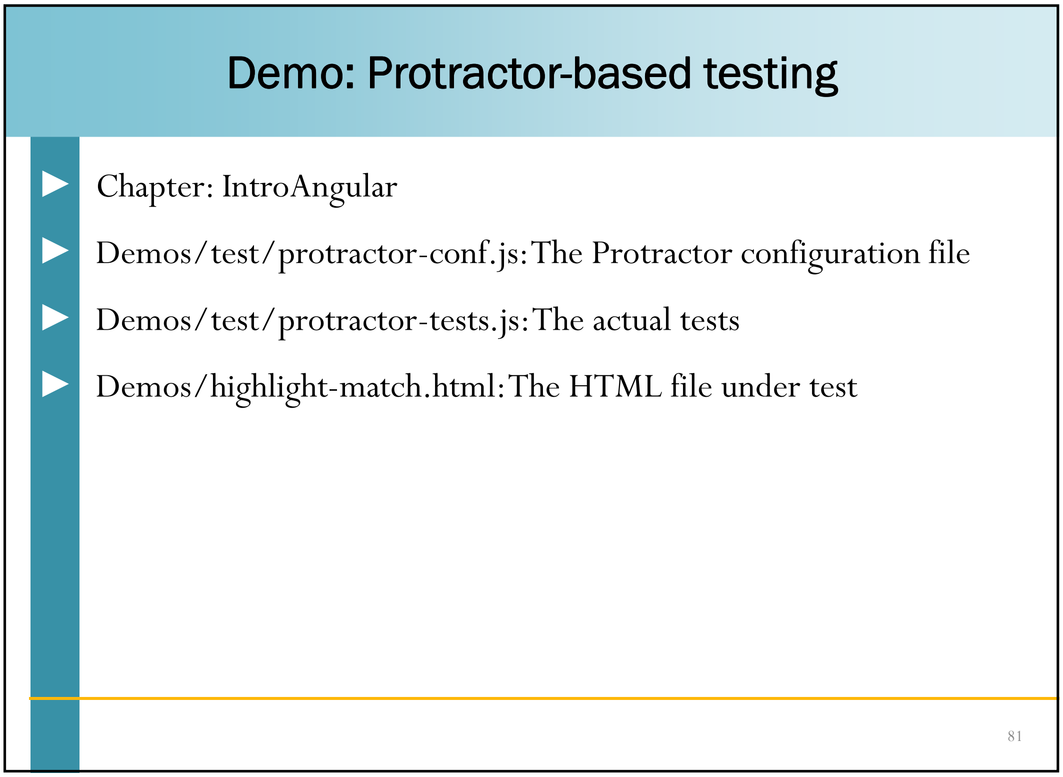
Setting up Protractor

- We have Protractor as one of our dependencies for our project
- This class may have **`protractor`** and **`webdriver-manager`** already installed; check with your instructor!
- For simplicity's sake, we will install it globally
  - **`npm install protractor -g`**
- This give you access to both **`protractor`** and **`webdriver-manager`**
  - Check Protractor's version with a call to protractor --version
- You will need to update webdriver:
  - **`webdriver-manager update`**
  - This may take a while!



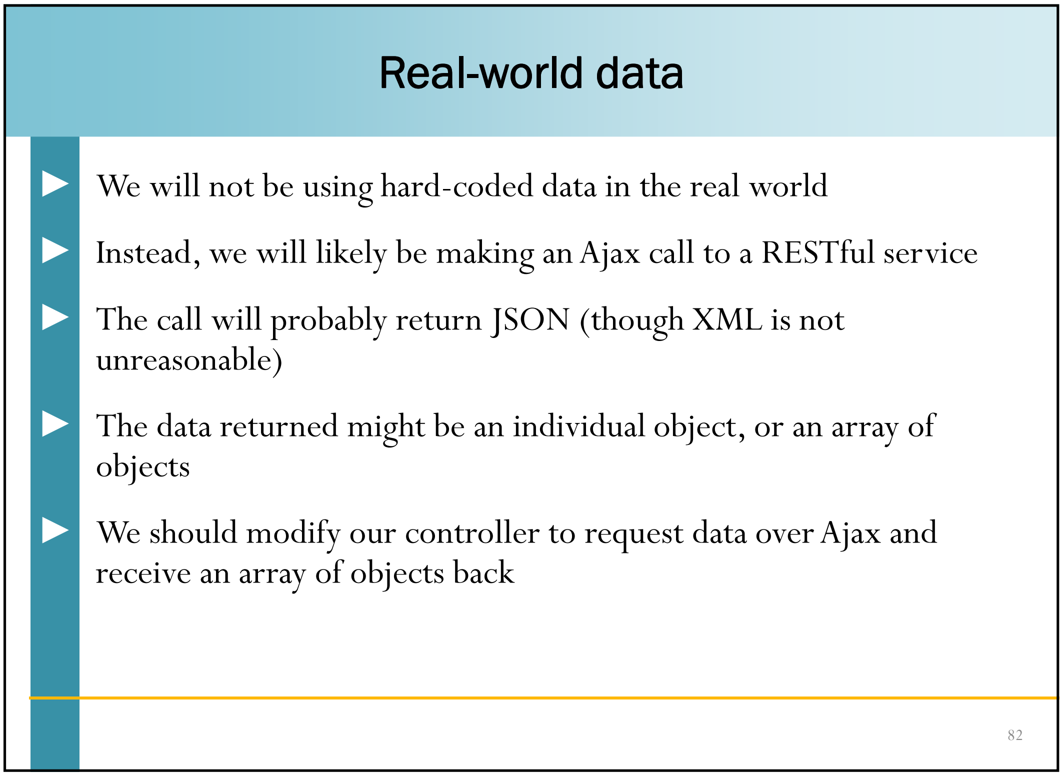
Running Protractor

- Start up the Selenium web driver
  - **`webdriver-manager start`**
- Then kick off your tests:
- **`protractor [protractor-config-file]`**



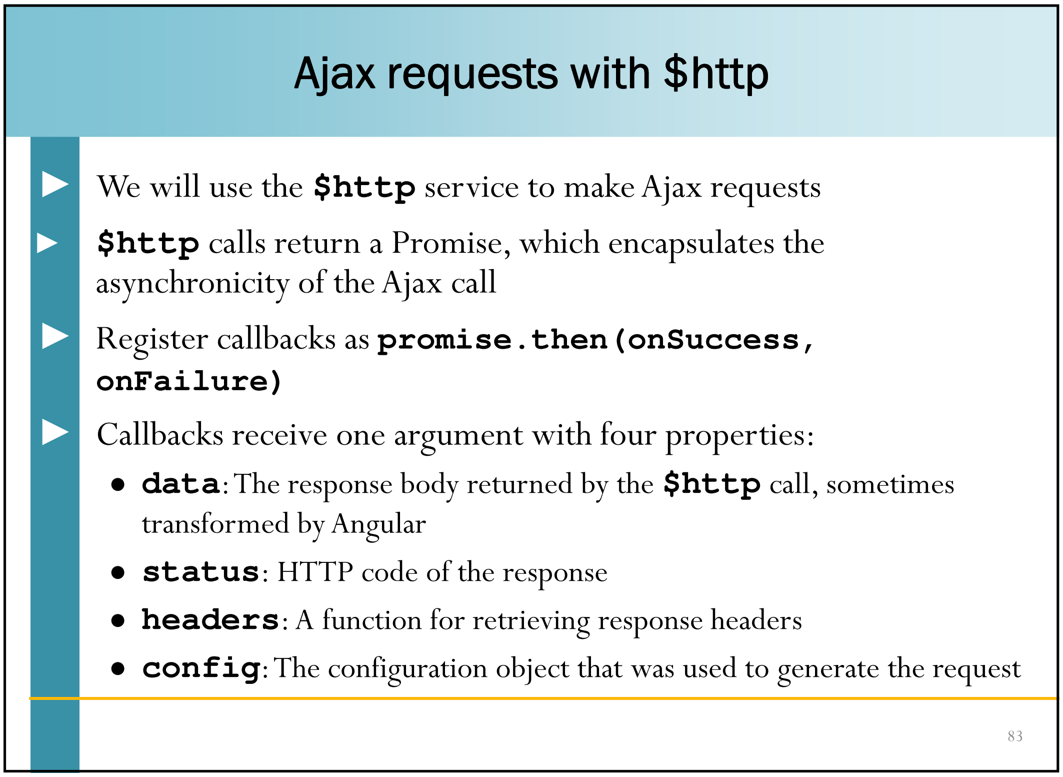
Demo: Protractor-based testing

- Chapter: IntroAngular
- Demos/test/protractor-conf.js: The Protractor configuration file
- Demos/test/protractor-tests.js: The actual tests
- Demos/highlight-match.html: The HTML file under test



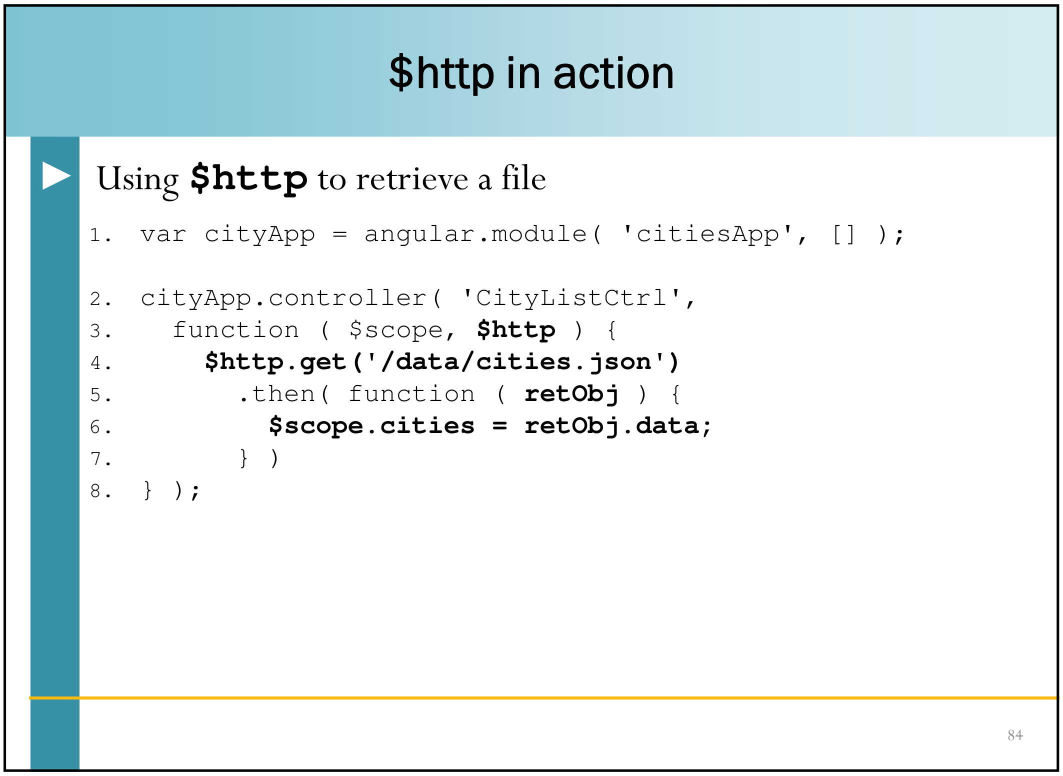
Real-world data

- We will not be using hard-coded data in the real world
- Instead, we will likely be making an Ajax call to a RESTful service
- The call will probably return JSON (though XML is not unreasonable)
- The data returned might be an individual object, or an array of objects
- We should modify our controller to request data over Ajax and receive an array of objects back



Ajax requests with $http

- We will use the **`$http`** service to make Ajax requests
- **`$http`** calls return a Promise, which encapsulates the asynchronicity of the Ajax call
- Register callbacks as **`promise.then(onSuccess, onFailure)`**
- Callbacks receive one argument with four properties:
  - **`data`**: The response body returned by the **`$http`** call, sometimes transformed by Angular
  - **`status`**: HTTP code of the response
  - **`headers`**: A function for retrieving response headers
  - **`config`**: The configuration object that was used to generate the request

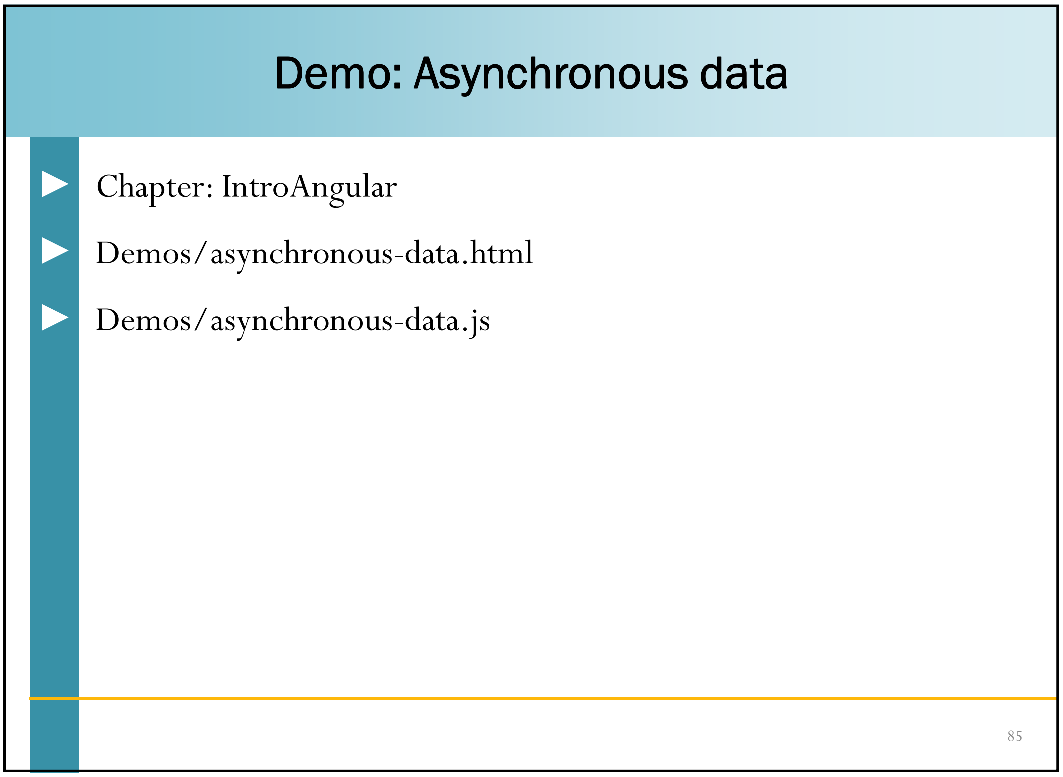


$http in action

- Using **`$http`** to retrieve a file

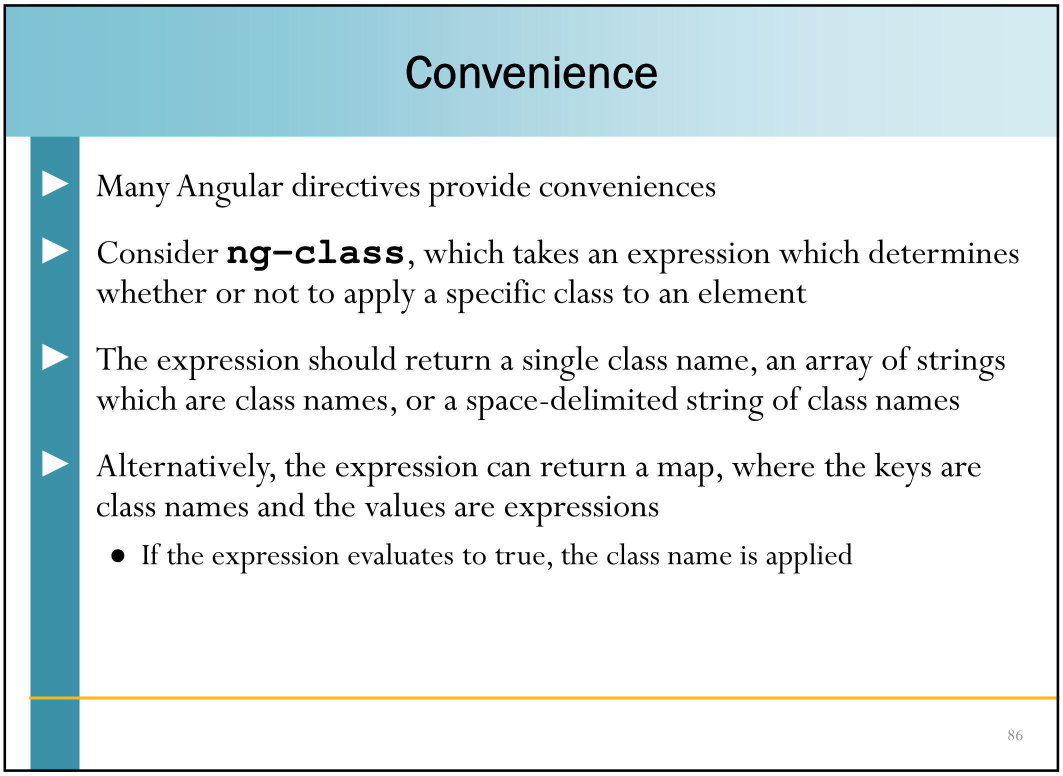
```
var cityApp = angular.module( 'citiesApp', [] );

cityApp.controller( 'CityListCtrl',
  function ( $scope, $http ) {
    $http.get('/data/cities.json')
      .then( function ( retObj ) {
        $scope.cities = retObj.data;
      } )
} );
```



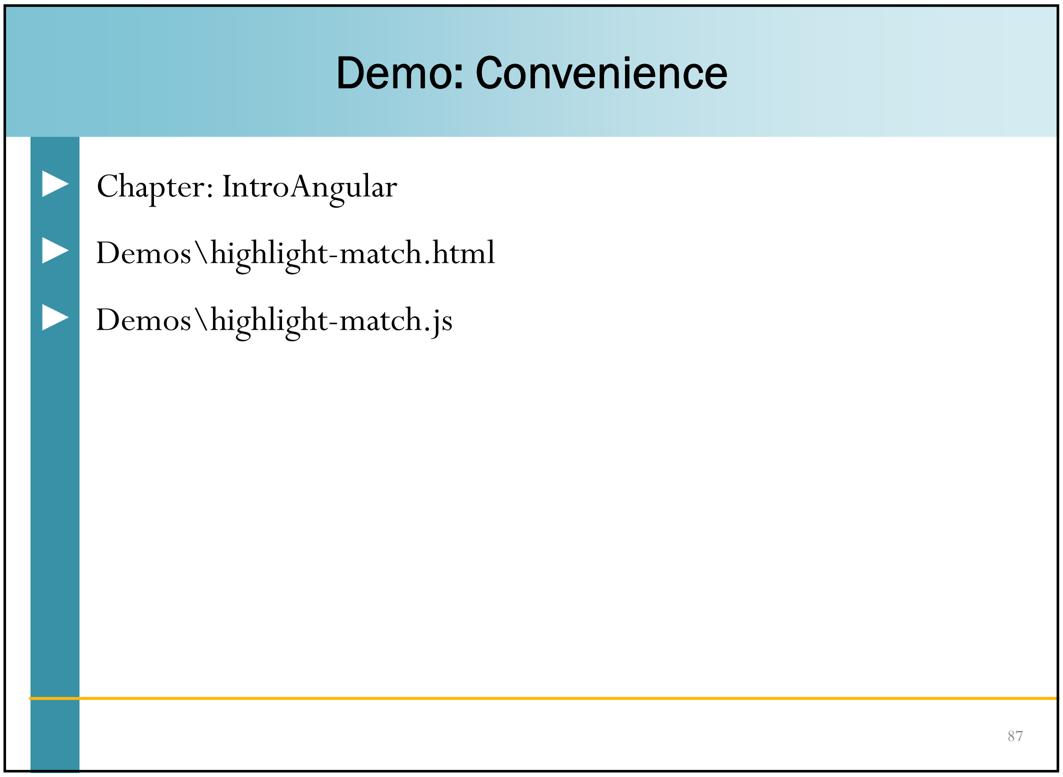
Demo: Asynchronous data

- Chapter: IntroAngular
- Demos/asynchronous-data.html
- Demos/asynchronous-data.js



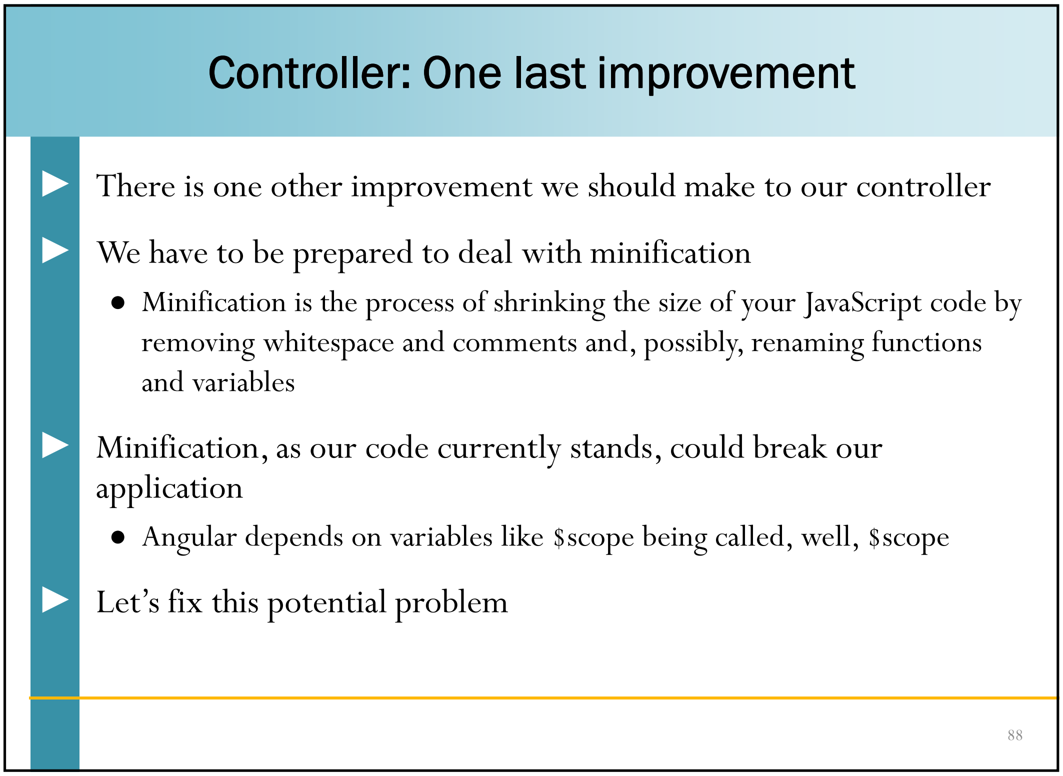
Convenience

- Many Angular directives provide conveniences
- Consider **`ng-class`**, which takes an expression which determines whether or not to apply a specific class to an element
- The expression should return a single class name, an array of strings which are class names, or a space-delimited string of class names
- Alternatively, the expression can return a map, where the keys are class names and the values are expressions
  - If the expression evaluates to true, the class name is applied



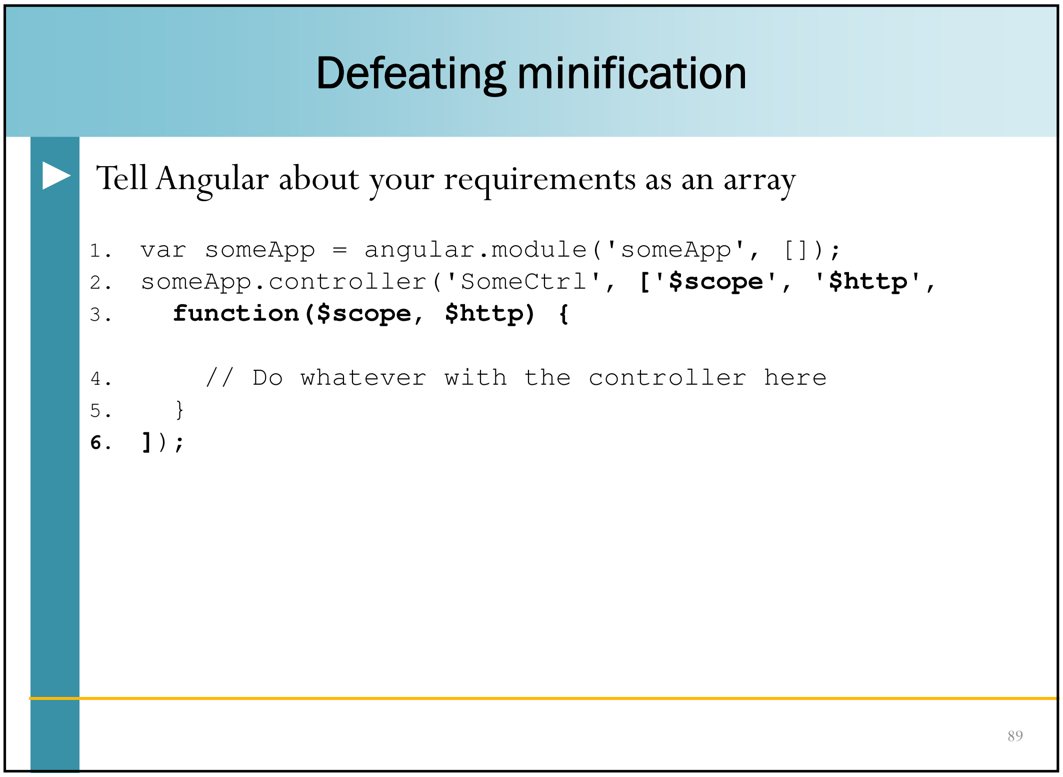
Demo: Convenience

- Chapter: IntroAngular
- Demos\highlight-match.html
- Demos\highlight-match.js



Controller: One last improvement

- There is one other improvement we should make to our controller
- We have to be prepared to deal with minification
  - Minification is the process of shrinking the size of your JavaScript code by removing whitespace and comments and, possibly, renaming functions and variables
- Minification, as our code currently stands, could break our application
  - Angular depends on variables like $scope being called, well, $scope
- Let’s fix this potential problem

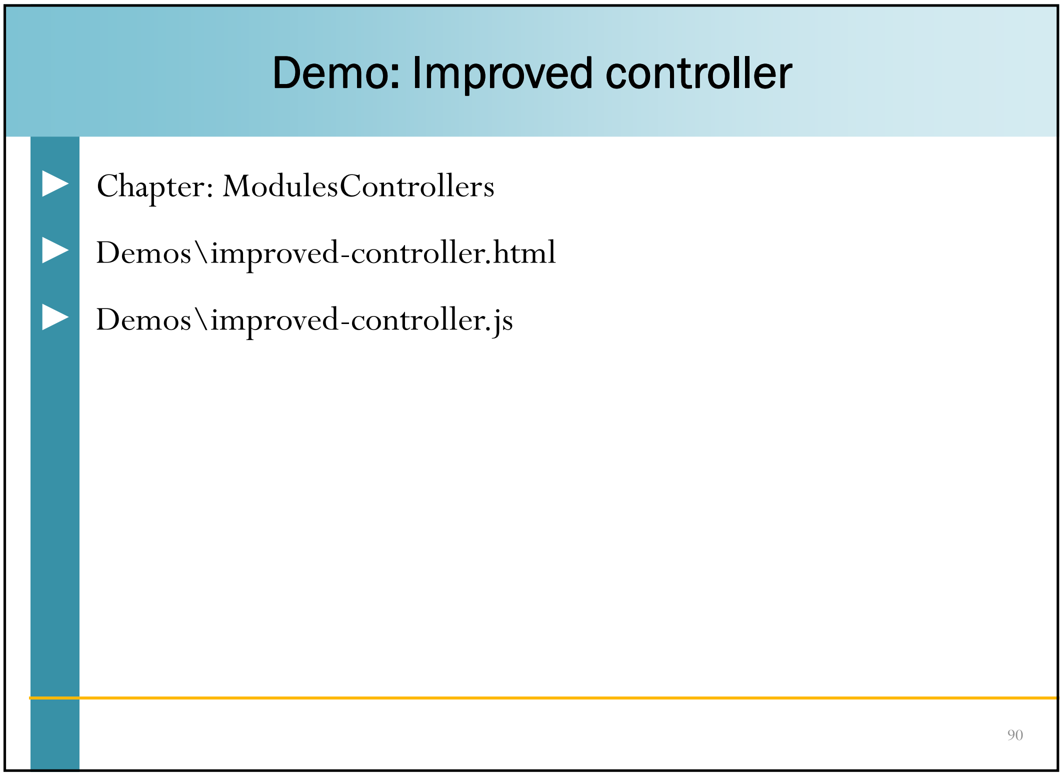


Defeating minification

- Tell Angular about your requirements as an array

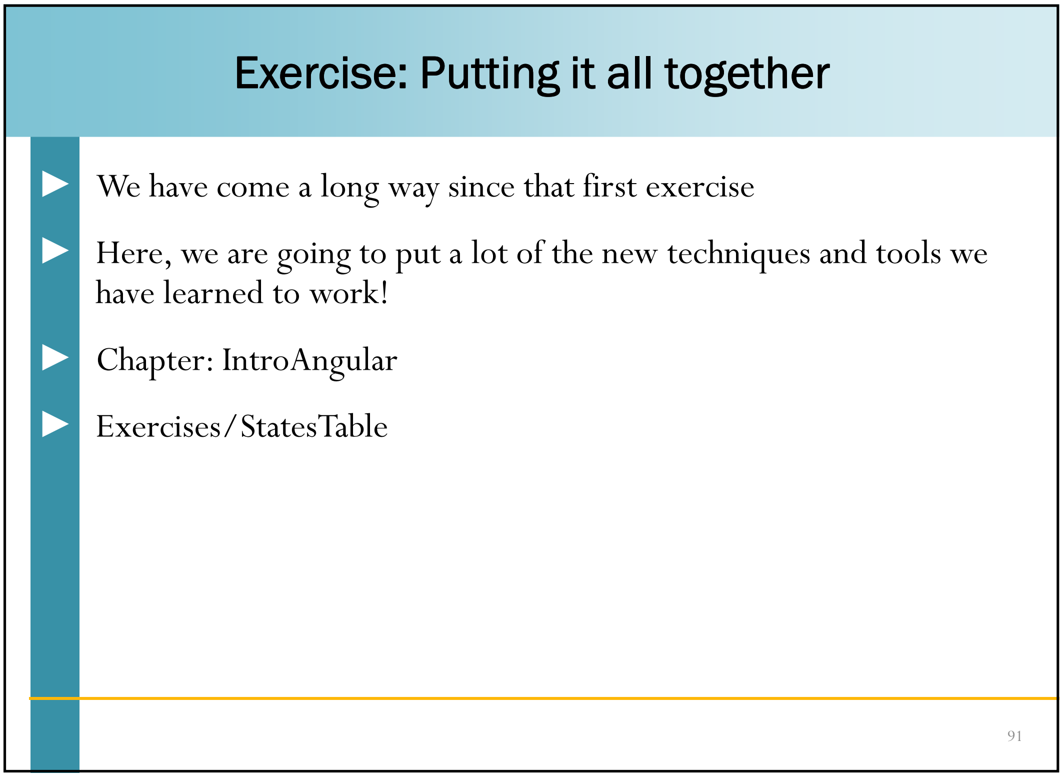
```
var someApp = angular.module('someApp', []);
someApp.controller('SomeCtrl', ['$scope', '$http',
  function($scope, $http) {

    // Do whatever with the controller here
  }
]);
```



Demo: Improved controller

- Chapter: ModulesControllers
- Demos\improved-controller.html
- Demos\improved-controller.js



Exercise: Putting it all together

- We have come a long way since that first exercise
- Here, we are going to put a lot of the new techniques and tools we have learned to work!
- Chapter: IntroAngular
- Exercises/StatesTable

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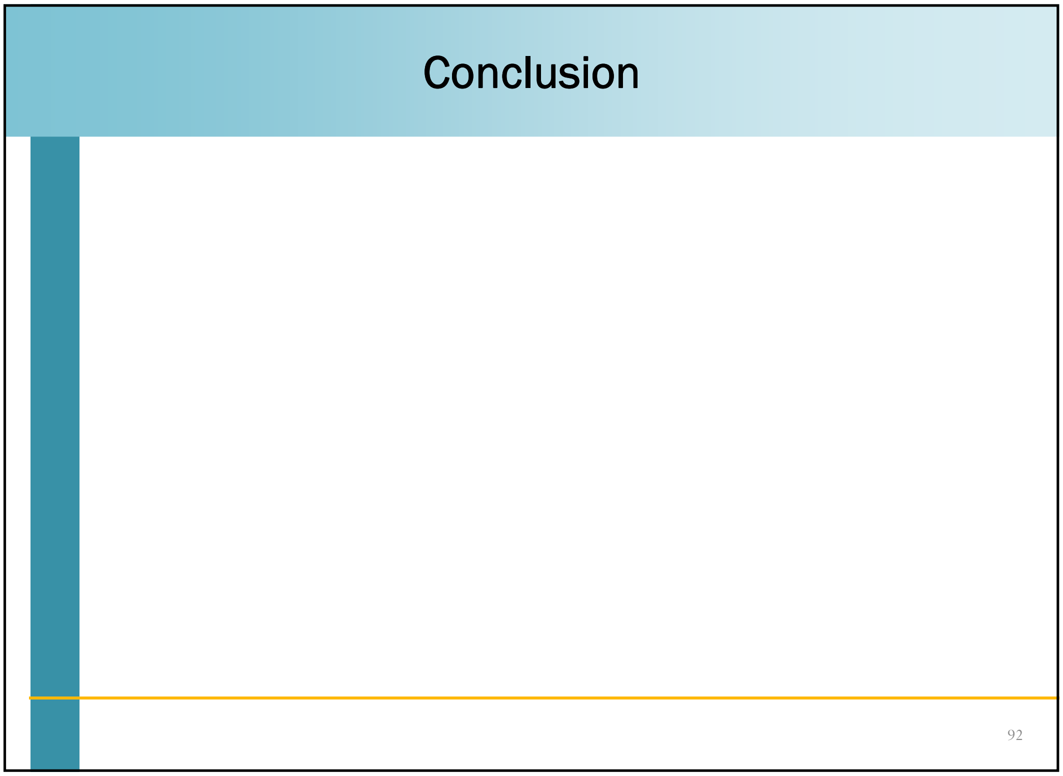

Conclusion

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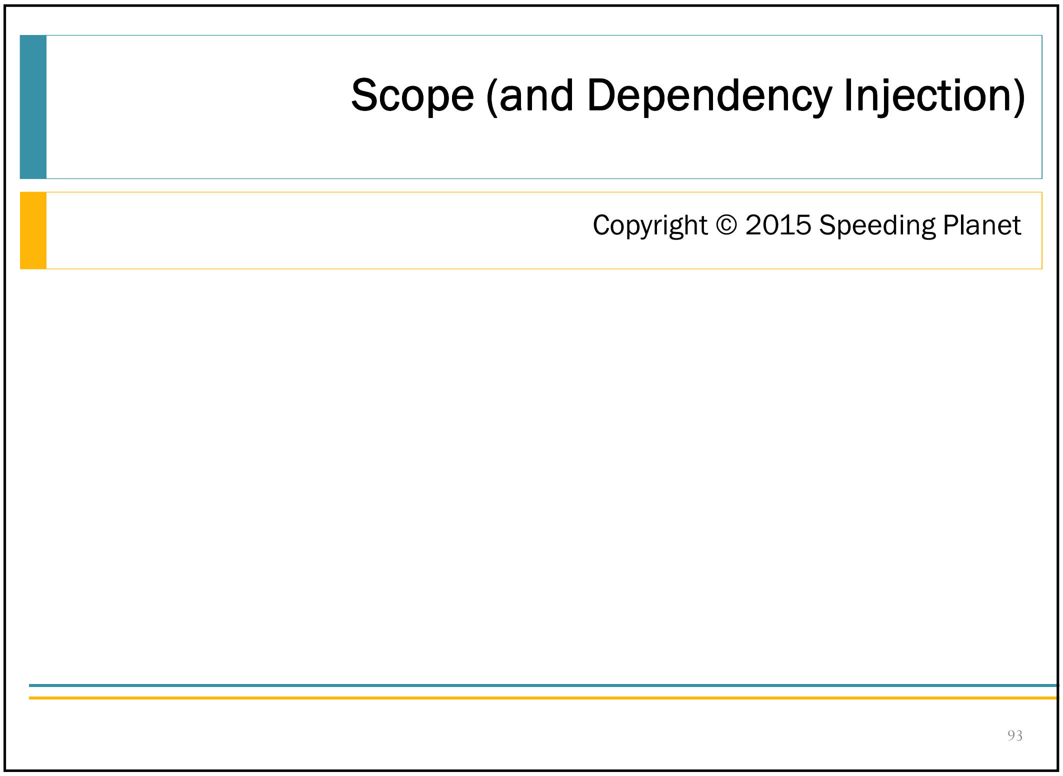

Scope (and Dependency Injection)

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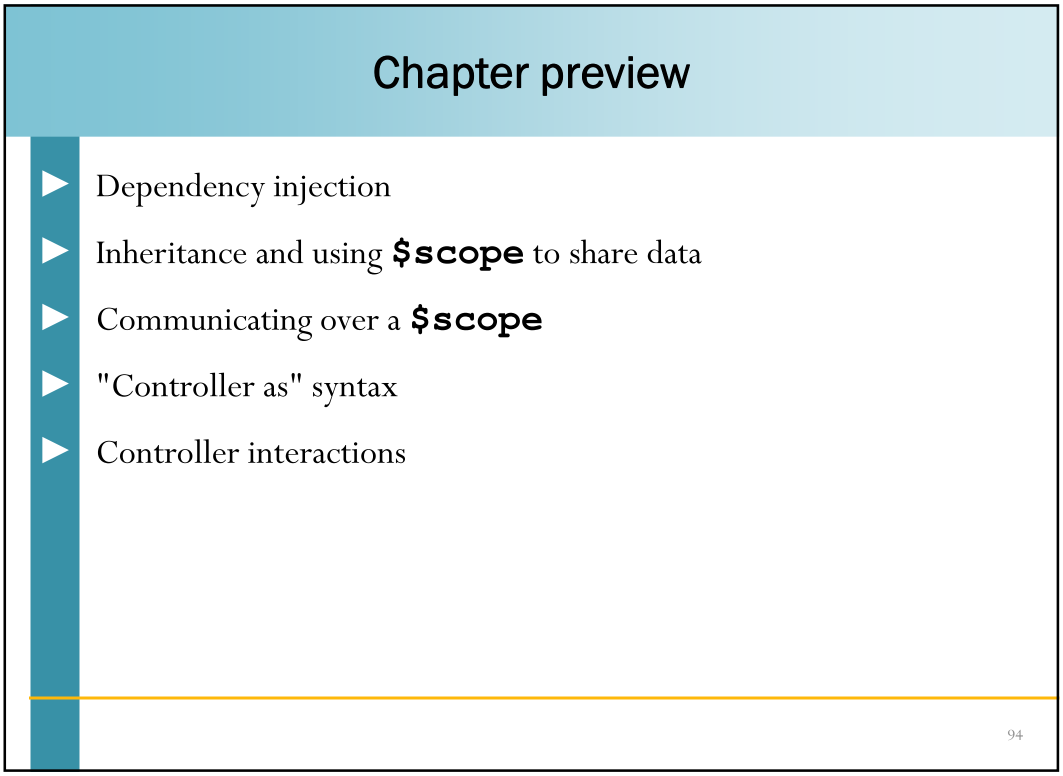

Chapter preview

- Dependency injection
- Inheritance and using **`$scope`** to share data
- Communicating over a **`$scope`**
- "Controller as" syntax
- Controller interactions

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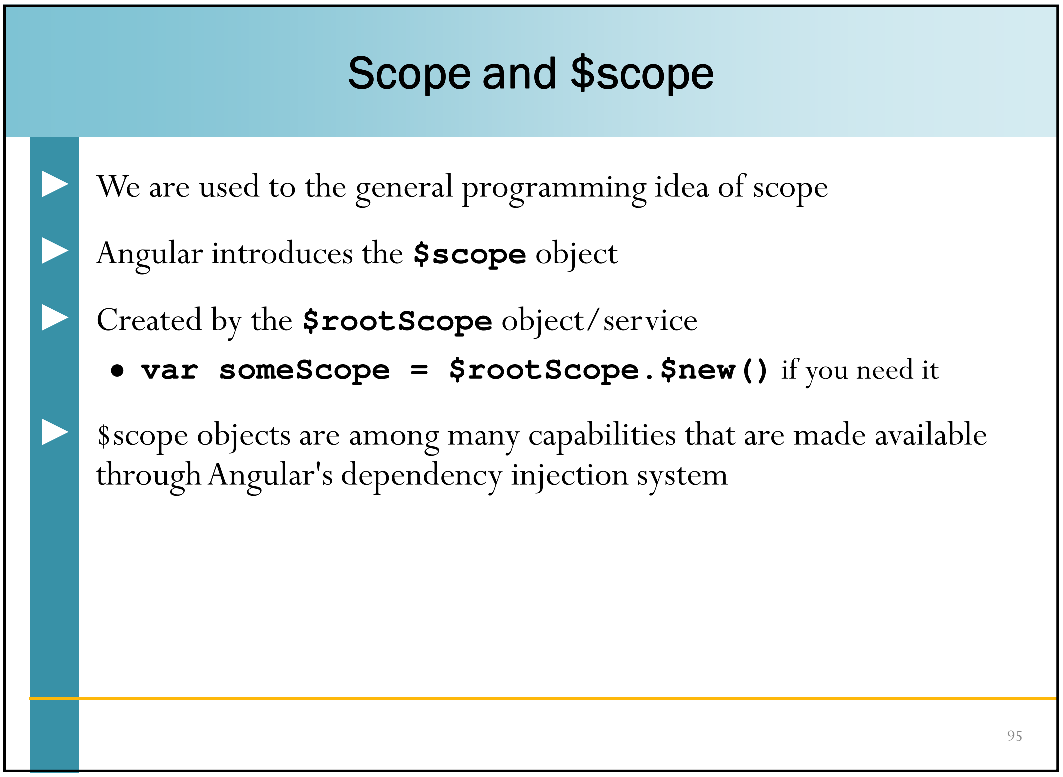
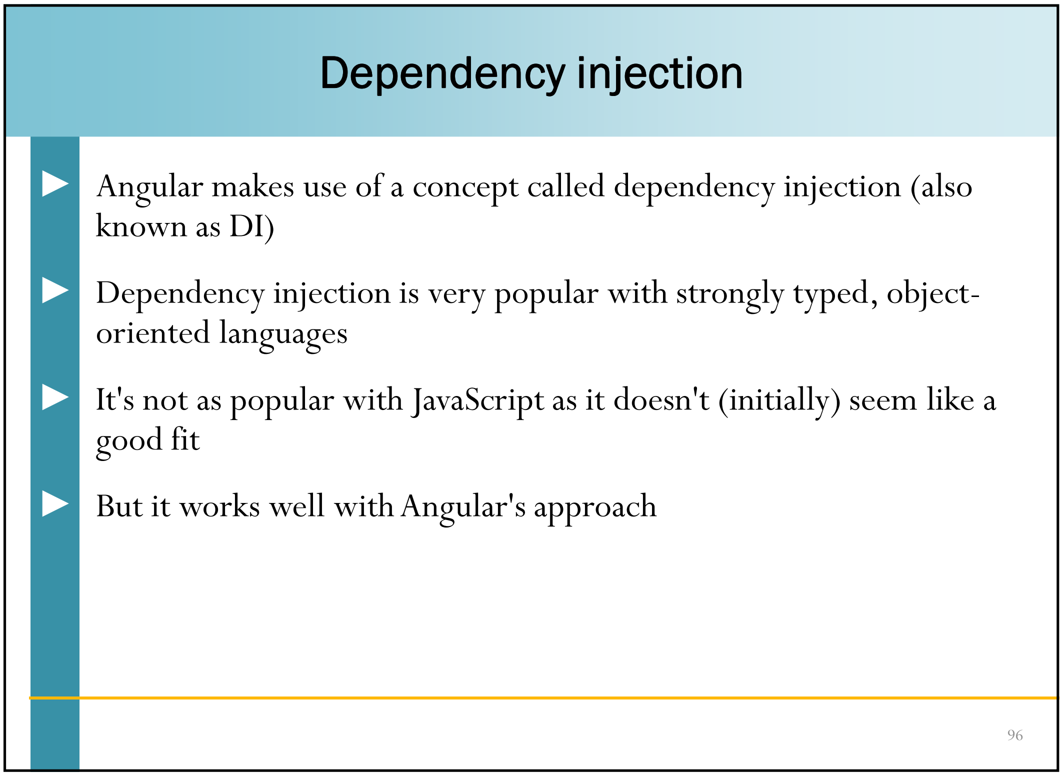


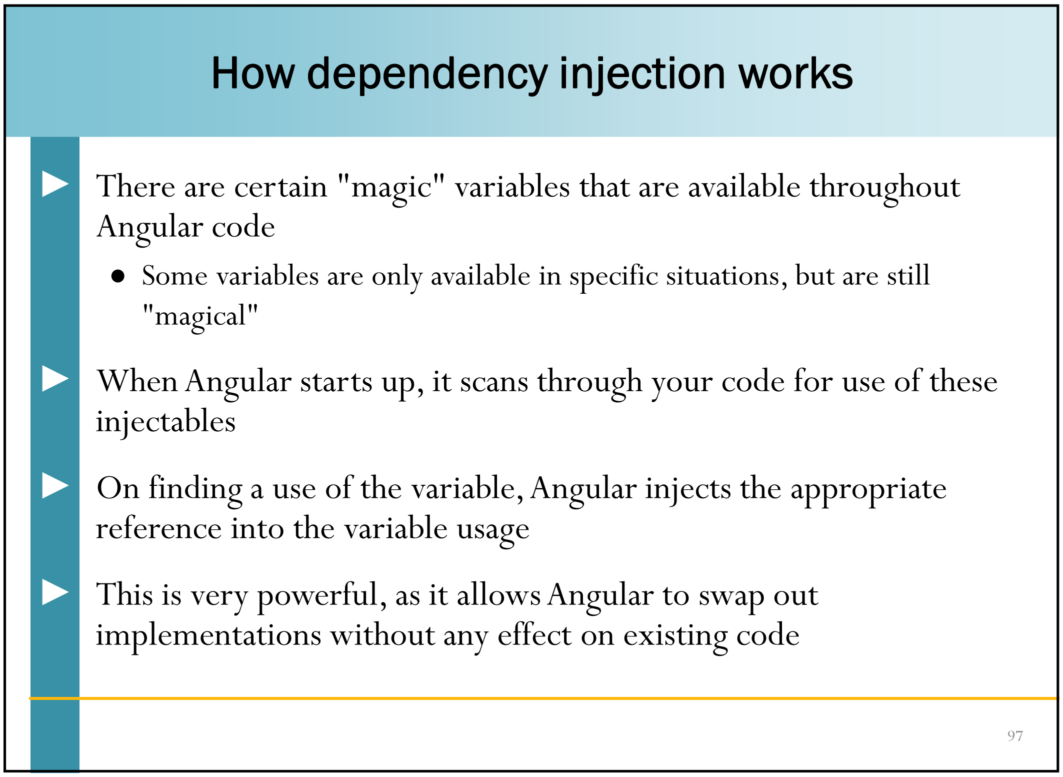
Scope and $scope

- We are used to the general programming idea of scope
- Angular introduces the **`$scope`** object
- Created by the **`$rootScope`** object/service
  - **`var someScope = $rootScope.$new()`** if you need it
- $scope objects are among many capabilities that are made available through Angular's dependency injection system



Dependency injection

- Angular makes use of a concept called dependency injection (also known as DI)
- Dependency injection is very popular with strongly typed, object-oriented languages
- It's not as popular with JavaScript as it doesn't (initially) seem like a good fit
- But it works well with Angular's approach



How dependency injection works

- There are certain "magic" variables that are available throughout Angular code
  - Some variables are only available in specific situations, but are still "magical"
- When Angular starts up, it scans through your code for use of these injectables
- On finding a use of the variable, Angular injects the appropriate reference into the variable usage
- This is very powerful, as it allows Angular to swap out implementations without any effect on existing code

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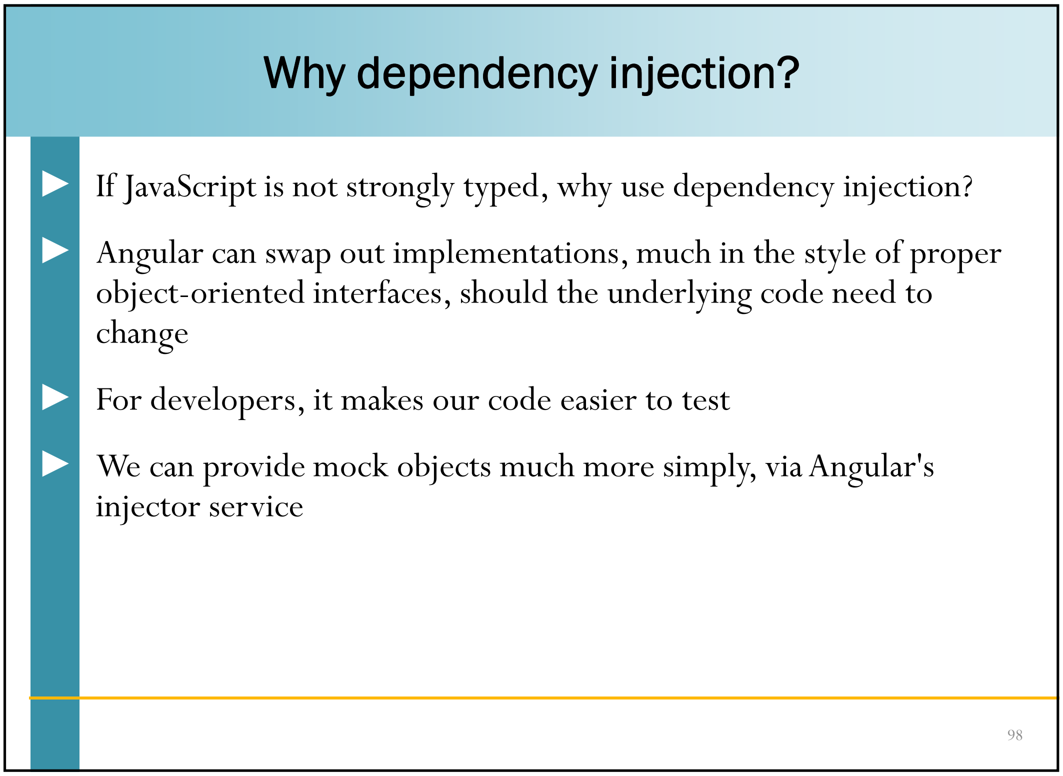

Why dependency injection?

- If JavaScript is not strongly typed, why use dependency injection?
- Angular can swap out implementations, much in the style of proper object-oriented interfaces, should the underlying code need to change
- For developers, it makes our code easier to test
- We can provide mock objects much more simply, via Angular's injector service

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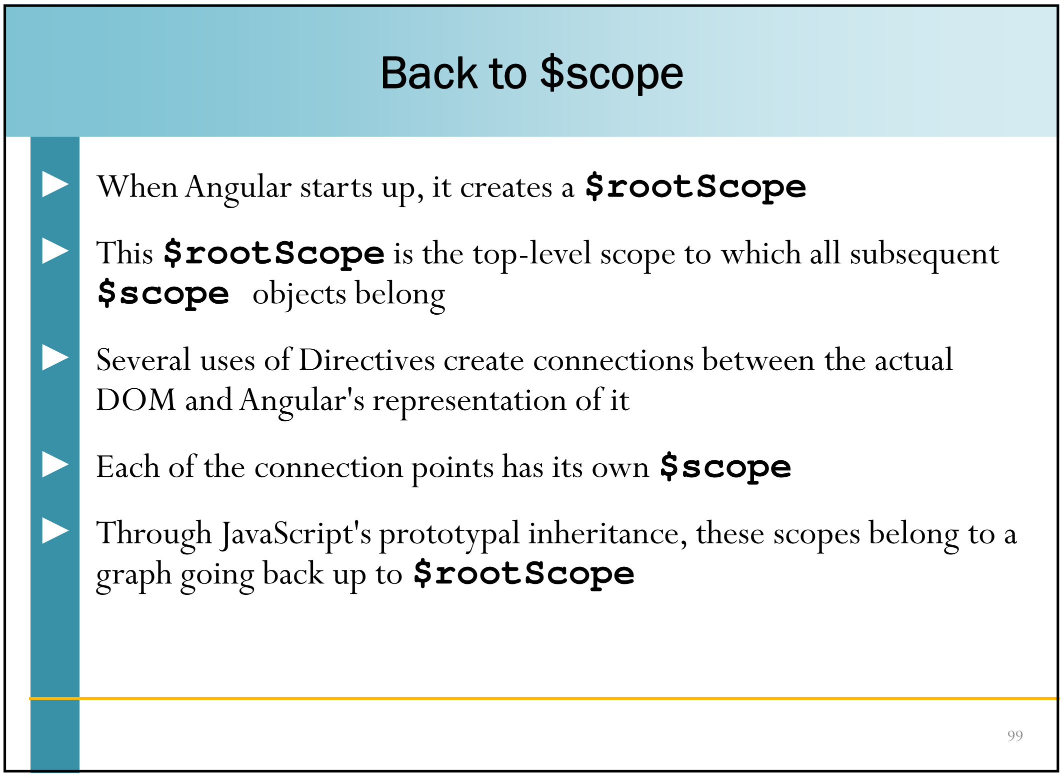

Back to $scope

- When Angular starts up, it creates a **`$rootScope`**
- This **`$rootScope`** is the top-level scope to which all subsequent **`$scope`** objects belong
- Several uses of Directives create connections between the actual DOM and Angular's representation of it
- Each of the connection points has its own **`$scope`**
- Through JavaScript's prototypal inheritance, these scopes belong to a graph going back up to **`$rootScope`**

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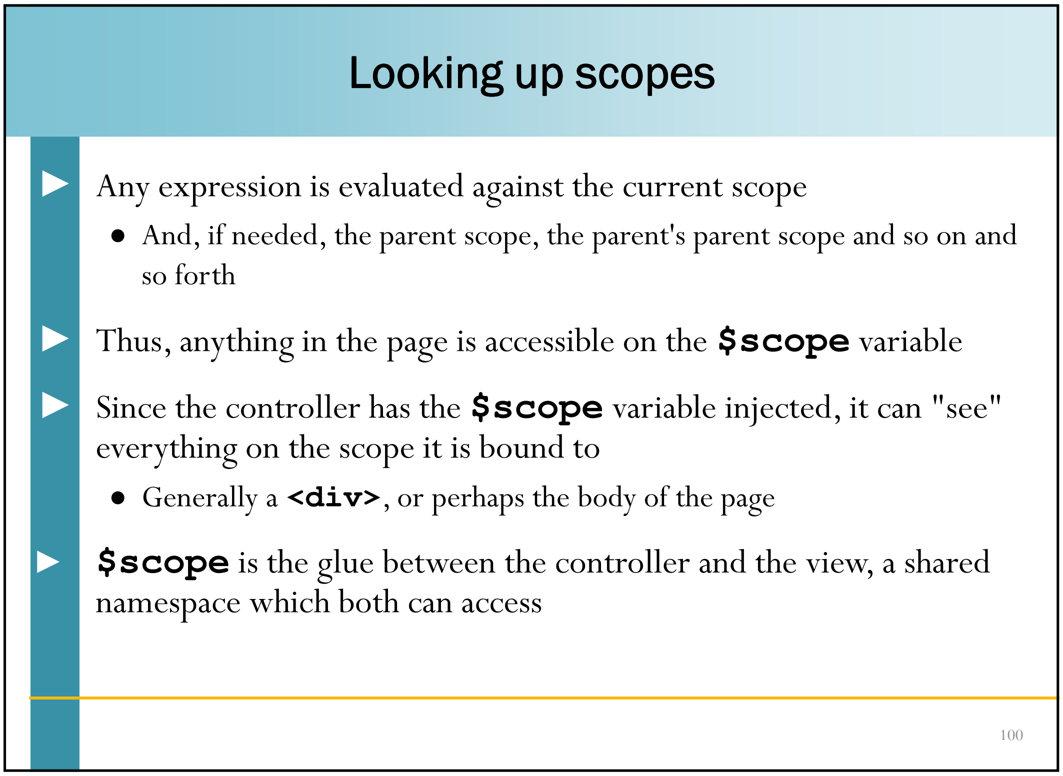

Looking up scopes

- Any expression is evaluated against the current scope
  - And, if needed, the parent scope, the parent's parent scope and so on and so forth
- Thus, anything in the page is accessible on the **`$scope`** variable
- Since the controller has the **`$scope`** variable injected, it can "see" everything on the scope it is bound to
  - Generally a **`<div>`**, or perhaps the body of the page
- **`$scope`** is the glue between the controller and the view, a shared namespace which both can access

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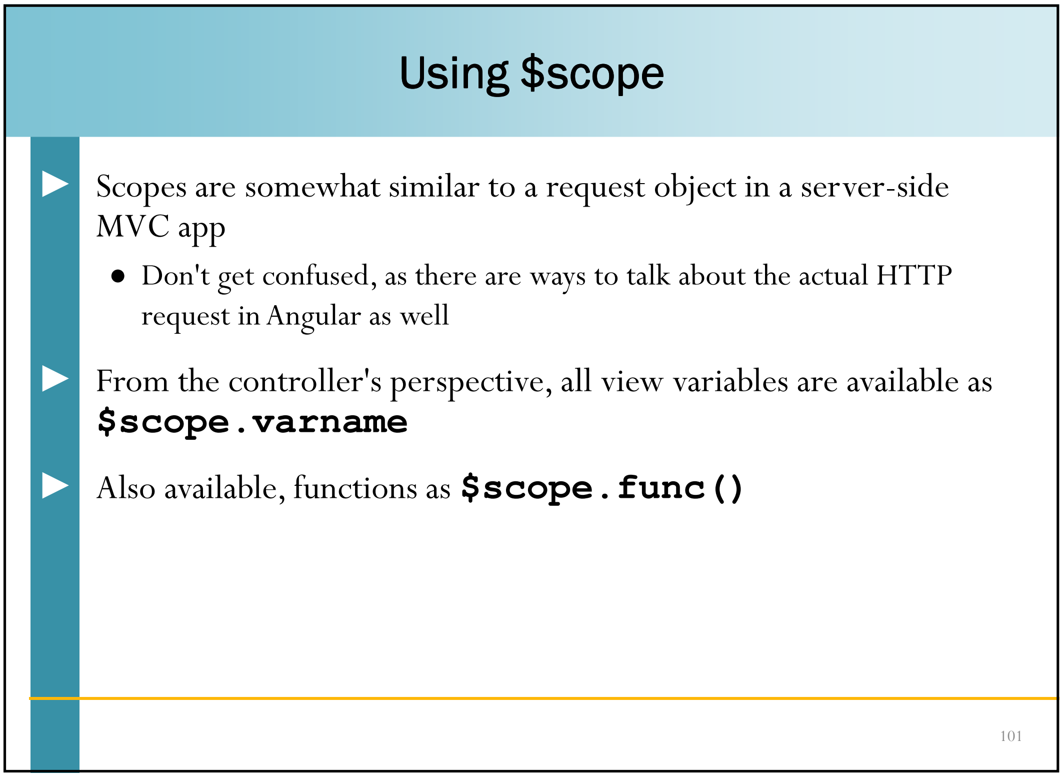
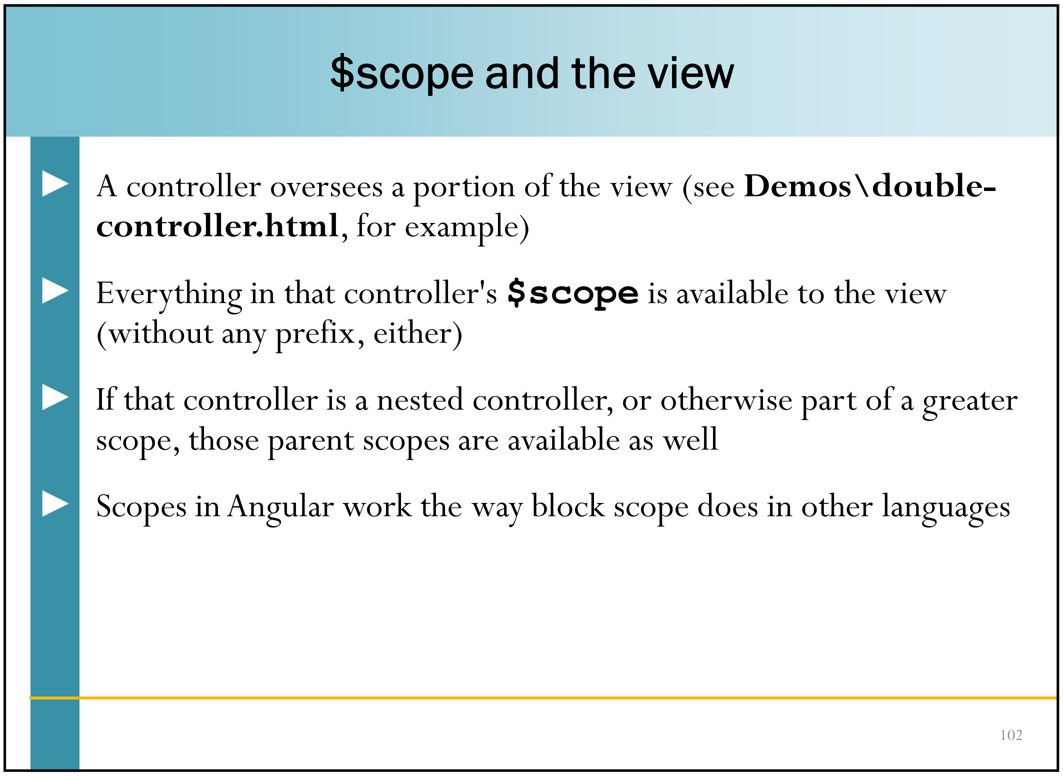


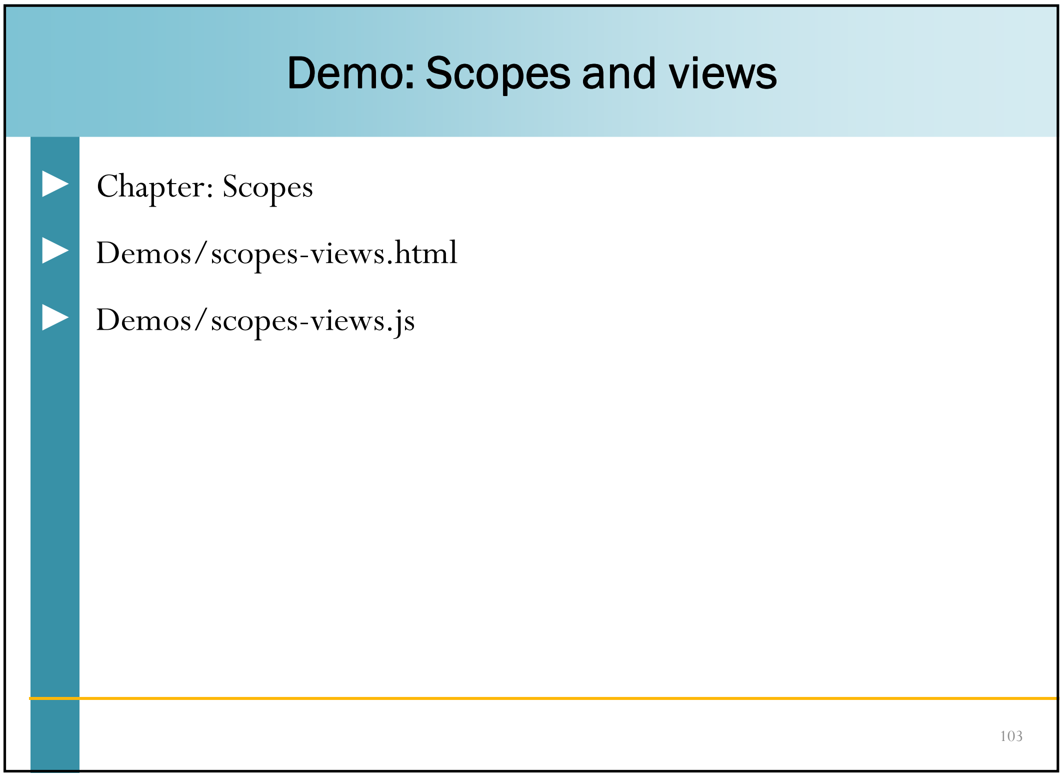
Using $scope

- Scopes are somewhat similar to a request object in a server-side MVC app
  - Don't get confused, as there are ways to talk about the actual HTTP request in Angular as well
- From the controller's perspective, all view variables are available as **`$scope.varname`**
- Also available, functions as **`$scope.func()`**



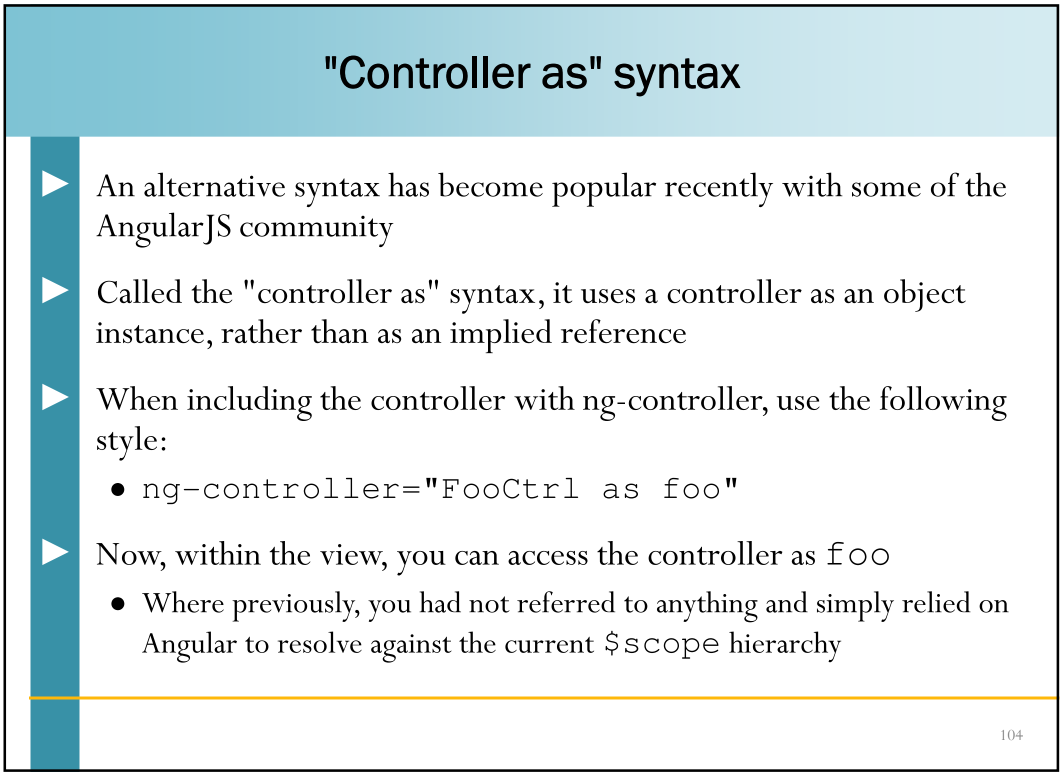
$scope and the view

- A controller oversees a portion of the view (see **Demos\double-controller.html**, for example)
- Everything in that controller's **`$scope`** is available to the view (without any prefix, either)
- If that controller is a nested controller, or otherwise part of a greater scope, those parent scopes are available as well
- Scopes in Angular work the way block scope does in other languages



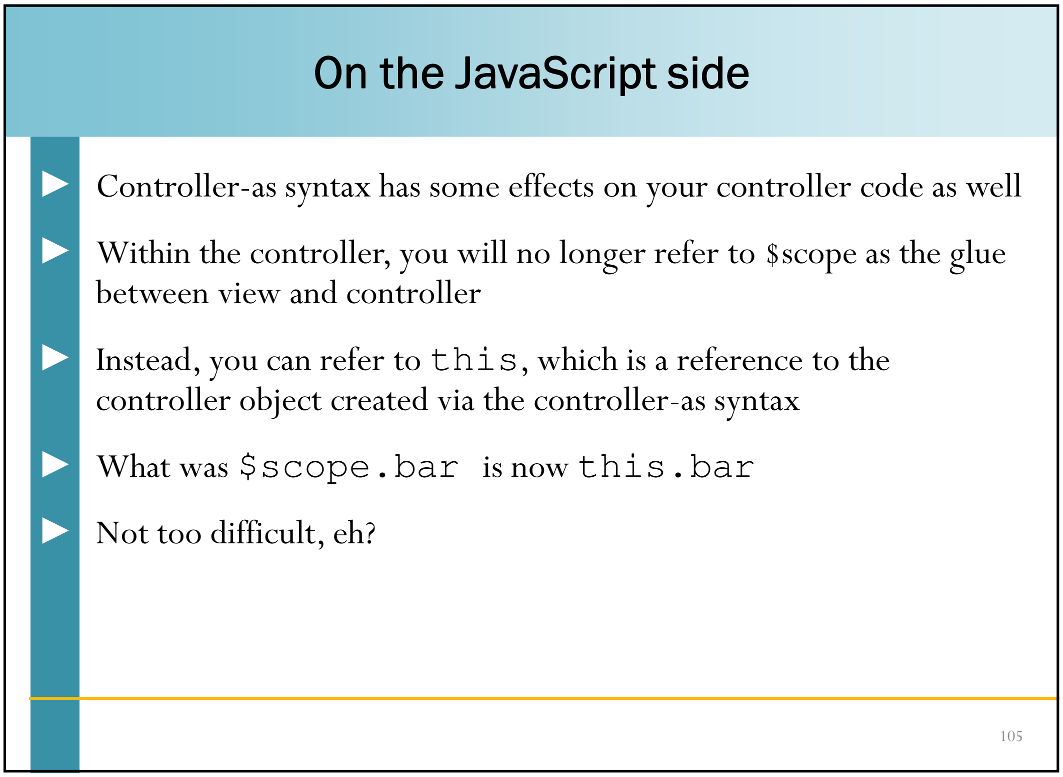
Demo: Scopes and views

- Chapter: Scopes
- Demos/scopes-views.html
- Demos/scopes-views.js



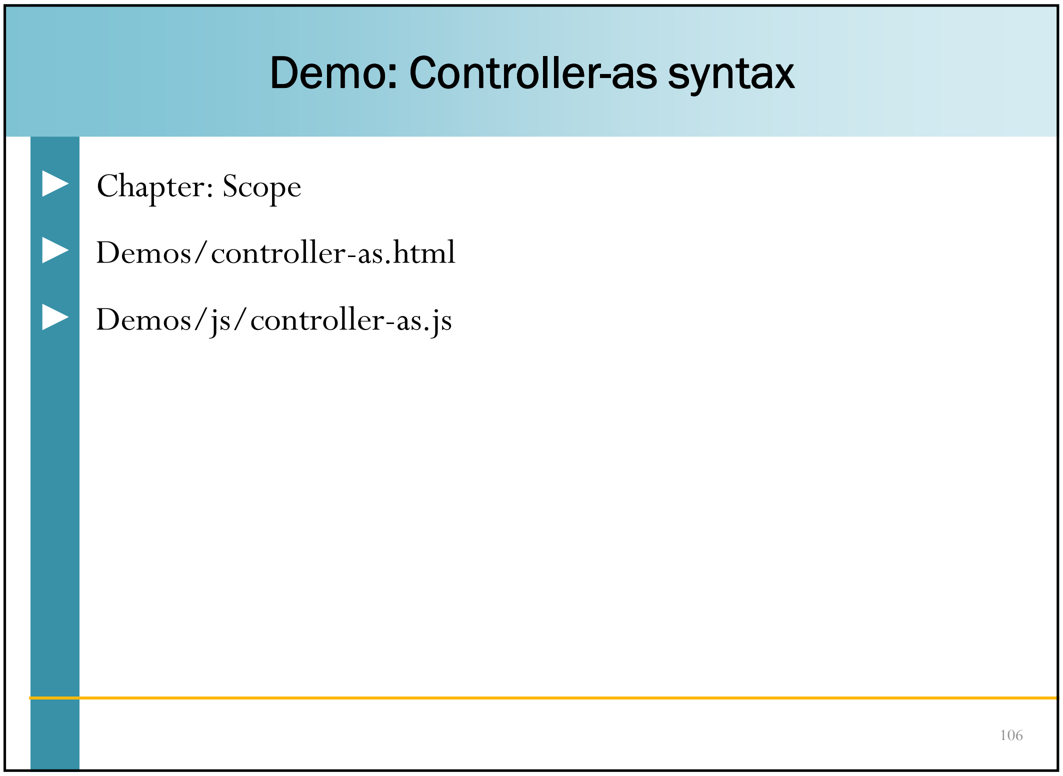
"Controller as" syntax

- An alternative syntax has become popular recently with some of the AngularJS community
- Called the "controller as" syntax, it uses a controller as an object instance, rather than as an implied reference
- When including the controller with ng-controller, use the following style:
  - `ng-controller="FooCtrl as foo"`
- Now, within the view, you can access the controller as `foo`
  - Where previously, you had not referred to anything and simply relied on Angular to resolve against the current `$scope` hierarchy



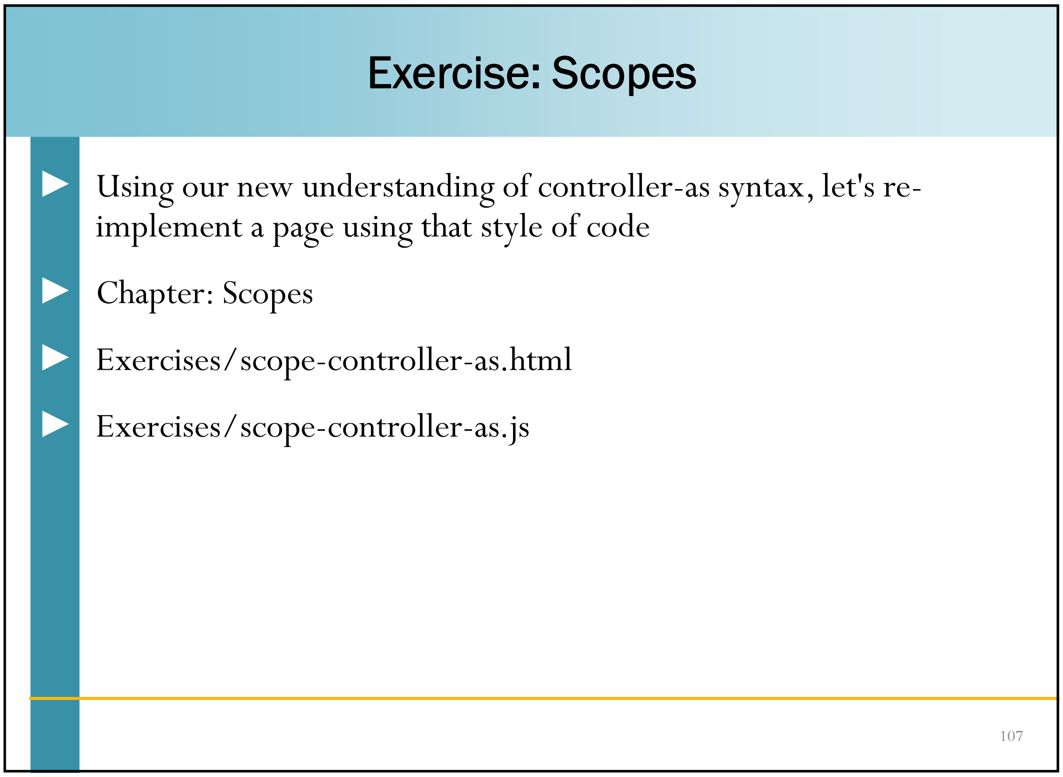
On the JavaScript side

- Controller-as syntax has some effects on your controller code as well
- Within the controller, you will no longer refer to $scope as the glue between view and controller
- Instead, you can refer to `this`, which is a reference to the controller object created via the controller-as syntax
- What was `$scope.bar` is now `this.bar`
- Not too difficult, eh?



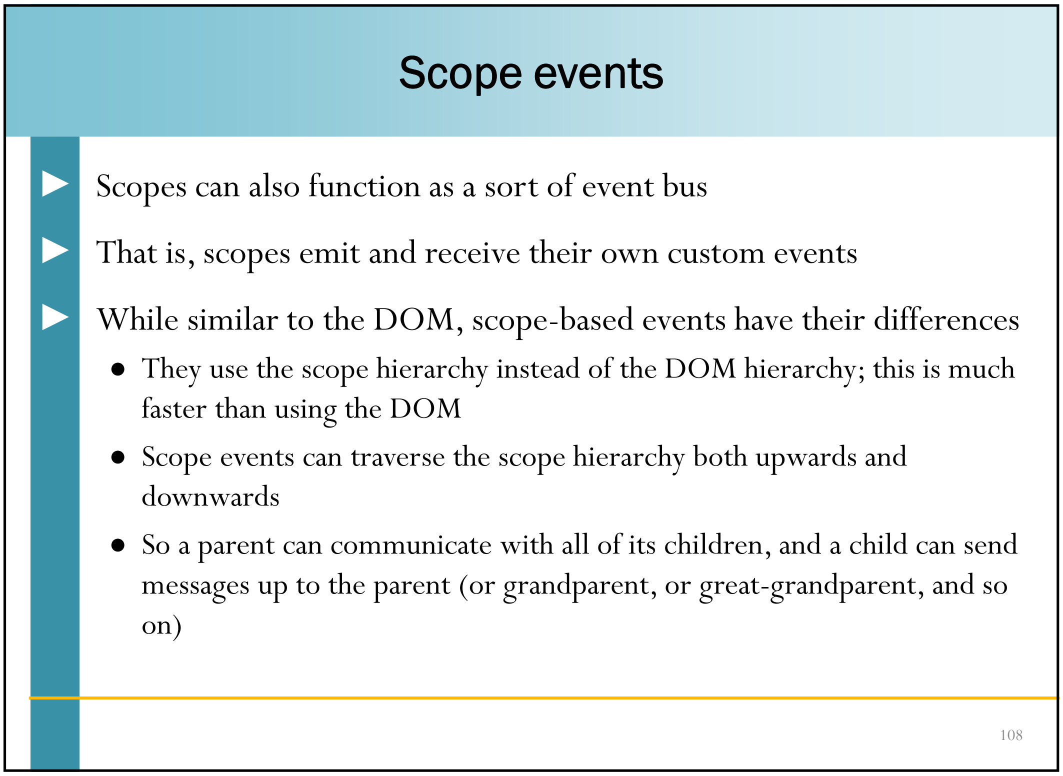
Demo: Controller-as syntax

- Chapter: Scope
- Demos/controller-as.html
- Demos/js/controller-as.js



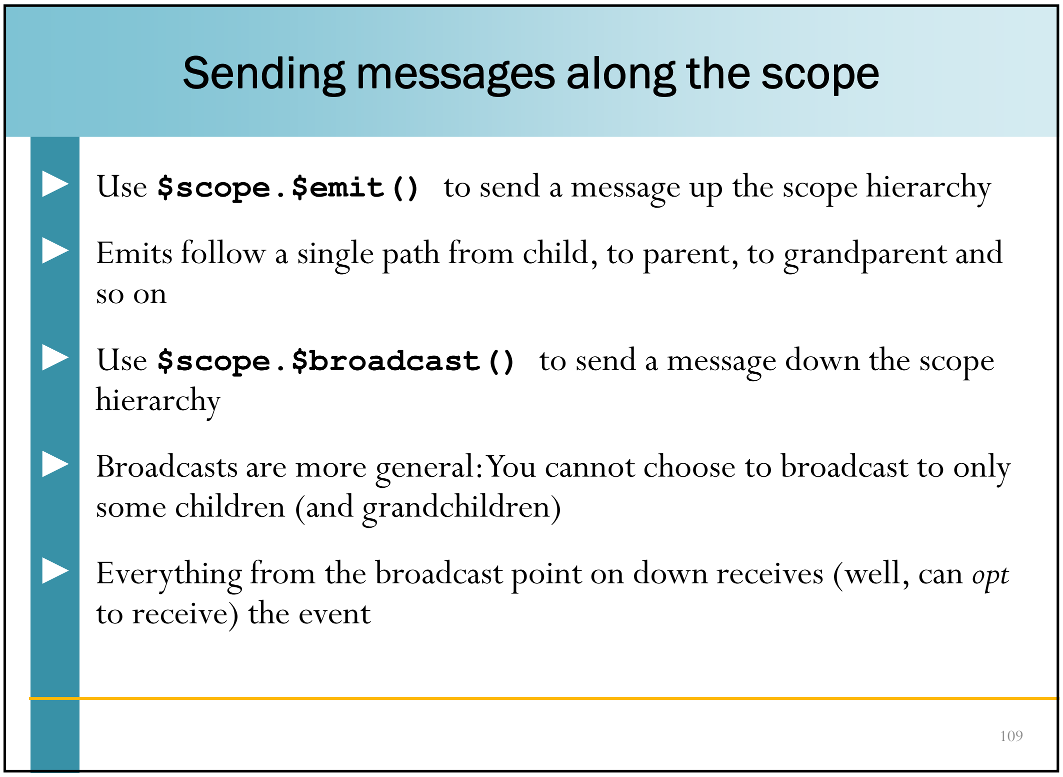
Exercise: Scopes

- Using our new understanding of controller-as syntax, let's re-implement a page using that style of code
- Chapter: Scopes
- Exercises/scope-controller-as.html
- Exercises/scope-controller-as.js



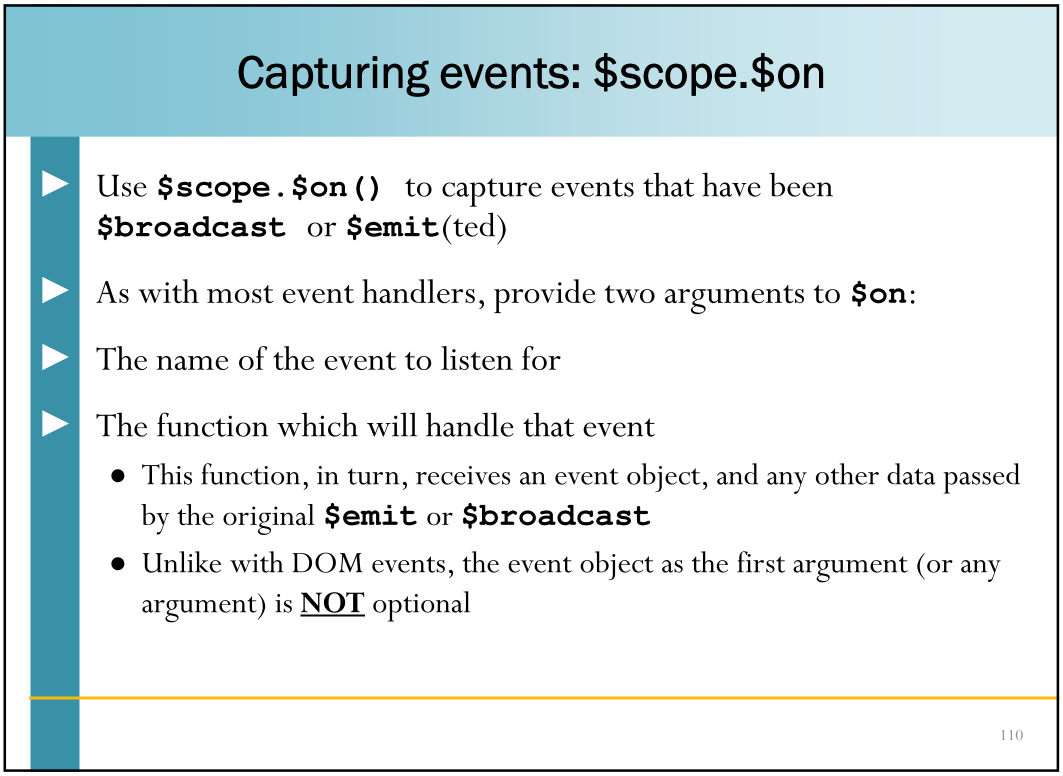
Scope events

- Scopes can also function as a sort of event bus
- That is, scopes emit and receive their own custom events
- While similar to the DOM, scope-based events have their differences
  - They use the scope hierarchy instead of the DOM hierarchy; this is much faster than using the DOM
  - Scope events can traverse the scope hierarchy both upwards and downwards
  - So a parent can communicate with all of its children, and a child can send messages up to the parent (or grandparent, or great-grandparent, and so on)



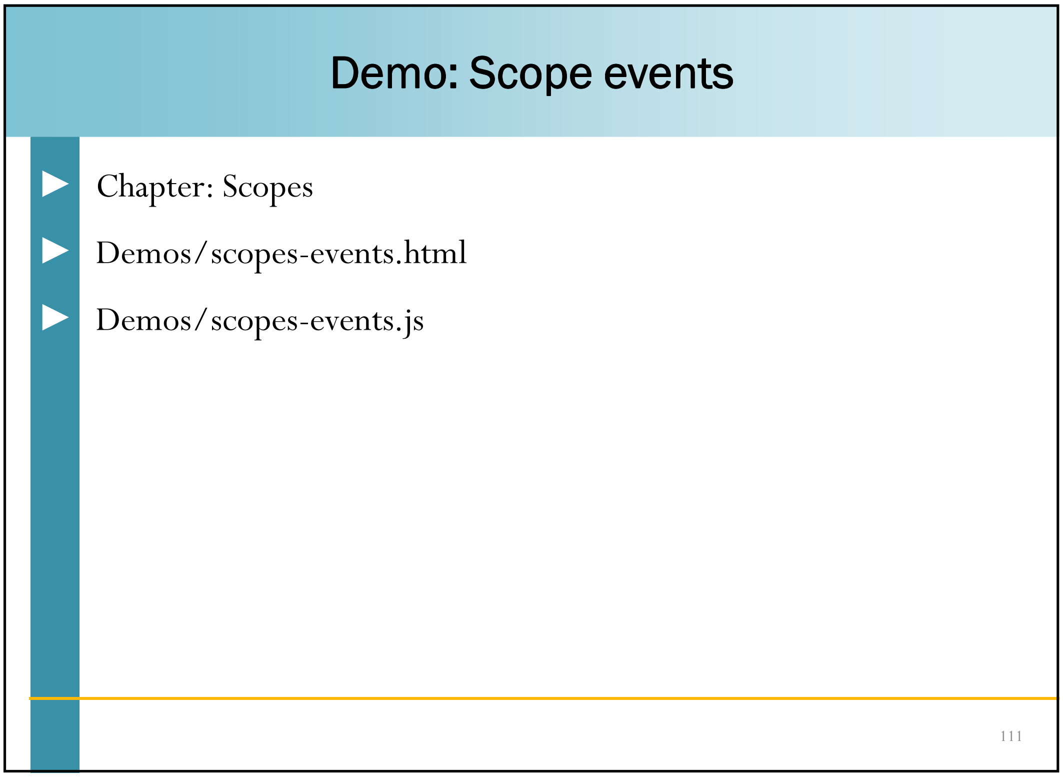
Sending messages along the scope

- Use **`$scope.$emit()`** to send a message up the scope hierarchy
- Emits follow a single path from child, to parent, to grandparent and so on
- Use **`$scope.$broadcast()`** to send a message down the scope hierarchy
- Broadcasts are more general: You cannot choose to broadcast to only some children (and grandchildren)
- Everything from the broadcast point on down receives (well, can *opt* to receive) the event



Capturing events: $scope.$on

- Use **`$scope.$on()`** to capture events that have been **`$broadcast`** or **`$emit`**(ted)
- As with most event handlers, provide two arguments to **`$on`**:
- The name of the event to listen for
- The function which will handle that event
  - This function, in turn, receives an event object, and any other data passed by the original **`$emit`** or **`$broadcast`**
  - Unlike with DOM events, the event object as the first argument (or any argument) is **NOT** optional



Demo: Scope events

- Chapter: Scopes
- Demos/scopes-events.html
- Demos/scopes-events.js

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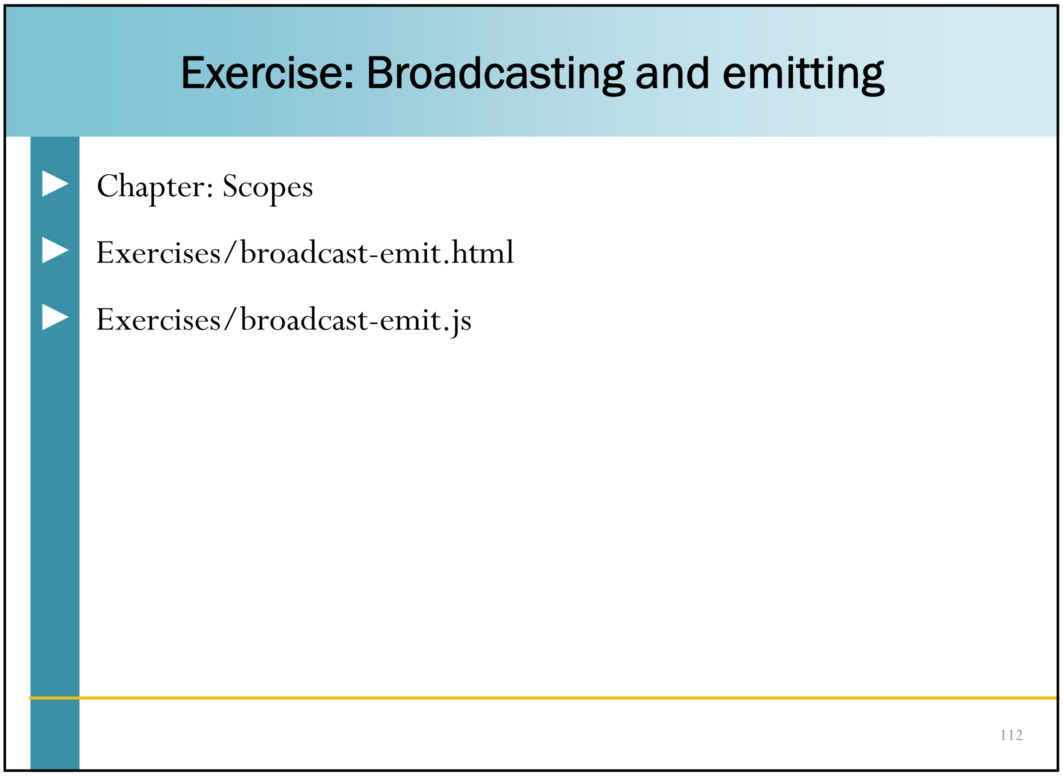

Exercise: Broadcasting and emitting

- Chapter: Scopes
- Exercises/broadcast-emit.html
- Exercises/broadcast-emit.js

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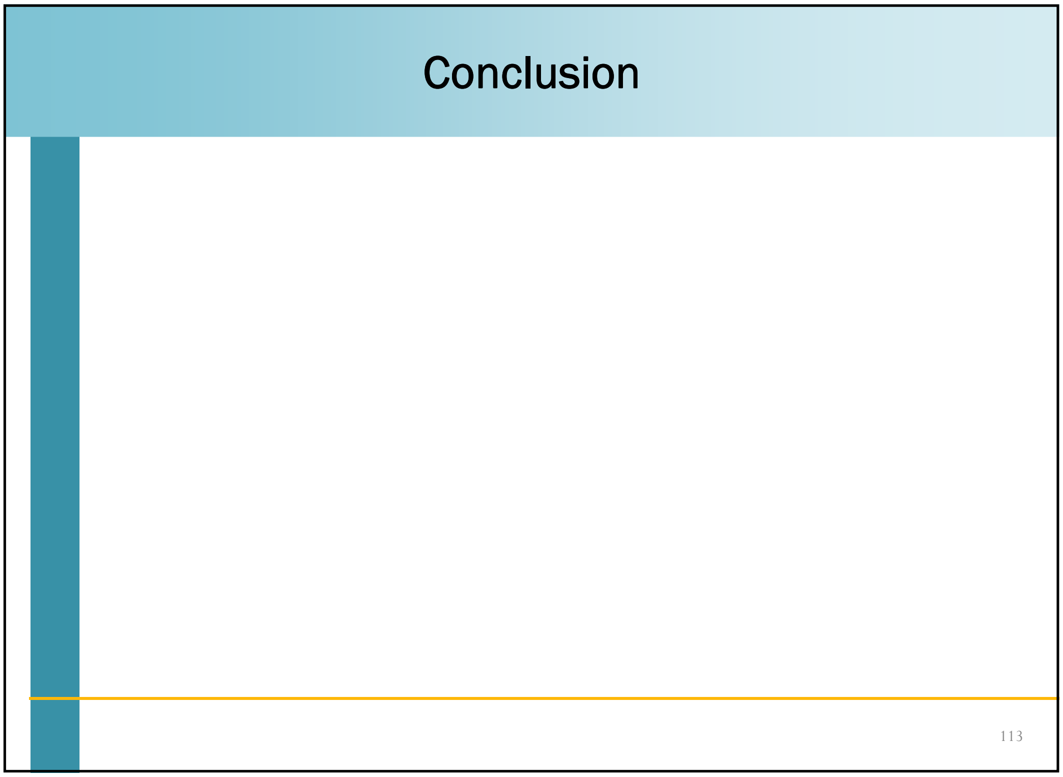
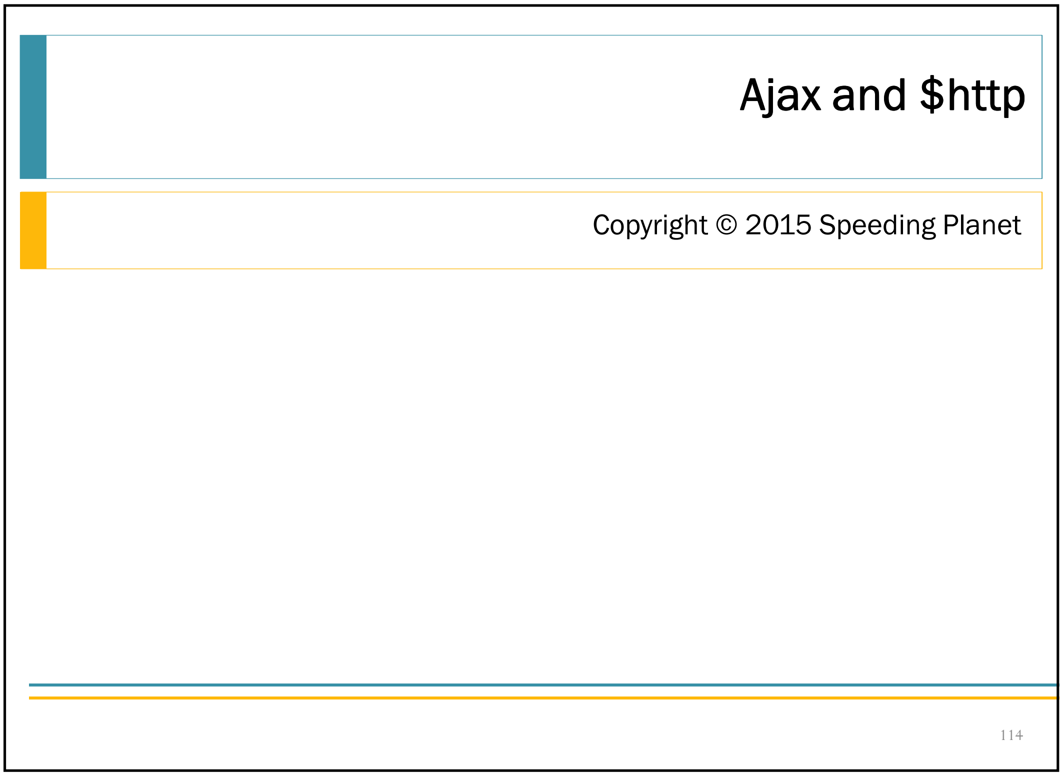
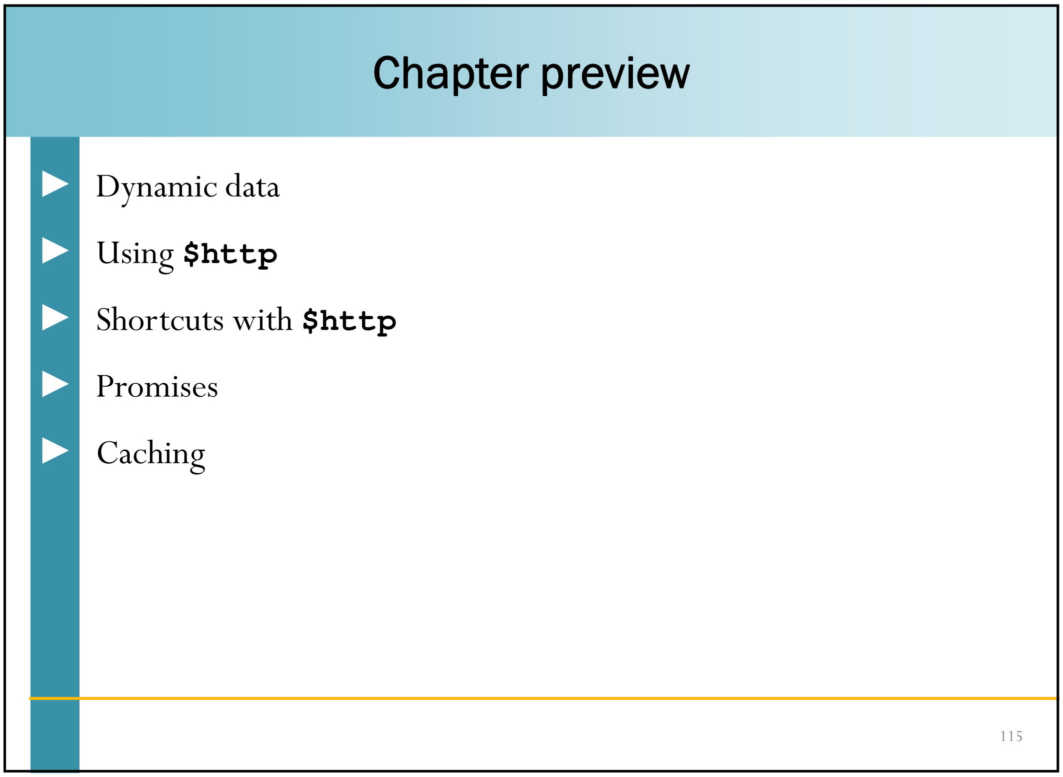


Conclusion

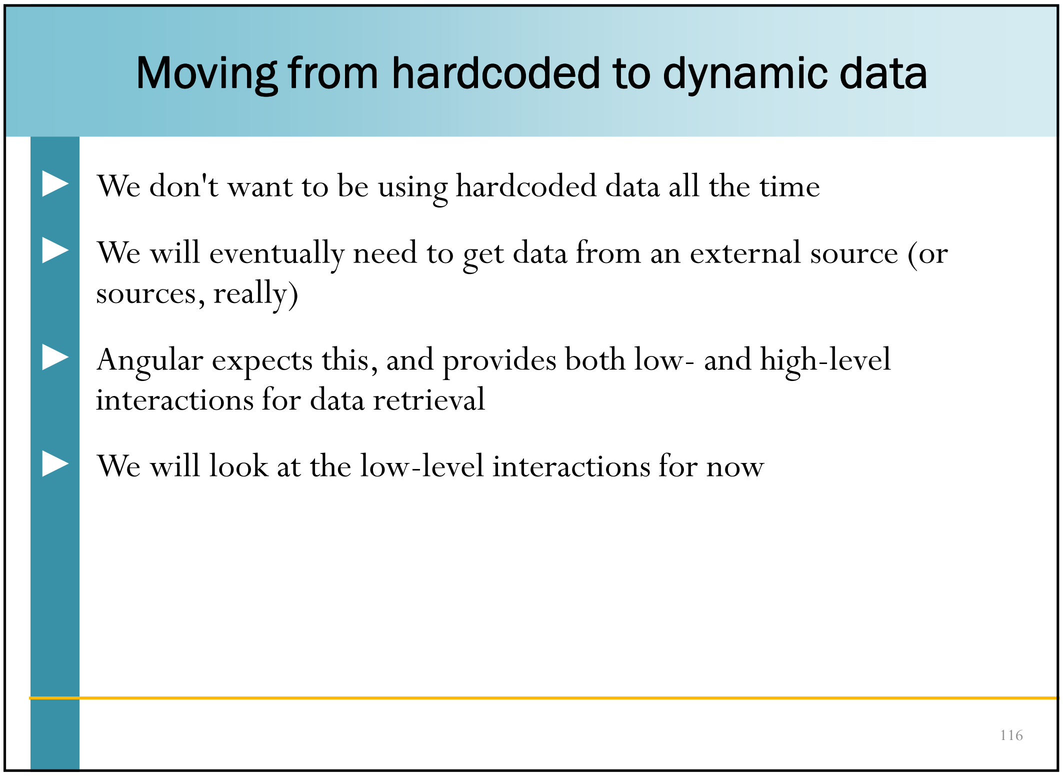


Ajax and $http



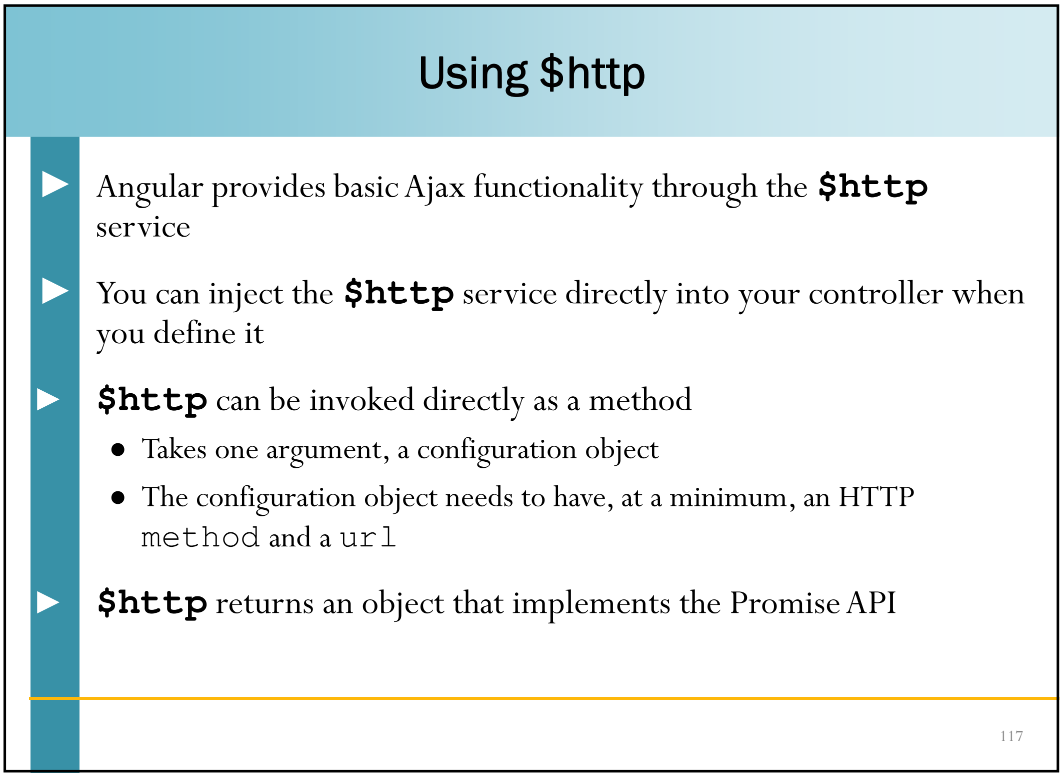
Chapter preview

- Dynamic data
- Using **`$http`**
- Shortcuts with **`$http`**
- Promises
- Caching



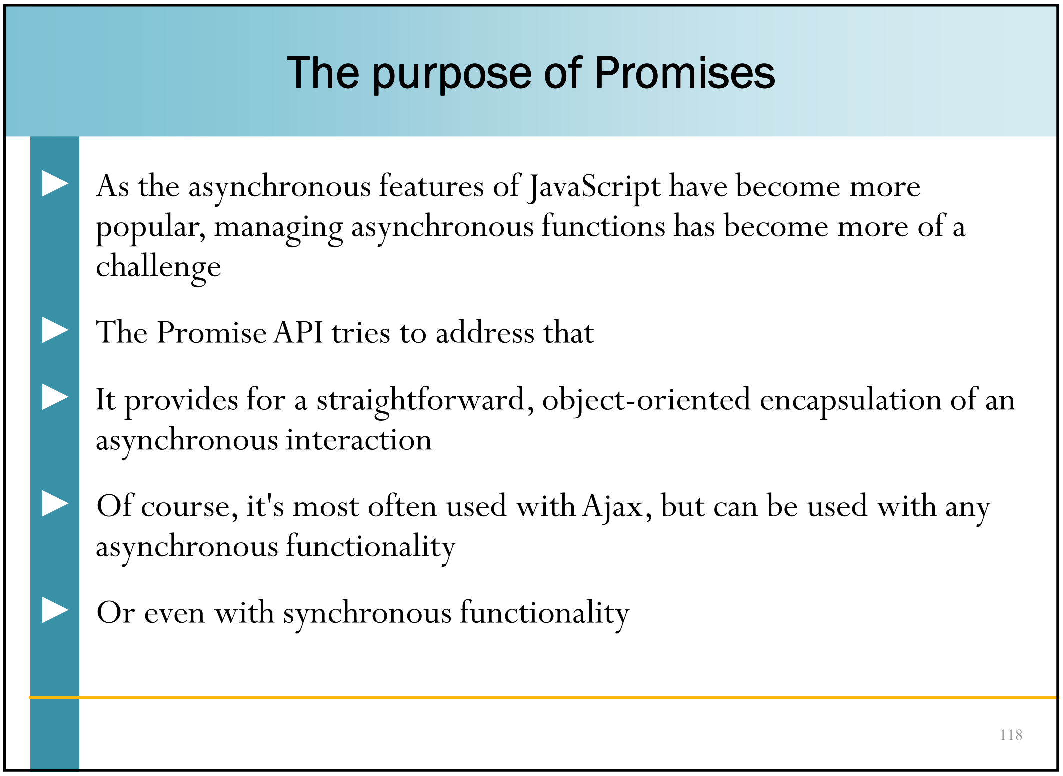
Moving from hardcoded to dynamic data

- We don't want to be using hardcoded data all the time
- We will eventually need to get data from an external source (or sources, really)
- Angular expects this, and provides both low- and high-level interactions for data retrieval
- We will look at the low-level interactions for now



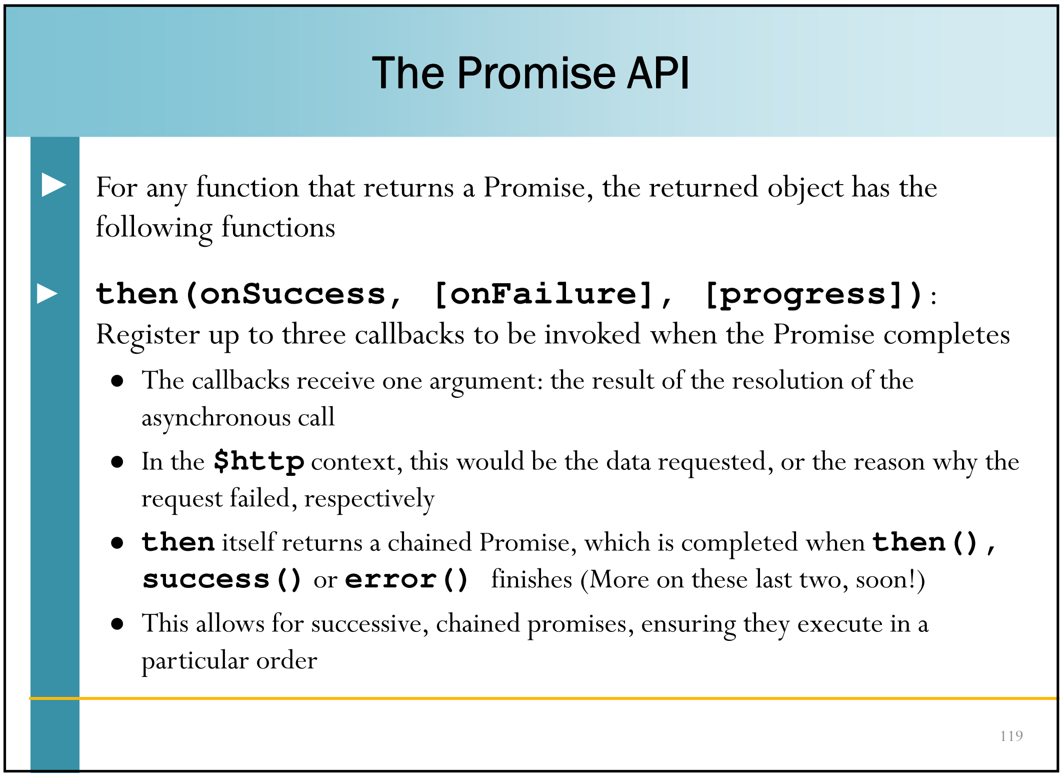
Using $http

- Angular provides basic Ajax functionality through the **`$http`** service
- You can inject the **`$http`** service directly into your controller when you define it
- **`$http`** can be invoked directly as a method
  - Takes one argument, a configuration object
  - The configuration object needs to have, at a minimum, an HTTP `method` and a `url`
- **`$http`** returns an object that implements the Promise API



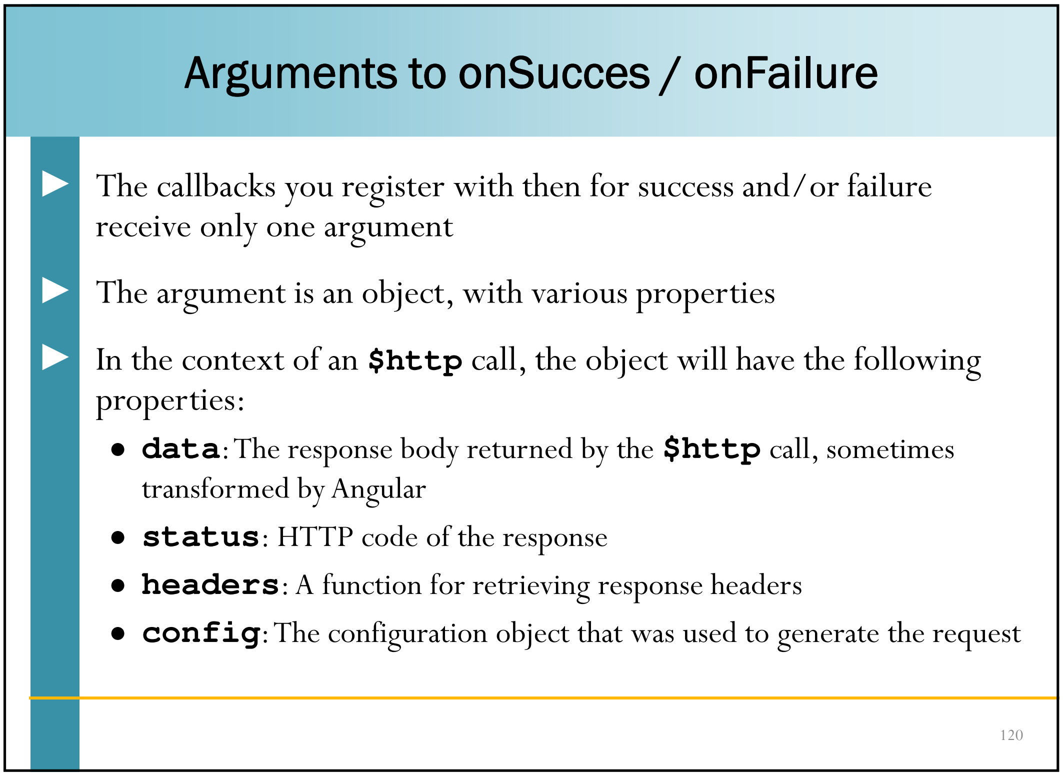
The purpose of Promises

- As the asynchronous features of JavaScript have become more popular, managing asynchronous functions has become more of a challenge
- The Promise API tries to address that
- It provides for a straightforward, object-oriented encapsulation of an asynchronous interaction
- Of course, it's most often used with Ajax, but can be used with any asynchronous functionality
- Or even with synchronous functionality



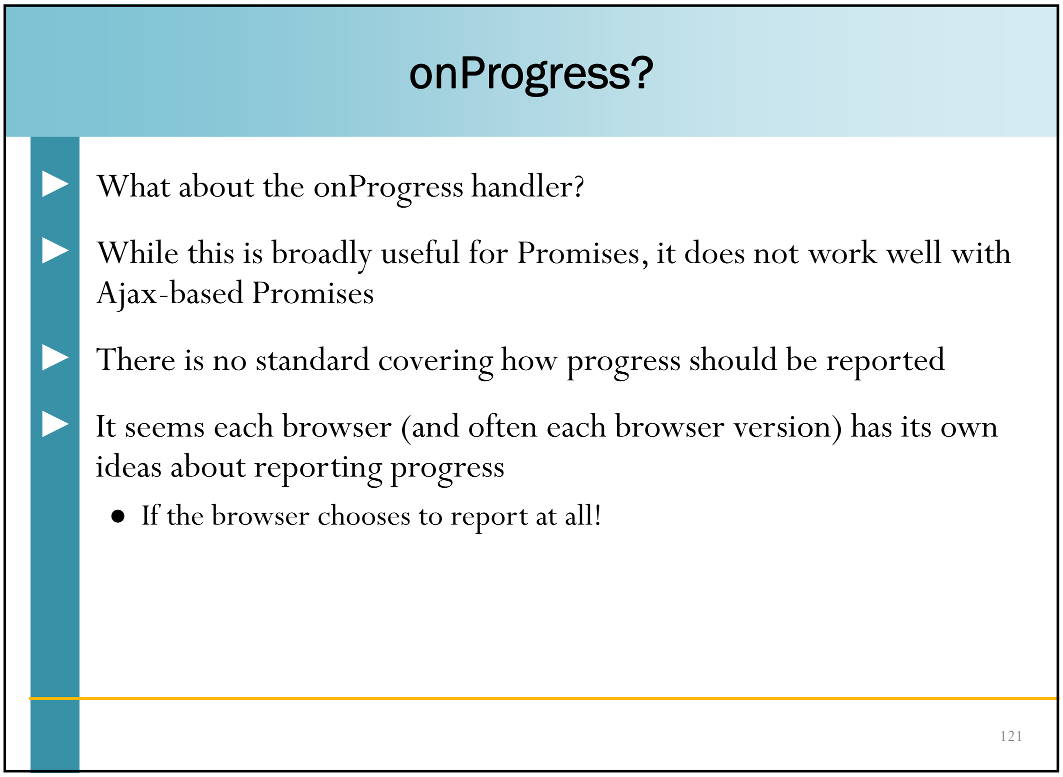
The Promise API

- For any function that returns a Promise, the returned object has the following functions
- **`then(onSuccess, [onFailure], [progress])`**: Register up to three callbacks to be invoked when the Promise completes
  - The callbacks receive one argument: the result of the resolution of the asynchronous call
  - In the **`$http`** context, this would be the data requested, or the reason why the request failed, respectively
  - **`then`** itself returns a chained Promise, which is completed when **`then()`**, **`success()`** or **`error()`** finishes (More on these last two, soon!)
  - This allows for successive, chained promises, ensuring they execute in a particular order



Arguments to onSucces / onFailure

- The callbacks you register with then for success and/or failure receive only one argument
- The argument is an object, with various properties
- In the context of an **`$http`** call, the object will have the following properties:
  - **`data`**: The response body returned by the **`$http`** call, sometimes transformed by Angular
  - **`status`**: HTTP code of the response
  - **`headers`**: A function for retrieving response headers
  - **`config`**: The configuration object that was used to generate the request



onProgress?

- What about the onProgress handler?
- While this is broadly useful for Promises, it does not work well with Ajax-based Promises
- There is no standard covering how progress should be reported
- It seems each browser (and often each browser version) has its own ideas about reporting progress
  - If the browser chooses to report at all!

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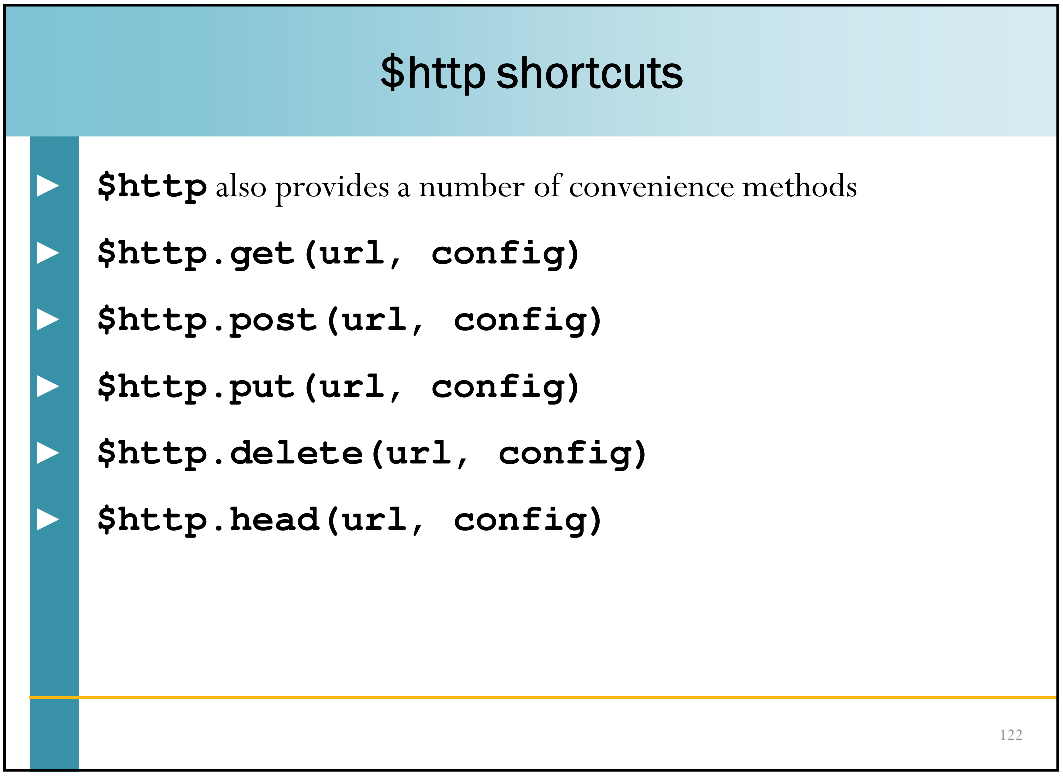

$http shortcuts

- **`$http`** also provides a number of convenience methods
- **`$http.get(url, config)`**
- **`$http.post(url, config)`**
- **`$http.put(url, config)`**
- **`$http.delete(url, config)`**
- **`$http.head(url, config)`**

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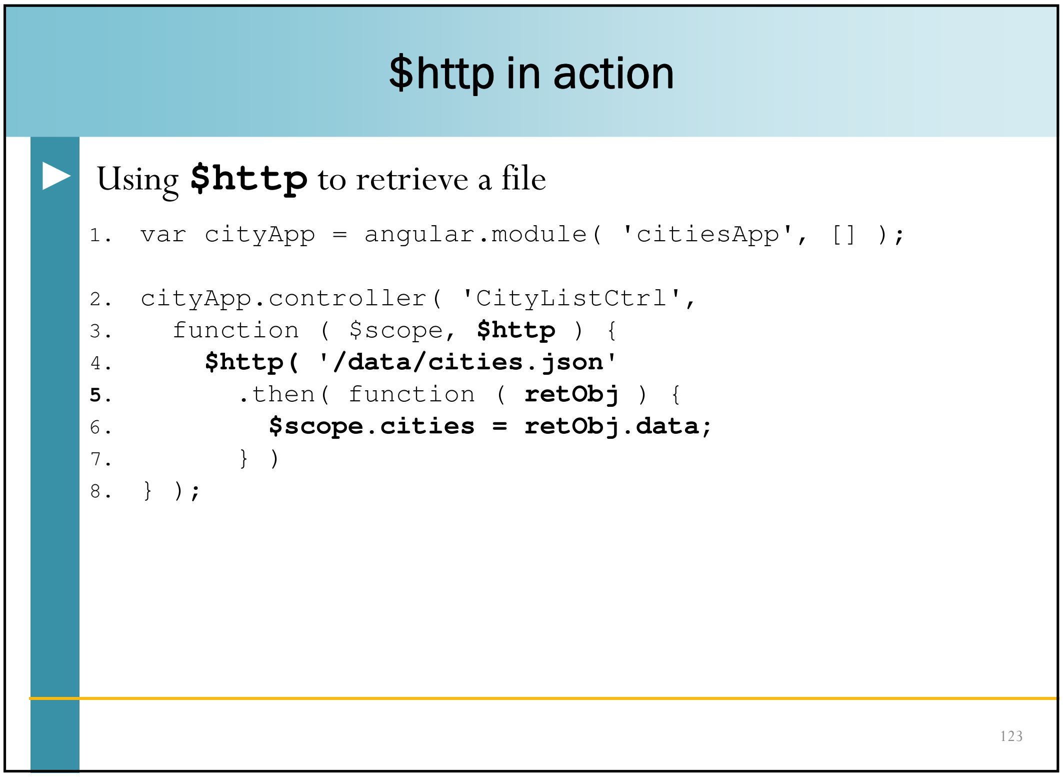
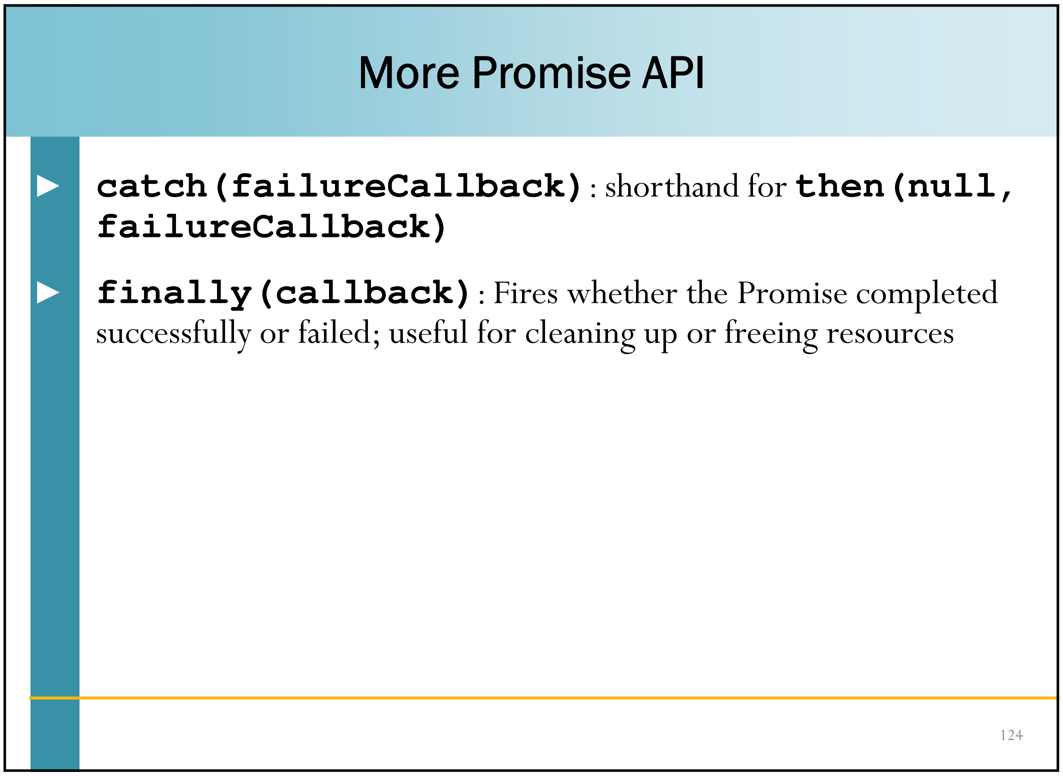


$http in action

- Using **$http** to retrieve a file

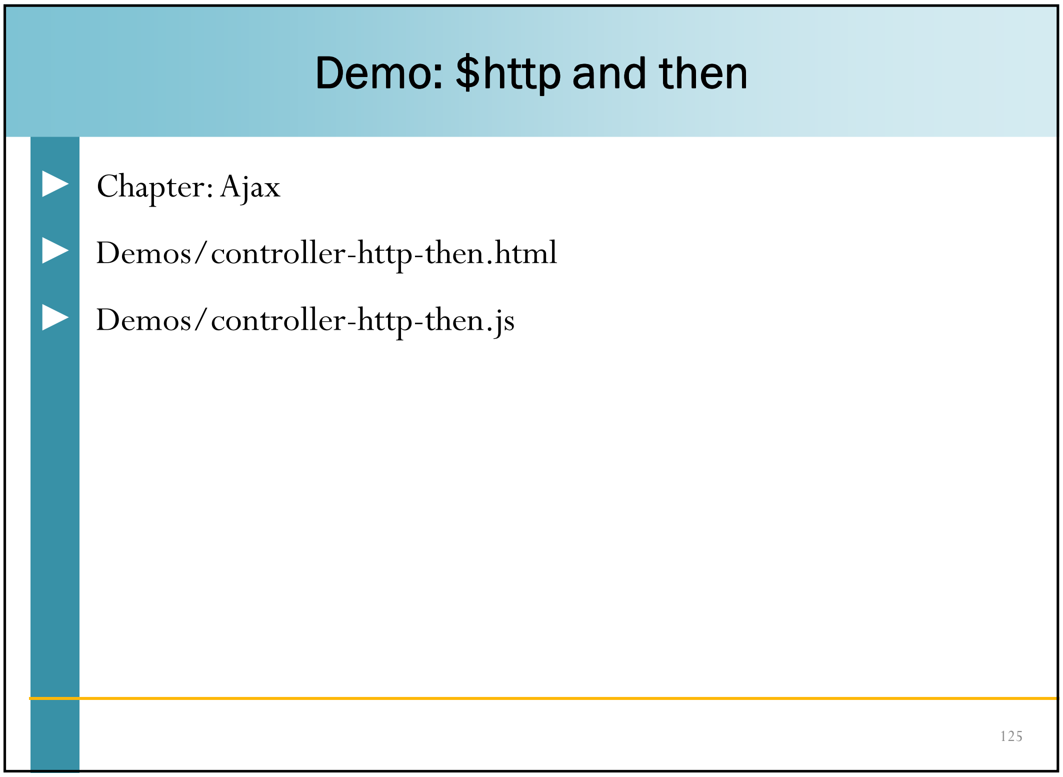
```
var cityApp = angular.module( 'citiesApp', [] );

cityApp.controller( 'CityListCtrl',
  function ( $scope, $http ) {
    $http( '/data/cities.json'
      .then( function ( retObj ) {
        $scope.cities = retObj.data;
      } )
} );
```



More Promise API

- **catch(failureCallback)** : shorthand for **then(null, failureCallback)**
- **finally(callback)** : Fires whether the Promise completed successfully or failed; useful for cleaning up or freeing resources



Demo: $http and then

- Chapter: Ajax
- Demos/controller-http-then.html
- Demos/controller-http-then.js

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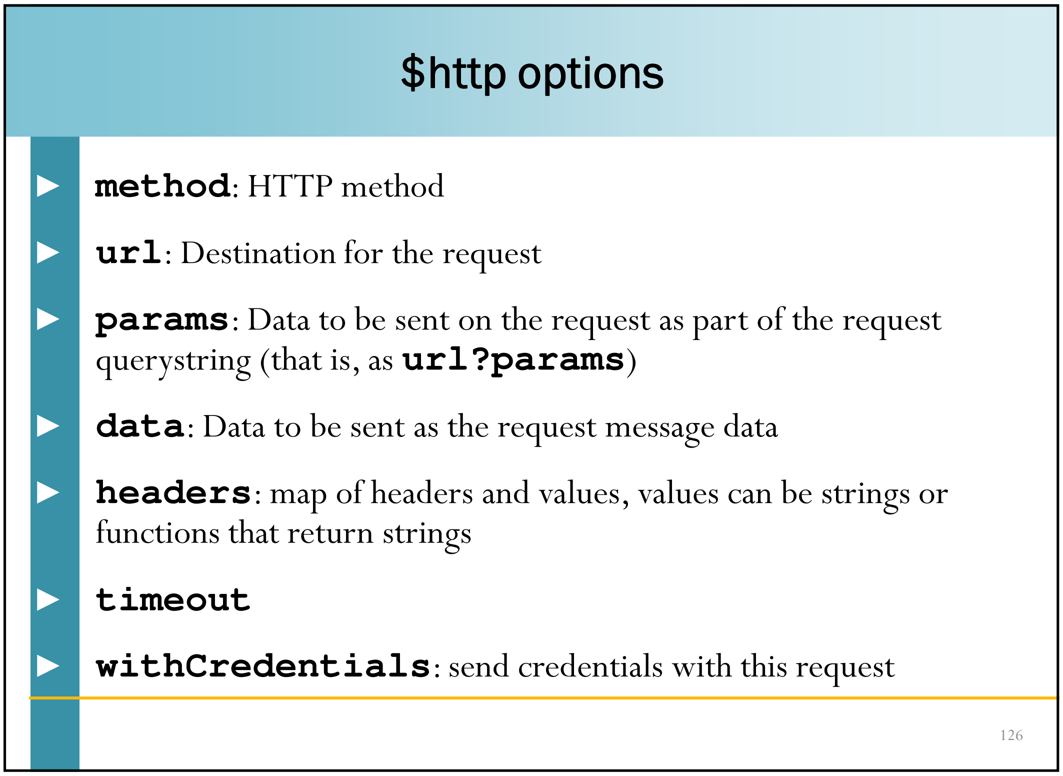

$http options

- **`method`**: HTTP method
- **`url`**: Destination for the request
- **`params`**: Data to be sent on the request as part of the request querystring (that is, as **`url?params`**)
- **`data`**: Data to be sent as the request message data
- **`headers`**: map of headers and values, values can be strings or functions that return strings
- **`timeout`**
- **`withCredentials`**: send credentials with this request

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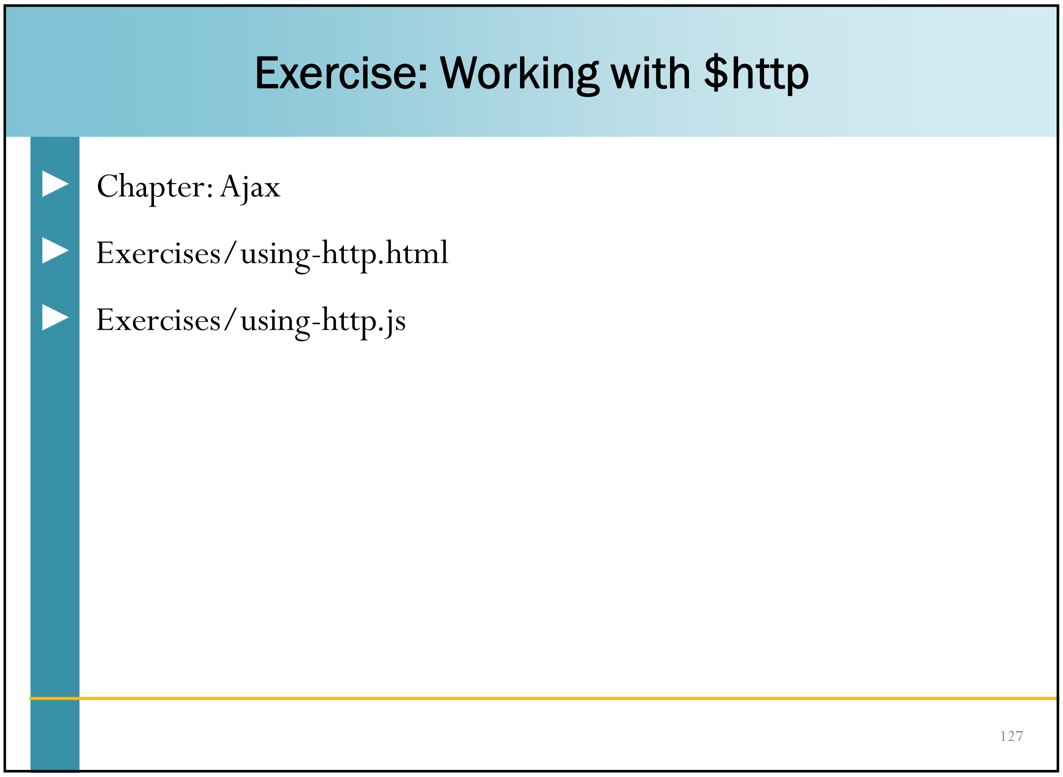
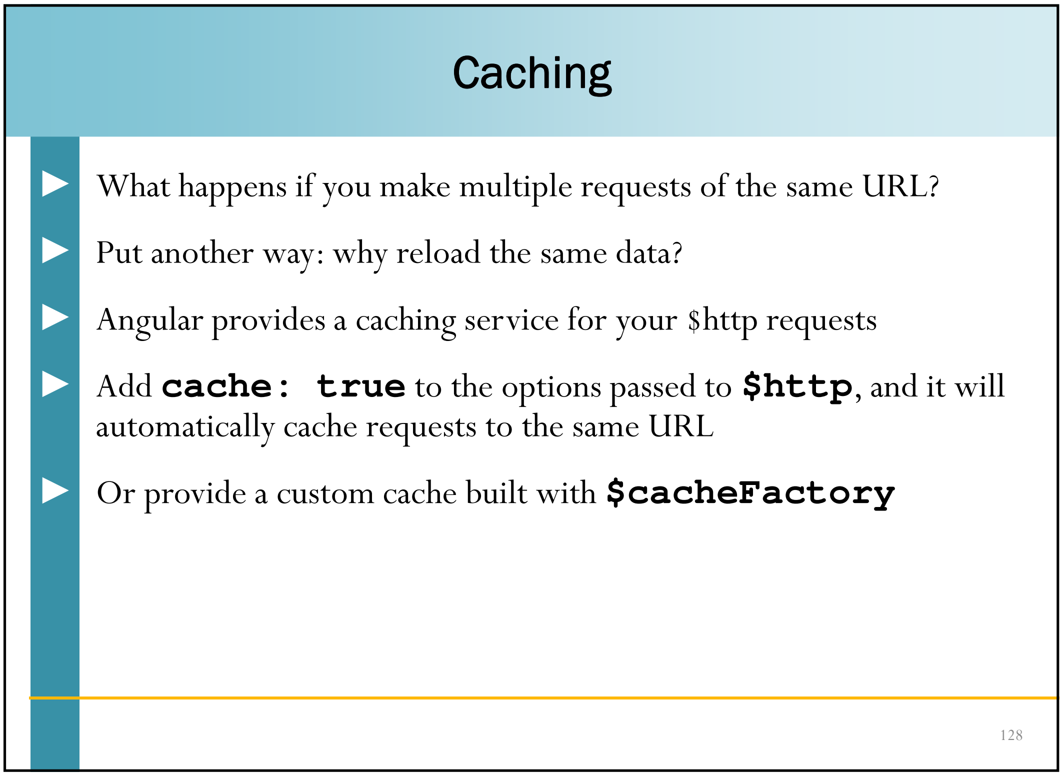


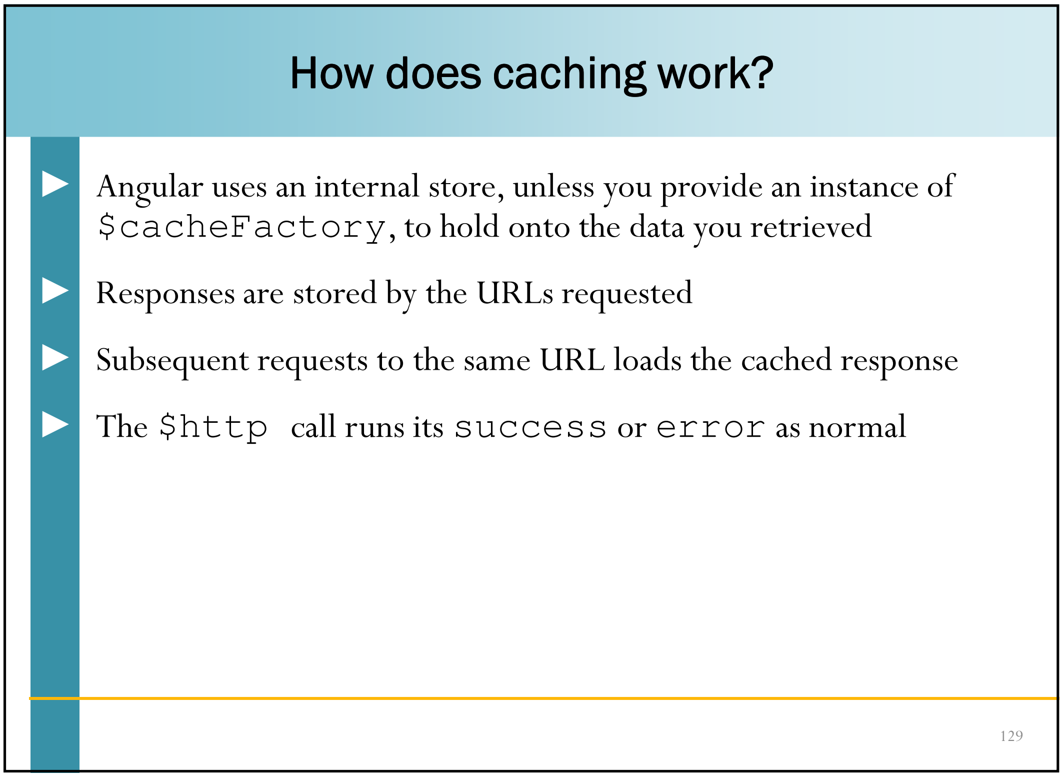
Exercise: Working with $http

- Chapter: Ajax
- Exercises/using-http.html
- Exercises/using-http.js



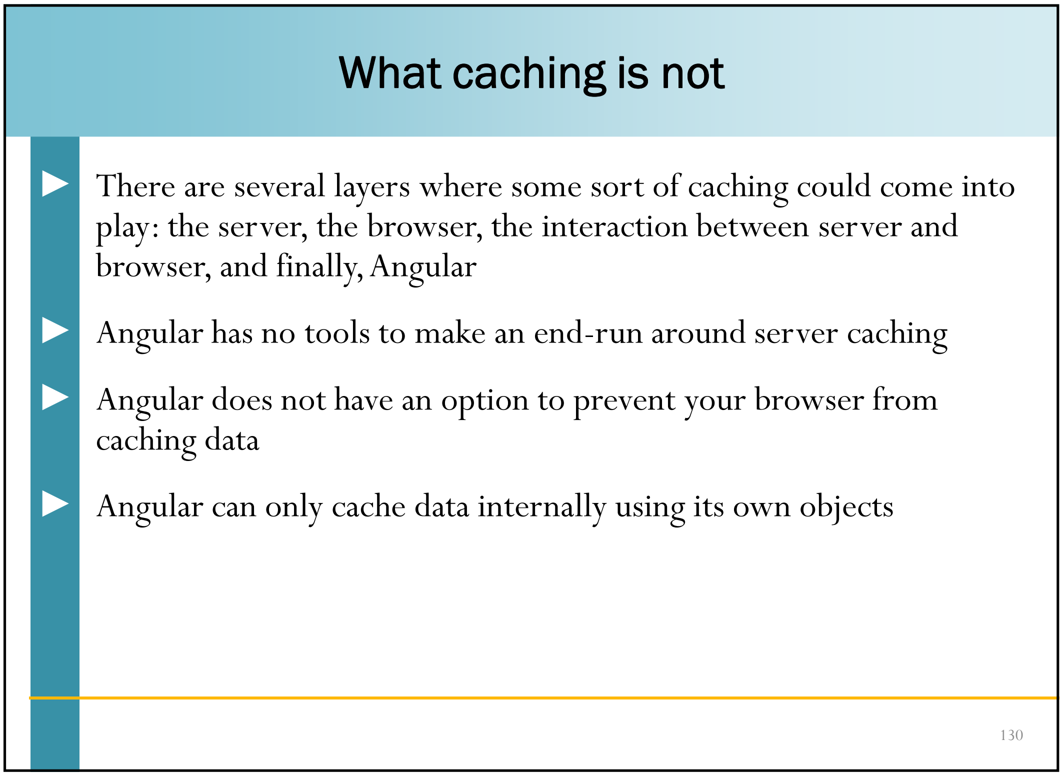
Caching

- What happens if you make multiple requests of the same URL?
- Put another way: why reload the same data?
- Angular provides a caching service for your $http requests
- Add **`cache: true`** to the options passed to **`$http`**, and it will automatically cache requests to the same URL
- Or provide a custom cache built with **`$cacheFactory`**



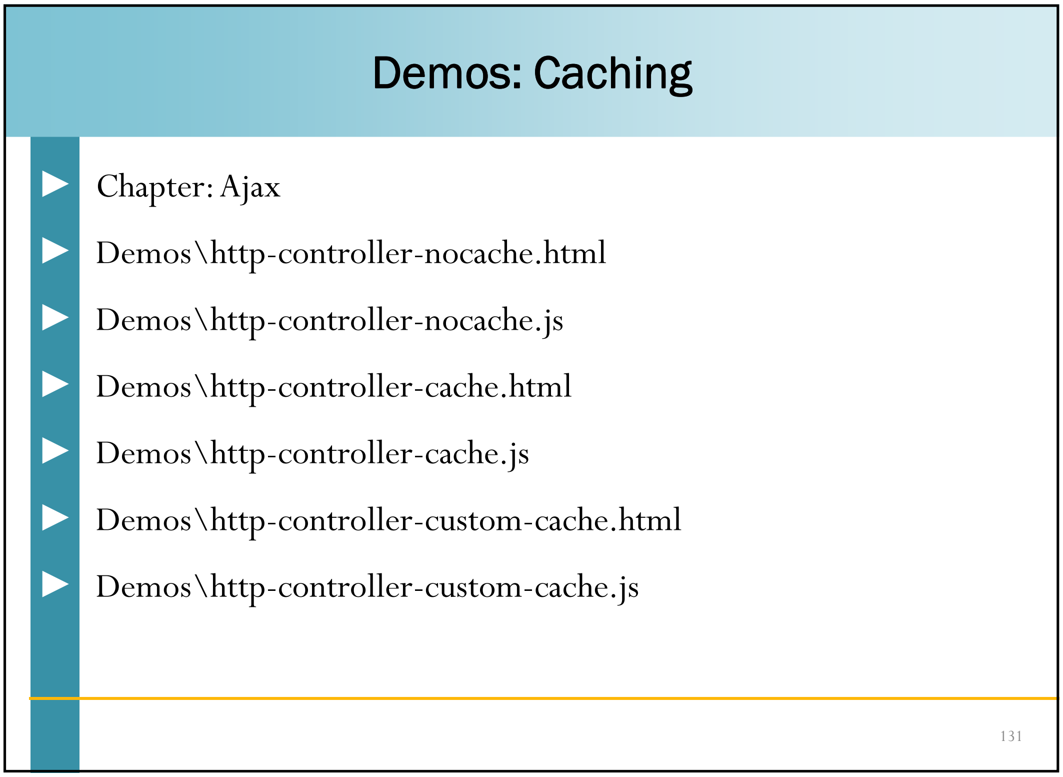
How does caching work?

- Angular uses an internal store, unless you provide an instance of `$cacheFactory`, to hold onto the data you retrieved
- Responses are stored by the URLs requested
- Subsequent requests to the same URL loads the cached response
- The `$http` call runs its `success` or `error` as normal



What caching is not

- There are several layers where some sort of caching could come into play: the server, the browser, the interaction between server and browser, and finally, Angular
- Angular has no tools to make an end-run around server caching
- Angular does not have an option to prevent your browser from caching data
- Angular can only cache data internally using its own objects



Demos: Caching

- Chapter: Ajax
- Demos\http-controller-nocache.html
- Demos\http-controller-nocache.js
- Demos\http-controller-cache.html
- Demos\http-controller-cache.js
- Demos\http-controller-custom-cache.html
- Demos\http-controller-custom-cache.js

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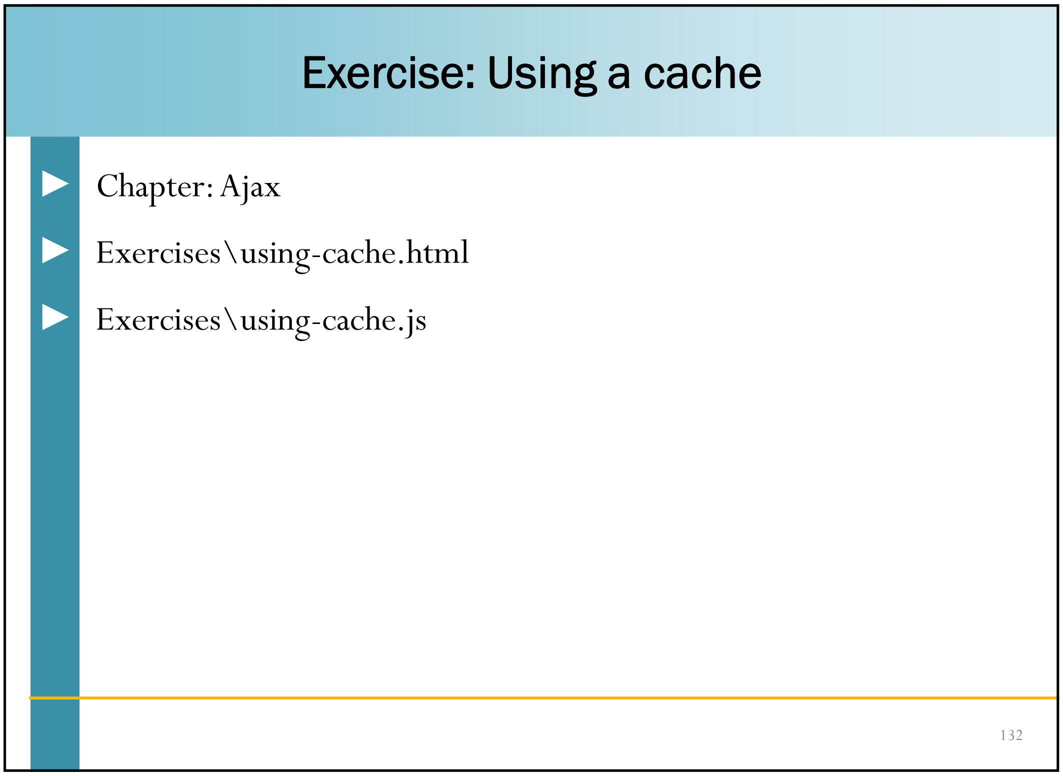

Exercise: Using a cache

- Chapter: Ajax
- Exercises\using-cache.html
- Exercises\using-cache.js

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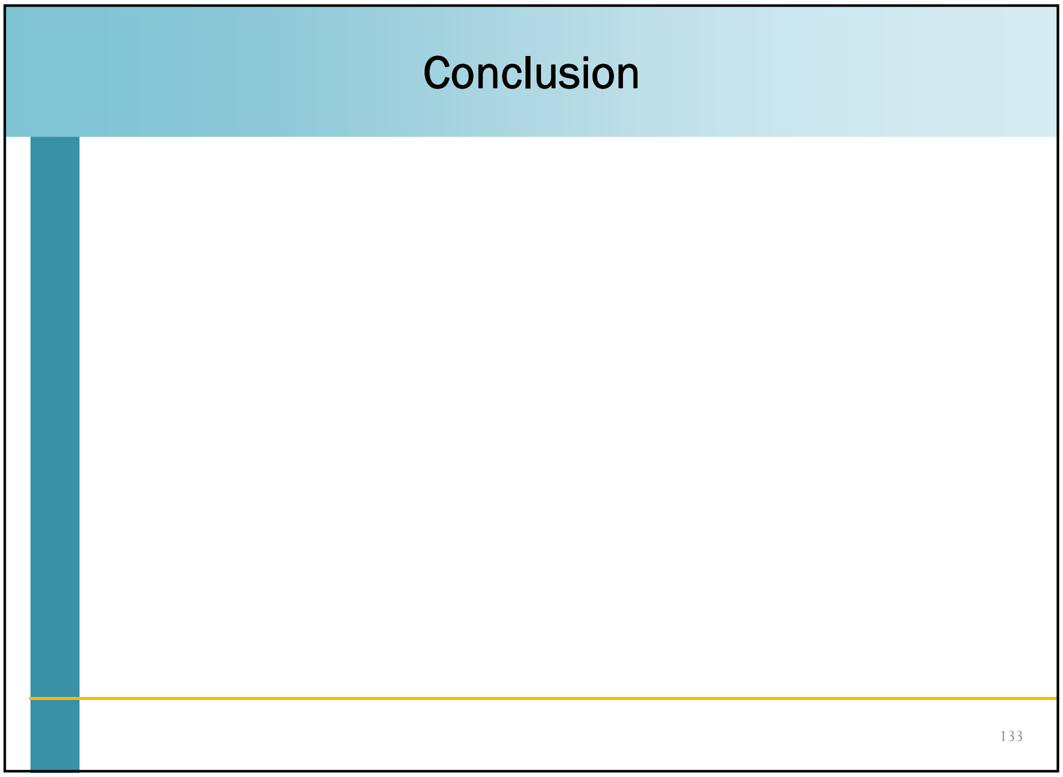
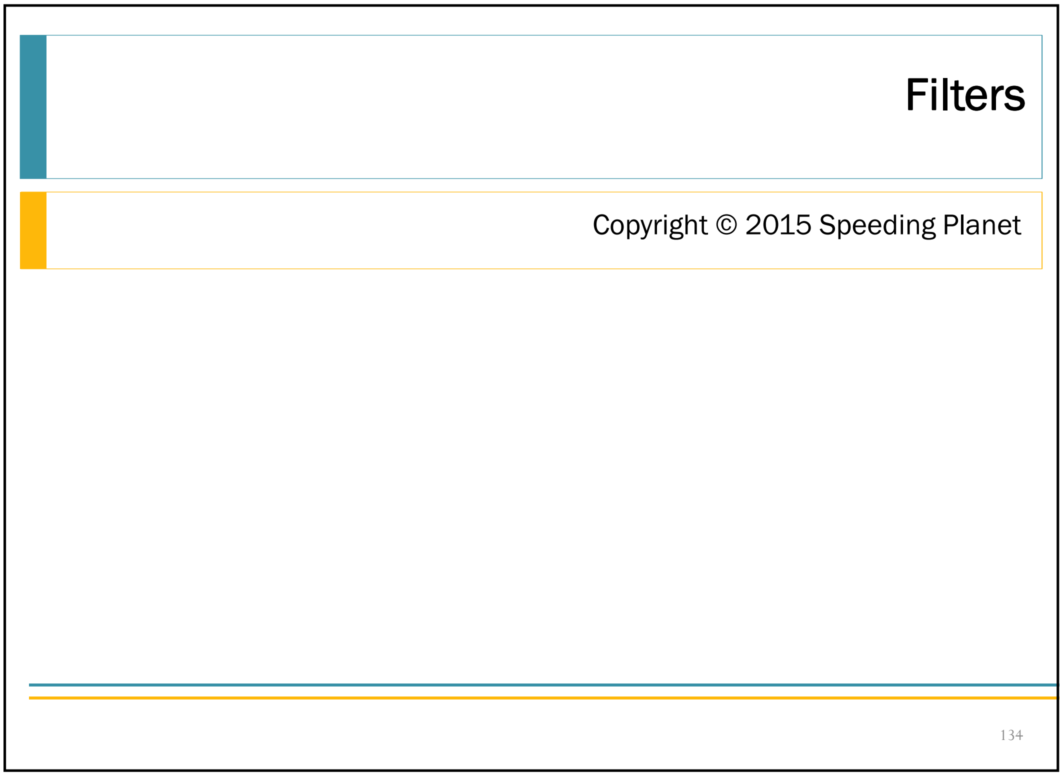
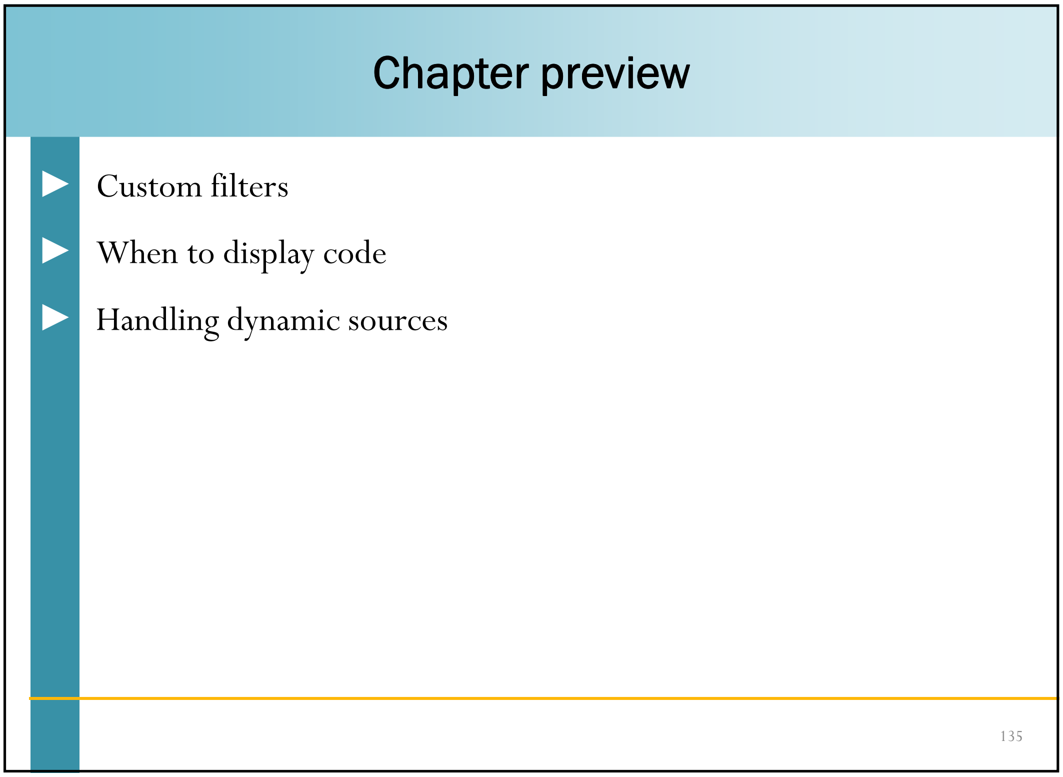


Conclusion

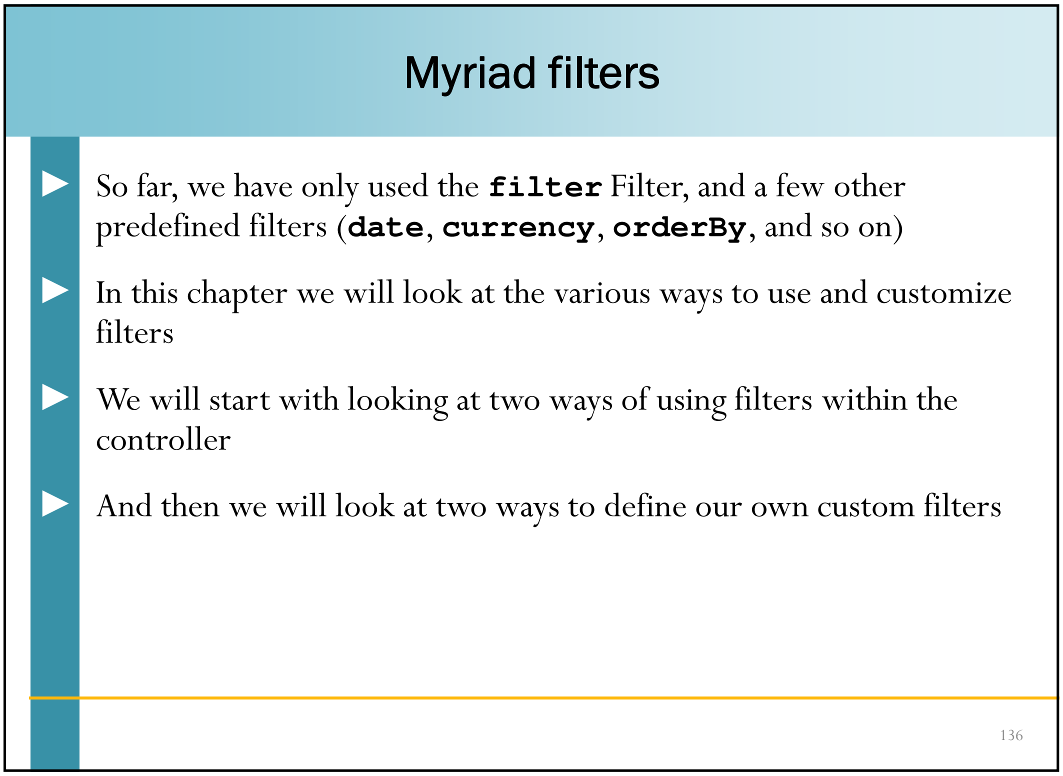


Filters



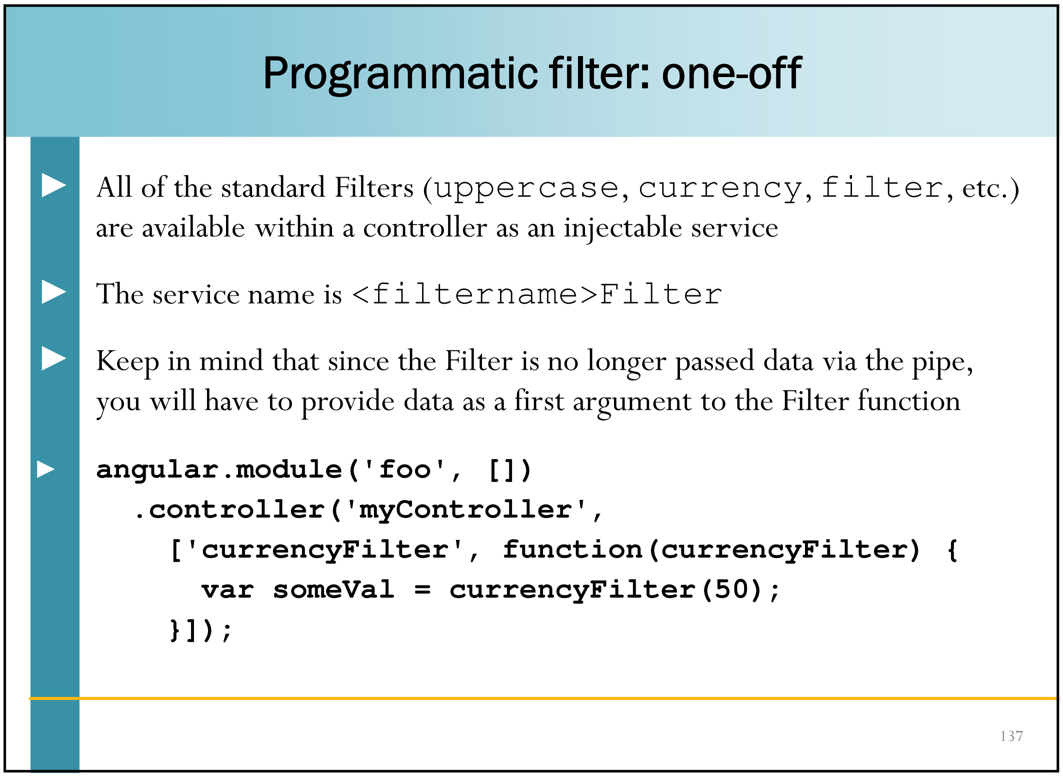
Chapter preview

- Custom filters
- When to display code
- Handling dynamic sources



Myriad filters

- So far, we have only used the **`filter`** Filter, and a few other predefined filters (**`date`**, **`currency`**, **`orderBy`**, and so on)
- In this chapter we will look at the various ways to use and customize filters
- We will start with looking at two ways of using filters within the controller
- And then we will look at two ways to define our own custom filters



Programmatic filter: one-off

- All of the standard Filters (`uppercase`, `currency`, `filter`, etc.) are available within a controller as an injectable service
- The service name is `<filtername>Filter`
- Keep in mind that since the Filter is no longer passed data via the pipe, you will have to provide data as a first argument to the Filter function

-
  ```
  angular.module('foo', [])
    .controller('myController',
      ['currencyFilter', function(currencyFilter) {
        var someVal = currencyFilter(50);
      }]);
  ```

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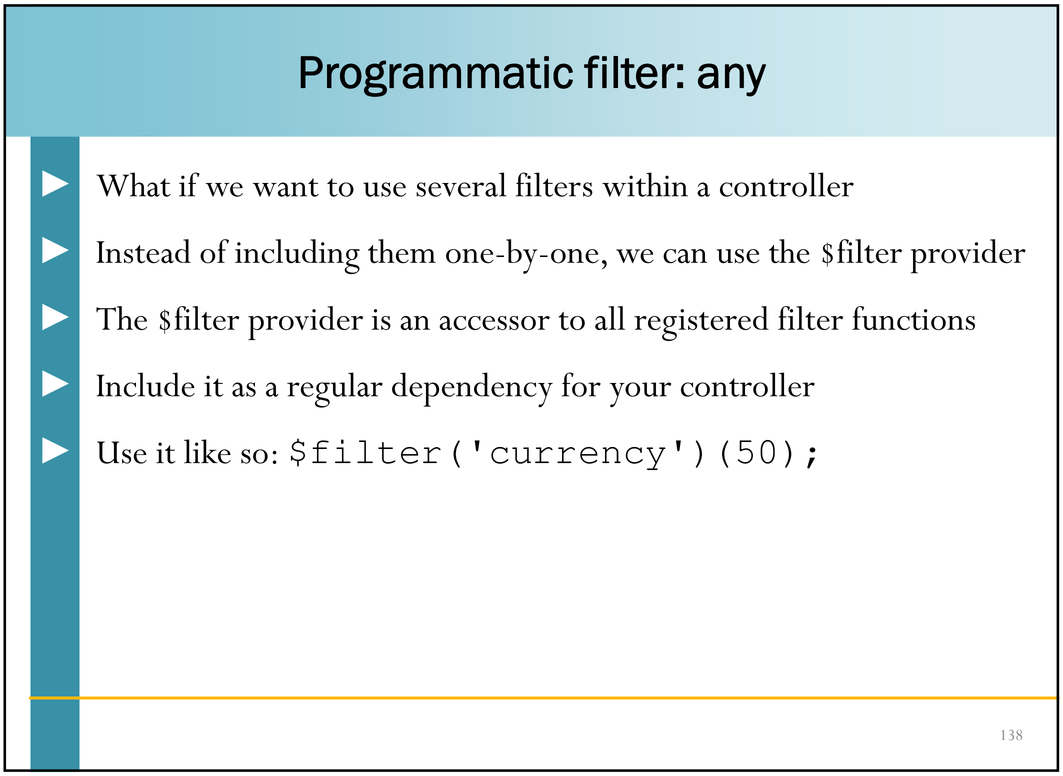

Programmatic filter: any

- What if we want to use several filters within a controller
- Instead of including them one-by-one, we can use the $filter provider
- The $filter provider is an accessor to all registered filter functions
- Include it as a regular dependency for your controller
- Use it like so: `$filter('currency')(50);`

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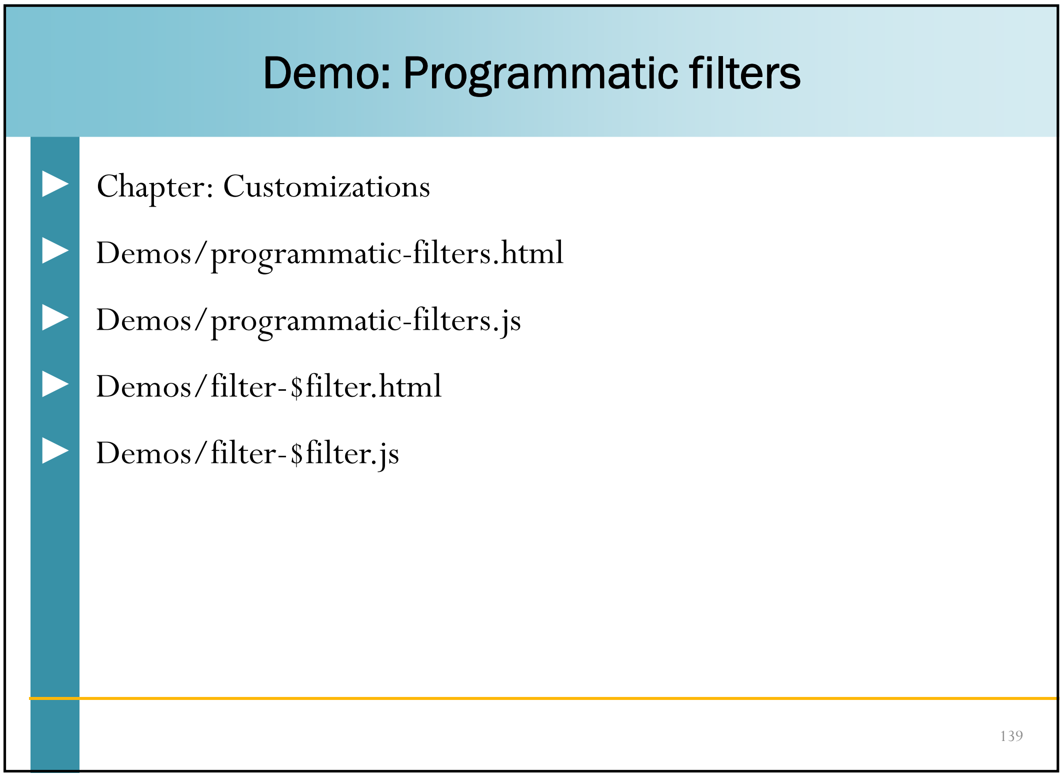

Demo: Programmatic filters

- Chapter: Customizations
- Demos/programmatic-filters.html
- Demos/programmatic-filters.js
- Demos/filter-$filter.html
- Demos/filter-$filter.js

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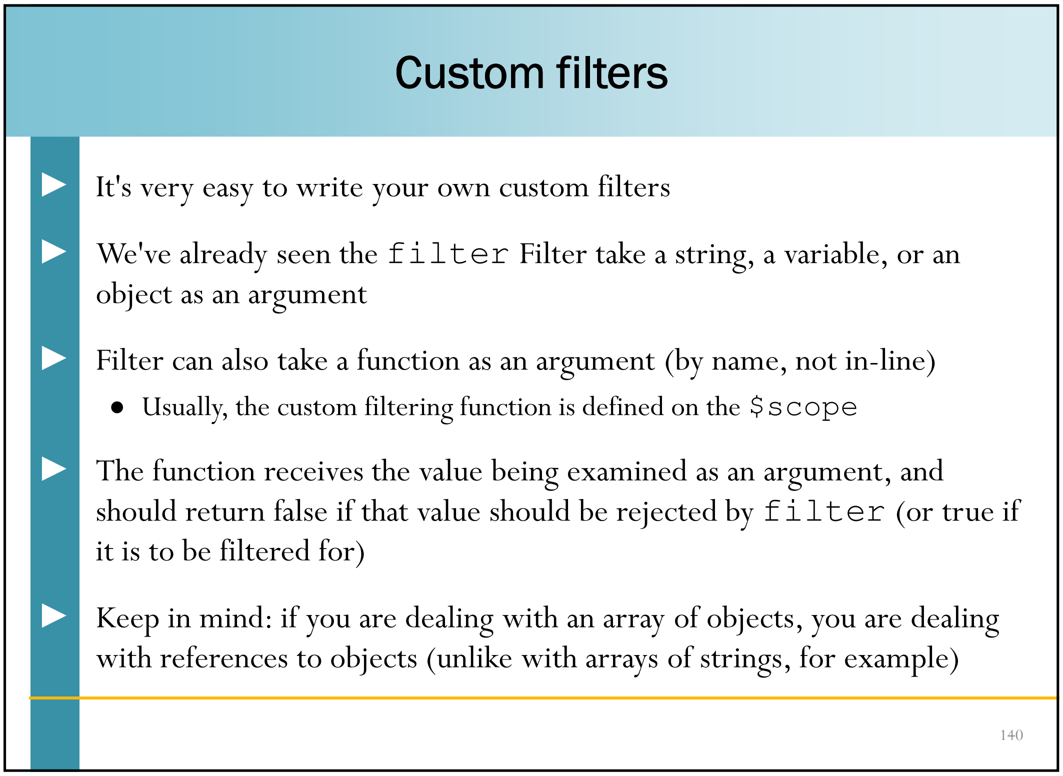

Custom filters

- It's very easy to write your own custom filters
- We've already seen the `filter` Filter take a string, a variable, or an object as an argument
- Filter can also take a function as an argument (by name, not in-line)
  - Usually, the custom filtering function is defined on the `$scope`
- The function receives the value being examined as an argument, and should return false if that value should be rejected by `filter` (or true if it is to be filtered for)
- Keep in mind: if you are dealing with an array of objects, you are dealing with references to objects (unlike with arrays of strings, for example)

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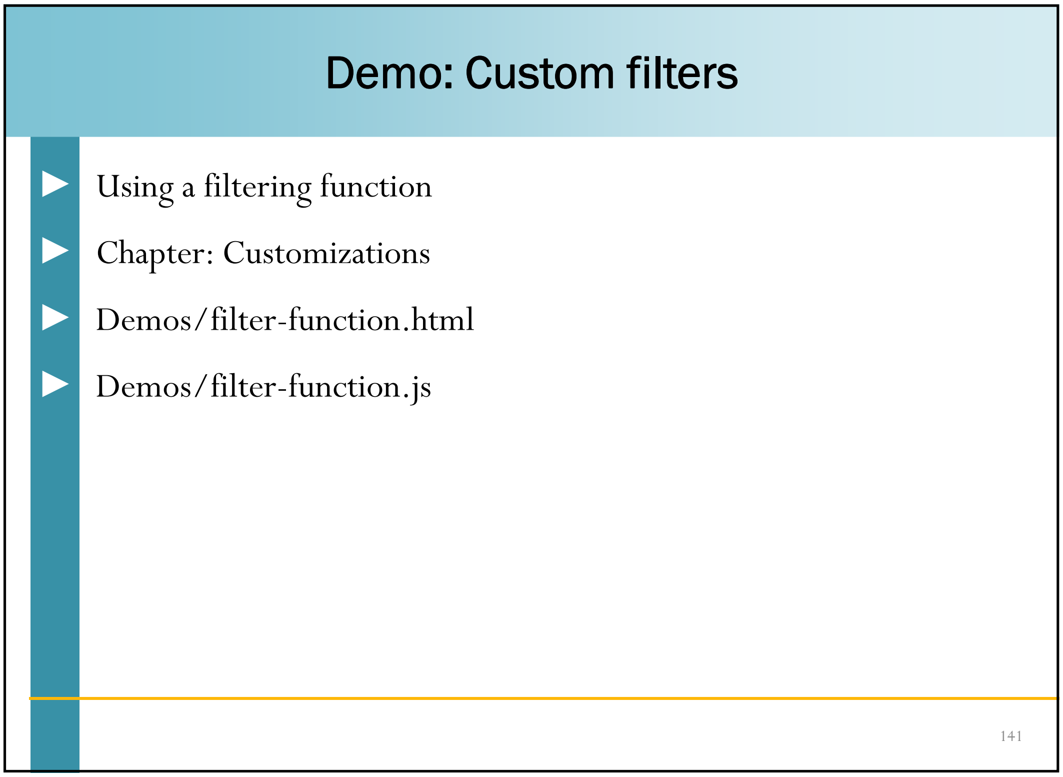

Demo: Custom filters

- Using a filtering function
- Chapter: Customizations
- Demos/filter-function.html
- Demos/filter-function.js

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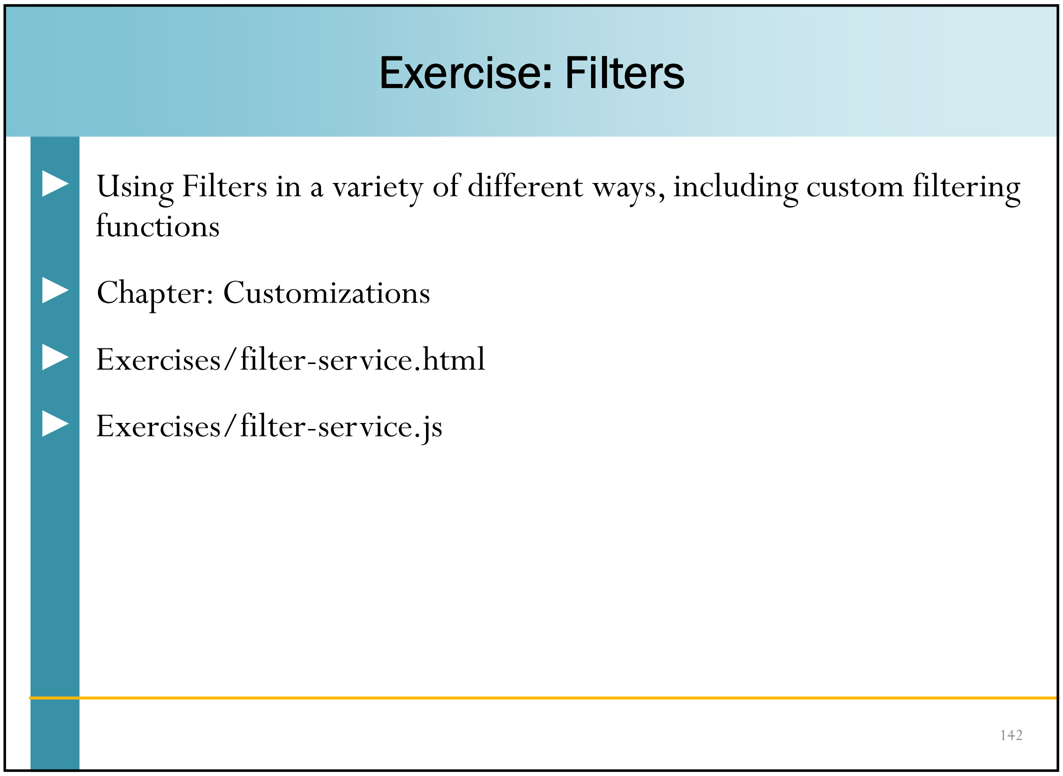

Exercise: Filters

- Using Filters in a variety of different ways, including custom filtering functions
- Chapter: Customizations
- Exercises/filter-service.html
- Exercises/filter-service.js

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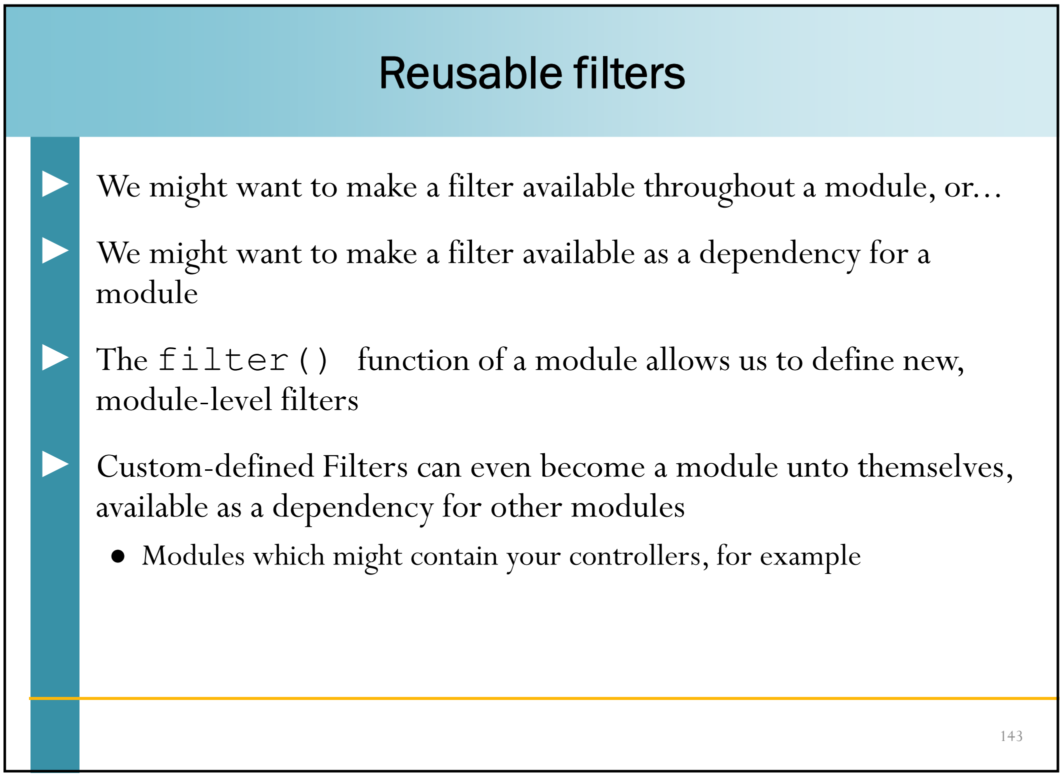
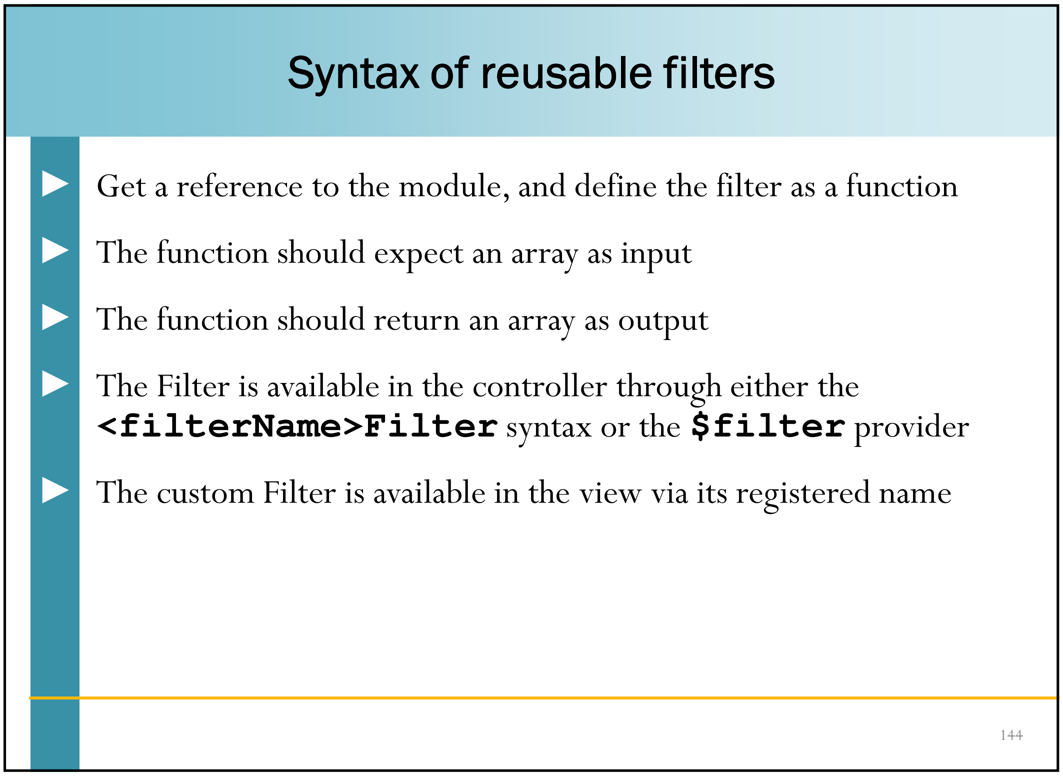


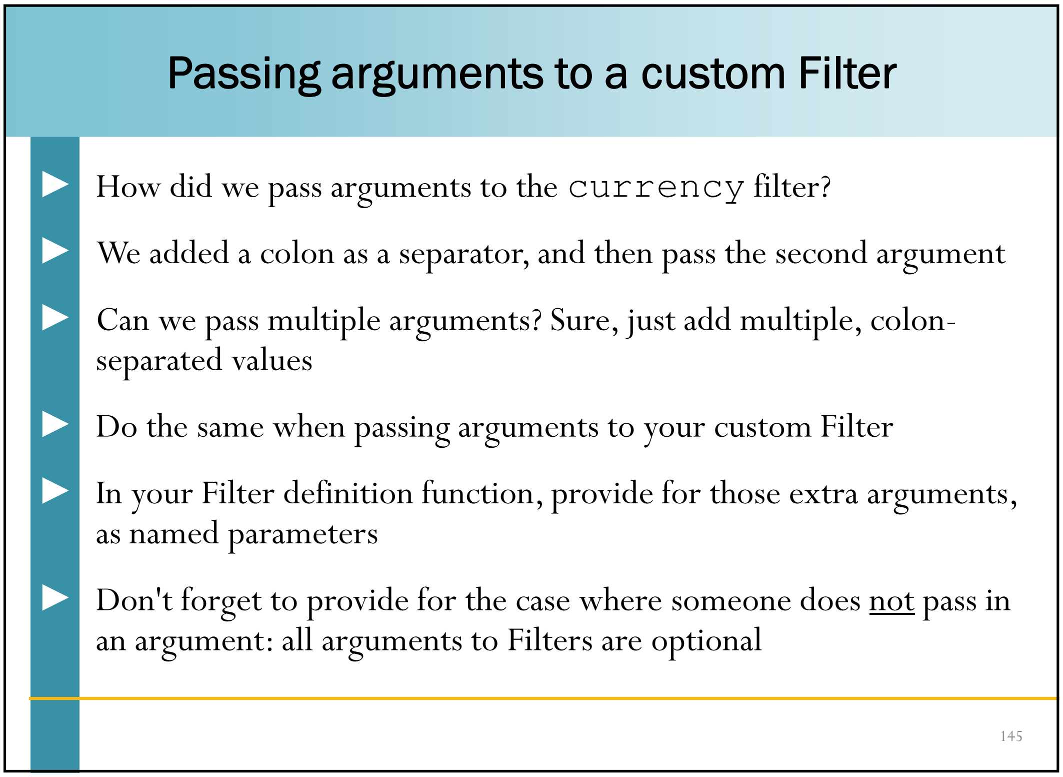
Reusable filters

- We might want to make a filter available throughout a module, or…
- We might want to make a filter available as a dependency for a module
- The `filter()` function of a module allows us to define new, module-level filters
- Custom-defined Filters can even become a module unto themselves, available as a dependency for other modules
  - Modules which might contain your controllers, for example



Syntax of reusable filters

- Get a reference to the module, and define the filter as a function
- The function should expect an array as input
- The function should return an array as output
- The Filter is available in the controller through either the **`<filterName>Filter`** syntax or the **`$filter`** provider
- The custom Filter is available in the view via its registered name



Passing arguments to a custom Filter

- How did we pass arguments to the `currency` filter?
- We added a colon as a separator, and then pass the second argument
- Can we pass multiple arguments? Sure, just add multiple, colon-separated values
- Do the same when passing arguments to your custom Filter
- In your Filter definition function, provide for those extra arguments, as named parameters
- Don't forget to provide for the case where someone does not pass in an argument: all arguments to Filters are optional

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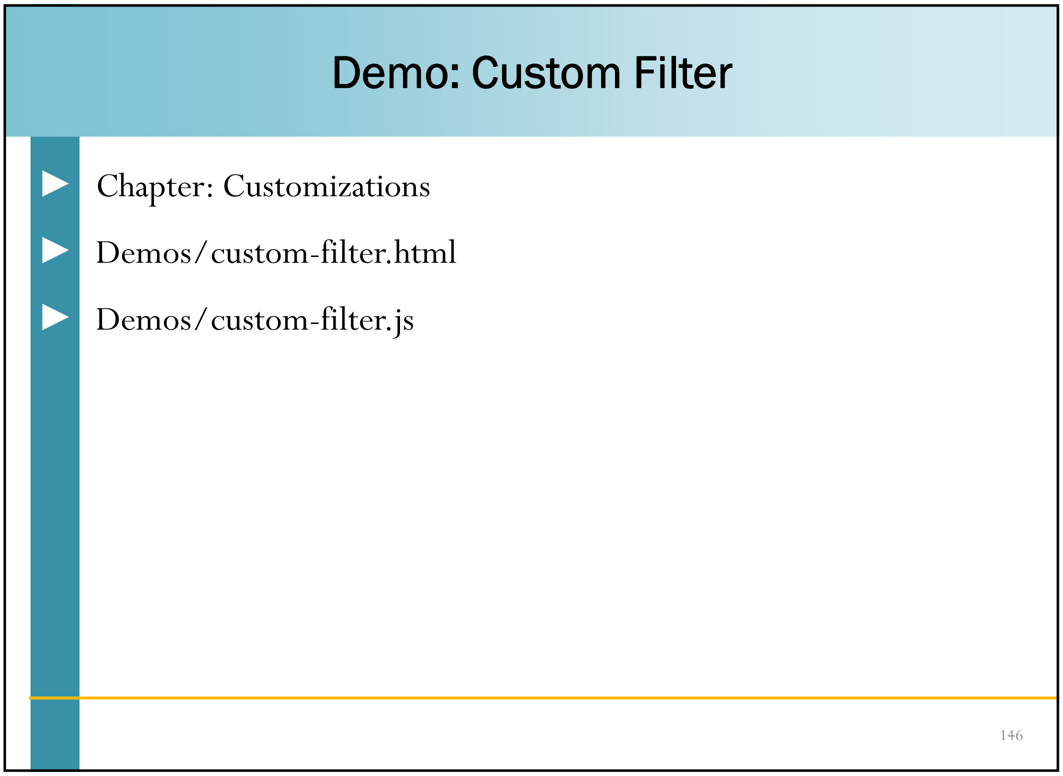

Demo: Custom Filter

- Chapter: Customizations
- Demos/custom-filter.html
- Demos/custom-filter.js

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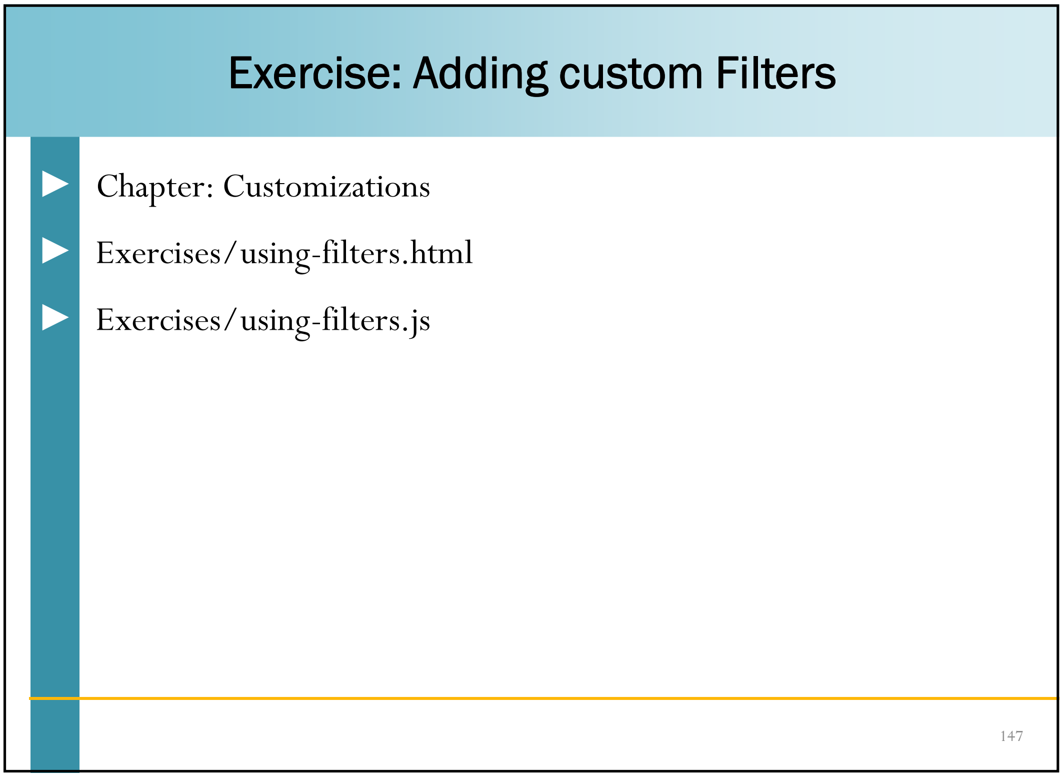

Exercise: Adding custom Filters

- Chapter: Customizations
- Exercises/using-filters.html
- Exercises/using-filters.js

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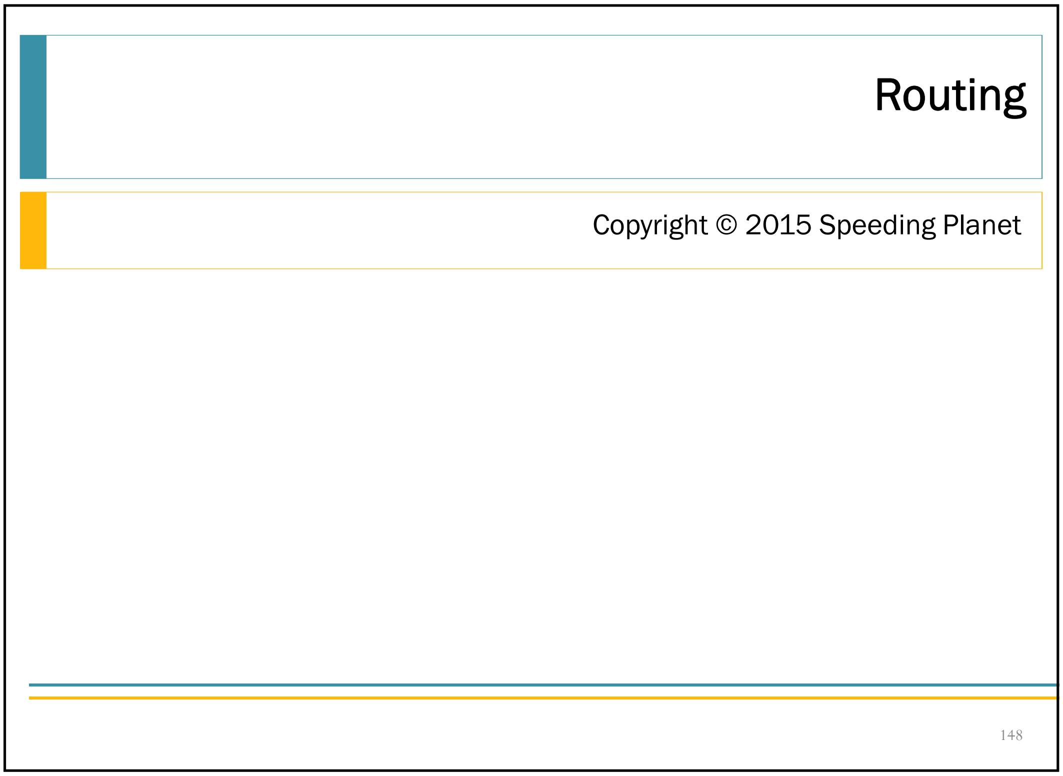

Routing

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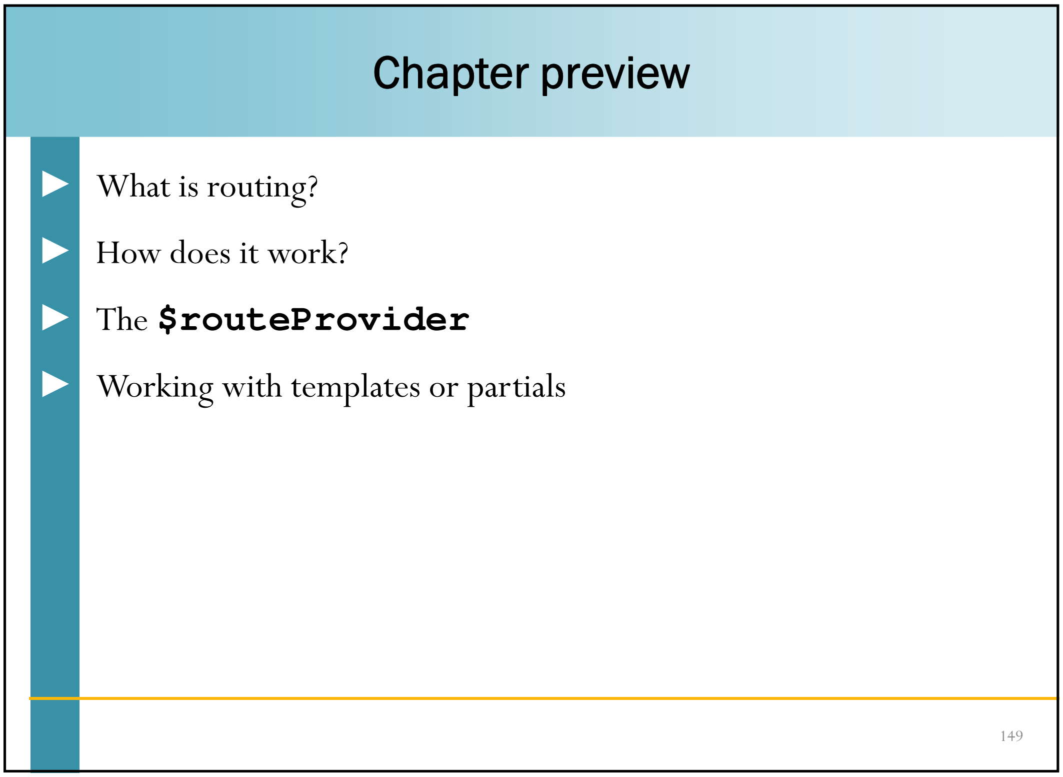
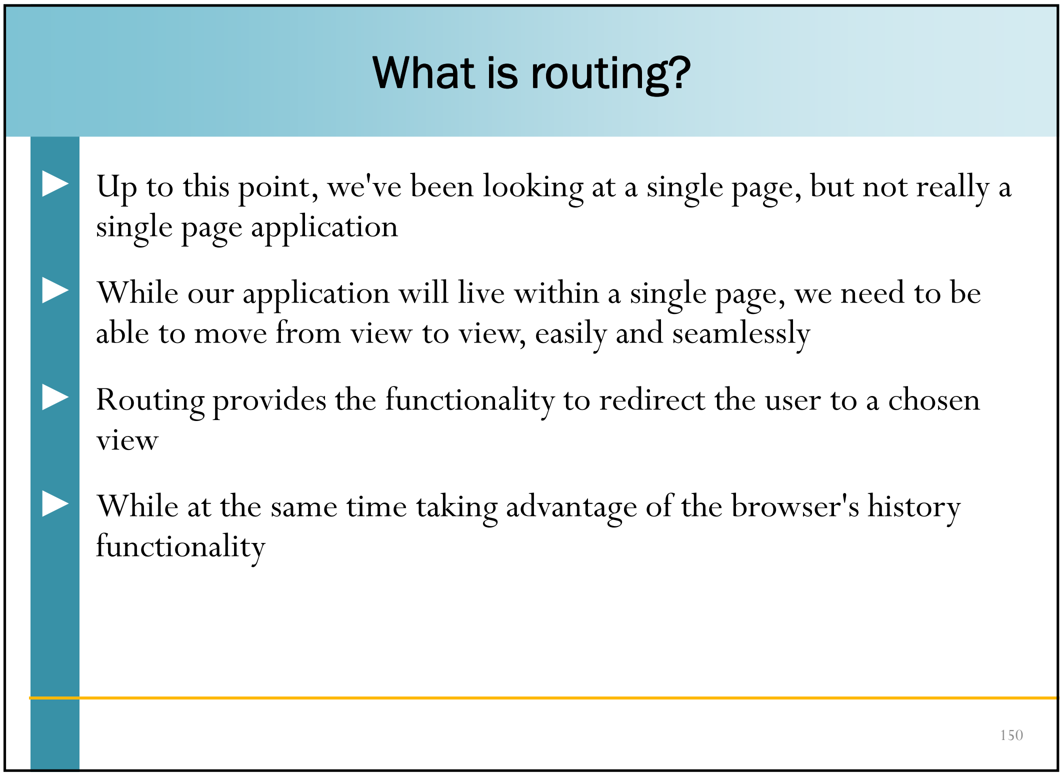


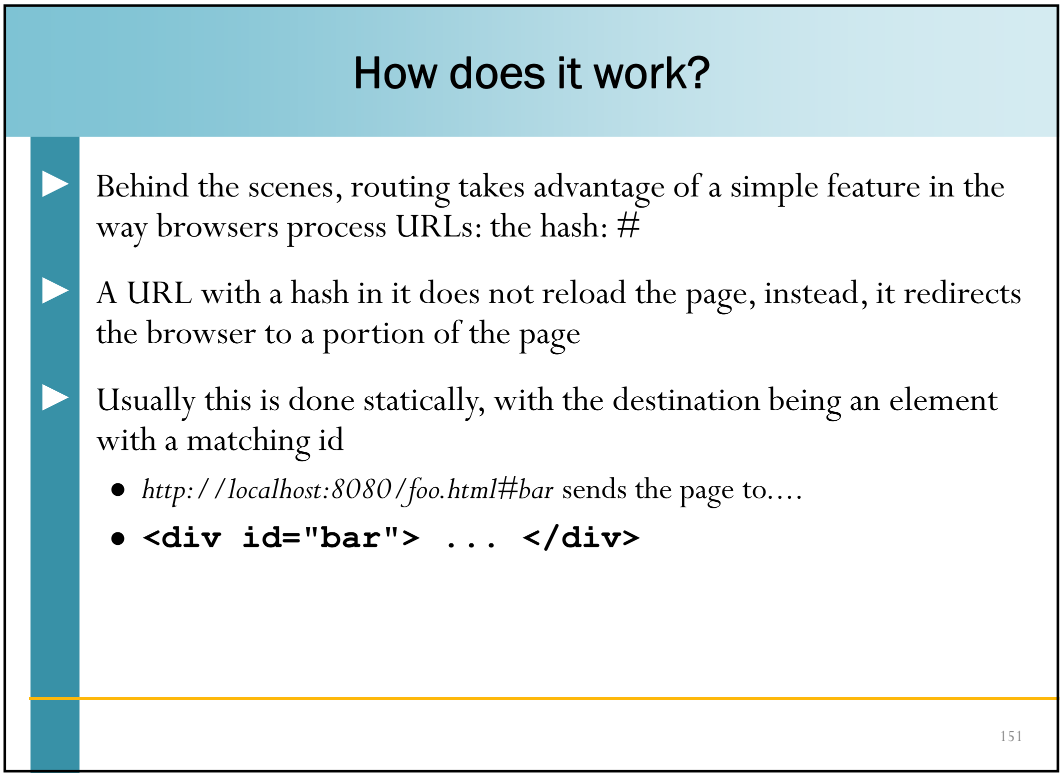
Chapter preview

- What is routing?
- How does it work?
- The **`$routeProvider`**
- Working with templates or partials



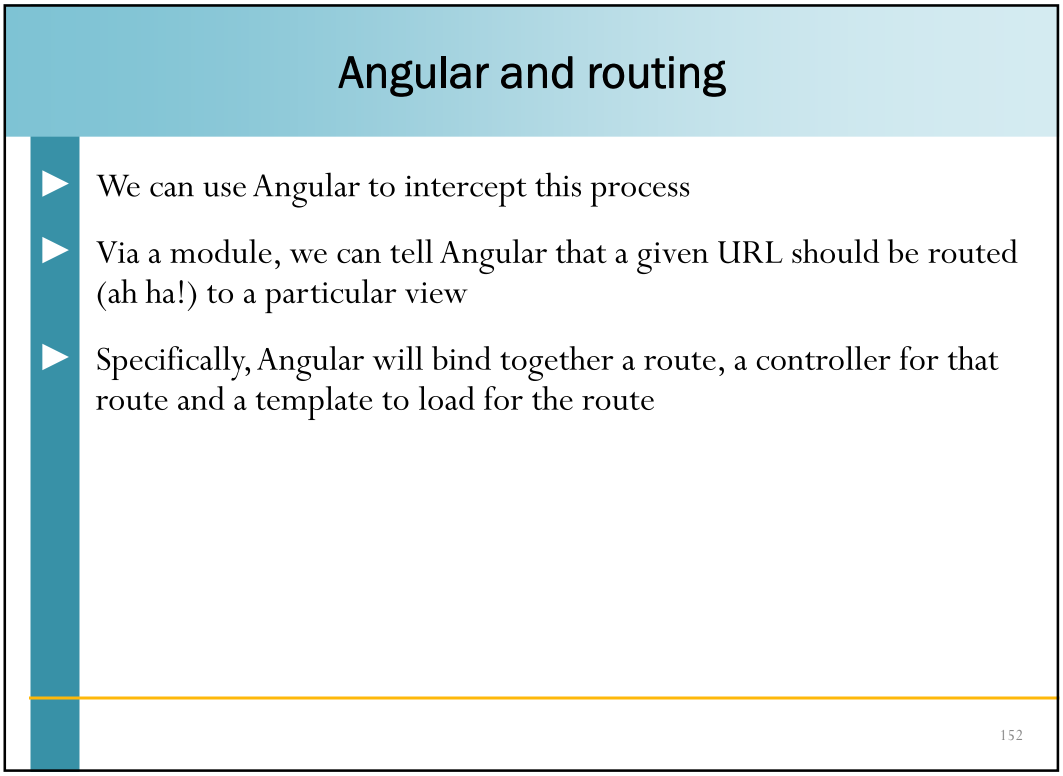
What is routing?

- Up to this point, we've been looking at a single page, but not really a single page application
- While our application will live within a single page, we need to be able to move from view to view, easily and seamlessly
- Routing provides the functionality to redirect the user to a chosen view
- While at the same time taking advantage of the browser's history functionality



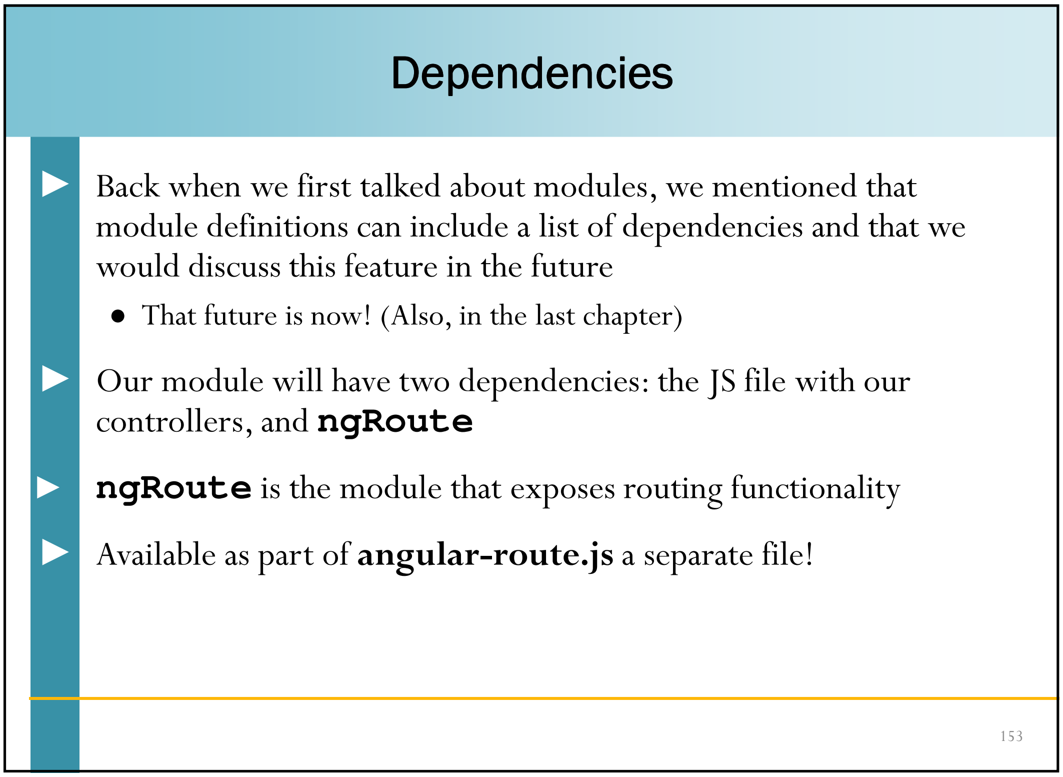
How does it work?

- Behind the scenes, routing takes advantage of a simple feature in the way browsers process URLs: the hash: #
- A URL with a hash in it does not reload the page, instead, it redirects the browser to a portion of the page
- Usually this is done statically, with the destination being an element with a matching id
  - *http://localhost:8080/foo.html#bar* sends the page to….
  - **`<div id="bar"> ... </div>`**



Angular and routing

- We can use Angular to intercept this process
- Via a module, we can tell Angular that a given URL should be routed (ah ha!) to a particular view
- Specifically, Angular will bind together a route, a controller for that route and a template to load for the route



Dependencies

- Back when we first talked about modules, we mentioned that module definitions can include a list of dependencies and that we would discuss this feature in the future
  - That future is now! (Also, in the last chapter)
- Our module will have two dependencies: the JS file with our controllers, and **`ngRoute`**
- **`ngRoute`** is the module that exposes routing functionality
- Available as part of **angular-route.js** a separate file!

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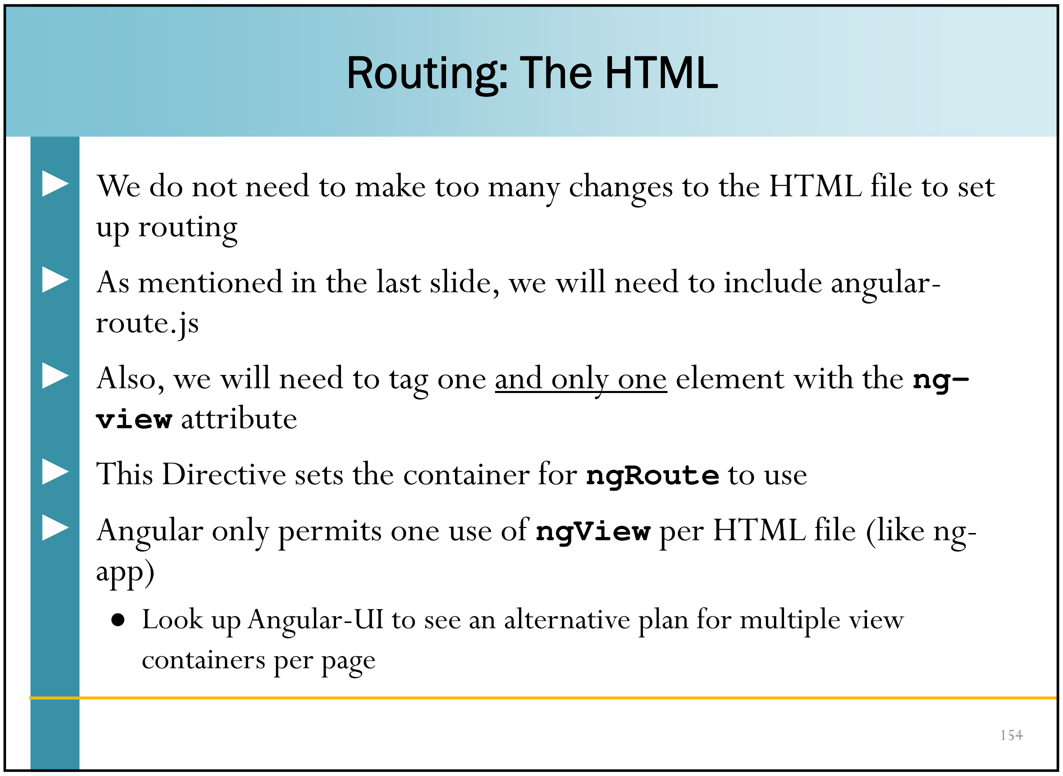

Routing: The HTML

- We do not need to make too many changes to the HTML file to set up routing
- As mentioned in the last slide, we will need to include angular-route.js
- Also, we will need to tag one <u>and only one</u> element with the **`ng-view`** attribute
- This Directive sets the container for **`ngRoute`** to use
- Angular only permits one use of **`ngView`** per HTML file (like ng-app)
  - Look up Angular-UI to see an alternative plan for multiple view containers per page

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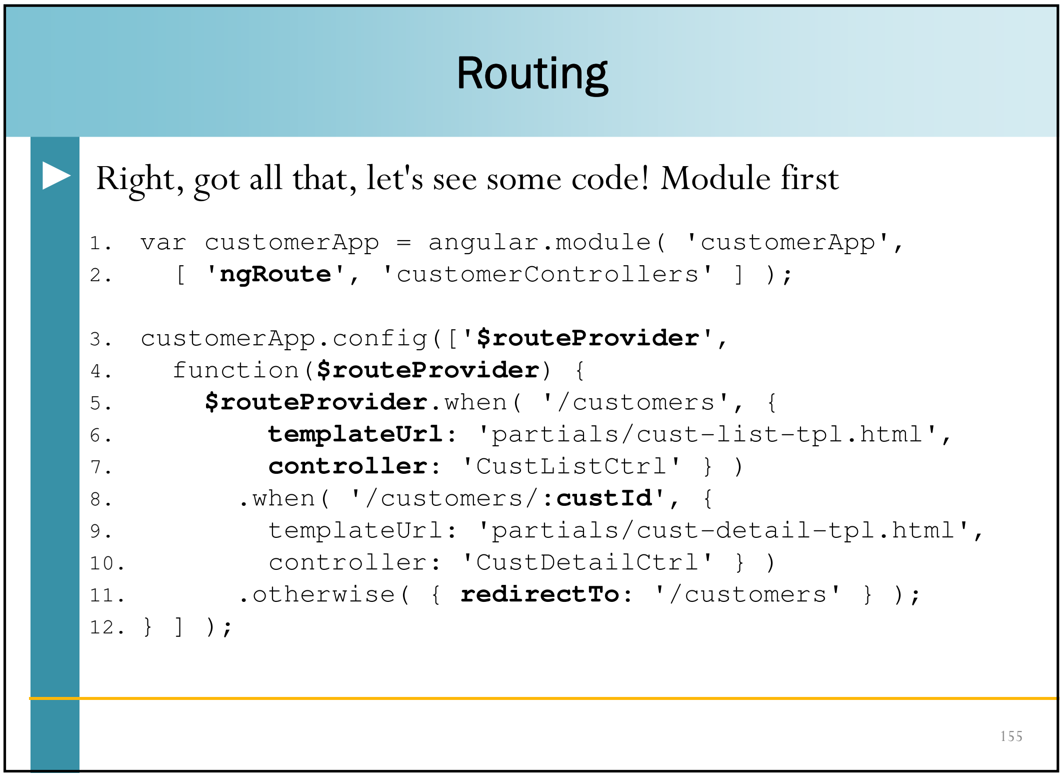

Routing

- Right, got all that, let's see some code! Module first

```
var customerApp = angular.module( 'customerApp',
  [ 'ngRoute', 'customerControllers' ] );

customerApp.config(['$routeProvider',
  function($routeProvider) {
    $routeProvider.when( '/customers', {
        templateUrl: 'partials/cust-list-tpl.html',
        controller: 'CustListCtrl' } )
      .when( '/customers/:custId', {
        templateUrl: 'partials/cust-detail-tpl.html',
        controller: 'CustDetailCtrl' } )
      .otherwise( { redirectTo: '/customers' } );
} ] );
```

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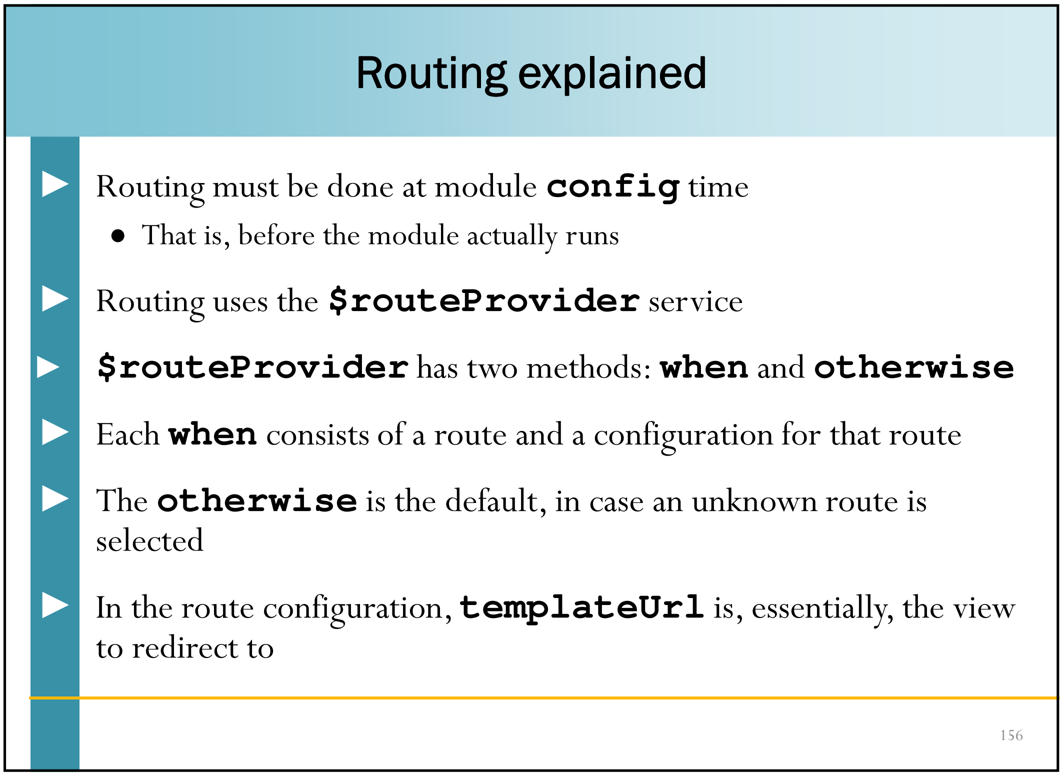

Routing explained

- Routing must be done at module **`config`** time
  - That is, before the module actually runs
- Routing uses the **`$routeProvider`** service
- **`$routeProvider`** has two methods: **`when`** and **`otherwise`**
- Each **`when`** consists of a route and a configuration for that route
- The **`otherwise`** is the default, in case an unknown route is selected
- In the route configuration, **`templateUrl`** is, essentially, the view to redirect to

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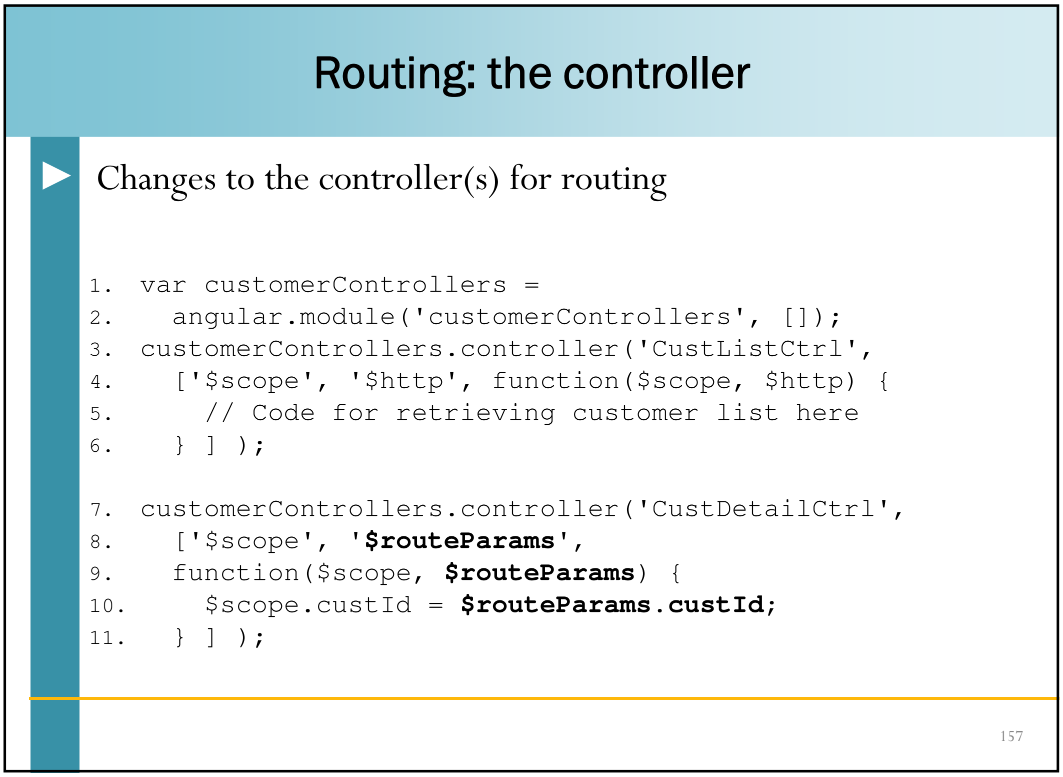
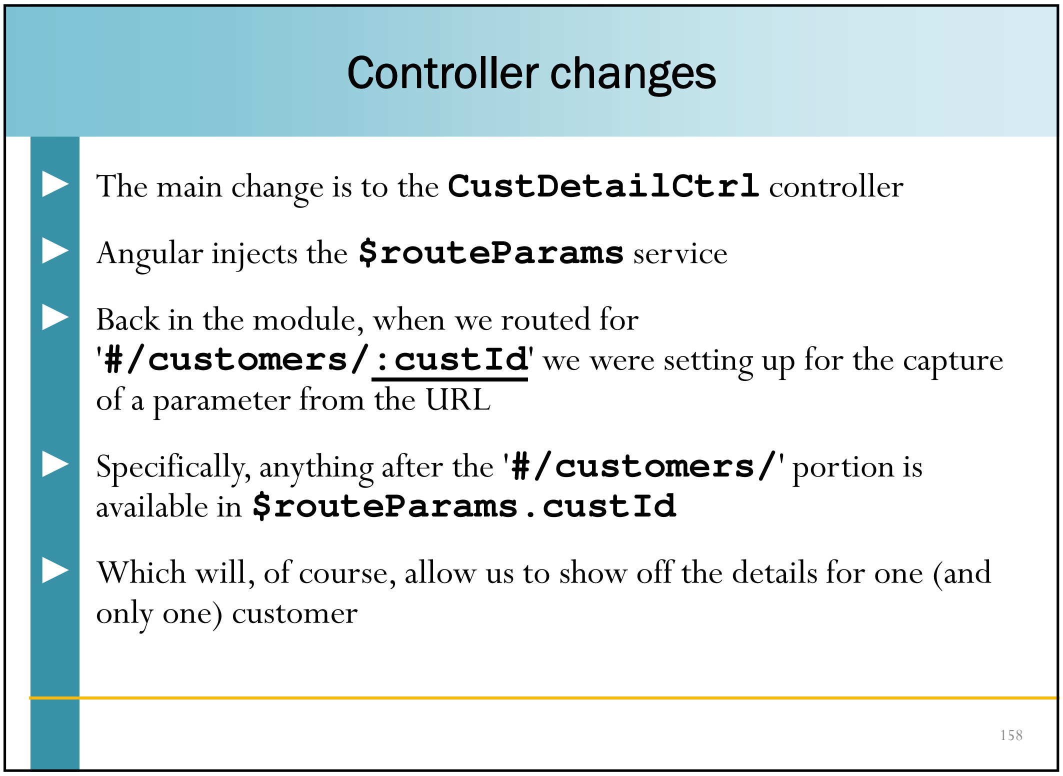


Routing: the controller

- Changes to the controller(s) for routing

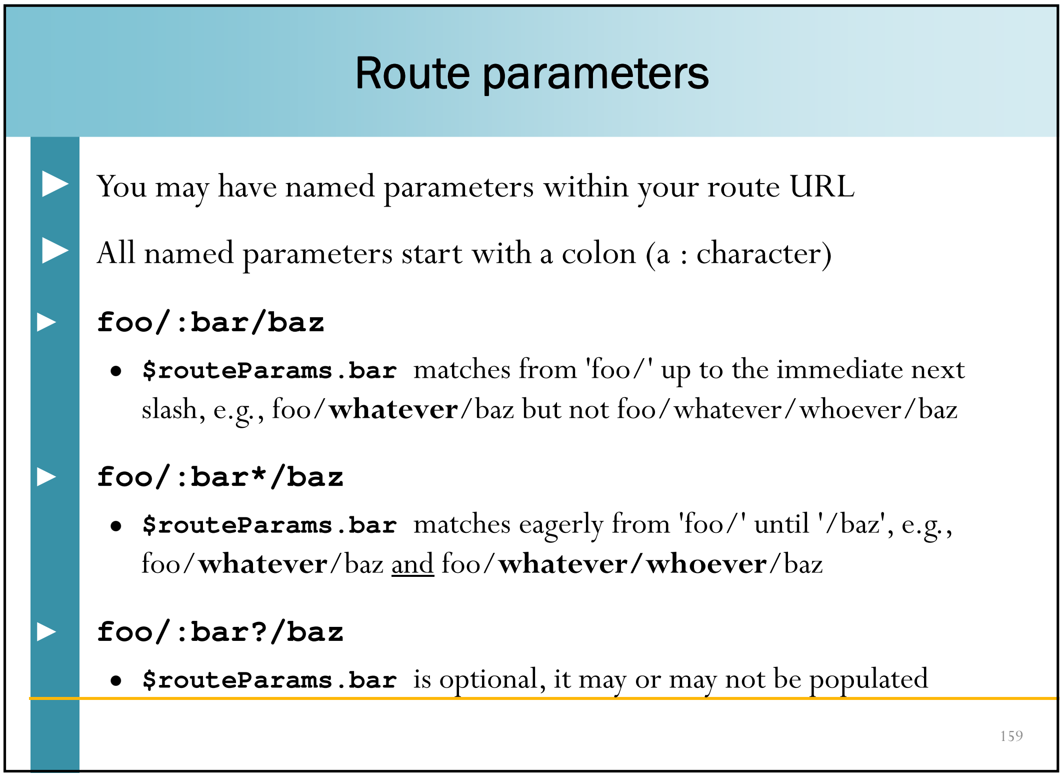
```
var customerControllers =
  angular.module('customerControllers', []);
customerControllers.controller('CustListCtrl',
  ['$scope', '$http', function($scope, $http) {
    // Code for retrieving customer list here
  } ] );

customerControllers.controller('CustDetailCtrl',
  ['$scope', '$routeParams',
  function($scope, $routeParams) {
    $scope.custId = $routeParams.custId;
  } ] );
```



Controller changes

- The main change is to the **`CustDetailCtrl`** controller
- Angular injects the **`$routeParams`** service
- Back in the module, when we routed for '**`#/customers/:custId`**' we were setting up for the capture of a parameter from the URL
- Specifically, anything after the '**`#/customers/`**' portion is available in **`$routeParams.custId`**
- Which will, of course, allow us to show off the details for one (and only one) customer



Route parameters

- You may have named parameters within your route URL
- All named parameters start with a colon (a : character)
- **`foo/:bar/baz`**
  - **`$routeParams.bar`** matches from 'foo/' up to the immediate next slash, e.g., foo/**whatever**/baz but not foo/whatever/whoever/baz
- **`foo/:bar*/baz`**
  - **`$routeParams.bar`** matches eagerly from 'foo/' until '/baz', e.g., foo/**whatever**/baz and foo/**whatever/whoever**/baz
- **`foo/:bar?/baz`**
  - **`$routeParams.bar`** is optional, it may or may not be populated

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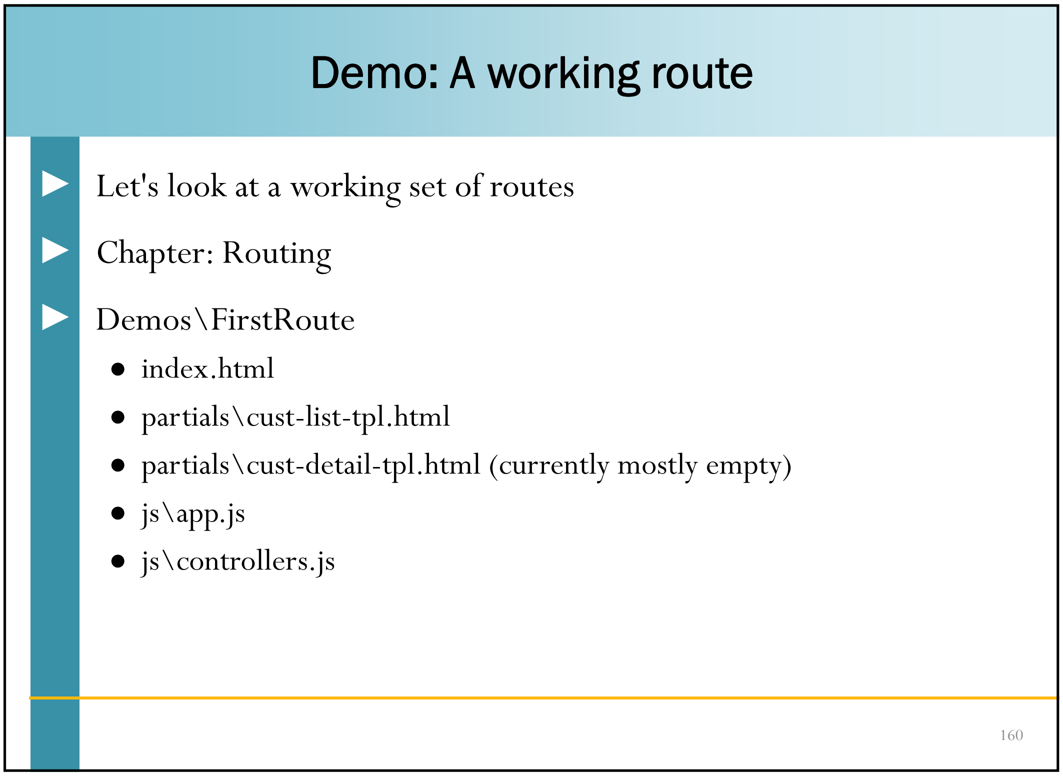

Demo: A working route

- Let's look at a working set of routes
- Chapter: Routing
- Demos\FirstRoute
  - index.html
  - partials\cust-list-tpl.html
  - partials\cust-detail-tpl.html (currently mostly empty)
  - js\app.js
  - js\controllers.js

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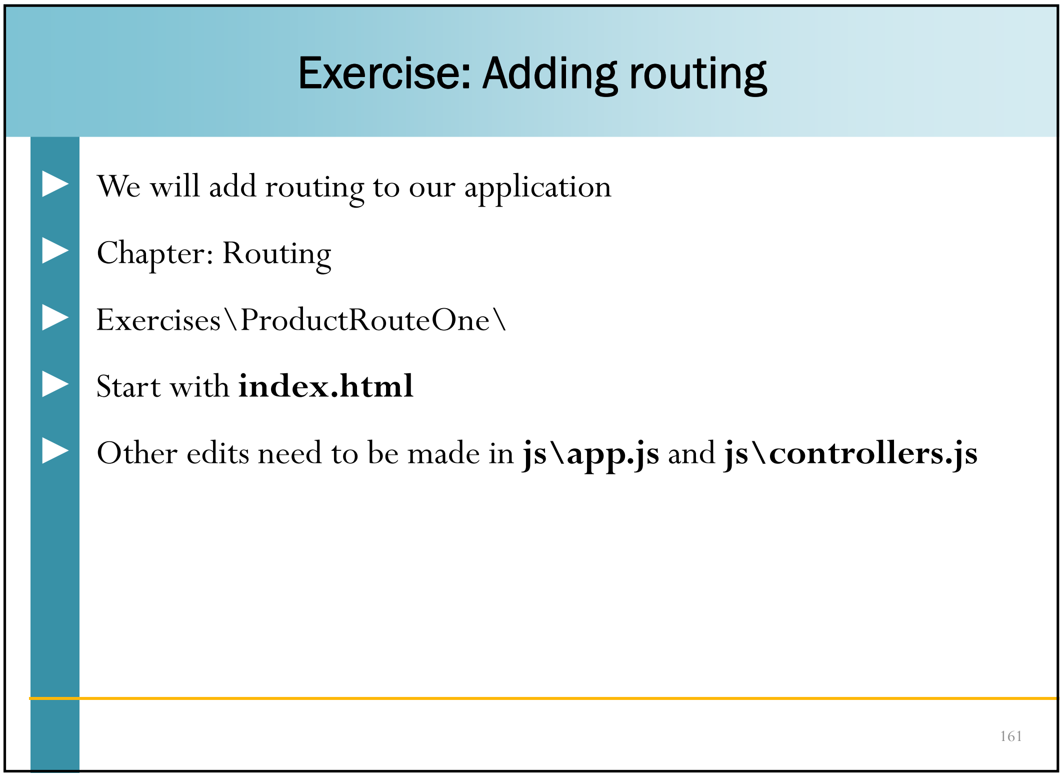
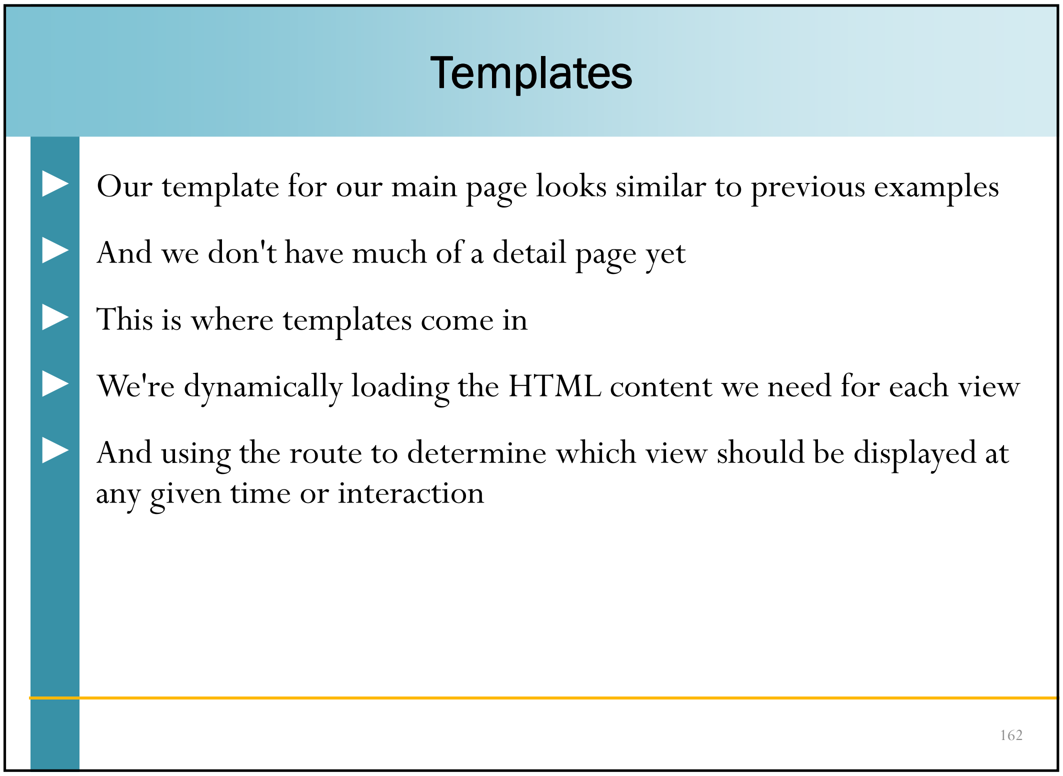


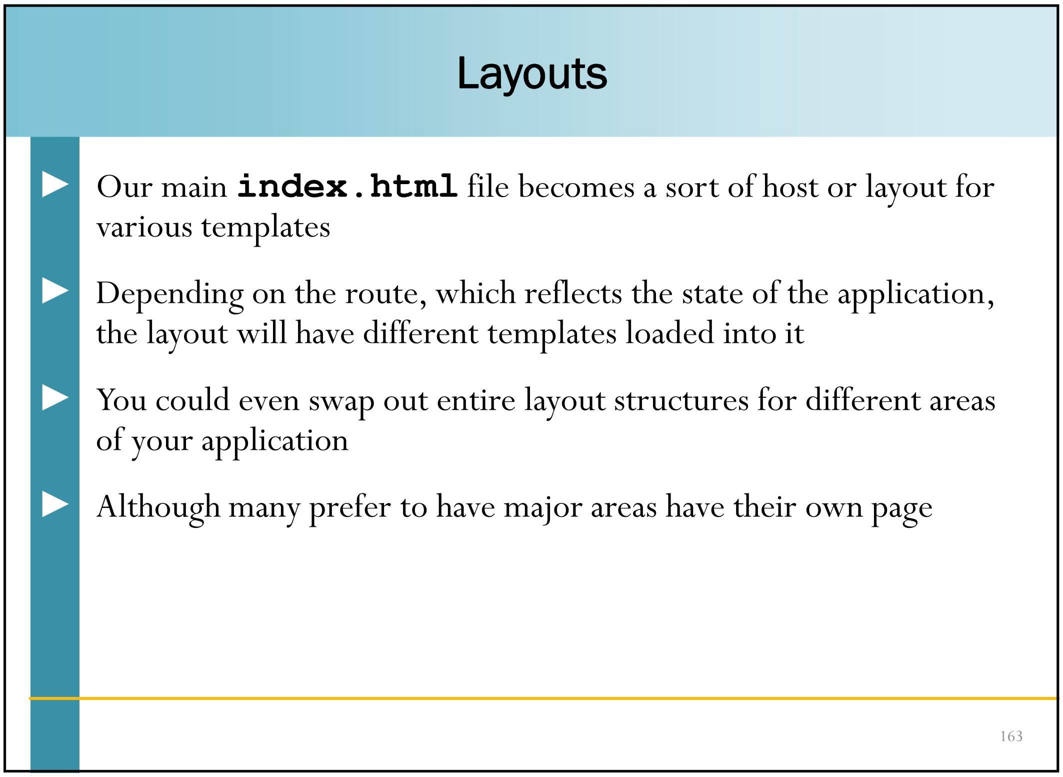
Exercise: Adding routing

- We will add routing to our application
- Chapter: Routing
- Exercises\ProductRouteOne\
- Start with **index.html**
- Other edits need to be made in **js\app.js** and **js\controllers.js**



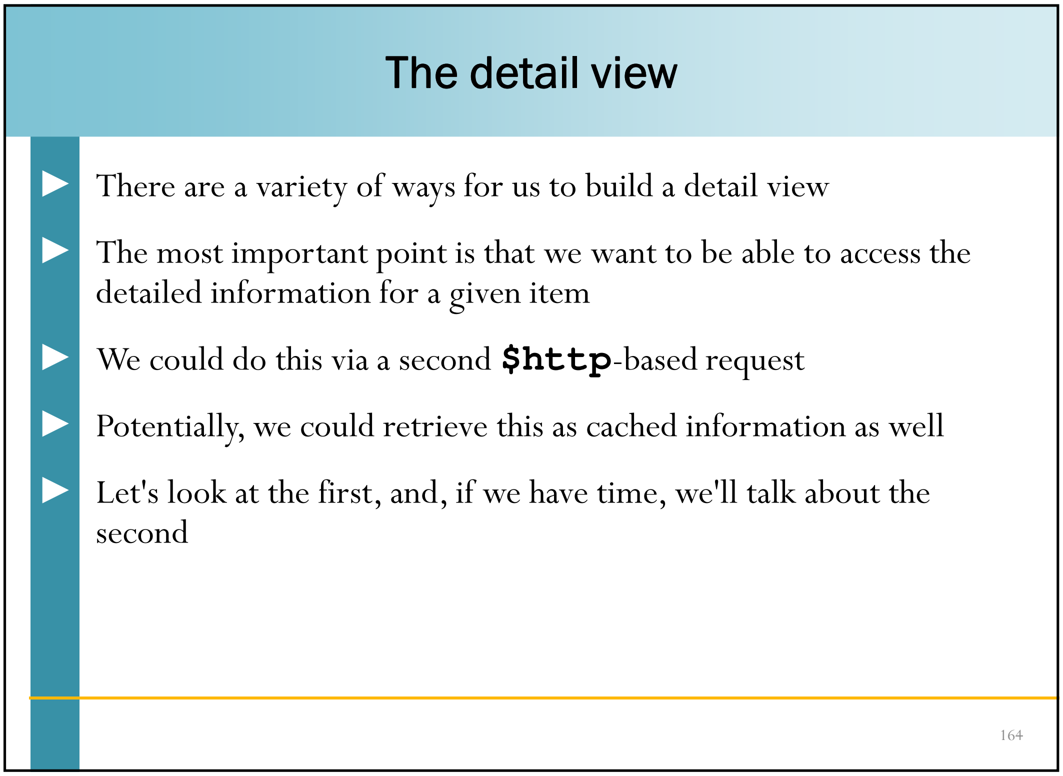
Templates

- Our template for our main page looks similar to previous examples
- And we don't have much of a detail page yet
- This is where templates come in
- We're dynamically loading the HTML content we need for each view
- And using the route to determine which view should be displayed at any given time or interaction



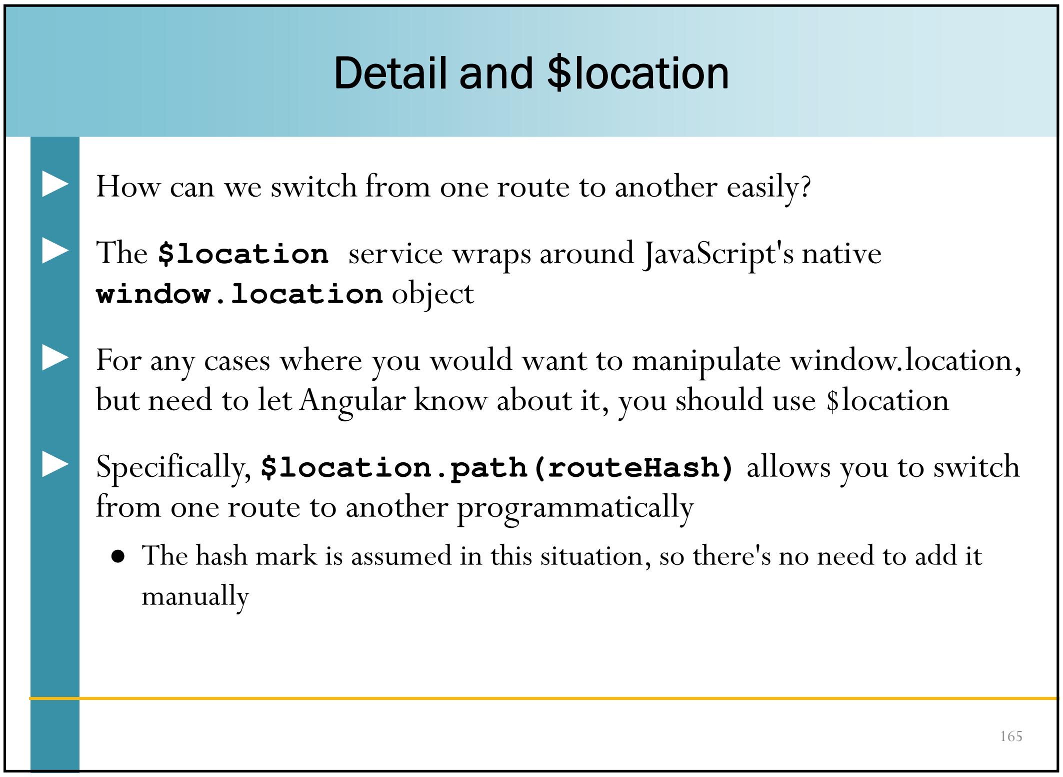
Layouts

- Our main **`index.html`** file becomes a sort of host or layout for various templates
- Depending on the route, which reflects the state of the application, the layout will have different templates loaded into it
- You could even swap out entire layout structures for different areas of your application
- Although many prefer to have major areas have their own page



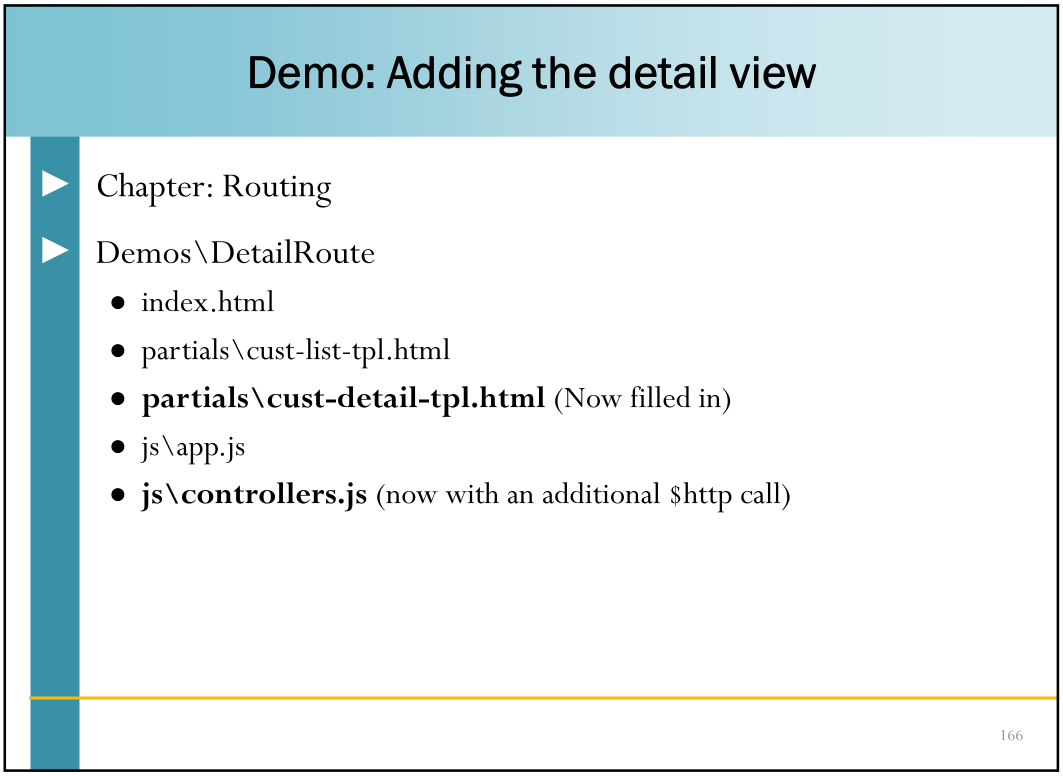
The detail view

- There are a variety of ways for us to build a detail view
- The most important point is that we want to be able to access the detailed information for a given item
- We could do this via a second **`$http`**-based request
- Potentially, we could retrieve this as cached information as well
- Let's look at the first, and, if we have time, we'll talk about the second



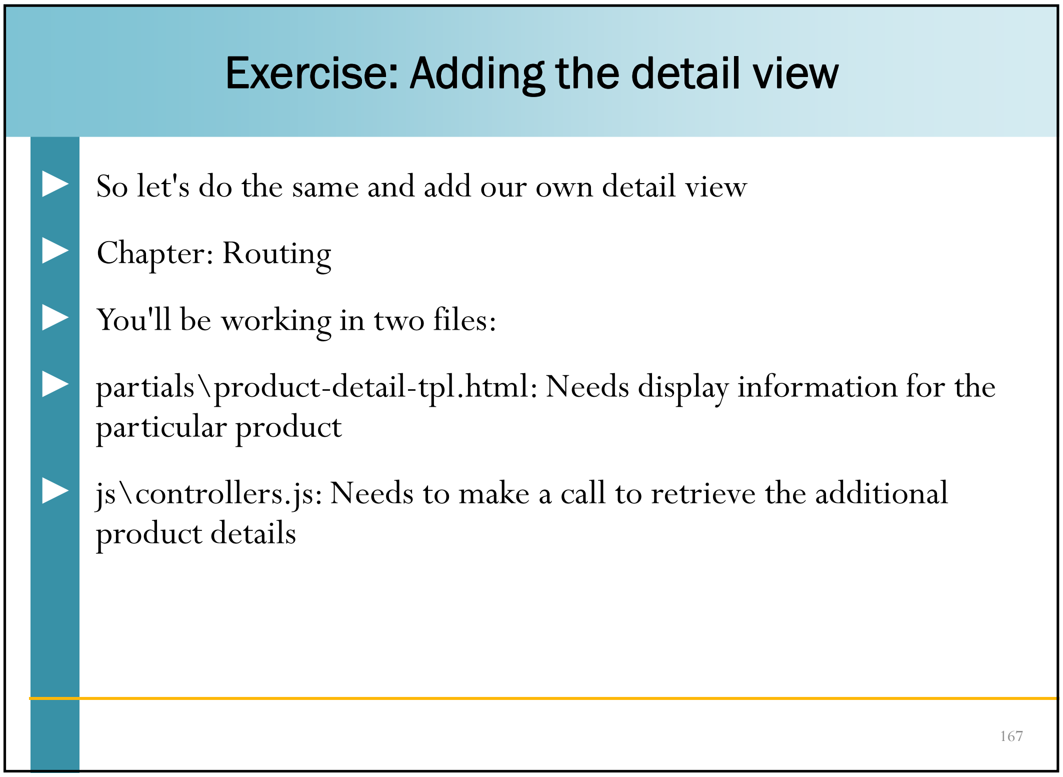
Detail and $location

- How can we switch from one route to another easily?
- The **`$location`** service wraps around JavaScript's native **`window.location`** object
- For any cases where you would want to manipulate window.location, but need to let Angular know about it, you should use $location
- Specifically, **`$location.path(routeHash)`** allows you to switch from one route to another programmatically
  - The hash mark is assumed in this situation, so there's no need to add it manually



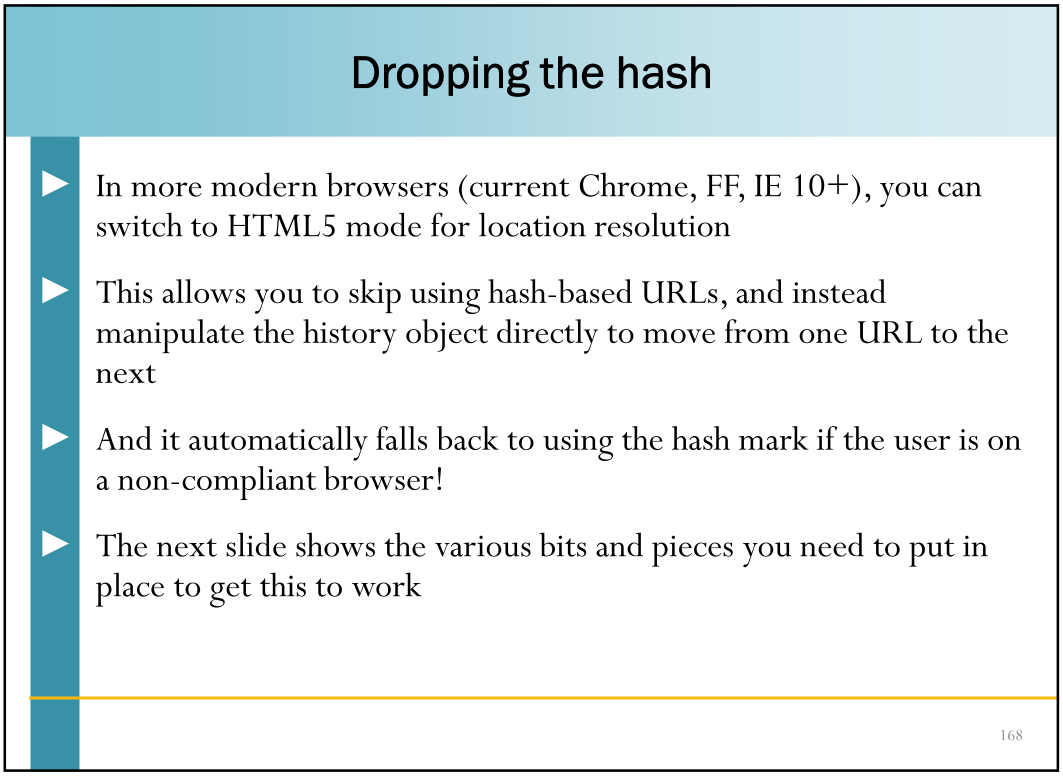
Demo: Adding the detail view

- Chapter: Routing
- Demos\DetailRoute
  - index.html
  - partials\cust-list-tpl.html
  - **partials\cust-detail-tpl.html** (Now filled in)
  - js\app.js
  - **js\controllers.js** (now with an additional $http call)



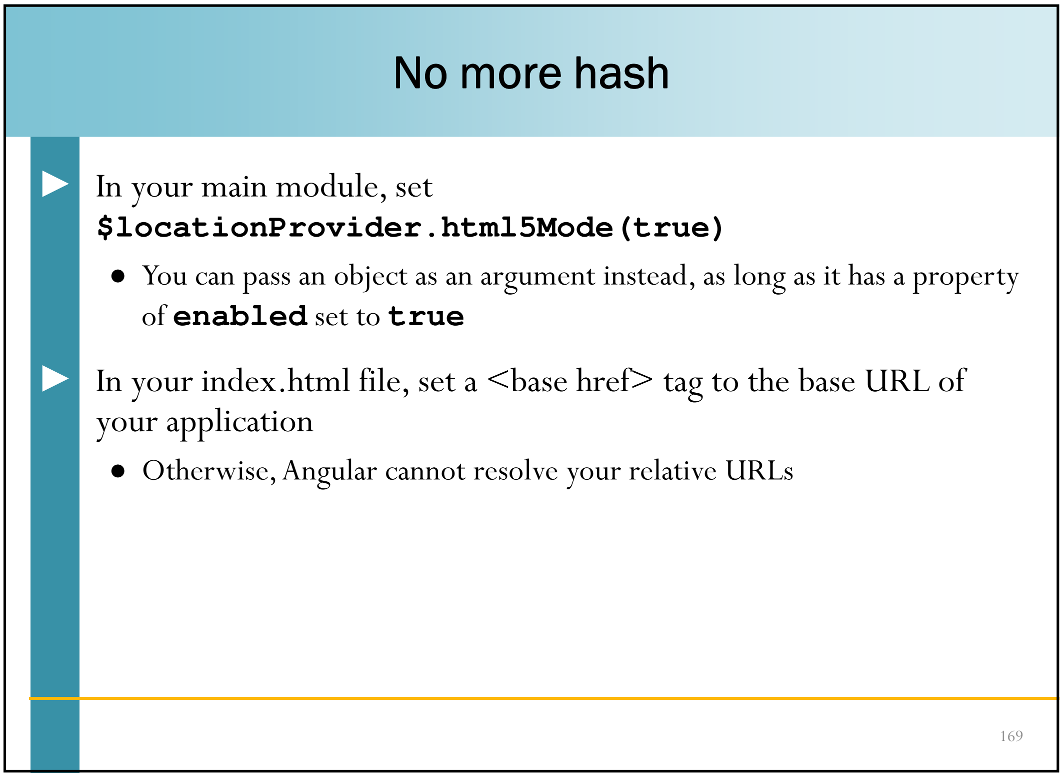
Exercise: Adding the detail view

- So let's do the same and add our own detail view
- Chapter: Routing
- You'll be working in two files:
- partials\product-detail-tpl.html: Needs display information for the particular product
- js\controllers.js: Needs to make a call to retrieve the additional product details



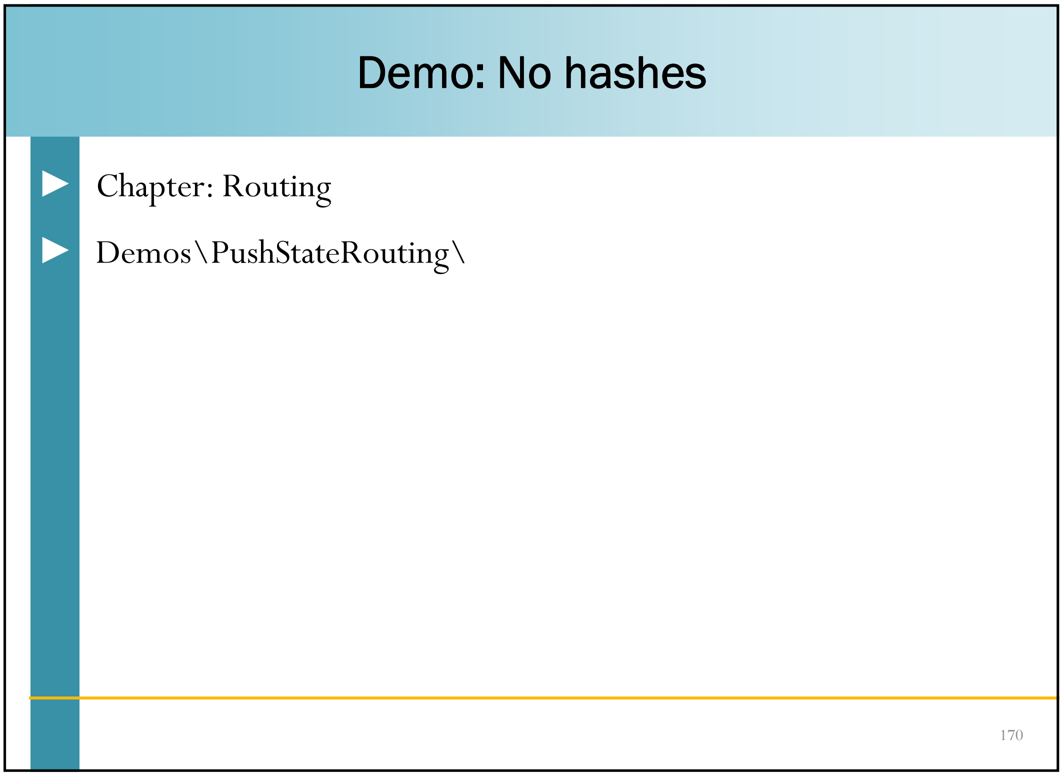
Dropping the hash

- In more modern browsers (current Chrome, FF, IE 10+), you can switch to HTML5 mode for location resolution
- This allows you to skip using hash-based URLs, and instead manipulate the history object directly to move from one URL to the next
- And it automatically falls back to using the hash mark if the user is on a non-compliant browser!
- The next slide shows the various bits and pieces you need to put in place to get this to work



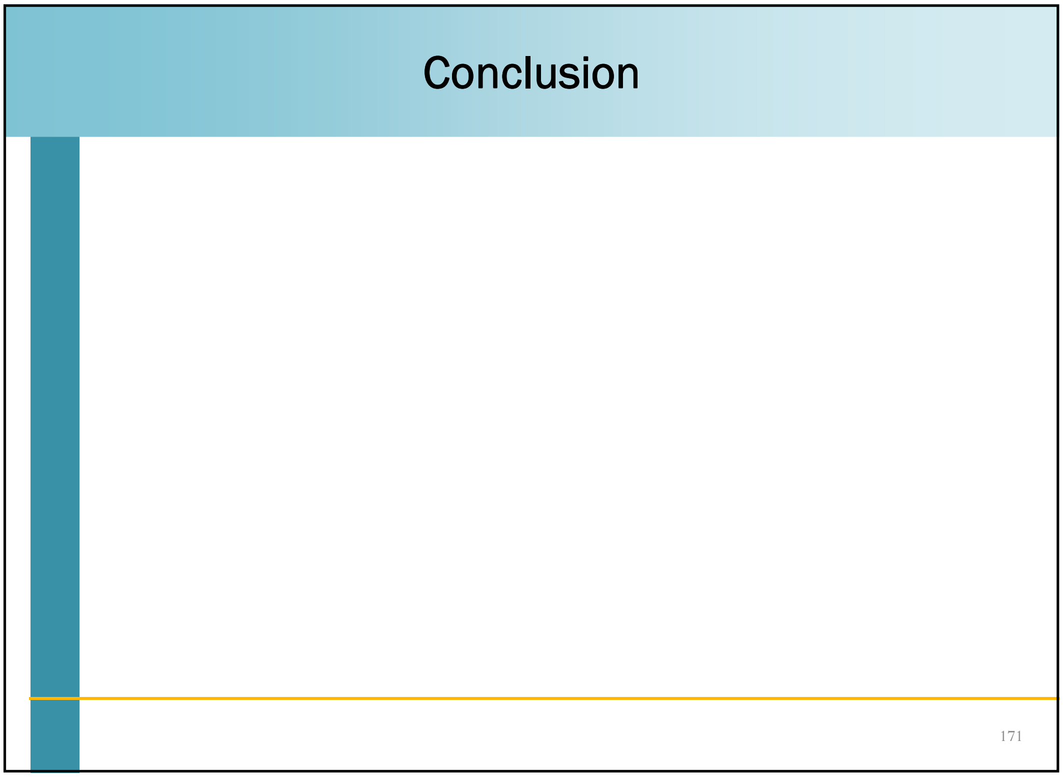
No more hash

- In your main module, set **`$locationProvider.html5Mode(true)`**
  - You can pass an object as an argument instead, as long as it has a property of **`enabled`** set to **`true`**
- In your index.html file, set a <base href> tag to the base URL of your application
  - Otherwise, Angular cannot resolve your relative URLs

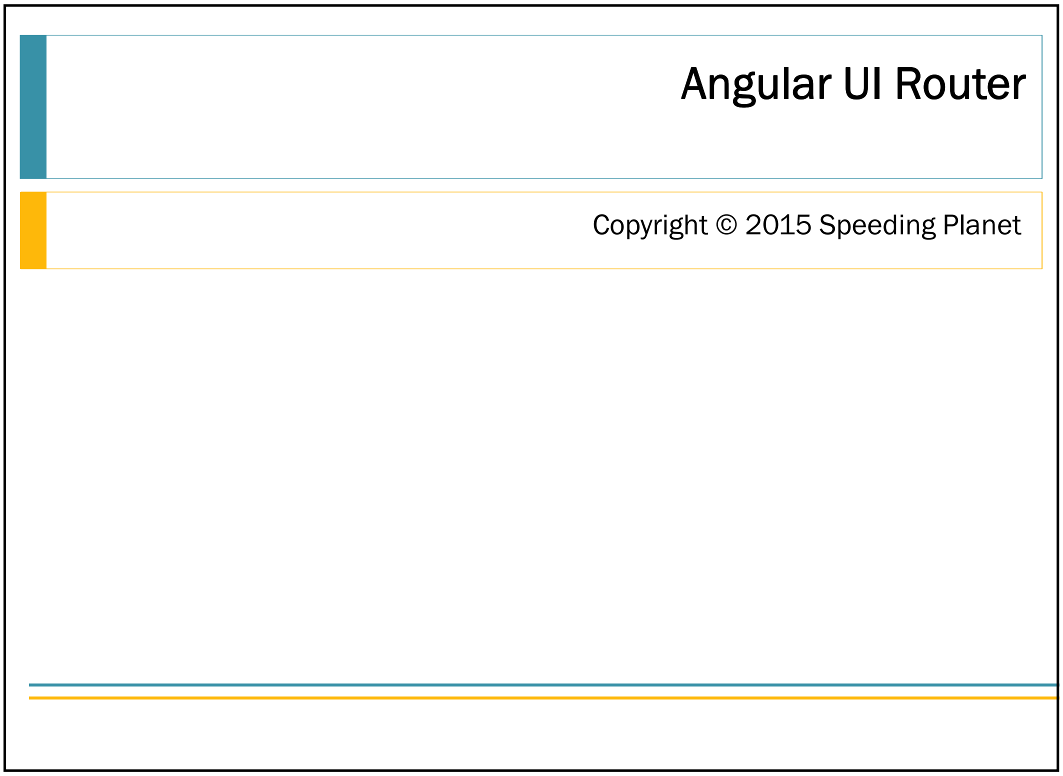


Demo: No hashes

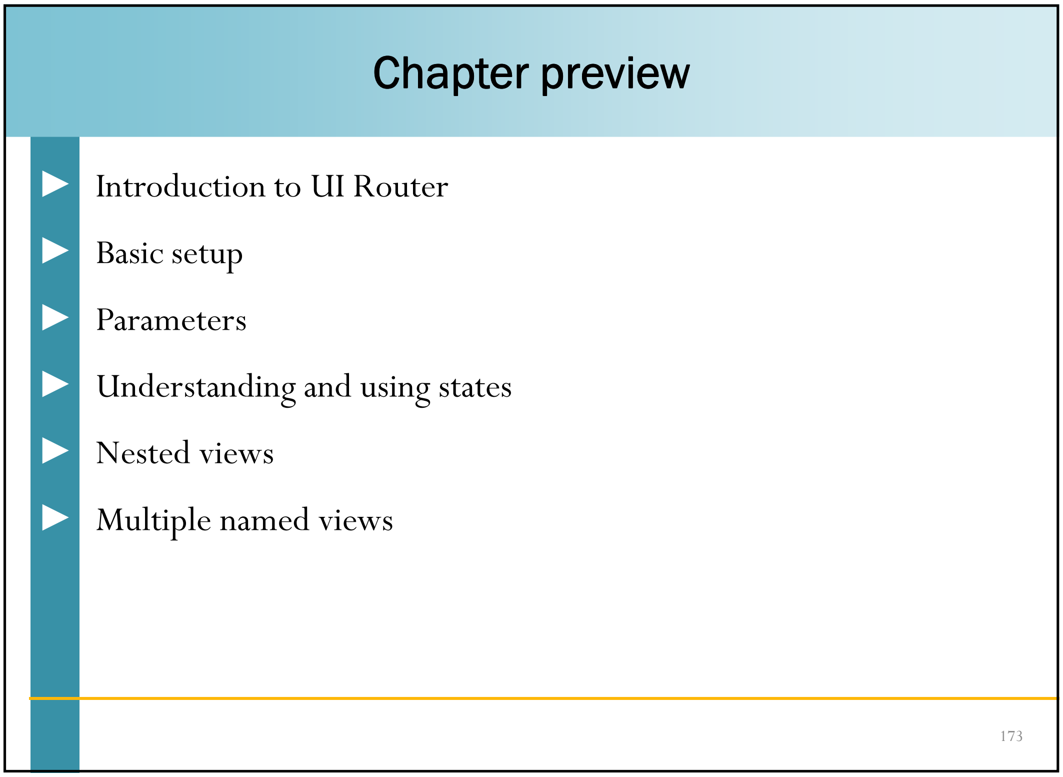
- Chapter: Routing
- Demos\PushStateRouting\



Conclusion

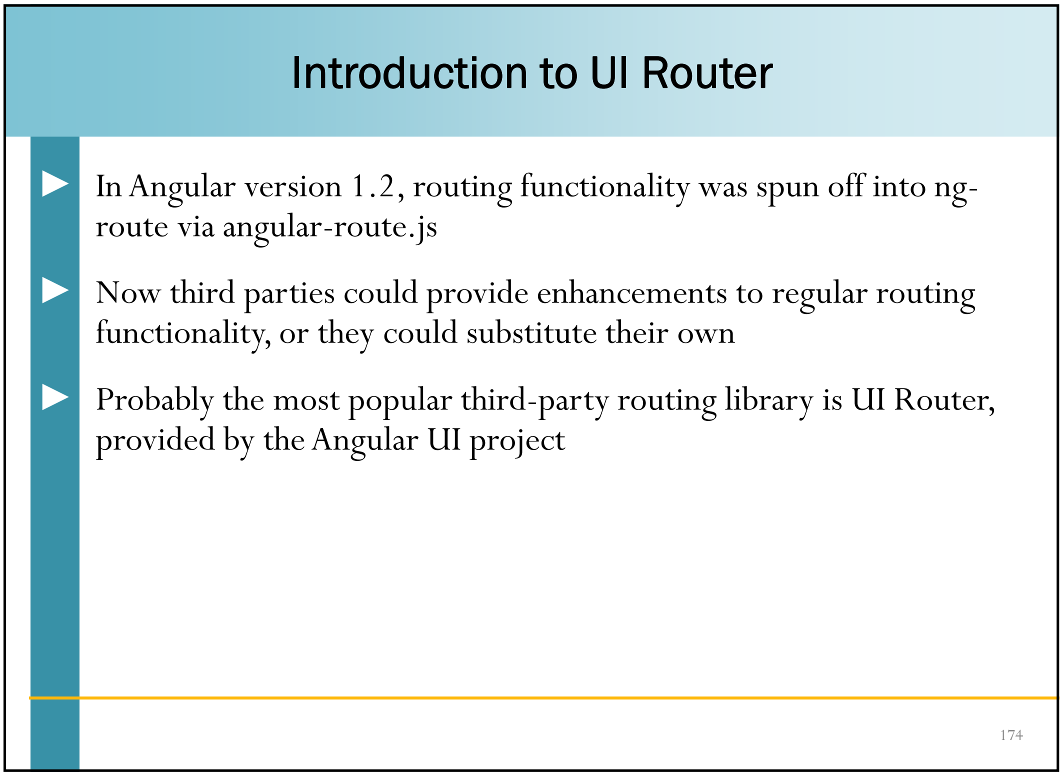


Angular UI Router



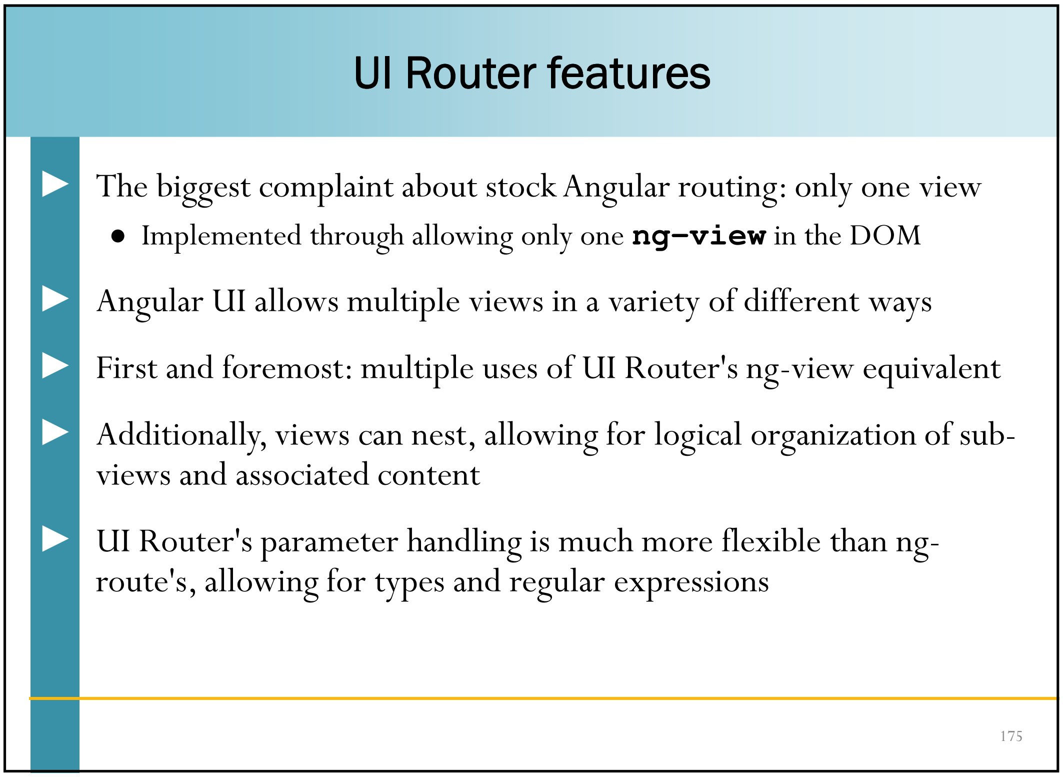
Chapter preview

- Introduction to UI Router
- Basic setup
- Parameters
- Understanding and using states
- Nested views
- Multiple named views



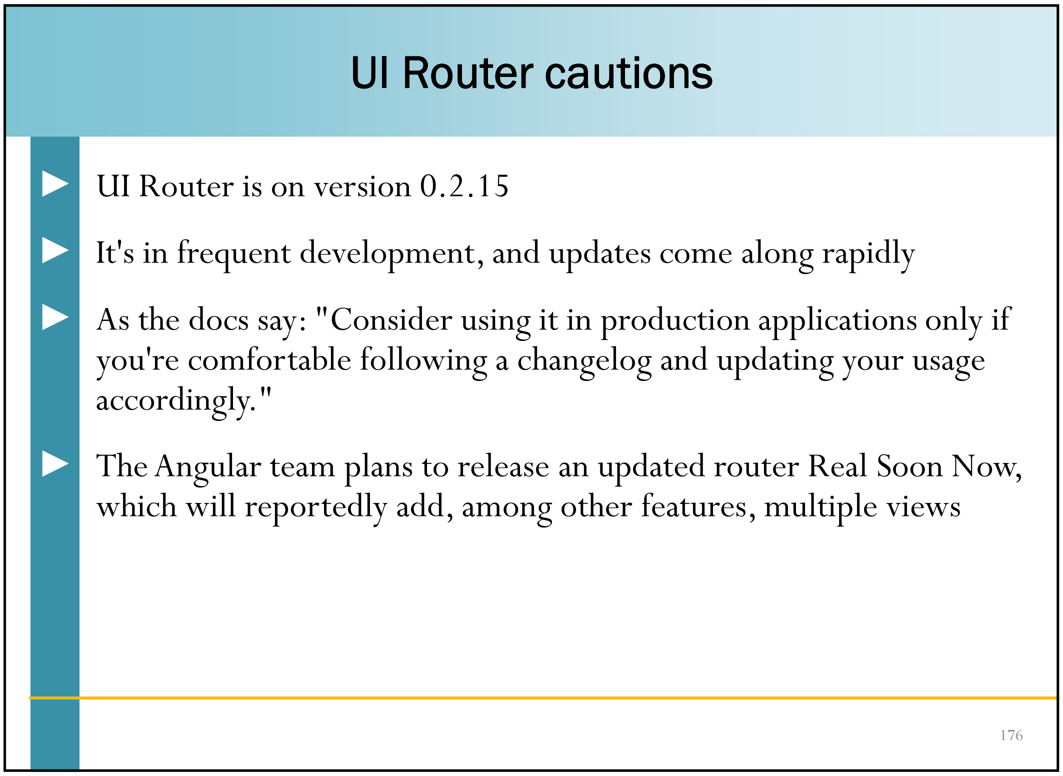
Introduction to UI Router

- In Angular version 1.2, routing functionality was spun off into ng-route via angular-route.js
- Now third parties could provide enhancements to regular routing functionality, or they could substitute their own
- Probably the most popular third-party routing library is UI Router, provided by the Angular UI project



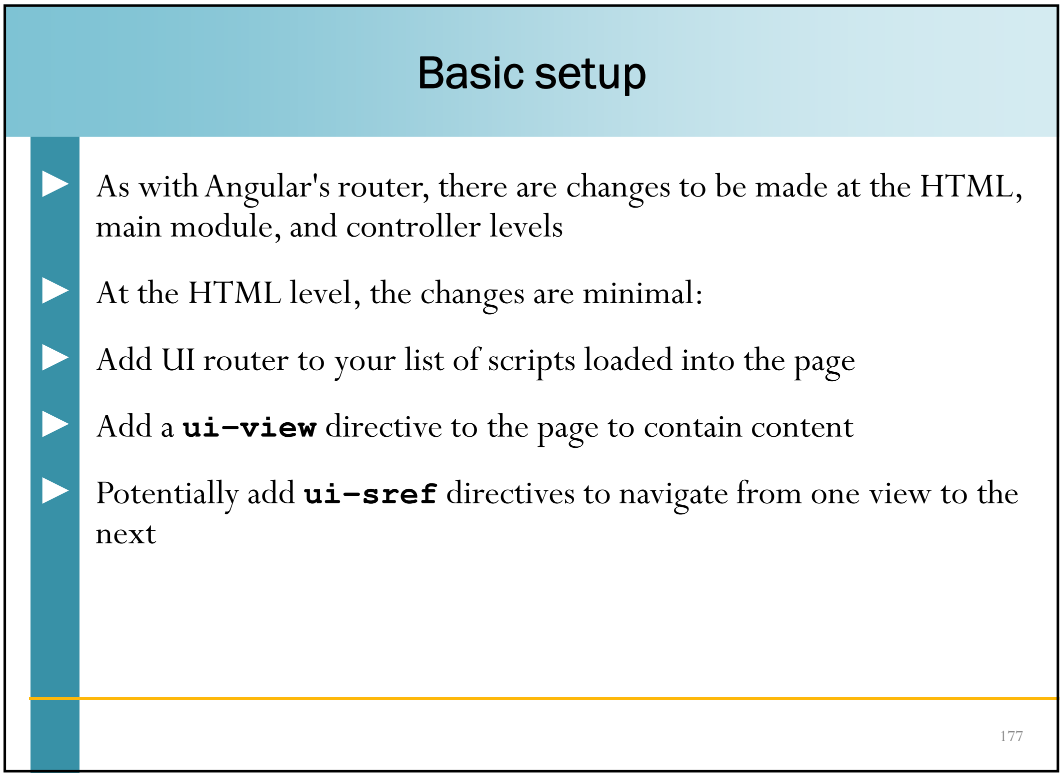
UI Router features

- The biggest complaint about stock Angular routing: only one view
  - Implemented through allowing only one **`ng-view`** in the DOM
- Angular UI allows multiple views in a variety of different ways
- First and foremost: multiple uses of UI Router's ng-view equivalent
- Additionally, views can nest, allowing for logical organization of sub-views and associated content
- UI Router's parameter handling is much more flexible than ng-route's, allowing for types and regular expressions



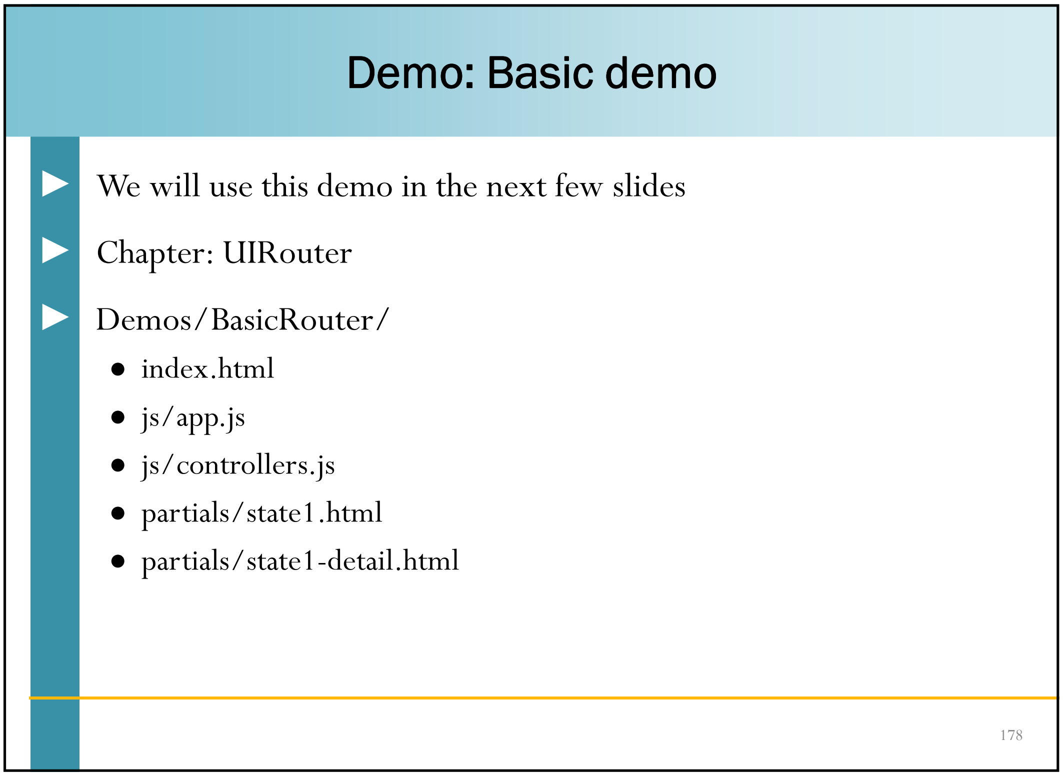
UI Router cautions

- UI Router is on version 0.2.15
- It's in frequent development, and updates come along rapidly
- As the docs say: "Consider using it in production applications only if you're comfortable following a changelog and updating your usage accordingly."
- The Angular team plans to release an updated router Real Soon Now, which will reportedly add, among other features, multiple views



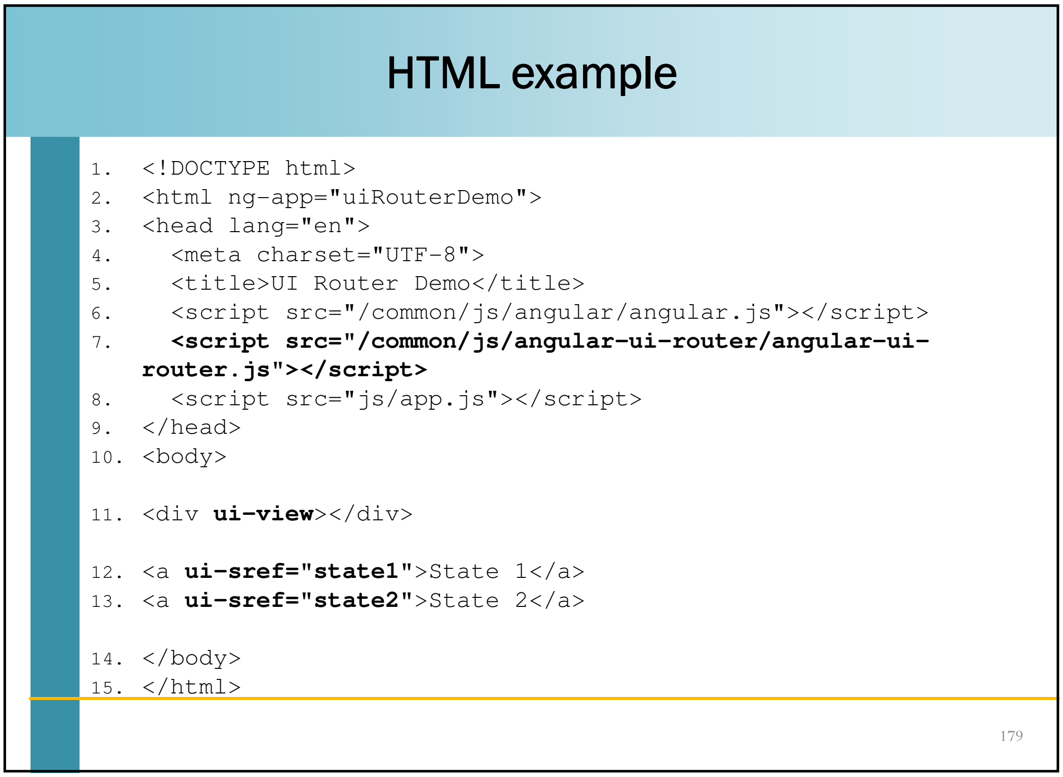
Basic setup

- As with Angular's router, there are changes to be made at the HTML, main module, and controller levels
- At the HTML level, the changes are minimal:
- Add UI router to your list of scripts loaded into the page
- Add a **`ui-view`** directive to the page to contain content
- Potentially add **`ui-sref`** directives to navigate from one view to the next



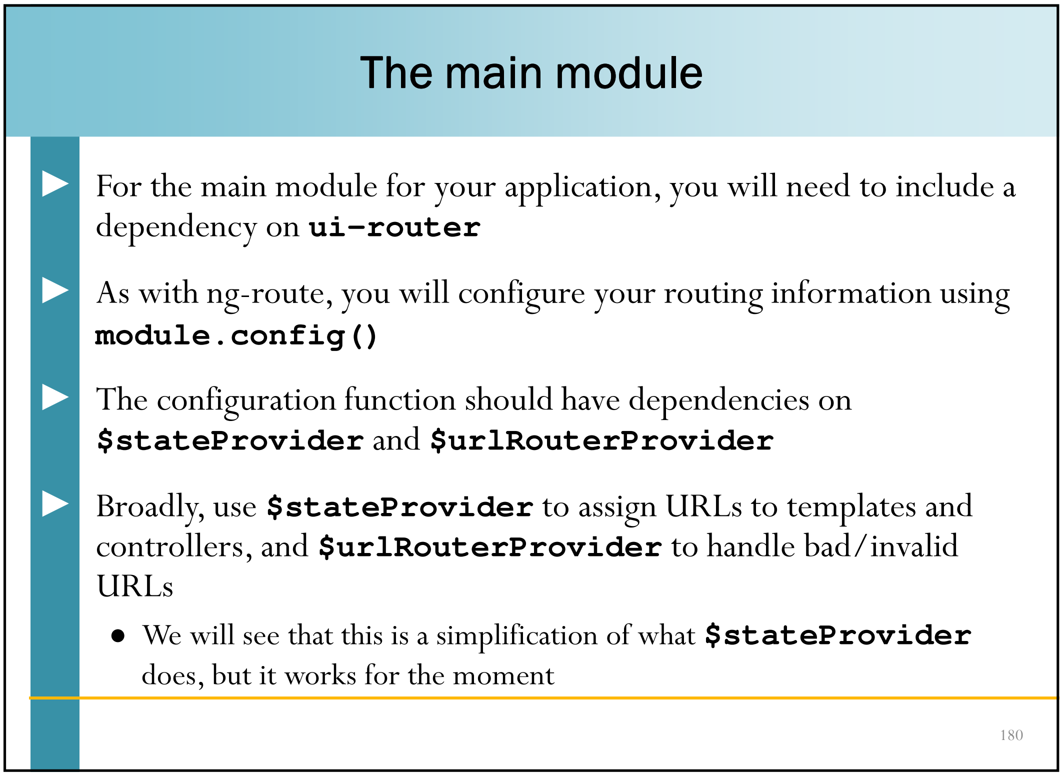
Demo: Basic demo

- We will use this demo in the next few slides
- Chapter: UIRouter
- Demos/BasicRouter/
  - index.html
  - js/app.js
  - js/controllers.js
  - partials/state1.html
  - partials/state1-detail.html



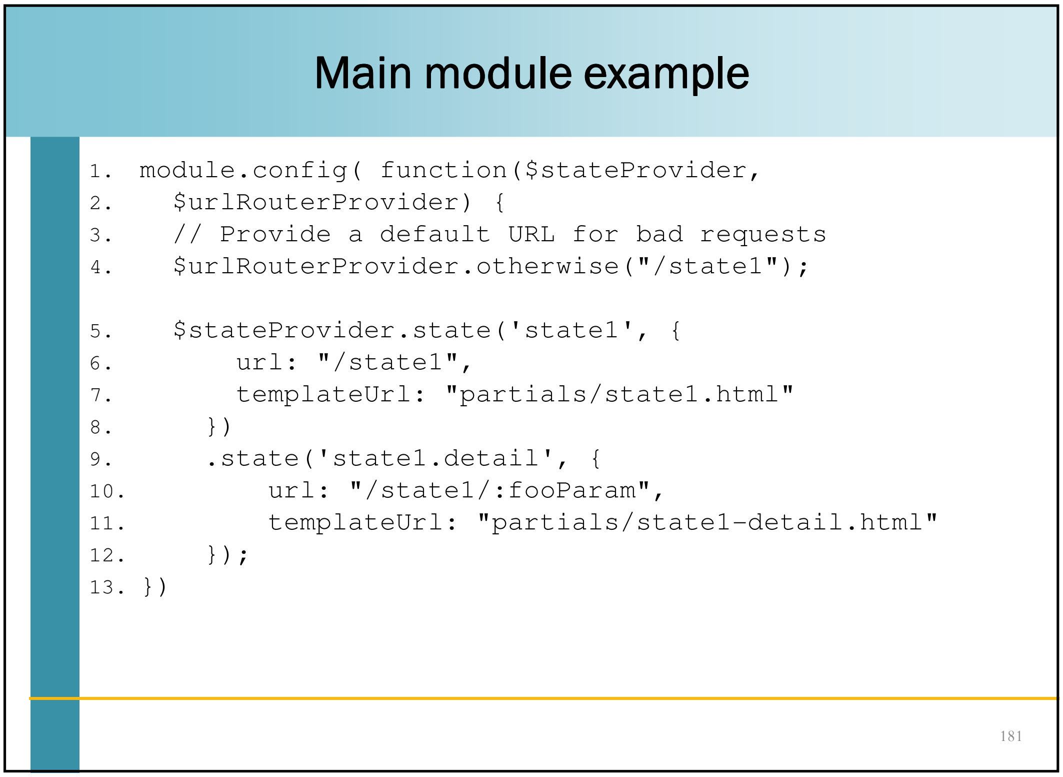
HTML example

```
<!DOCTYPE html>
<html ng-app="uiRouterDemo">
<head lang="en">
  <meta charset="UTF-8">
  <title>UI Router Demo</title>
  <script src="/common/js/angular/angular.js"></script>
  <script src="/common/js/angular-ui-router/angular-ui-router.js"></script>
  <script src="js/app.js"></script>
</head>
<body>

<div ui-view></div>

<a ui-sref="state1">State 1</a>
<a ui-sref="state2">State 2</a>

</body>
</html>
```



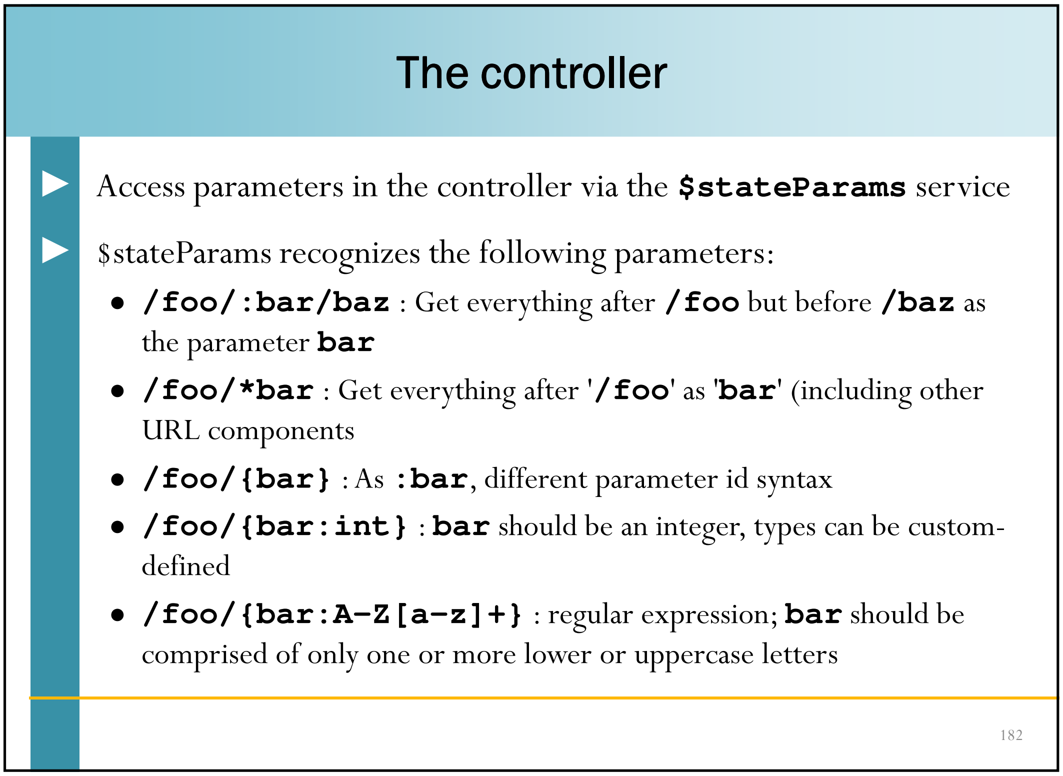
The main module

- For the main module for your application, you will need to include a dependency on **`ui-router`**
- As with ng-route, you will configure your routing information using **`module.config()`**
- The configuration function should have dependencies on **`$stateProvider`** and **`$urlRouterProvider`**
- Broadly, use **`$stateProvider`** to assign URLs to templates and controllers, and **`$urlRouterProvider`** to handle bad/invalid URLs
  - We will see that this is a simplification of what **`$stateProvider`** does, but it works for the moment



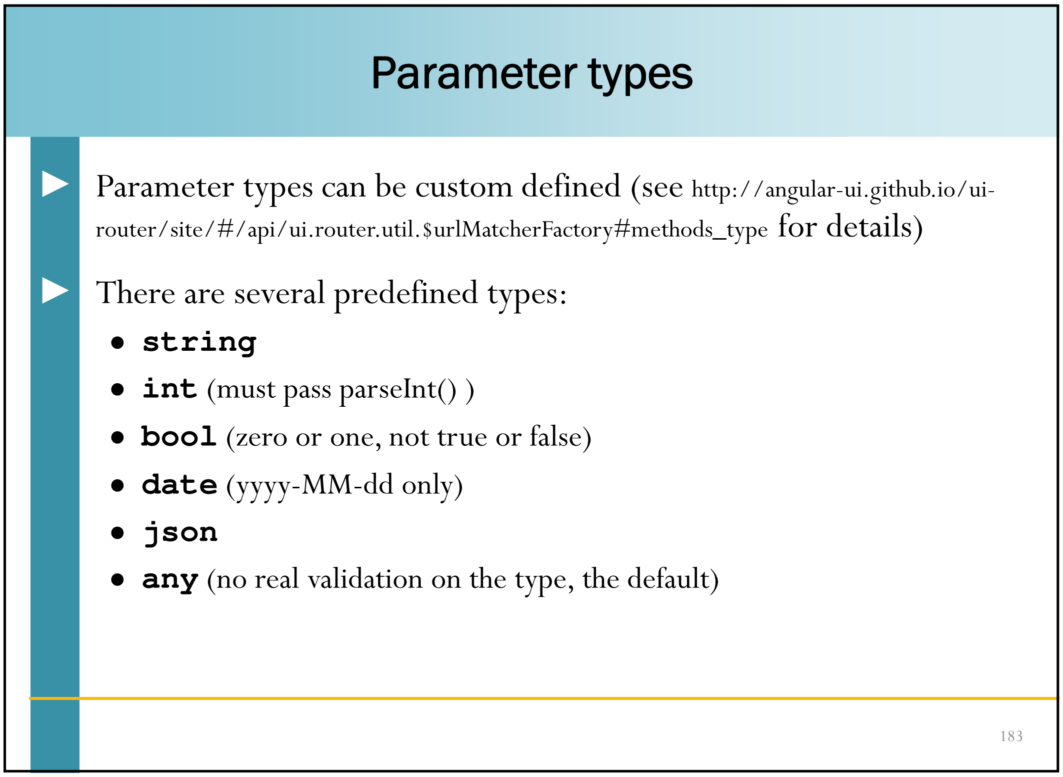
Main module example

```
module.config( function($stateProvider,
  $urlRouterProvider) {
  // Provide a default URL for bad requests
  $urlRouterProvider.otherwise("/state1");

  $stateProvider.state('state1', {
      url: "/state1",
      templateUrl: "partials/state1.html"
    })
    .state('state1.detail', {
        url: "/state1/:fooParam",
        templateUrl: "partials/state1-detail.html"
    });
})
```



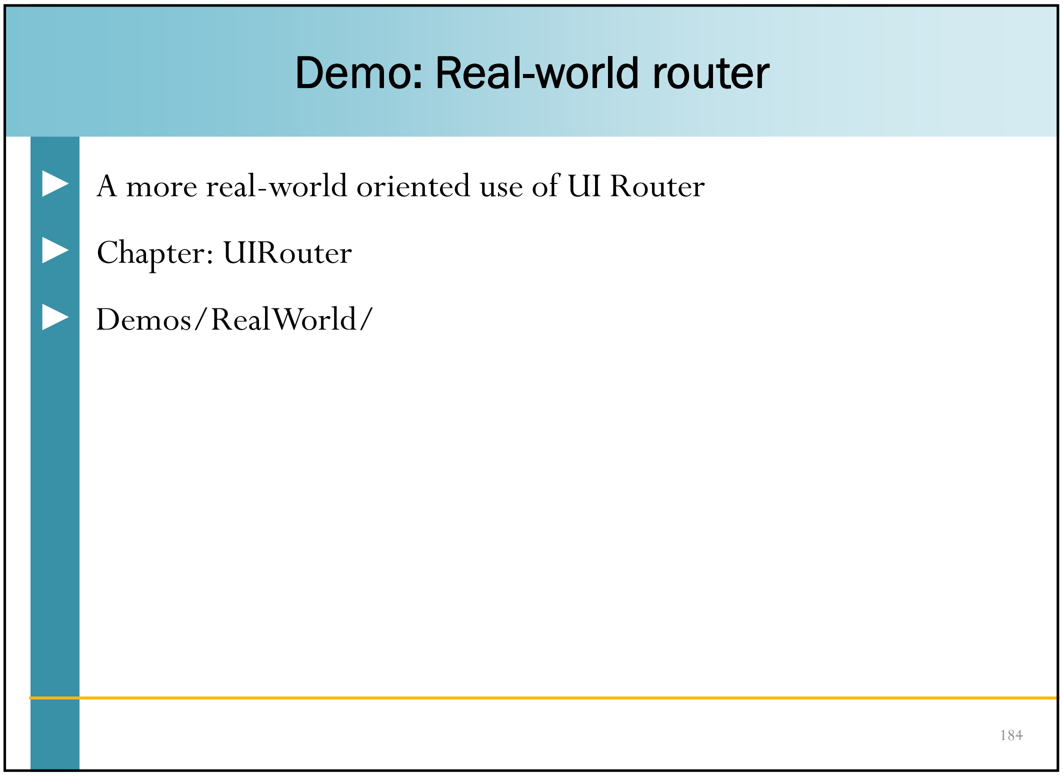
The controller

- Access parameters in the controller via the **`$stateParams`** service
- $stateParams recognizes the following parameters:
  - **`/foo/:bar/baz`** : Get everything after **`/foo`** but before **`/baz`** as the parameter **`bar`**
  - **`/foo/*bar`** : Get everything after '**`/foo`**' as '**`bar`**' (including other URL components
  - **`/foo/{bar}`** : As **`:bar`**, different parameter id syntax
  - **`/foo/{bar:int}`** : **`bar`** should be an integer, types can be custom-defined
  - **`/foo/{bar:A-Z[a-z]+}`** : regular expression; **`bar`** should be comprised of only one or more lower or uppercase letters



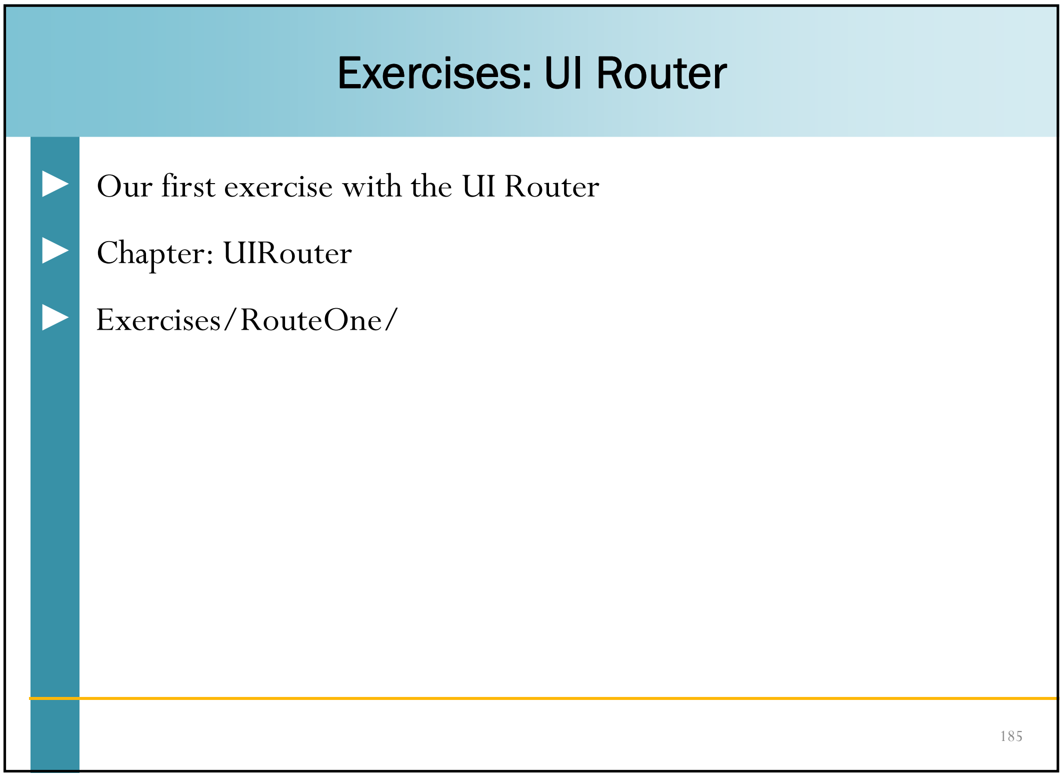
Parameter types

- Parameter types can be custom defined (see http://angular-ui.github.io/ui-router/site/#/api/ui.router.util.$urlMatcherFactory#methods_type for details)
- There are several predefined types:
  - **`string`**
  - **`int`** (must pass parseInt())
  - **`bool`** (zero or one, not true or false)
  - **`date`** (yyyy-MM-dd only)
  - **`json`**
  - **`any`** (no real validation on the type, the default)



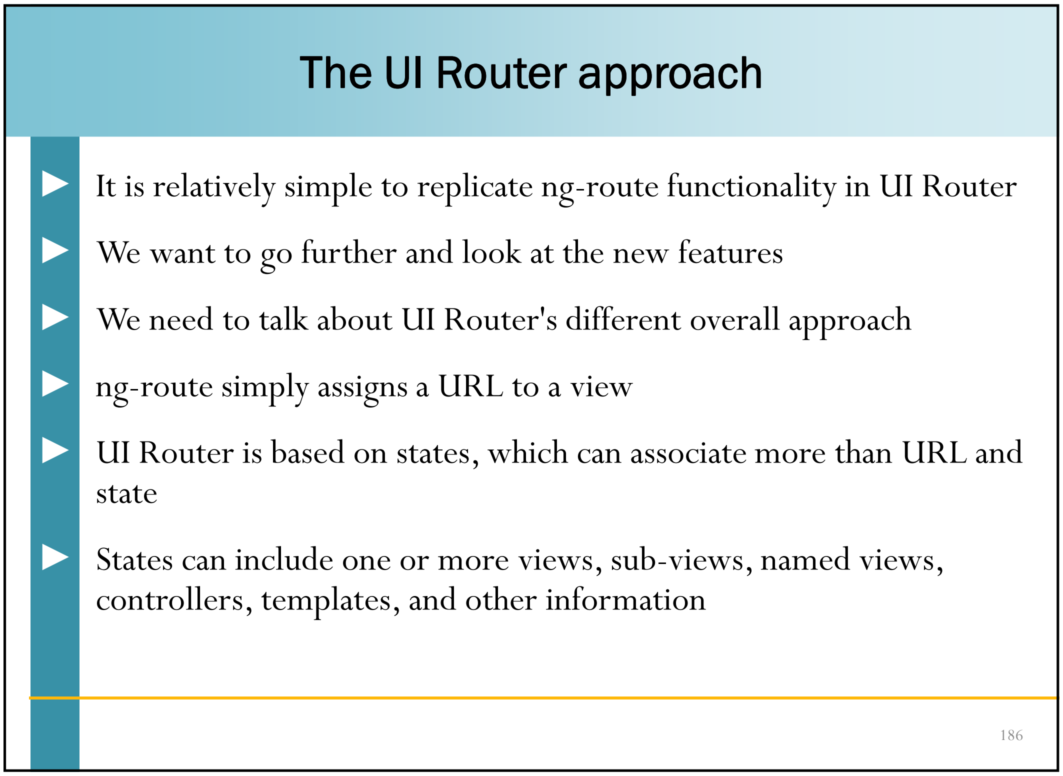
Demo: Real-world router

- A more real-world oriented use of UI Router
- Chapter: UIRouter
- Demos/RealWorld/



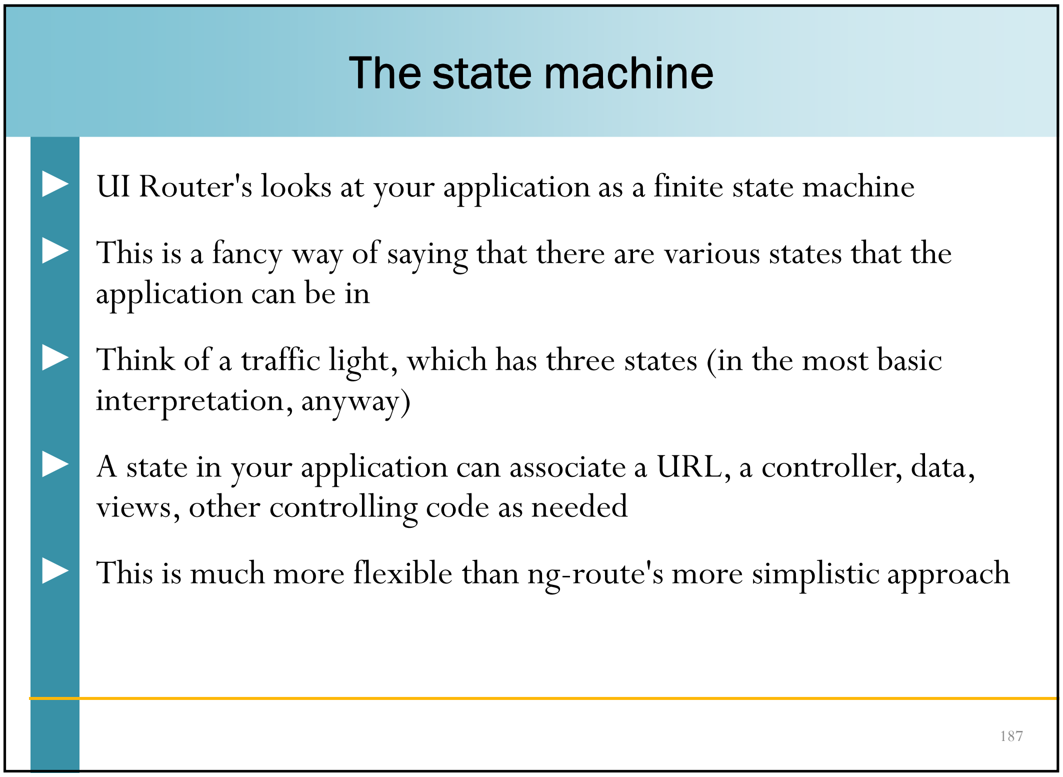
Exercises: UI Router

- Our first exercise with the UI Router
- Chapter: UIRouter
- Exercises/RouteOne/



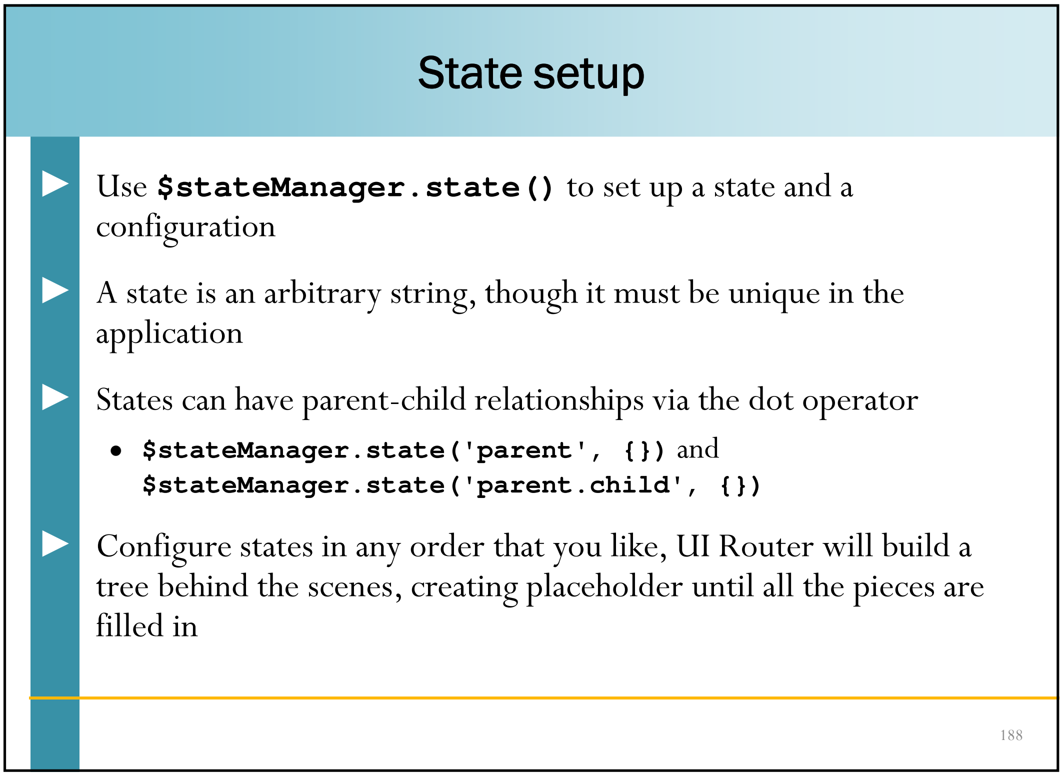
The UI Router approach

- It is relatively simple to replicate ng-route functionality in UI Router
- We want to go further and look at the new features
- We need to talk about UI Router's different overall approach
- ng-route simply assigns a URL to a view
- UI Router is based on states, which can associate more than URL and state
- States can include one or more views, sub-views, named views, controllers, templates, and other information



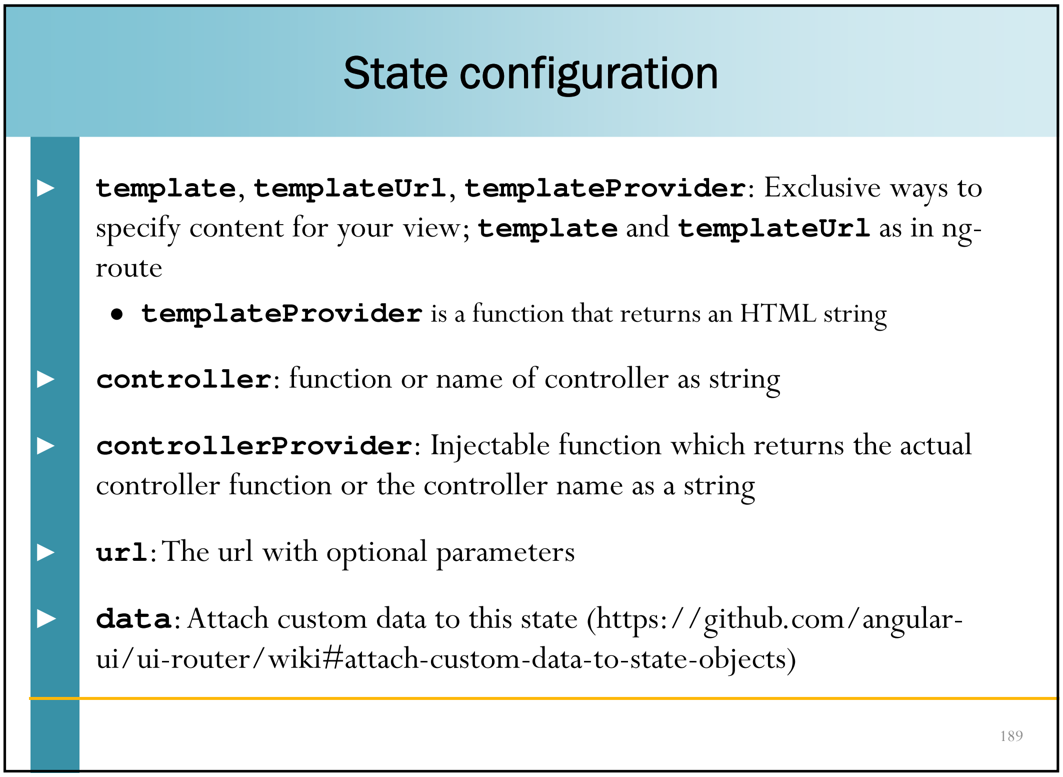
The state machine

- UI Router's looks at your application as a finite state machine
- This is a fancy way of saying that there are various states that the application can be in
- Think of a traffic light, which has three states (in the most basic interpretation, anyway)
- A state in your application can associate a URL, a controller, data, views, other controlling code as needed
- This is much more flexible than ng-route's more simplistic approach



State setup

- Use **`$stateManager.state()`** to set up a state and a configuration
- A state is an arbitrary string, though it must be unique in the application
- States can have parent-child relationships via the dot operator
  - **`$stateManager.state('parent', {})`** and **`$stateManager.state('parent.child', {})`**
- Configure states in any order that you like, UI Router will build a tree behind the scenes, creating placeholder until all the pieces are filled in



State configuration

- **`template`**, **`templateUrl`**, **`templateProvider`**: Exclusive ways to specify content for your view; **`template`** and **`templateUrl`** as in ng-route
  - **`templateProvider`** is a function that returns an HTML string
- **`controller`**: function or name of controller as string
- **`controllerProvider`**: Injectable function which returns the actual controller function or the controller name as a string
- **`url`**: The url with optional parameters
- **`data`**: Attach custom data to this state (https://github.com/angular-ui/ui-router/wiki#attach-custom-data-to-state-objects)

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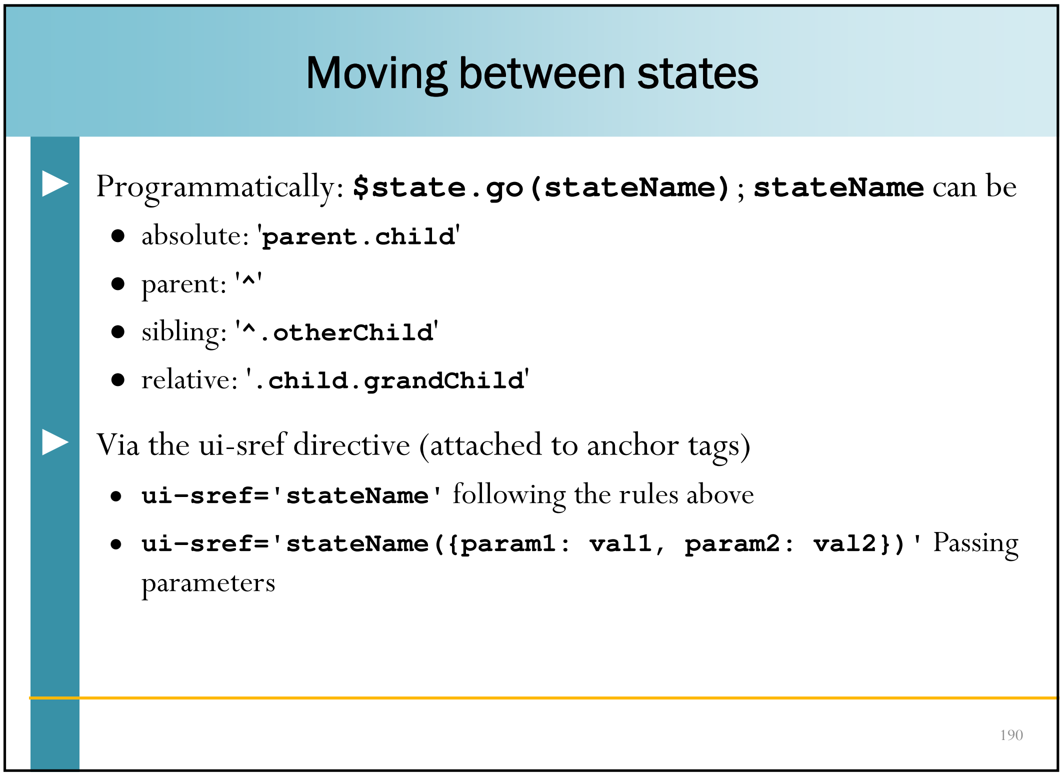

Moving between states

- Programmatically: **`$state.go(stateName)`**; **`stateName`** can be
  - absolute: '**`parent.child`**'
  - parent: '**`^`**'
  - sibling: '**`^.otherChild`**'
  - relative: '**`.child.grandChild`**'
- Via the ui-sref directive (attached to anchor tags)
  - **`ui-sref='stateName'`** following the rules above
  - **`ui-sref='stateName({param1: val1, param2: val2})'`** Passing parameters

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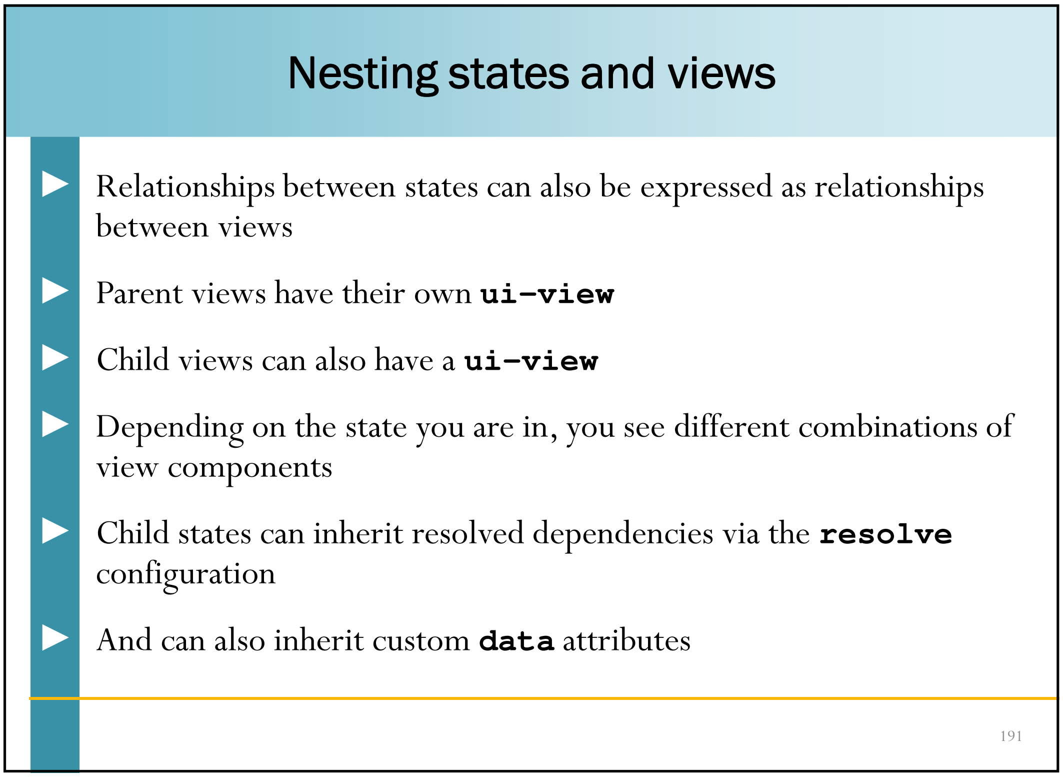
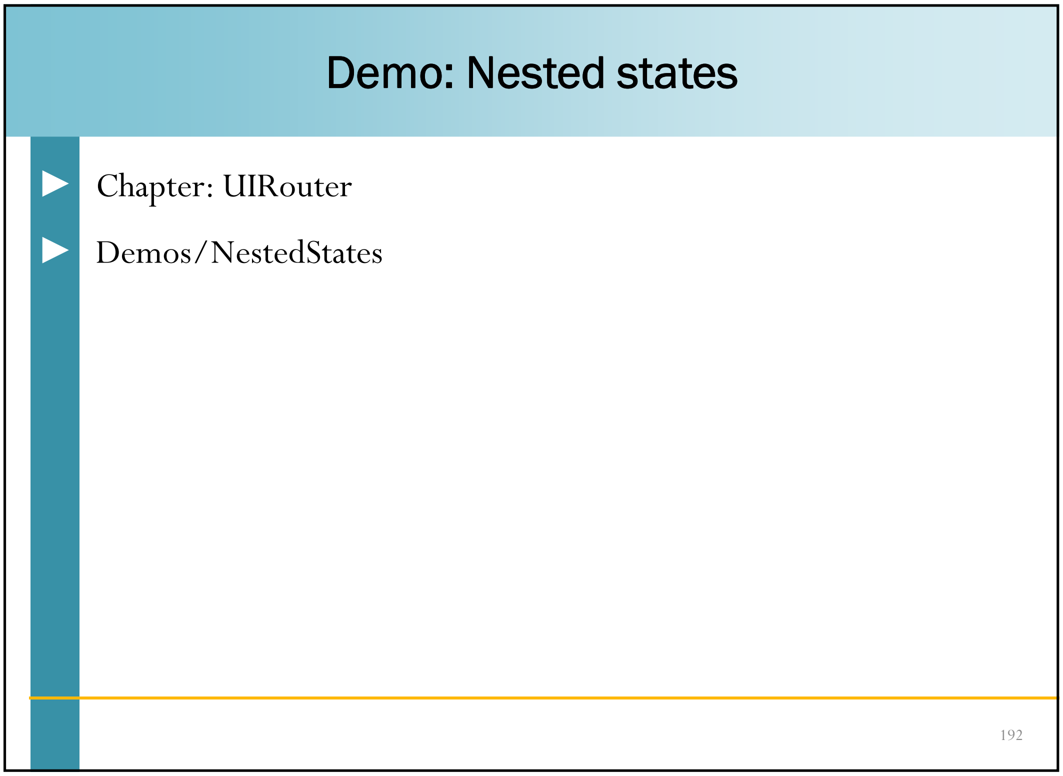


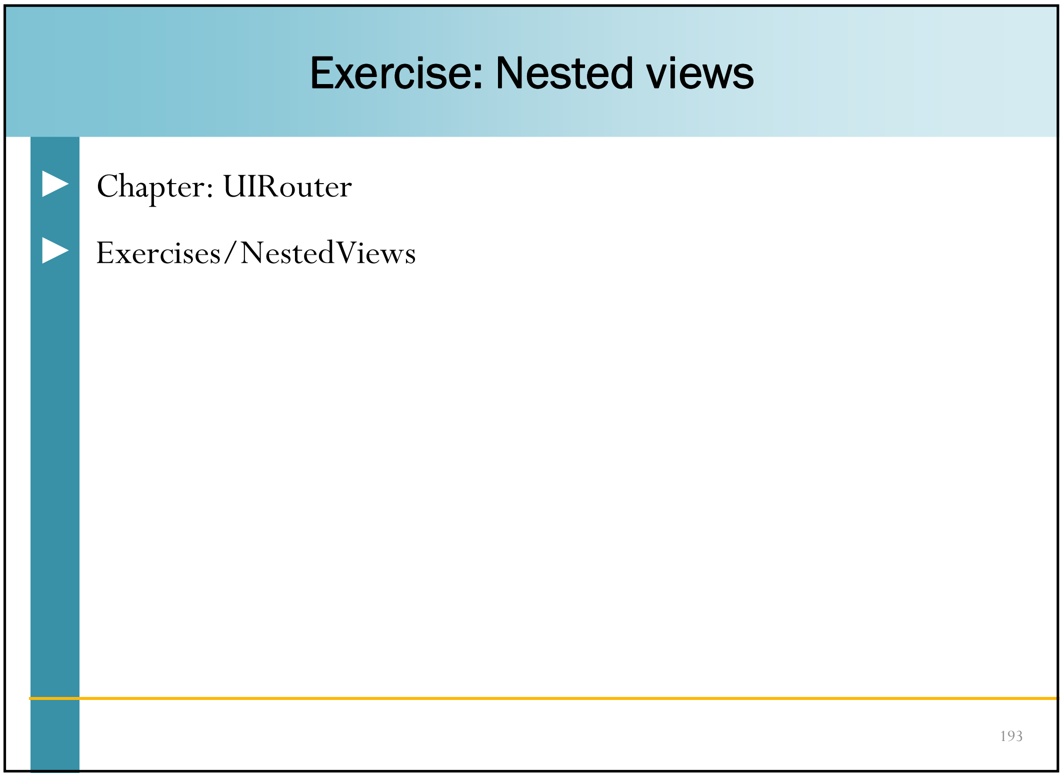
Nesting states and views

- Relationships between states can also be expressed as relationships between views
- Parent views have their own **`ui-view`**
- Child views can also have a **`ui-view`**
- Depending on the state you are in, you see different combinations of view components
- Child states can inherit resolved dependencies via the **`resolve`** configuration
- And can also inherit custom **`data`** attributes



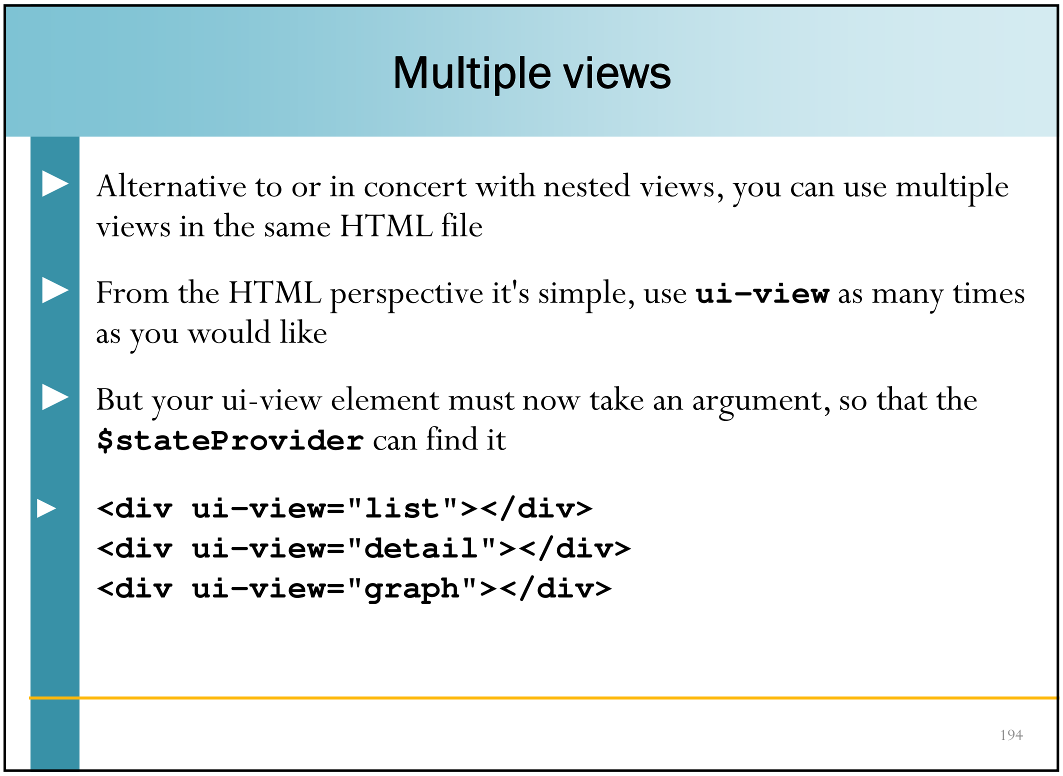
Demo: Nested states

- Chapter: UIRouter
- Demos/NestedStates



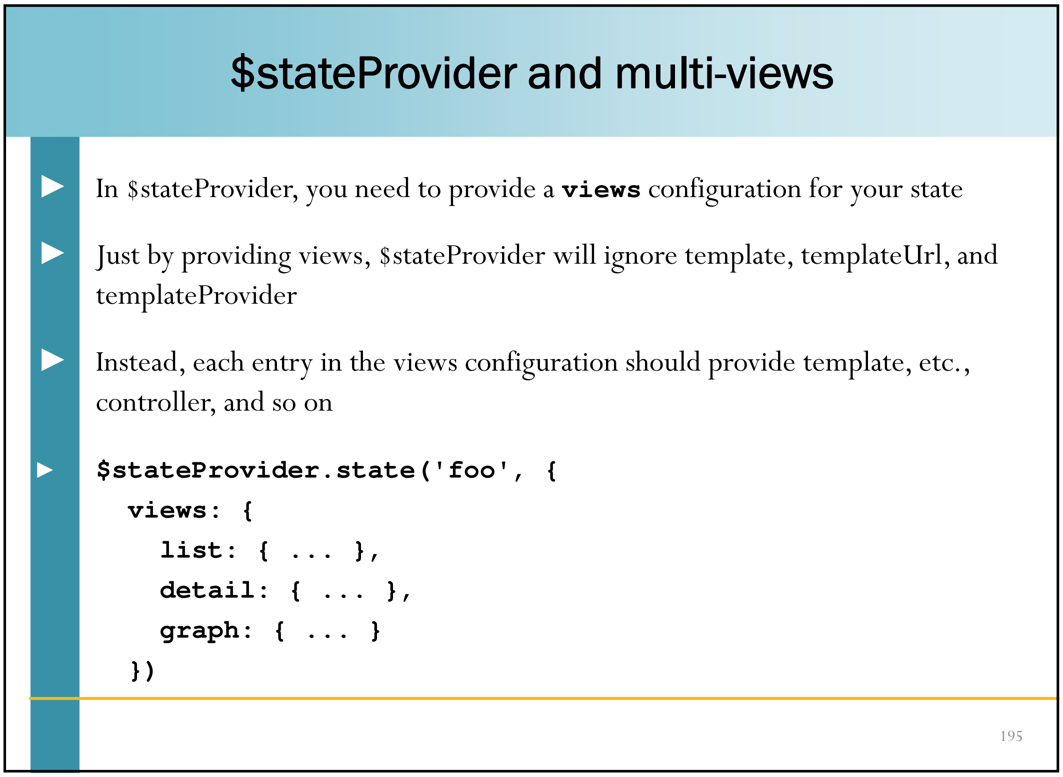
Exercise: Nested views

- Chapter: UIRouter
- Exercises/NestedViews



Multiple views

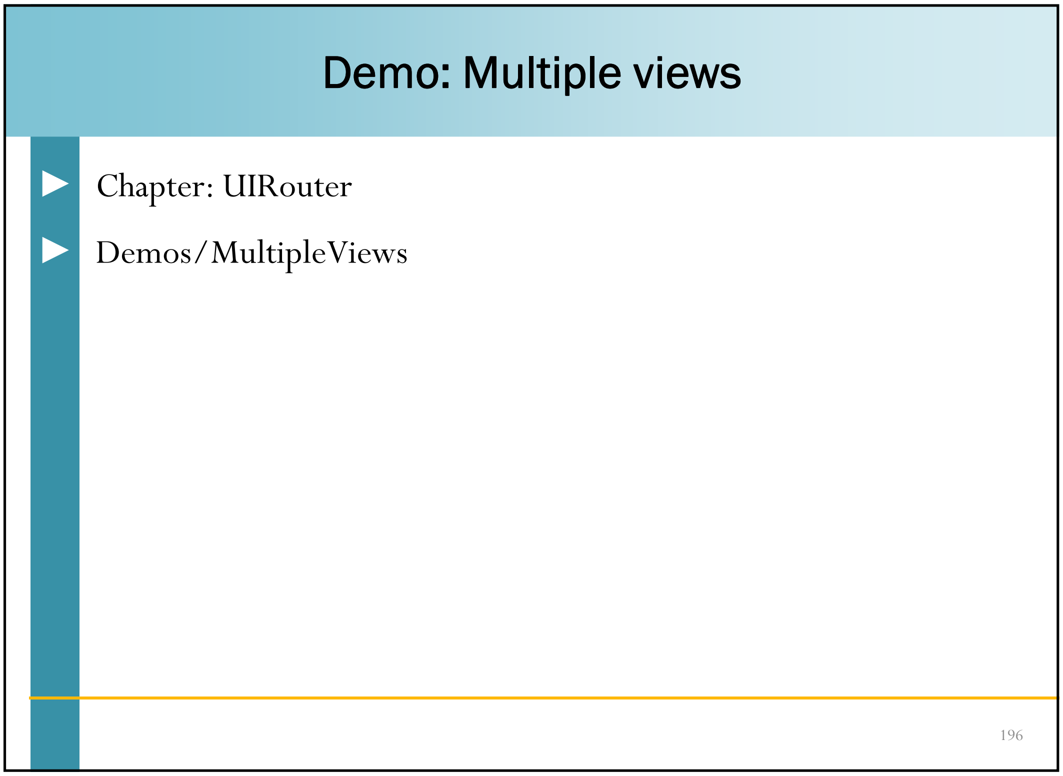
- Alternative to or in concert with nested views, you can use multiple views in the same HTML file
- From the HTML perspective it's simple, use **`ui-view`** as many times as you would like
- But your ui-view element must now take an argument, so that the **`$stateProvider`** can find it
-
```
<div ui-view="list"></div>
<div ui-view="detail"></div>
<div ui-view="graph"></div>
```



$stateProvider and multi-views

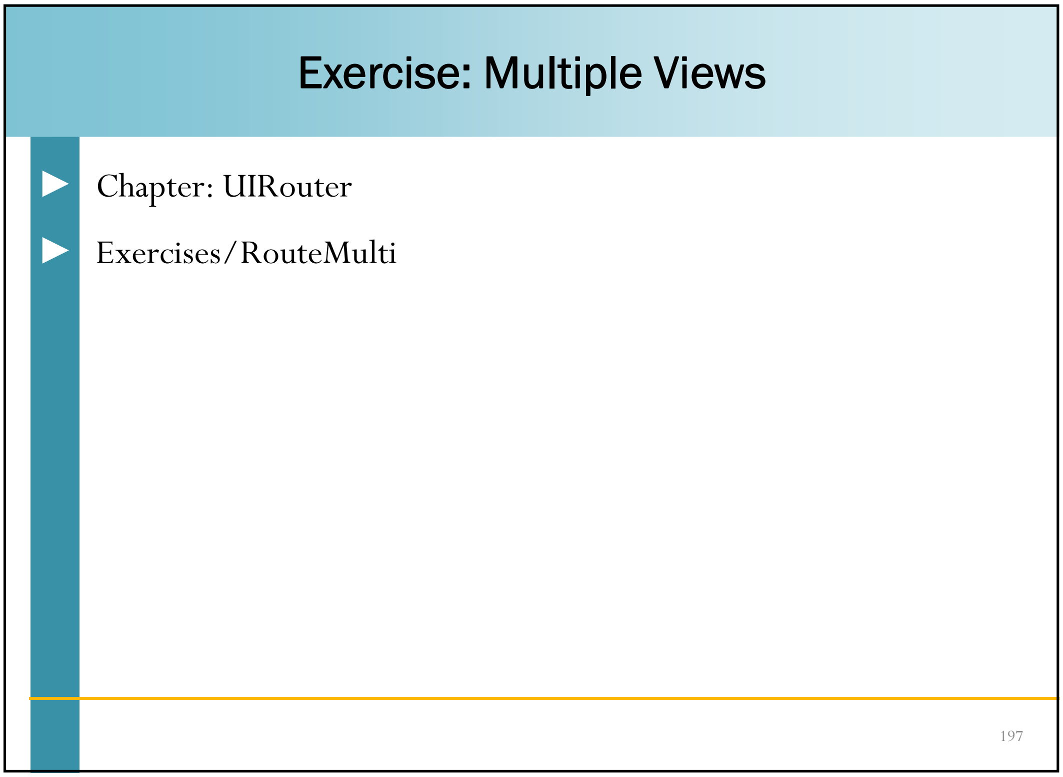
- In $stateProvider, you need to provide a **`views`** configuration for your state
- Just by providing views, $stateProvider will ignore template, templateUrl, and templateProvider
- Instead, each entry in the views configuration should provide template, etc., controller, and so on
-

```
$stateProvider.state('foo', {
  views: {
    list: { ... },
    detail: { ... },
    graph: { ... }
  })
```



Demo: Multiple views

- Chapter: UIRouter
- Demos/MultipleViews



Exercise: Multiple Views

- Chapter: UIRouter
- Exercises/RouteMulti

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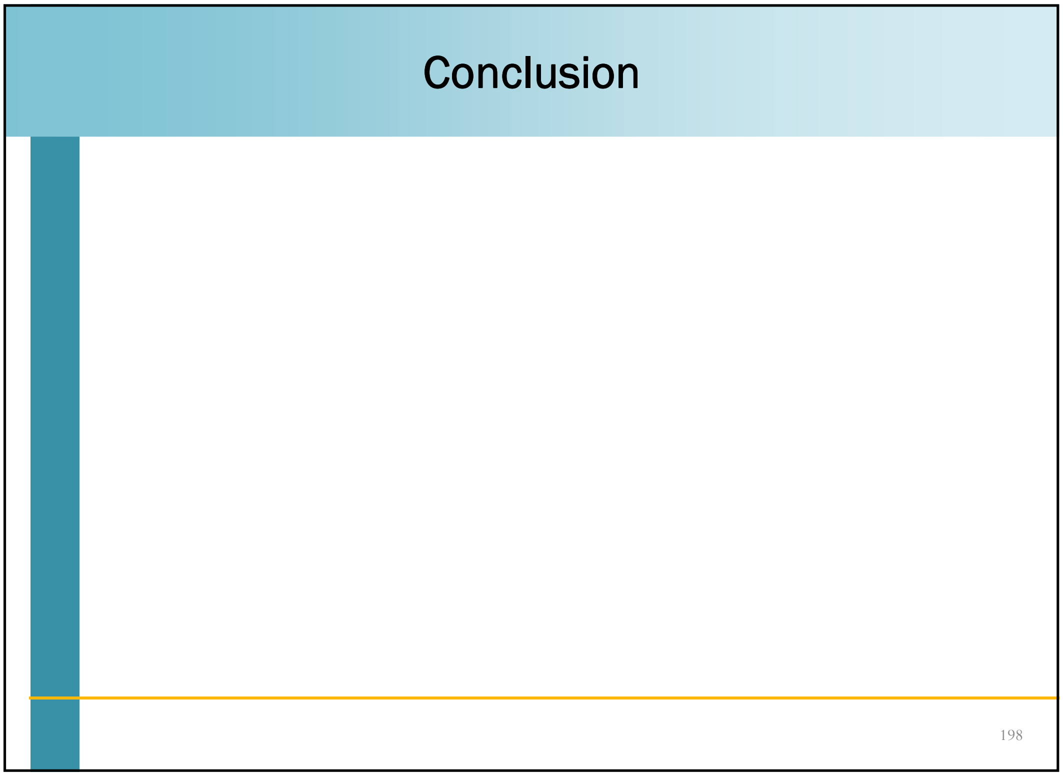

Conclusion

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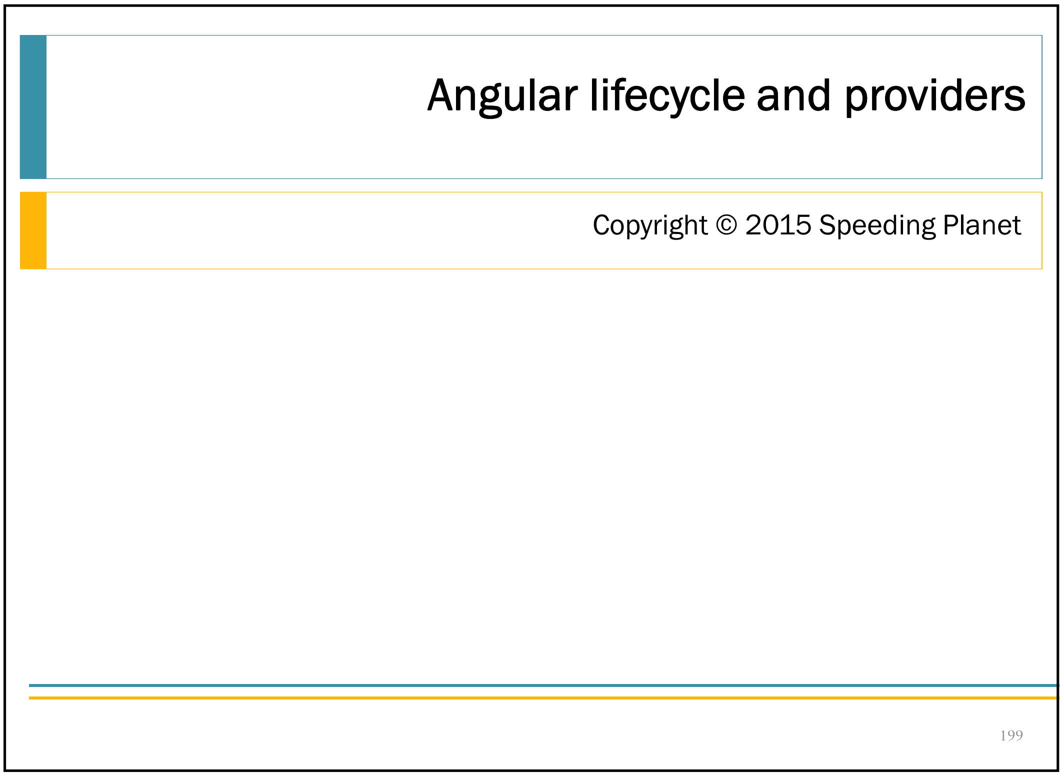

Angular lifecycle and providers

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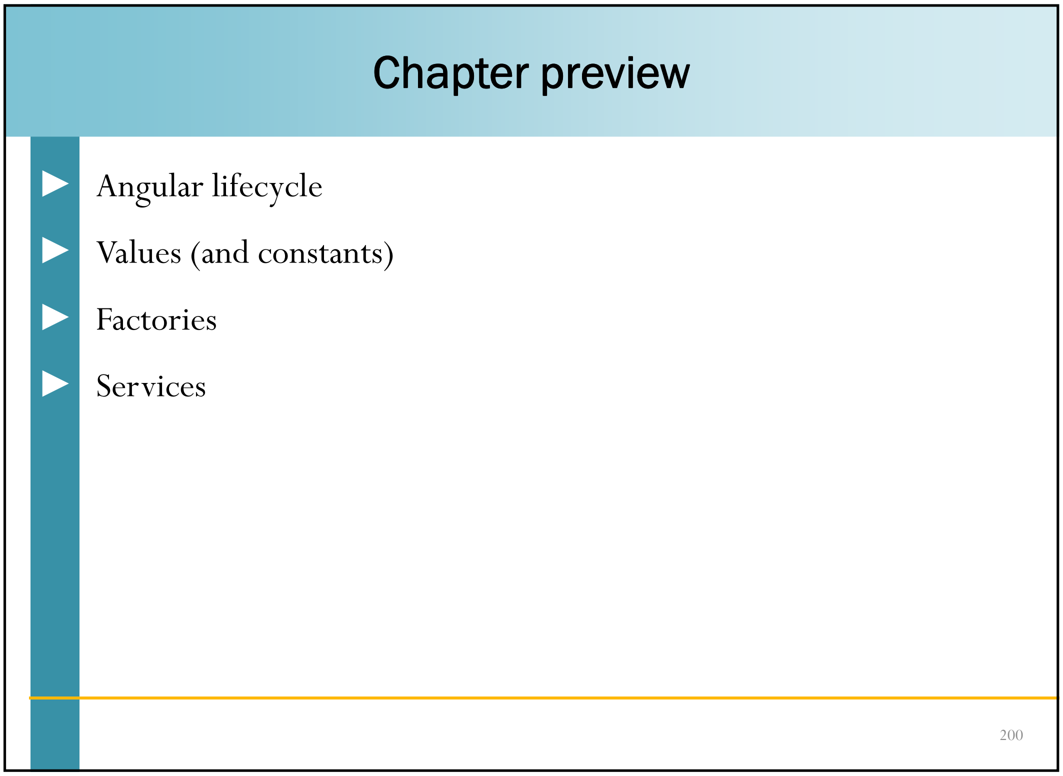

Chapter preview

- Angular lifecycle
- Values (and constants)
- Factories
- Services

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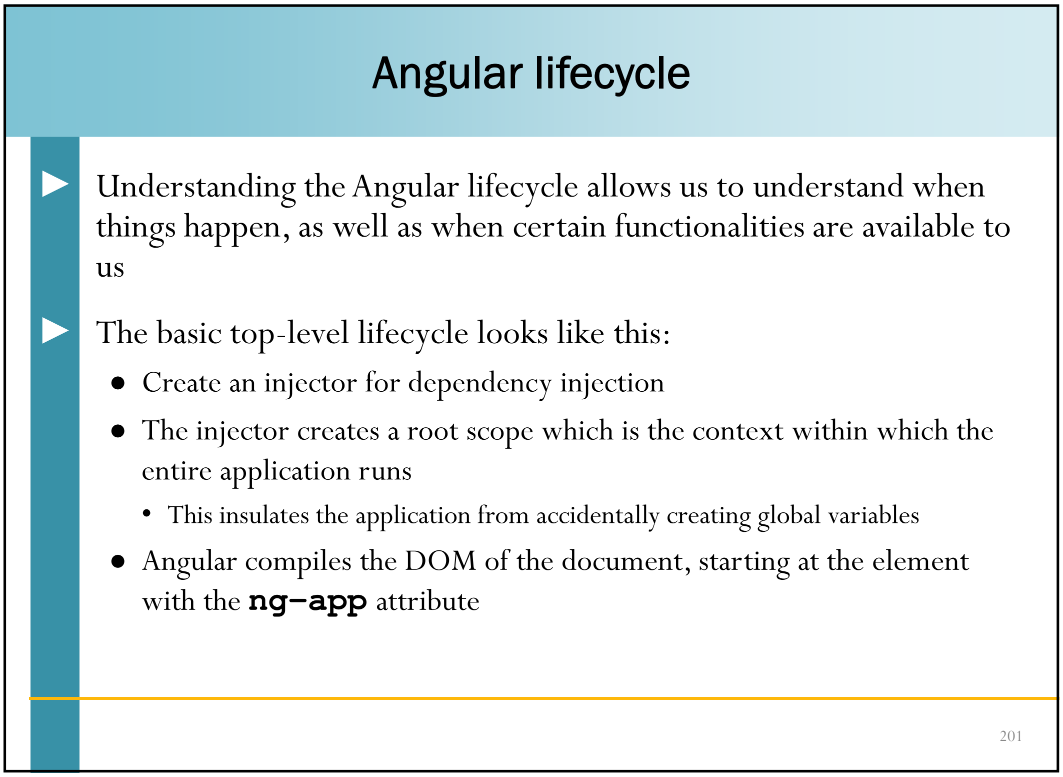
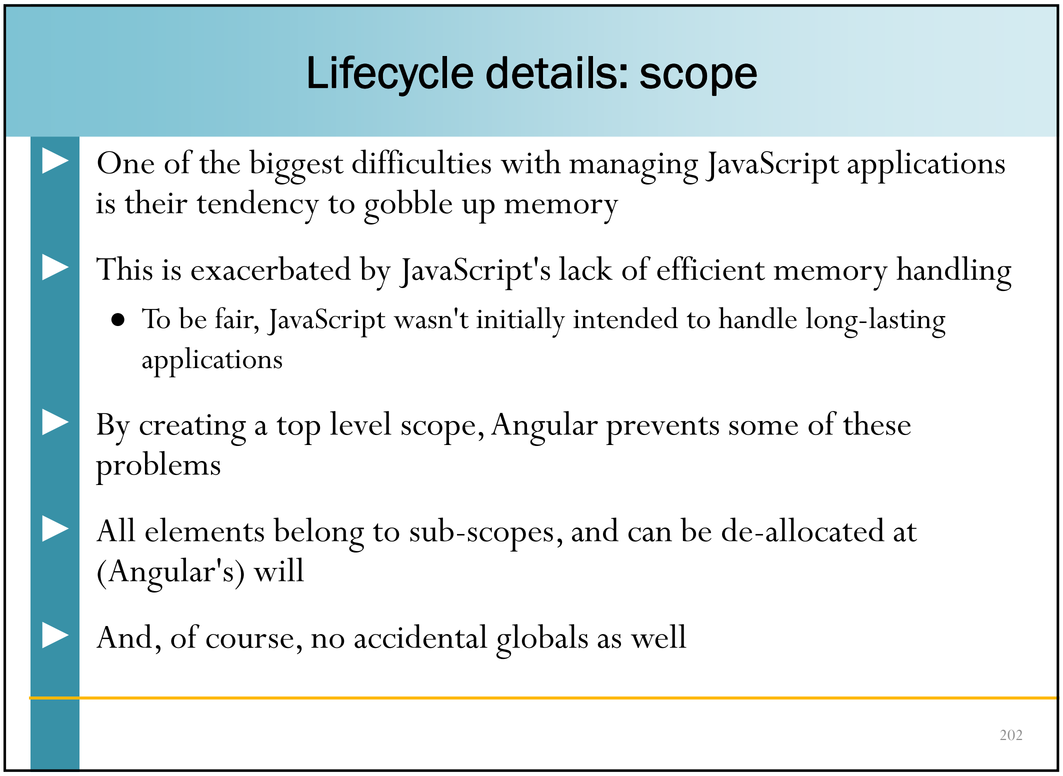


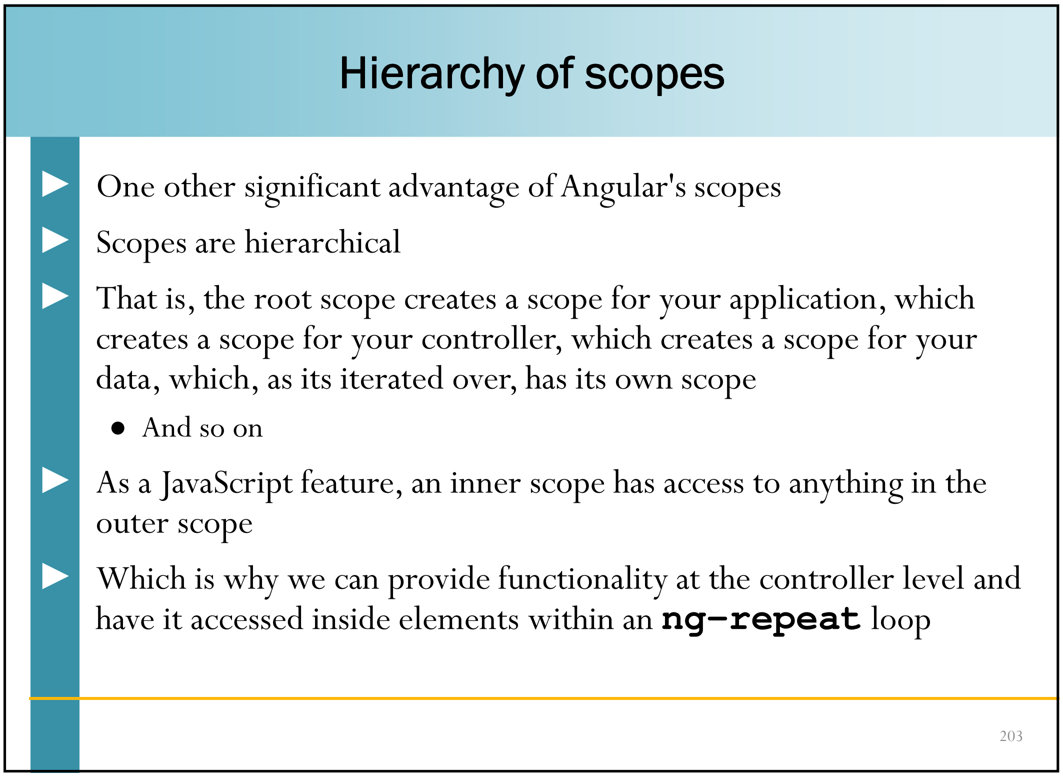
Angular lifecycle

- Understanding the Angular lifecycle allows us to understand when things happen, as well as when certain functionalities are available to us
- The basic top-level lifecycle looks like this:
  - Create an injector for dependency injection
  - The injector creates a root scope which is the context within which the entire application runs
    - This insulates the application from accidentally creating global variables
  - Angular compiles the DOM of the document, starting at the element with the **`ng-app`** attribute



Lifecycle details: scope

- One of the biggest difficulties with managing JavaScript applications is their tendency to gobble up memory
- This is exacerbated by JavaScript's lack of efficient memory handling
  - To be fair, JavaScript wasn't initially intended to handle long-lasting applications
- By creating a top level scope, Angular prevents some of these problems
- All elements belong to sub-scopes, and can be de-allocated at (Angular's) will
- And, of course, no accidental globals as well



Hierarchy of scopes

- One other significant advantage of Angular's scopes
- Scopes are hierarchical
- That is, the root scope creates a scope for your application, which creates a scope for your controller, which creates a scope for your data, which, as its iterated over, has its own scope
  - And so on
- As a JavaScript feature, an inner scope has access to anything in the outer scope
- Which is why we can provide functionality at the controller level and have it accessed inside elements within an **`ng-repeat`** loop

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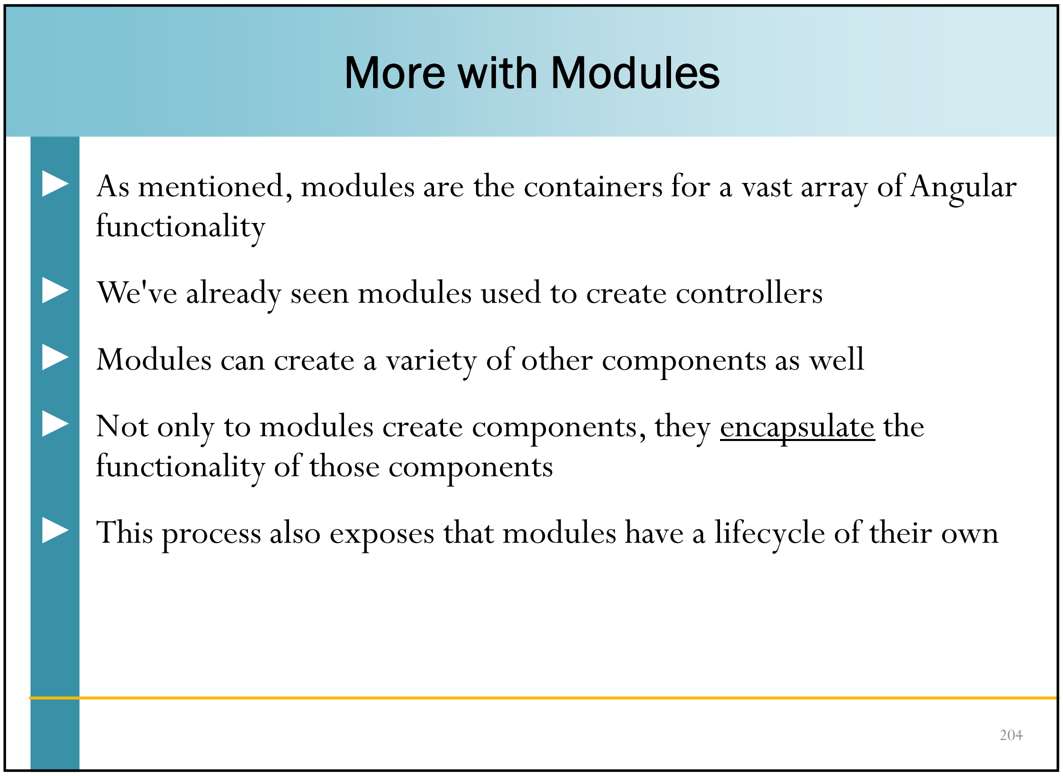

More with Modules

- As mentioned, modules are the containers for a vast array of Angular functionality
- We've already seen modules used to create controllers
- Modules can create a variety of other components as well
- Not only to modules create components, they encapsulate the functionality of those components
- This process also exposes that modules have a lifecycle of their own

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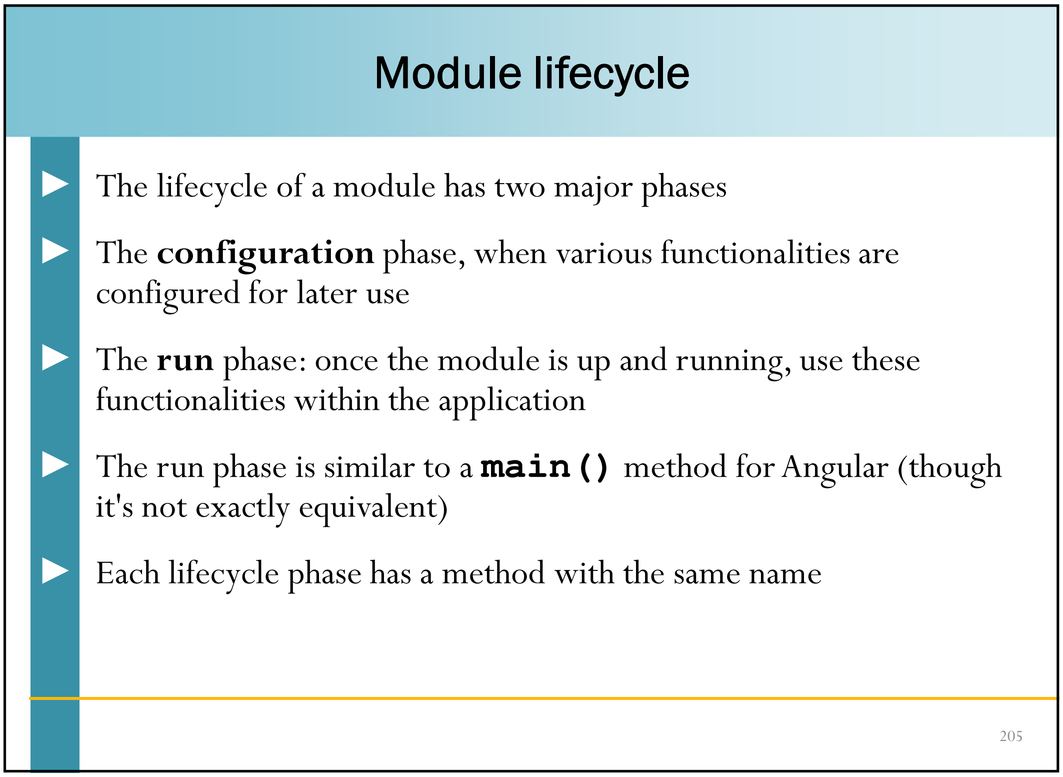
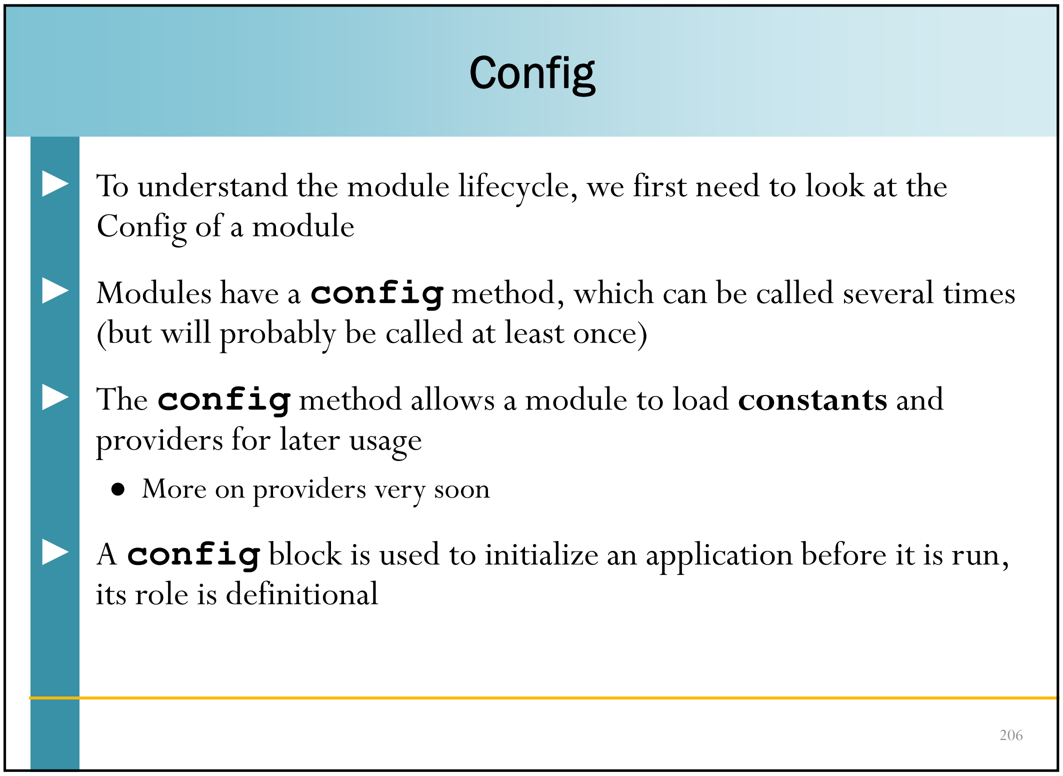


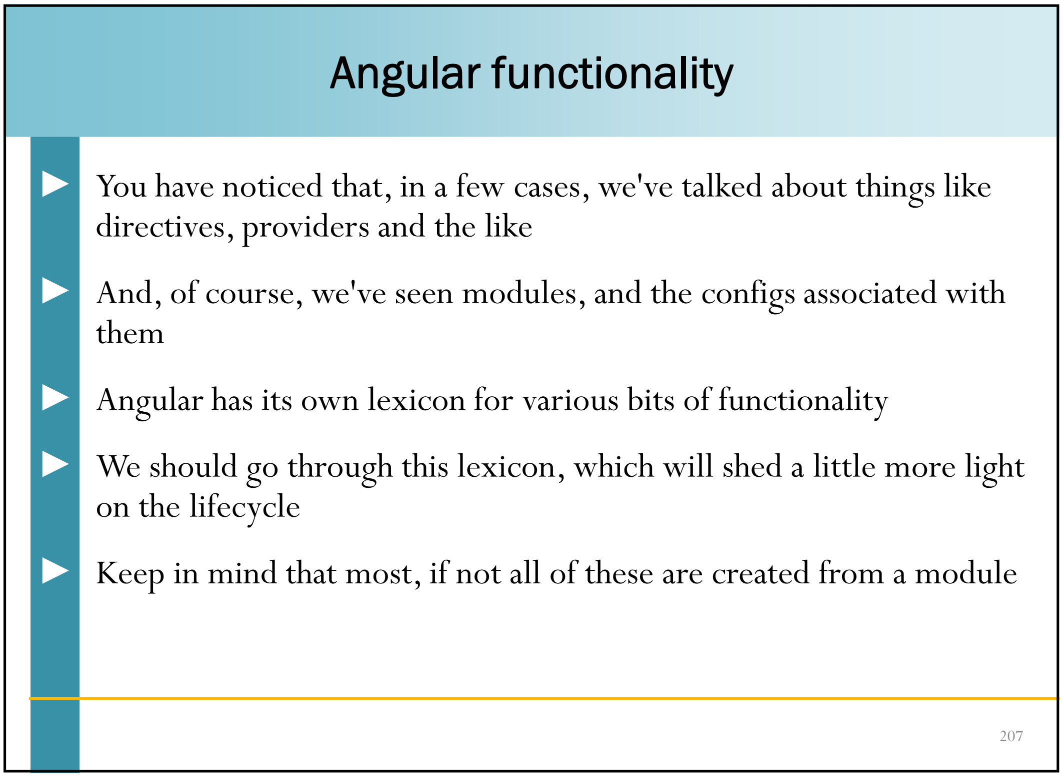
Module lifecycle

- The lifecycle of a module has two major phases
- The **configuration** phase, when various functionalities are configured for later use
- The **run** phase: once the module is up and running, use these functionalities within the application
- The run phase is similar to a **`main()`** method for Angular (though it's not exactly equivalent)
- Each lifecycle phase has a method with the same name



Config

- To understand the module lifecycle, we first need to look at the Config of a module
- Modules have a **`config`** method, which can be called several times (but will probably be called at least once)
- The **`config`** method allows a module to load **constants** and providers for later usage
  - More on providers very soon
- A **`config`** block is used to initialize an application before it is run, its role is definitional



Angular functionality

- You have noticed that, in a few cases, we've talked about things like directives, providers and the like
- And, of course, we've seen modules, and the configs associated with them
- Angular has its own lexicon for various bits of functionality
- We should go through this lexicon, which will shed a little more light on the lifecycle
- Keep in mind that most, if not all of these are created from a module

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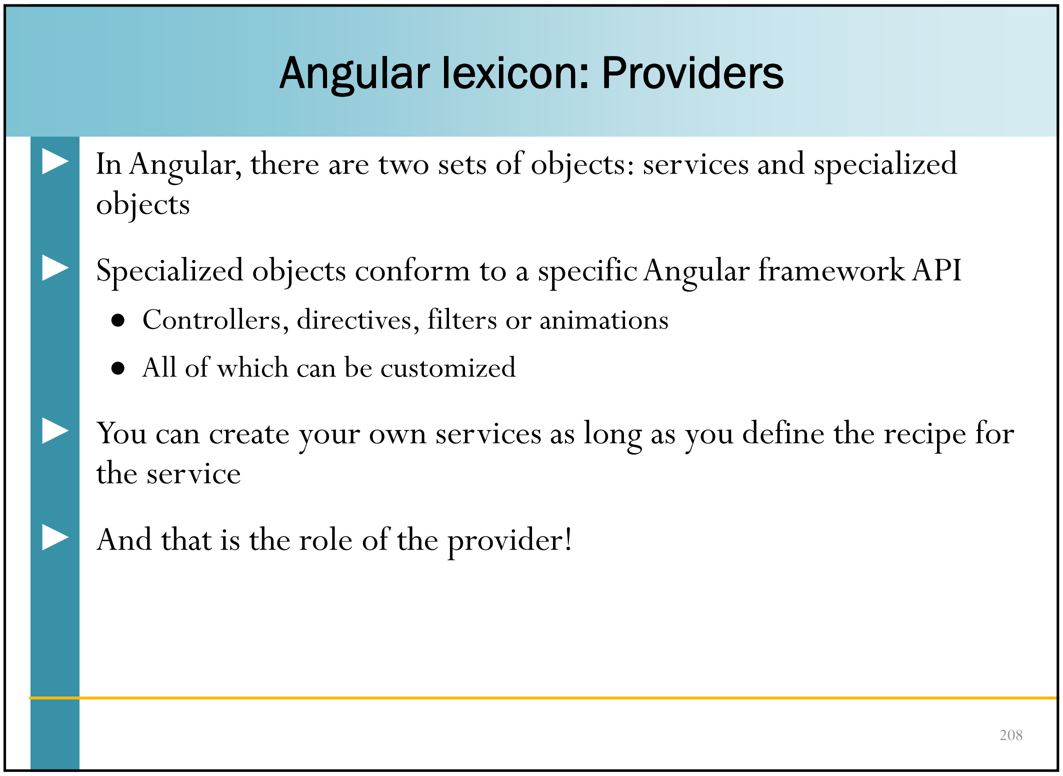

Angular lexicon: Providers

- In Angular, there are two sets of objects: services and specialized objects
- Specialized objects conform to a specific Angular framework API
  - Controllers, directives, filters or animations
  - All of which can be customized
- You can create your own services as long as you define the recipe for the service
- And that is the role of the provider!

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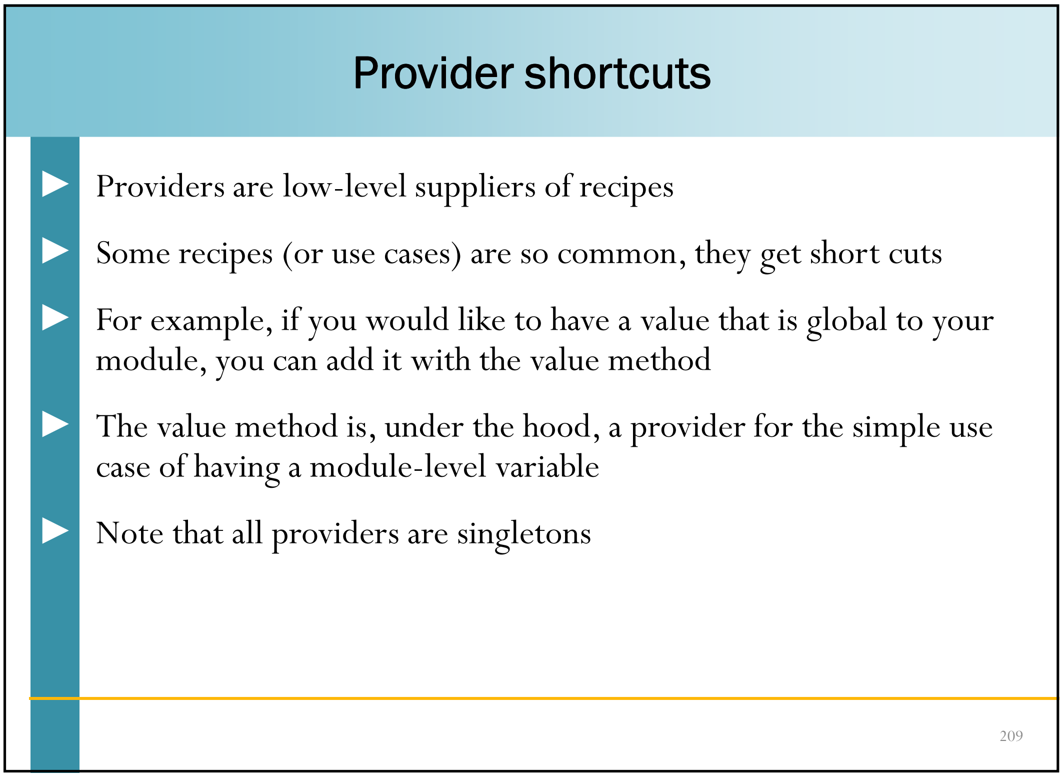
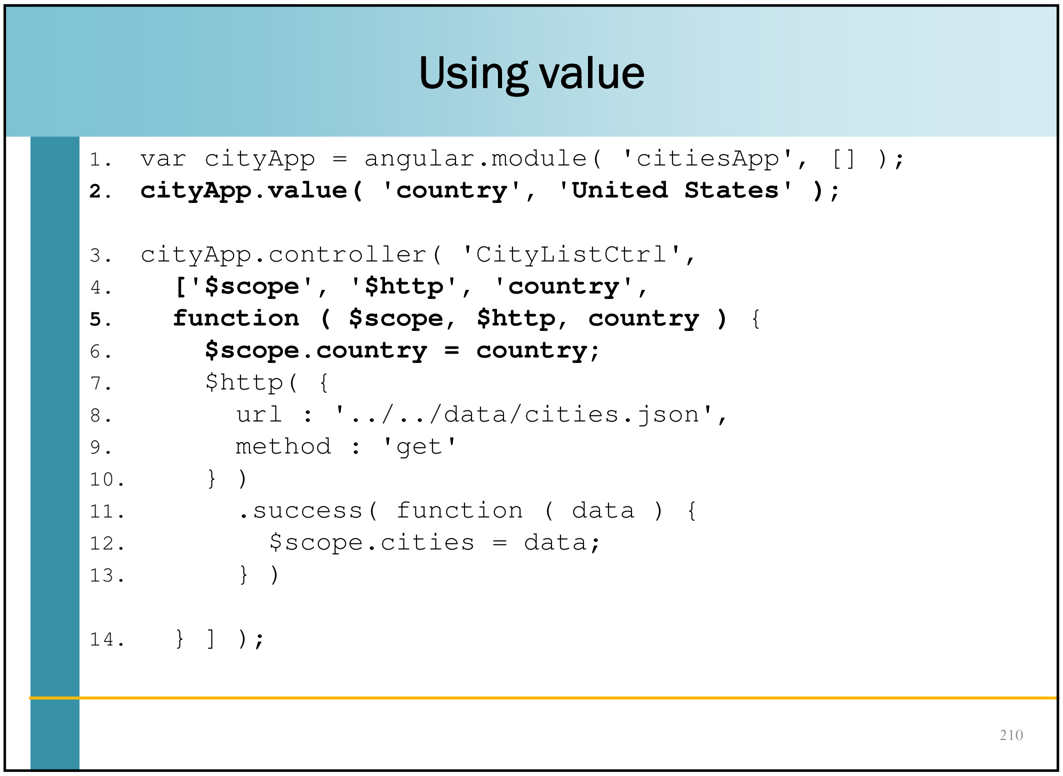


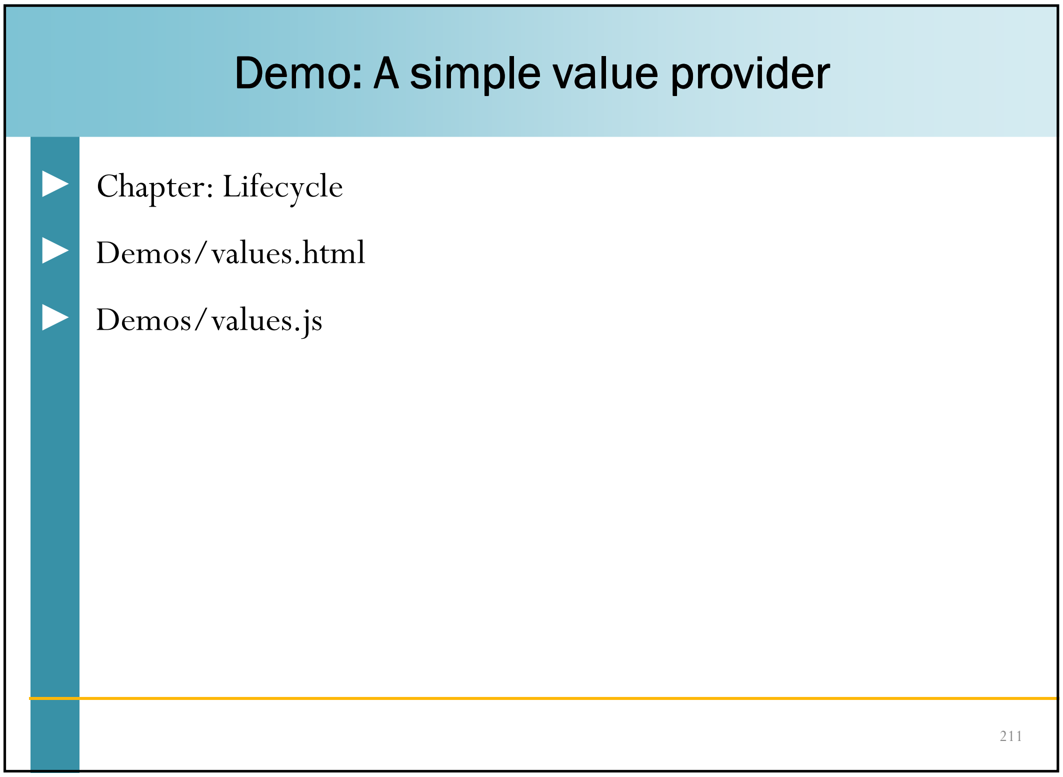
Provider shortcuts

- Providers are low-level suppliers of recipes
- Some recipes (or use cases) are so common, they get short cuts
- For example, if you would like to have a value that is global to your module, you can add it with the value method
- The value method is, under the hood, a provider for the simple use case of having a module-level variable
- Note that all providers are singletons



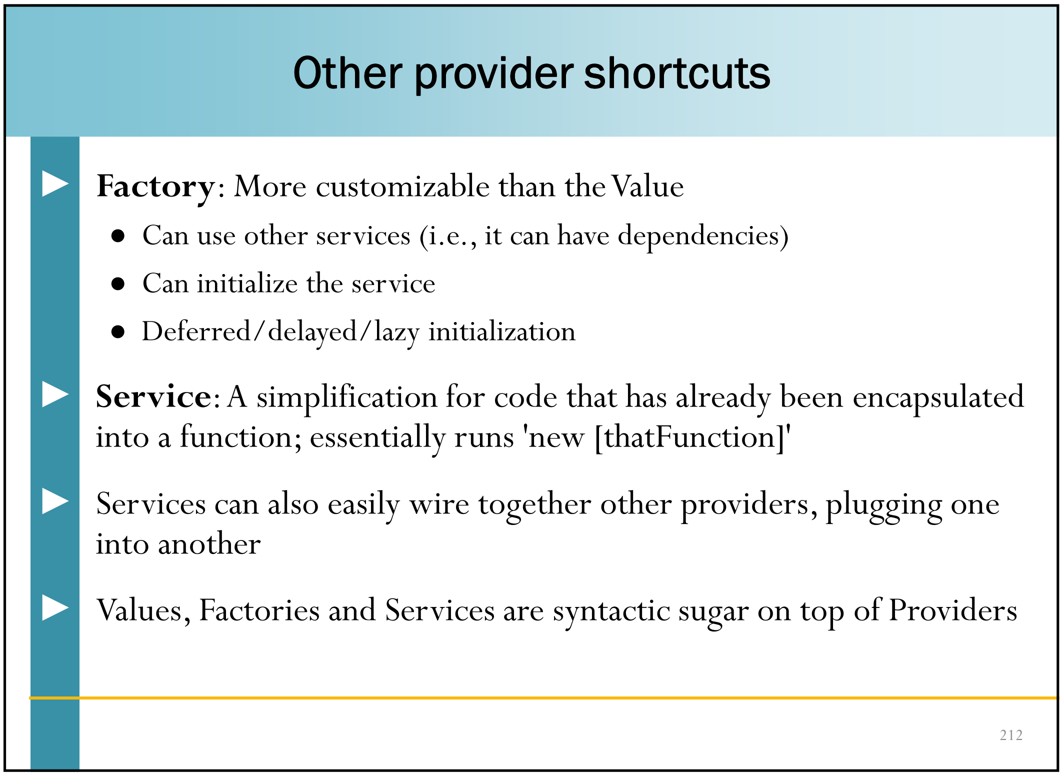
Using value

```
var cityApp = angular.module( 'citiesApp', [] );
cityApp.value( 'country', 'United States' );

cityApp.controller( 'CityListCtrl',
  ['$scope', '$http', 'country',
  function ( $scope, $http, country ) {
    $scope.country = country;
    $http( {
      url : '../../data/cities.json',
      method : 'get'
    } )
      .success( function ( data ) {
        $scope.cities = data;
      } )

  } ] );
```



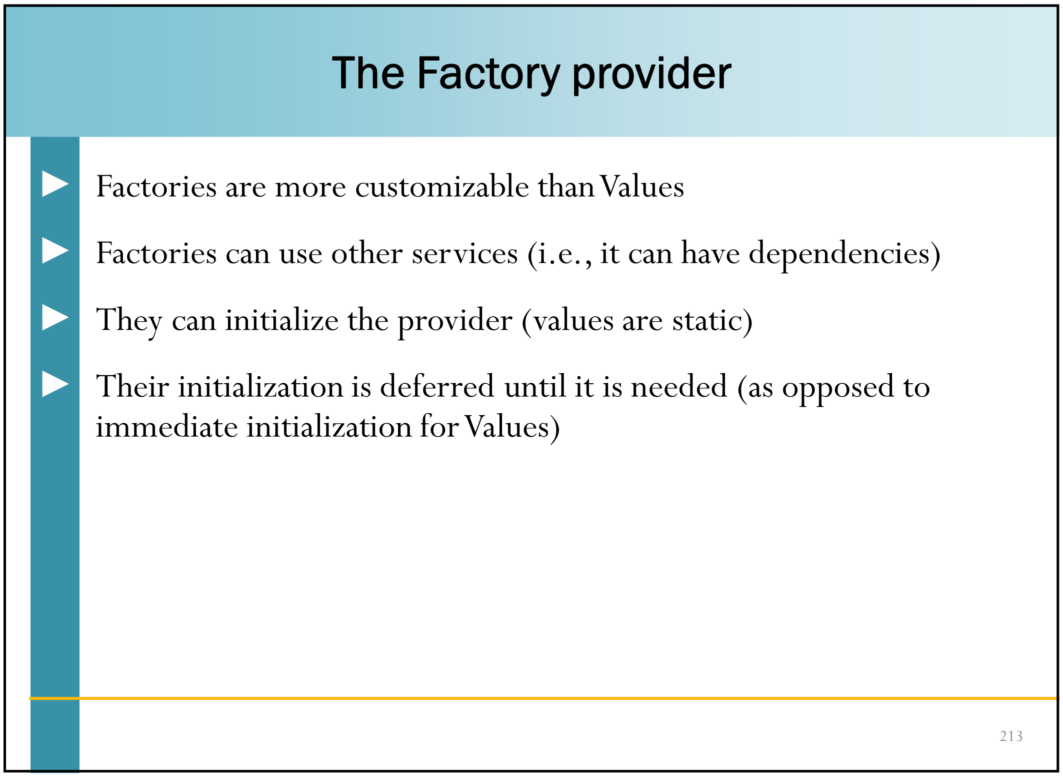
Demo: A simple value provider

- Chapter: Lifecycle
- Demos/values.html
- Demos/values.js



Other provider shortcuts

- **Factory**: More customizable than the Value
  - Can use other services (i.e., it can have dependencies)
  - Can initialize the service
  - Deferred/delayed/lazy initialization
- **Service**: A simplification for code that has already been encapsulated into a function; essentially runs 'new [thatFunction]'
- Services can also easily wire together other providers, plugging one into another
- Values, Factories and Services are syntactic sugar on top of Providers



The Factory provider

- Factories are more customizable than Values
- Factories can use other services (i.e., it can have dependencies)
- They can initialize the provider (values are static)
- Their initialization is deferred until it is needed (as opposed to immediate initialization for Values)

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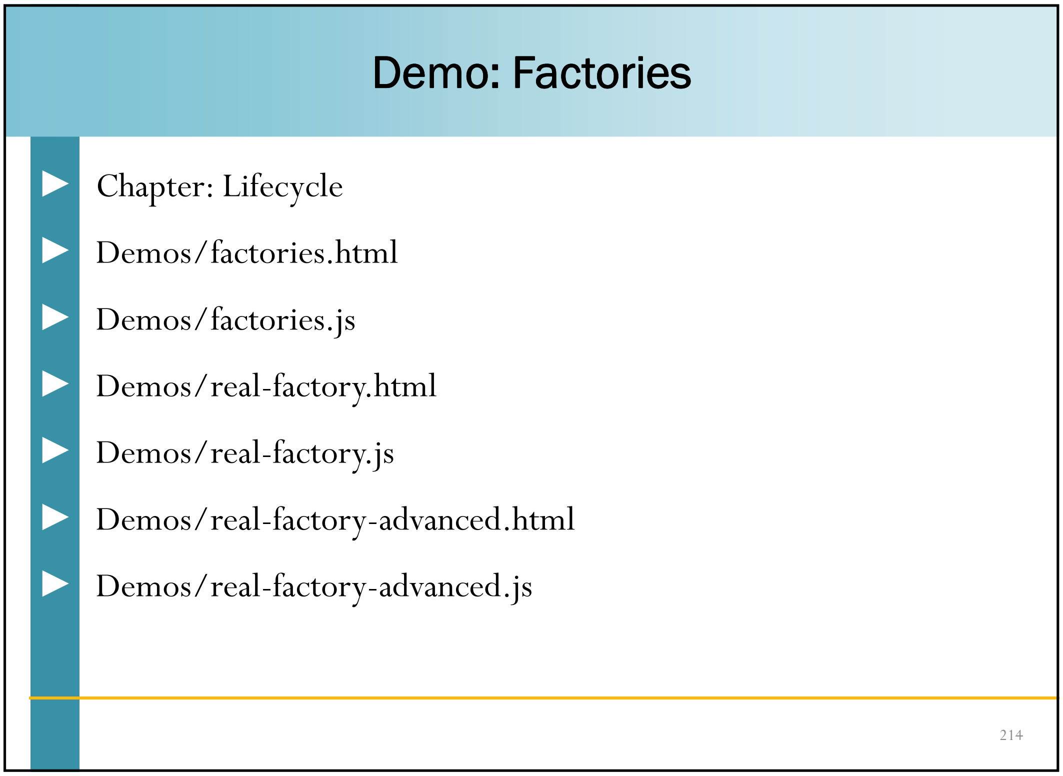

Demo: Factories

- Chapter: Lifecycle
- Demos/factories.html
- Demos/factories.js
- Demos/real-factory.html
- Demos/real-factory.js
- Demos/real-factory-advanced.html
- Demos/real-factory-advanced.js

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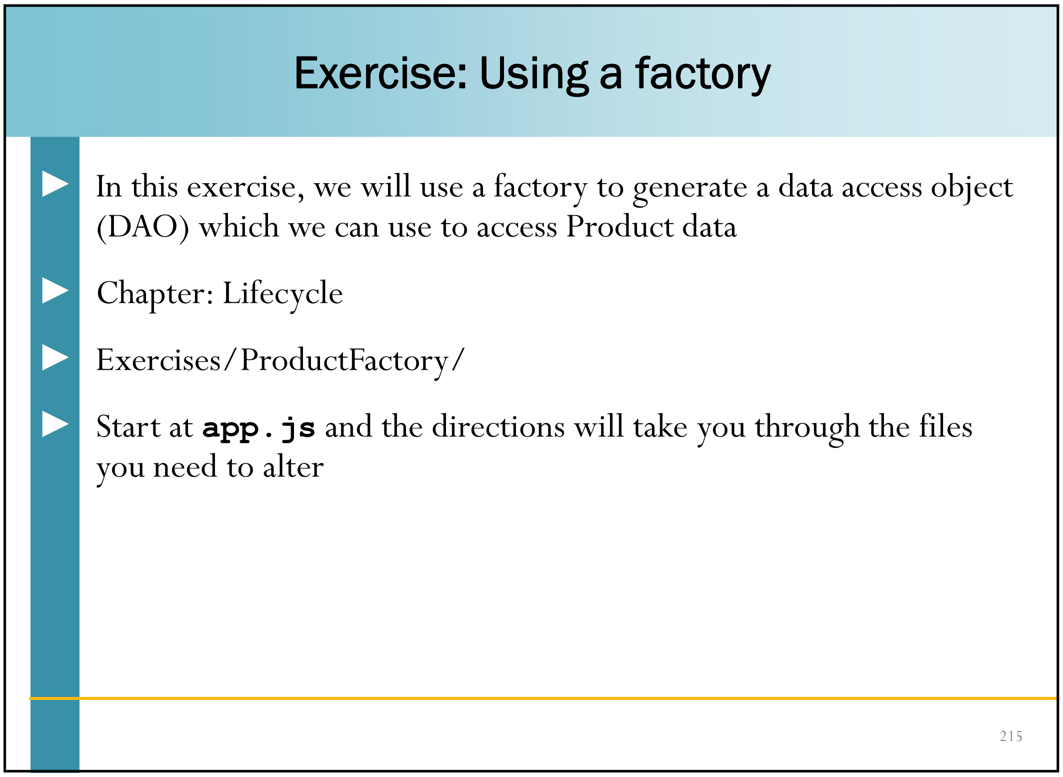
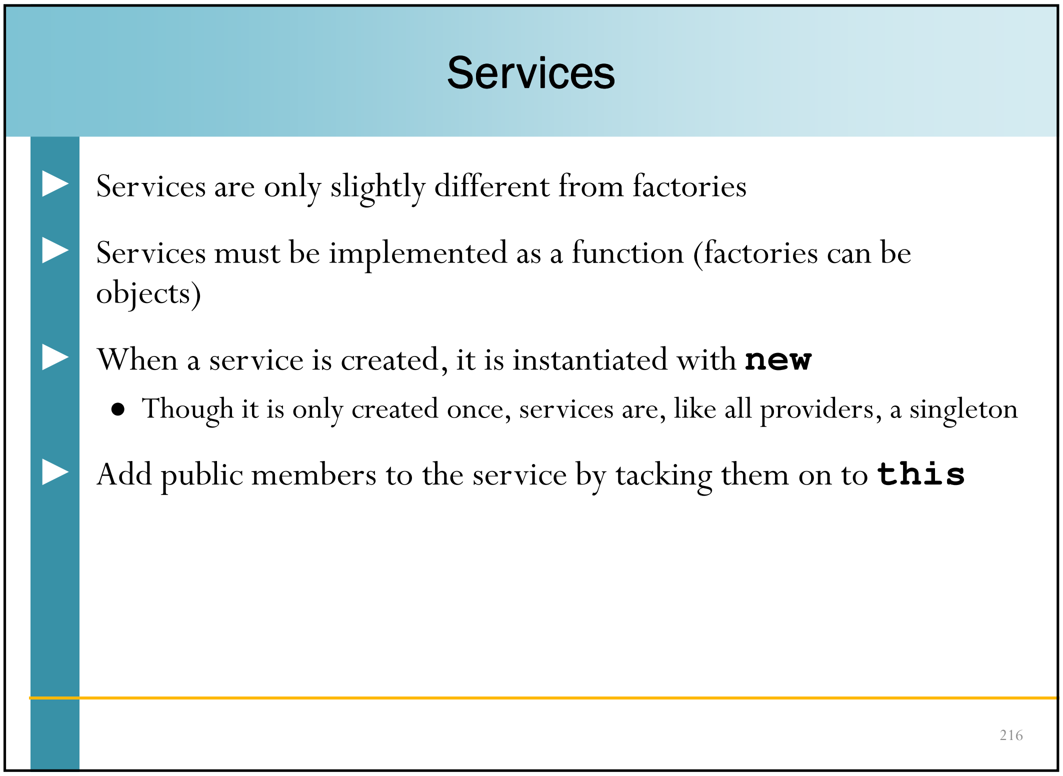


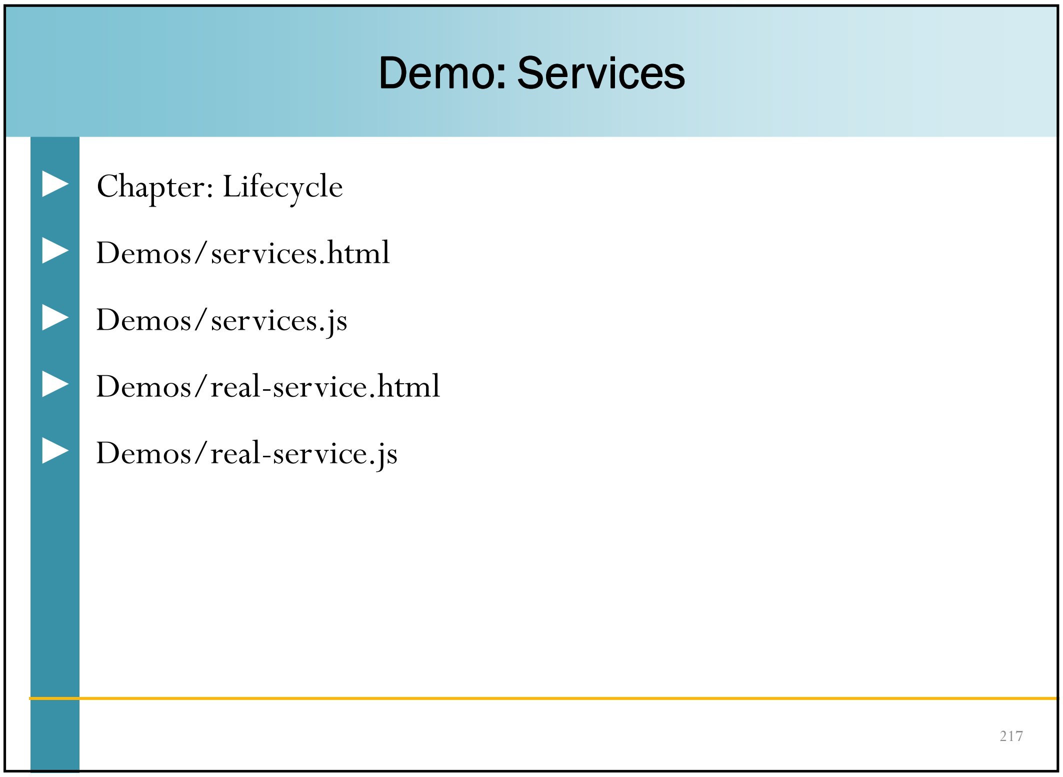
Exercise: Using a factory

- In this exercise, we will use a factory to generate a data access object (DAO) which we can use to access Product data
- Chapter: Lifecycle
- Exercises/ProductFactory/
- Start at **`app.js`** and the directions will take you through the files you need to alter



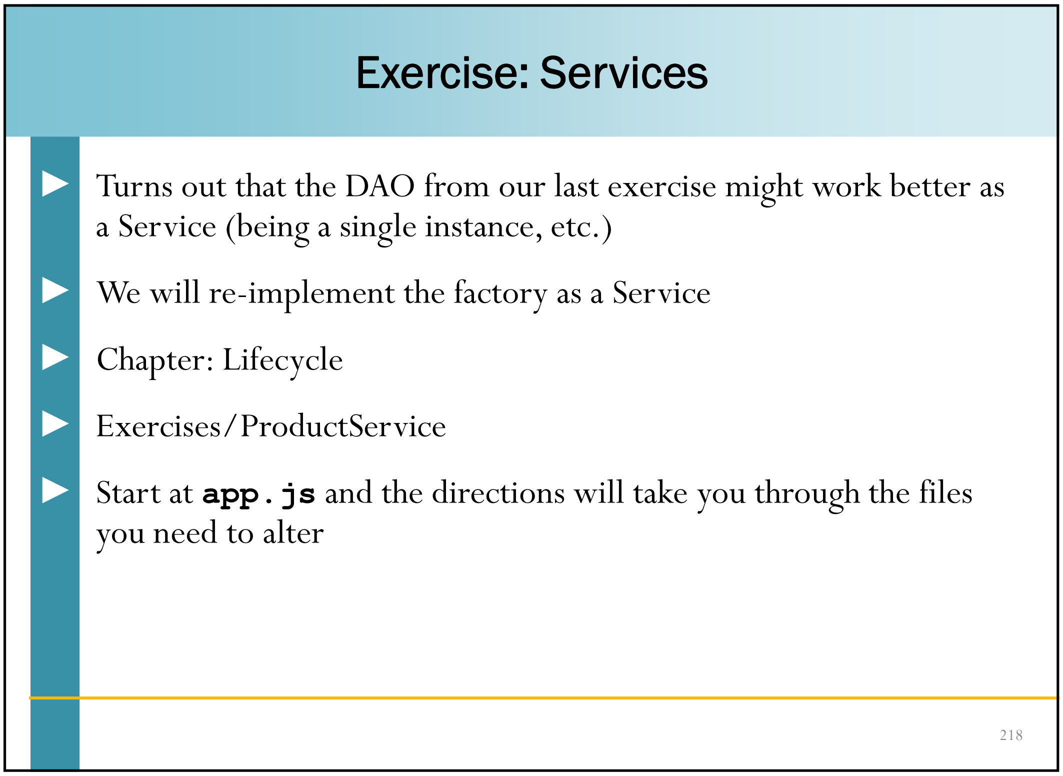
Services

- Services are only slightly different from factories
- Services must be implemented as a function (factories can be objects)
- When a service is created, it is instantiated with **`new`**
  - Though it is only created once, services are, like all providers, a singleton
- Add public members to the service by tacking them on to **`this`**



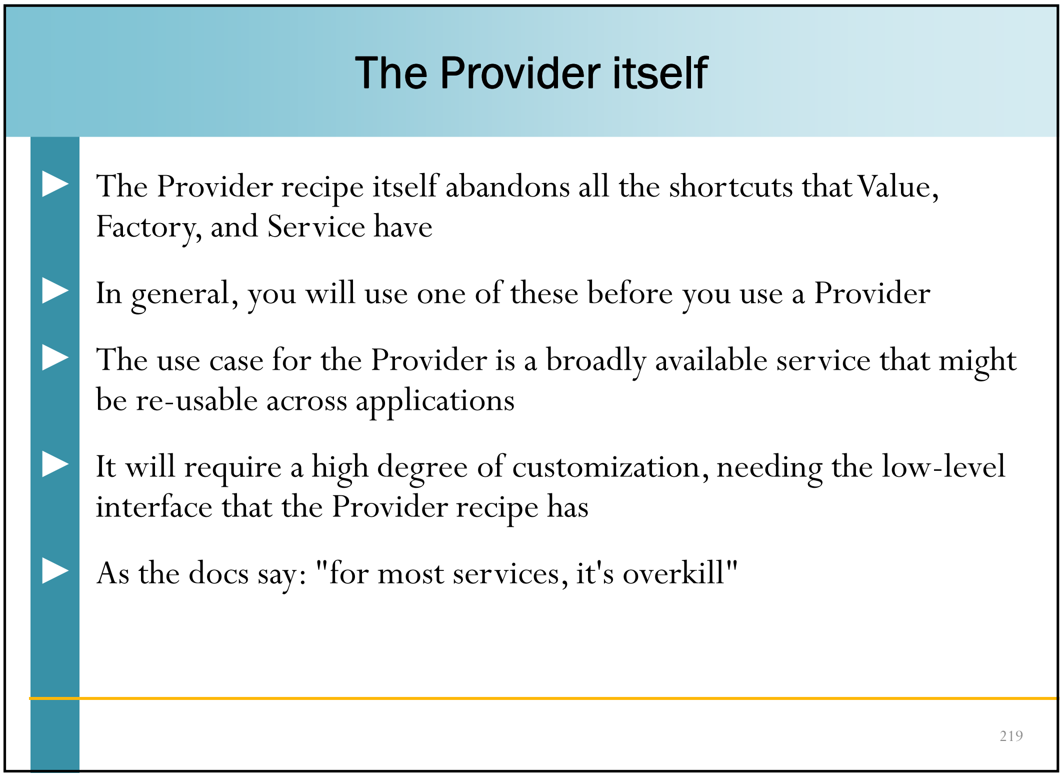
Demo: Services

- Chapter: Lifecycle
- Demos/services.html
- Demos/services.js
- Demos/real-service.html
- Demos/real-service.js



Exercise: Services

- Turns out that the DAO from our last exercise might work better as a Service (being a single instance, etc.)
- We will re-implement the factory as a Service
- Chapter: Lifecycle
- Exercises/ProductService
- Start at **`app.js`** and the directions will take you through the files you need to alter



The Provider itself

- The Provider recipe itself abandons all the shortcuts that Value, Factory, and Service have
- In general, you will use one of these before you use a Provider
- The use case for the Provider is a broadly available service that might be re-usable across applications
- It will require a high degree of customization, needing the low-level interface that the Provider recipe has
- As the docs say: "for most services, it's overkill"

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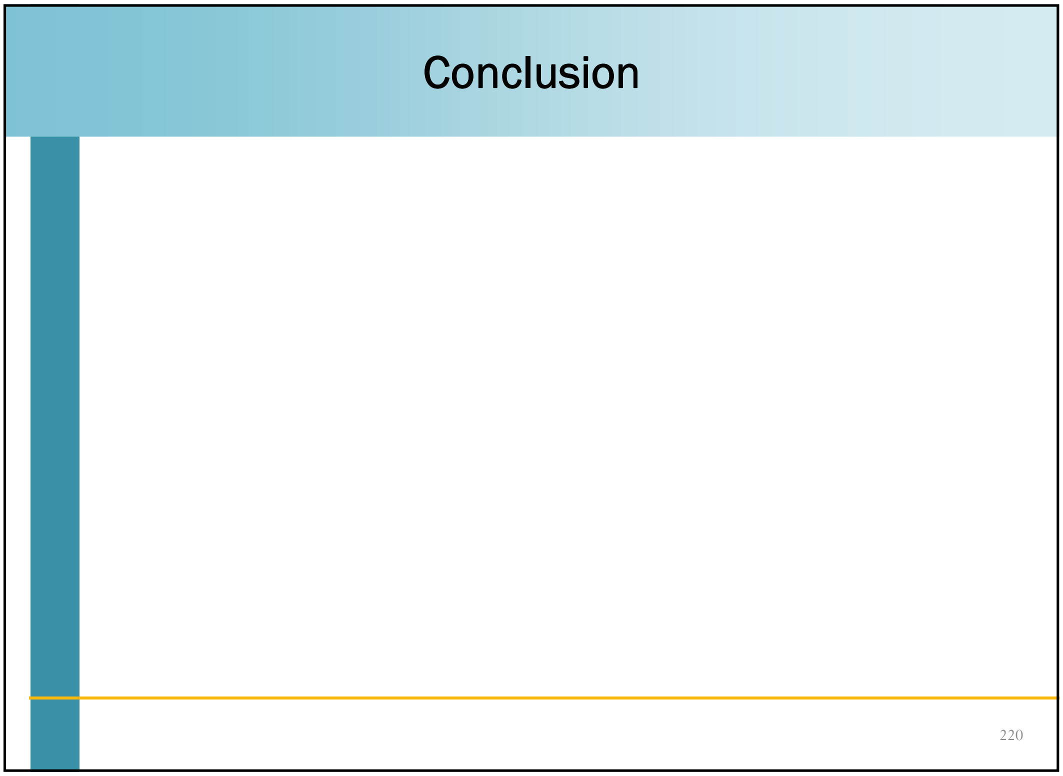

Conclusion

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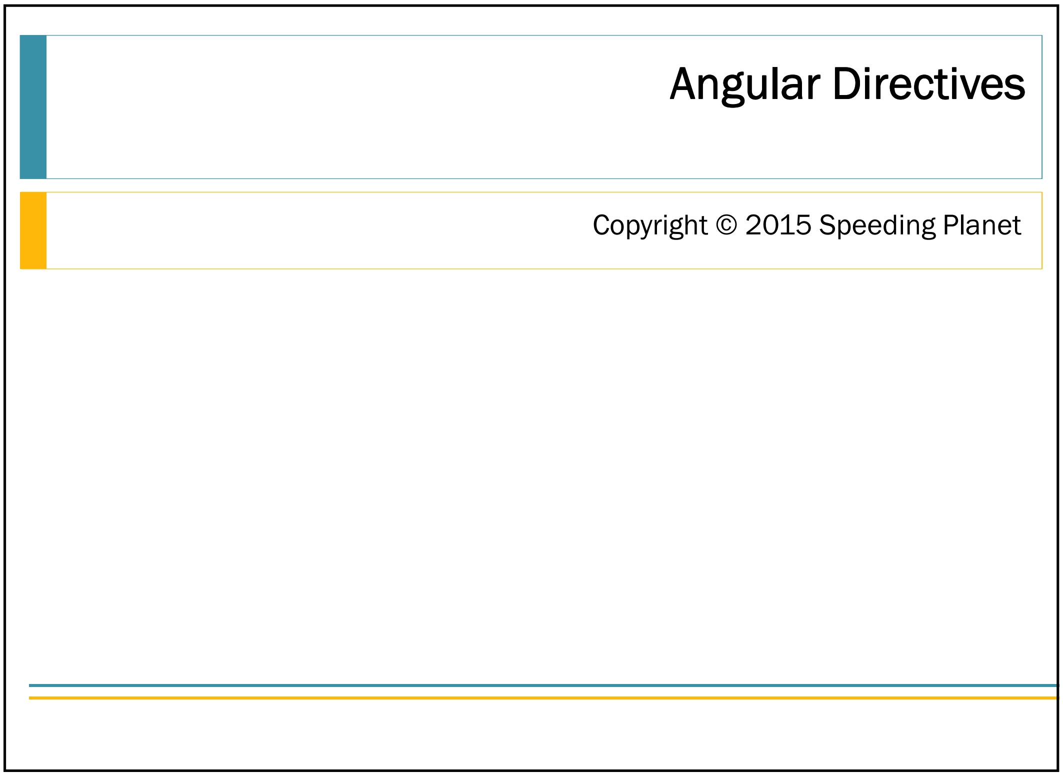
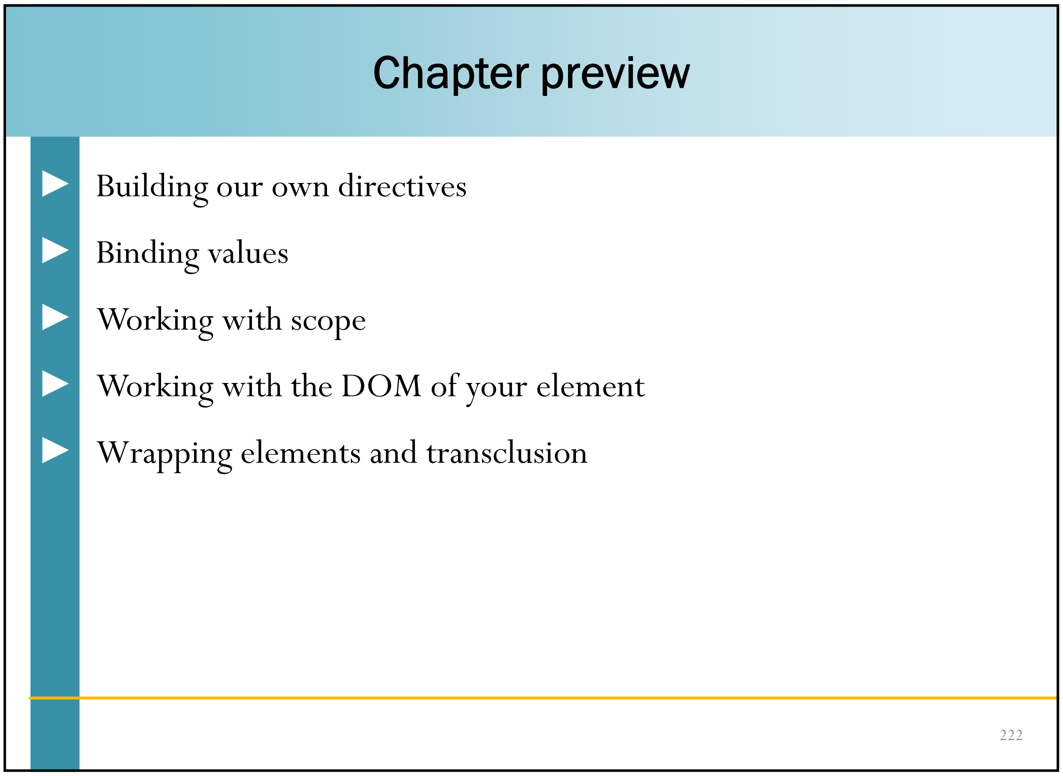


Angular Directives



Chapter preview

- Building our own directives
- Binding values
- Working with scope
- Working with the DOM of your element
- Wrapping elements and transclusion

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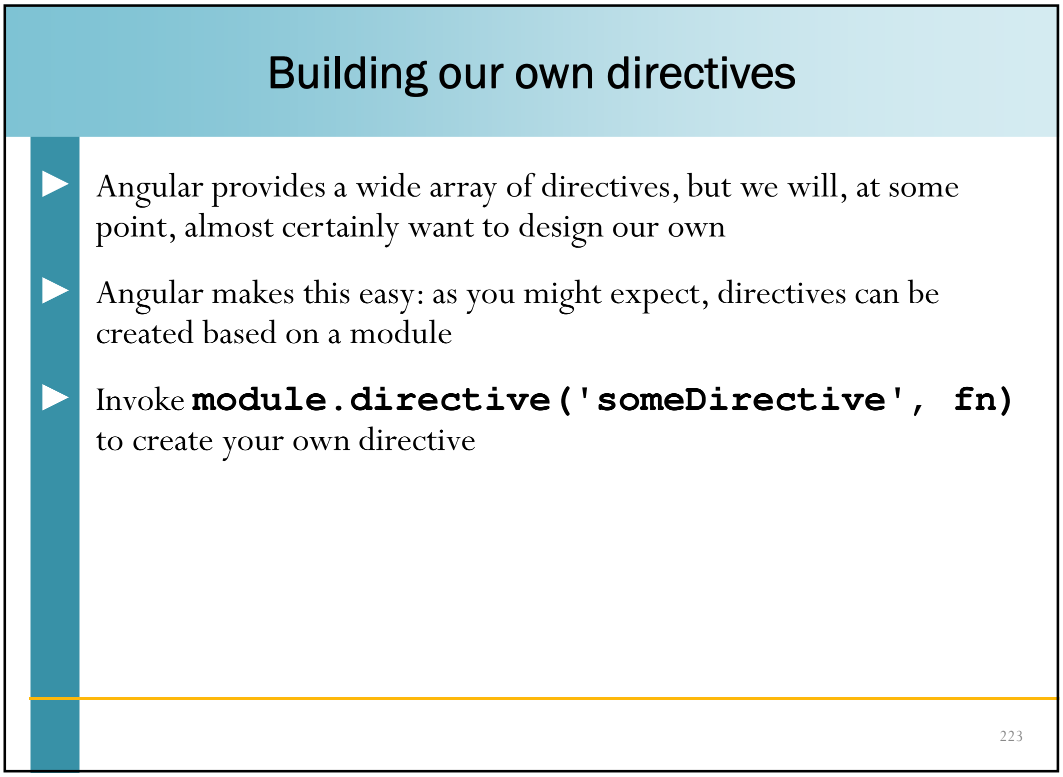
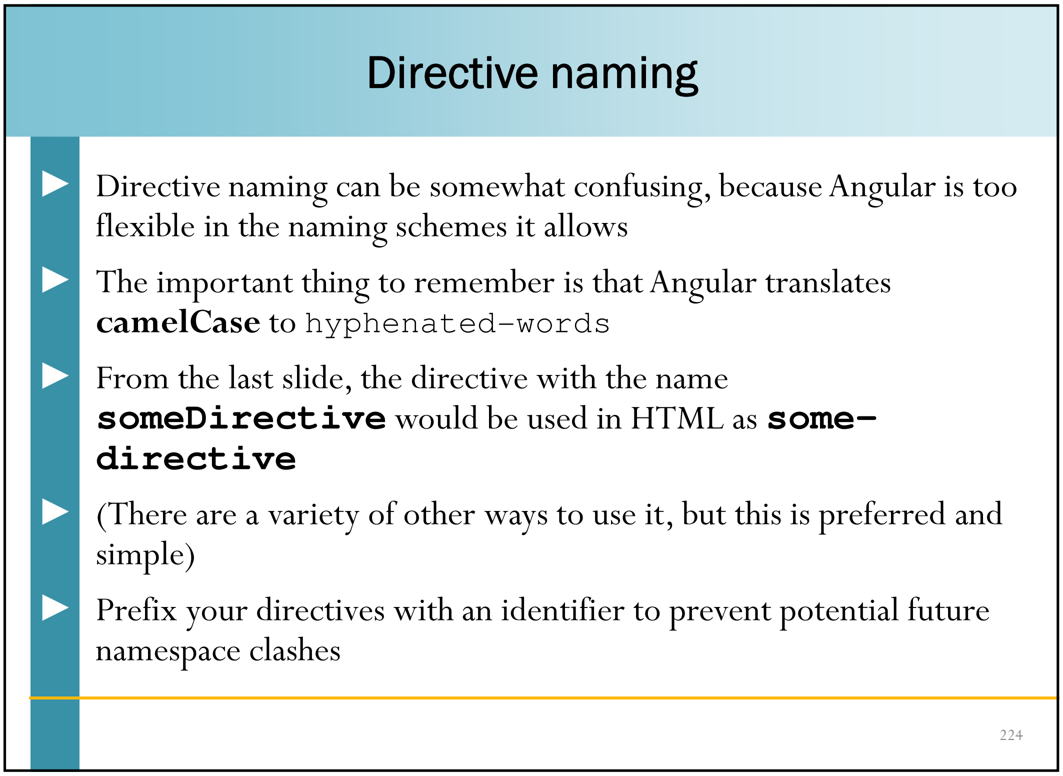


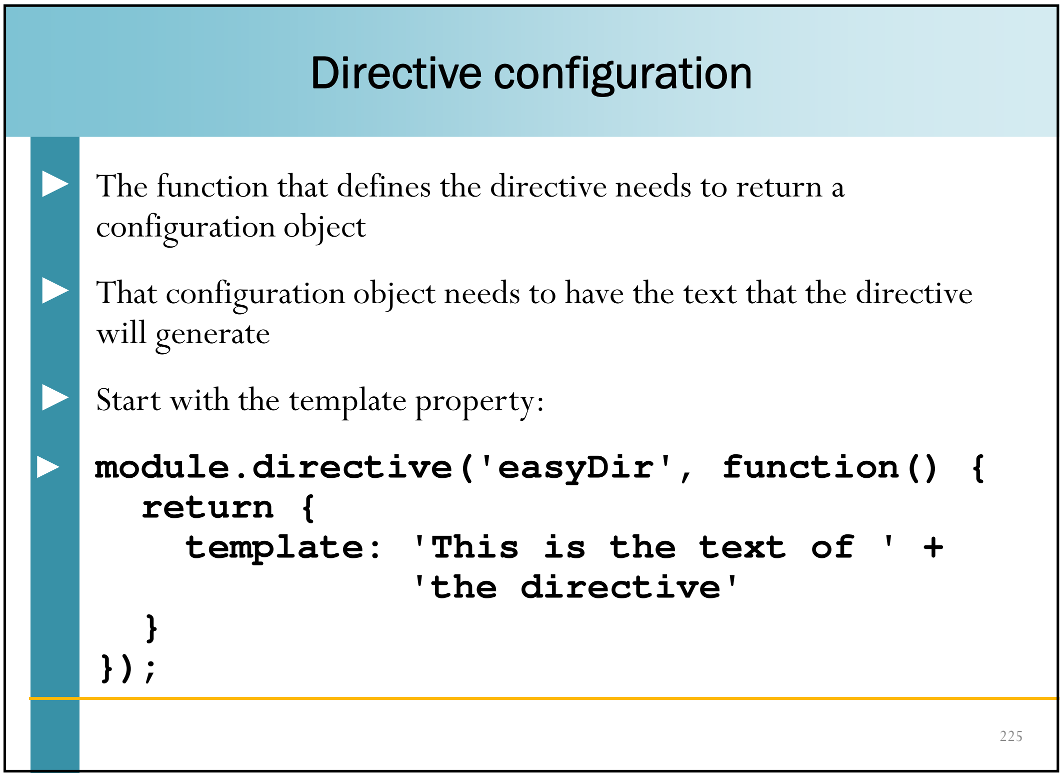
Building our own directives

- Angular provides a wide array of directives, but we will, at some point, almost certainly want to design our own
- Angular makes this easy: as you might expect, directives can be created based on a module
- Invoke **`module.directive('someDirective', fn)`** to create your own directive



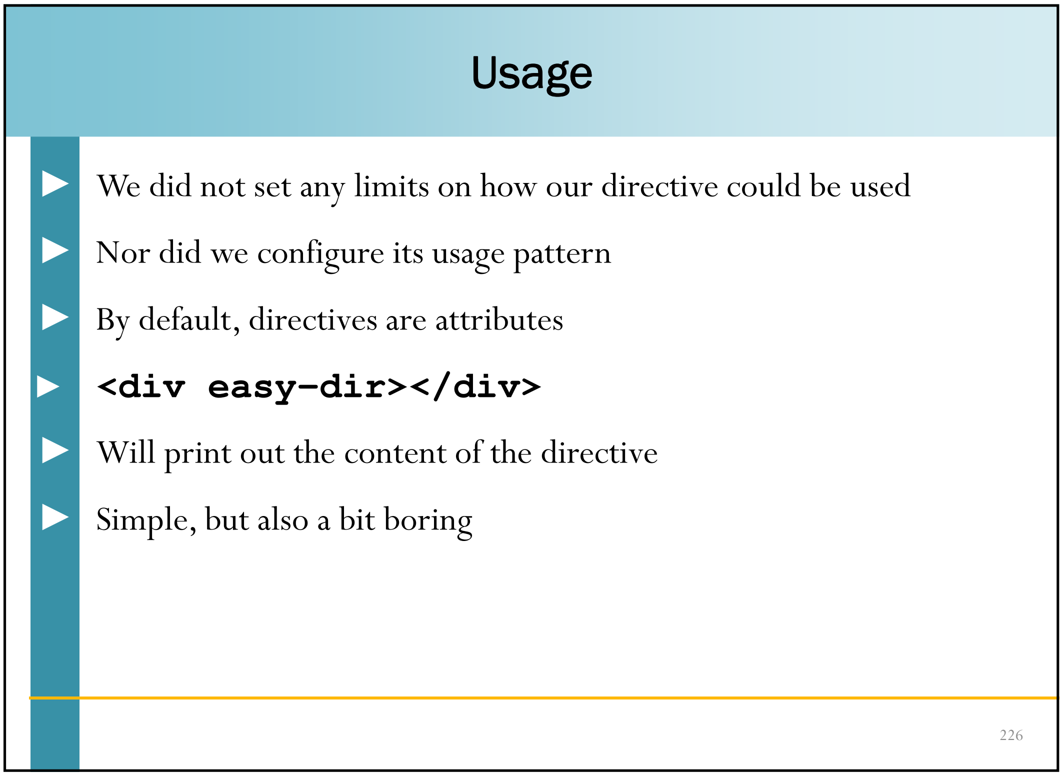
Directive naming

- Directive naming can be somewhat confusing, because Angular is too flexible in the naming schemes it allows
- The important thing to remember is that Angular translates **camelCase** to `hyphenated-words`
- From the last slide, the directive with the name **`someDirective`** would be used in HTML as **`some-directive`**
- (There are a variety of other ways to use it, but this is preferred and simple)
- Prefix your directives with an identifier to prevent potential future namespace clashes



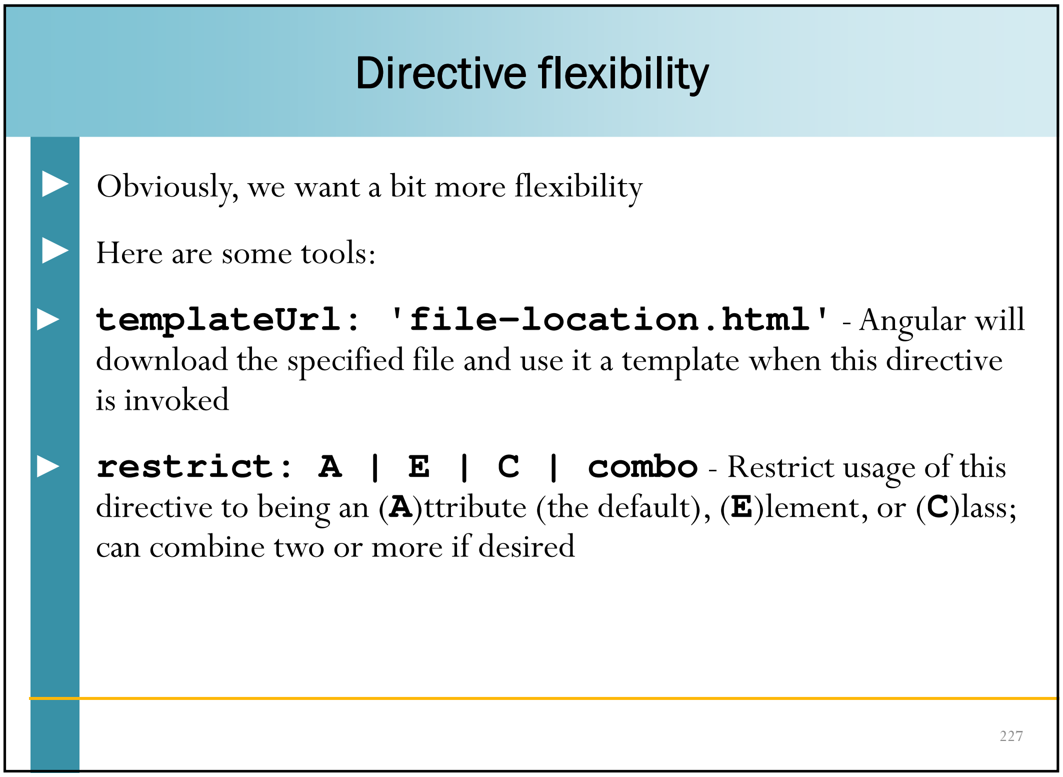
Directive configuration

- The function that defines the directive needs to return a configuration object
- That configuration object needs to have the text that the directive will generate
- Start with the template property:
-
```
module.directive('easyDir', function() {
  return {
    template: 'This is the text of ' +
              'the directive'
  }
});
```



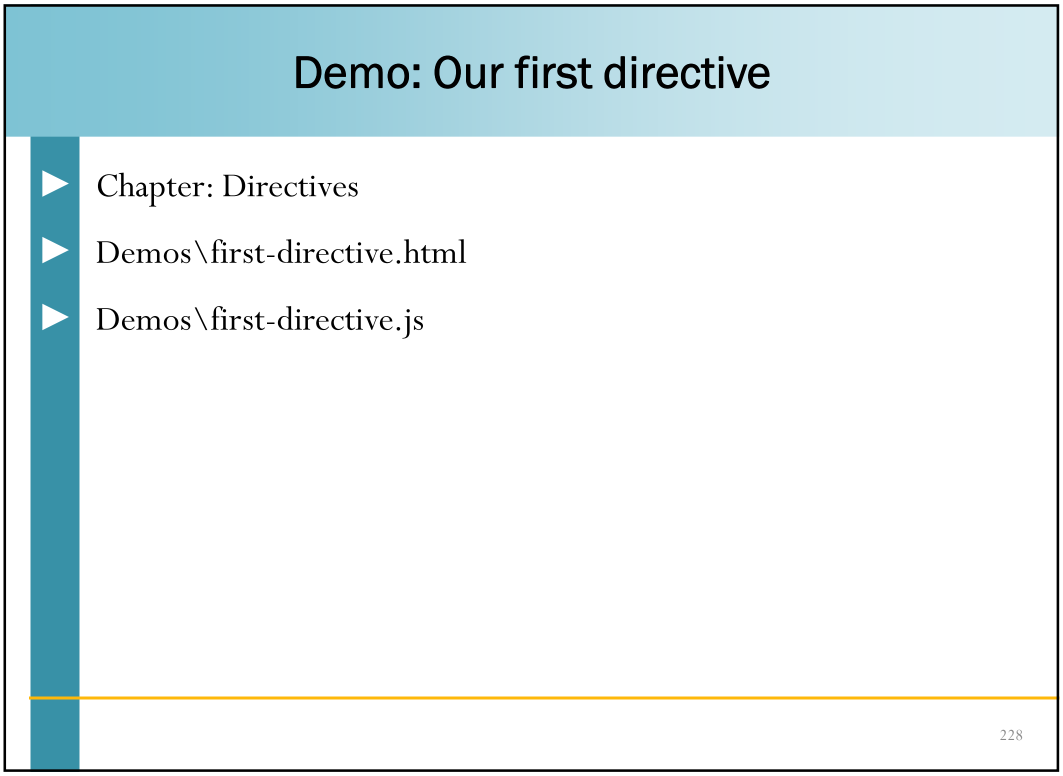
Usage

- We did not set any limits on how our directive could be used
- Nor did we configure its usage pattern
- By default, directives are attributes
- `<div easy-dir></div>`
- Will print out the content of the directive
- Simple, but also a bit boring



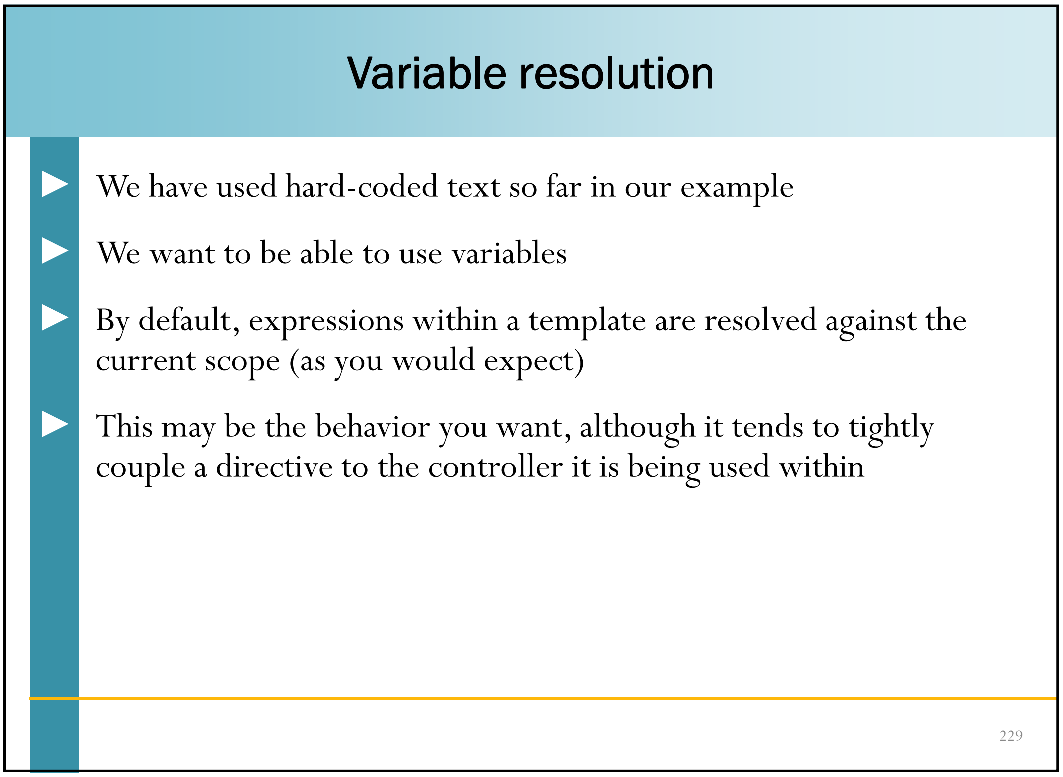
Directive flexibility

- Obviously, we want a bit more flexibility
- Here are some tools:
- **`templateUrl: 'file-location.html'`** - Angular will download the specified file and use it a template when this directive is invoked
- **`restrict: A | E | C | combo`** - Restrict usage of this directive to being an (**A**)ttribute (the default), (**E**)lement, or (**C**)lass; can combine two or more if desired



Demo: Our first directive

- Chapter: Directives
- Demos\first-directive.html
- Demos\first-directive.js



Variable resolution

- We have used hard-coded text so far in our example
- We want to be able to use variables
- By default, expressions within a template are resolved against the current scope (as you would expect)
- This may be the behavior you want, although it tends to tightly couple a directive to the controller it is being used within

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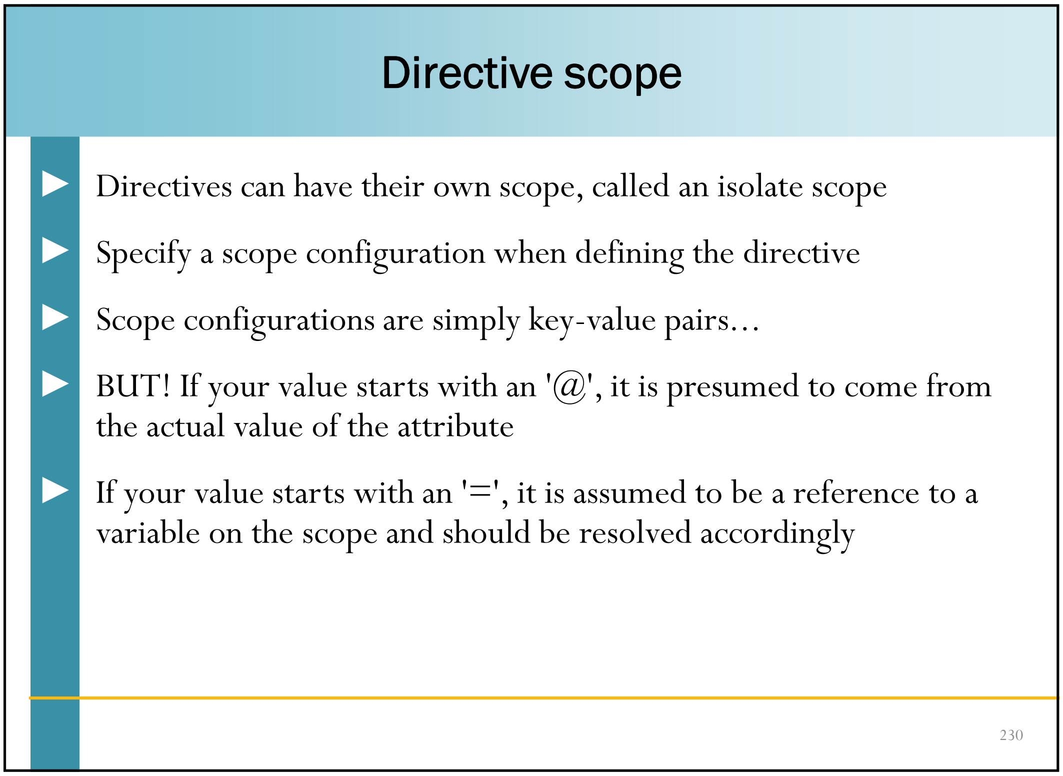

Directive scope

- Directives can have their own scope, called an isolate scope
- Specify a scope configuration when defining the directive
- Scope configurations are simply key-value pairs…
- BUT! If your value starts with an '@', it is presumed to come from the actual value of the attribute
- If your value starts with an '=', it is assumed to be a reference to a variable on the scope and should be resolved accordingly

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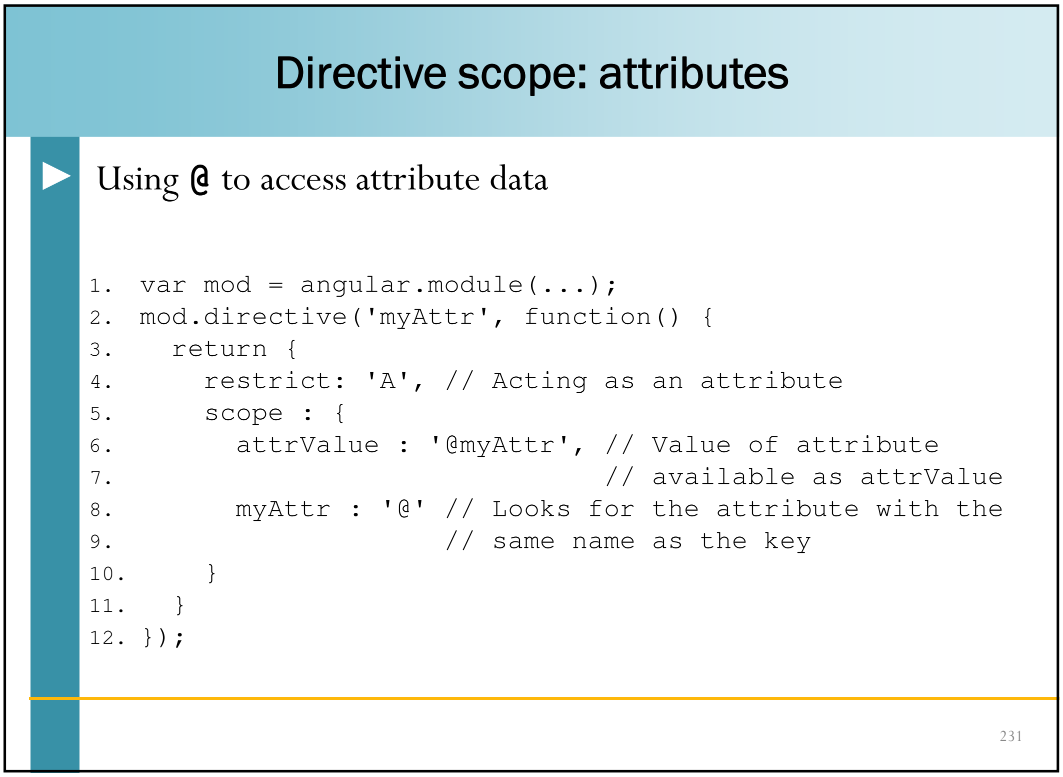
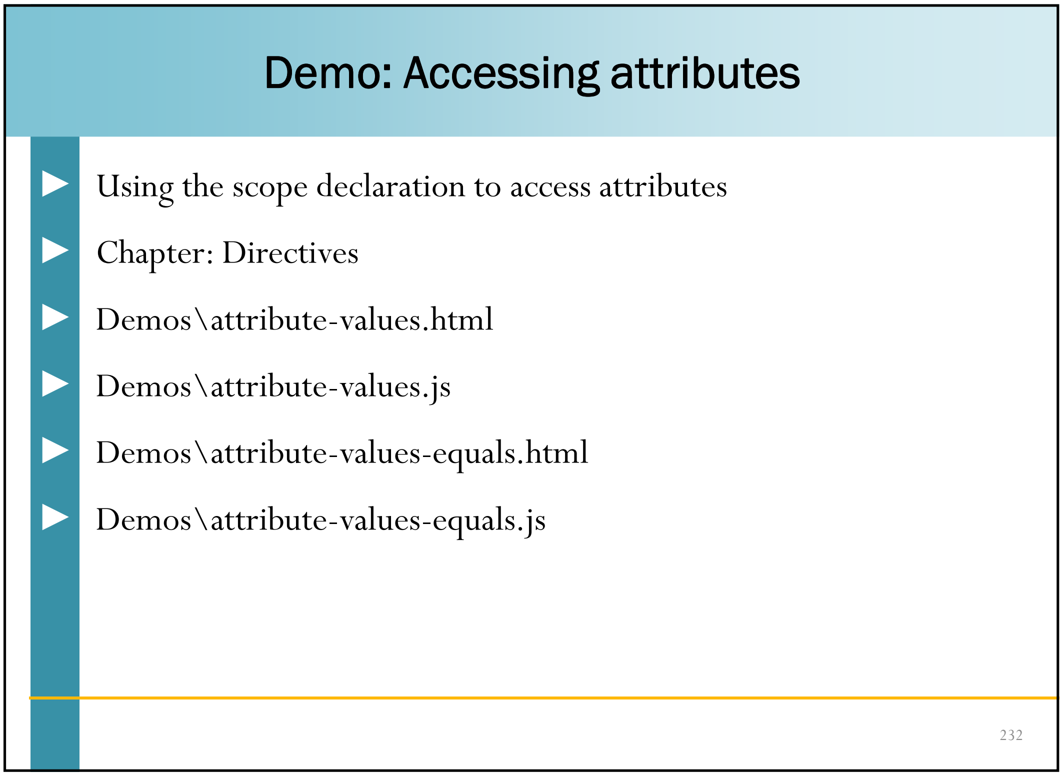


Directive scope: attributes

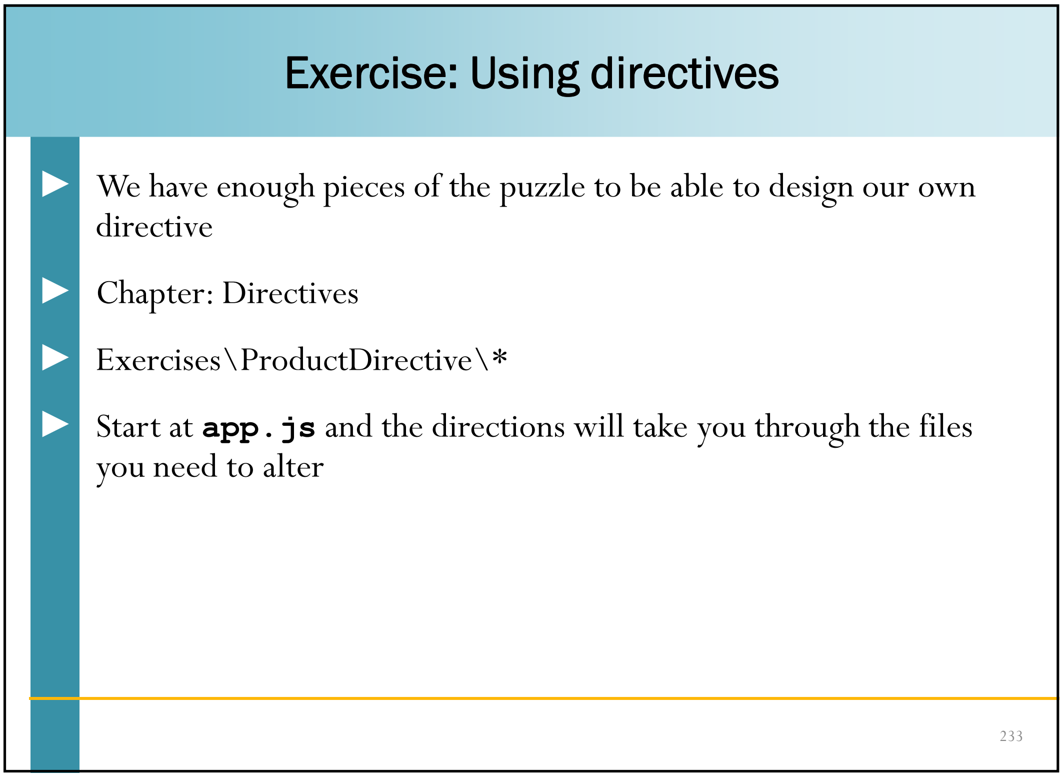
- Using @ to access attribute data

```
var mod = angular.module(...);
mod.directive('myAttr', function() {
  return {
    restrict: 'A', // Acting as an attribute
    scope : {
      attrValue : '@myAttr', // Value of attribute
                             // available as attrValue
      myAttr : '@' // Looks for the attribute with the
                   // same name as the key
    }
  }
});
```



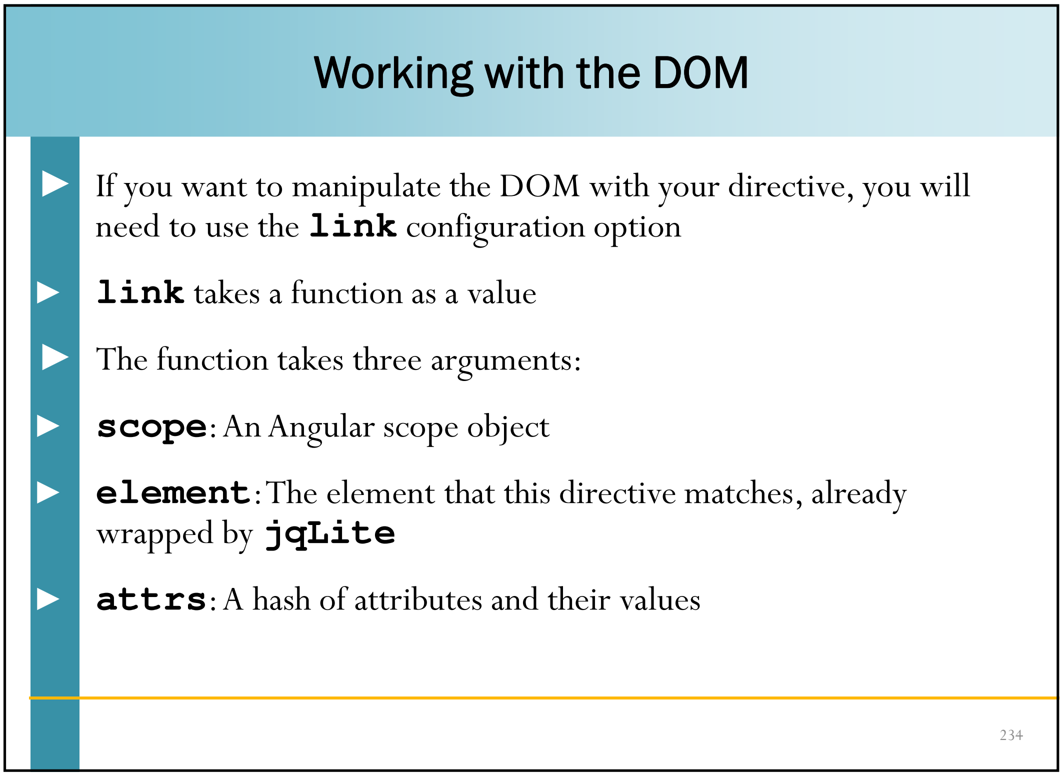
Demo: Accessing attributes

- Using the scope declaration to access attributes
- Chapter: Directives
- Demos\attribute-values.html
- Demos\attribute-values.js
- Demos\attribute-values-equals.html
- Demos\attribute-values-equals.js



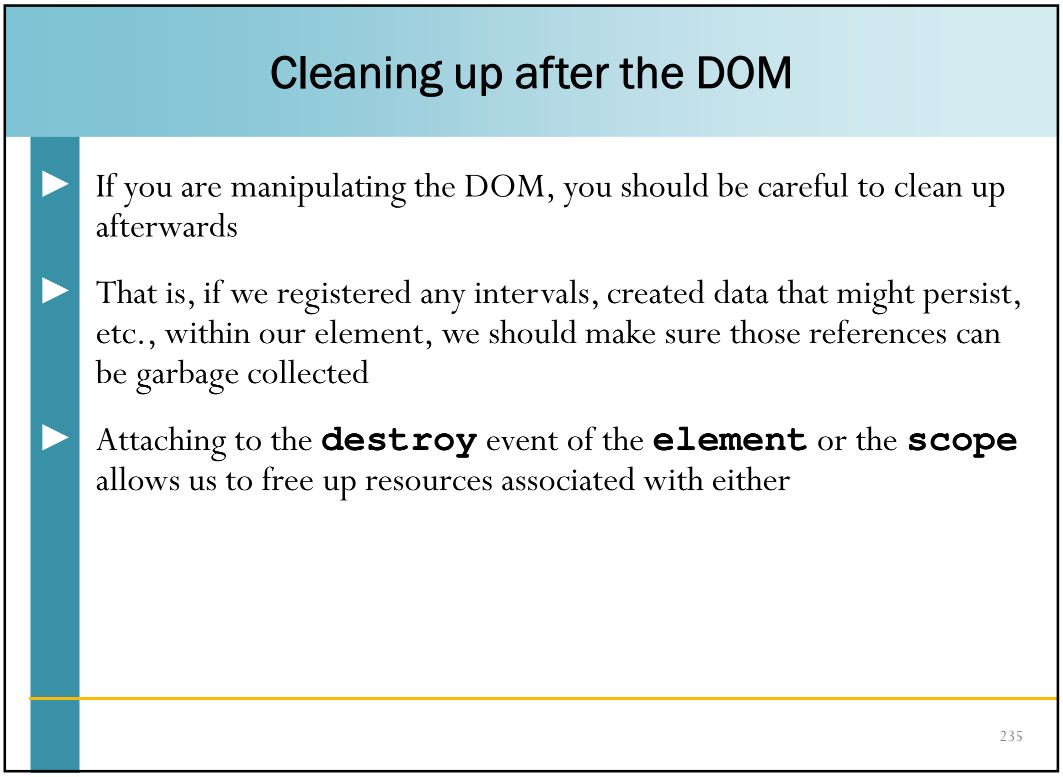
Exercise: Using directives

- We have enough pieces of the puzzle to be able to design our own directive
- Chapter: Directives
- Exercises\ProductDirective\*
- Start at **`app.js`** and the directions will take you through the files you need to alter



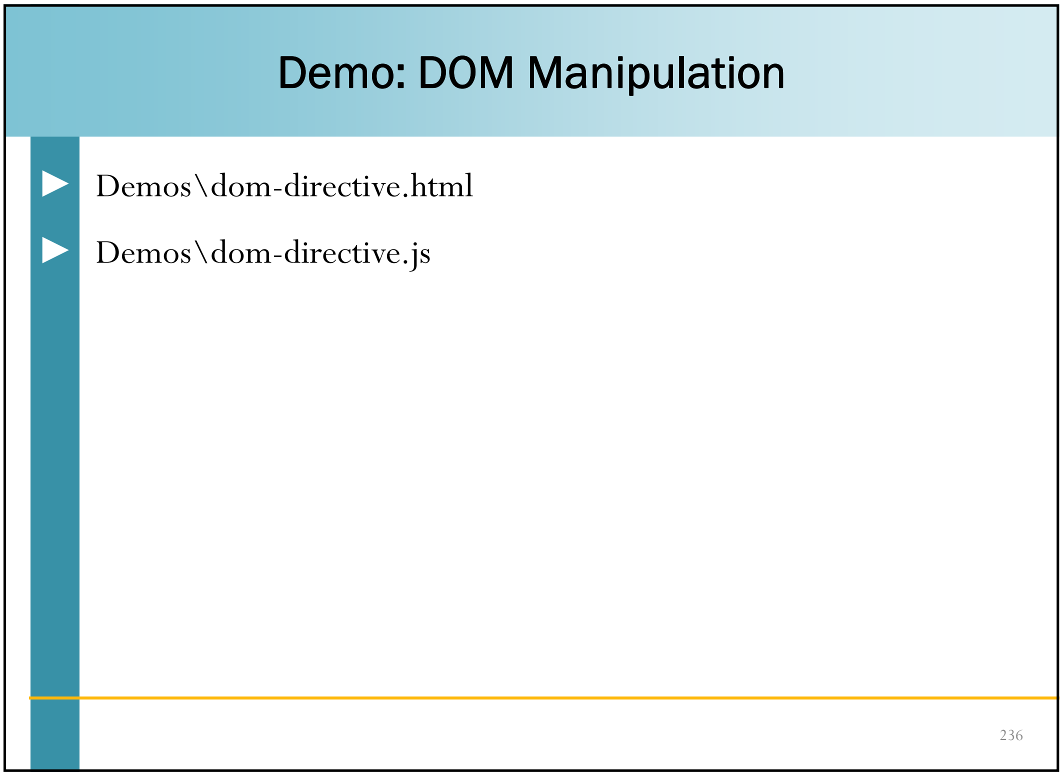
Working with the DOM

- If you want to manipulate the DOM with your directive, you will need to use the **`link`** configuration option
- **`link`** takes a function as a value
- The function takes three arguments:
- **`scope`**: An Angular scope object
- **`element`**: The element that this directive matches, already wrapped by **`jqLite`**
- **`attrs`**: A hash of attributes and their values



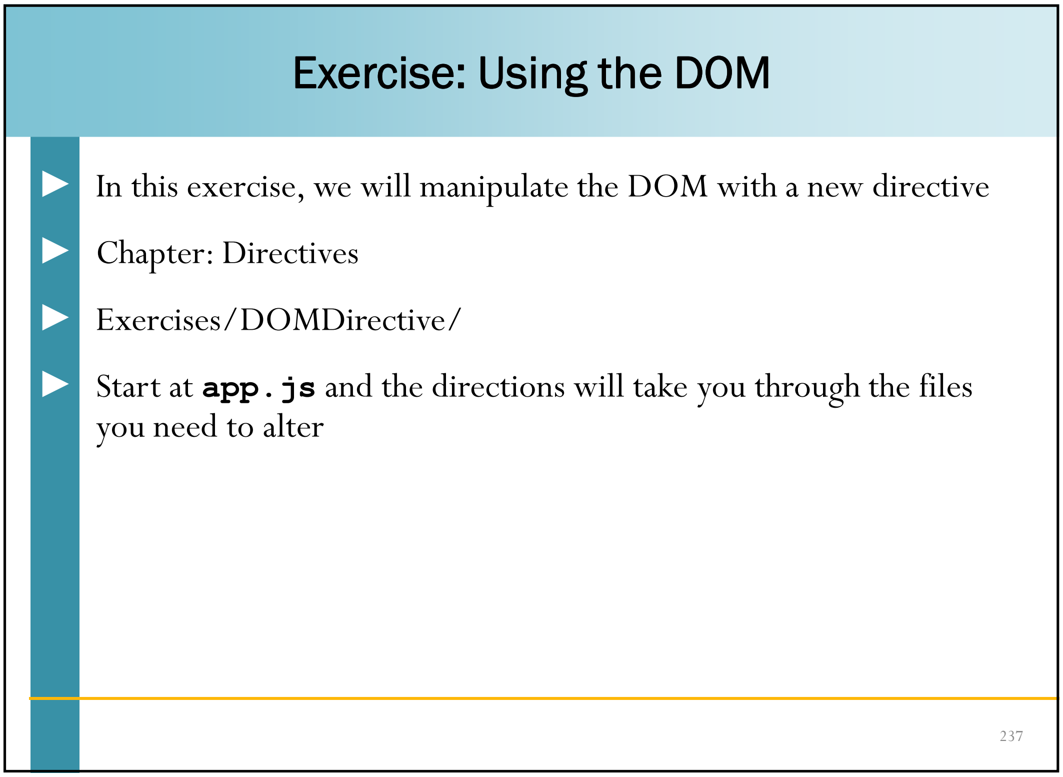
Cleaning up after the DOM

- If you are manipulating the DOM, you should be careful to clean up afterwards
- That is, if we registered any intervals, created data that might persist, etc., within our element, we should make sure those references can be garbage collected
- Attaching to the **`destroy`** event of the **`element`** or the **`scope`** allows us to free up resources associated with either



Demo: DOM Manipulation

- Demos\dom-directive.html
- Demos\dom-directive.js



Exercise: Using the DOM

- In this exercise, we will manipulate the DOM with a new directive
- Chapter: Directives
- Exercises/DOMDirective/
- Start at **`app.js`** and the directions will take you through the files you need to alter

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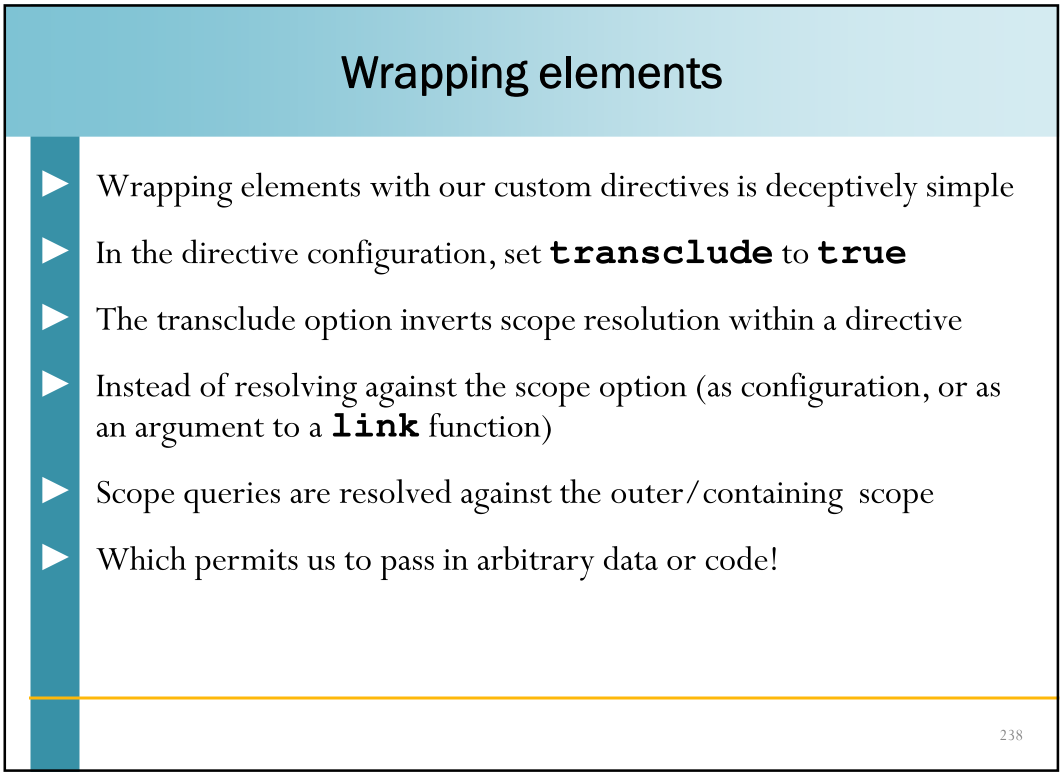

Wrapping elements

- Wrapping elements with our custom directives is deceptively simple
- In the directive configuration, set **`transclude`** to **`true`**
- The transclude option inverts scope resolution within a directive
- Instead of resolving against the scope option (as configuration, or as an argument to a **`link`** function)
- Scope queries are resolved against the outer/containing scope
- Which permits us to pass in arbitrary data or code!

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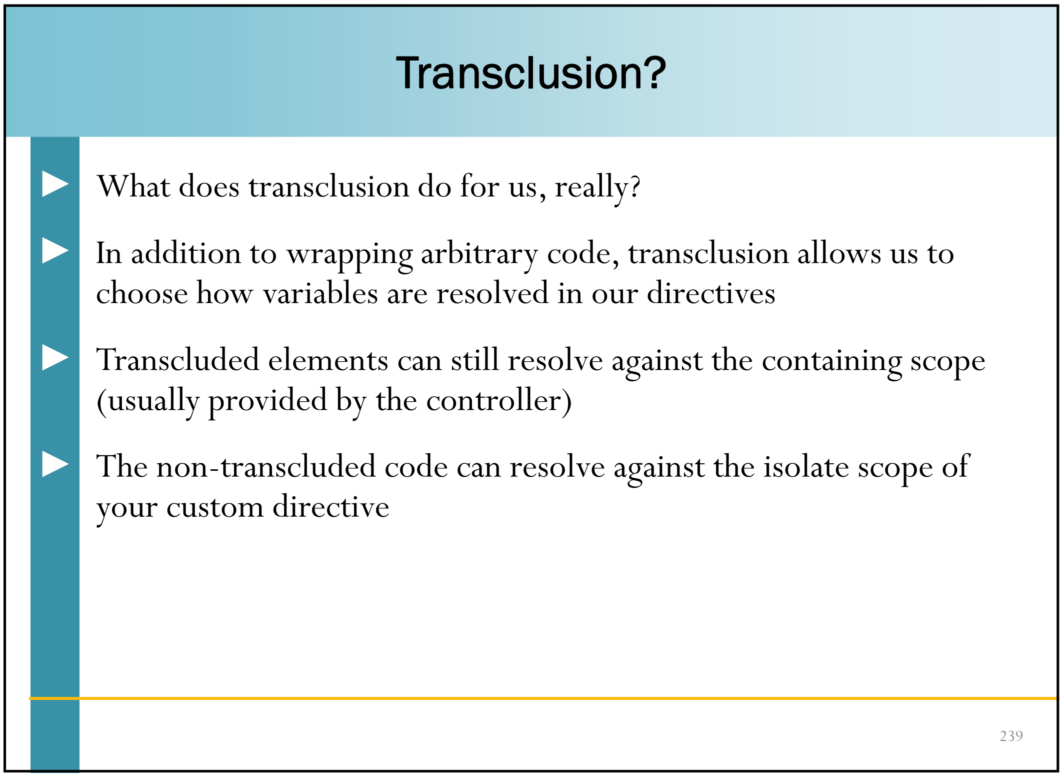

Transclusion?

- What does transclusion do for us, really?
- In addition to wrapping arbitrary code, transclusion allows us to choose how variables are resolved in our directives
- Transcluded elements can still resolve against the containing scope (usually provided by the controller)
- The non-transcluded code can resolve against the isolate scope of your custom directive

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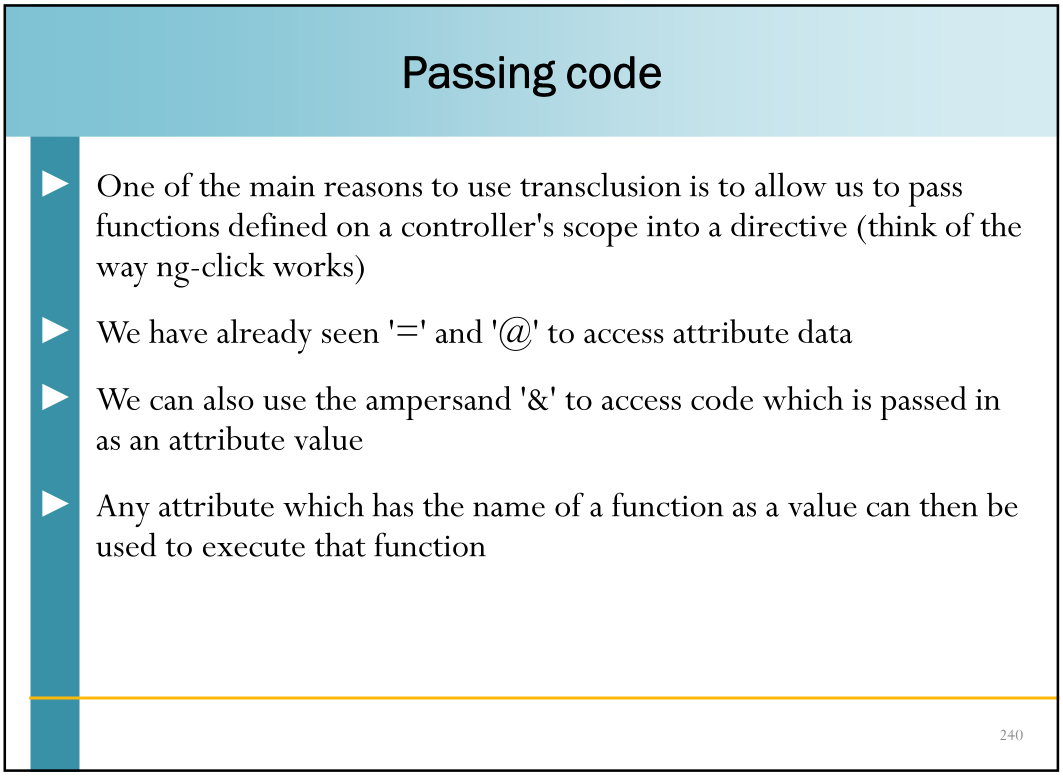

Passing code

- One of the main reasons to use transclusion is to allow us to pass functions defined on a controller's scope into a directive (think of the way ng-click works)
- We have already seen '=' and '@' to access attribute data
- We can also use the ampersand '&' to access code which is passed in as an attribute value
- Any attribute which has the name of a function as a value can then be used to execute that function

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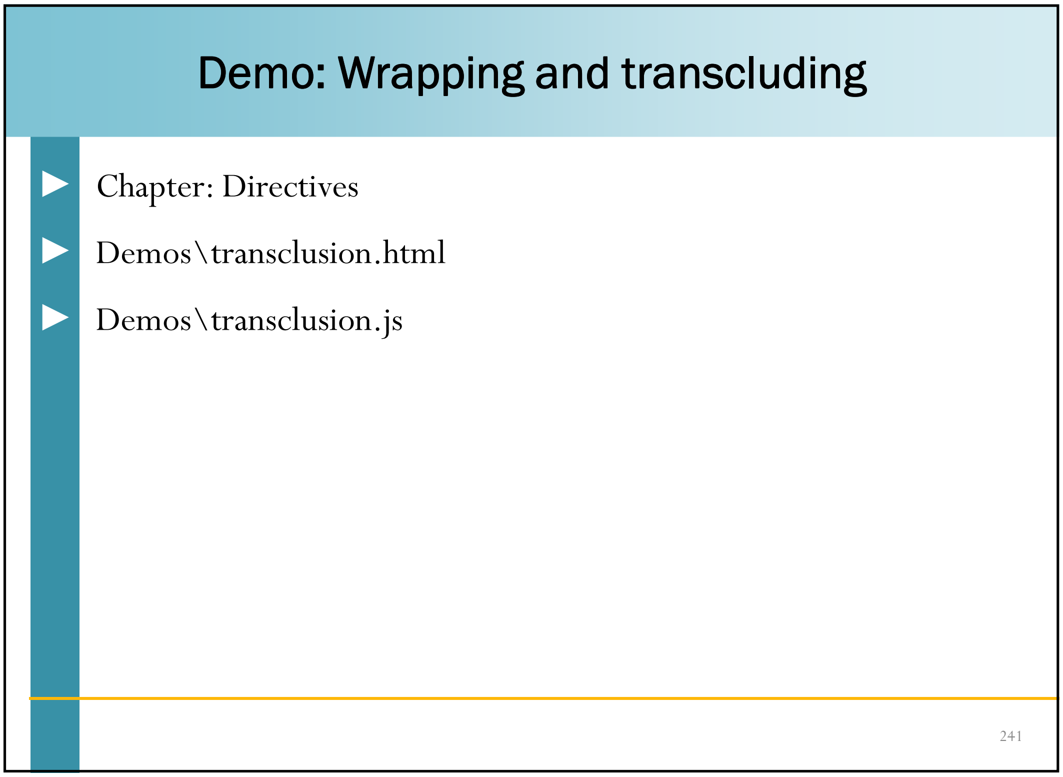

Demo: Wrapping and transcluding

- Chapter: Directives
- Demos\transclusion.html
- Demos\transclusion.js

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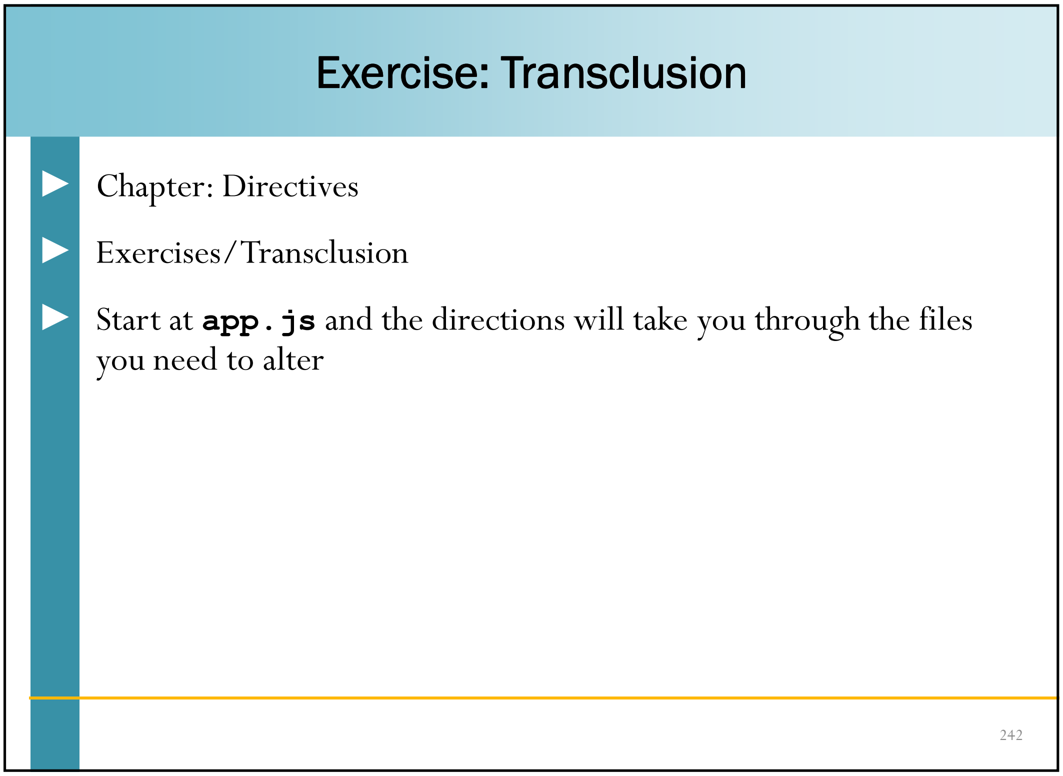

Exercise: Transclusion

- Chapter: Directives
- Exercises/Transclusion
- Start at **`app.js`** and the directions will take you through the files you need to alter

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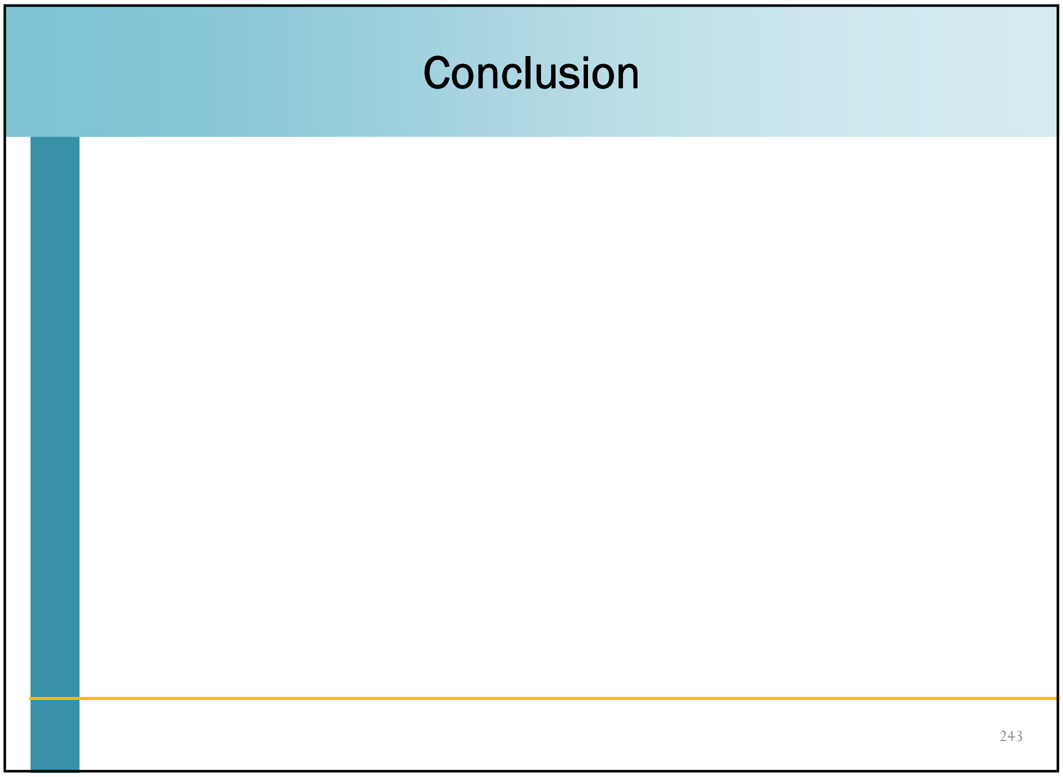
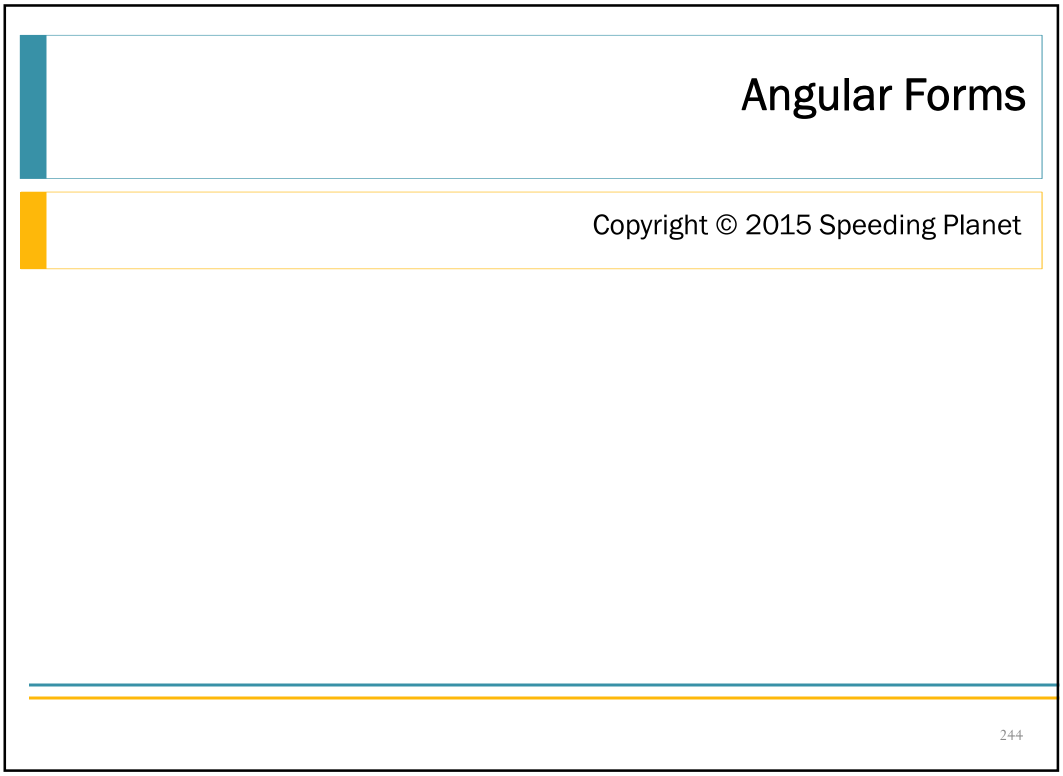
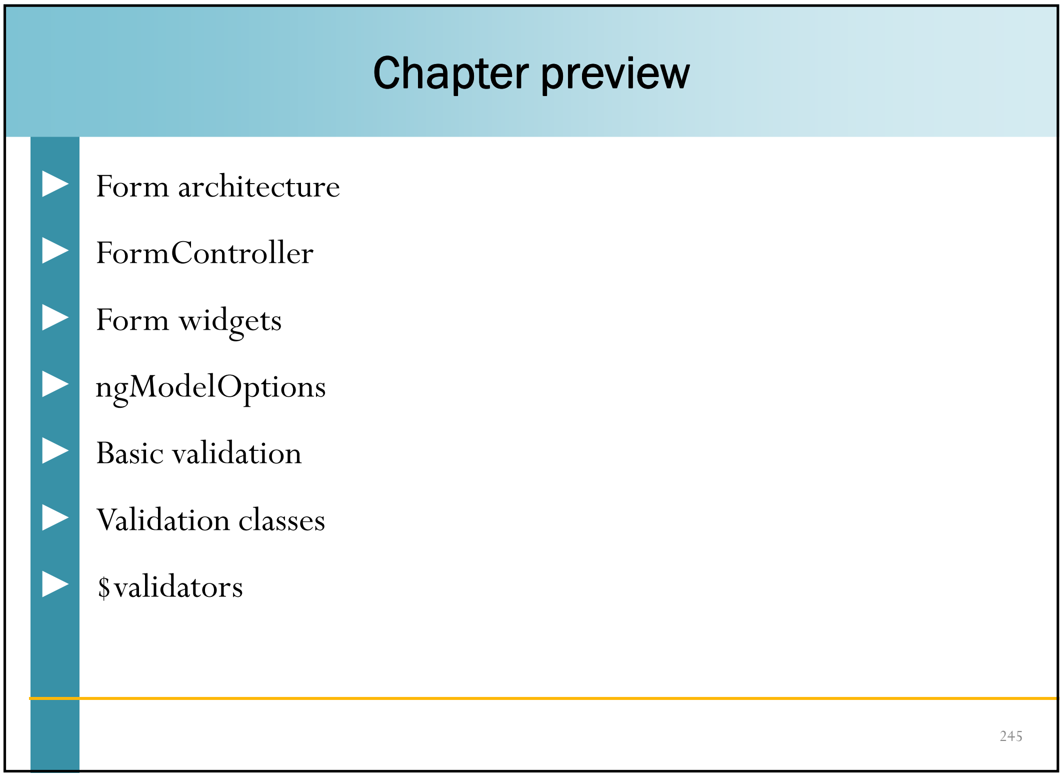


Conclusion

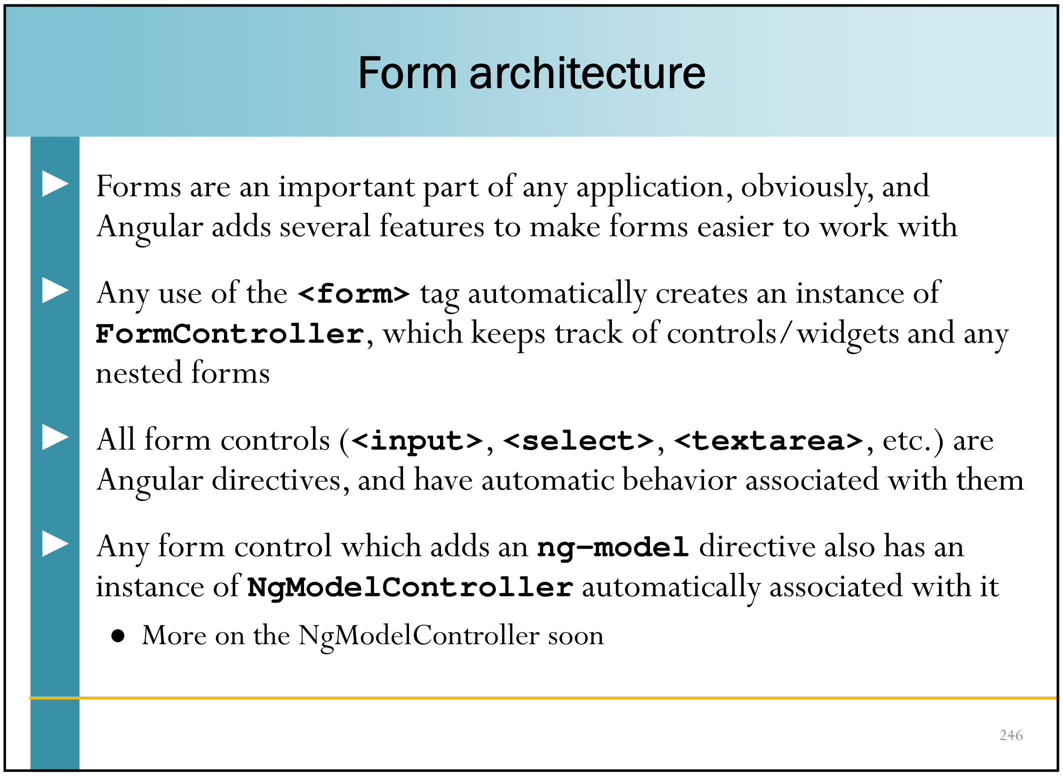


Angular Forms



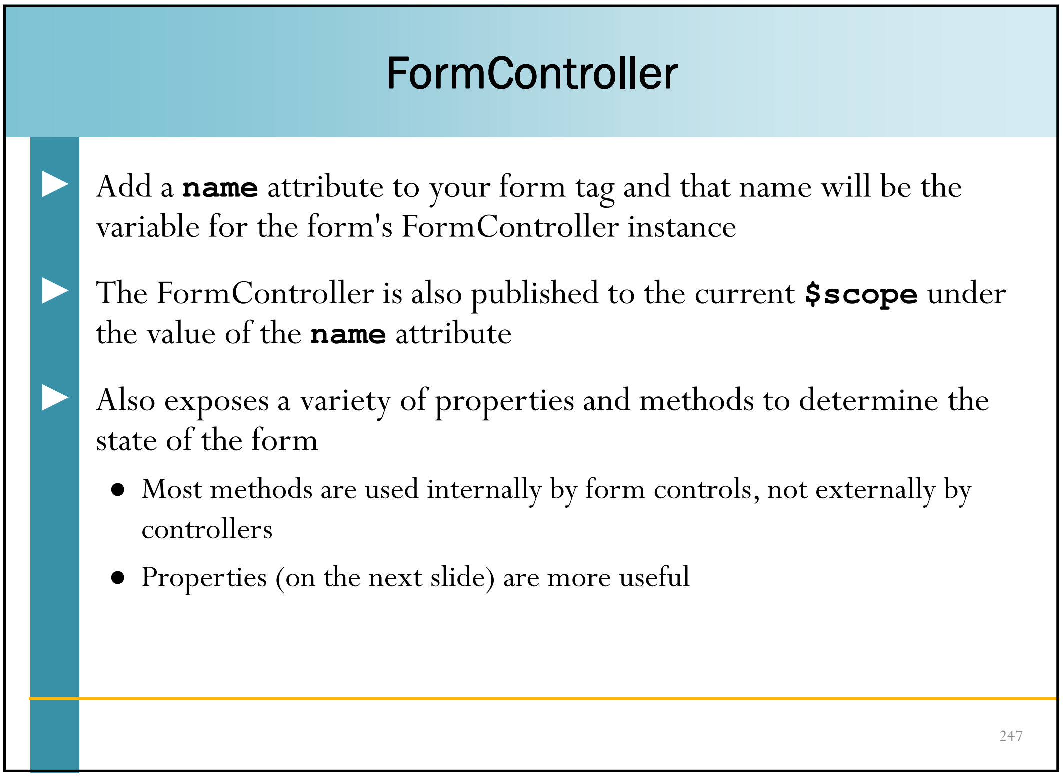
Chapter preview

- Form architecture
- FormController
- Form widgets
- ngModelOptions
- Basic validation
- Validation classes
- $validators



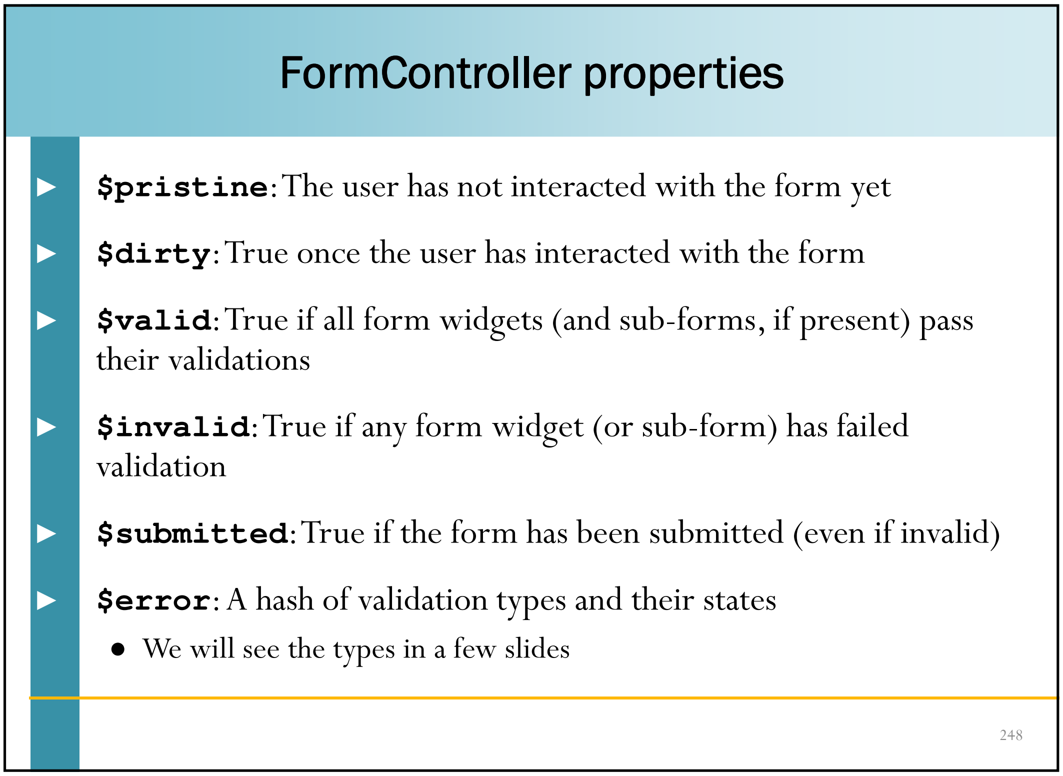
Form architecture

- Forms are an important part of any application, obviously, and Angular adds several features to make forms easier to work with
- Any use of the **`<form>`** tag automatically creates an instance of **`FormController`**, which keeps track of controls/widgets and any nested forms
- All form controls (**`<input>`**, **`<select>`**, **`<textarea>`**, etc.) are Angular directives, and have automatic behavior associated with them
- Any form control which adds an **`ng-model`** directive also has an instance of **`NgModelController`** automatically associated with it
  - More on the NgModelController soon



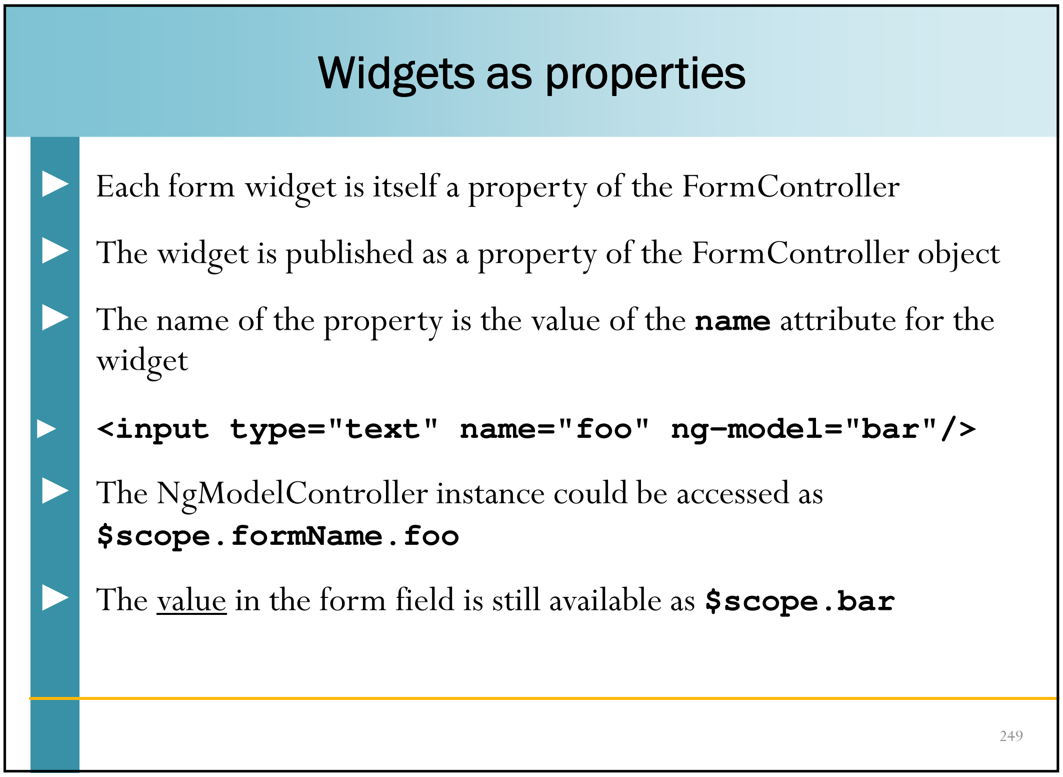
FormController

- Add a **`name`** attribute to your form tag and that name will be the variable for the form's FormController instance
- The FormController is also published to the current **`$scope`** under the value of the **`name`** attribute
- Also exposes a variety of properties and methods to determine the state of the form
  - Most methods are used internally by form controls, not externally by controllers
  - Properties (on the next slide) are more useful



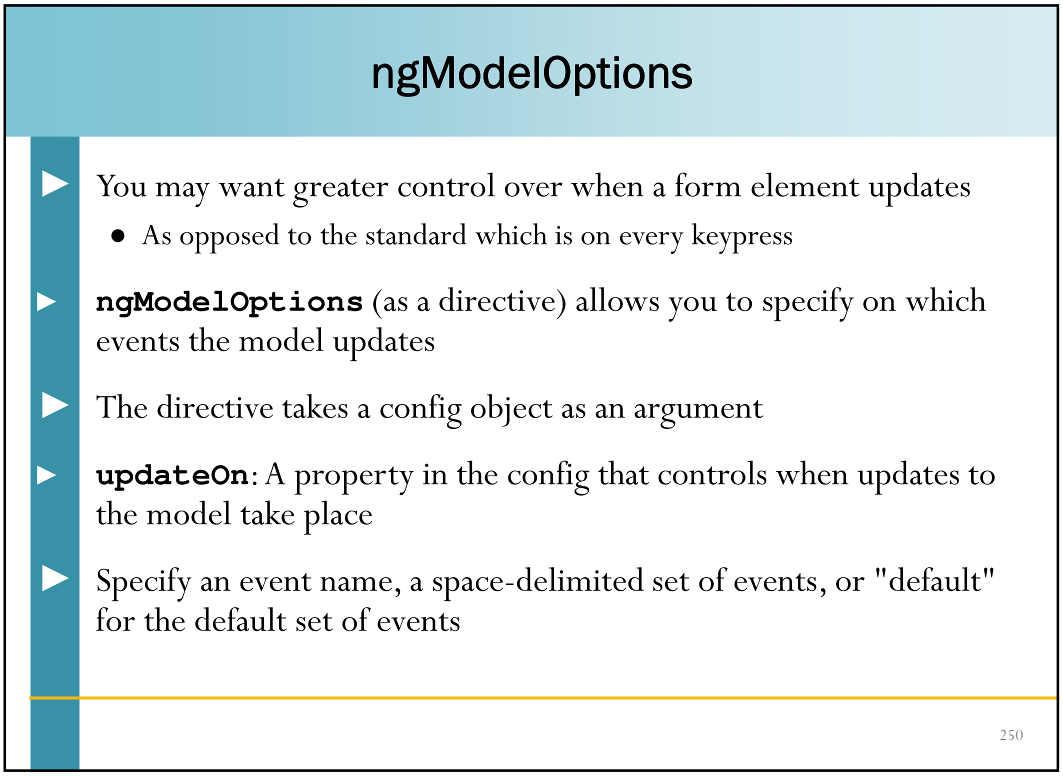
FormController properties

- **`$pristine`**: The user has not interacted with the form yet
- **`$dirty`**: True once the user has interacted with the form
- **`$valid`**: True if all form widgets (and sub-forms, if present) pass their validations
- **`$invalid`**: True if any form widget (or sub-form) has failed validation
- **`$submitted`**: True if the form has been submitted (even if invalid)
- **`$error`**: A hash of validation types and their states
  - We will see the types in a few slides



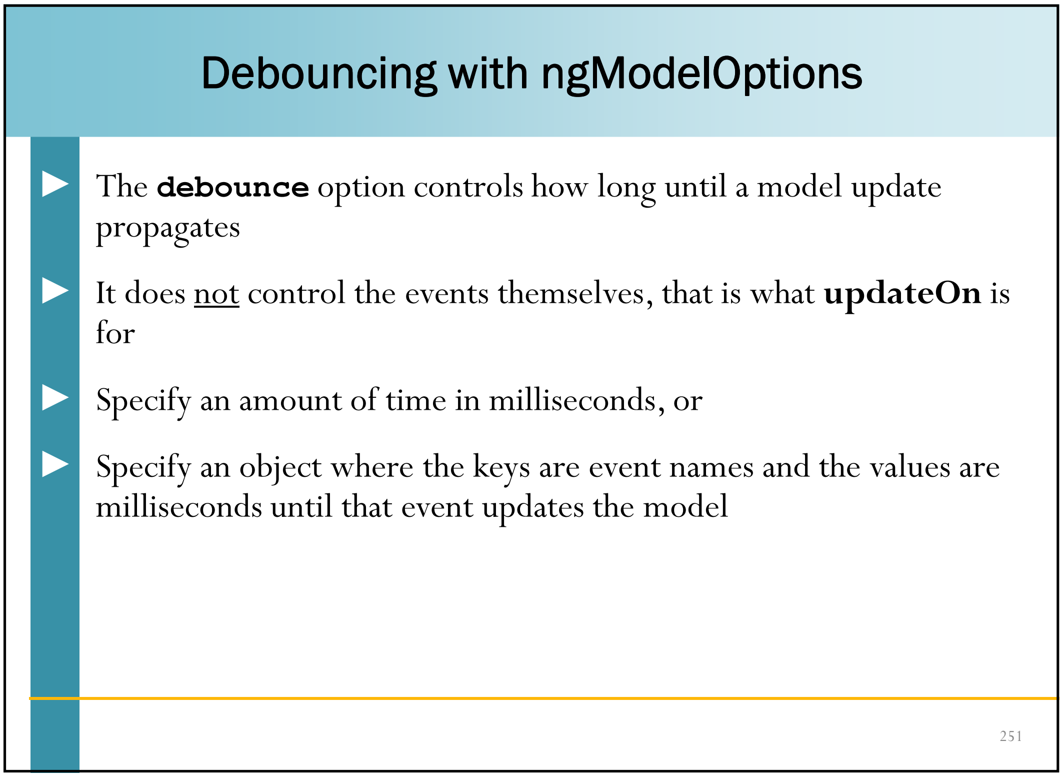
Widgets as properties

- Each form widget is itself a property of the FormController
- The widget is published as a property of the FormController object
- The name of the property is the value of the **`name`** attribute for the widget
- **`<input type="text" name="foo" ng-model="bar"/>`**
- The NgModelController instance could be accessed as **`$scope.formName.foo`**
- The value in the form field is still available as **`$scope.bar`**



ngModelOptions

- You may want greater control over when a form element updates
  - As opposed to the standard which is on every keypress
- **`ngModelOptions`** (as a directive) allows you to specify on which events the model updates
- The directive takes a config object as an argument
- **`updateOn`**: A property in the config that controls when updates to the model take place
- Specify an event name, a space-delimited set of events, or "default" for the default set of events



Debouncing with ngModelOptions

- The **`debounce`** option controls how long until a model update propagates
- It does <u>not</u> control the events themselves, that is what **updateOn** is for
- Specify an amount of time in milliseconds, or
- Specify an object where the keys are event names and the values are milliseconds until that event updates the model

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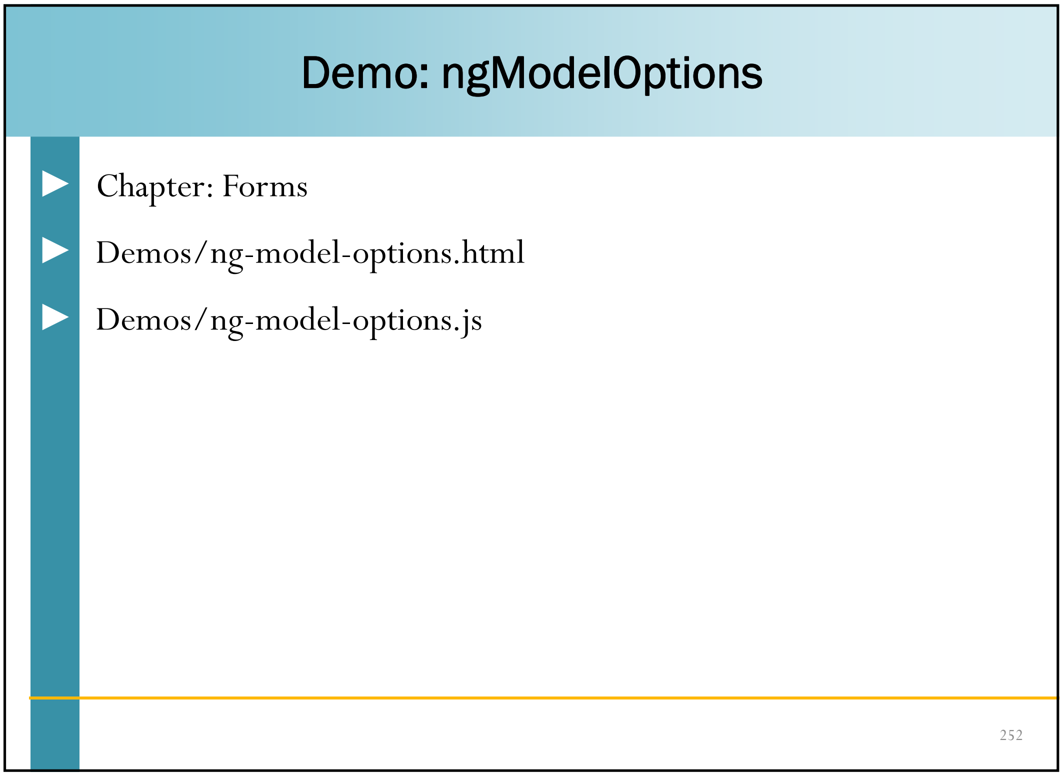

Demo: ngModelOptions

- Chapter: Forms
- Demos/ng-model-options.html
- Demos/ng-model-options.js

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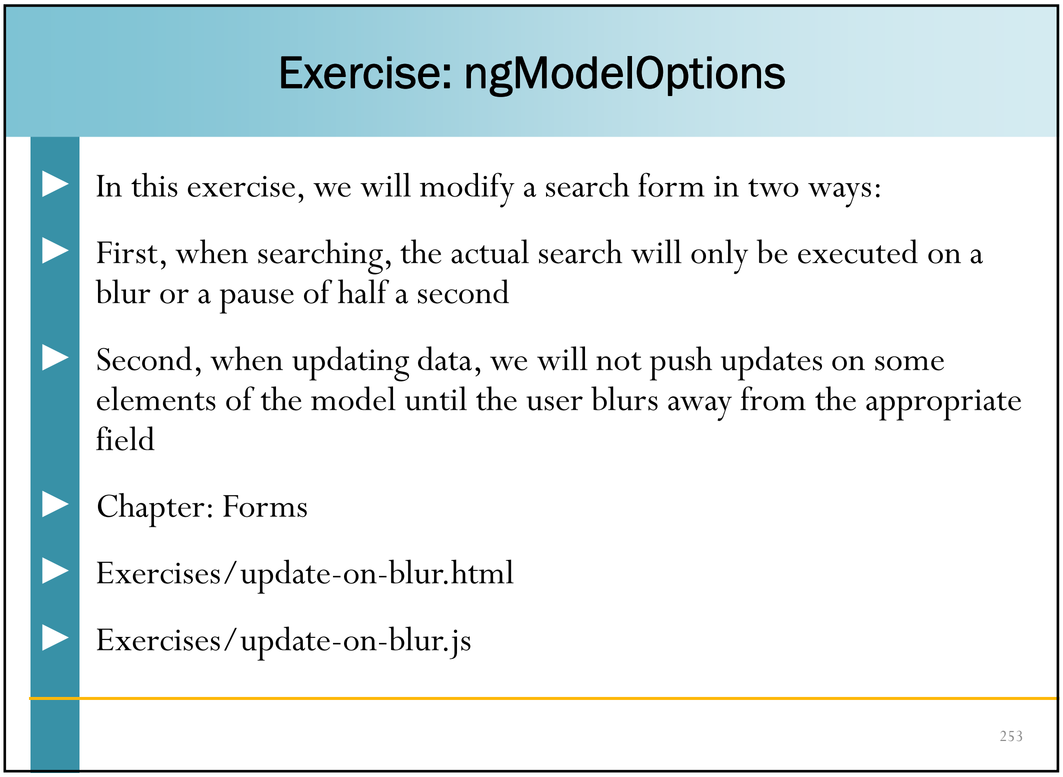
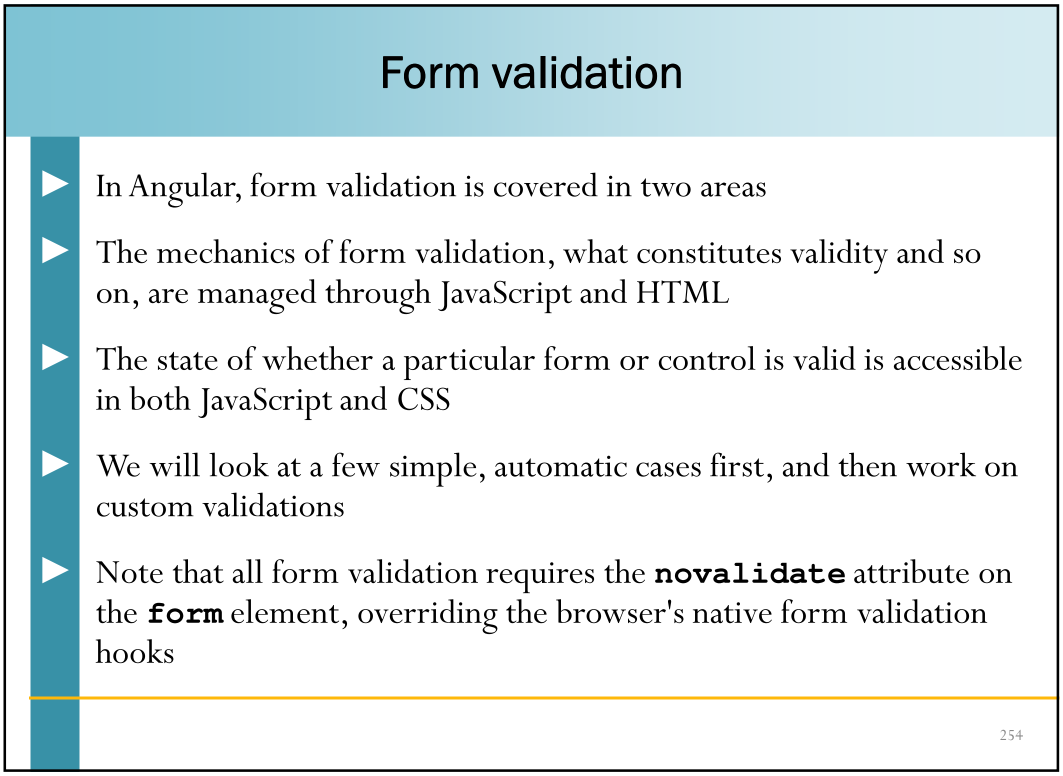


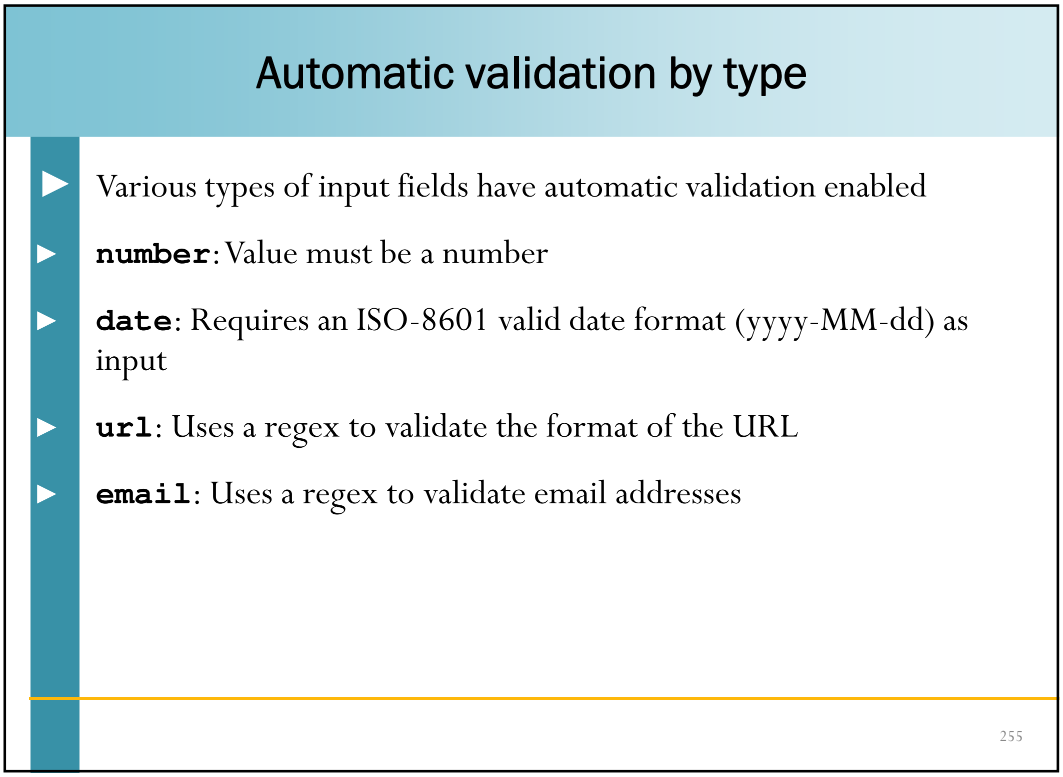
Exercise: ngModelOptions

- In this exercise, we will modify a search form in two ways:
- First, when searching, the actual search will only be executed on a blur or a pause of half a second
- Second, when updating data, we will not push updates on some elements of the model until the user blurs away from the appropriate field
- Chapter: Forms
- Exercises/update-on-blur.html
- Exercises/update-on-blur.js



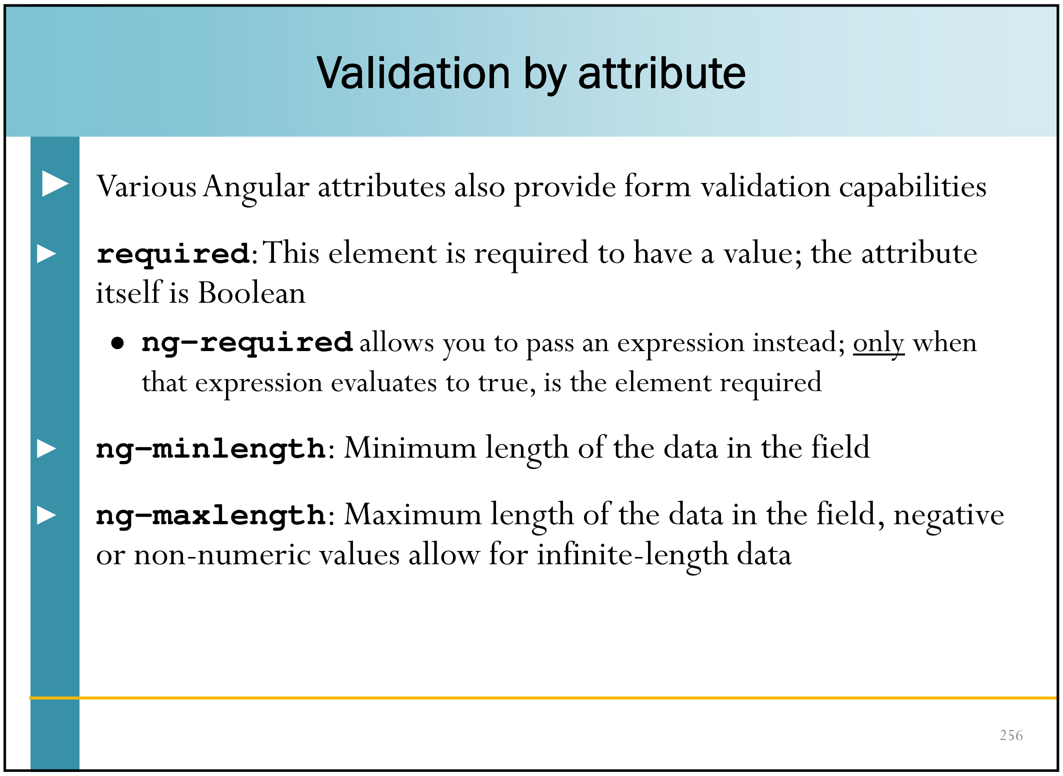
Form validation

- In Angular, form validation is covered in two areas
- The mechanics of form validation, what constitutes validity and so on, are managed through JavaScript and HTML
- The state of whether a particular form or control is valid is accessible in both JavaScript and CSS
- We will look at a few simple, automatic cases first, and then work on custom validations
- Note that all form validation requires the **`novalidate`** attribute on the **`form`** element, overriding the browser's native form validation hooks



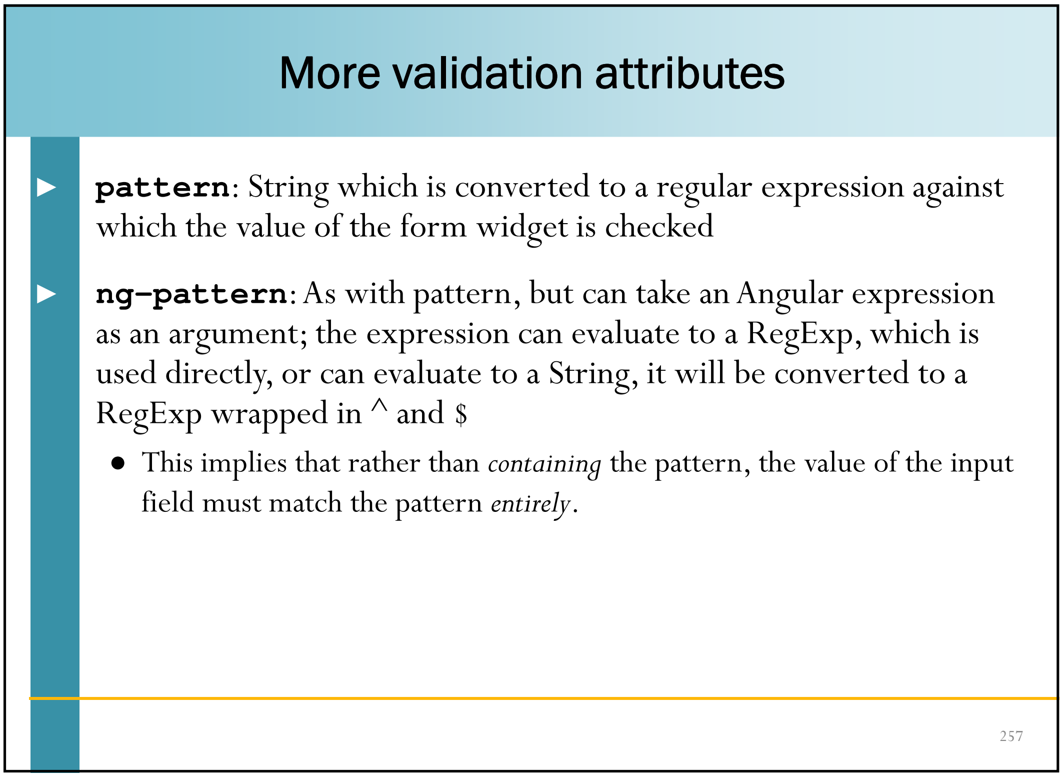
Automatic validation by type

- Various types of input fields have automatic validation enabled
- **`number`**: Value must be a number
- **`date`**: Requires an ISO-8601 valid date format (yyyy-MM-dd) as input
- **`url`**: Uses a regex to validate the format of the URL
- **`email`**: Uses a regex to validate email addresses



Validation by attribute

- Various Angular attributes also provide form validation capabilities
- **`required`**: This element is required to have a value; the attribute itself is Boolean
  - **`ng-required`** allows you to pass an expression instead; <u>only</u> when that expression evaluates to true, is the element required
- **`ng-minlength`**: Minimum length of the data in the field
- **`ng-maxlength`**: Maximum length of the data in the field, negative or non-numeric values allow for infinite-length data



More validation attributes

- **`pattern`**: String which is converted to a regular expression against which the value of the form widget is checked
- **`ng-pattern`**: As with pattern, but can take an Angular expression as an argument; the expression can evaluate to a RegExp, which is used directly, or can evaluate to a String, it will be converted to a RegExp wrapped in ^ and $
  - This implies that rather than *containing* the pattern, the value of the input field must match the pattern *entirely*.

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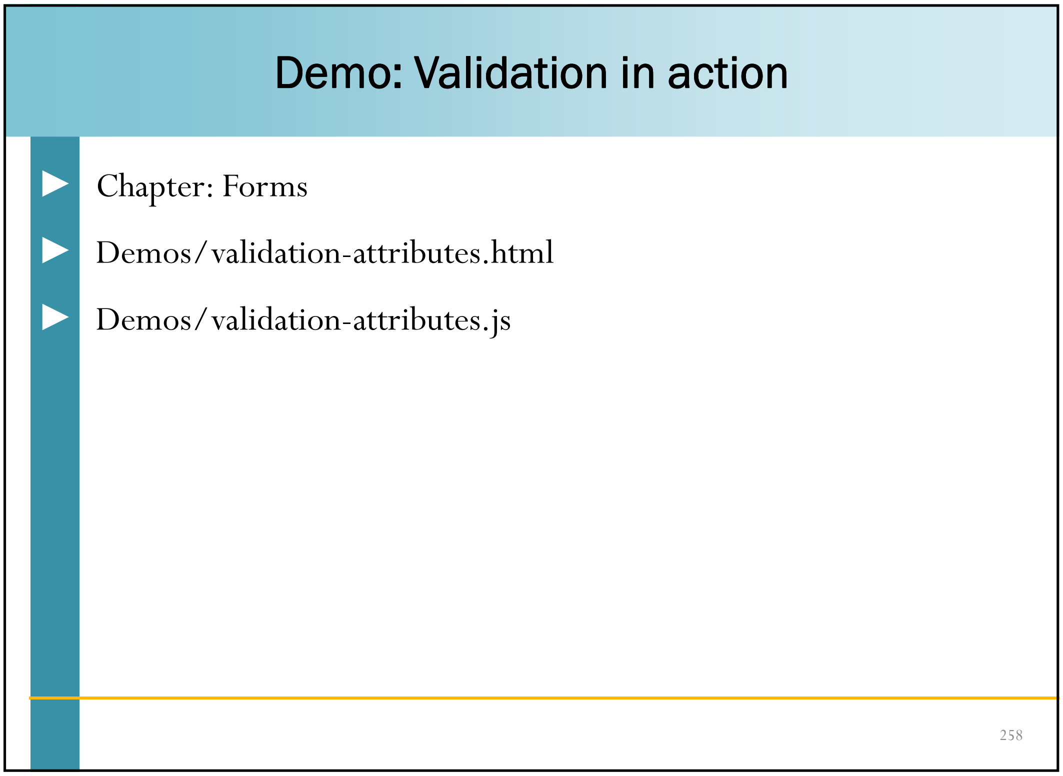

Demo: Validation in action

- Chapter: Forms
- Demos/validation-attributes.html
- Demos/validation-attributes.js

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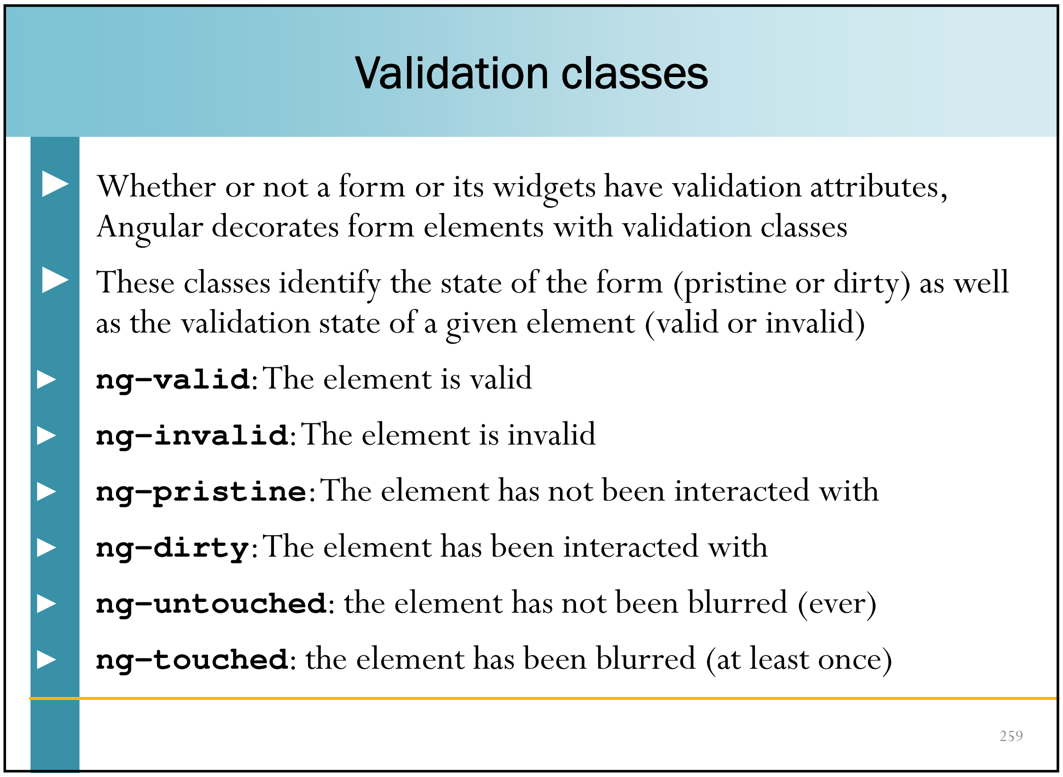
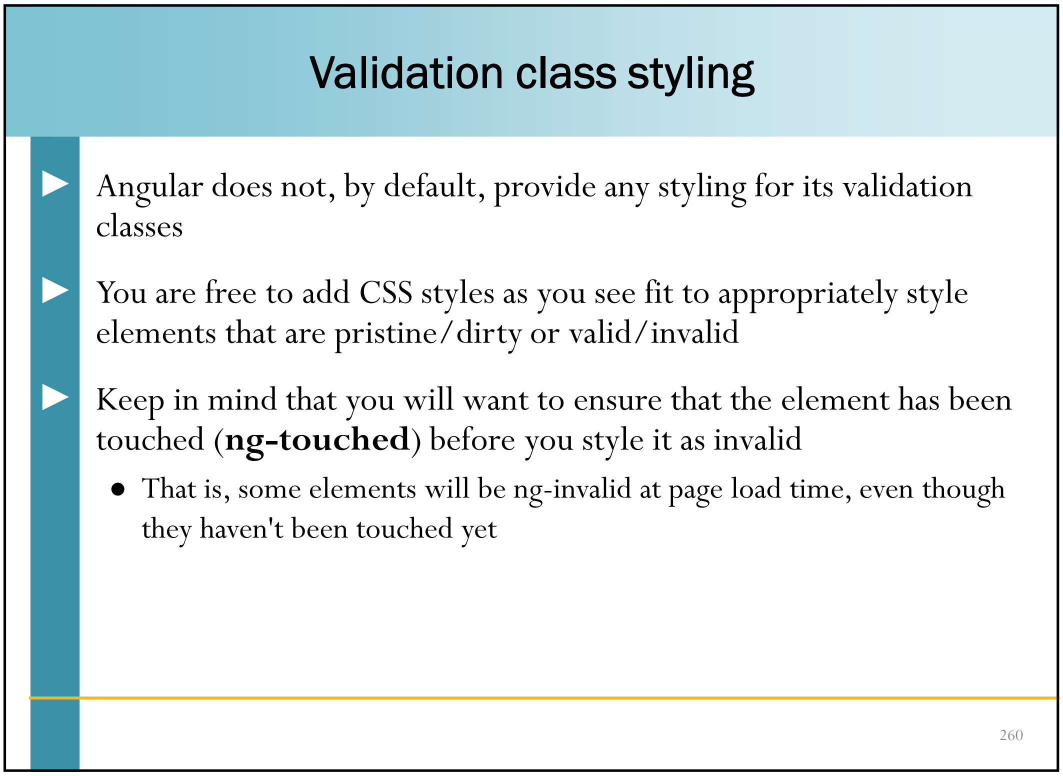


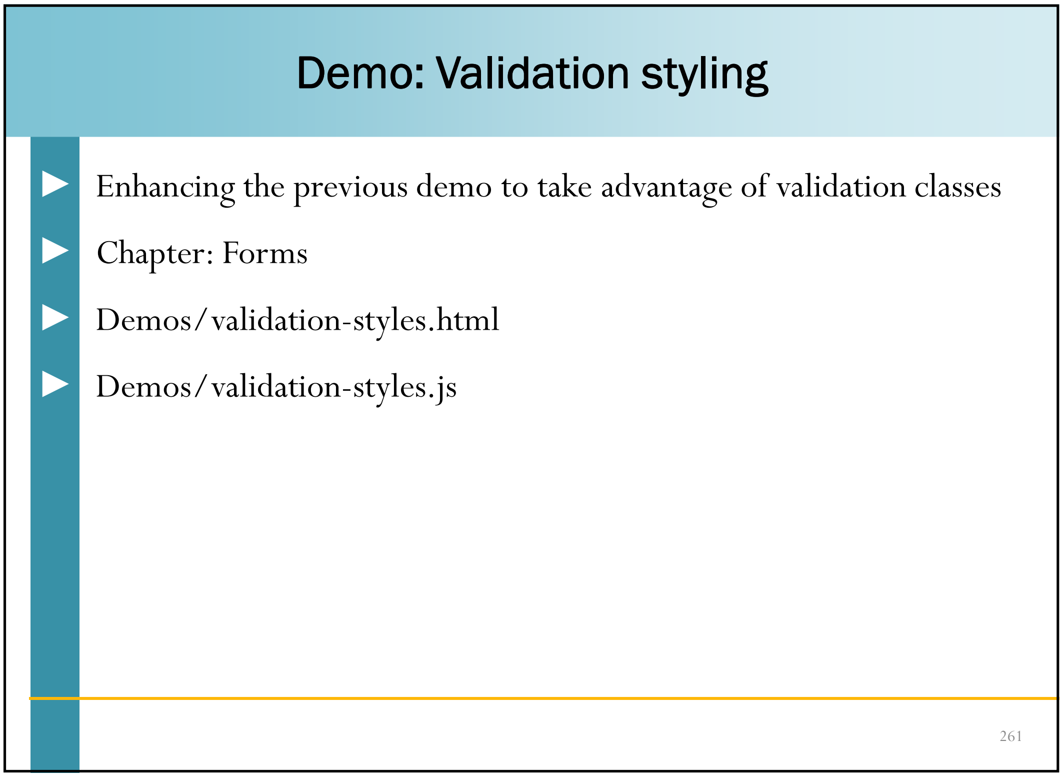
Validation classes

- Whether or not a form or its widgets have validation attributes, Angular decorates form elements with validation classes
- These classes identify the state of the form (pristine or dirty) as well as the validation state of a given element (valid or invalid)
- **ng-valid**:The element is valid
- **ng-invalid**:The element is invalid
- **ng-pristine**:The element has not been interacted with
- **ng-dirty**:The element has been interacted with
- **ng-untouched**: the element has not been blurred (ever)
- **ng-touched**: the element has been blurred (at least once)



Validation class styling

- Angular does not, by default, provide any styling for its validation classes
- You are free to add CSS styles as you see fit to appropriately style elements that are pristine/dirty or valid/invalid
- Keep in mind that you will want to ensure that the element has been touched (**ng-touched**) before you style it as invalid
  - That is, some elements will be ng-invalid at page load time, even though they haven't been touched yet



Demo: Validation styling

- Enhancing the previous demo to take advantage of validation classes
- Chapter: Forms
- Demos/validation-styles.html
- Demos/validation-styles.js

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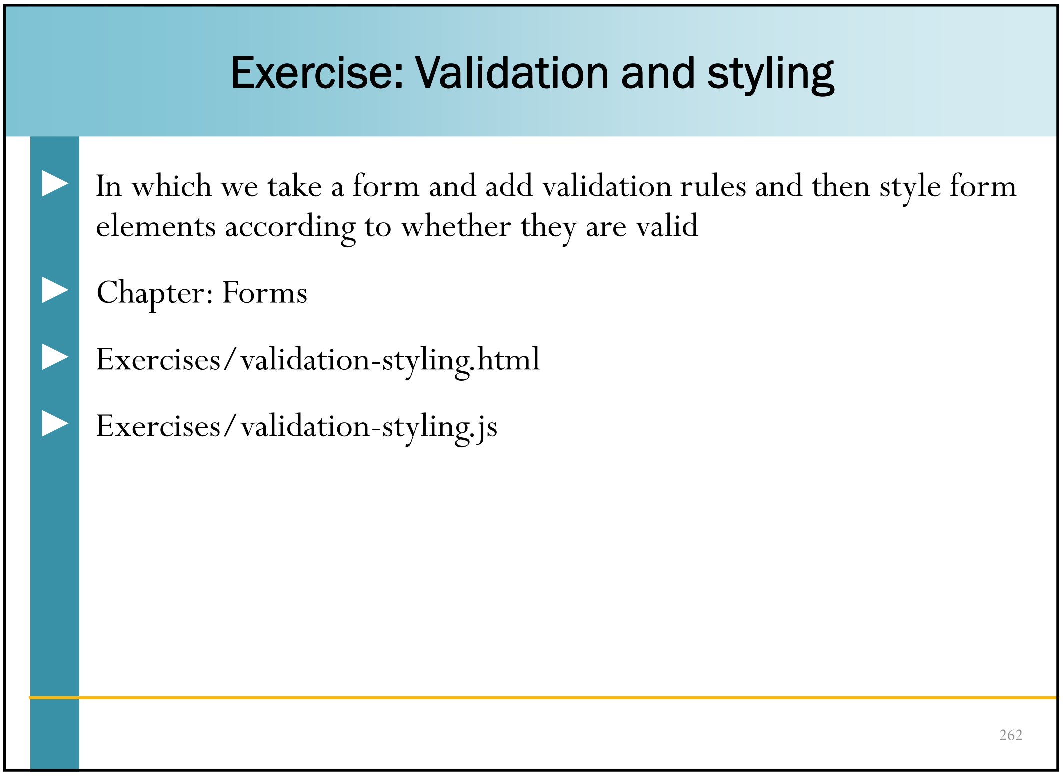

Exercise: Validation and styling

- In which we take a form and add validation rules and then style form elements according to whether they are valid
- Chapter: Forms
- Exercises/validation-styling.html
- Exercises/validation-styling.js

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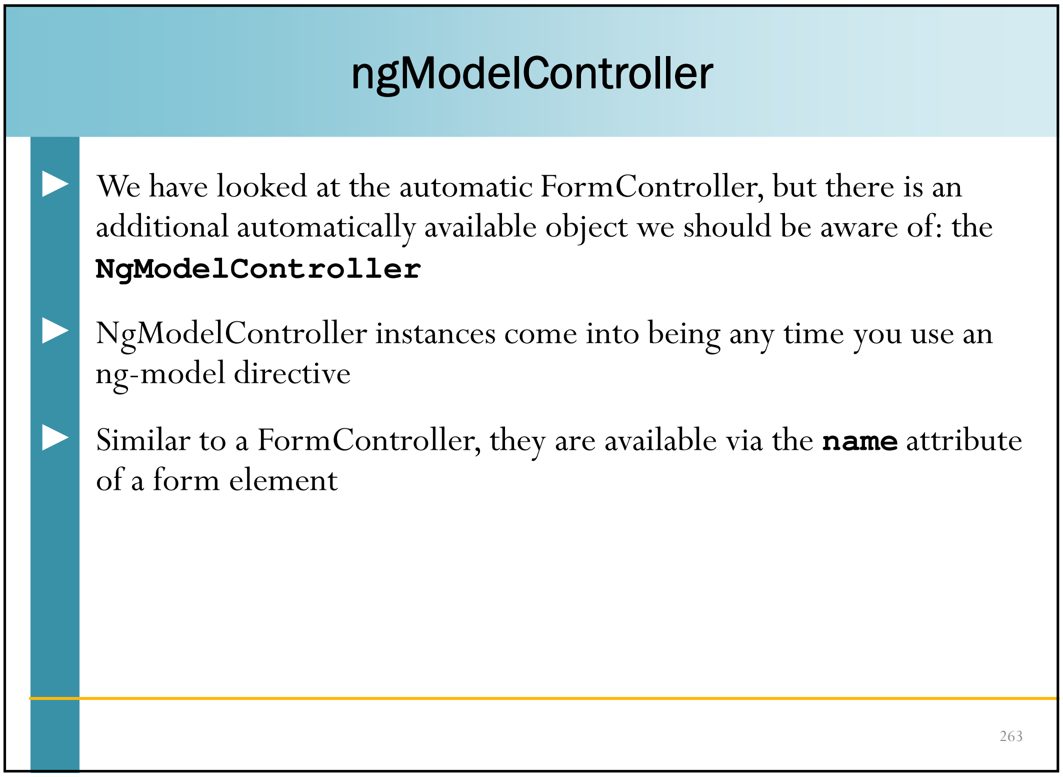
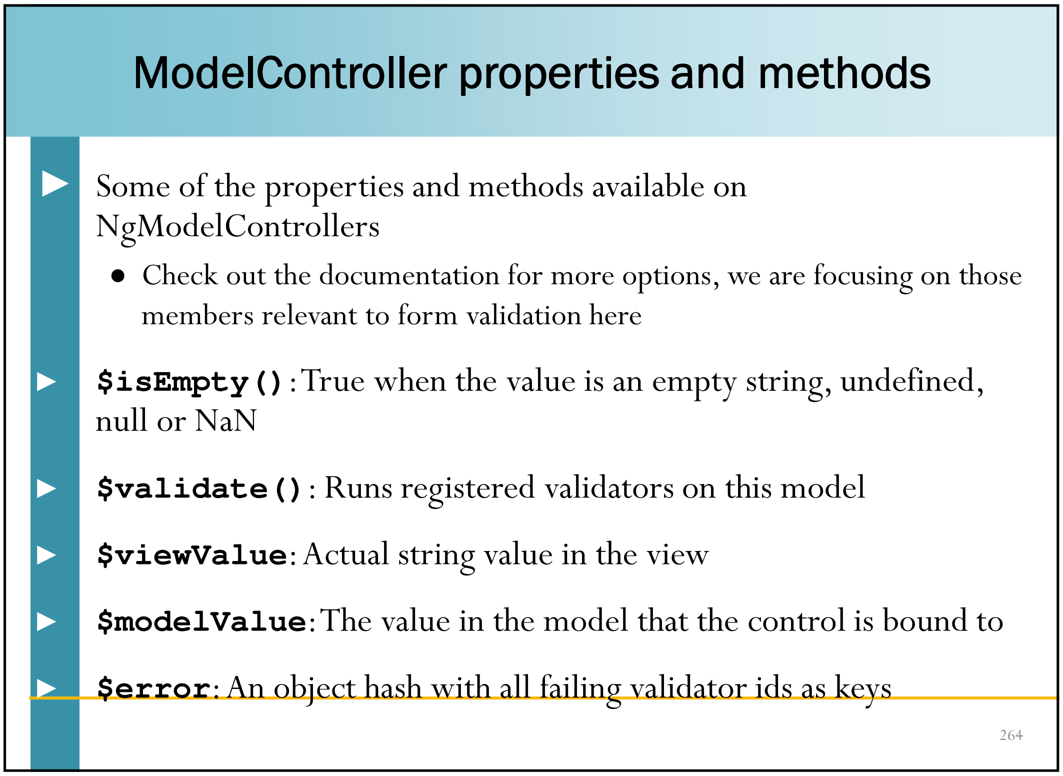


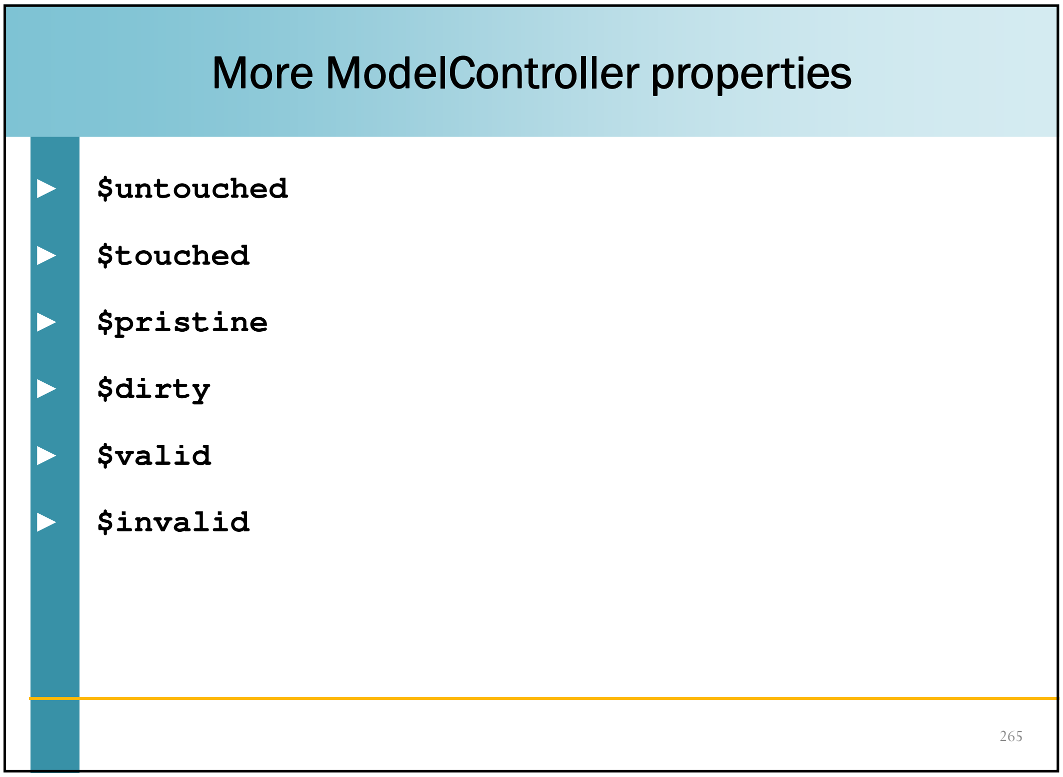
ngModelController

- We have looked at the automatic FormController, but there is an additional automatically available object we should be aware of: the **`NgModelController`**
- NgModelController instances come into being any time you use an ng-model directive
- Similar to a FormController, they are available via the **`name`** attribute of a form element



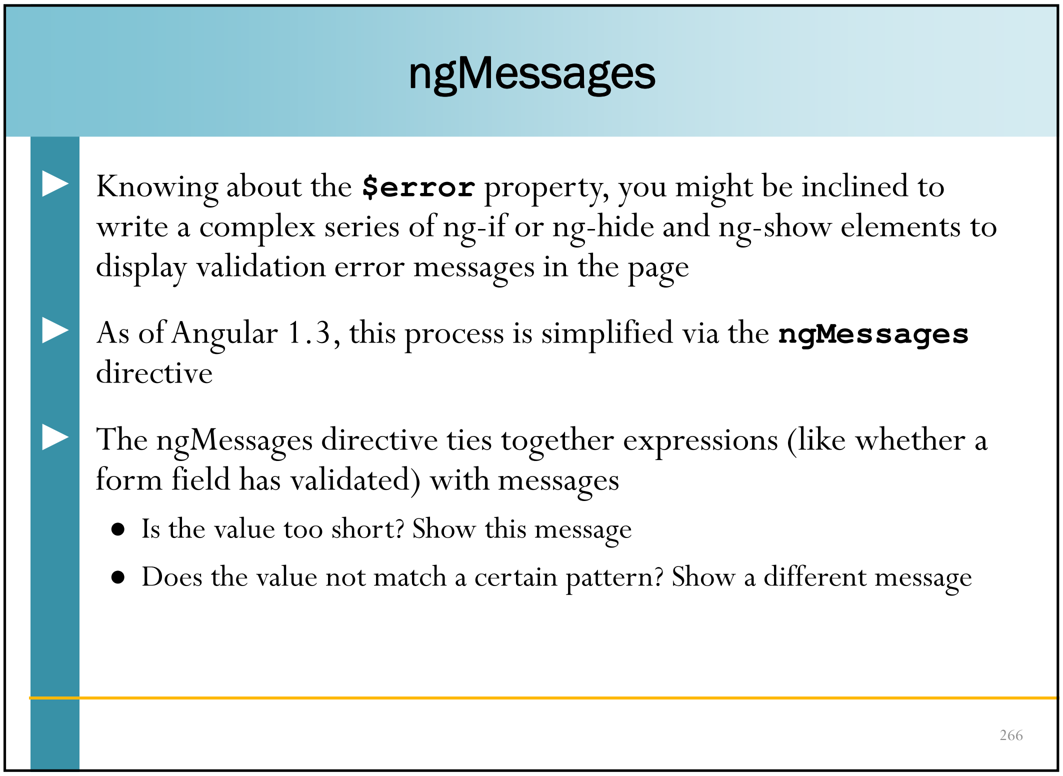
ModelController properties and methods

- Some of the properties and methods available on NgModelControllers
  - Check out the documentation for more options, we are focusing on those members relevant to form validation here
- **`$isEmpty()`**: True when the value is an empty string, undefined, null or NaN
- **`$validate()`**: Runs registered validators on this model
- **`$viewValue`**: Actual string value in the view
- **`$modelValue`**: The value in the model that the control is bound to
- **`$error`**: An object hash with all failing validator ids as keys



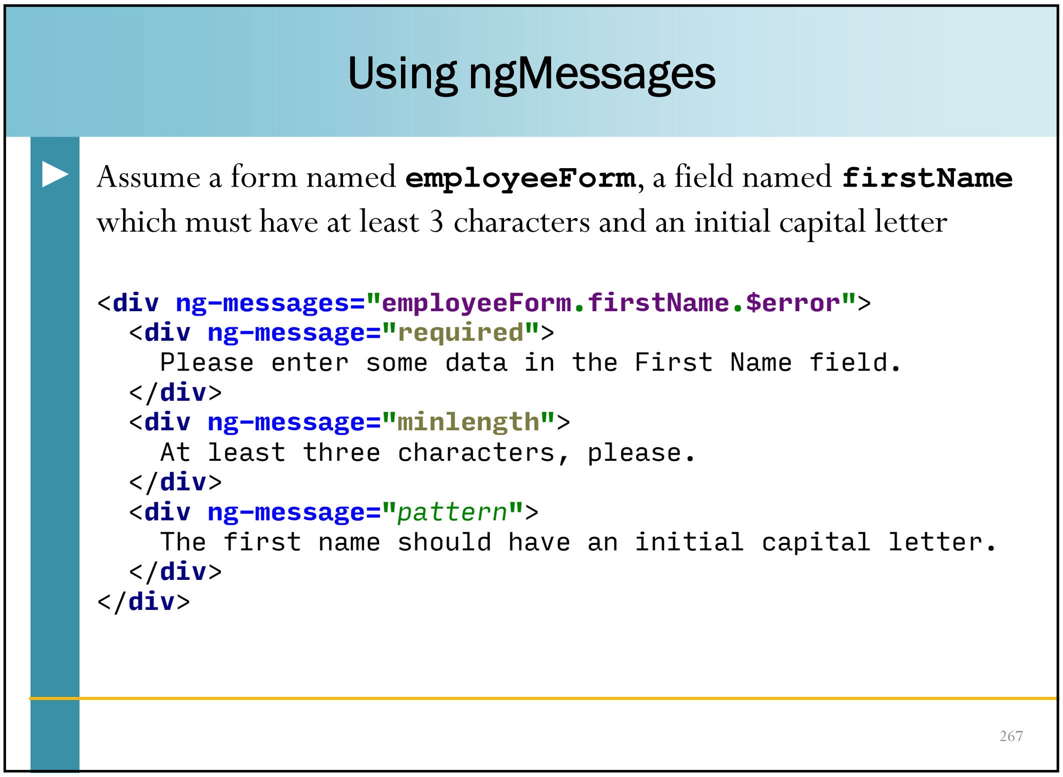
More ModelController properties

- `$untouched`
- `$touched`
- `$pristine`
- `$dirty`
- `$valid`
- `$invalid`



ngMessages

- Knowing about the **`$error`** property, you might be inclined to write a complex series of ng-if or ng-hide and ng-show elements to display validation error messages in the page
- As of Angular 1.3, this process is simplified via the **`ngMessages`** directive
- The ngMessages directive ties together expressions (like whether a form field has validated) with messages
  - Is the value too short? Show this message
  - Does the value not match a certain pattern? Show a different message



Using ngMessages

- Assume a form named **`employeeForm`**, a field named **`firstName`** which must have at least 3 characters and an initial capital letter

```
<div ng-messages="employeeForm.firstName.$error">
  <div ng-message="required">
    Please enter some data in the First Name field.
  </div>
  <div ng-message="minlength">
    At least three characters, please.
  </div>
  <div ng-message="pattern">
    The first name should have an initial capital letter.
  </div>
</div>
```

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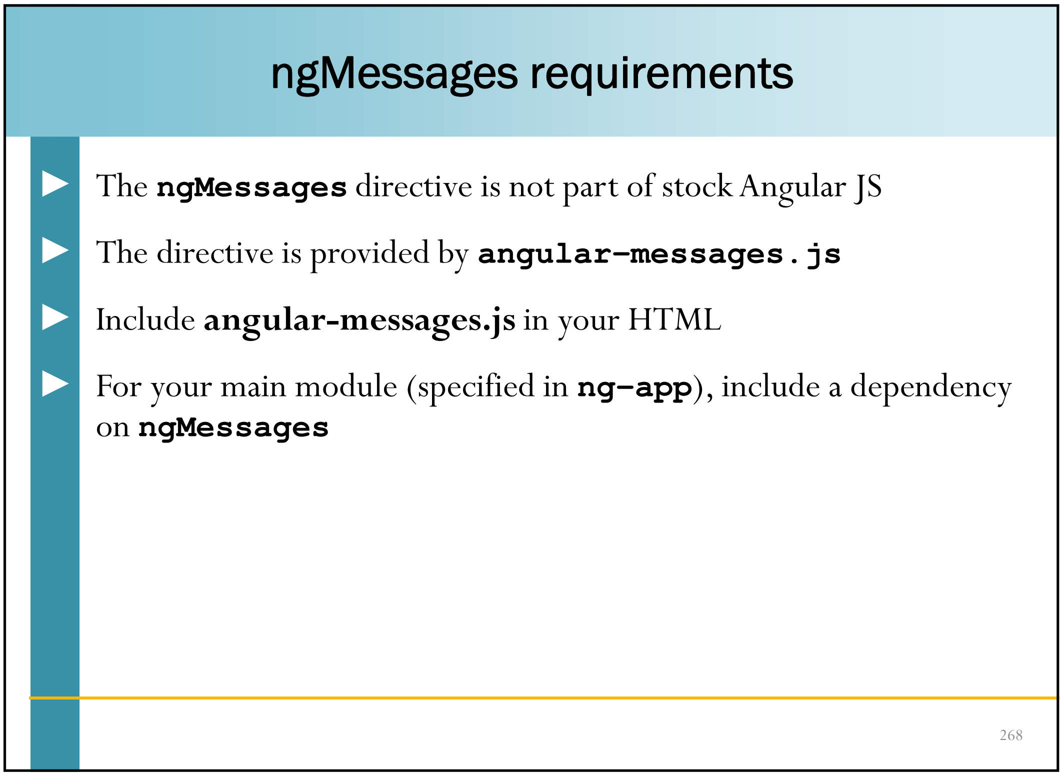

ngMessages requirements

- The **`ngMessages`** directive is not part of stock Angular JS
- The directive is provided by **`angular-messages.js`**
- Include **angular-messages.js** in your HTML
- For your main module (specified in **`ng-app`**), include a dependency on **`ngMessages`**

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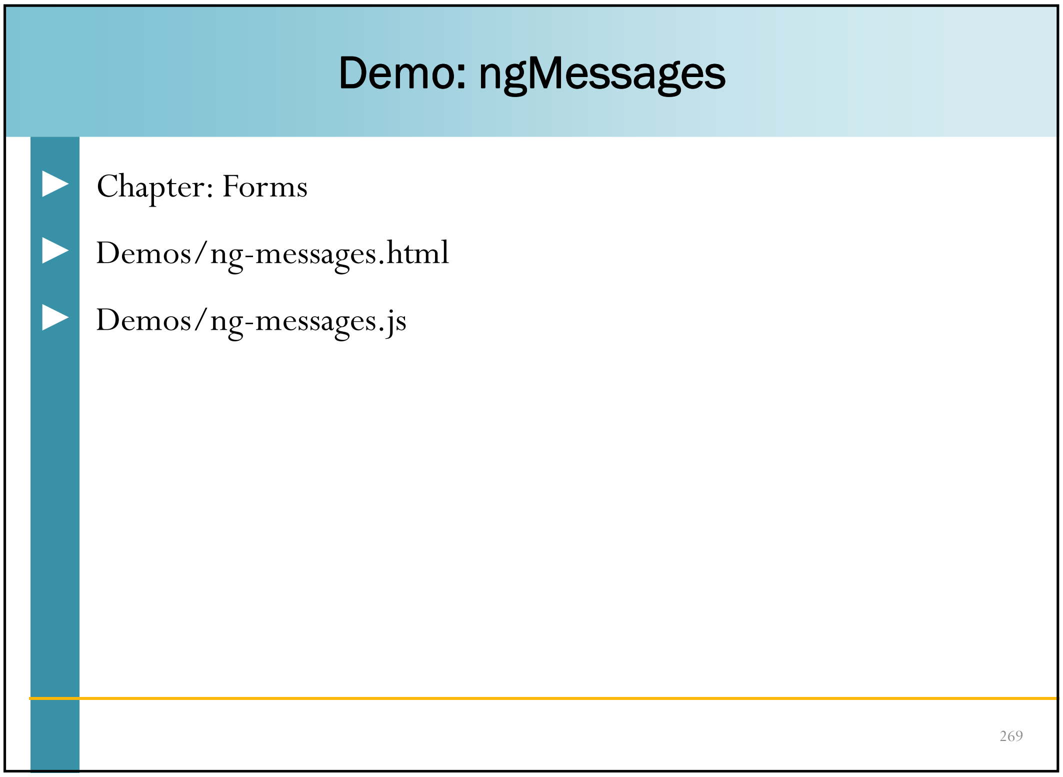
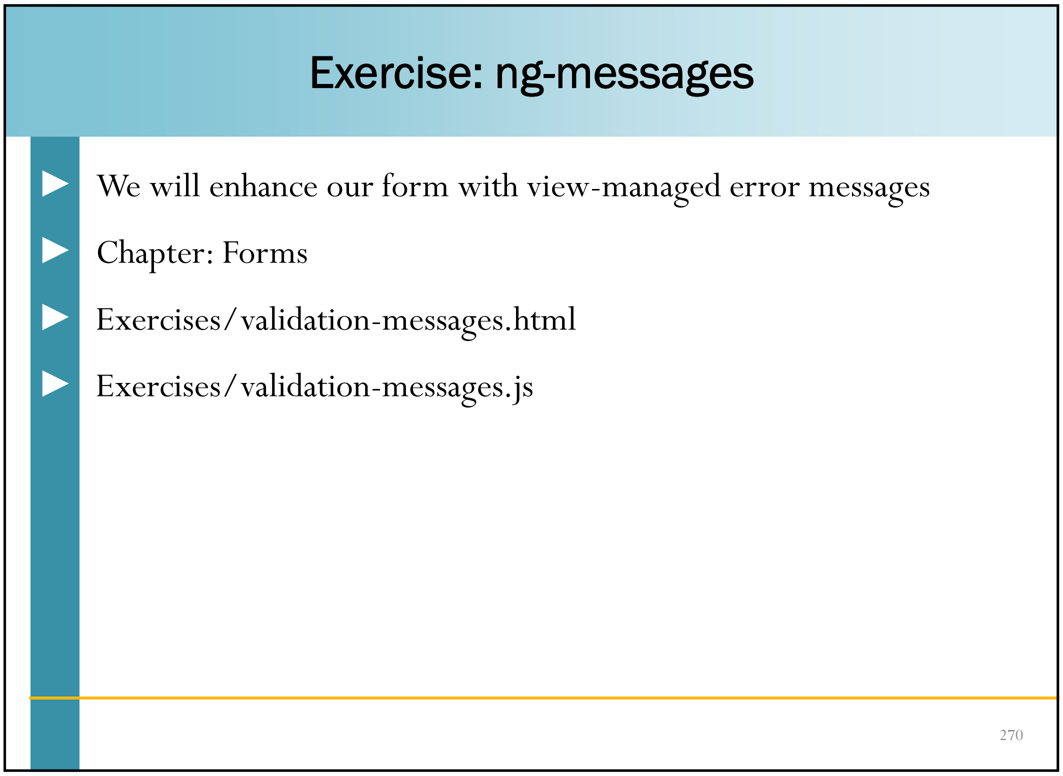


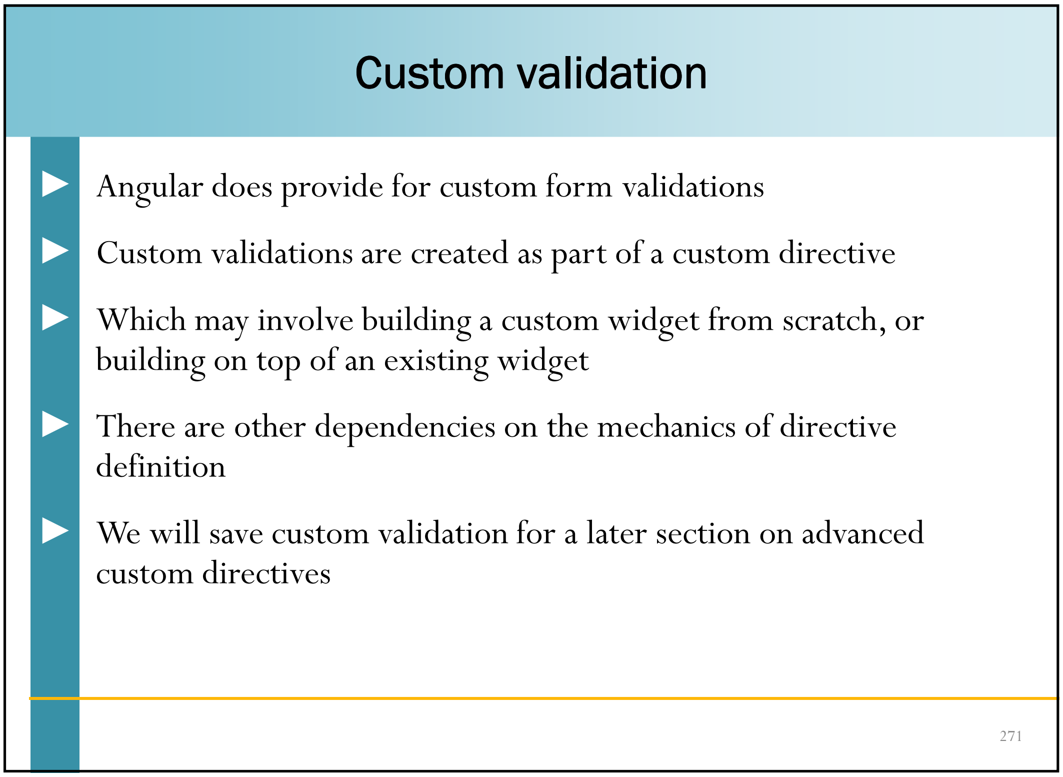
Demo: ngMessages

- Chapter: Forms
- Demos/ng-messages.html
- Demos/ng-messages.js



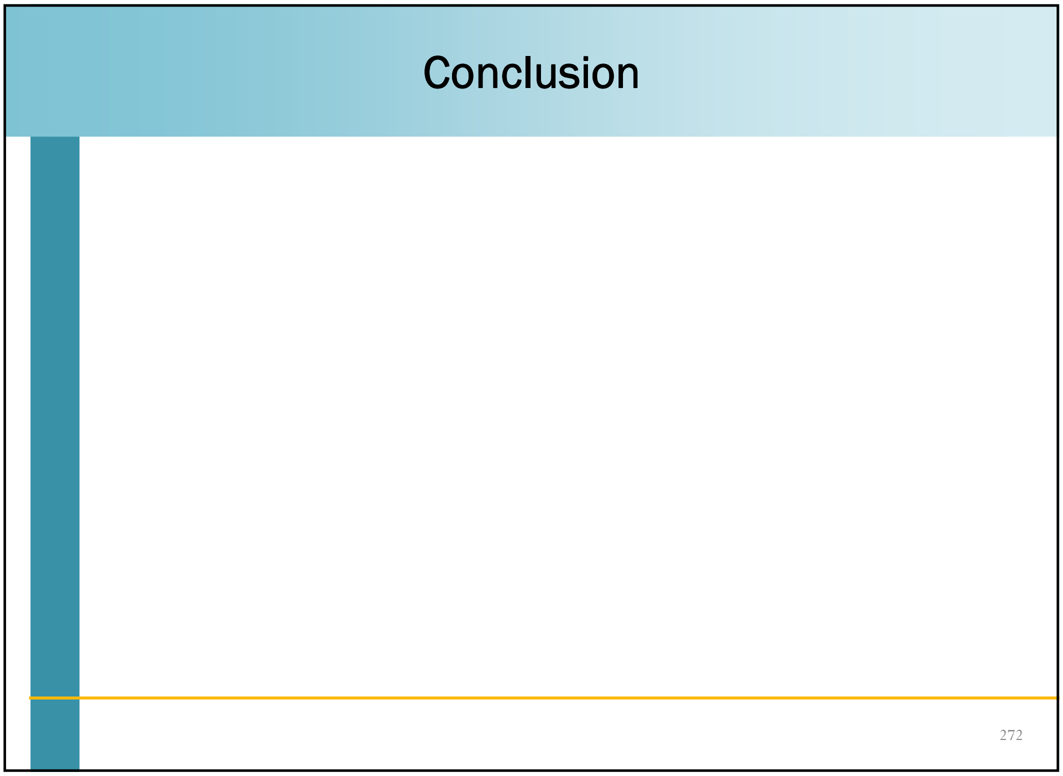
Exercise: ng-messages

- We will enhance our form with view-managed error messages
- Chapter: Forms
- Exercises/validation-messages.html
- Exercises/validation-messages.js

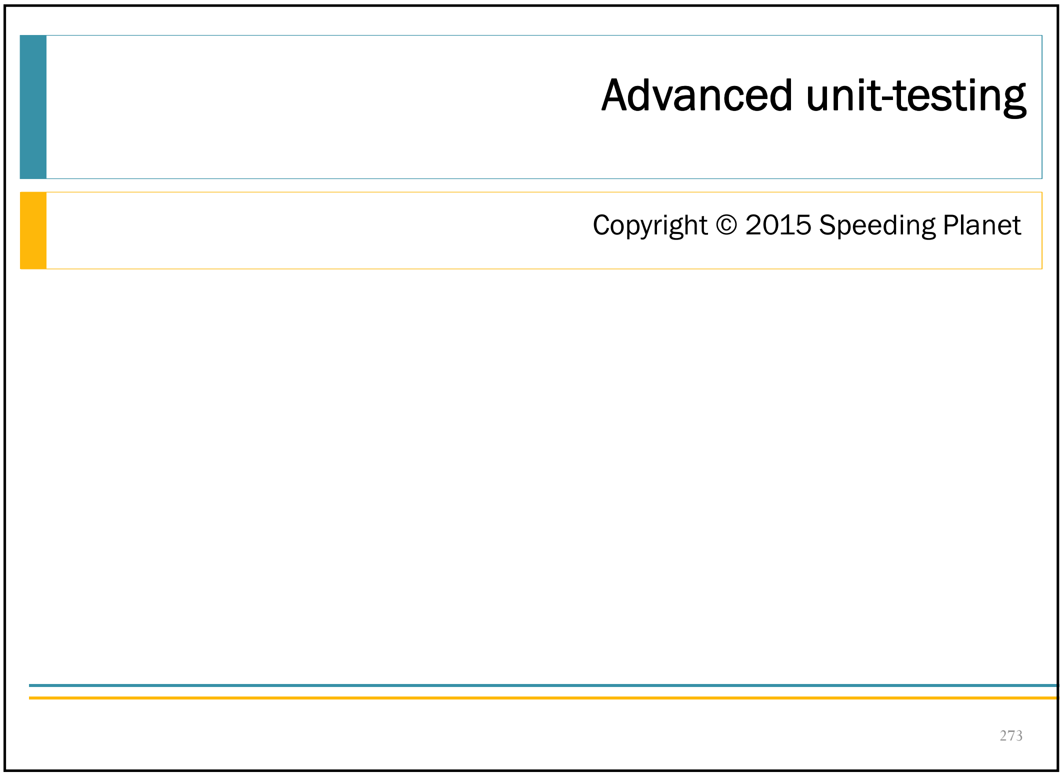


Custom validation

- Angular does provide for custom form validations
- Custom validations are created as part of a custom directive
- Which may involve building a custom widget from scratch, or building on top of an existing widget
- There are other dependencies on the mechanics of directive definition
- We will save custom validation for a later section on advanced custom directives



Conclusion



Advanced unit-testing

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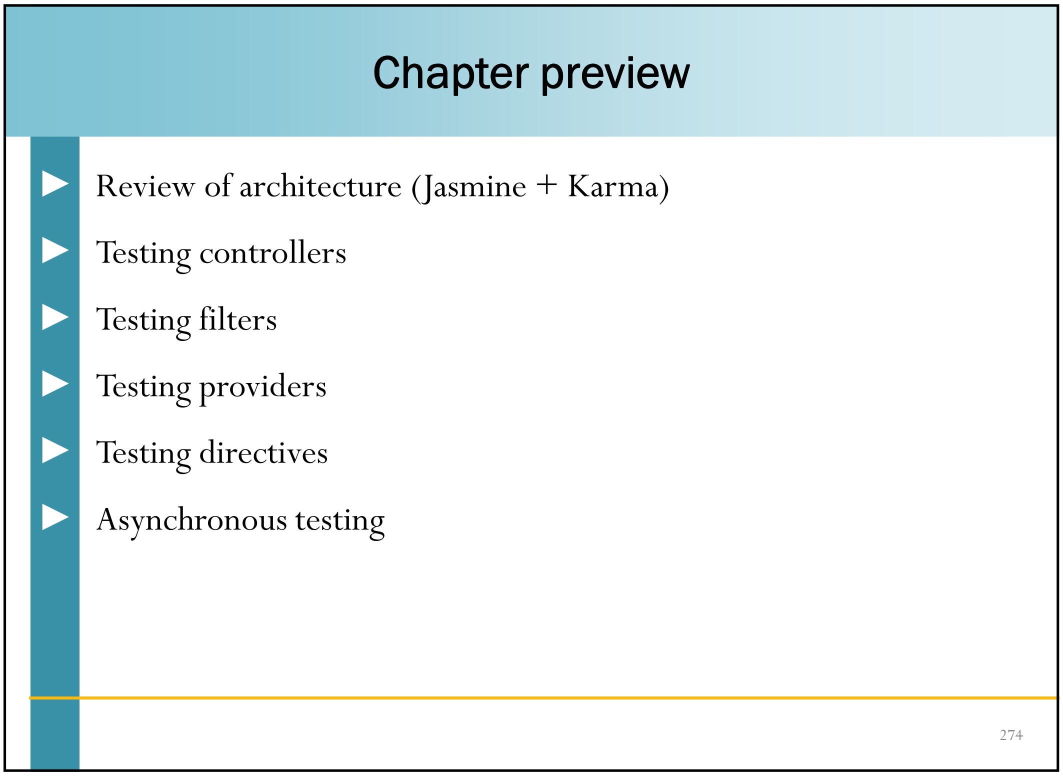

Chapter preview

- Review of architecture (Jasmine + Karma)
- Testing controllers
- Testing filters
- Testing providers
- Testing directives
- Asynchronous testing

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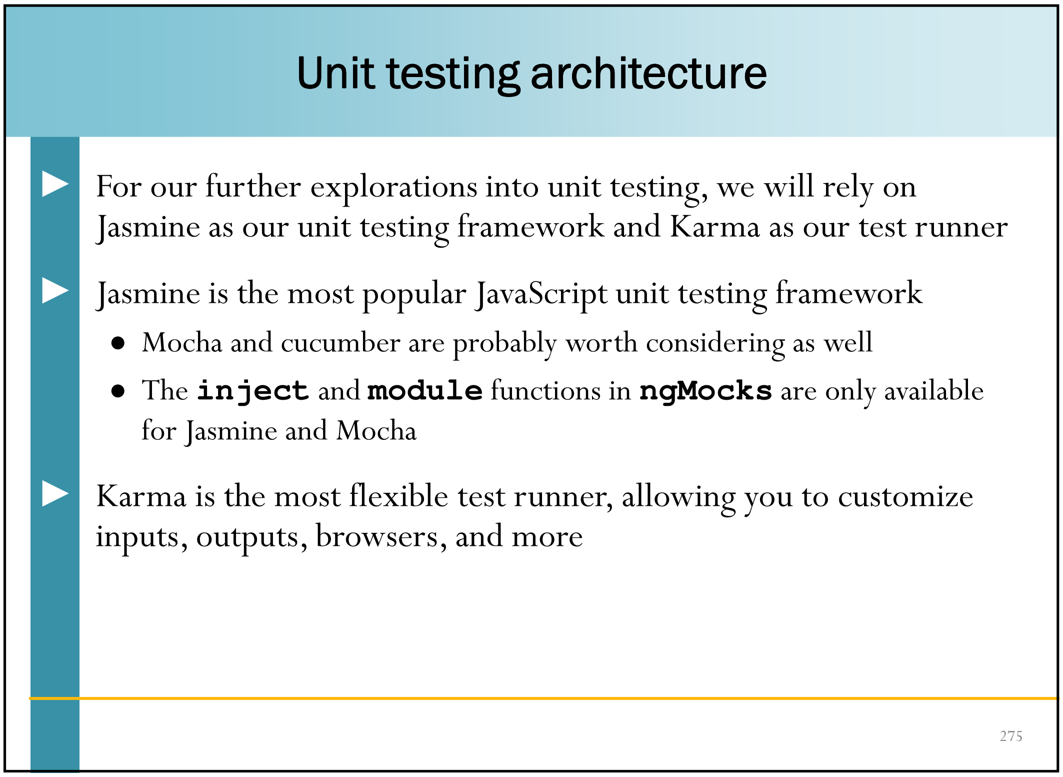
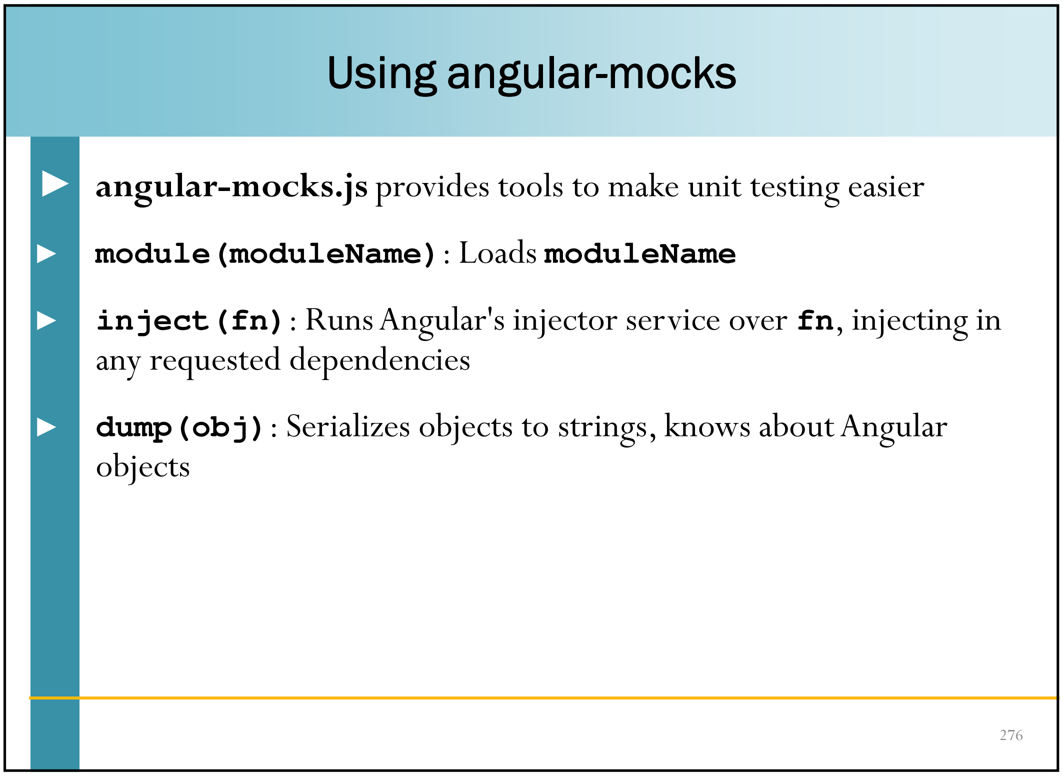


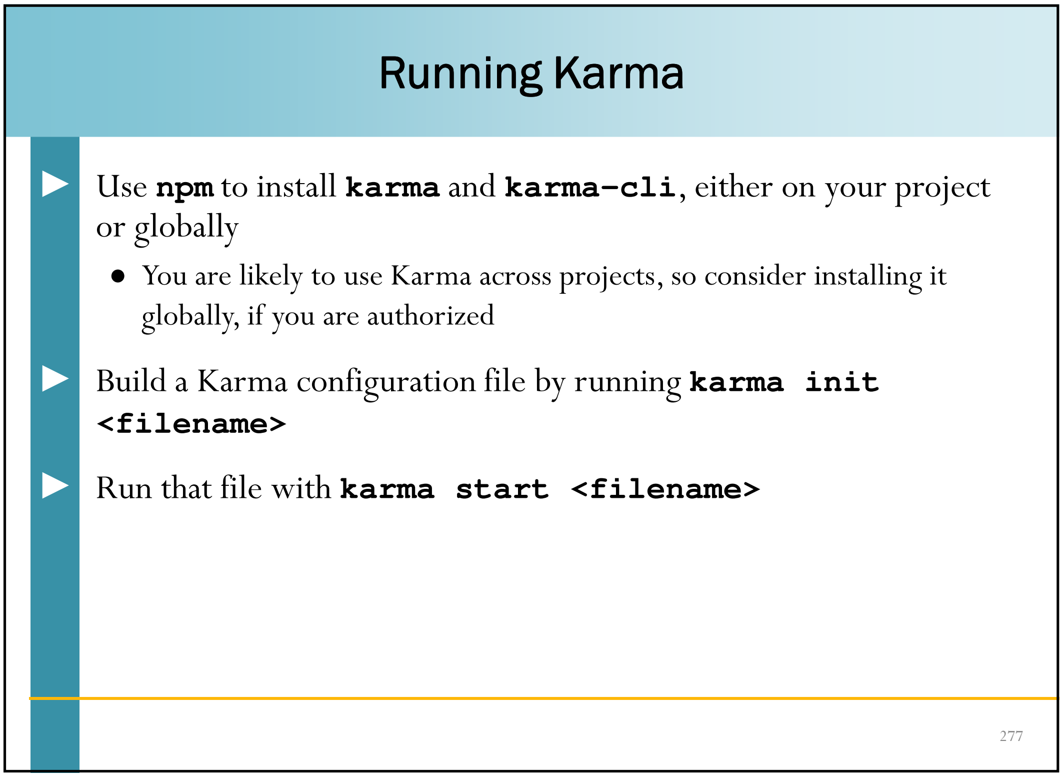
Unit testing architecture

- For our further explorations into unit testing, we will rely on Jasmine as our unit testing framework and Karma as our test runner
- Jasmine is the most popular JavaScript unit testing framework
  - Mocha and cucumber are probably worth considering as well
  - The **`inject`** and **`module`** functions in **`ngMocks`** are only available for Jasmine and Mocha
- Karma is the most flexible test runner, allowing you to customize inputs, outputs, browsers, and more



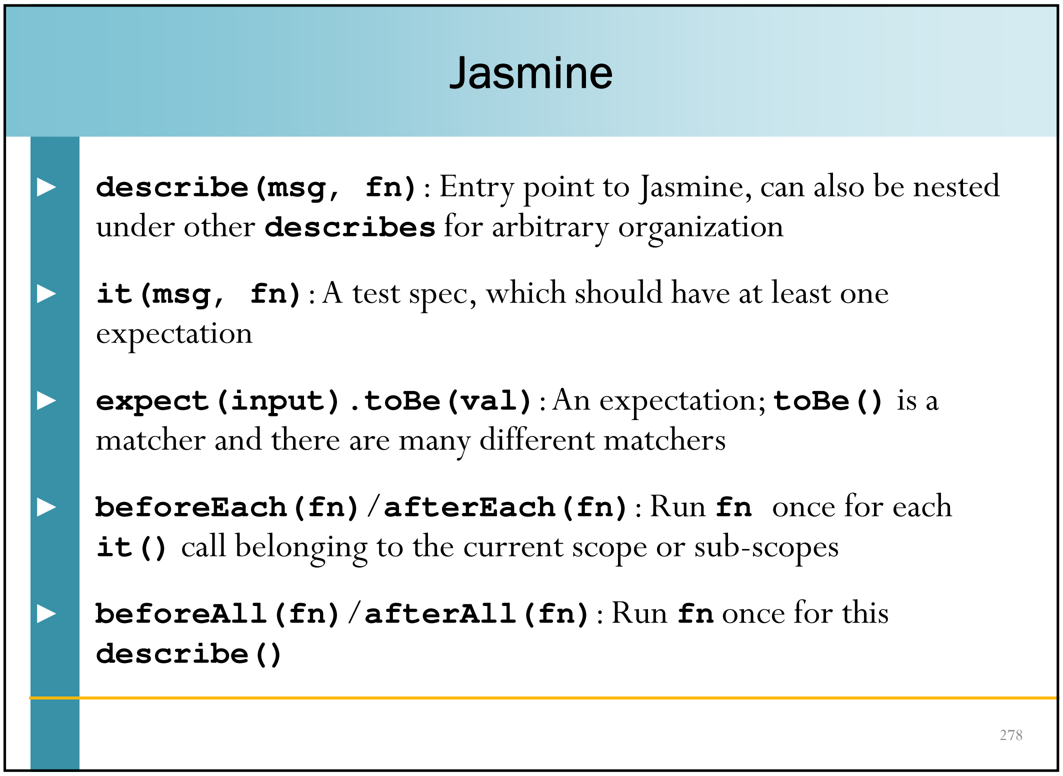
Using angular-mocks

- **angular-mocks.js** provides tools to make unit testing easier
- **`module(moduleName)`** : Loads **`moduleName`**
- **`inject(fn)`** : Runs Angular's injector service over **`fn`**, injecting in any requested dependencies
- **`dump(obj)`** : Serializes objects to strings, knows about Angular objects



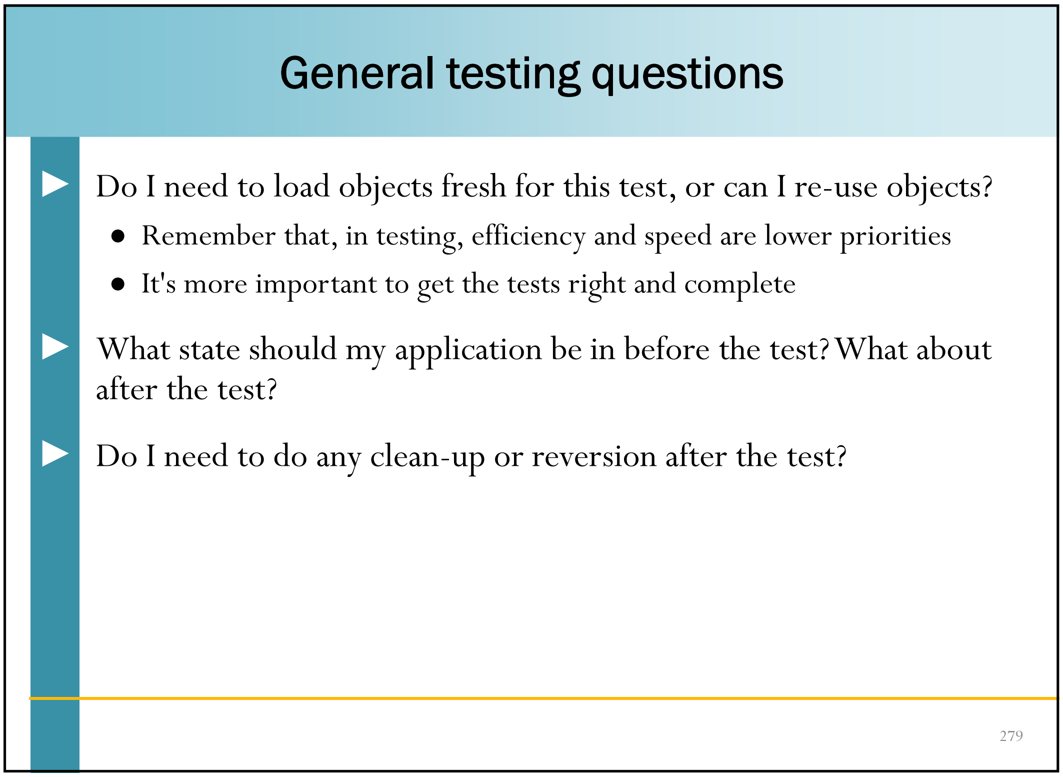
Running Karma

- Use **`npm`** to install **`karma`** and **`karma-cli`**, either on your project or globally
  - You are likely to use Karma across projects, so consider installing it globally, if you are authorized
- Build a Karma configuration file by running **`karma init <filename>`**
- Run that file with **`karma start <filename>`**



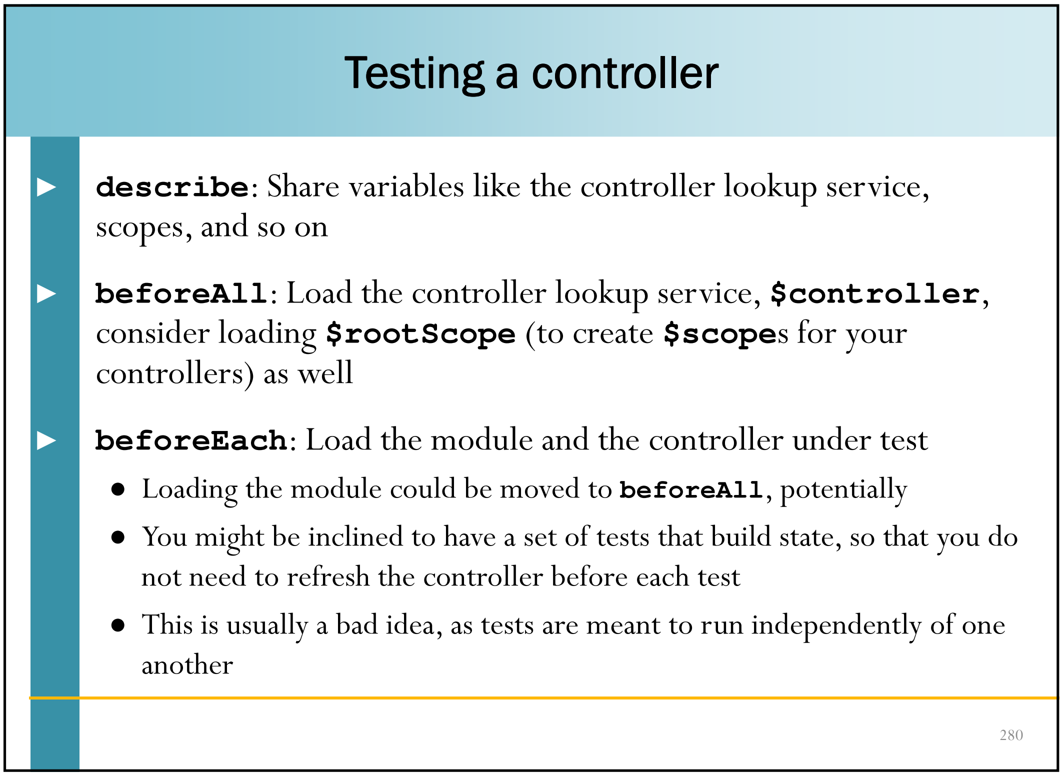
Jasmine

- **`describe(msg, fn)`** : Entry point to Jasmine, can also be nested under other **`describes`** for arbitrary organization
- **`it(msg, fn)`** : A test spec, which should have at least one expectation
- **`expect(input).toBe(val)`** : An expectation; **`toBe()`** is a matcher and there are many different matchers
- **`beforeEach(fn)`**/**`afterEach(fn)`** : Run **`fn`** once for each **`it()`** call belonging to the current scope or sub-scopes
- **`beforeAll(fn)`**/**`afterAll(fn)`** : Run **`fn`** once for this **`describe()`**



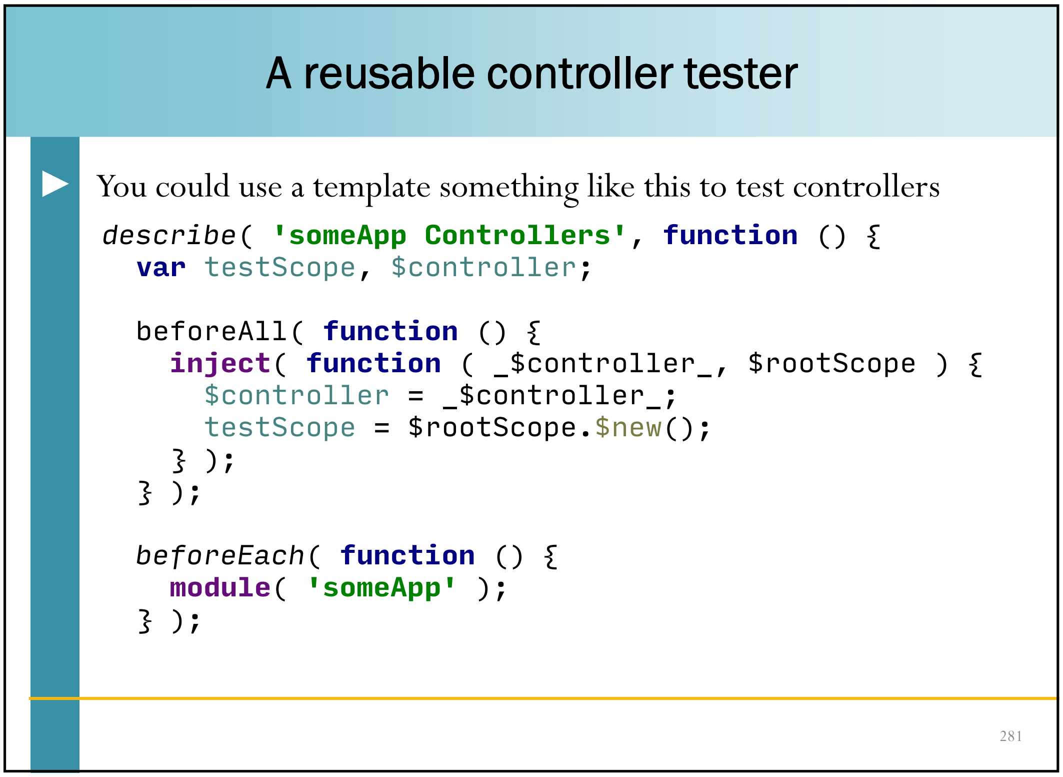
General testing questions

- Do I need to load objects fresh for this test, or can I re-use objects?
  - Remember that, in testing, efficiency and speed are lower priorities
  - It's more important to get the tests right and complete
- What state should my application be in before the test? What about after the test?
- Do I need to do any clean-up or reversion after the test?



Testing a controller

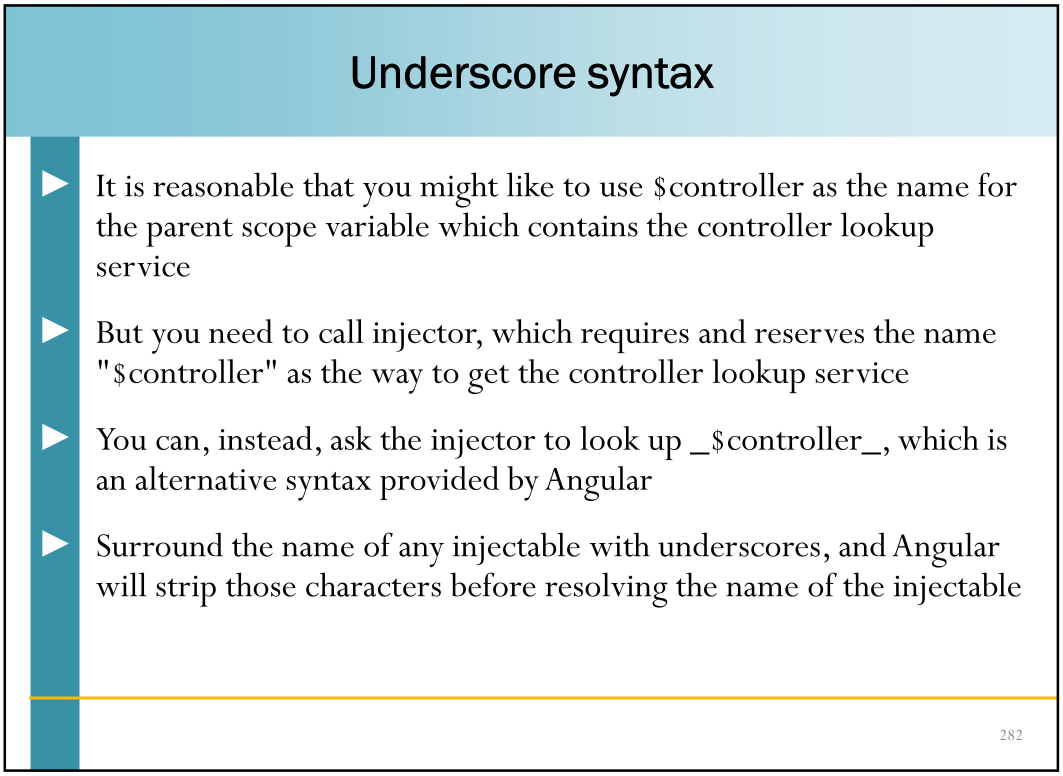
- **`describe`**: Share variables like the controller lookup service, scopes, and so on
- **`beforeAll`**: Load the controller lookup service, **`$controller`**, consider loading **`$rootScope`** (to create **`$scope`**s for your controllers) as well
- **`beforeEach`**: Load the module and the controller under test
  - Loading the module could be moved to **`beforeAll`**, potentially
  - You might be inclined to have a set of tests that build state, so that you do not need to refresh the controller before each test
  - This is usually a bad idea, as tests are meant to run independently of one another



A reusable controller tester

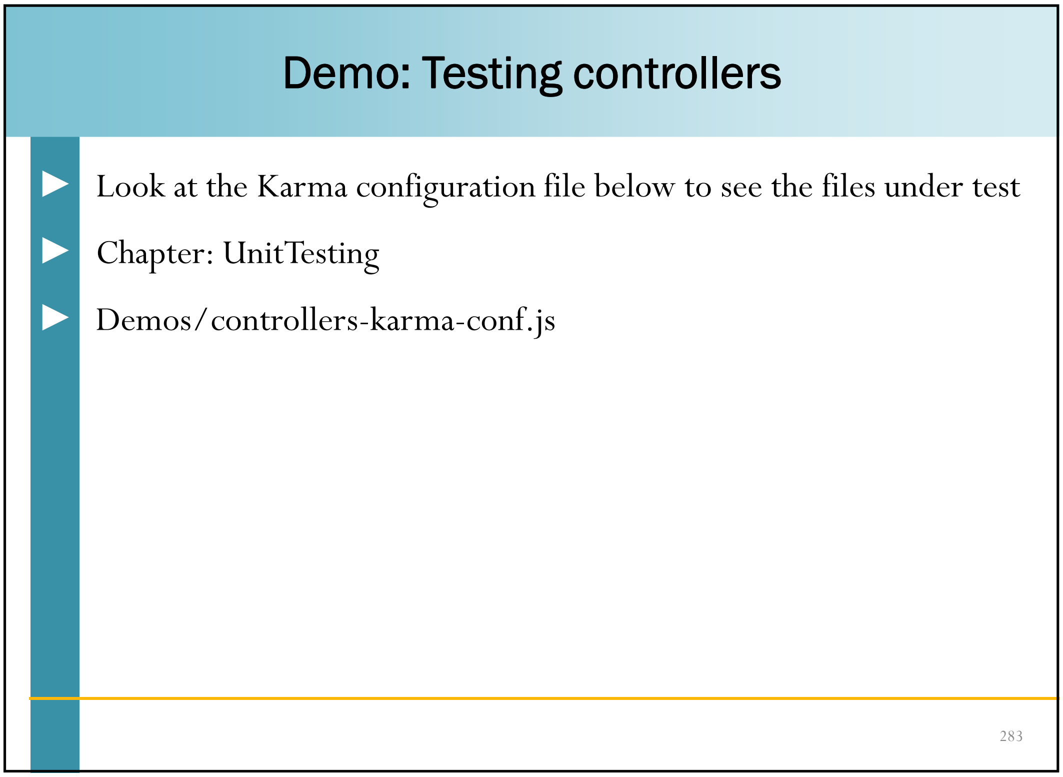
- You could use a template something like this to test controllers

```
describe( 'someApp Controllers', function () {
  var testScope, $controller;

  beforeAll( function () {
    inject( function ( _$controller_, $rootScope ) {
      $controller = _$controller_;
      testScope = $rootScope.$new();
    } );
  } );

  beforeEach( function () {
    module( 'someApp' );
  } );
```



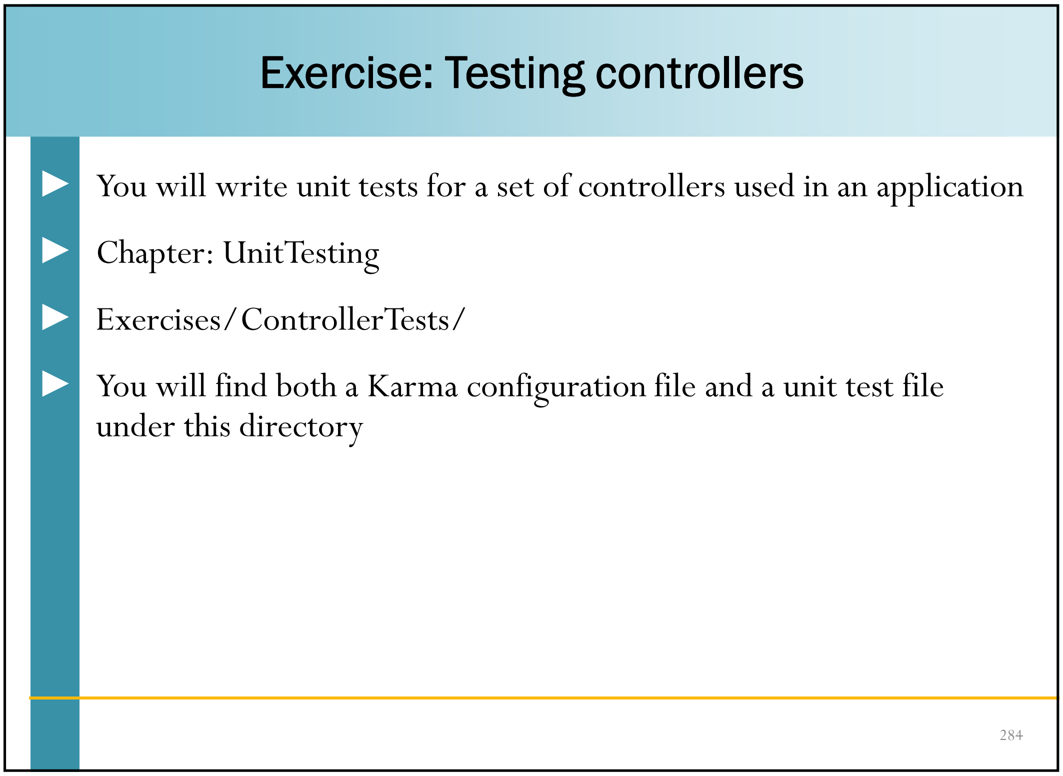
Underscore syntax

- It is reasonable that you might like to use $controller as the name for the parent scope variable which contains the controller lookup service
- But you need to call injector, which requires and reserves the name "$controller" as the way to get the controller lookup service
- You can, instead, ask the injector to look up _$controller_, which is an alternative syntax provided by Angular
- Surround the name of any injectable with underscores, and Angular will strip those characters before resolving the name of the injectable



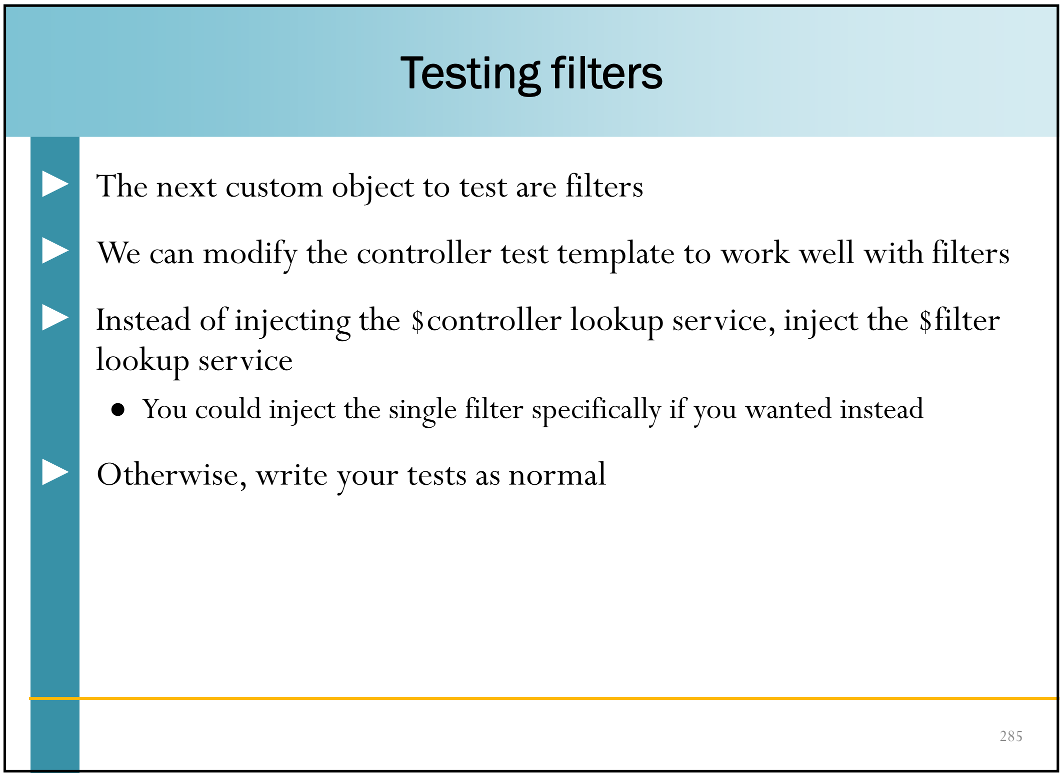
Demo: Testing controllers

- Look at the Karma configuration file below to see the files under test
- Chapter: UnitTesting
- Demos/controllers-karma-conf.js



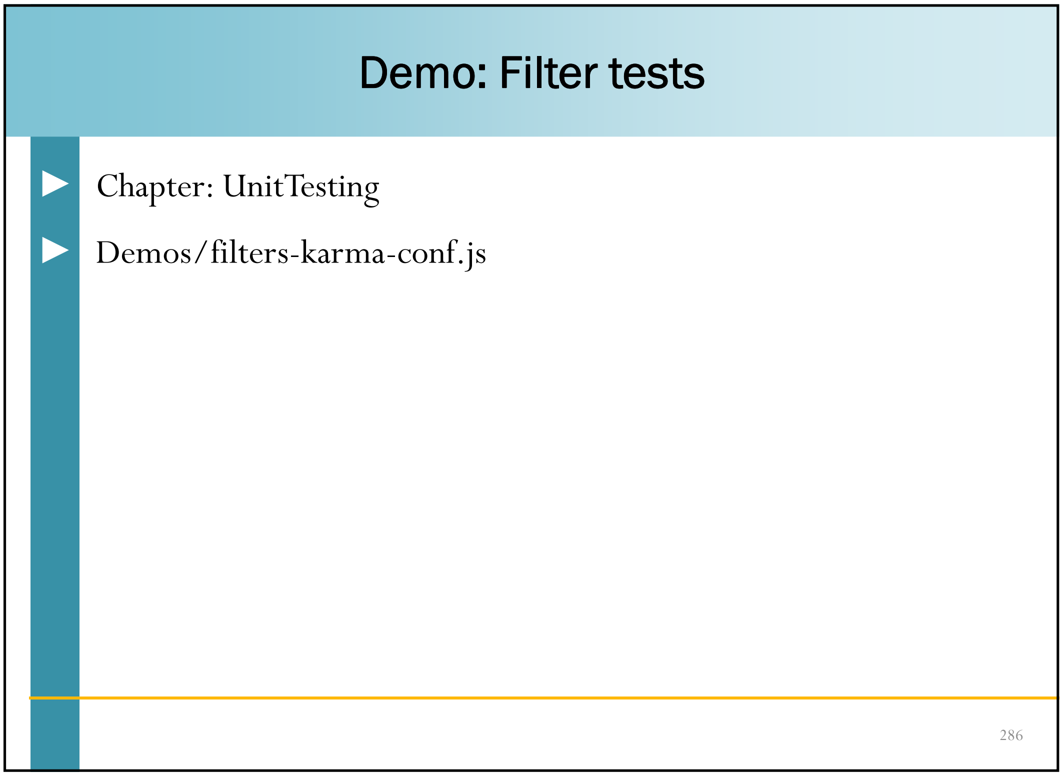
Exercise: Testing controllers

- You will write unit tests for a set of controllers used in an application
- Chapter: UnitTesting
- Exercises/ControllerTests/
- You will find both a Karma configuration file and a unit test file under this directory



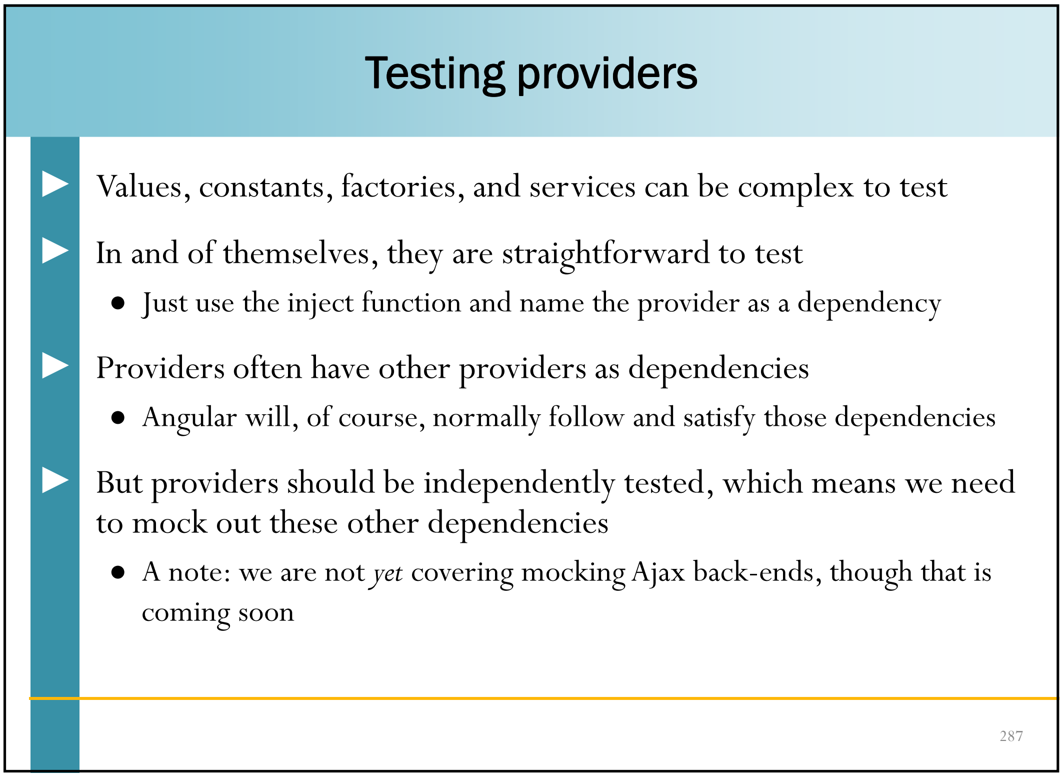
Testing filters

- The next custom object to test are filters
- We can modify the controller test template to work well with filters
- Instead of injecting the $controller lookup service, inject the $filter lookup service
  - You could inject the single filter specifically if you wanted instead
- Otherwise, write your tests as normal



Demo: Filter tests

- Chapter: UnitTesting
- Demos/filters-karma-conf.js



Testing providers

- Values, constants, factories, and services can be complex to test
- In and of themselves, they are straightforward to test
  - Just use the inject function and name the provider as a dependency
- Providers often have other providers as dependencies
  - Angular will, of course, normally follow and satisfy those dependencies
- But providers should be independently tested, which means we need to mock out these other dependencies
  - A note: we are not *yet* covering mocking Ajax back-ends, though that is coming soon

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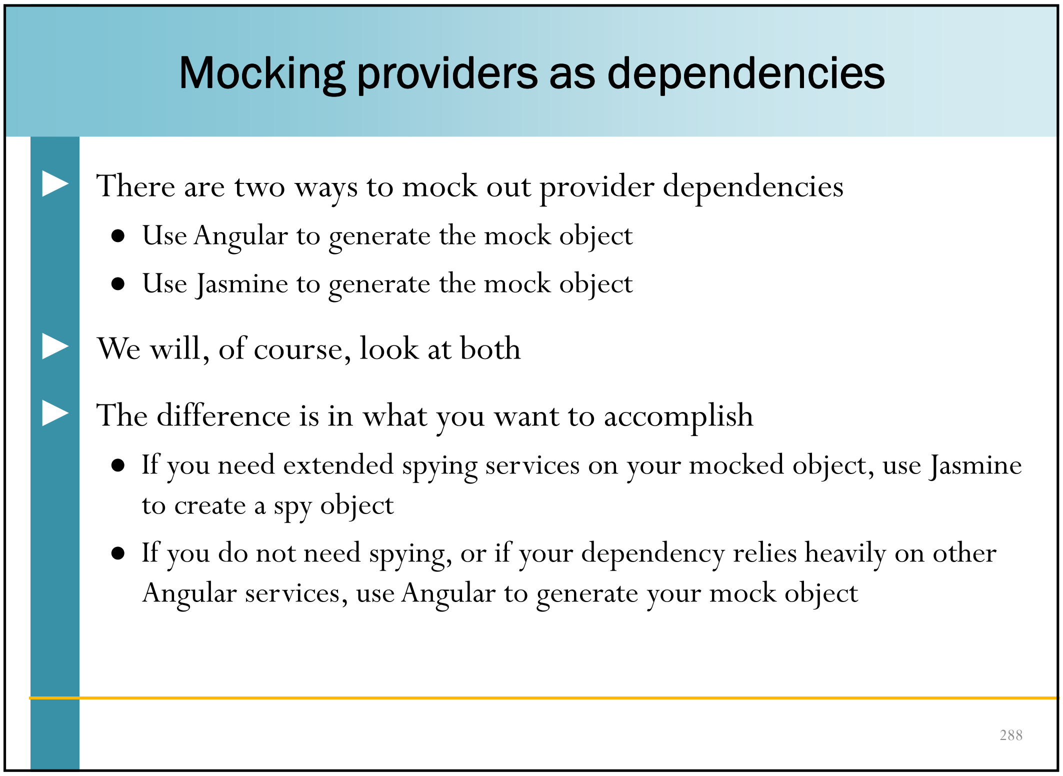

Mocking providers as dependencies

- There are two ways to mock out provider dependencies
  - Use Angular to generate the mock object
  - Use Jasmine to generate the mock object
- We will, of course, look at both
- The difference is in what you want to accomplish
  - If you need extended spying services on your mocked object, use Jasmine to create a spy object
  - If you do not need spying, or if your dependency relies heavily on other Angular services, use Angular to generate your mock object

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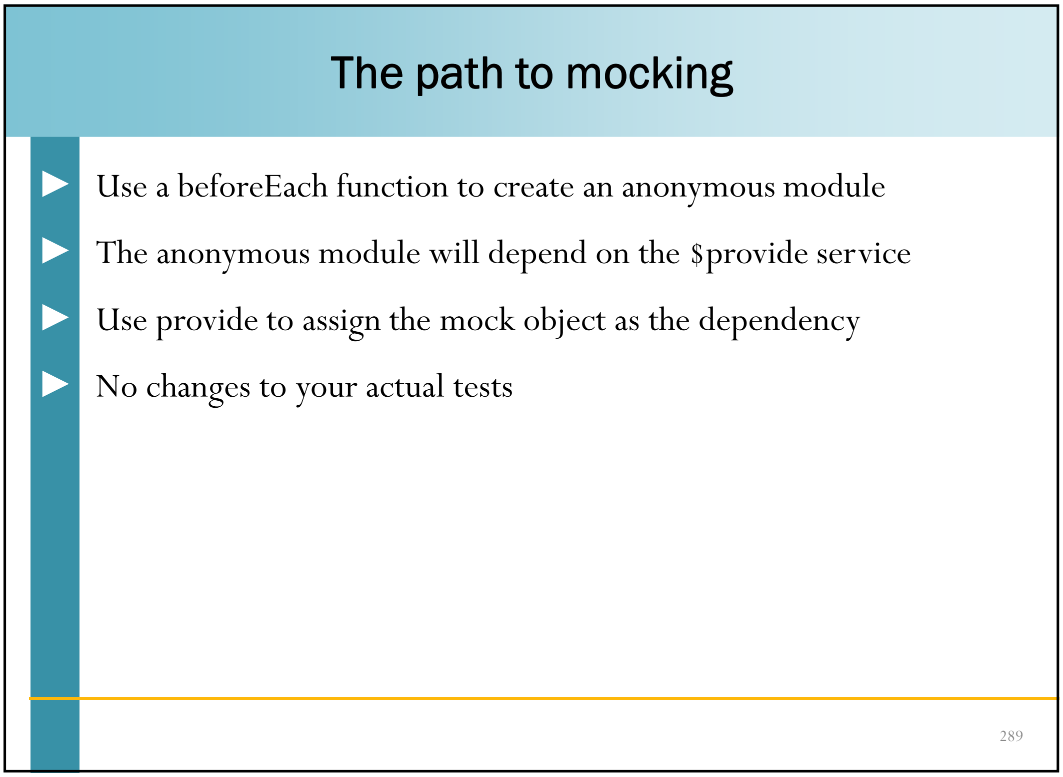
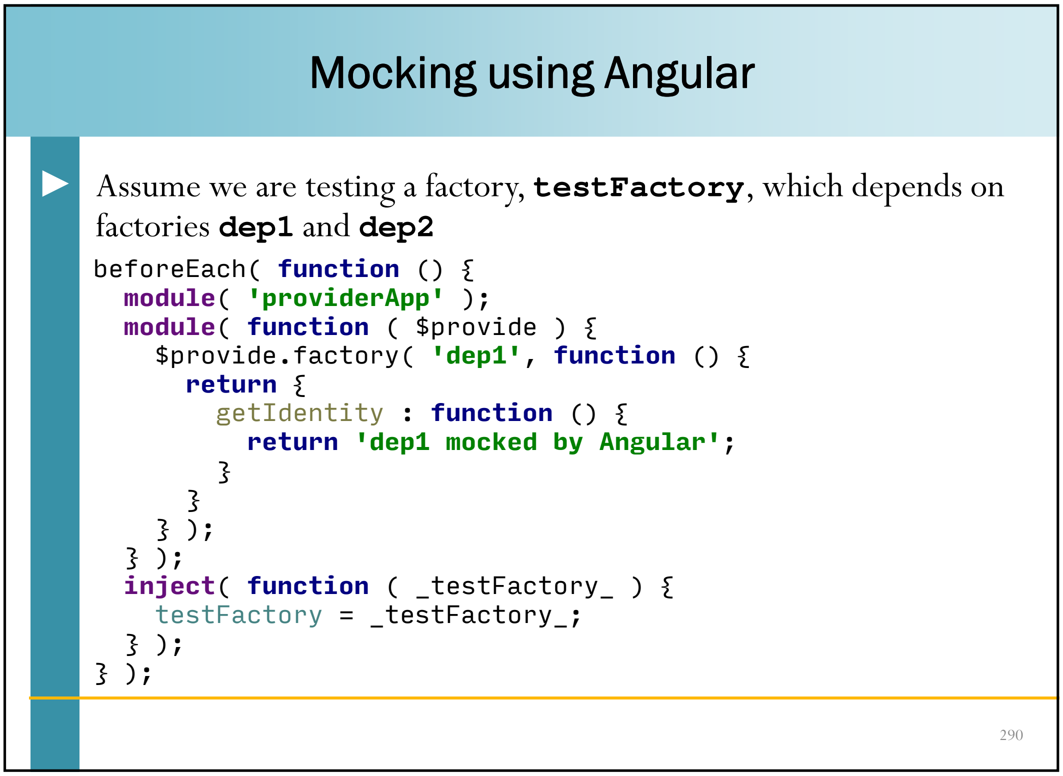


The path to mocking

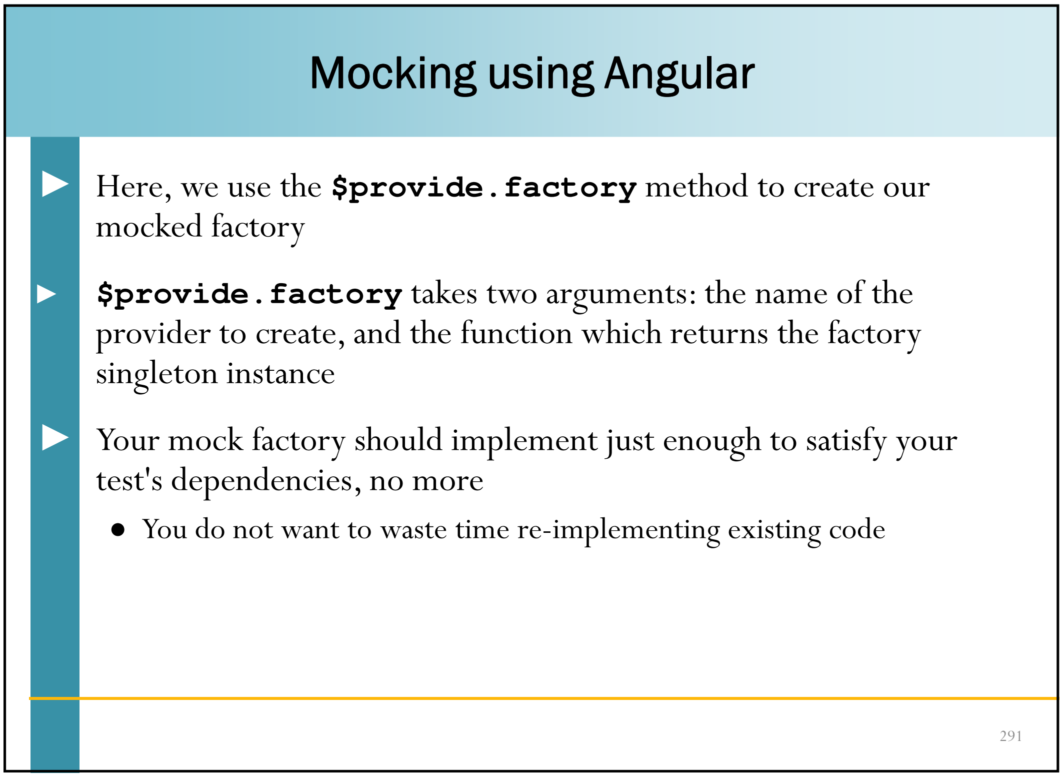
- Use a beforeEach function to create an anonymous module
- The anonymous module will depend on the $provide service
- Use provide to assign the mock object as the dependency
- No changes to your actual tests



Mocking using Angular

- Assume we are testing a factory, **testFactory**, which depends on factories **dep1** and **dep2**

```
beforeEach( function () {
  module( 'providerApp' );
  module( function ( $provide ) {
    $provide.factory( 'dep1', function () {
      return {
        getIdentity : function () {
          return 'dep1 mocked by Angular';
        }
      }
    } );
  } );
  inject( function ( _testFactory_ ) {
    testFactory = _testFactory_;
  } );
} );
```



Mocking using Angular

- Here, we use the **`$provide.factory`** method to create our mocked factory
- **`$provide.factory`** takes two arguments: the name of the provider to create, and the function which returns the factory singleton instance
- Your mock factory should implement just enough to satisfy your test's dependencies, no more
  - You do not want to waste time re-implementing existing code

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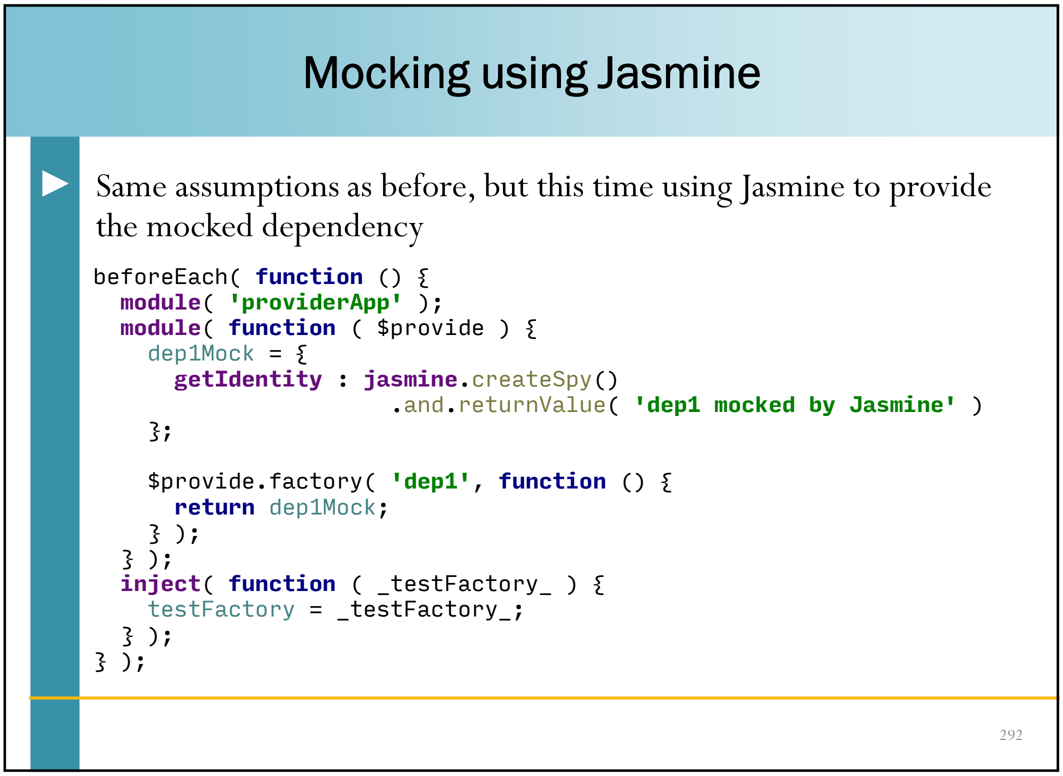

Mocking using Jasmine

- Same assumptions as before, but this time using Jasmine to provide the mocked dependency

```
beforeEach( function () {
  module( 'providerApp' );
  module( function ( $provide ) {
    dep1Mock = {
      getIdentity : jasmine.createSpy()
                        .and.returnValue( 'dep1 mocked by Jasmine' )
    };

    $provide.factory( 'dep1', function () {
      return dep1Mock;
    } );
  } );
  inject( function ( _testFactory_ ) {
    testFactory = _testFactory_;
  } );
} );
```

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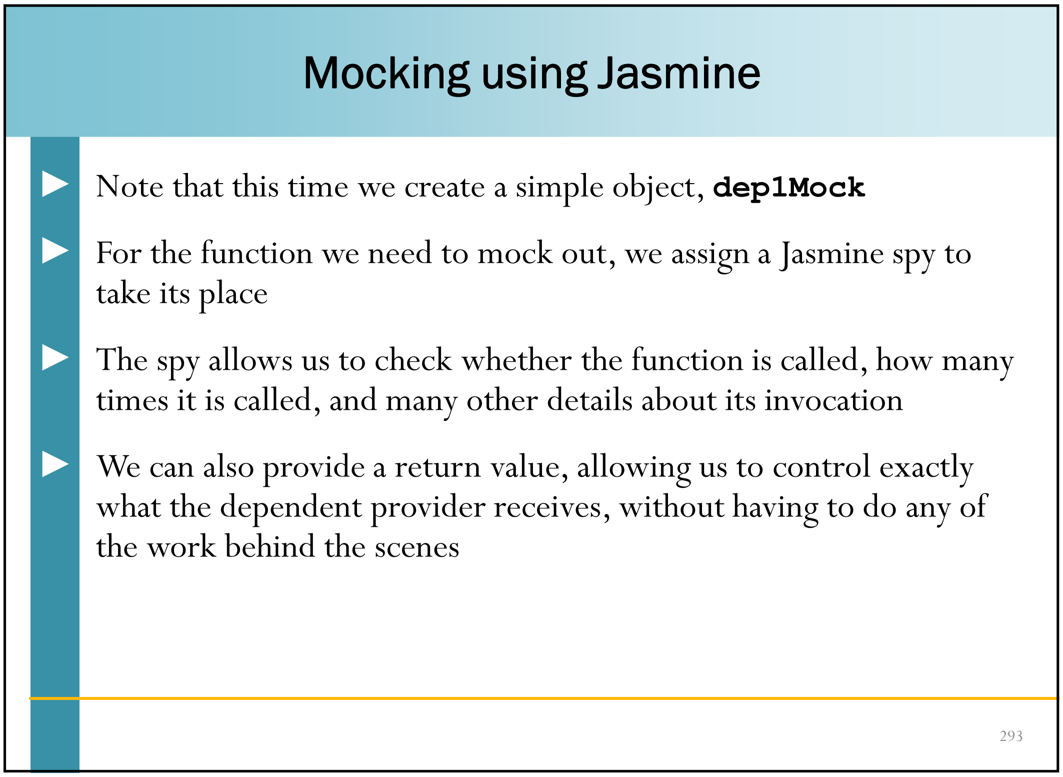
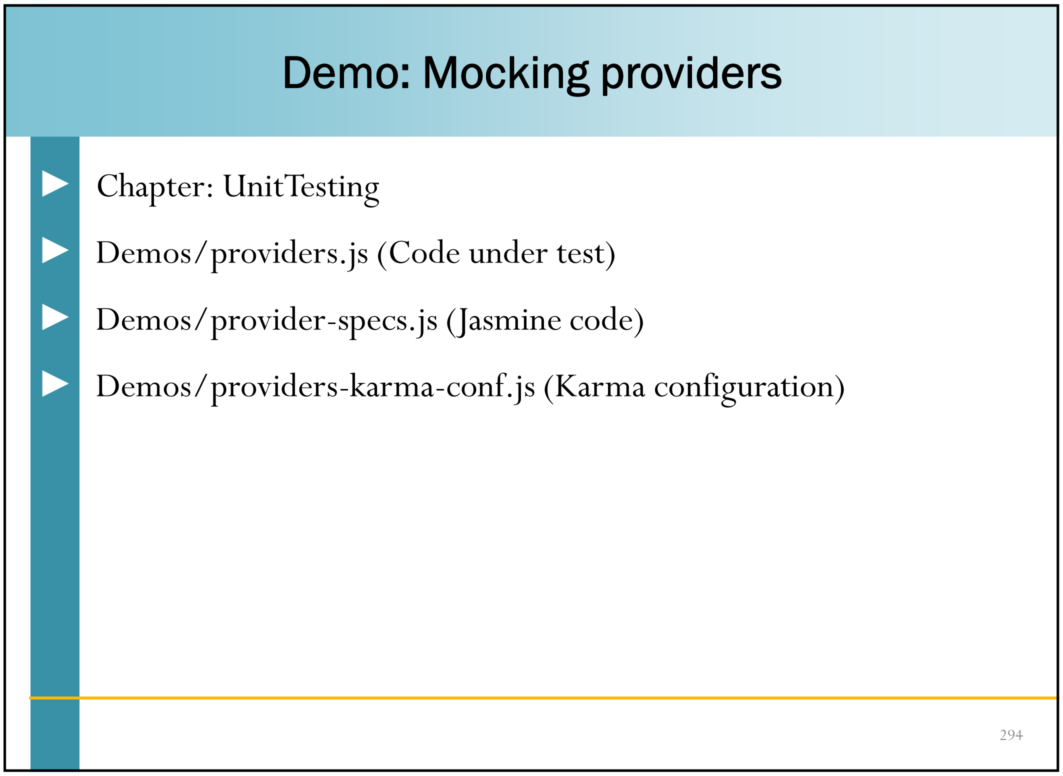


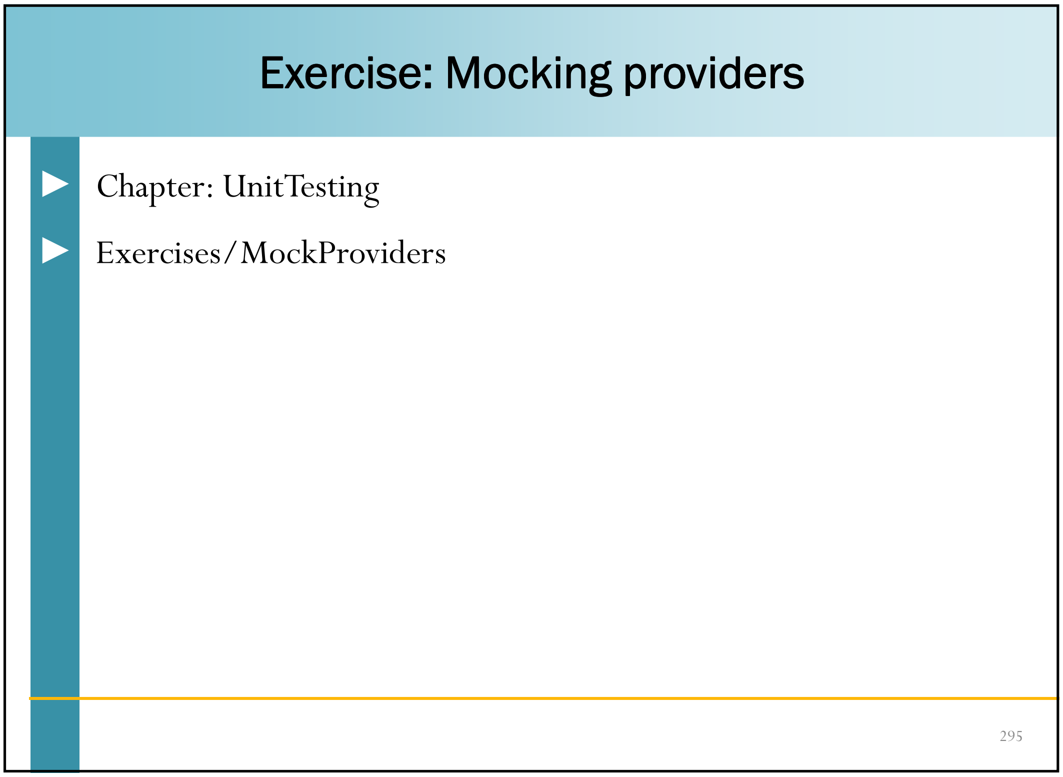
Mocking using Jasmine

- Note that this time we create a simple object, **`dep1Mock`**
- For the function we need to mock out, we assign a Jasmine spy to take its place
- The spy allows us to check whether the function is called, how many times it is called, and many other details about its invocation
- We can also provide a return value, allowing us to control exactly what the dependent provider receives, without having to do any of the work behind the scenes



Demo: Mocking providers

- Chapter: UnitTesting
- Demos/providers.js (Code under test)
- Demos/provider-specs.js (Jasmine code)
- Demos/providers-karma-conf.js (Karma configuration)



Exercise: Mocking providers

- Chapter: UnitTesting
- Exercises/MockProviders

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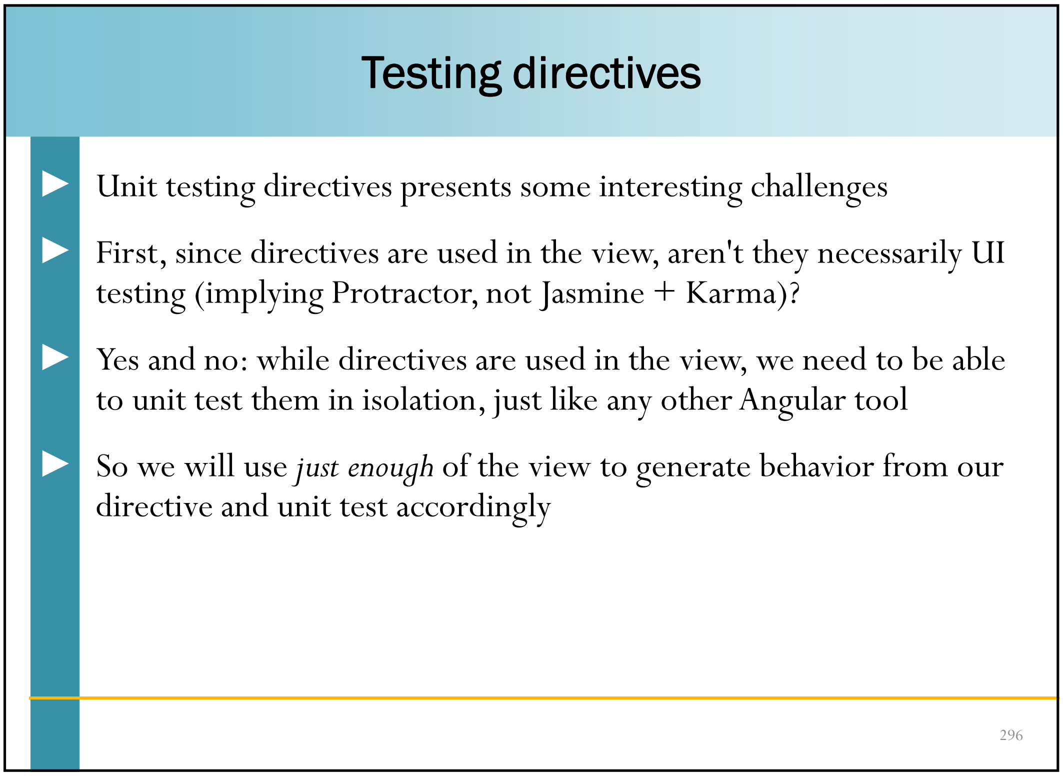

Testing directives

- Unit testing directives presents some interesting challenges
- First, since directives are used in the view, aren't they necessarily UI testing (implying Protractor, not Jasmine + Karma)?
- Yes and no: while directives are used in the view, we need to be able to unit test them in isolation, just like any other Angular tool
- So we will use *just enough* of the view to generate behavior from our directive and unit test accordingly

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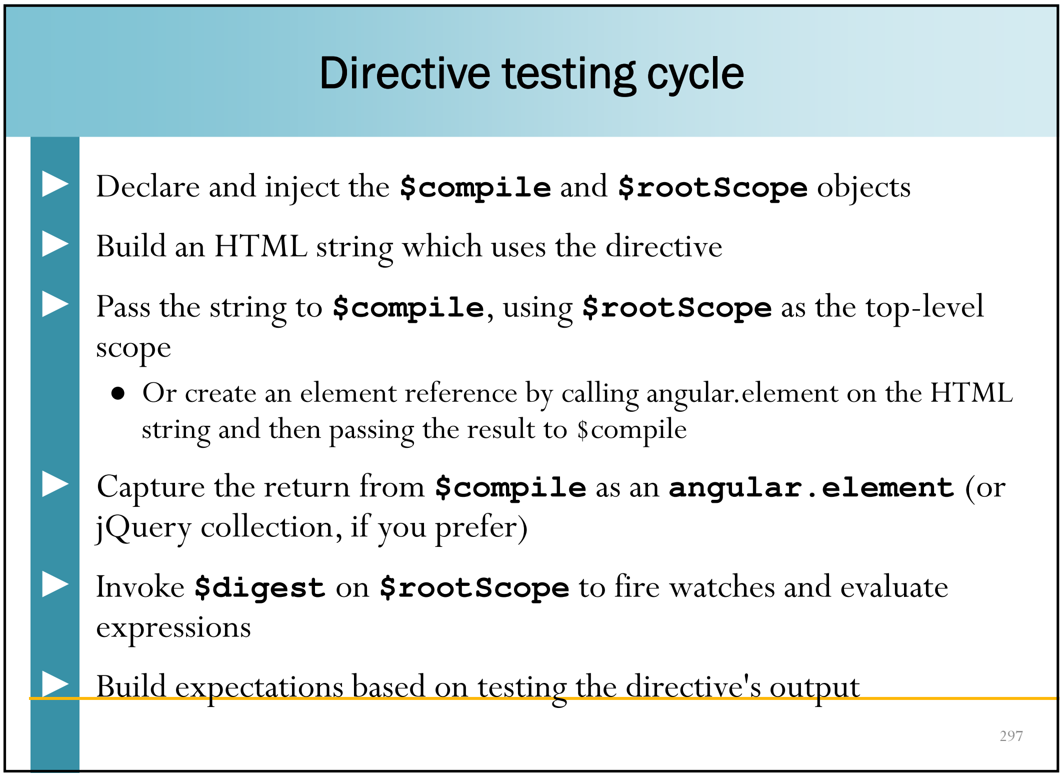
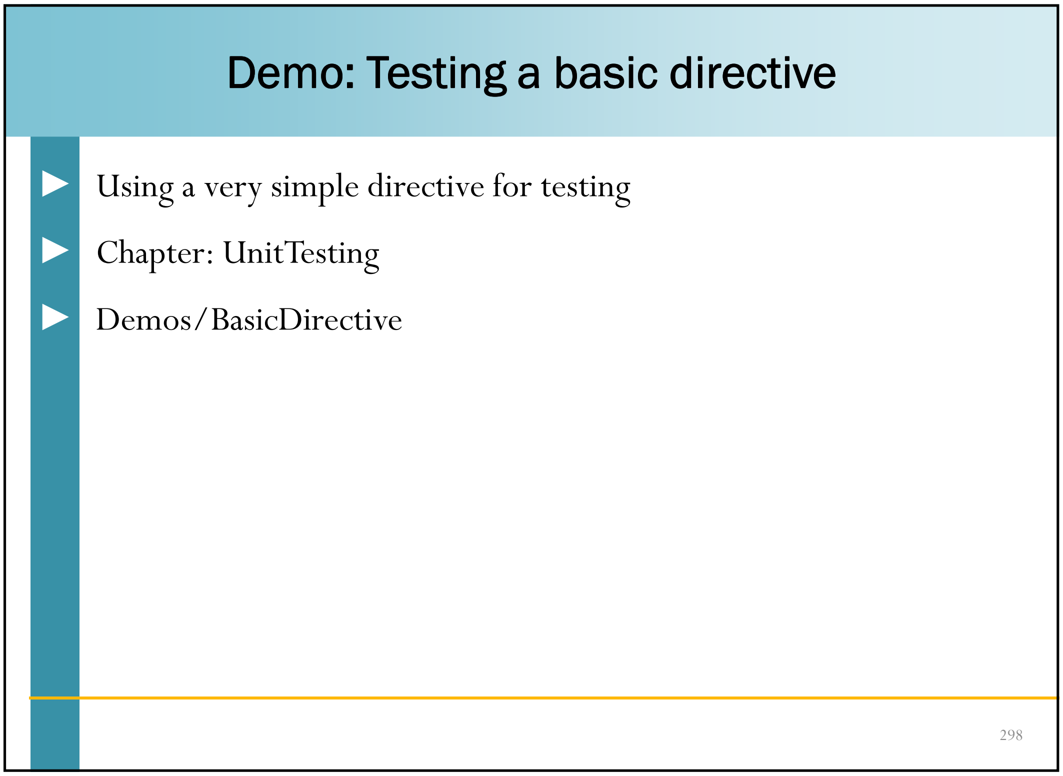


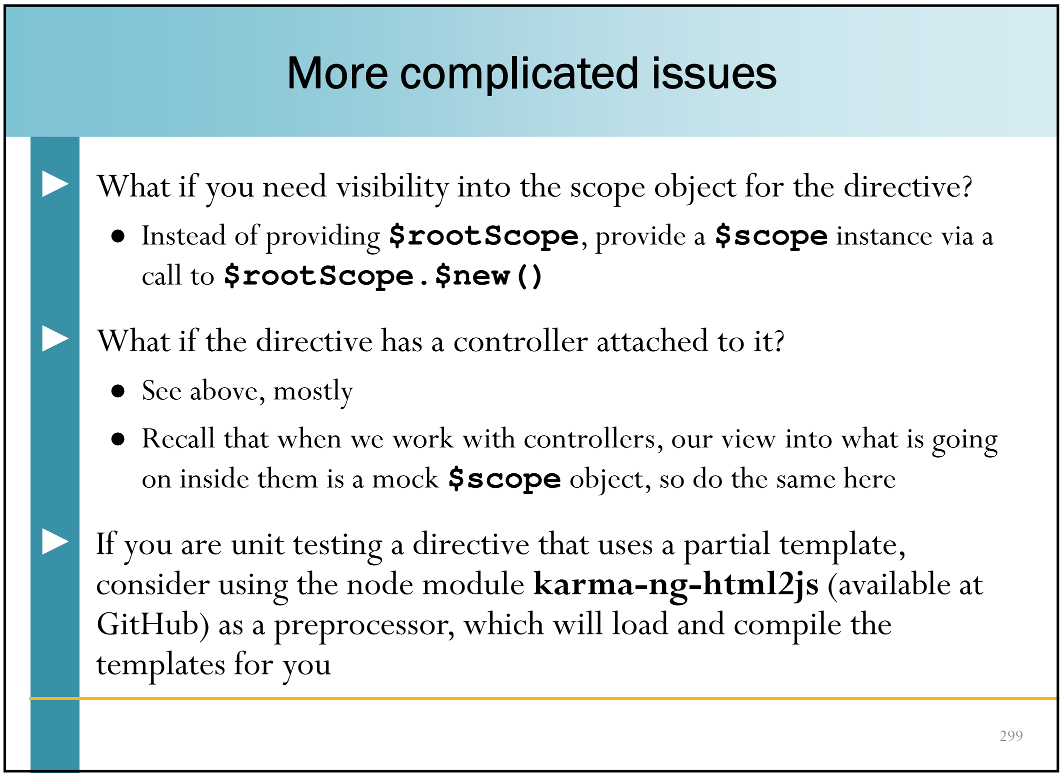
Directive testing cycle

- Declare and inject the `$compile` and `$rootScope` objects
- Build an HTML string which uses the directive
- Pass the string to `$compile`, using `$rootScope` as the top-level scope
  - Or create an element reference by calling angular.element on the HTML string and then passing the result to $compile
- Capture the return from `$compile` as an `angular.element` (or jQuery collection, if you prefer)
- Invoke `$digest` on `$rootScope` to fire watches and evaluate expressions
- Build expectations based on testing the directive's output



Demo: Testing a basic directive

- Using a very simple directive for testing
- Chapter: UnitTesting
- Demos/BasicDirective



More complicated issues

- What if you need visibility into the scope object for the directive?
  - Instead of providing **`$rootScope`**, provide a **`$scope`** instance via a call to **`$rootScope.$new()`**
- What if the directive has a controller attached to it?
  - See above, mostly
  - Recall that when we work with controllers, our view into what is going on inside them is a mock **`$scope`** object, so do the same here
- If you are unit testing a directive that uses a partial template, consider using the node module **karma-ng-html2js** (available at GitHub) as a preprocessor, which will load and compile the templates for you

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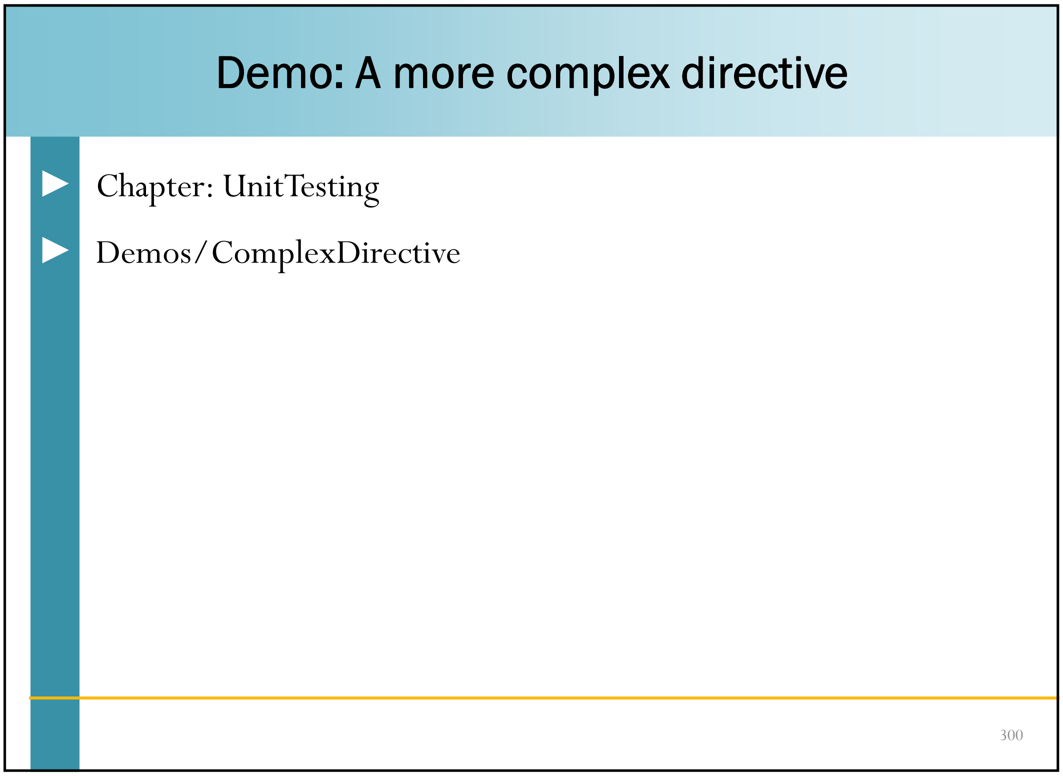

Demo: A more complex directive

- Chapter: UnitTesting
- Demos/ComplexDirective

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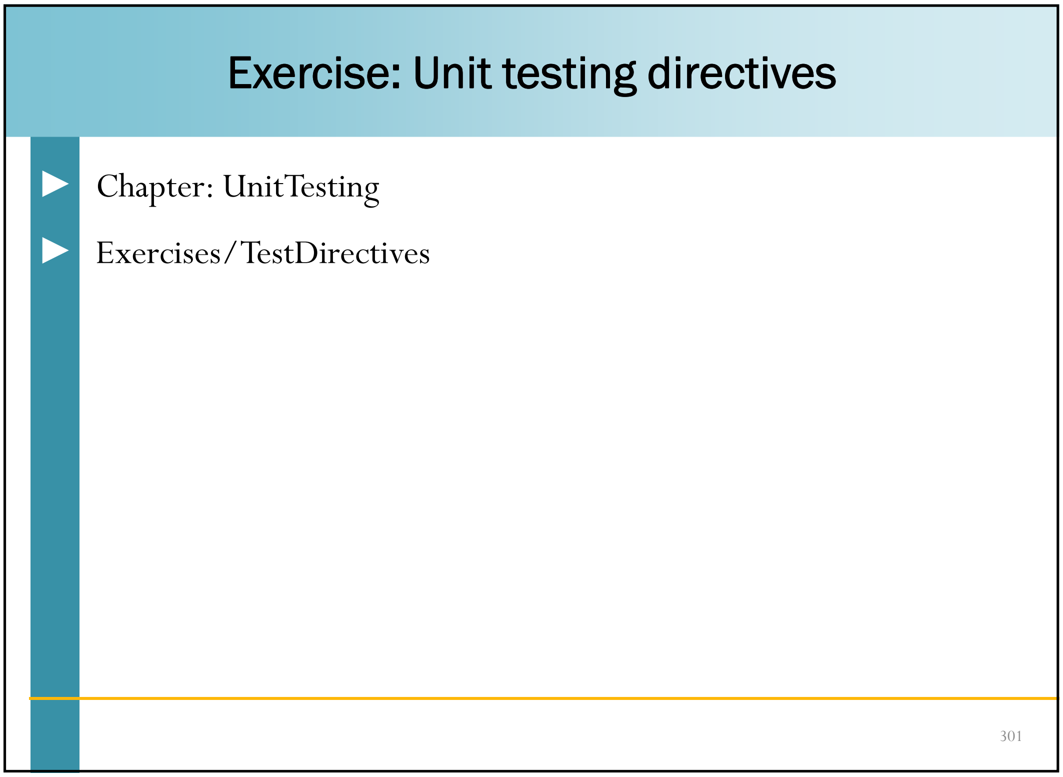
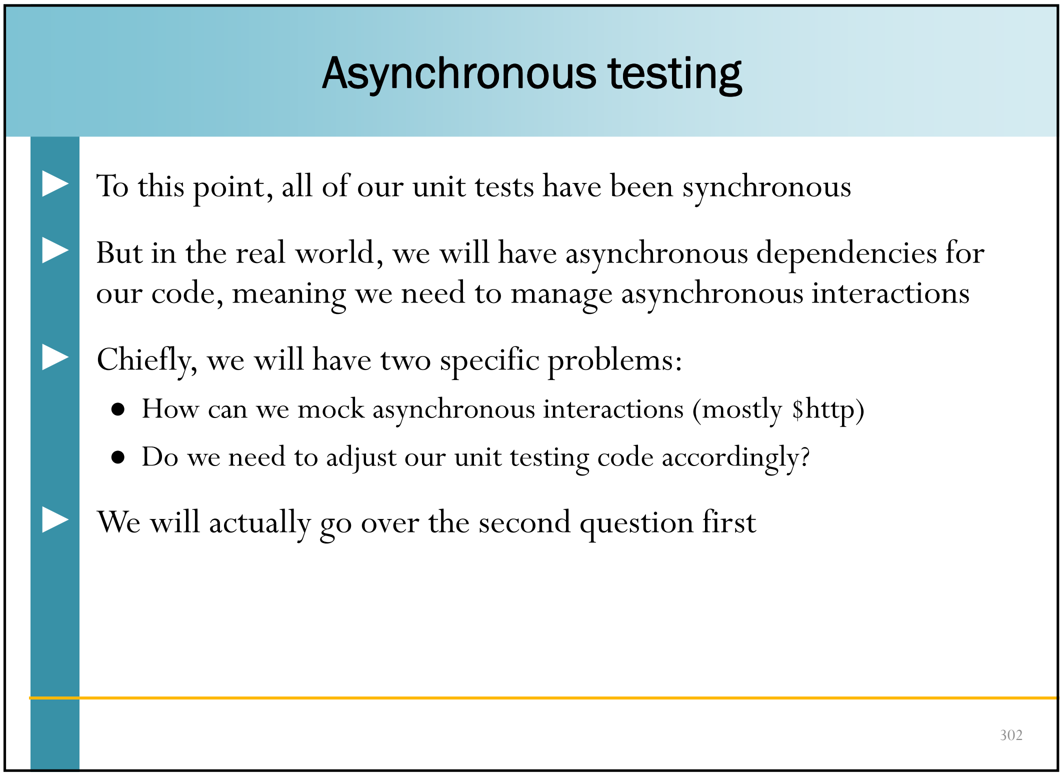


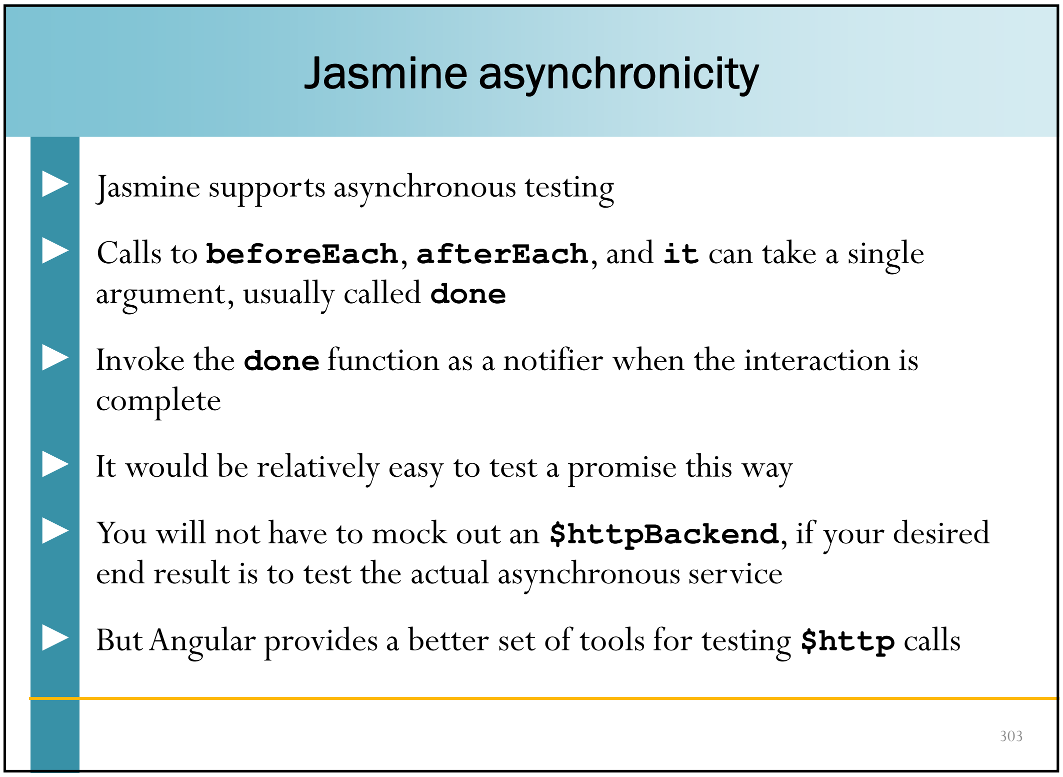
Exercise: Unit testing directives

- Chapter: UnitTesting
- Exercises/TestDirectives



Asynchronous testing

- To this point, all of our unit tests have been synchronous
- But in the real world, we will have asynchronous dependencies for our code, meaning we need to manage asynchronous interactions
- Chiefly, we will have two specific problems:
  - How can we mock asynchronous interactions (mostly $http)
  - Do we need to adjust our unit testing code accordingly?
- We will actually go over the second question first



Jasmine asynchronicity

- Jasmine supports asynchronous testing
- Calls to **`beforeEach`**, **`afterEach`**, and **`it`** can take a single argument, usually called **`done`**
- Invoke the **`done`** function as a notifier when the interaction is complete
- It would be relatively easy to test a promise this way
- You will not have to mock out an **`$httpBackend`**, if your desired end result is to test the actual asynchronous service
- But Angular provides a better set of tools for testing **`$http`** calls

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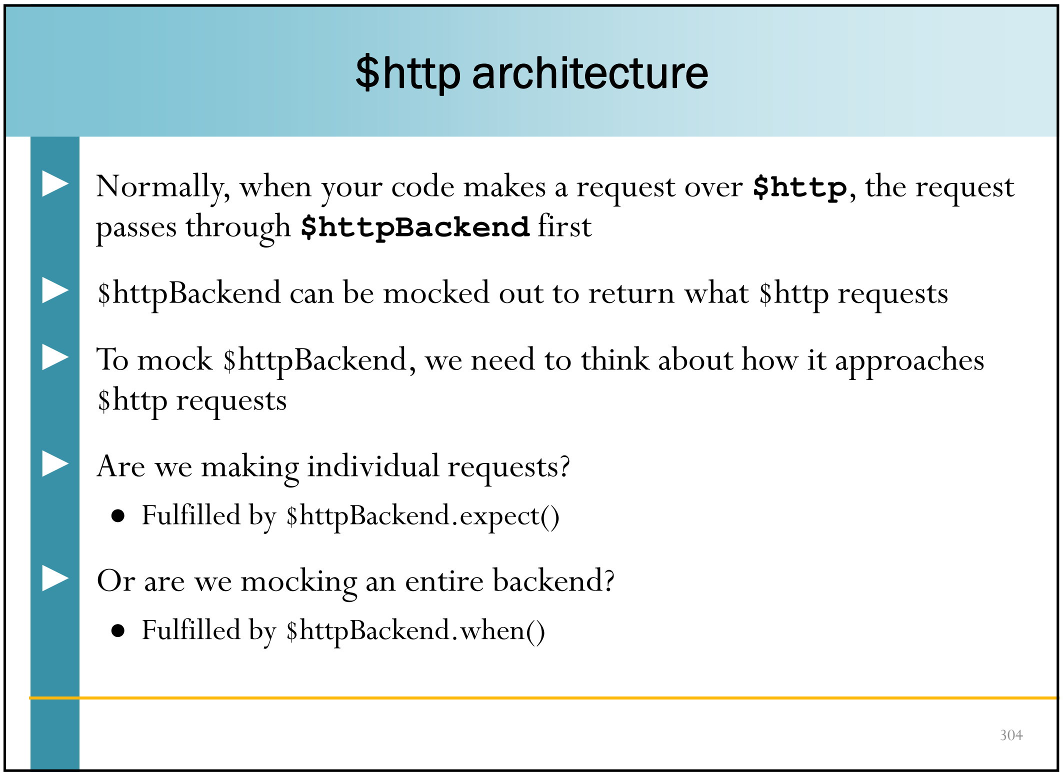

$http architecture

- Normally, when your code makes a request over **`$http`**, the request passes through **`$httpBackend`** first
- $httpBackend can be mocked out to return what $http requests
- To mock $httpBackend, we need to think about how it approaches $http requests
- Are we making individual requests?
  - Fulfilled by $httpBackend.expect()
- Or are we mocking an entire backend?
  - Fulfilled by $httpBackend.when()

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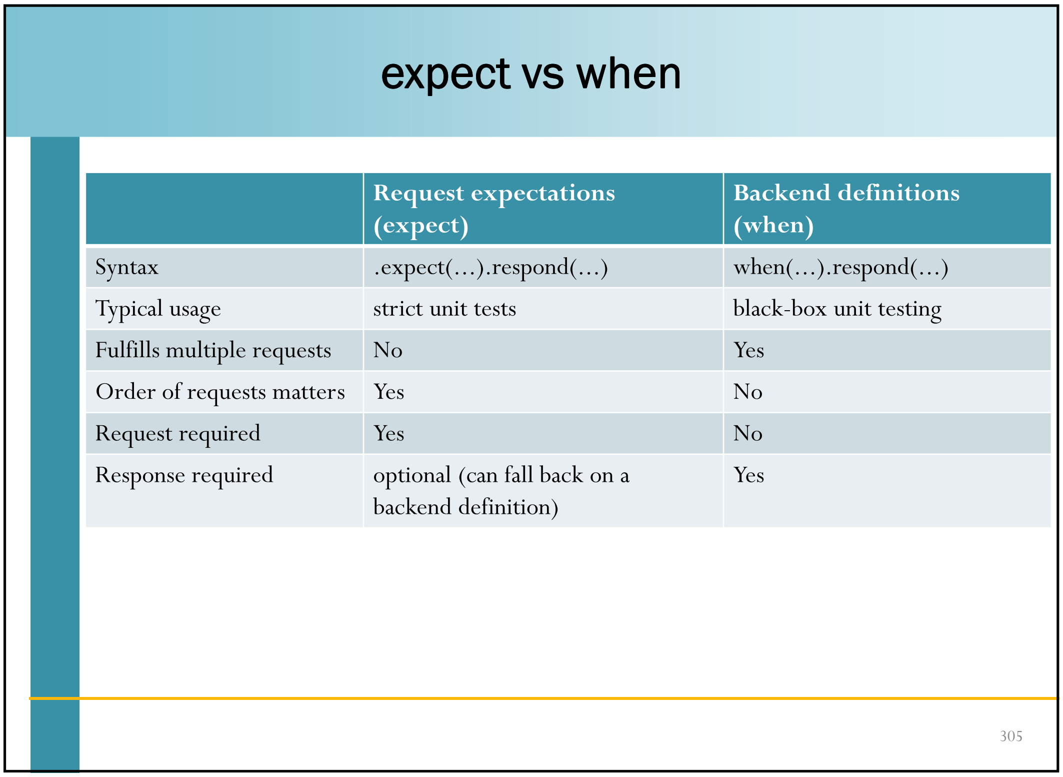
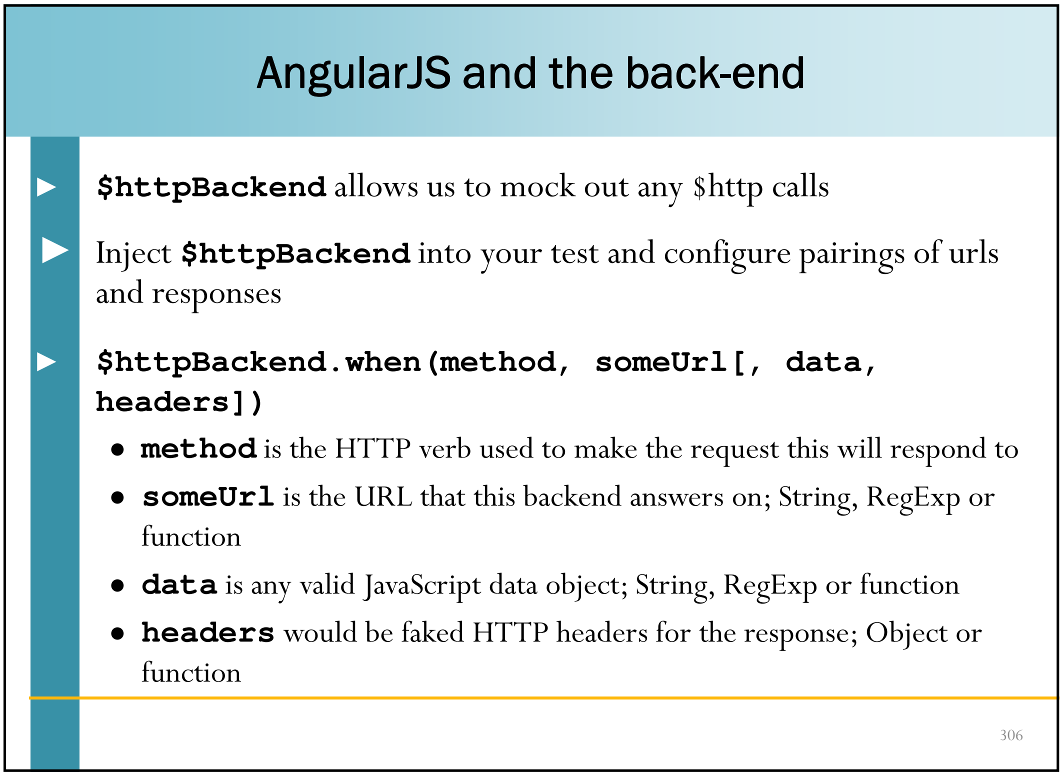


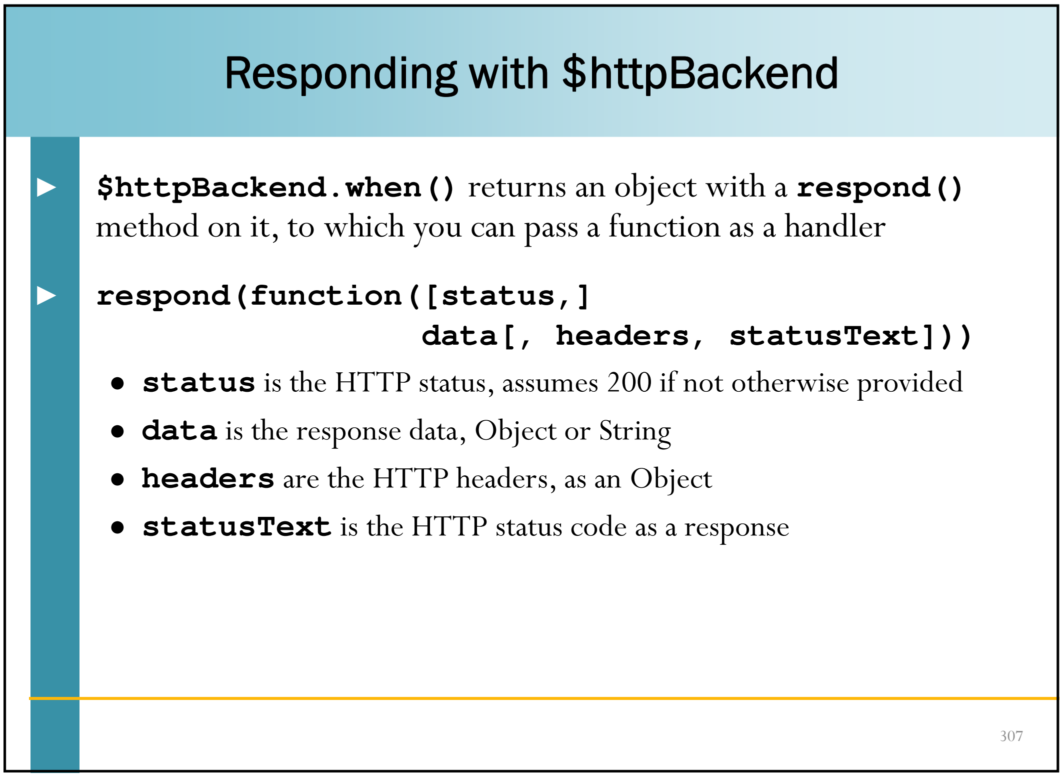
expect vs when

	Request expectations (expect)	Backend definitions (when)
Syntax	.expect(…).respond(…)	when(…).respond(…)
Typical usage	strict unit tests	black-box unit testing
Fulfills multiple requests	No	Yes
Order of requests matters	Yes	No
Request required	Yes	No
Response required	optional (can fall back on a backend definition)	Yes



AngularJS and the back-end

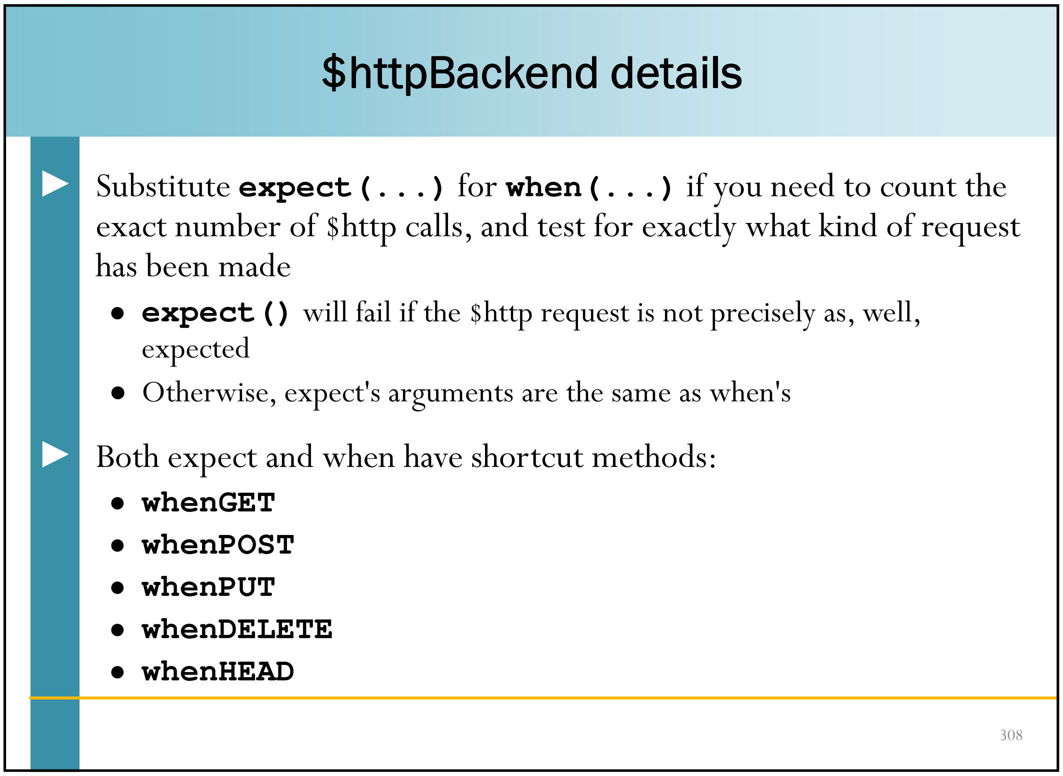
- **`$httpBackend`** allows us to mock out any $http calls
- Inject **`$httpBackend`** into your test and configure pairings of urls and responses
- **`$httpBackend.when(method, someUrl[, data, headers])`**
  - **`method`** is the HTTP verb used to make the request this will respond to
  - **`someUrl`** is the URL that this backend answers on; String, RegExp or function
  - **`data`** is any valid JavaScript data object; String, RegExp or function
  - **`headers`** would be faked HTTP headers for the response; Object or function



Responding with $httpBackend

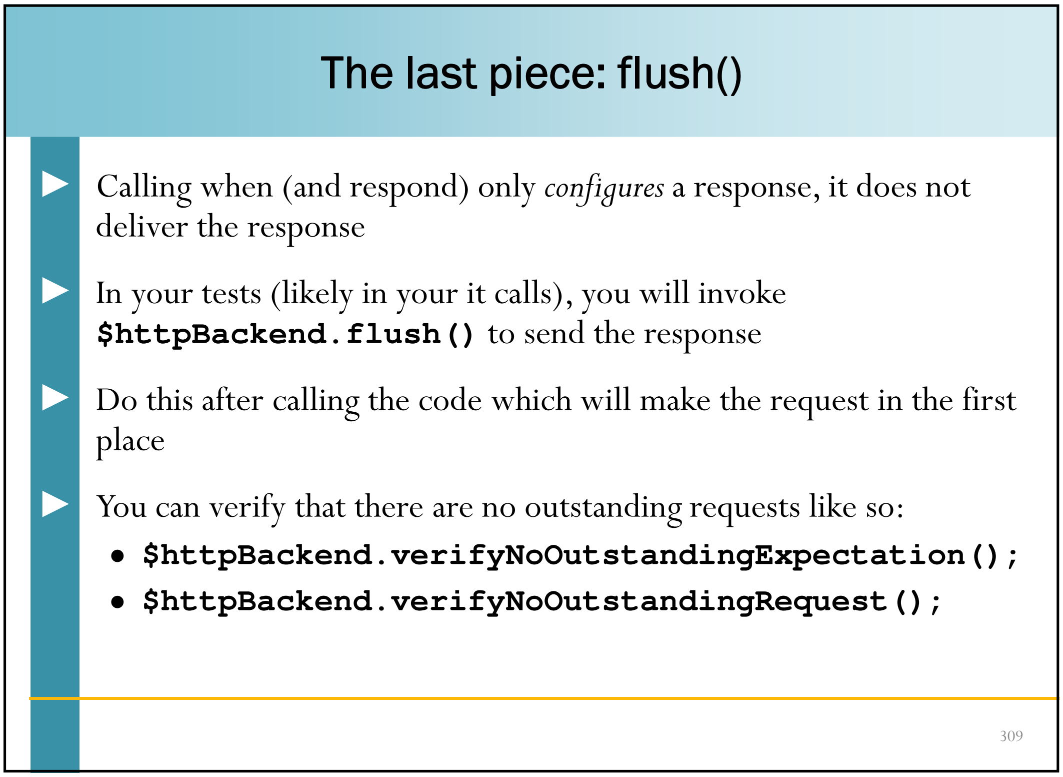
- **`$httpBackend.when()`** returns an object with a **`respond()`** method on it, to which you can pass a function as a handler

-
  ```
  respond(function([status,]
                   data[, headers, statusText]))
  ```
  - **`status`** is the HTTP status, assumes 200 if not otherwise provided
  - **`data`** is the response data, Object or String
  - **`headers`** are the HTTP headers, as an Object
  - **`statusText`** is the HTTP status code as a response



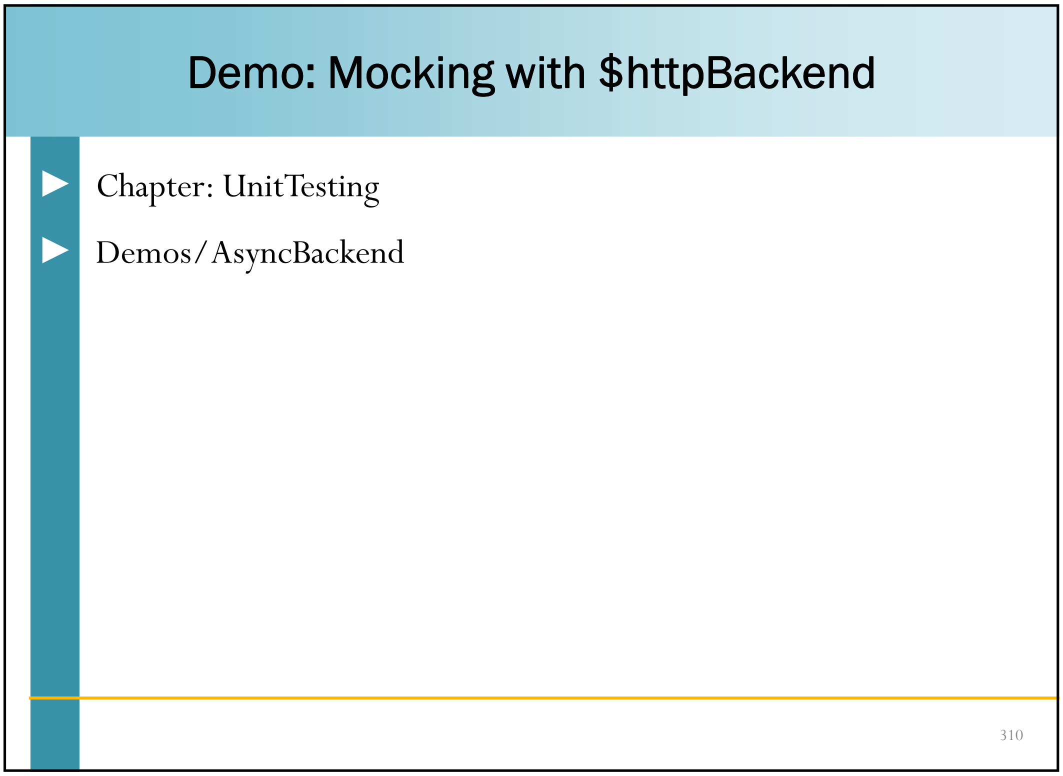
$httpBackend details

- Substitute **`expect(...)`** for **`when(...)`** if you need to count the exact number of $http calls, and test for exactly what kind of request has been made
  - **`expect()`** will fail if the $http request is not precisely as, well, expected
  - Otherwise, expect's arguments are the same as when's
- Both expect and when have shortcut methods:
  - **`whenGET`**
  - **`whenPOST`**
  - **`whenPUT`**
  - **`whenDELETE`**
  - **`whenHEAD`**



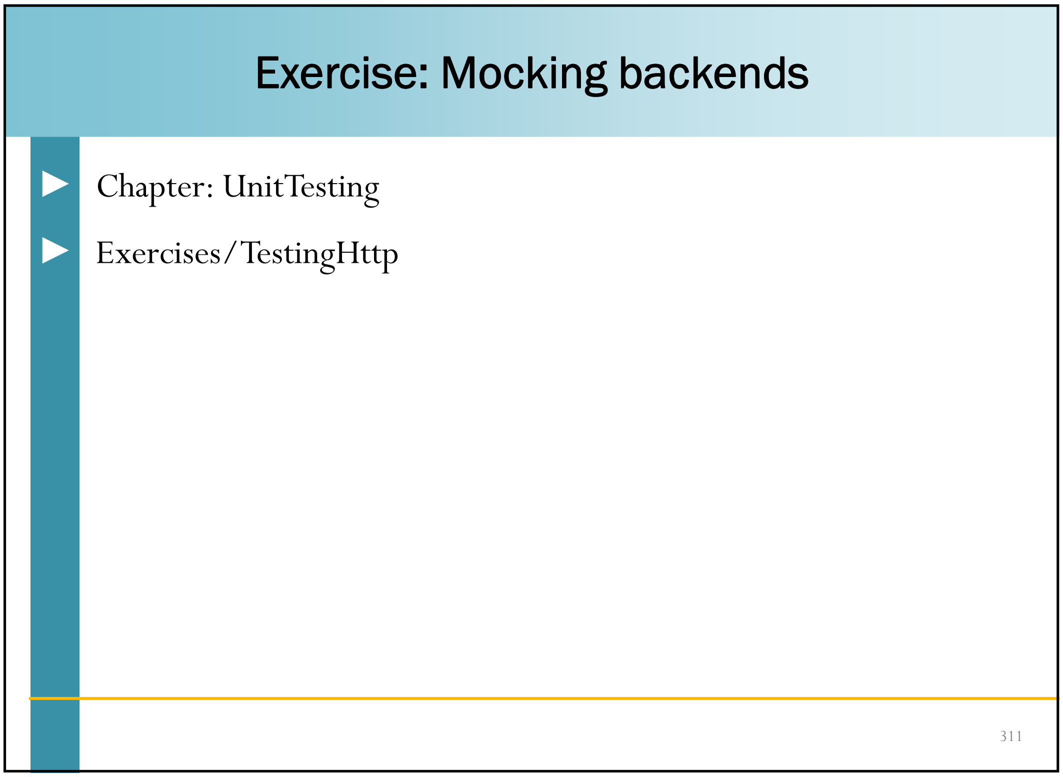
The last piece: flush()

- Calling when (and respond) only *configures* a response, it does not deliver the response
- In your tests (likely in your it calls), you will invoke **`$httpBackend.flush()`** to send the response
- Do this after calling the code which will make the request in the first place
- You can verify that there are no outstanding requests like so:
  - **`$httpBackend.verifyNoOutstandingExpectation();`**
  - **`$httpBackend.verifyNoOutstandingRequest();`**



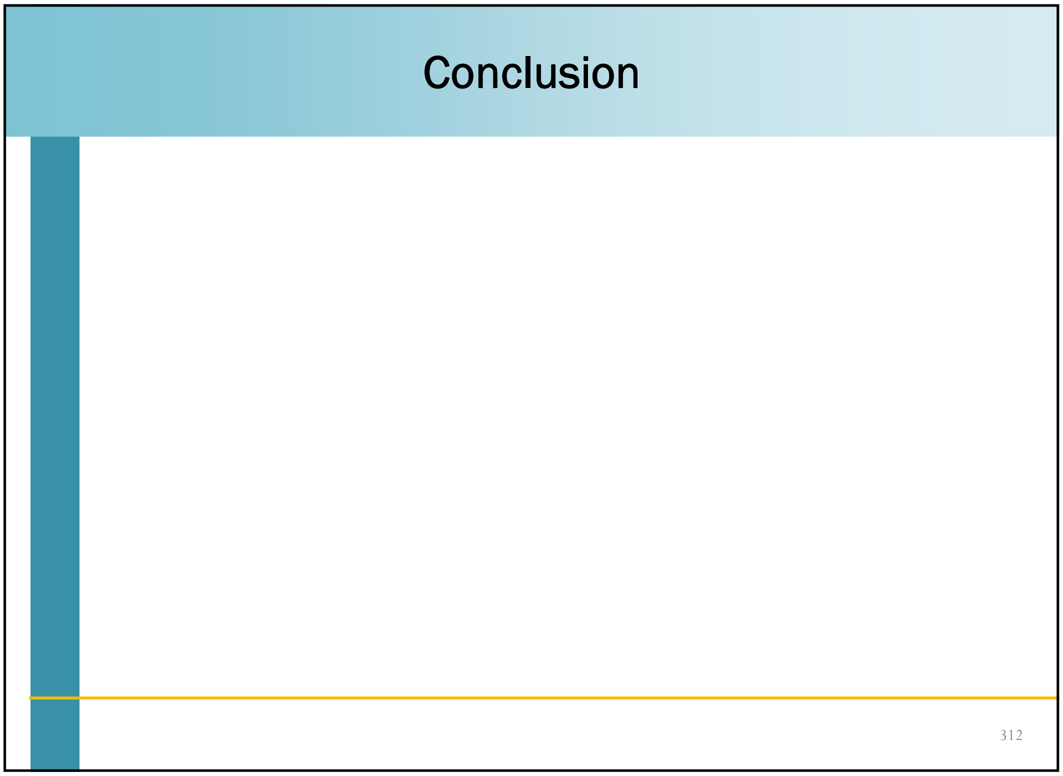
Demo: Mocking with $httpBackend

- Chapter: UnitTesting
- Demos/AsyncBackend

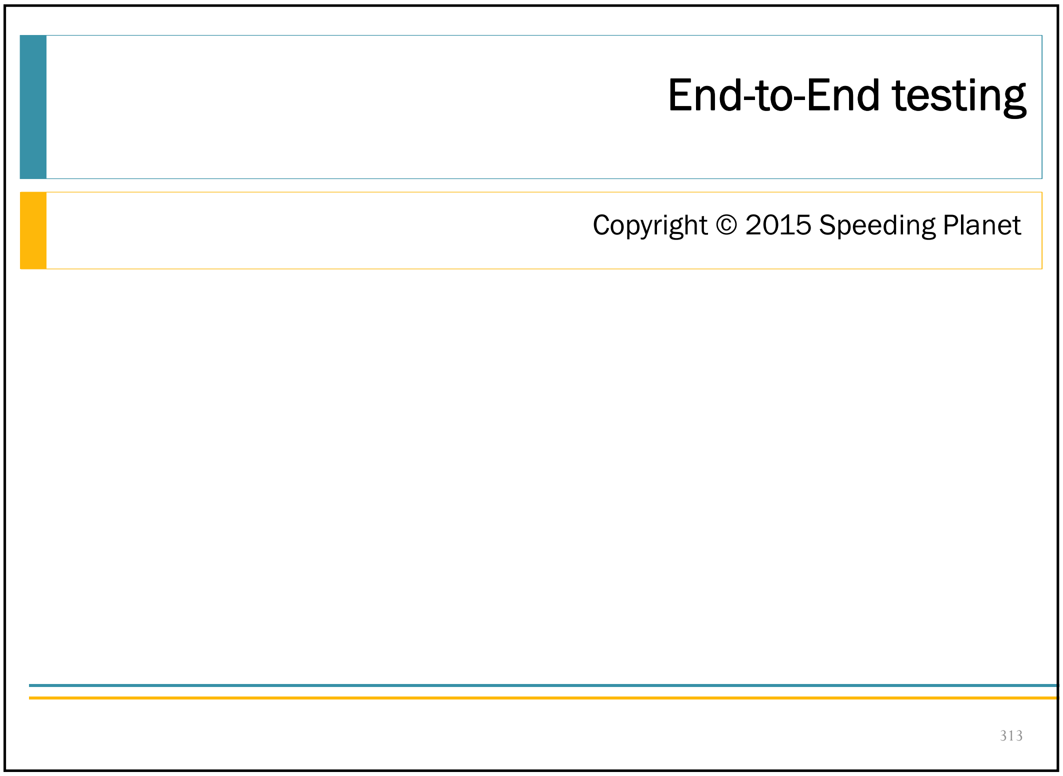


Exercise: Mocking backends

- Chapter: UnitTesting
- Exercises/TestingHttp



Conclusion



End-to-End testing

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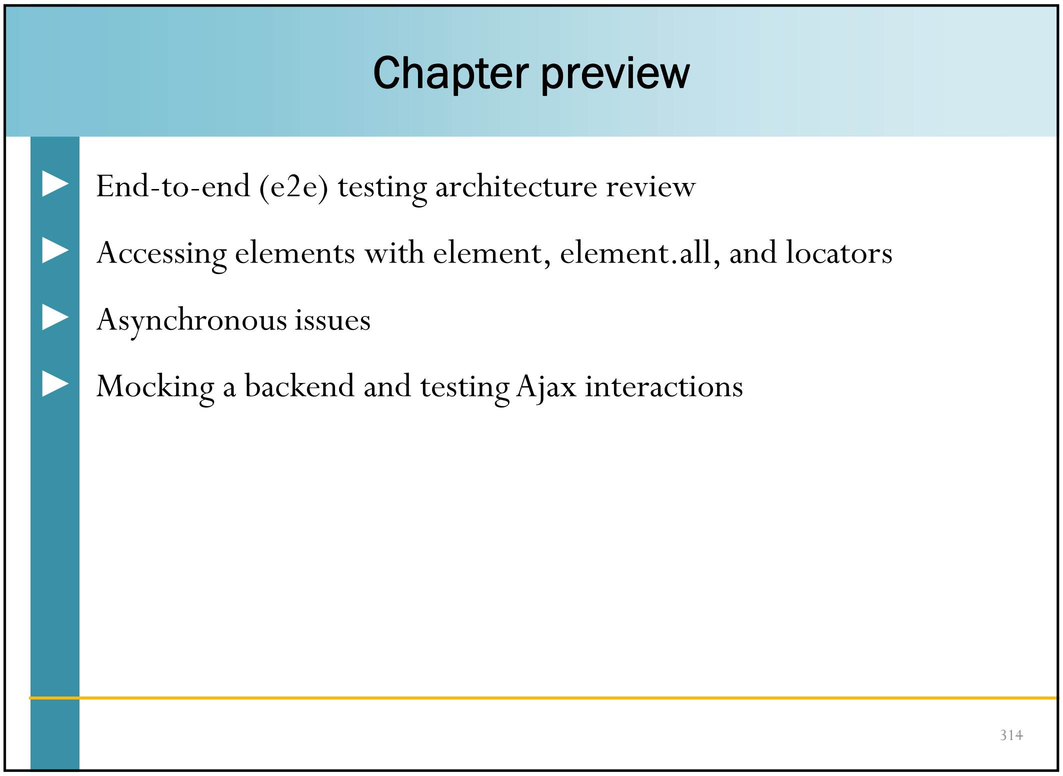

Chapter preview

- End-to-end (e2e) testing architecture review
- Accessing elements with element, element.all, and locators
- Asynchronous issues
- Mocking a backend and testing Ajax interactions

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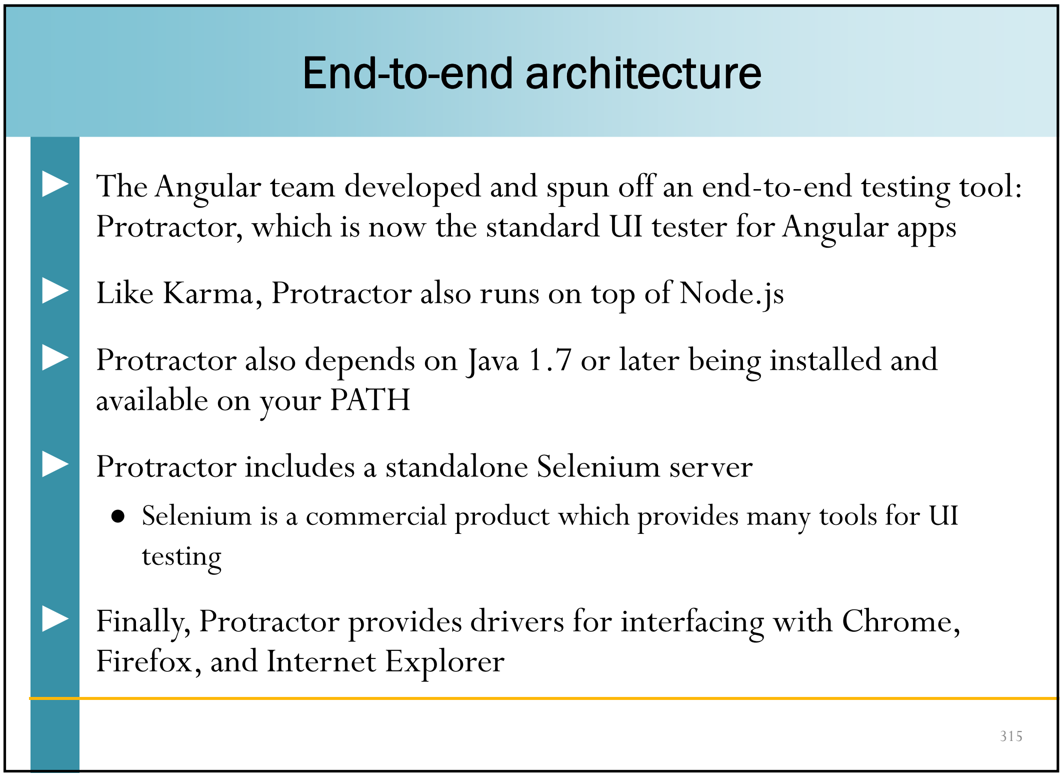
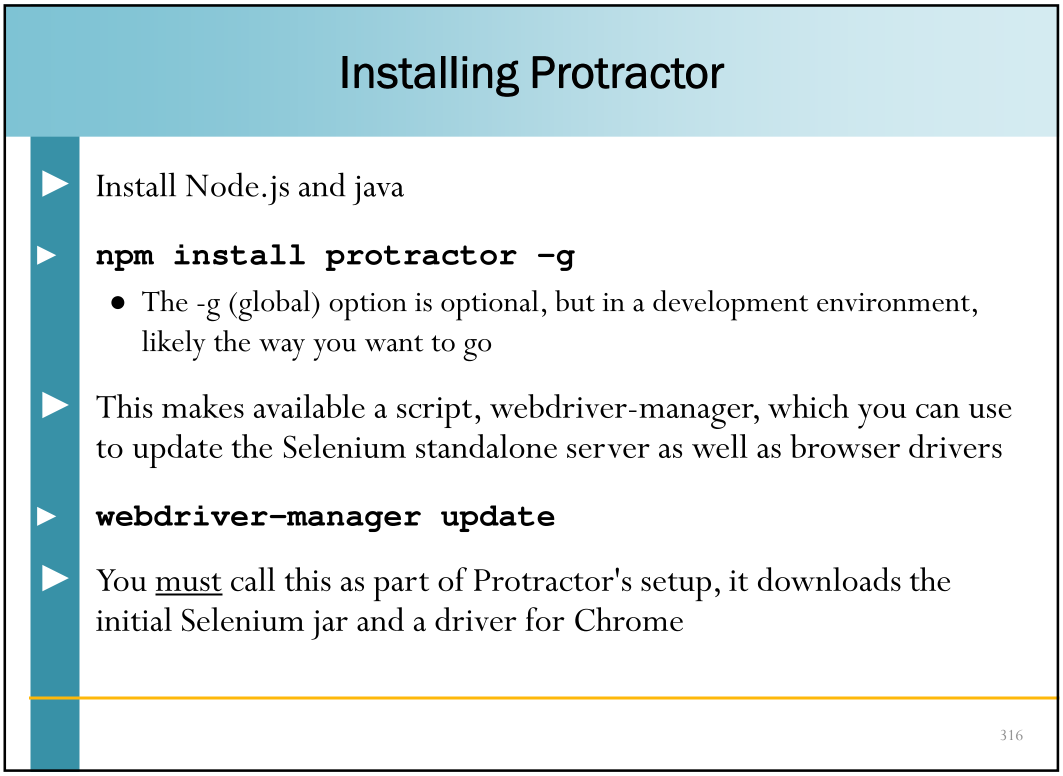


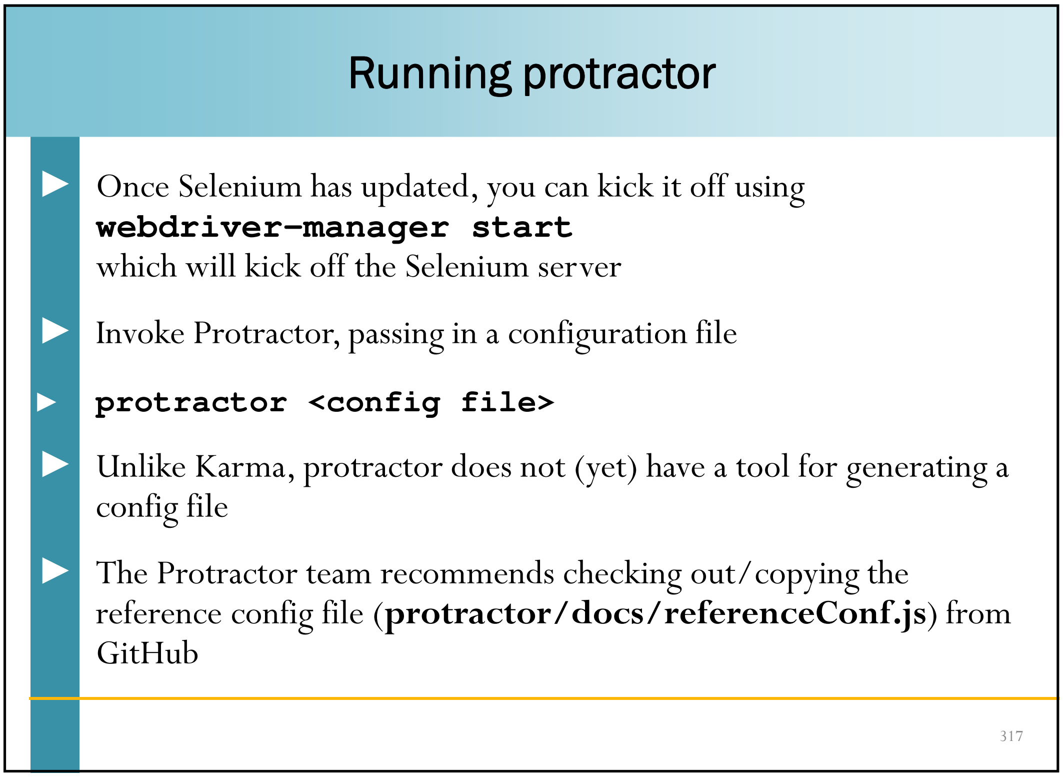
End-to-end architecture

- The Angular team developed and spun off an end-to-end testing tool: Protractor, which is now the standard UI tester for Angular apps
- Like Karma, Protractor also runs on top of Node.js
- Protractor also depends on Java 1.7 or later being installed and available on your PATH
- Protractor includes a standalone Selenium server
  - Selenium is a commercial product which provides many tools for UI testing
- Finally, Protractor provides drivers for interfacing with Chrome, Firefox, and Internet Explorer



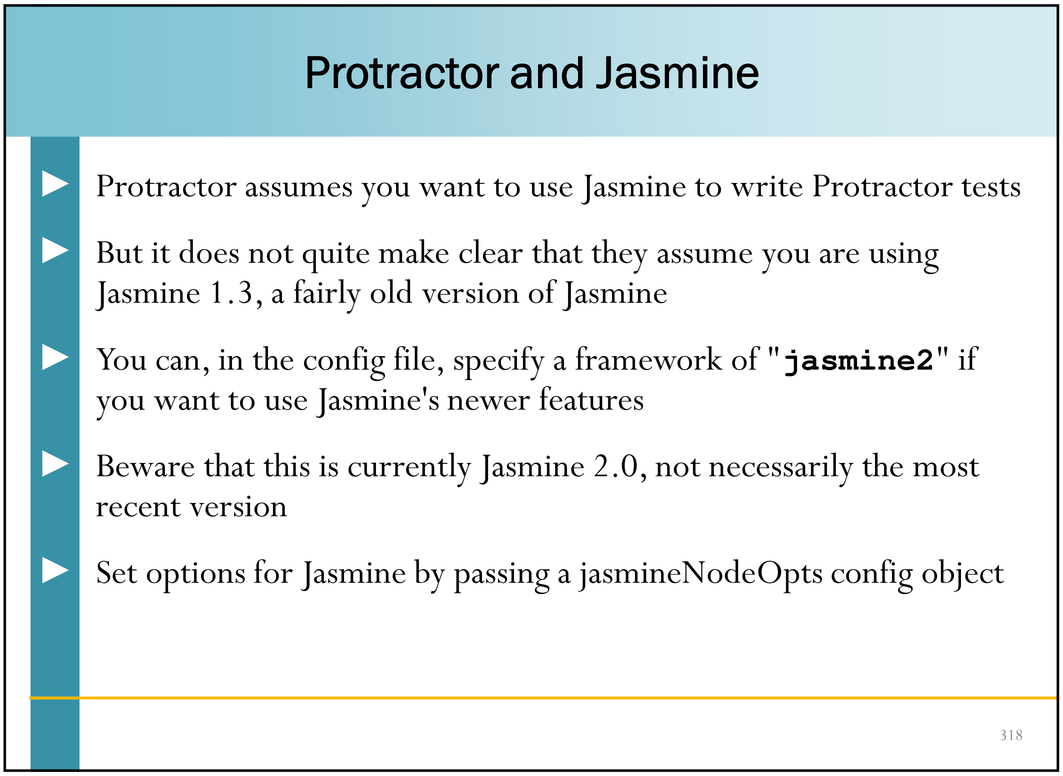
Installing Protractor

- Install Node.js and java
- **`npm install protractor -g`**
  - The -g (global) option is optional, but in a development environment, likely the way you want to go
- This makes available a script, webdriver-manager, which you can use to update the Selenium standalone server as well as browser drivers
- **`webdriver-manager update`**
- You must call this as part of Protractor's setup, it downloads the initial Selenium jar and a driver for Chrome



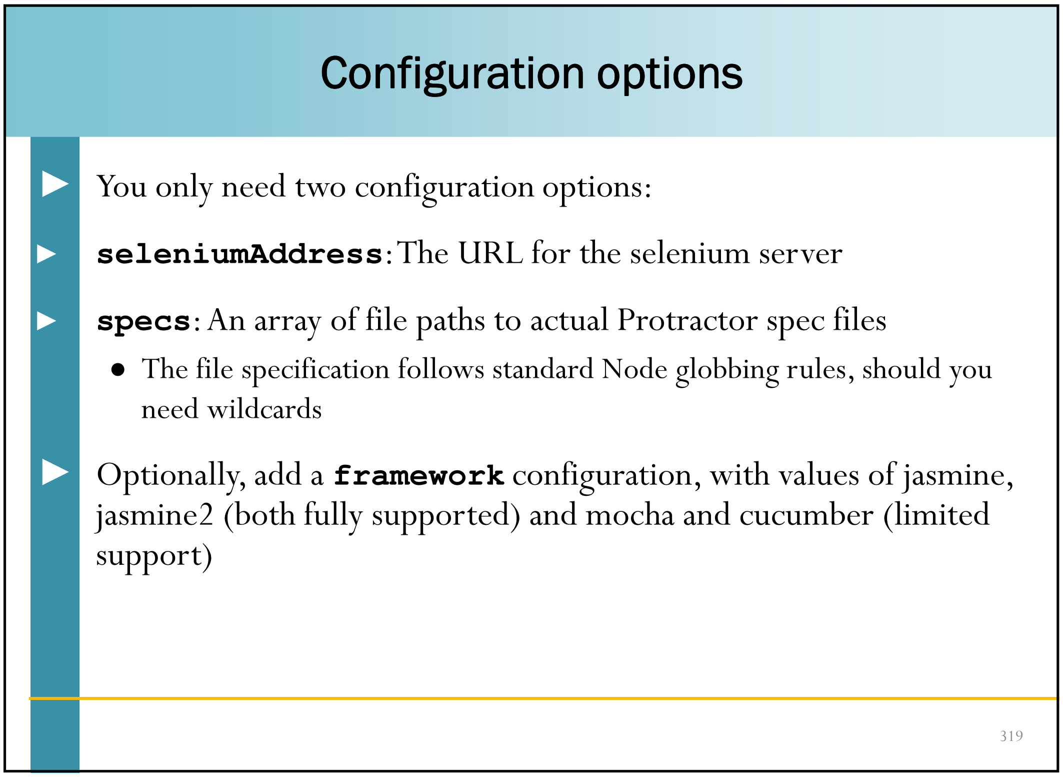
Running protractor

- Once Selenium has updated, you can kick it off using
  `webdriver-manager start`
  which will kick off the Selenium server
- Invoke Protractor, passing in a configuration file
- **`protractor <config file>`**
- Unlike Karma, protractor does not (yet) have a tool for generating a config file
- The Protractor team recommends checking out/copying the reference config file (**protractor/docs/referenceConf.js**) from GitHub



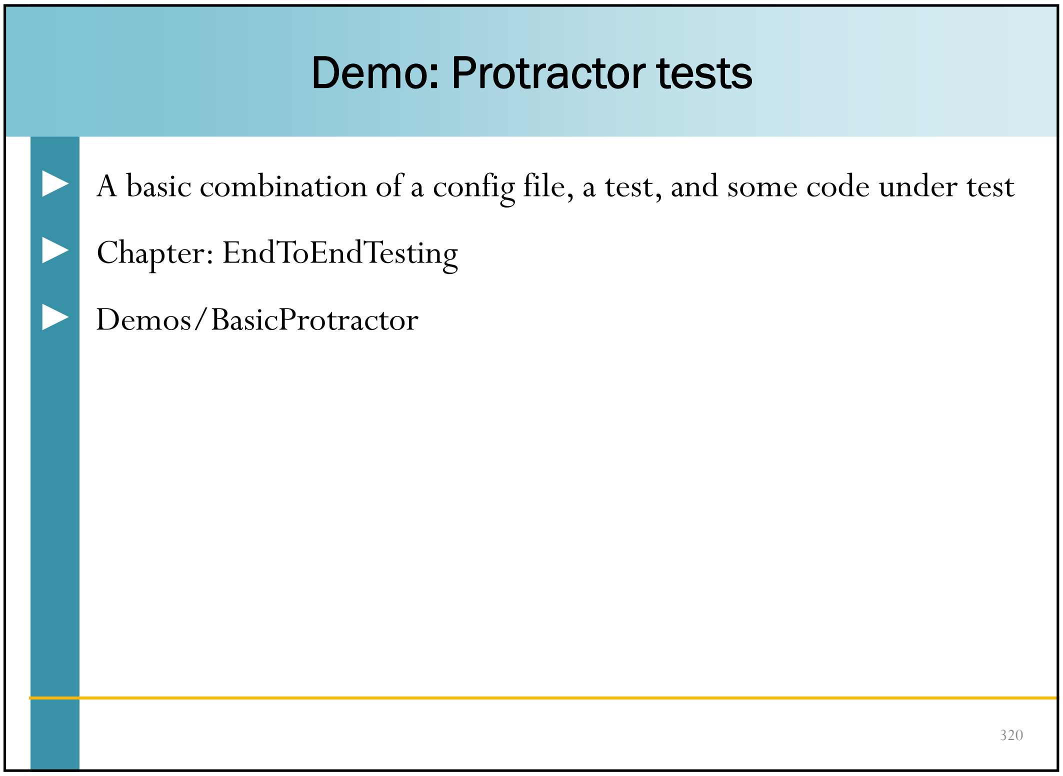
Protractor and Jasmine

- Protractor assumes you want to use Jasmine to write Protractor tests
- But it does not quite make clear that they assume you are using Jasmine 1.3, a fairly old version of Jasmine
- You can, in the config file, specify a framework of "**`jasmine2`**" if you want to use Jasmine's newer features
- Beware that this is currently Jasmine 2.0, not necessarily the most recent version
- Set options for Jasmine by passing a jasmineNodeOpts config object



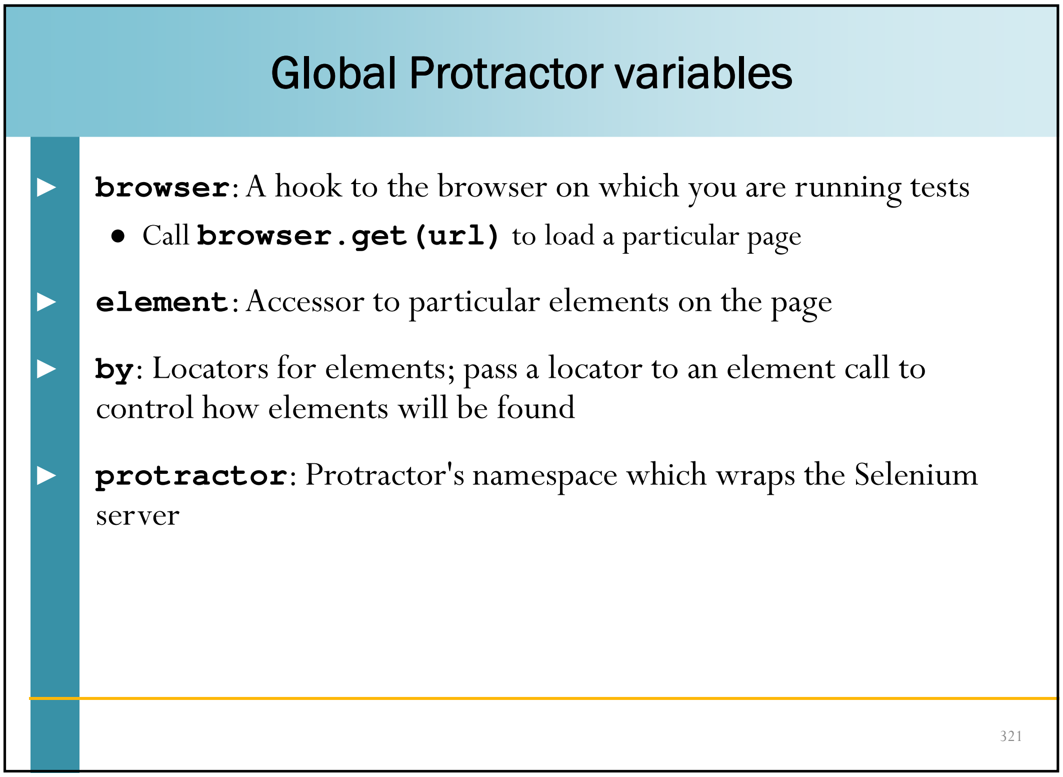
Configuration options

- You only need two configuration options:
- `seleniumAddress`: The URL for the selenium server
- `specs`: An array of file paths to actual Protractor spec files
  - The file specification follows standard Node globbing rules, should you need wildcards
- Optionally, add a `framework` configuration, with values of jasmine, jasmine2 (both fully supported) and mocha and cucumber (limited support)



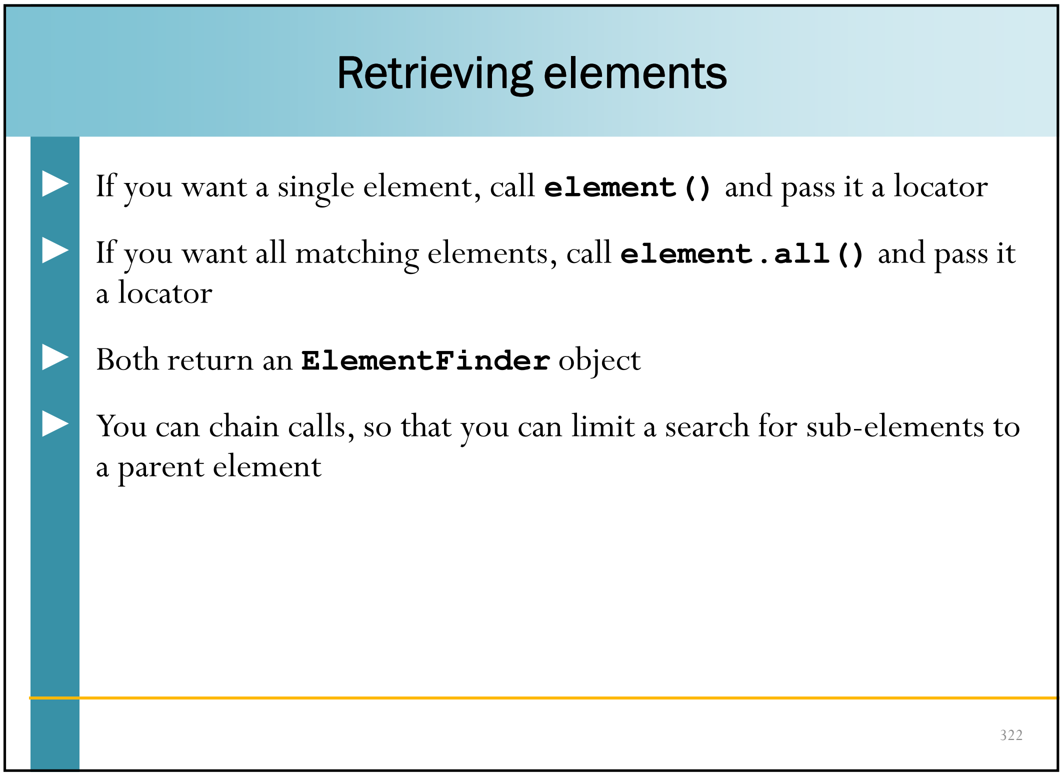
Demo: Protractor tests

- A basic combination of a config file, a test, and some code under test
- Chapter: EndToEndTesting
- Demos/BasicProtractor



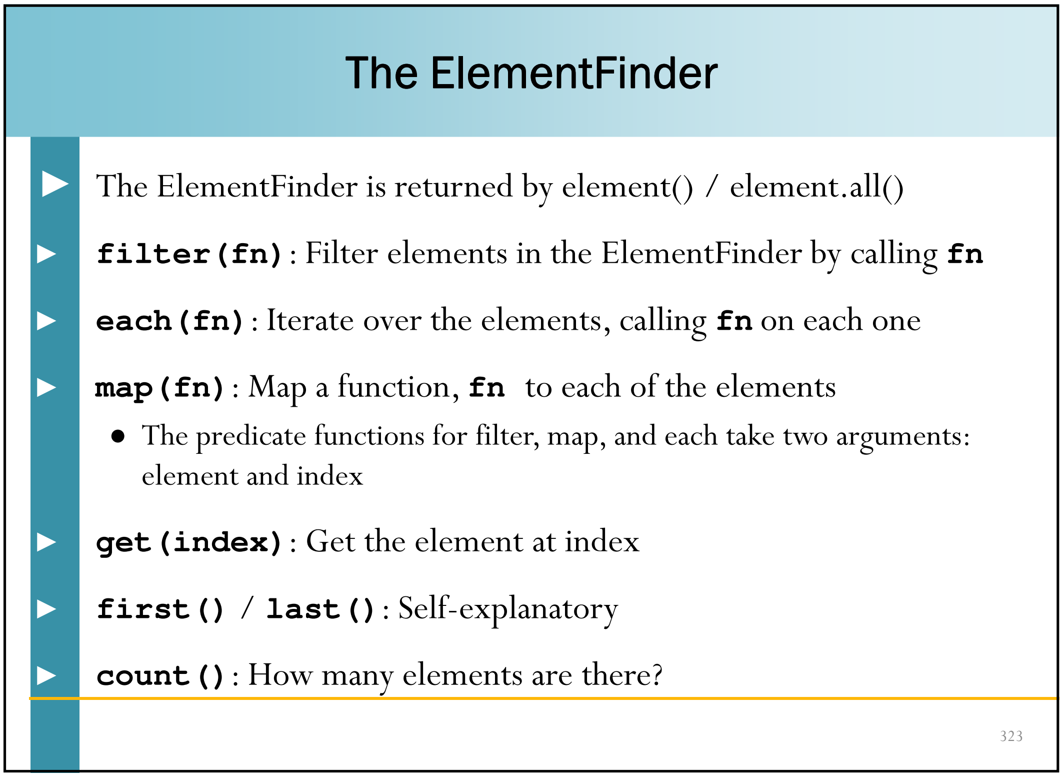
Global Protractor variables

- **`browser`**: A hook to the browser on which you are running tests
  - Call **`browser.get(url)`** to load a particular page
- **`element`**: Accessor to particular elements on the page
- **`by`**: Locators for elements; pass a locator to an element call to control how elements will be found
- **`protractor`**: Protractor's namespace which wraps the Selenium server



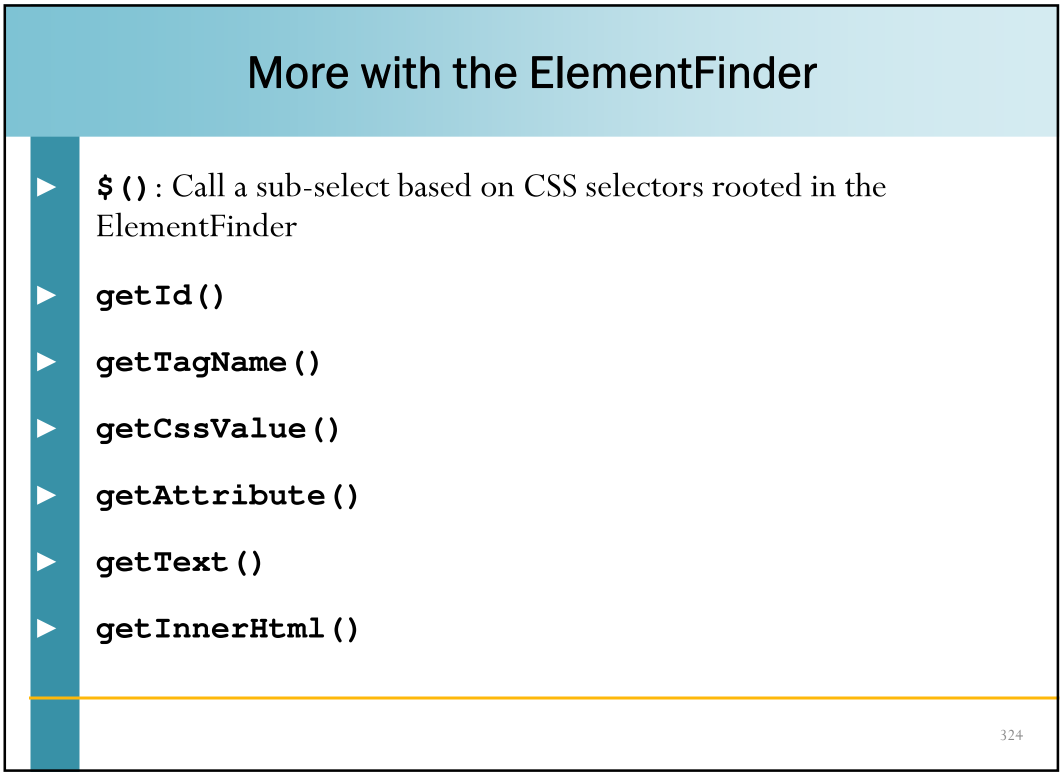
Retrieving elements

- If you want a single element, call **`element()`** and pass it a locator
- If you want all matching elements, call **`element.all()`** and pass it a locator
- Both return an **`ElementFinder`** object
- You can chain calls, so that you can limit a search for sub-elements to a parent element



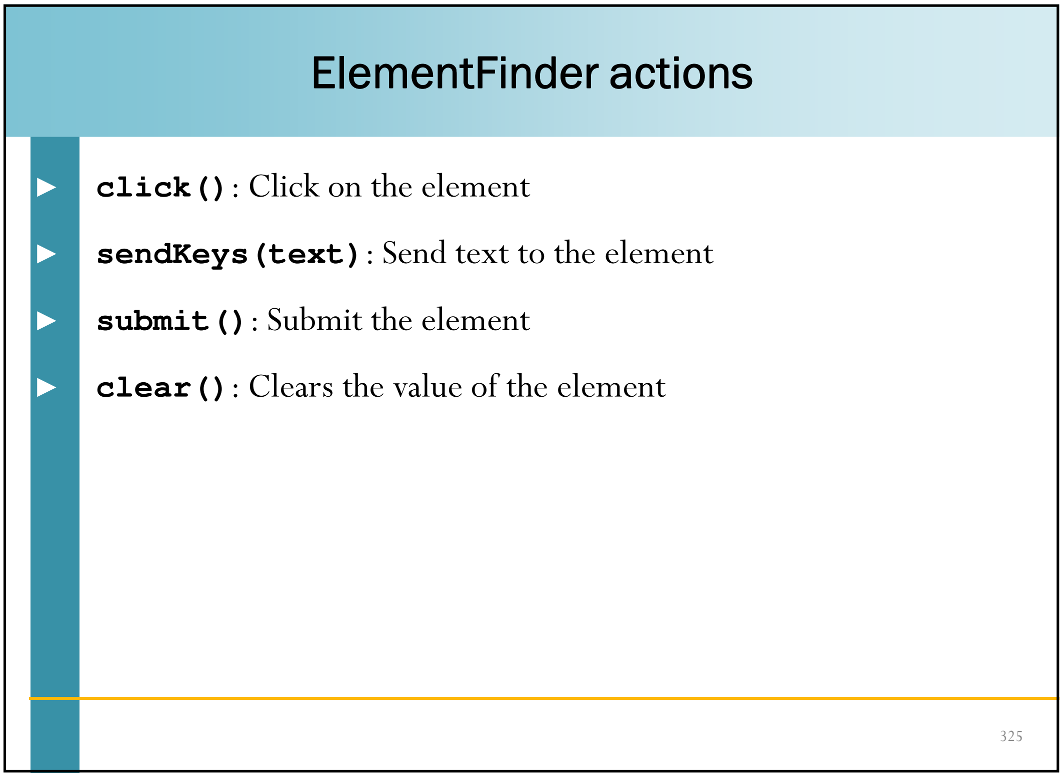
The ElementFinder

- The ElementFinder is returned by element() / element.all()
- **`filter(fn)`** : Filter elements in the ElementFinder by calling **`fn`**
- **`each(fn)`** : Iterate over the elements, calling **`fn`** on each one
- **`map(fn)`** : Map a function, **`fn`** to each of the elements
  - The predicate functions for filter, map, and each take two arguments: element and index
- **`get(index)`** : Get the element at index
- **`first()`** / **`last()`** : Self-explanatory
- **`count()`** : How many elements are there?



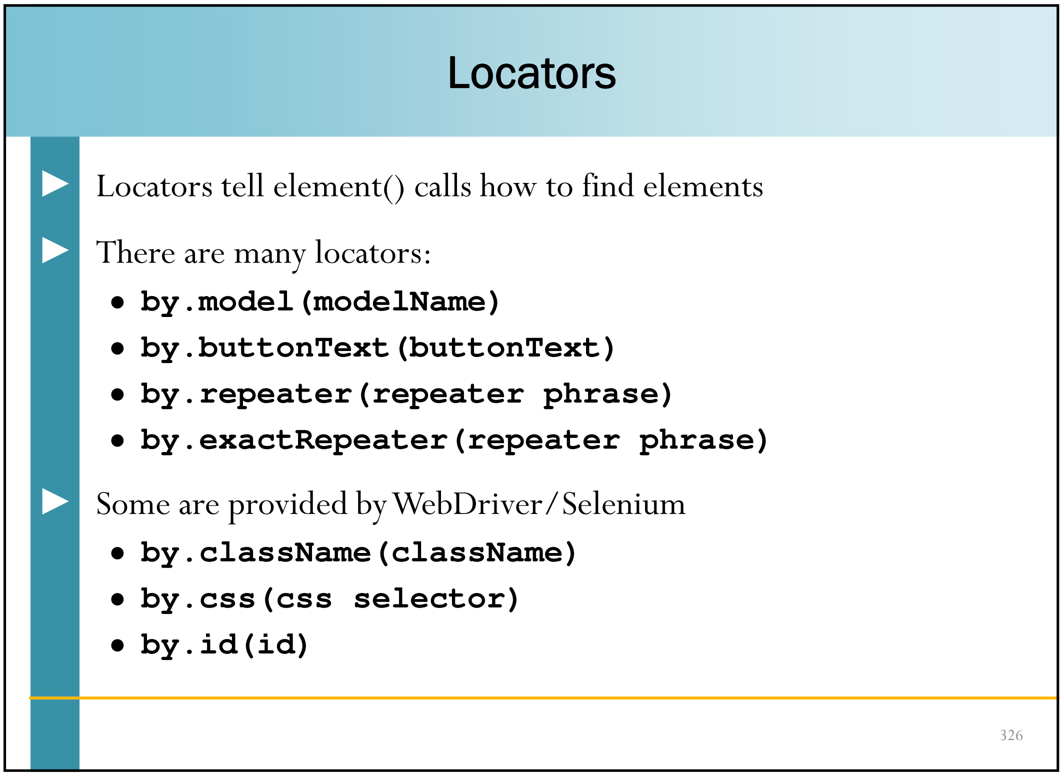
More with the ElementFinder

- **`$()`** : Call a sub-select based on CSS selectors rooted in the ElementFinder
- **`getId()`**
- **`getTagName()`**
- **`getCssValue()`**
- **`getAttribute()`**
- **`getText()`**
- **`getInnerHtml()`**



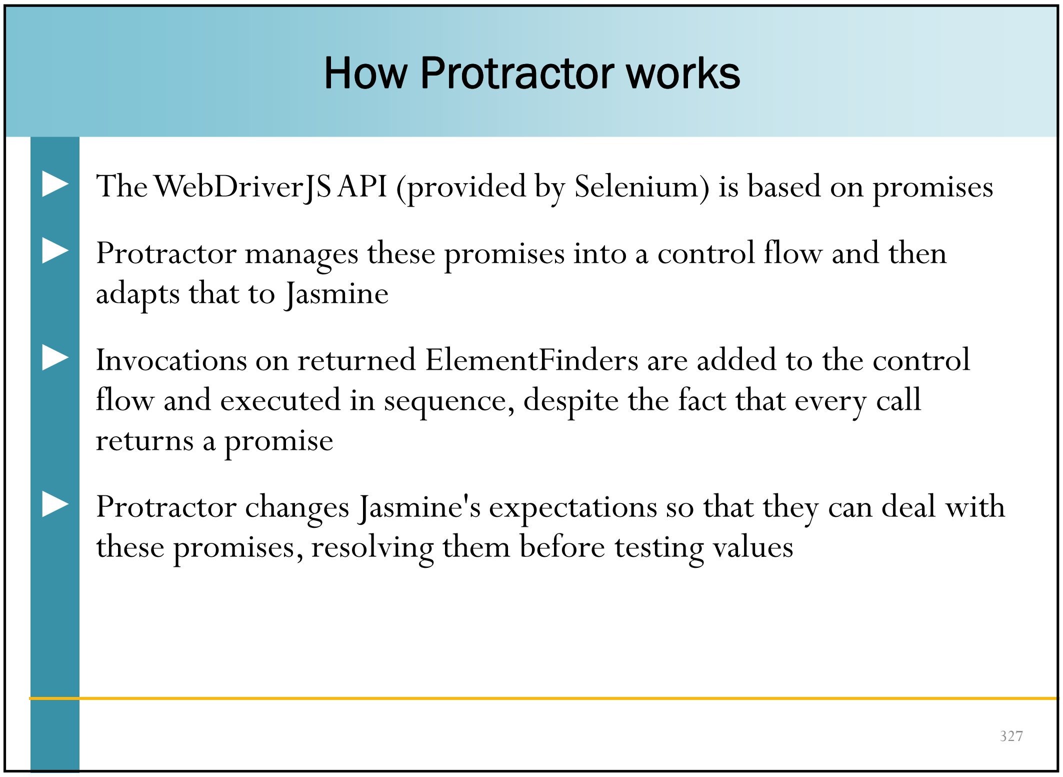
ElementFinder actions

- **`click()`** : Click on the element
- **`sendKeys(text)`** : Send text to the element
- **`submit()`** : Submit the element
- **`clear()`** : Clears the value of the element



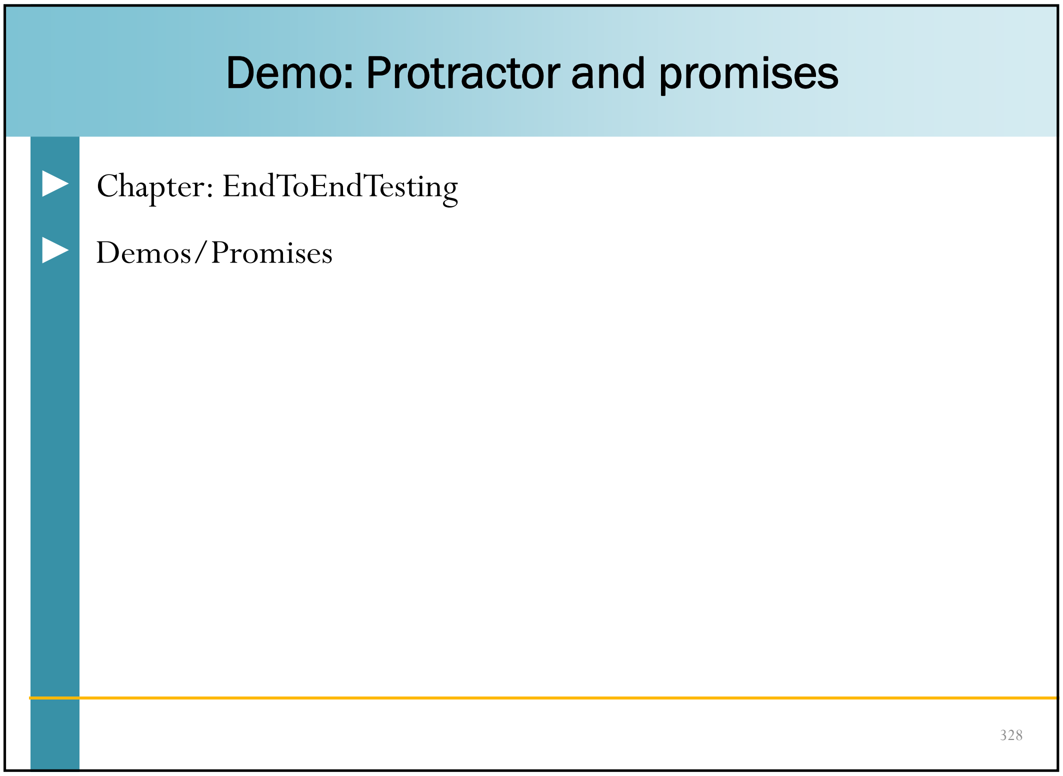
Locators

- Locators tell element() calls how to find elements
- There are many locators:
  - **`by.model(modelName)`**
  - **`by.buttonText(buttonText)`**
  - **`by.repeater(repeater phrase)`**
  - **`by.exactRepeater(repeater phrase)`**
- Some are provided by WebDriver/Selenium
  - **`by.className(className)`**
  - **`by.css(css selector)`**
  - **`by.id(id)`**



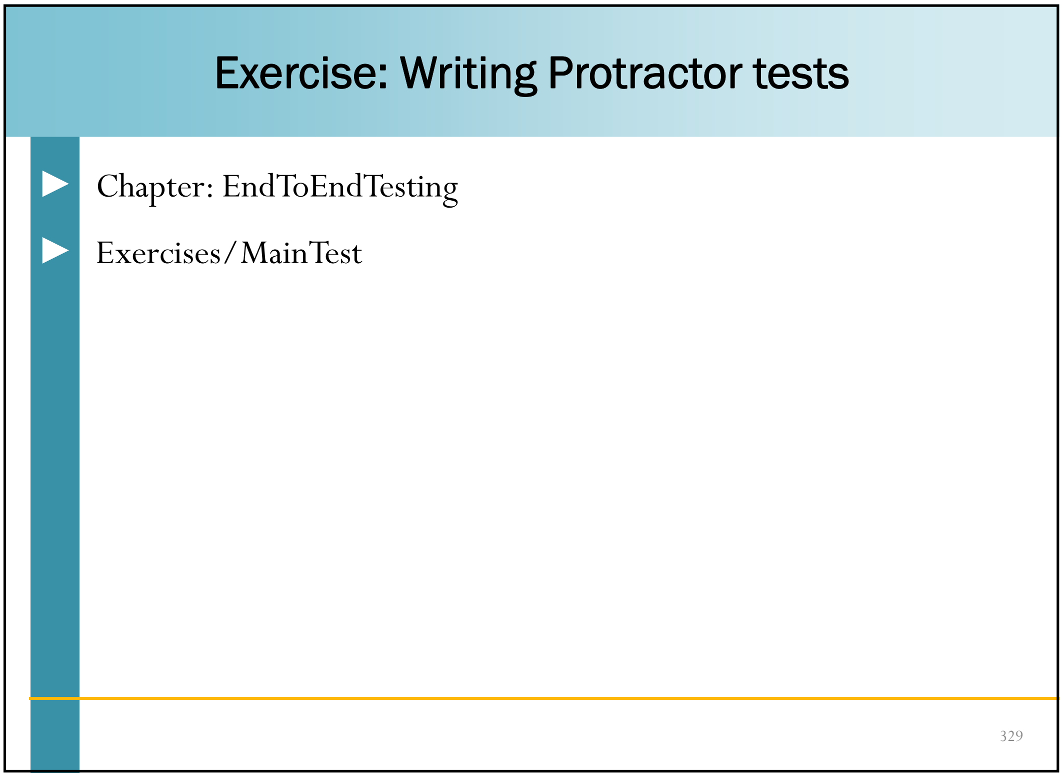
How Protractor works

- The WebDriverJS API (provided by Selenium) is based on promises
- Protractor manages these promises into a control flow and then adapts that to Jasmine
- Invocations on returned ElementFinders are added to the control flow and executed in sequence, despite the fact that every call returns a promise
- Protractor changes Jasmine's expectations so that they can deal with these promises, resolving them before testing values



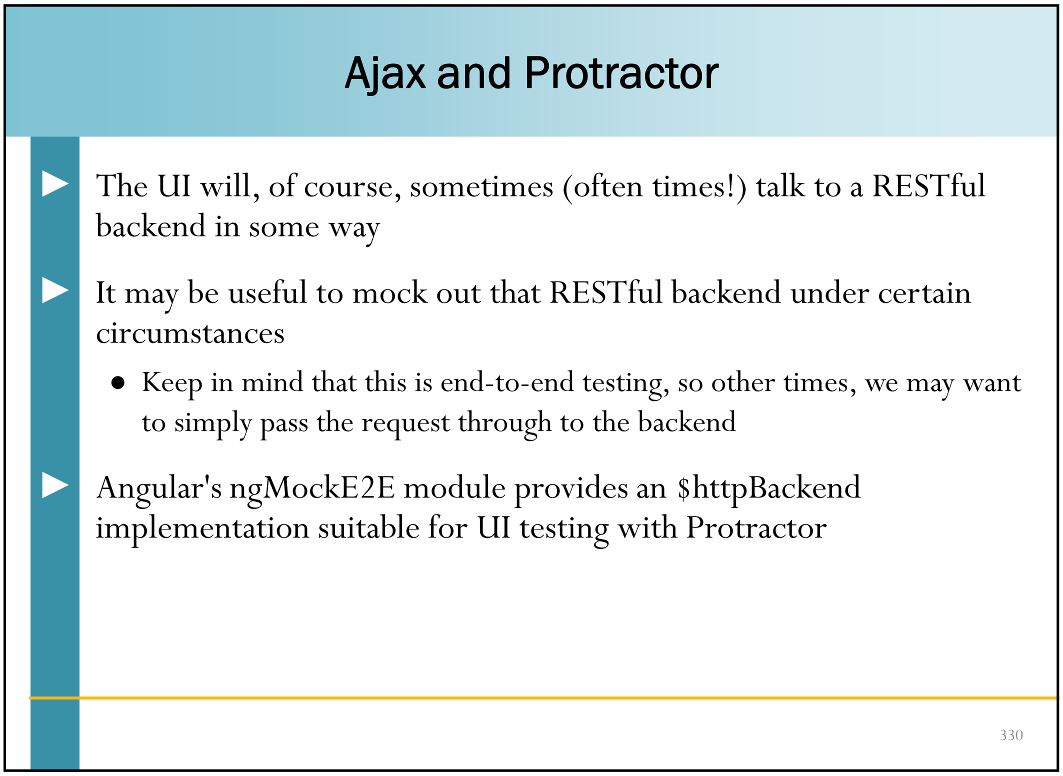
Demo: Protractor and promises

- Chapter: EndToEndTesting
- Demos/Promises



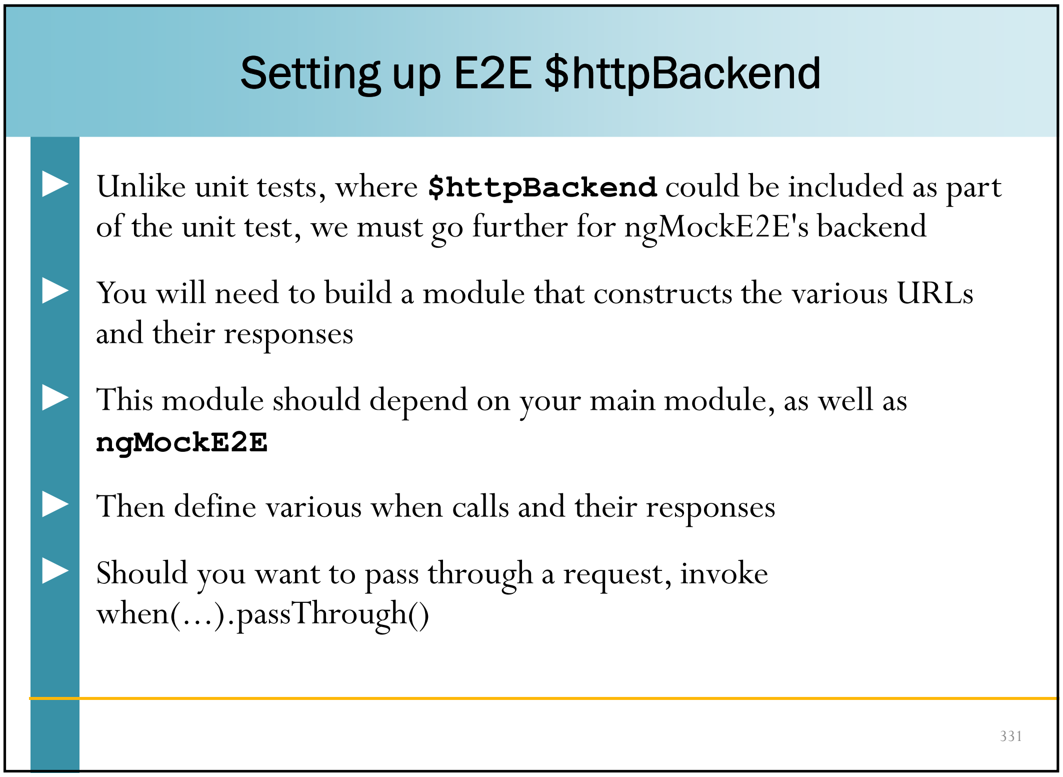
Exercise: Writing Protractor tests

- Chapter: EndToEndTesting
- Exercises/MainTest



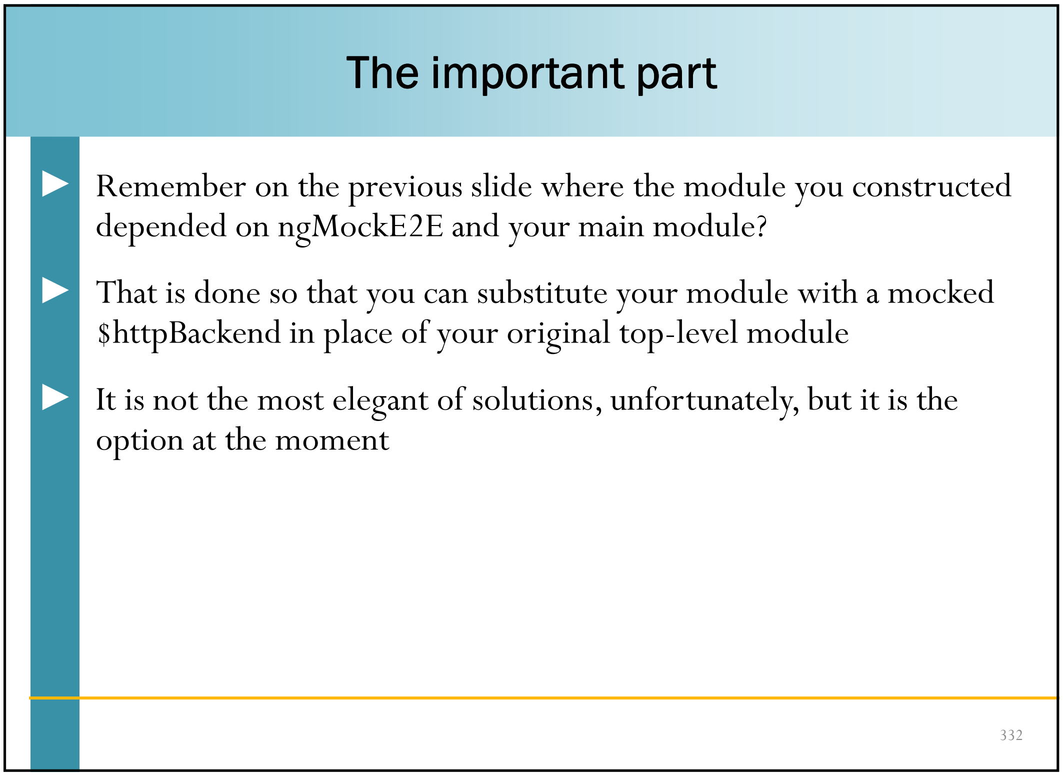
Ajax and Protractor

- The UI will, of course, sometimes (often times!) talk to a RESTful backend in some way
- It may be useful to mock out that RESTful backend under certain circumstances
  - Keep in mind that this is end-to-end testing, so other times, we may want to simply pass the request through to the backend
- Angular's ngMockE2E module provides an $httpBackend implementation suitable for UI testing with Protractor



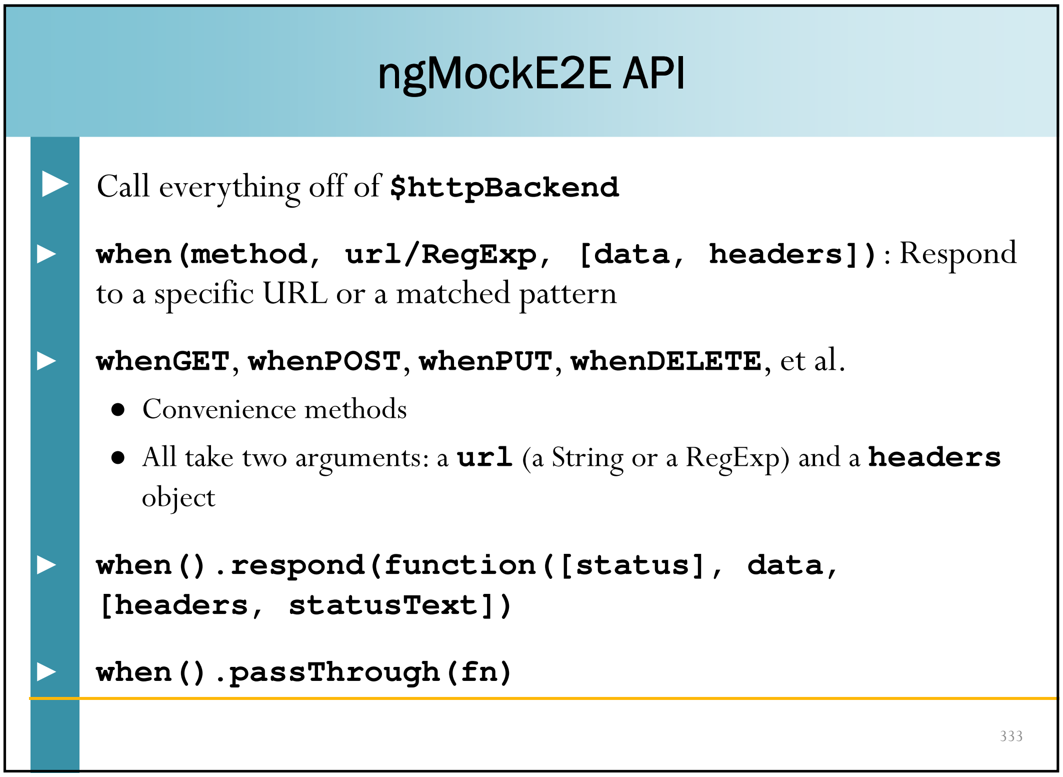
Setting up E2E $httpBackend

- Unlike unit tests, where **`$httpBackend`** could be included as part of the unit test, we must go further for ngMockE2E's backend
- You will need to build a module that constructs the various URLs and their responses
- This module should depend on your main module, as well as **`ngMockE2E`**
- Then define various when calls and their responses
- Should you want to pass through a request, invoke when(…).passThrough()



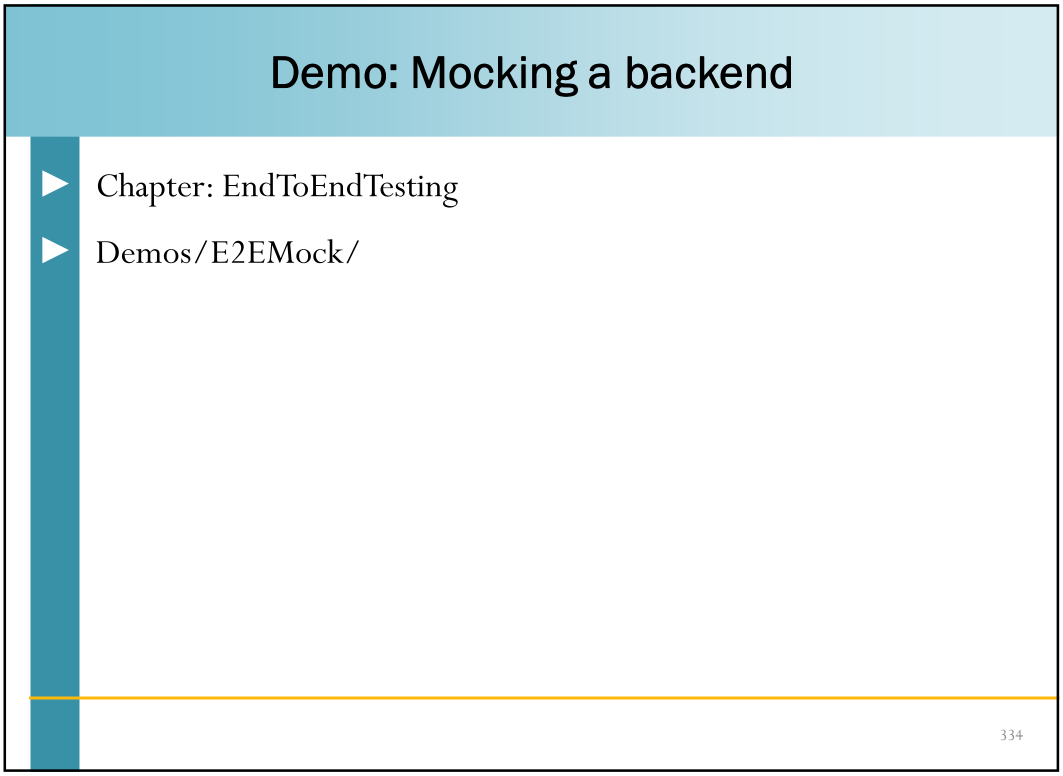
The important part

- Remember on the previous slide where the module you constructed depended on ngMockE2E and your main module?
- That is done so that you can substitute your module with a mocked $httpBackend in place of your original top-level module
- It is not the most elegant of solutions, unfortunately, but it is the option at the moment



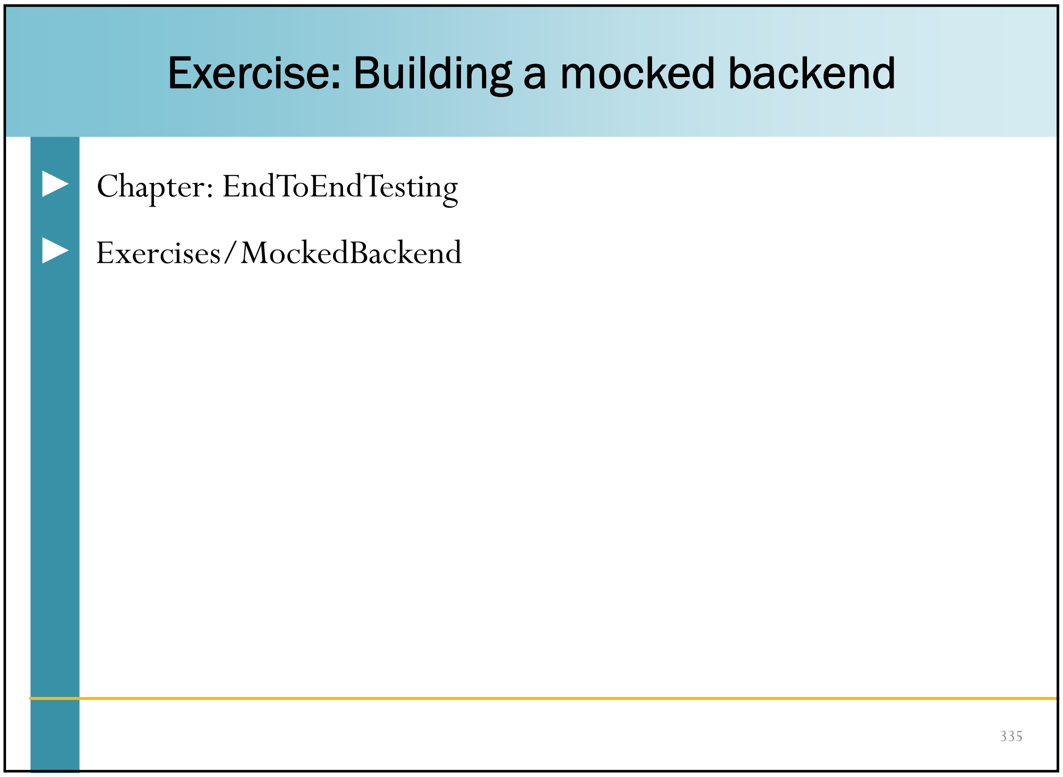
ngMockE2E API

- Call everything off of **`$httpBackend`**
- **`when(method, url/RegExp, [data, headers])`**: Respond to a specific URL or a matched pattern
- **`whenGET`**, **`whenPOST`**, **`whenPUT`**, **`whenDELETE`**, et al.
  - Convenience methods
  - All take two arguments: a **`url`** (a String or a RegExp) and a **`headers`** object
- **`when().respond(function([status], data, [headers, statusText])`**
- **`when().passThrough(fn)`**



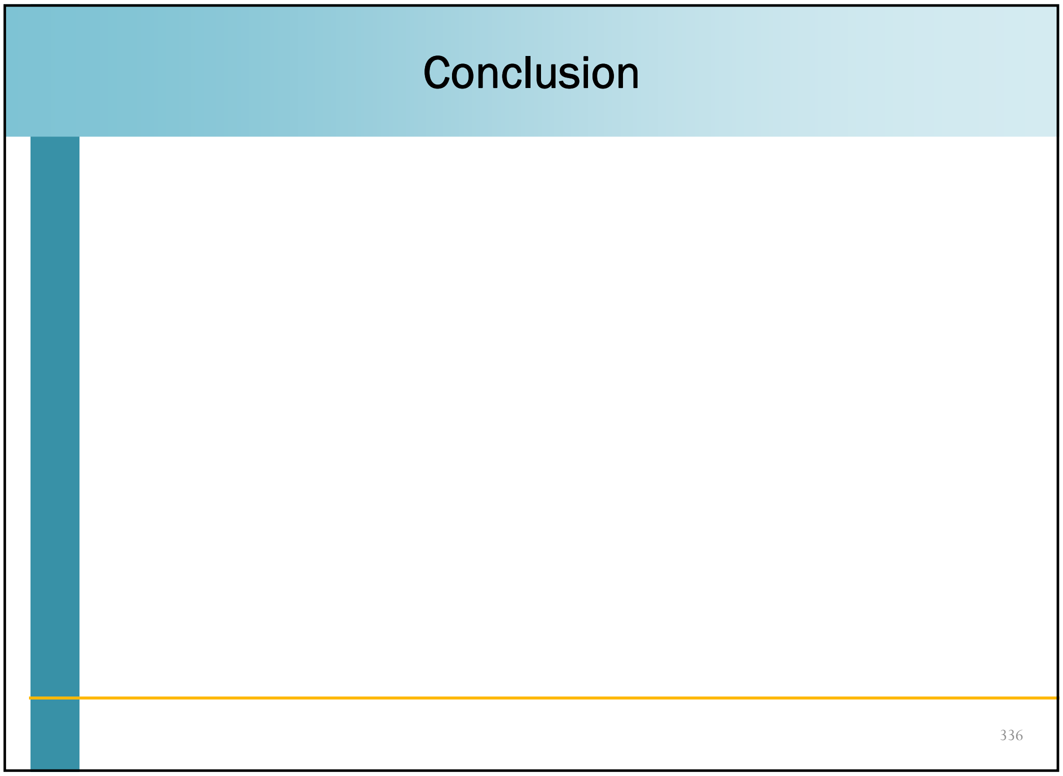
Demo: Mocking a backend

- Chapter: EndToEndTesting
- Demos/E2EMock/

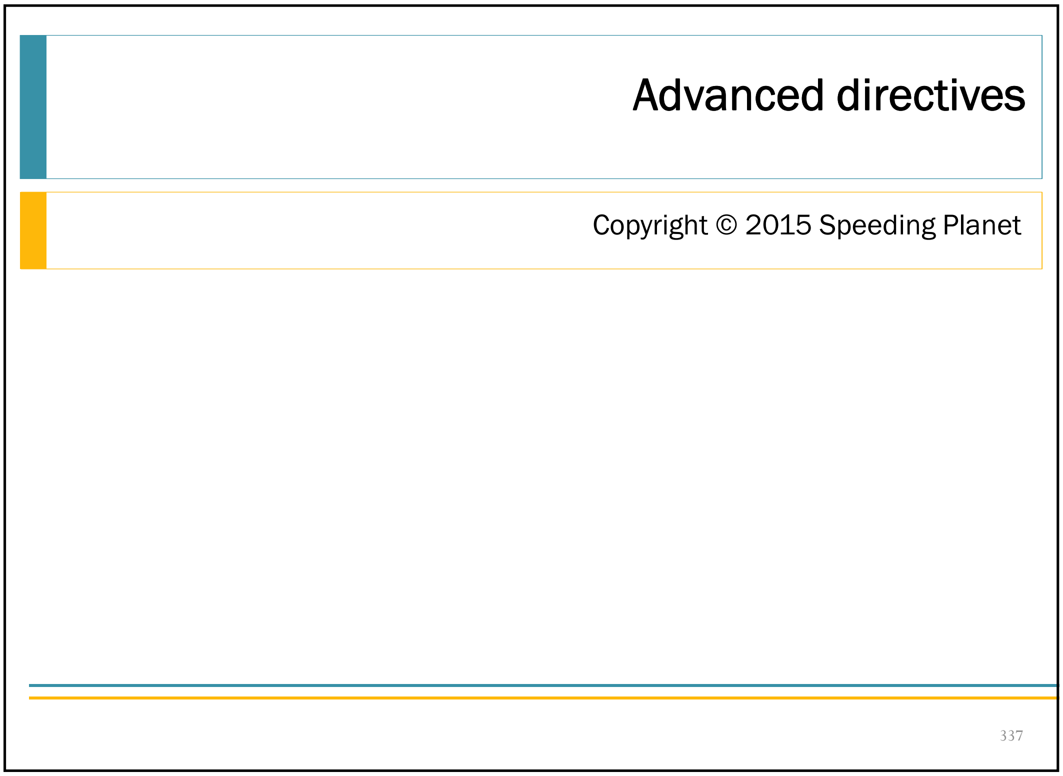


Exercise: Building a mocked backend

- Chapter: EndToEndTesting
- Exercises/MockedBackend



Conclusion



Advanced directives

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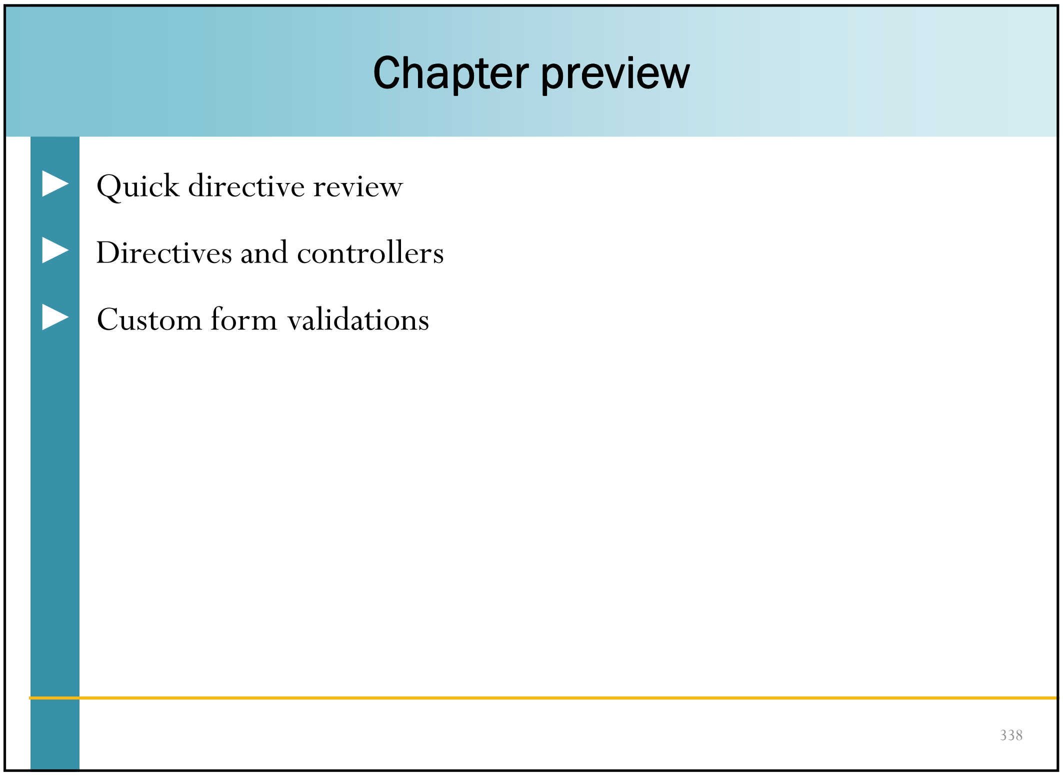
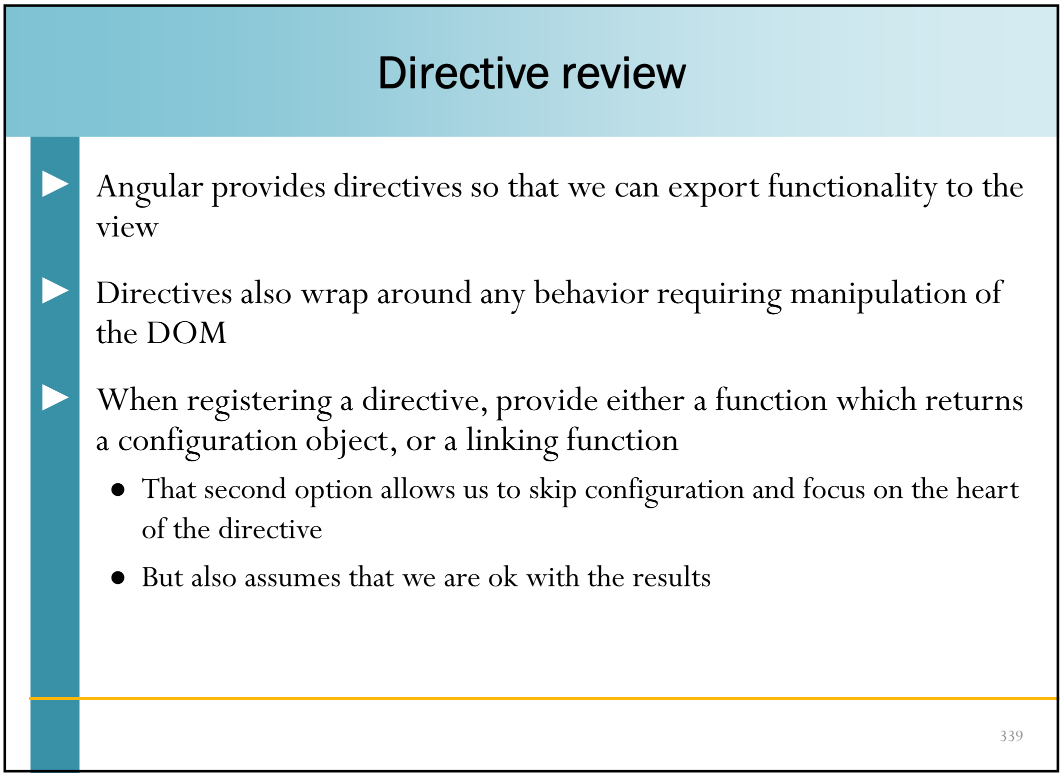


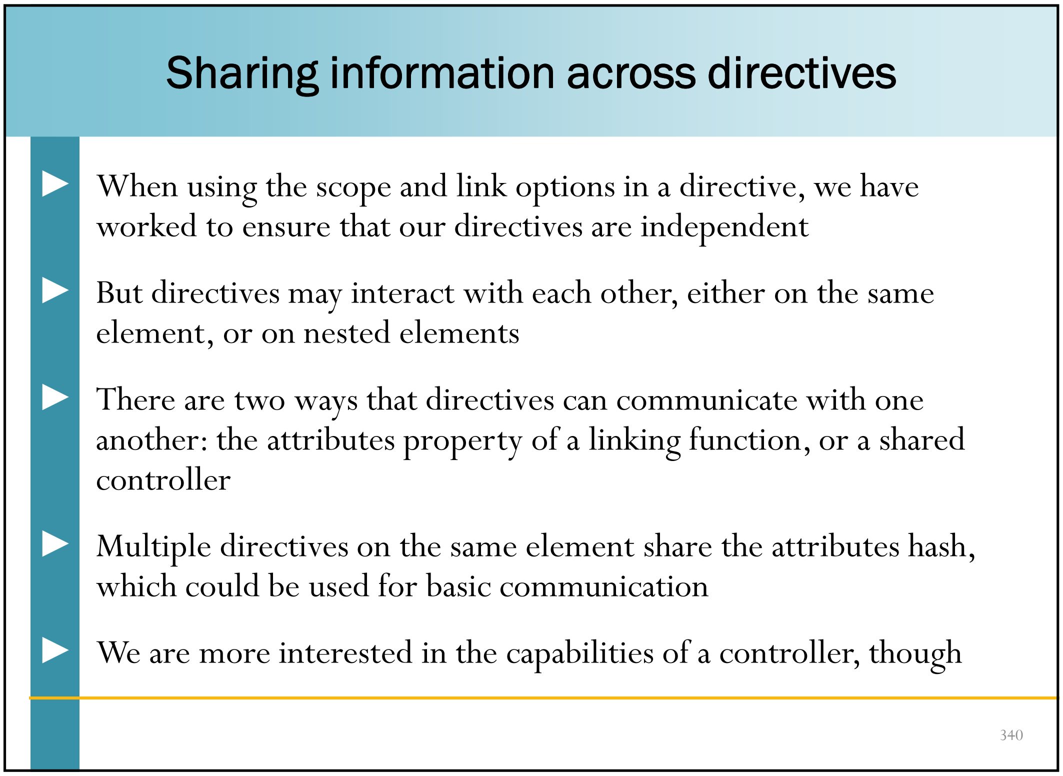
Chapter preview

- Quick directive review
- Directives and controllers
- Custom form validations



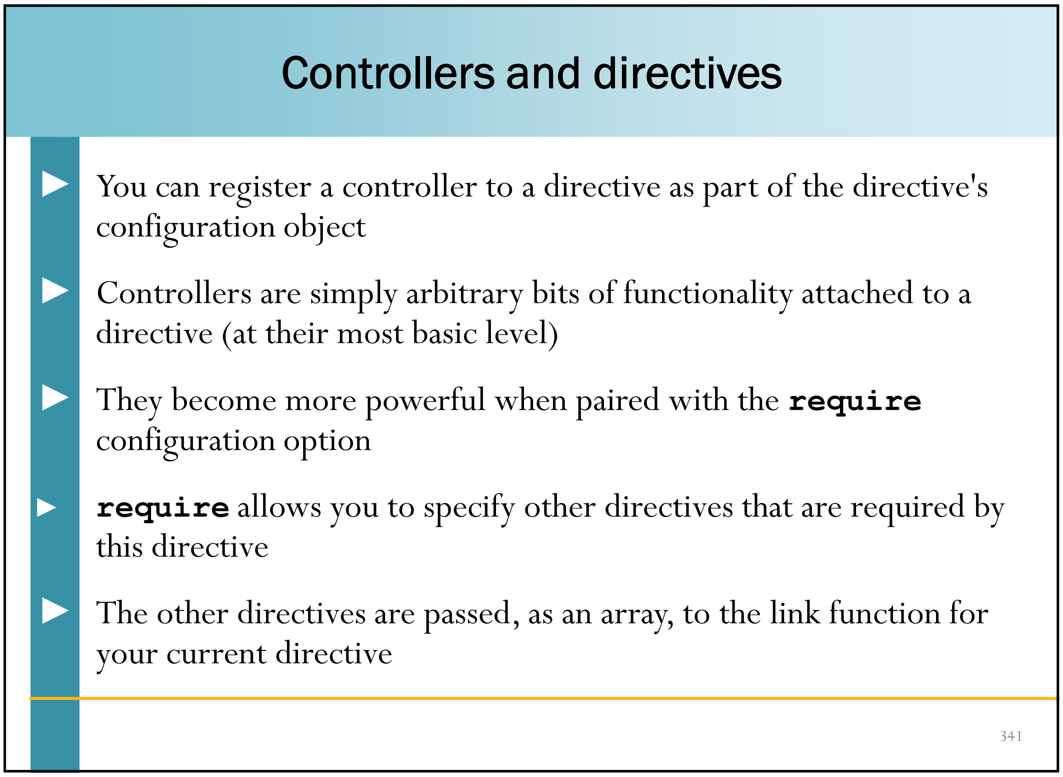
Directive review

- Angular provides directives so that we can export functionality to the view
- Directives also wrap around any behavior requiring manipulation of the DOM
- When registering a directive, provide either a function which returns a configuration object, or a linking function
  - That second option allows us to skip configuration and focus on the heart of the directive
  - But also assumes that we are ok with the results



Sharing information across directives

- When using the scope and link options in a directive, we have worked to ensure that our directives are independent
- But directives may interact with each other, either on the same element, or on nested elements
- There are two ways that directives can communicate with one another: the attributes property of a linking function, or a shared controller
- Multiple directives on the same element share the attributes hash, which could be used for basic communication
- We are more interested in the capabilities of a controller, though



Controllers and directives

- You can register a controller to a directive as part of the directive's configuration object
- Controllers are simply arbitrary bits of functionality attached to a directive (at their most basic level)
- They become more powerful when paired with the **`require`** configuration option
- **`require`** allows you to specify other directives that are required by this directive
- The other directives are passed, as an array, to the link function for your current directive

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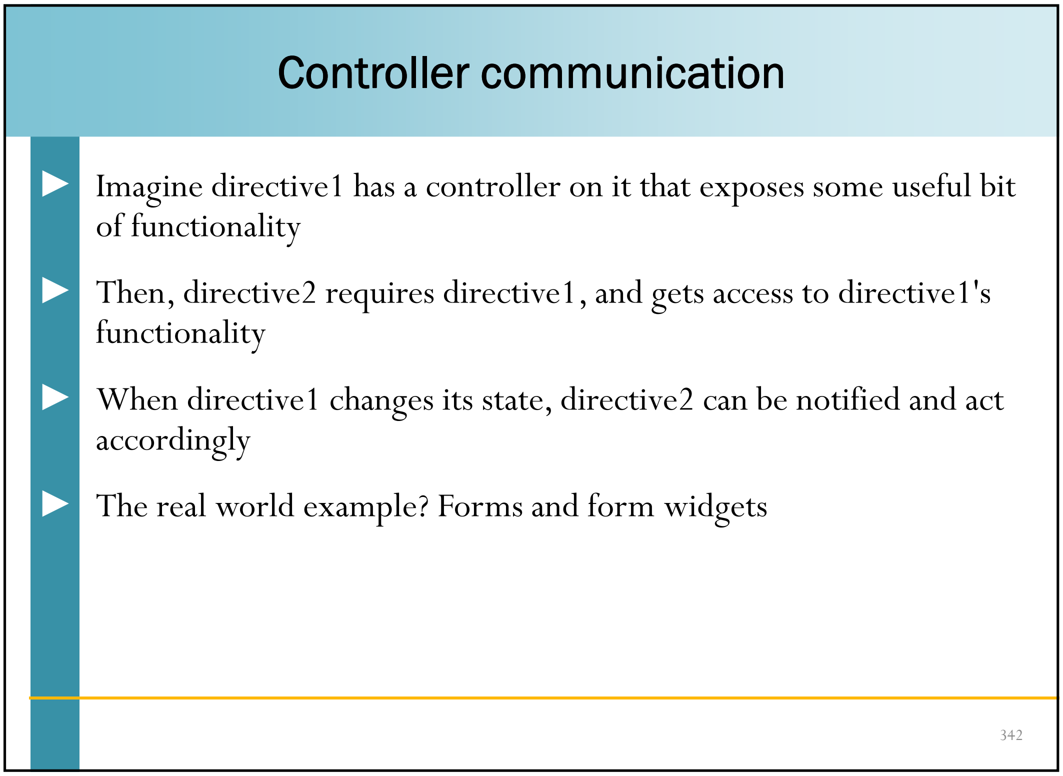

Controller communication

- Imagine directive1 has a controller on it that exposes some useful bit of functionality
- Then, directive2 requires directive1, and gets access to directive1's functionality
- When directive1 changes its state, directive2 can be notified and act accordingly
- The real world example? Forms and form widgets

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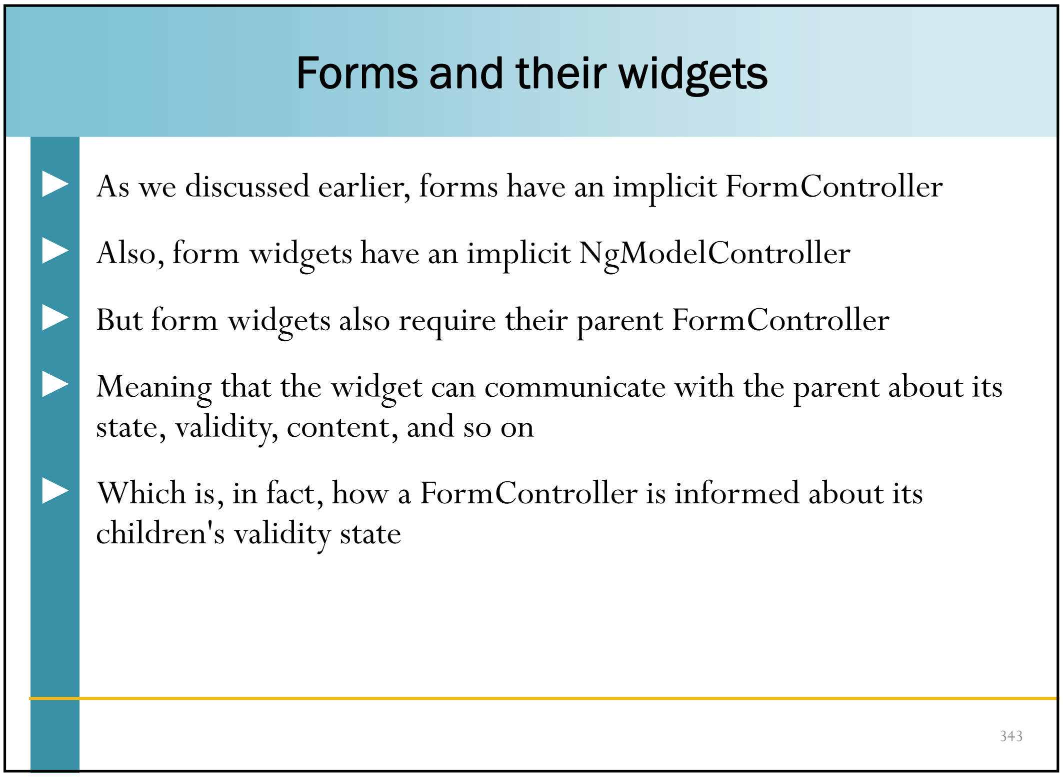

Forms and their widgets

- As we discussed earlier, forms have an implicit FormController
- Also, form widgets have an implicit NgModelController
- But form widgets also require their parent FormController
- Meaning that the widget can communicate with the parent about its state, validity, content, and so on
- Which is, in fact, how a FormController is informed about its children's validity state

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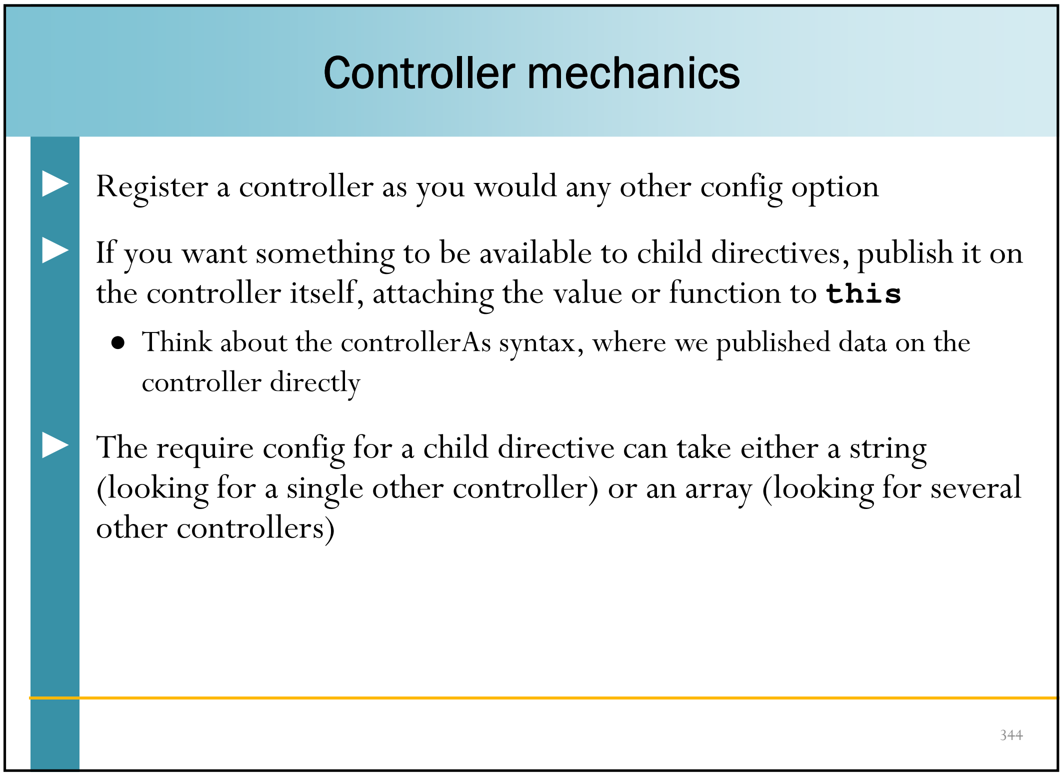

Controller mechanics

- Register a controller as you would any other config option
- If you want something to be available to child directives, publish it on the controller itself, attaching the value or function to **`this`**
  - Think about the controllerAs syntax, where we published data on the controller directly
- The require config for a child directive can take either a string (looking for a single other controller) or an array (looking for several other controllers)

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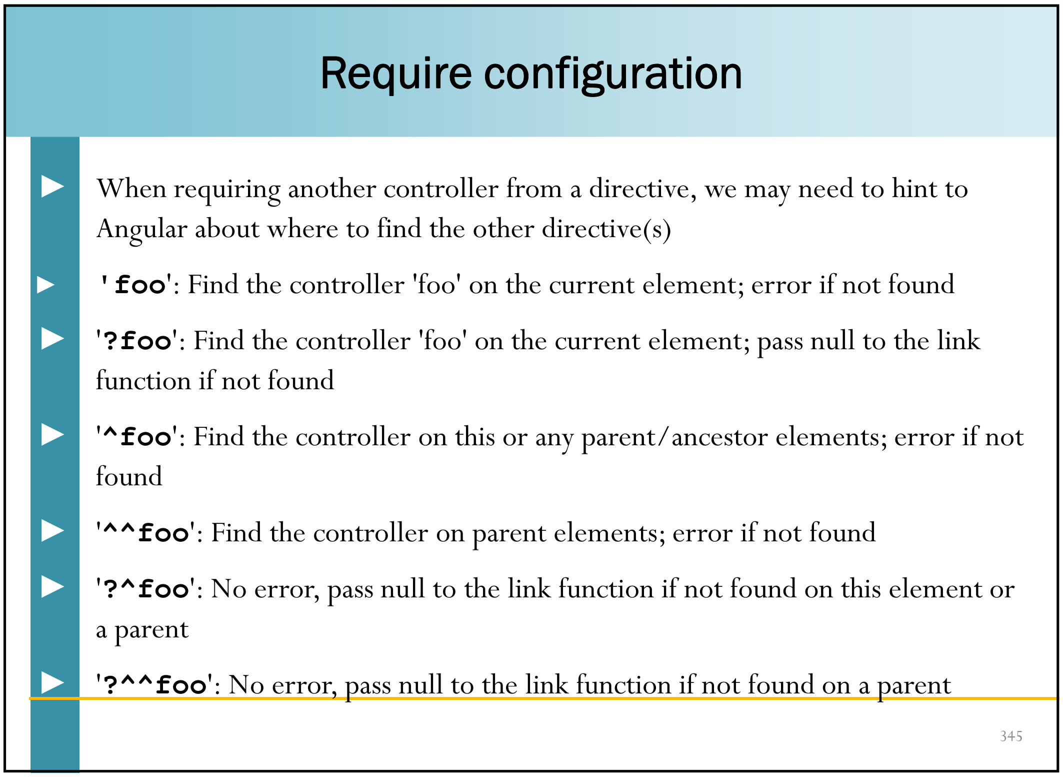
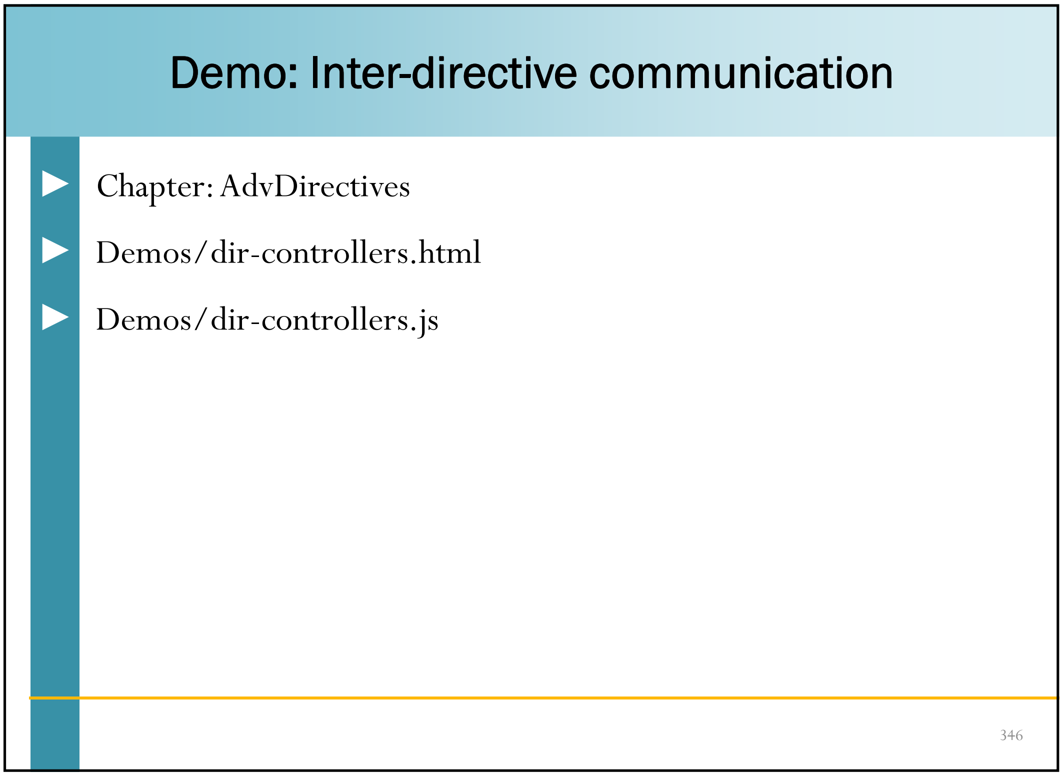


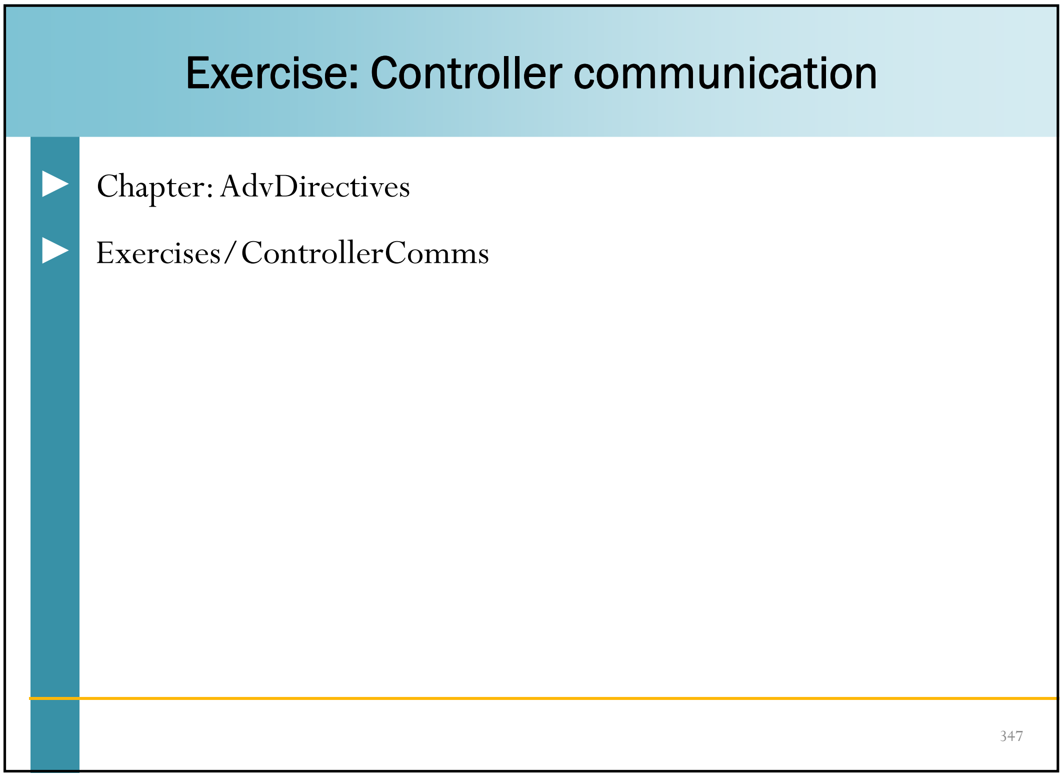
Require configuration

- When requiring another controller from a directive, we may need to hint to Angular about where to find the other directive(s)
- '**foo**': Find the controller 'foo' on the current element; error if not found
- '**?foo**': Find the controller 'foo' on the current element; pass null to the link function if not found
- '**^foo**': Find the controller on this or any parent/ancestor elements; error if not found
- '**^^foo**': Find the controller on parent elements; error if not found
- '**?^foo**': No error, pass null to the link function if not found on this element or a parent
- '**?^^foo**': No error, pass null to the link function if not found on a parent



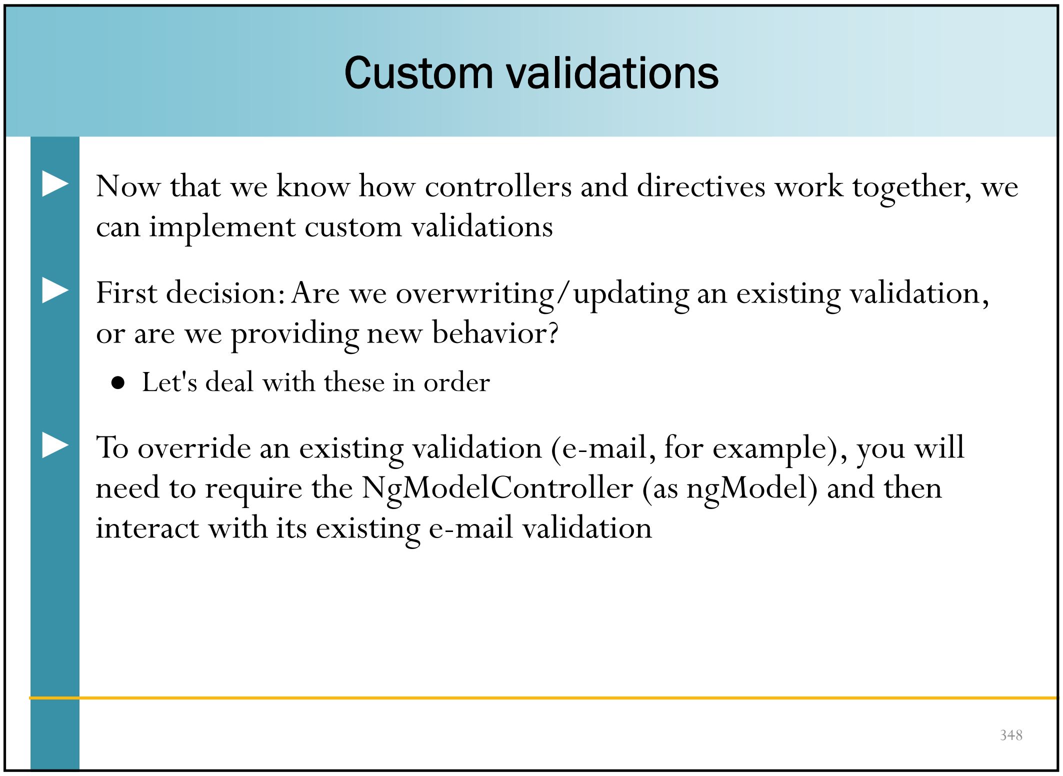
Demo: Inter-directive communication

- Chapter: AdvDirectives
- Demos/dir-controllers.html
- Demos/dir-controllers.js



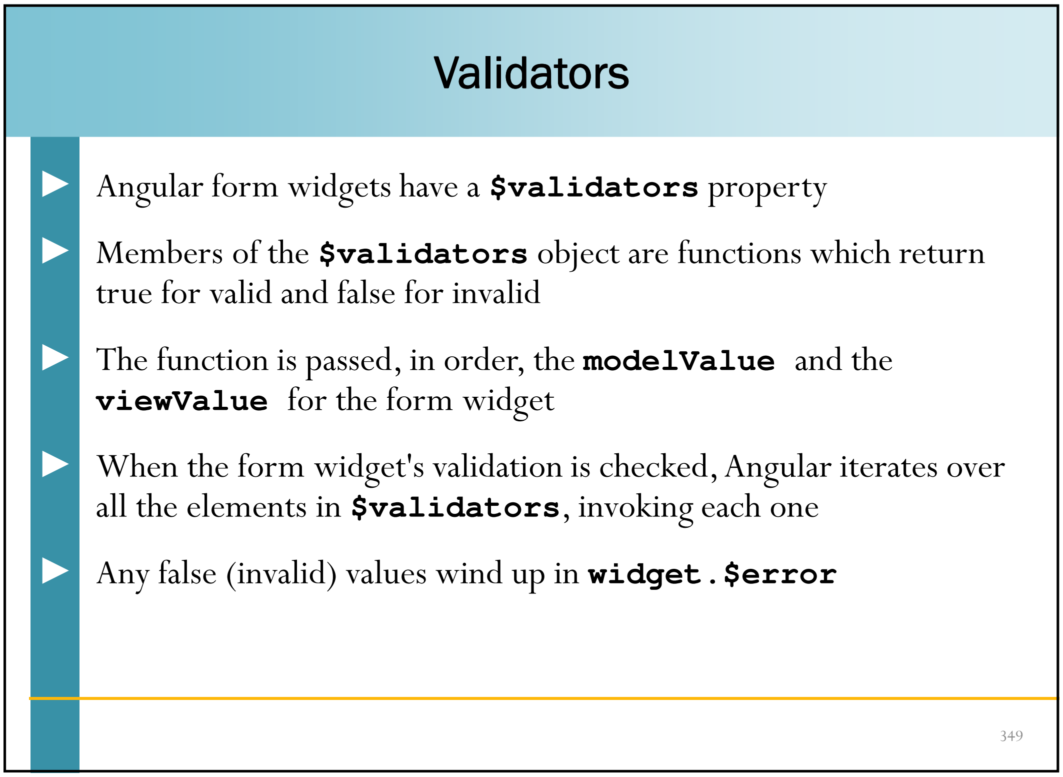
Exercise: Controller communication

- Chapter: AdvDirectives
- Exercises/ControllerComms



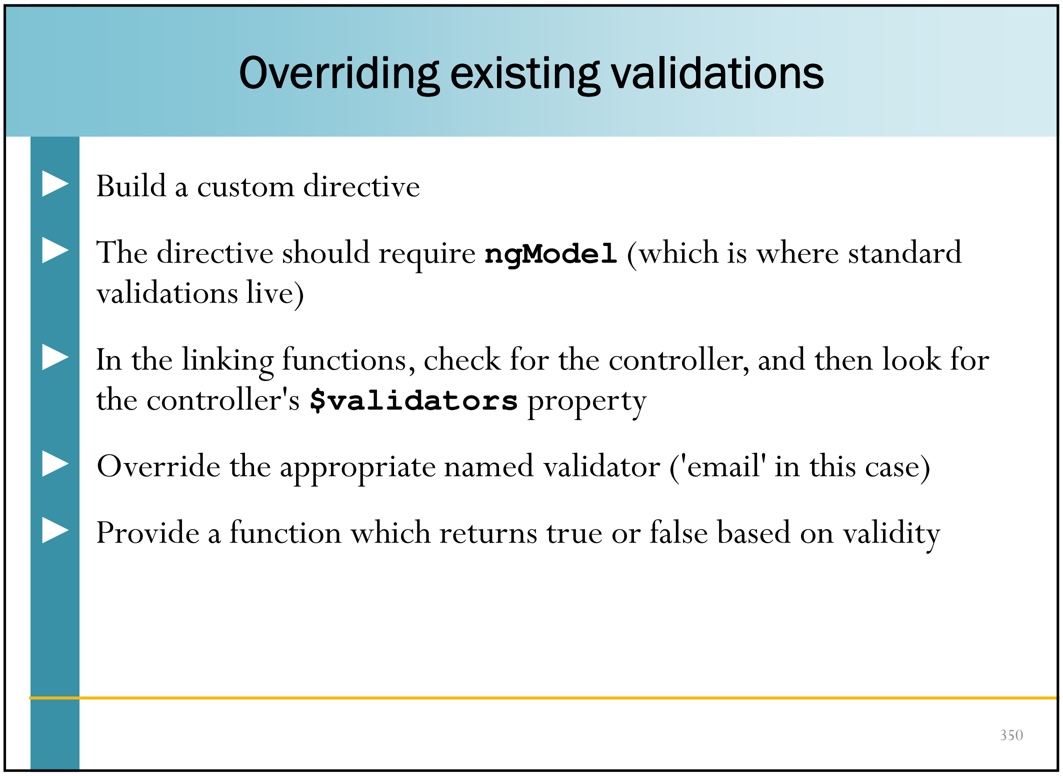
Custom validations

- Now that we know how controllers and directives work together, we can implement custom validations
- First decision: Are we overwriting/updating an existing validation, or are we providing new behavior?
  - Let's deal with these in order
- To override an existing validation (e-mail, for example), you will need to require the NgModelController (as ngModel) and then interact with its existing e-mail validation



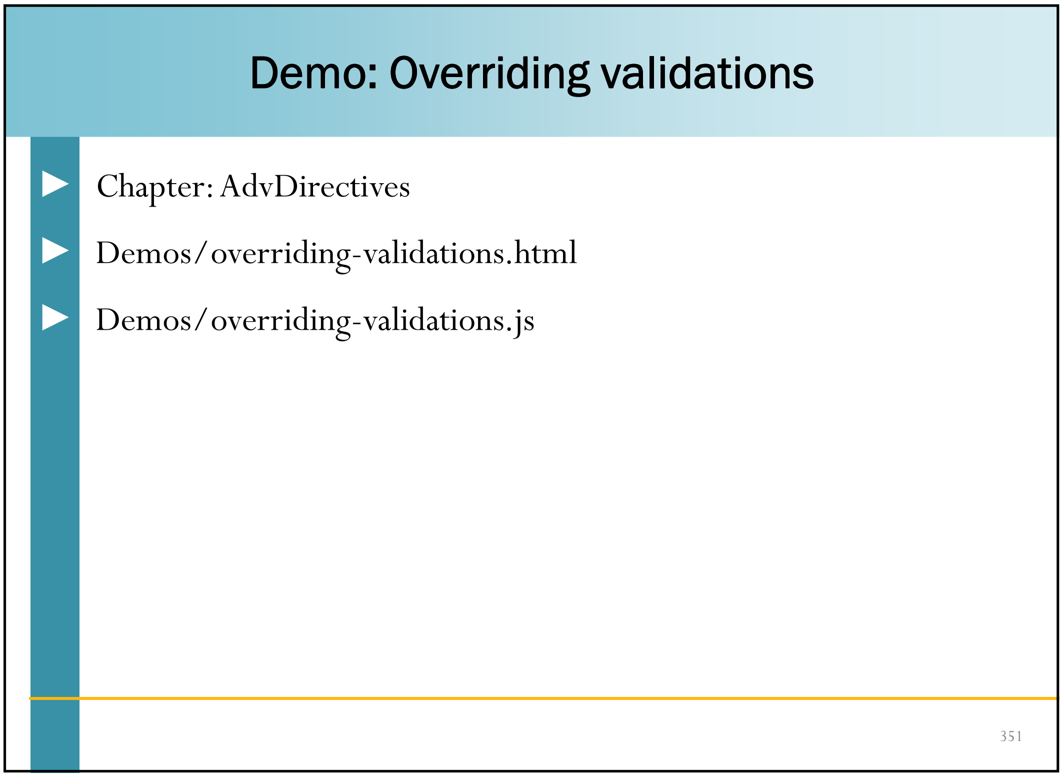
Validators

- Angular form widgets have a **`$validators`** property
- Members of the **`$validators`** object are functions which return true for valid and false for invalid
- The function is passed, in order, the **`modelValue`** and the **`viewValue`** for the form widget
- When the form widget's validation is checked, Angular iterates over all the elements in **`$validators`**, invoking each one
- Any false (invalid) values wind up in **`widget.$error`**



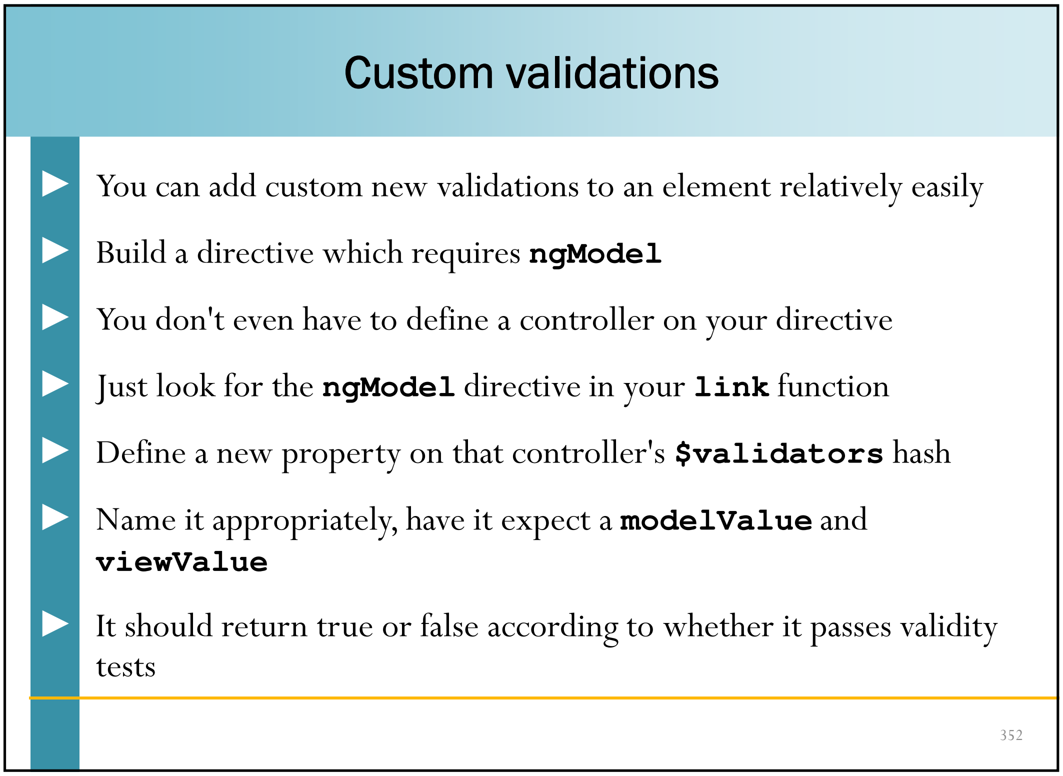
Overriding existing validations

- Build a custom directive
- The directive should require **`ngModel`** (which is where standard validations live)
- In the linking functions, check for the controller, and then look for the controller's **`$validators`** property
- Override the appropriate named validator ('email' in this case)
- Provide a function which returns true or false based on validity



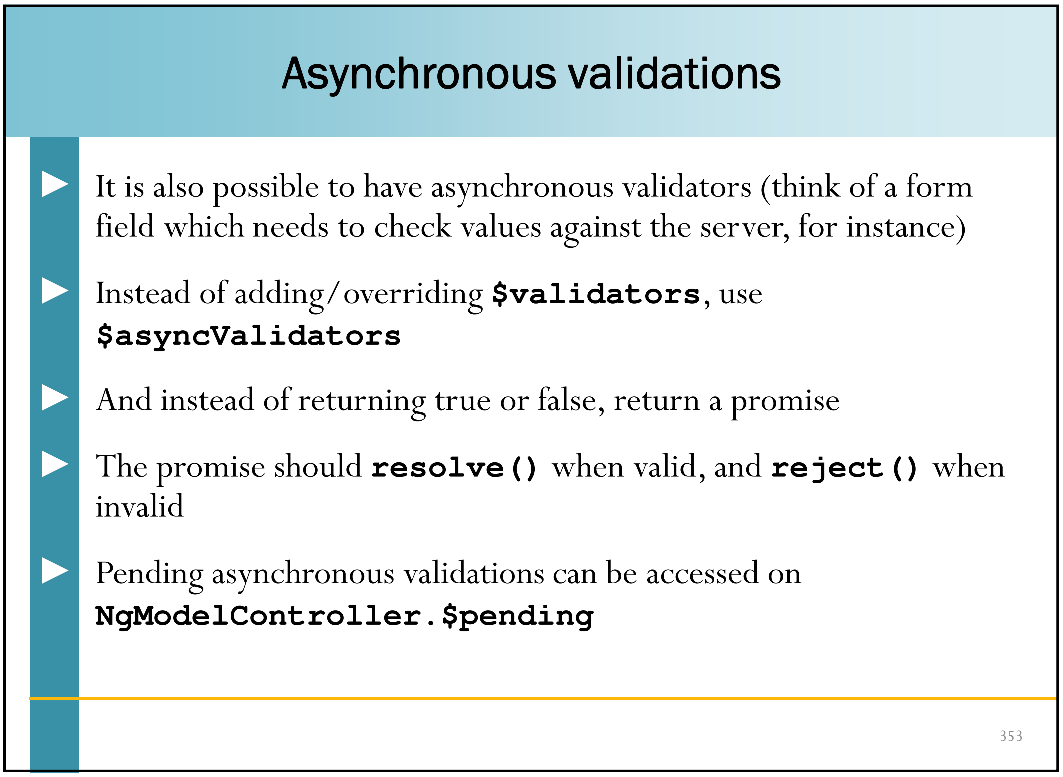
Demo: Overriding validations

- Chapter: AdvDirectives
- Demos/overriding-validations.html
- Demos/overriding-validations.js



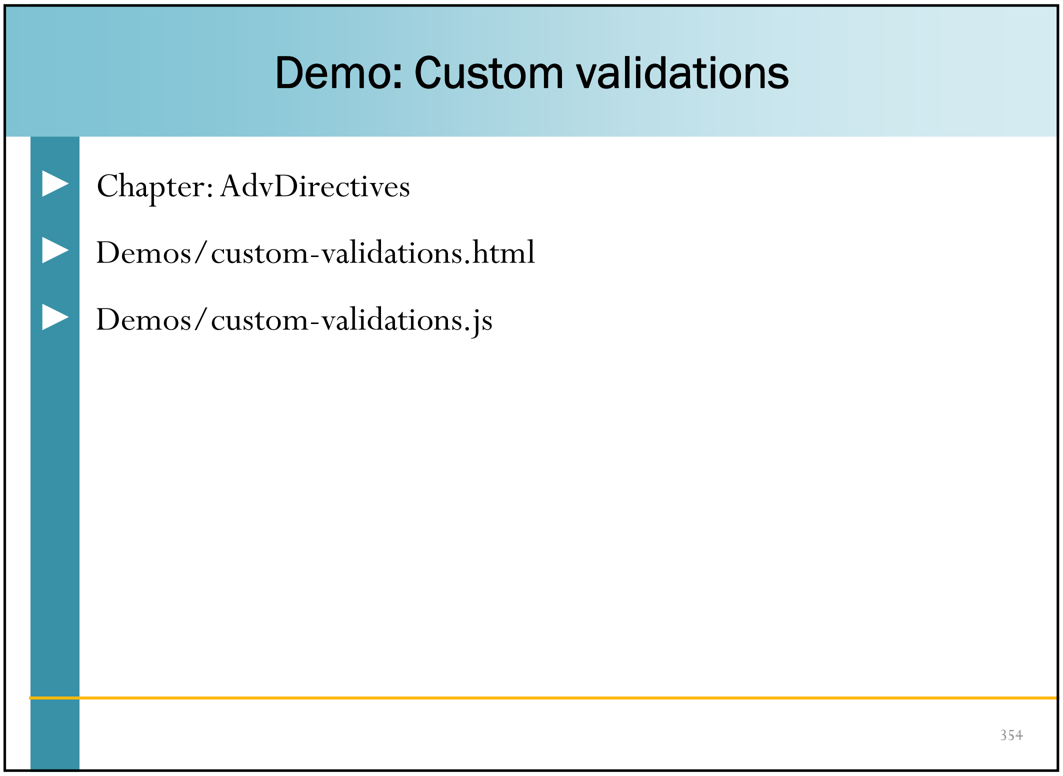
Custom validations

- You can add custom new validations to an element relatively easily
- Build a directive which requires **`ngModel`**
- You don't even have to define a controller on your directive
- Just look for the **`ngModel`** directive in your **`link`** function
- Define a new property on that controller's **`$validators`** hash
- Name it appropriately, have it expect a **`modelValue`** and **`viewValue`**
- It should return true or false according to whether it passes validity tests



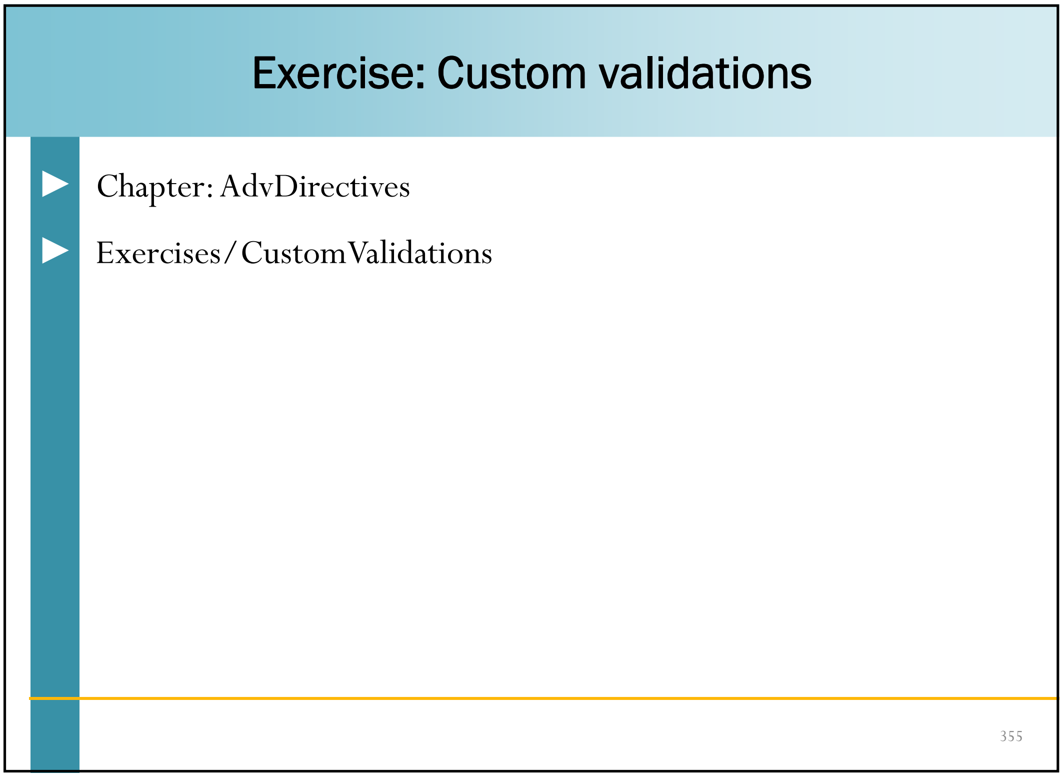
Asynchronous validations

- It is also possible to have asynchronous validators (think of a form field which needs to check values against the server, for instance)
- Instead of adding/overriding **`$validators`**, use **`$asyncValidators`**
- And instead of returning true or false, return a promise
- The promise should **`resolve()`** when valid, and **`reject()`** when invalid
- Pending asynchronous validations can be accessed on **`NgModelController.$pending`**



Demo: Custom validations

- Chapter: AdvDirectives
- Demos/custom-validations.html
- Demos/custom-validations.js



Exercise: Custom validations

- Chapter: AdvDirectives
- Exercises/CustomValidations

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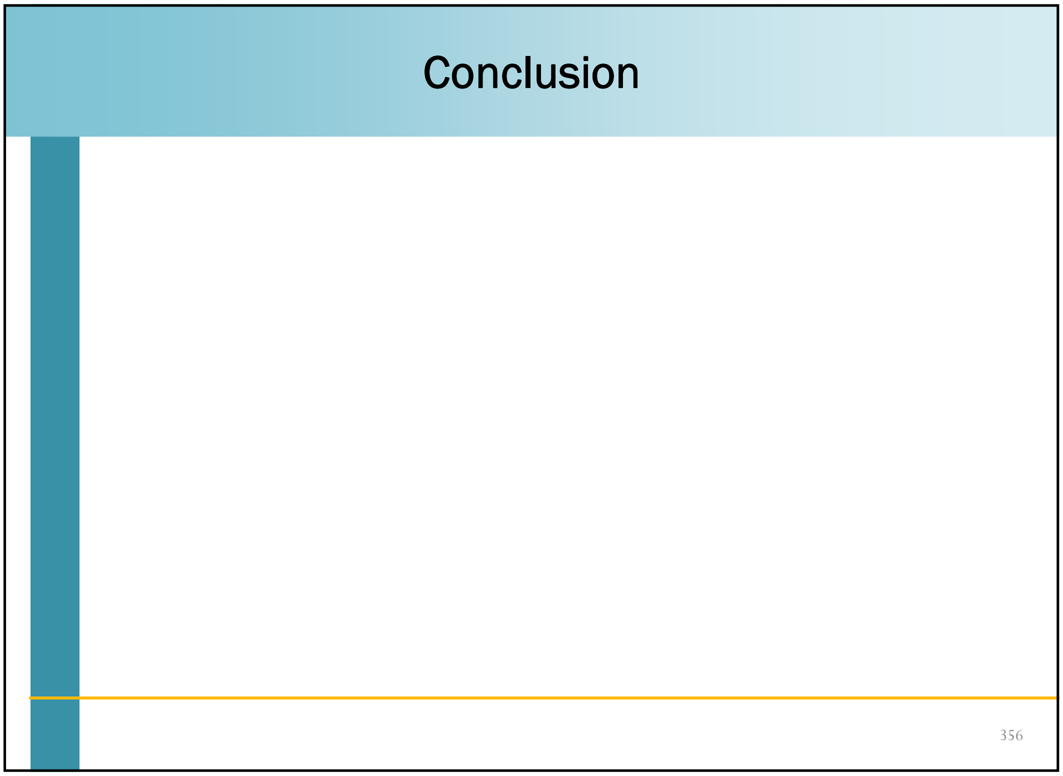

Conclusion

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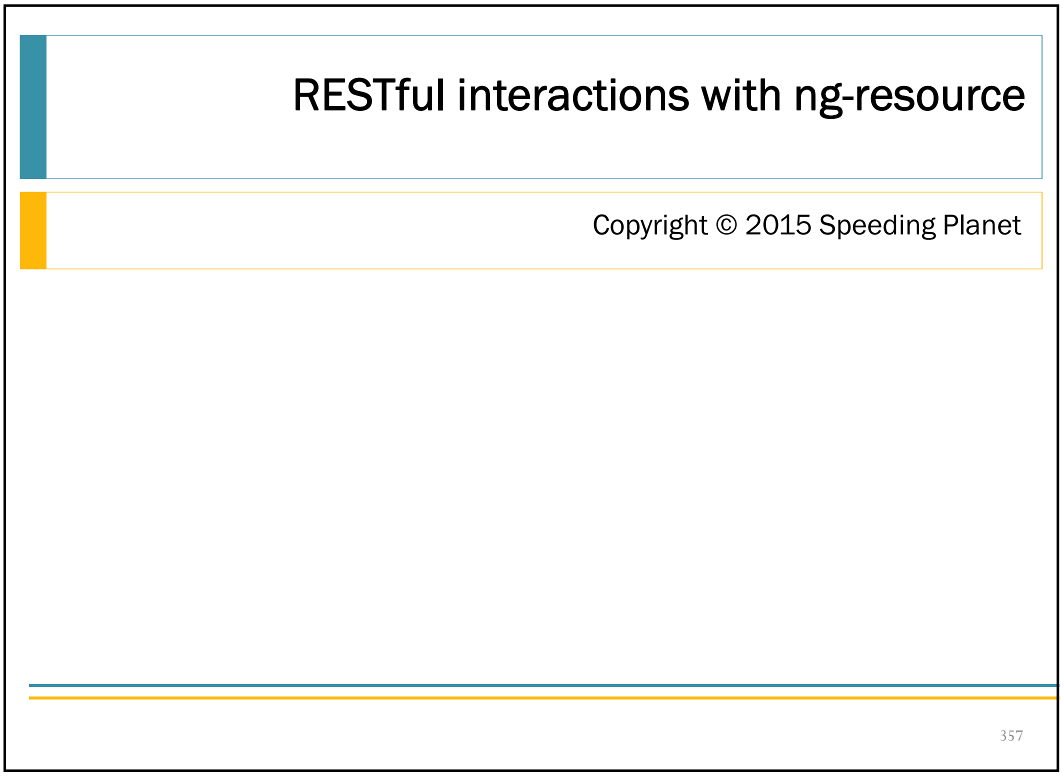

RESTful interactions with ng-resource

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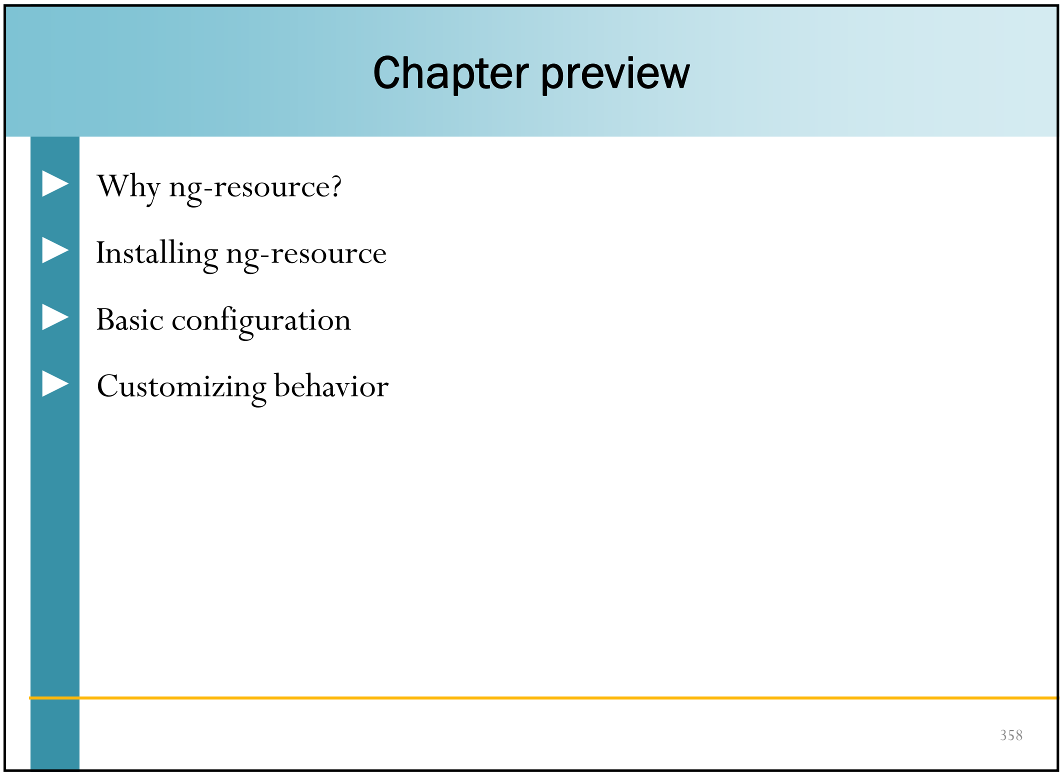

Chapter preview

- Why ng-resource?
- Installing ng-resource
- Basic configuration
- Customizing behavior

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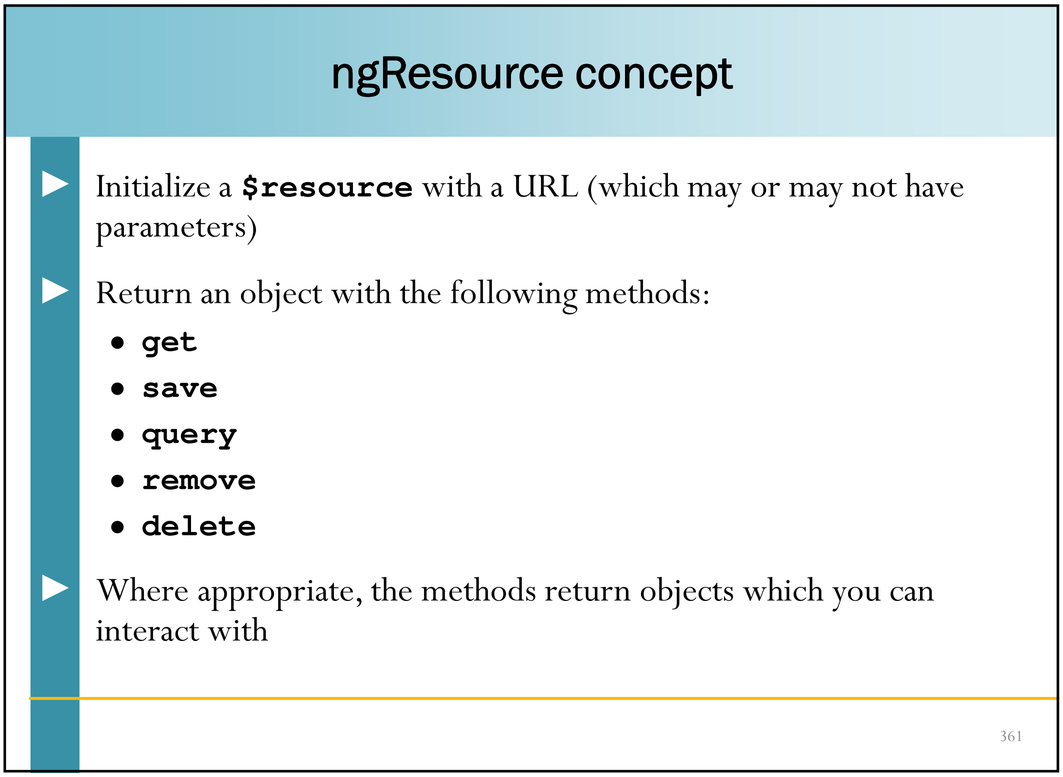
Why ng-resource?

- Up to this point, most of our interactions with a server have been through either $http directly, or a provider which wraps $http
- This is useful for one-off or custom behavior, but we have had to implement a somewhat extensive array of functionality
- We know what RESTful patterns of behavior are, yet we still had to implement CRUD operations on the client side ourselves
- Wouldn't it be nice to be able to point to a RESTful URL and tell Angular to configure a service based on reasonable assumptions?
  - Hint: yes, and that's exactly what ng-resource does

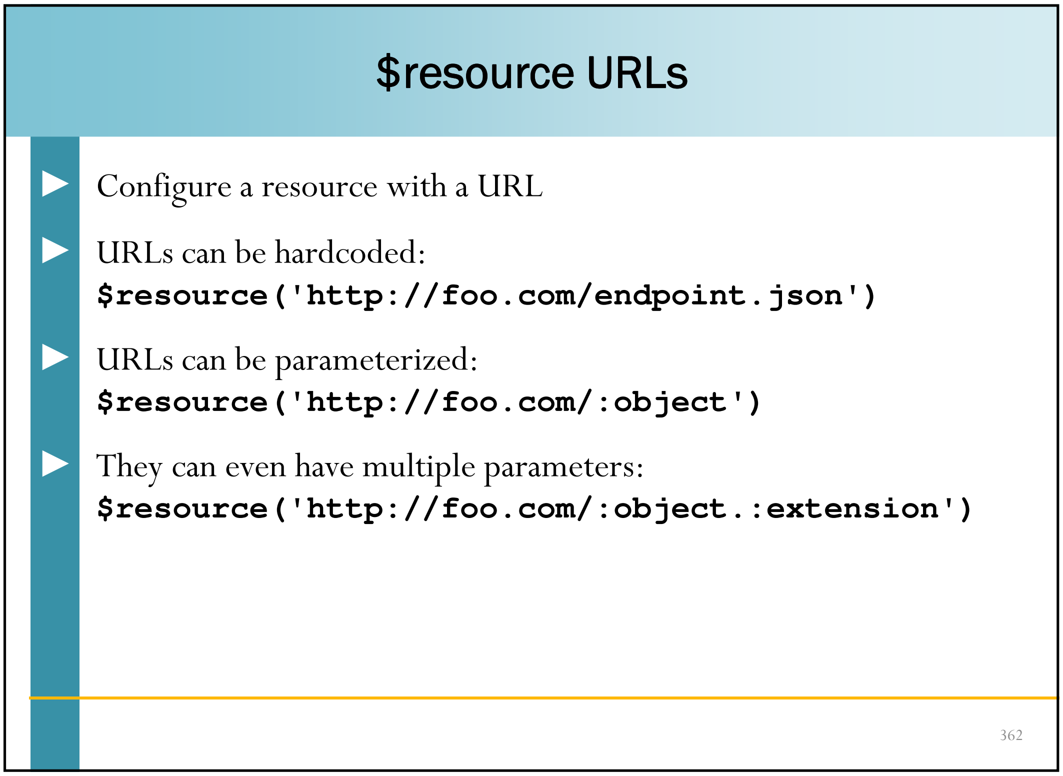
Adding ng-resource

- Download angular-resource.js
- Include angular-resource.js in your HTML, sometime after angular.js
- Have the appropriate modules (probably your top-level module) depend on ngResource



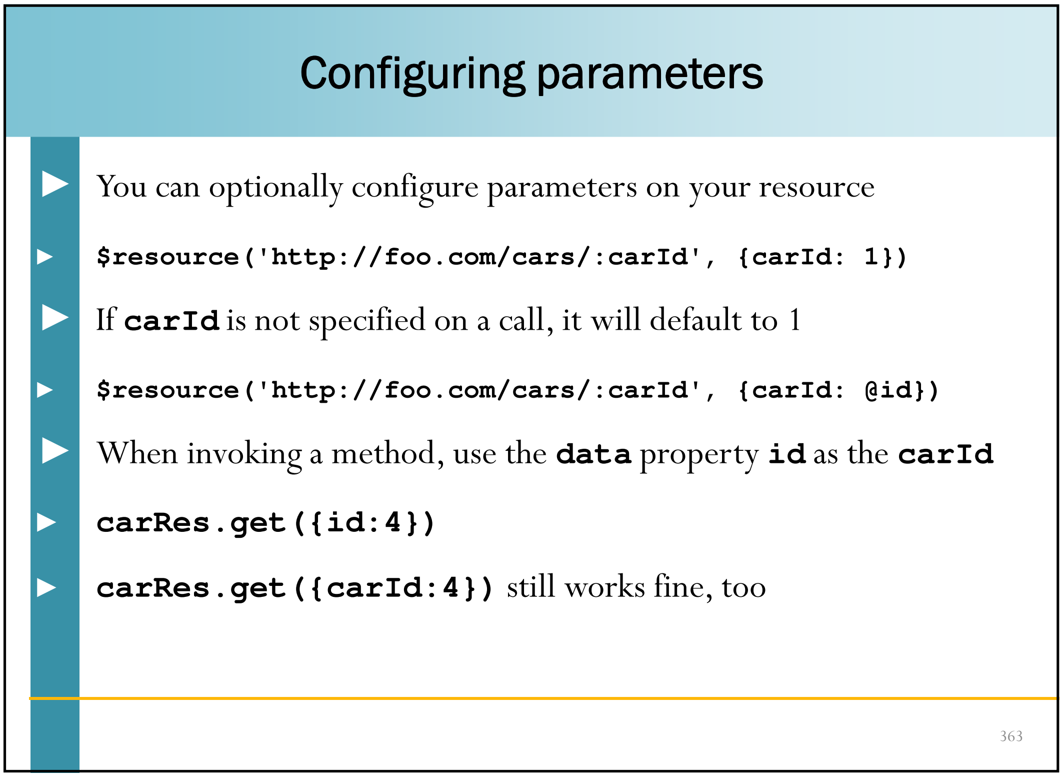
ngResource concept

- Initialize a **`$resource`** with a URL (which may or may not have parameters)
- Return an object with the following methods:
  - **`get`**
  - **`save`**
  - **`query`**
  - **`remove`**
  - **`delete`**
- Where appropriate, the methods return objects which you can interact with



$resource URLs

- Configure a resource with a URL
- URLs can be hardcoded:
  `$resource('http://foo.com/endpoint.json')`
- URLs can be parameterized:
  `$resource('http://foo.com/:object')`
- They can even have multiple parameters:
  `$resource('http://foo.com/:object.:extension')`



Configuring parameters

- You can optionally configure parameters on your resource
- `$resource('http://foo.com/cars/:carId', {carId: 1})`
- If **`carId`** is not specified on a call, it will default to 1
- `$resource('http://foo.com/cars/:carId', {carId: @id})`
- When invoking a method, use the **`data`** property **`id`** as the **`carId`**
- **`carRes.get({id:4})`**
- **`carRes.get({carId:4})`** still works fine, too

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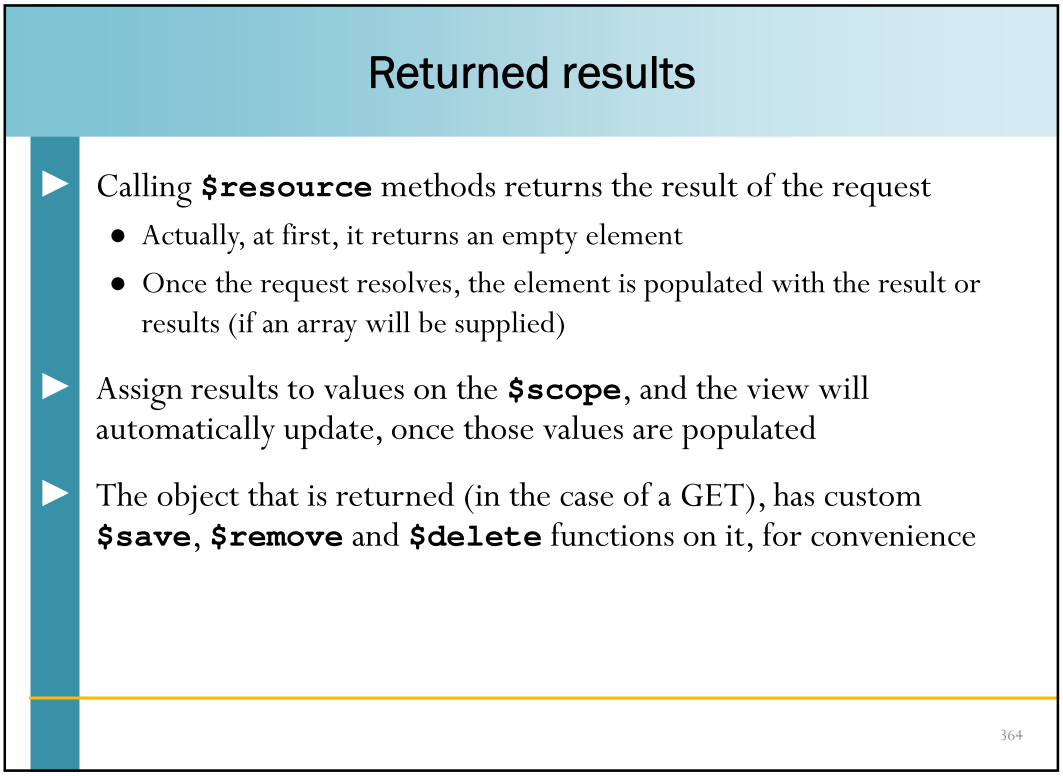

Returned results

- Calling **`$resource`** methods returns the result of the request
  - Actually, at first, it returns an empty element
  - Once the request resolves, the element is populated with the result or results (if an array will be supplied)
- Assign results to values on the **`$scope`**, and the view will automatically update, once those values are populated
- The object that is returned (in the case of a GET), has custom **`$save`**, **`$remove`** and **`$delete`** functions on it, for convenience

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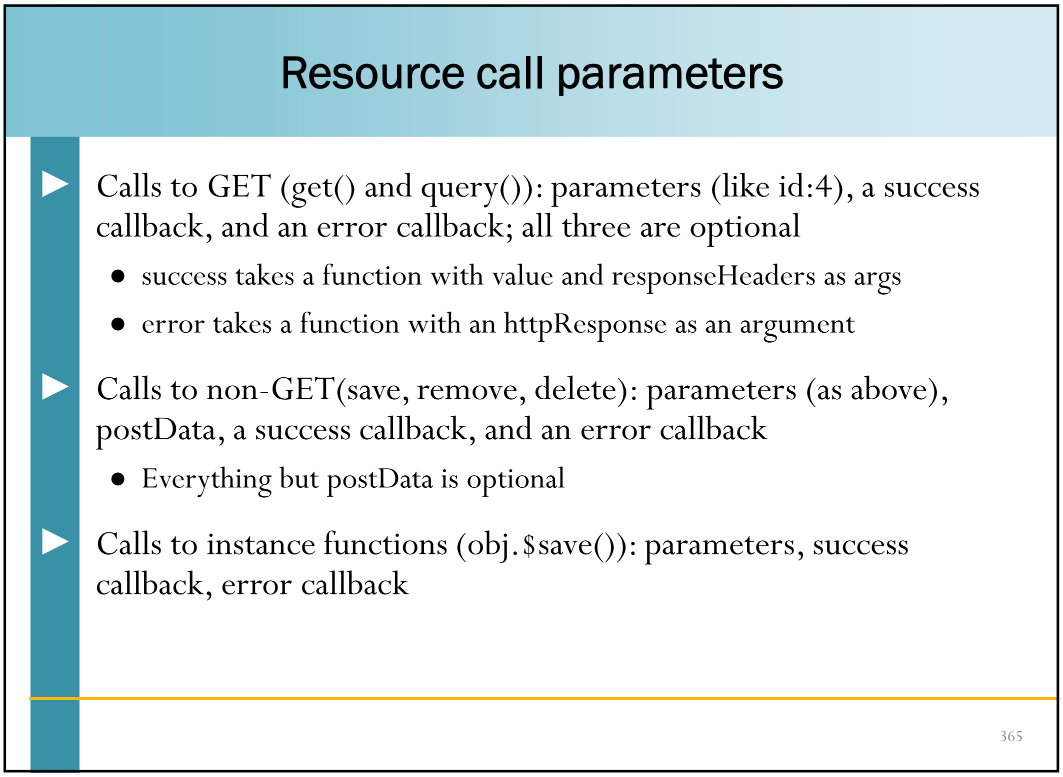
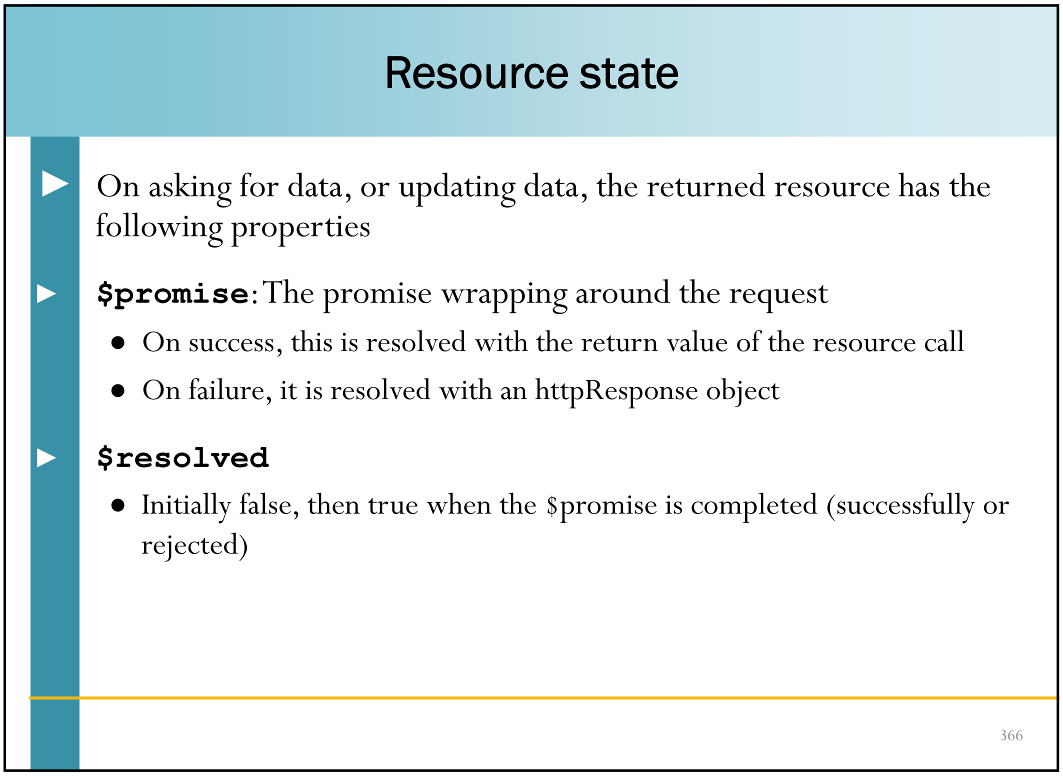


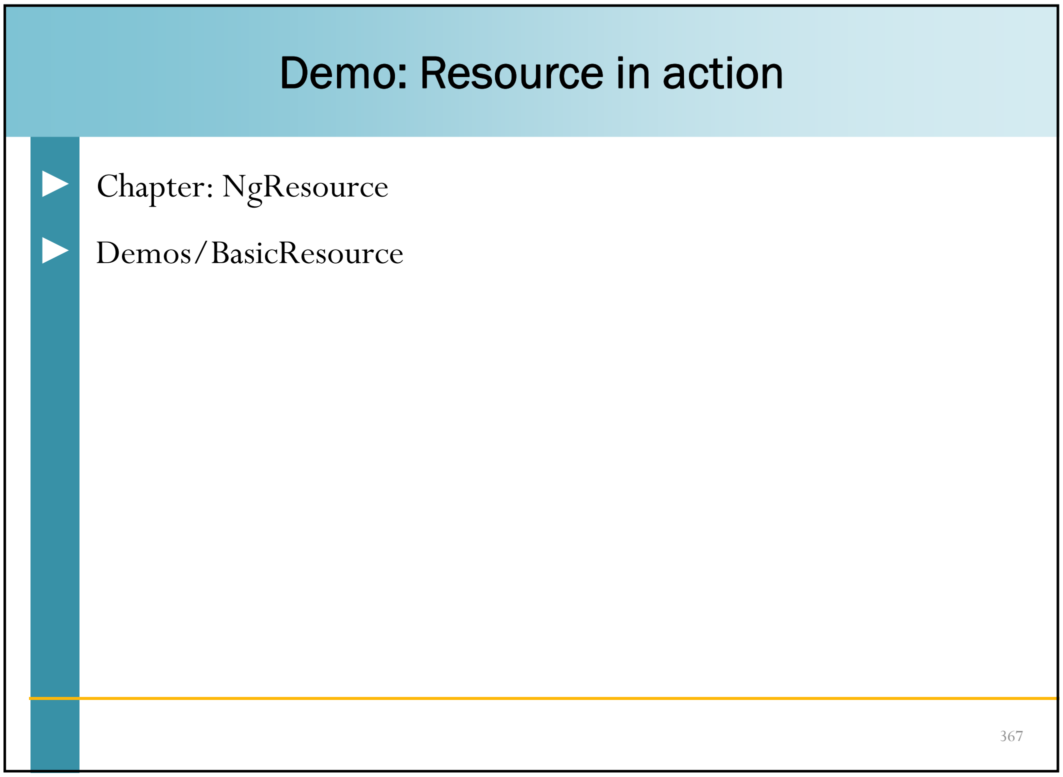
Resource call parameters

- Calls to GET (get() and query()): parameters (like id:4), a success callback, and an error callback; all three are optional
  - success takes a function with value and responseHeaders as args
  - error takes a function with an httpResponse as an argument
- Calls to non-GET(save, remove, delete): parameters (as above), postData, a success callback, and an error callback
  - Everything but postData is optional
- Calls to instance functions (obj.$save()): parameters, success callback, error callback



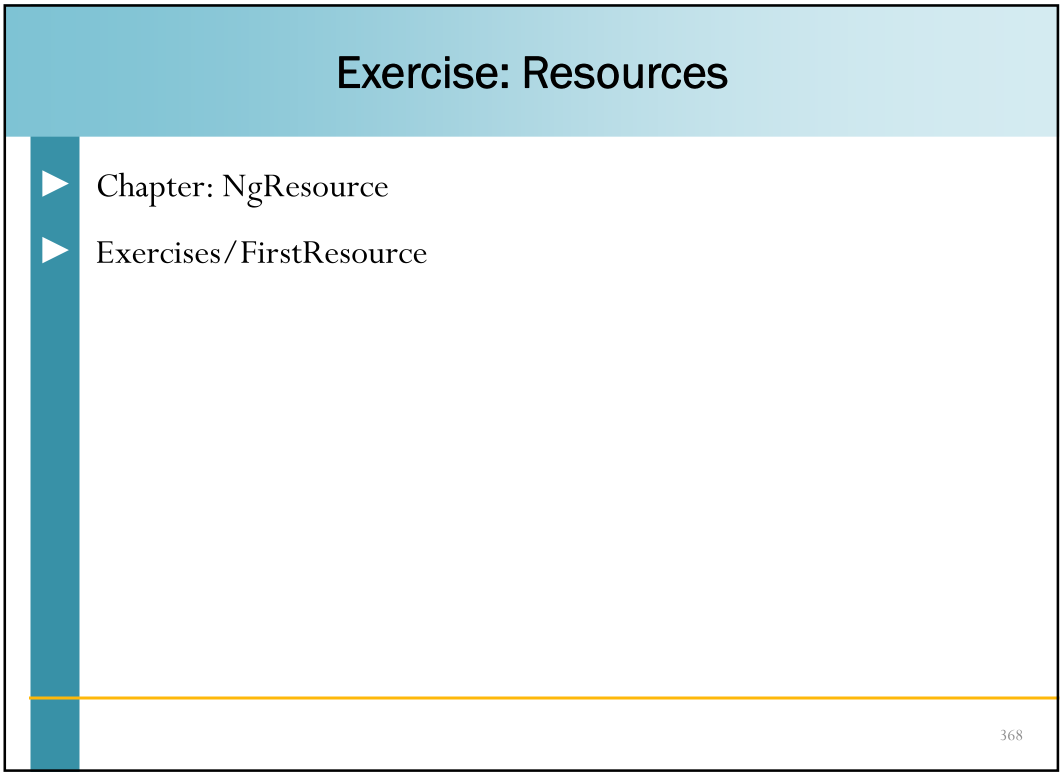
Resource state

- On asking for data, or updating data, the returned resource has the following properties
- **`$promise`**: The promise wrapping around the request
  - On success, this is resolved with the return value of the resource call
  - On failure, it is resolved with an httpResponse object
- **`$resolved`**
  - Initially false, then true when the $promise is completed (successfully or rejected)



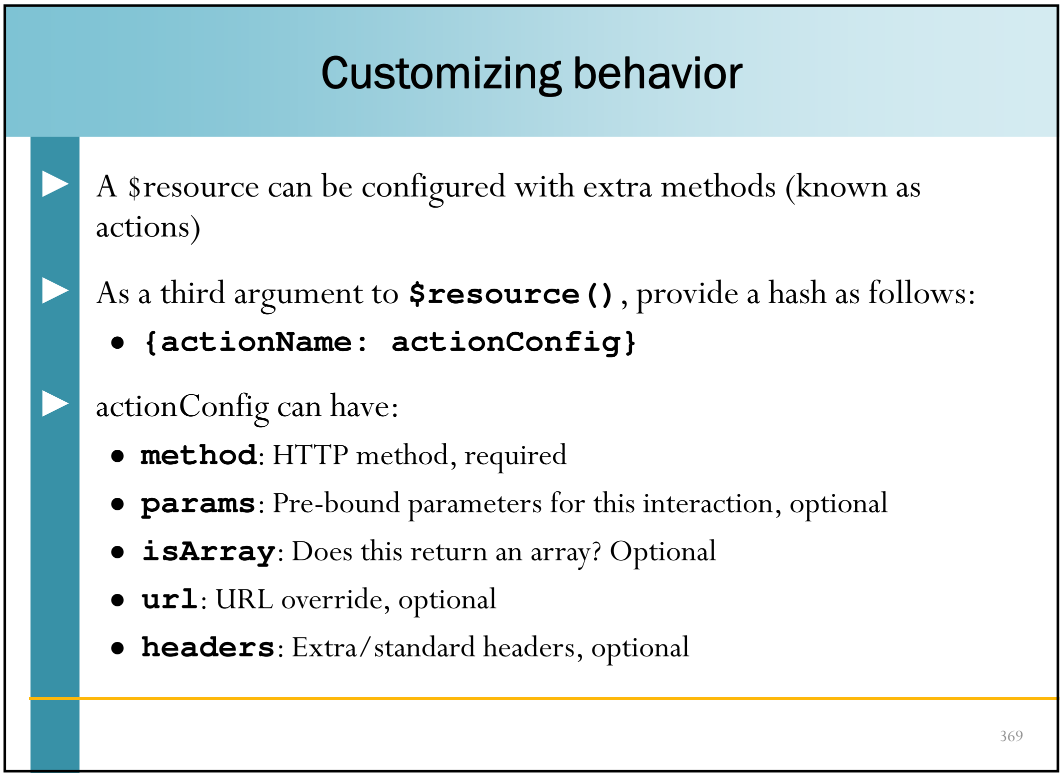
Demo: Resource in action

- Chapter: NgResource
- Demos/BasicResource



Exercise: Resources

- Chapter: NgResource
- Exercises/FirstResource



Customizing behavior

- A $resource can be configured with extra methods (known as actions)
- As a third argument to **`$resource()`**, provide a hash as follows:
  - **`{actionName: actionConfig}`**
- actionConfig can have:
  - **`method`**: HTTP method, required
  - **`params`**: Pre-bound parameters for this interaction, optional
  - **`isArray`**: Does this return an array? Optional
  - **`url`**: URL override, optional
  - **`headers`**: Extra/standard headers, optional

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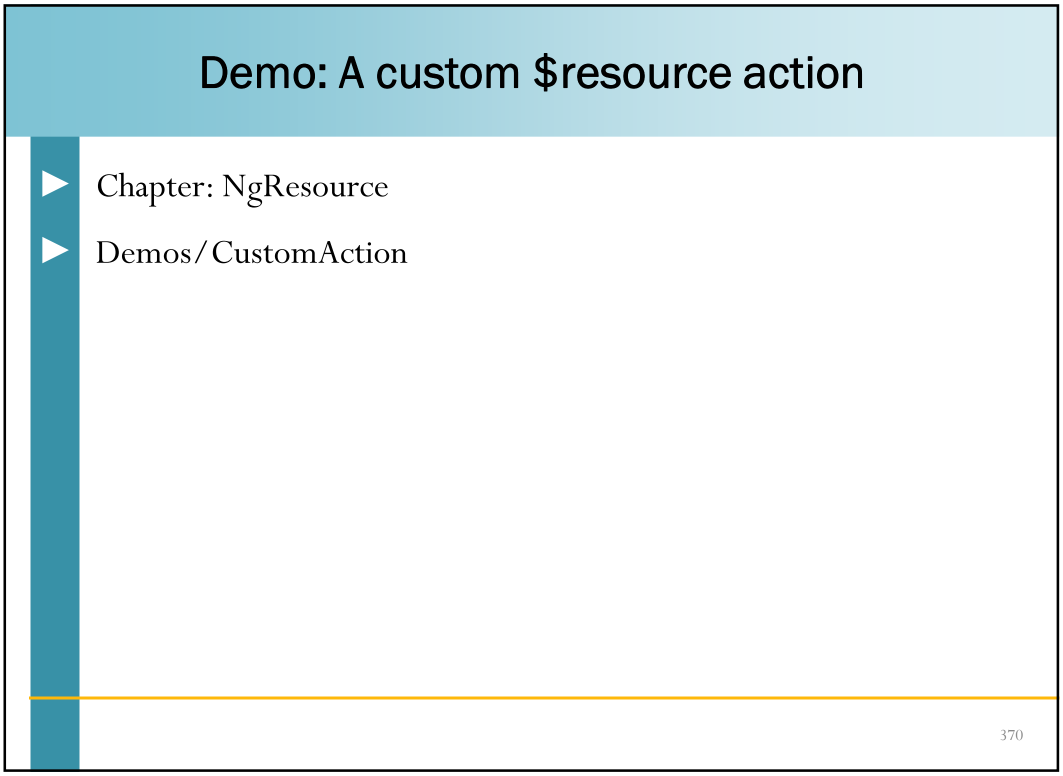

Demo: A custom $resource action

- Chapter: NgResource
- Demos/CustomAction

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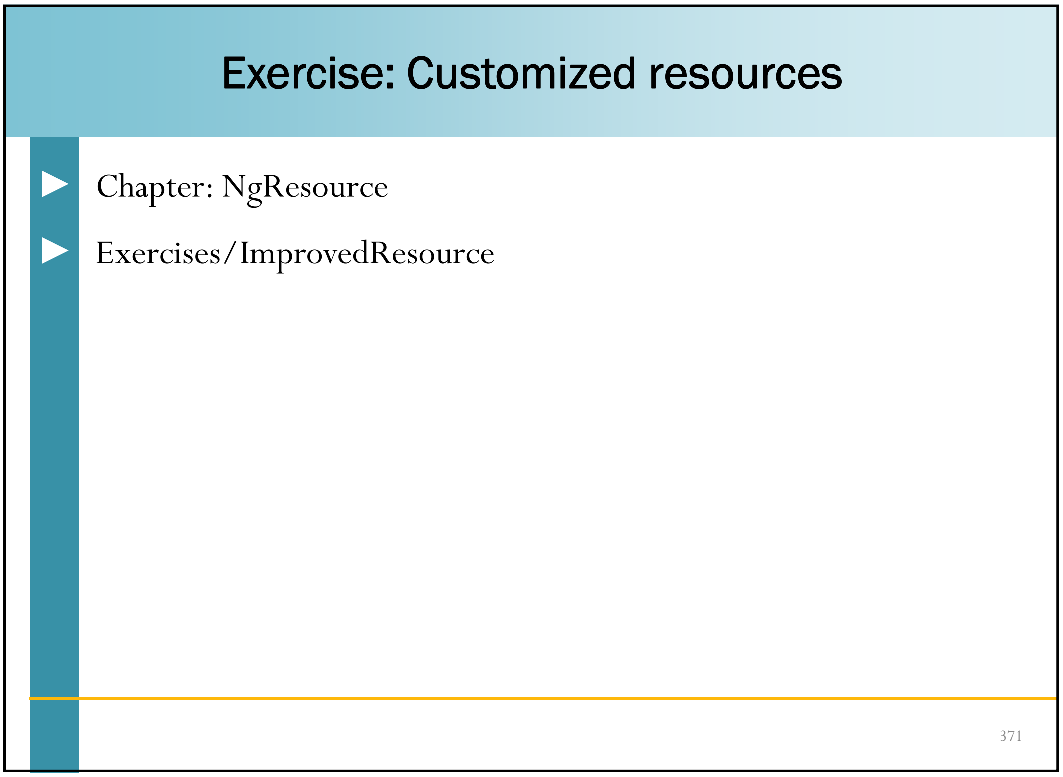
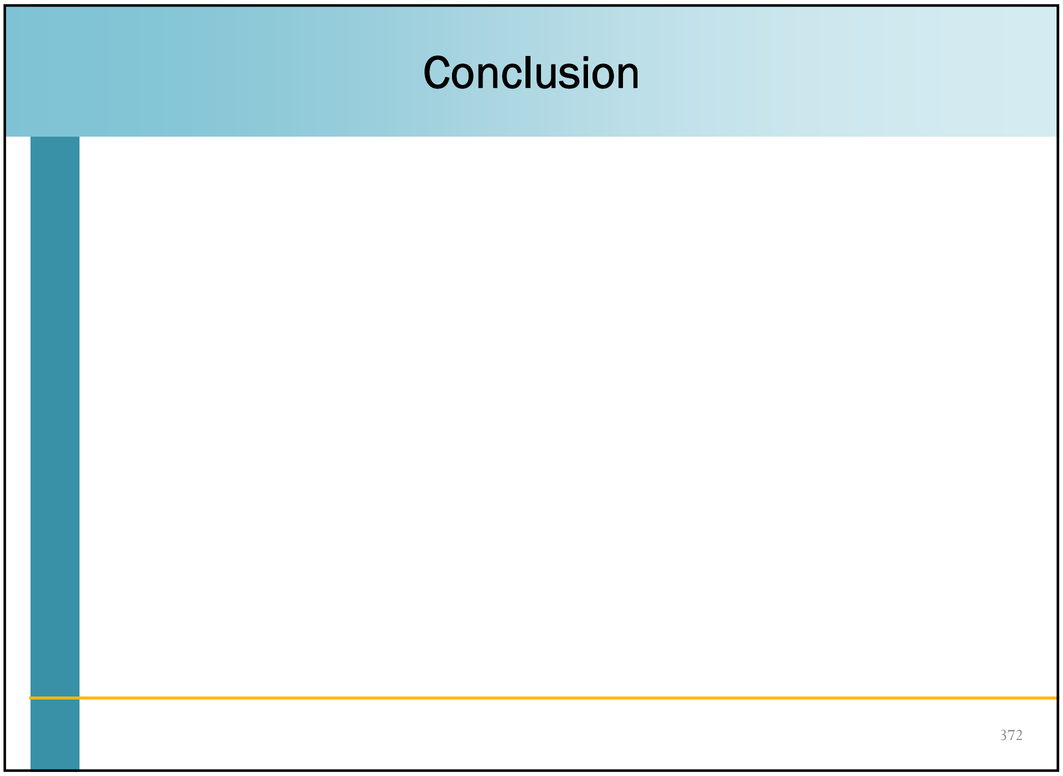


Exercise: Customized resources

- Chapter: NgResource
- Exercises/ImprovedResource



Conclusion