

Angular JS

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Setup

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Setup Checklist

- ▶ IDE of some sort (code highlighting, etc.)
 - WebStorm (jetbrains.com/webstorm, also IntelliJ, PyCharm, RubyMine)
 - Brackets (brackets.io)
 - SublimeText (sublimetext.com)
 - Eclipse doesn't work well with Node JS and tends to crash
- ▶ Firefox 14.x (or greater)
- ▶ Chrome 17.x (or greater)
- ▶ Internet Explorer 9 (or greater)
- ▶ Node JS 0.10.32 (or later)
- ▶ MongoDB 2.4 (or later, including recent Mongo 3.0)

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Setup Checklist

- ▶ If you haven't already, please download the zip files for the class (your instructor can tell you where they are located)
 - You will be downloading one set of class files: **AngularClass.zip**
- ▶ Unpack the files to a directory of your choosing
 - Windows users: usually the C:\ drive
- ▶ Open a DOS command prompt in the **AngularClass** directory

Setup for class files

- ▶ Enter **bin\set-path.cmd**, 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

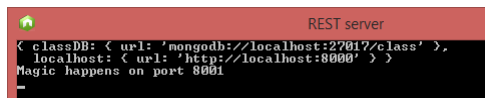
REST and database setup

- ▶ Your instructor will walk you through setting up the database for the class
- ▶ Broadly speaking, you will edit some config files to point to MongoDB servers already setup here at Goldman Sachs
- ▶ These servers have been pre-loaded with data for class
- ▶ Once the edits are complete, you will move on to setting up a REST server

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Setup scripts

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



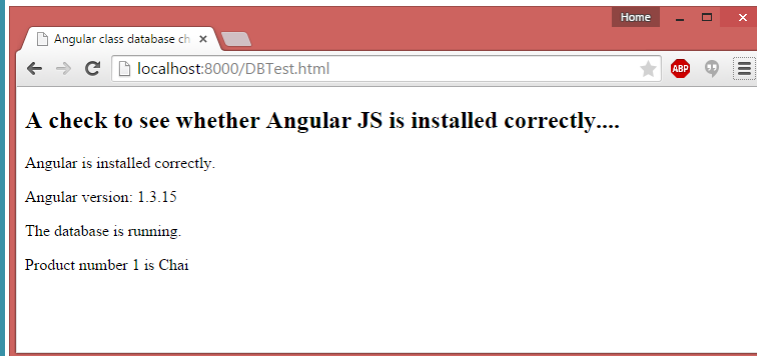
```
REST server
{ classDB: < url: 'mongodb://localhost:27012/class' >,
  localhost: < url: 'http://localhost:8000' > }
Magic happens on port 8001
```

- ▶ The **classDB** URL will be different, as it will depend on the configuration specific to Goldman Sachs
- ▶ You can test the server by checking **<http://localhost:8001/northwind/employees>**, which should return a JSON array of Employee objects

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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



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Assumptions

- ▶ First, this class assumes that you're 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!
- ▶ Second, we assume that you are conversant with the Model-View-Controller (MVC) design pattern

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Introduction

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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
 - Templating
 - Dependency Injection
 - Automagical event handling
- ▶ 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)

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How can I get Angular?

- ▶ Angular's website **<http://angularjs.org/>**
- ▶ Goldman Sachs provides a local CDN with angular.js (the file)
- ▶ Goldman also provides build tools for setting up a project based on AngularJS as well

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Angular reference sheet

- ▶ Version (for this class): 1.3.16
- ▶ Web site: angularjs.org
- ▶ API Docs: <https://code.angularjs.org/1.3.16/docs/api>
 - Generally, <http://docs.angularjs.org/api>, but that defaults to the most recent beta, which is currently from the 1.4 line
- ▶ AngularJS recently released version 1.4 (currently version 1.4.1). The updates were largely focused on stability and have little to no effect on the material covered in this class

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Conclusion

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Introduction to AngularJS

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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 attribute (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

```
1. <!DOCTYPE html>
2. <html ng-app>
3. <head>
4.   <title>Standard index.html file for Angular</title>
5.   <script src="/common/js/angular/angular.js"></script>
6. </head>
7. <body>
8. </body>
9. </html>
```

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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

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Adding interactivity

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

```

1. <!DOCTYPE html>
2. <html ng-app>
3. <head>
4.   <title>Angular's Hello World</title>
5.   <script src="/common/js/angular/angular.js"></script>
6. </head>
7. <body>
8. <form>
9. <label for="name">Name: </label>
10. <input id="name" type="text" ng-model="name" />
11. </form>
12. <p>Hello, {{name}}</p>
13. </body>
14. </html>

```

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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

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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**)

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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

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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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Real world Angular

- ▶ That was a nice exercise in instant gratification
- ▶ In the real world, we will use Angular in a more rigorous manner
- ▶ Specifically, we will need to tie the following together:
- ▶ Modules
- ▶ Controllers
- ▶ Views
- ▶ We will also use a JavaScript pattern called the Immediately Invoked Function expression to encapsulate our code

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Immediately Invoked Function Expressions

- ▶ Immediately-Invoked Function Expressions (IIFEs) allow us to run JavaScript in a local (as opposed to global) scope
- ▶ JavaScript only has global and functional scopes, so to properly encapsulate your code, you have to run it within a function
- ▶ A function that is immediately invoked never exports a name to the global namespace, and therefore does not run the risk of overwriting other modules, functions, objects, or variables
- ▶ Pass globals like **angular** into the IIFE to localize them to the function

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Angular Modules

- ▶ Modules are the container of code for Angular
- ▶ Something a little bit more than a class or even a package, they are an organizational unit of code
- ▶ Here, we are creating controllers from modules
- ▶ Later on, we will define filters, services, directives and more via modules
- ▶ Most Angular-specific code will be attached to a module in one way or another
- ▶ **angular.module()** takes two arguments: the name of the module, and an array of dependencies (even if there are no dependencies)

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Controllers

- ▶ Controllers are the traffic cops of the MVC world
- ▶ For us, they are closer to what is sometimes called a ViewModel
- ▶ They mediate interactions between data (the model) and presentation (the view)
- ▶ You will likely have multiple controllers per page
 - Though, initially, we will only have one
- ▶ We will explore controllers in great detail

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\$scope

- ▶ **\$scope** is a special variable provided by Angular which is connected to both the controller and the view
- ▶ Any variable name in the view (whether provided by **ng-model** or not) is evaluated against **\$scope**
- ▶ In the controller, you can access these variables directly as **\$scope.variableName**
 - Including **ng-model** values!

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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 );
```

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Tying a controller to the view

- ▶ Code in the view and Angular JS code are not automatically tied to one another
- ▶ The view must use both the appropriate module and the appropriate controller(s) within that module
- ▶ Tie the view to the module by setting **ng-app** equal to the name of the module
- ▶ Tie the view to the controller by adding an **ng-controller** directive to the element you want that controller to oversee (**<body>**, **<div>**, etc.)
 - Set the value of **ng-controller** to the name of the controller you want to use

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Demo: Module, controller, and view

▶ 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>
```

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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

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Exercise: Proper Angular

- ▶ Let's take the code that we've built so far and set it up using proper Angular style
- ▶ We will build a module and a controller
- ▶ Tie them to the view
- ▶ And include the new JavaScript file in the HTML as well
- ▶ `IntroAngular/Exercises/first-angular-better.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
 - 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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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!

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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>
```

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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

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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: "£"**

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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

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Demo: Testing expressions

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

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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)**

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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()**

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The module and dependencies

- ▶ The call to **angular.module** takes 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

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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!

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Demo: Array of objects

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

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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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Exercise: Filtering and ordering

- ▶ Chapter: IntroAngular
- ▶ Exercises/filtering-ordering.html
- ▶ Exercises/filtering-ordering.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-models** and the like

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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

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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

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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)"`

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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

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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 tests independent of angular-seed, you'll need:
 - A test runner
 - A testing framework
 - To choose a reporting framework

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Test runner

- ▶ JavaScript unit testing was originally done in the browser
- ▶ This is inconvenient for any number of reasons
- ▶ The Angular team has built a generic test runner, which does not require AngularJS at all
- ▶ It is built on top of Node JS, and called Karma
- ▶ Installing both karma and karma-cli via npm will make karma available on the command line
- ▶ It can also be plugged into various continuous integration setups

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Setting up Karma

- ▶ Karma provides a simple way to initialize a configuration file
- ▶ **karma init filename**
- ▶ Typically the filename takes the form **<filename>-karma-conf.js**
- ▶ This will interactively build a Karma configuration file for you
- ▶ The file is a plain JavaScript file, so you can edit it later on as well
- ▶ We will walk through a typical Karma configuration file

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Demo: A Karma config file

- ▶ We will use Karma's **init** command to build a configuration file
- ▶ And then go through the various options therein

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Test framework

- ▶ AngularJS is officially unit testing framework agnostic, but most people (and demos) use Jasmine
- ▶ Jasmine can be found at <http://jasmine.github.io/>
- ▶ Karma has a plug-in which allows it to run Jasmine tests
- ▶ Let's look at Jasmine's syntax

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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**
- ▶ **beforeAll(fn) / afterAll(fn)** : Once for this **describe** unit

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Demo: Basic unit testing

- ▶ Just a simple example of unit testing, without worrying about AngularJS
- ▶ Chapter: IntroAngular
- ▶ Demos/test/basic-test.js
- ▶ Demos/test/basic-test-karma-conf.js

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Angular Mocks

- ▶ When unit testing Angular, you will need to use the Angular Mocks library to interface with Angular
- ▶ 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

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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\controllers-karma-conf.js: Surf to this page to run the tests
- ▶ Demos\test\controllers-spec.js: Actual tests
- ▶ Demos\js\controllers.js : Under test

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Exercise: Unit testing

- ▶ Chapter: IntroAngular
- ▶ Exercises/test/unit-test-specs.js: This is where your actual work is, but it depends on ...
- ▶ Exercises/test/unit-test-specs-karma-conf.js: The file which runs your tests
- ▶ Exercises/js/unit-test-controllers.js: The code that's actually under test
- ▶ Exercises/unit-test.html: If you just want to see the code in action

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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
- ▶ Originally, the Angular team tried to build their own end-to-end testing framework
- ▶ Eventually, they abandoned the project in favor of wrapping a library around the widely-used UI testing software Selenium
- ▶ The Angular team have released this as Protractor, which includes both the core of Selenium and a series of extra, Angular-specific APIs

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Setting up Protractor

- ▶ In this class, Protractor is already set up and available
- ▶ Should you want to install Protractor on your own, look at the information below
- ▶ For simplicity's sake, we can 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!

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Running Protractor

- ▶ Protractor speaks to both the web server where your code resides and a Selenium server
- ▶ Assuming you already have your web server running...
- ▶ Start up the Selenium web driver
 - **webdriver-manager start**
- ▶ Then kick off your tests:
- ▶ **protractor [protractor-config-file]**

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Protractor configuration

- ▶ Protractor does not have a command to generate config files, as Karma does
- ▶ Instead, the Protractor team recommends using their default configuration file, available in their GitHub repository
- ▶ You can also use the file provided in this class, which is a little smaller and cleaner

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Demo: Protractor-based testing

- ▶ We are taking a basic look at Protractor here without a lot of depth
- ▶ Our shorter class does not afford us the time for a deep look into Protractor
- ▶ Chapter: IntroAngular
- ▶ Demos/test/protractor-config.js
- ▶ Demos/test/protractor-tests.js
- ▶ Demos/test/highlight-match.html

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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

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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
- ▶ Treat the Promise as an object with event handlers: **success** and **error**
- ▶ Register callbacks as **promise.success(function)** or **promise.error(function)**
- ▶ Callbacks receive four arguments:
 - **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

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\$http in action

▶ Using **\$http** to retrieve a file

```
1. var cityApp = angular.module( 'citiesApp', [] );
2. cityApp.controller( 'CityListCtrl',
3.   function ( $scope, $http ) {
4.     $http( {
5.       url : '/data/cities.json',
6.       method : 'get'
7.     } )
8.     .success( function ( data ) {
9.       $scope.cities = data;
10.     } )
11. } );
```

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Demo: Asynchronous data

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

88

Exercise: Asynchronous data

- ▶ Chapter: IntroAngular
- ▶ Demos/dynamic-fetching.html
- ▶ Demos/dynamic-fetching.js

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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

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Demo: Convenience

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

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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

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Defeating minification

- ▶ Tell Angular about your requirements as an array

```
1. var someApp = angular.module('someApp', []);
2. someApp.controller('SomeCtrl', ['$scope', '$http',
3.   function($scope, $http) {
4.       // Do whatever with the controller here
5.   }
6. ]);
```

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Demo: Improved controller

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

94

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

96

Ajax and \$http

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Chapter preview

- ▶ Dynamic data
- ▶ Using **\$http**
- ▶ Shortcuts with **\$http**
- ▶ Promises
- ▶ Caching

98

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

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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

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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
- ▶ Even with synchronous functionality

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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

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Arguments to onSuccess / 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

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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

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Demo: \$http and then

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

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\$http Promises

- ▶ The **\$http** service adds two specific methods to its Promises: **success()** and **error()**
- ▶ File a callback with each to run on the completion of the **\$http** Promise
- ▶ Both callbacks receive the same set of arguments (similar to **then()**):
 - **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

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\$http in action

▶ Using **\$http** to retrieve a file

```
1. var cityApp = angular.module( 'citiesApp', [] );
2. cityApp.controller( 'CityListCtrl',
3.   function ( $scope, $http ) {
4.     $http( {
5.       url : '/data/cities.json',
6.       method : 'get'
7.     } )
8.     .success( function ( data ) {
9.       $scope.cities = data;
10.     } )
11.   } );
```

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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 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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Demo: \$http

- ▶ Chapter: Ajax
- ▶ Demos\controller-http.html
- ▶ Demos\controller-http.js

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Exercise: Working with \$http

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

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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**

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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

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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

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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

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Angular UI Router

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Chapter preview

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

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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

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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

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UI Router cautions

- ▶ UI Router is on version 0.2.13
- ▶ 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

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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

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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

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HTML example

```

1. <!DOCTYPE html>
2. <html ng-app="uiRouterDemo">
3. <head lang="en">
4.   <meta charset="UTF-8">
5.   <title>UI Router Demo</title>
6.   <script src="/common/js/angular/angular.js"></script>
7.   <script src="/common/js/angular-ui-router/angular-ui-
   router.js"></script>
8.   <script src="js/app.js"></script>
9. </head>
10. <body>

11. <div ui-view></div>

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

14. </body>
15. </html>

```

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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

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Main module example

```

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

5.   $stateProvider.state('state1', {
6.     url: "/state1",
7.     templateUrl: "partials/state1.html"
8.   })
9.   .state('state1.detail', {
10.    url: "/state1/:fooParam",
11.    templateUrl: "partials/state1-detail.html"
12.  });
13. })

```

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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 **/bar** as the parameter **bar**
 - **/foo/*bar** : Get everything after **/foo** as **'bar'** (including other URL components)
 - **/foo/{bar}** : As above, different parameter id syntax
 - **/foo/{bar:int}** : **bar** should be an integer, types can be custom-defined
 - **/foo/{bar:[A-Za-z]+}** : regular expression; **bar** should be comprised of only one or more lower or uppercase letters

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Parameter types

- ▶ Parameter types can be custom defined (see [http://angular-ui.github.io/ui-router/site/#/api/ui.router.util.\\$urlMatcherFactory#methods_type](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)

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Demo: Real-world router

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

130

Exercises: UI Router

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

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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

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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

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State setup

- ▶ Use **`$stateProvider.state()`** to set up a state and a configuration
- ▶ A state is an arbitrary string, though it must be unique in the application
- ▶ States can have parent-child relationships via the dot operator
 - **`$stateProvider.state('parent', {})`** and **`$stateProvider.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

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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

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Demo: Nested states

- ▶ Chapter: UIRouter
- ▶ Demos/NestedStates

138

Exercise: Nested views

- ▶ Chapter: UIRouter
- ▶ Exercises/NestedViews

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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>
```

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\$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 templateUrlProvider
- ▶ Instead, each entry in the views configuration should provide template, etc., controller, and so on
- ▶

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

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Demo: Multiple views

- ▶ Chapter: UIRouter
- ▶ Demos/MultipleViews

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Exercise: Multiple Views

▶ Chapter: UIRouter

▶ Exercises/RouteMulti

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Conclusion

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Angular internals and lifecycle

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Chapter preview

- ▶ Providers in general
- ▶ Values
- ▶ Constants
- ▶ Factories
- ▶ Services

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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

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The value provider

- ▶ The value provider allows you to create a value that is available application-wide
 - As long as your module depends on the module where the value is defined
- ▶ Primitives (strings, numbers, booleans) are immutable
- ▶ References (objects, arrays) cannot change their reference, but can change their contents
- ▶ Values are an easy way to make simple chunks of data available throughout the application

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Using value

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

3. cityApp.controller( 'CityListCtrl',
4.   ['$scope', '$http', 'country',
5.     function ( $scope, $http, country ) {
6.       $scope.country = country;
7.       $http( {
8.         url : '../data/cities.json',
9.         method : 'get'
10.      } )
11.       .success( function ( data ) {
12.         $scope.cities = data;
13.       } )
14.     } ] );
```

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The constant provider

- ▶ The constant provider is very similar to the value provider
- ▶ The only major difference between a constant and a value is that a constant is available earlier in the module's lifecycle
- ▶ Constants are available at the config phase of a module's lifecycle, whereas values (and factories and services, for that matter) are only available at the run phase
- ▶ Code like routing configuration is set at config time, so if you want to use a provider to configure your router, you will need to use a constant (or a custom-built provider)

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Demo: A simple value provider

- ▶ Chapter: Providers
- ▶ Demos/values.html
- ▶ Demos/values.js
- ▶ Demos/constants.html
- ▶ Demos/constants.js

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Exercise: Values and constants

- ▶ Working with values and constants
- ▶ Chapter: Providers
- ▶ Exercises/ProductValues/

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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)
- ▶ They can create objects of various types (Values are limited to generating low-level types like objects and arrays)

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Demo: Factories

- ▶ Chapter: Providers
- ▶ 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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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**

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Demo: Services

- ▶ Chapter: Providers
- ▶ Demos/services.html
- ▶ Demos/services.js
- ▶ Demos/real-service.html
- ▶ Demos/real-service.js

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Exercise: Factories and Services

- ▶ Chapter: Providers
- ▶ Exercises/ProductFactoryServices

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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

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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 from a module
- ▶ Invoke `module.directive('someDirective', fn)` to create your own directive

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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

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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'  
    }  
});
```

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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

166

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 as a template when this directive is invoked
- ▶ **restrict: A | E | C | combo** - Restrict usage of this directive to being an **(A)**tttribute (the default), **(E)**lement, or **(C)**lass; can combine two or more if desired

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Demo: Our first directive

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

168

Exercise: A simple directive

- ▶ Chapter: Directives
- ▶ Exercises/simple-directive.html
- ▶ Exercises/simple-directive.js

169

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

170

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
- ▶ The key is the name of the variable to be used in the template
- ▶ The value is the name of the attribute in the directive
- ▶ The value will be prefixed by an @, = or &, depending on how data is passed to the attribute

171

Resolving attributes

- ▶ If you are passing data to an attribute literally, use an @ before the value
 - Any value passed to an @ attribute will have toString() called on it automatically before the template gets hold of that value
- ▶ If you want the data passed to the attribute to be resolved against the current scope that the directive is being used in, use an =
 - This is the only way to pass object, arrays, types, etc.
- ▶ If you want to pass a reference to a function that should be executed, use an &
- ▶ Finally, if the name of the attribute and the name of the variable in the template are the same, you can simply use an @, =, or & as appropriate

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Directive scope: attributes

▶ Using @ to access attribute data

```
1. var mod = angular.module(...);
2. mod.directive('myAttr', function() {
3.   return {
4.     restrict: 'A', // Acting as an attribute
5.     scope : {
6.       attrValue : '@myAttr', // Value of attribute
7.                               // available as attrValue
8.       myAttr : '@' // Looks for the attribute with the
9.                   // same name as the key
10.    }
11.  }
12. });
```

173

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

174

Exercise: Using directives

- ▶ We have enough pieces of the puzzle to be able to design our own directive
- ▶ Chapter: Directives
- ▶ Exercises\ProductDirective

175

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

176

jqLite

- ▶ The element argument to the link function is a DOM element wrapped by Angular's jqLite library
- ▶ jqLite is a lightweight implementation of jQuery's DOM manipulation API
- ▶ If you include jQuery into your application *before* including Angular, Angular will use jQuery instead of jqLite

177

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

178

Demo: DOM Manipulation

- ▶ Chapter: Directives
- ▶ Demos/object-dumper.html
- ▶ Demos/object-dumper.js
- ▶ Demos/dom-directive.html
- ▶ Demos/dom-directive.js

179

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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Demo: Wrapping and transcluding

- ▶ Chapter: Directives
- ▶ Demos\transclude.html
- ▶ Demos\transclude.js

181

Exercise: Complete directive

- ▶ In which we use a directive to generate a menu
- ▶ Chapter: Directives
- ▶ Exercises/ProductMenu

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Conclusion

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Customizations

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Chapter preview

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

185

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

186

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);  
    }]);
```

187

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);`

188

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)

190

Demo: Custom filters

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

191

Exercise: Filters

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

192

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

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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

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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`

196

Exercise: Adding custom Filters

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

197

The Document Object Model

- ▶ Angular does not interact with the DOM until it has done a variety of other setup work
- ▶ This can have a few side effects
- ▶ We have already experienced the possibility of the flash of uncompiled content
- ▶ But there is also the issue of what to do with dynamic HTML sources
- ▶ We will solve each in turn

198

Waiting for the DOM to be ready

- ▶ There are three basic ways to wait for the DOM to be ready before rendering your content
- ▶ Use Angular's **ng-bind**, which eliminates the `{{ }}` expression and hides the association within the attributes of the target element
- ▶ Use Angular's **ng-cloak**, which will hide certain elements on the page by applying a class early in the compilation process
- ▶ Move to using asynchronous templates (which we'll see soon) which are processed before they are displayed

199

Demo: Solving uncompiled content

- ▶ Two demos which use variations on ng-cloak and ng-bind to solve flashes of unstyled content
- ▶ Chapter: Customizations
- ▶ Demos\lifecycle-cloak.html
- ▶ Demos\lifecycle-cloak.js
- ▶ Demos\lifecycle-cloak-body.html

200

Problems with the src attribute

- ▶ There is no restriction on using Angular expressions as values within the attributes of HTML elements
- ▶ But this can be problematic within the **src** attribute
- ▶ Imagine this code:
 - ``
- ▶ When the browser initially loads the page, the **src** attribute will not make sense to it and may result in an error, or being ignored
- ▶ Only later, when Angular has had a chance to process this element, will the source attribute have the correct value

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The solution

- ▶ Angular provides a directive, **ng-src**, which solves this problem
- ▶ Set the value of **ng-src** to the value you would have set for **src**, get rid of **src** entirely, and everything works out fine
- ▶ Behind the scenes, **ng-src** is not processed by the browser but later on, by Angular
- ▶ At that point, the browser recognizes that the **src** attribute of the image has been set and downloads it appropriately

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Other attribute issues

- ▶ You could imagine a similar problem with the anchor tag's **href** attribute
- ▶ Of course, Angular provides the **ng-href** attribute, which does for **href** what **ng-src** does for **src**
- ▶ In fact, if you prefix any attribute with **ng-attr-**, it will be processed by Angular, instead of eagerly processed by your browser
- ▶ `<p ng-attr-class="whatever">...</p>`

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Demo: Using ng-src

- ▶ Chapter: Customizations
- ▶ Demos\using-sources.html
- ▶ Demos\using-sources.js

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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

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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

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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()**

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\$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

215

Demo: Scopes and views

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

216

"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

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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?

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Demo: Controller-as syntax

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

219

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

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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)

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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

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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

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Demo: Scope events

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

224

Exercise: Broadcasting and emitting

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

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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

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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`

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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

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\$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')`

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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

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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)

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Demo: Resource in action

- ▶ Chapter: NgResource
- ▶ Demos/BasicResource

237

Exercise: Resources

- ▶ Chapter: NgResource
- ▶ Exercises/FirstResource

238

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

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Conclusion

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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

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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

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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>**

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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()**

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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?

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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 **\$scopes** 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

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A reusable controller tester

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

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

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

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

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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

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Demo: Testing controllers

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

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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

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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

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Demo: Filter tests

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

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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

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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_;
  } );
} );
```

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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

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Demo: Mocking providers

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

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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

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Demo: Testing a basic directive

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

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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

270

Exercise: Unit testing directives

- ▶ Chapter: UnitTesting
- ▶ Exercises/TestDirectives

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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

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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	<code>.expect(...).respond(...)</code>	<code>when(...).respond(...)</code>
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

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AngularJS and the back-end	
▶	<code>\$httpBackend</code> allows us to mock out any <code>\$http</code> calls
▶	Inject <code>\$httpBackend</code> into your test and configure pairings of urls and responses
▶	<code>\$httpBackend.when(method, someUrl[, data, headers])</code> <ul style="list-style-type: none">• 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

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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

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\$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`**

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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()`** ;

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Demo: Mocking with \$httpBackend

- ▶ Chapter: UnitTesting
- ▶ Demos/AsyncBackend

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Exercise: Mocking backends

▶ Chapter: UnitTesting

▶ Exercises/TestingHttp

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Conclusion

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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

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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

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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

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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

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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)

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Demo: Protractor tests

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

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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

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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

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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?

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More with the ElementFinder

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

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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

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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)**

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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

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Demo: Protractor and promises

- ▶ Chapter: EndToEndTesting
- ▶ Demos/Promises

298

Exercise: Writing Protractor tests

- ▶ Chapter: EndToEndTesting
- ▶ Exercises/ MainTest

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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

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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()`

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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

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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)`

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Demo: Mocking a backend

- ▶ Chapter: EndToEndTesting
- ▶ Demos/E2EMock/

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Exercise: Building a mocked backend

▶ Chapter: EndToEndTesting

▶ Exercises/ MockedBackend

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Conclusion

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Angular Forms

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Chapter preview

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

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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

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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

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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

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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"/>`
- ▶ Could be accessed as `$scope.formName.foo`
- ▶ Or as `$scope.bar`

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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

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Debouncing with ngModelOptions

- ▶ The **debounce** option controls how long until a model update propagates
- ▶ It does not 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

315

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

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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

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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

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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; only 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

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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)

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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

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Demo: Validation styling

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

324

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

325

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

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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

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More ModelController properties

- ▶ **\$untouched**
- ▶ **\$touched**
- ▶ **\$pristine**
- ▶ **\$dirty**
- ▶ **\$valid**
- ▶ **\$invalid**

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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

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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

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Exercise: ng-messages

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

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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

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Conclusion

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Advanced directives

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Chapter preview

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

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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

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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

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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

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Demo: Inter-directive communication

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

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Exercise: Controller communication

- ▶ Chapter: AdvDirectives
- ▶ Exercises/ControllerComms

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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

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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`**

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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

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Demo: Overriding validations

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

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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

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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**

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Demo: Custom validations

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

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Exercise: Custom validations

- ▶ Chapter: AdvDirectives
- ▶ Exercises/CustomValidations

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Conclusion

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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

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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

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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>`

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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

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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 and only one 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

```

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

3. customerApp.config(['$routeProvider',
4.   function($routeProvider) {
5.     $routeProvider.when( '/customers', {
6.       templateUrl: 'partials/cust-list-tpl.html',
7.       controller: 'CustListCtrl' } )
8.     .when( '/customers/:custId', {
9.       templateUrl: 'partials/cust-detail-tpl.html',
10.      controller: 'CustDetailCtrl' } )
11.     .otherwise( { redirectTo: '/customers' } );
12. } ] );

```

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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

```
1. var customerControllers =
2.   angular.module('customerControllers', []);
3.   customerControllers.controller('CustListCtrl',
4.     ['$scope', '$http', function($scope, $http) {
5.       // Code for retrieving customer list here
6.     } ] );

7.   customerControllers.controller('CustDetailCtrl',
8.     ['$scope', '$routeParams',
9.     function($scope, $routeParams) {
10.       $scope.custId = $routeParams.custId;
11.     } ] );
```

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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

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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**

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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

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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

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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

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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

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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)

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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

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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

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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

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Demo: No hashes

- ▶ Chapter: Routing
- ▶ Demos\PushStateRouting\

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Conclusion

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