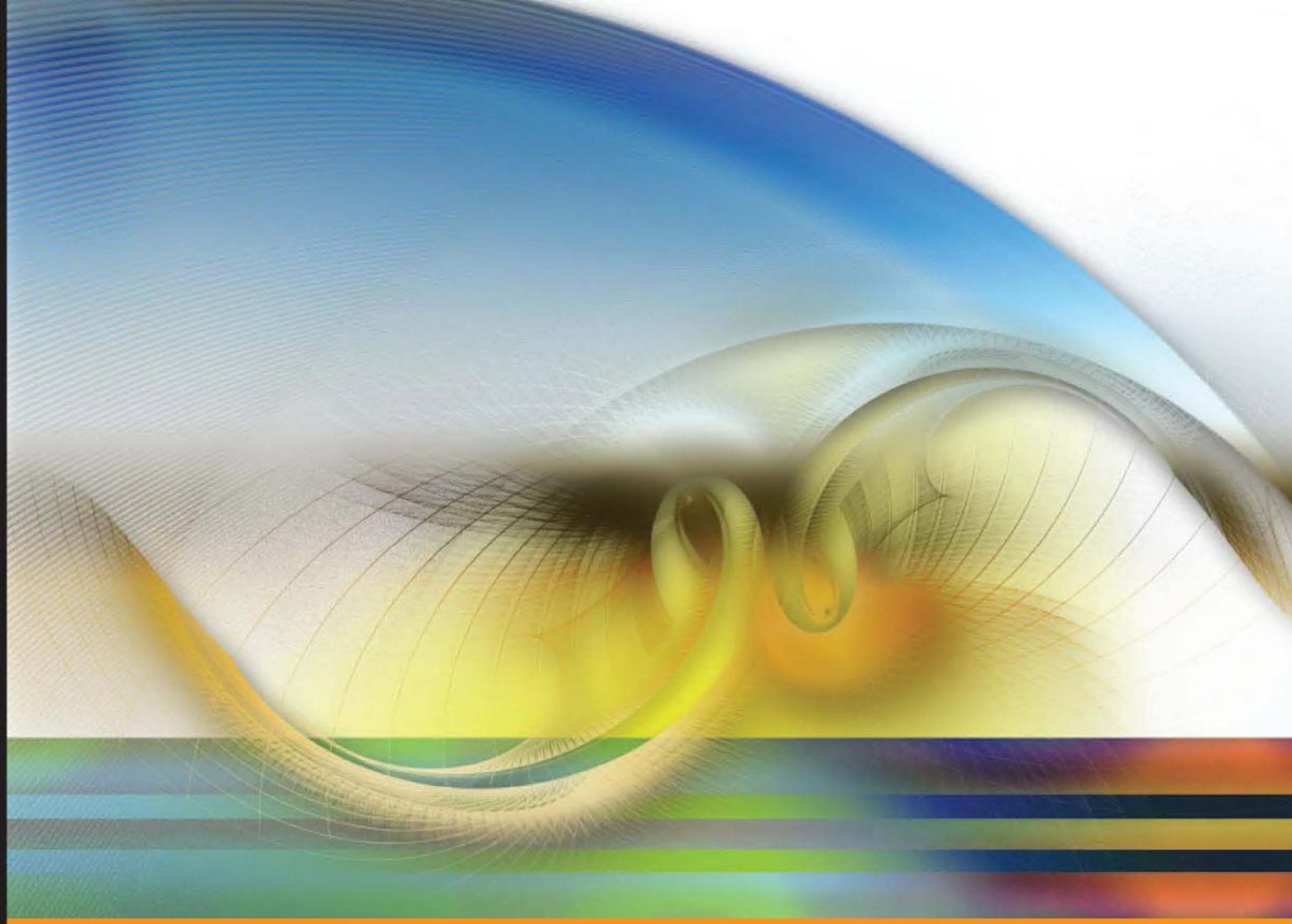

AngularJS Essentials

Design and construct reusable, maintainable, and modular web applications with AngularJS

Rodrigo Branas

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community experience distilled

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BIRMINGHAM - MUMBAI

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First published: August 2014

Production reference: 1140814

Published by Packt Publishing Ltd.
Livery Place
35 Livery Street
Birmingham B3 2PB, UK.

ISBN 978-1-78398-008-6

www.packtpub.com

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About the Author

Rodrigo Branas is a software architect, author, and international speaker on software development based in Brazil, with more than 12 years of experience in developing enterprise applications.

Lately, he has been participating in the development of many successful products based on the AngularJS framework. A major part of these applications were made available to the education industry, and are now used by thousands of users across the country.

He is also the founder of Agile Code, a consultancy and training company that works effectively with architects, developers, designers, and testers in order to produce high-quality products.

He graduated in Computer Science and has an MBA degree in Project Management. He is certified in SCJA, SCJP, SCJD, SCWCD, and SCBCD from Sun Microsystems; PMP from Project Management Institute; MCP from Microsoft; and CSM from Scrum Alliance.

In the past few years, he has dedicated himself to spreading knowledge in the software development community. Also, he is the author of *Java Magazine*, one of the most recognized technical publications in Brazil. His website address is `http://www.agilecode.com.br`. He can be contacted at `rodrigo.branas@gmail.com` and you can follow him on Twitter at `@rodrigobranas`.

Acknowledgments

Writing this book was an incredible challenge! Throughout this time, I had the pleasure to count on my lovely wife, Rosana Branas, who provided me with all the inspiration, motivation, and affection that I needed.

Also, I am very happy and glad about sharing this experience with my reviewers: Felipe Trevisol, Cleberson Faccin, Andrei Eichler, and Ruoyu Sun. They provided me with their views, which I feel were quite important, and advice that helped improve the text considerably.

I also would like to thank my great friend, Rafael Nami, who introduced me to the AngularJS world, helping me during my first steps with this amazing technology.

Special thanks to the outstanding editorial team at Packt Publishing: Ankita Goenka, Aboli Ambardekar, Harsha Bharwani, Sharvari Tawde, Shiny Poojary, Kirti Pujari, and Veena Manjrekar.

Finally, this book would not be complete without the support of my family! I would especially like to thank my mom and dad, for the continuous love, education, support, and encouragement that they have always provided me!

About the Reviewers

Andrei M. Eichler is a young developer with a great passion for learning. His main experiences include working with large Postgres databases and Java, and he is now venturing into Scala, performant JavaScript, and web application development.

Cleberson C. C. Faccin is a graduate in Systems Information from Universidade Federal de Santa Catarina, Brazil. Since 2004, he has been working in the field of software development. During these 10 years, he has worked with several technologies, from mainframes to applications of mobile devices. Currently, his focus is on his work in JavaScript, where he is building applications for mobiles with JavaScript.

Ruoyu Sun is a designer and developer living in Hong Kong. He is passionate about programming and has contributed to several open source projects. He is the founder of several tech start-ups using a variety of technologies before working in the industry. He is the author of *Designing for XOOPS*, *O'Reilly Media*.

I would like to thank all my friends and family who have always supported me.

Felipe Trevisol is a software architect who loves research, travel, and playing guitar. He has worked with SOA and systems integration.

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Preface

For more than 12 years, I have been developing all kinds of web applications, and along the way, I have had the opportunity to experience the vast majority of frameworks on the Java platform. In 2008, I moved from an architecture highly based on backend web frameworks such as Struts and JSF to experience new challenges at the frontend. I think the main goal was to stop creating those old-school and hard-to-use web applications, investing on interactivity and usability.

At that time, I adopted the Google Web Toolkit, also known as GWT, building some web applications for almost 2 years. The results were pretty amazing in terms of user experience; however, I felt very upset about low productivity and also the amount of code that I had to write every day.

After that, in 2010, I decided to change drastically, adopting a much simpler approach by using just HTML, CSS, and JavaScript to write the frontend code. The experience was fantastic, which provided me with a very fast feedback cycle. The only problem was the lack of a layered architecture, which was unable to provide a clear separation of concerns while working with the JavaScript language. Also, I was missing things such as a strong dependency injection mechanism that would allow me to create reusable and testable components.

While looking for a solution, a very experienced JavaScript developer and also a great friend of mine, Rafael Nami, introduced me to AngularJS. In the following weeks, I started to read everything about it and also writing some code. After a few weeks, I was thrilled because it had never been so easy to create amazing web applications with so little code!

Only 2 months later, I launched my first web application based entirely on AngularJS, and honestly, I cannot imagine writing this same application using another kind of technology in this short period of time. I was so excited about it that I wrote an article on using AngularJS with Spring MVC and Hibernate for a magazine called *Java Magazine*. After that, I created an AngularJS training program that already has more than 200 developers who enrolled last year.

This book, *AngularJS Essentials*, is the result of that experience. This is a very practical guide, filled with many step-by-step examples that will lead you through the best practices of this amazing framework.

We are going to start, after a brief introduction, by learning how to create reusable components with directives. Then, we will take a look at many data handling techniques, discovering a complete set of technologies that are capable to accomplish any challenge related to present, transform, and validate data on the user's interface.

After that, we will explore the secrets of the dependency injection mechanism and also learn how to create services in order to improve the application's design. Also, we are going to discover the best way to deal with the scope and how to break up the application into separate modules, giving rise to reusable and interchangeable libraries.

Finally, we are going to learn how to test each component of the framework using Jasmine and also how to automate the workflow, creating an optimized distribution package with Grunt.

Rodrigo Branas
Software Architect, Author and International Speaker
Agile Code

What this book covers

Chapter 1, *Getting Started with AngularJS*, introduces the framework and its architectural model. After that, we will start coding our first application and also understand how to organize our project.

Chapter 2, *Creating Reusable Components with Directives*, explains how the directives are one of the most important features of the framework. With them, we will understand how to extend the HTML language vocabulary, creating new behaviors and reusable components.

Chapter 3, *Data Handling*, explains how the framework provides a complete set of technologies to fulfill any requirement about presenting, transforming, synchronizing, and validating data on the user's interface. We will go through all of these technologies in order to improve the user experience with our applications.

Chapter 4, *Dependency Injection and Services*, explains how we are going to create reusable and decoupled components by implementing services and using the dependency injection mechanism.

Chapter 5, *Scope,* discusses how scope is one of the main concepts of the framework. In this chapter, we will discover the best practices to deal with scope.

Chapter 6, *Modules*, briefs us on how the framework is strongly based on the modules. In this chapter, we will understand how to break up our application into modules.

Chapter 7, *Unit Testing*, shows how we will dive deeply into testing techniques. We are going to understand how to test each framework component using Jasmine.

Chapter 8, *Automating the Workflow*, discusses how we will create an optimized distribution package for our application using Grunt and its plugins. Also, we will discover how to manage our dependencies with Bower.

What you need for this book

To implement the code in this book, you will need to use your favorite development interface and a web browser. I would recommend sublime text, but you may use Aptana (which is based on Eclipse), WebStorm, or any other IDE.

AngularJS is compatible with the most browsers such as Firefox, Chrome, Safari, and Internet Explorer. Feel free to choose the one you are used to.

Who this book is for

If you have a passion for web development and are looking for a framework that could provide a reusable, maintainable, and modular way to create applications, and at the same time, help increase your productivity and satisfaction, this is the book for you.

Conventions

In this book, you will find a number of styles of text that distinguish between different kinds of information. Here are some examples of these styles, and an explanation of their meaning.

Code words in text, database table names, folder names, filenames, file extensions, pathnames, dummy URLs, user input, and Twitter handles are shown as follows: "The `$http` service wraps the low-level interaction with the `XMLHttpRequest` object, providing an easy way to perform AJAX calls without headaches."

A block of code is set as follows:

```
$http.get("/cars")
  .success(function(data, status, headers, config) {
    $scope.car = data;
  })
  .error(function(data, status, headers, config) {
    console.log(data);
  });
```

When we wish to draw your attention to a particular part of a code block, the relevant lines or items are set in bold:

```
$http.get("/cars")
  .success(function(data, status, headers, config) {
    $scope.car = data;
  })
  .error(function(data, status, headers, config) {
    console.log(data);
  });
```

Any command-line input or output is written as follows:

```
bower install angular
```

New terms and **important words** are shown in bold. Words that you see on the screen, in menus or dialog boxes for example, appear in the text like this: "What happens when we change the plate and click on the **Show Plate** button?".

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Tips and tricks appear like this.

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1
Getting Started with AngularJS

HyperText Markup Language (**HTML**) was created in 1990 by Tim Berners-Lee—a famous physics and computer scientist—while he was working at CERN, the European Organization for Nuclear Research. He was motivated about discovering a better solution to share information among the researchers of the institution. To support that, he also created the **HyperText Transfer Protocol** (**HTTP**) and its first server, giving rise to the **World Wide Web** (**WWW**).

In the beginning, HTML was used just to create static documents with hyperlinks, allowing the navigation between them. However, in 1993, with the creation of **Common Gateway Interface** (**CGI**), it became possible to exhibit dynamic content generated by server-side applications. One of the first languages used for this purpose was Perl, followed by other languages such as Java, PHP, Ruby, and Python.

Because of that, interacting with any complex application through the browser wasn't an enjoyable task and it was hard to experience the same level of interaction provided by desktop applications. However, the technology kept moving forward, at first with technologies such as Flash and Silverlight, which provided an amazing user experience through the usage of plugins.

At the same time, the new versions of JavaScript, HTML, and CSS had been growing in popularity really fast, transforming the future of the Web by achieving a high level of user experience without using any proprietary plugin.

AngularJS is a part of this new generation of libraries and frameworks that came to support the development of more productive, flexible, maintainable, and testable web applications.

This chapter will introduce you to the most important concepts of AngularJS. The topics that we'll be covering in this chapter are:

- Introduction to AngularJS
- Understanding the architectural concepts
- Setting up the framework
- Organizing the code

Introduction to AngularJS

Created by Miško Hevery and Adam Abrons in 2009, AngularJS is an open source, client-side JavaScript framework that promotes a high-productivity web development experience.

It was built on the belief that declarative programming is the best choice to construct the user interface, while imperative programming is much better and preferred to implement an application's business logic.

To achieve this, AngularJS empowers traditional HTML by extending its current vocabulary, making the life of developers easier.

The result is the development of expressive, reusable, and maintainable application components, leaving behind a lot of unnecessary code and keeping the team focused on the valuable and important things.

In 2010, Miško Hevery was working at Google on a project called Feedback. Based on **Google Web Toolkit** (**GWT**), the Feedback project was reaching more than 17.000 lines of code and the team was not satisfied with their productivity. Because of that, Miško made a bet with his manager that he could rewrite the project in 2 weeks using his framework.

After 3 weeks and only 1.500 lines of code, he delivered the project! Nowadays, the framework is used by more than 100 projects just at Google, and it is maintained by its own internal team, in which Miško takes part.

The name of the framework was given by Adam Abrons, and it was inspired by the angle brackets of the HTML elements.

Architectural concepts

It's been a long time since the famous **Model-View-Controller** (**MVC**) pattern started to gain popularity in the software development industry and became one of the legends of the enterprise architecture design.

Basically, the model represents the knowledge that the view is responsible for presenting, while the controller mediates the relationship between model and view. However, these concepts are a little bit abstract, and this pattern may have different implementations depending on the language, platform, and purpose of the application.

After a lot of discussions about which architectural pattern the framework follows, its authors declared that from now on, AngularJS would adopt **Model-View-Whatever** (**MVW**). Regardless of the name, the most important benefit is that the framework provides a clear separation of the concerns between the application layers, providing modularity, flexibility, and testability.

In terms of concepts, a typical AngularJS application consists primarily of a view, model, and controller, but there are other important components, such as services, directives, and filters.

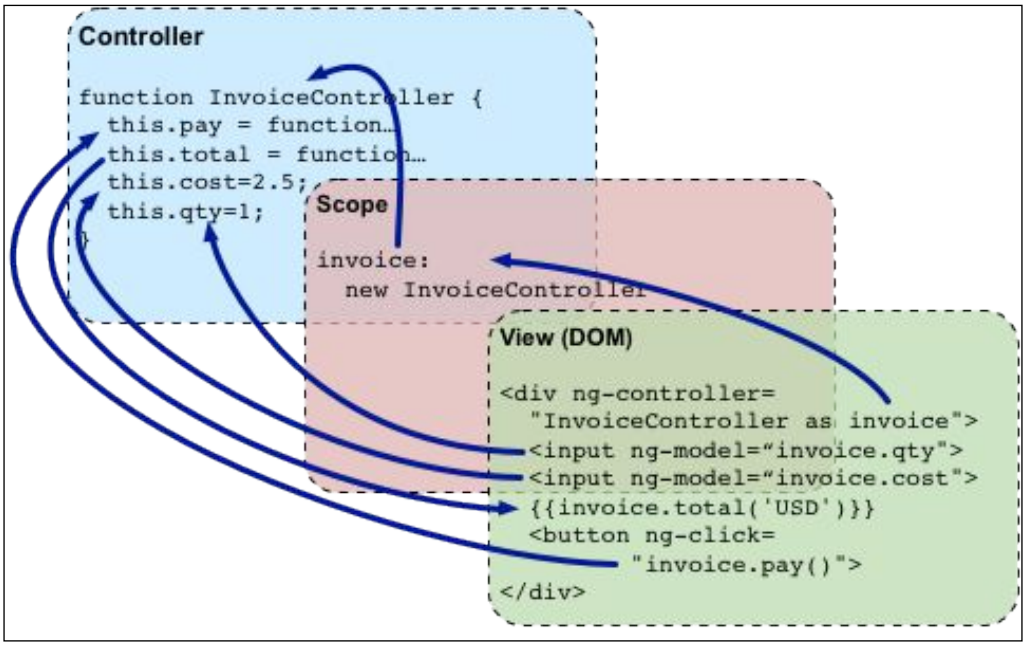
The view, also called template, is entirely written in HTML, which provides a great opportunity to see web designers and JavaScript developers working side by side. It also takes advantage of the directives mechanism, which is a type of extension of the HTML vocabulary that brings the ability to perform programming language tasks such as iterating over an array or even evaluating an expression conditionally.

Behind the view, there is the controller. At first, the controller contains all the business logic implementation used by the view. However, as the application grows, it becomes really important to perform some refactoring activities, such as moving the code from the controller to other components (for example, services) in order to keep the cohesion high.

The connection between the view and the controller is done by a shared object called scope. It is located between them and is used to exchange information related to the model.

The model is a simple **Plain-Old-JavaScript-Object** (**POJO**). It looks very clear and easy to understand, bringing simplicity to the development by not requiring any special syntax to be created.

The following diagram exhibits the interaction between the AngularJS architecture components:



Source: Official documentation (`www.angularjs.org`)

Setting up the framework

The configuration process is very simple and in order to set up the framework, we start by importing the `angular.js` script to our HTML file. After that, we need to create the application module by calling the `module` function from the Angular's API, with its name and dependencies.

With the module already created, we just need to place the `ng-app` attribute with the module's name inside the `html` element or any other element that surrounds the application. This attribute is important because it supports the initialization process of the framework that we will study in the later chapters.

In the following code, there is an introductory application about a parking lot. At first, we are able to add and also list the parked cars, storing its plate in memory. Throughout the book, we will evolve this parking control application by incorporating each newly studied concept.

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```
index.html – Parking Lot Application

<!doctype html>
<!-- Declaring the ng-app -->
<html ng-app="parking">
  <head>
    <title>Parking</title>
    <!-- Importing the angular.js script -->
    <script src="angular.js"></script>
    <script>
      // Creating the module called parking
      var parking = angular.module("parking", []);
      // Registering the parkingCtrl to the parking module
      parking.controller("parkingCtrl", function ($scope) {
        // Binding the car's array to the scope
        $scope.cars = [
          {plate: '6MBV006'},
          {plate: '5BBM299'},
          {plate: '5AOJ230'}
        ];
        // Binding the park function to the scope
        $scope.park = function (car) {
          $scope.cars.push(angular.copy(car));
          delete $scope.car;
        };
      });
    </script>
  </head>
  <!-- Attaching the view to the parkingCtrl -->
  <body ng-controller="parkingCtrl">
    <h3>[Packt] Parking</h3>
    <table>
      <thead>
        <tr>
          <th>Plate</th>
        </tr>
```

```
        </thead>
        <tbody>
          <!-- Iterating over the cars -->
          <tr ng-repeat="car in cars">
            <!-- Showing the car's plate -->
            <td>{{car.plate}}</td>
          </tr>
        </tbody>
      </table>
      <!-- Binding the car object, with plate, to the scope -->
      <input type="text" ng-model="car.plate"/>
      <!-- Binding the park function to the click event -->
      <button ng-click="park(car)">Park</button>
    </body>
  </html>
```

Apart from learning how to set up the framework in this section, we also introduced some directives that we are going to study in the *Chapter 2*, *Creating Reusable Components with Directives*.

The `ngController` directive is used to bind the `parkingCtrl` controller to the view, whereas the `ngRepeat` directive iterates over the car's array. Also, we employed expressions such as `{{car.plate}}` to display the plate of the car. Finally, to add new cars, we applied the `ngModel` directive, which creates a new object called `car` with the `plate` property, passing it as a parameter of the `park` function, called through the `ngClick` directive.

To improve the loading page's performance, you are recommended to use the minified and obfuscated version of the script that can be identified by `angular.min.js`. Both minified and regular distributions of the framework can be found on the official site of AngularJS (`http://www.angularjs.org`) or in the Google **Content Delivery Network** (**CDN**).

Organizing the code

As soon as we start coding our views, controllers, services, and other pieces of the application, as it used to happen in the past with many other languages and frameworks, one question will certainly come up: "how do we organize the code?"

Most software developers struggle to decide on a lot of factors. This includes figuring out which is the best approach to follow (not only regarding the directory layout, but also about the file in which each script should be placed), whether it is a good idea to break up the application into separated modules, and so on.

This is a tough decision and there are many different ways to decide on these factors, but in most cases, it will depend simply on the purpose and the size of the application. For the time being, our challenge is to define an initial strategy that allows the team to evolve and enhance the architecture alongside application development. The answers related to deciding on the factors will certainly keep coming up as time goes on, but we should be able to perform some refactoring activities to keep the architecture healthy and up to date.

Four ways to organize the code

There are many ways, tendencies, and techniques to organize the project's code within files and directories. However, it would be impossible to describe all of them in detail, and we will present the most used and discussed styles in the JavaScript community.

Throughout the book, we will apply each of the following styles to our project as far as it evolves.

The inline style

Imagine that you need to develop a fast and disposable application prototype. The purpose of the project is just to make a presentation or to evaluate a potential product idea. The only project structure that we may need is the old and good `index.html` file with inline declarations for the scripts and style:

```
app/                    -> files of the application
  index.html            -> main html file
  angular.js            -> AngularJS script
```

If the application is accepted, based on the prototype evaluation, and becomes a new project, it is highly recommended that you create a whole structure from scratch based on one of the following styles.

The stereotyped style

This approach is appropriate for small apps with a limited number of components such as controllers, services, directives, and filters. In this situation, creating a single file for each script may be a waste. Thus, it could be interesting to keep all the components in the same file in a stereotyped way as shown in the following code:

```
app/                  -> files of the application
  css/                -> css files
    app.css           -> default stylesheet
  js/                 -> javascript application components
```

```
    app.js              -> main application script
    controllers.js      -> all controllers script
    directives.js       -> all directives script
    filters.js          -> all filters script
    services.js         -> all services script
  lib/                  -> javascript libraries
    angular.js          -> AngularJS script
  partials/             -> partial view directory
    login.html          -> login view
    parking.html        -> parking view
    car.html            -> car view
  index.html            -> main html file
```

With the application growing, the team may choose to break up some files by shifting to the specific style step by step.

The specific style

Keeping a lot of code inside the same file is really hard to maintain. When the application reaches a certain size, the best choice might be to start splitting the scripts into specific ones as soon as possible. Otherwise, we may have a lot of unnecessary and boring tasks in the future. The code is as follows:

```
app/                    -> files of the application
  css/                  -> css files
    app.css             -> default stylesheet
  js/                   -> javascript application components
    controllers/        -> controllers directory
      loginCtrl.js      -> login controller
      parkingCtrl.js    -> parking controller
      carCtrl.js        -> car controller
    directives/         -> directives directory
    filters/            -> filters directory
    services/           -> services directory
    app.js              -> main application script
  lib/                  -> javascript libraries
    angular.js          -> AngularJS script
  partials/             -> partial view directory
    login.html          -> login view
    parking.html        -> parking view
    car.html            -> car view
  index.html            -> main html file
```

In this approach, if the number of files in each directory becomes oversized, it is better to start thinking about adopting another strategy, such as the domain style.

The domain style

With a complex domain model and hundreds of components, an enterprise application can easily become a mess if certain concerns are overlooked. One of the best ways to organize the code in this situation is by distributing each component in a domain-named folder structure. The code is as follows:

```
app/                    -> files of the application
  application/          -> application module directory
    app.css             -> main application stylesheet
    app.js              -> main application script
  login/                -> login module directory
    login.css           -> login stylesheet
    loginCtrl.js        -> login controller
    login.html          -> login view
  parking/              -> parking module directory
    parking.css         -> parking stylesheet
    parkingCtrl.js      -> parking controller
    parking.html        -> parking view
  car/                  -> car module directory
    car.css             -> car stylesheet
    carCtrl.js          -> car controller
    car.html            -> car view
  lib/                  -> javascript libraries
    angular.js          -> AngularJS script
  index.html            -> main html file
```

Summary

Since the creation of the Web, many technologies related to the use of HTML and JavaScript have evolved. These days, there are lots of great frameworks such as AngularJS that allow us to create really well-designed web applications.

In this chapter, you were introduced to AngularJS in order to understand its purposes. Also, we created our first application and took a look at how to organize the code.

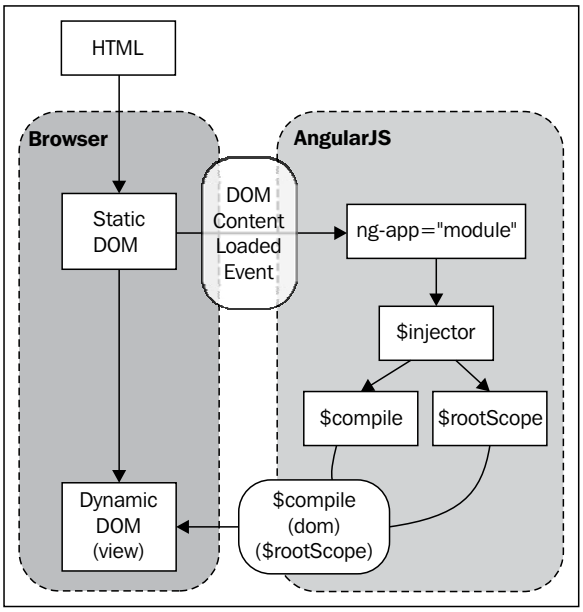
In the next chapter, you will understand how the AngularJS directives can be used and created to promote reuse and agility in your applications.

2
Creating Reusable Components with Directives

The **Document Object Model** (**DOM**) is a convention created by W3C in 1998 for documents written in HTML, XHTML, and XML in an object tree, which is used by the browsers throughout the rendering process. By means of the DOM API, it is possible to traverse the hierarchical structure of the tree to access and manipulate information.

Every time we access a web page, the browser sends a request to the server and then waits for the response. Once the content of the HTML document is received, the browser starts the analysis and the parse process in order to build the DOM tree. When the tree building is done, the AngularJS compiler comes in and starts to go through it, looking into the elements for special kinds of attributes known as directives.

The following diagram describes the bootstrapping process of the framework that is performed during the compilation process:



Source: Official documentation (`www.angularjs.org`)

This chapter will present everything about directives, which is one of the most important features of AngularJS. Also, we will create our own directives step by step. The following are the topics that we'll be covering in this chapter:

- What is a directive?
- Using built-in directives of AngularJS
- Refactoring application organization
- Creating our own directives
- Animation

What is a directive?

A directive is an extension of the HTML vocabulary that allows us to create new behaviors. This technology lets the developers create reusable components that can be used within the whole application and even provide their own custom components.

The directive can be applied as an attribute, element, class, and even as a comment, using the camelCase syntax. However, because HTML is case insensitive, we can use a lowercase form.

For the `ngModel` directive, we can use `ng-model`, `ng:model`, `ng_model`, `data-ng-model`, and `x-ng-model` in the HTML markup.

Using AngularJS built-in directives

By default, a framework brings with it a basic set of directives such as iterate over an array, execute a custom behavior when an element is clicked, or even show a given element based on a conditional expression, and many others.

The ngApp directive

The `ngApp` directive is the first directive we need to understand because it defines the root of an AngularJS application. Applied to one of the elements, in general HTML or body, this directive is used to bootstrap the framework. We can use it without any parameter, thereby indicating that the application will be bootstrapped in the automatic mode, as shown in the following code:

```
index.html

<!doctype html>
<html ng-app>
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
  </head>
  <body>
  </body>
</html>
```

However, it is recommended that you provide a module name, defining the entry point of the application in which other components such as controllers, services, filters, and directives can be bound, as shown in the following code:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
```

```
    <script>
      var parking = angular.module("parking", []);
    </script>
  </head>
  <body>
  </body>
</html>
```

There can be only one `ngApp` directive in the same HTML document that will be loaded and bootstrapped by the framework automatically. However, it's possible to have others as long as you manually bootstrap them.

The ngController directive

In our first application in *Chapter 1*, *Getting Started with AngularJS*, we used a controller called `parkingCtrl`. We can attach any controller to the view using the `ngController` directive. After using this directive, the view and controller start to share the same scope and are ready to work together, as shown in the following code:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
    <script>
      var parking = angular.module("parking", []);
      parking.controller("parkingCtrl", function ($scope) {
      });
    </script>
  </head>
  <body ng-controller="parkingCtrl">
  </body>
</html>
```

There is another way to attach a controller to a specific view. In the following chapters, we will learn how to create a single-page application using the `$route` service. To avoid undesired duplicated behavior, remember to avoid the `ngController` directive while using the `$route` service.

Nested controllers

Sometimes, our controller can become too complex, and it might be interesting to split the behavior into separated controllers. This can be achieved by creating nested controllers, which means registering controllers that will work only inside a specific element of the view, as shown in the following code:

```
<body ng-controller="parkingCtrl">
  <div ng-controller="parkingNestedCtrl">
  </div>
</body>
```

The scope of the nested controllers will inherit all the properties of the outside scope, overriding it in case of equality.

The ngBind directive

The `ngBind` directive is generally applied to a span element and replaces the content of the element with the results of the provided expression. It has the same meaning as that of the double curly markup, for example, `{{expression}}`.

Why would anyone like to use this directive when a less verbose alternative is available? This is because when the page is being compiled, there is a moment when the raw state of the expressions is shown. Since the directive is defined by the attribute of the element, it is invisible to the user. We will learn these expressions in *Chapter 3*, *Data Handling*. The following is an example of the `ngBind` directive usage:

index.html

```
<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
    <script>
      var parking = angular.module("parking", []);
      parking.controller("parkingCtrl", function ($scope) {
        $scope.appTitle = "[Packt] Parking";
      });
    </script>
  </head>
  <body ng-controller="parkingCtrl">
    <h3 ng-bind="appTitle"></h3>
  </body>
</html>
```

The ngBindHtml directive

Sometimes, it might be necessary to bind a string of raw HTML. In this case, the `ngBindHtml` directive can be used in the same way as `ngBind`; however, the only difference will be that it does not escape the content, which allows the browser to interpret it as shown in the following code:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
    <script src="angular-sanitize.js"></script>
    <script>
      var parking = angular.module("parking", []);
      parking.controller("parkingCtrl", function ($scope) {
        $scope.appTitle = "<b>[Packt] Parking</b>";
      });
    </script>
  </head>
  <body ng-controller="parkingCtrl">
    <h3 ng-bind-html="appTitle"></h3>
  </body>
</html>
```

In order to use this directive, we will need the `angular-sanitize.js` dependency. It brings the `ngBindHtml` directive and protects the application against common cross-site scripting (XSS) attacks.

The ngRepeat directive

The `ngRepeat` directive is really useful to iterate over arrays and objects. It can be used with any kind of element such as the rows of a table, the elements of a list, and even the options of `select`.

We must provide a special repeat expression that describes the array to iterate over the variable that will hold each item in the iteration. The most basic expression format allows us to iterate over an array, attributing each element to a variable:

```
variable in array
```

In the following code, we will iterate over the `cars` array and assign each element to the `car` variable:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
    <script>
      var parking = angular.module("parking", []);
      parking.controller("parkingCtrl", function ($scope) {
        $scope.appTitle = "[Packt] Parking";

        $scope.cars = [];
      });
    </script>
  </head>
  <body ng-controller="parkingCtrl">
    <h3 ng-bind="appTitle"></h3>
    <table>
      <thead>
        <tr>
          <th>Plate</th>
          <th>Entrance</th>
        </tr>
      </thead>
      <tbody>
        <tr ng-repeat="car in cars">
          <td><span ng-bind="car.plate"></span></td>
          <td><span ng-bind="car.entrance"></span></td>
        </tr>
      </tbody>
    </table>
  </body>
</html>
```

Also, it's possible to use a slightly different expression to iterate over objects:

```
(key, value) in object
```

Beyond iterating, we might need to identify which is the first or the last element, what is its index number, and many other things. This can be achieved by using the following properties:

Variable	Type	Details
`$index`	number	Number of the element
`$first`	Boolean	This is true if the element is the first one
`$last`	Boolean	This is true if the element is the last one
`$middle`	Boolean	This is true if the element is in the middle
`$even`	Boolean	This is true if the element is even
`$odd`	Boolean	This is true if the element is odd

The ngModel directive

The `ngModel` directive attaches the element to a property in the scope, thus binding the view to the model. In this case, the element can be `input` (all types), `select`, or `textarea`, as shown in the following code:

```
<input
  type="text"
  ng-model="car.plate"
  placeholder="What's the plate?"
/>
```

There is an important piece of advice regarding the use of this directive. We must pay attention to the purpose of the field that is using the `ngModel` directive. Every time the field is a part of the construction of an object, we must declare the object in which the property should be attached. In this case, the object that is being constructed is a car; so, we will use `car.plate` inside the directive expression.

However, sometimes it may so happen that there is an input field that is just used to change a flag, allowing the control of the state of a dialog or another UI component. In this case, we can use the `ngModel` directive without any object as long as it will not be used together with other properties or even persisted.

In *Chapter 5*, *Scope*, we will go through the two-way data binding concept. It is very important to understand how the `ngModel` directive works behind the scenes.

The ngClick directive and other event directives

The `ngClick` directive is one of the most useful kinds of directives in the framework. It allows you to bind any custom behavior to the click event of the element. The following code is an example of the usage of the `ngClick` directive calling a function:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
    <script>
      var parking = angular.module("parking", []);
      parking.controller("parkingCtrl", function ($scope) {
        $scope.appTitle = "[Packt] Parking";

        $scope.cars = [];

        $scope.park = function (car) {
          car.entrance = new Date();
          $scope.cars.push(car);
          delete $scope.car;
        };
      });
    </script>
  </head>
  <body ng-controller="parkingCtrl">
    <h3 ng-bind="appTitle"></h3>
    <table>
      <thead>
        <tr>
          <th>Plate</th>
          <th>Entrance</th>
        </tr>
      </thead>
      <tbody>
        <tr ng-repeat="car in cars">
          <td><span ng-bind="car.plate"></span></td>
          <td><span ng-bind="car.entrance"></span></td>
        </tr>
      </tbody>
```

```
    </table>
    <input
      type="text"
      ng-model="car.plate"
      placeholder="What's the plate?"
    />
    <button ng-click="park(car)">Park</button>
  </body>
</html>
```

In the preceding code, there is another pitfall. Inside the `ngClick` directive, we will call the `park` function, passing `car` as a parameter. As long as we have access to the scope through the controller, it would not be easy if we just accessed it directly, without passing any parameter at all.

Keep in mind that we must take care of the coupling level between the view and the controller. One way to keep it low is to avoid reading the scope object directly from the controller and replacing this intention by passing everything it needs with the parameter from the view. This will increase controller testability and also make the things more clear and explicit.

Other directives that have the same behavior but are triggered by other events are `ngBlur`, `ngChange`, `ngCopy`, `ngCut`, `ngDblClick`, `ngFocus`, `ngKeyPress`, `ngKeyDown`, `ngKeyUp`, `ngMousedown`, `ngMouseenter`, `ngMouseleave`, `ngMousemove`, `ngMouseover`, `ngMouseup`, and `ngPaste`.

The ngDisable directive

The `ngDisable` directive can disable elements based on the Boolean value of an expression. In this next example, we will disable the button when the variable is true:

```
<button
  ng-click="park(car)"
  ng-disabled="!car.plate"
>
  Park
</button>
```

In *Chapter 3*, *Data Handling*, we will learn how to combine this directive with validation techniques.

The ngClass directive

The `ngClass` directive is used every time you need to dynamically apply a class to an element by providing the name of the class in a data-binding expression. The following code shows the application of the `ngClass` directive:

index.html

```
<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
    <script>
      var parking = angular.module("parking", []);
      parking.controller("parkingCtrl", function ($scope) {
        $scope.appTitle = "[Packt] Parking";

        $scope.cars = [];

        $scope.park = function (car) {
          car.entrance = new Date();
          $scope.cars.push(car);
          delete $scope.car;
        };
      });
    </script>
    <style>
      .selected {
        background-color: #FAFAD2;
      }
    </style>
  </head>
  <body ng-controller="parkingCtrl">
    <h3 ng-bind="appTitle"></h3>
    <table>
      <thead>
        <tr>
          <th></th>
          <th>Plate</th>
          <th>Entrance</th>
        </tr>
      </thead>
      <tbody>
```

```
          <tr
            ng-class="{selected: car.selected}"
            ng-repeat="car in cars"
          >
            <td><input type="checkbox" ng-
              model="car.selected"/></td>
            <td><span ng-bind="car.plate"></span></td>
            <td><span ng-bind="car.entrance"></span></td>
          </tr>
        </tbody>
      </table>
      <input
        type="text"
        ng-model="car.plate"
        placeholder="What's the plate?"
      />
      <button
        ng-click="park(car)"
        ng-disabled="!car.plate"
      >
        Park
      </button>
    </body>
  </html>
```

The ngOptions directive

The `ngRepeat` directive can be used to create the options of a `select` element; however, there is a much more recommended directive that should be used for this purpose—the `ngOptions` directive.

Through an expression, we need to indicate the property of the scope from which the directive will iterate, the name of the temporary variable that will hold the content of each loop's iteration, and the property of the variable that should be displayed.

In the following example, we have introduced a list of colors:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <script src="angular.js"></script>
```

```
  <script>
    var parking = angular.module("parking", []);
    parking.controller("parkingCtrl", function ($scope) {
      $scope.appTitle = "[Packt] Parking";

      $scope.cars = [];

      $scope.colors = ["White", "Black", "Blue", "Red",
        "Silver"];

      $scope.park = function (car) {
        car.entrance = new Date();
        $scope.cars.push(car);
        delete $scope.car;
      };
    });
  </script>
  <style>
    .selected {
      background-color: #FAFAD2;
    }
  </style>
</head>
<body ng-controller="parkingCtrl">
  <h3 ng-bind="appTitle"></h3>
  <table>
    <thead>
      <tr>
        <th></th>
        <th>Plate</th>
        <th>Color</th>
        <th>Entrance</th>
      </tr>
    </thead>
    <tbody>
      <tr
        ng-class="{selected: car.selected}"
        ng-repeat="car in cars"
      >
        <td><input type="checkbox" ng-
          model="car.selected"/></td>
        <td><span ng-bind="car.plate"></span></td>
        <td><span ng-bind="car.color"></span></td>
```

```
            <td><span ng-bind="car.entrance"></span></td>
          </tr>
        </tbody>
      </table>
      <input
        type="text"
        ng-model="car.plate"
        placeholder="What's the plate?"
      />
      <select
        ng-model="car.color"
        ng-options="color for color in colors"
      >
        Pick a color
      </select>
      <button
        ng-click="park(car)"
        ng-disabled="!car.plate || !car.color"
      >
        Park
      </button>
    </body>
  </html>
```

This directive requires the use of the `ngModel` directive.

The ngStyle directive

The `ngStyle` directive is used to supply the dynamic style configuration demand. It follows the same concept used with the `ngClass` directive; however, here we can directly use the style properties and its values:

```
<td>
  <span ng-bind="car.color" ng-style="{color: car.color}">
  </span>
</td>
```

The ngShow and ngHide directives

The `ngShow` directive changes the visibility of an element based on its `display` property:

```
    <div ng-show="cars.length > 0">
      <table>
```

```
        <thead>
          <tr>
            <th></th>
            <th>Plate</th>
            <th>Color</th>
            <th>Entrance</th>
          </tr>
        </thead>
        <tbody>
          <tr
            ng-class="{selected: car.selected}"
            ng-repeat="car in cars"
          >
            <td><input type="checkbox" ng-
              model="car.selected"/></td>
            <td><span ng-bind="car.plate"></span></td>
            <td><span ng-bind="car.color"></span></td>
            <td><span ng-bind="car.entrance"></span></td>
          </tr>
        </tbody>
      </table>
    </div>
    <div ng-hide="cars.length > 0">
      The parking lot is empty
    </div>
```

Depending on the implementation, you can use the complementary `ngHide` directive of `ngShow`.

The ngIf directive

The `ngIf` directive could be used in the same way as the `ngShow` directive; however, while the `ngShow` directive just deals with the visibility of the element, the `ngIf` directive prevents the rendering of an element in our template.

The ngInclude directive

AngularJS provides a way to include other external HTML fragments in our pages. The `ngInclude` directive allows the fragmentation and reuse of the application layout and is an important concept to explore.

The following is an example code for the usage of the `ngInclude` directive:

```
<div ng-include="'menu.html'"></div>
```

Refactoring application organization

As long as our application grows with the creation of new components such as directives, the organization of the code needs to evolve. As we saw in the *Organizing the code* section in *Chapter 1*, *Getting Started with AngularJS*, we used the inline style; however, now we will use the stereotyped style, as shown in the following code:

index.html

```
<!doctype html>
<html ng-app="parking">
  <head>
<title>[Packt] Parking</title>
<script src="js/lib/angular.js"></script>
<script src="js/app.js"></script>
<script src="js/controllers.js"></script>
<script src="js/directives.js"></script>
<link rel="stylesheet" type="text/css" href="css/app.css">
  </head>
  <body ng-controller="parkingCtrl">
    <h3 ng-bind="appTitle"></h3>
    <div ng-show="cars.length > 0">
      <table>
        <thead>
          <tr>
            <th></th>
            <th>Plate</th>
            <th>Color</th>
            <th>Entrance</th>
          </tr>
        </thead>
        <tbody>
          <tr
            ng-class="{selected: car.selected}"
            ng-repeat="car in cars"
          >
            <td>
              <input
                type="checkbox"
                ng-model="car.selected"
              />
         </td>
            <td><span ng-bind="car.plate"></span></td>
```

```
            <td><span ng-bind="car.color"></span></td>
            <td><span ng-bind="car.entrance"></span></td>
          </tr>
        </tbody>
      </table>
    </div>
    <div ng-hide="cars.length > 0">
      The parking lot is empty
    </div>
    <input
      type="text"
      ng-model="car.plate"
      placeholder="What's the plate?"
    />
    <select
      ng-model="car.color"
      ng-options="color for color in colors"
    >
      Pick a color
    </select>
    <button
      ng-click="park(car)"
      ng-disabled="!car.plate || !car.color"
     >
       Park
    </button>
  </body>
</html>
```

app.js

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

controllers.js

```
parking.controller("parkingCtrl", function ($scope) {
  $scope.appTitle = "[Packt] Parking";

  $scope.cars = [];

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];

  $scope.park = function (car) {
```

```
    car.entrance = new Date();
    $scope.cars.push(car);
    delete $scope.car;
  };
});
```

Creating our own directives

Now that we have already studied a bunch of built-in directives of a framework, it's time to create our own reusable components! First, we need to know how to register a new directive into our module.

Basically, it's the same process that we use for the controller; however, the directives require the creation of something called **Directive Definition Object** that will be used to configure the directive's behavior:

```
parking.directive("directiveName", function () {
  return {
  };
});
```

Our first challenge involves the creation of an alert component. Following this, there is an image of the component that we are going to create together step by step:

The original code consists of a group of elements associated with some styles. Our mission is to transform this code into a reusable directive using the following directive configuration properties: `template`, `templateUrl`, `replace`, `restrict`, `scope`, and `transclude`:

```
<div class="alert">
  <span class="alert-topic">
    Something went wrong!
  </span>
  <span class="alert-description">
    You must inform the plate and the color of the car!
  </span>
</div>
```

template

Imagine the number of times you have had the same snippet of the HTML code repeated over your application code. In the following code snippet, we are going to create a new directive with the code to reuse this:

```
index.html

<div alert></div>

directives.js

parking.directive("alert", function () {
  return {
    template:   "<div class='alert'>" +
        "<span class='alert-topic'>" +
          "Something went wrong!" +
        "</span>" +
        "<span class='alert-description'>" +
          "You must inform the plate and the color of the car!" +
        "</span>" +
      "</div>"
  };
});
```

The output, after AngularJS has compiled the directive, is the following:

```
<div alert="">
  <div class="alert">
    <span class="alert-topic">
      Something went wrong!
    </span>
    <span class="alert-description">
      You must inform the plate and the color of the car!
    </span>
  </div>
</div>
```

templateUrl

There is another way to achieve the same goal with more quality. We just need to move the HTML snippet to an isolated file and bind it using the `templateUrl` property, as shown in the following code snippet:

```
index.html

<div alert></div>

directives.js

parking.directive("alert", function () {
  return {
    templateUrl: "alert.html"
  });

alert.html

<div class="alert">
  <span class="alert-topic">
  Something went wrong!
  </span>
  <span class="alert-description">
    You must inform the plate and the color of the car!
  </span>
</div>
```

replace

Sometimes it might be interesting to discard the original element, where the directive was attached, replacing it by the directive's template. This can be done by enabling the `replace` property:

```
directives.js

parking.directive("alert", function () {
  return {
    templateUrl: "alert.html",
    replace: true
  };
});
```

The following code is the compiled directive without the original element:

```
<div class="alert" alert="">
  <span class="alert-topic">
    Something went wrong!
  </span>
  <span class="alert-description">
    You must inform the plate and the color of the car!
  </span>
</div>
```

restrict

We attached our first directive by defining it as an attribute of the element. However, when we create a new directive as a reusable component, it doesn't make much sense. In this case, a better approach can restrict the directive to be an element.

By default, the directives are restricted to be applied as an attribute to a determined element, but we can change this behavior by declaring the restriction property inside our directive configuration object. The following table shows the possible values for the restriction property:

Restriction property	Values	Usage
Attribute (default)	`A`	`<div alert></div>`
Element name	`E`	`<alert></alert>`
Class	`C`	`<div class="alert"></div>`
Comment	`M`	`<!-- directive:alert -->`

Now, we just need to include this property in our directive, as shown in the following snippet:

```
index.html

<alert></alert>

directives.js

parking.directive("alert", function () {
return {
  restrict: 'E',
  templateUrl: "alert.html",
  replace: true
};
});
```

Also, it is possible to combine more than one restriction at the same time by just using a subset combination of `EACM`. If the directive is applied without the restrictions configuration, it will be ignored by the framework.

scope

Our alert component is almost ready but it has a problem! The topic and the description are hardcoded inside the component.

The best thing to do is to pass the data that needs to be rendered as a parameter. In order to achieve this, we need to create a new property inside our directive configuration object called scope.

There are three ways to configure the directive scope:

Prefix	Details
`@`	This prefix passes the data as a string.
`=`	This prefix creates a bidirectional relationship between a controller's scope property and a local scope directive property.
`&`	This prefix binds the parameter with an expression in the context of the parent scope. It is useful if you would like to provide some outside functions to the directive.

In the following code snippet, we will configure some parameters inside the `alert` directive:

```
index.html

<alert
  topic="Something went wrong!"
  description="You must inform the plate and the color of the
    car!"
>
</alert>

directives.js

parking.directive("alert", function () {
  return {
    restrict: 'E',
  scope: {
    topic: '@topic',
    description: '@description'
```

```
  },
  templateUrl: "alert.html",
  replace: true
};
});
```

```
alert.html

<div class="alert">
  <span class="alert-topic">
    <span ng-bind="topic"></span>
  </span>
  <span class="alert-description">
    <span ng-bind="description"></span>
  </span>
</div>
```

The left-hand side contains the name of the parameter available inside the directive's scope to be used in the template. The right-hand side contains the name of the attribute declared in the element, whose value will contain the expression to link to the property on the directive's template. By prefixing it with `@`, the literal value will be used as a parameter.

Following this, we are using the `=` prefix in order to create a bidirectional relationship between the controller and the directive. It means that every time anything changes inside the controller, the directive will reflect these changes:

```
index.html

<alert
  topic="alertTopic"
  description="descriptionTopic"
>
</alert>

controllers.js
parking.controller("parkingCtrl", function ($scope) {
  $scope.appTitle = "[Packt] Parking";
  $scope.alertTopic = "Something went wrong!";
  $scope.alertMessage = "You must inform the plate and the color
    of the car!";
});

directives.js
```

```
parking.directive("alert", function () {
  return {
    restrict: 'E',
  scope: {
    topic: '=topic',
    description: '=description'
  },
  templateUrl: "alert.html",
  replace: true
};
});
```

The last situation is when we need to execute something within the context of the parent scope. It could be achieved using the `&` prefix. In the following example, we are passing a function called `closeAlert` to the directive, defined by the controller to close the alert box:

```
index.html

<alert
  ng-show="showAlert"
  topic="alertTopic"
  description="descriptionTopic"
  close="closeAlert()"
>
</alert>

controllers.js
parking.controller("parkingCtrl", function ($scope) {
  $scope.appTitle = "[Packt] Parking";
  $scope.showAlert = true;
  $scope.alertTopic = "Something went wrong!";
  $scope.alertMessage = "You must inform the plate and the color of
the car!";
  $scope.closeAlert = function () {
    $scope.showAlert = false;
  };
});

directives.js

parking.directive("alert", function () {
  return {
    restrict: 'E',
```

```
  scope: {
    topic: '=topic',
    description: '=description',
    close: '&close'
  },
  templateUrl: "alert.html",
  replace: true
};
});
```

```
alert.html

<div class="alert">
  <span class="alert-topic">
    <span ng-bind="topic"></span>
  </span>
  <span class="alert-description">
    <span ng-bind="description"></span>
  </span>
  <a href="" ng-click="close()">Close</a>
</div>
```

Note that if the name of the directive's scope property is the same as of the expression, we can keep just the prefix. By convention, the framework will consider the name to be the identical to the scope property name. Our last directive can be written as follows:

```
directives.js

parking.directive("alert", function () {
  return {
    restrict: 'E',
  scope: {
    topic: '=',
    description: '=',
    close: '&'
  },
  templateUrl: "alert.html",
  replace: true
};
});
```

transclude

There are components that might need to wrap other elements in order to decorate them, such as `alert`, `tab`, `modal`, or `panel`. To achieve this goal, it is necessary to fall back upon a directive feature called **transclude**. This feature allows us to include the entire snippet from the view than just deal with the parameters. In the following code snippet, we will combine the **scope** and **transclude** strategies in order to pass parameters to the directive:

```
index.html

<alert topic="Something went wrong!">
  You must inform the plate and the color of the car!
</alert>

directives.js

parking.directive("alert", function () {
  return {
    restrict: 'E',
  scope: {
    topic: '@'
  },
  templateUrl: "alert.html",
  replace: true,
  transclude: true
  };
});

alert.html

<div class="alert">
  <span class="alert-topic">
    {{topic}}
  </span>
  <span class="alert-description" ng-transclude>
  </span>
</div>
```

Our second challenge involves the creation of an accordion component.

The next properties that we are going to study are considered more complex and reserved for advanced components. They are required every time we need to deal with the DOM or interact with other directives. These properties are `link`, `require`, `controller`, and `compile`.

link

Another important feature while creating directives is the ability to access the DOM in order to interact with its elements. To achieve this mission, we need to implement a function called `link` in our directive. The `link` function is invoked after the framework is compiled, and it is recommended that you add behavior to the directive. It takes five arguments as follows:

- `scope`: This is the scope object of the directive
- `element`: This is the element instance of directive
- `attrs`: This is the list of attributes declared within the directive's element
- `ctrl`: This is the controller of the `require` directive, and it will be available only if it is used with the `require` property
- `transcludeFn`: This is the transclude function

The following code shows the `accordion` directive using the `link` function:

```
index.html

<accordion-item title="MMM-8790">
  White - 10/10/2002 10:00
</accordion-item>
<accordion-item title="ABC-9954">
  Black - 10/10/2002 10:36
```

```
</accordion-item>
<accordion-item title="XYZ-9768">
  Blue - 10/10/2002 11:10
</accordion-item>

directives.html
parking.directive("accordionItem", function () {
  return {
    templateUrl: "accordionItem.html",
    restrict: "E",
    scope: {
      title: "@"
    },
    transclude: true,
    link: function (scope, element, attrs, ctrl, transcludeFn) {
      element.bind("click", function () {
        scope.$apply(function () {
          scope.active = !scope.active;
        });
      });
    }
  };
});

accordionItem.html

<div class='accordion-item'>
  {{title}}
</div>
<div ng-show='active' class='accordion-description' ng-transclude>
</div>
```

require

The `require` property is used to inject another directive controller as the fourth parameter of the `link` function. It means that using this property, we are able to communicate with the other directives. Some of the parameters are shown in the following table:

Prefix	Details
(no prefix)	This parameter locates the controller inside the current element. It throws an error if the controller is not defined within the `require` directive.
?	This parameter tries to locate the controller, passing null to the controller parameter of the `link` function if not found.
^	This parameter locates the controller in the parent element. It throws an error if the controller is not defined within any parent element.
?^	This parameter tries to locate the controller in the parent element, passing null to the controller parameter of the `link` function if not found.

In our last example, each accordion is independent. We can open and close all of them at our will. This property might be used to create an algorithm that closes all the other accordions as soon as we click on each of them:

index.html

```
<accordion>
  <accordion-item title="MMM-8790">
    White - 10/10/2002 10:00
  </accordion-item>
  <accordion-item title="ABC-9954">
    Black - 10/10/2002 10:36
  </accordion-item>
  <accordion-item title="XYZ-9768">
    Blue - 10/10/2002 11:10
  </accordion-item>
</accordion>
```

directives.html

```
parking.directive("accordion", function () {
  return {
    template: "<div ng-transclude></div>",
  restrict: "E",
  transclude: true
  };
});

parking.directive("accordionItem", function () {
  return {
    templateUrl: "accordionItem.html",
    restrict: "E",
    scope: {
```

```
        title: "@"
      },
      transclude: true,
      require: "^accordion",
      link: function (scope, element, attrs, ctrl, transcludeFn) {
        element.bind("click", function () {
          scope.$apply(function () {
            scope.active = !scope.active;
          });
        });
      }
    };
  });
```

Now, we need to define the controller inside the `accordion` directive; otherwise, an error will be thrown that says the controller can't be found.

controller

The controller is pretty similar to the `link` function and has almost the same parameters, except itself. However, the purpose of the controller is totally different. While it is recommended that you use the link to bind events and create behaviors, the controller should be used to create behaviors that will be shared with other directives by means of the `require` property:

```
directives.html

parking.directive("accordion", function () {
  return {
    template: "<div ng-transclude></div>",
  restrict: "E",
  transclude: true,
    controller: function ($scope, $element, $attrs, $transclude) {
      var accordionItens = [];

      var addAccordionItem = function (accordionScope) {
        accordionItens.push(accordionScope);
      };

      var closeAll = function () {
        angular.forEach(accordionItens, function (accordionScope) {
          accordionScope.active = false;
        });
```

```
        };

        return {
          addAccordionItem: addAccordionItem,
          closeAll: closeAll
        };
      }
    };
  });

  parking.directive("accordionItem", function () {
    return {
      templateUrl: "accordionItem.html",
      restrict: "E",
      scope: {
        title: "@"
      },
      transclude: true,
      require: "^accordion",
      link: function (scope, element, attrs, ctrl, transcludeFn) {
        ctrl.addAccordionItem(scope);
        element.bind("click", function () {
          ctrl.closeAll();
          scope.$apply(function () {
            scope.active = !scope.active;
          });
        });
      }
    };
  });
```

compile

During the compilation phase, the framework compiles each directive such that it is available to be attached to the template. The `compile` function is called once, during the compilation step and might be useful to transform the template, before the link phase.

However, since it is not used very often, we will not cover it in this book. To get more information about this directive, you could go to the AngularJS `$compile` documentation at `https://docs.angularjs.org/api/ng/service/$compile`.

Animation

The framework offers a very interesting mechanism to hook specific style classes to each step of the life cycle of some of the most used directives such as `ngRepeat`, `ngShow`, `ngHide`, `ngInclude`, `ngView`, `ngIf`, `ngClass`, and `ngSwitch`.

The first thing that we need to do in order to start is import the `angular-animation.js` file to our application. After that, we just need to declare it in our module as follows:

```
app.js

var parking = angular.module("parking", ["ngAnimate"]);
```

How it works?

The AngularJS animation uses CSS transitions in order to animate each kind of event such as when we add a new element the array that is being iterated by `ngRepeat` or when something is shown or hidden through the `ngShow` directive.

Based on this, it's time to check out the supported directives and their events:

Event	From	To	Directives
Enter	.ng-enter	.ng-enter-active	ngRepeat, ngInclude, ngIf, ngView
Leave	.ng-leave	.ng-leave-active	ngRepeat, ngInclude, ngIf, ngView
Hide	.ng-hide-add	.ng-hide-add-active	ngShow, ngHide
Show	.ng-hide-remove	.ng-hide-remove-active	ngShow, ngHide
Move	.ng-move	.ng-move-active	ngRepeat
addClass	.CLASS-add-class	.CLASS-add-class-active	ngClass
removeClass	.CLASS-remove-class	.CLASS-remove-class-active	ngClass

This means that every time a new element is rendered by an `ngRepeat` directive, the `.ng-enter` class is attached to the element and kept there until the transition is over. Right after this, the `.ng-enter-active` class is also attached, triggering the transition.

This is quite a simple mechanism, but we need to pay careful attention in order to understand it.

Animating ngRepeat

The following code is a simple example where we will animate the `enter` event of the `ngRepeat` directive:

```
app.css

.ng-enter {
  -webkit-transition: all 5s linear;
  -moz-transition: all 5s linear;
  -ms-transition: all 5s linear;
  -o-transition: all 5s linear;
  transition: all 5s linear;
  opacity: 0;
}

.ng-enter-active {
  opacity: 1;
}
```

That's all! With this configuration in place, every time a new element is rendered by an `ngRepeat` directive, it will respect the transition, appearing with a 5 second, linear, fade-in effect from the opacity 0 to 1.

For the opposite concept, we can follow the same process. Let's create a fade-out effect by means of the `.ng-leave` and `.ng-leave-active` classes:

```
app.css

.ng-leave {
  -webkit-transition: all 5s linear;
  -moz-transition: all 5s linear;
  -ms-transition: all 5s linear;
  -o-transition: all 5s linear;
  transition: all 5s linear;
  opacity: 1;
}

.ng-leave-active {
  opacity: 0;
}
```

Animating ngHide

To animate the `ngHide` directive, we need to follow the same previous steps, however, using the `.ng-hide-add` and `.ng-hide-add-active` classes:

```
app.css

.ng-hide-add {
  -webkit-transition: all 5s linear;
  -moz-transition: all 5s linear;
  -ms-transition: all 5s linear;
  -o-transition: all 5s linear;
  transition: all 5s linear;
  opacity: 1;
}

.ng-hide-add-active {
  display: block !important;
  opacity: 0;
}
```

In this case, the transition must flow in the opposite way. For the fade-out effect, we need to shift from the opacity 1 to 0.

Why is the display property set to block? This is because the regular behavior of the `ngHide` directive is to change the display property to none. With that property in place, the element will vanish instantly, and our fade-out effect will not work as expected.

Animating ngClass

Another possibility is to animate the `ngClass` directive. The concept is the same—enable a transition, however this time from the `.CLASS-add-class` class to the `.CLASS-add-class-active` class.

Let's take the same example we used in the `ngClass` explanation and animate it:

```
app.css

.selected {
  -webkit-transition: all 5s linear;
  -moz-transition: all 5s linear;
  -ms-transition: all 5s linear;
  -o-transition: all 5s linear;
  transition: all 5s linear;
```

```
    background-color: #FAFAD2 !important;
  }

  .selected-add-class {
    opacity: 0;
  }

  .selected-add-class-active {
    opacity: 1;
  }
```

Here, we added the fade-in effect again. You are absolutely free to choose the kind of effect that you like the most!

Summary

Directives are a strong technology to support the creation of reusable components, thereby saving a lot of time in the development schedule. In this chapter, we learned about the AngularJS built-in directives that are really useful in most parts of view development and also how to create our own directives and learned how to animate them.

In the next chapter, we will learn how to handle data in AngularJS using expressions, filters, and forms validation.

3
Data Handling

Most applications demand an intense development effort in order to provide a better interaction with its users. Bringing simplicity and usability is a huge challenge, and as our world is changing at the speed of the light, we must rely on a technology that really allows us to achieve this mission with the least amount of code and pain possible.

In terms of data handling, AngularJS offers a complete set of technologies that are capable of accomplishing any challenge related to presenting, transforming, synchronizing, and validating data on the user's interface. All this comes with a very simple syntax that can radically shorten the learning curve.

In this chapter, we will talk about data handling using AngularJS. The following topics will be covered in this chapter:

- Expressions
- Filters
- Form validation

Expressions

An expression is a simple piece of code that will be evaluated by the framework and can be written between double curly brackets, for example, `{{car.plate}}`. This way of writing expressions is known as interpolation and allows you to easily interact with anything from the scope.

The following code is an example that we have already seen before. Here, we are using it to retrieve the value of the car's plate, color, and entrance, and this is done inside the `ngRepeat` directive:

```
index.html

<table>
  <thead>
    <tr>
      <th></th>
      <th>Plate</th>
      <th>Color</th>
      <th>Entrance</th>
    </tr>
  </thead>
  <tbody>
    <tr
      ng-class="{selected: car.selected}"
      ng-repeat="car in cars"
 >
    <td>
         <input
           type="checkbox"
           ng-model="car.selected"
         />
      </td>
      <td>{{car.plate}}</td>
      <td>{{car.color}}</td>
      <td>{{car.entrance}}</td>
    </tr>
  </tbody>
</table>
```

In our example, for each iteration of the `ngRepeat` directive, a new child scope is created, which defines the boundaries of the expression.

Besides exhibiting the available objects in the scope, the expressions also give us the ability to perform some calculations such as `{{2+2}}`. However, if you put aside the similarities with JavaScript's `eval()` function, which is also used to evaluate expressions, AngularJS doesn't use the directive explicitly.

The expressions also forgive the undefined and null values, without displaying any error; instead, it doesn't show anything.

Sometimes, it might be necessary to transform the value of a given expression in order to exhibit it properly, however, without changing the underlying data. In the next section on filters, we will learn how expressions are well suited for this purpose.

Filters

Filters associated with other technologies, like directives and expressions, are responsible for the extraordinary expressiveness of the framework. They allow us to easily manipulate and transform any value, that is, not only just the ones combined with expressions inside a template, but also the ones injected in other components such as controllers and services.

Filters are really useful when we need to format dates and currency according to our current locale, or even when we need to support the filtering feature of a grid component. They are the perfect solution to easily perform any data manipulation.

Basic usage with expressions

To make filters interact with the expression, we just need to put them inside double curly brackets:

```
{{expression | filter}}
```

Also, the filters can be combined, thus creating a chain where the output of `filter1` is the input of `filter2`, which is similar to the pipeline that exists in the shell of Unix-based operating systems:

```
{{expression | filter1 | filter2}}
```

The framework already brings with it a set of ready-to-use filters that can be quite useful in your daily development. Now, let's have a look at the different types of AngularJS filters.

currency

The `currency` filter is used to format a number based on a currency. The basic usage of this filter is without any parameter:

```
{{ 10 | currency}}
```

The result of the evaluation will be the number `$10.00`, formatted and prefixed with the dollar sign. We can also apply a specific locale symbol, shown as follows:

```
{{ 10 | currency:'R$'}}
```

Now, the output will be `R$10.00`, which is the same as the previous output but prefixed with a different symbol. Although it seems right to apply just the currency symbol, and in this case the Brazilian Real (R$), this doesn't change the usage of the specific decimals and group separators.

In order to achieve the correct output, in this case R$10,00 instead of R$10.00, we need to configure the Brazilian (PT-BR) locale available inside the AngularJS distribution package. In this package, we might find locales for most countries, and we just need to import these locales to our application in the following manner:

```
<script src="js/lib/angular-locale_pt-br.js"></script>
```

After importing the locale, we will not have to use the currency symbol anymore because it's already wrapped inside.

Besides the currency, the locale also defines the configuration of many other variables, such as the days of the week and months, which is very useful when combined with the next filter used to format dates.

date

The `date` filter is one of the most useful filters of the framework. Generally, a date value comes from the database or any other source in a raw and generic format. Because of this, such filters are essential to any kind of application.

Basically, we can use this filter by declaring it inside any expression. In the following example, we have used the filter on a `date` variable attached to the scope:

```
{{ car.entrance | date }}
```

The output will be `Dec 10, 2013`. However, there are numerous combinations we can make with the optional format mask:

```
{{ car.entrance | date:'MMMM dd/MM/yyyy HH:mm:ss' }}
```

When you use this format, the output changes to `December 10/12/2013 21:42:10`.

filter

Have you ever tried to filter a list of data? This filter performs exactly this task, acting over an array and applying any filtering criteria.

Now, let's include a field in our car parking application to search any parked cars and use this filter to do the job:

```
index.html
<input
```

```
    type="text"
    ng-model="criteria"
    placeholder="What are you looking for?"
  />
  <table>
    <thead>
      <tr>
        <th></th>
        <th>Plate</th>
        <th>Color</th>
        <th>Entrance</th>
      </tr>
    </thead>
    <tbody>
      <tr
        ng-class="{selected: car.selected}"
        ng-repeat="car in cars | filter:criteria"
   >
     <td>
          <input
            type="checkbox"
            ng-model="car.selected"
          />
        </td>
        <td>{{car.plate}}</td>
        <td>{{car.color}}</td>
        <td>{{car.entrance | date:'dd/MM/yyyy hh:mm'}}</td>
      </tr>
    </tbody>
  </table>
```

The result is really impressive. With an input field and filter declaration, we did the job.

json

Sometimes, generally for debugging purposes, it might be necessary to display the contents of an object in the JSON format. JSON, also known as JavaScript Object Notation, is a lightweight data interchange format.

In the next example, we will apply the filter to a `car` object:

```
{{ car | json }}
```

The expected result if we use it based inside the car's list of our application is as follows:

```
{
  "plate": "6MBV006",
  "color": "Blue",
  "entrance": "2013-12-09T23:46:15.186Z"
}
```

limitTo

Sometimes, we need to display text, or even a list of elements, and it might be necessary to limit its size. This filter does exactly that and can be applied to a string or an array.

The following code is an example where there is a limit to the expression:

```
{{ expression | limitTo:10 }}
```

lowercase

The `lowercase` filter displays the content of the expression in lowercase:

```
{{ expression | lowercase }}
```

number

The `number` filter is used to format a string as a number. Similar to the currency and date filters, the locale can be applied to present the number using the conventions of each location.

Also, you can use a fraction-size parameter to support the rounding up of the number:

```
{{ 10 | number:2 }}
```

The output will be 10.00 because we used the fraction-size configuration. In this case, we can also take advantage of the locale configuration to change the fraction separator.

orderBy

With the `orderBy` filter, we can order any array based on a predicate expression. This expression is used to determine the order of the elements and works in three different ways:

- **String**: This is the property name. Also, there is an option to prefix `+` or `–` to indicate the order direction. At the end of the day, `+plate` or `-plate` are predicate expressions that will sort the array in an ascending or descending order.
- **Array**: Based on the same concept of String's predicate expression, more than one property can be added inside the array. Therefore, if two elements are considered equivalent by the first predicate, the next one can be used, and so on.
- **Function**: This function receives each element of the array as a parameter and returns a number that will be used to compare the elements against each other.

In the following code, the `orderBy` filter is applied to an expression with the predicate and reverse parameters:

```
{{ expression | orderBy:predicate:reverse }}
```

Let's change our example again. Now, it's time to apply the `orderBy` filter using the plate, color, or entrance properties:

```
index.html

<input
  type="text"
  ng-model="criteria"
  placeholder="What are you looking for?"
/>
<table>
  <thead>
    <tr>
      <th></th>
      <th>
        <a href=""ng-click="field = 'plate'; order=!order">
          Plate
        </a>
      </th>
      <th>
        <a href=""ng-click="field = 'color'; order=!order">
```

```
            Color
          </a>
        </th>
        <th>
          <a href=""ng-click="field = 'entrance'; order=!order">
            Entrance
          </a>
        </th>
      </tr>
    </thead>
    <tbody>
      <tr
        ng-class="{selected: car.selected}"
        ng-repeat="car in cars | filter:criteria |
          orderBy:field:order"
  >
    <td>
        <input
          type="checkbox"
          ng-model="car.selected"
        />
      </td>
      <td>{{car.plate}}</td>
      <td>{{car.color}}</td>
      <td>{{car.entrance | date:'dd/MM/yyyy hh:mm'}}</td>
    </tr>
  </tbody>
</table>
```

Now, we can order the car's list just by clicking on the header's link. Each click will reorder the list in the ascending or descending order based on the reverse parameter.

uppercase

This parameter displays the content of the expression in uppercase:

```
{{ expression | uppercase }}
```

Using filters in other places

We can also use filters in other components such as controllers and services. They can be used by just injecting `$filter` inside the desired components. The first argument of the `filter` function is the value, followed by the other required arguments.

Let's change our application by moving the `date` filter, which we used to display the date and hour separated in the view, to our controller:

```
controllers.js
parking.controller("parkingCtrl", function ($scope, $filter) {
  $scope.appTitle = $filter("uppercase")("[Packt] Parking");
});
```

This approach is often used when we need to transform the data before it reaches the view, sometimes even using it to the algorithms logic.

Creating filters

AngularJS already comes with a bunch of useful and interesting built-in filters, but even then, we'll certainly need to create our own filters in order to fulfill specific requirements.

To create a new filter, you just need to register it to the application's module, returning the `filter` function. This function takes the inputted value as the first parameter and other additional arguments if necessary.

Now, our application has a new requirement that can be developed through the creation of a customized filter.

This requirement involves formatting the car's plate by introducing a separator after the third character. To achieve this, we are going to create a filter called `plate`. It will receive a plate and will return it after formatting it, after following the rules:

```
filters.js

parking.filter("plate", function() {
  return function(input) {
    var firstPart = input.substring(0,3);
    var secondPart = input.substring(3);
    return firstPart + " - " + secondPart;
  };
});
```

With this filter, the **6MBV006** plate is displayed as **6MB - V006**.

Now, let's introduce a new parameter to give the users a chance to change the plate's separator:

```
filters.js

parking.filter("plate", function() {
  return function(input, separator) {
    var firstPart = input.substring(0,3);
    var secondPart = input.substring(3);
    return firstPart + separator + secondPart;
  };
});
```

Form validation

Almost every application has forms. It allows the users to type data that will be sent and processed at the backend. AngularJS provides a complete infrastructure to easily create forms with the validation support.

The form will always be synchronized to its model with the two-way data binding mechanism, through the `ngModel` directive; therefore, the code is not required to fulfill this purpose.

Creating our first form

Now, it's time to create our first form in the car parking application. Until now, we have been using the plate of the car in any format in order to allow parking. From now on, the driver must mention the details of the plate following some rules. This way, it's easier to keep everything under control inside the parking lot.

The HTML language has an element called `form` that surrounds the fields in order to pass them to the server. It also creates a boundary, isolating the form as a single and unique context.

With AngularJS, we will do almost the same thing. First, we need to surround our fields with the `form` element and also give a name to it. Without the name, it won't be possible to refer to it in the future. Also, it's important to assign a name to each field.

In the following code, we have added the form to our parking application:

```
index.html

<form name="carForm">
```

```
    <input
      type="text"
      name="plateField"
      ng-model="car.plate"
      placeholder="What's the plate?"
    />
  </form>
```

For the form, avoid using the name that has already been used inside the `ngModel` directive; otherwise, we will not be able to perform the validation properly. It would be nice to use some suffix for both the form and the field names as that would help to make things clearer, thus avoiding mistakes.

Basic validation

The validation process is quite simple and relies on some directives to do the job. The first one that we need to understand is the `ngRequired` directive. It could be attached to any field of the form in order to intimate the validation process that the field is actually required:

```
<input
  type="text"
  name="plateField"
  ng-model="car.plate"
  placeholder="What's the plate?"
  ng-required="true"
/>
```

In addition to this, we could be a little more specific by using the `ngMinlength` and `ngMaxlength` directives. It is really useful to fulfill some kinds of requirements such as defining a minimum or maximum limit to each field.

In the following code, we are going to add a basic validation to our parking application. From now on, the `field` plate will be a required parameter and will also have minimum and maximum limits:

```
<input
  type="text"
  name="plateField"
  ng-model="car.plate"
  placeholder="What's the plate?"
  ng-required="true"
  ng-minlength="6"
  ng-maxlength="10"
/>
```

To finish, we can add a regular expression to validate the format of the plate. This can be done through the `ngPattern` directive:

```
<input
  type="text"
  name="plateField"
  ng-model="car.plate"
  placeholder="What's the plate?"
  ng-required="true"
  ng-minlength="6"
  ng-maxlength="10"
  ng-pattern="/[A-Z]{3}[0-9]{3,7}/"
/>
```

The result can be evaluated through the implicit object `$valid`. It will be defined based on the directives of each field. If any of these violate the directives definition, the result will be false. Also, the `$invalid` object can be used, considering its usefulness, depending on the purpose:

```
<button
  ng-click="park(car)"
  ng-disabled="carForm.$invalid"
>
  Park
</button>
```

If the plate is not valid, the following alert should be displayed:

```
<alert
  ng-show="carForm.plateField.$invalid"
  topic="Something went wrong!"
>
  The plate is invalid!
</alert>
```

However, there is a problem with this approach. The alert is displayed even if we type nothing and this might confuse the user. To prevent such situations, there are two properties that we need to understand, which are covered in the next section.

Understanding the $pristine and $dirty properties

Sometimes, it would be useful to know whether the field was never touched in order to trigger (or not) some validation processes. This can be done by the means of two objects with very suggestive names: `$pristine` and `$dirty`.

Pristine means purity, and here, it denotes that the field wasn't touched by anyone. After it's been touched for the first time, it becomes dirty. So, the value of `$pristine` always starts with true and becomes false after any value is typed. Even if the field is empty again, the value remains false. The behavior of the `$dirty` object is just the opposite. It is by default false and becomes true after the first value is typed:

```
<alert
  ng-show="carForm.plateField.$dirty &&
    carForm.plateField.$invalid"
  topic="Something went wrong!"
>
  The plate is invalid!
</alert>
```

The $error object

In the end, the one that remains is the `$error` object. It accumulates the detailed list of everything that happens with the form and can be used to discover which field must be proofread in order to put the form in a valid situation.

Let's use it to help our users understand what's exactly going wrong with the form:

```
<alert
  ng-show="carForm.plateField.$dirty && carForm.plateField.$invalid"
  topic="Something went wrong!"
>
  <span ng-show="carForm.plateField.$error.required">
    You must inform the plate of the car!
  </span>
  <span ng-show="carForm.plateField.$error.minlength">
    The plate must have at least 6 characters!
  </span>
  <span ng-show="carForm.plateField.$error.maxlength">
    The plate must have at most 10 characters!
  </span>
```

```
    <span ng-show="carForm.plateField.$error.pattern">
      The plate must start with non-digits, followed by 4 to 7
        numbers!
    </span>
  </alert>
```

Summary

In this chapter, we studied how AngularJS provides a complete set of features related to data handling, allowing the developers to easily present, transform, synchronize, and validate the data on the user's interface with a simple syntax and a few lines of code.

In the next chapter, we will study more about services and also understand the dependency injection mechanism.

4
Dependency Injection and Services

Cohesion is one of the most important and perhaps overlooked concepts of the object-oriented programming paradigm. It refers to the responsibility of each part of the software. No matter which component we talk about, every time it implements behavior different from its responsibilities, cohesion is degraded.

Low cohesion applications contain plenty of duplicated code and are hard to unit test because it is difficult to isolate the behavior, which is usually hidden inside the component. It also reduces the reuse opportunities, demanding much more effort to implement the same thing several times. In the long term, the productivity decreases while the maintenance costs are raised.

With AngularJS, we are able to create services, isolating the business logic of every component of our application. Also, we can use the framework's dependency injection mechanism to easily supply any component with a desired dependency. The framework also comes with a bunch of built-in services, which are very useful in daily development.

In this chapter, we'll be covering the following topics:

- Dependency injection
- Creating services
- Using AngularJS built-in services

Dependency injection

In order to create testable and well-designed applications, we need to take care about the way their components are related to each other. This relationship, which is very famous in the object-oriented world, is known as **coupling**, and indicates the level of dependency between the components.

We need to be careful about using the operator `new` inside a component. It reduces the chances of replacing the dependency, making it difficult for us to test it.

Fortunately, AngularJS is powered by a dependency injection mechanism that manages the life cycle of each component. This mechanism is responsible for creating and distributing the components within the application.

The easiest way to obtain a dependency inside a component is by just declaring it as a parameter. The framework's dependency injection mechanism ensures that it will be injected properly. In the following code, there is a controller with two injected parameters, `$scope` and `$filter`:

```
controllers.js

parking.controller("parkingCtrl", function ($scope, $filter) {
  $scope.appTitle = $filter("uppercase")("[Packt] Parking");
});
```

Unfortunately, this approach will not work properly after the code is minified and obfuscated, which is very common these days. The main purpose of this kind of algorithm is to reduce the amount of code by removing whitespaces, comments, and newline characters, and also renaming local variables.

The following code is an example of our previous code after it is minified and obfuscated:

```
controllers.min.js

x.controller("parkingCtrl",function(a,b){a.appTitle=b("uppercase")
("[Packt] Parking");});
```

The `$scope` and `$filter` parameters were renamed arbitrarily. In this case, the framework will throw the following error, indicating that the required service provider could not be found:

```
Error: [$injector:unpr] Unknown provider: aProvider <- a
```

Because of this, the most recommended way to use the dependency injection mechanism, despite verbosity, is through the inline array annotation, as follows:

```
parking.controller("parkingCtrl", ["$scope", "$filter", function
($scope, $filter) {
  $scope.appTitle = $filter("uppercase")("[Packt] Parking");

}]);
```

This way, no matter what the name of each parameter is, the correct dependency will be injected, resisting the most common algorithms that minify and obfuscate the code.

The dependencies can also be injected in the same way inside directives, filters, and services. Later, in *Chapter 7, Unit Testing*, we are going to learn other strategies in order to inject dependencies for testing purposes.

In the following sections, we are going to use these concepts in greater detail while using and creating services.

Creating services

In AngularJS, a service is a singleton object that has its life cycle controlled by the framework. It can be used by any other component such as controllers, directives, filters, and even other services.

Now, it's time to evolve our application, introducing new features in order to calculate the parking time and also the price.

To keep high levels of cohesion inside each component, we must take care of what kind of behavior is implemented in the controller. This kind of feature could be the responsibility of a service that can be shared across the entire application and also tested separately.

In the following code, the controller is delegating a specific behavior to the service, creating a place to evolve the business rules in the future:

```
controllers.js

parking.controller("parkingCtrl", function ($scope, parkingService) {
  $scope.appTitle = "[Packt] Parking";

  $scope.cars = [];

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];
```

```
  $scope.park = function (car) {
    car.entrance = new Date();
    $scope.cars.push(car);
    delete $scope.car;
  };

  $scope.calculateTicket = function (car) {
    $scope.ticket = parkingService.calculateTicket(car);
  };
});
```

Creating services with the factory

The framework allows the creation of a service component in different ways. The most usual way is to create it using a factory. Therefore, we need to register the service in the application module that passes two parameters: the name of the service and the factory function.

A **factory function** is a pattern used to create objects. It is a simple function that returns a new object. However, it brings more concepts such as the **Revealing Module Pattern**, which we are going to cover in more detail.

To understand this pattern, let's start by declaring an object literal called `car`:

```
var car = {
  plate: "6MBV006",
  color: "Blue",
  entrance: "2013-12-09T23:46:15.186Z"
};
```

The JavaScript language does not provide any kind of visibility modifier; therefore, there is no way to encapsulate any property of this object, making it possible to access everything directly:

```
> console.log(car.plate);
6MB006
> console.log(car.color);
Blue
> console.log(car.entrance);
2013-12-09T23:46:15.186Z
```

In order to promote encapsulation, we need to use a function instead of an object literal, as follows:

```
var car = function () {
  var plate = "6MBV006";
  var color = "Blue";
  var entrance = "2013-12-09T23:46:15.186Z ";
};
```

Now, it's no longer possible to access any property of the object:

```
> console.log(car.plate);
undefined
> console.log(car.color);
undefined
> console.log(car.entrance);
undefined
```

This happens because the function isolates its internal scope, and based on this principle, we are going to introduce the concept of the Revealing Module Pattern.

This pattern, beyond taking care of the namespace, provides encapsulation. It allows the implementation of public and private methods, reducing the coupling within the components. It returns an object literal from the function, revealing only the desired properties:

```
var car = function () {
  var plate = "6MBV006";
  var color = "Blue";
  var entrance = "2013-12-09T23:46:15.186Z ";

  return {
    plate: plate,
    color: color
  };
};
```

Also, we need to invoke the function immediately; otherwise, the variable `car` will receive the entire function. This is a very common pattern and is called **IIFE**, which is also known as **Immediately-Invoked Function Expression**:

```
var car = function () {
  var plate = "6MBV006";
  var color = "Blue";
  var entrance = "2013-12-09T23:46:15.186Z ";
```

```
  return {
    plate: plate,
    color: color
  };
}();
```

Now, we are able to access the color but not the entrance of the car:

```
> console.log(car.plate);
6MB006
> console.log(car.color);
Blue
> console.log(car.entrance);
undefined
```

Beyond that, we can apply another convention by prefixing the private members with _, making the code much easier to understand:

```
var car = function () {
  var _plate = "6MBV006";
  var _color = "Blue";
  var _entrance = "2013-12-09T23:46:15.186Z ";

  return {
    plate: _plate,
    color: _color
  };
}();
```

This is much better than the old-school fashion implementation of the first example, don't you think? This approach could be used to declare any kind of AngularJS component, such as services, controllers, filters, and directives.

In the following code, we have created our `parkingService` using a factory function and the **Revealing Module Pattern**:

```
services.js

parking.factory("parkingService", function () {
  var _calculateTicket = function (car) {
    var departHour = new Date().getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * 10;
    return {
      period: parkingPeriod,
```

```
        price: parkingPrice
      };
    };

    return {
      calculateTicket: _calculateTicket
    };
  });
```

In our first service, we started to create some parking business rules. From now, the entrance hour is subtracted from the departure hour and multiplied by $10.00 to get the parking rate per hour.

However, these rules were created by means of hardcoded information inside the service and might bring maintenance problems in the future.

To figure out this kind of a situation, we can create constants. It's used to store configurations that might be required by any application component. We can store any kind of JavaScript data type such as a string, number, Boolean, array, object, function, null, and undefined.

To create a constant, we need to register it in the application module. In the following code, there is an example of the steps required to create a constant:

```
constants.js

parking.constant("parkingConfig", {
  parkingRate: 10
});
```

Next, we refactored the `_calculateTicket` method in order to use the settings from the `parkingConfig` constant, instead of the hard coded values. In the following code, we are injecting the constant inside the `parkingService` method and replacing the hard coded parking rate:

```
services.js

parking.factory("parkingService", function (parkingConfig) {
  var _calculateTicket = function (car) {
    var departHour = new Date().getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * parkingConfig.parkingRate;
    return {
      period: parkingPeriod,
```

```
        price: parkingPrice
      };
    };

    return {
      calculateTicket: _calculateTicket
    };
  });
```

The framework also provides another kind of service called **value**. It's pretty similar to the **constants**; however, it can be changed or decorated.

Creating services with the service

There are other ways to create services with AngularJS, but hold on, you might be thinking "why should we consider this choice if we have already used the factory?"

Basically, this decision is all about design. The **service** is very similar to the **factory**; however, instead of returning a factory function, it uses a constructor function, which is equivalent to using the **new operator**.

In the following code, we created our `parkingService` method using a constructor function:

```
services.js

parking.service("parkingService", function (parkingConfig) {
  this.calculateTicket = function (car) {
    var departHour = new Date().getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * parkingConfig.parkingRate;
    return {
      period: parkingPeriod,
      price: parkingPrice
    };
  };
});
```

Also, the framework allows us to create services in a more complex and configurable way using the `provider` function.

Creating services with the provider

Sometimes, it might be interesting to create configurable services. They are called providers, and despite being more complex to create, they can be configured before being available to be injected inside other components.

While the factory works by returning an object and the service with the constructor function, the provider relies on the `$get` function to expose its behavior. This way, everything returned by this function becomes available through the dependency injection.

In the following code, we refactored our service to be implemented by a provider. Inside the `$get` function, the `calculateTicket` method is being returned and will be accessible externally.

```
services.js

parking.provider("parkingService", function (parkingConfig) {
  var _parkingRate = parkingConfig.parkingRate;

  var _calculateTicket = function (car) {
    var departHour = new Date().getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * _parkingRate;
    return {
      period: parkingPeriod,
      price: parkingPrice
    };
  };
  this.setParkingRate = function (rate) {
    _parkingRate = rate;
  };
  this.$get = function () {
    return {
      calculateTicket: _calculateTicket
    };
  };
});
```

In order to configure our provider, we need to use the `config` function of the Module API, injecting the service through its function. In the following code, we are calling the `setParkingRate` method of the provider, overwriting the default rate that comes from the `parkingConfig` method.

```
config.js

parking.config(function (parkingServiceProvider) {
  parkingServiceProvider.setParkingRate(10);
});
```

The other service components such as constants, values, factories, and services are implemented on the top of the provider component, offering developers a simpler way of interaction.

Using AngularJS built-in services

Now, it's time to check out the most important and useful built-in services for our daily development. In the following topics, we will explore how to perform communication with the backend, create a logging mechanism, support timeout, single-page application, and many other important tasks.

Communicating with the backend

Every client-side JavaScript application needs to communicate with the backend. In general, this communication is performed through an interface, which is exposed by the server-side application that relies on the HTTP protocol to transfer data through the **JSON**.

HTTP, REST, and JSON

In the past, for many years, the most common way to interact with the backend was through HTTP with the help of the `GET` and `POST` methods. The `GET` method was usually used to retrieve data, while `POST` was used to create and update the same data. However, there was no rule, and we were feeling the lack of a good standard to embrace.

The following are some examples of this concept:

```
GET  /retrieveCars  HTTP/1.1
GET  /getCars       HTTP/1.1
GET  /listCars      HTTP/1.1
GET  /giveMeTheCars HTTP/1.1
GET  /allCars       HTTP/1.1
```

Now, if we want to obtain a specific car, we need to add some parameters to this URL, and again, the lack of standard makes things harder:

```
GET  /retrieveCar?carId=10  HTTP/1.1
GET  /getCar?idCar=10       HTTP/1.1
GET  /giveMeTheCar?car=10   HTTP/1.1
```

Introduced a long time ago by Roy Fielding, the `REST` method, or **Representational State Transfer**, has become one of the most adopted architecture styles in the last few years. One of the primary reasons for all of its success is the rise of the AJAX-based technology and also the new generation of web applications, based on the frontend.

It's strongly based on the HTTP protocol by means of the use of most of its methods such as `GET`, `POST`, `PUT`, and `DELETE`, bringing much more semantics and providing standardization.

Basically, the primary concept is to replace the verbs for nouns, keeping the URLs as simple and intuitive as possible. This means changing actions such as `retrieveCars`, `listCars`, and even `getCars` for the use of the resource cars, and the method `GET`, which is used to retrieve information, as follows:

```
GET /cars HTTP/1.1
```

Also, we can retrieve information about a specific car as follows:

```
GET /cars/1 HTTP/1.1
```

The `POST` method is reserved to create new entities and also to perform complex searches that involve a large amount of data. This is an important point; we should always avoid transmitting information that might be exposed to encoded errors through the `GET` method, as long as it doesn't have a content type.

This way, in order to create a new car, we should use the same resource, `cars`, but this time, with the `POST` method:

```
POST /cars HTTP/1.1
```

The car information will be transmitted within the request body, using the desired format. The major part of the libraries and frameworks works really well with **JSON**, also known as **JavaScript Object Notation**, which is a lightweight data interchange format.

The following code shows an object literal after being converted into JSON through the `JSON.stringify` function:

```
{
  "plate": "6MBV006",
  "color": "Blue",
  "entrance": "2013-12-09T23:46:15.186Z"
}
```

Also, the framework provides a built-in function called `angular.toJson` that does the same job of converting an object literal to JSON. To perform the other way round, we can use the `angular.fromJson` function, which is equivalent to the `JSON.parse` function.

To change any entity that already exists, we can rely on the `PUT` method, using the same concepts used by the `POST` method.

```
PUT /cars/1 HTTP/1.1
```

Finally, the `DELETE` method is responsible for deleting the existing entities.

```
DELETE /cars/1 HTTP/1.1
```

Another important thing to keep in mind is the status code that is returned in each response. It determines the result of the entire operation and must allow us to implement the correct application behavior in case there is an error.

There are many **status codes** available in the HTTP protocol; however, we should understand and handle at least the following:

- 200 OK
- 400 Bad Request
- 401 Unauthorized
- 403 Forbidden
- 404 Not Found
- 500 Internal Server Error

In case of an error, the response must bring the associated message, explaining what's happening and allowing the developers to handle it.

There are many other concepts involving `REST`. This is just a brief overview and as it is not the purpose of this book, you can consider studying it from a more specific source.

AJAX

AJAX, also known as **Asynchronous JavaScript and XML**, is a technology that allows the applications to send and retrieve data from the server asynchronously, without refreshing the page. The `$http` service wraps the low-level interaction with the `XMLHttpRequest` object, providing an easy way to perform calls.

This service could be called by just passing a configuration object, used to set a lot of important information such as the method, the URL of the requested resource, the data to be sent, and many others:

```
$http({method: "GET", url: "/resource"});
```

It also returns a promise that we are going to explain in more detail in the *Asynchronous with a promise-deferred pattern* section. We can attach the success and error behavior to this promise:

```
$http({method: "GET", url: "/resource"})
  .success(function (data, status, headers, config, statusText) {
  })
  .error(function (data, status, headers, config, statusText) {
  });
```

To make it easier to use, the following shortcut methods are available for this service. In this case, the configuration object is optional:

```
$http.get(url, [config])
$http.post(url, data, [config])
$http.put(url, data, [config])
$http.head(url, [config])
$http.delete(url, [config])
$http.jsonp(url, [config])
```

Now, it's time to integrate our parking application with the backend by calling the resource cars with the `GET` method. It will retrieve the cars, binding it to the `$scope` object. In the case that something goes wrong, we are going to log it to the console:

```
controllers.js

parking.controller("parkingCtrl", function ($scope, parkingService,
$http) {
  $scope.appTitle = "[Packt] Parking";

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];

  $scope.park = function (car) {
    car.entrance = new Date();
```

```
    $scope.cars.push(car);
    delete $scope.car;
  };

  $scope.calculateTicket = function (car) {
    $scope.ticket = parkingService.calculateTicket(car);
  };

  var retrieveCars = function () {
    $http.get("/cars")
      .success(function(data, status, headers, config) {
        $scope.cars = data;
      })
      .error(function(data, status, headers, config) {
        switch(status) {
          case 401: {
            $scope.message = "You must be authenticated!"
            break;
          }
          case 500: {
            $scope.message = "Something went wrong!";
            break;
          }
        }
        console.log(data, status);
      });
  };
  retrieveCars();
});
```

The success and error methods are called asynchronously when the server returns the HTTP request. In case of an error, we must handle the status code properly and implement the correct behavior.

There are certain methods that require a data parameter to be passed inside the request body such as the `POST` and `PUT` methods. In the following code, we are going to park a new car inside our parking lot:

```
controllers.js

parking.controller("parkingCtrl", function ($scope, parkingService,
$http) {
  $scope.appTitle = "[Packt] Parking";

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];
```

```
$scope.parkCar = function (car) {
  $http.post("/cars", car)
    .success(function (data, status, headers, config) {
      retrieveCars();
      $scope.message = "The car was parked successfully!";
    })
    .error(function (data, status, headers, config) {
      switch(status) {
        case 401: {
          $scope.message = "You must be authenticated!"
          break;
        }
        case 500: {
          $scope.message = "Something went wrong!";
          break;
        }
      }
      console.log(data, status);
    });
};

$scope.calculateTicket = function (car) {
  $scope.ticket = parkingService.calculateTicket(car);
};

var retrieveCars = function () {
  $http.get("/cars")
    .success(function(data, status, headers, config) {
      $scope.cars = data;
    })
   .error(function(data, status, headers, config) {
      switch(status) {
        case 401: {
          $scope.message = "You must be authenticated!"
          break;
        }
        case 500: {
          $scope.message = "Something went wrong!";
          break;
        }
      }
      console.log(data, status);
```

```
        });
    };

    retrieveCars();
});
```

Creating an HTTP facade

Now, we have the opportunity to evolve our design by introducing a service that will act as a facade and interact directly with the backend. The mapping of each URL pattern should not be under the controller's responsibility; otherwise, it could generate a huge amount of duplicated code and a high cost of maintenance.

In order to increase the cohesion of our controller, we moved the code responsible to make the calls to the backend of the `parkingHttpFacade` service, as follows:

`services.js`

```
parking.factory("parkingHttpFacade", function ($http) {
  var _getCars = function () {
    return $http.get("/cars");
  };

  var _getCar = function (id) {
    return $http.get("/cars/" + id);
  };

  var _saveCar = function (car) {
    return $http.post("/cars", car);
  };

  var _updateCar = function (car) {
    return $http.put("/cars" + car.id, car);
  };

  var _deleteCar = function (id) {
    return $http.delete("/cars/" + id);
  };


  return {
    getCars: _getCars,
    getCar: _getCar,
    saveCar: _saveCar,
```

```
    updateCar: _updateCar,
    deleteCar: _deleteCar
  };
});
```

controllers.js

```
parking.controller("parkingCtrl", function ($scope, parkingService,
parkingHttpFacade) {
  $scope.appTitle = "[Packt] Parking";

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];

  $scope.parkCar = function (car) {
    parkingHttpFacade.saveCar(car)
      .success(function (data, status, headers, config) {
        retrieveCars();
        $scope.message = "The car was parked successfully!";
      })
      .error(function (data, status, headers, config) {
        switch(status) {
          case 401: {
            $scope.message = "You must be authenticated!"
            break;
          }
          case 500: {
            $scope.message = "Something went wrong!";
            break;
          }
        }
        console.log(data, status);
      });
  };

  $scope.calculateTicket = function (car) {
    $scope.ticket = parkingService.calculateTicket(car);
  };

  var retrieveCars = function () {
    parkingHttpFacade.getCars()
      .success(function(data, status, headers, config) {
        $scope.cars = data;
      })
```

```
        .error(function(data, status, headers, config) {
           switch(status) {
             case 401: {
               $scope.message = "You must be authenticated!"
               break;
             }
             case 500: {
               $scope.message = "Something went wrong!";
               break;
             }
           }
           console.log(data, status);
         });
  };

  retrieveCars();
});
```

Headers

By default, the framework adds some HTTP headers to all of the requests, and other headers only to the `POST` and `PUT` methods.

The headers are shown in the following code, and we can check them out by analyzing the `$http.defaults.headers` configuration object:

```
{
  "common":{"Accept":"application/json, text/plain, */*"},
  "post":{"Content-Type":"application/json;charset=utf-8"},
  "put":{"Content-Type":"application/json;charset=utf-8"},
  "patch":{"Content-Type":"application/json;charset=utf-8"}
}
```

In case you want to add a specific header or even change the defaults, you can use the `run` function of the Module API, which is very useful in initializing the application:

```
run.js

parking.run(function ($http) {
  $http.defaults.headers.common.Accept = "application/json";
});
```

After the header configuration, the request starts to send the custom header:

```
GET /cars HTTP/1.1
Host: localhost:3412
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.8; rv:29.0)
Accept: application/json
Accept-Language: pt-br,pt;q=0.8,en-us;q=0.5,en;q=0.3
Accept-Encoding: gzip, deflate
```

The headers can also be configured through the configuration object of each request. It will overwrite the default headers configured here.

Caching

To improve the performance of our application, we can turn on the framework's caching mechanism. It will store each response from the server, returning the same result every time the same request is made.

However, take care. Some applications demand updated data, and the caching mechanism may introduce some undesired behavior. In the following code, we are enabling the cache mechanism:

```
run.js

parking.run(function ($http) {
  $http.defaults.cache = true;
});
```

Interceptors

The framework also provides an incredible HTTP intercepting mechanism. It allows us to create common behaviors for different kinds of situations such as verifying whether a user is already authenticated or to gather information for auditing purposes.

The first is the `request` interceptor. This interceptor is called before the request is being sent to the backend. It is very useful when we need to add information such as additional parameters or even headers to the request.

In the following code, we create an interceptor called `httpTimestampInterceptor`, which adds the current time in milliseconds to each request that is made by the application:

```
parking.factory('httpTimestampInterceptor', function(){
  return{
    'request' : function(config) {
```

```
        var timestamp = Date.now();
        config.url = config.url + "?x=" + timestamp;
        return config;
      }
    }
  });
```

Something might happen with the request, causing an error. With the `requestError` interceptor, we can handle this situation. It is called when the request is rejected and can't be sent to the backend.

The `response` interceptor is called right after the response arrives from the backend and receives a response as a parameter. It's a good opportunity to apply any preprocessing behavior that may be required.

One of the most common intercepting situations is when the backend produces any kind of error, returning a status code to indicate unauthorized access, a bad request, a not found error, or even an internal server error. It could be handled by the `responseError` interceptor, which allows us to properly apply the correct behavior in each situation.

This `httpUnauthorizedInterceptor` parameter, in the following code, is responsible for handling the unauthorized error and changing the login property of `$rootScope`, indicating that the application should open the login dialog:

```
parking.factory('httpUnauthorizedInterceptor', function($q,
$rootScope){
  return{
    'responseError' : function(rejection) {
   if (rejection.status === 401){
     $rootScope.login = true;
   }
   return $q.reject(rejection);
    }
  }
});
```

After defining the interceptors, we need to add them to `$httpProvider` using the `config` function of the Module API, as follows:

```
config.js

app.config(function ($httpProvider) {
  $httpProvider.interceptors.push('httpTimestampInterceptor');
  $httpProvider.interceptors.push('httpUnauthorizedInterceptor');
});
```

Creating a single-page application

In the past few years, the **single-page application**, also known as **SPA**, has been growing in popularity among frontend developers. It improves customers' experiences by not requiring the page to be constantly reloaded, taking advantage of technologies such as **AJAX** and massive DOM manipulation.

Installing the module

AngularJS supports this feature through the `$route` service. Basically, this service works by mapping URLs against controllers and views, also allowing parameter passing. This service is part of the `ngRoute` module and we need to declare it before using it, as follows:

```
index.html

<script src="angular-route.js"></script>
```

After this, the module should be imported to the `parking` module:

```
app.js

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

Configuring the routes

With the `$routeProvider` function, we are able to configure the routing mechanism of our application. This can be done by adding each route through the `when` function, which maps the URL pattern to a configuration object. This object has the following information:

- `controller`: This is the name of the controller that should be associated with the template
- `templateUrl`: This is the URL of the template that will be rendered by the `ngView` module
- `resolve`: This is the map of dependencies that should be resolved and injected inside the controller (optional)
- `redirectTo`: This is the redirected location

Also, there is an `otherwise` function. It is called when the route cannot be matched against any definition. This configuration should be done through the `config` function of the Module API, as follows:

```
config.js

parking.config(function ($routeProvider) {
  $routeProvider.
    when("/parking", {
      templateUrl: "parking.html",
   controller: "parkingCtrl"
  }).
     when("/car/:id", {
       templateUrl: "car.html",
    controller: "carCtrl"
  }).
  otherwise({
    redirectTo: '/parking'
  });
});
```

Rendering the content of each view

At the same time, we need to move the specific content from the `index.html` file to the `parking.html` file, and in its place, we introduce the `ngView` directive. This directive works with the `$route` service and is responsible for rendering each template according to the routing mechanism configuration:

```
index.html

<!doctype html>
<html ng-app="parking">
  <head>
  <title>[Packt] Parking</title>
  <script src="js/lib/angular.js"></script>
  <script src="js/lib/angular-route.js"></script>
  <script src="js/app.js"></script>
  <script src="js/config.js"></script>
  <script src="js/run.js"></script>

  <script src="js/controllers.js"></script>
  <script src="js/directives.js"></script>
  <script src="js/filters.js"></script>
  <script src="js/services.js"></script>
```

```
  <link rel="stylesheet" type="text/css" href="css/app.css">
  </head>
  <body>
    <div ng-view></div>
  </body>
</html>
```

parking.html

```
<input
  type="text"
  ng-model="criteria"
  placeholder="What are you looking for?"
/>
<table>
  <thead>
    <tr>
      <th></th>
      <th>
        <a href=""ng-click="field = 'plate'; order=!order">
          Plate
        </a>
      </th>
      <th>
        <a href=""ng-click="field = 'color'; order=!order">
          Color
        </a>
      </th>
      <th>
        <a href=""ng-click="field = 'entrance'; order=!order">
          Entrance
        </a>
      </th>
    </tr>
  </thead>
  <tbody>
    <tr
      ng-class="{selected: car.selected}"
      ng-repeat="car in cars | filter:criteria | orderBy:field:order"
 >
    <td>
        <input
          type="checkbox"
```

```
            ng-model="car.selected"
          />
      </td>
        <td><a href="#/car/{{car.id}}">{{car.plate}}</a></td>
        <td>{{car.color}}</td>
        <td>{{car.entrance | date:'dd/MM/yyyy hh:mm'}}</td>
      </tr>
    </tbody>
  </table>
  <form name="carForm">
    <input
      type="text"
      name="plateField"
      ng-model="car.plate"
      placeholder="What's the plate?"
      ng-required="true"
      ng-minlength="6"
      ng-maxlength="10"
      ng-pattern="/[A-Z]{3}[0-9]{3,7}/"
    />
    <select
      ng-model="car.color"
      ng-options="color for color in colors"
    >
      Pick a color
    </select>
    <button
      ng-click="park(car)"
      ng-disabled="carForm.$invalid"
    >
      Park
    </button>
  </form>
  <alert
    ng-show="carForm.plateField.$dirty && carForm.plateField.$invalid"
    topic="Something went wrong!"
  >
    <span ng-show="carForm.plateField.$error.required">
      You must inform the plate of the car!
    </span>
    <span ng-show="carForm.plateField.$error.minlength">
      The plate must have at least 6 characters!
    </span>
```

```
  <span ng-show="carForm.plateField.$error.maxlength">
    The plate must have at most 10 characters!
  </span>
  <span ng-show="carForm.plateField.$error.pattern">
    The plate must start with non-digits, followed by 4 to 7 numbers!
  </span>
</alert>
```

Passing parameters

The route mechanism also allows us to pass parameters. In order to obtain the passed parameter inside the controller, we need to inject the `$routeParams` service, which will provide us with the parameters passed through the URL:

```
controller.js

parking.controller("carController", function ($scope, $routeParams,
parkingHttpFacade, parkingService) {
  $scope.depart = function (car) {
    parkingHttpFacade.deleteCar(car)
      .success(function (data, status) {
        $scope.message = "OK";
      })
      .error(function (data, status) {
        $scope.message = "Something went wrong!";
      });
  };
  var retrieveCar = function (id) {
    parkingHttpFacade.getCar(id)
      .success(function (data, status) {
        $scope.car = data;
        $scope.ticket = parkingService.calculateTicket(car);
      })
      .error(function (data, status) {
        $scope.message = "Something went wrong!";
      });
  };
  retrieveCar($routeParams.id);
});

car.html

<h3>Car Details</h3>
<h5>Plate</h5>
```

```
{{car.plate}}
<h5>Color</h5>
{{car.color}}
<h5>Entrance</h5>
{{car.entrance | date:'dd/MM/yyyy hh:mm'}}
<h5>Period</h5>
{{ticket.period}}
<h5>Price</h5>
{{ticket.price | currency}}
<button ng-click="depart(car)">Depart</button>
<a href="#/parking">Back to parking</a>
```

Changing the location

There are many ways to navigate, but we need to identify where our resource is located before we decide which strategy to follow. In order to navigate within the route mechanism, without refreshing the page, we can use the `$location` service. There is a function called `path` that will change the URL after the `#`, allowing the application to be a single-page one.

However, sometimes, it might be necessary to navigate out of the application boundaries. It could be done by the `$window` service by means of the `location.href` property as follows:

```
controller.js

parking.controller("carController", function ($scope, $routeParams,
$location, $window, parkingHttpFacade, parkingService) {
  $scope.depart = function (car) {
    parkingHttpFacade.deleteCar(car)
      .success(function (data, status) {
        $location.path("/parking");
      })
      .error(function (data, status) {
        $window.location.href = "error.html";
      });
  };
  var retrieveCar = function (id) {
    parkingHttpFacade.getCar(id)
      .success(function (data, status) {
        $scope.car = data;
        $scope.ticket = parkingService.calculateTicket(car);
      })
      .error(function (data, status) {
```

```
        $window.location.href = "error.html";
      });
  };
  retrieveCar($routeParams.id);
});
```

Resolving promises

Very often, the controller needs to resolve some asynchronous promises before being able to render the view. These promises are, in general, the result of an AJAX call in order to obtain the data that will be rendered. We are going to study the promise-deferred pattern later in this chapter.

In our previous example, we figured this out by creating and invoking a function called `retrieveCars` directly from the controller:

```
controllers.js

parking.controller("parkingCtrl", function ($scope, parkingHttpFacade)
{
  var retrieveCars = function () {
    parkingHttpFacade.getCars()
      .success(function(data, status, headers, config) {
        $scope.cars = data;
      })
     .error(function(data, status, headers, config) {
        switch(status) {
          case 401: {
            $scope.message = "You must be authenticated!"
            break;
          }
          case 500: {
            $scope.message = "Something went wrong!";
            break;
          }
        }
        console.log(data, status);
      });
  };

  retrieveCars();
});
```

The same behavior could be obtained by means of the `resolve` property, defined inside the `when` function of the `$routeProvider` function with much more elegance, as follows:

```
config.js

parking.config(function ($routeProvider) {
  $routeProvider.
    when("/parking", {
      templateUrl: "parking.html",
   controller: "parkingCtrl",
   resolve: {
     "cars": function (parkingHttpFacade) {
       return parkingHttpFacade.getCars();
     }
   }
  }).
     when("/car/:id", {
       templateUrl: "car.html",
    controller: "carCtrl",
    resolve: {
      "car": function (parkingHttpFacade, $route) {
        var id = $route.current.params.id;
        return parkingHttpFacade.getCar(id);
      }
    }
  }).
  otherwise({
    redirectTo: '/parking'
  });
});
```

After this, there is a need to inject the resolved objects inside the controller:

```
controllers.js

parking.controller("parkingCtrl", function ($scope, cars) {
  $scope.cars = cars.data;
});

parking.controller("parkingCtrl", function ($scope, car) {
  $scope.car = car.data;
});
```

There are three events that can be broadcasted by the `$route` service and are very useful in many situations. The broadcasting mechanism will be studied in the next chapter, *Chapter 5*, *Scope*.

The first event is the `$routeChangeStart` event. It will be sent when the routing process starts and can be used to create a loading flag, as follows:

```
run.js

parking.run(function ($rootScope) {
  $rootScope.$on("$routeChangeStart", function(event, current,
previous, rejection)) {
    $rootScope.loading = true;
});
});
```

After this, if all the promises are resolved, the `$routeChangeSuccess` event is broadcasted, indicating that the routing process finished successfully:

```
run.js

parking.run(function ($rootScope) {
  $rootScope.$on("$routeChangeSuccess", function(event, current,
previous, rejection)) {
    $rootScope.loading = false;
  });
});
```

If any of the promises are rejected, the `$routeChangeError` event is broadcasted, as follows:

```
run.js

parking.run(function ($rootScope, $window) {
  $rootScope.$on("$routeChangeError", function(event, current,
previous, rejection) {
    $window.location.href = "error.html";
  });
});
```

Logging

This service is very simple and can be used to create a logging strategy for the application that could be used for debug purposes.

There are five levels available:

- info
- warn
- debug
- error
- log

We just need to inject this service inside the component in order to be able to log anything from it, as follows:

```
parking.controller('parkingController', function ($scope, $log) {
  $log.info('Entered inside the controller');
});
```

Is it possible to turn off the debug logging through the `$logProvider` event? We just need to inject the `$logProvider` event to our application `config` and set the desired configuration through the `debugEnabled` method:

```
parking.config(function ($logProvider) {
  $logProvider.debugEnabled(false);
});
```

Timeout

The `$timeout` service is really useful when we need to execute a specific behavior after a certain amount of time. Also, there is another service called `$interval`; however, it executes the behavior repeatedly.

In order to create a timeout, we need to obtain its reference through the dependency injection mechanism and invoke it by calling the `$timeout` service that passes two parameters: the function to be executed and the frequency in milliseconds.

Now, it's time to create an asynchronous search service that will be called by the controller every time the user presses a key down inside the search box. It will wait for 1000 milliseconds until the search algorithm is executed:

```
parking.factory('carSearchService', function ($timeout) {
  var _filter = function (cars, criteria, resultCallback) {
    $timeout(function () {
```

```
        var result = [];
        angular.forEach(cars, function (car) {
          if (_matches(car, criteria)) {
            result.push(car);
          }
        });
        resultCallback(result);
      }, 1000);
    };

    var _matches = function (car, criteria) {
      return angular.toJson(car).indexOf(criteria) > 0;
    };

    return {
      filter: _filter
    }
  });
```

A very common requirement when creating an instant search is to cancel the previously scheduled timeout, replacing it with a new one. It avoids an unnecessary consumption of resources, optimizing the whole algorithm.

In the following code, we are interrupting the timeout. It can be achieved by calling the `cancel` method on the `$timeout` object that is passing the promise reference as a parameter:

```
  parking.factory('carSearchService', function ($timeout) {
    var filterPromise;

    var _filter = function (cars, criteria, resultCallback) {
      $timeout.cancel(filterPromise);
      filterPromise = $timeout(function () {
        var result = [];
        angular.forEach(cars, function (car) {
          if (_matches(car, criteria)) {
            result.push(car);
          }
        });
        resultCallback(result);
      }, 1000);
    };

    var _matches = function (car, criteria) {
```

```
      return angular.toJson(car).indexOf(criteria) > 0;
    };

    return {
      filter: _filter
    }
  });
```

Asynchronous with a promise-deferred pattern

Nowadays, web applications are demanding increasingly advanced usability requirements, and therefore rely strongly on asynchronous implementation in order to obtain dynamic content from the backend, applying animated visual effects, or even to manipulate DOM all the time.

In the middle of this endless asynchronous sea, callbacks help many developers to navigate through its challenging and confusing waters.

According to Wikipedia:

> "*A callback is a piece of executable code that is passed as an argument to other code, which is expected to callback, executing the argument at some convenient time.*"

The following code shows the implementation of the `carSearchService` function. It uses a callback to return the results to the controller after the search has been executed. In this case, we can't just use the `return` keyword because the `$timeout` service executes the search in the future, when its timeout expires. Consider the following code snippet:

```
services.js

parking.factory('carSearchService', function ($timeout) {
  var _filter = function (cars, criteria, successCallback,
    errorCallback) {
    $timeout(function () {
      var result = [];
      angular.forEach(cars, function (car) {
        if (_matches(car, criteria)) {
          result.push(car);
        }
      });
```

```
        if (result.length > 0) {
          successCallback(result);
        } else {
          errorCallback("No results were found!");
        }
      }, 1000);
    };

    var _matches = function (car, criteria) {
      return angular.toJson(car).indexOf(criteria) > 0;
    };

    return {
      filter: _filter
    }
  });
```

In order to call the `filter` function properly, we need to pass both callbacks to perform the success, as follows:

```
controllers.js

$scope.searchCarsByCriteria = function (criteria) {
  carSearchService.filter($scope.cars, criteria, function (result) {
    $scope.searchResult = result;
  }, function (message) {
    $scope.message = message;
  });
};
```

However, there are situations in which the numerous number of callbacks, sometimes even dangerously chained, may increase the code complexity and transform the asynchronous algorithms into a source of headaches.

To figure it out, there is an alternative to the massive use of callbacks—the promise and the deferred patterns. They were created a long time ago and are intended to support this kind of situation by returning a promise object, which is unknown while the asynchronous block is processed. As soon as something happens, the promise is deferred and notifies its handlers. It is created without any side effects and returns the promise.

The deferred API

In order to create a new promise, we need to inject the `$q` service into our component and call the `$q.defer()` function to instantiate a deferred object. It will be used to implement the asynchronous behavior in a declarative way through its API. Some of the functions are as follows:

- `resolve(result)`: This resolves the promise with the result.
- `reject(reason)`: This rejects the promise with a reason.
- `notify(value)`: This provides updated information about the progress of the promise. Consider the following code snippet:

```
services.js

parking.factory('carSearchService', function ($timeout, $q) {
  var _filter = function (cars, criteria) {
    var deferred = $q.defer();
    $timeout(function () {
      var result = [];
      angular.forEach(cars, function (car) {
        if (_matches(car, criteria)) {
          result.push(car);
        }
      });
      if (result.length > 0) {
        deferred.resolve(result);
      } else {
        deferred.reject("No results were found!");
      }
    }, 1000);
    return deferred.promise;
  };

  var _matches = function (car, criteria) {
    return angular.toJson(car).indexOf(criteria) > 0;
  };

  return {
    filter: _filter
  }
});
```

The promise API

With the promise object in hand, we can handle the expected behavior of the asynchronous return of any function. There are three methods that we need to understand in order to deal with promises:

- `then (successCallback, errorCallback, notifyCallback)`: The success callback is invoked when the promise is resolved. In the same way, error callback is called if the promise is rejected. If we want to keep track of our promise, the notify callback is called every time the promise is notified. Also, this method returns a new promise, allowing us to create a chain of promises.
- `catch(errorCallback)`: This promise is just an alternative and is equivalent to `.then(null, errorCallback)`.
- `finally(callback)`: Like in other languages, `finally` can be used to ensure that all the used resources were released properly:

```
controllers.js

$scope.filterCars = function (criteria) {
  carSearchService.filter($scope.cars, criteria)
    .then(function (result) {
      $scope.searchResults = result;
    })
    .catch(function (message) {
      $scope.message = message;
    });
};
```

Summary

Throughout this chapter, we have studied several ways to evolve the design of our application through dependency injection and the creation of different kinds of constants, values, and services. Also, we understood how to use the AngularJS built-in services in order to communicate with the backend using HTTP, log the application events, create timeouts, perform routing, handle exceptions, and work with asynchronous algorithms with the promise-deferred pattern.

In the next chapter, we are going to study the scope in more detail.

5
Scope

The **scope** is an object that acts as a shared context between the view and the controller that allows these layers to exchange information related to the application model. Both sides are kept synchronized along the way through a mechanism called two-way data binding.

In this chapter, we are going to cover the following topics:

- Two-way data binding
- Best practices using the scope
- The $rootScope object
- Broadcasting the scope

Two-way data binding

Traditional web applications are commonly developed through a one-way data binding mechanism. This means there is only a rendering step that attaches the data to the view. This is done with the following code snippet in the `index.html` file:

```
<input id="plate" type="text"/>
<button id="showPlate">Show Plate</button>
```

Consider the following code snippet in the `render.js` file:

```
var plate = "AAA9999";
$("#plate").val(plate);

$("#showPlate").click(function () {
  alert(plate);
});
```

What happens when we change the plate and click on the button? Unfortunately, nothing.

In order to reflect the changes on the plate, we need to implement the binding in the other direction, as shown in the following code snippet (in the `render.js` file):

```
var plate = "AAA9999";
$("#plate").val(plate);

$("#showPlate").click(function () {
    plate = $("#plate").val();
    alert(plate);
});
```

Every change that occurs in the view needs to be explicitly applied to the model, and this requires a lot of boilerplate code, which means snippets of code that have to be included in many places just to keep everything synchronized. The highlighted sections in the following code snippet of the `render.js` file comprise the boilerplate code:

```
var plate = "AAA9999";
$("#plate").val(plate);

$("#showPlate").click(function () {
    plate = $("#plate").val();
    alert(plate);
});
```

To illustrate these examples, we used the jQuery library that can be easily obtained through its website at `www.jquery.com`, or we can use Bower, which we are going to study in more detail in *Chapter 8*, *Automating the Workflow*.

With two-way data binding, the view and controller are always kept synchronized without any kind of boilerplate code, as we will learn in the next topics.

$apply and $watch

During the framework initialization, the compiler walks through the DOM tree looking for directives. When it finds the `ngModel` directive attached to any kind of input field, it binds its own scope's `$apply` function to the `onkeydown` event. This function is responsible for invoking the notification process of the framework called the digest cycle.

This cycle is responsible for the notification process by looping over all the watchers, keeping them posted about any change that may occur in the scope. There are situations where we might need to invoke this mechanism manually by calling the `$apply` function directly, as follows:

```
$scope.$apply(function () {
  $scope.car.plate = '8AA5678';
});
```

On the other side, the components responsible for displaying the content of any element present inside the scope use their scope's `$watch` function to be notified about the changes on it. This function observes whether the value of a provided scope property has changed. To illustrate the basic usage of the `$watch` function, let's create a counter to track the number of times the value of a scope property has changed. Consider the following code snippet in the `parking.html` file:

```
<input type="text" ng-model="car.plate" placeholder="What's the
plate?"/>
<span>{{plateCounter}}</span>
```

Also, consider the following code snippet in the `controllers.js` file:

```
parking.controller("parkingCtrl", function ($scope) {
  $scope.plateCounter = -1;

  $scope.$watch("car.plate", function () {
    $scope.plateCounter++;
  });
});
```

Every time the plate property changes, this watcher will increment the `plateCounter` property, indicating the number of times it has changed. You may wonder why we are using `-1` instead of `0` to initialize the counter, when the value starts with `0` in the view. This is because the digest cycle is called during the initialization process and updates the counter to `0`.

To figure it out, we can use some parameters inside the `$watch` function to know what has changed. When the `$watch` function is being initialized, `newValue` will be equal to `oldValue`, as shown in the following code snippet (the `controllers.js` file):

```
parking.controller("parkingCtrl", function ($scope) {
  $scope.plateCounter = 0;

  $scope.$watch("car.plate", function (newValue, oldValue) {
```

```
    if (newValue == oldValue) return;
    $scope.plateCounter++;
  });
});
```

Best practices using the scope

The scope is not the model itself—it's just a way to reach it. Thus, the view and controller layers are absolutely free to share any kind of information, even those that are not related to the model, and they only exist to fulfill specific layout matters such as showing or hiding a field under a determined condition.

Be careful about falling into a design trap! The freedom provided by the scope can lead you to use it in a wrong way. Keep the following advice in mind:

> "*Treat scope as read-only inside the view and write-only inside the controller as possible.*"

Also, we will go through some important advice about using the scope:

Avoid making changes to the scope directly from the view

This means that though it is easy, we should avoid making changes to the scope by creating or modifying its properties directly inside the view. At the same time, we need to take care about reading the scope directly everywhere inside the controller.

The following is an example from the `faq.html` file where we can understand these concepts in more detail:

```
<button ng-click="faq = true">Open</button>
<div ng-modal="faq">
  <div class="header">
    <h4>FAQ</h4>
  </div>
  <div class="body">
    <p>You are in the Frequently Asked Questions!</p>
  </div>
  <div class="footer">
    <button ng-click="faq = false">Close</button>
  </div>
</div>
```

In the previous example, we changed the value of the dialog property directly from the `ngClick` directive declaration. The best choice in this case would be to delegate this intention to the controller and let it control the state of the dialog, such as the following code in the `faq.html` file:

```
<button ng-click="openFAQ()">Open</button>
<div ng-modal="faq">
  <div class="header">
    <h4>FAQ</h4>
  </div>
  <div class="body">
    <p>You are in the Frequently Asked Questions!</p>
  </div>
  <div class="footer">
    <button ng-click="closeFAQ()">Close</button>
  </div>
</div>
```

Consider the following code snippet in the `controllers.js` file:

```
parking.controller("faqCtrl", function ($scope) {
  $scope.faq = false;

  $scope.openFAQ = function () {
    $scope.faq = true;
  }

  $scope.closeFAQ = function () {
    $scope.faq = false;
  }
});
```

The idea to spread a variable across the whole view is definitely dangerous. It contributes to reducing the flexibility of the code and also increases the coupling between the view and the controller.

Avoid reading the scope inside the controller

Reading the `$scope` object inside the controller instead of passing data through parameters should be avoided. This increases the couple between them and makes the controller much harder to test. In the following code snippet of the `login.html` file, we will call the `login` function and access its parameters directly from the `$scope` object:

```
<div ng-controller="loginCtrl">
  <input
    type="text"
```

```
      ng-model="username"
      placeholder="Username"
    />
    <input
      type="password"
      ng-model="password"
      placeholder="Password"/>
    <button ng-click="login()">Login</button>
  </div>
```

Consider the following code snippet in the `controllers.js` file:

```
parking.controller("loginCtrl", function ($scope, loginService) {
  $scope.login = function () {
    loginService.login($scope.username, $scope.password);
  }
});
```

Do not let the scope cross the boundary of its controller

We should also take care about not allowing the `$scope` object to be used far a way from the controller's boundary. In the following code snippet from the `login.html` file, there is a situation where `loginCtrl` is sharing the `$scope` object with `loginService`:

```
<div ng-controller="loginCtrl">
  <input
    type="text"
    ng-model="username"
    placeholder="Username"
  />
  <input
    type="password"
    ng-model="password"
    placeholder="Password"/>
  <button ng-click="login()">Login</button>
</div>
```

Consider the following code snippet in the `controllers.js` file:

```
parking.controller("loginCtrl", function ($scope, loginService) {
  $scope.login = function () {
    loginService.login($scope);
  }
});
```

Consider the following code snippet in the `services.js` file:

```
parking.factory("loginService", function ($http) {
  var _login = function($scope) {
    var user = {
      username: $scope.username,
      password: $scope.password
    };
    return $http.post('/login', user);
  };

  return {
    login: _login
  };
});
```

Use a '.' inside the ngModel directive

The framework has the ability to create an object automatically when we introduce a period in the middle of the `ngModel` directive. Without that, we ourselves would need to create the object every time by writing much more code.

In the following code snippet of the `login.html` file, we will create an object called `user` and also define two properties, `username` and `password`:

```
<div ng-controller="loginCtrl">
  <input
    type="text"
    ng-model="user.username"
    placeholder="Username"
  />
  <input
    type="password"
    ng-model="user.password"
    placeholder="Password"
  />
  <button ng-click="login(user)">Login</button>
</div>
```

Consider the following code snippet of the `controllers.js` file:

```
parking.controller("loginCtrl", function ($scope, loginService) {
  $scope.login = function (user) {
    loginService.login(user);
  }
});
```

Consider the following code snippet of the `services.js` file:

```
services.js

parking.factory("loginService", function ($http) {
  var _login = function(user) {
    return $http.post('/login', user);
  };

  return {
    login: _login
  };
});
```

Now, the `login` method will be invoked just by creating a `user` object, which is not coupled with the `$scope` object anymore.

Avoid using scope unnecessarily

As we saw in *Chapter 3*, *Data Handling*, the framework keeps the view and the controller synchronized using the two-way data binding mechanism. Because of this, we are able to increase the performance of our application by reducing the number of things attached to `$scope`.

With this in mind, we should use `$scope` only when there are things to be shared with the view; otherwise, we can use a local variable to do the job.

The $rootScope object

The `$rootScope` object is inherited by all of the `$scope` objects within the same module. It is very useful and defines global behavior. It can be injected inside any component such as controllers, directives, filters, and services; however, the most common place to use it is through the `run` function of the module API, shown as follows (the `run.js` file):

```
parking.run(function ($rootScope) {
  $rootScope.appTitle = "[Packt] Parking";
});
```

Scope Broadcasting

The framework provides another way to communicate between components by the means of a scope, however, without sharing it. To achieve this, we can use a function called `$broadcast`.

When invoked, this function dispatches an event to all of its registered child scopes. In order to receive and handle the desired broadcast, `$scope` needs to call the `$on` function, thus informing you of the events you want to receive and also the functions that will be handling it.

For this implementation, we are going to send the broadcast through the `$rootScope` object, which means that the broadcast will affect the entire application.

In the following code, we created a service called `TickGenerator`. It informs the current date every second, thus sending a broadcast to all of its children (the `services.js` file):

```
parking.factory("tickGenerator", function($rootScope, $timeout) {
  var _tickTimeout;

  var _start = function () {
    _tick();
  };

  var _tick = function () {
    $rootScope.$broadcast("TICK", new Date());
    _tickTimeout = $timeout(_tick, 1000);
  };

  var _stop = function () {
    $timeout.cancel(_tickTimeout);
  };

  var _listenToStop = function () {
    $rootScope.$on("STOP_TICK", function (event, data) {
      _stop();
    });
  };

  _listenToStop();

  return {
    start: _start,
    stop: _stop
  };
});
```

Now, we need to start `tickGenerator`. This can be done using the `run` function of the module API, as shown in the following code snippet of the `app.js` file:

```
parking.run(function (tickGenerator) {
  tickGenerator.start();
});
```

To receive the current date, freshly updated, we just need to call the `$on` function of any `$scope` object, as shown in the following code snippet of the `parking.html` file:

```
{{tick | date:"hh:mm"}}
```

Consider the following code snippet in the `controllers.js` file:

```
parking.controller("parkingCtrl", function ($scope) {
  var listenToTick = function () {
    $scope.$on('TICK', function (event, tick) {
      $scope.tick = tick;
    });
  };
  listenToTick();
});
```

From now, after the `listenToTick` function is called, the controller's `$scope` object will start to receive a broadcast notification every 1000 ms, executing the desired function.

To stop the tick, we need to send a broadcast in the other direction in order to make it arrive at `$rootScope`. This can be done by means of the `$emit` function, shown as follows in the `parking.html` file:

```
{{tick | date:"hh:mm"}}
<button ng-click="stopTicking()">Stop</button>
```

Consider the following code snippet in the `controllers.js` file:

```
parking.controller("parkingCtrl", function ($scope) {
  $scope.stopTicking = function () {
    $scope.$emit("STOP_TICK");
  };
  var listenToTick = function () {
    $scope.$on('TICK', function (event, tick) {
      $scope.tick = tick;
    });
  };
  listenToTick();
});
```

Be aware that depending on the size of the application, the broadcast through `$rootScope` may become too heavy due to the number of objects listening to the same event.

There are a number of libraries that implement the publish and subscribe pattern in JavaScript. Of them, the most famous is AmplifyJS, but there are others such as RadioJS, ArbiterJS, and PubSubJS.

Summary

In this chapter, we studied what exactly `$scope` and `$rootScope` are and how the two-way data binding mechanism works. Also, we went through some of the best practices about using the scope, and we discovered its broadcasting mechanism.

In the next chapter, we are going to understand how to break up our application into reusable modules.

6
Modules

As our application grows, we need to consider the possibility of splitting it into different modules. It comes with it a lot of advantages, thus helping us to find the best way to test and evolve each module separately from the others and also to share each module with other projects.

In this chapter, we are going to cover the following topics:

- How to create modules
- Recommended modules

Creating modules

By gaining an in-depth understanding of the underlying business inside our application, we can isolate each group of functionalities (which are correlated) into a separated module. In the case of our parking application, we can split it into three different modules:

- **UI**: This module gives directives that could be used by other projects such as alert, accordion, modal, tab, and tooltip.
- **Search**: The search engine we created to filter cars could also be separated as an individual library and reused in other places.
- **Parking**: This is the parking application itself, with its own resources such as views, controllers, directives, filters, and services.

First, we need to create each new module separately and then they need to be declared inside the parking application module such that they are available.

The UI module

The UI module will contain the directives that we created in *Chapter 2*, *Creating Reusable Components with Directives*.

To create an isolated and easy-to-use module, we should consider placing the entire code inside a unique file. However, this is not the kind of task that you would want to perform manually, and the best way to achieve this is by concatenating the files together through a tool such as Grunt, which we are going to study in *Chapter 8*, *Automating the Workflow*, and will learn how to concatenate the files together.

For now, let's start by creating our new module called `ui` in the `app.js` file, as follows:

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

After that, we will declare each component separated in its own file. This will improve the maintainability of the module, facilitating the access to the components. The template is another aspect that we need to take care. In *Chapter 2*, *Creating Reusable Components with Directives*, we separated it from the directive's code. However, though we want to deliver this library in an easier format, it would be a good choice to embed its code within the component.

There are plugins for Grunt, such as `grunt-html-to-js` that may perform this tough and boring job for us. Consider the following code snippet in the `alertDirective.js` file:

```
ui.directive("alert", function () {
  return {
    restrict: 'E',
    scope: {
      topic: '@'
    },
    replace: true,
    transclude: true,
    template:
      "<div class='alert'>" +
        "<span class='alert-topic'>" +
          "{{topic}}" +
        "</span>" +
        "<span class='alert-description' ng-transclude>" +
        "</span>" +
      "</div>"
  };
});
```

Consider the following code snippet in the `accordionDirective.js` file:

```
ui.directive("accordion", function () {
  return {
    restrict: "E",
    transclude: true,
    controller: function ($scope, $element, $attrs, $transclude) {
      var accordionItens = [];

      var addAccordionItem = function (accordionScope) {
        accordionItens.push(accordionScope);
      };

      var closeAll = function () {
        angular.forEach(accordionItens, function (accordionScope) {
          accordionScope.active = false;
        });
      };

      return {
        addAccordionItem: addAccordionItem,
        closeAll: closeAll
      };
    },
    template: "<div ng-transclude></div>"
  };
});

ui.directive("accordionItem", function () {
  return {
    restrict: "E",
    scope: {
      title: "@"
    },
    transclude: true,
    require: "^accordion",
    link: function (scope, element, attrs, ctrl, transcludeFn) {
      ctrl.addAccordionItem(scope);
      element.bind("click", function () {
        ctrl.closeAll();
        scope.$apply(function () {
          scope.active = !scope.active;
        });
      });
```

```
      },
      template:
        "<div class='accordion-item'>" +
          "{{title}}" +
        "</div>" +
        "<div " +
          "ng-show='active' " +
          "class='accordion-description' " +
          "ng-transclude" +
        ">" +
        "</div>"
    };
});
```

Great! Now we are ready to pack our library inside one script file. For this, again, we may rely on Grunt, through the `grunt-contrib-concat` plugin, for creating this concatenation for us. The destination file in this case would be `ui.js`, and we are going to declare it inside the `index.html` file of our parking application.

The search module

The search module will contain `carSearchService`, which we created in *Chapter 4*, *Dependency Injection and Services*.

Again, we are going to start by declaring the module search in the `app.js` file, as follows:

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

Because we want to deliver this service as a reusable component, it would be nice to get rid of the car concept, making it more generic. To do that, let's just change it from car to entity. Consider the following code snippet in the `searchService.js` file:

```
search.factory('searchService', function ($timeout, $q) {
  var _filter = function (entities, criteria) {
    var deferred = $q.defer();
    $timeout(function () {
      var result = [];
      angular.forEach(entities, function (entity) {
        if (_matches(entity, criteria)) {
          result.push(entity);
        }
      });
      if (result.length > 0) {
```

```
          deferred.resolve(result);
        } else {
          deferred.reject("No results were found!");
        }
      }, 1000);
      return deferred.promise;
    };

    var _matches = function (entity, criteria) {
      return angular.toJson(entity).indexOf(criteria) > 0;
    };

    return {
      filter: _filter
    }
  });
```

Now that our `search` module is ready, we can use it with any project we want! The name of this script, after the files, concatenation, will be `search.js`, and we need to import it to the `index.html` file.

The parking application module

It's time to create our application module and declare our new modules `ui` and `search` as our dependencies. Also, we need to include the `ngRoute` and `ngAnimate` modules in order to to enable the routing and animation mechanisms. Consider the following code snippet in the `app.js` file:

```
var parking = angular.module("parking", ["ngRoute", "ngAnimate", "ui",
"search"]);
```

That's it! Now, we just need to import the scripts inside our `index.html` file, as follows:

```
<!doctype html>
<html ng-app="parking">
  <head>
    <title>[Packt] Parking</title>
    <!-- Application CSS -->
    <link rel="stylesheet" type="text/css" href="css/app.css">
    <!-- Application Libraries -->
    <script src="lib/angular.js"></script>
    <script src="lib/angular-route.js"></script>
    <script src="lib/angular-animate.js"></script>
    <script src="lib/ui.js"></script>
```

```
    <script src="lib/search.js"></script>
    <!-- Application Scritps -->
    <script src="js/app.js"></script>
    <script src="js/constants.js"></script>
    <script src="js/controllers.js"></script>
    <script src="js/filters.js"></script>
    <script src="js/services.js"></script>
    <script src="js/config.js"></script>
    <script src="js/run.js"></script>
  </head>
  <body>
    <div ng-view></div>
  </body>
</html>
```

A major part of the applications has concepts, which we could think of developing as a separated module. Beyond this, it is an excellent opportunity to contribute by opening the source code and evolving it with the community!

Recommended modules

AngularJS has a huge community and thousands of modules available for use. There are lots of things that we actually don't need to worry about while developing something by ourselves! From tons of UI components to the integration with many of the most well-known JavaScript libraries such as Highcharts, Google Maps and Analytics, Bootstrap, Foundation, Facebook, and many others, you may find more than 500 modules on the Angular Modules website, at `www.ngmodules.org`.

Summary

In this chapter, we understood how to break up our applications in modules. Also, we discovered the angular module's website, where we can find hundreds of modules for our application.

In the next chapter, we are going understand how to automate the tests using Jasmine and Karma.

7
Unit Testing

Have you ever stopped to think about how much time we've spent just to understand and reproduce a defect? After this, we need to spend even more time looking for, between thousands of lines, the exact piece of the code that is causing this defect. Many times, the fastest, and perhaps the easiest step is fixing it. And what about manually testing the code repeatedly? Every time anything is changed, you need to test it again. However, as the nature of software is all about changing, test automation should be considered as an important long-term investment that will support a sustainable pace and also improve the quality of each release.

Talking about quality, tests are the seeds of quality. Without that, nobody would have enough confidence, or even courage, to improve the existing code by refactoring it more often. Therefore, we could accumulate too much technical debt, affecting the productivity and also bringing down the motivation of the team.

In the case of JavaScript, it is a very dynamic language that provides a strong combination of both functional and object-oriented paradigms. However, despite the advantage of being interpreted easily, JavaScript comes with a risk. The lack of a compiler may lead you to introduce many syntax errors such as unknown variables or function names, missing semicolons, and many others.

Beyond tools such as **JSLint** and **JSHint** that verify our code by looking for the most common syntax errors, there are many testing frameworks available for JavaScript. We are going to use **Jasmine**, which is easy to use and also has a great community and support.

In order to test the AngularJS components, we'll use a module called `ngMock` that supports dependency injection and also comes with a mocking mechanism.

The topics that we'll cover in this chapter are:

- The Jasmine testing framework
- Testing AngularJS components
- Mocking with `$httpBackend`
- Running tests with Karma

The Jasmine testing framework

Jasmine is an open source testing framework for the JavaScript language developed by **Pivotal Labs**. Its syntax is pretty similar to one of the most famous testing frameworks, **RSpec**.

Basically, you just need to download it from **GitHub** at `http://jasmine.github.io` and unzip it. Later in this chapter, you'll see how to use it with Karma, a runner that could offer us many interesting benefits.

To clarify our first step with Jasmine, let's implement a factory function based on our `parkingService` example from *Chapter 4*, *Dependency Injection and Services*, and use a **Revealing Module Pattern**:

```
parkingFactoryFunction.js

var parkingFactoryFunction = function () {
  var _calculateTicket = function (car) {
    var departHour = new Date().getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * 10;
    return {
      period: parkingPeriod,
      price: parkingPrice
    };
  };

  return {
    calculateTicket: _calculateTicket
  };
};
```

Before writing the test, you should take care about the existing dependencies in your code. In this case, inside the `_calculateTicket` function, we are creating a `Date` object by calling the `new` operator. This kind of a situation should be avoided, otherwise you can't write an effective test.

The following code considers the `depart` property inside the parked `car` object. In this way, we could manage the `depart` property, and thus be able to test it properly:

```
parkingFactoryFunction.js

var parkingFactoryFunction = function () {
  var _calculateTicket = function (car) {
    var departHour = car.depart.getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * 10;
    return {
      period: parkingPeriod,
      price: parkingPrice
    };
  };

  return {
    calculateTicket: _calculateTicket
  };
};
```

The creation of the `parkingFactoryFunctionSpec` function starts by calling the `describe` function. It takes a description of the specification and a function that contains the test scenarios:

```
parkingFactoryFunctionSpec.js

describe("Parking Factory Function Specification", function () {
});
```

Now, we need to create each of our test scenarios through the `it` function. Here, we will need to place a description and expectation for each test:

```
parkingFactoryFunctionSpec.js

describe("Parking Factory Function Specification", function () {
  it("Should calculate the ticket for a car that arrives any day at
08:00 and departs in the same day at 16:00", function () {
    var car = {place: "AAA9988", color: "Blue"};
```

```
    car.entrance = new Date(1401620400000);
    car.depart = new Date(1401649200000);
    var parkingService = parkingFactoryFunction();
    var ticket = parkingService.calculateTicket(car);
    expect(ticket.period).toBe(8);
    expect(ticket.price).toBe(80);
  });
});
```

In order to execute our specification, let's check out Jasmine's built-in HTML-based runner called `SpecRunner.html`, which can be configured as follows:

```
SpecRunner.html

<!DOCTYPE HTML>
<html>
  <head>
    <title>Jasmine Spec Runner v2.0.0</title>
    <link rel="stylesheet" type="text/css" href="lib/jasmine-2.0.0/
jasmine.css">
    <script src="lib/jasmine-2.0.0/jasmine.js"></script>
    <script src="lib/jasmine-2.0.0/jasmine-html.js"></script>
    <script src="lib/jasmine-2.0.0/boot.js"></script>
    <script src="js/parkingFactoryFunction.js"></script>
    <script src="spec/parkingFactoryFunctionSpec.js"></script>
  </head>
  <body>
  </body>
</html>
```

After including the `parkingFactoryFunction.js` and `parkingFactoryFunctionSpec.js` files, we just need to open the `SpecRunner.html` file in our browser.

Testing AngularJS components

To test any AngularJS component such as controllers, directives, filters, and services, we need to go beyond the basics and use the `ngMock` library. It provides a dependency injection mechanism, allowing us to locate and inject any component of a specified module. Also, there are services such as `$http`, `$log`, and `$timeout` that could be mocked in order to allow our code to be more testable.

Services

For now, let's create a service based on our `parkingFactoryFunction` function, as follows:

```
parkingApp.js

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

parkingService.js

parking.factory("parkingService", function () {
  var _calculateTicket = function (car) {
    var departHour = car.depart.getHours();
    var entranceHour = car.entrance.getHours();
    var parkingPeriod = departHour - entranceHour;
    var parkingPrice = parkingPeriod * 10;
    return {
      period: parkingPeriod,
      price: parkingPrice
    };
  };

  return {
    calculateTicket: _calculateTicket
  };
});
```

To avoid duplicated setup and teardown code, Jasmine provides two important functions, `beforeEach` and `afterEach`, which are executed before and after the execution of each test. With the `module` function of `ngMock`, we can load the desired module and inject its components through the `inject` function just by informing the name of the component. Optionally, we may enclose the name of the component with underscores. In the following code, we are loading the `parking` module and injecting the `parkingService` specification:

```
parkingServiceSpec.js

describe("Parking Service Specification", function () {
  var parkingService;

  beforeEach(module("parking"));

  beforeEach(inject(function (_parkingService_) {
```

```
    parkingService = _parkingService_;
  }));

  it("Should calculate the ticket for a car that arrives any day at
08:00 and departs in the same day at 16:00", function () {
    var car = {place: "AAA9988", color: "Blue"};
    car.entrance = new Date(1401620400000);
    car.depart = new Date(1401649200000);
    var ticket = parkingService.calculateTicket(car);
    expect(ticket.period).toBe(8);
    expect(ticket.price).toBe(80);
  });
});
```

Controllers

The controller will be the next component that we will test. In the following code, there is the code of our controller from *Chapter 2*, *Creating Reusable Components with Directives*:

```
parkingCtrl.js

parking.controller("parkingCtrl", function ($scope) {
  $scope.appTitle = "[Packt] Parking";

  $scope.cars = [];

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];

  $scope.park = function (car) {
    car.entrance = new Date();
    $scope.cars.push(car);
    delete $scope.car;
  };
});
```

It is more complex to test controllers than services because we need to mock its `$scope`. We will start by injecting the `$controller` dependency, which will be responsible for instantiating new controllers. Also, we need the `$rootScope` dependency in order to create a new `$scope` object through its `$new` function.

The expectations of the test should be done over the `$scope` object and not directly through the controller itself. This is very important because the view interacts with the controller through this shared object. Consider the following code snippet:

parkingCtrlSpec.js

```
describe("Parking Controller Specification", function () {
  var $scope;

  beforeEach(module("parking"));

  beforeEach(inject(function ($controller, $rootScope) {
    $scope = $rootScope.$new();
    $controller("parkingCtrl", {
      $scope: $scope
    });
  }));

  it("The title of the application should be [Packt] Parking",
function () {
    var expectedAppTitle = "[Packt] Parking";
    expect($scope.appTitle).toBe(expectedAppTitle);
  });

  it("The available colors should be white, black, blue, red and
silver", function () {
    var expectedColors = ["White", "Black", "Blue", "Red", "Silver"];
    expect($scope.colors).toEqual(expectedColors);
  });

  it("The car should be parked", function () {
    var car = {
      plate: "AAAA9999",
      color: "Blue"
    };
    $scope.park(car);
    expect($scope.cars.length).toBe(1);
    expect($scope.car).toBeUndefined();
  });
});
```

Filters

Next, we are going to test filters. In the following code, there is the `plate` filter, which we developed in *Chapter 3*, *Data Handling*:

```
plateFilter.js

parking.filter("plate", function() {
  return function(input, separator) {
    var firstPart = input.substring(0,3);
    var secondPart = input.substring(3);
    return firstPart + separator + secondPart;
  };
});
```

The filter dependency of any service could be obtained in the same way; however, we need to concatenate its name with `Filter`. In this case, it could be injected as `plateFilter` or `_plateFilter_`. Also, the `$filter` service could be used for the same purpose. Consider the following code snippet:

```
plateFilterSpec.js

describe("Plate Filter Specification", function () {
  var plateFilter;

  beforeEach(module("parking"));

  beforeEach(inject(function (_plateFilter_) {
    plateFilter = _plateFilter_;
  }));

  it("Should format the plate", function () {
    var plate = "AAA9999"
    var expectedPlate = "AAA-9999";
    expect(plateFilter(plate, "-")).toBe(expectedPlate);
});
});
```

Directives

The last kind of component that we are going to test is the directive. Let's start with one of the directives we created in *Chapter 2*, *Creating Reusable Components with Directives*, and converted it into a separated module in *Chapter 6*, *Modules*:

```
uiApp.js

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

alertDirective.js

ui.directive("alert", function () {
  return {
    restrict: "E",
    scope: {
      topic: "@"
    },
    replace: true,
    transclude: true,
    template:
      "<div class='alert'>" +
        "<span class='alert-topic'>" +
          "{{topic}}" +
        "</span>" +
        "<span class='alert-description' ng-transclude>" +
        "</span>" +
      "</div>"
  };
});
```

The directive is by far the most complex component to be tested. Part of the complexity comes from the framework's life cycle, which we should understand before creating any directive specification. In the following section, you will understand this, step by step.

Creating the element with the directive

The framework's compiler walks through the DOM, looking for elements that match the directives. In the following code is our directive before being compiled:

```
<alert topic='Something went wrong!'>
  Please inform the plate and the color of the car
</alert>
```

Compiling the directive

After this, the element is compiled by the `$compile` service, returning the `link` function of the directive. At this moment, the template is already generated, however, we still need to call the `link` function, passing the `$scope` object in order to bind the template to the `$scope` service:

```
<span class="alert-topic">
  {{topic}}
</span>
<span class="alert-description" ng-transclude="">
</span>
```

Calling the link function with the scope

Now, after the `link` function is executed, we are almost done! The `{{topic}}` expression could be retrieved from the `$scope` object; however, as we saw in *Chapter 5*, *Scope*, we need to invoke the digest cycle in order to notify the expression:

```
<span class="alert-topic ng-binding">
  {{topic}}
</span>
<span class="alert-description" ng-transclude="">
  <span class="ng-scope">
    Please inform the plate and the color of the car
  </span>
</span>
```

Invoking the digest cycle

Finally, we have to call the `$digest` function to update the view:

```
<span class="alert-topic ng-binding">
  Something went wrong!
</span>
```

```
<span class="alert-description" ng-transclude="">
  <span class="ng-scope">
    Please inform the plate and the color of the car
  </span>
</span>
```

According to the steps that we just followed, you can understand how you can go from the raw element to the completed, compiled, and rendered directive.

First, you need to create an element that contains the directive you want to test, and then it will be compiled by the framework in the following steps. Now, you need to inject the `$compile` service in order to compile the directive, returning its `link` function. After this, you just have to call the `link` function passing the `$scope` object. Finally, the digest cycle should be invoked by calling it through the `$digest` function of the `$rootScope` object. Consider the following code snippet:

```
alertDirectiveSpec.js

describe("Alert Directive Specification", function () {
  var element, scope;

  beforeEach(module('ui'));

  beforeEach(inject(function ($rootScope, $compile) {
    scope = $rootScope;
    // Create the element with the directive
    element = angular.element(
      "<alert topic='Something went wrong!'>" +
        "Please inform the plate and the color of the car" +
      "</alert>"
    );
    // Compile the directive
    var linkFunction = $compile(element);
    // Call the link function with the scope
    linkFunction(scope);
    // Invoke the digest cycle
    scope.$digest();
  }));

  it("Should compile the alert directive", function () {
    var expectedElement =
    '<span class="alert-topic ng-binding">' +
      'Something went wrong!' +
    '</span>' +
```

```
      '<span class="alert-description" ng-transclude="">' +
        '<span class="ng-scope">' +
          'Please inform the plate and the color of the car' +
        '</span>' +
      '</span>'
      ;
      expect(element.html()).toBe(expectedElement);
    });
  });
```

Mocking with $httpBackend

The `ngMock` library also provides the `$httpBackend` service. It mocks the backend, allowing us to test components that depend on the `$http` service. In the following code, there is the `parkingHttpFacade` service, which is responsible for integrating with the car's API at the backend:

```
parkingHttpFacade.js

parking.factory("parkingHttpFacade", function ($http) {
  var _getCars = function () {
    return $http.get("/cars");
  };

  var _getCar = function (id) {
    return $http.get("/cars/" + id);
  };

  var _saveCar = function (car) {
    return $http.post("/cars", car);
  };

  var _updateCar = function (id, car) {
    return $http.put("/cars/" + id, car);
  };

  var _deleteCar = function (id) {
    return $http.delete("/cars/" + id);
  };


  return {
    getCars: _getCars,
```

```
    getCar: _getCar,
    saveCar: _saveCar,
    updateCar: _updateCar,
    deleteCar: _deleteCar
  };
});
```

Inside each test, we defined the expected response to each request. It could be done through the `$httpBackend` service, as follows:

parkingHttpFacadeSpec.js

```
describe("Parking Http Facade Specification", function () {
  var parkingHttpFacade, $httpBackend, mockedCars;

  beforeEach(module("parking"));

  beforeEach(inject(function (_parkingHttpFacade_, _$httpBackend_) {
    parkingHttpFacade = _parkingHttpFacade_;
    $httpBackend = _$httpBackend_;
    mockedCars = buildMockedCars();
  }));

  it("Should get the parked cars", function () {
    $httpBackend.whenGET("/cars").respond(function (method, url, data,
headers) {
      return [200, mockedCars.getCars(), {}];
    });
    parkingHttpFacade.getCars().success(function (data, status) {
      expect(data).toEqual(mockedCars.getCars());
      expect(status).toBe(200);
    });
    $httpBackend.flush();
  });

  it("Should get a parked car", function () {
    $httpBackend.whenGET("/cars/1").respond(function (method, url,
data, headers) {
      return [200, mockedCars.getCar(1), {}];
    });
    parkingHttpFacade.getCar(1).success(function (data, status) {
      expect(data).toEqual(mockedCars.getCar(1));
      expect(status).toBe(200);
    });
```

```
    $httpBackend.flush();
  });

  it("Should save a parked car", function () {
    var car = {
      plate: "AAA9977",
      color: "Green"
    };
    $httpBackend.whenPOST("/cars").respond(function (method, url,
data, headers) {
      var id = mockedCars.saveCar(angular.fromJson(data));
      return [201, mockedCars.getCar(id), {}];
    });
    parkingHttpFacade.saveCar(car).success(function (data, status) {
      expect(car).toEqual(data);
      expect(status).toBe(201);
      expect(mockedCars.getNumberOfCars()).toBe(3);
    });
    $httpBackend.flush();
  });

  it("Should update a parked car with id=1", function () {
    var car = {
      plate: "AAA9977",
      color: "Red"
    };
    $httpBackend.whenPUT("/cars/1").respond(function (method, url,
data, headers) {
      mockedCars.updateCar(1, angular.fromJson(data));
      return [204, "", {}];
    });
    parkingHttpFacade.updateCar(1, car).success(function (data,
status) {
      expect(car).toEqual(mockedCars.getCar(1));
      expect(data).toBe("");
      expect(status).toBe(204);
    });
    $httpBackend.flush();
  });

  it("Should delete a parked car", function () {
    $httpBackend.whenDELETE("/cars/1").respond(function (method, url,
data, headers) {
      mockedCars.deleteCar(1);
```

```
        return [204, "", {}];
      });
      parkingHttpFacade.deleteCar(1).success(function (data, status) {
        expect(data).toBe("");
        expect(status).toBe(204);
        expect(mockedCars.getNumberOfCars()).toBe(1);
      });
      $httpBackend.flush();
    });
  });
```

Each response is configured through the `respond` function which takes a function that contains the `method`, `url`, `data`, and `headers` parameters of the `request` function. This function returns an array with three elements: the first is the status code, the second is the body, and the third is the header inside an object literal.

Also, as the `parkingHttpFacade` function returns a promise from each operation, which delegates to the `$http` service; you have to use the `flush` function of the `$httpBackend` service to dispatch the pending requests.

To simulate the interaction with the database, we also provided a `mockedCars` object, created through the `buildMockedCars` factory function, as follows:

mockedCarsFactoryFunction.js

```
var buildMockedCars = function () {
  var _cars = [
    {
      plate: "AAA9999",
      color: "Blue"
    },
    {
      plate: "AAA9988",
      color: "White"
    }
  ];

  var _getCars = function () {
    return _cars;
  };

  var _getCar = function (id) {
    return _cars[_id(id)];
  };
```

```
    var _saveCar = function (car) {
      return _cars.push(car);
    };

    var _updateCar = function (id, car) {
      _cars[_id(id)] = car;
    }

    var _deleteCar = function (id) {
      _cars.splice(_id(id), 1);
    };

    var _getNumberOfCars = function () {
      return _cars.length;
    }

    var _id = function (id) {
      return id - 1;
    };

    return {
      getCars: _getCars,
      getCar: _getCar,
      saveCar: _saveCar,
      updateCar: _updateCar,
      deleteCar: _deleteCar,
      getNumberOfCars: _getNumberOfCars
    };
  };
```

Our last specification will be a combination of the `parkingController` controller and the `parkingHttpFacade` controller at the same time. In *Chapter 4, Dependency Injection and Services*, we changed this controller to avoid the interaction with the `$http` service directly, leaving it to the `parkingHttpFacade` controller that we already created as an entire specification in the last example. The following is the controller:

```
parkingCtrlWithHttpFacade.js

parking.controller("parkingCtrlWithParkingHttpFacade", function
($scope, parkingHttpFacade) {
  $scope.appTitle = "[Packt] Parking";

  $scope.colors = ["White", "Black", "Blue", "Red", "Silver"];
```

```
  $scope.park = function (car) {
    parkingHttpFacade.saveCar(car)
      .success(function (data, status, headers, config) {
        delete $scope.car;
        retrieveCars();
        $scope.message = "The car was parked successfully!";
      })
      .error(function (data, status, headers, config) {
        switch(status) {
          case 401: {
            $scope.message = "You must be authenticated!"
            break;
          }
          case 500: {
            $scope.message = "Something went wrong!";
            break;
          }
        }
      });
  };

  var retrieveCars = function () {
    parkingHttpFacade.getCars()
      .success(function(data, status, headers, config) {
        $scope.cars = data;
      })
     .error(function(data, status, headers, config) {
        switch(status) {
          case 401: {
            $scope.message = "You must be authenticated!"
            break;
          }
          case 500: {
            $scope.message = "Something went wrong!";
            break;
          }
        }
      });
  };

  retrieveCars();
});
```

At the moment, we have instantiated the controller, which calls the `retrieveCars` function and interacts with the `parkingHttpFacade` controller, thus aiming to interact with the backend and retrieve the cars. The `park` function also interacts with the facade in order to park a new car. Also, in case of any error, a property called `message` will be defined into the `$scope` object and will also be tested:

```
parkingCtrlWithHttpFacadeSpec.js

describe("Parking Controller With Parking Http Facade Specification",
function () {
  var $scope, $httpBackend, mockedCars;

  beforeEach(module("parking"));

  beforeEach(inject(function ($controller, $rootScope, _$httpBackend_)
{
    $scope = $rootScope.$new();
    $controller("parkingCtrlWithParkingHttpFacade", {
      $scope: $scope
    });
    $httpBackend = _$httpBackend_;
    mockedCars = buildMockedCars();
  }));

  it("The cars should be retrieved", function () {
    $httpBackend.whenGET("/cars").respond(function (method, url, data,
headers) {
      return [200, mockedCars.getCars(), {}];
    });
    $httpBackend.flush();
    expect($scope.cars.length).toBe(2);
  });

  it("The user should be authenticated", function () {
    $httpBackend.whenGET("/cars").respond(function (method, url, data,
headers) {
      return [401, mockedCars.getCars(), {}];
    });
    $httpBackend.flush();
    expect($scope.message).toBe("You must be authenticated!");
  });

  it("Something should went wrong!", function () {
```

```
    $httpBackend.whenGET("/cars").respond(function (method, url, data,
headers) {
      return [500, mockedCars.getCars(), {}];
    });
    $httpBackend.flush();
    expect($scope.message).toBe("Something went wrong!");
  });

  it("The car should be parked", function () {
    $httpBackend.whenGET("/cars").respond(function (method, url, data,
headers) {
      return [200, mockedCars.getCars(), {}];
    });
    $httpBackend.whenPOST("/cars").respond(function (method, url,
data, headers) {
      var id = mockedCars.saveCar(angular.fromJson(data));
      return [201, mockedCars.getCar(id), {}];
    });
    $scope.car = {
      plate: "AAAA9977",
      color: "Blue"
    };
    $scope.park($scope.car);
    $httpBackend.flush();
    expect($scope.cars.length).toBe(3);
    expect($scope.car).toBeUndefined();
    expect($scope.message).toBe("The car was parked successfully!");
  });
});
```

Now, you just need to add the files to the `SpecRunner.html` file and open it in your browser:

SpecRunner.html

```
<!DOCTYPE HTML>
<html>
  <head>
    <title>Jasmine Spec Runner v2.0.0</title>
    <link rel="stylesheet" type="text/css" href="lib/jasmine-2.0.0/
jasmine.css">
    <script src="lib/jasmine-2.0.0/jasmine.js"></script>
    <script src="lib/jasmine-2.0.0/jasmine-html.js"></script>
    <script src="lib/jasmine-2.0.0/boot.js"></script>
```

```
    <script src="lib/angular/angular.js"></script>
    <script src="lib/angular/angular-mocks.js"></script>
    <script src="js/parkingApp.js"></script>
    <script src="js/parkingCtrl.js"></script>
    <script src="js/plateFilter.js"></script>
    <script src="js/parkingService.js"></script>
    <script src="js/uiApp.js"></script>
    <script src="js/alertDirective.js"></script>
    <script src="js/mockedCarFactoryFunction.js"></script>
    <script src="js/parkingHttpFacade.js"></script>
    <script src="js/parkingCtrlWithHttpFacade.js"></script>
    <script src="spec/parkingCtrlSpec.js"></script>
    <script src="spec/plateFilterSpec.js"></script>
    <script src="spec/parkingServiceSpec.js"></script>
    <script src="spec/alertDirectiveSpec.js"></script>
    <script src="spec/parkingHttpFacadeSpec.js"></script>
    <script src="spec/parkingCtrlWithHttpFacadeSpec.js"></script>
  </head>
  <body>
  </body>
</html>
```

Running tests with Karma

In comparison with the built-in Jasmine's HTML-based runner that we are using so far, there is another great option. Actually, one of the most reliable runners, compatible with Jasmine and many other frameworks, is **Karma**. It allows many kinds of configurations to define the testing framework, the files to be tested, and also the environment details such as the level of logging and the desired browser. Also, it could be integrated to our automated workflow.

You would be interested and also excited to know that Karma was created by Vojta Jína, member of the AngularJS development team at Google. The tool is the result of his Master's thesis called *JavaScript Test Runner*, for the Czech Technical University in Prague.

Installation

Before installing **Karma**, you need to have the **NodeJS** already installed. It is a quite simple process, and you just need to visit their website, download the package, and proceed with installation.

After this, you can use the **Node Package Manager**, also known as **npm**. It will manage the installation of everything that we need to set up our environment, as follows:

```
npm install -g karma
```

Configuration

The configuration is quite simple. It just requires a file called `karma.conf.js`, located in the root application directory. The best way to create it is by following the configuration wizard through the following command:

```
karma init
```

Karma's configurator will be shown, and you just have to follow the instructions in order to generate your configuration file.

The first question will be regarding the testing framework you would like to use. Karma supports **Mocha** and **QUnit** beyond Jasmine. After that, it will ask you about **RequireJS**, adding it depending on our answer. Then, you will be asked a question about which browser you want to use. There are many options such as **Chrome**, **Firefox**, **Opera**, **Safari**, **IE**, and even **PhantomJS**.

Take care of the next question about the location of each source and test file. You should place it in the correct order, otherwise you can have some trouble. For our application, the best strategy to adopt is to follow the code organization that we studied in *Chapter 1*, *Getting Started with AngularJS*. After this, you could exclude the files that you don't want to test.

Finally, Karma will ask you about watching the files and running the tests on every change. It is a very nice feature to enable, bringing with it a very fast feedback cycle while you are programming. You can also check out the configuration details generated through Karma's configurator:

```
karma.conf.js

module.exports = function(config) {
  config.set({
    basePath: '',
    frameworks: ['jasmine'],
    files: [
      'lib/angular/angular.js',
      'lib/angular/angular-mocks.js',
      'src/parkingApp.js',
      'src/parkingService.js',
```

```
        'src/parkingCtrl.js',
        'src/plateFilter.js',
        'src/uiApp.js',
        'src/alertDirective.js',
        'src/mockedCarsFactoryFunction.js',
        'src/parkingHttpFacade.js',
        'src/parkingCtrlWithHttpFacade.js',
        'spec/parkingServiceSpec.js',
        'spec/parkingCtrlSpec.js',
        'spec/plateFilterSpec.js',
        'spec/alertDirectiveSpec.js',
        'spec/parkingHttpFacadeSpec.js'
        'spec/parkingCtrlWithHttpFacadeSpec.js'
      ],
      exclude: [
      ],
      reporters: ['progress'],
      port: 9876,
      colors: true,
      logLevel: config.LOG_INFO,
      autoWatch: true,
      browsers: ['Chrome'],
      captureTimeout: 60000,
      singleRun: false
    });
};
```

Running tests

Before you run the tests, you need to start the Karma server. It is based on the browser configuration and can be started with the following command:

```
karma start
```

After this, we will be able to run the tests with the following command in another terminal window:

```
karma run
```

However, the behavior of Karma is different based on the `autoWatch` and `singleRun` properties. When the `autoWatch` property is enabled, Karma watches the source and test files, running tests every time to check whether anything has changed. The `singleRun` property is very useful when you are interested in just a single execution of the tests, such as when you are in an automated workflow.

Every time the `autoWatch` or `singleRun` property is enabled, you can use Karma just by using the `karma start` command.

Summary

In this chapter, we studied how to automate tests using **Jasmine** and **Karma**, adding productivity and quality to our development process.

You learned how to create tests for each kind of component such as controllers, directives, filters, and services. Also, you discovered how to mock the `$http` service through the `$httpBackend` service.

In the next chapter, we discuss automating the workflow and creating a completely automated distribution with **Grunt**.

8
Automating the Workflow

Every time we perform the same activity over and over again, it can be considered waste, and we stand losing a great opportunity to automate it.

Depending on the complexity of the workflow of our product, there are many steps that have to be performed, such as cleaning the temporary files from the last distribution, validating the code, concatenating and minifying the JavaScript files, copying resources such as images and configuration files, running the tests, and many others. Also, based on the environment, the workflow could be very different—development, staging, or production.

The topics that we'll cover in this chapter are related to workflow automation such as the following:

- Automating the workflow with Grunt
- Managing packages with Bower

Automating the workflow with Grunt

Grunt is a JavaScript task runner that automates repetitive and boring tasks. Also, it can group the desired tasks in any sequence, thus creating a workflow.

It works over plugins, and there is a huge ecosystem with thousands of choices just waiting to be downloaded! We also have the opportunity to create our own plugins and share them within the community.

The warranty is that all of the required tasks of our workflow will be fulfilled!

Installation

Just like Karma, Grunt requires **NodeJS** and the **Node Package Manager** to be installed. To proceed with the installation, we just need to type in the following command:

```
npm install -g grunt-cli grunt
```

After this, we are ready to configure it!

Configuration

The `Gruntfile.js` file is the JavaScript file that defines the configuration of each task, plugin, and workflow. Let's take a look at its basic structure:

```
module.exports = function (grunt) {
  // 1 – Configuring each task
  grunt.initConfig({
  });
  // 2 - Loading the plug-ins
  grunt.loadNpmTasks('plugin name');
  // 3 - Creating a workflow by grouping tasks together
  grunt.registerTask('taskName', ['task1','task2','task3']);
}
```

Also, it's really recommended that you generate the `package.jsonfile` file. It is important to track each dependency, and this file can be generated with the following command:

```
npm init
```

After this, you are ready to create your distribution package!

Creating a distribution package

Before being ready for the production environment, you need to create an optimized distribution package of your product. This is very important for the following reasons:

- **Performance**: Through the concatenation step, you could drastically reduce the amount of requests that the browser needs to perform every time the application is loaded. All the scripts of the application are concatenated in just one file. After that, the minifying step removes all the white spaces, line breaks, and comments, and replaces the names of the local variables and functions and makes them shorter than the original. It contributes to improving the performance by reducing the amount of bytes that need to be transferred. Also, the HTML and CSS files can be minified, and the images can be optimized by specific processors. Grunt has a lot of plugins for performing its tasks.
- **Security**: By removing the white spaces, line breaks, comments, and replacing the local variable names, the JavaScript files become much harder to understand. However, take care before submitting an AngularJS application to this kind of process. As we saw in *Chapter 4*, *Dependency Injection and Services*, we should apply the array notation for the dependency injection mechanism by declaring each dependency as a string; otherwise, the framework will not find the expected dependency, throwing an error.
- **Quality**: There are two steps that improve the quality of the distribution. The first one is the validating step. With tools such as **JSLint** or **JSHint**, the code is validated against rules that verify things such as the absence of semicolons, wrong indentation, undeclared or unused variables and functions, and many others. Also, the tests are executed, preventing the process from proceeding in the case of errors.

In order to follow each step of our workflow, we are now going to discover how to install and configure each plugin:

1. **Cleaning step**: The first step is about cleaning the files that were created in the last distribution. This can be done through the `grunt-contrib-clean` plugin. Take care about which directory will be configured, avoiding any accidental deletion of the wrong files. To install this plugin, type in the following command:

   ```
   npm install grunt-contrib-clean --save-dev
   ```

   After this, we just need to configure it inside the `Gruntfile.js` file, as follows:

   `Gruntfile.js`

   ```
   module.exports = function (grunt) {
   ```

```
  grunt.initConfig({
    clean: {
      dist: ["dist/"]
    }
  });

  grunt.loadNpmTasks("grunt-contrib-clean");

  grunt.registerTask("dist", ["clean"]);
}
```

In this case, we are creating our distribution package inside the `dist/` directory; however, you are free to choose another directory.

2. **Validating step**: Now, it's time to configure the validation step. There is a plugin called `grunt-contrib-jshint` that can be installed with the following command:

```
npm install grunt-contrib-jshint --save-dev
```

Next, we need to configure it inside our `Gruntfile.js` file as follows:

`Gruntfile.js`

```
module.exports = function (grunt) {
  grunt.initConfig({
    clean: {
      dist: ["dist/"]
    },
    jshint: {
      all: ['Gruntfile.js', 'js/**/*.js', 'test/**/*.js']
    }
  });

  grunt.loadNpmTasks("grunt-contrib-clean");
  grunt.loadNpmTasks("grunt-contrib-jshint");

  grunt.registerTask("dist", ["clean", "jshint"]);
}
```

After we run this step, a report will be shown with the warnings and errors that it found in our code.

3. **Concatenating step**: The concatenation step, done by the `grunt-contrib-concat` plugin, concatenates the configured source files inside a single destination file. This plugin can be installed with the following command:

   ```
   npm install grunt-contrib-concat --save-dev
   ```

   In order to configure it, we need to inform the source files and the destination file through the `src` and `dest` properties of the `concat` object, as follows:

   Gruntfile.js

   ```
   module.exports = function (grunt) {
     grunt.initConfig({
       clean: {
         dist: ["dist/"]
       },
       jshint: {
         dist: ['Gruntfile.js', 'js/**/*.js', 'test/**/*.js']
       },
       concat: {
         dist: {
           src: ["src/**/*.js"],
           dest: "dist/js/scripts.js"
         }
       }
     });

     grunt.loadNpmTasks("grunt-contrib-clean");
     grunt.loadNpmTasks("grunt-contrib-jshint");
     grunt.loadNpmTasks("grunt-contrib-concat");

     grunt.registerTask("dist", ["clean", "jshint", "concat"]);
   }
   ```

4. **Minifying step**: Now, let's talk about the minifying step. As we mentioned before, it removes the white spaces, line breaks, comments, and replaces the names of the variables and functions. This can be done using the `grunt-contrib-uglify` plugin, which is installed using the following command:

   ```
   npm install grunt-contrib-uglify --save-dev
   ```

   The configuration is very similar to the `grunt-contrib-concat` plugin and involves the definition of the `src` and `dest` properties of the `uglify` object, as follows:

   Gruntfile.js

   ```
   module.exports = function (grunt) {
   ```

```
  grunt.initConfig({
    clean: {
      dist: ["dist/"]
    },
    jshint: {
      dist: ['Gruntfile.js', 'js/**/*.js', 'test/**/*.js']
    },
    concat: {
      dist: {
        src: ["js/**/*.js"],
        dest: "dist/js/scripts.js"
      }
    },
    uglify: {
      dist: {
        src: ["dist/js/scripts.js"],
        dest: "dist/js/scripts.min.js"
      }
    }
  });

  grunt.loadNpmTasks("grunt-contrib-clean");
  grunt.loadNpmTasks("grunt-contrib-jshint");
  grunt.loadNpmTasks("grunt-contrib-concat");
  grunt.loadNpmTasks("grunt-contrib-uglify");

  grunt.registerTask("dist", ["clean", "jshint", "concat",
"uglify"]);
}
```

5. **Copying step**: There are many files such as images, fonts, and others that just need to be copied to the distribution without any change. This can be done using the `grunt-contrib-copy` plugin, which is capable of copying files and folders. The installation process is done with the following command:

   ```
   npm install grunt-contrib-copy --save-dev
   ```

   The configuration involves the source and destination of each folder and file, as follows:

   ```
   Gruntfile.js

   module.exports = function (grunt) {
     grunt.initConfig({
       clean: {
   ```

```
      dist: ["dist/"]
    },
    jshint: {
      dist: ['Gruntfile.js', 'js/**/*.js', 'test/**/*.js']
    },
    concat: {
      dist: {
        src: ["js/**/*.js"],
        dest: "dist/js/scripts.js"
      }
    },
    uglify: {
      dist: {
        src: ["dist/js/scripts.js"],
        dest: "dist/js/scripts.min.js"
      }
    },
    copy: {
      dist: {
        src: ["index.html", "lib/*", "partials/*", "css/*"],
        dest: "dist/"
      }
    }
  });

  grunt.loadNpmTasks("grunt-contrib-clean");
  grunt.loadNpmTasks("grunt-contrib-jshint");
  grunt.loadNpmTasks("grunt-contrib-concat");
  grunt.loadNpmTasks("grunt-contrib-uglify");
  grunt.loadNpmTasks("grunt-contrib-copy");

  grunt.registerTask("dist", ["clean", "jshint", "concat",
"uglify", "copy"]);
}
```

6. **Testing step**: Grunt has a plugin called `grunt-karma` that works with Karma by reading its `karma.conf.js` file and running the tests. It can be installed with the following command:

   ```
   npm install grunt-karma --save-dev
   ```

   After this, we just need to configure the location of Karma's configuration file, as well as load the plugin and include the task in our workflow, as follows:

   `Gruntfile.js`

   ```
   module.exports = function (grunt) {
   ```

```
  grunt.initConfig({
    clean: {
      dist: ["dist/"]
    },
    jshint: {
      dist: ['Gruntfile.js', 'js/**/*.js', 'test/**/*.js']
    },
    concat: {
      dist: {
        src: ["js/**/*.js"],
        dest: "dist/js/scripts.js"
      }
    },
    uglify: {
      dist: {
        src: ["dist/js/scripts.js"],
        dest: "dist/js/scripts.min.js"
      }
    },
    copy: {
      dist: {
        src: ["index.html", "lib/*", "partials/*", "css/*"],
        dest: "dist/"
      }
    },
    karma: {
      dist: {
        configFile: "karma.conf.js"
      }
    }
  });

  grunt.loadNpmTasks("grunt-contrib-clean");
  grunt.loadNpmTasks("grunt-contrib-jshint");
  grunt.loadNpmTasks("grunt-contrib-concat");
  grunt.loadNpmTasks("grunt-contrib-uglify");
  grunt.loadNpmTasks("grunt-contrib-copy");
  grunt.loadNpmTasks("grunt-karma");

  grunt.registerTask("dist", ["clean", "jshint", "concat",
"uglify", "copy", "karma"]);
}
```

7. **Running step**: The last and optional step is about running the application after the distribution package is built. Grunt has a web server plugin called `grunt-connect`, and we just need to type in the following command to install it:

   ```
   npm install grunt-contrib-connect --save-dev
   ```

   After this, we need to configure at least the base directory of the distribution package and also the port in which the server will run:

   `Gruntfile.js`

   ```
   module.exports = function (grunt) {
     grunt.initConfig({
       clean: {
         dist: ["dist/"]
       },
       jshint: {
         dist: ['Gruntfile.js', 'js/**/*.js', 'test/**/*.js']
       },
       concat: {
         dist: {
           src: ["js/**/*.js"],
           dest: "dist/js/scripts.js"
         }
       },
       uglify: {
         dist: {
           src: ["dist/js/scripts.js"],
           dest: "dist/js/scripts.min.js"
         }
       },
       copy: {
         dist: {
           src: ["index.html", "lib/*", "partials/*", "css/*"],
           dest: "dist/"
         }
       },
       karma: {
         dist: {
           configFile: "karma.conf.js"
         }
       },
       connect: {
   ```

```
        dist: {
          options: {
            port: 9001,
            base: 'dist/'
          }
        }
      }
    });

    grunt.loadNpmTasks("grunt-contrib-clean");
    grunt.loadNpmTasks("grunt-contrib-jshint");
    grunt.loadNpmTasks("grunt-contrib-concat");
    grunt.loadNpmTasks("grunt-contrib-uglify");
    grunt.loadNpmTasks("grunt-contrib-copy");
    grunt.loadNpmTasks("grunt-karma");
    grunt.loadNpmTasks("grunt-contrib-connect");

    grunt.registerTask("dist", ["clean", "jshint", "concat",
"uglify", "copy", "karma", "connect:dist:keepalive"])
}
```

Note that we need to use the `keepalive` option with the `connect` task inside our workflow definition. This is important because, by default, the server will run only as long as Grunt is running. In the following code, the `package.jsonfile` file is installed after the installation of the plugins:

`package.json`

```
{
  "name": "parking",
  "version": "0.1.0",
  "devDependencies": {
    "grunt": "~0.4.5",
    "grunt-contrib-clean": "~0.5.0",
    "grunt-contrib-jshint": "~0.10.0",
    "grunt-contrib-concat": "~0.4.0",
    "grunt-contrib-uglify": "~0.5.0",
    "grunt-contrib-copy": "~0.5.0",
    "grunt-karma": "~0.8.3",
    "karma": "~0.12.16",
    "grunt-contrib-connect": "~0.8.0"
  }
}
```

With the `package.json` file created, we can install the plugins just by typing in the following command:

```
npm install
```

This is very useful when we share the project with other developers, thus avoiding the installation of each plugin separately.

Executing the workflow

In order to execute any specific task or even the entire workflow, we just need to type in the following command:

```
grunt <name of the task or workflow>
```

In case we just want to clean the last distribution, we may call only the `clean` task as follows:

```
grunt clean
```

You could also create more than one configuration for each task. For instance, to configure two environments for the `grunt-contrib-connect` plugin, you could perform the following:

```
connect: {
  production: {
    options: {
      port: 9001,
      base: 'dist/'
    }
  },
  development: {
    options: {
      port: 9002,
      base: '/'
    }
  }
}
```

Also, you could generate two concatenated files, one with the sources and another with the libraries, as follows:

```
concat: {
  js: {
    src: ["js/**/*.js"],
    dest: "dist/js/scripts.js"
```

```
    },
    lib: {
      src: ["lib/**/*.js"],
      dest: "dist/lib/lib.js"
    }
  }
```

After this, you can run all the configurations by calling the task directly, as follows:

```
grunt concat
```

Or call any specific task by using a colon, as follows:

```
grunt concat:js
grunt concat:lib
```

Managing packages with Bower

Bower is a package manager created by Twitter that focuses on frontend applications. It not only handles JavaScript libraries, but also takes care of the HTML, CSS, and images. We can consider any kind of encapsulated group of files as a package that is accessible from a **Git** repository.

Installation

The installation process is quite simple. You just need to type in the following command:

```
npm install -g bower
```

Finding packages

Bower also comes with search support in order to find registered packages, and you can find anything with the following command:

```
bower search <package name>
```

For instance, to find the packages related to AngularJS, you can use the following command:

```
bower search angular
```

Installing packages

After finding the desired package, you just need to execute the following command in order to download and install it:

```
bower install <package name>
```

To install the package, you just need to use this command with the package name as follows:

```
bower install angular --save
```

The `angular` package will be downloaded from its **Git** repository and placed inside the `bower_components/` directory. With the `--save` option enabled, the `bower.json` file will be updated.

We can check which packages are already installed in the application by means of the following command:

```
bower list
```

This command needs to be executed within the application directory, and the result will be shown in a list with the dependencies and versions of each package. This is an opportunity to evaluate whether it is possible to update a package.

In order to update a package to its latest version, there is also an `update` command. This will try to update the outdated package. However, if there are dependencies to the outdated package, it will be kept:

```
bower update<package name>
```

To uninstall a package, we can follow the same installation procedure, just replacing the command, as follows:

```
bower uninstall angularjs-file-upload --save
```

The package will be removed from the application's bower components directory and also from the `bower.json` file.

Using packages

After we have installed a package, we need to update our `index.html` file in order to include it in our application. The following code is an example where we included the `angular` package in our project:

```
<script src="bower_components/angular/angular.min.js"></script>
```

Cache

The removed packages will be stored cached inside Bower's cache, located in the `cache/bower` directory inside the user's `home` folder. You can retrieve the list of cached packages using the following command:

```
bower cache list
```

Bower also allows for offline package installation, just in case we do not have an Internet connection and need to install a cached package. In order to use this feature, we just need to add the `--offline` flag with the installation command, as follows:

```
bower install angular --offline
```

To clean the cache and delete all the downloaded packages, you can use the following command:

```
bower cache clean
```

Summary

In this chapter, we studied how to automate the workflow and created a distribution package. Also, we learned how to use Grunt by installing plugins and configuring each task and workflow.

Finally, we discovered a great tool to manage our packages called Bower that allows us to easily find, install, update, and remove any package from the application.

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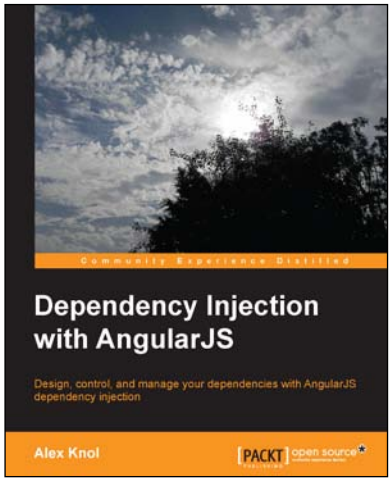

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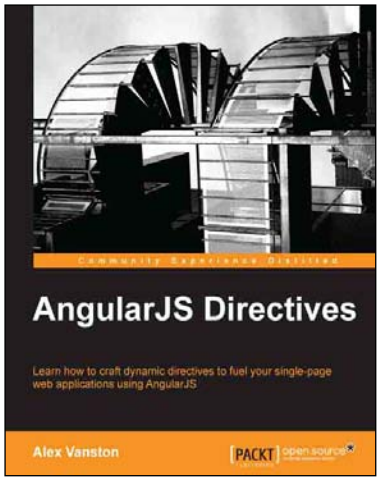

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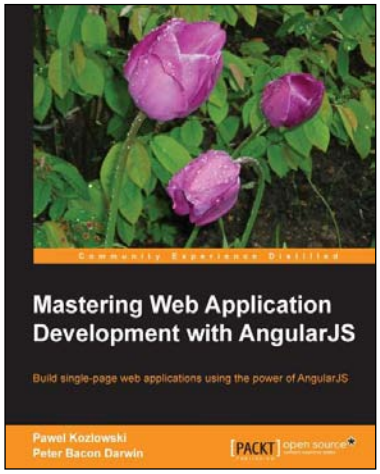

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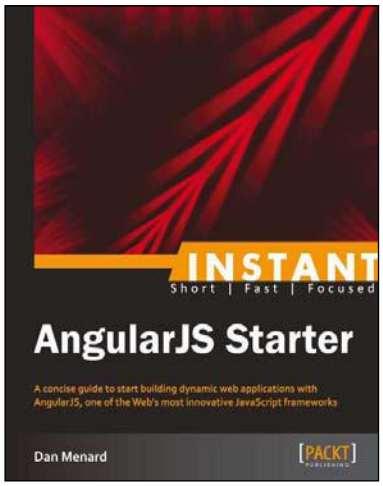

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