CHAPTER 13

Getting Started with Identity

Identity is a new API from Microsoft to manage users in ASP.NET applications. The mainstay for user management in recent years has been ASP.NET Membership, which has suffered from design choices that were reasonable when it was introduced in 2005 but that have aged badly. The biggest limitation is that the schema used to store the data worked only with SQL Server and was difficult to extend without re-implementing a lot of provider classes. The schema itself was overly complex, which made it harder to implement changes than it should have been.

Microsoft made a couple of attempts to improve Membership prior to releasing Identity. The first was known as *simple membership*, which reduced the complexity of the schema and made it easier to customize user data but still needed a relational storage model. The second attempt was the ASP.NET *universal providers*, which I used in Chapter 10 when I set up SQL Server storage for session data. The advantage of the universal providers is that they use the Entity Framework Code First feature to automatically create the database schema, which made it possible to create databases where access to schema management tools wasn't possible, such as the Azure cloud service. But even with the improvements, the fundamental issues of depending on relational data and difficult customizations remained.

To address both problems and to provide a more modern user management platform, Microsoft has replaced Membership with Identity. As you'll learn in this chapter and Chapters 14 and 15, ASP.NET Identity is flexible and extensible, but it is immature, and features that you might take for granted in a more mature system can require a surprising amount of work.

Microsoft has over-compensated for the inflexibility of Membership and made Identity so open and so adaptable that it can be used in just about any way—just as long as you have the time and energy to implement what you require.

In this chapter, I demonstrate the process of setting up ASP.NET Identity and creating a simple user administration tool that manages individual user accounts that are stored in a database.

ASP.NET Identity supports other kinds of user accounts, such as those stored using Active Directory, but I don't describe them since they are not used that often outside corporations (where Active Directive implementations tend to be so convoluted that it would be difficult for me to provide useful general examples).

In Chapter 14, I show you how to perform authentication and authorization using those user accounts, and in Chapter 15, I show you how to move beyond the basics and apply some advanced techniques. Table 13-1 summarizes this chapter.

Table 13-1. *Chapter Summary*

Problem	Solution	Listing
Install ASP.NET Identity.	Add the NuGet packages and define a connection string and an OWIN start class in the `Web.config` file.	1–4
Prepare to use ASP.NET Identity.	Create classes that represent the user, the user manager, the database context, and the OWIN start class.	5–8
Enumerate user accounts.	Use the `Users` property defined by the user manager class.	9, 10
Create user accounts.	Use the `CreateAsync` method defined by the user manager class.	11–13
Enforce a password policy.	Set the `PasswordValidator` property defined by the user manager class, either using the built-in `PasswordValidator` class or using a custom derivation.	14–16
Validate new user accounts.	Set the `UserValidator` property defined by the user manager class, either using the built-in `UserValidator` class or using a custom derivation.	17–19
Delete user accounts.	Use the `DeleteAsync` method defined by the user manager class.	20–22
Modify user accounts.	Use the `UpdateAsync` method defined by the user manager class.	23–24

Preparing the Example Project

I created a project called Users for this chapter, following the same steps I have used throughout this book. I selected the Empty template and checked the option to add the folders and references required for an MVC application. I will be using Bootstrap to style the views in this chapter, so enter the following command into the Visual Studio Package Manager Console and press Enter to download and install the NuGet package:

```
Install-Package -version 3.0.3 bootstrap
```

I created a `Home` controller to act as the focal point for the examples in this chapter. The definition of the controller is shown in Listing 13-1. I'll be using this controller to describe details of user accounts and data, and the `Index` action method passes a dictionary of values to the default view via the `View` method.

Listing 13-1. The Contents of the HomeController.cs File

```
using System.Web.Mvc;
using System.Collections.Generic;

namespace Users.Controllers {

    public class HomeController : Controller {

        public ActionResult Index() {
            Dictionary<string, object> data
                = new Dictionary<string, object>();
            data.Add("Placeholder", "Placeholder");
            return View(data);
        }
    }
}
```

I created a view by right-clicking the Index action method and selecting Add View from the pop-up menu. I set View Name to Index and set Template to Empty (without model). Unlike the examples in previous chapters, I want to use a common layout for this chapter, so I checked the Use a Layout Page option. When I clicked the Add button, Visual Studio created the Views/Shared/_Layout.cshtml and Views/Home/Index.cshtml files. Listing 13-2 shows the contents of the _Layout.cshtml file.

Listing 13-2. The Contents of the _Layout.cshtml File

```
<!DOCTYPE html>
<html>
<head>
    <meta name="viewport" content="width=device-width" />
    <title>@ViewBag.Title</title>
    <link href="~/Content/bootstrap.min.css" rel="stylesheet" />
    <link href="~/Content/bootstrap-theme.min.css" rel="stylesheet" />
    <style>
        .container {  padding-top: 10px; }
        .validation-summary-errors { color: #f00; }
    </style>
</head>
<body class="container">
    <div class="container">
        @RenderBody()
    </div>
</body>
</html>
```

Listing 13-3 shows the contents of the Index.cshtml file.

Listing 13-3. The Contents of the Index.cshtml File

```
@{
    ViewBag.Title = "Index";
}

<div class="panel panel-primary">
    <div class="panel-heading">User Details</div>
    <table class="table table-striped">
        @foreach (string key in Model.Keys) {
            <tr>
                <th>@key</th>
                <td>@Model[key]</td>
            </tr>
        }
    </table>
</div>
```

To test that the example application is working, select Start Debugging from the Visual Studio Debug menu and navigate to the /Home/Index URL. You should see the result illustrated by Figure 13-1.

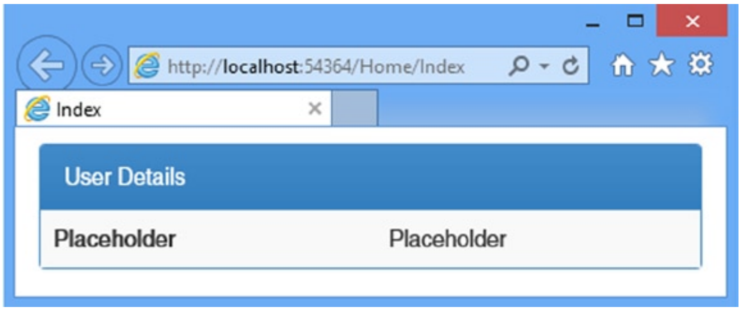


Figure 13-1. *Testing the example application*

Setting Up ASP.NET Identity

For most ASP.NET developers, Identity will be the first exposure to the Open Web Interface for .NET (OWIN). OWIN is an abstraction layer that isolates a web application from the environment that hosts it. The idea is that the abstraction will allow for greater innovation in the ASP.NET technology stack, more flexibility in the environments that can host ASP.NET applications, and a lighter-weight server infrastructure.

OWIN is an open standard (which you can read at `http://owin.org/spec/owin-1.0.0.html`). Microsoft has created Project Katana, its implementation of the OWIN standard and a set of components that provide the functionality that web applications require. The attraction to Microsoft is that OWIN/Katana isolates the ASP.NET technology stack from the rest of the .NET Framework, which allows a greater rate of change.

OWIN developers select the services that they require for their application, rather than consuming an entire platform as happens now with ASP.NET. Individual services—known as *middleware* in the OWIN terminology—can be developed at different rates, and developers will be able to choose between providers for different services, rather than being tied to a Microsoft implementation.

There is a lot to like about the direction that OWIN and Katana are heading in, but it is in the early days, and it will be some time before it becomes a complete platform for ASP.NET applications. As I write this, it is possible to build Web API and SignalR applications without needing the `System.Web` namespace or IIS to process requests, but that's about all. The MVC framework requires the standard ASP.NET platform and will continue to do so for some time to come.

The ASP.NET platform and IIS are not going away. Microsoft has been clear that it sees one of the most attractive aspects of OWIN as allowing developers more flexibility in which middleware components are hosted by IIS, and Project Katana already has support for the `System.Web` namespaces. OWIN and Katana are not the end of ASP.NET—rather, they represent an evolution where Microsoft allows developers more flexibility in how ASP.NET applications are assembled and executed.

■ **Tip** Identity is the first major ASP.NET component to be delivered as OWIN middleware, but it won't be the last. Microsoft has made sure that the latest versions of Web API and SignalR don't depend on the `System.Web` namespaces, and that means that any component intended for use across the ASP.NET family of technologies has to be delivered via OWIN. I get into more detail about OWIN in my *Expert ASP.NET Web API 2 for MVC Developers* book, which will be published by Apress in 2014.

OWIN and Katana won't have a major impact on MVC framework developers for some time, but changes are already taking effect—and one of these is that ASP.NET Identity is implemented as an OWIN middleware component. This isn't ideal because it means that MVC framework applications have to mix OWIN and traditional ASP.NET platform techniques to use Identity, but it isn't too burdensome once you understand the basics and know how to get OWIN set up, which I demonstrate in the sections that follow.

Creating the ASP.NET Identity Database

ASP.NET Identity isn't tied to a SQL Server schema in the same way that Membership was, but relational storage is still the default—and simplest—option, and it is the one that I will be using in this chapter. Although the NoSQL movement has gained momentum in recent years, relational databases are still the mainstream storage choice and are well-understood in most development teams.

ASP.NET Identity uses the Entity Framework Code First feature to automatically create its schema, but I still need to create the database into which that schema—and the user data—will be placed, just as I did in Chapter 10 when I created the database for session state data (the universal provider that I used to manage the database uses the same Code First feature).

■ **Tip** You don't need to understand how Entity Framework or the Code First feature works to use ASP.NET Identity.

As in Chapter 10, I will be using the `localdb` feature to create my database. As a reminder, `localdb` is included in Visual Studio and is a cut-down version of SQL Server that allows developers to easily create and work with databases.

Select SQL Server Object Explorer from the Visual Studio View menu and right-click the SQL Server object in the window that appears. Select Add SQL Server from the pop-up menu, as shown in Figure 13-2.

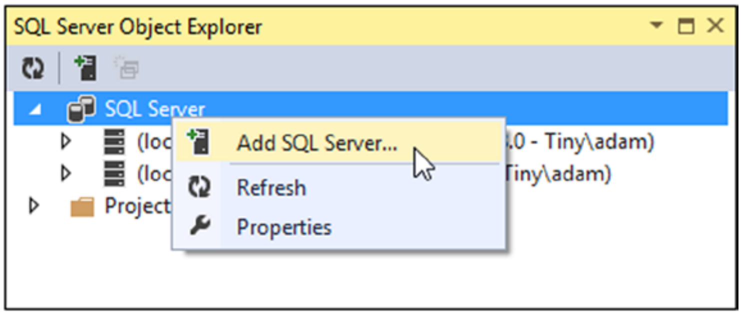


Figure 13-2. *Creating a new database connection*

Visual Studio will display the Connect to Server dialog. Set the server name to (localdb)\v11.0, select the Windows Authentication option, and click the Connect button. A connection to the database will be established and shown in the SQL Server Object Explorer window. Expand the new item, right-click Databases, and select Add New Database from the pop-up window, as shown in Figure 13-3.

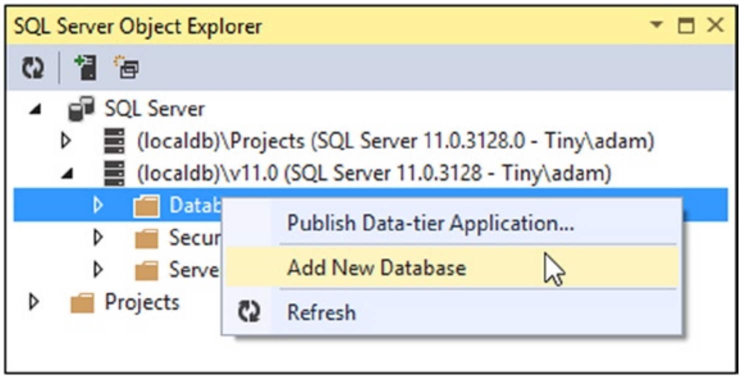

SQL Server Object Explorer
SQL Server
(localdb)\Projects (SQL Server 11.0.3128.0 - Tiny\adam)
(localdb)\v11.0 (SQL Server 11.0.3128 - Tiny\adam)
Datab
Secur
Serve
Projects
Publish Data-tier Application...
Add New Database
Refresh

Figure 13-3. Adding a new database

Set the Database Name option to IdentityDb, leave the Database Location value unchanged, and click the OK button to create the database. The new database will be shown in the Databases section of the SQL connection in the SQL Server Object Explorer.

Adding the Identity Packages

Identity is published as a set of NuGet packages, which makes it easy to install them into any project. Enter the following commands into the Package Manager Console:

```
Install-Package Microsoft.AspNet.Identity.EntityFramework -Version 2.0.0
Install-Package Microsoft.AspNet.Identity.OWIN -Version 2.0.0
Install-Package Microsoft.Owin.Host.SystemWeb -Version 2.1.0
```

Visual Studio can create projects that are configured with a generic user account management configuration, using the Identity API. You can add the templates and code to a project by selecting the MVC template when creating the project and setting the Authentication option to Individual User Accounts. I don't use the templates because I find them too general and too verbose and because I like to have direct control over the contents and configuration of my projects. I recommend you do the same, not least because you will gain a better understanding of how important features work, but it can be interesting to look at the templates to see how common tasks are performed.

Updating the Web.config File

Two changes are required to the `Web.config` file to prepare a project for ASP.NET Identity. The first is a connection string that describes the database I created in the previous section. The second change is to define an application setting that names the class that initializes OWIN middleware and that is used to configure Identity. Listing 13-4 shows the changes I made to the `Web.config` file. (I explained how connection strings and application settings work in Chapter 9.)

Listing 13-4. Preparing the Web.config File for ASP.NET Identity

```
<?xml version="1.0" encoding="utf-8"?>
<configuration>
```

```
  <configSections>
    <section name="entityFramework"
        type="System.Data.Entity.Internal.ConfigFile.EntityFrameworkSection,
        EntityFramework, Version=6.0.0.0, Culture=neutral,
        PublicKeyToken=b77a5c561934e089" requirePermission="false" />
  </configSections>

  <connectionStrings>
    <add name="IdentityDb" providerName="System.Data.SqlClient"
         connectionString="Data Source=(localdb)\v11.0;Initial
             Catalog=IdentityDb;Integrated Security=True;Connect
              Timeout=15;Encrypt=False;TrustServerCertificate=False;
              MultipleActiveResultSets=True"/>
  </connectionStrings>

  <appSettings>
    <add key="webpages:Version" value="3.0.0.0" />
    <add key="webpages:Enabled" value="false" />
    <add key="ClientValidationEnabled" value="true" />
    <add key="UnobtrusiveJavaScriptEnabled" value="true" />
    <add key="owin:AppStartup" value="Users.IdentityConfig" />
  </appSettings>
  <system.web>
    <compilation debug="true" targetFramework="4.5.1" />
    <httpRuntime targetFramework="4.5.1" />
  </system.web>
  <entityFramework>
    <defaultConnectionFactory
        type="System.Data.Entity.Infrastructure.LocalDbConnectionFactory,
            EntityFramework">
      <parameters>
        <parameter value="v11.0" />
      </parameters>
    </defaultConnectionFactory>
    <providers>
      <provider invariantName="System.Data.SqlClient"
         type="System.Data.Entity.SqlServer.SqlProviderServices,
            EntityFramework.SqlServer" />
    </providers>
  </entityFramework>
</configuration>
```

■ **Caution** Make sure you put the `connectionString` value on a single line. I had to break it over several lines to make the listing fit on the page, but ASP.NET expects a single, unbroken string. If in doubt, download the source code that accompanies this book, which is freely available from `www.apress.com`.

OWIN defines its own application startup model, which is separate from the global application class that I described in Chapter 3. The application setting, called `owin:AppStartup`, specifies a class that OWIN will instantiate when the application starts in order to receive its configuration.

■ **Tip** Notice that I have set the `MultipleActiveResultSets` property to `true` in the connection string. This allows the results from multiple queries to be read simultaneously, which I rely on in Chapter 14 when I show you how to authorize access to action methods based on role membership.

Creating the Entity Framework Classes

If you have used Membership in projects, you may be surprised by just how much initial preparation is required for ASP.NET Identity. The extensibility that Membership lacked is readily available in ASP.NET Identity, but it comes with a price of having to create a set of implementation classes that the Entity Framework uses to manage the database. In the sections that follow, I'll show you how to create the classes needed to get Entity Framework to act as the storage system for ASP.NET Identity.

Creating the User Class

The first class to define is the one that represents a user, which I will refer to as the *user class*. The user class is derived from `IdentityUser`, which is defined in the `Microsoft.AspNet.Identity.EntityFramework` namespace. `IdentityUser` provides the basic user representation, which can be extended by adding properties to the derived class, which I describe in Chapter 15. Table 13-2 shows the built-in properties that `IdentityUser` defines, which are the ones I will be using in this chapter.

Table 13-2. *The Properties Defined by the IdentityUser Class*

Name	Description
`Claims`	Returns the collection of claims for the user, which I describe in Chapter 15
`Email`	Returns the user's e-mail address
`Id`	Returns the unique ID for the user
`Logins`	Returns a collection of logins for the user, which I use in Chapter 15
`PasswordHash`	Returns a hashed form of the user password, which I use in the "Implementing the Edit Feature" section
`Roles`	Returns the collection of roles that the user belongs to, which I describe in Chapter 14
`PhoneNumber`	Returns the user's phone number
`SecurityStamp`	Returns a value that is changed when the user identity is altered, such as by a password change
`UserName`	Returns the username

■ **Tip** The classes in the `Microsoft.AspNet.Identity.EntityFramework` namespace are the Entity Framework–specific concrete implementations of interfaces defined in the `Microsoft.AspNet.Identity` namespace. `IdentityUser`, for example, is the implementation of the `IUser` interface. I am working with the concrete classes because I am relying on the Entity Framework to store my user data in a database, but as ASP.NET Identity matures, you can expect to see alternative implementations of the interfaces that use different storage mechanisms (although most projects will still use the Entity Framework since it comes from Microsoft).

What is important at the moment is that the `IdentityUser` class provides access only to the basic information about a user: the user's name, e-mail, phone, password hash, role memberships, and so on. If I want to store any additional information about the user, I have to add properties to the class that I derive from `IdentityUser` and that will be used to represent users in my application. I demonstrate how to do this in Chapter 15.

To create the user class for my application, I created a class file called `AppUserModels.cs` in the `Models` folder and used it to create the `AppUser` class, which is shown in Listing 13-5.

Listing 13-5. The Contents of the AppUser.cs File

```
using System;
using Microsoft.AspNet.Identity.EntityFramework;

namespace Users.Models {
    public class AppUser : IdentityUser {
        // additional properties will go here
    }
}
```

That's all I have to do at the moment, although I'll return to this class in Chapter 15, when I show you how to add application-specific user data properties.

Creating the Database Context Class

The next step is to create an Entity Framework database context that operates on the `AppUser` class. This will allow the Code First feature to create and manage the schema for the database and provide access to the data it stores. The context class is derived from `IdentityDbContext<T>`, where `T` is the user class (`AppUser` in the example). I created a folder called `Infrastructure` in the project and added to it a class file called `AppIdentityDbContext.cs`, the contents of which are shown in Listing 13-6.

Listing 13-6. The Contents of the AppIdentityDbContext.cs File

```
using System.Data.Entity;
using Microsoft.AspNet.Identity.EntityFramework;
using Users.Models;

namespace Users.Infrastructure {
    public class AppIdentityDbContext : IdentityDbContext<AppUser> {

        public AppIdentityDbContext() : base("IdentityDb") { }
        static AppIdentityDbContext() {
            Database.SetInitializer<AppIdentityDbContext>(new IdentityDbInit());
        }

        public static AppIdentityDbContext Create() {
            return new AppIdentityDbContext();
        }
    }

    public class IdentityDbInit
            : DropCreateDatabaseIfModelChanges<AppIdentityDbContext> {

        protected override void Seed(AppIdentityDbContext context) {
            PerformInitialSetup(context);
            base.Seed(context);
        }

        public void PerformInitialSetup(AppIdentityDbContext context) {
            // initial configuration will go here
        }
    }
}
```

The constructor for the `AppIdentityDbContext` class calls its base with the name of the connection string that will be used to connect to the database, which is `IdentityDb` in this example. This is how I associate the connection string I defined in Listing 13-4 with ASP.NET Identity.

The `AppIdentityDbContext` class also defines a static constructor, which uses the `Database.SetInitializer` method to specify a class that will seed the database when the schema is first created through the Entity Framework Code First feature. My seed class is called `IdentityDbInit`, and I have provided just enough of a class to create a placeholder so that I can return to seeding the database later by adding statements to the `PerformInitialSetup` method. I show you how to seed the database in Chapter 14.

Finally, the `AppIdentityDbContext` class defines a `Create` method. This is how instances of the class will be created when needed by the OWIN, using the class I describe in the "Creating the Start Class" section.

■ **Note** Don't worry if the role of these classes doesn't make sense. If you are unfamiliar with the Entity Framework, then I suggest you treat it as something of a black box. Once the basic building blocks are in place—and you can copy the ones into your chapter to get things working—then you will rarely need to edit them.

Creating the User Manager Class

One of the most important Identity classes is the *user manager*, which manages instances of the user class. The user manager class must be derived from `UserManager<T>`, where `T` is the user class. The `UserManager<T>` class isn't specific to the Entity Framework and provides more general features for creating and operating on user data. Table 13-3 shows the basic methods and properties defined by the `UserManager<T>` class for managing users. There are others, but rather than list them all here, I'll describe them in context when I describe the different ways in which user data can be managed.

Table 13-3. *The Basic Methods and Properties Defined by the UserManager<T> Class*

Name	Description
`ChangePasswordAsync(id, old, new)`	Changes the password for the specified user.
`CreateAsync(user)`	Creates a new user without a password. See Chapter 15 for an example.
`CreateAsync(user, pass)`	Creates a new user with the specified password. See the “Creating Users” section.
`DeleteAsync(user)`	Deletes the specified user. See the “Implementing the Delete Feature” section.
`FindAsync(user, pass)`	Finds the object that represents the user and authenticates their password. See Chapter 14 for details of authentication.
`FindByIdAsync(id)`	Finds the user object associated with the specified ID. See the “Implementing the Delete Feature” section.
`FindByNameAsync(name)`	Finds the user object associated with the specified name. I use this method in the “Seeding the Database” section of Chapter 14.
`UpdateAsync(user)`	Pushes changes to a user object back into the database. See the “Implementing the Edit Feature” section.
`Users`	Returns an enumeration of the users. See the “Enumerating User Accounts” section.

■ **Tip** Notice that the names of all of these methods end with `Async`. This is because ASP.NET Identity is implemented almost entirely using C# asynchronous programming features, which means that operations will be performed concurrently and not block other activities. You will see how this works once I start demonstrating how to create and manage user data. There are also synchronous extension methods for each `Async` method. I stick to the asynchronous methods for most examples, but the synchronous equivalents are useful if you need to perform multiple related operations in sequence. I have included an example of this in the “Seeding the Database” section of Chapter 14. The synchronous methods are also useful when you want to call Identity methods from within property getters or setters, which I do in Chapter 15.

I added a class file called `AppUserManager.cs` to the `Infrastructure` folder and used it to define the user manager class, which I have called `AppUserManager`, as shown in Listing 13-7.

Listing 13-7. The Contents of the AppUserManager.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {
    public class AppUserManager : UserManager<AppUser> {
        public AppUserManager(IUserStore<AppUser> store)
            : base(store) {
        }

        public static AppUserManager Create(
                IdentityFactoryOptions<AppUserManager> options,
                IOwinContext context) {

            AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
            AppUserManager manager = new AppUserManager(new UserStore<AppUser>(db));

            return manager;
        }
    }
}
```

The static `Create` method will be called when Identity needs an instance of the `AppUserManager`, which will happen when I perform operations on user data—something that I will demonstrate once I have finished performing the setup.

To create an instance of the `AppUserManager` class, I need an instance of `UserStore<AppUser>`. The `UserStore<T>` class is the Entity Framework implementation of the `IUserStore<T>` interface, which provides the storage-specific implementation of the methods defined by the `UserManager` class. To create the `UserStore<AppUser>`, I need an instance of the `AppIdentityDbContext` class, which I get through OWIN as follows:

```
...
AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
...
```

The `IOwinContext` implementation passed as an argument to the `Create` method defines a generically typed `Get` method that returns instances of objects that have been registered in the OWIN start class, which I describe in the following section.

Creating the Start Class

The final piece I need to get ASP.NET Identity up and running is a *start class*. In Listing 13-4, I defined an application setting that specified a configuration class for OWIN, like this:

```
...
<add key="owin:AppStartup" value="Users.IdentityConfig" />
...
```

OWIN emerged independently of ASP.NET and has its own conventions. One of them is that there is a class that is instantiated to load and configure middleware and perform any other configuration work that is required. By default, this class is called `Start`, and it is defined in the global namespace. This class contains a method called `Configuration`, which is called by the OWIN infrastructure and passed an implementation of the `Owin.IAppBuilder` interface, which supports setting up the middleware that an application requires. The `Start` class is usually defined as a partial class, with its other class files dedicated to each kind of middleware that is being used.

I freely ignore this convention, given that the only OWIN middleware that I use in MVC framework applications is Identity. I prefer to use the application setting in the `Web.config` file to define a single class in the top-level namespace of the application. To this end, I added a class file called `IdentityConfig.cs` to the `App_Start` folder and used it to define the class shown in Listing 13-8, which is the class that I specified in the `Web.config` folder.

Listing 13-8. The Contents of the IdentityConfig.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.Owin;
using Microsoft.Owin.Security.Cookies;
using Owin;
using Users.Infrastructure;

namespace Users {
    public class IdentityConfig {
        public void Configuration(IAppBuilder app) {

            app.CreatePerOwinContext<AppIdentityDbContext>(AppIdentityDbContext.Create);
            app.CreatePerOwinContext<AppUserManager>(AppUserManager.Create);

            app.UseCookieAuthentication(new CookieAuthenticationOptions {
                AuthenticationType = DefaultAuthenticationTypes.ApplicationCookie,
                LoginPath = new PathString("/Account/Login"),
            });
        }
    }
}
```

The IAppBuilder interface is supplemented by a number of extension methods defined in classes in the Owin namespace. The CreatePerOwinContext method creates a new instance of the AppUserManager and AppIdentityDbContext classes for each request. This ensures that each request has clean access to the ASP.NET Identity data and that I don't have to worry about synchronization or poorly cached database data.

The UseCookieAuthentication method tells ASP.NET Identity how to use a cookie to identity authenticated users, where the options are specified through the CookieAuthenticationOptions class. The important part here is the LoginPath property, which specifies a URL that clients should be redirected to when they request content without authentication. I have specified /Account/Login, and I will create the controller that handles these redirections in Chapter 14.

Using ASP.NET Identity

Now that the basic setup is out of the way, I can start to use ASP.NET Identity to add support for managing users to the example application. In the sections that follow, I will demonstrate how the Identity API can be used to create administration tools that allow for centralized management of users. Table 13-4 puts ASP.NET Identity into context.

Table 13-4. *Putting Content Caching by Attribute in Context*

Question	Answer
What is it?	ASP.NET Identity is the API used to manage user data and perform authentication and authorization.
Why should I care?	Most applications require users to create accounts and provide credentials to access content and features. ASP.NET Identity provides the facilities for performing these operations.
How is it used by the MVC framework?	ASP.NET Identity isn't used directly by the MVC framework but integrates through the standard MVC authorization features.

Enumerating User Accounts

Centralized user administration tools are useful in just about all applications, even those that allow users to create and manage their own accounts. There will always be some customers who require bulk account creation, for example, and support issues that require inspection and adjustment of user data. From the perspective of this chapter, administration tools are useful because they consolidate a lot of basic user management functions into a small number of classes, making them useful examples to demonstrate the fundamental features of ASP.NET Identity.

I started by adding a controller called `Admin` to the project, which is shown in Listing 13-9, and which I will use to define my user administration functionality.

Listing 13-9. The Contents of the AdminController.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;

namespace Users.Controllers {
    public class AdminController : Controller {

        public ActionResult Index() {
            return View(UserManager.Users);
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

The `Index` action method enumerates the users managed by the `Identity` system; of course, there aren't any users at the moment, but there will be soon. The important part of this listing is the way that I obtain an instance of the `AppUserManager` class, through which I manage user information. I will be using the `AppUserManager` class repeatedly as I implement the different administration functions, and I defined the `UserManager` property in the `Admin` controller to simplify my code.

The `Microsoft.Owin.Host.SystemWeb` assembly adds extension methods for the `HttpContext` class, one of which is `GetOwinContext`. This provides a per-request context object into the OWIN API through an `IOwinContext` object. The `IOwinContext` isn't that interesting in an MVC framework application, but there is another extension method called `GetUserManager<T>` that is used to get instances of the user manager class.

■ **Tip** As you may have gathered, there are lots of extension methods in ASP.NET Identity; overall, the API is something of a muddle as it tries to mix OWIN, abstract Identity functionality, and the concrete Entity Framework storage implementation.

I called the GetUserManager with a generic type parameter to specify the AppUserManager class that I created earlier in the chapter, like this:

```
...
return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
...
```

Once I have an instance of the AppUserManager class, I can start to query the data store. The AppUserManager.Users property returns an enumeration of user objects—instances of the AppUser class in my application—which can be queried and manipulated using LINQ.

In the Index action method, I pass the value of the Users property to the View method so that I can list details of the users in the view. Listing 13-10 shows the contents of the Views/Admin/Index.cshtml file that I created by right-clicking the Index action method and selecting Add View from the pop-up menu.

Listing 13-10. The Contents of the Index.cshtml File in the /Views/Admin Folder

```
@using Users.Models
@model IEnumerable<AppUser>
@{
    ViewBag.Title = "Index";
}

<div class="panel panel-primary">
    <div class="panel-heading">
        User Accounts
    </div>
    <table class="table table-striped">
        <tr><th>ID</th><th>Name</th><th>Email</th></tr>
        @if (Model.Count() == 0) {
            <tr><td colspan="3" class="text-center">No User Accounts</td></tr>
        } else {
            foreach (AppUser user in Model) {
                <tr>
                    <td>@user.Id</td>
                    <td>@user.UserName</td>
                    <td>@user.Email</td>
                </tr>
            }
        }
    </table>
</div>
@Html.ActionLink("Create", "Create", null, new { @class = "btn btn-primary" })
```

This view contains a table that has rows for each user, with columns for the unique ID, username, and e-mail address. If there are no users in the database, then a message is displayed, as shown in Figure 13-4.

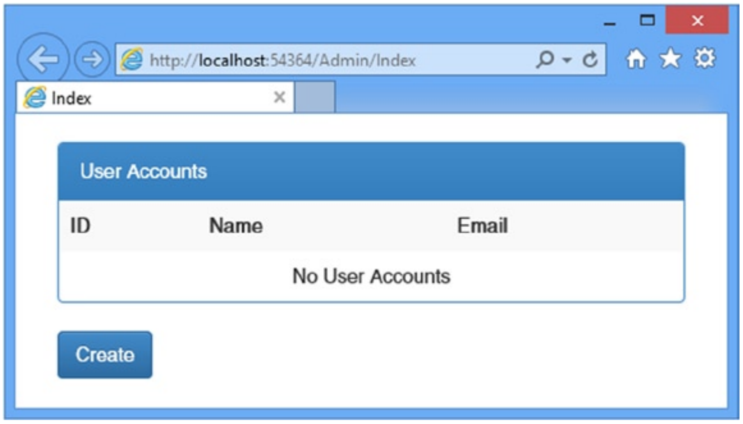


Figure 13-4. *Display the (empty) list of users*

I included a Create link in the view (which I styled as a button using Bootstrap) that targets the `Create` action on the `Admin` controller. I'll implement this action shortly to support adding users.

RESETTING THE DATABASE

When you start the application and navigate to the `/Admin/Index` URL, it will take a few moments before the contents rendered from the view are displayed. This is because the Entity Framework has connected to the database and determined that there is no schema defined. The Code First feature uses the classes I defined earlier in the chapter (and some which are contained in the Identity assemblies) to create the schema so that it is ready to be queried and to store data.

You can see the effect by opening the Visual Studio SQL Server Object Explorer window and expanding entry for the `IdentityDB` database schema, which will include tables with names such as `AspNetUsers` and `AspNetRoles`.

To delete the database, right-click the IdentityDb item and select Delete from the pop-up menu. Check both of the options in the Delete Database dialog and click the OK button to delete the database.

Right-click the Databases item, select Add New Database (as shown in Figure 13-3), and enter **IdentityDb** in the Database Name field. Click OK to create the empty database. The next time you start the application and navigate to the `Admin/Index` URL, the Entity Framework will detect that there is no schema and re-create it.

Creating Users

I am going to use MVC framework model validation for the input my application receives, and the easiest way to do this is to create simple view models for each of the operations that my controller supports. I added a class file called `UserViewModels.cs` to the `Models` folder and used it to define the class shown in Listing 13-11. I'll add further classes to this file as I define models for additional features.

Listing 13-11. The Contents of the UserViewModels.cs File

```
using System.ComponentModel.DataAnnotations;

namespace Users.Models {

    public class CreateModel {
        [Required]
        public string Name { get; set; }
        [Required]
        public string Email { get; set; }
        [Required]
        public string Password { get; set; }
    }
}
```

The initial model I have defined is called `CreateModel`, and it defines the basic properties that I require to create a user account: a username, an e-mail address, and a password. I have used the `Required` attribute from the `System.ComponentModel.DataAnnotations` namespace to denote that values are required for all three properties defined in the model.

I added a pair of `Create` action methods to the `Admin` controller, which are targeted by the link in the `Index` view from the previous section and which uses the standard controller pattern to present a view to the user for a GET request and process form data for a POST request. You can see the new action methods in Listing 13-12.

Listing 13-12. Defining the Create Action Methods in the AdminController.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;
using Microsoft.AspNet.Identity;
using System.Threading.Tasks;

namespace Users.Controllers {
    public class AdminController : Controller {

        public ActionResult Index() {
            return View(UserManager.Users);
        }

        public ActionResult Create() {
            return View();
        }

        [HttpPost]
        public async Task<ActionResult> Create(CreateModel model) {
            if (ModelState.IsValid) {
                AppUser user = new AppUser {UserName = model.Name, Email = model.Email};
                IdentityResult result = await UserManager.CreateAsync(user,
                    model.Password);
                if (result.Succeeded) {
                    return RedirectToAction("Index");
                } else {
                    AddErrorsFromResult(result);
                }
            }
            return View(model);
        }

        private void AddErrorsFromResult(IdentityResult result) {
            foreach (string error in result.Errors) {
                ModelState.AddModelError("", error);
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }

    }
}
```

The important part of this listing is the `Create` method that takes a `CreateModel` argument and that will be invoked when the administrator submits their form data. I use the `ModelState.IsValid` property to check that the data I am receiving contains the values I require, and if it does, I create a new instance of the `AppUser` class and pass it to the `UserManager.CreateAsync` method, like this:

```
...
AppUser user = new AppUser {UserName = model.Name, Email = model.Email};
IdentityResult result = await UserManager.CreateAsync(user, model.Password);
...
```

The result from the `CreateAsync` method is an implementation of the `IdentityResult` interface, which describes the outcome of the operation through the properties listed in Table 13-5.

Table 13-5. *The Properties Defined by the IdentityResult Interface*

Name	Description
`Errors`	Returns a string enumeration that lists the errors encountered while attempting the operation
`Succeeded`	Returns `true` if the operation succeeded

USING THE ASP.NET IDENTITY ASYNCHRONOUS METHODS

You will notice that all of the operations for manipulating user data, such as the UserManager.CreateAsync method I used in Listing 13-12, are available as asynchronous methods. Such methods are easily consumed with the async and await keywords. Using asynchronous Identity methods allows your action methods to be executed asynchronously, which can improve the overall throughput of your application.

However, you can also use synchronous extension methods provided by the Identity API. All of the commonly used asynchronous methods have a synchronous wrapper so that the functionality of the UserManager.CreateAsync method can be called through the synchronous UserManager.Create method. I use the asynchronous methods for preference, and I recommend you follow the same approach in your projects. The synchronous methods can be useful for creating simpler code when you need to perform multiple dependent operations, so I used them in the "Seeding the Database" section of Chapter 14 as a demonstration.

I inspect the Succeeded property in the Create action method to determine whether I have been able to create a new user record in the database. If the Succeeded property is true, then I redirect the browser to the Index action so that list of users is displayed:

```
...
if (result.Succeeded) {
    return RedirectToAction("Index");
} else {
    AddErrorsFromResult(result);
}
...
```

If the Succeeded property is false, then I call the AddErrorsFromResult method, which enumerates the messages from the Errors property and adds them to the set of model state errors, taking advantage of the MVC framework model validation feature. I defined the AddErrorsFromResult method because I will have to process errors from other operations as I build the functionality of my administration controller. The last step is to create the view that will allow the administrator to create new accounts. Listing 13-13 shows the contents of the Views/Admin/Create.cshtml file.

Listing 13-13. The Contents of the Create.cshtml File

```
@model Users.Models.CreateModel
@{ ViewBag.Title = "Create User";}
<h2>Create User</h2>
@Html.ValidationSummary(false)
@using (Html.BeginForm()) {
    <div class="form-group">
        <label>Name</label>
        @Html.TextBoxFor(x => x.Name, new { @class = "form-control"})
    </div>
    <div class="form-group">
        <label>Email</label>
        @Html.TextBoxFor(x => x.Email, new { @class = "form-control" })
    </div>
    <div class="form-group">
        <label>Password</label>
        @Html.PasswordFor(x => x.Password, new { @class = "form-control" })
    </div>
    <button type="submit" class="btn btn-primary">Create</button>
    @Html.ActionLink("Cancel", "Index", null, new { @class = "btn btn-default"})
}
```

There is nothing special about this view—it is a simple form that gathers values that the MVC framework will bind to the properties of the model class that is passed to the `Create` action method.

Testing the Create Functionality

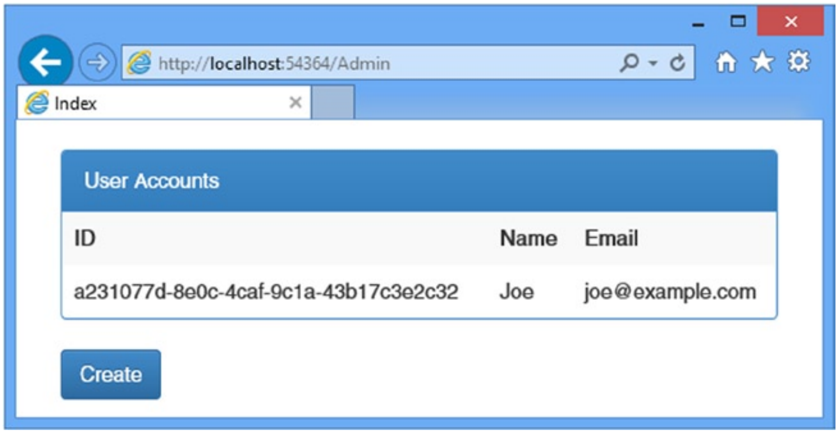
To test the ability to create a new user account, start the application, navigate to the `/Admin/Index` URL, and click the Create button. Fill in the form with the values shown in Table 13-6.

Table 13-6. *The Values for Creating an Example User*

Name	Value
`Name`	`Joe`
`Email`	`joe@example.com`
`Password`	`secret`

■ **Tip** Although not widely known by developers, there are domains that are reserved for testing, including `example.com`. You can see a complete list at `https://tools.ietf.org/html/rfc2606`.

Once you have entered the values, click the Create button. ASP.NET Identity will create the user account, which will be displayed when your browser is redirected to the `Index` action method, as shown in Figure 13-5. You will see a different ID value because IDs are randomly generated for each user account.

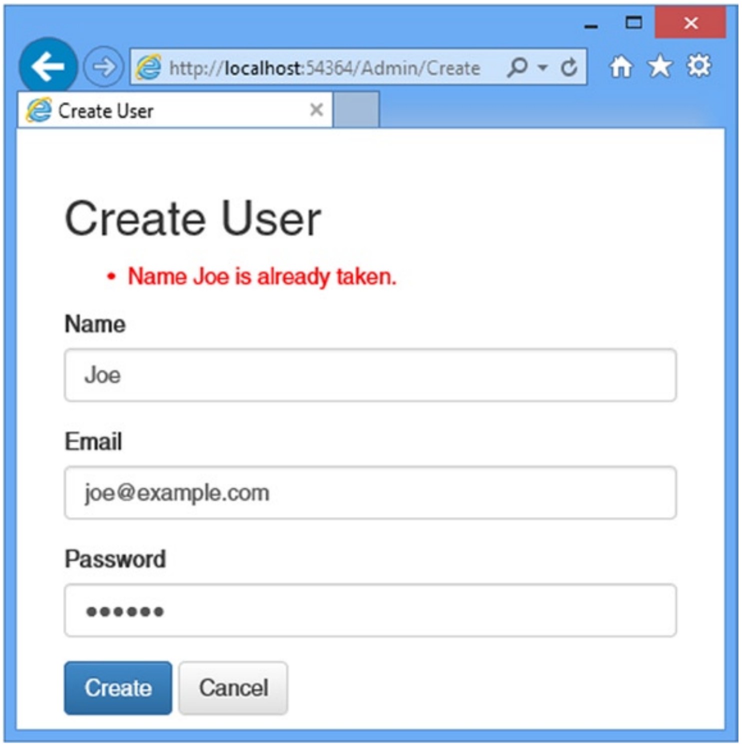


User Accounts

ID	Name	Email
a231077d-8e0c-4caf-9c1a-43b17c3e2c32	Joe	joe@example.com

Figure 13-5. *The effect of adding a new user account*

Click the Create button again and enter the same details into the form, using the values in Table 13-6. This time when you submit the form, you will see an error reported through the model validation summary, as shown in Figure 13-6.



Create User

- Name Joe is already taken.

Name: Joe

Email: joe@example.com

Password: ●●●●●●

Figure 13-6. *An error trying to create a new user*

Validating Passwords

One of the most common requirements, especially for corporate applications, is to enforce a password policy. ASP.NET Identity provides the `PasswordValidator` class, which can be used to configure a password policy using the properties described in Table 13-7.

Table 13-7. *The Properties Defined by the PasswordValidator Class*

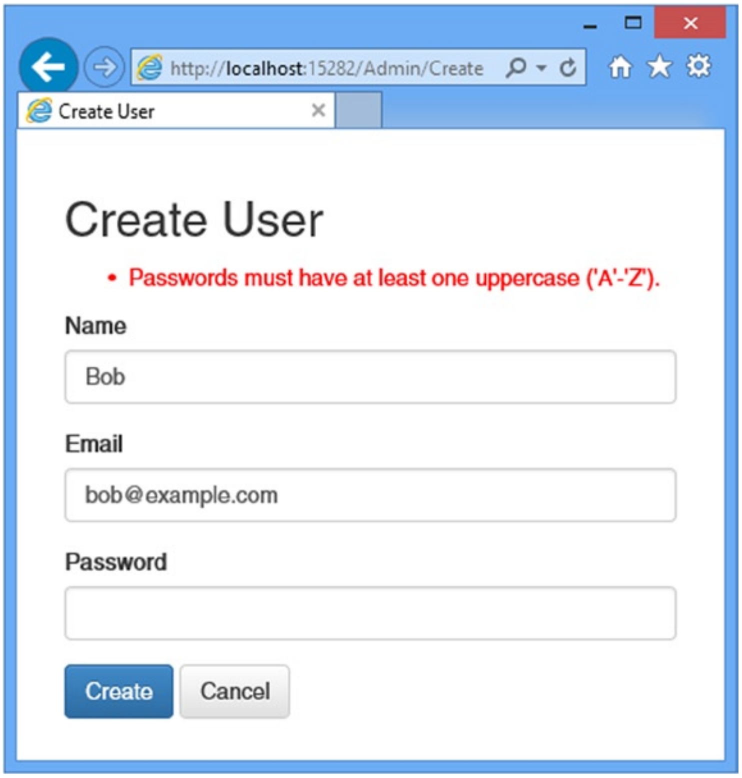
Name	Description
`RequiredLength`	Specifies the minimum length of a valid passwords.
`RequireNonLetterOrDigit`	When set to `true`, valid passwords must contain a character that is neither a letter nor a digit.
`RequireDigit`	When set to `true`, valid passwords must contain a digit.
`RequireLowercase`	When set to `true`, valid passwords must contain a lowercase character.
`RequireUppercase`	When set to `true`, valid passwords must contain a uppercase character.

A password policy is defined by creating an instance of the PasswordValidator class, setting the property values, and using the object as the value for the PasswordValidator property in the Create method that OWIN uses to instantiate the AppUserManager class, as shown in Listing 13-14.

Listing 13-14. Setting a Password Policy in the AppUserManager.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {
    public class AppUserManager : UserManager<AppUser> {

        public AppUserManager(IUserStore<AppUser> store) : base(store) {
        }

        public static AppUserManager Create(IdentityFactoryOptions<AppUserManager>
                options, IOwinContext context) {

            AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
            AppUserManager manager = new AppUserManager(
                new UserStore<AppUser>(db));

            manager.PasswordValidator = new PasswordValidator {
                RequiredLength = 6,
                RequireNonLetterOrDigit = false,
                RequireDigit = false,
                RequireLowercase = true,
                RequireUppercase = true
            };

            return manager;
        }
    }
}
```

I used the PasswordValidator class to specify a policy that requires at least six characters and a mix of uppercase and lowercase characters. You can see how the policy is applied by starting the application, navigating to the /Admin/Index URL, clicking the Create button, and trying to create an account that has the password secret. The password doesn't meet the new password policy, and an error is added to the model state, as shown in Figure 13-7.



Create User

- Passwords must have at least one uppercase ('A'-'Z').

Name: Bob

Email: bob@example.com

Password:

Figure 13-7. *Reporting an error when validating a password*

Implementing a Custom Password Validator

The built-in password validation is sufficient for most applications, but you may need to implement a custom policy, especially if you are implementing a corporate line-of-business application where complex password policies are common. Extending the built-in functionality is done by deriving a new class from PasswordValidatator and overriding the ValidateAsync method. As a demonstration, I added a class file called CustomPasswordValidator.cs in the Infrastructure folder and used it to define the class shown in Listing 13-15.

Listing 13-15. The Contents of the CustomPasswordValidator.cs File

```
using System.Linq;
using System.Threading.Tasks;
using Microsoft.AspNet.Identity;

namespace Users.Infrastructure {

    public class CustomPasswordValidator : PasswordValidator {
        public override async Task<IdentityResult> ValidateAsync(string pass) {
            IdentityResult result = await base.ValidateAsync(pass);
            if (pass.Contains("12345")) {
                var errors = result.Errors.ToList();
                errors.Add("Passwords cannot contain numeric sequences");
                result = new IdentityResult(errors);
            }
            return result;
        }
    }
}
```

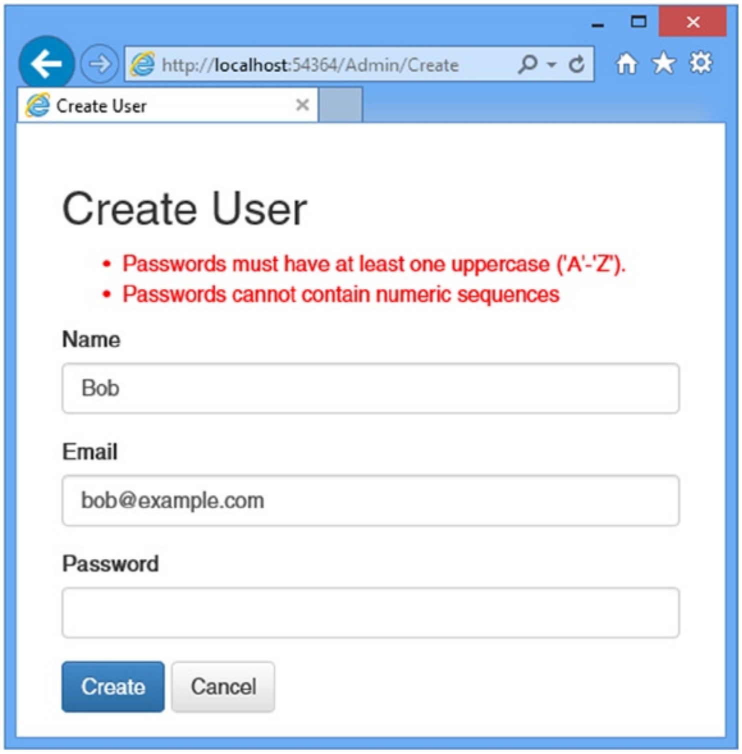
I have overridden the `ValidateAsync` method and call the base implementation so I can benefit from the built-in validation checks. The `ValidateAsync` method is passed the candidate password, and I perform my own check to ensure that the password does not contain the sequence `12345`. The properties of the `IdentityResult` class are read-only, which means that if I want to report a validation error, I have to create a new instance, concatenate my error with any errors from the base implementation, and pass the combined list as the constructor argument. I used LINQ to concatenate the base errors with my custom one.

Listing 13-16 shows the application of my custom password validator in the `AppUserManager` class.

Listing 13-16. Applying a Custom Password Validator in the AppUserManager.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {
    public class AppUserManager : UserManager<AppUser> {

        public AppUserManager(IUserStore<AppUser> store) : base(store) {
        }

        public static AppUserManager Create(IdentityFactoryOptions<AppUserManager>
                options, IOwinContext context) {

            AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
            AppUserManager manager = new AppUserManager(
                new UserStore<AppUser>(db));

            manager.PasswordValidator = new CustomPasswordValidator {
                RequiredLength = 6,
                RequireNonLetterOrDigit = false,
                RequireDigit = false,
                RequireLowercase = true,
                RequireUppercase = true
            };

            return manager;
        }
    }
}
```

To test the custom password validation, try to create a new user account with the password `secret12345`. This will break two of the validation rules—one from the built-in validator and one from my custom implementation. Error messages for both problems are added to the model state and displayed when the Create button is clicked, as shown in Figure 13-8.



Create User

- Passwords must have at least one uppercase ('A'-'Z').
- Passwords cannot contain numeric sequences

Name: Bob

Email: bob@example.com

Password:

Figure 13-8. *The effect of a custom password validation policy*

Validating User Details

More general validation can be performed by creating an instance of the `UserValidator` class and using the properties it defines to restrict other user property values. Table 13-8 describes the `UserValidator` properties.

Table 13-8. *The Properties Defined by the UserValidator Class*

Name	Description
`AllowOnlyAlphanumericUserNames`	When `true`, usernames can contain only alphanumeric characters.
`RequireUniqueEmail`	When `true`, e-mail addresses must be unique.

Performing validation on user details is done by creating an instance of the `UserValidator` class and assigning it to the `UserValidator` property of the user manager class within the `Create` method that OWIN uses to create instances. Listing 13-17 shows an example of using the built-in validator class.

Listing 13-17. Using the Built-in user Validator Class in the AppUserManager.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {
    public class AppUserManager : UserManager<AppUser> {

        public AppUserManager(IUserStore<AppUser> store) : base(store) {
        }

        public static AppUserManager Create(IdentityFactoryOptions<AppUserManager>
                options, IOwinContext context) {

            AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
            AppUserManager manager = new AppUserManager(
                new UserStore<AppUser>(db));

            manager.PasswordValidator = new CustomPasswordValidator {
                RequiredLength = 6,
                RequireNonLetterOrDigit = false,
                RequireDigit = false,
                RequireLowercase = true,
                RequireUppercase = true
            };

            manager.UserValidator = new UserValidator<AppUser>(manager) {
                AllowOnlyAlphanumericUserNames = true,
                RequireUniqueEmail = true
            };

            return manager;
        }
    }
}
```

The UserValidator class takes a generic type parameter that specifies the type of the user class, which is AppUser in this case. Its constructor argument is the user manager class, which is an instance of the user manager class (which is AppUserManager for my application).

The built-in validation support is rather basic, but you can create a custom validation policy by creating a class that is derived from UserValidator. As a demonstration, I added a class file called CustomUserValidator.cs to the Infrastructure folder and used it to create the class shown in Listing 13-18.

Listing 13-18. The Contents of the CustomUserValidator.cs File

```
using System.Linq;
using System.Threading.Tasks;
using Microsoft.AspNet.Identity;
using Users.Models;
```

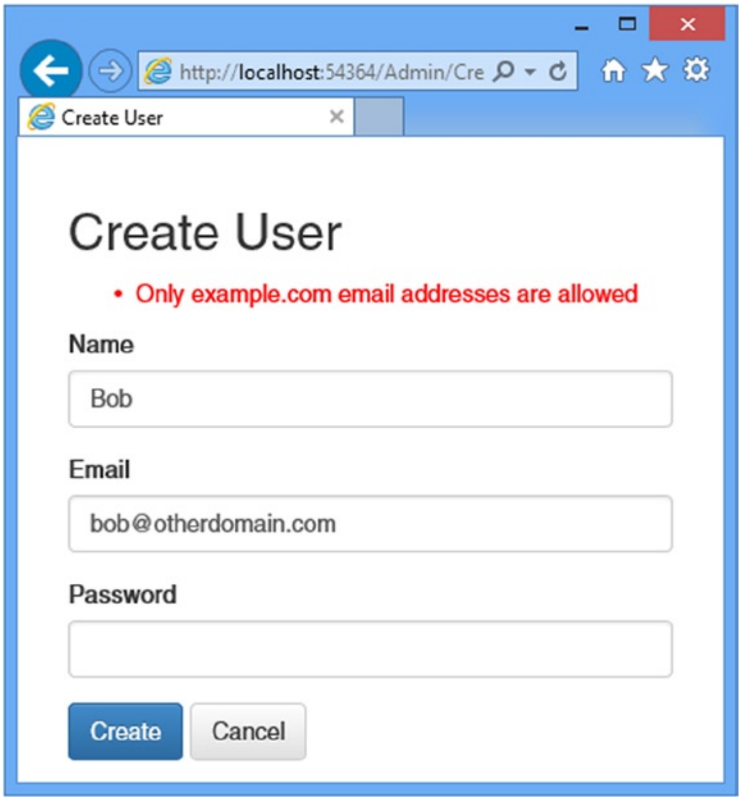
```
namespace Users.Infrastructure {

    public class CustomUserValidator : UserValidator<AppUser> {

        public CustomUserValidator(AppUserManager mgr)
            : base(mgr) {
        }

        public override async Task<IdentityResult> ValidateAsync(AppUser user) {
            IdentityResult result = await base.ValidateAsync(user);

            if (!user.Email.ToLower().EndsWith("@example.com")) {
                var errors = result.Errors.ToList();
                errors.Add("Only example.com email addresses are allowed");
                result = new IdentityResult(errors);
            }
            return result;
        }
    }
}
```

The constructor of the derived class must take an instance of the user manager class and call the base implementation so that the built-in validation checks can be performed. Custom validation is implemented by overriding the `ValidateAsync` method, which takes an instance of the user class and returns an `IdentityResult` object. My custom policy restricts users to e-mail addresses in the `example.com` domain and performs the same LINQ manipulation I used for password validation to concatenate my error message with those produced by the base class. Listing 13-19 shows how I applied my custom validation class in the `Create` method of the `AppUserManager` class, replacing the default implementation.

Listing 13-19. Using a Custom User Validation Class in the AppUserManager.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {
    public class AppUserManager : UserManager<AppUser> {

        public AppUserManager(IUserStore<AppUser> store) : base(store) {
        }

        public static AppUserManager Create(IdentityFactoryOptions<AppUserManager>
                options, IOwinContext context) {

            AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
            AppUserManager manager = new AppUserManager(
                new UserStore<AppUser>(db));
            manager.PasswordValidator = new CustomPasswordValidator {
                RequiredLength = 6,
                RequireNonLetterOrDigit = false,
                RequireDigit = false,
                RequireLowercase = true,
                RequireUppercase = true
            };

            manager.UserValidator = new CustomUserValidator(manager) {
                AllowOnlyAlphanumericUserNames = true,
                RequireUniqueEmail = true
            };

            return manager;
        }
    }
}
```

You can see the result if you try to create an account with an e-mail address such as `bob@otherdomain.com`, as shown in Figure 13-9.



Create User

- Only example.com email addresses are allowed

Name: Bob

Email: bob@otherdomain.com

Password:

Figure 13-9. *An error message shown by a custom user validation policy*

Completing the Administration Features

I only have to implement the features for editing and deleting users to complete my administration tool. In Listing 13-20, you can see the changes I made to the `Views/Admin/Index.cshtml` file to target `Edit` and `Delete` actions in the `Admin` controller.

Listing 13-20. Adding Edit and Delete Buttons to the Index.cshtml File

```
@using Users.Models
@model IEnumerable<AppUser>
@{ ViewBag.Title = "Index"; }
<div class="panel panel-primary">
    <div class="panel-heading">
        User Accounts
    </div>
    <table class="table table-striped">
        <tr><th>ID</th><th>Name</th><th>Email</th><th></th></tr>
        @if (Model.Count() == 0) {
            <tr><td colspan="4" class="text-center">No User Accounts</td></tr>
        } else {
            foreach (AppUser user in Model) {
                <tr>
                    <td>@user.Id</td>
                    <td>@user.UserName</td>
                    <td>@user.Email</td>
                    <td>
                        @using (Html.BeginForm("Delete", "Admin",
                            new { id = user.Id })) {
                            @Html.ActionLink("Edit", "Edit", new { id = user.Id },
                                    new { @class = "btn btn-primary btn-xs" })
                            <button class="btn btn-danger btn-xs"
                                    type="submit">
                                Delete
                            </button>
                        }
                    </td>
                </tr>
            }
        }
    </table>
</div>
@Html.ActionLink("Create", "Create", null, new { @class = "btn btn-primary" })
```

■ **Tip** You will notice that I have put the `Html.ActionLink` call that targets the `Edit` action method inside the scope of the `Html.Begin` helper. I did this solely so that the Bootstrap styles will style both elements as buttons displayed on a single line.

Implementing the Delete Feature

The user manager class defines a `DeleteAsync` method that takes an instance of the user class and removes it from the database. In Listing 13-21, you can see how I have used the `DeleteAsync` method to implement the delete feature of the `Admin` controller.

Listing 13-21. Deleting Users in the AdminController.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;
using Microsoft.AspNet.Identity;
using System.Threading.Tasks;

namespace Users.Controllers {
    public class AdminController : Controller {

        // ...other action methods omitted for brevity...

        [HttpPost]
        public async Task<ActionResult> Delete(string id) {
            AppUser user = await UserManager.FindByIdAsync(id);
            if (user != null) {
                IdentityResult result = await UserManager.DeleteAsync(user);
                if (result.Succeeded) {
                    return RedirectToAction("Index");
                } else {
                    return View("Error", result.Errors);
                }
            } else {
                return View("Error", new string[] { "User Not Found" });
            }
        }

        private void AddErrorsFromResult(IdentityResult result) {
            foreach (string error in result.Errors) {
                ModelState.AddModelError("", error);
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

My action method receives the unique ID for the user as an argument, and I use the FindByIdAsync method to locate the corresponding user object so that I can pass it to DeleteAsync method. The result of the DeleteAsync method is an IdentityResult, which I process in the same way I did in earlier examples to ensure that any errors are displayed to the user. You can test the delete functionality by creating a new user and then clicking the Delete button that appears alongside it in the Index view.

There is no view associated with the Delete action, so to display any errors I created a view file called Error.cshtml in the Views/Shared folder, the contents of which are shown in Listing 13-22.

Listing 13-22. The Contents of the Error.cshtml File

```
@model IEnumerable<string>
@{ ViewBag.Title = "Error";}

<div class="alert alert-danger">
    @switch (Model.Count()) {
        case 0:
            @: Something went wrong. Please try again
            break;
        case 1:
            @Model.First();
            break;
        default:
            @: The following errors were encountered:
            <ul>
                @foreach (string error in Model) {
                    <li>@error</li>
                }
            </ul>
            break;
    }
</div>
@Html.ActionLink("OK", "Index", null, new { @class = "btn btn-default" })
```

■ **Tip** I put this view in the Views/Shared folder so that it can be used by other controllers, including the one I create to manage roles and role membership in Chapter 14.

Implementing the Edit Feature

To complete the administration tool, I need to add support for editing the e-mail address and password for a user account. These are the only properties defined by users at the moment, but I'll show you how to extend the schema with custom properties in Chapter 15. Listing 13-23 shows the Edit action methods that I added to the Admin controller.

Listing 13-23. Adding the Edit Actions in the AdminController.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;
using Microsoft.AspNet.Identity;
using System.Threading.Tasks;

namespace Users.Controllers {
    public class AdminController : Controller {

       // ...other action methods omitted for brevity...

        public async Task<ActionResult> Edit(string id) {
            AppUser user = await UserManager.FindByIdAsync(id);
            if (user != null) {
                return View(user);
            } else {
                return RedirectToAction("Index");
            }
        }

        [HttpPost]
        public async Task<ActionResult> Edit(string id, string email, string password) {
            AppUser user = await UserManager.FindByIdAsync(id);
            if (user != null) {
                user.Email = email;
                IdentityResult validEmail
                    = await UserManager.UserValidator.ValidateAsync(user);
                if (!validEmail.Succeeded) {
                    AddErrorsFromResult(validEmail);
                }
                IdentityResult validPass = null;
                if (password != string.Empty) {
                    validPass
                        = await UserManager.PasswordValidator.ValidateAsync(password);
                    if (validPass.Succeeded) {
                        user.PasswordHash =
                            UserManager.PasswordHasher.HashPassword(password);
                    } else {
                        AddErrorsFromResult(validPass);
                    }
                }
                if ((validEmail.Succeeded && validPass == null) || ( validEmail.Succeeded
                        && password != string.Empty && validPass.Succeeded)) {
                    IdentityResult result = await UserManager.UpdateAsync(user);
                    if (result.Succeeded) {
                        return RedirectToAction("Index");
                    } else {
                        AddErrorsFromResult(result);
                    }
                }
            } else {
                ModelState.AddModelError("", "User Not Found");
            }
            return View(user);
        }

        private void AddErrorsFromResult(IdentityResult result) {
            foreach (string error in result.Errors) {
                ModelState.AddModelError("", error);
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

The `Edit` action targeted by GET requests uses the ID string embedded in the `Index` view to call the `FindByIdAsync` method in order to get an `AppUser` object that represents the user.

The more complex implementation receives the POST request, with arguments for the user ID, the new e-mail address, and the password. I have to perform several tasks to complete the editing operation.

The first task is to validate the values I have received. I am working with a simple user object at the moment—although I'll show you how to customize the data stored for users in Chapter 15—but even so, I need to validate the user data to ensure that I don't violate the custom policies defined in the "Validating User Details" and "Validating Passwords" sections. I start by validating the e-mail address, which I do like this:

```
...
user.Email = email;
IdentityResult validEmail = await UserManager.UserValidator.ValidateAsync(user);
if (!validEmail.Succeeded) {
    AddErrorsFromResult(validEmail);
}
...
```

■ **Tip** Notice that I have to change the value of the `Email` property before I perform the validation because the `ValidateAsync` method only accepts instances of the user class.

The next step is to change the password, if one has been supplied. ASP.NET Identity stores hashes of passwords, rather than the passwords themselves—this is intended to prevent passwords from being stolen. My next step is to take the validated password and generate the hash code that will be stored in the database so that the user can be authenticated (which I demonstrate in Chapter 14).

Passwords are converted to hashes through an implementation of the IPasswordHasher interface, which is obtained through the AppUserManager.PasswordHasher property. The IPasswordHasher interface defines the HashPassword method, which takes a string argument and returns its hashed value, like this:

```
...
if (password != string.Empty) {
    validPass = await UserManager.PasswordValidator.ValidateAsync(password);
    if (validPass.Succeeded) {
        user.PasswordHash = UserManager.PasswordHasher.HashPassword(password);
    } else {
        AddErrorsFromResult(validPass);
    }
}
...
```

Changes to the user class are not stored in the database until the UpdateAsync method is called, like this:

```
...
if ((validEmail.Succeeded && validPass == null)
    || ( validEmail.Succeeded && password != string.Empty &&
        validPass.Succeeded)) {
    IdentityResult result = await UserManager.UpdateAsync(user);
    if (result.Succeeded) {
        return RedirectToAction("Index");
    } else {
        AddErrorsFromResult(result);
    }
}
...
```

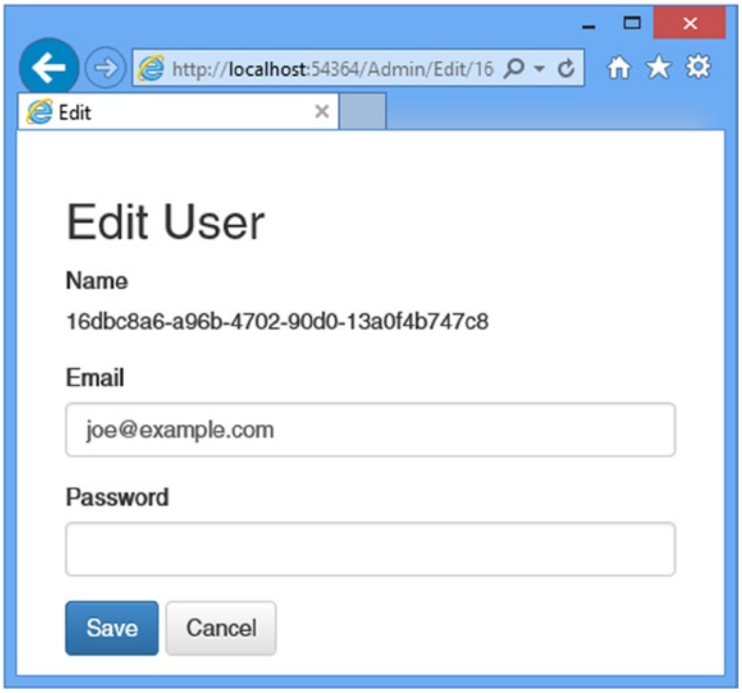
Creating the View

The final component is the view that will render the current values for a user and allow new values to be submitted to the controller. Listing 13-24 shows the contents of the Views/Admin/Edit.cshtml file.

Listing 13-24. The Contents of the Edit.cshtml File

```
@model Users.Models.AppUser
@{ ViewBag.Title = "Edit"; }
@Html.ValidationSummary(false)
<h2>Edit User</h2>

<div class="form-group">
    <label>Name</label>
    <p class="form-control-static">@Model.Id</p>
</div>
@using (Html.BeginForm()) {
    @Html.HiddenFor(x => x.Id)
    <div class="form-group">
        <label>Email</label>
        @Html.TextBoxFor(x => x.Email, new { @class = "form-control" })
    </div>
    <div class="form-group">
        <label>Password</label>
        <input name="password" type="password" class="form-control" />
    </div>
    <button type="submit" class="btn btn-primary">Save</button>
    @Html.ActionLink("Cancel", "Index", null, new { @class = "btn btn-default" })
}
```

There is nothing special about the view. It displays the user ID, which cannot be changed, as static text and provides a form for editing the e-mail address and password, as shown in Figure 13-10. Validation problems are displayed in the validation summary section of the view, and successfully editing a user account will return to the list of accounts in the system.



http://localhost:54364/Admin/Edit/16

Edit

Edit User

Name

16dbc8a6-a96b-4702-90d0-13a0f4b747c8

Email

joe@example.com

Password

Save

Cancel

Figure 13-10. *Editing a user account*

Summary

In this chapter, I showed you how to create the configuration and classes required to use ASP.NET Identity and demonstrated how they can be applied to create a user administration tool. In the next chapter, I show you how to perform authentication and authorization with ASP.NET Identity.

CHAPTER 14

Applying ASP.NET Identity

In this chapter, I show you how to apply ASP.NET Identity to authenticate and authorize the user accounts created in the previous chapter. I explain how the ASP.NET platform provides a foundation for authenticating requests and how ASP.NET Identity fits into that foundation to authenticate users and enforce authorization through roles. Table 14-1 summarizes this chapter.

Table 14-1. *Chapter Summary*

Problem	Solution	Listing
Prepare an application for user authentication.	Apply the `Authorize` attribute to restrict access to action methods and define a controller to which users will be redirected to provide credentials.	1–4
Authenticate a user.	Check the name and password using the `FindAsync` method defined by the user manager class and create an implementation of the `IIdentity` interface using the `CreateIdentityMethod`. Set an authentication cookie for subsequent requests by calling the `SignIn` method defined by the authentication manager class.	5
Prepare an application for role-based authorization.	Create a role manager class and register it for instantiation in the OWIN startup class.	6–8
Create and delete roles.	Use the `CreateAsync` and `DeleteAsync` methods defined by the role manager class.	9–12
Manage role membership.	Use the `AddToRoleAsync` and `RemoveFromRoleAsync` methods defined by the user manager class.	13–15
Use roles for authorization.	Set the `Roles` property of the `Authorize` attribute.	16–19
Seed the database with initial content.	Use the database context initialization class.	20, 21

Preparing the Example Project

In this chapter, I am going to continue working on the Users project I created in Chapter 13. No changes to the application components are required.

Authenticating Users

The most fundamental activity for ASP.NET Identity is to authenticate users, and in this section, I explain and demonstrate how this is done. Table 14-2 puts authentication into context.

Table 14-2. *Putting Authentication in Context*

Question	Answer
What is it?	Authentication validates credentials provided by users. Once the user is authenticated, requests that originate from the browser contain a cookie that represents the user identity.
Why should I care?	Authentication is how you check the identity of your users and is the first step toward restricting access to sensitive parts of the application.
How is it used by the MVC framework?	Authentication features are accessed through the Authorize attribute, which is applied to controllers and action methods in order to restrict access to authenticated users.

■ **Tip** I use names and passwords stored in the ASP.NET Identity database in this chapter. In Chapter 15, I demonstrate how ASP.NET Identity can be used to authenticate users with a service from Google (Identity also supports authentication for Microsoft, Facebook, and Twitter accounts).

Understanding the Authentication/Authorization Process

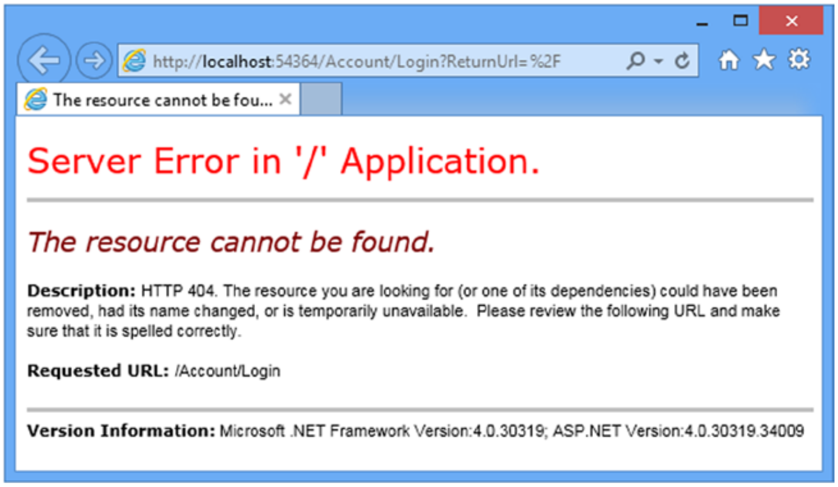
The ASP.NET Identity system integrates into the ASP.NET platform, which means you use the standard MVC framework techniques to control access to action methods, such as the Authorize attribute. In this section, I am going to apply basic restrictions to the Index action method in the Home controller and then implement the features that allow users to identify themselves so they can gain access to it. Listing 14-1 shows how I have applied the Authorize attribute to the Home controller.

Listing 14-1. Securing the Home Controller

```
using System.Web.Mvc;
using System.Collections.Generic;

namespace Users.Controllers {

    public class HomeController : Controller {

        [Authorize]
        public ActionResult Index() {
            Dictionary<string, object> data
                = new Dictionary<string, object>();
            data.Add("Placeholder", "Placeholder");
            return View(data);
        }
    }
}
```

Using the Authorize attribute in this way is the most general form of authorization and restricts access to the Index action methods to requests that are made by users who have been authenticated by the application.

If you start the application and request a URL that targets the Index action on the Home controller (/Home/Index, /Home, or just /), you will see the error shown by Figure 14-1.


http://localhost:54364/Account/Login?ReturnUrl=%2F
The resource cannot be fou...

Server Error in '/' Application.

The resource cannot be found.

Description: HTTP 404. The resource you are looking for (or one of its dependencies) could have been removed, had its name changed, or is temporarily unavailable. Please review the following URL and make sure that it is spelled correctly.

Requested URL: /Account/Login

Version Information: Microsoft .NET Framework Version:4.0.30319; ASP.NET Version:4.0.30319.34009

Figure 14-1. *Requesting a protected URL*

The ASP.NET platform provides some useful information about the user through the `HttpContext` object, which is used by the `Authorize` attribute to check the status of the current request and see whether the user has been authenticated. The `HttpContext.User` property returns an implementation of the `IPrincipal` interface, which is defined in the `System.Security.Principal` namespace. The `IPrincipal` interface defines the property and method shown in Table 14-3.

Table 14-3. *The Members Defined by the IPrincipal Interface*

Name	Description
`Identity`	Returns an implementation of the `IIdentity` interface that describes the user associated with the request.
`IsInRole(role)`	Returns `true` if the user is a member of the specified role. See the “Authorizing Users with Roles” section for details of managing authorizations with roles.

The implementation of `IIdentity` interface returned by the `IPrincipal.Identity` property provides some basic, but useful, information about the current user through the properties I have described in Table 14-4.

Table 14-4. *The Properties Defined by the IIdentity Interface*

Name	Description
`AuthenticationType`	Returns a string that describes the mechanism used to authenticate the user
`IsAuthenticated`	Returns `true` if the user has been authenticated
`Name`	Returns the name of the current user

■ **Tip** In Chapter 15 I describe the implementation class that ASP.NET Identity uses for the `IIdentity` interface, which is called `ClaimsIdentity`.

ASP.NET Identity contains a module that handles the `AuthenticateRequest` life-cycle event, which I described in Chapter 3, and uses the cookies sent by the browser to establish whether the user has been authenticated. I'll show you how these cookies are created shortly. If the user is authenticated, the ASP.NET framework module sets the value of the `IIdentity.IsAuthenticated` property to `true` and otherwise sets it to `false`. (I have yet to implement the feature that will allow users to authenticate, which means that the value of the `IsAuthenticated` property is always `false` in the example application.)

The `Authorize` module checks the value of the `IsAuthenticated` property and, finding that the user isn't authenticated, sets the result status code to 401 and terminates the request. At this point, the ASP.NET Identity module intercepts the request and redirects the user to the `/Account/Login` URL. This is the URL that I defined in the `IdentityConfig` class, which I specified in Chapter 13 as the OWIN startup class, like this:

```
using Microsoft.AspNet.Identity;
using Microsoft.Owin;
using Microsoft.Owin.Security.Cookies;
using Owin;
using Users.Infrastructure;

namespace Users {
    public class IdentityConfig {
        public void Configuration(IAppBuilder app) {

            app.CreatePerOwinContext<AppUserManager>(AppUserManager.Create);

            app.UseCookieAuthentication(new CookieAuthenticationOptions {
                AuthenticationType = DefaultAuthenticationTypes.ApplicationCookie,
                LoginPath = new PathString("/Account/Login"),
            });
        }
    }
}
```

The browser requests the `/Account/Login` URL, but since it doesn't correspond to any controller or action in the example project, the server returns a 404 – Not Found response, leading to the error message shown in Figure 14-1.

Preparing to Implement Authentication

Even though the request ends in an error message, the request in the previous section illustrates how the ASP.NET Identity system fits into the standard ASP.NET request life cycle. The next step is to implement a controller that will receive requests for the `/Account/Login` URL and authenticate the user. I started by adding a new model class to the `UserViewModels.cs` file, as shown in Listing 14-2.

Listing 14-2. Adding a New Model Class to the UserViewModels.cs File

```
using System.ComponentModel.DataAnnotations;

namespace Users.Models {

    public class CreateModel {
        [Required]
        public string Name { get; set; }
        [Required]
        public string Email { get; set; }
        [Required]
        public string Password { get; set; }
    }

    public class LoginModel {
        [Required]
        public string Name { get; set; }
        [Required]
        public string Password { get; set; }
    }
}
```

The new model has `Name` and `Password` properties, both of which are decorated with the `Required` attribute so that I can use model validation to check that the user has provided values.

■ **Tip** In a real project, I would use client-side validation to check that the user has provided name and password values before submitting the form to the server, but I am going to keep things focused on Identity and the server-side functionality in this chapter. See *Pro ASP.NET MVC 5* for details of client-side form validation.

I added an `Account` controller to the project, as shown in Listing 14-3, with `Login` action methods to collect and process the user's credentials. I have not implemented the authentication logic in the listing because I am going to define the view and then walk through the process of validating user credentials and signing users into the application.

Listing 14-3. The Contents of the AccountController.cs File

```
using System.Threading.Tasks;
using System.Web.Mvc;
using Users.Models;

namespace Users.Controllers {

    [Authorize]
    public class AccountController : Controller {

        [AllowAnonymous]
        public ActionResult Login(string returnUrl) {
            if (ModelState.IsValid) {
            }
            ViewBag.returnUrl = returnUrl;
            return View();
        }

        [HttpPost]
        [AllowAnonymous]
        [ValidateAntiForgeryToken]
        public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
            return View(details);
        }
    }
}
```

Even though it doesn't authenticate users yet, the Account controller contains some useful infrastructure that I want to explain separately from the ASP.NET Identity code that I'll add to the Login action method shortly.

First, notice that both versions of the Login action method take an argument called returnUrl. When a user requests a restricted URL, they are redirected to the /Account/Login URL with a query string that specifies the URL that the user should be sent back to once they have been authenticated. You can see this if you start the application and request the /Home/Index URL. Your browser will be redirected, like this:

```
/Account/Login?ReturnUrl=%2FHome%2FIndex
```

The value of the ReturnUrl query string parameter allows me to redirect the user so that navigating between open and secured parts of the application is a smooth and seamless process.

Next, notice the attributes that I have applied to the Account controller. Controllers that manage user accounts contain functionality that should be available only to authenticated users, such as password reset, for example. To that end, I have applied the Authorize attribute to the controller class and then used the AllowAnonymous attribute on the individual action methods. This restricts action methods to authenticated users by default but allows unauthenticated users to log in to the application.

Finally, I have applied the ValidateAntiForgeryToken attribute, which works in conjunction with the Html.AntiForgeryToken helper method in the view and guards against cross-site request forgery. Cross-site forgery exploits the trust that your user has for your application and it is especially important to use the helper and attribute for authentication requests.

■ **Tip** You can learn more about cross-site request forgery at http://en.wikipedia.org/wiki/Cross-site_request_forgery.

My last preparatory step is to create the view that will be rendered to gather credentials from the user. Listing 14-4 shows the contents of the Views/Account/Login.cshtml file, which I created by right-clicking the Index action method and selecting Add View from the pop-up menu.

Listing 14-4. The Contents of the Login.cshtml File

```
@model Users.Models.LoginModel
@{ ViewBag.Title = "Login";}
<h2>Log In</h2>

@Html.ValidationSummary()
```

```
@using (Html.BeginForm()) {
    @Html.AntiForgeryToken();
    <input type="hidden" name="returnUrl" value="@ViewBag.returnUrl" />
    <div class="form-group">
        <label>Name</label>
        @Html.TextBoxFor(x => x.Name, new { @class = "form-control" })
    </div>
    <div class="form-group">
        <label>Password</label>
        @Html.PasswordFor(x => x.Password, new { @class = "form-control" })
    </div>
    <button class="btn btn-primary" type="submit">Log In</button>
}
```

The only notable aspects of this view are using the `Html.AntiForgeryToken` helper and creating a hidden `input` element to preserve the `returnUrl` argument. In all other respects, this is a standard Razor view, but it completes the preparations for authentication and demonstrates the way that unauthenticated requests are intercepted and redirected. To test the new controller, start the application and request the `/Home/Index` URL. You will be redirected to the `/Account/Login` URL, as shown in Figure 14-2.

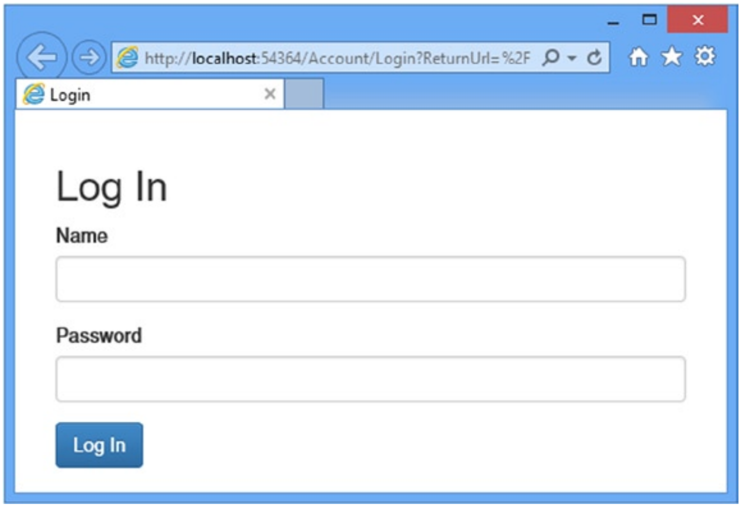


***Figure 14-2.** Prompting the user for authentication credentials*

Adding User Authentication

Requests for protected URLs are being correctly redirected to the `Account` controller, but the credentials provided by the user are not yet used for authentication. In Listing 14-5, you can see how I have completed the implementation of the `Login` action.

Listing 14-5. Adding Authentication to the AccountController.cs File

```
using System.Threading.Tasks;
using System.Web.Mvc;
using Users.Models;
using Microsoft.Owin.Security;
using System.Security.Claims;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using System.Web;

namespace Users.Controllers {

    [Authorize]
    public class AccountController : Controller {

        [AllowAnonymous]
        public ActionResult Login(string returnUrl) {
            ViewBag.returnUrl = returnUrl;
            return View();
        }

        [HttpPost]
        [AllowAnonymous]
        [ValidateAntiForgeryToken]
        public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
            if (ModelState.IsValid) {
                AppUser user = await UserManager.FindAsync(details.Name,
                    details.Password);
                if (user == null) {
                    ModelState.AddModelError("", "Invalid name or password.");
                } else {
                    ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
                        DefaultAuthenticationTypes.ApplicationCookie);
                    AuthManager.SignOut();
                    AuthManager.SignIn(new AuthenticationProperties {
                        IsPersistent = false}, ident);
                    return Redirect(returnUrl);
                }
            }
            ViewBag.returnUrl = returnUrl;
            return View(details);
        }

        private IAuthenticationManager AuthManager {
            get {
                return HttpContext.GetOwinContext().Authentication;
            }
        }
        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

The simplest part is checking the credentials, which I do through the FindAsync method of the AppUserManager class, which you will remember as the user manager class from Chapter 13:

```
...
AppUser user = await UserManager.FindAsync(details.Name, details.Password);
...
```

I will be using the AppUserManager class repeatedly in the Account controller, so I defined a property called UserManager that returns the instance of the class using the GetOwinContext extension method for the HttpContext class, just as I did for the Admin controller in Chapter 13.

The FindAsync method takes the account name and password supplied by the user and returns an instance of the user class (AppUser in the example application) if the user account exists *and* if the password is correct. If there is no such account or the password doesn't match the one stored in the database, then the FindAsync method returns null, in which case I add an error to the model state that tells the user that something went wrong.

If the FindAsync method does return an AppUser object, then I need to create the cookie that the browser will send in subsequent requests to show they are authenticated. Here are the relevant statements:

```
...
ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
    DefaultAuthenticationTypes.ApplicationCookie);
AuthManager.SignOut();
AuthManager.SignIn(new AuthenticationProperties {IsPersistent = false}, ident);
return Redirect(returnUrl);
...
```

The first step is to create a ClaimsIdentity object that identifies the user. The ClaimsIdentity class is the ASP.NET Identity implementation of the IIdentity interface that I described in Table 14-4 and that you can see used in the "Using Roles for Authorization" section later in this chapter.

■ **Tip** Don't worry about why the class is called ClaimsIdentity at the moment. I explain what claims are and how they can be used in Chapter 15.

Instances of ClaimsIdentity are created by calling the user manager CreateIdentityAsync method, passing in a user object and a value from the DefaultAuthenticationTypes enumeration. The ApplicationCookie value is used when working with individual user accounts.

The next step is to invalidate any existing authentication cookies and create the new one. I defined the AuthManager property in the controller because I'll need access to the object it provides repeatedly as I build the functionality in this chapter. The property returns an implementation of the IAuthenticationManager interface that is responsible for performing common authentication options. I have described the most useful methods provided by the IAuthenticationManager interface in Table 14-5.

Table 14-5. *The Most Useful Methods Defined by the IAuthenticationManager Interface*

Name	Description
`SignIn(options, identity)`	Signs the user in, which generally means creating the cookie that identifies authenticated requests
`SignOut()`	Signs the user out, which generally means invalidating the cookie that identifies authenticated requests

The arguments to the `SignIn` method are an `AuthenticationProperties` object that configures the authentication process and the `ClaimsIdentity` object. I set the `IsPersistent` property defined by the `AuthenticationProperties` object to `true` to make the authentication cookie persistent at the browser, meaning that the user doesn't have to authenticate again when starting a new session. (There are other properties defined by the `AuthenticationProperties` class, but the `IsPersistent` property is the only one that is widely used at the moment.)

The final step is to redirect the user to the URL they requested before the authentication process started, which I do by calling the `Redirect` method.

CONSIDERING TWO-FACTOR AUTHENTICATION

I have performed single-factor authentication in this chapter, which is where the user is able to authenticate using a single piece of information known to them in advance: the password.

ASP.NET Identity also supports two-factor authentication, where the user needs something extra, usually something that is given to the user at the moment they want to authenticate. The most common examples are a value from a SecureID token or an authentication code that is sent as an e-mail or text message (strictly speaking, the two factors can be anything, including fingerprints, iris scans, and voice recognition, although these are options that are rarely required for most web applications).

Security is increased because an attacker needs to know the user's password *and* have access to whatever provides the second factor, such an e-mail account or cell phone.

I don't show two-factor authentication in the book for two reasons. The first is that it requires a lot of preparatory work, such as setting up the infrastructure that distributes the second-factor e-mails and texts and implementing the validation logic, all of which is beyond the scope of this book.

The second reason is that two-factor authentication forces the user to remember to jump through an additional hoop to authenticate, such as remembering their phone or keeping a security token nearby, something that isn't always appropriate for web applications. I carried a SecureID token of one sort or another for more than a decade in various jobs, and I lost count of the number of times that I couldn't log in to an employer's system because I left the token at home.

If you are interested in two-factor security, then I recommend relying on a third-party provider such as Google for authentication, which allows the user to choose whether they want the additional security (and inconvenience) that two-factor authentication provides. I demonstrate third-party authentication in Chapter 15.

Testing Authentication

To test user authentication, start the application and request the /Home/Index URL. When redirected to the /Account/Login URL, enter the details of one of the users I listed at the start of the chapter (for instance, the name joe and the password MySecret). Click the Log In button, and your browser will be redirected back to the /Home/Index URL, but this time it will submit the authentication cookie that grants it access to the action method, as shown in Figure 14-3.

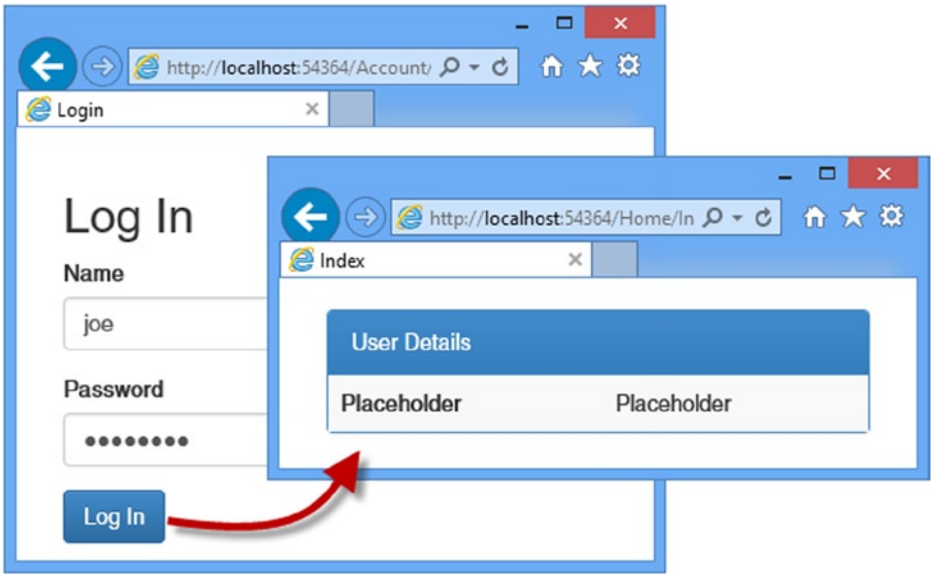


Figure 14-3. *Authenticating a user*

■ **Tip** You can use the browser F12 tools to see the cookies that are used to identify authenticated requests.

Authorizing Users with Roles

In the previous section, I applied the Authorize attribute in its most basic form, which allows any authenticated user to execute the action method. In this section, I will show you how to refine authorization to give finer-grained control over which users can perform which actions. Table 14-6 puts authorization in context.

Table 14-6. *Putting Authorization in Context*

Question	Answer
What is it?	Authorization is the process of granting access to controllers and action methods to certain users, generally based on role membership.
Why should I care?	Without roles, you can differentiate only between users who are authenticated and those who are not. Most applications will have different types of users, such as customers and administrators.
How is it used by the MVC framework?	Roles are used to enforce authorization through the Authorize attribute, which is applied to controllers and action methods.

■ **Tip** In Chapter 15, I show you a different approach to authorization using *claims*, which are an advanced ASP.NET Identity feature.

Adding Support for Roles

ASP.NET Identity provides a strongly typed base class for accessing and managing roles called `RoleManager<T>`, where `T` is the implementation of the `IRole` interface supported by the storage mechanism used to represent roles. The Entity Framework uses a class called `IdentityRole` to implement the `IRole` interface, which defines the properties shown in Table 14-7.

Table 14-7. *The Properties Defined by the IdentityRole Class*

Name	Description
`Id`	Defines the unique identifier for the role
`Name`	Defines the name of the role
`Users`	Returns a collection of `IdentityUserRole` objects that represents the members of the role

I don't want to leak references to the `IdentityRole` class throughout my application because it ties me to the Entity Framework for storing role data, so I start by creating an application-specific role class that is derived from `IdentityRole`. I added a class file called `AppRole.cs` to the `Models` folder and used it to define the class shown in Listing 14-6.

Listing 14-6 The Contents of the AppRole.cs File

```
using Microsoft.AspNet.Identity.EntityFramework;

namespace Users.Models {
    public class AppRole : IdentityRole {

        public AppRole() : base() {}

        public AppRole(string name) : base(name) { }
    }
}
```

The `RoleManager<T>` class operates on instances of the `IRole` implementation class through the methods and properties shown in Table 14-8.

Table 14-8. *The Members Defined by the RoleManager<T> Class*

Name	Description
`CreateAsync(role)`	Creates a new role
`DeleteAsync(role)`	Deletes the specified role
`FindByIdAsync(id)`	Finds a role by its ID
`FindByNameAsync(name)`	Finds a role by its name
`RoleExistsAsync(name)`	Returns `true` if a role with the specified name exists
`UpdateAsync(role)`	Stores changes to the specified role
`Roles`	Returns an enumeration of the roles that have been defined

These methods follow the same basic pattern of the `UserManager<T>` class that I described in Chapter 13. Following the pattern I used for managing users, I added a class file called `AppRoleManager.cs` to the `Infrastructure` folder and used it to define the class shown in Listing 14-7.

Listing 14-7 The Contents of the AppRoleManager.cs File

```
using System;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {

    public class AppRoleManager : RoleManager<AppRole>, IDisposable {

        public AppRoleManager(RoleStore<AppRole> store)
            : base(store) {
        }

        public static AppRoleManager Create(
                IdentityFactoryOptions<AppRoleManager> options,
                IOwinContext context) {
            return new AppRoleManager(new
                RoleStore<AppRole>(context.Get<AppIdentityDbContext>()));
        }
    }
}
```

This class defines a `Create` method that will allow the OWIN start class to create instances for each request where Identity data is accessed, which means I don't have to disseminate details of how role data is stored throughout the application. I can just obtain and operate on instances of the `AppRoleManager` class. You can see how I have registered the role manager class with the OWIN start class, `IdentityConfig`, in Listing 14-8. This ensures that instances of the `AppRoleManager` class are created using the same Entity Framework database context that is used for the `AppUserManager` class.

Listing 14-8. Creating Instances of the AppRoleManager Class in the IdentityConfig.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.Owin;
using Microsoft.Owin.Security.Cookies;
using Owin;
using Users.Infrastructure;

namespace Users {
    public class IdentityConfig {
        public void Configuration(IAppBuilder app) {

            app.CreatePerOwinContext<AppIdentityDbContext>(AppIdentityDbContext.Create);
            app.CreatePerOwinContext<AppUserManager>(AppUserManager.Create);
            app.CreatePerOwinContext<AppRoleManager>(AppRoleManager.Create);

            app.UseCookieAuthentication(new CookieAuthenticationOptions {
                AuthenticationType = DefaultAuthenticationTypes.ApplicationCookie,
                LoginPath = new PathString("/Account/Login"),
            });
        }
    }
}
```

Creating and Deleting Roles

Having prepared the application for working with roles, I am going to create an administration tool for managing them. I will start the basics and define action methods and views that allow roles to be created and deleted. I added a controller called RoleAdmin to the project, which you can see in Listing 14-9.

Listing 14-9. The Contents of the RoleAdminController.cs File

```
using System.ComponentModel.DataAnnotations;
using System.Linq;
using System.Threading.Tasks;
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;

namespace Users.Controllers {
    public class RoleAdminController : Controller {

        public ActionResult Index() {
            return View(RoleManager.Roles);
        }

        public ActionResult Create() {
            return View();
        }
        [HttpPost]
        public async Task<ActionResult> Create([Required]string name) {
            if (ModelState.IsValid) {
                IdentityResult result
                    = await RoleManager.CreateAsync(new AppRole(name));
                if (result.Succeeded) {
                    return RedirectToAction("Index");
                } else {
                    AddErrorsFromResult(result);
                }
            }
            return View(name);
        }

        [HttpPost]
        public async Task<ActionResult> Delete(string id) {
            AppRole role = await RoleManager.FindByIdAsync(id);
            if (role != null) {
                IdentityResult result = await RoleManager.DeleteAsync(role);
                if (result.Succeeded) {
                    return RedirectToAction("Index");
                } else {
                    return View("Error", result.Errors);
                }
            } else {
                return View("Error", new string[] { "Role Not Found" });
            }
        }

        private void AddErrorsFromResult(IdentityResult result) {
            foreach (string error in result.Errors) {
                ModelState.AddModelError("", error);
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }

        private AppRoleManager RoleManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppRoleManager>();
            }
        }
    }
}
```

I have applied many of the same techniques that I used in the Admin controller in Chapter 13, including a UserManager property that obtains an instance of the AppUserManager class and an AddErrorsFromResult method that processes the errors reported in an IdentityResult object and adds them to the model state.

I have also defined a RoleManager property that obtains an instance of the AppRoleManager class, which I used in the action methods to obtain and manipulate the roles in the application. I am not going to describe the action methods in detail because they follow the same pattern I used in Chapter 13, using the AppRoleManager class in place of AppUserManager and calling the methods I described in Table 14-8.

Creating the Views

The views for the RoleAdmin controller are standard HTML and Razor markup, but I have included them in this chapter so that you can re-create the example. I want to display the names of the users who are members of each role. The Entity Framework IdentityRole class defines a Users property that returns a collection of IdentityUserRole user objects representing the members of the role. Each IdentityUserRole object has a UserId property that returns the unique ID of a user, and I want to get the username for each ID. I added a class file called IdentityHelpers.cs to the Infrastructure folder and used it to define the class shown in Listing 14-10.

Listing 14-10. The Contents of the IdentityHelpers.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;

namespace Users.Infrastructure {
    public static class IdentityHelpers {
        public static MvcHtmlString GetUserName(this HtmlHelper html, string id) {
            AppUserManager mgr
                =  HttpContext.Current.GetOwinContext().GetUserManager<AppUserManager>();
            return new MvcHtmlString(mgr.FindByIdAsync(id).Result.UserName);
        }
    }
}
```

Custom HTML helper methods are defined as extensions on the HtmlHelper class. My helper, which is called GetUsername, takes a string argument containing a user ID, obtains an instance of the AppUserManager through the GetOwinContext.GetUserManager method (where GetOwinContext is an extension method on the HttpContext class), and uses the FindByIdAsync method to locate the AppUser instance associated with the ID and to return the value of the UserName property.

Listing 14-11 shows the contents of the Index.cshtml file from the Views/RoleAdmin folder, which I created by right-clicking the Index action method in the code editor and selecting Add View from the pop-up menu.

Listing 14-11. The Contents of the Index.cshtml File in the Views/RoleAdmin Folder

```
@using Users.Models
@using Users.Infrastructure
@model IEnumerable<AppRole>
@{ ViewBag.Title = "Roles"; }
<div class="panel panel-primary">
    <div class="panel-heading">Roles</div>
    <table class="table table-striped">
        <tr><th>ID</th><th>Name</th><th>Users</th><th></th></tr>
        @if (Model.Count() == 0) {
            <tr><td colspan="4" class="text-center">No Roles</td></tr>
        } else {
            foreach (AppRole role in Model) {
                <tr>
                    <td>@role.Id</td>
                    <td>@role.Name</td>
                    <td>
                        @if (role.Users == null || role.Users.Count == 0) {
                            @: No Users in Role
                        } else {
                            <p>@string.Join(", ", role.Users.Select(x =>
                                Html.GetUserName(x.UserId)))</p>
                        }
                    </td>
                    <td>
                        @using (Html.BeginForm("Delete", "RoleAdmin",
                            new { id = role.Id })) {
                            @Html.ActionLink("Edit", "Edit", new { id = role.Id },
                                    new { @class = "btn btn-primary btn-xs" })
                            <button class="btn btn-danger btn-xs"
                                    type="submit">
                                Delete
                            </button>
                        }
                    </td>
                </tr>
            }
        }
    </table>
</div>
@Html.ActionLink("Create", "Create", null, new { @class = "btn btn-primary" })
```

This view displays a list of the roles defined by the application, along with the users who are members, and I use the `GetUserName` helper method to get the name for each user.

Listing 14-12 shows the `Views/RoleAdmin/Create.cshtml` file, which I created to allow new roles to be created.

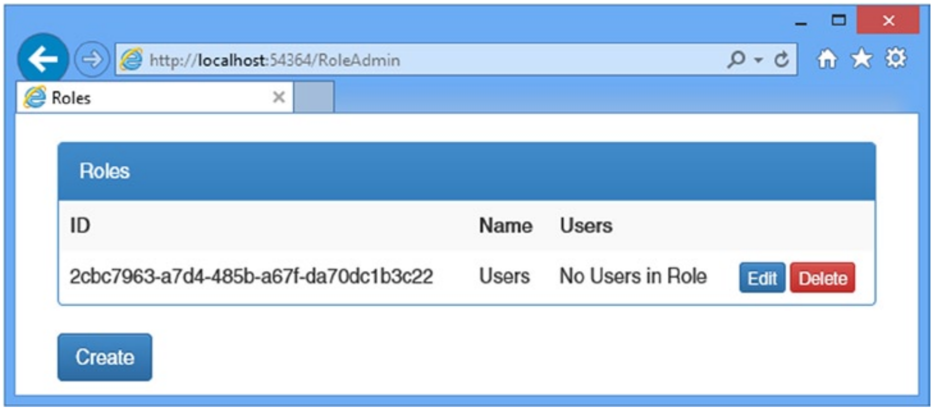
Listing 14-12. The Contents of the Create.cshtml File in the Views/RoleAdmin Folder

```
@model string
@{ ViewBag.Title = "Create Role";}
<h2>Create Role</h2>
@Html.ValidationSummary(false)
@using (Html.BeginForm()) {
    <div class="form-group">
        <label>Name</label>
        <input name="name" value="@Model" class="form-control" />
    </div>
    <button type="submit" class="btn btn-primary">Create</button>
    @Html.ActionLink("Cancel", "Index", null, new { @class = "btn btn-default" })
}
```

The only information required to create a new view is a name, which I gather using a standard `input` element and submit the value to the `Create` action method.

Testing Creating and Deleting Roles

To test the new controller, start the application and navigate to the /RoleAdmin/Index URL. To create a new role, click the Create button, enter a name in the input element, and click the second Create button. The new view will be saved to the database and displayed when the browser is redirected to the Index action, as shown in Figure 14-4. You can remove the role from the application by clicking the Delete button.



Roles

ID	Name	Users	
2cbc7963-a7d4-485b-a67f-da70dc1b3c22	Users	No Users in Role	Edit Delete

Figure 14-4. *Creating a new role*

Managing Role Memberships

To authorize users, it isn't enough to just create and delete roles; I also have to be able to manage role memberships, assigning and removing users from the roles that the application defines. This isn't a complicated process, but it invokes taking the role data from the AppRoleManager class and then calling the methods defined by the AppUserMangager class that associate users with roles.

I started by defining view models that will let me represent the membership of a role and receive a new set of membership instructions from the user. Listing 14-13 shows the additions I made to the UserViewModels.cs file.

Listing 14-13. Adding View Models to the UserViewModels.cs File

```
using System.ComponentModel.DataAnnotations;
using System.Collections.Generic;

namespace Users.Models {

    public class CreateModel {
        [Required]
        public string Name { get; set; }
        [Required]
        public string Email { get; set; }
        [Required]
        public string Password { get; set; }
    }
    public class LoginModel {
        [Required]
        public string Name { get; set; }
        [Required]
        public string Password { get; set; }
    }

    public class RoleEditModel {
        public AppRole Role { get; set; }
        public IEnumerable<AppUser> Members { get; set; }
        public IEnumerable<AppUser> NonMembers { get; set; }
    }

    public class RoleModificationModel {
        [Required]
        public string RoleName { get; set; }
        public string[] IdsToAdd { get; set; }
        public string[] IdsToDelete { get; set; }
    }
}
```

The RoleEditModel class will let me pass details of a role and details of the users in the system, categorized by membership. I use AppUser objects in the view model so that I can extract the name and ID for each user in the view that will allow memberships to be edited. The RoleModificationModel class is the one that I will receive from the model binding system when the user submits their changes. It contains arrays of user IDs rather than AppUser objects, which is what I need to change role memberships.

Having defined the view models, I can add the action methods to the controller that will allow role memberships to be defined. Listing 14-14 shows the changes I made to the RoleAdmin controller.

Listing 14-14. Adding Action Methods in the RoleAdminController.cs File

```
using System.ComponentModel.DataAnnotations;
using System.Linq;
using System.Threading.Tasks;
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;
using System.Collections.Generic;

namespace Users.Controllers {
    public class RoleAdminController : Controller {

        // ...other action methods omitted for brevity...

        public async Task<ActionResult> Edit(string id) {
            AppRole role = await RoleManager.FindByIdAsync(id);
            string[] memberIDs = role.Users.Select(x => x.UserId).ToArray();
            IEnumerable<AppUser> members
                = UserManager.Users.Where(x => memberIDs.Any(y => y == x.Id));
            IEnumerable<AppUser> nonMembers = UserManager.Users.Except(members);
            return View(new RoleEditModel {
                Role = role,
                Members = members,
                NonMembers = nonMembers
            });
        }

        [HttpPost]
        public async Task<ActionResult> Edit(RoleModificationModel model) {
            IdentityResult result;
            if (ModelState.IsValid) {
                foreach (string userId in model.IdsToAdd ?? new string[] { }) {
                    result = await UserManager.AddToRoleAsync(userId, model.RoleName);
                    if (!result.Succeeded) {
                        return View("Error", result.Errors);
                    }
                }
                foreach (string userId in model.IdsToDelete ?? new string[] { }) {
                    result = await UserManager.RemoveFromRoleAsync(userId,
                        model.RoleName);
                    if (!result.Succeeded) {
                        return View("Error", result.Errors);
                    }
                }
                return RedirectToAction("Index");
            }
            return View("Error", new string[] { "Role Not Found" });
        }

        private void AddErrorsFromResult(IdentityResult result) {
            foreach (string error in result.Errors) {
                ModelState.AddModelError("", error);
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }

        private AppRoleManager RoleManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppRoleManager>();
            }
        }
    }
}
```

The majority of the code in the GET version of the Edit action method is responsible for generating the sets of members and nonmembers of the selected role, which is done using LINQ. Once I have grouped the users, I call the View method, passing a new instance of the RoleEditModel class I defined in Listing 14-13.

The POST version of the Edit method is responsible for adding and removing users to and from roles. The AppUserManager class inherits a number of role-related methods from its base class, which I have described in Table 14-9.

Table 14-9. *The Role-Related Methods Defined by the UserManager<T> Class*

Name	Description
AddToRoleAsync(id, name)	Adds the user with the specified ID to the role with the specified name
GetRolesAsync(id)	Returns a list of the names of the roles of which the user with the specified ID is a member
IsInRoleAsync(id, name)	Returns true if the user with the specified ID is a member of the role with the specified name
RemoveFromRoleAsync(id, name)	Removes the user with the specified ID as a member from the role with the specified name

An oddity of these methods is that the role-related methods operate on user IDs and role *names*, even though roles also have unique identifiers. It is for this reason that my RoleModificationModel view model class has a RoleName property.

Listing 14-15 shows the view for the Edit.cshtml file, which I added to the Views/RoleAdmin folder and used to define the markup that allows the user to edit role memberships.

Listing 14-15. The Contents of the Edit.cshtml File in the Views/RoleAdmin Folder

```
@using Users.Models
@model RoleEditModel
@{ ViewBag.Title = "Edit Role";}
@Html.ValidationSummary()
@using (Html.BeginForm()) {
    <input type="hidden" name="roleName" value="@Model.Role.Name" />
    <div class="panel panel-primary">
        <div class="panel-heading">Add To @Model.Role.Name</div>
        <table class="table table-striped">
            @if (Model.NonMembers.Count() == 0) {
                <tr><td colspan="2">All Users Are Members</td></tr>
            } else {
                <tr><td>User ID</td><td>Add To Role</td></tr>
                foreach (AppUser user in Model.NonMembers) {
                    <tr>
                        <td>@user.UserName</td>
                        <td>
                            <input type="checkbox" name="IdsToAdd" value="@user.Id">
                        </td>
                    </tr>
                }
            }
        </table>
    </div>
    <div class="panel panel-primary">
        <div class="panel-heading">Remove from @Model.Role.Name</div>
        <table class="table table-striped">
            @if (Model.Members.Count() == 0) {
                <tr><td colspan="2">No Users Are Members</td></tr>
            } else {
                <tr><td>User ID</td><td>Remove From Role</td></tr>
                foreach (AppUser user in Model.Members) {
                    <tr>
                        <td>@user.UserName</td>
                        <td>
                            <input type="checkbox" name="IdsToDelete" value="@user.Id">
                        </td>
                    </tr>
                }
            }
        </table>
    </div>
    <button type="submit" class="btn btn-primary">Save</button>
    @Html.ActionLink("Cancel", "Index", null, new { @class = "btn btn-default" })
}
```

The view contains two tables: one for users who are not members of the selected role and one for those who are members. Each user's name is displayed along with a check box that allows the membership to be changed.

Testing Editing Role Membership

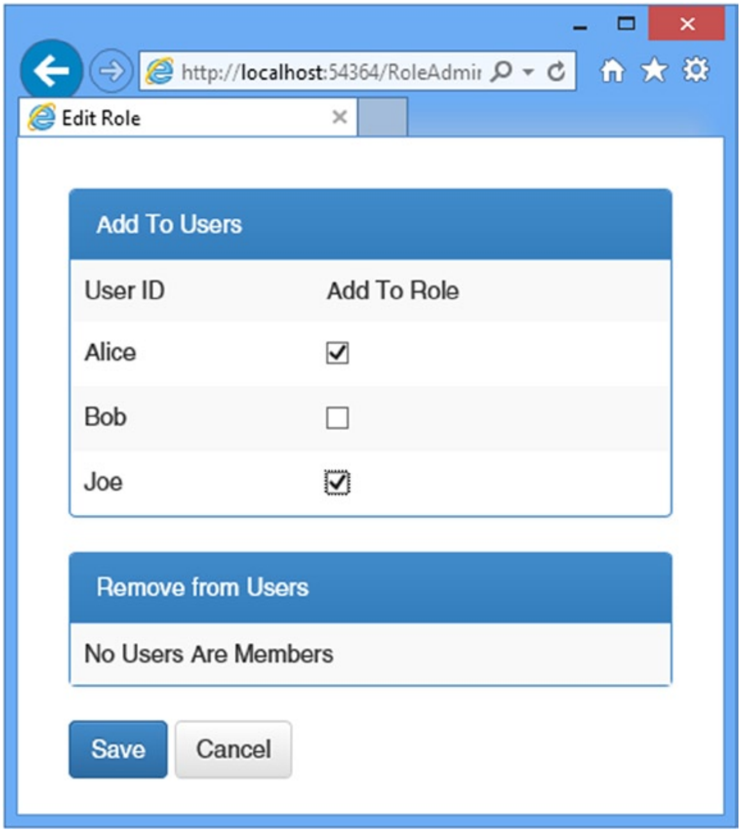
Adding the AppRoleManager class to the application causes the Entity Framework to delete the contents of the database and rebuild the schema, which means that any users you created in the previous chapter have been removed. So that there are users to assign to roles, start the application and navigate to the /Admin/Index URL and create users with the details in Table 14-10.

Table 14-10. *The Values for Creating Example User*

Name	Email	Password
Alice	alice@example.com	MySecret
Bob	bob@example.com	MySecret
Joe	joe@example.com	MySecret

■ **Tip** Deleting the user database is fine for an example application but tends to be a problem in real applications. I show you how to gracefully manage changes to the database schema in Chapter 15.

To test managing role memberships, navigate to the /RoleAdmin/Index URL and create a role called Users, following the instructions from the "Testing, Creating, and Deleting Roles" section. Click the Edit button and check the boxes so that Alice and Joe are members of the role but Bob is not, as shown in Figure 14-5.



Add To Users

User ID	Add To Role
Alice	☑
Bob	☐
Joe	☑

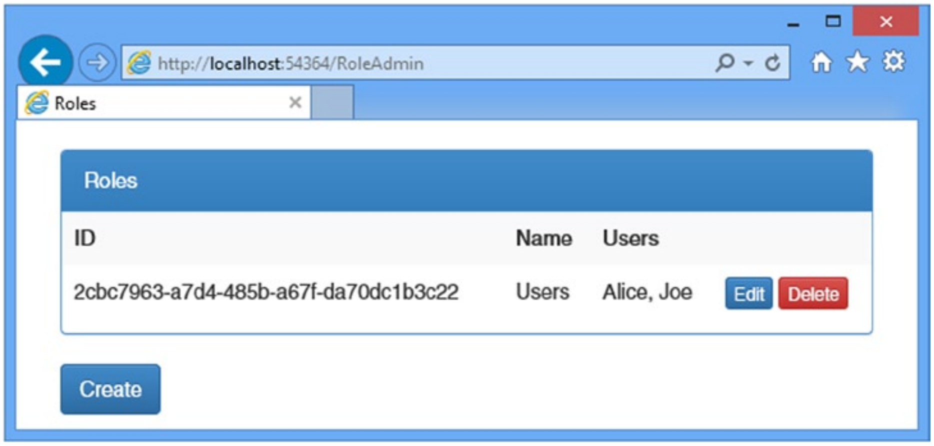
Remove from Users

No Users Are Members

Figure 14-5. *Editing role membership*

■ **Tip** If you get an error that tells you there is already an open a data reader, then you didn't set the `MultipleActiveResultSets` setting to `true` in the connection string in Chapter 13.

Click the Save button, and the controller will update the role memberships and redirect the browser to the `Index` action. The summary of the `Users` role will show that Alice and Joe are now members, as illustrated by Figure 14-6.



ID	Name	Users	
2cbc7963-a7d4-485b-a67f-da70dc1b3c22	Users	Alice, Joe	Edit Delete

Figure 14-6. *The effect of adding users to a role*

Using Roles for Authorization

Now that I have the ability to manage roles, I can use them as the basis for authorization through the `Authorize` attribute. To make it easier to test role-based authorization, I have added a `Logout` method to the `Account` controller, as shown in Listing 14-16, which will make it easier to log out and log in again as a different user to see the effect of role membership.

Listing 14-16. Adding a Logout Method to the AccountController.cs File

```
using System.Threading.Tasks;
using System.Web.Mvc;
using Users.Models;
using Microsoft.Owin.Security;
using System.Security.Claims;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using System.Web;

namespace Users.Controllers {

    [Authorize]
    public class AccountController : Controller {

        [AllowAnonymous]
        public ActionResult Login(string returnUrl) {
            ViewBag.returnUrl = returnUrl;
            return View();
        }

        [HttpPost]
        [AllowAnonymous]
        [ValidateAntiForgeryToken]
        public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
            // ...statements omitted for brevity...
        }

        [Authorize]
        public ActionResult Logout() {
            AuthManager.SignOut();
            return RedirectToAction("Index", "Home");
        }

        private IAuthenticationManager AuthManager {
            get {
                return HttpContext.GetOwinContext().Authentication;
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

I have updated the Home controller to add a new action method and pass some information about the authenticated user to the view, as shown in Listing 14-17.

Listing 14-17. Adding an Action Method and Account Information to the HomeController.cs File

```
using System.Web.Mvc;
using System.Collections.Generic;
using System.Web;
using System.Security.Principal;

namespace Users.Controllers {

    public class HomeController : Controller {

        [Authorize]
        public ActionResult Index() {
            return View(GetData("Index"));
        }

        [Authorize(Roles="Users")]
        public ActionResult OtherAction() {
            return View("Index", GetData("OtherAction"));
        }

        private Dictionary<string, object> GetData(string actionName) {
            Dictionary<string, object> dict
                = new Dictionary<string, object>();
            dict.Add("Action", actionName);
            dict.Add("User", HttpContext.User.Identity.Name);
            dict.Add("Authenticated", HttpContext.User.Identity.IsAuthenticated);
            dict.Add("Auth Type", HttpContext.User.Identity.AuthenticationType);
            dict.Add("In Users Role", HttpContext.User.IsInRole("Users"));
            return dict;
        }
    }
}
```

I have left the Authorize attribute unchanged for the Index action method, but I have set the Roles property when applying the attribute to the OtherAction method, specifying that only members of the Users role should be able to access it. I also defined a GetData method, which adds some basic information about the user identity, using the properties available through the HttpContext object. The final change I made was to the Index.cshtml file in the Views/Home folder, which is used by both actions in the Home controller, to add a link that targets the Logout method in the Account controller, as shown in Listing 14-18.

Listing 14-18. Adding a Sign-Out Link to the Index.cshtml File in the Views/Home Folder

```
@{ ViewBag.Title = "Index"; }

<div class="panel panel-primary">
    <div class="panel-heading">User Details</div>
    <table class="table table-striped">
        @foreach (string key in Model.Keys) {
            <tr>
                <th>@key</th>
                <td>@Model[key]</td>
            </tr>
        }
    </table>
</div>

@Html.ActionLink("Sign Out", "Logout", "Account", null, new {@class = "btn btn-primary"})
```

■ **Tip** The Authorize attribute can also be used to authorize access based on a list of individual usernames. This is an appealing feature for small projects, but it means you have to change the code in your controllers each time the set of users you are authorizing changes, and that usually means having to go through the test-and-deploy cycle again. Using roles for authorization isolates the application from changes in individual user accounts and allows you to control access to the application through the memberships stored by ASP.NET Identity.

To test the authentication, start the application and navigate to the /Home/Index URL. Your browser will be redirected so that you can enter user credentials. It doesn't matter which of the user details from Table 14-10 you choose to authenticate with because the Authorize attribute applied to the Index action allows access to any authenticated user.

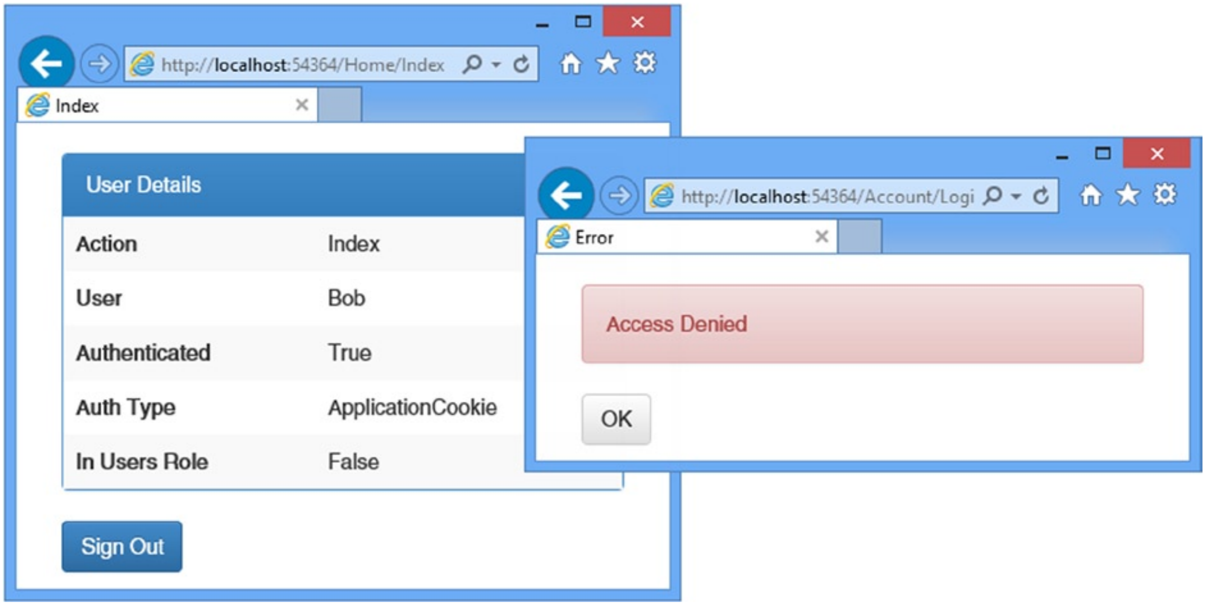
However, if you now request the /Home/OtherAction URL, the user details you chose from Table 14-10 will make a difference because only Alice and Joe are members of the Users role, which is required to access the OtherAction method. If you log in as Bob, then your browser will be redirected so that you can be prompted for credentials once again.

Redirecting an already authenticated user for more credentials is rarely a useful thing to do, so I have modified the Login action method in the Account controller to check to see whether the user is authenticated and, if so, redirect them to the shared Error view. Listing 14-19 shows the changes.

Listing 14-19. Detecting Already Authenticated Users in the AccountController.cs File

```
using System.Threading.Tasks;
using System.Web.Mvc;
using Users.Models;
using Microsoft.Owin.Security;
using System.Security.Claims;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using System.Web;

namespace Users.Controllers {

    [Authorize]
    public class AccountController : Controller {

        [AllowAnonymous]
        public ActionResult Login(string returnUrl) {
            if (HttpContext.User.Identity.IsAuthenticated) {
                return View("Error", new string[] { "Access Denied" });
            }
            ViewBag.returnUrl = returnUrl;
            return View();
        }

        [HttpPost]
        [AllowAnonymous]
        [ValidateAntiForgeryToken]
        public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
            // ...code omitted for brevity...
        }

        [Authorize]
        public ActionResult Logout() {
            AuthManager.SignOut();
            return RedirectToAction("Index", "Home");
        }

        private IAuthenticationManager AuthManager {
            get {
                return HttpContext.GetOwinContext().Authentication;
            }
        }
        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

Figure 14-7 shows the responses generated for the user Bob when requesting the `/Home/Index` and `/Home/OtherAction` URLs.


http://localhost:54364/Home/Index
Index
http://localhost:54364/Account/Logi
Error
Sign Out
OK

User Details

Action	Index
User	Bob
Authenticated	True
Auth Type	ApplicationCookie
In Users Role	False

Access Denied

Figure 14-7. Using roles to control access to action methods

■ **Tip** Roles are loaded when the user logs in, which means if you change the roles for the user you are currently authenticated as, the changes won't take effect until you log out and authenticate.

Seeding the Database

One lingering problem in my example project is that access to my `Admin` and `RoleAdmin` controllers is not restricted. This is a classic chicken-and-egg problem because in order to restrict access, I need to create users and roles, but the `Admin` and `RoleAdmin` controllers are the user management tools, and if I protect them with the `Authorize` attribute, there won't be any credentials that will grant me access to them, especially when I first deploy the application.

The solution to this problem is to seed the database with some initial data when the Entity Framework Code First feature creates the schema. This allows me to automatically create users and assign them to roles so that there is a base level of content available in the database.

The database is seeded by adding statements to the `PerformInitialSetup` method of the `IdentityDbInit` class, which is the application-specific Entity Framework database setup class. Listing 14-20 shows the changes I made to create an administration user.

Listing 14-20. Seeding the Database in the AppIdentityDbContext.cs File

```
using System.Data.Entity;
using Microsoft.AspNet.Identity.EntityFramework;
using Users.Models;
using Microsoft.AspNet.Identity;

namespace Users.Infrastructure {
    public class AppIdentityDbContext : IdentityDbContext<AppUser> {

        public AppIdentityDbContext() : base("IdentityDb") { }

        static AppIdentityDbContext() {
            Database.SetInitializer<AppIdentityDbContext>(new IdentityDbInit());
        }

        public static AppIdentityDbContext Create() {
            return new AppIdentityDbContext();
        }
    }

    public class IdentityDbInit
            : DropCreateDatabaseIfModelChanges<AppIdentityDbContext> {
        protected override void Seed(AppIdentityDbContext context) {
            PerformInitialSetup(context);
            base.Seed(context);
        }

        public void PerformInitialSetup(AppIdentityDbContext context) {
            AppUserManager userMgr = new AppUserManager(new UserStore<AppUser>(context));
            AppRoleManager roleMgr = new AppRoleManager(new RoleStore<AppRole>(context));

            string roleName = "Administrators";
            string userName = "Admin";
            string password = "MySecret";
            string email = "admin@example.com";

            if (!roleMgr.RoleExists(roleName)) {
                roleMgr.Create(new AppRole(roleName));
            }

            AppUser user = userMgr.FindByName(userName);
            if (user == null) {
                userMgr.Create(new AppUser { UserName = userName, Email = email },
                    password);
                user = userMgr.FindByName(userName);
            }
            if (!userMgr.IsInRole(user.Id, roleName)) {
                userMgr.AddToRole(user.Id, roleName);
            }
        }
    }
}
```

■ **Tip** For this example, I used the synchronous extension methods to locate and manage the role and user. As I explained in Chapter 13, I prefer the asynchronous methods by default, but the synchronous methods can be useful when you need to perform a sequence of related operations.

I have to create instances of AppUserManager and AppRoleManager directly because the PerformInitialSetup method is called before the OWIN configuration is complete. I use the RoleManager and AppManager objects to create a role called Administrators and a user called Admin and add the user to the role.

■ **Tip** Read Chapter 15 before you add database seeding to your project. I describe database migrations, which allow you to take control of schema changes in the database and which put the seeding logic in a different place.

With this change, I can use the Authorize attribute to protect the Admin and RoleAdmin controllers. Listing 14-21 shows the change I made to the Admin controller.

Listing 14-21. Restricting Access in the AdminController.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;
using Microsoft.AspNet.Identity;
using System.Threading.Tasks;

namespace Users.Controllers {

    [Authorize(Roles = "Administrators")]
    public class AdminController : Controller {
        // ...statements omitted for brevity...
    }
}
```

Listing 14-22 shows the corresponding change I made to the RoleAdmin controller.

Listing 14-22. Restricting Access in the RoleAdminController.cs File

```
using System.ComponentModel.DataAnnotations;
using System.Linq;
using System.Threading.Tasks;
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using Users.Models;
using System.Collections.Generic;

namespace Users.Controllers {

    [Authorize(Roles = "Administrators")]
    public class RoleAdminController : Controller {
        // ...statements omitted for brevity...
    }
}
```

The database is seeded only when the schema is created, which means I need to reset the database to complete the process. This isn't something you would do in a real application, of course, but I wanted to wait until I demonstrated how authentication and authorization worked before creating the administrator account.

To delete the database, open the Visual Studio SQL Server Object Explorer window and locate and right-click the `IdentityDb` item. Select Delete from the pop-up menu and check both of the options in the Delete Database dialog window. Click the OK button to delete the database.

Now create an empty database to which the schema will be added by right-clicking the Databases item, selecting Add New Database, and entering **IdentityDb** in the Database Name field. Click OK to create the empty database.

■ **Tip** There are step-by-step instructions with screenshots in Chapter 13 for creating the database.

Now start the application and request the `/Admin/Index` or `/RoleAdmin/Index` URL. There will be a delay while the schema is created and the database is seeded, and then you will be prompted to enter your credentials. Use `Admin` as the name and `MySecret` as the password, and you will be granted access to the controllers.

■ **Caution** Deleting the database removes the user accounts you created using the details in Table 14-10, which is why you would not perform this task on a live database containing user details.

Summary

In this chapter, I showed you how to use ASP.NET Identity to authenticate and authorize users. I explained how the ASP.NET life-cycle events provide a foundation for authenticating requests, how to collect and validate credentials users, and how to restrict access to action methods based on the roles that a user is a member of. In the next chapter, I demonstrate some of the advanced features that ASP.NET Identity provides.

CHAPTER 15

Advanced ASP.NET Identity

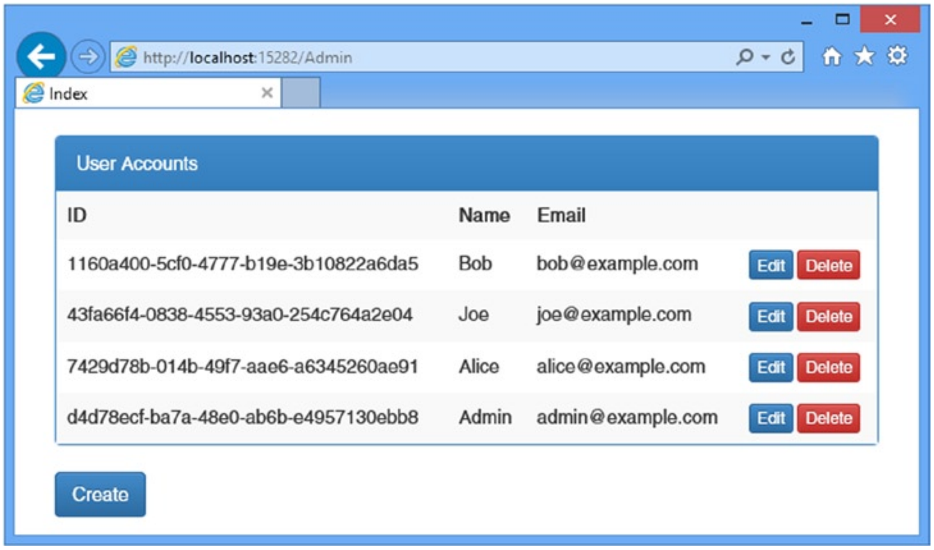
In this chapter, I finish my description of ASP.NET Identity by showing you some of the advanced features it offers. I demonstrate how you can extend the database schema by defining custom properties on the user class and how to use database migrations to apply those properties without deleting the data in the ASP.NET Identity database. I also explain how ASP.NET Identity supports the concept of claims and demonstrate how they can be used to flexibly authorize access to action methods. I finish the chapter—and the book—by showing you how ASP.NET Identity makes it easy to authenticate users through third parties. I demonstrate authentication with Google accounts, but ASP.NET Identity has built-in support for Microsoft, Facebook, and Twitter accounts as well. Table 15-1 summarizes this chapter.

Table 15-1. *Chapter Summary*

Problem	Solution	Listing
Store additional information about users.	Define custom user properties.	1–3, 8–11
Update the database schema without deleting user data.	Perform a database migration.	4–7
Perform fine-grained authorization.	Use claims.	12–14
Add claims about a user.	Use the `ClaimsIdentity.AddClaims` method.	15–19
Authorize access based on claim values.	Create a custom authorization filter attribute.	20–21
Authenticate through a third party.	Install the NuGet package for the authentication provider, redirect requests to that provider, and specify a callback URL that creates the user account.	22–25

Preparing the Example Project

In this chapter, I am going to continue working on the Users project I created in Chapter 13 and enhanced in Chapter 14. No changes to the application are required, but start the application and make sure that there are users in the database. Figure 15-1 shows the state of my database, which contains the users Admin, Alice, Bob, and Joe from the previous chapter. To check the users, start the application and request the `/Admin/Index` URL and authenticate as the Admin user.



User Accounts

ID	Name	Email	
1160a400-5cf0-4777-b19e-3b10822a6da5	Bob	bob@example.com	Edit Delete
43fa66f4-0838-4553-93a0-254c764a2e04	Joe	joe@example.com	Edit Delete
7429d78b-014b-49f7-aae6-a6345260ae91	Alice	alice@example.com	Edit Delete
d4d78ecf-ba7a-48e0-ab6b-e4957130ebb8	Admin	admin@example.com	Edit Delete

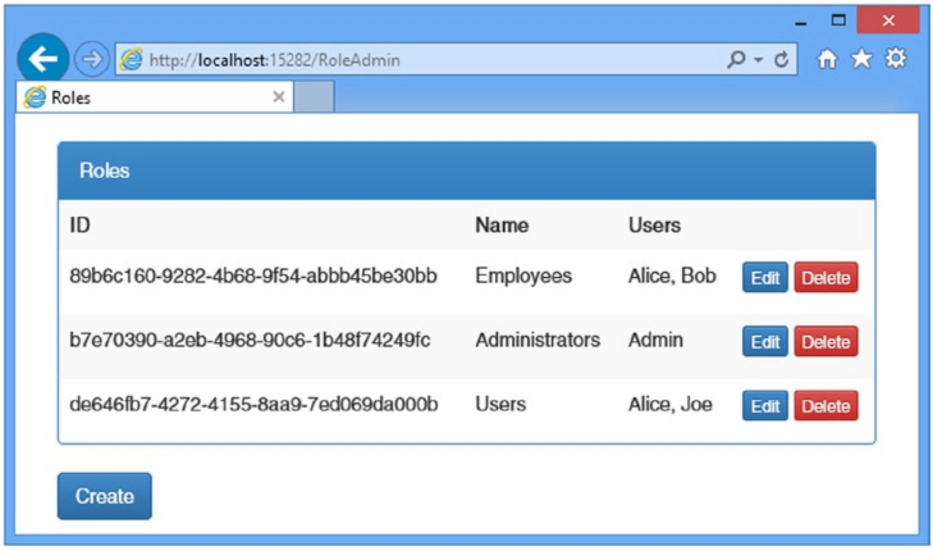
Figure 15-1. *The initial users in the Identity database*

I also need some roles for this chapter. I used the `RoleAdmin` controller to create roles called `Users` and `Employees` and assigned the users to those roles, as described in Table 15-2.

Table 15-2. *The Types of Web Forms Code Nuggets*

Role	Members
`Users`	`Alice`, `Joe`
`Employees`	`Alice`, `Bob`

Figure 15-2 shows the required role configuration displayed by the `RoleAdmin` controller.



Roles

ID	Name	Users	
89b6c160-9282-4b68-9f54-abbb45be30bb	Employees	Alice, Bob	Edit Delete
b7e70390-a2eb-4968-90c6-1b48f74249fc	Administrators	Admin	Edit Delete
de646fb7-4272-4155-8aa9-7ed069da000b	Users	Alice, Joe	Edit Delete

Figure 15-2. *Configuring the roles required for this chapter*

Adding Custom User Properties

When I created the `AppUser` class to represent users in Chapter 13, I noted that the base class defined a basic set of properties to describe the user, such as e-mail address and telephone number. Most applications need to store more information about users, including persistent application preferences and details such as addresses—in short, any data that is useful to running the application and that should last between sessions. In ASP.NET Membership, this was handled through the user profile system, but ASP.NET Identity takes a different approach.

Because the ASP.NET Identity system uses Entity Framework to store its data by default, defining additional user information is just a matter of adding properties to the user class and letting the Code First feature create the database schema required to store them. Table 15-3 puts custom user properties in context.

Table 15-3. *Putting Cusotm User Properties in Context*

Question	Answer
What is it?	Custom user properties allow you to store additional information about your users, including their preferences and settings.
Why should I care?	A persistent store of settings means that the user doesn't have to provide the same information each time they log in to the application.
How is it used by the MVC framework?	This feature isn't used directly by the MVC framework, but it is available for use in action methods.

Defining Custom Properties

Listing 15-1 shows how I added a simple property to the AppUser class to represent the city in which the user lives.

Listing 15-1. Adding a Property in the AppUser.cs File

```
using System;
using Microsoft.AspNet.Identity.EntityFramework;

namespace Users.Models {
    public enum Cities {
        LONDON, PARIS, CHICAGO
    }

    public class AppUser : IdentityUser {
        public Cities City { get; set; }
    }
}
```

I have defined an enumeration called Cities that defines values for some large cities and added a property called City to the AppUser class. To allow the user to view and edit their City property, I added actions to the Home controller, as shown in Listing 15-2.

Listing 15-2. Adding Support for Custom User Properties in the HomeController.cs File

```
using System.Web.Mvc;
using System.Collections.Generic;
using System.Web;
using System.Security.Principal;
using System.Threading.Tasks;
using Users.Infrastructure;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Models;

namespace Users.Controllers {

    public class HomeController : Controller {

        [Authorize]
        public ActionResult Index() {
            return View(GetData("Index"));
        }

        [Authorize(Roles = "Users")]
        public ActionResult OtherAction() {
            return View("Index", GetData("OtherAction"));
        }
        private Dictionary<string, object> GetData(string actionName) {
            Dictionary<string, object> dict
                = new Dictionary<string, object>();
            dict.Add("Action", actionName);
            dict.Add("User", HttpContext.User.Identity.Name);
            dict.Add("Authenticated", HttpContext.User.Identity.IsAuthenticated);
            dict.Add("Auth Type", HttpContext.User.Identity.AuthenticationType);
            dict.Add("In Users Role", HttpContext.User.IsInRole("Users"));
            return dict;
        }

        [Authorize]
        public ActionResult UserProps() {
            return View(CurrentUser);
        }

        [Authorize]
        [HttpPost]
        public async Task<ActionResult> UserProps(Cities city) {
            AppUser user = CurrentUser;
            user.City = city;
            await UserManager.UpdateAsync(user);
            return View(user);
        }

        private AppUser CurrentUser {
            get {
                return UserManager.FindByName(HttpContext.User.Identity.Name);
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

I added a `CurrentUser` property that uses the `AppUserManager` class to retrieve an `AppUser` instance to represent the current user. I pass the `AppUser` object as the view model object in the GET version of the `UserProps` action method, and the POST method uses it to update the value of the new `City` property. Listing 15-3 shows the `UserProps.cshtml` view, which displays the `City` property value and contains a form to change it.

Listing 15-3. The Contents of the UserProps.cshtml File in the Views/Home Folder

```
@using Users.Models
@model AppUser
@{ ViewBag.Title = "UserProps";}
```

```
<div class="panel panel-primary">
    <div class="panel-heading">
        Custom User Properties
    </div>
    <table class="table table-striped">
        <tr><th>City</th><td>@Model.City</td></tr>
    </table>
</div>

@using (Html.BeginForm()) {
    <div class="form-group">
        <label>City</label>
        @Html.DropDownListFor(x => x.City, new SelectList(Enum.GetNames(typeof(Cities))))
    </div>
    <button class="btn btn-primary" type="submit">Save</button>
}
```

■ **Caution** Don't start the application when you have created the view. In the sections that follow, I demonstrate how to preserve the contents of the database, and if you start the application now, the ASP.NET Identity users will be deleted.

Preparing for Database Migration

The default behavior for the Entity Framework Code First feature is to drop the tables in the database and re-create them whenever classes that drive the schema have changed. You saw this in Chapter 14 when I added support for roles: When the application was started, the database was reset, and the user accounts were lost.

Don't start the application yet, but if you were to do so, you would see a similar effect. Deleting data during development is usually not a problem, but doing so in a production setting is usually disastrous because it deletes all of the real user accounts and causes a panic while the backups are restored. In this section, I am going to demonstrate how to use the database migration feature, which updates a Code First schema in a less brutal manner and preserves the existing data it contains.

The first step is to issue the following command in the Visual Studio Package Manager Console:

```
Enable-Migrations -EnableAutomaticMigrations
```

This enables the database migration support and creates a `Migrations` folder in the Solution Explorer that contains a `Configuration.cs` class file, the contents of which are shown in Listing 15-4.

Listing 15-4. The Contents of the Configuration.cs File

```
namespace Users.Migrations {
    using System;
    using System.Data.Entity;
    using System.Data.Entity.Migrations;
    using System.Linq;
    internal sealed class Configuration
            : DbMigrationsConfiguration<Users.Infrastructure.AppIdentityDbContext> {
        public Configuration() {
            AutomaticMigrationsEnabled = true;
            ContextKey = "Users.Infrastructure.AppIdentityDbContext";
        }

        protected override void Seed(Users.Infrastructure.AppIdentityDbContext context) {
            //  This method will be called after migrating to the latest version.

            //  You can use the DbSet<T>.AddOrUpdate() helper extension method
            //  to avoid creating duplicate seed data. E.g.
            //
            //    context.People.AddOrUpdate(
            //      p => p.FullName,
            //      new Person { FullName = "Andrew Peters" },
            //      new Person { FullName = "Brice Lambson" },
            //      new Person { FullName = "Rowan Miller" }
            //    );
            //
        }
    }
}
```

■ **Tip** You might be wondering why you are entering a database migration command into the console used to manage NuGet packages. The answer is that the Package Manager Console is really *PowerShell*, which is a general-purpose tool that is mislabeled by Visual Studio. You can use the console to issue a wide range of helpful commands. See `http://go.microsoft.com/fwlink/?LinkID=108518` for details.

The class will be used to migrate existing content in the database to the new schema, and the Seed method will be called to provide an opportunity to update the existing database records. In Listing 15-5, you can see how I have used the Seed method to set a default value for the new `City` property I added to the `AppUser` class. (I have also updated the class file to reflect my usual coding style.)

Listing 15-5. Managing Existing Content in the Configuration.cs File

```
using System.Data.Entity.Migrations;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Users.Infrastructure;
using Users.Models;

namespace Users.Migrations {

    internal sealed class Configuration
            : DbMigrationsConfiguration<AppIdentityDbContext> {
```

```
        public Configuration() {
            AutomaticMigrationsEnabled = true;
            ContextKey = "Users.Infrastructure.AppIdentityDbContext";
        }

        protected override void Seed(AppIdentityDbContext context) {

            AppUserManager userMgr = new AppUserManager(new UserStore<AppUser>(context));
            AppRoleManager roleMgr = new AppRoleManager(new RoleStore<AppRole>(context));

            string roleName = "Administrators";
            string userName = "Admin";
            string password = "MySecret";
            string email = "admin@example.com";

            if (!roleMgr.RoleExists(roleName)) {
                roleMgr.Create(new AppRole(roleName));
            }

            AppUser user = userMgr.FindByName(userName);
            if (user == null) {
                userMgr.Create(new AppUser { UserName = userName, Email = email },
                    password);
                user = userMgr.FindByName(userName);
            }

            if (!userMgr.IsInRole(user.Id, roleName)) {
                userMgr.AddToRole(user.Id, roleName);
            }

            foreach (AppUser dbUser in userMgr.Users) {
                dbUser.City = Cities.PARIS;
            }
            context.SaveChanges();
        }
    }
}
```

You will notice that much of the code that I added to the Seed method is taken from the IdentityDbInit class, which I used to seed the database with an administration user in Chapter 14. This is because the new Configuration class added to support database migrations will replace the seeding function of the IdentityDbInit class, which I'll update shortly. Aside from ensuring that there is an admin user, the statements in the Seed method that are important are the ones that set the initial value for the City property I added to the AppUser class, as follows:

```
...
foreach (AppUser dbUser in userMgr.Users) {
    dbUser.City = Cities.PARIS;
}
context.SaveChanges();
...
```

You don't have to set a default value for new properties—I just wanted to demonstrate that the Seed method in the `Configuration` class can be used to update the existing user records in the database.

■ **Caution** Be careful when setting values for properties in the `Seed` method for real projects because the values will be applied every time you change the schema, overriding any values that the user has set since the last schema update was performed. I set the value of the `City` property just to demonstrate that it can be done.

Changing the Database Context Class

The reason that I added the seeding code to the `Configuration` class is that I need to change the `IdentityDbInit` class. At present, the `IdentityDbInit` class is derived from the descriptively named `DropCreateDatabaseIfModelChanges<AppIdentityDbContext>` class, which, as you might imagine, drops the entire database when the Code First classes change. Listing 15-6 shows the changes I made to the `IdentityDbInit` class to prevent it from affecting the database.

Listing 15-6. Preventing Database Schema Changes in the AppIdentityDbContext.cs File

```
using System.Data.Entity;
using Microsoft.AspNet.Identity.EntityFramework;
using Users.Models;
using Microsoft.AspNet.Identity;

namespace Users.Infrastructure {
    public class AppIdentityDbContext : IdentityDbContext<AppUser> {

        public AppIdentityDbContext() : base("IdentityDb") { }

        static AppIdentityDbContext() {
            Database.SetInitializer<AppIdentityDbContext>(new IdentityDbInit());
        }

        public static AppIdentityDbContext Create() {
            return new AppIdentityDbContext();
        }
    }

    public class IdentityDbInit : NullDatabaseInitializer<AppIdentityDbContext> {
    }
}
```

I have removed the methods defined by the class and changed its base to `NullDatabaseInitializer<AppIdentityDbContext>`, which prevents the schema from being altered.

Performing the Migration

All that remains is to generate and apply the migration. First, run the following command in the Package Manager Console:

```
Add-Migration CityProperty
```

This creates a new migration called `CityProperty` (I like my migration names to reflect the changes I made). A class new file will be added to the `Migrations` folder, and its name reflects the time at which the command was run and the name of the migration. My file is called `201402262244036_CityProperty.cs`, for example. The contents of this file contain the details of how Entity Framework will change the database during the migration, as shown in Listing 15-7.

Listing 15-7. The Contents of the 201402262244036_ CityProperty.cs File

```
namespace Users.Migrations {
    using System;
    using System.Data.Entity.Migrations;

    public partial class Init : DbMigration {
        public override void Up() {
            AddColumn("dbo.AspNetUsers", "City", c => c.Int(nullable: false));
        }

        public override void Down() {
            DropColumn("dbo.AspNetUsers", "City");
        }
    }
}
```

The `Up` method describes the changes that have to be made to the schema when the database is upgraded, which in this case means adding a `City` column to the `AspNetUsers` table, which is the one that is used to store user records in the ASP.NET Identity database.

The final step is to perform the migration. Without starting the application, run the following command in the Package Manager Console:

```
Update-Database -TargetMigration CityProperty
```

The database schema will be modified, and the code in the `Configuration.Seed` method will be executed. The existing user accounts will have been preserved and enhanced with a `City` property (which I set to `Paris` in the `Seed` method).

Testing the Migration

To test the effect of the migration, start the application, navigate to the `/Home/UserProps` URL, and authenticate as one of the Identity users (for example, as Alice with the password `MySecret`). Once authenticated, you will see the current value of the `City` property for the user and have the opportunity to change it, as shown in Figure 15-3.

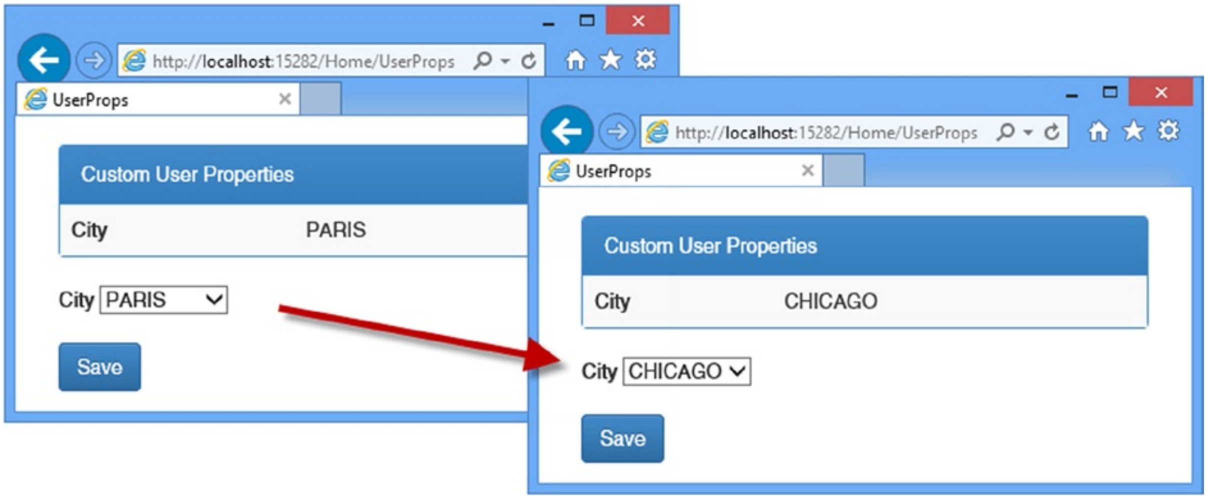


Figure 15-3. *Displaying and changing a custom user property*

Defining an Additional Property

Now that database migrations are set up, I am going to define a further property just to demonstrate how subsequent changes are handled and to show a more useful (and less dangerous) example of using the `Configuration.Seed` method. Listing 15-8 shows how I added a `Country` property to the `AppUser` class.

Listing 15-8. Adding Another Property in the AppUserModels.cs File

```
using System;
using Microsoft.AspNet.Identity.EntityFramework;

namespace Users.Models {

    public enum Cities {
        LONDON, PARIS, CHICAGO
    }

    public enum Countries {
        NONE, UK, FRANCE, USA
    }

    public class AppUser : IdentityUser {
        public Cities City { get; set; }
        public Countries Country { get; set; }

        public void SetCountryFromCity(Cities city) {
            switch (city) {
                case Cities.LONDON:
                    Country = Countries.UK;
                    break;
                case Cities.PARIS:
                    Country = Countries.FRANCE;
                    break;
                case Cities.CHICAGO:
                    Country = Countries.USA;
                    break;
                default:
                    Country = Countries.NONE;
                    break;
            }
        }
    }
}
```

I have added an enumeration to define the country names and a helper method that selects a country value based on the City property. Listing 15-9 shows the change I made to the Configuration class so that the Seed method sets the Country property based on the City, but only if the value of Country is NONE (which it will be for all users when the database is migrated because the Entity Framework sets enumeration columns to the first value).

Listing 15-9. Modifying the Database Seed in the Configuration.cs File

```
using System.Data.Entity.Migrations;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Users.Infrastructure;
using Users.Models;

namespace Users.Migrations {

    internal sealed class Configuration
            : DbMigrationsConfiguration<AppIdentityDbContext> {

        public Configuration() {
            AutomaticMigrationsEnabled = true;
            ContextKey = "Users.Infrastructure.AppIdentityDbContext";
        }

        protected override void Seed(AppIdentityDbContext context) {

            AppUserManager userMgr = new AppUserManager(new UserStore<AppUser>(context));
            AppRoleManager roleMgr = new AppRoleManager(new RoleStore<AppRole>(context));

            string roleName = "Administrators";
            string userName = "Admin";
            string password = "MySecret";
            string email = "admin@example.com";

            if (!roleMgr.RoleExists(roleName)) {
                roleMgr.Create(new AppRole(roleName));
            }
            AppUser user = userMgr.FindByName(userName);
            if (user == null) {
                userMgr.Create(new AppUser { UserName = userName, Email = email },
                    password);
                user = userMgr.FindByName(userName);
            }

            if (!userMgr.IsInRole(user.Id, roleName)) {
                userMgr.AddToRole(user.Id, roleName);
            }

            foreach (AppUser dbUser in userMgr.Users) {
                if (dbUser.Country == Countries.NONE) {
                    dbUser.SetCountryFromCity(dbUser.City);
                }
            }

            context.SaveChanges();
        }
    }
}
```

This kind of seeding is more useful in a real project because it will set a value for the Country property only if one has not already been set—subsequent migrations won't be affected, and user selections won't be lost.

Adding Application Support

There is no point defining additional user properties if they are not available in the application, so Listing 15-10 shows the change I made to the Views/Home/UserProps.cshtml file to display the value of the Country property.

Listing 15-10. Displaying an Additional Property in the UserProps.cshtml File

```
@using Users.Models
@model AppUser
@{ ViewBag.Title = "UserProps";}

<div class="panel panel-primary">
    <div class="panel-heading">
        Custom User Properties
    </div>
    <table class="table table-striped">
        <tr><th>City</th><td>@Model.City</td></tr>
        <tr><th>Country</th><td>@Model.Country</td></tr>
    </table>
</div>

@using (Html.BeginForm()) {
    <div class="form-group">
        <label>City</label>
        @Html.DropDownListFor(x => x.City, new SelectList(Enum.GetNames(typeof(Cities))))
    </div>
    <button class="btn btn-primary" type="submit">Save</button>
}
```

Listing 15-11 shows the corresponding change I made to the Home controller to update the Country property when the City value changes.

Listing 15-11. Setting Custom Properties in the HomeController.cs File

```
using System.Web.Mvc;
using System.Collections.Generic;
using System.Web;
using System.Security.Principal;
using System.Threading.Tasks;
using Users.Infrastructure;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;

using Users.Models;

namespace Users.Controllers {

    public class HomeController : Controller {

        // ...other action methods omitted for brevity...

        [Authorize]
        public ActionResult UserProps() {
            return View(CurrentUser);
        }

        [Authorize]
        [HttpPost]
        public async Task<ActionResult> UserProps(Cities city) {
            AppUser user = CurrentUser;
            user.City = city;
            user.SetCountryFromCity(city);
            await UserManager.UpdateAsync(user);
            return View(user);
        }

        // ...properties omitted for brevity...
    }
}
```

Performing the Migration

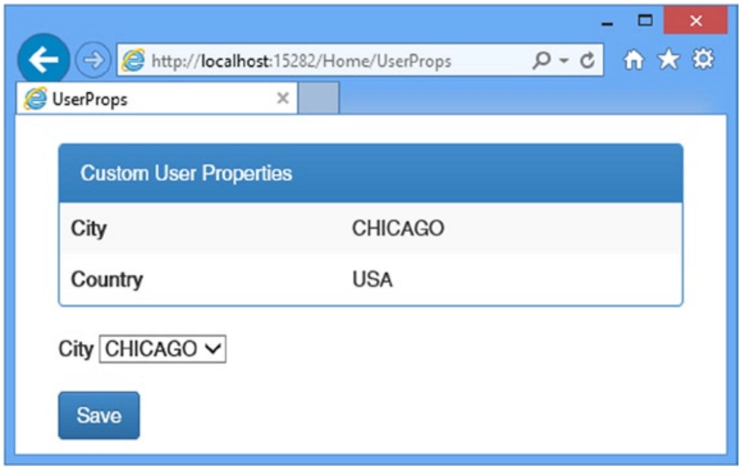
All that remains is to create and apply a new migration. Enter the following command into the Package Manager Console:

```
Add-Migration CountryProperty
```

This will generate another file in the `Migrations` folder that contains the instruction to add the `Country` column. To apply the migration, execute the following command:

```
Update-Database -TargetMigration CountryProperty
```

The migration will be performed, and the value of the `Country` property will be set based on the value of the existing `City` property for each user. You can check the new user property by starting the application and authenticating and navigating to the `/Home/UserProps` URL, as shown in Figure 15-4.



Custom User Properties

City	CHICAGO
Country	USA

Figure 15-4. *Creating an additional user property*

■ **Tip** Although I am focused on the process of upgrading the database, you can also migrate back to a previous version by specifying an earlier migration. Use the `-Force` argument make changes that cause data loss, such as removing a column.

Working with Claims

In older user-management systems, such as ASP.NET Membership, the application was assumed to be the authoritative source of all information about the user, essentially treating the application as a closed world and trusting the data that is contained within it.

This is such an ingrained approach to software development that it can be hard to recognize that's what is happening, but you saw an example of the closed-world technique in Chapter 14 when I authenticated users against the credentials stored in the database and granted access based on the roles associated with those credentials. I did the same thing again in this chapter when I added properties to the user class. Every piece of information that I needed to manage user authentication and authorization came from within my application—and that is a perfectly satisfactory approach for many web applications, which is why I demonstrated these techniques in such depth.

ASP.NET Identity also supports an alternative approach for dealing with users, which works well when the MVC framework application isn't the sole source of information about users and which can be used to authorize users in more flexible and fluid ways than traditional roles allow.

This alternative approach uses *claims*, and in this section I'll describe how ASP.NET Identity supports *claims-based authorization*. Table 15-4 puts claims in context.

Table 15-4. *Putting Claims in Context*

Question	Answer
What is it?	Claims are pieces of information about users that you can use to make authorization decisions. Claims can be obtained from external systems as well as from the local Identity database.
Why should I care?	Claims can be used to flexibly authorize access to action methods. Unlike conventional roles, claims allow access to be driven by the information that describes the user.
How is it used by the MVC framework?	This feature isn't used directly by the MVC framework, but it is integrated into the standard authorization features, such as the `Authorize` attribute.

■ **Tip** You don't have to use claims in your applications, and as Chapter 14 showed, ASP.NET Identity is perfectly happy providing an application with the authentication and authorization services without any need to understand claims at all.

Understanding Claims

A *claim* is a piece of information about the user, along with some information about where the information came from. The easiest way to unpack claims is through some practical demonstrations, without which any discussion becomes too abstract to be truly useful. To get started, I added a `Claims` controller to the example project, the definition of which you can see in Listing 15-12.

Listing 15-12. The Contents of the ClaimsController.cs File

```
using System.Security.Claims;
using System.Web;
using System.Web.Mvc;

namespace Users.Controllers {
    public class ClaimsController : Controller {

        [Authorize]
        public ActionResult Index() {
            ClaimsIdentity ident = HttpContext.User.Identity as ClaimsIdentity;
            if (ident == null) {
                return View("Error", new string[] { "No claims available" });
            } else {
                return View(ident.Claims);
            }
        }
    }
}
```

■ **Tip** You may feel a little lost as I define the code for this example. Don't worry about the details for the moment—just stick with it until you see the output from the action method and view that I define. More than anything else, that will help put claims into perspective.

You can get the claims associated with a user in different ways. One approach is to use the `Claims` property defined by the user class, but in this example, I have used the `HttpContext.User.Identity` property to demonstrate the way that ASP.NET Identity is integrated with the rest of the ASP.NET platform. As I explained in Chapter 13, the `HttpContext.User.Identity` property returns an implementation of the `IIdentity` interface, which is a `ClaimsIdentity` object when working using ASP.NET Identity. The `ClaimsIdentity` class is defined in the `System.Security.Claims` namespace, and Table 15-5 shows the members it defines that are relevant to this chapter.

Table 15-5. *The Members Defined by the ClaimsIdentity Class*

Name	Description
`Claims`	Returns an enumeration of `Claim` objects representing the claims for the user.
`AddClaim(claim)`	Adds a claim to the user identity.
`AddClaims(claims)`	Adds an enumeration of `Claim` objects to the user identity.
`HasClaim(predicate)`	Returns true if the user identity contains a claim that matches the specified predicate. See the "Applying Claims" section for an example predicate.
`RemoveClaim(claim)`	Removes a claim from the user identity.

Other members are available, but the ones in the table are those that are used most often in web applications, for reason that will become obvious as I demonstrate how claims fit into the wider ASP.NET platform.

In Listing 15-12, I cast the `IIdentity` implementation to the `ClaimsIdentity` type and pass the enumeration of `Claim` objects returned by the `ClaimsIdentity.Claims` property to the `View` method. A `Claim` object represents a single piece of data about the user, and the `Claim` class defines the properties shown in Table 15-6.

Table 15-6. *The Properties Defined by the Claim Class*

Name	Description
`Issuer`	Returns the name of the system that provided the claim
`Subject`	Returns the `ClaimsIdentity` object for the user who the claim refers to
`Type`	Returns the type of information that the claim represents
`Value`	Returns the piece of information that the claim represents

Listing 15-13 shows the contents of the `Index.cshtml` file that I created in the `Views/Claims` folder and that is rendered by the `Index` action of the `Claims` controller. The view adds a row to a table for each claim about the user.

Listing 15-13. The Contents of the Index.cshtml File in the Views/Claims Folder

```
@using System.Security.Claims
@using Users.Infrastructure
@model IEnumerable<Claim>
@{ ViewBag.Title = "Claims"; }

<div class="panel panel-primary">
    <div class="panel-heading">
        Claims
    </div>
    <table class="table table-striped">
        <tr>
            <th>Subject</th><th>Issuer</th>
            <th>Type</th><th>Value</th>
        </tr>
        @foreach (Claim claim in Model.OrderBy(x => x.Type)) {
            <tr>
                <td>@claim.Subject.Name</td>
                <td>@claim.Issuer</td>
                <td>@Html.ClaimType(claim.Type)</td>
                <td>@claim.Value</td>
            </tr>
        }
    </table>
</div>
```

The value of the Claim.Type property is a URI for a Microsoft schema, which isn't especially useful. The popular schemas are used as the values for fields in the System.Security.Claims.ClaimTypes class, so to make the output from the Index.cshtml view easier to read, I added an HTML helper to the IdentityHelpers.cs file, as shown in Listing 15-14. It is this helper that I use in the Index.cshtml file to format the value of the Claim.Type property.

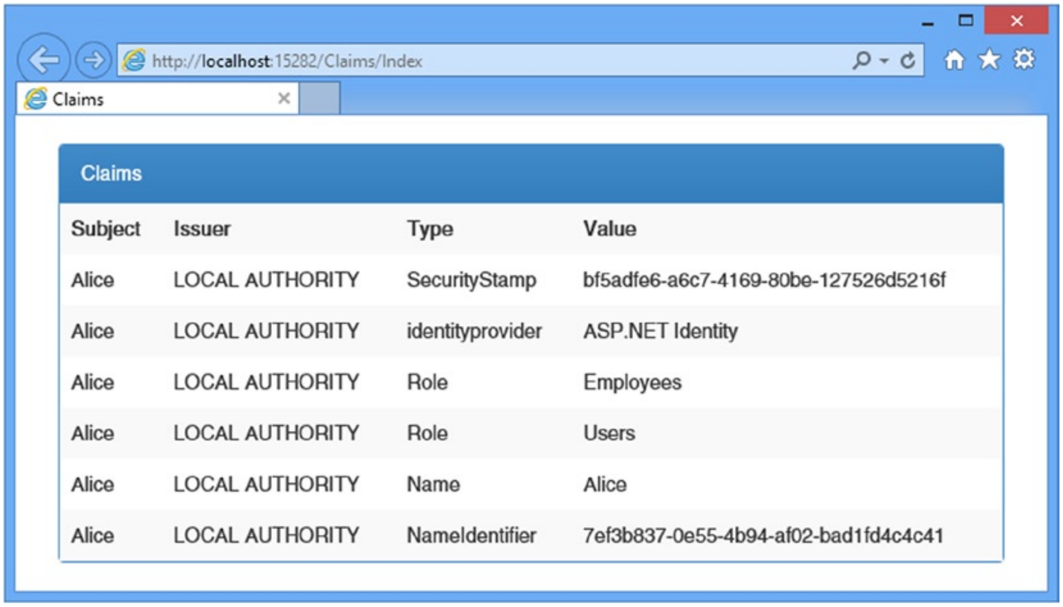
Listing 15-14. Adding a Helper to the IdentityHelpers.cs File

```
using System.Web;
using System.Web.Mvc;
using Microsoft.AspNet.Identity.Owin;
using System;
using System.Linq;
using System.Reflection;
using System.Security.Claims;

namespace Users.Infrastructure {
    public static class IdentityHelpers {

        public static MvcHtmlString GetUserName(this HtmlHelper html, string id) {
            AppUserManager mgr
                = HttpContext.Current.GetOwinContext().GetUserManager<AppUserManager>();
            return new MvcHtmlString(mgr.FindByIdAsync(id).Result.UserName);
        }
```

```
            public static MvcHtmlString ClaimType(this HtmlHelper html, string claimType) {
                FieldInfo[] fields = typeof(ClaimTypes).GetFields();
                foreach (FieldInfo field in fields) {
                    if (field.GetValue(null).ToString() == claimType) {
                        return new MvcHtmlString(field.Name);
                    }
                }
                return new MvcHtmlString(string.Format("{0}",
                    claimType.Split('/', '.').Last()));
            }
        }
    }
```

■ **Note** The helper method isn't at all efficient because it reflects on the fields of the `ClaimType` class for each claim that is displayed, but it is sufficient for my purposes in this chapter. You won't often need to display the claim type in real applications.

To see why I have created a controller that uses claims without really explaining what they are, start the application, authenticate as the user Alice (with the password `MySecret`), and request the `/Claims/Index` URL. Figure 15-5 shows the content that is generated.



Claims

Subject	Issuer	Type	Value
Alice	LOCAL AUTHORITY	SecurityStamp	bf5adfe6-a6c7-4169-80be-127526d5216f
Alice	LOCAL AUTHORITY	identityprovider	ASP.NET Identity
Alice	LOCAL AUTHORITY	Role	Employees
Alice	LOCAL AUTHORITY	Role	Users
Alice	LOCAL AUTHORITY	Name	Alice
Alice	LOCAL AUTHORITY	NameIdentifier	7ef3b837-0e55-4b94-af02-bad1fd4c4c41

Figure 15-5. *The output from the Index action of the Claims controller*

It can be hard to make out the detail in the figure, so I have reproduced the content in Table 15-7.

Table 15-7. *The Data Shown in Figure 15-5*

Subject	Issuer	Type	Value
Alice	LOCAL AUTHORITY	SecurityStamp	Unique ID
Alice	LOCAL AUTHORITY	IdentityProvider	ASP.NET Identity
Alice	LOCAL AUTHORITY	Role	Employees
Alice	LOCAL AUTHORITY	Role	Users
Alice	LOCAL AUTHORITY	Name	Alice
Alice	LOCAL AUTHORITY	NameIdentifier	Alice's user ID

The table shows the most important aspect of claims, which is that I have already been using them when I implemented the traditional authentication and authorization features in Chapter 14. You can see that some of the claims relate to user identity (the Name claim is Alice, and the NameIdentifier claim is Alice's unique user ID in my ASP.NET Identity database).

Other claims show membership of roles—there are two Role claims in the table, reflecting the fact that Alice is assigned to both the Users and Employees roles. There is also a claim about how Alice has been authenticated: The IdentityProvider is set to ASP.NET Identity.

The difference when this information is expressed as a set of claims is that you can determine where the data came from. The Issuer property for all the claims shown in the table is set to LOCAL AUTHORITY, which indicates that the user's identity has been established by the application.

So, now that you have seen some example claims, I can more easily describe what a claim is. A claim is any piece of information about a user that is available to the application, including the user's identity and role memberships. And, as you have seen, the information I have been defining about my users in earlier chapters is automatically made available as claims by ASP.NET Identity.

Creating and Using Claims

Claims are interesting for two reasons. The first reason is that an application can obtain claims from multiple sources, rather than just relying on a local database for information about the user. You will see a real example of this when I show you how to authenticate users through a third-party system in the "Using Third-Party Authentication" section, but for the moment I am going to add a class to the example project that simulates a system that provides claims information. Listing 15-15 shows the contents of the LocationClaimsProvider.cs file that I added to the Infrastructure folder.

Listing 15-15. The Contents of the LocationClaimsProvider.cs File

```
using System.Collections.Generic;
using System.Security.Claims;

namespace Users.Infrastructure {

    public static class LocationClaimsProvider {

        public static IEnumerable<Claim> GetClaims(ClaimsIdentity user) {
            List<Claim> claims = new List<Claim>();
            if (user.Name.ToLower() == "alice") {
                    claims.Add(CreateClaim(ClaimTypes.PostalCode, "DC 20500"));
                    claims.Add(CreateClaim(ClaimTypes.StateOrProvince, "DC"));
            } else {
                    claims.Add(CreateClaim(ClaimTypes.PostalCode, "NY 10036"));
                    claims.Add(CreateClaim(ClaimTypes.StateOrProvince, "NY"));
            }
            return claims;
        }

        private static Claim CreateClaim(string type, string value) {
            return new Claim(type, value, ClaimValueTypes.String, "RemoteClaims");
        }
    }
}
```

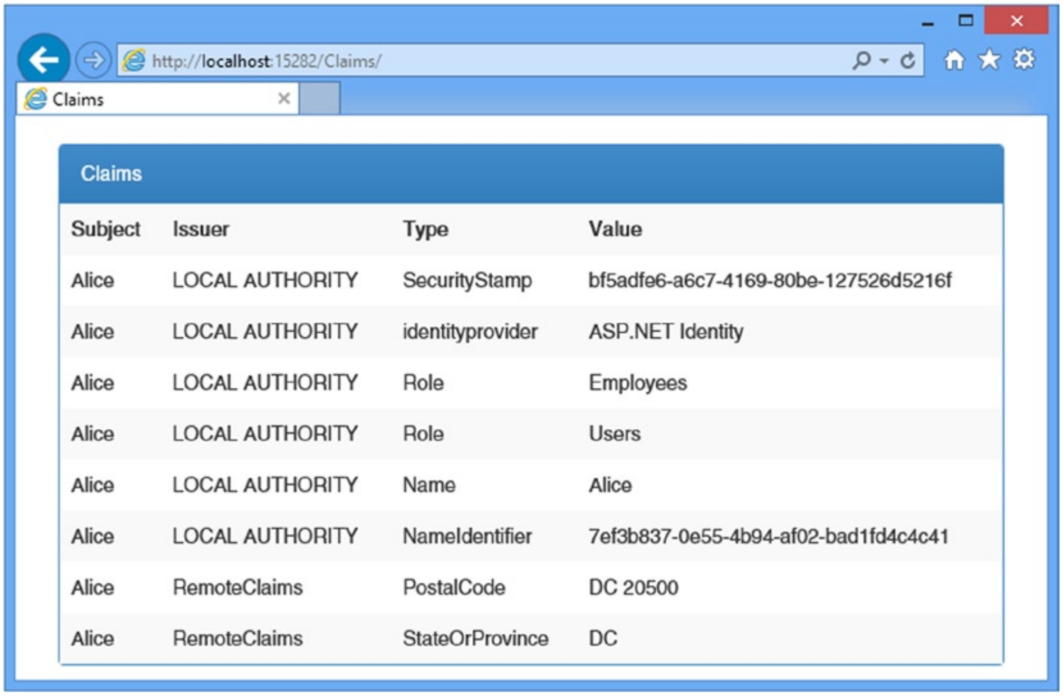
The GetClaims method takes a ClaimsIdentity argument and uses the Name property to create claims about the user's ZIP code and state. This class allows me to simulate a system such as a central HR database, which would be the authoritative source of location information about staff, for example.

Claims are associated with the user's identity during the authentication process, and Listing 15-16 shows the changes I made to the Login action method of the Account controller to call the LocationClaimsProvider class.

Listing 15-16. Associating Claims with a User in the AccountController.cs File

```
...
[HttpPost]
[AllowAnonymous]
[ValidateAntiForgeryToken]
public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
    if (ModelState.IsValid) {
        AppUser user = await UserManager.FindAsync(details.Name,
            details.Password);
        if (user == null) {
            ModelState.AddModelError("", "Invalid name or password.");
        } else {
            ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
                DefaultAuthenticationTypes.ApplicationCookie);
            ident.AddClaims(LocationClaimsProvider.GetClaims(ident));
            AuthManager.SignOut();
            AuthManager.SignIn(new AuthenticationProperties {
                IsPersistent = false
            }, ident);
            return Redirect(returnUrl);
        }
    }
    ViewBag.returnUrl = returnUrl;
    return View(details);
}
...
```

You can see the effect of the location claims by starting the application, authenticating as a user, and requesting the /Claim/Index URL. Figure 15-6 shows the claims for Alice. You may have to sign out and sign back in again to see the change.



Claims

Subject	Issuer	Type	Value
Alice	LOCAL AUTHORITY	SecurityStamp	bf5adfe6-a6c7-4169-80be-127526d5216f
Alice	LOCAL AUTHORITY	identityprovider	ASP.NET Identity
Alice	LOCAL AUTHORITY	Role	Employees
Alice	LOCAL AUTHORITY	Role	Users
Alice	LOCAL AUTHORITY	Name	Alice
Alice	LOCAL AUTHORITY	NameIdentifier	7ef3b837-0e55-4b94-af02-bad1fd4c4c41
Alice	RemoteClaims	PostalCode	DC 20500
Alice	RemoteClaims	StateOrProvince	DC

Figure 15-6. *Defining additional claims for users*

Obtaining claims from multiple locations means that the application doesn't have to duplicate data that is held elsewhere and allows integration of data from external parties. The `Claim.Issuer` property tells you where a claim originated from, which helps you judge how accurate the data is likely to be and how much weight you should give the data in your application. Location data obtained from a central HR database is likely to be more accurate and trustworthy than data obtained from an external mailing list provider, for example.

Applying Claims

The second reason that claims are interesting is that you can use them to manage user access to your application more flexibly than with standard roles. The problem with roles is that they are static, and once a user has been assigned to a role, the user remains a member until explicitly removed. This is, for example, how long-term employees of big corporations end up with incredible access to internal systems: They are assigned the roles they require for each new job they get, but the old roles are rarely removed. (The unexpectedly broad systems access sometimes becomes apparent during the investigation into how someone was able to ship the contents of the warehouse to their home address—true story.)

Claims can be used to authorize users based directly on the information that is known about them, which ensures that the authorization changes when the data changes. The simplest way to do this is to generate `Role` claims based on user data that are then used by controllers to restrict access to action methods. Listing 15-17 shows the contents of the `ClaimsRoles.cs` file that I added to the `Infrastructure`.

Listing 15-17. The Contents of the ClaimsRoles.cs File

```
using System.Collections.Generic;
using System.Security.Claims;

namespace Users.Infrastructure {
    public class ClaimsRoles {

        public static IEnumerable<Claim> CreateRolesFromClaims(ClaimsIdentity user) {
            List<Claim> claims = new List<Claim>();
            if (user.HasClaim(x => x.Type == ClaimTypes.StateOrProvince
                        && x.Issuer == "RemoteClaims" && x.Value == "DC")
                    && user.HasClaim(x => x.Type == ClaimTypes.Role
                        && x.Value == "Employees")) {
                claims.Add(new Claim(ClaimTypes.Role, "DCStaff"));
            }
            return claims;
        }
    }
}
```

The gnarly looking `CreateRolesFromClaims` method uses lambda expressions to determine whether the user has a `StateOrProvince` claim from the `RemoteClaims` issuer with a value of `DC` and a `Role` claim with a value of `Employees`. If the user has both claims, then a `Role` claim is returned for the `DCStaff` role. Listing 15-18 shows how I call the `CreateRolesFromClaims` method from the `Login` action in the `Account` controller.

Listing 15-18. Generating Roles Based on Claims in the AccountController.cs File

```
...
[HttpPost]
[AllowAnonymous]
[ValidateAntiForgeryToken]
public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
    if (ModelState.IsValid) {
        AppUser user = await UserManager.FindAsync(details.Name,
            details.Password);
        if (user == null) {
            ModelState.AddModelError("", "Invalid name or password.");
        } else {
            ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
                DefaultAuthenticationTypes.ApplicationCookie);
            ident.AddClaims(LocationClaimsProvider.GetClaims(ident));
            ident.AddClaims(ClaimsRoles.CreateRolesFromClaims(ident));
            AuthManager.SignOut();
            AuthManager.SignIn(new AuthenticationProperties {
                IsPersistent = false
            }, ident);
            return Redirect(returnUrl);
        }
    }
    ViewBag.returnUrl = returnUrl;
    return View(details);
}
...
```

I can then restrict access to an action method based on membership of the DCStaff role. Listing 15-19 shows a new action method I added to the Claims controller to which I have applied the Authorize attribute.

Listing 15-19. Adding a New Action Method to the ClaimsController.cs File

```
using System.Security.Claims;
using System.Web;
using System.Web.Mvc;

namespace Users.Controllers {
    public class ClaimsController : Controller {

        [Authorize]
        public ActionResult Index() {
            ClaimsIdentity ident = HttpContext.User.Identity as ClaimsIdentity;
            if (ident == null) {
                return View("Error", new string[] { "No claims available" });
            } else {
                return View(ident.Claims);
            }
        }

        [Authorize(Roles="DCStaff")]
        public string OtherAction() {
            return "This is the protected action";
        }
    }
}
```

Users will be able to access OtherAction only if their claims grant them membership to the DCStaff role. Membership of this role is generated dynamically, so a change to the user's employment status or location information will change their authorization level.

Authorizing Access Using Claims

The previous example is an effective demonstration of how claims can be used to keep authorizations fresh and accurate, but it is a little indirect because I generate roles based on claims data and then enforce my authorization policy based on the membership of that role. A more direct and flexible approach is to enforce authorization directly by creating a custom authorization filter attribute. Listing 15-20 shows the contents of the ClaimsAccessAttribute.cs file, which I added to the Infrastructure folder and used to create such a filter.

Listing 15-20. The Contents of the ClaimsAccessAttribute.cs File

```
using System.Security.Claims;
using System.Web;
using System.Web.Mvc;

namespace Users.Infrastructure {
    public class ClaimsAccessAttribute : AuthorizeAttribute {
        public string Issuer { get; set; }
        public string ClaimType { get; set; }
        public string Value { get; set; }

        protected override bool AuthorizeCore(HttpContextBase context) {
            return context.User.Identity.IsAuthenticated
                && context.User.Identity is ClaimsIdentity
                && ((ClaimsIdentity)context.User.Identity).HasClaim(x =>
                    x.Issuer == Issuer && x.Type == ClaimType && x.Value == Value
                );
        }
    }
}
```

The attribute I have defined is derived from the AuthorizeAttribute class, which makes it easy to create custom authorization policies in MVC framework applications by overriding the AuthorizeCore method. My implementation grants access if the user is authenticated, the IIdentity implementation is an instance of ClaimsIdentity, and the user has a claim with the issuer, type, and value matching the class properties. Listing 15-21 shows how I applied the attribute to the Claims controller to authorize access to the OtherAction method based on one of the location claims created by the LocationClaimsProvider class.

Listing 15-21. Performing Authorization on Claims in the ClaimsController.cs File

```
using System.Security.Claims;
using System.Web;
using System.Web.Mvc;
using Users.Infrastructure;

namespace Users.Controllers {
    public class ClaimsController : Controller {

        [Authorize]
        public ActionResult Index() {
            ClaimsIdentity ident = HttpContext.User.Identity as ClaimsIdentity;
            if (ident == null) {
                return View("Error", new string[] { "No claims available" });
            } else {
                return View(ident.Claims);
            }
        }

        [ClaimsAccess(Issuer="RemoteClaims", ClaimType=ClaimTypes.PostalCode,
             Value="DC 20500")]
        public string OtherAction() {
            return "This is the protected action";
        }
    }
}
```

My authorization filter ensures that only users whose location claims specify a ZIP code of DC 20500 can invoke the OtherAction method.

Using Third-Party Authentication

One of the benefits of a claims-based system such as ASP.NET Identity is that any of the claims can come from an external system, even those that identify the user to the application. This means that other systems can authenticate users on behalf of the application, and ASP.NET Identity builds on this idea to make it simple and easy to add support for authenticating users through third parties such as Microsoft, Google, Facebook, and Twitter.

There are some substantial benefits of using third-party authentication: Many users will already have an account, users can elect to use two-factor authentication, and you don't have to manage user credentials in the application. In the sections that follow, I'll show you how to set up and use third-party authentication for Google users, which Table 15-8 puts into context.

Table 15-8. *Putting Third-Party Authentication in Context*

Question	Answer
What is it?	Authenticating with third parties lets you take advantage of the popularity of companies such as Google and Facebook.
Why should I care?	Users don't like having to remember passwords for many different sites. Using a provider with large-scale adoption can make your application more appealing to users of the provider's services.
How is it used by the MVC framework?	This feature isn't used directly by the MVC framework.

■ **Note** The reason I have chosen to demonstrate Google authentication is that it is the only option that doesn't require me to register my application with the authentication service. You can get details of the registration processes required at `http://bit.ly/1cqLTrE`.

Enabling Google Authentication

ASP.NET Identity comes with built-in support for authenticating users through their Microsoft, Google, Facebook, and Twitter accounts as well more general support for any authentication service that supports `OAuth`. The first step is to add the NuGet package that includes the Google-specific additions for ASP.NET Identity. Enter the following command into the Package Manager Console:

```
Install-Package Microsoft.Owin.Security.Google -version 2.0.2
```

There are NuGet packages for each of the services that ASP.NET Identity supports, as described in Table 15-9.

Table 15-9. *The NuGet Authenticaton Packages*

Name	Description
`Microsoft.Owin.Security.Google`	Authenticates users with Google accounts
`Microsoft.Owin.Security.Facebook`	Authenticates users with Facebook accounts
`Microsoft.Owin.Security.Twitter`	Authenticates users with Twitter accounts
`Microsoft.Owin.Security.MicrosoftAccount`	Authenticates users with Microsoft accounts
`Microsoft.Owin.Security.OAuth`	Authenticates users against any OAuth 2.0 service

Once the package is installed, I enable support for the authentication service in the OWIN startup class, which is defined in the `App_Start/IdentityConfig.cs` file in the example project. Listing 15-22 shows the change that I have made.

Listing 15-22. Enabling Google Authentication in the IdentityConfig.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.Owin;
using Microsoft.Owin.Security.Cookies;
using Owin;
using Users.Infrastructure;
using Microsoft.Owin.Security.Google;

namespace Users {
    public class IdentityConfig {
        public void Configuration(IAppBuilder app) {

            app.CreatePerOwinContext<AppIdentityDbContext>(AppIdentityDbContext.Create);
            app.CreatePerOwinContext<AppUserManager>(AppUserManager.Create);
            app.CreatePerOwinContext<AppRoleManager>(AppRoleManager.Create);

            app.UseCookieAuthentication(new CookieAuthenticationOptions {
                AuthenticationType = DefaultAuthenticationTypes.ApplicationCookie,
                LoginPath = new PathString("/Account/Login"),
            });

            app.UseExternalSignInCookie(DefaultAuthenticationTypes.ExternalCookie);
            app.UseGoogleAuthentication();
        }
    }
}
```

Each of the packages that I listed in Table 15-9 contains an extension method that enables the corresponding service. The extension method for the Google service is called `UseGoogleAuthentication`, and it is called on the `IAppBuilder` implementation that is passed to the `Configuration` method.

Next I added a button to the `Views/Account/Login.cshtml` file, which allows users to log in via Google. You can see the change in Listing 15-23.

Listing 15-23. Adding a Google Login Button to the Login.cshtml File

```
@model Users.Models.LoginModel
@{ ViewBag.Title = "Login";}
<h2>Log In</h2>

@Html.ValidationSummary()

@using (Html.BeginForm()) {
    @Html.AntiForgeryToken();
    <input type="hidden" name="returnUrl" value="@ViewBag.returnUrl" />
    <div class="form-group">
        <label>Name</label>
        @Html.TextBoxFor(x => x.Name, new { @class = "form-control" })
    </div>
    <div class="form-group">
        <label>Password</label>
        @Html.PasswordFor(x => x.Password, new { @class = "form-control" })
    </div>
    <button class="btn btn-primary" type="submit">Log In</button>
}

@using (Html.BeginForm("GoogleLogin", "Account")) {
    <input type="hidden" name="returnUrl" value="@ViewBag.returnUrl" />
    <button class="btn btn-primary" type="submit">Log In via Google</button>
}
```

The new button submits a form that targets the `GoogleLogin` action on the `Account` controller. You can see this method—and the other changes I made the controller—in Listing 15-24.

Listing 15-24. Adding Support for Google Authentication to the AccountController.cs File

```
using System.Threading.Tasks;
using System.Web.Mvc;
using Users.Models;
using Microsoft.Owin.Security;
using System.Security.Claims;
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.Owin;
using Users.Infrastructure;
using System.Web;

namespace Users.Controllers {

    [Authorize]
    public class AccountController : Controller {

        [AllowAnonymous]
        public ActionResult Login(string returnUrl) {
            if (HttpContext.User.Identity.IsAuthenticated) {
                return View("Error", new string[] { "Access Denied" });
            }
    ViewBag.returnUrl = returnUrl;
    return View();
}

[HttpPost]
[AllowAnonymous]
[ValidateAntiForgeryToken]
public async Task<ActionResult> Login(LoginModel details, string returnUrl) {
    if (ModelState.IsValid) {
        AppUser user = await UserManager.FindAsync(details.Name,
            details.Password);
        if (user == null) {
            ModelState.AddModelError("", "Invalid name or password.");
        } else {
            ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
                DefaultAuthenticationTypes.ApplicationCookie);

            ident.AddClaims(LocationClaimsProvider.GetClaims(ident));
            ident.AddClaims(ClaimsRoles.CreateRolesFromClaims(ident));

            AuthManager.SignOut();
            AuthManager.SignIn(new AuthenticationProperties {
                IsPersistent = false
            }, ident);
            return Redirect(returnUrl);
        }
    }
    ViewBag.returnUrl = returnUrl;
    return View(details);
}

[HttpPost]
[AllowAnonymous]
public ActionResult GoogleLogin(string returnUrl) {
    var properties = new AuthenticationProperties {
        RedirectUri = Url.Action("GoogleLoginCallback",
            new { returnUrl = returnUrl})
    };
    HttpContext.GetOwinContext().Authentication.Challenge(properties, "Google");
    return new HttpUnauthorizedResult();
}

[AllowAnonymous]
public async Task<ActionResult> GoogleLoginCallback(string returnUrl) {
    ExternalLoginInfo loginInfo = await AuthManager.GetExternalLoginInfoAsync();
    AppUser user = await UserManager.FindAsync(loginInfo.Login);
    if (user == null) {
        user = new AppUser {
            Email = loginInfo.Email,
            UserName = loginInfo.DefaultUserName,
            City = Cities.LONDON, Country = Countries.UK
        };
```

```
                IdentityResult result = await UserManager.CreateAsync(user);
                if (!result.Succeeded) {
                    return View("Error", result.Errors);
                } else {
                    result = await UserManager.AddLoginAsync(user.Id, loginInfo.Login);
                    if (!result.Succeeded) {
                        return View("Error", result.Errors);
                    }
                }
            }

            ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
                DefaultAuthenticationTypes.ApplicationCookie);
            ident.AddClaims(loginInfo.ExternalIdentity.Claims);
            AuthManager.SignIn(new AuthenticationProperties {
                IsPersistent = false }, ident);
            return Redirect(returnUrl ?? "/");
        }

        [Authorize]
        public ActionResult Logout() {
            AuthManager.SignOut();
            return RedirectToAction("Index", "Home");
        }

        private IAuthenticationManager AuthManager {
            get {
                return HttpContext.GetOwinContext().Authentication;
            }
        }

        private AppUserManager UserManager {
            get {
                return HttpContext.GetOwinContext().GetUserManager<AppUserManager>();
            }
        }
    }
}
```

The GoogleLogin method creates an instance of the AuthenticationProperties class and sets the RedirectUri property to a URL that targets the GoogleLoginCallback action in the same controller. The next part is a magic phrase that causes ASP.NET Identity to respond to an unauthorized error by redirecting the user to the Google authentication page, rather than the one defined by the application:

```
...
HttpContext.GetOwinContext().Authentication.Challenge(properties, "Google");
return new HttpUnauthorizedResult();
...
```

This means that when the user clicks the Log In via Google button, their browser is redirected to the Google authentication service and then redirected back to the GoogleLoginCallback action method once they are authenticated.

I get details of the external login by calling the GetExternalLoginInfoAsync of the IAuthenticationManager implementation, like this:

```
...
ExternalLoginInfo loginInfo = await AuthManager.GetExternalLoginInfoAsync();
...
```

The ExternalLoginInfo class defines the properties shown in Table 15-10.

Table 15-10. *The Properties Defined by the ExternalLoginInfo Class*

Name	Description
DefaultUserName	Returns the username
Email	Returns the e-mail address
ExternalIdentity	Returns a ClaimsIdentity that identities the user
Login	Returns a UserLoginInfo that describes the external login

I use the FindAsync method defined by the user manager class to locate the user based on the value of the ExternalLoginInfo.Login property, which returns an AppUser object if the user has been authenticated with the application before:

```
...
AppUser user = await UserManager.FindAsync(loginInfo.Login);
...
```

If the FindAsync method doesn't return an AppUser object, then I know that this is the first time that this user has logged into the application, so I create a new AppUser object, populate it with values, and save it to the database. I also save details of how the user logged in so that I can find them next time:

```
...
result = await UserManager.AddLoginAsync(user.Id, loginInfo.Login);
...
```

All that remains is to generate an identity the user, copy the claims provided by Google, and create an authentication cookie so that the application knows the user has been authenticated:

```
...
ClaimsIdentity ident = await UserManager.CreateIdentityAsync(user,
    DefaultAuthenticationTypes.ApplicationCookie);
ident.AddClaims(loginInfo.ExternalIdentity.Claims);
AuthManager.SignIn(new AuthenticationProperties { IsPersistent = false }, ident);
...
```

Testing Google Authentication

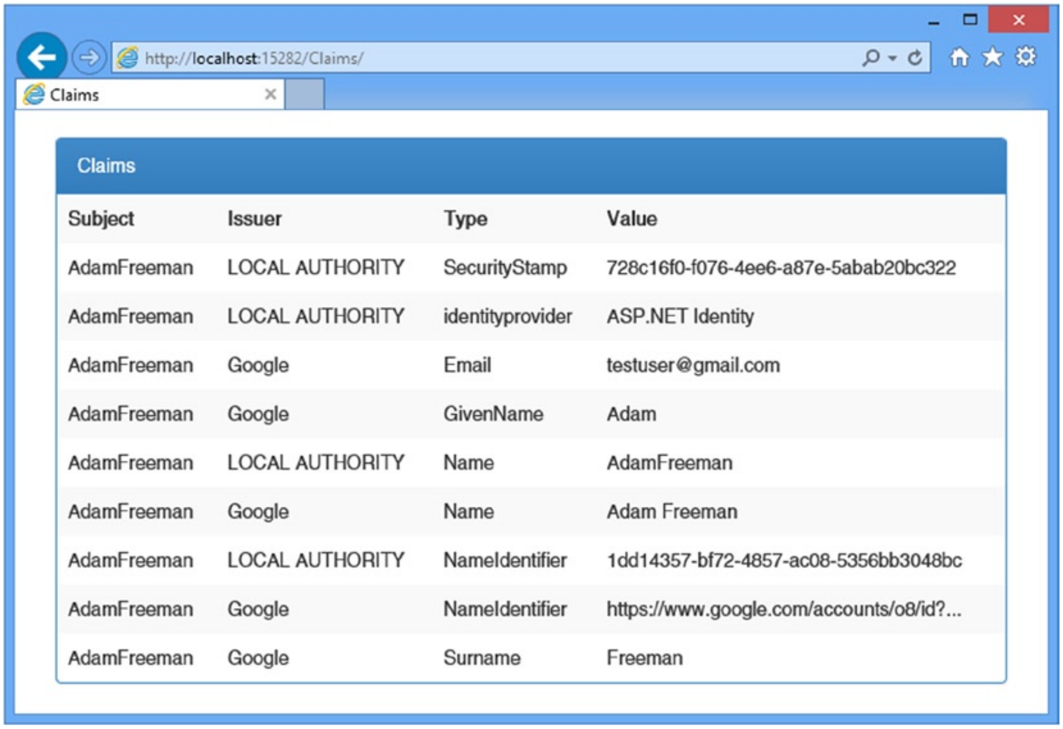
There is one further change that I need to make before I can test Google authentication: I need to change the account verification I set up in Chapter 13 because it prevents accounts from being created with e-mail addresses that are not within the `example.com` domain. Listing 15-25 shows how I removed the verification from the `AppUserManager` class.

Listing 15-25. Disabling Account Validation in the AppUserManager.cs File

```
using Microsoft.AspNet.Identity;
using Microsoft.AspNet.Identity.EntityFramework;
using Microsoft.AspNet.Identity.Owin;
using Microsoft.Owin;
using Users.Models;

namespace Users.Infrastructure {
    public class AppUserManager : UserManager<AppUser> {

        public AppUserManager(IUserStore<AppUser> store)
            : base(store) {
        }

        public static AppUserManager Create(
                IdentityFactoryOptions<AppUserManager> options,
                IOwinContext context) {

            AppIdentityDbContext db = context.Get<AppIdentityDbContext>();
            AppUserManager manager = new AppUserManager(new UserStore<AppUser>(db));

            manager.PasswordValidator = new CustomPasswordValidator {
                RequiredLength = 6,
                RequireNonLetterOrDigit = false,
                RequireDigit = false,
                RequireLowercase = true,
                RequireUppercase = true
            };

            //manager.UserValidator = new CustomUserValidator(manager) {
            //    AllowOnlyAlphanumericUserNames = true,
            //    RequireUniqueEmail = true
            //};

            return manager;
        }
    }
}
```

■ **Tip** You can use validation for externally authenticated accounts, but I am just going to disable the feature for simplicity.

To test authentication, start the application, click the Log In via Google button, and provide the credentials for a valid Google account. When you have completed the authentication process, your browser will be redirected back to the application. If you navigate to the `/Claims/Index` URL, you will be able to see how claims from the Google system have been added to the user's identity, as shown in Figure 15-7.



Claims

Subject	Issuer	Type	Value
AdamFreeman	LOCAL AUTHORITY	SecurityStamp	728c16f0-f076-4ee6-a87e-5abab20bc322
AdamFreeman	LOCAL AUTHORITY	identityprovider	ASP.NET Identity
AdamFreeman	Google	Email	testuser@gmail.com
AdamFreeman	Google	GivenName	Adam
AdamFreeman	LOCAL AUTHORITY	Name	AdamFreeman
AdamFreeman	Google	Name	Adam Freeman
AdamFreeman	LOCAL AUTHORITY	NameIdentifier	1dd14357-bf72-4857-ac08-5356bb3048bc
AdamFreeman	Google	NameIdentifier	https://www.google.com/accounts/o8/id?...
AdamFreeman	Google	Surname	Freeman

Figure 15-7. *Claims from Google*

Summary

In this chapter, I showed you some of the advanced features that ASP.NET Identity supports. I demonstrated the use of custom user properties and how to use database migrations to preserve data when you upgrade the schema to support them. I explained how claims work and how they can be used to create more flexible ways of authorizing users. I finished the chapter by showing you how to authenticate users via Google, which builds on the ideas behind the use of claims.

And that is all I have to teach you about the ASP.NET platform and how it supports MVC framework applications. I started by exploring the request handling life cycle and how it can be extended, managed, and disrupted. I then took you on a tour of the services that ASP.NET provides, showing you how they can be used to enhance and optimize your applications and improve the experience you deliver to your users. When writing MVC framework applications, it is easy to take the ASP.NET platform for granted, but this book has shown you just how much low-level functionality is available and how valuable it can be. I wish you every success in your web application projects, and I can only hope you have enjoyed reading this book as much as I enjoyed writing it.