Tutorial: Add sorting, filtering, and paging with the Entity Framework in an ASP.NET MVC application

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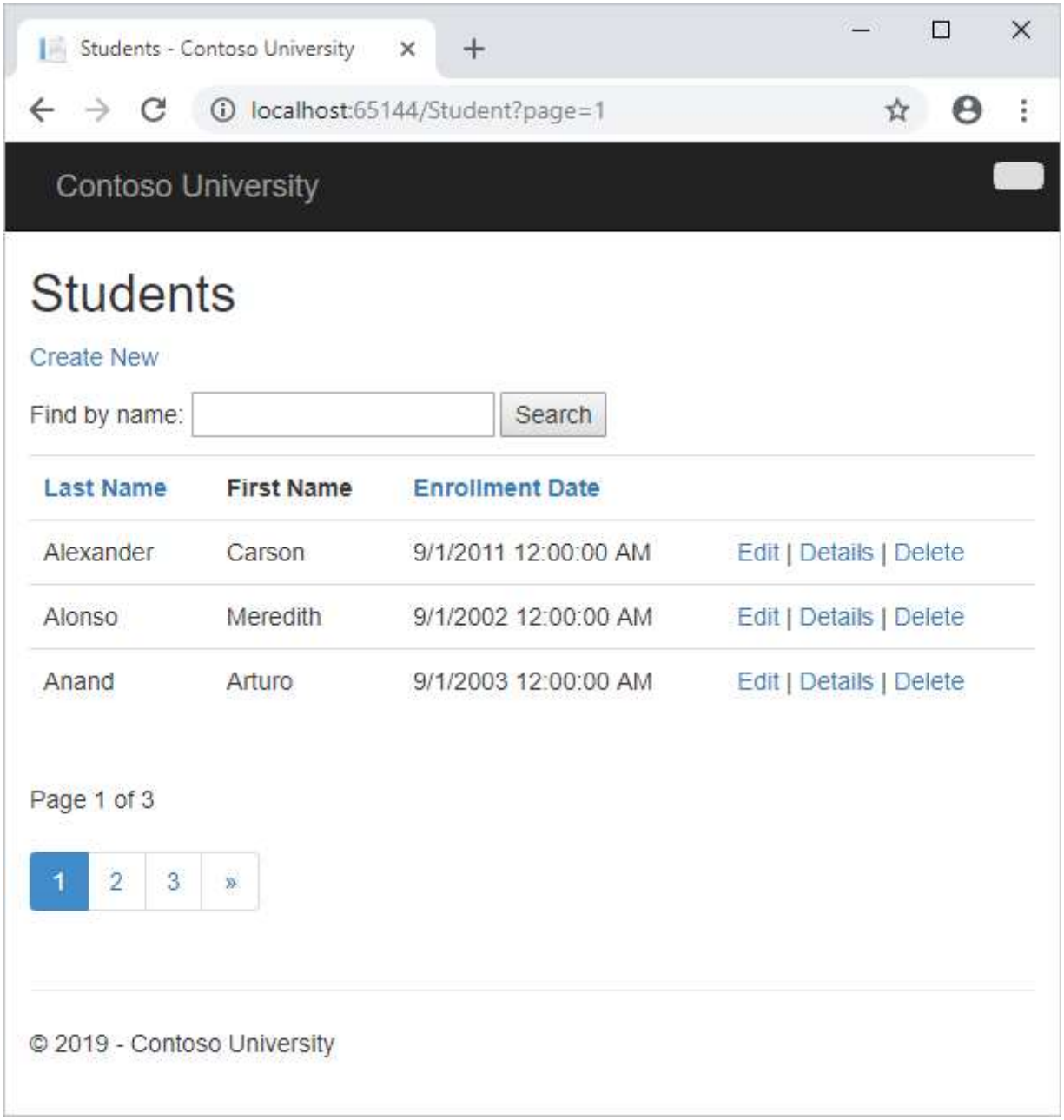
In the previous tutorial, you implemented a set of web pages for basic CRUD operations for `Student` entities. In this tutorial you add sorting, filtering, and paging functionality to the **Students** Index page. You also create a simple grouping page.

The following image shows what the page will look like when you're done. The column headings are links that the user can click to sort by that column. Clicking a column heading repeatedly toggles between ascending and descending sort order.



In this tutorial, you:

- ✓ Add column sort links
- ✓ Add a Search box
- ✓ Add paging
- ✓ Create an About page

Prerequisites

- Implementing Basic CRUD Functionality

Add column sort links

To add sorting to the Student Index page, you'll change the `Index` method of the `Student` controller and add code to the `Student` Index view.

Add sorting functionality to the Index method

- In *Controllers\StudentController.cs*, replace the `Index` method with the following code:

```
C#
```

```
public ActionResult Index(string sortOrder)
{
   ViewBag.NameSortParm = String.IsNullOrEmpty(sortOrder) ? "name_desc" :
"";
   ViewBag.DateSortParm = sortOrder == "Date" ? "date_desc" : "Date";
   var students = from s in db.Students
                  select s;
   switch (sortOrder)
   {
      case "name_desc":
         students = students.OrderByDescending(s => s.LastName);
         break;
      case "Date":
         students = students.OrderBy(s => s.EnrollmentDate);
         break;
      case "date_desc":
         students = students.OrderByDescending(s => s.EnrollmentDate);
         break;
      default:
         students = students.OrderBy(s => s.LastName);
         break;
   }
   return View(students.ToList());
}
```

This code receives a `sortOrder` parameter from the query string in the URL. The query string value is provided by ASP.NET MVC as a parameter to the action method. The parameter is a string that's either "Name" or "Date", optionally followed by an underscore and the string "desc" to specify descending order. The default sort order is ascending.

The first time the Index page is requested, there's no query string. The students are displayed in ascending order by `LastName`, which is the default as established by the fall-

through case in the `switch` statement. When the user clicks a column heading hyperlink, the appropriate `sortOrder` value is provided in the query string.

The two `ViewBag` variables are used so that the view can configure the column heading hyperlinks with the appropriate query string values:

```
C#

ViewBag.NameSortParm = String.IsNullOrEmpty(sortOrder) ? "name_desc" : "";
ViewBag.DateSortParm = sortOrder == "Date" ? "date_desc" : "Date";
```

These are ternary statements. The first one specifies that if the `sortOrder` parameter is null or empty, `ViewBag.NameSortParm` should be set to "name_desc"; otherwise, it should be set to an empty string. These two statements enable the view to set the column heading hyperlinks as follows:

Current sort order	Last Name Hyperlink	Date Hyperlink
Last Name ascending	descending	ascending
Last Name descending	ascending	ascending
Date ascending	ascending	descending
Date descending	ascending	ascending

The method uses LINQ to Entities to specify the column to sort by. The code creates an IQueryable<T> variable before the `switch` statement, modifies it in the `switch` statement, and calls the `ToList` method after the `switch` statement. When you create and modify `IQueryable` variables, no query is sent to the database. The query is not executed until you convert the `IQueryable` object into a collection by calling a method such as `ToList`. Therefore, this code results in a single query that is not executed until the `return View` statement.

As an alternative to writing different LINQ statements for each sort order, you can dynamically create a LINQ statement. For information about dynamic LINQ, see Dynamic LINQ .

Add column heading hyperlinks to the Student index view

1. In *Views\Student\Index.cshtml*, replace the `<tr>` and `<th>` elements for the heading row with the highlighted code:

```
CSHTML

<p>
    @Html.ActionLink("Create New", "Create")
</p>
<table class="table">
    <tr>
        <th>
            @Html.ActionLink("Last Name", "Index", new { sortOrder =
ViewBag.NameSortParm })
        </th>
        <th>First Name
        </th>
        <th>
            @Html.ActionLink("Enrollment Date", "Index", new { sortOrder =
ViewBag.DateSortParm })
        </th>
        <th></th>
    </tr>

@foreach (var item in Model) {
```

   This code uses the information in the `ViewBag` properties to set up hyperlinks with the appropriate query string values.

2. Run the page and click the **Last Name** and **Enrollment Date** column headings to verify that sorting works.

   After you click the **Last Name** heading, students are displayed in descending last name order.

Add a Search box

To add filtering to the Students index page, you'll add a text box and a submit button to the view and make corresponding changes in the `Index` method. The text box lets you enter a string to search for in the first name and last name fields.

Add filtering functionality to the Index method

- In *Controllers\StudentController.cs*, replace the `Index` method with the following code (the changes are highlighted):

```
C#
```

```
public ViewResult Index(string sortOrder, string searchString)
{
    ViewBag.NameSortParm = String.IsNullOrEmpty(sortOrder) ? "name_desc" :
"";
    ViewBag.DateSortParm = sortOrder == "Date" ? "date_desc" : "Date";
    var students = from s in db.Students
                   select s;
    if (!String.IsNullOrEmpty(searchString))
    {
        students = students.Where(s => s.LastName.Contains(searchString)
                               || s.FirstMidName.Contains(searchString));
    }
    switch (sortOrder)
    {
        case "name_desc":
            students = students.OrderByDescending(s => s.LastName);
            break;
        case "Date":
            students = students.OrderBy(s => s.EnrollmentDate);
            break;
        case "date_desc":
            students = students.OrderByDescending(s => s.EnrollmentDate);
            break;
        default:
            students = students.OrderBy(s => s.LastName);
            break;
    }

    return View(students.ToList());
}
```

The code adds a `searchString` parameter to the `Index` method. The search string value is received from a text box that you'll add to the Index view. It also adds a `where` clause to the LINQ statement that selects only students whose first name or last name contains the search string. The statement that adds the Where clause executes only if there's a value to search for.

> **Note**
>
> In many cases you can call the same method either on an Entity Framework entity set or as an extension method on an in-memory collection. The results are normally the

same but in some cases may be different.

For example, the .NET Framework implementation of the `Contains` method returns all rows when you pass an empty string to it, but the Entity Framework provider for SQL Server Compact 4.0 returns zero rows for empty strings. Therefore the code in the example (putting the `Where` statement inside an `if` statement) makes sure that you get the same results for all versions of SQL Server. Also, the .NET Framework implementation of the `Contains` method performs a case-sensitive comparison by default, but Entity Framework SQL Server providers perform case-insensitive comparisons by default. Therefore, calling the `ToUpper` method to make the test explicitly case-insensitive ensures that results do not change when you change the code later to use a repository, which will return an `IEnumerable` collection instead of an `IQueryable` object. (When you call the `Contains` method on an `IEnumerable` collection, you get the .NET Framework implementation; when you call it on an `IQueryable` object, you get the database provider implementation.)

Null handling may also be different for different database providers or when you use an `IQueryable` object compared to when you use an `IEnumerable` collection. For example, in some scenarios a `Where` condition such as `table.Column != 0` may not return columns that have `null` as the value. By default, EF generates additional SQL operators to make equality between null values work in the database like it works in memory, but you can set the **UseDatabaseNullSemantics** flag in EF6 or call the **UseRelationalNulls** method in EF Core to configure this behavior.

Add a search box to the Student index view

1. In *Views\Student\Index.cshtml*, add the highlighted code immediately before the opening `table` tag in order to create a caption, a text box, and a **Search** button.

CSHTML

```
<p>
    @Html.ActionLink("Create New", "Create")
</p>
```

```
@using (Html.BeginForm())
{
    <p>
        Find by name: @Html.TextBox("SearchString")
        <input type="submit" value="Search" /></p>
}
<table>
    <tr>
```

2. Run the page, enter a search string, and click **Search** to verify that filtering is working.

   Notice the URL doesn't contain the "an" search string, which means that if you bookmark this page, you won't get the filtered list when you use the bookmark. This applies also to the column sort links, as they will sort the whole list. You'll change the **Search** button to use query strings for filter criteria later in the tutorial.

Add paging

To add paging to the Students index page, you'll start by installing the **PagedList.Mvc** NuGet package. Then you'll make additional changes in the `Index` method and add paging links to the `Index` view. **PagedList.Mvc** is one of many good paging and sorting packages for ASP.NET MVC, and its use here is intended only as an example, not as a recommendation for it over other options.

Install the PagedList.MVC NuGet package

The NuGet **PagedList.Mvc** package automatically installs the **PagedList** package as a dependency. The **PagedList** package installs a `PagedList` collection type and extension methods for `IQueryable` and `IEnumerable` collections. The extension methods create a single page of data in a `PagedList` collection out of your `IQueryable` or `IEnumerable`, and the `PagedList` collection provides several properties and methods that facilitate paging. The **PagedList.Mvc** package installs a paging helper that displays the paging buttons.

1. From the **Tools** menu, select **NuGet Package Manager** and then **Package Manager Console**.

2. In the **Package Manager Console** window, make sure the **Package source** is **nuget.org** and the **Default project** is **ContosoUniversity**, and then enter the following command:

```
text

Install-Package PagedList.Mvc
```

3. Build the project.

Add paging functionality to the Index method

1. In *Controllers\StudentController.cs*, add a `using` statement for the `PagedList` namespace:

```
C#

using PagedList;
```

2. Replace the `Index` method with the following code:

```
C#

public ViewResult Index(string sortOrder, string currentFilter, string
searchString, int? page)
{
   ViewBag.CurrentSort = sortOrder;
   ViewBag.NameSortParm = String.IsNullOrEmpty(sortOrder) ? "name_desc" :
"";
   ViewBag.DateSortParm = sortOrder == "Date" ? "date_desc" : "Date";

   if (searchString != null)
   {
      page = 1;
   }
   else
   {
      searchString = currentFilter;
   }

   ViewBag.CurrentFilter = searchString;

   var students = from s in db.Students
                  select s;
   if (!String.IsNullOrEmpty(searchString))
   {
      students = students.Where(s => s.LastName.Contains(searchString)
                           || s.FirstMidName.Contains(searchString));
   }
   switch (sortOrder)
```

```
    {
        case "name_desc":
            students = students.OrderByDescending(s => s.LastName);
            break;
        case "Date":
            students = students.OrderBy(s => s.EnrollmentDate);
            break;
        case "date_desc":
            students = students.OrderByDescending(s => s.EnrollmentDate);
            break;
        default:  // Name ascending
            students = students.OrderBy(s => s.LastName);
            break;
    }

    int pageSize = 3;
    int pageNumber = (page ?? 1);
    return View(students.ToPagedList(pageNumber, pageSize));
}
```

This code adds a `page` parameter, a current sort order parameter, and a current filter parameter to the method signature:

C#

```
public ActionResult Index(string sortOrder, string currentFilter, string
searchString, int? page)
```

The first time the page is displayed, or if the user hasn't clicked a paging or sorting link, all the parameters are null. If a paging link is clicked, the `page` variable contains the page number to display.

A `ViewBag` property provides the view with the current sort order, because this must be included in the paging links in order to keep the sort order the same while paging:

C#

```
ViewBag.CurrentSort = sortOrder;
```

Another property, `ViewBag.CurrentFilter`, provides the view with the current filter string. This value must be included in the paging links in order to maintain the filter settings during paging, and it must be restored to the text box when the page is redisplayed. If the search string is changed during paging, the page has to be reset to 1, because the new filter can result in different data to display. The search string is

changed when a value is entered in the text box and the submit button is pressed. In that case, the `searchString` parameter is not null.

```
C#
```

```
if (searchString != null)
{
    page = 1;
}
else
{
    searchString = currentFilter;
}
```

At the end of the method, the `ToPagedList` extension method on the students `IQueryable` object converts the student query to a single page of students in a collection type that supports paging. That single page of students is then passed to the view:

```
C#
```

```
int pageSize = 3;
int pageNumber = (page ?? 1);
return View(students.ToPagedList(pageNumber, pageSize));
```

The `ToPagedList` method takes a page number. The two question marks represent the null-coalescing operator. The null-coalescing operator defines a default value for a nullable type; the expression `(page ?? 1)` means return the value of `page` if it has a value, or return 1 if `page` is null.

Add paging links to the Student index view

1. In *Views\Student\Index.cshtml*, replace the existing code with the following code. The changes are highlighted.

```
CSHTML
```

```
@model PagedList.IPagedList<ContosoUniversity.Models.Student>
@using PagedList.Mvc;
<link href="~/Content/PagedList.css" rel="stylesheet" type="text/css" />

@{
    ViewBag.Title = "Students";
```

```
}

<h2>Students</h2>

<p>
    @Html.ActionLink("Create New", "Create")
</p>
@using (Html.BeginForm("Index", "Student", FormMethod.Get))
{
    <p>
        Find by name: @Html.TextBox("SearchString", ViewBag.CurrentFilter
as string)
        <input type="submit" value="Search" />
    </p>
}
<table class="table">
    <tr>
        <th>
            @Html.ActionLink("Last Name", "Index", new { sortOrder =
ViewBag.NameSortParm, currentFilter=ViewBag.CurrentFilter })
        </th>
        <th>
            First Name
        </th>
        <th>
            @Html.ActionLink("Enrollment Date", "Index", new { sortOrder =
ViewBag.DateSortParm, currentFilter=ViewBag.CurrentFilter })
        </th>
        <th></th>
    </tr>

@foreach (var item in Model) {
    <tr>
        <td>
            @Html.DisplayFor(modelItem => item.LastName)
        </td>
        <td>
            @Html.DisplayFor(modelItem => item.FirstMidName)
        </td>
        <td>
            @Html.DisplayFor(modelItem => item.EnrollmentDate)
        </td>
        <td>
            @Html.ActionLink("Edit", "Edit", new { id=item.ID }) |
            @Html.ActionLink("Details", "Details", new { id=item.ID }) |
            @Html.ActionLink("Delete", "Delete", new { id=item.ID })
        </td>
    </tr>
}

</table>
```

```
<br />
Page @(Model.PageCount < Model.PageNumber ? 0 : Model.PageNumber) of
@Model.PageCount

@Html.PagedListPager(Model, page => Url.Action("Index",
    new { page, sortOrder = ViewBag.CurrentSort, currentFilter =
ViewBag.CurrentFilter }))
```

The `@model` statement at the top of the page specifies that the view now gets a `PagedList` object instead of a `List` object.

The `using` statement for `PagedList.Mvc` gives access to the MVC helper for the paging buttons.

The code uses an overload of BeginForm that allows it to specify FormMethod.Get.

CSHTML

```
@using (Html.BeginForm("Index", "Student", FormMethod.Get))
{
    <p>
        Find by name: @Html.TextBox("SearchString", ViewBag.CurrentFilter
as string)
        <input type="submit" value="Search" />
    </p>
}
```

The default BeginForm submits form data with a POST, which means that parameters are passed in the HTTP message body and not in the URL as query strings. When you specify HTTP GET, the form data is passed in the URL as query strings, which enables users to bookmark the URL. The W3C guidelines for the use of HTTP GET recommend that you should use GET when the action does not result in an update.

The text box is initialized with the current search string so when you click a new page you can see the current search string.

CSHTML

```
Find by name: @Html.TextBox("SearchString", ViewBag.CurrentFilter as
string)
```

The column header links use the query string to pass the current search string to the controller so that the user can sort within filter results:

```
CSHTML

@Html.ActionLink("Last Name", "Index", new {
sortOrder=ViewBag.NameSortParm, currentFilter=ViewBag.CurrentFilter })
```

The current page and total number of pages are displayed.

```
CSHTML

Page @(Model.PageCount < Model.PageNumber ? 0 : Model.PageNumber) of
@Model.PageCount
```

If there are no pages to display, "Page 0 of 0" is shown. (In that case the page number is greater than the page count because `Model.PageNumber` is 1, and `Model.PageCount` is 0.)

The paging buttons are displayed by the `PagedListPager` helper:

```
CSHTML

@Html.PagedListPager( Model, page => Url.Action("Index", new { page }) )
```

The `PagedListPager` helper provides a number of options that you can customize, including URLs and styling. For more information, see TroyGoode / PagedList on the GitHub site.

2. Run the page.

   Click the paging links in different sort orders to make sure paging works. Then enter a search string and try paging again to verify that paging also works correctly with sorting and filtering.

Create an About page

For the Contoso University website's About page, you'll display how many students have enrolled for each enrollment date. This requires grouping and simple calculations on the groups. To accomplish this, you'll do the following:

- Create a view model class for the data that you need to pass to the view.
- Modify the `About` method in the `Home` controller.

- Modify the `About` view.

Create the View Model

Create a *ViewModels* folder in the project folder. In that folder, add a class file *EnrollmentDateGroup.cs* and replace the template code with the following code:

```
C#
```

```
using System;
using System.ComponentModel.DataAnnotations;

namespace ContosoUniversity.ViewModels
{
    public class EnrollmentDateGroup
    {
        [DataType(DataType.Date)]
        public DateTime? EnrollmentDate { get; set; }

        public int StudentCount { get; set; }
    }
}
```

Modify the Home Controller

1. In *HomeController.cs*, add the following `using` statements at the top of the file:

   ```
   C#
   ```

   ```
   using ContosoUniversity.DAL;
   using ContosoUniversity.ViewModels;
   ```

2. Add a class variable for the database context immediately after the opening curly brace for the class:

   ```
   C#
   ```

   ```
   public class HomeController : Controller
   {
       private SchoolContext db = new SchoolContext();
   ```

3. Replace the `About` method with the following code:

C#

```
public ActionResult About()
{
    IQueryable<EnrollmentDateGroup> data = from student in db.Students
                group student by student.EnrollmentDate into dateGroup
                select new EnrollmentDateGroup()
                {
                    EnrollmentDate = dateGroup.Key,
                    StudentCount = dateGroup.Count()
                };
    return View(data.ToList());
}
```

The LINQ statement groups the student entities by enrollment date, calculates the number of entities in each group, and stores the results in a collection of `EnrollmentDateGroup` view model objects.

4. Add a `Dispose` method:

C#

```
protected override void Dispose(bool disposing)
{
    db.Dispose();
    base.Dispose(disposing);
}
```

Modify the About View

1. Replace the code in the *Views\Home\About.cshtml* file with the following code:

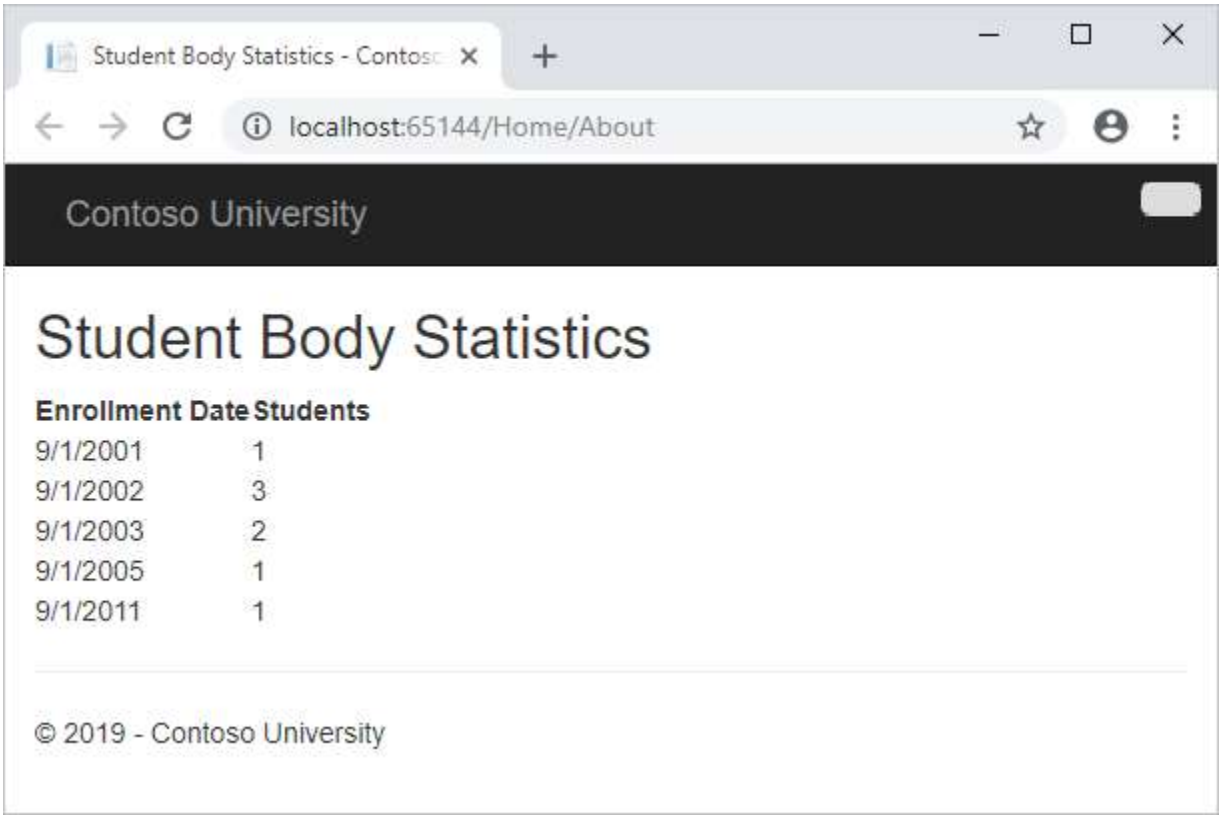
CSHTML

```
@model IEnumerable<ContosoUniversity.ViewModels.EnrollmentDateGroup>

@{
    ViewBag.Title = "Student Body Statistics";
}

<h2>Student Body Statistics</h2>

<table>
    <tr>
        <th>
```

```
            Enrollment Date
        </th>
        <th>
            Students
        </th>
    </tr>

@foreach (var item in Model) {
    <tr>
        <td>
            @Html.DisplayFor(modelItem => item.EnrollmentDate)
        </td>
        <td>
            @item.StudentCount
        </td>
    </tr>
}
</table>
```

2. Run the app and click the **About** link.

   The count of students for each enrollment date displays in a table.



Get the code

Download the Completed Project

Additional resources

Links to other Entity Framework resources can be found in ASP.NET Data Access - Recommended Resources.

Next steps

In this tutorial, you:

- ✓ Add column sort links
- ✓ Add a Search box
- ✓ Add paging
- ✓ Create an About page

Advance to the next article to learn how to use connection resiliency and command interception.

Connection resiliency and command interception