

Visual C#® and Databases



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Visual C#® And Databases

A Computer Programming Tutorial

By
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Printed in the United States of America

ISBN-13: 978-1-937161-66-8 (Electronic)
ISBN-13: 978-1-937161-74-3 (Printed)

Previous edition published as “Visual C# & Databases - 2012 Professional Edition”

Cover Design by Neil Sauvageau
Illustrations by Kevin Brockschmidt

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Philip Conrod has authored, co-authored and edited numerous computer programming books for kids, teens and adults. Philip holds a BS in Computer Information Systems and a Master's certificate in the Essentials of Business Development from Regis University. He also holds a Certificate in Programming for Business from Warren-Tech. Philip has been programming computers since 1977. He has held various Information Technology leadership roles in companies like Command Plus, BibleBytes Software, Sundstrand Aerospace, Safeco Insurance Companies, FamilyLife, Kenworth Truck Company, PACCAR and Darigold. In his spare time, Philip serves as the President & Publisher of Kidware Software, LLC. He is the proud father of three "techie" daughters and he and his beautiful family live in Maple Valley, Washington.

Lou Tylee holds BS and MS degrees in Mechanical Engineering and a PhD in Electrical Engineering. Lou has been programming computers since 1969 when he took his first Fortran course in college. He has written software to control suspensions for high speed ground vehicles, monitor nuclear power plants, lower noise levels in commercial jetliners, compute takeoff speeds for jetliners, locate and identify air and ground traffic and to let kids count bunnies, learn how to spell and do math problems. He has written several online texts teaching Visual Basic, Visual C# and Java to thousands of people. He taught a beginning Visual Basic course for over 15 years at a major university. Currently, Lou works as an engineer at a major Seattle aerospace firm. He is the proud father of five children and proud husband of his special wife. Lou and his family live in Seattle, Washington.

Acknowledgements

I want to thank my three wonderful daughters - Stephanie, Jessica and Chloe, who helped with various aspects of the book publishing process including software testing, book editing, creative design and many other more tedious tasks like finding errors and typos. I could not have accomplished this without all your hard work, love and support. I want to also thank my best friend Jesus, who has always been there by my side giving me wisdom and guidance. Without you, this book would have never been printed or published.

I also want to thank my multi-talented co-author, Lou Tylee, for doing all the real hard work necessary to develop, test, debug, and keep current all the ‘beginner-friendly’ applications, games and base tutorial text found in this book. Lou has tirelessly poured his heart and soul into so many previous versions of this tutorial and there are so many beginners who have benefited from his work over the years. Lou is by far one of the best application developers and tutorial writers I have ever worked with. Thank you Lou for collaborating with me on this book project.

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Course Description:

Visual C# and Databases is a tutorial that provides a detailed introduction to using Visual C# for accessing and maintaining databases. Topics covered include: database structure, database design, Visual C# project building, ADO .NET data objects, data bound controls, proper interface design, structured query language (SQL), and database reports.

Visual C# and Databases is presented using a combination of over 850 pages of course notes and actual Visual C# examples. No previous experience working with databases is presumed. It is assumed, however, that users of the course are familiar with the Visual C# environment and the steps involved in building a Visual C# application.

Course Prerequisites:

To grasp the concepts presented in *Visual C# and Databases*, you should possess a working knowledge of Microsoft Windows. No previous experience working with databases is presumed. It is assumed, however, that users of the course are familiar with the Visual C# environment and the steps involved in building a Visual C# application (such background can be gained from our *Learn Visual C#* course). You will also need the ability to view and print documents saved in Microsoft Word. Finally, and most obvious, you need to have Microsoft Visual Studio Community Edition. This is a separate product that can be downloaded for free from Microsoft's website:

<https://www.visualstudio.com/free-developer-offers/>

How To Take the Course:

Visual C# and Databases is a self-paced course. Each chapter will require a different amount of time. The suggested approach is to decide how much time you can spend each week working through the notes. Print out the notes one chapter at a time. Then, work through the notes at your own pace. Try to do each example as it is encountered in the notes. Work through the projects. If you need any help, all completed projects are included in the **Code** folder.

Software Requirements

Visual Studio 2017 will install and run on the following operating systems:

- Windows 10 version 1507 or higher: Home, Professional, Education, and Enterprise (LTSB is not supported)
- Windows Server 2016: Standard and Datacenter
- Windows 8.1 (with Update 2919355): Basic, Professional, and Enterprise
- Windows Server 2012 R2 (with Update 2919355): Essentials, Standard, Datacenter
- Windows 7 SP1 (with latest Windows Updates): Home Premium, Professional, Enterprise, Ultimate

Hardware Requirements

- 1.8 GHz or faster processor. Dual-core or better recommended
- 2 GB of RAM; 4 GB of RAM recommended (2.5 GB minimum if running on a virtual machine)
- Hard disk space: 1GB to 40GB, depending on features installed
- Video card that supports a minimum display resolution of 720p (1280 by 720); Visual Studio will work best at a resolution of WXGA (1366 by 768) or higher

Installing and Using the Downloadable Solution Files:

If you purchased this directly from our website you received an email with a special and individualized internet download link where you could download the compressed Program Solution Files. If you purchased this book through a 3rd Party Book Store like Amazon.com, the solutions files for this tutorial are included in a compressed ZIP file that is available for download directly from our website (after registration) at:

<http://www.kidwaresoftware.com/vcsdb2015-registration.html>

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Installing Visual C# and Databases:

The course notes and code for *Visual C# and Databases* are included in one single ZIP file. Use your favorite ‘unzipping’ application to write all files to your computer. The course is included in the folder entitled VCSDB. This folder contains three other folders: **Databases**, **Notes** and **Code**.

The **Databases** folder holds the sample databases used in the course. The **Code** folder includes all the Visual C# projects developed during the course. The applications are further divided into **Class** folders. Each class folder contains the *Visual C# and Databases* project folders. As an example, to open the project named Example 1-1 discussed in Class 1, you would go to this directory:

C:\VCSDB\Code\Class 1\Example 1-1

Foreword By David B. Taylor, Former College Professor & Department Chair

Most computer programs in use today require some interaction with information stored in a database so learning to program with databases increases the marketability of a developer exponentially.

This book is structured as a self-study guide but it is easily adapted to classroom lectures and discussion. The content of the book is excellent. It starts with the basics and graduates in small and clear but functional increments. It makes database programming much easier to teach and learn.

“Visual C# and Databases” provides a complete, thorough, and easy to understand explanation of database program development from two people who came up through the ranks as software developers. Their examples reflect real-world applications that will help new developers quickly master database software development. Students can easily convert and expand the examples for their own applications. For example, the Books Database in Chapter 4 could easily be modified to search a similar database of cars, bikes, or passwords, etc. Examples are created using Microsoft’s Access database management system (DBMS) and SQL Server. This makes it easy for the student to compare their capabilities and syntax.

I have sincerely enjoyed reading and working through the examples in, “Visual C# and Databases”. The examples are clear and easy to follow. If I had any questions or if my code did not work I could simply peek at the author’s completed code examples to get back on track.

Throughout the book the authors bring attention to the importance of user interface (UI) design. This is more important than may be obvious at first but developers tend to focus on the code and forget

about the UI but eventually someone needs to use this program so a functional and attractive presentation of the program can be the difference between success and failure of the end product.

A major plus for this text is how the authors include additional and very useful parallel topics such as the On-Line Help system created in HTML in Chapter 5 and the Graphics Methods in Chapter 7. The book is not about HTML or graphics but the coincidental inclusion give the student a valuable glimpse at other topics of importance. These are just two examples that didn't have to be included but they are added as part of other chapters and will ultimately benefit the student. This took a lot of forethought by the authors and demonstrates the real value of the book.

As a programmer, a long-time college professor, and as the former head of the Computer, Engineering, and Business Department, I have reviewed countless programming books for most of the popular programming languages. "Visual C# and Databases" by Conrod and Tylee is my favorite text for helping developers make the leap into the rewarding field of database development. I highly recommend this book for anyone who is serious about becoming a professional software developer/engineer.

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1

Introducing Visual C# and Databases

Preview

In this first chapter, we will do a quick overview of what the course entails. We will discuss what you need to complete the course.

We'll take a brief look at what databases are, where they are used, and how Visual C# is used with databases. And, we'll review the Visual C# development environment and the steps followed to build an application in Visual C#.

Course Objectives

- ⇒ Understand the benefits of using Microsoft Visual C# to build a ‘front-end’ interface as a database programming tool
- ⇒ Learn database structure, terminology, and proper database design
- ⇒ Learn how to connect to a database using Visual C# data objects
- ⇒ Learn the use of Visual C# data bound controls
- ⇒ Learn to make database queries using SQL (structured query language)
- ⇒ Understand proper database search techniques
- ⇒ Learn how to ADOX (Active Data Object Extended) technology to create a database
- ⇒ Learn database management techniques
- ⇒ Learn to create and produce database reports
- ⇒ Learn how to distribute a Visual C# database application
- ⇒ Understand connection to different types of databases and remote databases
- ⇒ Introduce other database concepts

Course Requirements

An obvious requirement is a Windows-based computer with Microsoft Windows as well as Visual Studio 2015 Community Edition. The student should be familiar with the basics of using the Windows operating system.

No knowledge of databases or how to work with databases is presumed. Adequate introductory material is presented. Even if you've worked with databases before, it is suggested you read through this introductory information to become acquainted with the nomenclature used by the author for databases and their component parts.

This course does *not* teach you how to build a Visual C# application. It is assumed that the reader has a basic understanding of the Visual C# development environment and knows the steps involved in building a Visual C# application. You should feel quite comfortable with building the example application at the end of this first chapter. If not, our company, Kidware Software, offers several tutorials that teach this information. Please visit our web site at:

<http://www.kidwaresoftware.com>

What is a Database?

A **database** is a collection of **information**. This information is stored in a very structured manner. By exploiting this known structure, we can access and modify the information quickly and correctly.

In this information age, databases are everywhere:

- ⇒ When you go to the library and look up a book on their computer, you are accessing the library's book **database**.
- ⇒ When you go on-line and purchase some product, you are accessing the web merchant's product **database**.
- ⇒ Your friendly bank keeps all your financial records on their **database**. When you receive your monthly statement, the bank generates a **database report**.
- ⇒ When you call to make a doctor appointment, the receptionist looks into their **database** for available times.
- ⇒ When you go to your car dealer for repairs, the technician calls up your past work record on the garage **database**.
- ⇒ At the grocery store, when the checker scans each product, the price is found in the store's **database**, where inventory control is also performed.
- ⇒ When you are watching a baseball game on television and the announcer tells you that “the batter is hitting .328 against left-handed pitchers whose mother was born in Kentucky on a Tuesday morning,” that useless information is pulled from the team's **database** (apologies to our foreign readers who don't understand the American game of baseball!).

You can surely think of many more places that databases enter your life. The idea is that they are everywhere. And, each database requires some way for a user to interact with the information

within. Such interaction is performed by a **database management system (DBMS)**.

The tasks of a **DBMS** are really quite simple. In concept, there are only a few things you can do with a database:

1. View the data
2. Find some data of interest
3. Modify the data
4. Add some data
5. Delete some data

There are many commercial database management systems that perform these tasks. Programs like Access (a Microsoft product) and Oracle are used worldwide. In this course, we look at using **Visual C# as a DBMS**.

Examples where you might use Visual C# as a DBMS:

- ⇒ Implementing a new application that requires management of a database
- ⇒ Connecting to an existing database
- ⇒ Interacting with a database via a server or the internet

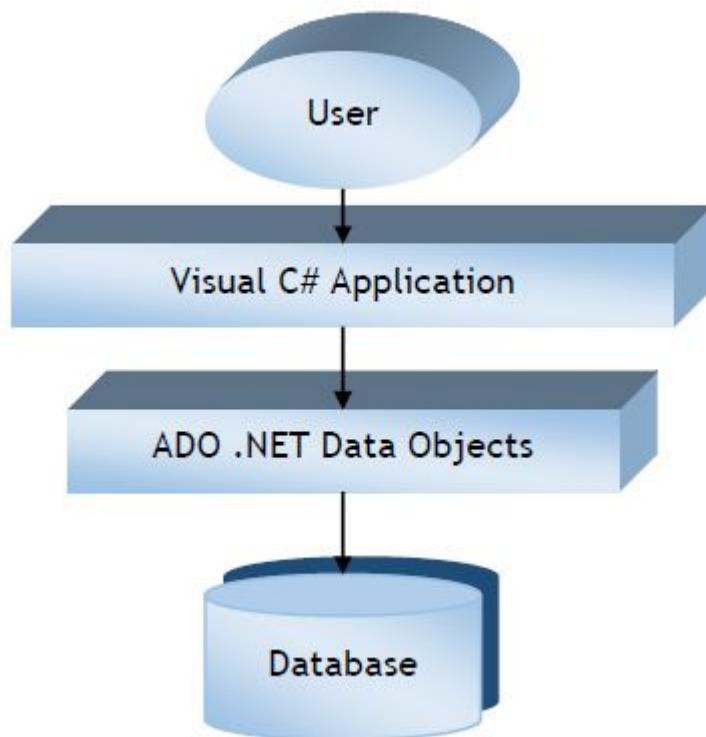
In a DBMS, the database may be available **locally** on your (or the user's) computer, available on a **LAN** (local area network) shared by multiple users, or only available on a **web server** via the Internet. In this course, we spend most of our time looking at local databases, but access with remote databases is addressed.

We will look at databases in more depth in the next chapter. You will see that databases have their own vocabulary. Now, let's take a look at how Visual C# fits into the database management system.

Where Does Visual C# Fit In?

For database management, we say our Visual C# application acts as a **front-end** to the database. This means the Visual C# application provides the **interface** between the user and the database. This interface allows the user to tell the database what he or she needs and allows the database to respond to the request displaying the requested information in some manner.

A Visual C# application cannot directly interact with a database. There is a set of intermediate components between the application and the database known as **ADO (ActiveX Data Object) .NET data objects**:



The **data objects** are Visual C# components that allow connection to the database, creation of data sets from the database and management of the database contents. These objects are the conduit between the application and the database, passing information back and forth between the two.

As mentioned earlier, there are many commercial products (Access, SQL Server, Oracle) that do database management tasks. You may be asking why use Visual C# as a database management system (DBMS) when these commercial products are available? There are two primary advantages to using Visual C# as a DBMS instead of Access:

1. Your users don't need to have any commercial product installed on their computers or know how to use such products. This saves the users money.
2. By building a custom front-end, you limit what your user can do with the information within the database. Under normal operation, commercial DBMS provide no such limits.

So, in this course, we will look at how to build Visual C# applications that operate as front-ends to databases. Research has shown that over half of all Visual C# applications involve working with databases. We will look at how to make our applications into complete database management systems, being able to view, search, modify, add, and/or delete database information.

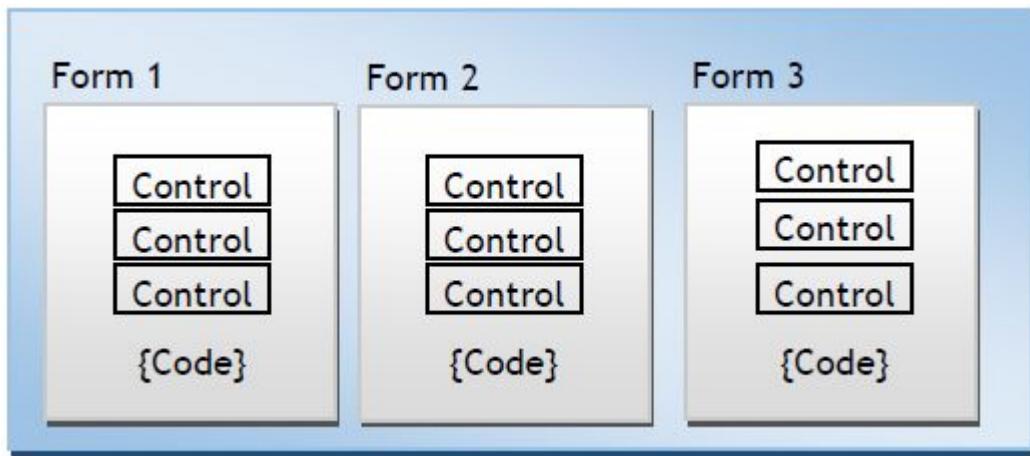
Before going any further, let's review the steps in building a Visual C# application and then build a simple application for practice.

Building a Visual C# Application

In the remainder of this chapter, we will provide an overview of a Visual C# application and how the Visual C# development environment is used to develop an application. This should provide you with some idea of what knowledge you need to possess to proceed in this course and introduce the terminology used by the author to describe a Visual C# application.

Structure of a Visual C# Windows Application

Project



Application (Project) is made up of:

- **Forms** - Windows that you create for user interface
- **Controls** - Graphical features drawn on forms to allow user interaction (text boxes, labels, scroll bars, buttons, etc.) (Forms and Controls are **objects**.)
- **Properties** - Every characteristic of a form or control is specified by a property. Example properties include names, captions, size, color, position, and contents. Visual C# applies default properties. You can change properties when designing the application or even when an application is executing.
- **Methods** - Built-in methods that can be invoked to impart some action to a particular control or object.
- **Event Methods** - **Code** related to some object or control. This is the code that is executed when a certain event occurs. In

our applications, this code will be written in the C# language (covered in detail in Chapter 2 of these notes).

- **General Methods** - Code not related to objects. This code must be invoked or called in the application.

Steps in Developing Application

There are three primary steps involved in building a Visual C# application:

1. **Draw the user interface**
2. **Assign properties to controls**
3. **Write code for event methods.** Develop any needed general methods.

We'll look at each step.

Drawing the User Interface and Setting Properties

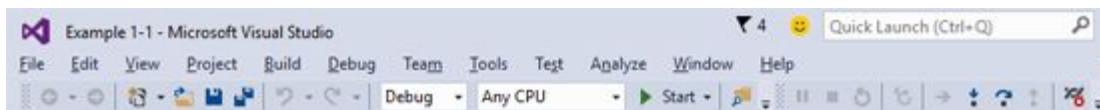
Visual C# operates in three modes.

- ⇒ **Design mode** - used to build application
- ⇒ **Running mode** - used to run the application
- ⇒ **Debugging mode** - application halted and debugger is available

We focus here on the **design mode**.

Several windows should appear when you start Visual C#. If any of these windows do not appear, they may be accessed using the main window **View** item.

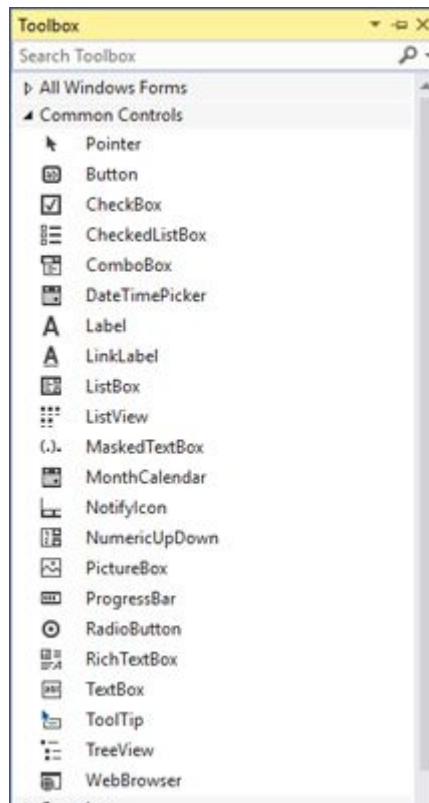
- ⇒ The **Main Window** consists of the title bar, menu bar, and toolbar. The title bar indicates the project name. The menu bar has drop-down menus from which you control the operation of the Visual C# environment. The toolbar has buttons that provide shortcuts to some of the menu options (ToolTips indicate their function).



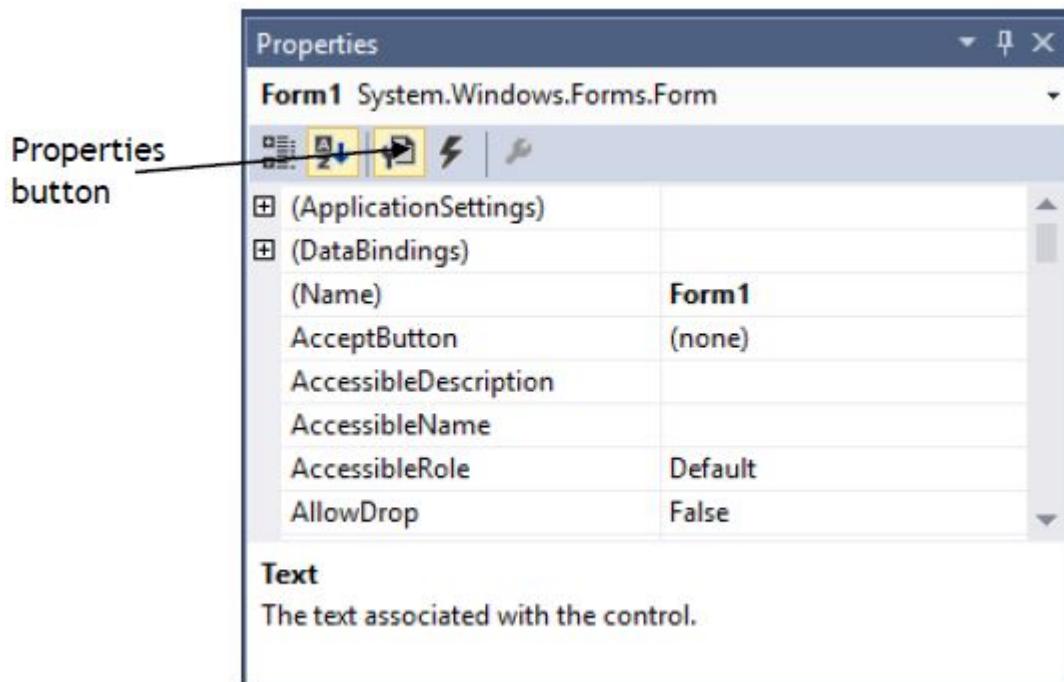
- ⇒ The **Form Window** is central to developing Visual C# applications. It is where you draw your application.



⇒ The **Toolbox** is the selection menu for controls (objects) used in your application.

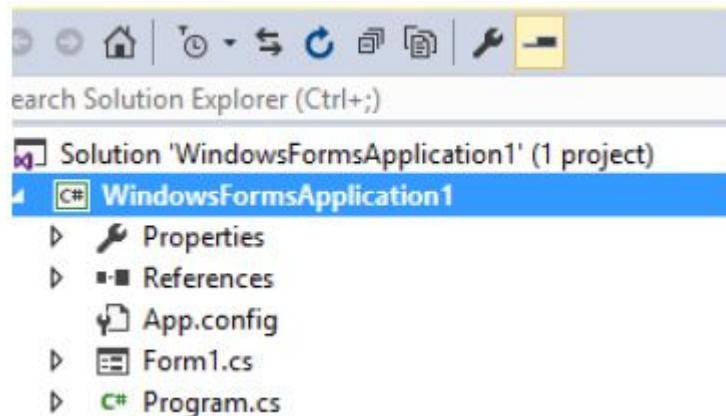


The **Properties Window** serves two purposes. Its primary purpose is to establish design mode (initial) property values for objects (controls). It can also be used to establish event methods for controls. Here, we just look at how to work with properties. To do this, click the **Properties** button in the task bar:



The drop-down box at the top of the window lists all objects in the current form. Under this box are the available properties for the active (currently selected) object. Two property views are available: **Alphabetic** and **Categorized** (selection is made using menu bar under drop-down box). Help with any property can be obtained by highlighting the property of interest and pressing <F1>.

- ⇒ The **Solution Explorer Window** displays a list of all forms and other files making up your application

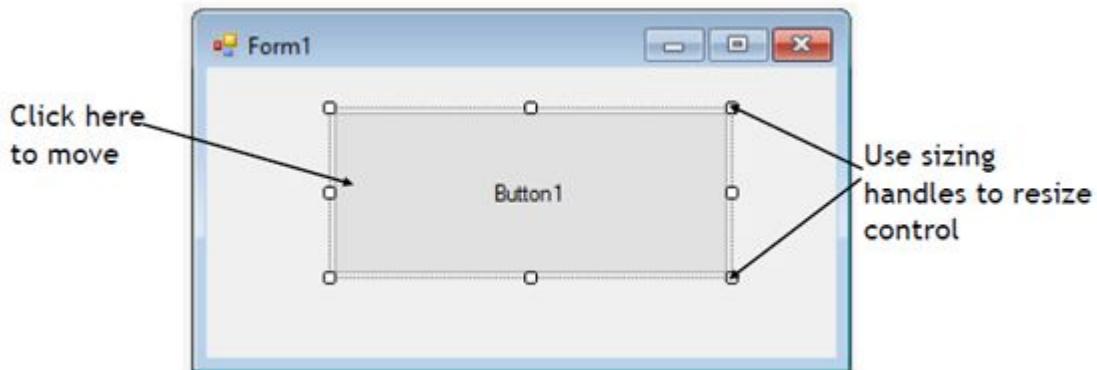


As mentioned, the user interface is ‘drawn’ in the form window. There are four ways to place controls on a form:

1. Click the tool in the toolbox and hold the mouse button down. Drag the selected tool over the form. When the cursor pointer is at the desired upper left corner, release the mouse button and the default size control will appear. This is the classic “drag and drop” operation.
2. Double-click the tool in the toolbox and it is created with a default size on the form. You can then move it or resize it.
3. Click the tool in the toolbox, then move the mouse pointer to the form window. The cursor changes to a crosshair. Place the crosshair at the upper left corner of where you want the control to be and click the left mouse button. The control will appear at the clicked point.
4. Click the tool in the toolbox, then move the mouse pointer to the form window. The cursor changes to a crosshair. Place the crosshair at the upper left corner of where you want the control to be, press the left mouse button and hold it down while dragging the cursor toward the lower right corner. A rectangle will be drawn. When you release the mouse button, the control is drawn in the rectangle.

To **move** a control you have drawn, click the object in the form (a cross with arrows will appear). Now, drag the control to the new location. Release the mouse button.

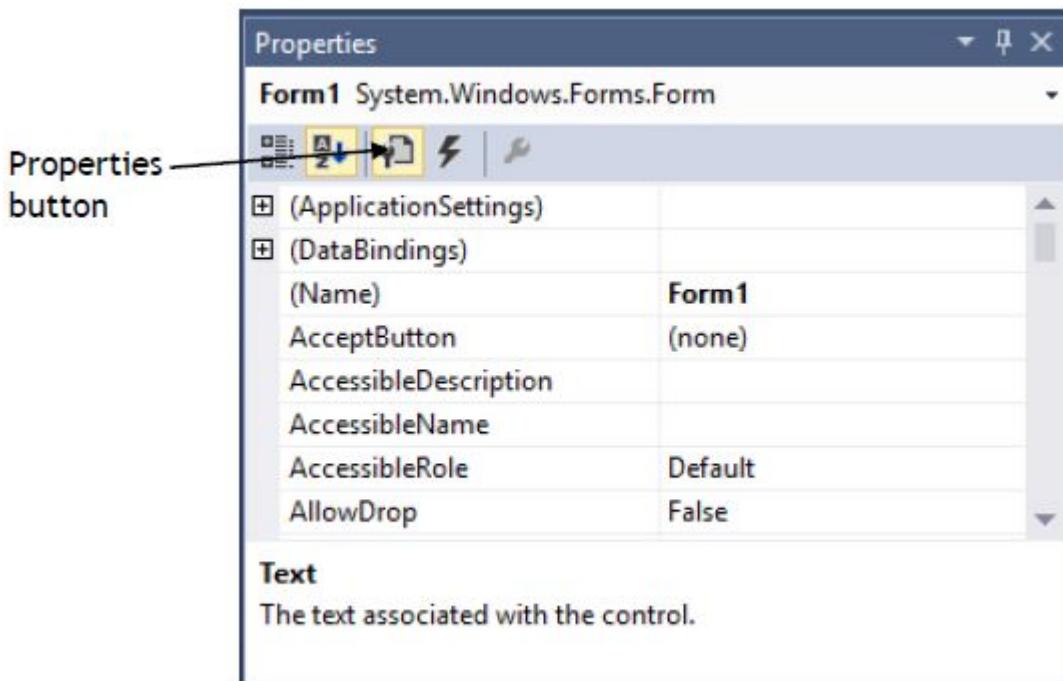
To **resize** a control, click the control so that it is selected (active) and sizing handles appear. Use these handles to resize the object.



To delete a control, select that control so it is active (sizing handles will appear). Then, press **<Delete>** on the keyboard. Or, right-click the control. A menu will appear. Choose the **Delete** option. You can change your mind immediately after deleting a control by choosing the **Undo** option under the **Edit** menu.

Setting Properties of Controls at Design Time

Each form and control has **properties** assigned to it by default when you start up a new project. There are two ways to display the properties of an object. The first way is to click on the object (form or control) in the form window. Sizing handles will appear on that control. When a control has sizing handles, we say it is the **active** control. Now, click on the Properties window or the Properties window button in the tool bar. The second way is to first click on the Properties window. Then, select the object from the drop-down box at the top of the Properties window. When you do this, the selected object (control) will now be active (have sizing handles). Shown is the Properties window (make sure the **Properties** button, not the **Events** button is selected in the toolbar) for the Form object:



The drop-down box at the top of the Properties Window is the **Object** box. It displays the name of each object in the application as well as its type. This display shows the **Form** object. The **Properties** list is directly below this box. In this list, you can scroll through the list of properties for the selected object. You select a property by clicking on it. Properties can be changed by typing a new value or choosing from a list of predefined settings (available as a drop down list). Properties can be viewed in two ways: **Alphabetic** and **Categorized** (selected using the menu bar under the Object box). At the bottom of the Properties window is a short description of the selected property (a kind of dynamic help system).

A very important property for each control is its **Name**. The name is used by Visual C# to refer to a particular object or control in code. A convention has been established for naming Visual C# controls. This convention is to use a three letter (lower case) prefix (identifying the type of control) followed by a name you assign. A few of the prefixes are (we'll see more as we progress in the notes):

Control	Prefix	Example
Form	frm	frmWatch
Button	btn	btnExit, btnStart
Label	lbl	lblStart, lblEnd
Text Box	txt	txtTime, txtName
Menu	mnu	mnuExit, mnuSave
Check box	chk	chkChoice

It is suggested to use a mixture of upper and lower case letters for better readability. But, be aware that Visual C# is a case-sensitive language, meaning the names **frmWatch** and **FRMWATCH** would not be the same name.

Control (object) names can be up to 40 characters long, must start with a letter, must contain only letters, numbers, and the underscore (_) character. Names are used in setting properties at run-time and also in establishing method names for control events. Use meaningful names that help you (or another programmer) understand the type and purpose of the respective controls.

Setting Properties at Run Time

In addition to setting properties at design time, you can set or modify properties while your application is running. To do this, you must write some code. The code format is:

```
objectName.PropertyName = NewValue;
```

Such a format is referred to as dot notation. For example, to change the **BackColor** property of a button named **btnStart**, we'd type:

```
btnStart.BackColor = Color.Blue;
```

Good naming conventions make it easy to understand what's going on here. The button named **btnStart** will now have a blue background.

How Names are Used in Control Events

The names you assign to controls are also used by Visual C# to set up a framework of event-driven methods for you to add code to. Hence, proper naming makes these methods easier to understand.

The format for each of these methods is:

```
private void ControlName_Event(Arguments)
{
}
```

where **Arguments** provides information needed by the method to do its work.

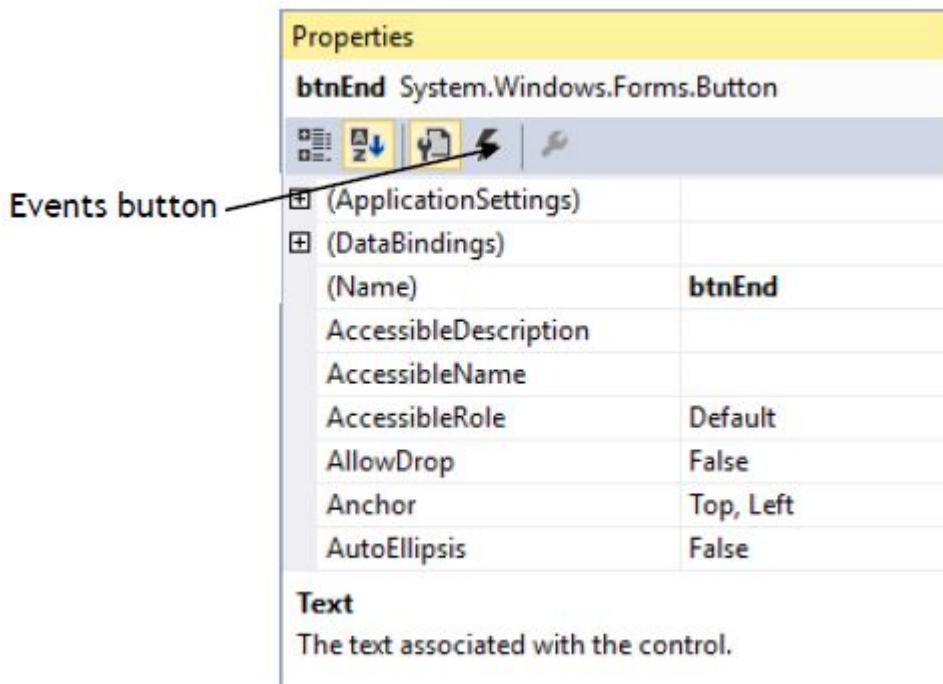
Visual C# provides the header line with its information and arguments and left and right curly braces (all code goes between these two braces) delineating the start and end of the method. Notice that with proper naming convention, it is easy to identify what tasks are associated with a particular event of a particular control.

Writing Code

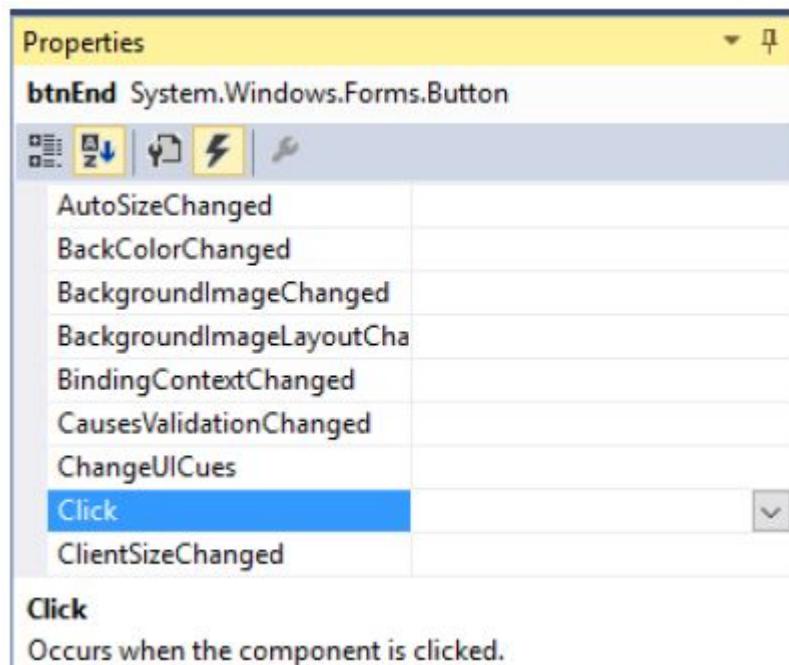
The last step in building a Visual C# application is to write code using the **C#** language. This is the most time consuming task in any Visual C# application. It is also the most fun and most rewarding task. As controls are added to a form, Visual C# automatically builds a framework of all event methods. We simply add code to the event methods we want our application to respond to. And, if needed, we write general methods.

Code is placed in the **Code Window**. There are two ways to establish event methods for controls - one directly from the form and one using the properties window. Let's look at both. Every control has a **default event method**. This is the method most often used by the control. For example, a button control's default event method is the **Click** event, since this is most often what we do to a button. To access a control's default event method, you simply double-click the control on the form.

Though simple and quick, double-clicking a control to establish a control event method will not work if you are not interested in the default event. In that case, you need to use the properties window. Recall we mentioned that the properties window is not only used to establish properties, but also event methods. To establish an event method using the properties window, click on the **Events** button (appears as a lightning bolt) in the properties window toolbar:



The active control's events will be listed (the default event will be highlighted):



To establish an event method, scroll down the listed events and double-click the one of interest. The selected event method will

appear in the code window.

There are a few rules to pay attention to as you type Visual C# code:

- Visual C# is case-sensitive, meaning upper and lower case letters are considered to be different characters. When typing code, make sure you use upper and lower case letters properly
- Visual C# ignores any “**white space**” such as blanks. We will often use white space to make our code more readable.
- Curly **braces** are used for grouping. They mark the beginning and end of programming sections. Make sure your Visual C# programs have an equal number of left and right braces. We call the section of code between matching braces a **block**.
- It is good coding practice to **indent** code within a block. This makes code easier to follow. The Visual C# environment automatically indents code in blocks for you.
- Every Visual C# statement will end with a semicolon. A **statement** is a program expression that generates some result. Note that not all Visual C# expressions are statements (for example, the line defining the form constructor has no semicolon).

Review of Variables

Variables are used by Visual C# to hold information needed by your application. Rules used in naming variables:

- ⇒ No more than 40 characters
- ⇒ They may include letters, numbers, and underscore (_)
- ⇒ The first character must be a letter which, by convention, is usually lower case
- ⇒ You cannot use a reserved word (word needed by Visual C#)

Visual C# Data Types

- ⇒ **bool** (true or false)
- ⇒ **int, long** (Whole numbers)
- ⇒ **short, float, double** (Floating point numbers)
- ⇒ **DateTime**
- ⇒ **string** (Used for many control properties)
- ⇒ **char** (single character string variables)
- ⇒ **Object** (yes, objects can be variables!)

Variable Declaration

Once we have decided on a variable name and the type of variable, we must tell our Visual C# application what that name and type are. We say, we must **explicitly declare** the variable.

There are many advantages to **explicitly** typing variables. Primarily, we insure all computations are properly done, mistyped variable names are easily spotted, and Visual C# will take care of insuring consistency in variable names. Because of these advantages, and because it is good programming practice, we will always explicitly type variables.

To **explicitly** type a variable, you must first determine its **scope**. Scope identifies how widely disseminated we want the variable value to be. We will use three levels of scope:

- Block level
- Method level
- Form level

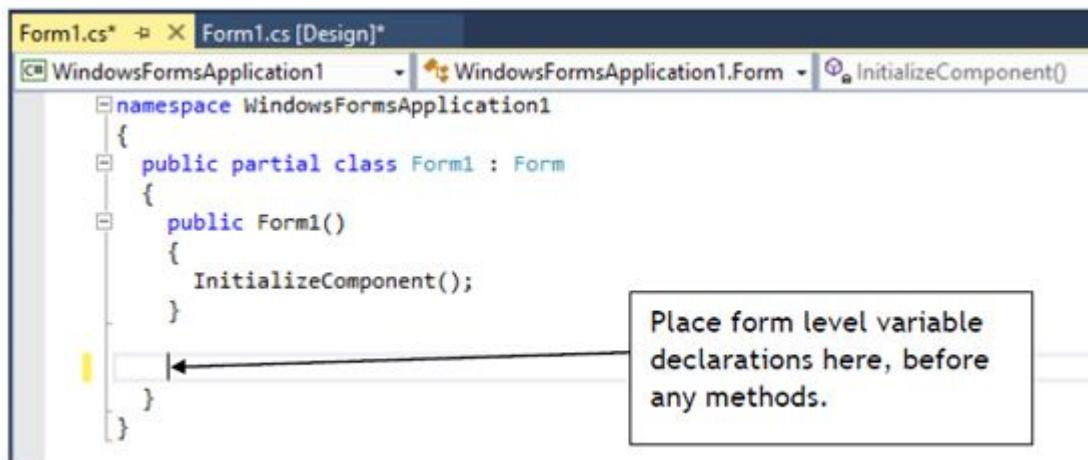
Block level variables are only usable within a single block of code (will be discussed in more detail in Class 2).

The value of **method level** variables are only available within a method. Such variables are declared within a method, using the variable type as a declarer:

```
int myInt;  
double myDouble;  
string myString, yourString;
```

These declarations are usually placed after the opening left curly brace of a method.

Form level variables retain their value and are available to all methods within that form. Form level variables are declared in the code window right after the **Form constructor** generated automatically by Visual C#, outside of any other method:



The screenshot shows the Visual Studio IDE with the code editor open for Form1.cs. The code is as follows:

```
namespace WindowsFormsApplication1
{
    public partial class Form1 : Form
    {
        public Form1()
        {
            InitializeComponent();
        }
    }
}
```

A callout box points to the line before the constructor declaration, with the text: "Place form level variable declarations here, before any methods."

Form level variables are declared just like method level variables:

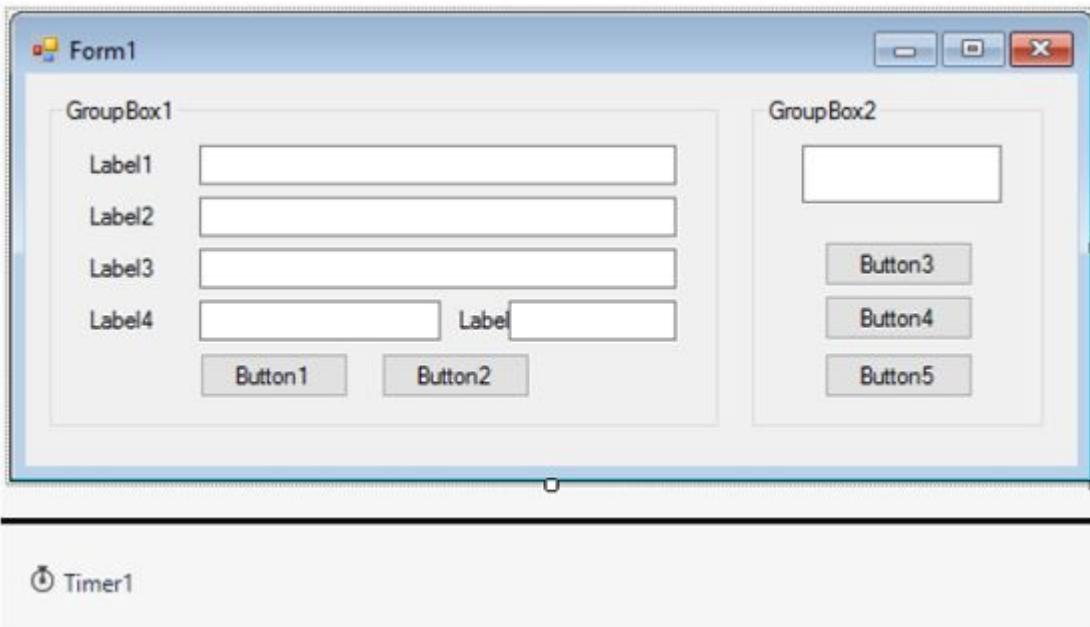
```
int myInt;
DateTime myDate;
```


Example 1-1

Mailing List Application

In this example, we will build a Visual C# application that could function as a database interface. The application allows the entry of information (names and addresses) to build a mailing list. An added feature is a timer that keeps track of the time spent entering addresses. After each entry, rather than write the information to a database (as we would normally do), the input information is simply displayed in a Visual C# message box. We present this example to illustrate the steps in building an application. If you feel comfortable building this application and understanding the corresponding code, you probably possess the Visual C# skills needed to proceed with this course.

1. Start a new project. Place two group boxes on the form (one for entry of address information and one for the timing function). In the first group box, place five labels, five text boxes, and two buttons. In the second group box, place a text box and three buttons. Add a timer control. Resize and position controls so your form resembles this:



- Set properties for the form and controls (these are just suggestions - make any changes you might like):

Form1:

Name	frmMailingList
FormBorderStyle	Fixed Single
Text	Mailing List Application

groupBox1:

Name	grpMail
Text	Address Information
Enabled	False

label1:

Text	Name
------	------

label2:

Text	Address
------	---------

label3:

Text City

label4:

Text State

label5:

Text Zip

textBox1:

Name txtName
TabIndex 0

textBox2:

Name txtAddress
TabIndex 1

textBox3:

Name txtCity
TabIndex 2

textBox4:

Name txtState
TabIndex 3

textBox5:

Name txtZip
TabIndex 4

button1:

Name btnAccept
Text &Accept
TabIndex 5

button2:

Name btnClear
Text &Clear

groupBox2:

Name grpTime
Text Elapsed Time

textBox6:

Name txtElapsedTime
Font Bold, Size 14
TabStop False
Text 00:00:00
TextAlign Center

button3:

Name btnStart
Text &Start

button4:

Name btnPause
Text &Pause
Enabled False

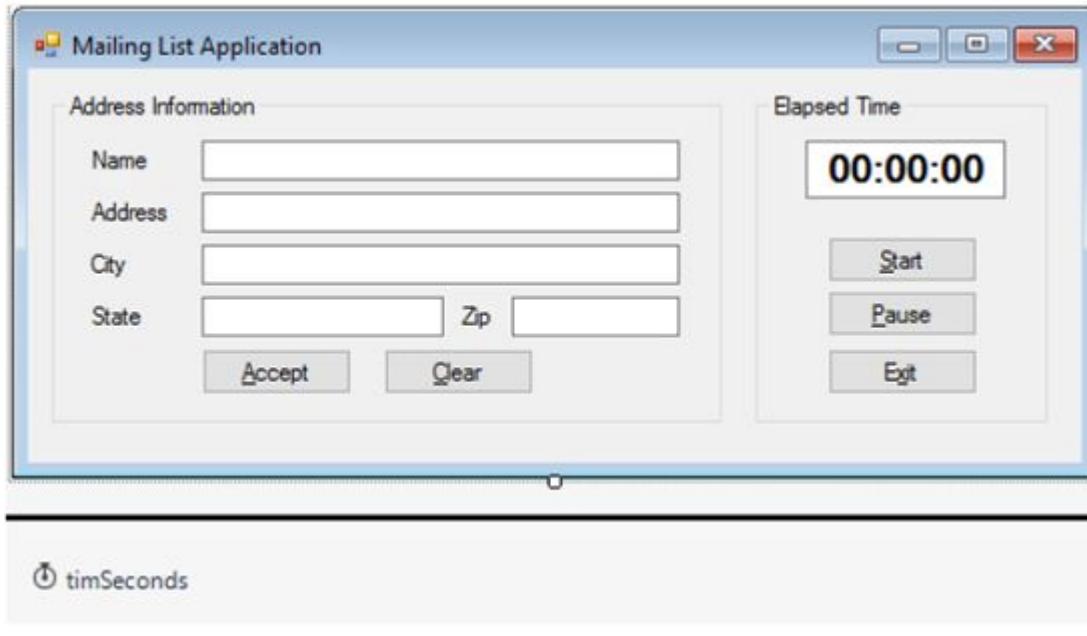
button5:

Name btnExit
Text E&xit

timer1:

Name timSeconds
Enabled False
Interval 1000

When done, the form should appear something like this:



3. Form level variable declarations:

```
DateTime lastNow;  
TimeSpan elapsedTime;
```

4. Put this code in the `btnStart_Click` event method:

```
private void btnStart_Click(object sender, EventArgs e)  
{  
    // Start button clicked  
    // Disable start and exit buttons  
    // Enabled pause button  
    btnStart.Enabled = false;  
    btnExit.Enabled = false;  
    btnPause.Enabled = true;  
    // Establish start time and start timer control  
    lastNow = DateTime.Now;  
    timSeconds.Enabled = true;  
    // Enable mailing list frame
```

```
    grpMail.Enabled = true;  
    txtName.Focus();  
}
```

5. Put this code in the **btnPause_Click** event method:

```
private void btnPause_Click(object sender, EventArgs e)  
{  
    // Pause button clicked  
    // Disable pause button  
    // Enabled start and exit buttons  
    btnPause.Enabled = false;  
    btnStart.Enabled = true;  
    btnExit.Enabled = true;  
    // Stop timer  
    timSeconds.Enabled = false;  
    // Disable editing frame  
    grpMail.Enabled = false;  
}
```

6. Put this code in the **btnExit_Click** event method:

```
private void btnExit_Click(object sender, EventArgs e)  
{  
    this.Close();  
}
```

7. Put this code in the **timSeconds_Timer** event method:

```
private void timSeconds_Tick(object sender, EventArgs e)
```

```

{
    // Compute elapsed time and display
    elapsedTime += DateTime.Now - lastNow;
    txtElapsedTime.Text = Convert.ToString(new
TimeSpan(elapsedTime.Hours, elapsedTime.Minutes,
elapsedTime.Seconds));
    lastNow = DateTime.Now;
}

```

Note a couple of lines in the code above are so long that the word processor wraps them around at the margin. Type each as one long line, not two separate lines. Be aware this happens quite often in these notes when actual code is being presented.

8. Put this code in the **txtInput_KeyPress** event method (handles the KeyPress event for all input text boxes):

```

private void txtInput_KeyPress(object sender,
KeyPressEventArgs e)
{
    String boxName = ((TextBox) sender).Name;
    // Check for return key
    if ((int) e.KeyChar == 13)
    {
        switch (boxName)
        {
            case "txtName":
                txtAddress.Focus();
                break;
            case "txtAddress":
                txtCity.Focus();
                break;
        }
    }
}

```

```

        case "txtCity":
            txtState.Focus();
            break;
        case "txtState":
            txtZip.Focus();
            break;
        case "txtZip":
            btnAccept.Focus();
            break;
    }
}

// In zip text box, make sure only numbers or
// backspace pressed
if (boxName.Equals("txtZip"))
{
    if ((e.KeyChar >= '0' && e.KeyChar <= '9') ||
        (int) e.KeyChar == 8)
    {
        e.Handled = false;
    }
    else
    {
        e.Handled = true;
    }
}

```

9. Put this code in the **btnAccept_Click** event method:

```

private void btnAccept_Click(object sender, EventArgs
e)
{

```

```

string s;
// Accept button clicked - form label and output
// in message box
// Make sure each text box has entry
if (txtName.Text.Equals("") ||
txtAddress.Text.Equals("") ||
txtCity.Text.Equals("") ||
txtState.Text.Equals("") ||
txtZip.Text.Equals("")))
{
    MessageBox.Show("Each box must have an entry!",
    "Error", MessageBoxButtons.OK,
    MessageBoxIcon.Information);
    txtName.Focus();
    return;
}
s = txtName.Text + "\r\n" + txtAddress.Text +
"\r\n";
s += txtCity.Text + ", " + txtState.Text + " " +
txtZip.Text;
MessageBox.Show(s, "Mailing Label",
MessageBoxButtons.OK);
btnClear.PerformClick();
}

```

10. Put this code in the `btnClear_Click` event method:

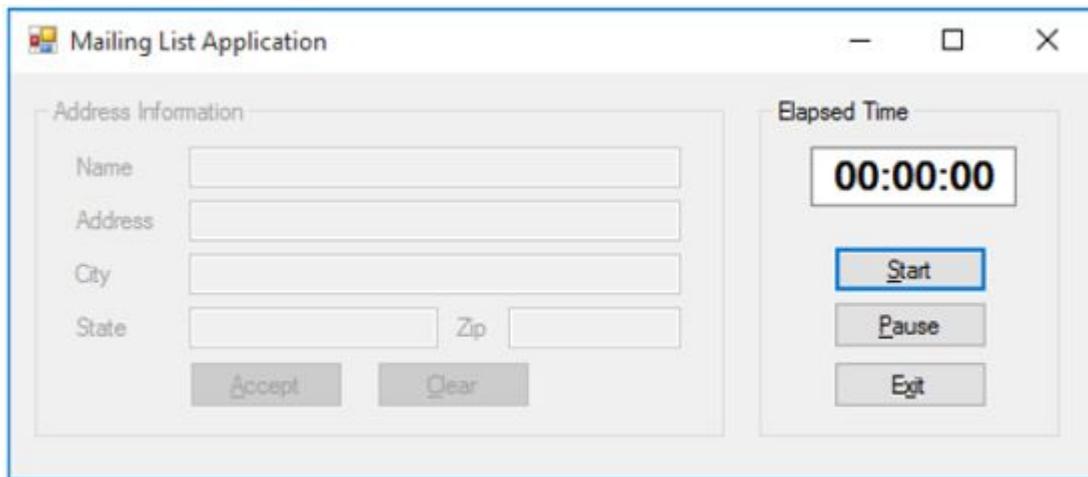
```

private void btnClear_Click(object sender, EventArgs
e)
{
    txtName.Text = "";
    txtAddress.Text = "";
    txtCity.Text = "";

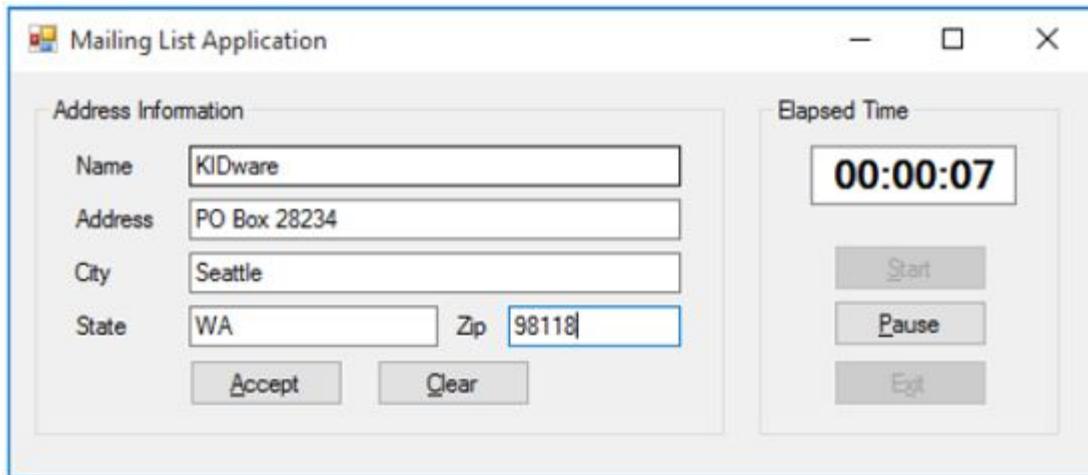
```

```
txtState.Text = "";  
txtZip.Text = "";  
txtName.Focus();  
}
```

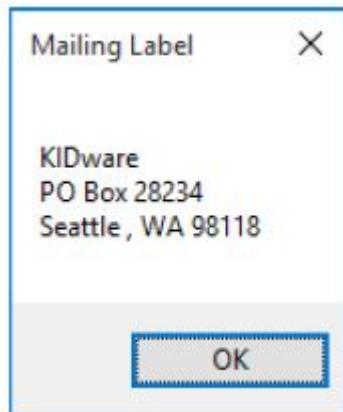
11. Save the application (saved in the **Example 1-1** folder in **VCSDB\Code\Class 1** folder). Run the application. Make sure it functions as designed. Here's the running program.



Note that you cannot enter mailing list information unless the timer is running. Here's the program after I entered some information:



and here's what I see when I click **Accept**:



Summary

In this chapter, we introduced databases in general terms and how Visual C# can be used to develop a front-end application to interact with the database. And, we reviewed the steps involved in building a Visual C# application.

In the second chapter, we take a closer look at databases. We look at their structure, their terminology, and how they are constructed. You may be asking - when do we get to do some programming? The answer - in a couple more chapters. We want to make sure we have a firm foundation in place before diving into actual coding.

2

Introduction to Databases

Review and Preview

In the last chapter, we looked at a database in very general terms. We learned that the central parts of a Visual C# database application are the ADO .NET data objects.

In this chapter, we provide more details into the structure of databases and how they are created. We will use a sample database to illustrate the concepts presented.

Database Structure and Terminology

In simplest terms, a **database** is a collection of information. This collection is stored in one or more well-defined **tables**, or **matrices**.

The **rows** in a database table are used to describe similar items. The rows are referred to as database **records**. In general, no two rows in a database table will be alike.

The **columns** in a database table provide characteristics of the records. These characteristics are called database **fields**. Each field contains one specific piece of information. In defining a database field, you specify the data type, assign a length, and describe other attributes. Some field types include Binary, Boolean, Counter, Double, Single, Long, Integer, etc.

Here is a simple database example:

Field				
ID_No	Name	Date_of_Birth	Height	Weight
1	Bob Jones	01/04/58	72	170
2	Mary Rodgers	11/22/61	65	125
3	Sue Williams	06/11/57	68	130

Table

Record

In this database **table**, each **record** represents a single individual. The **fields** (descriptors of the individuals) include an identification number (ID_No), Name, Date_of_Birth, Height, and Weight.

Most databases use **indexes** to allow faster access to the information in the database. Indexes are sorted lists that point to a particular row in a table. We can create an index for any field we might want to perform a search on. The neat thing about an index is that the Visual C# data objects handle all the details. We simply flag a field as an index and the code does the work.

A database using a single table is called a **flat database**. Early database software worked only with flat databases. And, for simple applications, flat databases may be adequate. For large amounts of data, however, flat databases are cumbersome and become very large, very quickly.

Relational Databases

Most databases are made up of many tables stored in a single file. Each table contains a logical grouping of information with its own records and fields. When using multiple tables within a database, the tables must have some common fields to allow cross-referencing of the tables. The referral of one table to another via a common field is called a **relation**. Such groupings of tables are called **relational databases**.

Relational databases allow us to store vast amounts of data with far simpler maintenance and smaller storage requirements than the equivalent flat database. As an example, say we had a flat database listing products stocked by a grocery store with several fields describing each product's manufacturer (manufacturer name, address, phone, ...). If you have 1,000 products made by the same manufacturer, there is much repetition of information in the flat database. And, if the manufacturer changed their phone number, you would have to make that change in 1,000 places! In a relational database, you could use two tables, one for products, one for manufacturers. In the product table, you would simply have a manufacturer ID that would correspond with an ID in the manufacturer table (a **relation**), which would have that manufacturer's information. Then, if the phone number changed, you would only have to change one field in the manufacturer table - quite a savings in work! When you break down database tables into simpler tables, the process is known as **database normalization**.

Relations among tables in a relational database are established using **keys**. A **primary key** is a field that uniquely identifies a record so it can be referenced from a related table. A **foreign key** is a field that holds identification values to relate records stored in other tables.

When one record in one table is linked to only one record in another table, we say there is a **one-to-one** relation. When one record in one table links to many records in another table, we say there is a **one-to-many** relation. And, when many records in one table are linked to many records in another table, we say there is a **many-to-many** relation.

In the first few chapters in this course, we will use a sample Microsoft Access database. This relational database (**BooksDB.accdb**) is found in the **VCSDB\Datasets** folder installed with these notes. This database is a classic, used by generations of programmers to understand database programming. You will become very familiar with this database. It is a database of books about computer programming (and databases). Let's look at its relational structure to illustrate the many new concepts being introduced.

Using SQL Server Databases

You may notice that the sample used here (**BooksDB.accdb**) is a Microsoft Access database. These notes were originally developed using Access databases. If you prefer to use SQL Server databases, the notes have been modified to allow this capability. In each chapter of the notes look for sections entitled **Using SQL Server Databases** for particular modifications needed in that particular chapter.

To use SQL Server databases, it is assumed you have installed SQL Server on your computer. We use **SQL Server Express 2014** version available as a free download from Microsoft:

<https://www.microsoft.com/en-us/download/details.aspx?id=42299>

The website gives full installation instructions. Download the 64 bit version.

Also, to use SQL Server databases, you need SQL Server versions of the Access databases included with these notes. The SQL Server databases are distinguished by an **mdf** file extension. If interested, these conversions were created with another free Microsoft Product named **SQL Server Migration Assistant for Access**. Information about this product can be found at:

<https://www.microsoft.com/en-us/download/details.aspx?id=43690>

The remainder of the information in this chapter is independent of which database product you choose to use.

Sample Relational Database

The books (BooksDB.accdb) database is made up of four tables:

- Authors** (6,246 records)
- Publishers** (727 records)
- Titles** (8,569 records)
- Title_Author** (16,056 records)

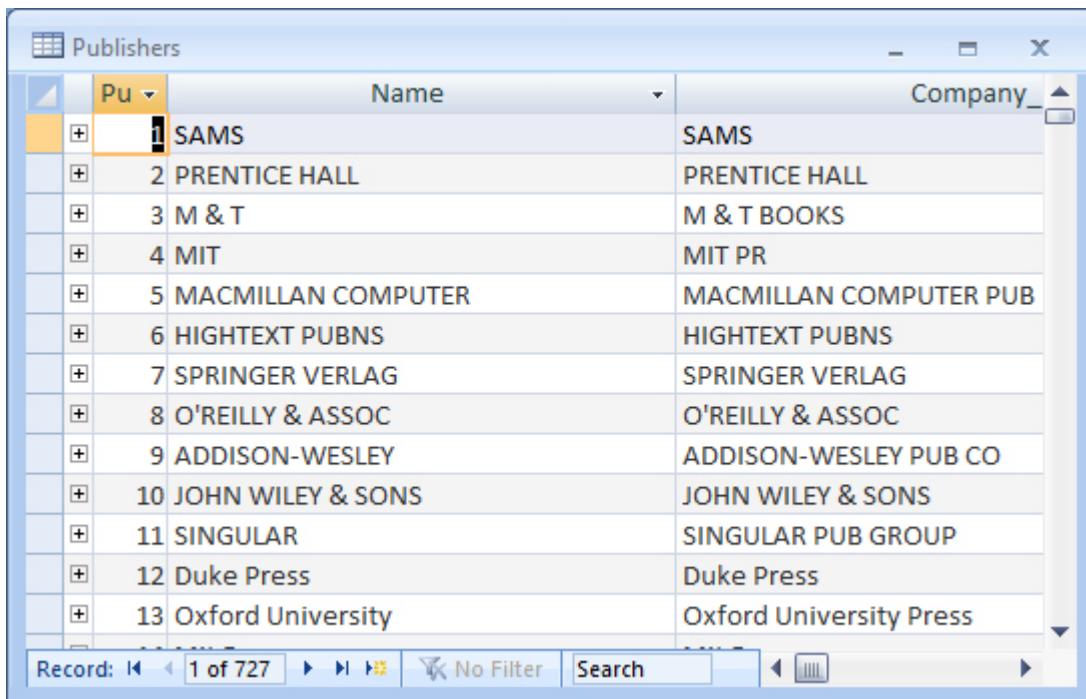
As you look at each table, pay attention to how the tables are logical groupings of information. Examine the record and field structures. In particular, note each field with an 'ID' in the name acts as a key to relate one table to another.

The **Authors** table contains information about the authors of the books in the database. The table has three (3) fields: Au_ID, Name, and Year_Born:

	Au_ID	Author	Year_Born
	1	Jacobs, Russell	
	2	Metzger, Philip W.	
	3	Boddie, John	
	4	Sydow, Dan Parks	
	6	Lloyd, John	
	8	Thiel, James R.	
	10	Ingham, Kenneth	
	12	Wellin, Paul	
	13	Kamin, Sam	
	14	Gaylord, Richard	
	15	Curry, Dave	
	17	Gardner, Juanita Mercado	

There are 6,246 different authors in the database.

The **Publishers** table contains information about the publishers in the book database. The table has ten (10) fields: PubID, Name, Company_Name, Address, City, State, Zip, Telephone, Fax, and Comments:



Pu	Name	Company_
1	SAMS	SAMS
2	PRENTICE HALL	PRENTICE HALL
3	M & T	M & T BOOKS
4	MIT	MIT PR
5	MACMILLAN COMPUTER	MACMILLAN COMPUTER PUB
6	HIGHTEXT PUBNS	HIGHTEXT PUBNS
7	SPRINGER VERLAG	SPRINGER VERLAG
8	O'REILLY & ASSOC	O'REILLY & ASSOC
9	ADDISON-WESLEY	ADDISON-WESLEY PUB CO
10	JOHN WILEY & SONS	JOHN WILEY & SONS
11	SINGULAR	SINGULAR PUB GROUP
12	Duke Press	Duke Press
13	Oxford University	Oxford University Press

There are 727 different publishers in the database.

The **Titles** table contains information about each book title in the database. The table has eight (8) fields: Title, Year_Published, ISBN, PubID, Description, Notes, Subject, and Comments:

	Title
[+]	dBASE III : A Practical Guide
[+]	The dBASE Programming Language
[+]	dBASE III Plus
[+]	Database Management : Developing Application Systems Using Oracle
[+]	Wordstar 4.0-6.0 Quick Reference Guide
[+]	Oracle Triggers and Stored Procedure Programming
[+]	Programming in Clipper
[+]	Inside Macintosh
[+]	Omni Online Database Directory
[+]	Structured C for Engineering and Technology/Book and Diskette
[+]	An Introduction to Assembly Language Programming for the Intel 8088 I
[+]	Applied Calculus With Linear Programming : For Business, Economics, L
[+]	Information Systems Literacy and Software Productivity Tools : Dos, Wc
[+]	Information Systems Literacy and Software Productivity Tools : dBASE II
[+]	Information Systems Literacy and Software Productivity Tools : Lotus 1-

There are 8,569 distinct book titles in the database.

The **Title_Author** table contains information relating book titles to authors within the database. It has just two fields: ISBN (International Standard Book Number, a number used by bookstores and libraries to reference books) and Au_ID:

ISBN	Au_ID
0-0038307-6-4	7576
0-0038326-7-8	7576
0-0038337-8-X	7661
0-0131985-2-1	5681
0-0131985-2-1	5684
0-0133656-1-4	1454
0-0134436-3-1	128
0-0134436-3-1	132
0-0230081-2-1	203
0-0230081-2-1	659
0-0230081-2-1	1304
0-0230081-2-1	1306
0-0230362-0-6	203

There are 16,056 entries in this table. You may wonder - if there are 8,569 titles in the database, how can there be nearly twice as many entries in this table. The answer is that many books have more than one author and this table lists all the authors for each title.

There is obviously a lot of information in the books database! This example, though, is very useful and shows the kind of database we can work with using Visual C#. It is a well-designed database we can learn from. We will discuss database design in a later chapter, so much of what is discussed here will be very useful information later on. You may be wondering - where did these views of the database tables come from? They were obtained using Microsoft Access. In a couple of more chapters, you will be able to obtain such views using Visual C#.

Sample Database Structure

Let's examine the books database a little closer. To help, we'll use this block diagram (obtained using Access) that illustrates the database structure:



This diagram shows each table as a separate window listing the corresponding fields. Relations between tables are illustrated via linear links.

Look at the books database tables. Note each table is a logical grouping of information. Book publishers are in a single table (**Publishers**), book titles are in a single table (**Titles**), and book authors are in a single table (**Authors**). A well-designed database has such well-defined tables. Well-defined tables make database management a far simpler task.

Note each table has two types of information: **source data** and **relational data**. Source data is actual information, such as names, phone numbers, and addresses. Relational data are references to data in other tables via **keys**, such as **PubID**, **ISBN**, and **Au_ID**.

A **primary key** defines a unique record. **PubID** in the **Publishers** table, **ISBN** in the **Titles** Table, and **Au_ID** in the **Authors** table are

primary keys. They identify a unique entry in their respective table.

A **foreign key** is a piece of relational information in one table that links to information in another table. In the **Titles** table, **PubID** is a foreign key. Using a **PubID** from this table in conjunction with the **PubID** primary key in the **Publishers** table will provide us with complete information about a particular publisher. In the **Title_Author** table, **ISBN** and **Au_ID** are foreign keys.

How the keys are used in the database is shown via the linear links. For example, **PubID** (a primary key) in the **Publishers** table relates to the **PubID** (a foreign key) in the **Titles** table. The one (1) next to **PubID** in the **Publishers** table and the infinity symbol (∞) next to **PubID** in the **Titles** table show this is a **one-to-many** relationship. That is, there is one **PubID** in the **Publishers** table, but this value may appear many times in the **Titles** table.

There is also a one-to-many relationship between **Au_ID** (primary key) in the **Authors** table and **Au_ID** (foreign key) in the **Title_Author** table. The exact relationship between **ISBN** in the **Titles** table and **ISBN** in the **Title_Author** table cannot be determined by Access (indicated by no markings on the linear link). Such indeterminate links will happen occasionally.

Virtual Database Tables

The primary purpose of the books database (BooksDB.accdb) is to track information about book titles. Note each table gives us a piece of information about a particular book, but to get all the information about a book, we need all four tables.

Using the relational data in the four tables, we should be able to obtain a complete description of any book in the database. Let's look at one example. Here's an entry (a record) from the **Titles** table:

Title	1-2-3 Database Techniques
Year_Published	1990
ISBN	0-8802234-6-4
PubID	45
Description	29.95
Notes	650.0285536920
Subject	[Blank]
Comments	HF5548.4.L67A52 1989

Taking the **ISBN** into the **Title_Author** table will provide us with these **Au_ID** values:

Au_ID	2467, 5265, 5266
-------	------------------

Note the book has three authors. Using these **Au_ID** values in the **Authors** table reveals author information:

Au_ID=2467

Author	Stern, Nancy
Year_Born	[Blank]

Au_ID=5265

Author	Weil, Bill
Year_Born	[Blank]

Au_ID=5266

Author	Anderson, Dick
Year_Born	[Blank]

A last relational move of using the PubID in the Publishers table will give us complete details about the book publisher:

Name	QUE CORP
Company_Name	QUE CORP
Address	11711 N College Ave, Suite 140
City	Carmel
State	IN
Zip	46032
Telephone	[Blank]
Fax	[Blank]
Comments	[Blank]

Once done, we know everything there is to know about this one particular book “1-2-3 Database Techniques.” What we essentially have done is formed one huge table with a single record and many, many fields. This new view of the data in the database is called a **virtual database table**. It is virtual because it doesn’t exist as a native table in the BooksDB.accdb database - it was formed using the native four tables.

Making a **query** of the database created a virtual table above. We asked the database to tell us everything it knew about the book “1-2-3 Database Techniques.” The database responded (well, we really did the work) with all information from its four tables. This is a very common task in database management systems and one we will be doing often in this course, **querying the database**. With

each query of the database, we form a virtual table that contains the results of our query. Our queries will not be as comprehensive as the one made here (show me everything!). Usually, the query will ask for all records that meet some particular criteria. As an example, we might like to query the books database to show us all books published by a specific company. The results of this query would be returned in a virtual table.

Database queries are made with a specific language named **SQL** (structured query language). We will study SQL in a later chapter. For now, be aware that SQL can be used to form virtual tables from a database. These tables show us information of interest from the database. And, with Visual C# as the front-end, doing a query with SQL is simple. We form the query, pass it on to the data objects and these objects do all the work for us, returning all records that our query requested. It's like magic! In the first few chapters, we will be doing just that - opening the books database and forming virtual tables we can view.

Creating a Database

Before leaving this database introduction, you may be asking yourself - how are databases like the books database created? How are tables defined? How are fields defined? How are records created?

Databases are created using commercial applications like Access, Oracle, Microsoft SQL Server and others. Each of these products has a design mode where you define a table and the fields that are part of the table. You can also enter records into the table using these applications. The books database was built with Access. In the first part of this course, we will work with existing databases and will not be concerned with creating a database.

Later chapters discuss proper database design and creation of databases. If you have Access and know how to use it, you could also use that when the time for creating a database arises. We will address other possibilities later in the course, including using Visual C# to create a database.

Summary

In this chapter, we looked at our first database - the books database (BooksDB.accdb) that is included with these course notes. We studied the structure of a relational database, discussing tables, records, and fields. Relationships using primary and foreign keys were illustrated.

The concept of a virtual table was introduced. Making a query of the database forms virtual tables. In the next chapter, we begin learning how to use Visual C# to connect to a database and process queries to form such virtual tables.

3

Database Connection

Review and Preview

At this point, we have looked at databases and how they are structured. We have seen that data objects work between the database and the Visual C# ‘front-end’ to manage the database.

In this chapter, for the first time, we use Visual C# to connect to a database. This connection is made with the data objects we have been referring to. Using data bound controls, in conjunction with the data objects, will allow us to view information in the database.

Data Object Overview

Visual C# provides several objects that allow interaction with databases. These objects fall in one of five categories:

- ⇒ **Connections** allow a program to connect to a database
- ⇒ **Data containers** hold data after it has been loaded from a database.
- ⇒ **Data adapters** move data between databases and containers
- ⇒ **Command objects** allow manipulation of the data
- ⇒ **Navigation objects** allow a user to move through (and also modify) data

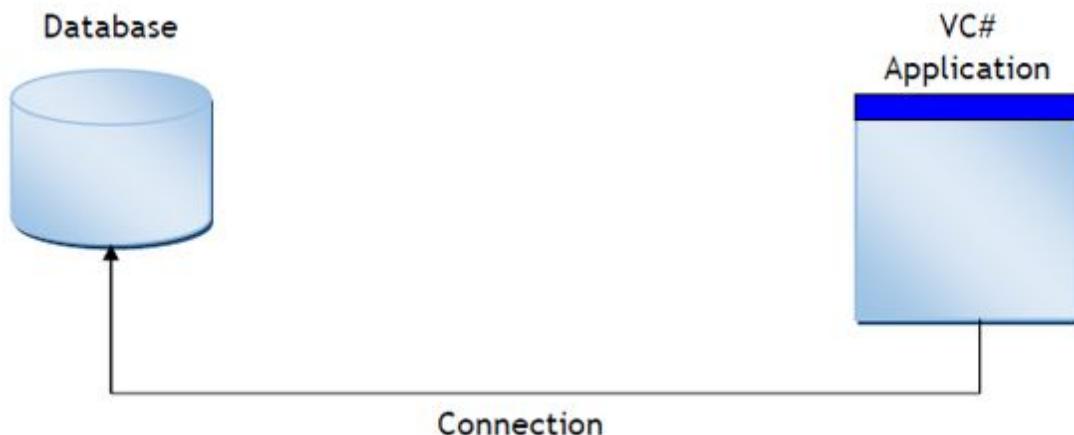
Some objects (data containers, data adapters, navigation objects) are generic in nature and work with any type of database.

Connection objects and command objects are specific to the type of database being used. Visual C# provides objects that work with Object Linking and Embedding Databases (OLE DB), SQL Server, including the Microsoft Data Engine (MSDE), Open Database Connectivity (ODBC) and Oracle databases. Don't worry if you don't understand all this, right now. In these notes, we will work with Access databases (OLE DB) and SQL Server databases. In the final chapter, we'll look at connecting to other databases.

We will look at each data object in detail. As we progress through our discussion of these objects, we will gradually open and view items from the books database using Visual C#.

Connection Object

The **connection object** establishes a connection between your application and the database.



As mentioned, Visual C# supports several databases types. Hence, it offers several different connection objects: **OleDbConnection**, **SqlConnection**, **OdbcConnection**, **OracleConnection**.

Connection object properties:

ConnectionString	Contains the information used to establish a connection to a database.
Database	Name of the current database.
DataSource	Name of the current database file.
State	Current connection state (Closed, Connecting, Open, Executing, Fetching, Broken)

Connection object methods:

Open	Open the connection.
Close	Close the connection.
Dispose	Dispose of the connection object.

Connection Object - Access Database

To use the `OleDbConnection` object and other OLE database objects, an application must have this line at the top of the corresponding code listing:

```
using System.Data.OleDb;
```

Every Access example we build in this class will have this line.

To declare and construct an `OleDbConnection` object named `myConnection`, using a `ConnectionString` named `myConnectionString`, use:

```
OleDbConnection myConnection;  
myConnection = new  
OleDbConnection(myConnectionString);
```

The `ConnectionString` for an Access database is the following string:

```
Provider=Microsoft.ACE.OLEDB.12.0; Data Source =  
DatabaseName
```

where `DatabaseName` is a complete path to the database.

We're about to start looking at the books database (`BooksDB.accdb`) discussed in Chapter 2. This database is found in the `VCSDB\Datasets` directory. Make a copy of the database and place it in a working directory (you decide on a name - we will use `VCSDB\Working`). We do this to insure there is always a valid copy of `BooksDB.accdb` on your computer. You will see that the power of the Visual C# opens up the possibility of doing damage to a

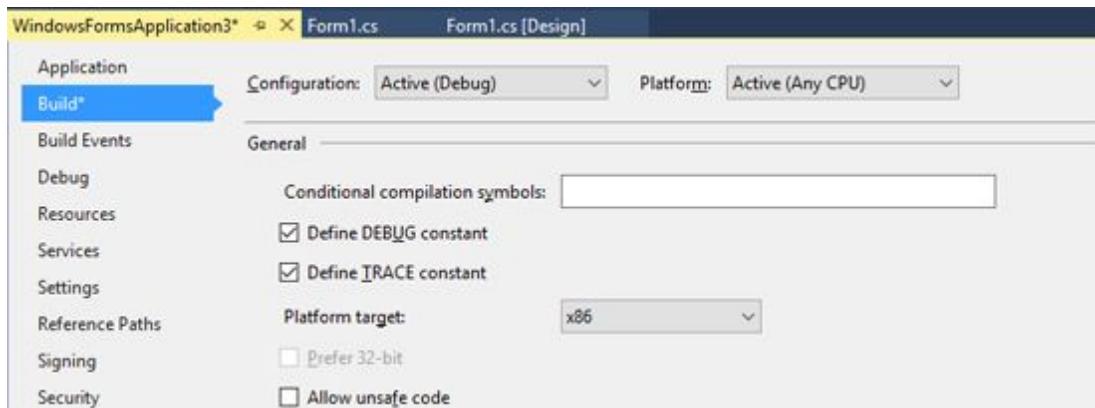
database (we, of course, will try to minimize this possibility). So, we are just living by the adage, “Better safe, than sorry.”

Access Databases and 64-Bit Operating Systems

The Access databases used in these notes only work with 32-bit operating systems. If you are using a 64-bit version of Visual Studio, you need to make one change to each project you build.

Follow these steps:

- Once your project is built, choose the **Project** menu item, and select your project's **Properties** entry.
- In the window that appears, choose the **Build** tab.
- Under **Platform target**, make sure the selection is **x86**, not **AnyCPU**. The changed window should look like this:

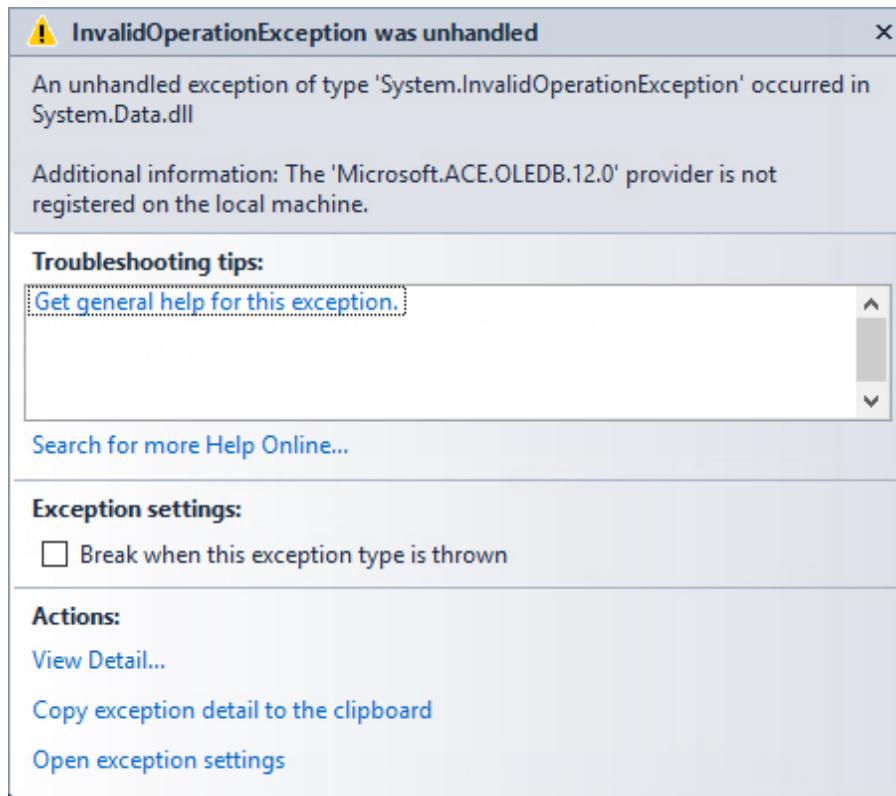


- Close the window to finalize the change.

How will you know if you have an operating system problem? The first symptom is that your application will have no data displayed, indicating the database did not open correctly. Secondly, the **Immediate Window** will have this error message:

```
An unhandled exception of type 'System.InvalidOperationException' occurred in System.Data.dll
```

Or, when opening the database, you may see this window:



If you see such symptoms, make the above note correction to your project's properties.

Connection Object - SQL Server Database

To use the `SqlConnection` object, an application must have this line at the top of the corresponding code listing:

```
using System.Data.SqlClient;
```

Every SQL Server example we build in this class should have this line.

To declare and construct an `SqlConnection` object named `myConnection`, using a `ConnectionString` named `myConnectionString`, use:

```
SqlConnection myConnection;  
myConnection = new SqlConnection(myConnectionString);
```

The `ConnectionString` for an SQL Server database is the following string:

```
Data Source=SQLInstanceName;  
AttachDbFilename=DatabaseName; Integrated  
Security=True;  
Connect Timeout=30; User Instance=True
```

where `SQLInstanceName` is the name of your SQL Server instance (set when installed; if using default SQL Server Express settings, name is `.\SQLEXPRESS`) and `DatabaseName` is a complete path to the database.

We're about to start looking at the books database (`SQLBooksDB.mdf`), SQL Server version of `BooksDB.accdb`). Make a

copy of the database and place it in a working directory (you decide on a name - we will use **VBDB\Working**).

Example 3-1

Accessing the Books Database

After copying the database (**BooksDB.accdb** or **SQLBooksDB.mdf**) to your working directory, start a new application. Our end goal with this application is to develop a form where we can look through the **Titles** table in the books database. We start by simply opening the database using a connection object.

1. Place a single label control on the form.
2. Set the following properties:

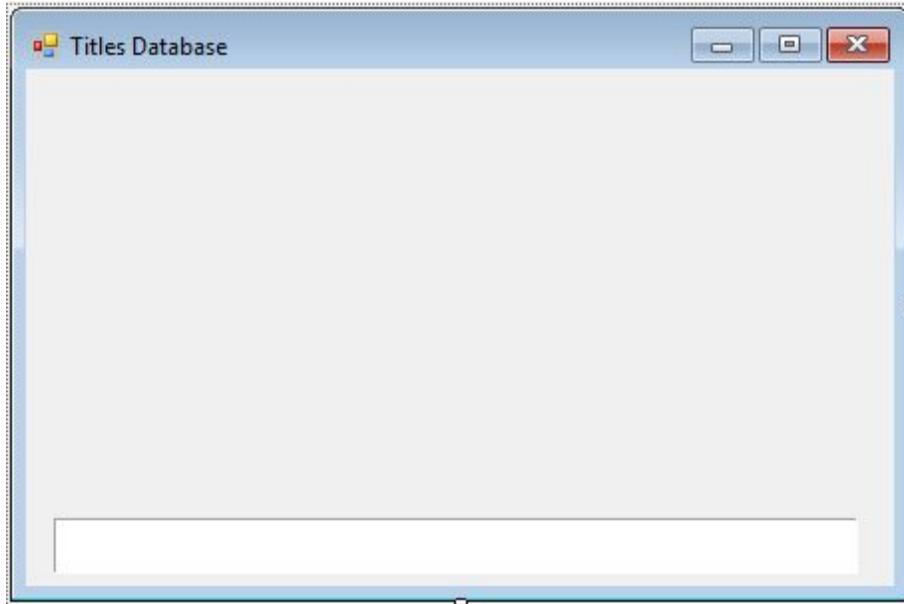
Form1:

Name	frmTitles
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Titles Database

label1:

Name	lblState
AutoSize	True
BackColor	White
BorderStyle	Fixed3D
Text	[blank]

When done, the form will look something like this:



All the extra space will be used as we continue building this application.

3. Open the code window and add this line at the top:

Access Database:

```
using System.Data.OleDb;
```

SQL Server Database:

```
using System.Data.SqlClient;
```

4. Use this form level declaration to declare the connection:

Access Database:

```
OleDbConnection booksConnection;
```

SQL Server Database:

```
SqlConnection booksConnection;
```

5. Add this code to the frmTitles_Load method:

Access Database:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
    //open the connection
    booksConnection.Open();
    //display state
    lblState.Text = booksConnection.State.ToString();
    //close the connection
    booksConnection.Close();
    //display state
    lblState.Text += booksConnection.State.ToString();
    //dispose of the connection object
    booksConnection.Dispose();
}
```

SQL Server Database:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new SqlConnection("Data
Source=.\\SQLEXPRESS;
```

```
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;
Integrated Security=True; Connect Timeout=30; User
Instance=True");
//open the connection
booksConnection.Open();
//display state
lblState.Text = booksConnection.State.ToString();
//close the connection
booksConnection.Close();
//display state
lblState.Text += booksConnection.State.ToString();
//dispose of the connection object
booksConnection.Dispose();
}
```

In this code we construct the connection using the proper connection string. Notice the connection string assumes the database is in the **c:\VCSDB\Working** folder. You will have to change this if your working copy of the database is located elsewhere. Then, we simply open, close and dispose of the connection. The status is displayed in the **lblState** control.

The Access Database finished code should be (lines added are shaded):

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Text;
using System.Windows.Forms;
```

```
using System.Data.OleDb;
namespace Example_3_1
{
    public partial class frmTitles : Form
    {
        public frmTitles()
        {
            InitializeComponent();
        }
        OleDbConnection booksConnection;
        private void frmTitles_Load(object sender,
        EventArgs e)
        {
            // connect to books database
            booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSD\\Working\\BooksDB.accdb");
            //open the connection
            booksConnection.Open();
            //display state
            lblState.Text =
            booksConnection.State.ToString();
            //close the connection
            booksConnection.Close();
            //display state
            lblState.Text +=
            booksConnection.State.ToString();
            //dispose of the connection object
            booksConnection.Dispose();
        }
    }
}
```

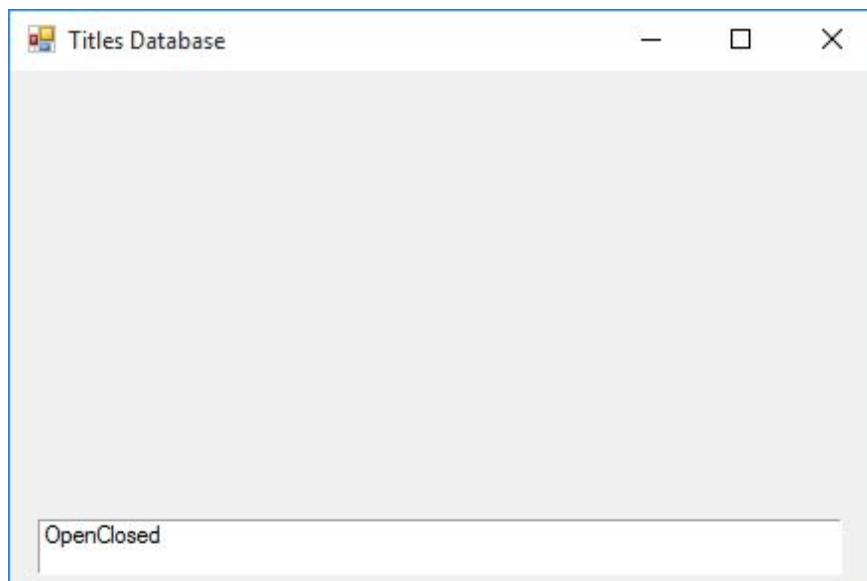
```
    }  
}  
}
```

The **SQL Server Database** finished code should be (lines added are shaded):

```
using System;  
using System.Collections.Generic;  
using System.ComponentModel;  
using System.Data;  
using System.Drawing;  
using System.Text;  
using System.Windows.Forms;  
using System.Data.SqlClient;  
namespace Example_3_1  
{  
    public partial class frmTitles : Form  
    {  
        public frmTitles()  
        {  
            InitializeComponent();  
        }  
        SqlConnection booksConnection;  
        private void frmTitles_Load(object sender,  
        EventArgs e)  
        {  
            // connect to books database  
            booksConnection = new SqlConnection("Data  
Source=.\SQLExpress;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User
```

```
Instance=True");  
        //open the connection  
        booksConnection.Open();  
        //display state  
        lblState.Text =  
        booksConnection.State.ToString();  
        //close the connection  
        booksConnection.Close();  
        //display state  
        lblState.Text +=  
        booksConnection.State.ToString();  
        //dispose of the connection object  
        booksConnection.Dispose();  
    }  
}  
}
```

6. Save the application. Run the application. You should see:



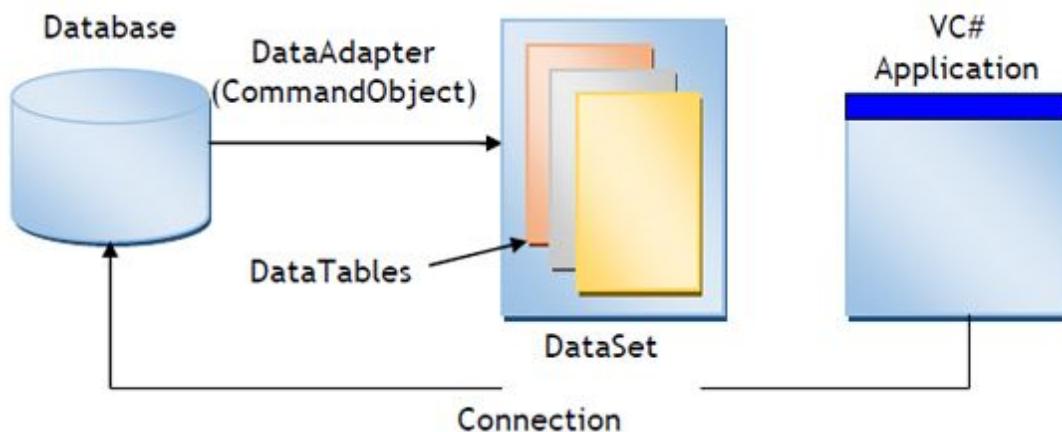
This shows that the connection was opened and then closed. If you do not see this or you get an error message, make sure your

connection string is correct and the books database is really located where you (and your connection string) thinks it is.

Command Object

The **command object** is used to define commands to send to the database. In this course, these commands will be SQL queries. We'll learn SQL in Chapter 4. For now, we'll just give you any queries you may need.

Command objects are used by **data adapter** objects (discussed next) to create **datasets** which hold **data tables** (discussed after data adapters). The information in these tables can then be viewed in a Visual C# application:



Command Object - Access Database

To declare and construct an `OleDbCommand` object named `myCommand` using a SQL query named `myQuery` for a connection object named `myConnection`, use:

```
OleDbCommand myCommand;  
myCommand = new OleDbCommand(myQuery, myConnection)
```

After a quick example, we see how to use such an object with a data adapter to create a data table.

Command Object - SQL Server Database

To declare and construct an `SqlCommand` object named `myCommand` using a SQL query named `myQuery` for a connection object named `myConnection`, use:

```
SqlCommand myCommand;  
myCommand = new SqlCommand(myQuery, myConnection)
```

After a quick example, we see how to use such an object with a data adapter to create a data table.

Example 3-1 (Command Object)

Accessing the Books Database

We add a command object to our example. We need a SQL query to retrieve data from the **Titles** table of the books database. The query that does this is:

Select * From Titles

This says select all fields (* is a wildcard) from the **Titles** table.

1. Add this form level declaration:

Access Database:

```
OleDbCommand titlesCommand;
```

SQL Server Database:

```
SqlCommand titlesCommand;
```

2. Add the shaded code to the **frmTitles_Load** method:

Access Database:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
```

```
//open the connection
booksConnection.Open();
//display state
lblState.Text = booksConnection.State.ToString();
// establish command object
titlesCommand = new OleDbCommand("Select * from
Titles",
booksConnection);
//close the connection
booksConnection.Close();
//display state
lblState.Text += booksConnection.State.ToString();
//dispose of the connection object
booksConnection.Dispose();
titlesCommand.Dispose();
}
```

SQL Server Database:

```
private void frmTitles_Load(object sender, EventArgs
e)
{
    // connect to books database
    booksConnection = new SqlConnection("Data
Source=.\SQLEXPRESS;
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;
Integrated Security=True; Connect Timeout=30; User
Instance=True");
    //open the connection
    booksConnection.Open();
    //display state
```

```
lblState.Text = booksConnection.State.ToString();
// establish command object
titlesCommand = new SqlCommand("Select * from
Titles",
booksConnection);
//close the connection
booksConnection.Close();
//display state
lblState.Text += booksConnection.State.ToString();
//dispose of the connection object
booksConnection.Dispose();
titlesCommand.Dispose();
}
```

This code creates the command object for the books connection object.

3. Resave and rerun the application, making sure you get no errors.

DataAdapter Object

As just seen, a **data adapter** object uses a **command object** to transfer data between a **connection object** and a **dataset** containing one or more **data table(s)**. For our initial work, we will use a data adapter to directly form a data table (discussed next), without using a dataset. In general, you need one data adapter object for each table of data you want to view.

Data adapter properties:

- DeleteCommand** Command object that allows the adapter to delete rows from a data table.
- InsertCommand** Command object that allows the adapter to insert rows into a data table.
- SelectCommand** Command object that the adapter uses to select rows for a data table.
- UpdateCommand** Command object that the adapter uses to update rows in a data table.

Data adapter methods:

- Fill** Fills the data adapter with a given data table.
- Update** Updates the data table held by the data adapter.

DataAdapter Object - Access Database

To declare and construct an **OleDbDataAdapter** named **myAdapter**, use:

```
OleDbDataAdapter myAdapter;  
myAdapter = new OleDbDataAdapter();
```

We specify the **SelectCommand** (**myCommand**, a command object) with a SQL query to select the rows that will make up the corresponding data table.

```
myAdapter.SelectCommand = myCommand;
```

Once the **SelectCommand** is specified, the other command objects (**DeleteCommand**, **InsertCommand**, **UpdateCommand**) are built using a **command builder** object. The statement that accomplishes this task for our example adapter (**myAdapter**) is:

```
OleDbCommandBuilder myCommandBuilder = new  
OleDbCommandBuilder(myAdapter);
```

Once this line is executed, the three command objects can be viewed (if desired) by examining:

```
myCommandBuilder.GetDeleteCommand.CommandText  
myCommandBuilder.GetInsertCommand.CommandText  
myCommandBuilder.GetUpdateCommand.CommandText
```

We really don't ever look at these command objects - they are used by the **Update** method of the data adapter. We look at that method in Chapter 5 when we start our study of database management tasks.

Believe it or not, we're getting close to seeing some actual data! The data adapter's **Fill** method accomplishes this task, but first we need to look at datasets and data tables.

DataAdapter Object - SQL Server Database

To declare and construct an `SqlDataAdapter` named `myAdapter`, use:

```
SqlDataAdapter myAdapter;  
myAdapter = new SqlDataAdapter();
```

We specify the `SelectCommand` (`myCommand`, a command object) with a SQL query to select the rows that will make up the corresponding data table.

```
myAdapter.SelectCommand = myCommand;
```

Once the `SelectCommand` is specified, the other command objects (`DeleteCommand`, `InsertCommand`, `UpdateCommand`) are built using a command builder object. The statement that accomplishes this task for our example adapter (`MyAdapter`) is:

```
SqlCommandBuilder myCommandBuilder = new  
SqlCommandBuilder(myAdapter);
```

Once this line is executed, the three command objects can be viewed (if desired) by examining:

```
myCommandBuilder.GetDeleteCommand.CommandText  
myCommandBuilder.GetInsertCommand.CommandText  
myCommandBuilder.GetUpdateCommand.CommandText
```

We really don't ever look at these command objects - they are used by the `Update` method of the data adapter. We look at that method in Chapter 5 when we start our study of database management tasks.

Believe it or not, we're getting close to seeing some actual data! The data adapter's **Fill** method accomplishes this task, but first we need to look at datasets and data tables.

DataSet Object

A **dataset** object provides all the features you need to build, load, store, manipulate and save data in a relational database. It is a ‘container’ for multiple data table objects.

Dataset properties:

DataSetName	Name assigned to dataset.
Tables	A collection of data tables stored in the dataset.

To declare and construct a **DataSet** named **myDataSet**, use:

```
DataSet myDataSet;  
myDataSet = new DataSet()
```

To add a data table (**myTable**) to a dataset, use:

```
myDataSet.Tables.Add(myTable);
```

We don’t use data set objects a lot in this course. We prefer to work directly with data tables.

DataTable Object

A **data table** object represents the data contained in one table of a **dataset** object.

Data table properties:

Columns	Collection of DataColumn objects that define information in the columns of the table.
DataSet	The DataSet object (if any) that contains this DataTable .
DefaultView	A DataView representing the DataTable contents.
Rows	Collection of DataRow objects that define each table row.
TableName	Name of data table.

Data table methods:

Clear	Removes all rows from data table.
Copy	Makes a copy of the data table.
ImportRow	Copies a DataRow object into the data table.
NewRow	Creates a new DataRow object for the data table.

To declare and construct a data table named **myTable**, use:

```
DataTable myTable;  
myTable = new DataTable();
```

Once the table is created, it is filled with data using the **Fill** method for a corresponding data adapter control. If that adapter is

myAdapter, the syntax is:

```
myAdapter.Fill(myTable);
```

At this point, we have a data table (formed using by sending a SQL query to the database) we can view in a Visual C# application.

DataRow Object

A **data row** object represents the information in one record of a data table. It is very useful for retrieving and/or modifying individual fields in a record.

Data row properties:

Item	Gets or sets one of the row's fields. The parameter can be the column index or the field name.
Table	Reference to data table containing the row.

Data row methods:

BeginEdit	Puts data row in edit mode.
CancelEdit	Cancels the current edit on the data row.
Delete	Deletes the row from the data table.

We will look at data rows in more detail later in the course, especially in the example projects in Chapter 10.

Example 3-1 (Data Table)

Accessing the Books Database

We add a data adapter object and a data table object to our example. The data table associated with the data adapter will have the **Titles** table from the books database.

1. Add these form level declarations:

Access Database:

```
OleDbDataAdapter titlesAdapter;  
DataTable titlesTable;
```

SQL Server Database:

```
SqlDataAdapter titlesAdapter;  
DataTable titlesTable;
```

2. Add the shaded code to the **frmTitles_Load** method:

Access Database:

```
private void frmTitles_Load(object sender, EventArgs  
e)  
{  
    // connect to books database  
    booksConnection = new  
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
    Data  
    Source = c:\\VCSDB\\Working\\BooksDB.accdb");  
    //open the connection
```

```

booksConnection.Open();
//display state
lblState.Text = booksConnection.State.ToString();
// establish command object
titlesCommand = new OleDbCommand("Select * from
Titles",
booksConnection);
// establish data adapter/data table
titlesAdapter = new OleDbDataAdapter();
titlesAdapter.SelectCommand = titlesCommand;
titlesTable = new DataTable();
titlesAdapter.Fill(titlesTable);

//close the connection
booksConnection.Close();
//display state
lblState.Text += booksConnection.State.ToString();
//dispose of the connection object
booksConnection.Dispose();
titlesCommand.Dispose();
titlesAdapter.Dispose();
titlesTable.Dispose();
}

}

```

SQL Server Database:

```

private void frmTitles_Load(object sender, EventArgs
e)
{
    // connect to books database
    booksConnection = new SqlConnection("Data
Source=.\SQLEXPRESS;

```

```
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;
Integrated Security=True; Connect Timeout=30; User
Instance=True");
//open the connection
booksConnection.Open();
//display state
lblState.Text = booksConnection.State.ToString();
// establish command object
titlesCommand = new SqlCommand("Select * from
Titles",
booksConnection);
// establish data adapter/data table
titlesAdapter = new SqlDataAdapter();
titlesAdapter.SelectCommand = titlesCommand;
titlesTable = new DataTable();
titlesAdapter.Fill(titlesTable);
//close the connection
booksConnection.Close();
//display state
lblState.Text += booksConnection.State.ToString();
//dispose of the connection object
booksConnection.Dispose();
titlesCommand.Dispose();
titlesAdapter.Dispose();
titlesTable.Dispose();
}
```

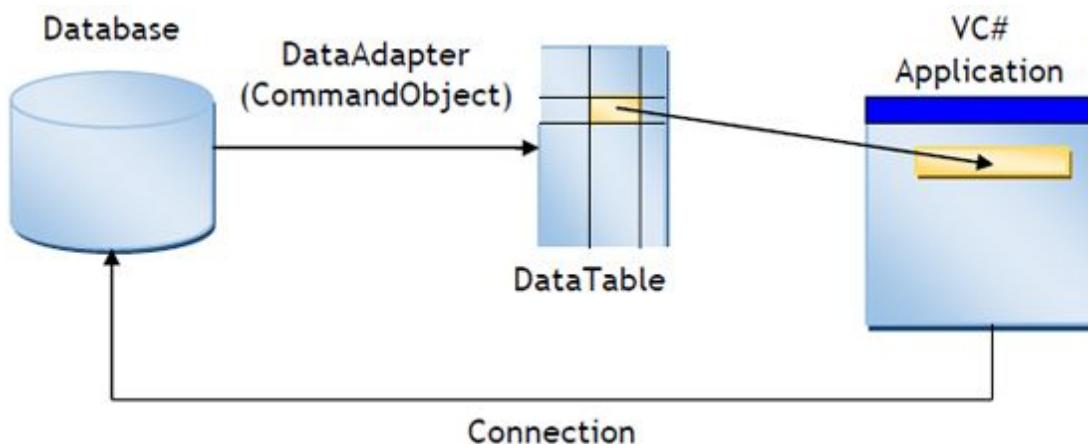
This new code creates the data adapter and loads it with data from the **Titles** table.

3. Resave and rerun the application. Again, make sure there are no errors. If no errors occur, you have successfully created a data

table. Next, we look at how to view information from this table in a Visual C# application.

Data Bound Controls

We have seen that the ADO .NET data objects allow us to connect to a database and form a data table. Yet, these objects do not provide us with any way to view the information in a database. To view the information, we use **data bound controls** that are special controls with properties established by database fields. A data bound control is needed for each field (column) in the database table you need to view. Most of the standard Visual C# tools can be used as **data bound controls**.



Some data bound data controls (using simple binding) are:

Label	Can be used to provide display-only access to a specified text data field. The label Text property is usually bound.
Text Box	Can be used to provide read/write access to a specified text data field. Probably, the most widely used data bound tool. Text property is usually bound.
Check Box	Used to provide read/write access to a Boolean field. Value property is data bound.
Picture Box	Used to display a graphical image from a bitmap, icon, gif, jpeg, or metafile file.

Provides read/write access to a image/binary data field. **Image** property is data bound.

Other controls using complex binding (look at in further detail later in this course):

List Box	Can be used to display all values of a particular field in a database.
Combo Box	Can be used to display all values of a particular field in a database.
Data Grid View	Can be used to display an entire database table.

To bind a particular property (**myProperty**) of a control (**myControl**) to a particular field (**myField**) of a data table object (**myTable**), the syntax is:

```
myControl.DataBindings.Add(myProperty, myTable,  
myField);
```

So, every control that is to be bound to a database field needs a statement like this. The bindings are usually done in the initial form's **Load** method.

To clear a previously defined data binding, the syntax is:

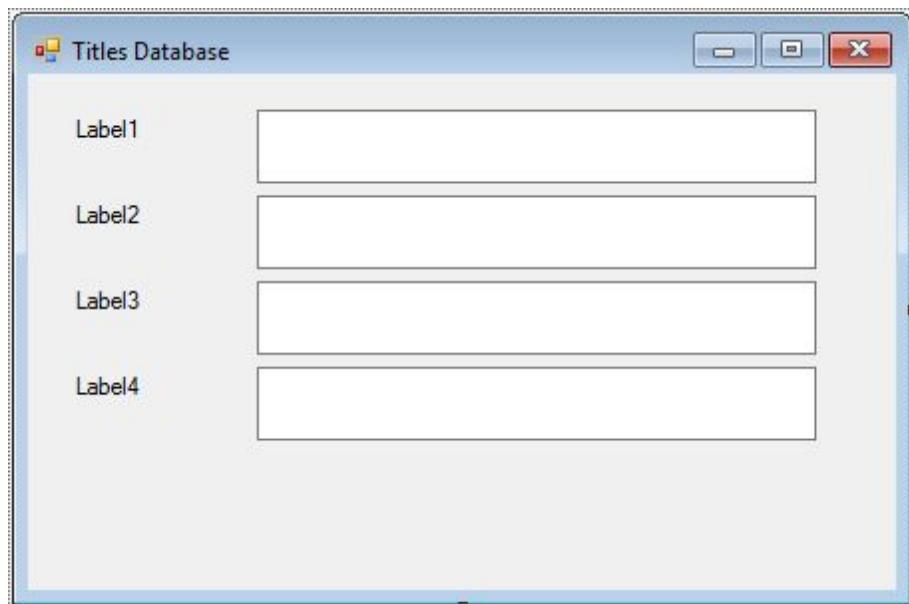
```
myControl.DataBindings.Clear();
```


Example 3-1 (Data Binding)

Accessing the Books Database

We now add some controls that are bound to fields in the **Titles** database table so we can view some data.

1. Remove the label control used to display state (we know things are working okay by now).
2. Add four label controls and four text box controls, so the form looks like this:



3. Set the following properties:

Label1:

Text Title

Label2:

Text Year Published

Label3:

Text ISBN

Label4:

Text Publisher ID

Text Box1:

Name txtTitle
BackColor White
ReadOnly True
MultiLine True

Text Box2:

Name txtYearPublished
BackColor White
ReadOnly True
MultiLine True

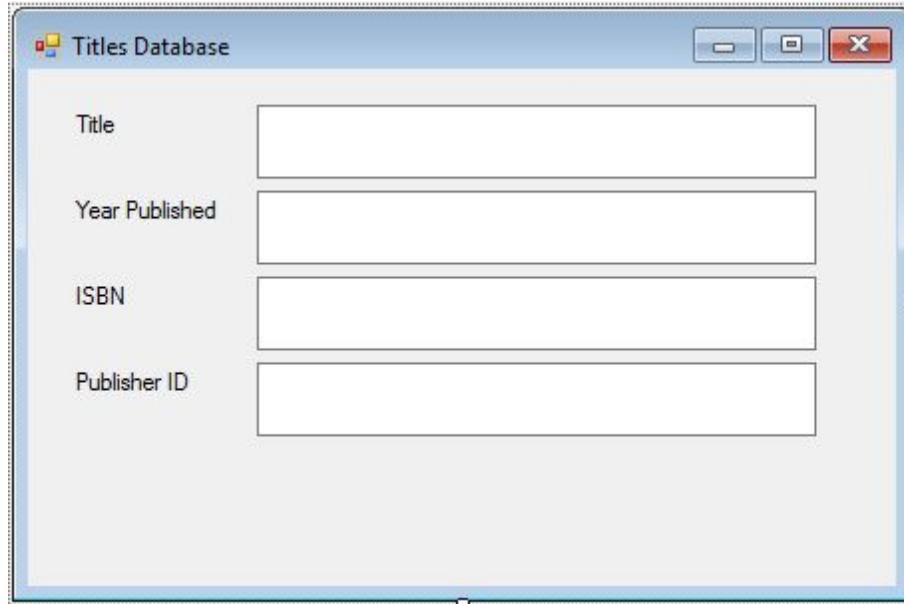
Text Box3:

Name txtISBN
BackColor White
ReadOnly True
MultiLine True

Text Box4:

Name txtPubID
BackColor White
ReadOnly True
MultiLine True

The finished form should appear as:



4. Add the shaded lines to the **frmTitles_Load** method. These lines bind the four text boxes to their respective fields in the **Titles** table. Remove the lines referring to **lblState** (we removed that control).

Access Database:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
    //open the connection
    booksConnection.Open();
    // establish command object
    titlesCommand = new OleDbCommand("Select * from
    Titles",
    booksConnection);
```

```

// establish data adapter/data table
titlesAdapter = new OleDbDataAdapter();
titlesAdapter.SelectCommand = titlesCommand;
titlesTable = new DataTable();
titlesAdapter.Fill(titlesTable);

// bind controls to data table
txtTitle.DataBindings.Add("Text", titlesTable,
"Title");
txtYearPublished.DataBindings.Add("Text",
titlesTable, "Year_Published");
txtISBN.DataBindings.Add("Text", titlesTable,
"ISBN");
txtPubID.DataBindings.Add("Text", titlesTable,
"PubID");

//close the connection
booksConnection.Close();
//dispose of the connection object
booksConnection.Dispose();
titlesCommand.Dispose();
titlesAdapter.Dispose();
titlesTable.Dispose();

}

```

SQL Server Database:

```

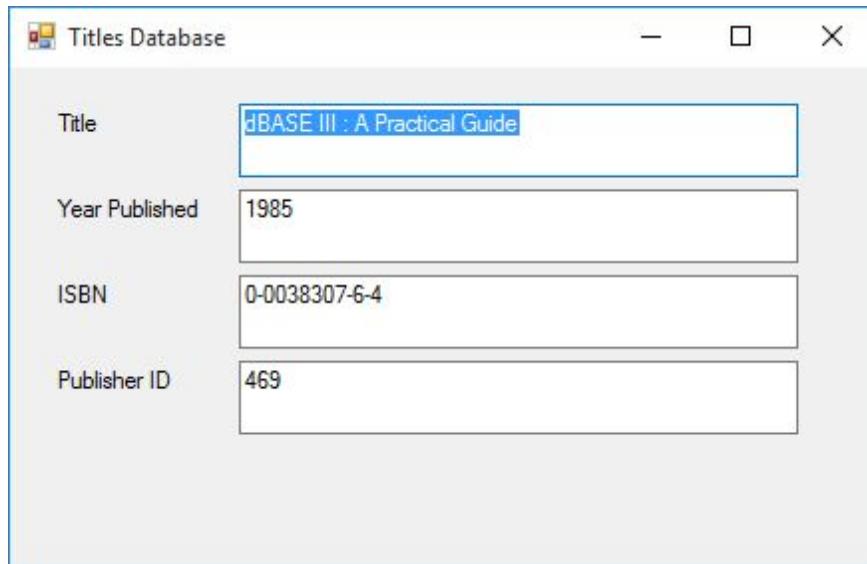
private void frmTitles_Load(object sender, EventArgs
e)
{
    // connect to books database
    booksConnection = new SqlConnection("Data
Source=.\SQLEXPRESS;
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;

```

```
Integrated Security=True; Connect Timeout=30; User  
Instance=True");  
    //open the connection  
    booksConnection.Open();  
    //display state  
    lblState.Text = booksConnection.State.ToString();  
    // establish command object  
    titlesCommand = new SqlCommand("Select * from  
    Titles",  
    booksConnection);  
    // establish data adapter/data table  
    titlesAdapter = new SqlDataAdapter();  
    titlesAdapter.SelectCommand = titlesCommand;  
    titlesTable = new DataTable();  
    titlesAdapter.Fill(titlesTable);  
    // bind controls to data table  
    txtTitle.DataBindings.Add("Text", titlesTable,  
    "Title");  
    txtYearPublished.DataBindings.Add("Text",  
    titlesTable, "Year_Published");  
    txtISBN.DataBindings.Add("Text", titlesTable,  
    "ISBN");  
    txtPubID.DataBindings.Add("Text", titlesTable,  
    "PubID");  
    //close the connection  
    booksConnection.Close();  
    //display state  
    lblState.Text += booksConnection.State.ToString();  
    //dispose of the connection object  
    booksConnection.Dispose();  
    titlesCommand.Dispose();
```

```
titlesAdapter.Dispose();  
titlesTable.Dispose();  
}  
}
```

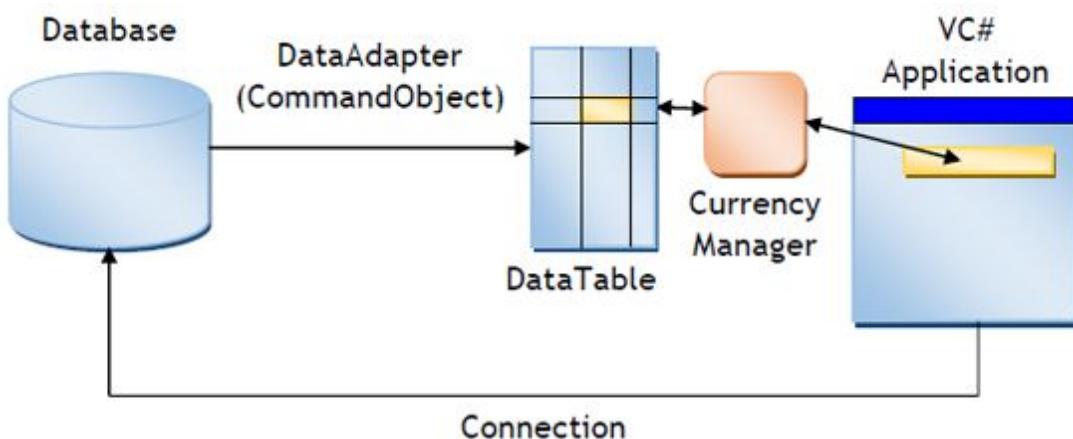
5. Resave and rerun the application. You should see:



At long last, we see some data in our Visual C# application. The first record in the **Titles** table is being displayed. We still have no way of navigating through the table. We add that capability next with a very powerful data object, the **CurrencyManager** object.

CurrencyManager Object

A final component we need to view data is a **currency manager** object. Once associated with a **data table** object, the currency manager not only allows navigation through the rows of the table, but also provides several database management tasks such as editing, adding record and deleting records.



Currency manager object properties:

Bindings	Collection of controls bound to this manager.
Count	Number of rows in table associated with manager.
Position	Gets or sets the current row in the data table (ranges from 0 to Count - 1).

Currency manager methods:

AddNew	Add a new row to the data source.
CancelCurrentEdit	Cancels the current editing operation.
EndCurrentEdit	Ends the current editing operation, accepting any changes.
Refresh	Refreshes the bound controls.

RemoveAt	Removes the indicated data row.
-----------------	---------------------------------

For now, we look specifically at the navigational abilities of the currency manager object. First, declare a currency manager object (**myManager**) using:

```
CurrencyManager myManager;
```

We use the **BindingContext** of the associated data table to establish a reference for the currency manager. For a table named **myTable**, we use this syntax:

```
myManager = (CurrencyManager)  
this.BindingContext[myTable];
```

This simply converts the binding context information of the table into a currency manager object.

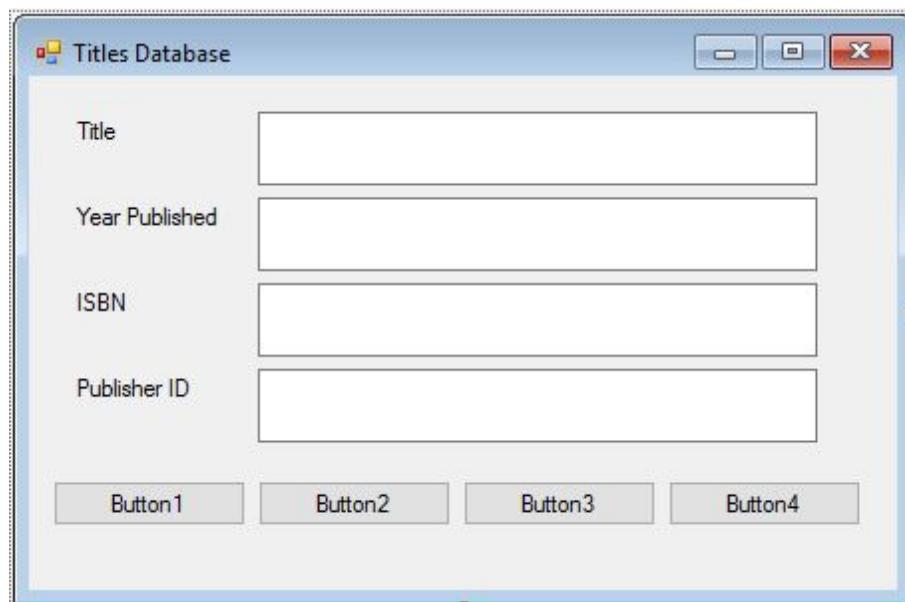
Once the currency manager object is established, basic navigation among the **Count** rows in the data table is accomplished via a simple modification of the **Position** property. Look at the final incarnation of Example 3-1 to see its use in such a manner.

Example 3-1 (Final Version)

Accessing the Books Database

Lastly, we add some controls that allow navigation through the rows of the **Titles** database table

1. Add four button controls so the form looks like this:



2. Set the following properties:

Button1:

Name btnFirst
Text &First

Button2:

Name btnPrevious
Text &Previous

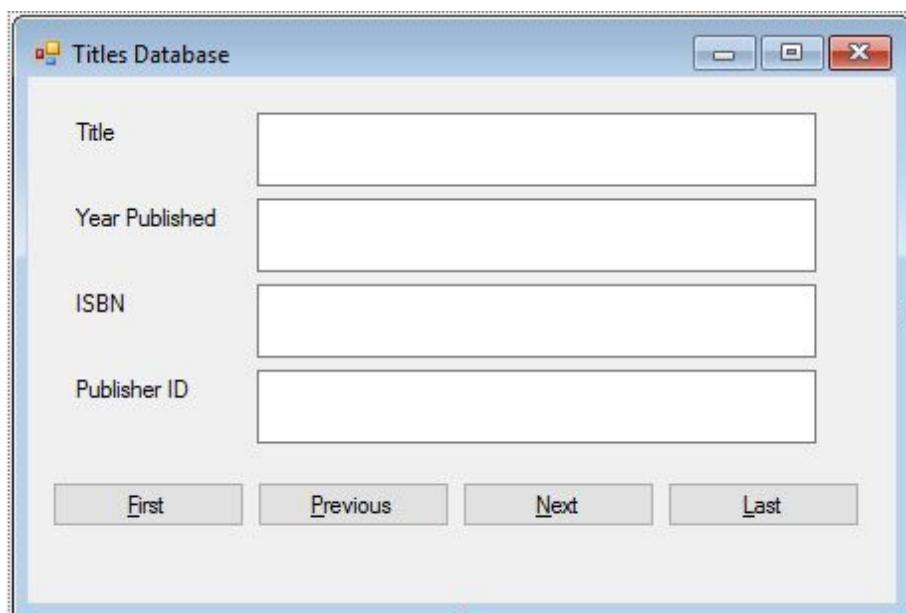
Button3:

Name btnNext
Text &Next

Button4:

Name btnLast
Text &Last

The finished form is:



3. Add this form level declaration:

CurrencyManager titlesManager;

4. Add the shaded lines to the **frmTitles_Load** method. These lines set up the currency manager reference to the **Titles** table.

Access Database:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    // connect to books database
```

```
booksConnection = new  
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = c:\\VCSD\\Working\\BooksDB.accdb");  
//open the connection  
booksConnection.Open();  
// establish command object  
titlesCommand = new OleDbCommand("Select * from  
Titles",  
booksConnection);  
// establish data adapter/data table  
titlesAdapter = new OleDbDataAdapter();  
titlesAdapter.SelectCommand = titlesCommand;  
titlesTable = new DataTable();  
titlesAdapter.Fill(titlesTable);  
// bind controls to data table  
txtTitle.DataBindings.Add("Text", titlesTable,  
"Title");  
txtYearPublished.DataBindings.Add("Text",  
titlesTable, "Year_Published");  
txtISBN.DataBindings.Add("Text", titlesTable,  
"ISBN");  
txtPubID.DataBindings.Add("Text", titlesTable,  
"PubID");  
// establish currency manager  
titlesManager = (CurrencyManager)  
BindingContext[titlesTable];  
//close the connection  
booksConnection.Close();  
//dispose of the connection object  
booksConnection.Dispose();  
titlesCommand.Dispose();
```

```
    titlesAdapter.Dispose();
    titlesTable.Dispose();
}
```

SQL Server Database:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new SqlConnection("Data
Source=.\SQLEXPRESS;
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;
Integrated Security=True; Connect Timeout=30; User
Instance=True");
    //open the connection
    booksConnection.Open();
    //display state
    lblState.Text = booksConnection.State.ToString();
    // establish command object
    titlesCommand = new SqlCommand("Select * from
    Titles", booksConnection);
    // establish data adapter/data table
    titlesAdapter = new SqlDataAdapter();
    titlesAdapter.SelectCommand = titlesCommand;
    titlesTable = new DataTable();
    titlesAdapter.Fill(titlesTable);
    // bind controls to data table
    txtTitle.DataBindings.Add("Text", titlesTable,
    "Title");
    txtYearPublished.DataBindings.Add("Text",
    titlesTable, "Year_Published");
```

```

txtISBN.DataBindings.Add("Text", titlesTable,
"ISBN");
txtPubID.DataBindings.Add("Text", titlesTable,
"PubID");
// establish currency manager
titlesManager = (CurrencyManager)
BindingContext[titlesTable];
//close the connection
booksConnection.Close();
//display state
lblState.Text += booksConnection.State.ToString();
//dispose of the connection object
booksConnection.Dispose();
titlesCommand.Dispose();
titlesAdapter.Dispose();
titlesTable.Dispose();
}

```

5. Add these four **Click** methods for the navigation buttons; each method simply modifies the **Position** property accordingly:

```

private void btnFirst_Click(object sender, EventArgs e)
{
    titlesManager.Position = 0;
}

private void btnPrevious_Click(object sender,
EventArgs e)
{
    titlesManager.Position--;
}

```

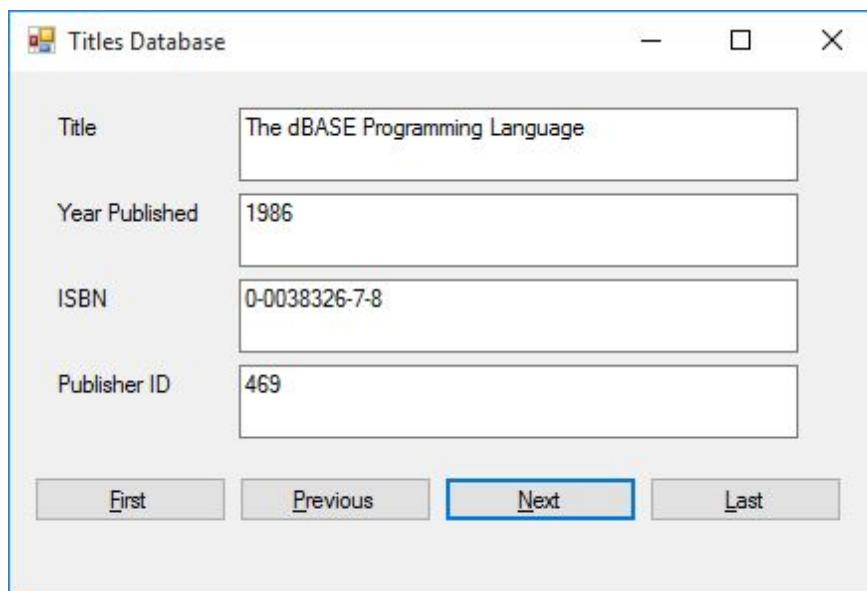
```

private void btnNext_Click(object sender, EventArgs e)
{
    titlesManager.Position++;
}

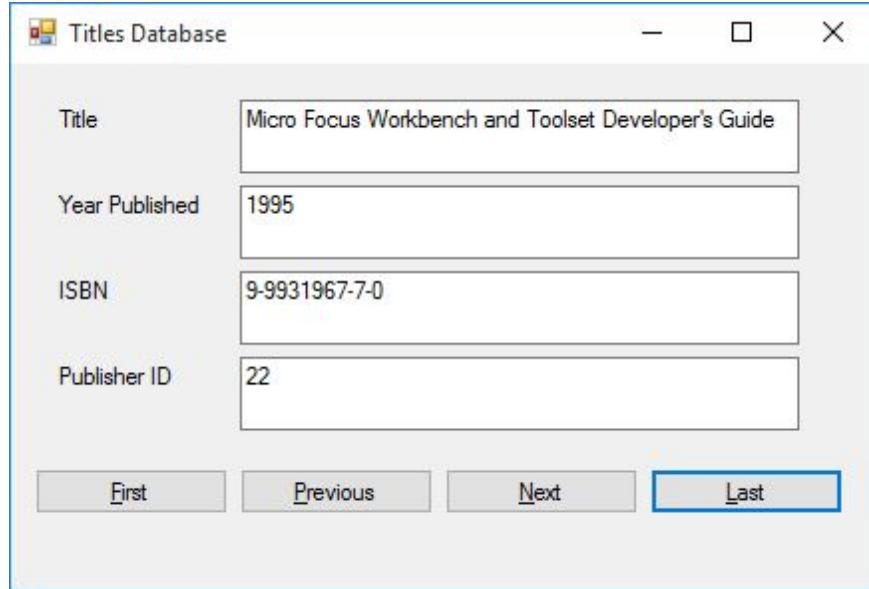
private void btnLast_Click(object sender, EventArgs e)
{
    titlesManager.Position = titlesManager.Count - 1;
}

```

6. Save the application one last time (Access version saved in the **Example 3-1** folder in **VCSDB\Code\Class 3** folder; SQL Server version saved in the **Example 3-1 SQL** folder in **VCSDB\Code\Class 3** folder). Run the application. Try out the navigation buttons. Notice how all the fields update with each click of a button. Here's the second record (I clicked **Next** once).



Here's the last record:



There's one last thing. If you load this example from the code accompanying the course, you may need to modify the line of code constructing the **booksConnection** object. The modification is needed if your working copy of the books database (either the Access version, **BooksDB.accdb**, or the SQL Server version, **SQLBooksDB.mdf**) is not in the same directory indicated in code. In fact, you will have to do this anytime you use the examples provided with the course.

Data Wizards

When learning new material, many times you are taught the “hard way” to do something before learning the “easy way.” We’re going to show you an easier way to build the application we just built by using Visual C#’s **data wizards**. Wizards are just that - tools that make your life easier. You will see Example 3-1 can be rebuilt without writing a single line of code!

Even though wizards are easy to use, they have their drawbacks. That’s why you haven’t seen wizards yet - we will always use the “hard way” (data objects) to connect to databases. Wizards provide quick results, but their results are many times inflexible. For databases, the big drawback is that connection information is hard-coded into your programs, making distribution to others very difficult.

Look through Example 3-2 if you like. It steps you through use of data wizards to rebuild Example 3-1. You’ll see that wizards are pretty cool! I still use them for quickly building applications for personal use. And they’re great for quick testing of database application concepts. You decide if you like them or not. As mentioned, they will not be used in this course.

Example 3-2 (Access Database)

Books Database with Wizards

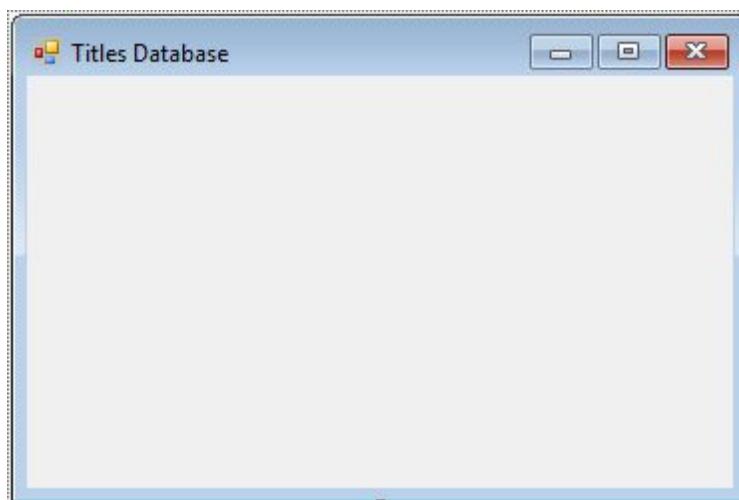
We will rebuild Example 3-1 using data wizards - an application where we can look at a few fields in the **Titles** table of the books database (**BooksDB.accdb**).

1. Start a new application with just a form. Set the following properties:

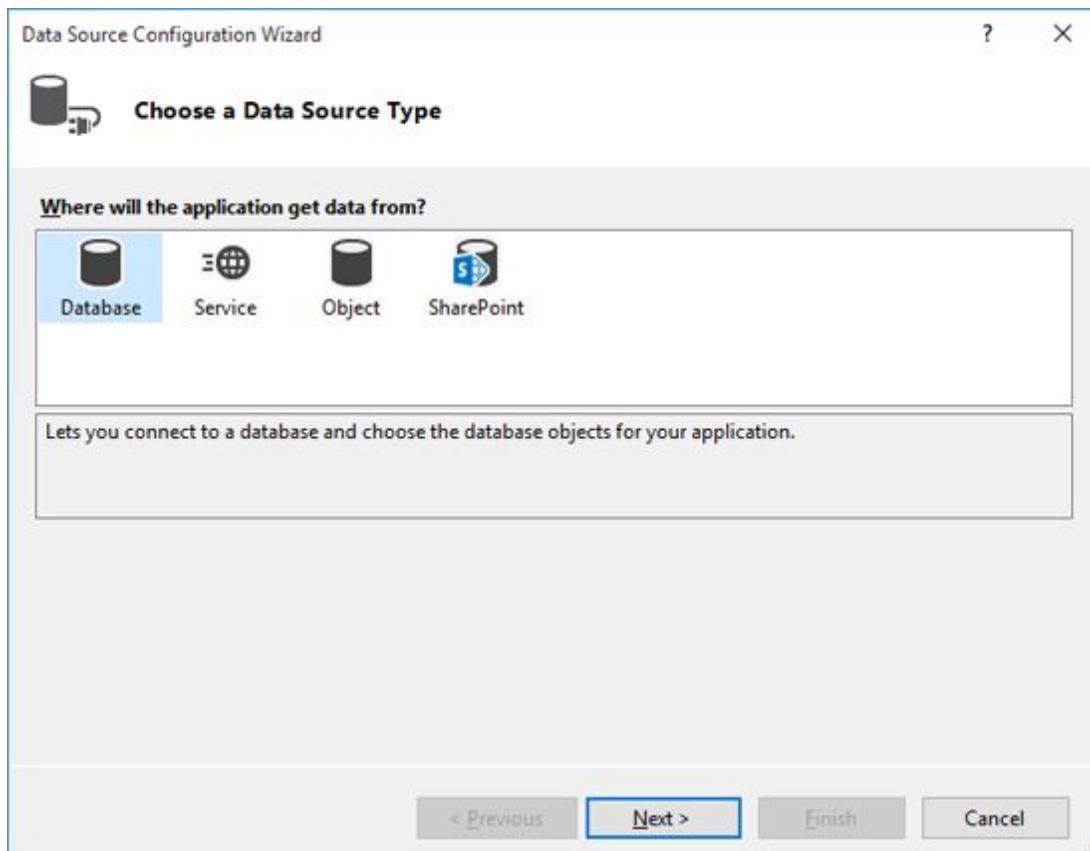
Form1:

Name	frmTitles
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Titles Database

The form should look something like this:

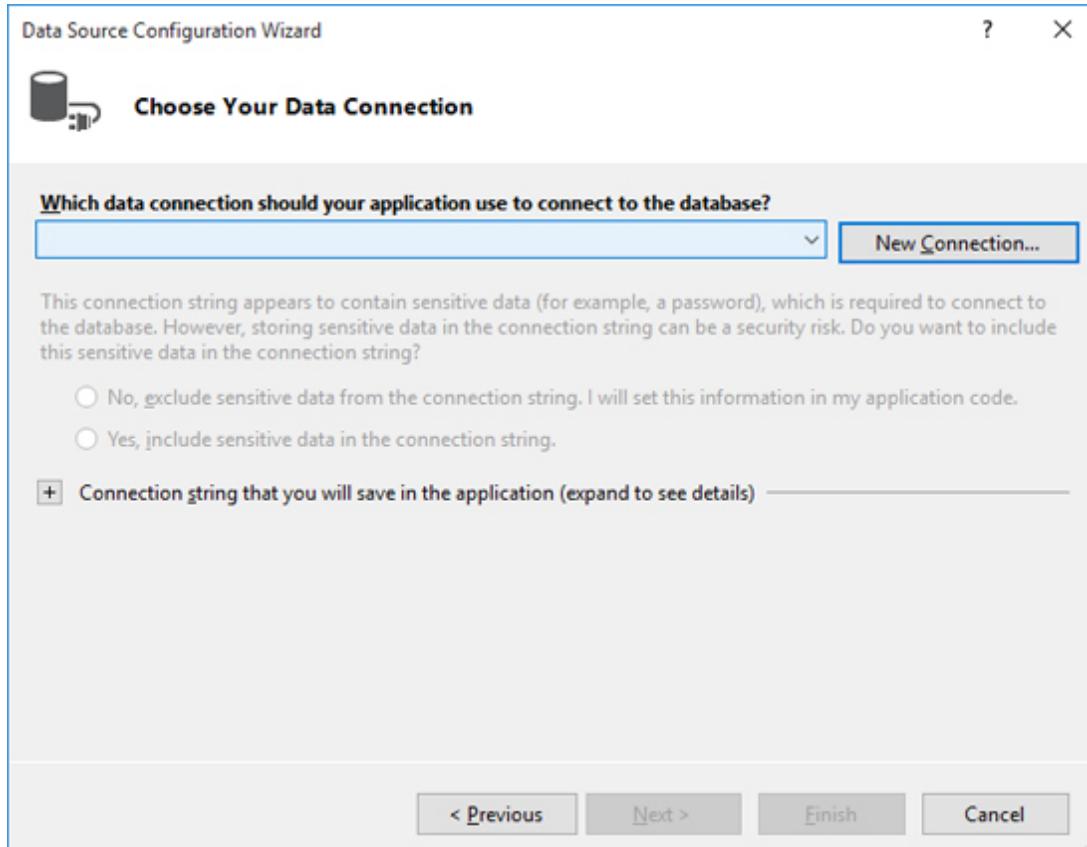


2. We now connect to the database. There are many steps. Select the **Project** menu option and choose **Add New Data Source**. This window will appear:



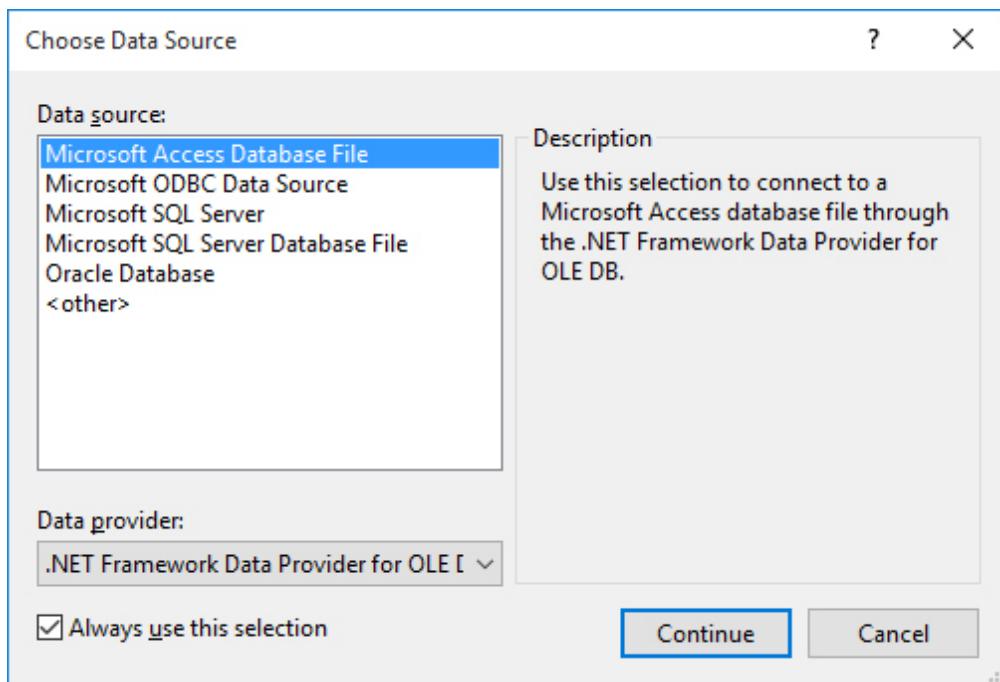
Choose the **Database** icon and click **Next**. You will see a screen asking what **database model** you want to use. Choose **Dataset** and click **Next**.

You next specify where the database is located:



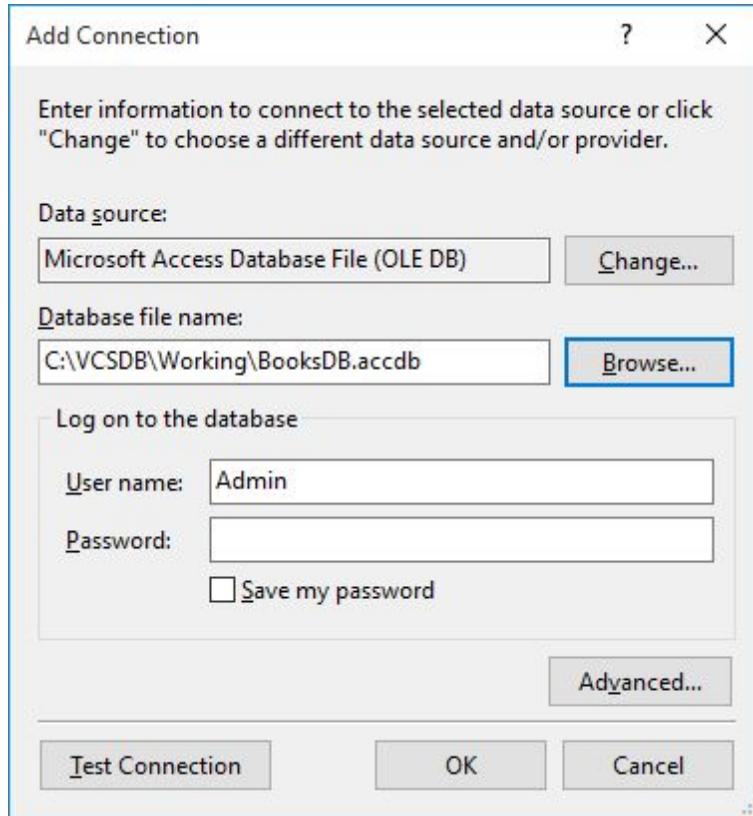
There may or may not be a connection listed in the drop down box. Here is where we will form a needed **Connection string** to connect to the database. Click **New Connection**.

In the next screen, you will see:



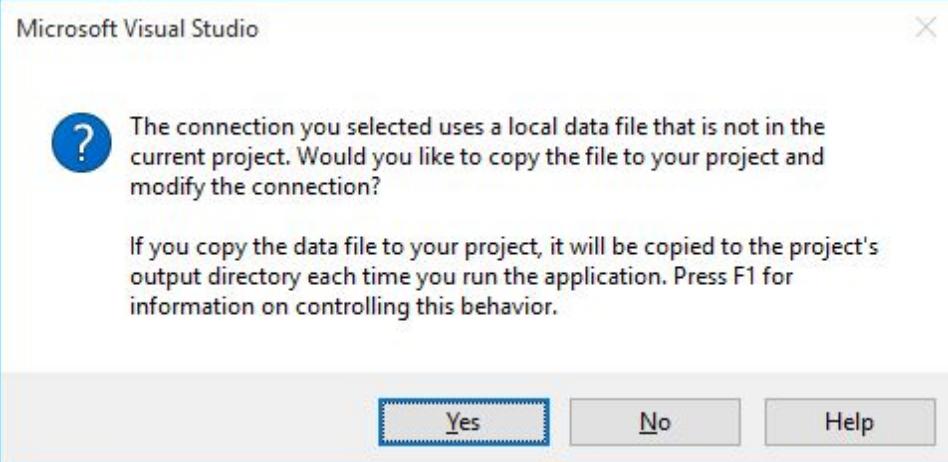
As shown, choose **Microsoft Access Database File**. This is the proper choice for a Microsoft Access database. Click **Continue**.

You are shown to the Add Connection window:



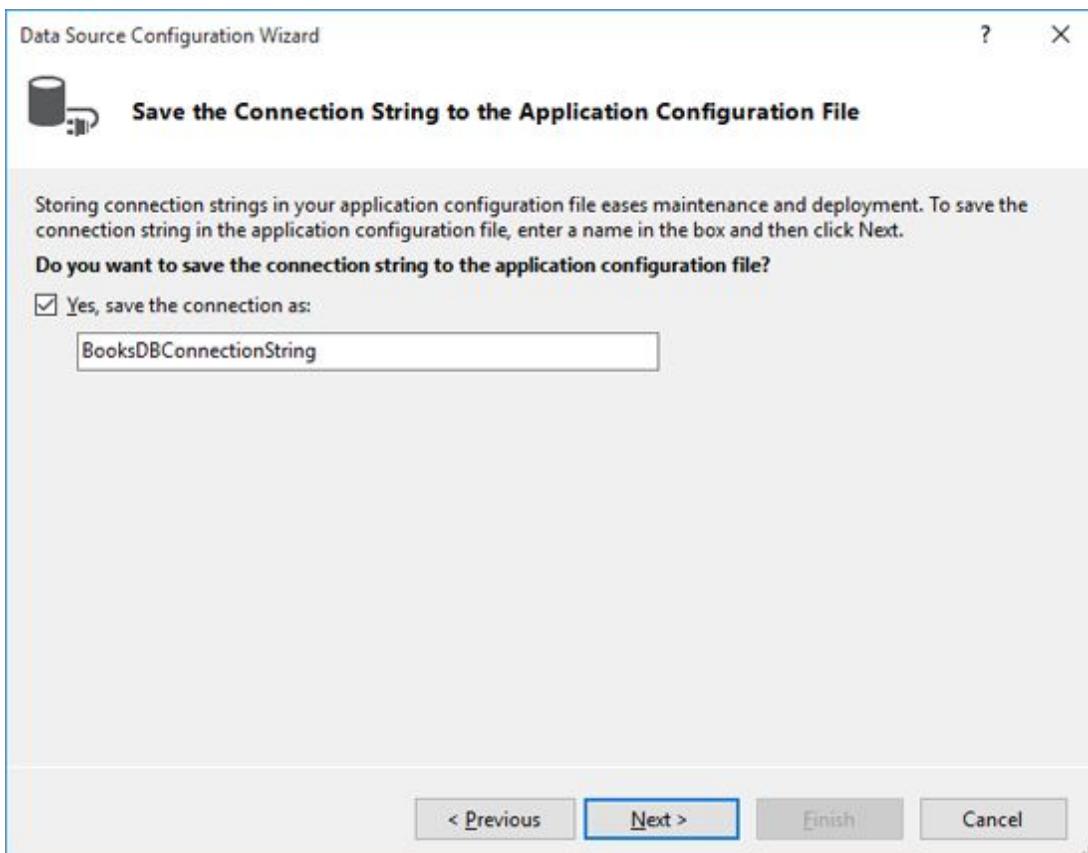
Click the **Browse** button and point to the **BooksDB.accdb** database in your working folder - here it is **VCSDB\Working**). Once selected, click **Test Connection** to insure a proper connection.

Once the connection is verified, click **OK** and you will be returned to the **Data Source Configuration Wizard** main screen. Click **Next** and you may be asked if you want to copy the database to your project:



For our example, answer **No**.

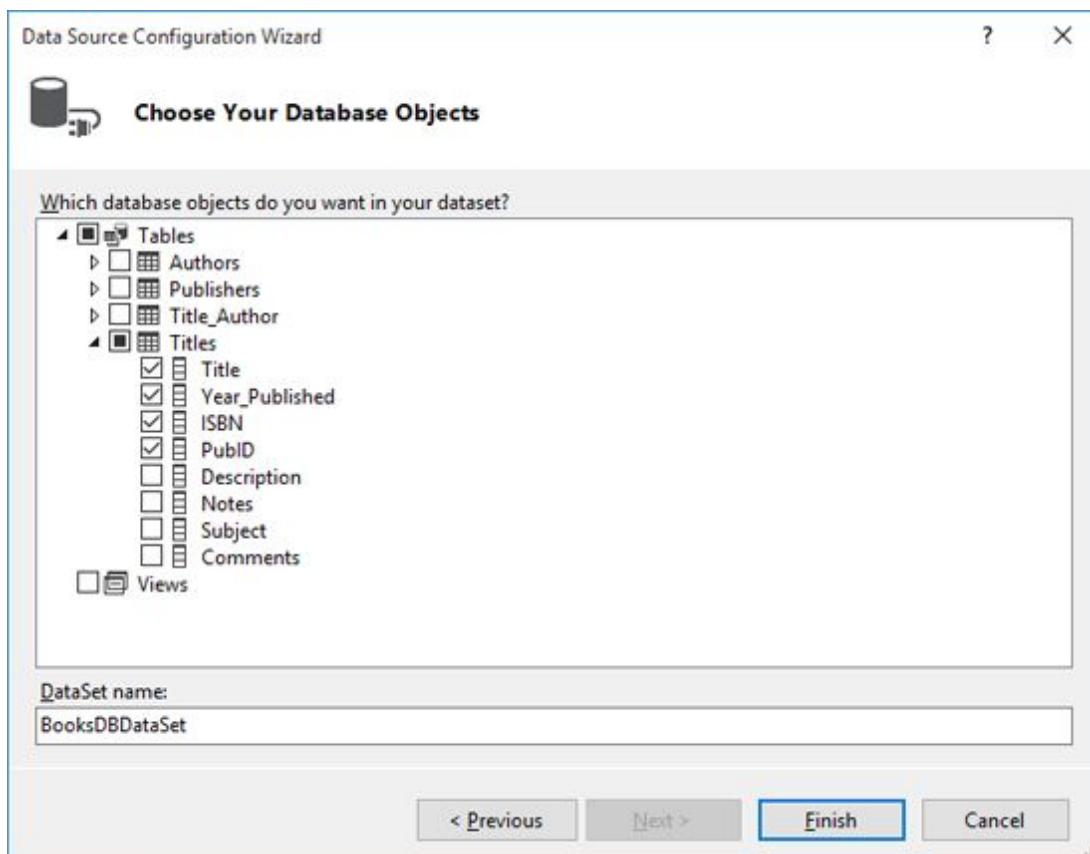
The next screen shows:



The **connection string** specifies what database fields are used to form the dataset. Choose the default connection string and click

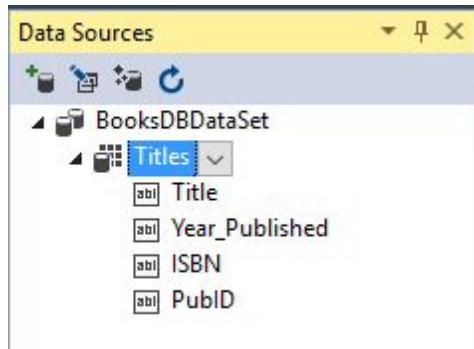
Next. The database connection is finally complete.

3. We now need to specify the **DataSet** or table of data we want to generate. We want to choose the **Title**, **Year_Published**, **ISBN** and **PubID** fields in the **Titles** table. Expand the **Tables** object, then choose the **Titles** table and place checks next to the desired fields:



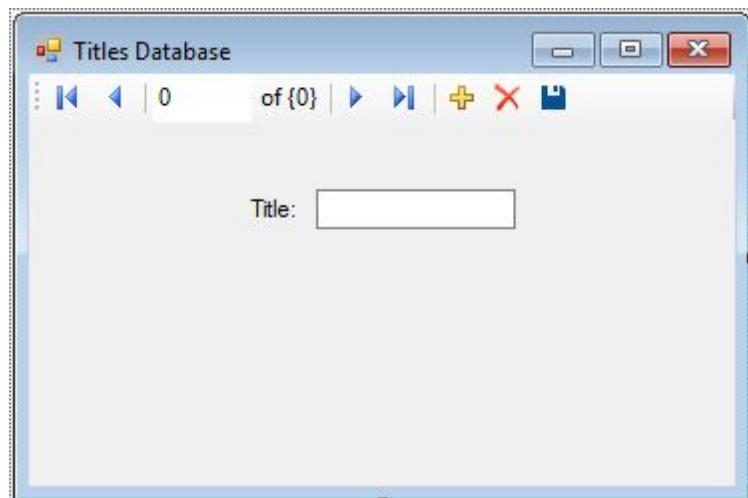
Once these selections are done, click **Finish** to complete specification of the **DataSet**.

4. Choose the **View** menu option, then **Other Windows** and click **Data Sources**. Pin this window to the IDE. Look in the **Data Sources** window in your project and you should see the newly created **DataSet** object (**booksDataSet**). The dataset contains one table (**Titles**):



To form this **DataTable**, Visual C# ‘queried’ the database (generating its own SQL statement) to pull the **Title**, **Year_Published**, **ISBN** and **PubID** fields out of the database.

5. Here’s where the magic begins. Click the **Title** field in the **Data Sources** window, then drag and drop it onto the form. You will see:

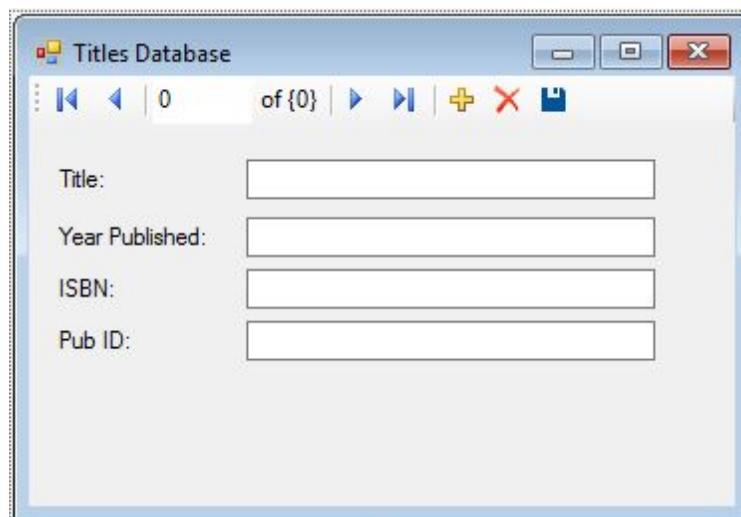


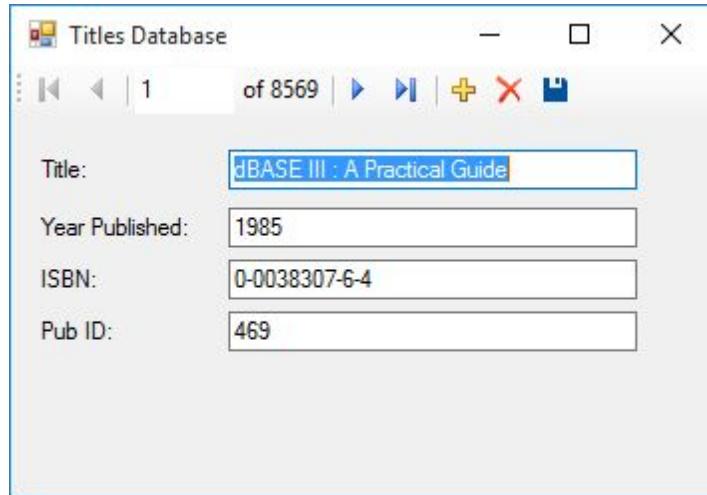
The wizard has created a label and a data bound text box for the **Title** field. It has also added a navigation tool at the top (you should recognize buttons to move to the first, previous, next and last records, respectively). Below the form are:



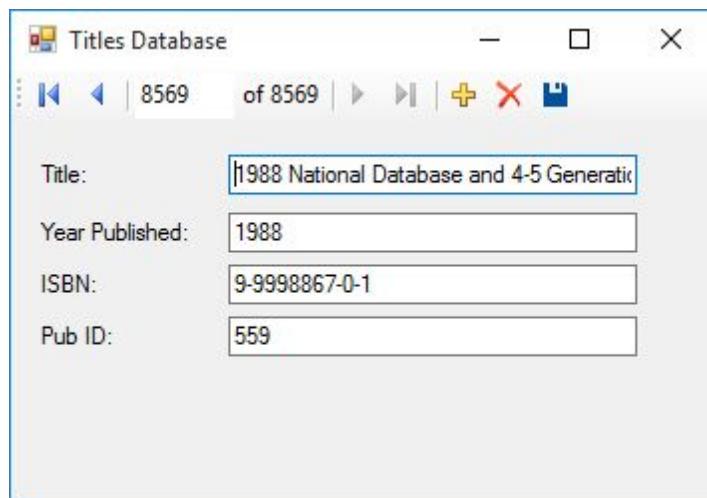
We recognize the `booksDataSet` object. The `titlesTableAdapter` object is a `DataAdapter` that controls communication between the books database and the dataset. The `titlesBindingSource` and `titlesBindingNavigator` controls navigation through the dataset. The wizard has essentially done all the steps of doing a connection, establishing a command object, creating a data adapter, a data table and a navigation object. These are all steps we did with code in Example 3-1.

6. Drag and drop the three other fields (`Year_Published`, `ISBN`, `PubID`) from the data source window onto the form. Resize things until it resembles this:





Here's the last record:



There's lots of power with this data wizard. A tool to view the **Titles** table was built without writing a line of code. The power of the wizard is its downfall, however. If you don't like the appearance of the navigation tool, you can't use the wizard. All of the information used to build the database connection and other objects is hard-coded into the application. So, if the **BooksDB.accdb** database is not in the specific folder designated when building the connection, the application will not work.

You decide where data wizards fit within your arsenal of database programming tools. I use them for quick personal applications and

to test various database management tasks.

Example 3-2 (SQL Server Database)

Books Database with Wizards

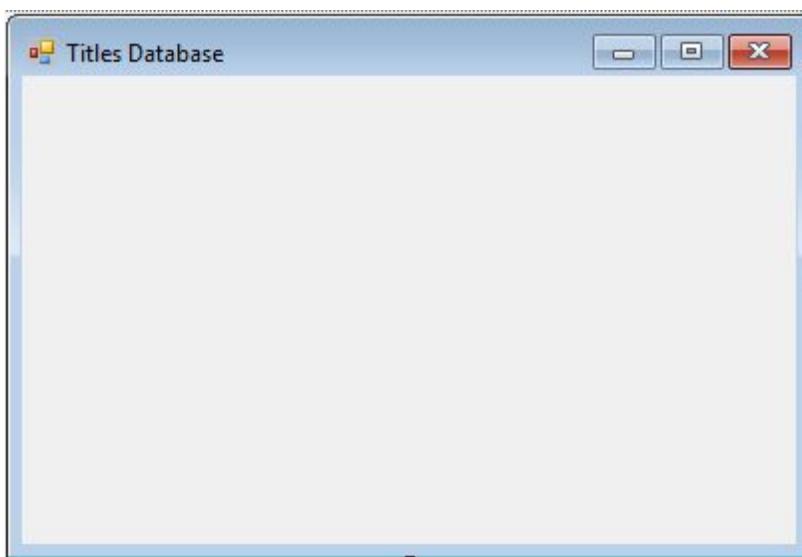
We will rebuild Example 3-1 using data wizards - an application where we can look at a few fields in the **Titles** table of the books database (**BooksDB.accdb**).

1. Start a new application with just a form. Set the following properties:

Form1:

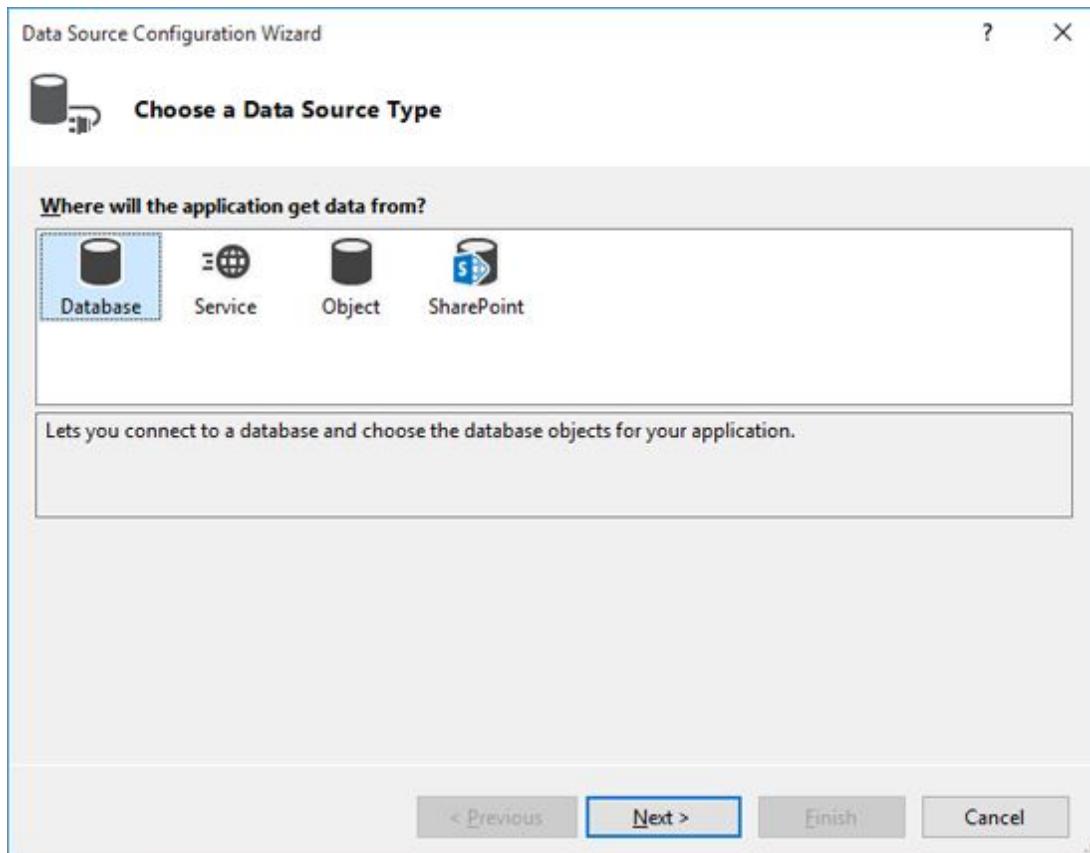
Name	frmTitles
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Titles Database

The form should look something like this:



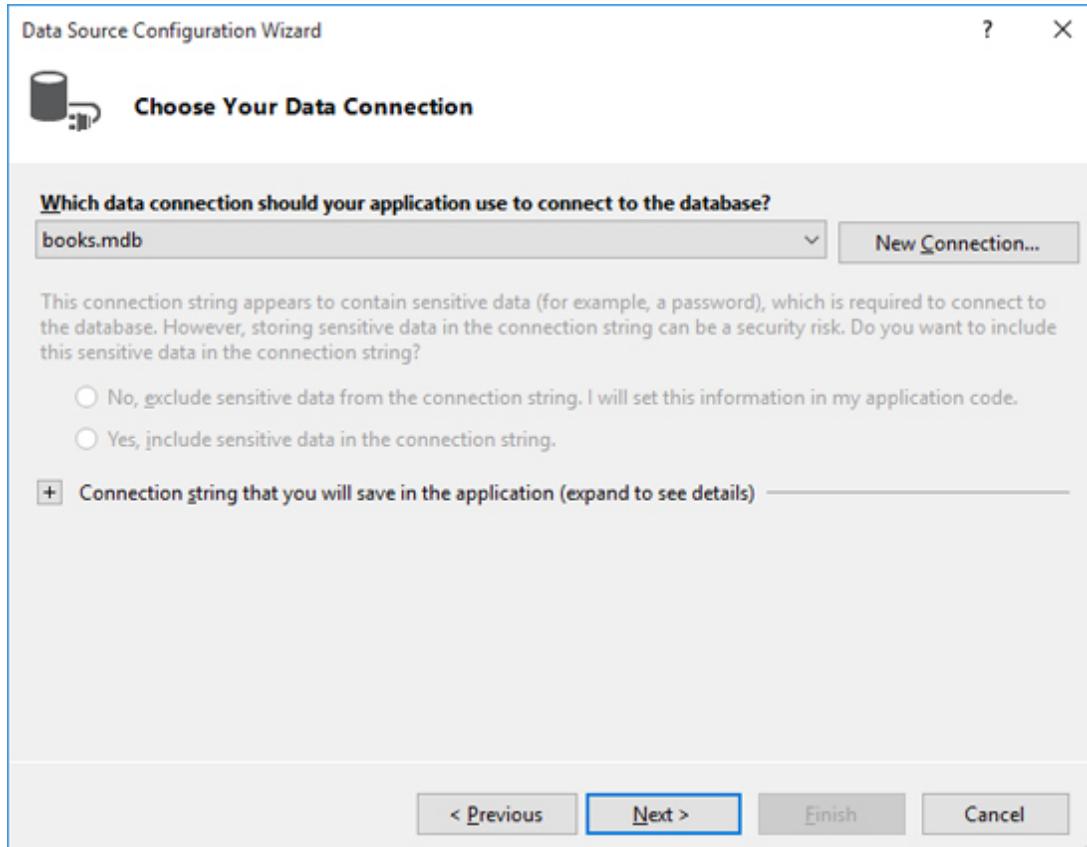
2. We now connect to the database. There are many steps. Select the **Data** menu option and choose **Add New Data Source**. This

window will appear:



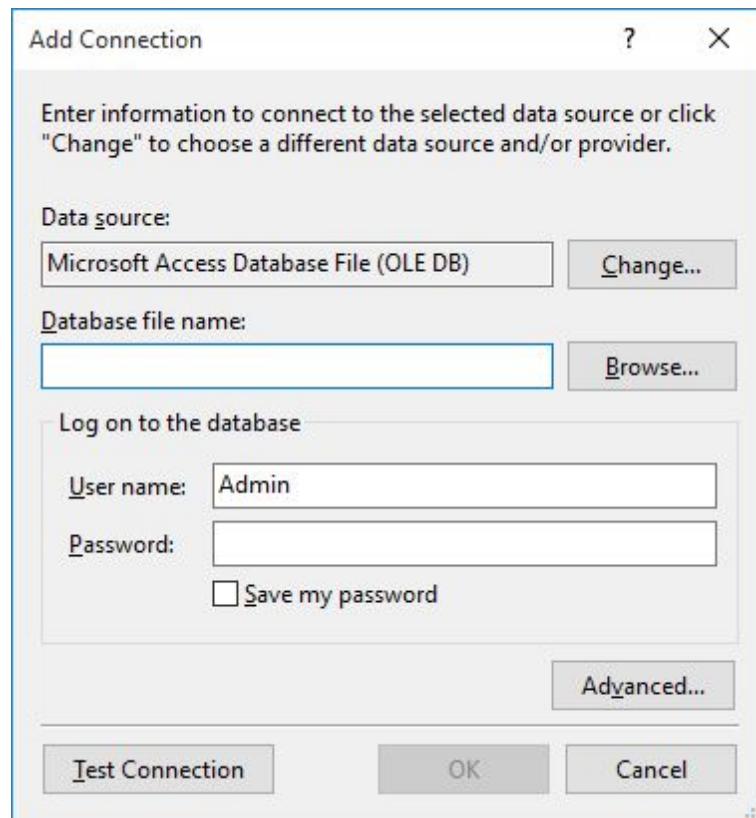
Choose the **Database** icon and click **Next**. You will see a screen asking what **database model** you want to use. Choose **Dataset** and click **Next**.

You next specify where the database is located:

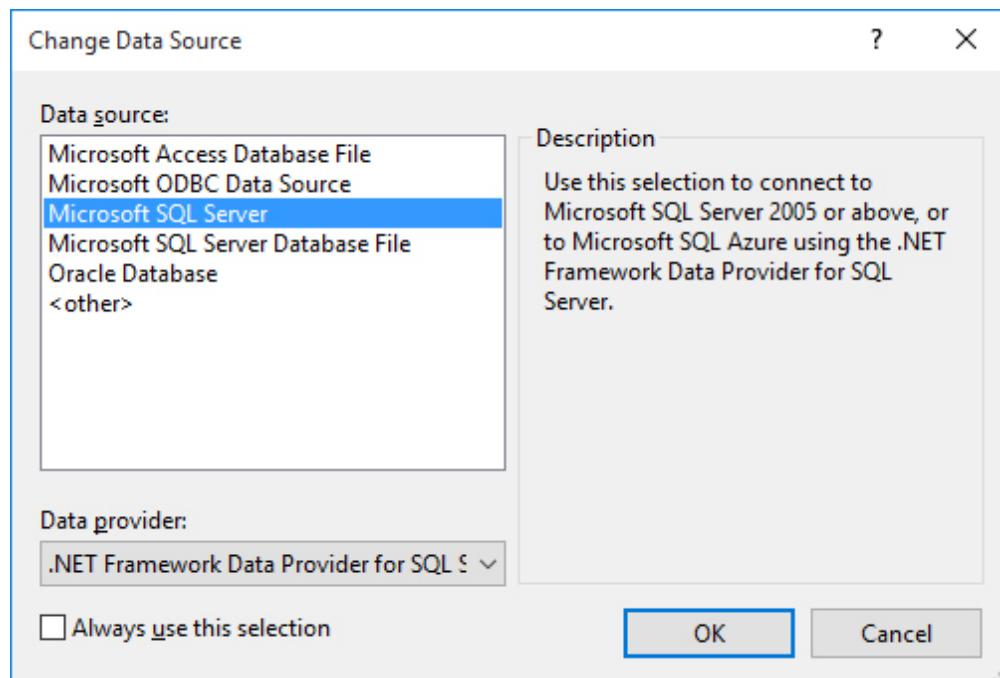


There may or may not be a connection listed in the drop down box. Here is where we will form a needed **Connection string** to connect to the database. Click **New Connection**.

In the next screen, you will see:

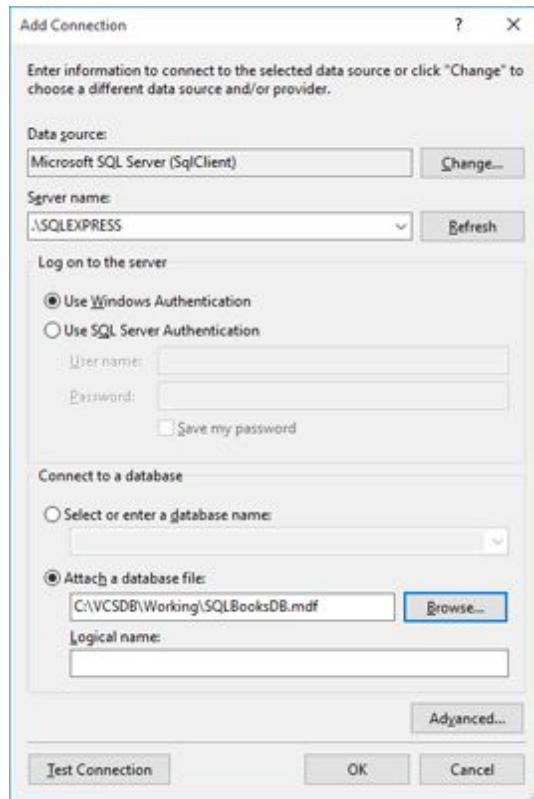


Make sure the **Data source** shows **Microsoft Sql Server**. If not, click **Change** to see:



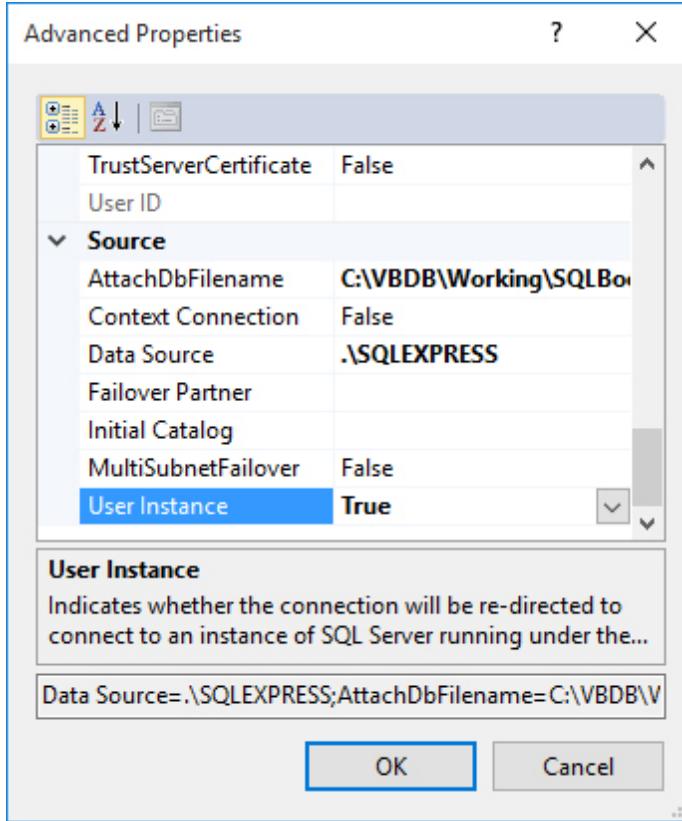
As shown, choose **Microsoft Sql Server**. Click **OK**.

You will return to the **Add Connection** window:



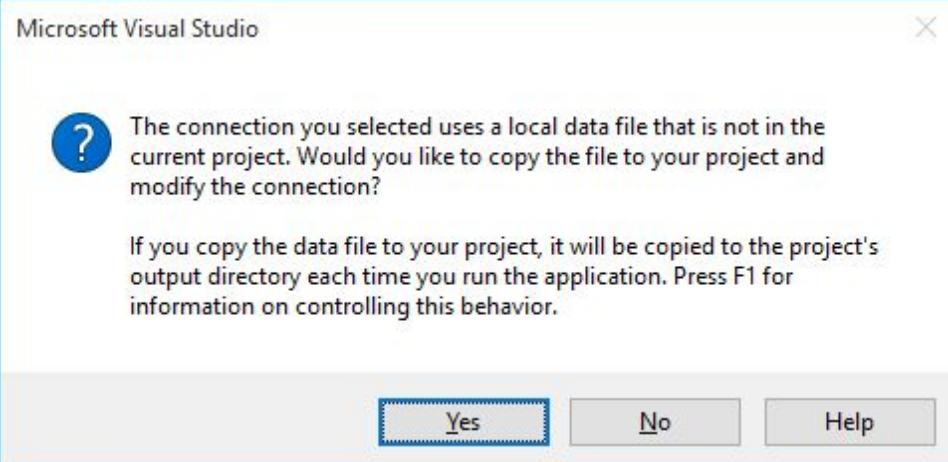
Type your SQL Server name in **Server Name**. Choose **Attach a database file** and click the **Browse** button and point to the **SQLBooksDB.mdf** database in your working folder - here it is **VCSDB\Working**).

Click the **Advanced** button to see:



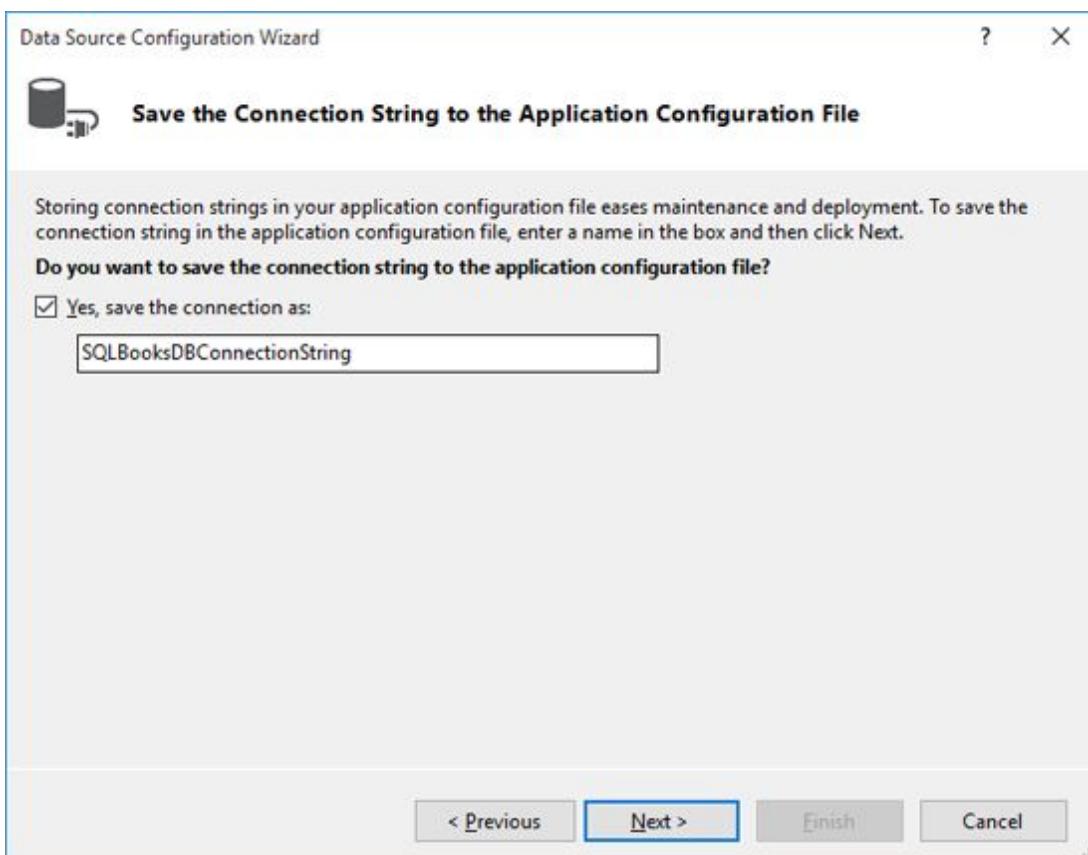
As shown, change the **User Instance** property to **True** (needed because SQL Server is on your account). Click **OK** to return to the **Add Connection** window. Click **Test Connection** to insure a proper connection.

Once the connection is verified, click **OK** and you will be returned to the **Data Source Configuration Wizard** main screen. Click **Next** and you may be asked if you want to copy the database to your project:



For our example, answer **No**.

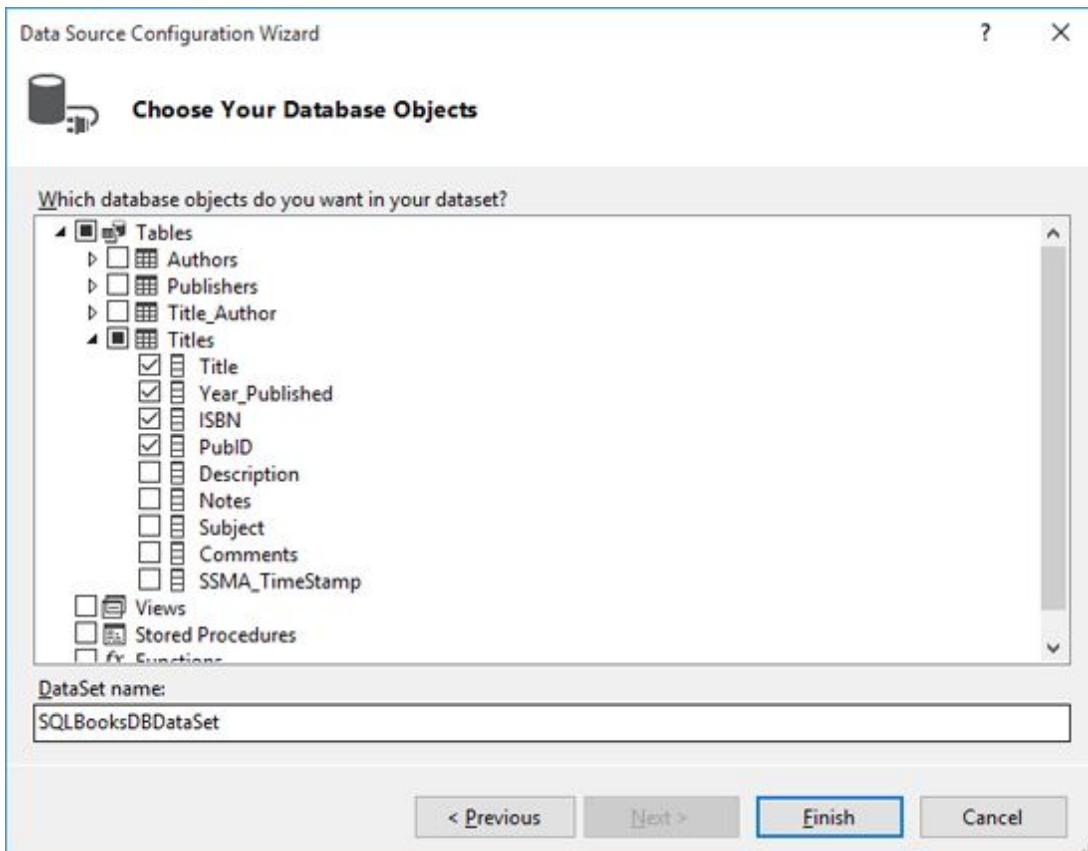
The next screen shows:



The **connection string** specifies what database fields are used to form the dataset. Choose the default connection string and click

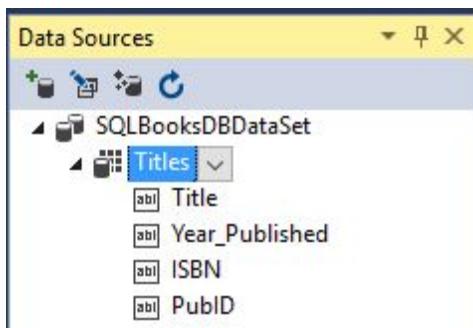
Next. The database connection is finally complete.

3. We now need to specify the **DataSet** or table of data we want to generate. We want to choose the **Title**, **Year_Published**, **ISBN** and **PubID** fields in the **Titles** table. Expand the **Tables** object, then choose the **Titles** table and place checks next to the desired fields:



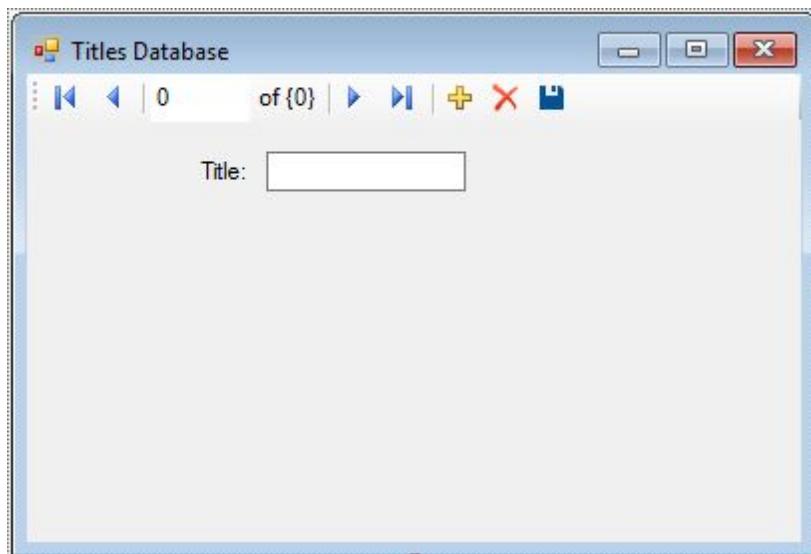
Once these selections are done, click **Finish** to complete specification of the **DataSet**.

4. Choose the **View** menu option, then **Other Windows** and click **Data Sources**. Pin this window to the IDE. Look in the **Data Sources** window in your project and you should see the newly created **DataSet** object (**booksDataSet**). The dataset contains one table (**Titles**):



To form this **DataTable**, Visual C# ‘queried’ the database (generating its own SQL statement) to pull the **Title**, **Year_Published**, **ISBN** and **PubID** fields out of the database.

5. Here’s where the magic begins. Click the **Title** field in the **Data Sources** window, then drag and drop it onto the form. You will see:

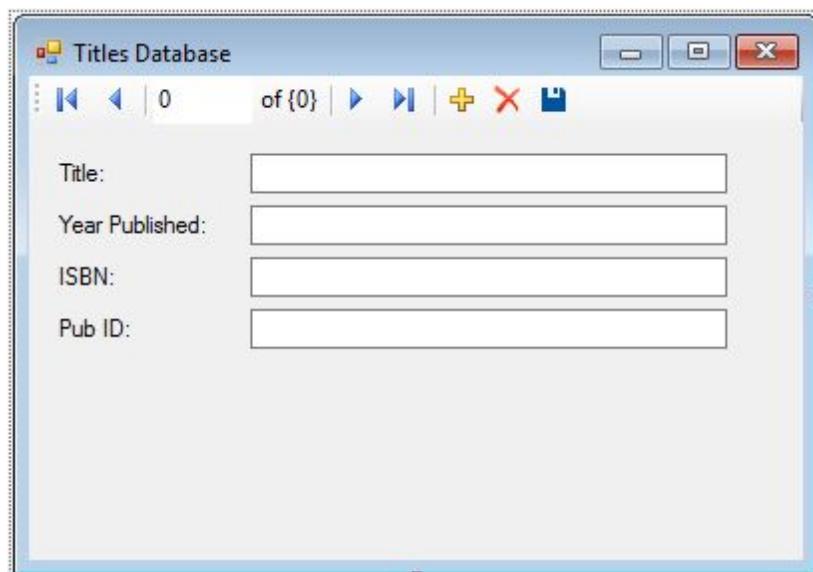


The wizard has created a label and a data bound text box for the **Title** field. It has also added a navigation tool at the top (you should recognize buttons to move to the first, previous, next and last records, respectively). Below the form are:

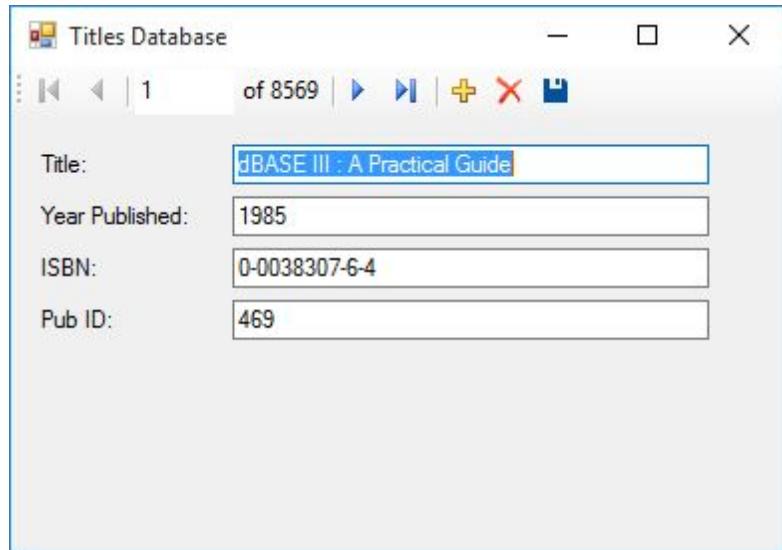


We recognize the **SQLBooksDataSet** object. The **TitlesTableAdapter** object is a **DataAdapter** that controls communication between the books database and the dataset. The **TitlesBindingSource** and **TitlesBindingNavigator** controls navigation through the dataset. The wizard has essentially done all the steps of doing a connection, establishing a command object, creating a data adapter, a data table and a navigation object. These are all steps we did with code in Example 3-1.

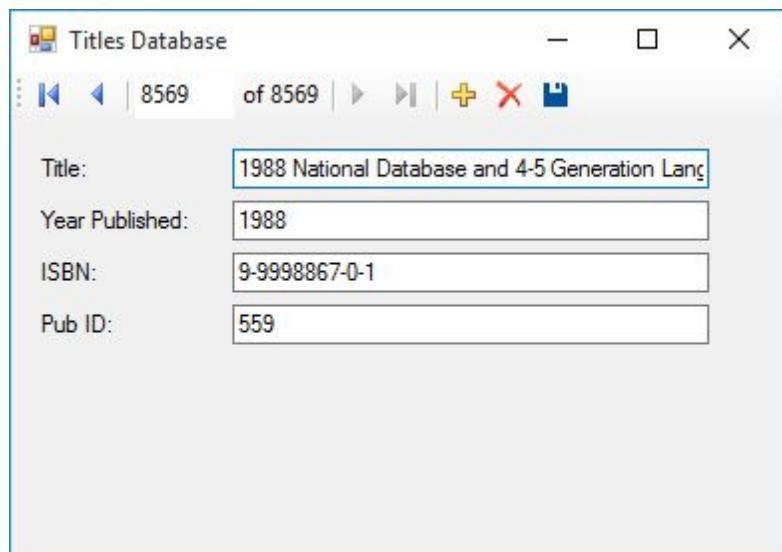
6. Drag and drop the three other fields (**Year_Published**, **ISBN**, **PubID**) from the data source window onto the form. Resize things until it resembles this:



7. Save the application (saved in the **Example 3-2 SQL** folder in **VCSDB\Code\Class 3** folder). Run the application. Try out the navigation buttons. Notice how all the fields update with each click of a button. Here's the first record:



Here's the last record:



There's lots of power with this data wizard. A tool to view the **Titles** table was built without writing a line of code. The power of the wizard is its downfall, however. If you don't like the appearance of the navigation tool, you can't use the wizard. All of the information used to build the database connection and other objects is hard-coded into the application. So, if the **SQLBooksDB.mdf** database is not in the specific folder designated when building the connection, the application will not work.

You decide where data wizards fit within your arsenal of database programming tools. I use them for quick personal applications and to test various database management tasks.

Using SQL Server Databases in Examples

In the two examples in this chapter, we built one for Access databases and one for SQL Server databases. I think you'll agree there is not a lot of difference in building each type of application.

In future chapters and in Example 3-3, we will only build Access versions of each example and give you the few steps needed to adapt the example to a SQL Server database. Look for areas titled **Using SQL Server Databases** at the end of each example.

Summary

In this chapter, we finally used Visual C# to connect to an actual database (both Access and SQL Server versions). We used several ADO .NET data objects to connect to and view the **Titles** table of the books database using data bound controls.

The objects used were:

Connection Object	Forms connection to the database.
Command Object	Forms SQL query to retrieve data table from database.
Data Adapter Object	Uses command object to transfer data between database and data table.
Data Table Object	Holds the table of data retrieved by the data adapter object.
Data Bound Controls	Controls ‘bound’ to fields of the data table object.
Currency Manager Object	Manages the controls bound to the data table. Provides both navigation and editing capabilities.

We looked at the Visual C# data wizard. The wizard is good for quick prototyping of database applications, but its inflexibility for distribution purposes makes it unsuitable for our work here.

Even after all the work we’ve done, all we can do right now is view database tables, which in some applications is sufficient (think of your local library - they certainly don’t want patrons changing information in their database). To build a complete database management system, we need to know SQL, the powerful language behind database queries. This is discussed in the next chapter.

If you're feeling overwhelmed by all the material presented thus far, don't worry - you'll see it many more times as you continue through this course and become a more proficient database programmer.

Example 3-3

Northwind Traders Database

A second sample database is included with these notes. The Access version is **NWIND.MDB**, located in the **VCSDB\Datasets** folder. This database is used by a fictional company (**Northwind Traders**) It has eight tables. In this exercise, we repeat the tasks of Example 3-1, using one table (**Customers**) in this database. The SQL statement (used in the command object) to do this is:

Select * from Customers

This example gives you further practice in using the ADO .NET data objects and data bound controls and allows you to study the structure of another database.

1. Copy **NWIND.MDB** to your working directory and start a new application. We'll develop a form where we can look through the **Customers** table in the Northwind Traders database. Place four label, four text boxes, and four buttons on the form.
2. Set the following properties for each control. For the data control and the four text boxes, make sure you set the properties in the order given.

Form1:

Name	frmCustomers
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Customers Database

Label1:

Text	Customer ID
------	-------------

Label2:

Text	Company Name
------	--------------

Label3:

Text	Contact Name
------	--------------

Label4:

Text	Contact Title
------	---------------

TextBox1:

Name	txtCustomerID
BackColor	White
ReadOnly	True
MultiLine	True

TextBox2:

Name	txtCompanyName
BackColor	White
ReadOnly	True
MultiLine	True

TextBox3:

Name	txtContactName
BackColor	White
ReadOnly	True
MultiLine	True

TextBox4:

Name	txtContactTitle
BackColor	White
ReadOnly	True
MultiLine	True

Button1:

Name btnFirst
Text &First

Button2:

Name btnPrevious
Text &Previous

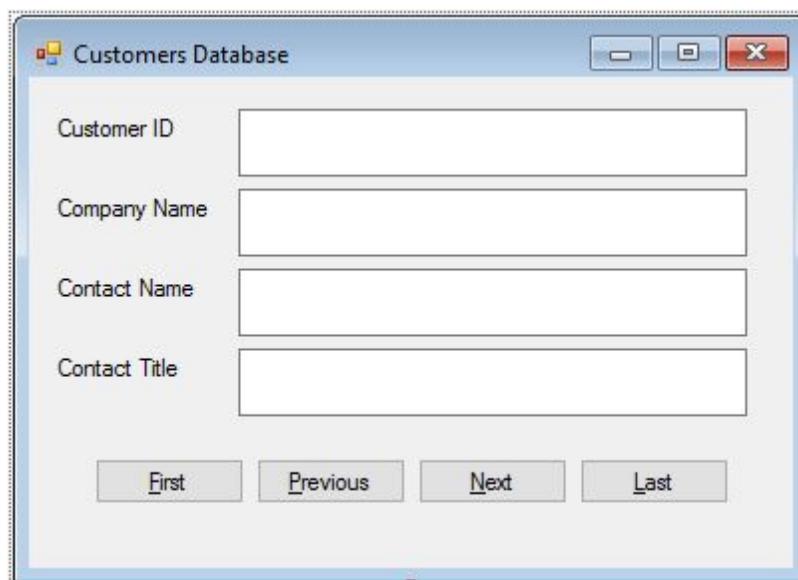
Button3:

Name btnNext
Text &Next

Button4:

Name btnLast
Text &Last

When done, the form will look something like this:



3. Add this line at the top of the code window:

```
using System.Data.OleDb;
```

4. Form level declarations to create data objects:

```
OleDbConnection NWindConnection;
OleDbCommand customersCommand;
OleDbDataAdapter customersAdapter;
DataTable customersTable;
CurrencyManager customersManager;
```

5. Add this code the **frmCustomers_Load** method:

```
private void frmCustomers_Load(object sender,
EventArgs e)
{
    // connect to NWind database
    NWindConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSD\\Working\\NWindDB.accdb");
    //open the connection
    NWindConnection.Open();
    // establish command object
    customersCommand = new OleDbCommand("SELECT * FROM
Customers", NWindConnection);
    // establish data adapter/data table
    customersAdapter = new OleDbDataAdapter();
    customersAdapter.SelectCommand = customersCommand;
    customersTable = new DataTable();
    customersAdapter.Fill(customersTable);
    // bind controls to data table
    txtCustomerID.DataBindings.Add("Text",
customersTable, "CustomerID");
    txtCompanyName.DataBindings.Add("Text",
customersTable, "CompanyName");
```

```

txtContactName.DataBindings.Add("Text",
customersTable, "ContactName");
txtContactTitle.DataBindings.Add("Text", customersTa
ble, "ContactTitle");
// establish currency manager
customersManager = (CurrencyManager)
BindingContext[customersTable];
//close the connection
NWindConnection.Close();
//dispose of the connection object
NWindConnection.Dispose();
customersCommand.Dispose();
customersAdapter.Dispose();
customersTable.Dispose();
}

```

6. Code for the four button Click events to allow navigation:

```

private void btnFirst_Click(object sender, EventArgs
e)
{
    customersManager.Position = 0;
}

private void btnPrevious_Click(object sender,
EventArgs e)
{
    customersManager.Position--;
}

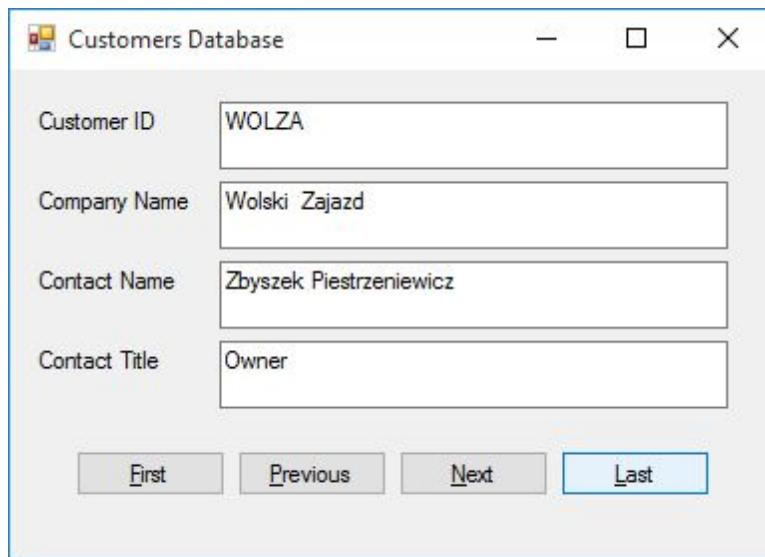
private void btnNext_Click(object sender, EventArgs
e)
{

```

```
customersManager.Position++;
}

private void btnLast_Click(object sender, EventArgs e)
{
    customersManager.Position = customersManager.Count
        - 1;
}
```

7. Save the application (saved in the **Example 3-3** folder in **VCSDB\Code\Class 3** folder). Run the application. Cycle through the various customers using the navigation buttons. Here's the last record:



Example 3-3

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the Northwind Traders database (**SQLNWindDB.mdf**) can be downloaded from our web site, as explained in Chapter 2, or if you have a CD-ROM of these notes, it is also in the **VCSD\Datasets** folder. Copy **SQLNWindDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. Use these statements to declare the data objects:

```
SqlConnection NWindConnection;  
SqlCommand customersCommand;  
SqlDataAdapter customersAdapter;
```

4. In **frmCustomers_Load** method, use this connection object:

```
NWindConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSD\\Working\\SQLNWindDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

4

Database Queries with SQL

Review and Preview

At this point in our study, we can view any table that is part of a database (**a native table**). A powerful feature of any database management system is to have the ability to form any view of the data we desire. The formation of such **virtual tables** is discussed in this chapter.

Virtual data views are obtained by querying the database. The language used for such queries is the structured query language, or **SQL**. In this chapter, we will learn how to use SQL to extract desired information from a database. Note SQL is not just used with Visual C# database applications. It is the standard language for database queries, hence all material learned here can be transferred to other database management systems.

SQL Background

SQL was developed at IBM in the early 1970's, coincident with relational database theory developed by E. F. Codd. SQL succeeded a previous database language called Sequel - hence, SQL is the "sequel to Sequel." Because of this, many programmers pronounce SQL as "sequel." The correct pronunciation is "ess-que-ell," that is, just say the letters.

SQL is a set of statements that tell a database engine (such as the ADO .NET engine with Visual C#) what information the user wants displayed. The engine then processes that set of statements, as it sees fit, to provide the information. SQL statements fall into two categories: data manipulation language (**DML**) and data definition language (**DDL**). DDL statements can be used to define tables, indexes, and database relations. DML statements are used to select, sort, summarize, and make computations on data. We will discuss primarily DML statements.

SQL has been adopted as an **ANSI** (American National Standards Institute) standard. This means there is an established set of SQL statements that every database management system recognizes. Yet, even with this standard, each manufacturer has added its own 'dialect' to the standard. In these notes, we will use Microsoft SQL. When a statement or function does not agree with the ANSI standard, this will be pointed out to the reader.

Basics of SQL

SQL can be used with any database management system, not just Visual C#. Hence, the syntax learned here will help any database programmer. SQL is a set of about 30 statements for database management tasks.

To query a database, we form a **SQL statement**. A statement is a string of SQL keywords and other information, such as database table and field names. This statement tells the database engine what information we want from the database. You do not have to tell the database engine how to get the information - it does all the hard work for you!

What can a SQL statement accomplish?

- ⇒ Sort records
- ⇒ Choose fields
- ⇒ Choose records
- ⇒ Cross reference tables
- ⇒ Perform calculations
- ⇒ Provide data for database reports
- ⇒ Modify data

Even though we don't even know what a SQL statement looks like yet, we need to set some rules on how to construct such statements. Then, we will look at how to use a SQL statement in a Visual C# application.

All **SQL keywords** in a SQL statement will be typed in **upper case** letters. Even though SQL is ‘case-insensitive,’ this is good programming practice and allows us (and others) to differentiate between keywords and other information in a SQL statement.

SQL uses the term **row** to refer to a database **record** and the term **column** to refer to database **field**. This will not come into play in this class, but you should be aware of this difference if you read other books about SQL.

String information embedded within a SQL statement can be enclosed in double-quotes ("") or single-quotes (''). With Visual C#, you should only use single-quotes to enclose embedded strings. The reason for this is that the SQL statement is itself a string - so, in Visual C# code, SQL statements must be enclosed in double-quotes. We enclose embedded strings with single-quotes to avoid confusion.

SQL supports the use of **wildcards** in forming data views. Here, we use the Microsoft SQL wildcard character, an asterisk (*). Use of wildcards will be illustrated in many examples. ANSI Standard SQL implementations use the percent sign (%) as a wildcard.

If a table or field name has an embedded space, that name must be enclosed in brackets ([]). For example, if the table name is **My Big Table**, in a SQL statement you would use:

[My Big Table]

This notation is not allowed in some SQL implementations. But in implementations that don't recognize brackets, embedded spaces in table and field names are not allowed, so it should never be a problem. A good rule of thumb is to avoid embedded spaces in table and field names if you can.

To refer to a particular field in a particular table in a SQL statement, use a dot notation:

TableName.FieldName

If either the table or field name has embedded spaces, it must be enclosed in brackets. Again, avoid embedded spaces if possible.

Now, we're ready to start forming SQL statements and using them with Visual C# applications. One warning - SQL is a very powerful ally in obtaining and modifying data in a database. But, it can also be very destructive - a single SQL statement can wipe out an entire database! So, be careful and always provide safeguards against such potential destruction.

Where Does SQL Fit In Visual C#?

In Chapter 3, we used a single SQL statement to look at some fields from the **Titles** table of the books database. The SQL statement was used to form a command object (based on a connection object), which in turn was used by a data adapter object to form a data table. The data table is then available for viewing using data bound controls.

The code involved in processing a SQL statement is (assumes all objects have been properly declared):

Access Database:

```
myCommand = new OleDbCommand(mySQL, myConnection);
myAdapter.SelectCommand = myCommand;
myAdapter.Fill(myTable);
```

SQL Server Database:

```
myCommand = new SqlCommand(mySQL, myConnection);
myAdapter.SelectCommand = myCommand;
myAdapter.Fill(myTable);
```

In this code, **mySQL** is the SQL statement applied against a connection object **myConnection** (it is assumed that the connection object has been opened against a database). The resulting command object (**myCommand**) is used by the data adapter (**myAdapter**) to form the data table (**myTable**). This table is then used for data binding.

A result of interest from a SQL query is the number of records returned (if any). The data table formed has that information in the following property:

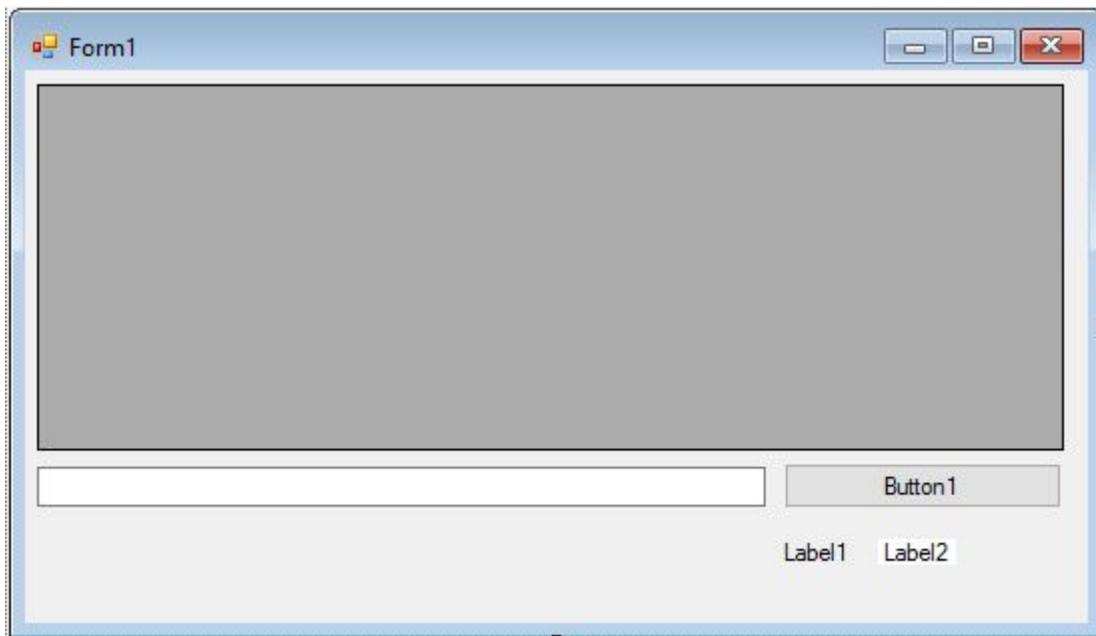
myTable.Rows.Count

Example 4-1

SQL Tester

Well, now we know some of the rules and syntax of SQL statements and how to use them with Visual C#, but we still don't know what a SQL statement looks like (well, we saw a couple of examples in Chapter 3). We correct all that now and start learning more about SQL. To test SQL statements we form, we build this example which allows us to enter SQL statements and see the results of the formed database queries. The books database (**BooksDB.accdb**) is used in this example.

1. Start a new project. Add a text box control, two label controls, a button, and a data grid view control to the form. Wait, you say, what is a **DataGridView** control? The **DataGridView** control allows us to view and edit an entire database table by setting just one property (**DataSource**). Resize and position the controls so your form looks something like this:



2. Set properties for the form and controls:

Form1:

Name	frmSQLTester
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	SQL Tester

label1:

AutoSize	False
Text	Records Returned

label2:

Name	lblRecords
AutoSize	False
TextAlign	MiddleCenter
BackColor	White
BorderStyle	FixedSingle
Text	0
FontSize	12

button1:

Name	btnTest
Text	Test SQL Statement
TabStop	False

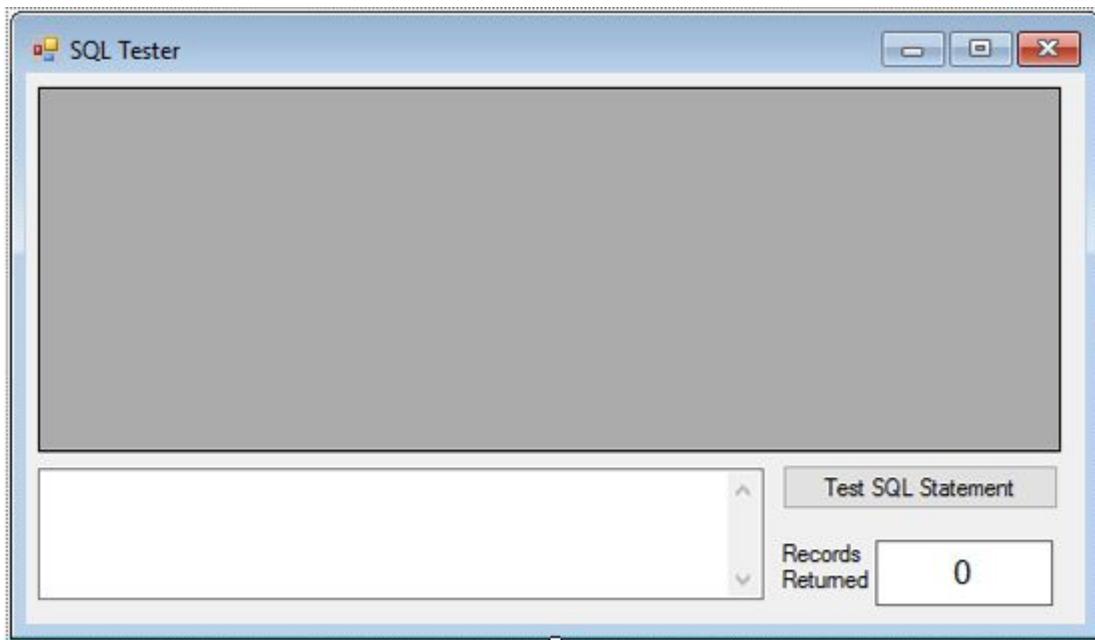
dataGridView1:

Name	grdSQLTester
TabStop	False

textBox1:

Name	txtSQLTester
MultiLine	True
ScrollBars	Vertical

When done, the form should look like this:



With this example, we will type SQL statements in the text box area, then click the **Test SQL Statement** button. The data grid will display the returned records, while the label control will display the number of records returned. We need some code to do all of this.

3. Add this line at the top of the code window to allow use of data objects:

```
using System.Data.OleDb;
```

4. Form level declaration for connection object:

```
OleDbConnection booksConnection;
```

5. Code for the `frmSQLTester_Load` method that opens the database:

```
private void frmSQLTester_Load(object sender,  
EventArgs e)
```

```
{  
    // connect to books database  
    booksConnection = new  
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = c:\\VCSD\\Working\\BooksDB.accdb");  
    booksConnection.Open();  
}
```

6. Code for the frmSQLTester_FormClosing method:

```
private void frmSQLTester_FormClosing(object sender,  
FormClosingEventArgs e)  
{  
    booksConnection.Close();  
    booksConnection.Dispose();  
}
```

7. Code for the btnTest_Click method:

```
private void btnTest_Click(object sender, EventArgs  
e)  
{  
    OleDbCommand resultsCommand = null;  
    OleDbDataAdapter resultsAdapter = new  
OleDbDataAdapter();  
    DataTable resultsTable = new DataTable();  
    try  
    {  
        // establish command object and data adapter  
        resultsCommand = new  
        OleDbCommand(txtSQLTester.Text,  
        booksConnection);
```

```

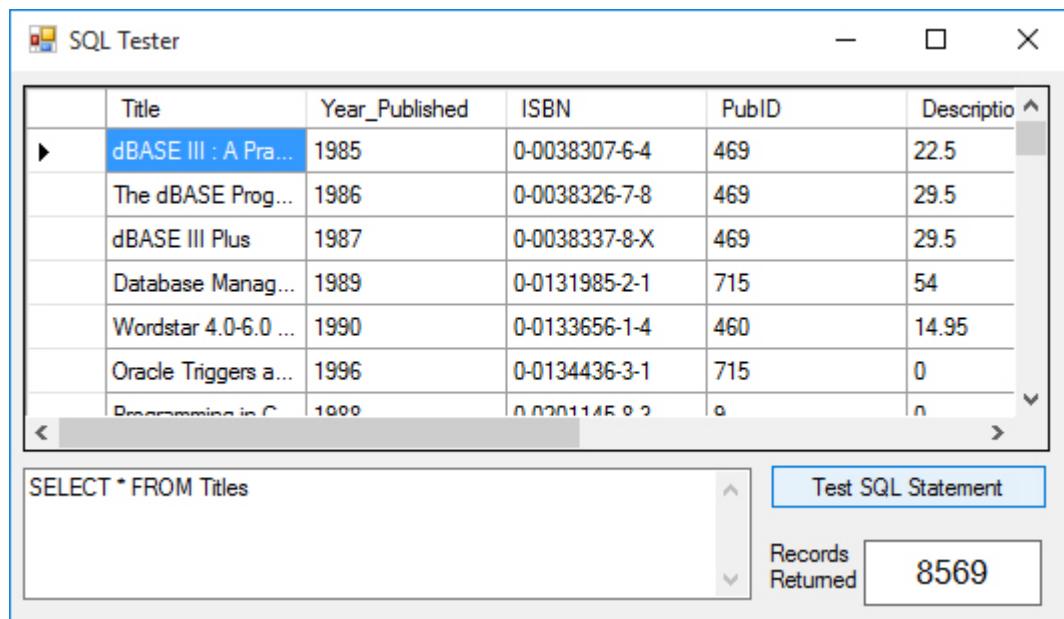
        resultsAdapter.SelectCommand = resultsCommand;
        resultsAdapter.Fill(resultsTable);
        // bind grid view to data table
        grdSQLTester.DataSource = resultsTable;
        lblRecords.Text =
        resultsTable.Rows.Count.ToString();
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error in Processing
        SQL",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    resultsCommand.Dispose();
    resultsAdapter.Dispose();
    resultsTable.Dispose();
}

```

Let's spend some time seeing what's going on in this code. The first thing we do is use exception handling (the `try` block). Without it, if we make a small error in a SQL statement, the program will stop. With it, we get a message indicating our mistake and are allowed to continue. Following error control, the SQL statement (from `txtSQLTester`) is processed by the data adapter (`resultsAdapter`) and the data table (`resultsTable`) established. The number of records is then displayed.

Be careful in typing SQL statements. Although we have exception handling in SQL Tester, if you make a mistake, the returned error messages are (many times) not of much help. If you get an error, the best thing to do is retype the SQL command, paying attention to spacing, spelling, and proper punctuation.

8. Save the application (saved in the **Example 4-1** folder in **VCSDB\Code\Class 4** folder) and run it. Type the only SQL statement you know at this time in the text box (**SELECT * FROM Titles**). Click **Test SQL Statement** and you should see (it may take several seconds for the records to appear):



Note the data grid view control displays the entire table. You can scroll through the table or edit any values you choose. Any changes are automatically reflected in the underlying database. Column widths can be changed at runtime. Multiple row and column selections are possible. It's a very powerful tool. Please note **Records Returned** values for your results may be different, depending on the current data in the database.

Change the word **SELECT** to **SLECT** to make sure the error trapping works. You should see:

Error in Processing SQL

X



Invalid SQL statement; expected 'DELETE', 'INSERT', 'PROCEDURE',
'SELECT', or 'UPDATE'.

OK

Now, let's use this SQL Tester to examine many kinds of SQL statements. When typing the statements, use upper case letters for the SQL keywords. Statements do not necessarily have to be on a single line - multiple line SQL statements are fine and usually make them easier to read and understand.

Example 4-1

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Copy **SQLBooksDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. In declarations, use this connection object:

```
SqlConnection booksConnection;
```

4. In **frmSQLTester_Load** method, use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

5. In **btnTest_Click** method:

Change all instances of **OleDbCommand** to **SqlCommand**

Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

SELECT/FROM SQL Statement

The most commonly used SQL statement is the one we've been using as an example: the **SELECT/FROM** statement. This statement allows you to pick fields from one or more tables.

The syntax for a **SELECT/FROM** SQL statement is:

```
SELECT [Fields] FROM [Tables]
```

where **[Fields]** is a list of the fields desired and **[Tables]** is a list of the tables where the fields are to be found. The wildcard character (*) can be used for the fields list to select all fields from the listed table(s). For example, the statement we have been using:

```
SELECT * FROM Titles
```

selects and returns all fields from the books database **Titles** table. Look at all fields in the other tables (Authors, Publishers, Title_Author) using similar statements. Looking at each table will reacquaint you with the structure of the books database tables and fields. We will use a lot in the rest of this chapter.

If we only want selected fields from a table, we use a **field list**, which is a comma-delimited list of the fields desired, or:

```
SELECT Field1, Field2, Field3 FROM Table
```

will return three named fields from Table. Make sure you do not put a comma after the last field name. To obtain just the Title and Year_Published fields from the books database Titles table, use:

```
SELECT Title,Year_Published FROM Titles
```

Note the field names are not written using the prescribed dot notation of **Table.Field**. The table name omission is acceptable here because there is no confusion as to where the fields are coming from. When using multiple tables, we must use the dot notation.

Try this with the SQL tester and you will see just two fields are returned.

The screenshot shows the 'SQL Tester' application window. At the top, there's a title bar with the application name. Below it is a grid view displaying a table with two columns: 'Title' and 'Year_Published'. The data in the grid is as follows:

	Title	Year_Published
▶	dBASE III : A Pra...	1985
	The dBASE Prog...	1986
	dBASE III Plus	1987
	Database Manag...	1989
	Wordstar 4.0-6.0 ...	1990
	Oracle Triggers a...	1996
	Programming in C...	1988

Below the grid, there's a text input area containing the SQL query: `SELECT Title,Year_Published FROM Titles`. To the right of the input area is a button labeled 'Test SQL Statement'. Further down, there's a status message 'Records Returned' followed by the number '8569'.

The **DISTINCT** keyword can be used with SELECT to restrict the returned records to one per unique entry for the field. That is, there are no duplicate entries. As an example, first try this with the SQL tester:

SELECT PubID FROM Titles

SQL Tester

	PubID
▶	3
	3
	3
	3
	3
	3
	3
	3

SELECT PubID FROM Titles

Test SQL Statement

Records Returned 8569

Now, try:

SELECT DISTINCT PubID FROM Titles

SQL Tester

	PubID
▶	3
	4
	5
	6
	7
	8
	9

SELECT DISTINCT PubID FROM Titles

Test SQL Statement

Records Returned 708

You should see far fewer records are returned - only distinct publishers are returned.

ORDER BY Clause

When you use a SELECT/FROM statement, the records are returned in the order they are found in the selected table(s). To sort the returned records in some other order, you use the ORDER BY clause. The syntax is:

```
SELECT [Fields] FROM [Tables] ORDER BY FieldSort
```

This statement selects the listed fields from the listed tables and sorts them by the field named FieldSort. By default, the ordering is in ascending order. If you want the sort to be in descending order, the FieldSort name is followed by the keyword DESC.

Try this statement with the SQL Tester:

```
SELECT * FROM Titles ORDER BY PubID
```

All records in the Titles table will be returned in order of Publisher ID.

The screenshot shows the SQL Tester application window. At the top, there's a title bar with the application name. Below it is a grid view displaying data from the 'Titles' table, sorted by 'PubID'. The columns shown are PubID, Title, Year_Published, ISBN, and Description. The first row has 'PubID' set to 3, and the 'Title' column contains 'Time and Task M...'. The bottom part of the window contains the SQL query used to generate the results: 'SELECT * FROM Titles ORDER BY PubID'. To the right of the query, there's a button labeled 'Test SQL Statement'. On the far right, there's a summary box showing 'Records Returned' with the value '8569'.

	PubID	Title	Year_Published	ISBN	Description
▶	3	Time and Task M...	1986	0-9343750-9-7	49.95
	3	Sales Manageme...	1986	0-9343751-5-1	49.95
	3	Nr : An Implemen...	1987	0-9343753-3-X	29.95
	3	The New Basics/...	1987	0-9343754-3-7	39.95
	3	Turbo C : The Art...	1987	0-9343754-5-3	39.95
	3	Advanced X Win...	1994	1-5582802-9-4	0
	2	Software by Dosi	1994	1-5582802-9-3	29.95

```
SELECT * FROM Titles ORDER BY PubID
```

Test SQL Statement

Records Returned 8569

Try this and the order should be reversed:

```
SELECT * FROM Titles ORDER BY PubID DESC
```

You can use more than one field in the ORDER BY clause. SQL will create a data table based on all requested orderings. Try this with SQL tester:

```
SELECT * FROM Titles ORDER BY PubID,Title
```

The returned records will be in order of the publishers, with each publisher's titles in alphabetic order.

	PubID	Title	Year_Published	ISBN	Description
▶	3	Access 2.0 : A D...	1995	1-5585133-5-3	39.95
	3	Access for Wind...	1995	1-5582844-1-9	24.95
	3	Advanced Fracta...	1990	1-5585109-6-6	29.95
	3	Advanced Fracta...	1990	9-9922645-9-4	20
	3	Advanced Graphi...	1991	1-5585117-1-7	29.95
	3	Advanced Graphi...	1991	1-5585117-3-3	39.95
	2	Advanced Graphi...	1991	1-5585112-1-0	29.95

SELECT * FROM Titles ORDER BY PubID,Title

Test SQL Statement

Records Returned 8569

If you want to restrict the number of records returned by a SQL statement that orders the returned records, you can use the **TOP** keyword with **SELECT**. **TOP n** returns the first n records. **TOP n PERCENT** returns the first n percent of the returned records. If two or more records have the same order value, they are all returned. Use the SQL Tester and try:

```
SELECT TOP 20 * FROM Titles ORDER BY PubID,Title
```

Twenty books should be returned. Now, try:

SELECT TOP 20 PERCENT * FROM Titles ORDER BY PubID,Title

Far more books will be returned.

WHERE Clause

One of the most useful aspects of the SELECT/FROM SQL statement is its ability to limit the returned data table via the **WHERE** clause. This clause specifies some criteria that must be met in forming the data table. The syntax is:

SELECT [Fields] FROM [Tables] WHERE Criteria

The WHERE clause limits the number of returned records by allowing you to do logical checks on the value of any field(s). Operators used to perform these checks include:

- < Less than
- > Greater than
- = Equal
- <= Less than or equal to
- >= Greater than or equal to
- <> Not equal

Other operators are:

- Between** Within a specified range
- In** Specify a list of values
- Like** Wild card matching

The WHERE clause can limit information displayed from one table or combine information from one or more tables. First, let's do some single table examples using SQL Tester.

Single Table WHERE Clause

Say we want to see all fields in the books database **Titles** table for books published after 1995. And, we want the returned records ordered by **Title**. The SQL statement to do this is (we'll type each clause on a separate line to clearly indicate what is going on - multiple line SQL statements are acceptable and, many times, desirable):

```
SELECT *
FROM Titles
WHERE Year_Published > 1995
ORDER BY Title
```

This is where the real power of SQL comes in. With this simple statement, the database engine quickly finds the desired records and sorts them - all without any coding on our part!

The screenshot shows the SQL Tester application window. At the top, it displays the title "SQL Tester". Below the title bar is a toolbar with standard window controls (minimize, maximize, close). The main area contains a grid table showing book data from the "Titles" table. The columns are labeled: PubID, Title, Year_Published, ISBN, and Description. The data grid shows several rows of books published in 1996. At the bottom left of the window, there is a text input field containing the SQL query:

```
SELECT *
FROM Titles
WHERE Year_Published > 1995
ORDER BY Title
```

To the right of the query input is a button labeled "Test SQL Statement". Further down on the right, there is a status bar with the text "Records Returned" followed by the number "230".

What if we want to know information about all the book publishers in the state of Washington. Try this SQL statement with the **BooksDB.accdb** Publishers table:

```
SELECT * FROM Publishers WHERE State = 'WA'
```

Note we enclosed the state name abbreviation (a string) in single quotes, as discussed earlier in this chapter. Try this SQL statement with the SQL tester and you should find one lonely publisher (BetaV) in the state of Washington!:

The screenshot shows the 'SQL Tester' application window. At the top, there are standard window controls (minimize, maximize, close). Below the title bar is a table with six columns: PubID, Name, Company_Name, Address, and City. The first row contains data: PubID 727, Name Beta V, Company_Name Beta V, Address 16212 NE 113th ..., and City Redmond. A second row is present but empty. Below the table is a large grayed-out area. At the bottom left is a text input field containing the SQL query: 'SELECT * FROM Publishers WHERE State = 'WA''. To its right is a button labeled 'Test SQL Statement'. On the far right, there is a status bar with the text 'Records Returned' followed by a box containing the number '1'.

	PubID	Name	Company_Name	Address	City
▶	727	Beta V	Beta V	16212 NE 113th ...	Redmond
*					

Wonder where Microsoft is?

The **BETWEEN** keyword allows us to search for a range of values. Want all books published between 1995 and 1998? Use this SQL statement:

```
SELECT * FROM Titles WHERE Year_Published  
BETWEEN 1995 AND 1998
```

SQL Tester

	PubID	Title	Year_Published	ISBN	Description
▶	715	Oracle Triggers a...	1996	0-0134436-3-1	0
	715	Structured C for ...	1995	0-0230081-2-1	54
	715	An Introduction t...	1995	0-0230362-0-6	60
	119	Applied Calculus ...	1995	0-0230650-8-7	70.67
	715	Programming the ...	1996	0-0231426-3-4	0
	715	Applications Prog...	1996	0-0236114-1-3	0
	156	Database Proces...	1995	0-0236607-5-4	n

```
SELECT * FROM Titles WHERE Year_Published
BETWEEN 1995 AND 1998
```

Test SQL Statement

Records Returned 1860

The IN keyword lets us specify a comma-delimited list of desired values in the returned data table. Say, we want to know the publishers in New York, Massachusetts, and California. This SQL statement will do the trick:

SELECT * FROM Publishers WHERE State IN ('NY', 'MA', 'CA')

SQL Tester

	PubID	Name	Company_Name	Address	City
▶	2	PRENTICE HALL	PRENTICE HALL	15 Columbus Cir.	New York
	5	MACMILLAN CO...	MACMILLAN CO...	11 W. 42nd St., ...	New York
	8	O'REILLY & ASS...	O'REILLY & ASS...	90 Sherman St.	Cambridge
	9	ADDISON-WESL...	ADDISON-WESL...	Rte 128	Reading
	10	JOHN WILEY & ...	JOHN WILEY & ...	605 Third Ave	New York
	21	John Wiley	John Wiley	605 Third Ave	New York
	20	PRENTICE HALL	PRENTICE HALL	15 Columbus Cir	New York

```
SELECT * FROM Publishers WHERE State IN ('NY', 'MA', 'CA')
```

Test SQL Statement

Records Returned 69

The **LIKE** keyword allows us to use wildcards in the **WHERE** clause. This lets us find similar fields. Recall, the Microsoft SQL wildcard character is the asterisk (*). For this example to work, you need to use % as a wildcard in the **LIKE** clause. The % is a SQL standard for wildcards. To find all authors with a 'g' anywhere in their name, try:

```
SELECT * FROM Authors WHERE Author LIKE '%g%'
```

The screenshot shows the 'SQL Tester' application window. At the top, there's a title bar with the application name. Below it is a grid table with four columns: Au_ID, Author, and Year_Born (partially visible). The first row has Au_ID 2, Author 'Metzger, Philip W.', and Year_Born blank. The second row has Au_ID 10, Author 'Ingham, Kenneth'. The third row has Au_ID 14, Author 'Gaylord, Richard'. The fourth row has Au_ID 17, Author 'Gardner, Juanita ...'. The fifth row has Au_ID 27, Author 'Coolbaugh, James'. The sixth row has Au_ID 31, Author 'Gabriel, Richard P.'. The seventh row has Au_ID 35, Author 'Smolka, G.'. The bottom section of the window contains the SQL query 'SELECT * FROM Authors WHERE Author LIKE "%g%"' in a text input field, a 'Test SQL Statement' button, and a status area showing 'Records Returned 1520'.

	Au_ID	Author	Year_Born
▶	2	Metzger, Philip W.	
	10	Ingham, Kenneth	
	14	Gaylord, Richard	
	17	Gardner, Juanita ...	
	27	Coolbaugh, James	
	31	Gabriel, Richard P.	
	35	Smolka, G.	

SELECT * FROM Authors WHERE Author LIKE "%g%"

Test SQL Statement

Records Returned 1520

Multiple criteria are possible by using the logical operators **AND** and **OR**. For example, to find all books in the **Titles** table published after 1993 with a title that starts with the letters **Data**, we would use the SQL statement:

```
SELECT * FROM Titles  
WHERE Year_Published > 1993 AND Title LIKE 'Data%'
```

SQL Tester

	Title	Year_Published	ISBN	PubID	Description
▶	Database Proces...	1995	0-0236687-5-X	156	0
	Database Proces...	1995	0-0236688-1-4	156	68
	Data and Comput...	1994	0-0241544-1-5	188	69
	Data and Comput...	1994	0-0241545-4-7	188	0
	Database Manag...	1994	0-0303158-8-3	176	44.22
	Data Abstraction ...	1994	0-0791169-2-2	22	60.95
	Data Communication	1995	0-0791105-7-7	20	50

SELECT * FROM Titles
WHERE Year_Published > 1993 AND Title LIKE 'Data%'

Test SQL Statement

Records Returned 64

Multiple Table WHERE Clause

So far, almost everything we've done in this course has involved looking at a single native (built-in) table in a database. This has been valuable experience in helping us understand database design, learning how to use the Visual C# database tools, and learning some simple SQL statements. Now, we begin looking at one of the biggest uses of database management systems - combining information from multiple tables within a database. SQL makes such combinations a simple task.

We still use the same SELECT/FROM syntax, along with the WHERE and ORDER BY clauses to form our new virtual tables:

```
SELECT [Fields]  
FROM [Tables]  
WHERE Criteria  
ORDER BY [Fields]
```

The only difference here is there's more information in each SQL statement, resulting in some very long statements. The [Fields] list will have many fields, the [Tables] list will have multiple tables, and the Criteria will have several parts. The basic idea is to have the SQL statement specify what fields you want displayed (SELECT), what tables those fields are found in (FROM), how you want the tables to be combined (WHERE), and how you want them sorted (ORDER BY). Let's try an example.

Notice the Titles table does not list a book's publisher, but just publisher identification (PubID). What if we want to display a book's title (Title field in Titles table) and publisher (Company_Name in Publishers table) in the same data table? Let's build the SQL statement. First, the SELECT clause specifies the fields we want in our 'virtual' table:

SELECT Titles.Title,Publishers.Company_Name

Note the use of dot notation to specify the desired fields. With multiple tables, this avoids any problems with naming ambiguities.

The FROM clause names the tables holding these fields:

FROM Titles,Publishers

The WHERE clause declares what criteria must be met in combining the two tables. The usual selection is to match a **primary key** in one table with the corresponding **foreign key** in another table. Here, we want the publisher identification numbers from each table to match:

WHERE Titles.PubID = Publishers.PubID

Any records from the tables that do not match the WHERE criteria are not included in the returned data table.

Lastly, we declare how we want the resulting data table to be sorted:

ORDER BY Titles.Title

The complete SQL statement is thus:

```
SELECT Titles.Title,Publishers.Company_Name
FROM Titles,Publishers
WHERE Titles.PubID = Publishers.PubID
ORDER BY Titles.Title
```

Try this with the SQL tester.

SQL Tester

	Title	Company_Name
▶	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	QUE CORP
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS

```
SELECT Titles.Title,Publishers.Company_Name
FROM Titles,Publishers
WHERE Titles.PubID = Publishers.PubID
ORDER BY Titles.Title
```

Test SQL Statement

Records Returned 8569

Are you amazed? You have just seen one of the real powers of using SQL with the ADO .NET database engine (or any database system, for that matter). We simply told the engine what we wanted (via the SQL statement) and it did all of the work for us - no coding needed! Let's do some more examples.

In the previous example, say you just want books published by Que Corporation. Modify the SQL statement to read (we added an AND clause):

```
SELECT Titles.Title,Publishers.Company_Name
FROM Titles,Publishers
WHERE Titles.PubID = Publishers.PubID
AND Publishers.Company_Name = 'QUE CORP'
ORDER BY Titles.Title
```

SQL Tester

	Title	Company_Name
▶	10 Minute Guide ...	QUE CORP
	1-2-3 Database T...	QUE CORP
	1-2-3 Power Mac...	QUE CORP
	1-2-3 Release 2....	QUE CORP
	3-D Graphics Pro...	QUE CORP
	Access 2 for Win...	QUE CORP
	Access 2 for Win...	QUE CORP

```
SELECT Titles.Title, Publishers.Company_Name
FROM Titles, Publishers
WHERE Titles.PubID = Publishers.PubID
AND Publishers.Company_Name = 'QUE CORP'
```

Test SQL Statement

Records Returned 338

What if we want to list a book's title, publisher, and author, ordered by the author names? This requires using all four tables in the books database. Let's build the SQL statement. We want three fields:

SELECT Authors.Author, Titles.Title, Publishers.Company_Name

As mentioned, to retrieve this information requires all four tables:

FROM Authors, Titles, Publishers, Title_Author

We still need the publisher identification numbers to match, but now also need to make sure book titles (via the ISBN field) and author identification numbers match. The corresponding WHERE clause is:

**WHERE Titles.ISBN = Title_Author.ISBN
AND Authors.Au_ID = Title_Author.Au_ID
AND Titles.PubID = Publishers.PubID**

Finally, the results are sorted:

ORDER BY Authors.Author

Putting all this in the SQL tester gives us over 16,000 listings (one entry for every author and every book he or she wrote or co-wrote):

The screenshot shows the 'SQL Tester' application window. At the top, there's a title bar with the application name. Below it is a grid table with four columns: 'Title', 'Company_Name', and 'Author'. The first row has a blue highlight on the 'Title' column. The data in the grid is as follows:

	Title	Company_Name	Author
▶	Truetype Text Fo...	SYBEX Inc	Aaron, Alex
	Truetype Text Fo...	SYBEX Inc	Aaron, Bud
	Shareware Treas...	SYBEX Inc	Aaron, Bud
	Shareware Treas...	SYBEX Inc	Aaron, Bud
	Shareware Treas...	SYBEX Inc	Aaron, Bud
	Shareware Treas...	SYBEX Inc	Aaron, Bud
	Shareware Treas...	SYBEX Inc	Aaron, Bud

Below the grid, the SQL query is displayed:

```
WHERE Titles.ISBN = Title_Author.ISBN  
AND Authors.Au_ID = Title_Author.Au_ID  
AND Titles.PubID = Publishers.PubID  
ORDER BY Authors.Author
```

On the right side of the interface, there are buttons for 'Test SQL Statement' and 'Records Returned'. The 'Records Returned' field is set to 16056.

Such power! Can you imagine trying to write C# code to perform this record retrieval task?

If the displayed field name does not clearly describe the displayed information, you can **alias** the name, or change it to something more meaningful using the **AS** clause. As a simple example, try this:

```
SELECT Au_ID AS This_Author FROM Authors
```

Notice the displayed column is now **This_Author**.

SQL Tester

	This_Author
▶	1
	2
	3
	4
	6
	8
	10

```
SELECT Au_ID AS This_Author FROM Authors
```

Test SQL Statement

Records Returned 6246

The field name is unaffected by aliasing - only the displayed name changes.

INNER JOIN Clause

When combining tables, the SQL **INNER JOIN** clause does the same work as the **WHERE** clause. The syntax for an **INNER JOIN** is a little different than that of the **WHERE** clause.

```
SELECT [Fields]  
FROM Table1 INNER JOIN Table2 ON Linking Criteria  
WHERE Criteria  
ORDER BY [Fields]
```

This rather long statement begins by specifying the fields to **SELECT**. The **FROM** clause specifies the fields will come from the first table (Table1) being **INNER JOINed** with a second table (Table2). The **ON** clause states the linking criteria (usually a matching of key values) to be used in the join. At this point, the tables are combined. You can still use a **WHERE** clause to extract specific information from this table (you just can't use it to combine tables) and an **ORDER BY** clause, if desired. Let's repeat the examples just done with the **WHERE** clause.

To display a book title and publisher name, the **SELECT** clause is:

```
SELECT Titles.Title, Publishers.Company_Name
```

We want to ‘join’ the **Titles** table with the **Publishers** table, making sure the **PubID** fields match. The corresponding **INNER JOIN** statement is:

```
FROM Titles INNER JOIN Publishers  
ON Titles.PubID = Publishers.PubID
```

Lastly, we order by the **Title**:

ORDER BY Titles.Title

Try this SQL statement in the SQL tester and you should obtain the same results seen earlier with the WHERE clause:

The screenshot shows the 'SQL Tester' application window. The results pane displays a table with two columns: 'Title' and 'Company_Name'. All rows show 'Title' as '10 Minute Guide ...' and 'Company_Name' as 'ALPHA BOOKS'. The SQL pane contains the following query:

```
SELECT Titles.Title, Publishers.Company_Name
FROM Titles INNER JOIN Publishers
ON Titles.PubID = Publishers.PubID
ORDER BY Titles.Title
```

The status bar at the bottom right indicates 'Records Returned' is 8569.

To illustrate use of the WHERE clause (to limit displayed records) in conjunction with the JOIN clause, try this modified SQL statement with SQL Tester:

```
SELECT Titles.Title, Publishers.Company_Name
FROM Titles INNER JOIN Publishers
ON Titles.PubID = Publishers.PubID
WHERE Publishers.Company_Name = 'QUE CORP'
ORDER BY Titles.Title
```

Only QUE CORP publishers will be listed.

Use of the INNER JOIN clause to combine information from more than two tables is a little more complicated. The tables need be joined in stages, nesting the INNER JOIN clauses using parentheses for grouping. Assume we have three tables (Table1, Table2,

Table3) we want to combine. Table1 and Table3 have a common key field for linking (**Key13**), as do Table2 and Table3 (**Key23**). Let's combine these three tables using INNER JOIN. In the first stage, we form a temporary table that is a result of joining Table2 and Table3 using Key23 for linking:

Table2 INNER JOIN Table3 ON Table2.Key23 = Table3.Key23

In the next stage, we join Table1 with this temporary table (enclose it in parentheses) using Key13 for linking:

Table1 INNER JOIN

(Table2 INNER JOIN Table3 ON Table2.Key23 = Table3.Key23)
ON Table1.Key13 = Table3.Key13

This nested statement is used in the SQL statement to specify the tables for field selection. Notice we've spread this over a few lines to make it clearer - any SQL processor can handle multiple line statements. The multiple table INNER JOIN can be generalized to more tables - just pay attention to what tables link with each other. Always make sure the tables you are joining, whether a temporary joined table or a database table, have a common key.

Remember the example we did earlier where we listed Author, Title, and Publisher in the books database? Let's build that SQL statement. First, SELECT the fields:

SELECT Authors.Author,Titles.Title,Publishers.Company_Name

This is the same SELECT we used previously. Now, we need to form the FROM clause by combining four tables in three stages (one for each common key linking). In the first stage, combine the Publishers and Titles tables (PubID is common key):

FROM Publishers INNER JOIN Titles
ON Publishers.PubID=Titles.PubID

Now, join this temporary table (put its statement in parentheses) with the Title_Author table (ISBN is common key):

```
FROM (Publishers INNER JOIN Titles  
ON Publishers.PubID=Titles.PubID)  
INNER JOIN Title_Author  
ON Titles.ISBN=Title_Author.ISBN
```

In the final stage, join the Authors table with this temporary table (enclose its statement in parentheses) using Au_ID as the key:

```
FROM Authors INNER JOIN  
((Publishers INNER JOIN Titles  
ON Publishers.PubID=Titles.PubID)  
INNER JOIN Title_Author  
ON Titles.ISBN=Title_Author.ISBN)  
ON Authors.Au_ID=Title_Author.Au_ID
```

The **FROM** clause needed for the combined data view is now complete. The final line in the SQL statement orders the data:

```
ORDER BY Authors.Author
```

Whew! Try this full statement with the SQL tester and you should get the same results seen earlier using the WHERE clause.

OUTER JOIN Clause

The INNER JOIN only retrieves records that have a match on both sides of the JOIN. For example, with the books database, look at this INNER JOIN statement:

```
Publishers INNER JOIN Titles ON Publishers.PubID =  
Titles.PubID
```

In this statement, if there is a PubID in the Publishers table without a corresponding PubID in the Titles table, that value will not be in the returned data table. If you want all records returned, whether there is a match or not, you need to use what is called an **OUTER JOIN**. There are two forms for the OUTER JOIN.

A **RIGHT OUTER JOIN** includes all records from the second-named table (the right-most table), even if there are no matching values for records in the first-named (left-most table). Try this with SQL Tester:

```
SELECT Titles.Title, Publishers.Company_Name  
FROM Titles  
RIGHT OUTER JOIN Publishers  
ON Titles.PubID = Publishers.PubID  
ORDER BY Titles.Title
```

SQL Tester

	Title	Company_Name
▶		SYBEX
		Addison-Wesley
		INTERTEXT
		SAMS
		YOURDON
		BANTAM BOOKS
		McGraw-Hill Inc

```
SELECT Titles.Title, Publishers.Company_Name
FROM Titles
RIGHT OUTER JOIN Publishers
ON Titles.PubID = Publishers.PubID
```

Test SQL Statement

Records Returned 8588

There are several publishers (about 19 or so) without corresponding titles in the database.

A **LEFT OUTER JOIN** includes all records from the first-named table (the leftmost table), even if there are not matching values for records in the second-named (right-most table). Try this with SQL Tester:

```
SELECT Titles.Title, Publishers.Company_Name
FROM Titles
LEFT OUTER JOIN Publishers
ON Titles.PubID = Publishers.PubID
ORDER BY Titles.Title
```

SQL Tester

	Title	Company_Name
▶	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	QUE CORP
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS
	10 Minute Guide ...	ALPHA BOOKS

SELECT Titles.Title, Publishers.Company_Name
FROM Titles
LEFT OUTER JOIN Publishers
ON Titles.PubID = Publishers.PubID

Test SQL Statement

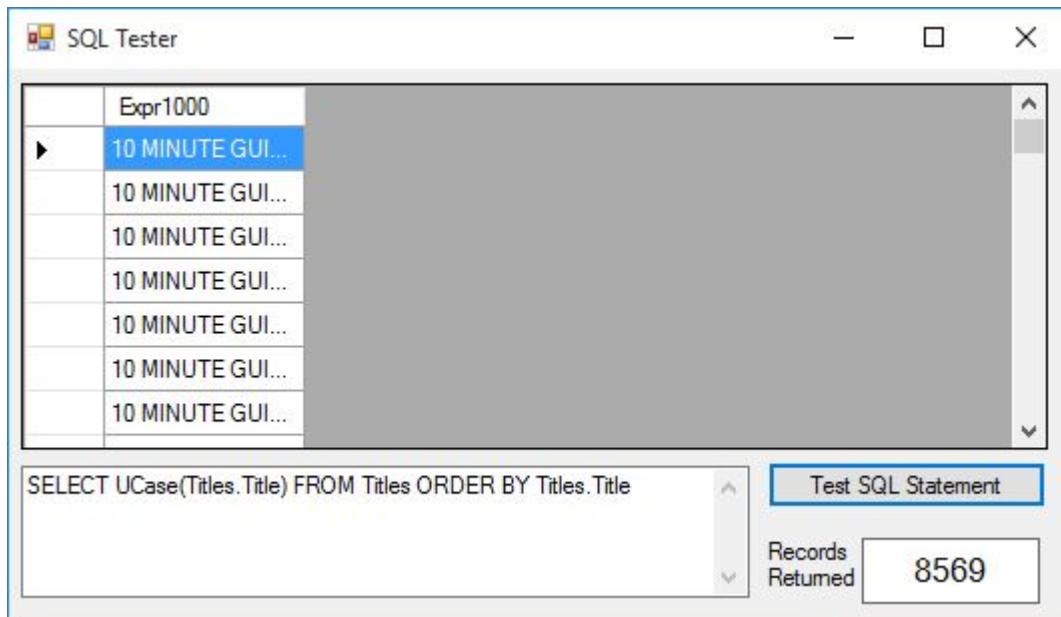
Records Returned 8569

The returned data table is identical to that obtained with the INNER JOIN. Obviously, all books in the database have a corresponding publisher - that's actually a good thing.

Functions with SQL (Access Database)

SQL offers some basic functions that let you modify the displayed information. It does not affect the underlying information in the database. As an example, say you want all book titles in the books database Titles table to be listed in upper case letters. Try this SQL statement with SQL Tester:

```
SELECT UCASE(Titles.Title) FROM Titles ORDER BY Titles.Title
```



Notice SQL assigns a heading of Expr1000 to this ‘derived’ field. We can use the alias feature of SQL change this heading to anything we want (except the name of an existing field). Try this:

```
SELECT UCASE(Titles.Title) AS Title FROM Titles
```

Or, what if we had some process that could only use the 10 left-most characters of the book title. This SQL statement will do the trick:

```
SELECT Left(UCase(Titles.Title), 10) AS Title FROM Titles
```

You can also do BASIC math in a SQL statement. The BOOKS database Authors table has Year_Born as a field. This SQL statement will display each author and their age in 2006 (when this is being written):

```
SELECT Authors.Author,(2006-Authors.Year_Born) AS Age  
FROM Authors
```

The screenshot shows the 'SQL Tester' application window. It contains a table with two columns: 'Author' and 'Age'. The table data is as follows:

Author	Age
Molluzzo, John C.	
Amush, Craig	
Shammas, Namir ...	52
Stoughton, Cathe...	
Gapen, Patrice	
Gaonkar, Rames...	
Sigfried, Stefan	

Below the table, the SQL query is displayed in the 'Test SQL Statement' input field:

```
SELECT Authors.Author,(2006-Authors.Year_Born) AS Age  
FROM Authors
```

On the right side of the interface, there is a 'Records Returned' counter showing the value 6246.

Note that most of the listings do not have an Age value - I had to scroll down a bit to find one. The reason for this is because only a few of the author records have birth year entries - the entries are NULL (containing no information).

NULL is a special value meaning there is nothing there - this is not the same as an empty string or blank space. In our work, we will try to avoid placing NULLs in a database, but sometimes this is not possible or they may exist in other databases. You need to decide how to handle NULLs in your design. We will see examples where they cause problems. A NULL field can be tested using the SQL

functions **IS NULL** and **IS NOT NULL**. We can add this to the SQL statement above to find just the Authors records with a birth year:

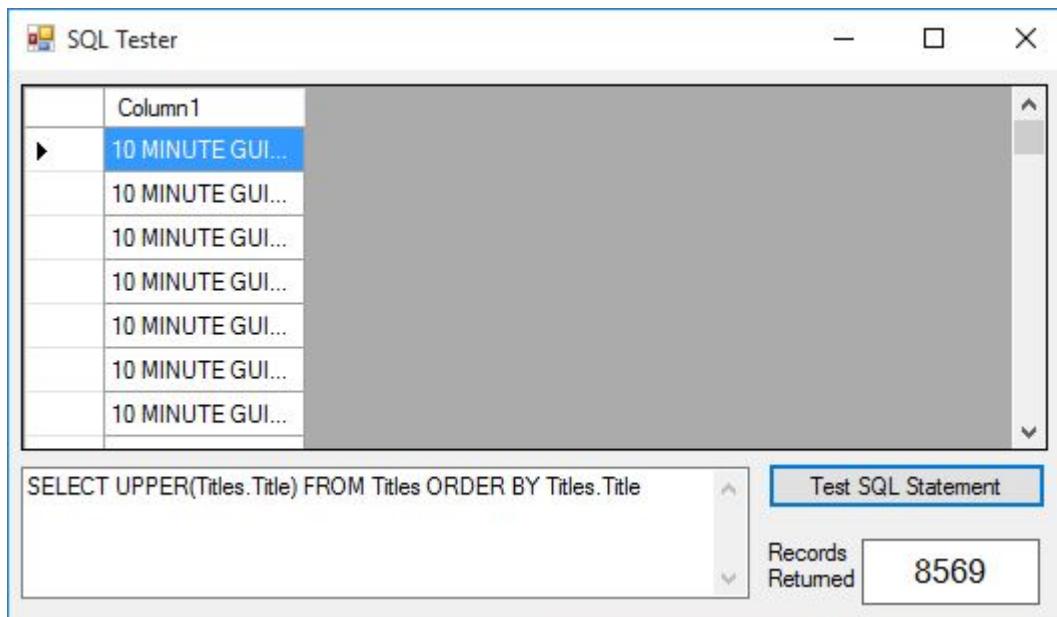
```
SELECT Authors.Author,(2006-Authors.Year_Born) AS Age  
FROM Authors  
WHERE Authors.Year_Born IS NOT NULL
```

You should now find 20 authors with ages listed.

Functions with SQL (SQL Server Database)

There are functions available for use as part of a SQL statement with SQL Server databases (consult SQL Server references for a full list of such functions). This lets you modify the displayed information. It does not affect the underlying information in the database. As an example, say you want all book titles in the **SQLBooksDB.mdf** database **Titles** table to be listed in upper case letters. Try this SQL statement with SQL Tester:

```
SELECT UPPER(Titles.Title) FROM Titles ORDER BY Titles.Title
```



Notice SQL assigns a heading of Column1 to this ‘derived’ field. We can use the alias feature of SQL change this heading to anything we want (except the name of an existing field). Try this:

```
SELECT UPPER(Titles.Title) AS Title FROM Titles
```

Or, what if we had some process that could only use the 10 left-most characters of the book title. This SQL statement will do the

trick:

```
SELECT LEFT(UPPER(Titles.Title), 10) AS Title FROM Titles
```

You can also do BASIC math in a SQL statement. The **BOOKS** database **Authors** table has **Year_Born** as a field. This SQL statement will display each author and their age in 2006 (when this is being written):

```
SELECT Authors.Author,(2006-Authors.Year_Born) AS Age  
FROM Authors
```

The screenshot shows a window titled "SQL Tester". Inside, there is a table with two columns: "Author" and "Age". The data includes: Laurel, Chris; Fraize, Scott; Trujillo, Stan; Stevens, Al (with an age of 66); Bulback, Fred; Schildt, Herbert; and Smith, Tim. Below the table, the SQL query is displayed: "SELECT Authors.Author,(2006-Authors.Year_Born) AS Age FROM Authors". To the right of the query, there is a button labeled "Test SQL Statement". At the bottom right, it says "Records Returned" followed by the number 6246.

Author	Age
Laurel, Chris	
Fraize, Scott	
Trujillo, Stan	
Stevens, Al	66
Bulback, Fred	
Schildt, Herbert	
Smith, Tim	

Note that most of the listings do not have an Age value - I had to scroll down a bit to find one. The reason for this is because only a few of the author records have birth year entries - the entries are **NULL** (containing no information).

NULL is a special value meaning there is nothing there - this is not the same as an empty string or blank space. In our work, we will try to avoid placing **NULLs** in a database, but sometimes this is not possible or they may exist in other databases. You need to decide how to handle **NULLs** in your design. We will see examples where

they cause problems. A NULL field can be tested using the SQL functions **IS NULL** and **IS NOT NULL**. We can add this to the SQL statement above to find just the Authors records with a birth year:

```
SELECT Authors.Author,(2006-Authors.Year_Born) AS Age  
FROM Authors  
WHERE Authors.Year_Born IS NOT NULL
```

You should now find 20 authors with ages listed.

SQL Aggregate Functions

In addition to SQL functions, the ADO .NET database engine supports the standard **SQL aggregate functions**. These are functions that let you compute summary statistics for fields in your database, alias the results, and display them in a data table. NULL fields are ignored by the aggregate functions.

The aggregate functions and their results are:

AVG(Field)	Average value of the field
COUNT(Field)	Number of entries for the field
FIRST(Field)	First value of the field
LAST(Field)	Last value of the field
MAX(Field)	Maximum value of the field
MIN(Field)	Minimum value of the field
SUM(Field)	Sum of the field values

Try this example with the Authors table:

```
SELECT  
COUNT(Authors.Author) AS HowMany,  
AVG(Authors.Year_Born) AS AveYear,  
FIRST(Authors.Year_Born) AS FirstYear,  
LAST(Authors.Year_Born) AS LastYear,  
MAX(Authors.Year_Born) AS MaxYear,  
MIN(Authors.Year_Born) AS MinYear,  
SUM(Authors.Year_Born) AS SumYear  
FROM Authors
```

SQL Tester

	HowMany	AveYear	MaxYear	MinYear	SumYear
▶	6246	1947	1963	1936	38953
*					

```
SELECT
COUNT(Authors.Author) AS HowMany,
AVG(Authors.Year_Born) AS AveYear,
MAX(Authors.Year_Born) AS MaxYear,
```

Test SQL Statement

Records Returned

Note some of the aggregate fields (FirstYear, LastYear) have no values since these are NULL fields.

Aggregate functions can be used to group results. The **GROUP BY** clause lets you determine records with duplicate field values. Want to know how many publishers in your database are in each state? Try this SQL statement:

```
SELECT Publishers.State, Count(Publishers.State) as HowMany
FROM Publishers
GROUP BY Publishers.State
```

SQL Tester

	HowMany	State
▶	0	
	2	AK
	18	CA
	1	GA
	8	IL
	13	IN
	9	MA

```
SELECT Publishers.State, Count(Publishers.State) as HowMany
FROM Publishers
GROUP BY Publishers.State
```

Test SQL Statement

Records Returned 17

You can use the HAVING qualifier to further reduce the grouping obtained with a GROUP BY clause. Say in the above example, you only want to display states starting with the letter M (a strange request, we know). This SQL statement will do the trick:

```
SELECT Publishers.State, Count(Publishers.State) as HowMany
FROM Publishers
GROUP BY Publishers.State
HAVING Publishers.State LIKE 'M%'
```

SQL Tester

	HowMany	State
▶	9	MA
	1	MD
	1	MI
	11	MN
*		

```
SELECT Publishers.State, Count(Publishers.State) as HowMany
FROM Publishers
GROUP BY Publishers.State
HAVING Publishers.State LIKE 'M%'
```

Test SQL Statement

Records Returned 4

SQL Construction Tools

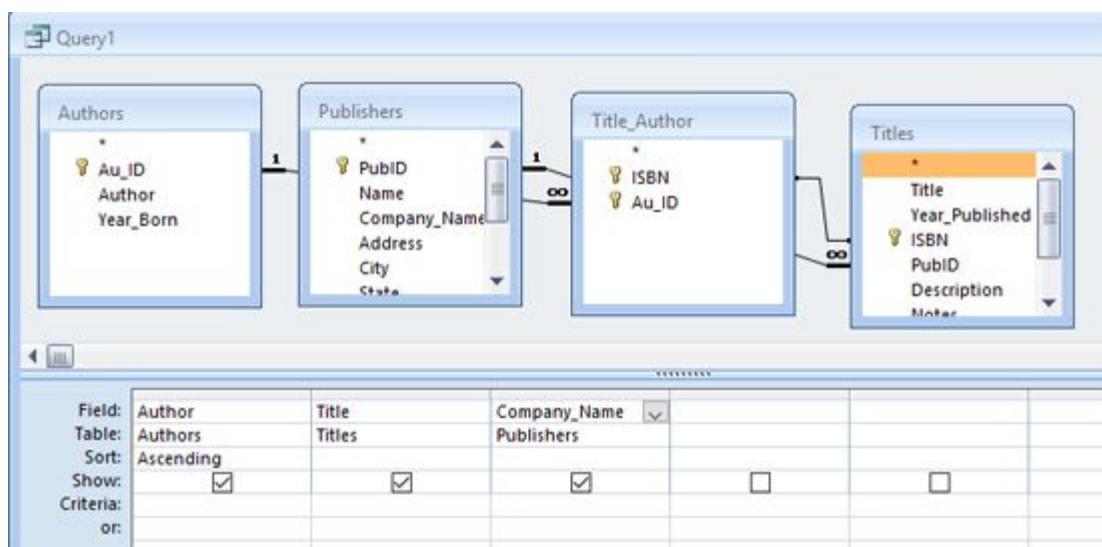
We've completed our review of the SQL language. There are other commands we haven't looked at. If you would like to know more, there are numerous references available for both ANSI standard SQL and the Microsoft version. You now know how to construct SQL statements to extract desired information from a multi-table database and you know how to read other's SQL statements.

You have seen that constructing SQL statements is, at times, a tedious process. To aid in the construction of such statements, there are several tools available for our use. We'll discuss two: one in **Microsoft Access** and one available with the **data wizard** (discussed in Chapter 3).

SQL Statements with Access

To build a SQL query using Microsoft Access, you obviously must have Access installed on your computer. As an example, we will build the SQL query that displays Author, Title, and Publisher for each book in the books database:

- ⇒ Start Access and open your copy of the BooksDB.accdb. Click the **Queries** tab and select **Create Query in Design View**, click **Open**.
- ⇒ In the **Show Table** form, add all four tables. When done, click **Close**. A split window appears with the four linked tables at the top (showing the relationships between primary and foreign keys) and a table in the lower portion.
- ⇒ In the lower portion of the window, click the first **Field** column, click the drop-down arrow and select **Authors.Author**. Under **Sort**, choose **Ascending** (sorting by Author). In the second column, click the drop-down arrow and select **Titles.Title**. In the third column, click the drop-down arrow and select **Publishers.Company_Name**. When done, you should see (I moved the tables around a bit):



- ⇒ Click the exclamation point (!) on the Access toolbar to build the data table. Now, click **View** on the main Access menu and select **SQL View**.
- ⇒ Like magic, the SQL statement that was used to develop the data table is displayed:

```
SELECT Authors.Author, Titles.Title,  
Publishers.Company_Name  
FROM (Publishers INNER JOIN Titles ON Publishers.PubID =  
Titles.PubID) INNER JOIN (Authors INNER JOIN Title_Author  
ON  
Authors.Au_ID = Title_Author.Au_ID) ON Titles.ISBN =  
Title_Author.ISBN  
ORDER BY Authors.Author;
```

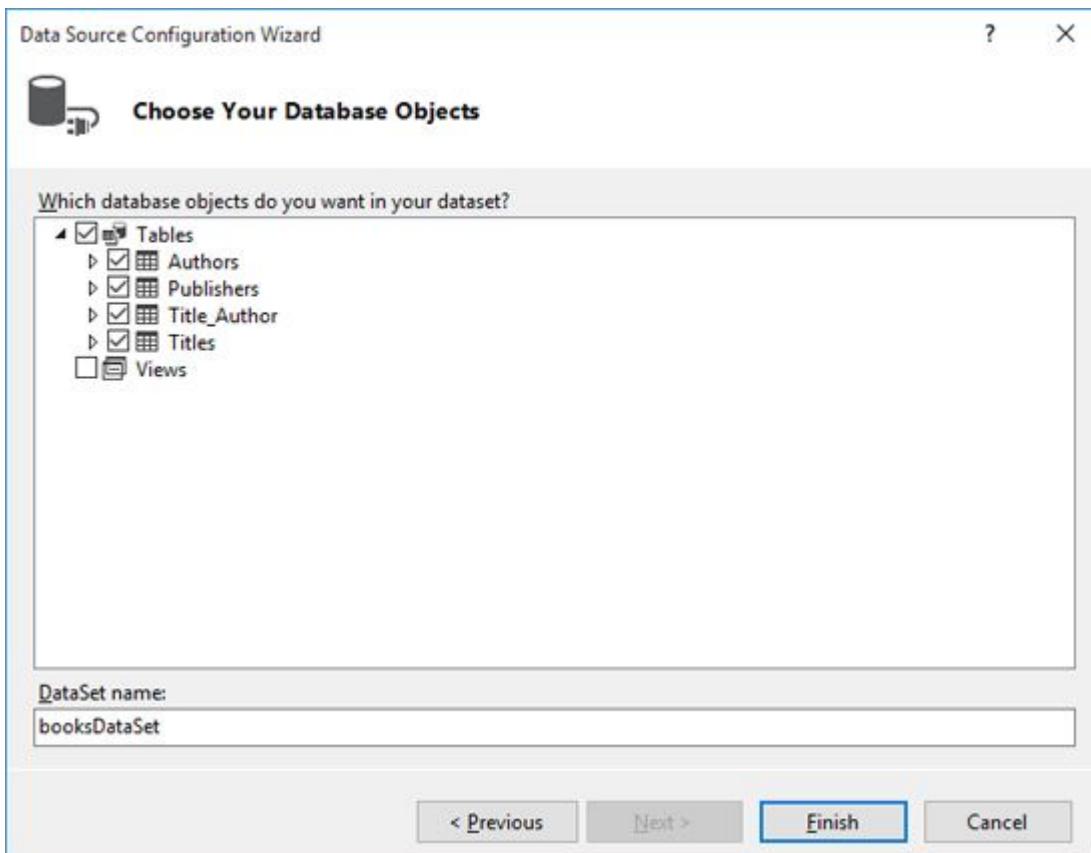
Notice a couple of things about this query. First, it uses the **INNER JOIN** clause to combine tables. Second, notice the semicolon (;) at the end of the query. This is not needed and will be ignored by the ADO .NET database engine. You could now cut and paste the above query wherever you need it in your Visual C# application. You may need to make some adjustments to the query to make sure it does not result in any syntax errors at run-time. Notice this generated query is very much like that developed earlier in these notes. It's similar because the author used Access to generate that query - you, too, should use the Access query building capabilities whenever you can. You are assured of a correct SQL statement, helping to minimize your programming headaches.

SQL Statements with the Data Wizard

In Chapter 3, we looked at the Visual C# data wizard as a tool for building applications. Even though we won't be using the wizard to build applications (primarily to simplify distribution of our applications), it can be used to generate any SQL statements we might need.

The steps here are similar to those just used with Access (not unexpected since they probably use the same underlying code). And, even though this example uses **BooksDB.accdb**, it can also be done with the SQL Server version (**SQLBooksDB.mdf**). Start a new project in Visual C#.

- ⇒ Choose the **Project** menu item, then **Add New Data Source**. Click **Next** on the screens until you see (we assume the connection still ‘points’ to the books database; if not, do the steps necessary):



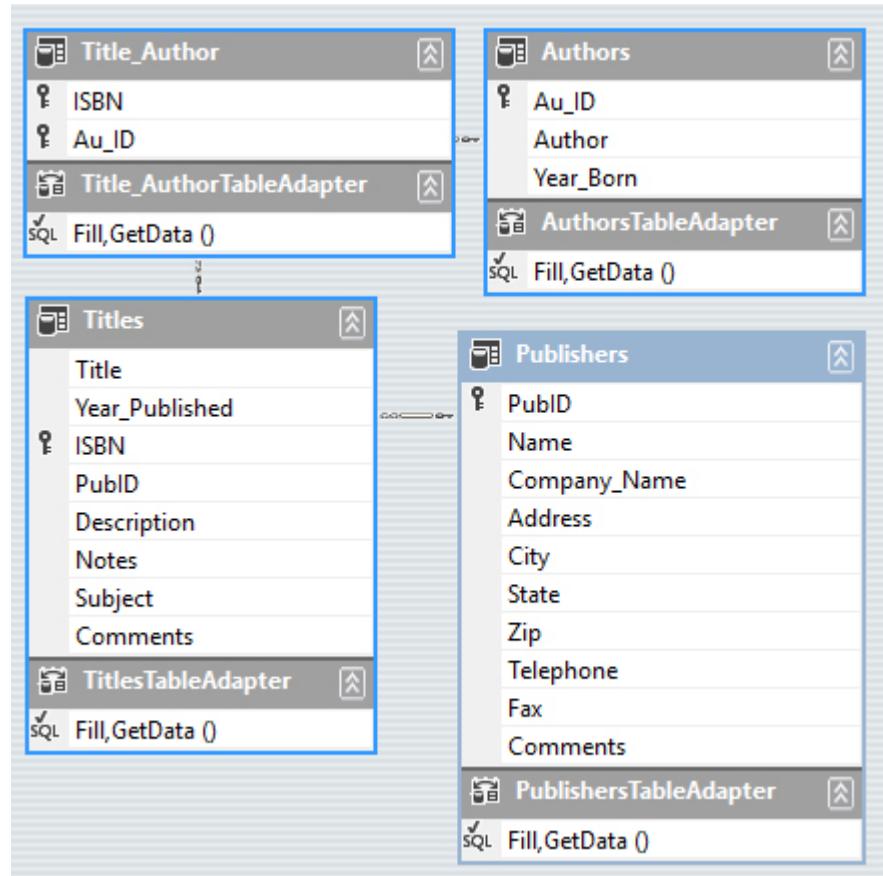
We need all tables in our dataset. Check **Authors**, **Publishers**, **Title_Author** and **Titles**. Then, click **Finish**.

A new dataset (**booksDataSet**) will appear in the Data Sources window:



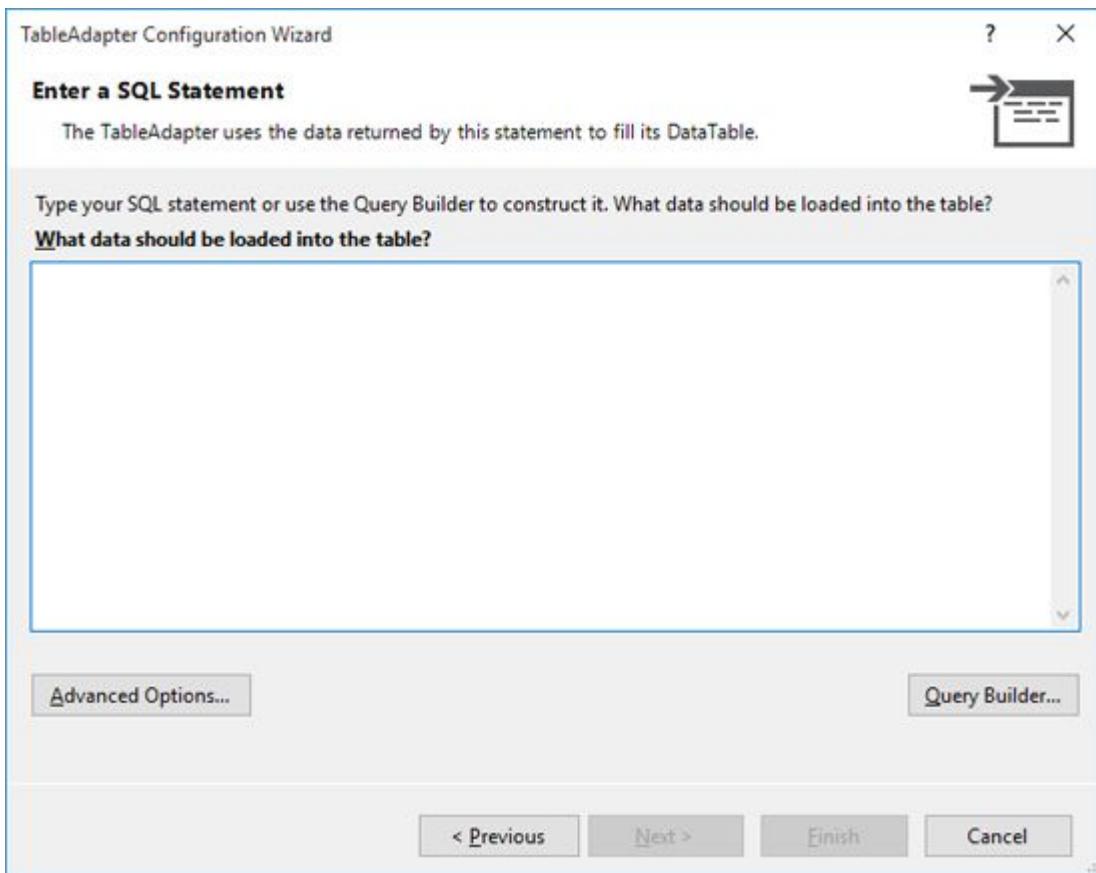
⇒ We now need to add a table adapter to generate the needed fields from the tables to form another table. Highlight the **booksDataSet** in the Data Sources window and click the **Edit**

DataSet with Designer button in the toolbar in that window. This window, displaying the four individual tables, will appear:



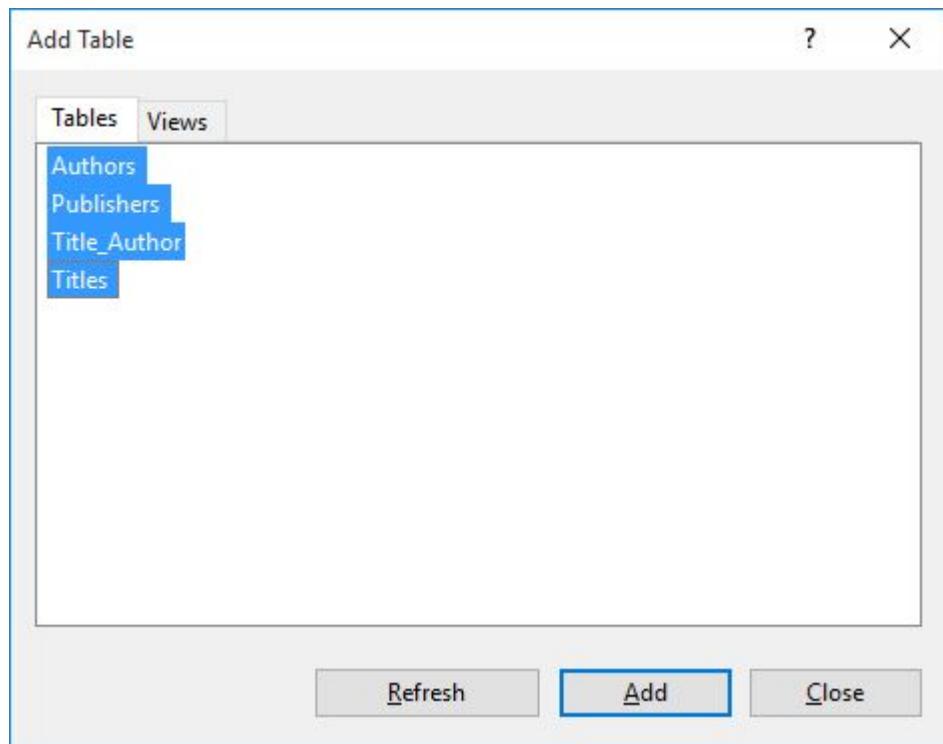
Our virtual table will include the **Author**, **Title**, and **Company_Name** fields. To build this table, we need a new **TableAdapter**. Right-click the display window, and choose **Add**, then **TableAdapter**.

⇒ A new adapter will be added and the **TableAdapter Configuration Wizard** will start up. Click **Next** on the **Choose Your Data Connection** window and the subsequent **Choose a Command Type Window** (where we tell the adapter we are using SQL). The **Enter a SQL Statement** window will appear:



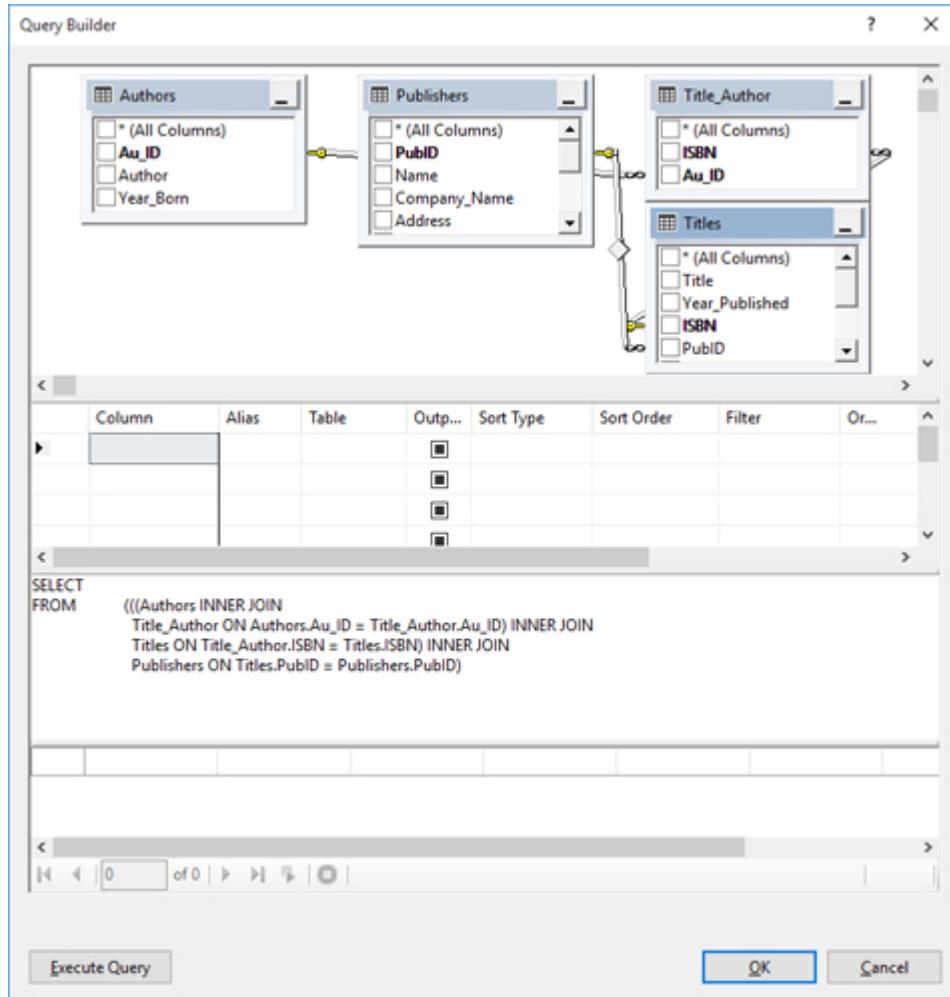
Here's where we let the wizard build the SQL statement.

⇒ Click **Query Builder** to see:



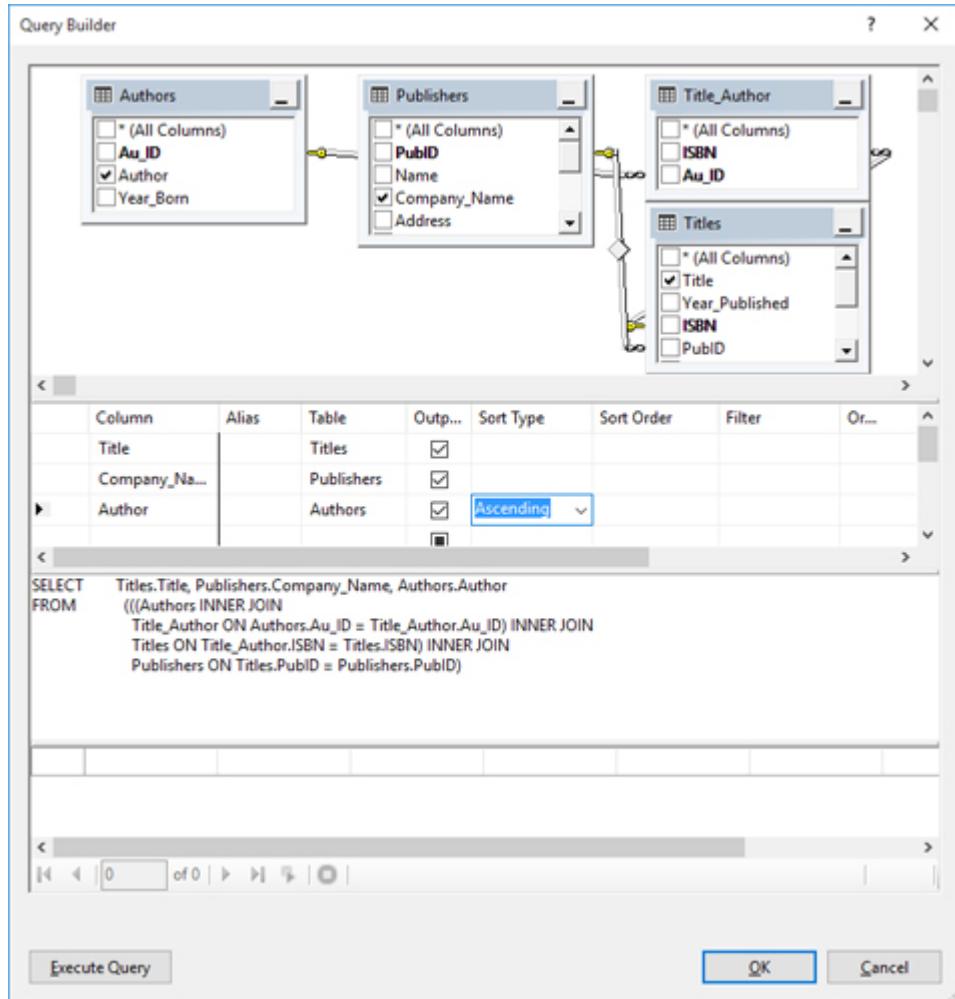
Select the **Authors**, **Publishers**, **Title_Author** and **Titles** tables and click **Add**.

⇒ Click **Close**. You will see:



The Query Builder is showing the relationships among the tables (i.e. how the **ISBN** value connects **Titles** with **Title_Author** and how **Au_ID** connects **Title_Author** with **Authors**, how **PubID** connects **Titles** with **Publishers**). Select **Title** in the **Titles** table. Select **Company_Name** in the **Publishers** table. Then, select **Author** in the **Authors** table. Once added, select a sort type of **Ascending** in the table below. This will sort the table according to Author name.

⇒ Once your selections are complete the window will appear as:



Click OK to see the following SQL statement is generated:

```

SELECT Titles.Title, Publishers.Company_Name,
Authors.Author
FROM (((Authors INNER JOIN
        Title_Author ON Authors.Au_ID = Title_Author.Au_ID) INNER JOIN
        Titles ON Title_Author.ISBN = Titles.ISBN) INNER JOIN
        Publishers ON Titles.PubID = Publishers.PubID)
    ORDER BY Authors.Author
    
```

This is essentially the same SQL statement generated using Access (except there is no semicolon at the end). More steps were

required. If you have Access, it's probably the best way to generate SQL statements.

Building SQL Commands in Code

In each example in this chapter, we formed a SQL command and processed it to obtain a returned data table (our virtual data view). What do you do if you don't know the SQL command prior to implementing it as a Visual C# property? For example, the user of the books database may want to know all the publishers in Chicago. Or, the user may want to search the database for all authors whose name starts with a G.

In both of the above examples, we have no idea what the user will select. We need to provide the user a method to make a selection then, once the selection is made, build the SQL statement in Visual C#. Fortunately, the C# language (used in all methods) is rich with string handling functions and building such statements in code is a relatively straightforward process.

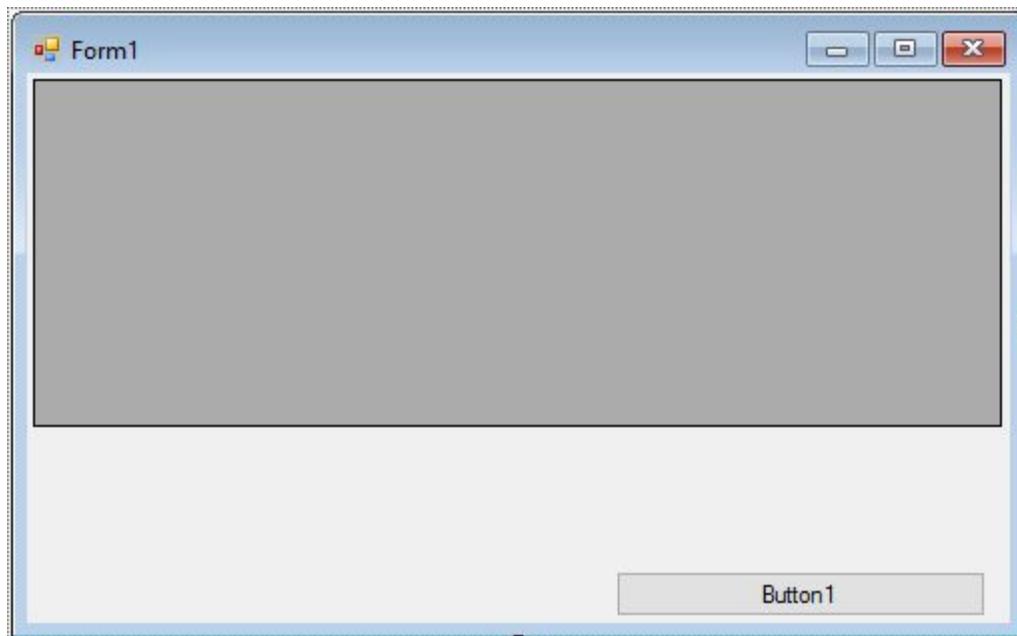
To build a SQL command in code, form all the known clauses as string variables. Once the user makes the selections forming the unknown information, using the string concatenation operator (+) to place these selections in their proper position in the complete SQL statement. That statement can then be processed at run-time, using one of the methods discussed earlier in this chapter. The next example demonstrates this technique.

Example 4-2

Searching the Books Database

We build an application (using the **BooksDB.accdb** books database) that displays a book's author, title, and publisher. The user may display all books in the database or, alternately, search the database for books by particular authors (searching by the first letter of the last name, using buttons for selection). There is a lot to learn in this example. You'll see how to form a SQL command in code, how to get that statement into code, how to set up convenient search mechanisms, and how to build a nice interface, all topics covered in detail in Chapter 5.

1. Start a new project. Add a data view grid control and one button. Position and resize the controls until the form looks something like this:



Make sure to leave space between the data grid and the button. We will use this space for two rows of button controls needed to search the database table.

2. Set properties for the form and controls:

Form1:

Name	frmBooks
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Books Database

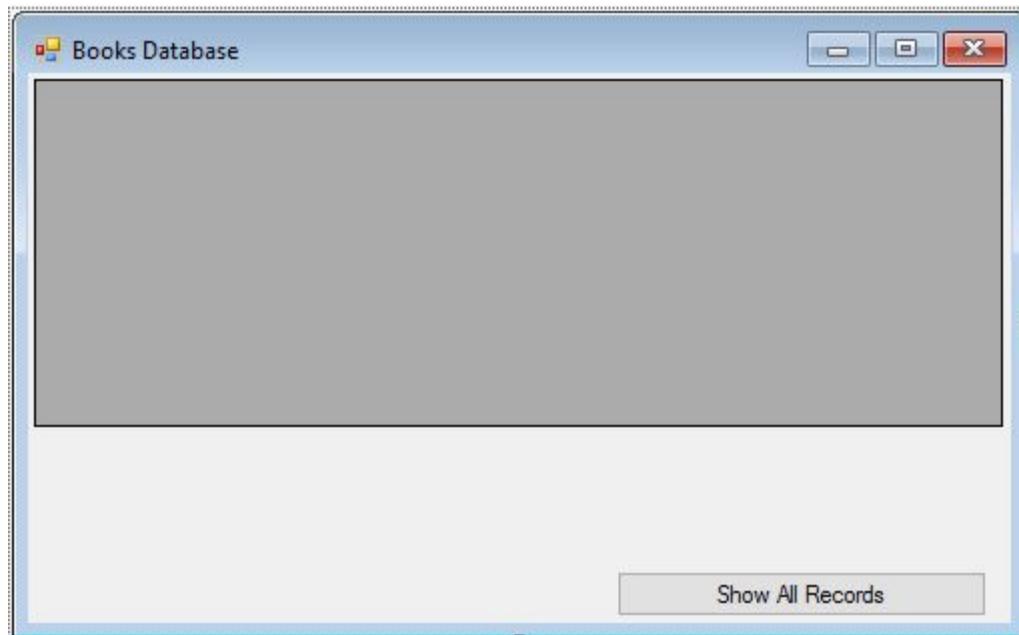
button1:

Name	btnAll
Text	Show All Records

dataGridView1:

Name	grdBooks
AutoSizeColumnsMode	Fill

At this point, the form should appear similar to this:



3. Add this line at the top of the code window to allow use of data objects:

```
using System.Data.OleDb;
```

4. Form level declarations:

```
OleDbConnection booksConnection;
String SQLAll;
Button[] btnRolodex = new Button[26];
```

SQLAll will be the variable that holds the default SQL statement.
btnRolodex is an array of buttons used for searching.

5. Code for the frmBooks_Load method:

```
private void frmBooks_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDb.accdb");
    booksConnection.Open();
    // create Rolodex buttons for searching
    int w, lStart, l, t;
    int buttonHeight = 33;
    // found by trial and error
    // search buttons
    // determine button width - 13 on a row
    w = Convert.ToInt32(this.ClientSize.Width / 14);
    // center buttons on form
    lStart = Convert.ToInt32(0.5 *
    (this.ClientSize.Width - 13 * w));
    l = lStart;
```

```
t = grdBooks.Top + grdBooks.Height + 2;
// create and position 26 buttons
for (int i = 0; i < 26; i++)
{
    // create new pushbutton
    btnRolodex[i] = new Button();
    btnRolodex[i].TabStop = false;
    // set text property
    btnRolodex[i].Text = ((char) (65 +
i)).ToString();
    // position
    btnRolodex[i].Width = w;
    btnRolodex[i].Height = buttonHeight;
    btnRolodex[i].Left = l;
    btnRolodex[i].Top = t;
    // give cool colors
    btnRolodex[i].BackColor = Color.Blue;
    btnRolodex[i].ForeColor = Color.White;
    // add button to form
    this.Controls.Add(btnRolodex[i]);
    // add event handler
    btnRolodex[i].Click += new
System.EventHandler(this.btnSQL_Click);
    // next left
    l += w;
    if (i == 12)
    {
        // move to next row
        l = lStart;
        t += buttonHeight;
    }
}
```

```

        }

        // Build basic SQL statement
        SQLAll = "SELECT
        Authors.Author, Titles.Title, Publishers.Company_Nam
        e ";
        SQLAll += "FROM Authors, Titles, Publishers,
        Title_Author ";
        SQLAll += "WHERE Titles.ISBN = Title_Author.ISBN
        ";
        SQLAll += "AND Authors.Au_ID = Title_Author.Au_ID
        ";
        SQLAll += "AND Titles.PubID = Publishers.PubID ";
        // show form and click on all records initially
        this.Show();
        btnAll.PerformClick();
    }
}

```

This routine creates the connection object and establishes the search buttons A through Z using the `btnRolodex` array. It determines button width and places them accordingly. Study the code that does this - it's very useful. This routine also builds the default SQL statement that gets the Author, Title, and Publisher from the database. Note the statement is built in several stages, each stage appending another clause to the statement. Note, particularly, each subsequent clause has a space at the end to make sure there are no 'run-ons' of keywords. Lastly, all records are displayed by 'clicking' on the `btnAll` control.

6. Code for the `frmBooks_FormClosing` method:

```

private void frmBooks_FormClosing(object sender,
FormClosingEventArgs e)
{
    booksConnection.Close();
}

```

```
    booksConnection.Dispose();  
}
```

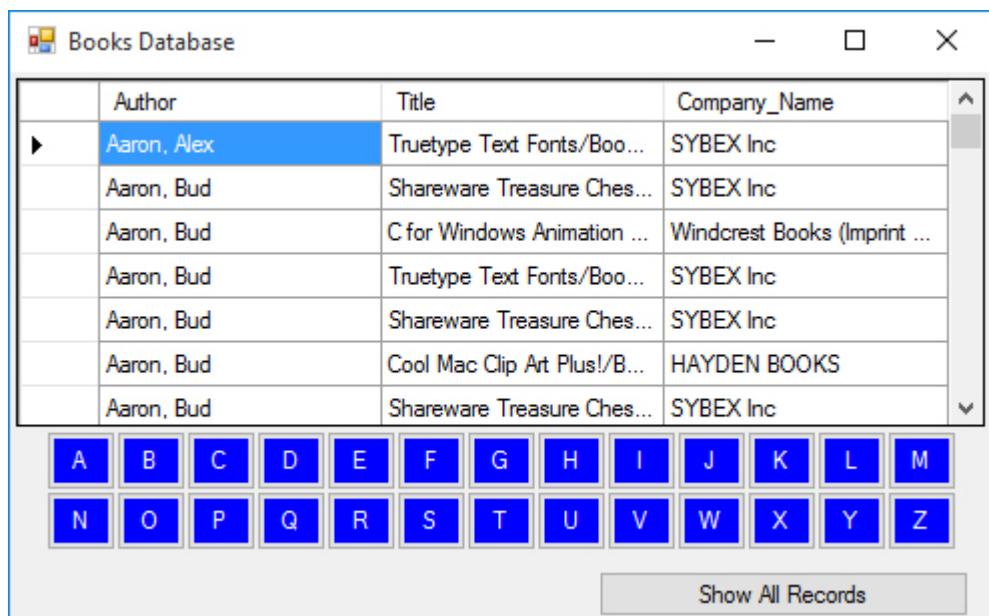
7. Code for the `btnSQL_Click` method (handles the `Click` event for all control buttons):

```
private void btnSQL_Click(object sender, EventArgs e)  
{  
    OleDbCommand resultsCommand = null;  
    OleDbDataAdapter resultsAdapter = new  
OleDbDataAdapter();  
    DataTable resultsTable = new DataTable();  
    String SQLStatement;  
    // determine which button was clicked and form SQL  
    statement  
    Button buttonClicked = (Button) sender;  
    switch (buttonClicked.Text)  
    {  
        case "Show All Records":  
            SQLStatement = SQLAll;  
            break;  
        case "Z":  
            // Z Clicked  
            // Append to SQLAll to limit records to Z  
            Authors  
            SQLStatement = SQLAll + "AND Authors.Author >  
            'Z' ";  
            break;  
        default:  
            // Letter key other than Z clicked  
            // Append to SQLAll to limit records to  
            letter clicked
```

```
        int index = (int)
        (Convert.ToChar(buttonClicked.Text)) - 65;
        SQLStatement = SQLAll + "AND Authors.Author >
        '" + btnRolodex[index].Text + " ' ";
        SQLStatement += "AND Authors.Author < '" +
        btnRolodex[index + 1].Text + " ' ";
        break;
    }
    SQLStatement += "ORDER BY Authors.Author";
    // apply SQL statement
    try
    {
        // establish command object and data adapter
        resultsCommand = new OleDbCommand(SQLStatement,
        booksConnection);
        resultsAdapter.SelectCommand = resultsCommand;
        resultsAdapter.Fill(resultsTable);
        // bind grid view to data table
        grdBooks.DataSource = resultsTable;
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error in Processing
        SQL",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    resultsCommand.Dispose();
    resultsAdapter.Dispose();
    resultsTable.Dispose();
}
```

This routine determines which button was clicked and forms the SQL statement. If the ‘Show All Records’ button is clicked, all records are displayed. If a letter button is clicked, it determines which letter was clicked by the user and appends an additional test (using AND) to the WHERE clause in the default SQL statement. This test limits the returned records to author’s names between the clicked letter and the next letter in the alphabet. Note that clicking Z is a special case. Once the SQL statement is formed, it is processed by the data adapter to form the data table.

8. Save the application (saved in the **Example 4-2** folder in **VCSDB\Code\Class 4** folder). Run it. You should see:



Notice how the search buttons are built and nicely displayed. Notice, too, that all records are displayed. Click one of the search buttons. Only records with author names matching the clicked letter will be displayed. Here’s what I see when I click the ‘G’ button:

Books Database

	Author	Title	Company_Name
▶	Gabarro, Joaquim	Structural Complexity II (E...)	SPRINGER VERLAG
	Gabbay, Dov M.	Foundations of Parallel Pr...	IEEE Computer Society Pr...
	Gabbay, Dov M.	Handbook of Logic in Artif...	OXFORD UNIV PR
	Gabbay, Dov M.	C++ Object-Oriented Data...	SPRINGER VERLAG
	Gabbay, Dov M.	Algebraic and Logic Progr...	SPRINGER VERLAG
	Gabbay, Dov M.	Temporal Logic : Mathem...	CLARENDON PR
	Gabbay, Dov M.	Handbook of Logic in Artif...	CLARENDON PR

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z

Show All Records

Example 4-2

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Copy **SQLBooksDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. In declarations, use this connection object:

```
SqlConnection booksConnection;
```

4. In **frmBooks_Load** method, use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

5. In **btnSQL_Click** method:

Change all instances of **OleDbCommand** to **SqlCommand**

Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

Summary

We're now done with our long journey into the world of SQL. This has been a relatively complete overview and you will learn more as you become a more proficient database programmer. SQL is at the heart of obtaining a virtual view of desired database information.

Forming this virtual view using SQL was seen to be a straightforward, and sometimes complicated, process. Tools such as the Access SQL Builder and the SQL Build function of the Visual C# data wizard can help us build error free SQL queries. Even with such tools, it is important to know SQL so you can understand and modify SQL statements built and implemented by others.

SQL also has the ability to modify information in a database. You can also use SQL to add records, delete records, and even create new database tables. But, such capabilities are beyond this course. Besides, the same abilities are available to us using Visual C#. That is the approach we will use for actual database management tasks. Such tasks are covered in Chapter 6, following a discussion of building a proper Visual C# interface in Chapter 5.

Example 4-3

Northwind Traders Database

This example gives you more practice with SQL by looking at another database - the Northwind Traders database (**NWindDB.accdb**) studied in other chapters. This is an “open” exercise where you can do what you want until you feel you are more proficient in understanding SQL.

1. First, modify the SQL Tester in Example 4-1 so it uses **NWindDB.accdb** (simply change the **ConnectionObject**):

```
NWindConnection = new  
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = c:\\VCSDB\\Working\\NWindDB.accdb");
```

The connection object has been renamed for this example.

2. Save (saved in the **Example 4-3** folder in **VCSDB\Code\Class 4** folder) and run your application. Now, try things. Use SQL to examine each of the eight tables (Categories, Customers, Employees, Order Details, Orders, Products, Shippers, Suppliers). Examine each field. Try selecting specific fields from tables. Try ordering the results. Try combining tables to show various information. Try the SQL aggregate functions to do some math. Use Access’s or the data wizard’s ability to generate SQL statements. Cut and paste those statements into SQL Tester to try them.

Here’s the result from finding all fields in the **Customers** table:

SQL Tester

	CustomerID	CompanyName	ContactName	ContactTitle	Address
▶	ALFKI	Alfreds Futterkiste	Maria Anders	Sales Represent...	Obere Str. 57, 8053
	ANATR	Ana Trujillo Empa...	Ana Trujillo	Owner	Avda. de la Constitución 22, 7900 C...
	ANTON	Antonio Moreno ...	Antonio Moreno	Owner	Mataderos 12, 2000
	AROUT	Around the Horn	Thomas Hardy	Sales Represent...	120 Hanover St., Boston, MA, 02114-1234
	BERGS	Berglunds snabb...	Christina Berglund	Order Administrator	Berguvsvägen 8
	BLAUS	Blauer See Delik...	Hanna Moos	Sales Represent...	Forsterstr. 37, 9900
	BLONDI	Blondel pâtisserie	Eduardo Cabral	Marketing Manager	24, rue de la Chaussée d'Antin, Paris, 75009

SELECT * FROM Customers

Test SQL Statement

Records Returned 91

and here's the same from the Products table:

SQL Tester

	ProductID	ProductName	SupplierID	CategoryID	QuantityPerUnit
▶	1	Chai	1	1	10 boxes x 20 bags
	2	Chang	1	1	24 - 12 oz cans
	3	Aniseed Syrup	1	2	12 - 550 ml bottles
	4	Chef Anton's Caj...	2	2	48 - 6 oz jars
	5	Chef Anton's Gu...	2	2	36 boxes
	6	Grandma's Boysen...	3	2	12 - 8 oz jars
	7	Uncle Bob's Organic Dried Pears	2	7	12 - 1 lb pkgs.

SELECT * FROM Products

Test SQL Statement

Records Returned 77

Example 4-3

Using SQL Server Databases

Modify the SQL Server version of Example 4-1 as follows:

1. The SQL Server version of the database is **SQLNWindDB.mdf**.
Make sure **SQLNWindDB.mdf** is in your working directory
2. In **frmSQLTester_Load** method, use this connection object:

```
NWindConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLNWindDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

5

Visual C# Interface Design

Review and Preview

At this point in the course, we can use Visual C# to connect to a database and SQL statements allow us to obtain any view of the database information we desire. But, that's all we can do - view the data.

We now want to know how to allow a user to interact with the data - obtain alternate views, modify it, add to it, delete it. To do this, we need a well-designed user interface.

In this chapter, we look at some design considerations for the Visual C# front-end. We examine the toolbox controls and Visual C# coding techniques needed to build a useful interface and application. Several examples illustrate use of the tools and techniques.

Interface Design Philosophy

The design philosophy for a proper application interface is very basic - keep it as **simple** as possible and as **intuitive** as possible. By doing this, you will save yourself (the programmer) and your users a lot of problems. This may be an obvious statement, but you would be surprised at how many programmers do not follow it.

A first consideration should be to determine what **processes** and **functions** you want your application to perform. What are the **inputs** and **outputs**? Develop a framework or flow chart of all your application's processes. Possible functions of a database interface include: data entry, searching, deleting information, adding information, editing information, sorting data, and printing capabilities.

Decide if multiple **forms** are required. Decide what **controls** from the Visual C# toolbox you need. Do the built-in Visual C# tools and functions meet your needs? Do you need to develop some tools or functions of your own? Do you need to acquire some third-party controls?

Minimize the possibility of user errors. This is a very important step. The fewer errors your user can make, the less error checking you have to do. If a particular input calls for numeric data, make sure your user can't type in his name. Choose 'point and click' type tools whenever they can be used to replace tools requiring the user to type in something. For example, let the user point at a month of the year, rather than have the user type in the month. If you can avoid letting your user type anything, do it! Every "typed input" requires some kind of validation that means extra work on your part.

At all steps in the application, make it **intuitive** to the user what he or she is to do. Don't make or let the user guess. You, as the programmer, control the flow of information from the user to the

program and vice versa. Maintain that control at all times. Try to anticipate all possible ways a user can mess up in using your application. It's fairly easy to write an application that works properly when the user does everything correctly. It's difficult to write an application that can handle all the possible wrong things a user can do and still not bomb out. And, although it is difficult, it is straightforward and just a matter of following your common sense.

Make your interface appealing to the user. Use tolerable colors and don't get carried away with too many font types. Make sure there are no misspellings (a personal pet peeve). Make the interface consistent with other Windows applications. Familiarity is good in program design. It is quite proper to 'borrow' ideas from other applications.

Although not part of the interface the user sees, you should make your code readable and traceable - future code modifiers will thank you. Choose meaningful variable and control names. Use comments to explain what you are doing. Consider developing reusable code - modules with utility outside your current development. This will save you time in future developments.

Debug your application completely before distributing it. There's nothing worse than having a user call you to point out flaws in your application. A good way to find all the bugs is to let several people try the code - a mini beta-testing program. Let's illustrate some of these philosophies with an example.

Example 5-1

Mailing List Revisited

Open and run the mailing list example built in Chapter 1 (**Example 1-1**, also saved in the **Example 5-1** folder in the **VCSDB\Code\Class 5** folder). It illustrates many of the interface design philosophies just discussed. Notice the program flow - how it directs the user about what to do and minimizes the possibility of errors. In particular, note:

- ⇒ You cannot type **Address Information** unless the timer has started (controlled via the **Enabled** property of **grpMail**).
- ⇒ When the Address Information frame is active, the cursor appears in the first text box, so the user starts typing the Name field first (controlled with the **txtName** text box **Focus** method).
- ⇒ After the user types information in each text box, hitting <Enter> or <Tab> automatically moves them to the next text box (controlled with the **Focus** method).
- ⇒ After the user types in the last text box (**Zip**), the focus moves to the **Accept** button, so a simple <Enter> accepts the mailing label (using **Focus** on the **btnAccept** button).

Notice how the program flow leads the user through the input process. Regarding the timer portion of the application, notice the **Pause** button is faded (**Enabled** is **False**) initially and is only active (**Enabled** is **True**) when the timer is running. The other timer control buttons toggle accordingly.

There is some validation of inputs in this application also. If there are not five values input, a message box appears informing the user of his error. And, only numbers can be typed when **txtZip** is active (done in the **KeyPress** event). This is the box for the **Zip** that can

only be a number. It would probably be more proper to also make sure the entered zip matches either the five or nine digit zip code format. Another validation possible would be to provide a list box control with the 50 states (apologies to our foreign readers for using a provincial example) to choose from instead of asking the user to type in a state name.

Regarding the code in the example, notice the use of comments to explain what is happening in each method. This helps others read and understand your code. It also helps you know what you were doing when you look back on the code a year later. Also notice that selection of proper variable and control names aids in understanding what is going on in the code portion of the application. Now, let's look at interface design in more detail.

Visual C# Standard Controls

The first step in building a Visual C# interface is to ‘draw’ the application on a form. We place the required controls on the form, set properties, and write C# code for the needed event and general methods. As the interface designer, you need to decide which controls best meet your needs regarding efficiency, applicability, and minimization of error possibilities.

In this section, we briefly look at the standard Visual C# controls. We examine how they might be used in a database ‘front-end’ and present some of the important properties, events, and methods associated with these controls. This information is provided as a quick review of what is available in the Visual C# toolbox - a “one-stop” reference to standard controls and how they are used with databases. A later look at more advanced controls will complete the reference.

Form Control

The **Form** is where the user interface is drawn. It is central to the development of Visual C# applications, whether for databases or other uses.

Form Properties:

Name	Gets or sets the name of the form (three letter prefix for form name is frm).
AcceptButton	Gets or sets the button on the form that is clicked when the user presses the <Enter> key.
BackColor	Get or sets the form background color.
CancelButton	Gets or sets the button control that is clicked when the user presses the <Esc> key.
ControlBox	Gets or sets a value indicating whether a control box is displayed in the caption bar of the form.
Enabled	If False, all controls on form are disabled.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
FormBorderStyle	Sets the form border to be fixed or sizeable.
Height	Height of form in pixels.
Help	Gets or sets a value indicating whether a Help button should be displayed in the caption box of the form.
Icon	Gets or sets the icon for the form.
Left	Distance from left of screen to left edge

	of form, in pixels.
MaximizeButton	Gets or sets a value indicating whether the maximize button is displayed in the caption bar of the form.
MinimizeButton	Gets or sets a value indicating whether the minimize button is displayed in the caption bar of the form.
StartPosition	Gets or sets the starting position of the form when the application is running.
Text	Gets or sets the form window title.
Top	Distance from top of screen to top edge of form, in pixels.
Width	Width of form in pixels.

Form Methods:

Close	Closes the form.
Focus	Sets focus to the form.
Hide	Hides the form.
Refresh	Forces the form to immediately repaint itself.
Show	Makes the form display by setting the Visible property to True.

The normal syntax for invoking a method is to type the control name, a dot, then the method name. For form methods, the name to use is **this**. This is a Visual C# keyword used to refer to a form. Hence, to close a form, use:

```
this.Close();
```

Form Events:

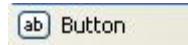
Activated	Occurs when the form is activated in code or by the user.
------------------	---

Click	Occurs when the form is clicked by the user.
FormClosing	Occurs when the form is closing.
DoubleClick	Occurs when the form is double clicked.
Load	Occurs before a form is displayed for the first time.
Paint	Occurs when the form is redrawn.

Typical use of **Form** object (for each control in this, and following chapters, we will provide information for how that control is typically used):

- Set the **Name** and **Text** properties
- Set the **StartPosition** property (in this course, this property will almost always be set to **CenterScreen**)
- Set the **FormBorderStyle** to some value. In this course, we will mostly use **FixedSingle** forms. You can have resizable forms in Visual C# (and there are useful properties that help with this task), but we will not use resizable forms in this course.
- Write any needed initialization code in the form's **Load** event. To access this event in the Code window, double-click the form.

Button Control



The **button** is probably the most widely used control. It is used to begin, interrupt, or end a particular process. With **databases**, it is used to **navigate** among records, **add** records, and **delete** records.

Button Properties:

Name	Gets or sets the name of the button (three letter prefix for button name is btn).
BackColor	Get or sets the button background color.
Enabled	If False, button is visible, but cannot accept clicks.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
Image	Gets or sets the image that is displayed on a button control.
Text	Gets or sets string displayed on button.
 TextAlign	Gets or sets the alignment of the text on the button control.

Button Methods:

Focus	Sets focus to the button.
PerformClick	Generates a Click event for a button.

Button Events:

Click	Event triggered when button is selected either by clicking on it or by pressing the access key.
--------------	---

Typical use of **Button** control:

- Set the **Name** and **Text** property.
- Write code in the button's **Click** event.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

Label Control

A Label

A **label** is a control you use to display text. The text in a label can be changed at run-time in response to events. It is widely used in **database applications for information display**.

Label Properties:

Name	Gets or sets the name of the label (three letter prefix for label name is lbl).
AutoSize	Gets or sets a value indicating whether the label is automatically resized to display its entire contents.
BackColor	Get or sets the label background color.
BorderStyle	Gets or sets the border style for the label.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
Text	Gets or sets string displayed on label.
 TextAlign	Gets or sets the alignment of text in the label.

Note, by default, the label control has no resizing handles. To resize the label, set **AutoSize** to **False**.

Label Methods:

Refresh	Forces an update of the label control contents.
----------------	---

Label Events:

Click	Event triggered when user clicks on a label.
DblClick	Event triggered when user double-clicks on a label.

Typical use of **Label** control for static, unchanging display:

- Set the **Name** (though not really necessary for static display) and **Text** property.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

Typical use of **Label** control for changing display:

- Set the **Name** property. Initialize **Text** to desired string.
- Set **AutoSize** to **False**, resize control and select desired value for **TextAlign**.
- Assign **Text** property (String type) in code where needed.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

TextBox Control



A **text box** is used to display information entered at design time, by a user at run-time, or assigned within code. The displayed text may be edited. This is the tool used in **database** applications for **editing** fields.

TextBox Properties:

Name	Gets or sets the name of the text box (three letter prefix for text box name is txt).
BackColor	Get or sets the text box background color.
BorderStyle	Gets or sets the border style for the text box.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
HideSelection	Gets or sets a value indicating whether the selected text in the text box control remains highlighted when the control loses focus.
Lines	Gets or sets the lines of text in a text box control.
MaxLength	Gets or sets the maximum number of characters the user can type into the text box control.
MultiLine	Gets or sets a value indicating whether this is a multiline text box control.
PasswordChar	Gets or sets the character used to mask

	characters of a password in a single-line TextBox control.
ReadOnly	Gets or sets a value indicating whether text in the text box is read-only.
ScrollBars	Gets or sets which scroll bars should appear in a multiline TextBox control.
SelectedText	Gets or sets a value indicating the currently selected text in the control.
SelectionLength	Gets or sets the number of characters selected in the text box.
SelectionStart	Gets or sets the starting point of text selected in the text box.
Text	Gets or sets the current text in the text box.
 TextAlign	Gets or sets the alignment of text in the text box.
TextLength	Gets length of text in text box.

TextBox Methods:

AppendText	Appends text to the current text of text box.
Clear	Clears all text in text box.
Focus	Places the cursor in a specified text box.
SelectAll	Selects all text in text box.
Undo	Undoes the last edit operation in the text box.

TextBox Events:

KeyDown	Occurs when a key is pressed down while the control has focus.
KeyPress	Occurs when a key is pressed while the control has focus - used for key trapping.

Leave	Triggered when the user leaves the text box. This is a good place to examine the contents of a text box after editing.
TextChanged	Occurs when the Text property value has changed.

Typical use of **TextBox** control as display control:

- Set the **Name** property. Initialize **Text** property to desired string.
- Set **ReadOnly** property to **True**.
- If displaying more than one line, set **MultiLine** property to **True**.
- Assign **Text** property in code where needed.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

Typical use of **TextBox** control as input device:

- Set the **Name** property. Initialize **Text** property to desired string.
- If it is possible to input multiple lines, set **MultiLine** property to **True**.
- In code, give **Focus** to control when needed. Provide key trapping code in **KeyPress** event. Read **Text** property when **Leave** event occurs.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

CheckBox Control



Check boxes provide a way to make choices from a list of potential candidates. Some, all, or none of the choices in a group may be selected. With **databases**, check boxes are used for many kinds of choices.

CheckBox Properties:

Name	Gets or sets the name of the check box (three letter prefix for check box name is chk).
AutoSize	Gets or sets a value indicating whether the check box is automatically resized to display its entire contents.
BackColor	Get or sets the check box background color.
Checked	Gets or sets a value indicating whether the check box is in the checked state.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
Text	Gets or sets string displayed next to check box.
 TextAlign	Gets or sets the alignment of text of the check box.

CheckBox Methods:

Focus	Moves focus to this check box.
--------------	--------------------------------

CheckBox Events:

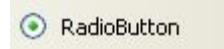
CheckedChanged Occurs when the value of the **Checked** property changes, whether in code or when a check box is clicked.

Click Triggered when a check box is clicked.
Checked property is automatically changed by Visual C#.

Typical use of CheckBox control:

- Set the **Name** and **Text** property. Initialize the **Checked** property.
- Monitor **Click** or **CheckChanged** event to determine when button is clicked. At any time, read **Checked** property to determine check box state.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

RadioButton Control



Radio buttons provide the capability to make a mutually exclusive choice among a group of potential candidate choices. Hence, radio buttons work as a group, only one of which can have a True (or selected) value. Radio buttons on a form work as an independent group as do groups of radio buttons within panels and group boxes. Radio buttons are not data bound controls, yet they can still be used for a variety of options in database interfaces.

RadioButton Properties:

Name	Gets or sets the name of the radio button (three letter prefix for radio button name is rdo).
AutoSize	Gets or sets a value indicating whether the radio button is automatically resized to display its entire contents.
BackColor	Get or sets the radio button background color.
Checked	Gets or sets a value indicating whether the radio button is checked.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
 TextAlign	Gets or sets the alignment of text of the radio button.

RadioButton Methods:

Focus	Moves focus to this radio button.
--------------	-----------------------------------

PerformClick Generates a Click event for the button, simulating a click by a user.

RadioButton Events:

CheckedChanged Occurs when the value of the Checked property changes, whether in code or when a radio button is clicked.

Click Triggered when a button is clicked. **Checked** property is automatically changed by Visual C#.

Typical use of RadioButton control:

- Establish a group of radio buttons.
- For each button in the group, set the **Name** (give each button a similar name to identify them with the group) and **Text** property. You might also change the **Font**, **BackColor** and **Forecolor** properties.
- Initialize the **Checked** property of one button to **True**.
- Monitor the **Click** or **CheckChanged** event of each radio button in the group to determine when a button is clicked. The ‘last clicked’ button in the group will always have a **Checked** property of **True**.

GroupBox Control



Group boxes provide a way of grouping related controls on a form. Radio buttons within a group box act independently of other radio buttons in an application.

GroupBox Properties:

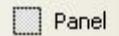
Name	Gets or sets the name of the group box (three letter prefix for group box name is grp).
BackColor	Get or sets the group box background color.
Enabled	Gets or sets a value indicating whether the group box is enabled. If False, all controls in the group box are disabled.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text.
Text	Gets or sets string displayed in title region of group box.
Visible	If False, hides the group box (and all its controls).

The GroupBox control has some methods and events, but these are rarely used. We are more concerned with the methods and events associated with the controls in the group box.

Typical use of GroupBox control:

- Set **Name** and **Text** property (perhaps changing **Font**, **BackColor** and **ForeColor** properties).
- Place desired controls in group box. Monitor events of controls in group box using usual techniques.

Panel Control



The **Panel** control is another Visual C# grouping control. It is nearly identical to the **GroupBox** control in behavior. The panel control lacks a **Text** property (titling information), but has optional scrolling capabilities. Radio buttons in the panel control act as an independent group. Panel controls can also be used to display graphics (lines, curves, shapes, animations).

Panel Properties:

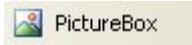
Name	Gets or sets the name of the panel (three letter prefix for panel name is pnl).
AutoScroll	Gets or sets a value indicating whether the panel will allow the user to scroll to any controls placed outside of its visible boundaries.
BackColor	Get or sets the panel background color.
BorderStyle	Get or set the panel border style.
Enabled	Gets or sets a value indicating whether the panel is enabled. If False, all controls in the panel are disabled.
Visible	If False, hides the panel (and all its controls).

Like the **GroupBox** control, the **Panel** control has some methods and events, but these are rarely used (we will see a few **Panel** events in later graphics chapters). We usually only are concerned with the methods and events associated with the controls in the panel.

Typical use of **Panel** control:

- Set **Name** property.
- Place desired controls in panel control.
- Monitor events of controls in panel using usual techniques.

PictureBox Control



The **picture box** allows you to place graphics information on a form. In a **database**, picture boxes are used to store **graphic** data.

PictureBox Properties:

Name	Gets or sets the name of the picture box (three letter prefix for picture box name is pic).
BackColor	Get or sets the picture box background color.
BorderStyle	Indicates the border style for the picture box.
Height	Height of picture box in pixels.
Image	Establishes the graphics file to display in the picture box (jpeg, gif, bmp files).
Left	Distance from left edge of form to left edge of picture box, in pixels.
SizeMode	Indicates how the image is displayed.
Top	Distance bottom of form title bar area to top edge of picture box, in pixels.
Width	Width of picture box in pixels.

PictureBox Events:

Click	Triggered when a picture box is clicked.
--------------	--

Typical use of **PictureBox** control for displaying images:

- Set the **Name** and **SizeMode** property (most often, **StretchImage**).
- Set **Image** property, either in design mode or at run-time, remembering icon files are not automatically displayed.

Example 5-2

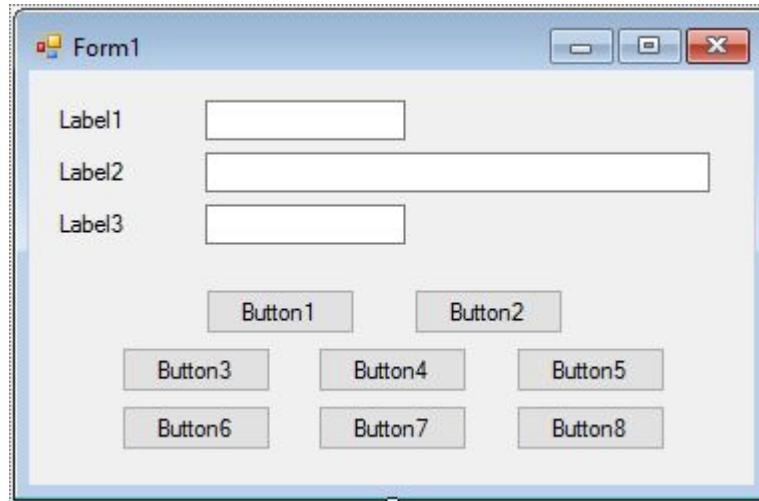
Authors Table Input Form

In Chapter 6, we will build a complete database management system for the books database. Each table in the database will require some kind of input form. In this chapter, we build such a form for the **Authors** table. Even though it is a very simple table (only three fields: **Au_ID**, **Author**, **Year_Born**), it provides an excellent basis to illustrate many of the steps of proper interface design. The SQL statement needed by the command object to retrieve the fields (sorted by **Author**) is:

```
SELECT * FROM Authors ORDER BY Author
```

We need an input form that allows a user to edit an existing record, delete an existing record or add a new record. The form should also allow navigation from one record to another. The steps to follow:

1. Start a new application. We need three label controls and three text boxes to display the fields. We need two buttons to move from one record to the next. We need five buttons to control editing features and one button to allow us to stop editing. Place these controls on a form. The layout should resemble:



2. Set these properties for the form and controls:

Form1:

Name	frmAuthors
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Authors

label1:

Text	Author ID
------	-----------

textBox1:

Name	txtAuthorID
BackColor	White
ReadOnly	True

label2:

Text	Author Name
------	-------------

textBox2:

Name	txtAuthorName
BackColor	White
ReadOnly	True

label3:

Text	Year Born
------	-----------

textBox3:

Name	txtYearBorn
BackColor	White
ReadOnly	True

button1:

Name	btnPrevious
Text	<= Previous

button2:

Name	btnNext
Text	Next =>

button3:

Name	btnEdit
Text	&Edit

button4:

Name	btnSave
Text	&Save

button5:

Name	btnCancel
Text	&Cancel

button6:

Name	btnAddNew
Text	&Add New

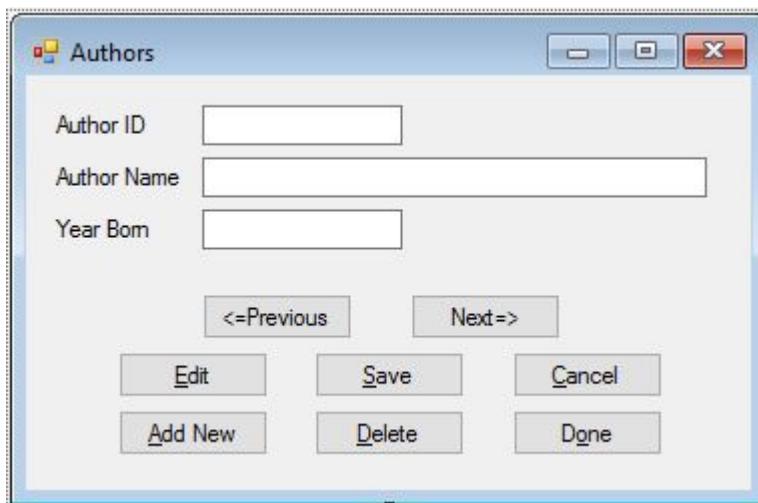
button7:

Name	btnDelete
Text	&Delete

button8:

Name	btnDone
Text	Do&ne

Note, we ‘lock’ (**ReadOnly** = True) all the text boxes. We will unlock them when we (as the programmer) decide the user can change a value (remember, we are in control). At this point, the form should appear as:



3. We will add features to this input application as we progress through the chapter. At this point, we add code to form the data table and allow us to navigate through the **Authors** table records. Add this line at the top of the code window:

```
using System.Data.OleDb;
```

4. Form level declarations to create data objects:

```
OleDbConnection booksConnection;  
OleDbCommand authorsCommand;  
OleDbDataAdapter authorsAdapter;
```

```
DataTable authorsTable;
CurrencyManager authorsManager;
```

5. Add this code the frmAuthors_Load method:

```
private void frmAuthors_Load(object sender, EventArgs e)
{
    // connect to books database
    booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSD\\Working\\BooksDB.accdb");
booksConnection.Open();

    // establish command object
    authorsCommand = new OleDbCommand("Select * from
Authors
ORDER BY Author", booksConnection);
    // establish data adapter/data table
    authorsAdapter = new OleDbDataAdapter();
    authorsAdapter.SelectCommand = authorsCommand;
    authorsTable = new DataTable();
    authorsAdapter.Fill(authorsTable);
    // bind controls to data table
    txtAuthorID.DataBindings.Add("Text", authorsTable,
"Au_ID");
    txtAuthorName.DataBindings.Add("Text",
authorsTable, "Author");
    txtYearBorn.DataBindings.Add("Text", authorsTable,
"Year_Born");
    // establish currency manager
    authorsManager = (CurrencyManager)
this.BindingContext[authorsTable];
```

```
}
```

This code creates the needed data objects to open the database and form the **Authors** table (includes all fields ordered by Author). It then binds the controls to the currency manager object. This code is identical to code seen in the previous two chapters.

6. Add this code to the **frmAuthors_FormClosing** event method to close the database connection:

```
private void frmAuthors_FormClosing(object sender,
FormClosingEventArgs e)
{
    // close the connection
    booksConnection.Close();
    // dispose of the objects
    booksConnection.Dispose();
    authorsCommand.Dispose();
    authorsAdapter.Dispose();
    authorsTable.Dispose();
}
```

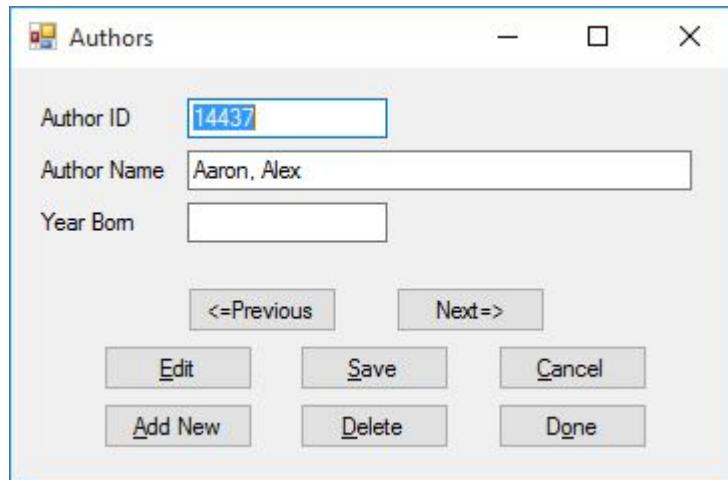
7. Code for the two button **Click** events to allow navigation:

```
private void btnPrevious_Click(object sender,
EventArgs e)
{
    authorsManager.Position--;
}

private void btnNext_Click(object sender, EventArgs e)
{
    authorsManager.Position++;
}
```

}

8. Save the application (saved in the **Example 5-2** folder in **VCSDB\Code\Class 5** folder). Run it. Here is the first record:



Navigate among the records. Note you cannot edit anything. The text boxes are read-only. As we progress through this chapter (and the next), we will continue to add features to this example until it is complete.

Example 5-2

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Copy **SQLBooksDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. In declarations, use these objects:

```
SqlConnection booksConnection;  
SqlCommand authorsCommand;  
SqlDataAdapter authorsAdapter;
```

4. In **frmAuthors_Load** method, use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

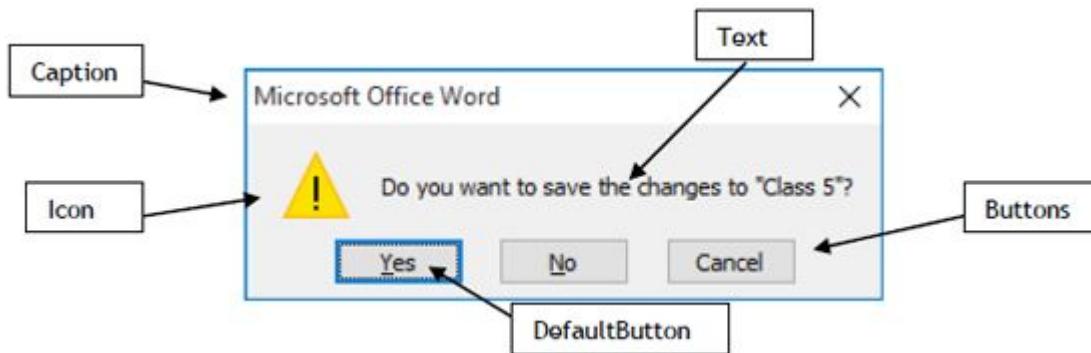
5. In **frmAuthors_Load**:

Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

MessageBox Object

Many times, in a database application, you will want to impart some information to your user. That information may be a courtesy message ("New record written") or a question requiring feedback ("Do you really want to delete this record?"). Visual C# (and Windows) provides an excellent medium for providing such information - the **MessageBox** object.

You've seen message boxes if you've ever used a Windows application. Think of all the examples you've seen. For example, message boxes are used to ask you if you wish to save a file before exiting and to warn you if a disk drive is not ready. For example, if while writing these notes in Microsoft Word, I attempt to exit, I see this message box:



In this message box, the different parts that you control have been labeled. You will see how you can format a message box any way you desire.

To use the **MessageBox** object, you decide what the **Text** of the message should be, what **Caption** you desire, what **Icon** and **Buttons** are appropriate, and which **DefaultButton** you want. To display the message box in code, you use the **MessageBox Show** method.

The MessageBox is overloaded with several ways to implement the Show method. Some of the more common ways are:

```
MessageBox.Show(Text);  
MessageBox.Show(Text, Caption);  
MessageBox.Show(Text, Caption, Buttons);  
MessageBox.Show(Text, Caption, Buttons, Icon);  
MessageBox.Show(Text, Caption, Buttons, Icon,  
DefaultButton);
```

In these implementations, if **DefaultButton** is omitted, the first button is default. If **Icon** is omitted, no icon is displayed. If **Buttons** is omitted, an ‘OK’ button is displayed. And, if **Caption** is omitted, no caption is displayed.

You decide what you want for the message box **Text** and **Caption** information (string data types). The other arguments are defined by Visual C# predefined constants. The **Buttons** constants are defined by the **MessageBoxButtons** constants:

Member	Description
AbortRetryIgnore	Displays Abort, Retry and Ignore buttons
OK	Displays an OK button
OKCancel	Displays OK and Cancel buttons
RetryCancel	Displays Retry and Cancel buttons
YesNo	Displays Yes and No buttons
YesNoCancel	Displays Yes, No and Cancel buttons

The syntax for specifying a choice of buttons is the usual dot-notation:

MessageBoxButtons.Member

So, to display an OK and Cancel button, the constant is:

MessageBoxButtons.OKCancel

You don't have to remember this, however. When typing the code, the Intellisense feature will provide a drop-down list of button choices when you reach that argument! This will happen for all the arguments in the **MessageBox** object.

The displayed Icon is established by the **MessageBoxIcon** constants:

Member	Description
IconAsterisk	Displays an information icon
IconInformation	Displays an information icon
IconError	Displays an error icon (white X in red circle)
IconHand	Displays an error icon
IconNone	Display no icon
IconStop	Displays an error icon
IconExclamation	Displays an exclamation point icon
IconWarning	Displays an exclamation point icon
IconQuestion	Displays a question mark icon

To specify an icon, the syntax is:

MessageBoxIcon.Member

Note there are eight different members of the **MessageBoxIcon** constants, but only four icons (information, error, exclamation, question) available. This is because the current Windows operating system only offers four icons. Future implementations may offer more.

When a message box is displayed, one of the displayed buttons will have focus or be the default button. If the user presses <Enter>, this button is selected. You specify which button is default using the **MessageBoxDefaultButton** constants:

Member	Description
Button1	First button in message box is default
Button2	Second button in message box is default
Button3	Third button in message box is default

To specify a default button, the syntax is:

MessageBoxDefaultButton.Member

The specified default button is relative to the displayed buttons, left to right. So, if you have Yes, No and Cancel buttons displayed and the second button is selected as default, the No button will have focus (be default). Always try to make the default response the “least damaging,” if the user just blindly accepts it.

When you invoke the **Show** method of the **MessageBox** object, the method returns a value from the **DialogResult** constants. The available members are:

Member	Description
Abort	The Abort button was selected
Cancel	The Cancel button was selected
Ignore	The Ignore button was selected
No	The No button was selected
OK	The OK button was selected
Retry	The Retry button was selected
Yes	The Yes button was selected

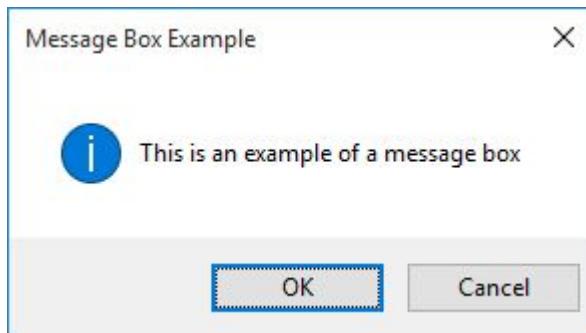
MessageBox Example:

This little code snippet (the first line is very long):

```
if (MessageBox.Show("This is an example of a message  
box",
```

```
"Message Box Example", MessageBoxButtons.OKCancel,  
MessageBoxIcon.Information,  
MessageBoxDefaultButton.Button1) == DialogResult.OK)  
{  
    // everything is OK  
}  
else  
{  
    // cancel was pressed  
}
```

displays this message box:



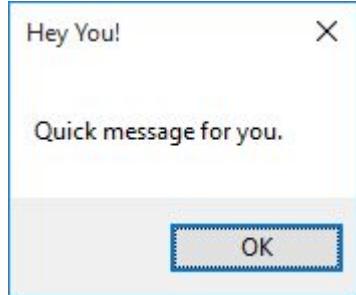
Of course, you would need to add code for the different tasks depending on whether **OK** or **Cancel** is clicked by the user.

Another MessageBox Example:

Many times, you just want to display a quick message to the user with no need for feedback (just an **OK** button). This code does the job:

```
MessageBox.Show("Quick message for you.", "Hey  
You!");
```

The resulting message box:



Notice there is no icon and the OK button (default if no button specified) is shown. Also, notice in the code, there is no need to read the returned value - we know what it is! You will find a lot of uses for this simple form of the message box (with perhaps some kind of icon) as you progress in this course.

Message boxes should be used whenever your application needs to inform the user of action or requires user feedback to continue. It is probably better to have too many message boxes, than too few. You always want to make sure your application is performing as it should and the more information you have, the better.

Example 5-3

Authors Table Input Form (Message Box)

There are two places where we could use message boxes in the Authors Table example. A simple box after saving an update to let the user know the save occurred and one related to deleting records.

1. Load Example 5-2 completed earlier. We will modify this example to include message boxes.
2. Use this code in the `btnSave_Click` event:

```
private void btnSave_Click(object sender, EventArgs e)
{
    MessageBox.Show("Record saved.", "Save",
        MessageBoxButtons.OK, MessageBoxIcon.Information);
}
```

Obviously, there will be more code in this event as we continue with this example. This code just implements the message box.

3. Use this code in the `btnDelete_Click` event:

```
private void btnDelete_Click(object sender, EventArgs e)
{
    DialogResult response;
    response = MessageBox.Show("Are you sure you want
        to
```

```
delete this record?", "Delete",
MessageBoxButtons.YesNo,
MessageBoxIcon.Question,
MessageBoxDefaultButton.Button2);
if (response == DialogResult.No)
{
    return;
}
}
```

Note we exit the method if the user selects **No**. And, notice the **No** button is default - this makes the user think a bit before hitting **Enter**. Like above, there will be more code in this method as we proceed.

4. Save the application (saved in the **Example 5-3** folder in **VCSDB\Code\Class 5** folder) and run it. Click the **Save** button and you will see:



Click **OK**, then try clicking the **Delete** button to see:

Delete



Are you sure you want to delete this record?

Yes

No

Example 5-3

Using SQL Server Databases

Using the SQL Server version of the project, make the same changes to **btnSave_Click**, and **btnDelete_Click**.

Application State

When presenting a Visual C# database interface to a user, it should be obvious, to the user, what needs to be done. Options should be intuitive and the possibility of mistakes minimized, if not completely eliminated. To maintain this obvious quality, you should always be aware of what **state** your application is in.

Application state implies knowing just what is currently being done within the interface. Are you adding a record, editing a record, deleting a record, or perhaps leaving the application? Once you know the state the application is in, you adjust the interface so that options needed for that particular state are available to the user. You also need to know when and how to transition from one state to another.

What options are adjusted to reflect application state? A primary option is a control's **Enabled** property. By setting **Enabled** to **False**, you disable a control, making it unavailable to the user. So, if the user is not able to save a current record, the button that does the save should have an **Enabled** property of **False**. A more drastic disabling of a control is setting its **Visible** property to **False**. In this case, there is no misunderstanding about application state. As the application moves from one state to another, you need to determine which controls should be enabled and which should be disabled.

For **text box** controls, a property of importance is the **ReadOnly** property. If a value in a text box is not to be edited, set **ReadOnly** to **True**. When editing is allowed (the state changes), toggle the **ReadOnly** property to **False**. For text boxes that are always read-only (used for display, not editing purposes), use color (red is good) to indicate they are not accessible. When editing in a text box, use the **Focus** method to place the cursor in the box, making it the active control (giving it focus) and saving the user a mouse click.

The **Focus** method can also be used to programmatically move the user from one text box to the next in a desired order.

Another mechanism for moving from one control to another in a prescribed order is the **TabIndex** property, in conjunction with **TabStop**. If **TabStop** is **True**, **TabIndex** defines the order controls become active (only one control can be active at a time) as the **<Tab>** key is pressed (the order is reversed when **<Shift>-<Tab>** is pressed). When controls are placed on a form at design time, they are assigned a **TabIndex** value with **TabStop = true**;. If you don't want a control to be made active with **<Tab>**, you need to reset its **TabStop** property to **False**. If the assigned order is not acceptable, reset the **TabIndex** properties for the desired controls, starting with a low number and increasing that value with each control added to the **<Tab>** sequence. A primary application for **<Tab>** sequencing is moving from one text box to the next in a detailed input form.

If the concepts of control focus and tab movements are new or unfamiliar, try this. Start a new application in Visual C#. Add three buttons (**Button1**, **Button2**, **Button3**), then three text boxes (**Text1**, **Text2**, **Text3**). Run the application. The first button (**Button1**) should have focus (a little outline box is around the **Text**). If you press **<Enter>** at this point, this button is 'clicked.' Press the **<Tab>** key and the focus moves to the second button. Press **<Tab>** twice. The focus should now be in the first text box (the cursor is in the box). Keep pressing **<Tab>** and watch the focus move from one control to the other, always in the same order. Pressing **<Shift>-<Tab>** reverses the order. Now, for each button, set the **TabStop** property to **False** (removing them from the tab sequence). Re-run the application and you should note the focus only shifts among the text boxes. Try resetting the **TabIndex** properties of the text boxes to change the shift direction. Always use the idea of focus in your applications to indicate to the user what control is active.

All of this application state talk may sound complicated, but it really isn't. Again, it's all just a matter of common sense. After you

design your interface, sit back and step through your application in the Visual C# environment, exercising every option available. With each option, ask yourself what the user needs to see. Implement the necessary logic to make sure this is all the user sees. Make sure moves from one state to another are apparent and correct. Try lots of things until you are comfortable with the finished product. The Visual C# environment makes performing such tasks quite easy.

Example 5-4

Authors Table Input Form (Application State)

The Authors Table Input Form can operate in one of three states: **View** state, **Add** state or **Edit** state. In **View** state, the user can navigate from record to record, switch to **Edit** state, add and/or delete records, or exit the application. In both **Add** and **Edit** states, no navigation should be possible, data can be changed, and the user should have access to the **Save** and **Cancel** functions. Each of these states can be implemented using button **Enabled** properties and text box **ReadOnly** properties. We use **TabIndex** (and **TabOrder**) to control shift of focus in the text box controls. We will use a general method to allow switching from one state to another.

1. Open Example 5-3 in the Visual C# environment. We will modify this example to include state considerations.
2. Remove the buttons from tab sequencing by setting all (eight buttons) of their **TabStop** properties to **False**. Also set **TabStop** to **False** for the **txtAuthorID** text box (we will not edit this value - we'll explain why later). Set **TabIndex** for **txtAuthorName** to 1 and **TabIndex** for **txtYearBorn** to 2.
3. Add a general method named **SetState** with string argument **appState**. Add this code to the **SetState** method:

```
private void SetState(string appState)
{
    switch (appState)
    {
        case "View":
```

```
        txtAuthorID.BackColor = Color.White;
        txtAuthorID.ForeColor = Color.Black;
        txtAuthorName.ReadOnly = true;
        txtYearBorn.ReadOnly = true;
        btnPrevious.Enabled = true;
        btnNext.Enabled = true;
        btnAddNew.Enabled = true;
        btnSave.Enabled = false;
        btnCancel.Enabled = false;
        btnEdit.Enabled = true;
        btnDelete.Enabled = true;
        btnDone.Enabled = true;
        txtAuthorName.Focus();
        break;

    default: // Add or Edit if not View
        txtAuthorID.BackColor = Color.Red;
        txtAuthorID.ForeColor = Color.White;
        txtAuthorName.ReadOnly = false;
        txtYearBorn.ReadOnly = false;
        btnPrevious.Enabled = false;
        btnNext.Enabled = false;
        btnAddNew.Enabled = false;
        btnSave.Enabled = true;
        btnCancel.Enabled = true;
        btnEdit.Enabled = false;
        btnDelete.Enabled = false;
        btnDone.Enabled = false;
        txtAuthorName.Focus();
        break;
    }
}
```

This code sets the application in View, Add or Edit state. Note which buttons are available and which are not. Notice the **Author ID** box is red in Add and Edit state to indicate it cannot be changed. Notice that the Add and Edit states are the same (for now) and are just a ‘toggling’ of the View state - this will occur quite often - a great place for ‘cut and paste’ coding. We now need to modify the application code to use this method to move from state to state.

4. We want to be in the **View** state when the application is initialized. Add these two lines at the bottom of the **frmAuthors_Load** event:

```
this.Show();
SetState("View");
```

5. When the **Add New** button is clicked, we want to switch to **Add** state. Add this line of code at the top of the **btnAddNew_Click** event method:

```
SetState("Add");
```

6. When the **Edit** button is clicked, we switch to **Edit** state. Add this line of code at the top of the **btnEdit_Click** event method:

```
SetState("Edit");
```

7. Following a **Cancel** or **Save** operation (in **Add** or **Edit** state), we want to return to **View** state. Place this line at the end of the **btnCancel_Click** and **btnSave_Click** event methods:

```
SetState("View");
```

The **Delete** button does not need any change of state code - it only works in **View** state and stays in that state following a delete.

8. We're almost done. This is a small change, but an important one that gives your application a professional touch. Notice that if you click the **Previous** button and the pointer is at the first record, nothing changes. Similarly, at the end of the data table, if you click **Next**, nothing happens. This lack of change might confuse the user. To give the user some feedback that they've reached a limit, I like to provide some audible feedback. Make the shaded changes to the **btnPrevious** and **btnNext Click** event methods to play a beep when the user bumps into a limit:

```
private void btnPrevious_Click(object sender,
EventArgs e)
{
    if (authorsManager.Position == 0)
    {
        Console.Beep();
    }
    authorsManager.Position--;
}

private void btnNext_Click(object sender, EventArgs e)
{
    if (authorsManager.Position ==
authorsManager.Count - 1)
    {
        Console.Beep();
    }
    authorsManager.Position++;
}
```

9. Save and run the application (saved in the **Example 5-4** folder in **VCSDB\Code\Class 5** folder). The initial (**View**) state is:

A screenshot of a Windows-style application window titled "Authors". The window contains three text input fields: "Author ID" with value "14437", "Author Name" with value "Aaron, Alex", and "Year Born" which is empty. Below the fields are two sets of buttons: "<=Previous" and "Next=>", followed by "Edit", "Save", and "Cancel" buttons in the first row, and "Add New", "Delete", and "Done" buttons in the second row. The "Author Name" field has a blue border, indicating it is the active or selected field.

Notice how the various buttons change state as different functions are accessed on the interface form. In **Add** and **Edit** state (the ID box is red), check the tab order of the two text boxes (a very short tab order!):

A screenshot of the same "Authors" form, but now the "Author ID" field has a red border, indicating it is the active field. The other fields and buttons are in their original state. The "Author Name" field still has a blue border from the previous screenshot.

In each state, it is obvious to the user what functions are available and when they are available. Do you hear the beep when you try to move past a limit at the end or beginning of the data table?

Example 5-4

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Entry Validation

Throughout your work with databases, you will find that viewing database information is an easy task with Visual C#. Things quickly become difficult, though, when you want to modify information in a database. And, things become very difficult when you allow your user to type information. That's why, if at all possible, don't allow your user to type things. Use point and click type controls whenever possible.

Checking input information from a user requires programming on your part. You must insure information being put in a database is correct. There are two steps to checking information from a user: **entry validation** and **input validation**. Entry validation is associated with text box controls and checks for proper keystrokes. Input validation is associated with several control types and checks to make sure entries and choices meet certain requirements. In this section, we address entry validation. Input validation is addressed in the next section of this chapter.

As mentioned, entry validation checks for proper keystrokes. For example, if a numerical entry is needed, only allow the pressing of number keys. If spaces are not allowed, don't allow them. If an input must be in upper case letters, don't allow lower case letters to be typed. Restricting keystrokes is referred to as **key trapping**.

Key Trapping

Key trapping is done in the **KeyPress** event method of a text box control. Such a method has the form (for a text box named **txtExample**):

```
private void txtExample_KeyPress(object sender,  
KeyPressEventArgs e)  
{  
  
}
```

What happens in this method is that every time a key is pressed in the corresponding text box, the **KeyPressEventArgs** class passes the key that has been pressed into the method via the **char** type **e.KeyChar** property. Recall the **char** type is used to represent a single character. We can thus examine this key. If it is an acceptable key, we set the **e.Handled** property to **False**. This tells Visual C# that this method has not been handled and the **KeyPress** should be allowed. If an unacceptable key is detected, we set **e.Handled** to **true**. This ‘tricks’ Visual C# into thinking the **KeyPress** event has already been handled and the pressed key is ignored.

We need some way of distinguishing what keys are pressed. The usual alphabetic, numeric and character keys are fairly simple to detect. To help detect non-readable keys, we can examine the key’s corresponding Unicode value. Two values we will use are:

Definition	Value
Backspace	8
Carriage return (<Enter> key)	13

As an example, let’s say we have text box (**txtExample**) and we only want to enter numbers or a decimal point. There are several ways to build a key trapping routine. I suggest an if block that,

based on different values of `e.KeyChar`, takes different steps. If `e.KeyChar` represents a number, a decimal point or a backspace key (always include backspace or the user won't be able to edit the text box properly), we will allow the keypress (`e.Handled = false`). Otherwise, we will set `e.Handled = true` to ignore the keypress (we also add a beep). The code to do this is:

```
if (e.KeyChar >= '0' && e.KeyChar <= '9')
{
    // number values
    e.Handled = false;
}
else if ((int) e.KeyChar == 8)
{
    // backspace
    e.Handled = false;
}
else if (e.KeyChar == '.')
{
    // decimal point
    e.Handled = false;
}
else
{
    // any other character
    e.Handled = true;
}
```

Note the use of single quotes to signify `char` types, the same type as `e.KeyChar`.

Example 5-5

Authors Table Input Form (Entry Validation)

In the Authors Table Input Form, the Year Born field can only be numeric data.

1. Load Example 5-4 completed earlier. We will modify this example to include entry validation.
2. Use this code to the **txtYearBorn_KeyPress** event (make sure you select the proper event - don't use the **TextChanged** event!):

```
private void txtYearBorn_KeyPress(object sender,  
KeyPressEventArgs e)  
{  
    if ((e.KeyChar >= '0' && e.KeyChar <= '9') ||  
        (int) e.KeyChar == 8)  
    {  
        //Acceptable keystrokes  
        e.Handled = false;  
    }  
    else  
    {  
        e.Handled = true;  
        Console.Beep();  
    }  
}
```

3. Save and run the application (saved in the **Example 5-5** folder in **VCSDB\Code\Class 5** folder). Click **Edit** to switch to Edit state. Click the **Year Born** text box. Try some typing. You should only be able to type numbers (or use the backspace key) in the Year Born entry box. You should hear a beep sound when you type an incorrect key.

Example 5-5

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Input Validation

In the example just studied, although the user can only input numeric data for the Year Born field, there is no guarantee the final input would be acceptable. What if the input year is past the current year? What if the year is 1492? A second step in validation is to check values in context. Do the input values make sense? Do the values meet established rules? This step is **input validation**.

Some common validation rules are:

- ⇒ Is this field required? If a field is required and no input is provided, this could cause problems.
- ⇒ Is the input within an established range? For example, if entering a day number for the month of April, is the value between 1 and 30?
- ⇒ Is the input the proper length? Social security numbers (including hyphens) require 11 characters. If 11 characters are not detected, the input is not a valid social security number. The C# **Length** property can be used here, as can a text box **MaxLength** property (to limit the length).
- ⇒ Is the input conditional? Some fields only need to be filled in if other fields are filled in. For example, if a user clicks to ship to another address, you need to make sure that address exists.
- ⇒ Is the input a primary key? If so, and the user has the capability of entering a value, we must insure it is a unique value. Each primary key value in a table must be different.

The amount of input validation required is dependent on the particular field. Many times, there is none needed. You, as the programmer, need to examine each input field and answer the questions posed above: is the field required, must it be within a range, is it length restricted, is it conditional? Any Yes answers

require C# code to do the validation. You will probably find additional questions as you develop your database skills.

Where does the validation code go? It really depends on how you implement database editing. We will discuss this topic in detail in Chapter 6. For our example we have been creating, we will write a general method named **ValidateData** that is called in the **Click** event of the **Save** button. The user clicks this button when done editing, making it a great place to check validity. If any validation rules are violated, we don't allow the requested change(s).

We see entry and input validation require a bit of programming on our part. But, it is worth it. Field validation insures the integrity of the information we are putting in a database. We always need to maintain that integrity. And, one last time for emphasis (are you getting the idea this is important) - if you can eliminate user typing - do it!

Example 5-6

Authors Table Input Form (Input Validation)

As mentioned, the **Year Born** must be validated. We will make sure that, if an input is attempted (we won't require a year be input), the year has no more than four characters, is not greater than the current year and is greater than 150 years prior to the current year (by not hard coding a minimum year, the code automatically upgrades itself). We will also make sure the user enters an Author Name.

1. Load Example 5-5 completed earlier. We will modify this example to include input validation.
2. Set **MaxLength** property for **txtYearBorn** text box to 4.
3. Add a method named **ValidateData** that returns a Boolean argument (if true, all validation rules were met). Add this code:

```
private bool ValidateData()
{
    string message = "";
    int inputYear, currentYear;
    bool allOK = true;
    // Check for name
    if (txtAuthorName.Text.Trim().Equals(""))
    {
        message = "You must enter an Author Name." +
        "\r\n";
        txtAuthorName.Focus();
    }
}
```

```

    allOK = false;
}
// Check length and range on Year Born
if (!txtYearBorn.Text.Trim().Equals(""))
{
    inputYear = Convert.ToInt32(txtYearBorn.Text);
    currentYear = DateTime.Now.Year;
    if (inputYear > currentYear || inputYear <
    currentYear - 150)
    {
        message += "Year born must be between " +
(currentYear - 150).ToString() + " and " +
currentYear.ToString();
        txtYearBorn.Focus();
        allOK = false;
    }
}
if (!allOK)
{
    MessageBox.Show(message, "Validation Error",
MessageBoxButtons.OK, MessageBoxIcon.Information);
}
return (allOK);
}

```

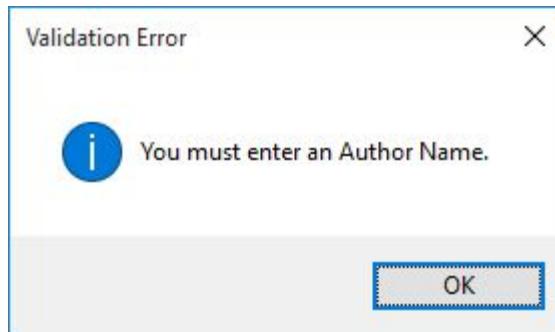
In this code, we first check to see if an **Author Name** is entered and then validate the **Year Born** field. If either validation rule is violated, the variable **allOK** is set to **false** and a message box displayed. If any of this code is unfamiliar, try Visual C# on-line help for assistance.

4. Modify the **btnSave_Click** event to read (new lines are shaded):

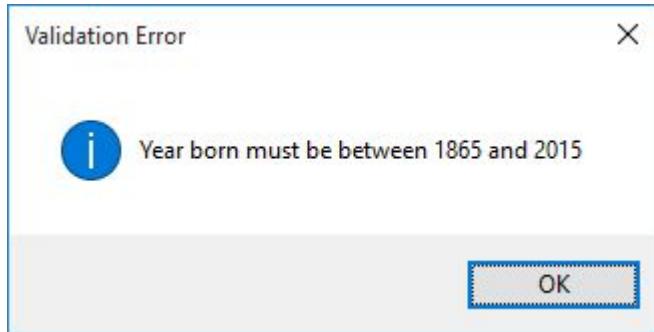
```
private void btnSave_Click(object sender, EventArgs e)
{
    if (!ValidateData())
    {
        return;
    }
    MessageBox.Show("Record saved.", "Save",
    MessageBoxButtons.OK, MessageBoxIcon.Information);
    SetState("View");
}
```

In the new line of code, if the **ValidateData** function returns a **false**, the data is not valid and we exit the method.

4. Save and run the application. Click **Edit** and blank out the **Author Name**. Click **Save**. A message box should appear:



Click **OK** and the focus is reset on the **Author Name** text box, helping the user. Type an invalid numeric value in the **Year Born** box. Click **Save**. A new message should be displayed:



If you attempt a year, you must either enter a valid value or click **Cancel**. Try a valid year and valid name - make sure they are accepted.

5. After typing a new Author name, to type a Year Born, you need to click in that text box. This clicking (especially when working with lots of text boxes) is cumbersome. A preferred method would be a programmatic shift of focus. Add this code at the top of the **txtAuthorName_KeyPress** event:

```
private void txtAuthorName_KeyPress(object sender,  
KeyPressEventArgs e)  
{  
    if ((int) e.KeyChar == 13)  
    {  
        txtYearBorn.Focus();  
    }  
}
```

In this code, if the <Enter> key is pressed, the focus is shifted from the Author text box to the Year Born text box (if a valid name is input). This programmatic change of focus is used all the time in database interfaces. Users like to see the focus move when they press <Enter>. It is an additional step in maintaining proper application state. To shift from the Year Born box to the Author box, add the shaded code to the **txtYearBorn_KeyPress** event:

```
private void txtYearBorn_KeyPress(object sender,
KeyEventArgs e)
{
    if ((e.KeyChar >= '0' && e.KeyChar <= '9') ||
(int) e.KeyChar == 8)
    {
        //Acceptable keystrokes
        e.Handled = false;
    }
    else if ((int)e.KeyChar == 13)
    {
        txtAuthorName.Focus();
    }
    else
    {
        e.Handled = true;
        Console.Beep();
    }
}
```

6. Save (saved in the **Example 5-6** folder in **VCSDB\Code\Class 5** folder) and run the example again. Click **Edit**. Notice how the focus shifts between the two text boxes as you change the values and press **<Enter>**. Pressing **<Tab>** should also change the focus appropriately.

Example 5-6

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Error Trapping and Handling

Even with a well-designed, ‘user-proof’ interface, errors can still occur. This is especially true when working with databases. Occasionally, data cannot be written to, or deleted from, the database or invalid fields are encountered. Without any action on our part, these **run-time errors** might bring our application to an unceremonious end. If, however, we recognize an error has occurred and inform the user of the problem, we might be able to recover.

Run-time errors (referred to in Visual C# as **exceptions**) are “catchable.” That is, Visual C# recognizes an error has occurred and enables you to catch it and take corrective action (handle the error). As mentioned, if an error occurs and is not caught, your program will usually end in a rather unceremonious manner. Most run-time errors occur when your application is working with files, either trying to open, read, write or save a file. Other common run-time errors are divide by zero, overflow (exceeding a data type’s range) and improper data types.

Error trapping and handling must be implemented in every method in your application where you think it might be needed. Visual C# does not allow global error trapping. At a minimum, you should implement error trapping and handling in every method that writes to or reads from the database.

Visual C# uses a structured approach to catching and handling exceptions. The structure is referred to as a **try/catch/finally** block. And the annotated syntax for using this block is:

```
try
{
    // here is code you try where some kind of
    // error may occur
```

```
}

catch (ExceptionType ex)
{
    // if error described by exception of
    // ExceptionType
    // occurs, process this code

}

catch (Exception ex)
{
    // if any other error occurs, process this code

}

finally
{
    // Execute this code whether error occurred or not
    // this block is optional

}

// Execution continues here
```

The above code works from the top, down. It ‘tries’ the code between **try** and the first **catch** statement. If no error is encountered, any code in the **finally** block will be executed and the program will continue after the right brace closing the **try/catch/finally** block. If an exception (error) occurs, the program will look to find, if any, the first **catch** statement (you can have multiple catch statements and must have at least one) that matches the exception that occurred. If one is found, the code in that respective block is executed (code to help clear up the error - the exception handling), then the code in the **finally** block, then program execution continues after the closing brace. If an error occurs that doesn’t match a particular exception, the code in the ‘generic’ **catch** block is executed, followed by the code in the

finally block. And, program execution continues after the closing brace.

This structure can be used to trap and handle any **Type** of exception defined in the Visual C# **Exception** class. There are hundreds of possible exceptions related to data access, input and output functions, graphics functions, data types and numerical computations. Here is a list of example exception types (their names are descriptive of the corresponding error condition):

ArgumentException	ArgumentNullException
ArgumentOutOfRangeException	ArithmeticException
ArrayTypeMismatchException	DivideByZeroException
DllNotFoundException	Exception
FormatException	IndexOutOfRangeException
DirectoryNotFoundException	EndOfStreamException
FileNotFoundException	IOException
OutOfMemoryException	OverflowException

Let's take a closer look at the **catch** block. When you define a catch block, you define the exception type you want to catch. For example, if want to catch a divide by zero condition, an **DivideByZeroException**, we use:

```
catch (DivideByZeroException ex)
{
    // Code to execute if divide by zero occurs
}
```

If in the **try** block, a divide by zero occurs, the code following this **catch** statement will be executed. You would probably put a message box here to tell the user what happened and provide him or her with options of how to fix the problem. To help with the messaging capability, the optional variable you define as the

exception (**ex**, in this case) has a **Message** property you can use. The message is retrieved using **ex.Message**.

A **try** block may be exited using the **break** statement. Be aware any code in the **finally** block will still be executed even if break is encountered. Once the finally code is executed, program execution continues after the brace closing the try block.

Example of try block to catch a “file not found” error:

```
try
{
    // Code to open file
}
catch (FileNotFoundException ex)
{
    // message box describing the error
    MessageBox.Show(ex.Message, "Error",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
}
finally
{
    //Code to close file (even if error occurred)
}
```

Example of try block to catch a “formatting” error (happens when trying to convert an empty text string to a numeric value):

```
try
{
    // Code to format text string
}
catch (FormatException ex)
```

```
{  
    // write code that just sets numeric value to 0.0  
}  
finally  
{  
    //Code to close file (even if error occurred)  
}
```

Example of a generic error catching routine:

```
try  
{  
    // Code to try  
}  
catch (Exception ex)  
{  
    // message box describing the error  
    MessageBox.Show(ex.Message, "Error",  
    MessageBoxButtons.OK, MessageBoxIcon.Error);  
}  
finally  
{  
    //Code to finish the block  
}
```

We've only taken a brief look at the structured run-time error handling capabilities of Visual C#. It is difficult to be more specific without knowing just what an application's purpose is. You need to know what type of errors you are looking for and what corrective actions should be taken if these errors are encountered. As you build and run your own applications, you will encounter run-time errors. These errors may be due to errors in your code. If so, fix them. But, they may also be errors that arise due to some invalid

inputs from your user, because a file does not meet certain specifications or because a disk drive is not ready. You need to use error handling to keep such errors from shutting down your application, leaving your user in a frustrated state.

Example 5-7

Authors Table Input Form (Error Trapping)

As mentioned, error trapping and handling should be included within every method where database information is read or written. It should also be included in methods where database files are being opened or saved.

1. Load Example 5-6 completed earlier. We will modify this example to include error trapping handling
2. Modify the `frmAuthors_Load` method to incorporate error handling. Changes are shaded:

```
private void frmAuthors_Load(object sender, EventArgs e)
{
    try
    {
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        // establish command object
        authorsCommand = new OleDbCommand("Select * from
Authors ORDER BY Author", booksConnection);
        // establish data adapter/data table
        authorsAdapter = new OleDbDataAdapter();
```

```

        authorsAdapter.SelectCommand = authorsCommand;
        authorsTable = new DataTable();
        authorsAdapter.Fill(authorsTable);
        // bind controls to data table
        txtAuthorID.DataBindings.Add("Text",
        authorsTable, "Au_ID");
        txtAuthorName.DataBindings.Add("Text",
        authorsTable, "Author");
        txtYearBorn.DataBindings.Add("Text",
        authorsTable, "Year_Born");
        // establish currency manager
        authorsManager =
        (CurrencyManager)this.BindingContext[authorsTable];
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error establishing
        Authors table.", MessageBoxButtons.OK,
        MessageBoxIcon.Error);
        return;
    }
    this.Show();
    SetState("View");
}

```

3. Modify the `btnAddNew_Click`, `btnSave_Click`, and `btnDelete_Click` event methods to allow error trapping and handling. Use the generic code developed in this section, taking advantage of ‘cut and paste’ editing. The changes are shaded (more code will be added later):

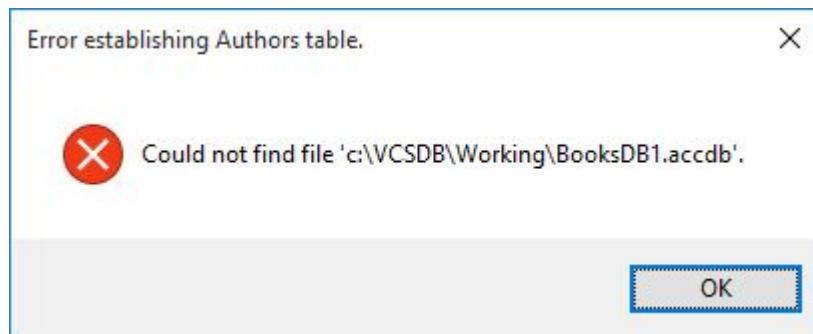
```
private void btnAddNew_Click(object sender, EventArgs e)
```

```
{  
    try  
    {  
        SetState("Add");  
    }  
    catch (Exception ex)  
    {  
        MessageBox.Show("Error adding record.",  
            "Error",  
        MessageBoxButtons.OK, MessageBoxIcon.Error);  
    }  
}  
  
private void btnSave_Click(object sender, EventArgs e)  
{  
    if (!ValidateData())  
    {  
        return;  
    }  
    try  
    {  
        MessageBox.Show("Record saved.", "Save",  
            MessageBoxButtons.OK, MessageBoxIcon.Information);  
        SetState("View");  
    }  
    catch (Exception ex)  
    {  
        MessageBox.Show("Error saving record.",  
            "Error",  
        MessageBoxButtons.OK, MessageBoxIcon.Error);  
    }  
}
```

```
    }

private void btnDelete_Click(object sender, EventArgs e)
{
    DialogResult response;
    response = MessageBox.Show("Are you sure you want
        to
    delete this record?", "Delete",
    MessageBoxButtons.YesNo,
    MessageBoxIcon.Question,
    MessageBoxDefaultButton.Button2);
    if (response == DialogResult.No)
    {
        return;
    }
    try
    {
    }
    catch (Exception ex)
    {
        MessageBox.Show("Error deleting record.",
            "Error",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}
```

4. Save the application (saved in the **Example 5-7** folder in **VCSDB\Code\Class 5** folder). In the connection string, change the database name to **BooksDB1.accdb**. Run the application. The error trapping should display this message telling us it can't find the database:



If error trapping were not in place, the user would have no idea what caused the program to stop. Change the database name back to the correct value (**BooksDB.accdb**).

Example 5-7

Using SQL Server Databases

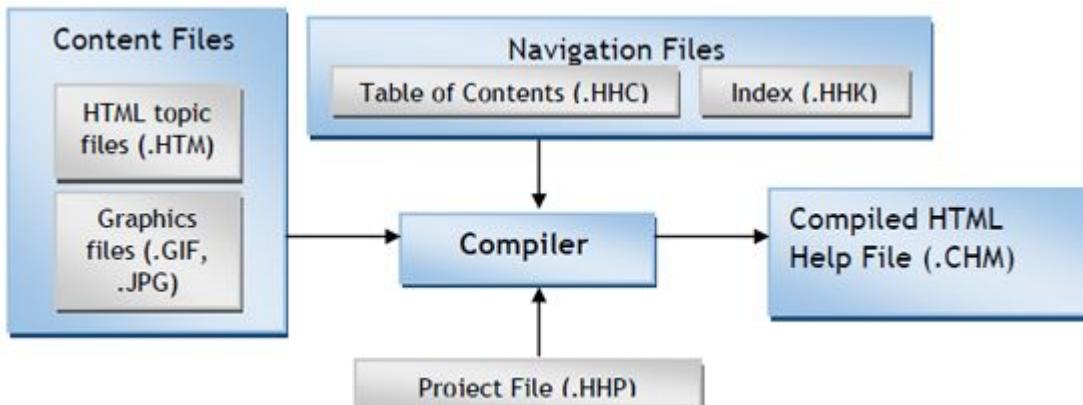
Using the SQL Server version of the project, make the same changes to `frmAuthors_Load`, `btnAddNew_Click`, `btnSave_Click`, and `btnDelete_Click`

On-Line Help Systems

So, at this point, we know how to build a powerful, intuitive interface, insure valid inputs, and handle any run-time errors that might occur. Even with all this work, there still may be times when the user is stumped as to what to do next. Instinct tells the user to press the <F1> function key. Long ago, someone in the old DOS world decided this would be the magic “Help Me!” key. Users expect help when pressing <F1> (I’m sure you rely on it a lot when using Visual C#). If nothing appears after pressing <F1>, user frustration sets in - not a good thing.

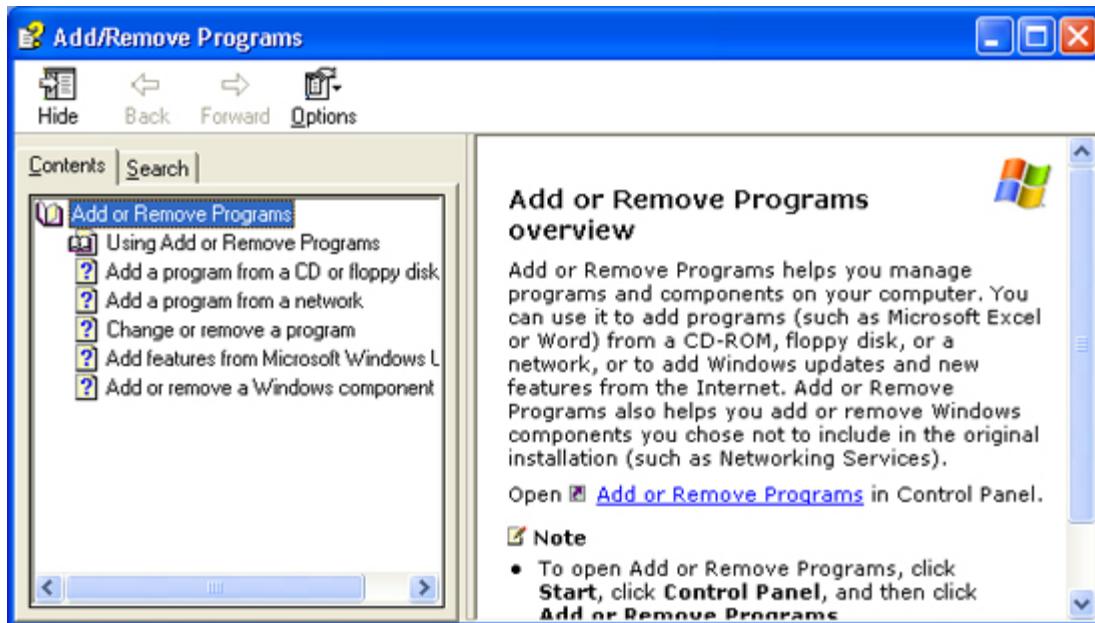
All applications written for other than your personal use should include some form of an on-line help system. It doesn’t have to be elegant, but it should be there. Adding a **help file** to your Visual C# application will give it real polish, as well as making it easier to use. In this section, we will show you how to build a very basic on-line help system for your database applications. This system will simply have a list of help topics the user can choose from.

We create what is known as an **HTML help** system. HTML stands for **hypertext markup language** and is the ‘programming’ language of choice for generating web pages. This language will be used to generate and display the topics displayed in the help system. Fortunately, we won’t need to learn much (if any) HTML. Building an HTML help system involves several files and several steps. In diagram form, we have:



We need to create topic files (.HTM files) for each topic in our help system. (We could also add graphics.) These topics are organized by a Table of Contents file (.HHC) and Index file (.HHK). The Project File (.HHP) specifies the components of a help project. All of these files are ‘compiled’ to create the finished help file (.CHM). This file is the file that can be opened for viewing the finished help system.

The developed help system is similar to help systems used by all Windows applications. As an example, here is a help system (.CHM file) that explains how to add or remove programs from your computer:



The left frame is a hierarchical structure (**Contents**) of clickable topics. The right frame displays the currently selected topic information. Other tabs in the left frame allow a user to browse an **Index** (none shown here) and **Search** the help file. The file also features several navigation features and print options. The key point here is that this help system is familiar to your user. No new instruction is needed in how to use on-line help.

We will build an HTML help system similar to the one displayed above, but with minimal features. Learning how to build a full-featured help system would be a course in itself. In this chapter, we will learn how to create text-only topics, add a contents file, create a project file and see how to compile the entire package into a useful (if simple) help system.

Creating a Help File

We could create a help system using only text editors if we knew the required structure for the various files. We won't take that approach. The on-line help system will be built using the **Microsoft HTML Help Workshop**. This is a free product from Microsoft that greatly simplifies the building of a help system. The workshop lets you build and organize all the files needed for building the help system. Once built, simple clicks allow compiling and viewing of the help system.

So, obviously, you need to have the workshop installed on your computer. The **HTML Help Workshop** can be downloaded from various Microsoft web sites. To find a download link, go to Microsoft's web site (<http://www.microsoft.com>). Search on "**HTML Help**" - the search results should display a topic **HTML Downloads**. Select that link and you will be led to a place where you can do the download. Once downloaded, install the workshop as directed.

Creating a complete help file is a major task and sometimes takes as much time as creating the application itself! Because of this, we will only skim over the steps involved, generate a simple example, and provide guidance for further reference. There are five major steps involved in building your own help file:

1. Create your application and develop a hierarchical list of help system topics. This list would consist of headings and topics under specific headings.
2. Create the **topic files (HTM extensions)**. Please make sure you spell and grammar check your topic files. If there are mistakes in your help system, your user base may not have

much confidence in the care you showed in developing your application.

3. Create a **Table of Contents** (HHC extension).
4. Create the **Help Project File** (HHP extension).
5. Compile the help file to create your finished help system (**CHM** extension).

Step 1 is application-dependent. Here, we'll look at how to use the HTML Help Workshop to complete the last four steps.

Starting the HTML Help Workshop

We will demonstrate the use of the **HTML Help Workshop** to build a very basic help system. The help file will have two headings. Each heading will have three sub-topics:

Heading 1

Topic 1

Topic 2

Topic 3

Heading 2

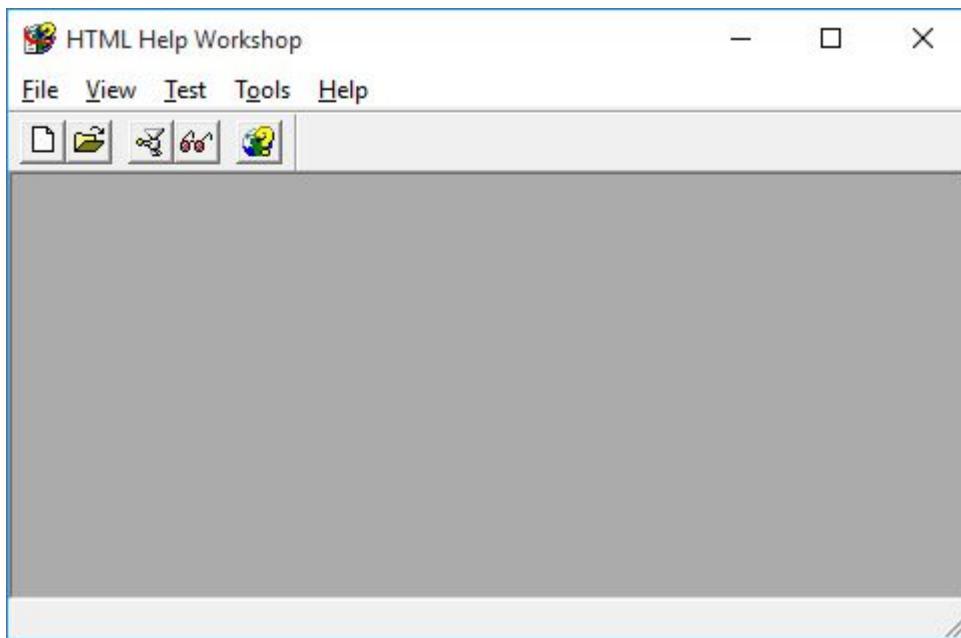
Topic 1

Topic 2

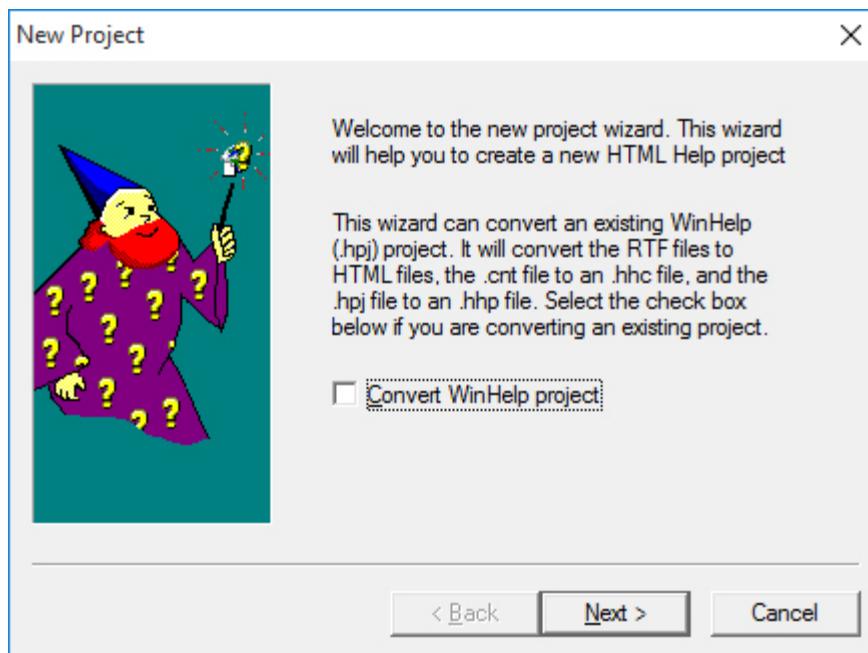
Topic 3

Though simple, the steps followed here can be used to build an adequate help system. All of the files created while building this help system can be found in the **VCSDB\Code\Class 5\Sample Help** folder.

If properly installed, there will be an entry for the help workshop on your computer's **Programs** menu. Click **Start**, then **Programs**. Select **HTML Help Workshop**, then **HTML Help Workshop** again. This dialog box should appear:

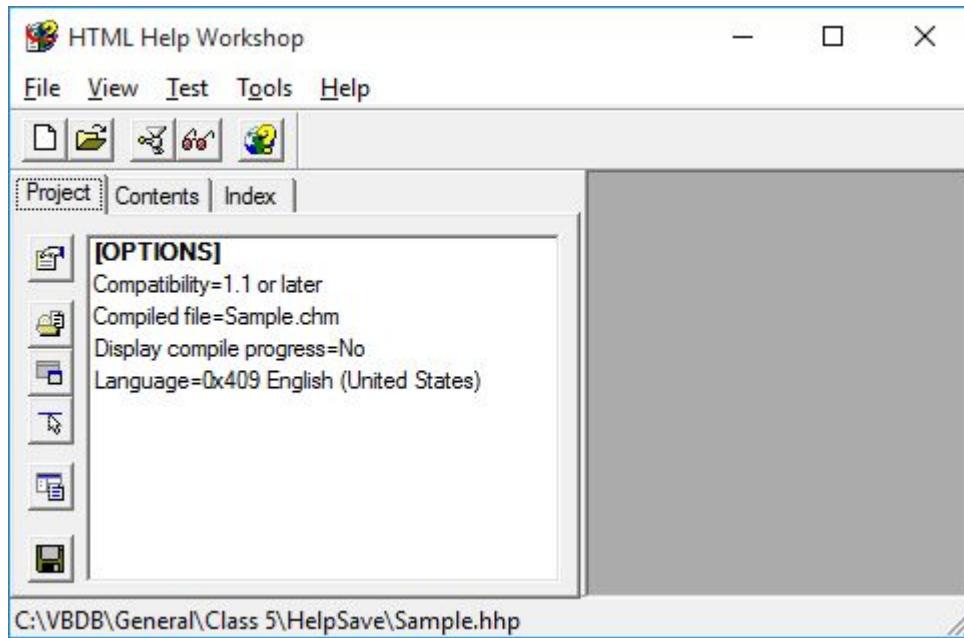


We want to start a new project. Select **New** under the **File** menu. In the selection box that appears, choose **Project** and click **OK**. A cute little **New Project Wizard** appears:



All we need to tell the wizard at this point is the name of our project file. Click **Next**. On the next screen, find (or create) the folder to hold your files (again, I used **VCSDB\Code\Class 5\Sample**

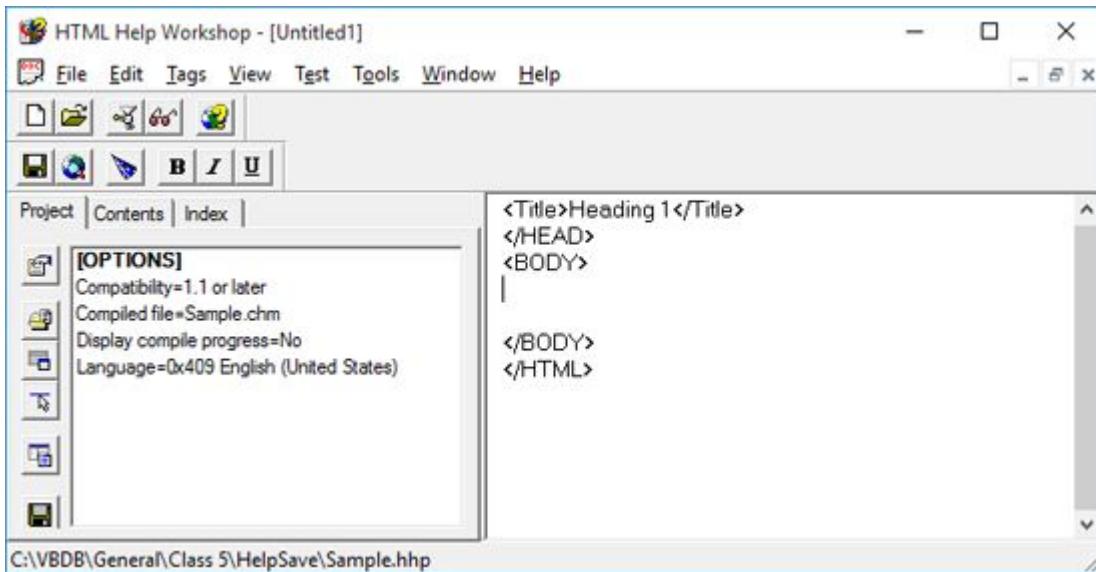
Help) and use the project name **Sample**. Click **Next** two times (make no further selections), then **Finish**. The file **Sample.hhp** is created and you will see:



Creating Topic Files

At this point, we are ready to create our topic files. These are the files your user can view for help on topics listed in the contents region of the help system. We will have eight such files in our example (one for each of the two headings and one for each of the two sets of three topics).

Each file is individually created and saved as an HTM file. To create the first file (for Heading 1), choose **New** under the **File** menu. Select **HTML File** and click **OK**. Enter a name for the file (**Heading 1**) and click **OK**. A topic file HTML framework will appear:



The window on the right is where you type your topic information. The file has some HTML code there already. If you've never seen HTML before, don't panic. We will make it easy. We are only concerned with what goes between the **<BODY>** and **</BODY>** 'tags'. These tags mark the beginning and end of the text displayed when a user selects this particular heading topic.

Most HTML tags work in pairs. The first tag says start something, then the second tag with the slash preface `</>` says stop something. Hence, `<BODY>` says the body of the text starts here. The `</BODY>` tag says the body stops here. It's really pretty easy to understand HTML.

It would help to know just a little more HTML to make your text have a nice appearance. To change the font, use the `FONT` tag:

```
<FONT FACE="FontName" SIZE="FontSize">
```

where `FontName` is the name of the desired font and `FontSize` the desired size. Notice this is very similar to the `Font` constructor in Visual Basic. When you are done with one font and want to specify a new one, you must use a `` tag before specifying the new font. To bold text, use the `` and `` tags. To delineate a paragraph in HTML, use the `<P>` and `</P>` tags. To cause a line break, use `
`. There is no corresponding `</BR>` tag.

So, using our minimal HTML knowledge (if you know more, use it), we can create our first topic file. The HTML I used to create the first topic (`Heading1`) is:

```
<BODY>
<STRONG>
This is Heading 1
</STRONG>
<P>
This is where I explain what the subtopics available under this heading are.
</P>
</BODY>
```

This HTML will create this finished topic:

This is Heading 1

This is where I explain what the subtopics available under this heading are.

When done typing this first topic, choose **Close File** under the **File** menu. Select a file name (I used **Heading1.HTM**) to use and save the topic file. Of course, at any time, you can reopen, modify and resave any topic file.

You repeat the above process for every topic in your help system. That is, create a new file, type your topic and save it. You will have an HTM file for every topic in your help system. For our example, create seven more HTM files using whatever text and formatting you desire. The files I created are saved as: **Heading1.HTM**, **Topic11.HTM**, **Topic12.HTM**, **Topic13.HTM**, **Heading2.HTM**, **Topic21.HTM**, **Topic22.HTM**, **Topic23.HTM**.

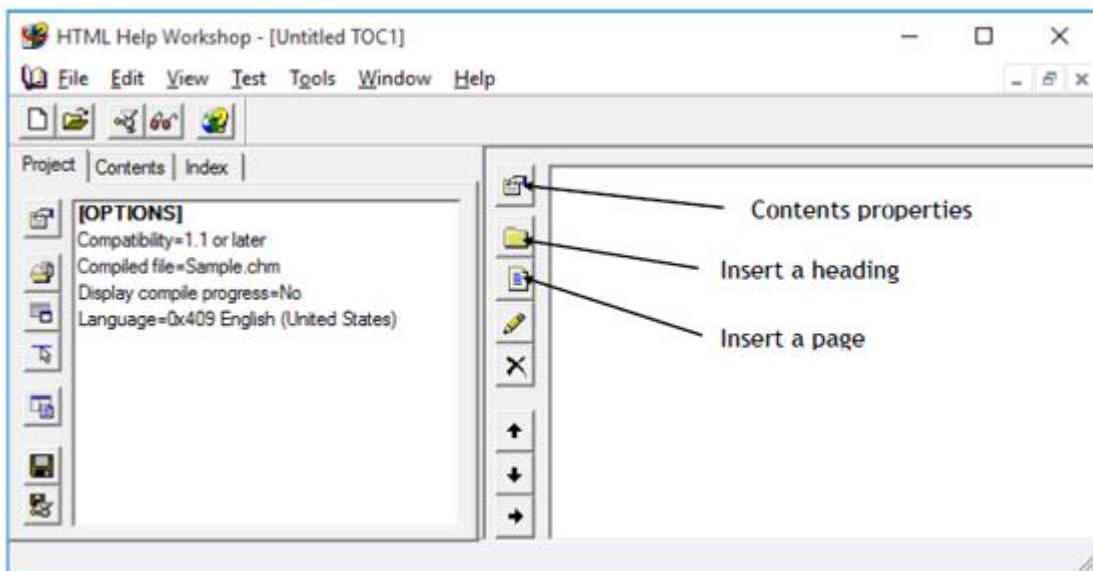
Creating HTML topic files using the Help Workshop is a bit tedious. You need to use HTML tags and don't really know what your topic file will look like until you've completed the help system. Using a **WYSIWYG** (what you see is what you get) editor is a better choice. Such editors allow you to create HTML files without knowing any HTML. You just type the file in a normal word processing-type environment, then save it in HTML format. There are several WYSIWYG HTML editors available. Check Internet download sites for options. Also, most word processors offer an option to save a document as an HTML file. I always use a WYSIWYG editor (FrontPage is my choice) for topic files. I simply save each topic file in the same folder as my help system files, just as if I was using the built-in editor.

Next, we create a **Table of Contents** file. But, before leaving your topic files, make sure they are as complete and accurate as possible. And, again, please check for misspellings - nothing scares a user more than a poorly prepared help file. They quickly draw

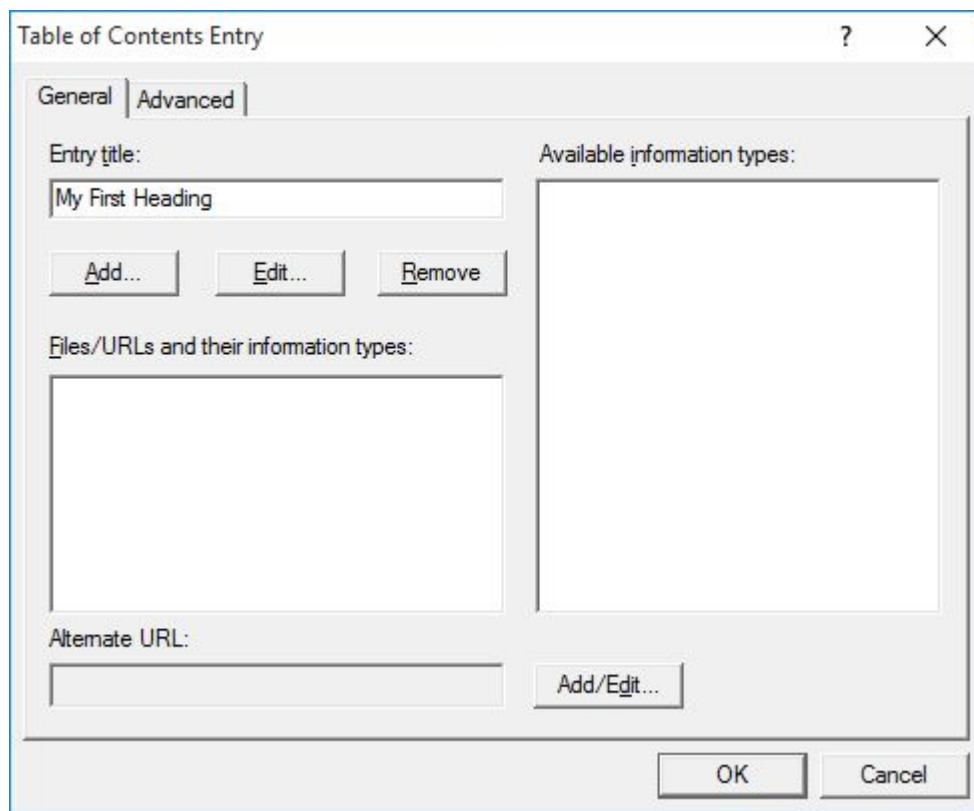
the conclusion that if the help system is not built with care, the application must also be sloppily built.

Creating Table of Contents File

The **Table of Contents** file specifies the hierarchy of topics to display when the help system's **Contents** tab is selected. In the **HTML Help Workshop**, choose the **New** option under the **File** menu. Choose **Table of Contents**, then click **OK**. The following window appears:

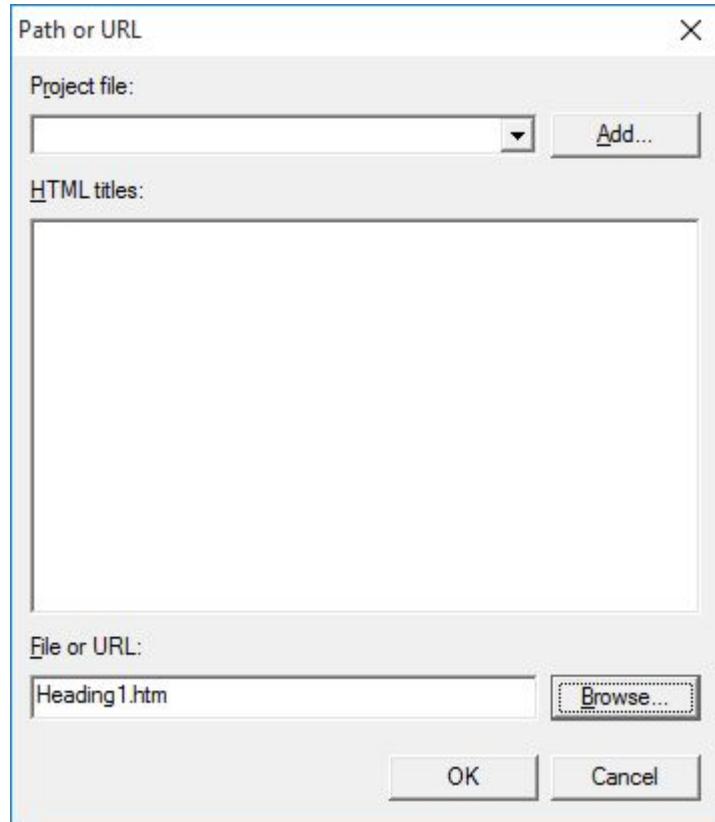


We want to add two headings with three topics under each. To insert a heading, in the right frame, click the toolbar button with a folder (**Insert a heading**). This window appears:



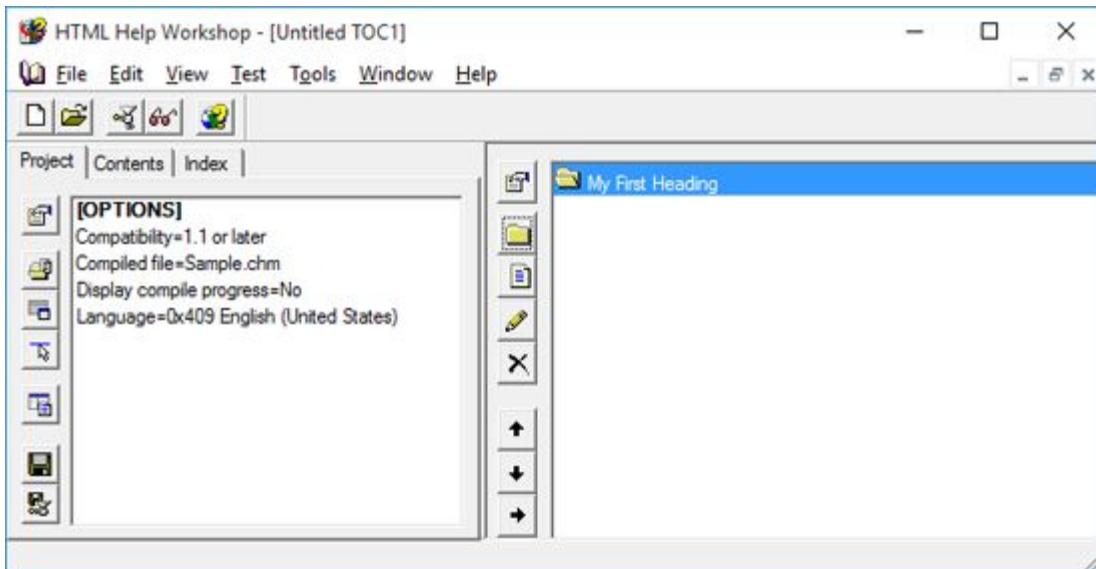
Type a title for the entry in **Entry title** (this is what will appear in the **Contents** - I used **My First Heading**).

You also need to link this topic to its topic file (HTM file). To do this, click **Add** and this appears:



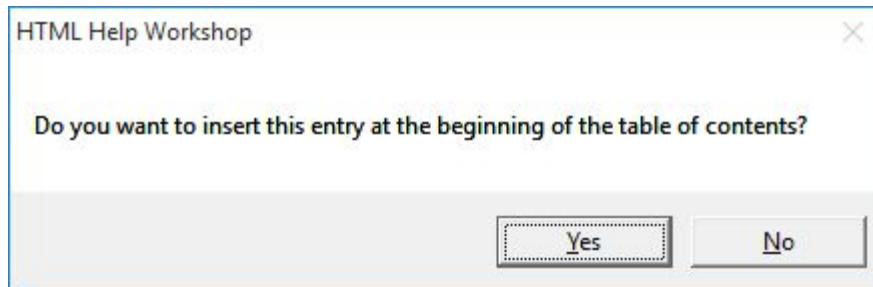
Click the **Browse** button and ‘point’ to the corresponding topic file (**Heading1.HTM** in this case). Click **OK** to close this window.

Click **OK** to close the Table of Contents entry window and you’ll now see:



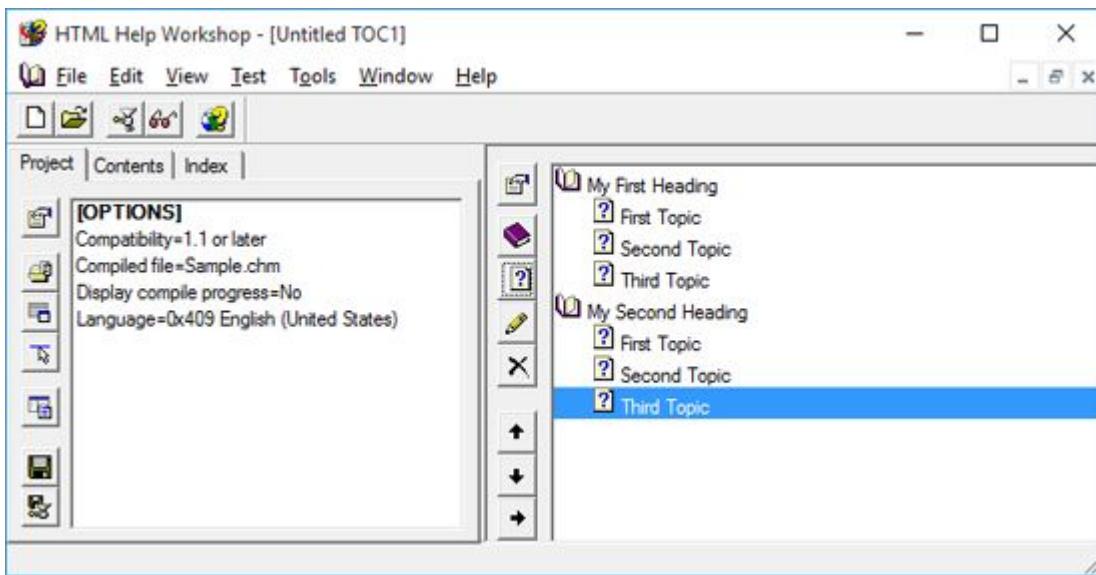
You've created your first entry in the Table of Contents. Notice the icon next to the heading is an 'open folder.' To change this to the more familiar 'open book,' click the top toolbar button (**Contents properties**). In the window that appears, remove the check mark next to 'Use Folders Instead of Books,' and click OK.

Now, we need to enter our first topic under this first heading. Click the toolbar button (**Insert a page**) under the heading button. This dialog will appear:



Answer **No** - we want the entry after the heading topic. At this point, you follow the same steps followed for the heading: enter a title and add a link to the topic file.

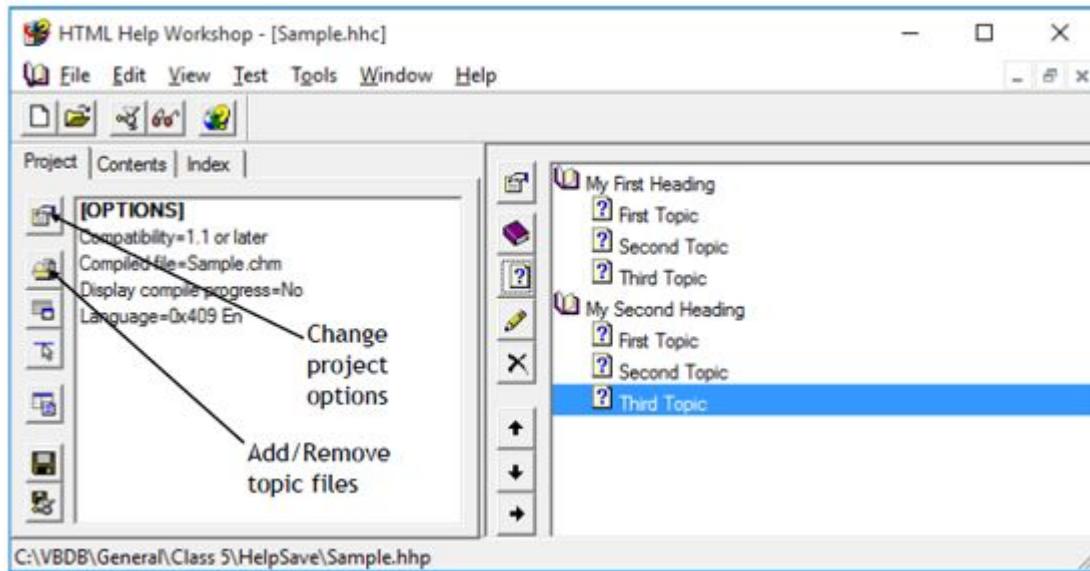
Add Table of Contents entries for all topic files in our little example. Use whatever titling information you choose. When you enter the second heading, it will be listed under the third topic in the first heading. To move it to the left (making it a major heading), right-click the heading and choose **Move Left**, the left arrow button on the toolbar). When done, I have this:



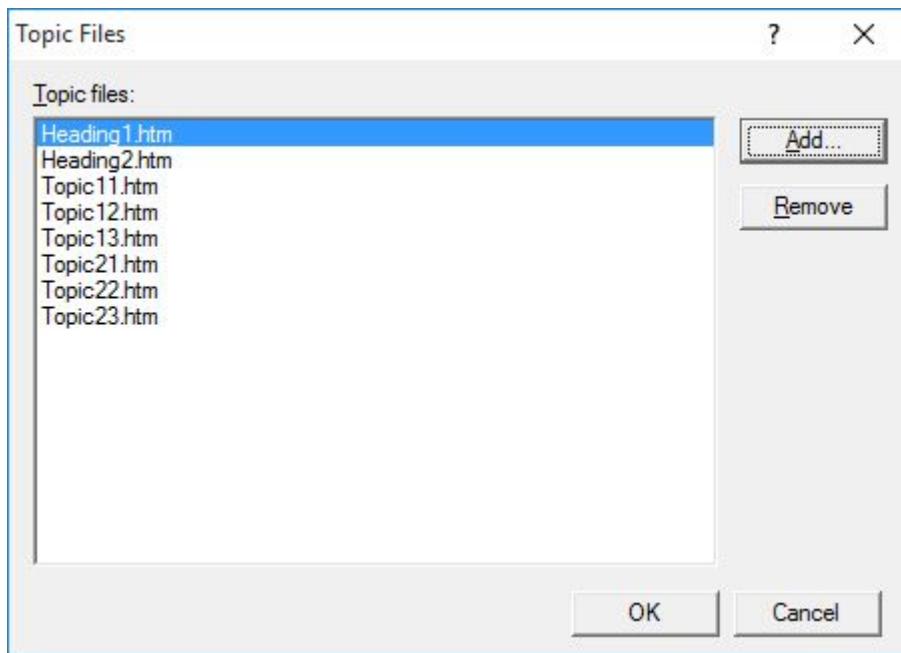
Save the contents file. Choose **Close File** under the **File** menu and assign a name of **Sample.HHC** to this contents file.

Compiling the Help File

We're almost ready to compile and create our help system. Before doing this, we need to add entries to the **Project** file. The project file at this point appears as:

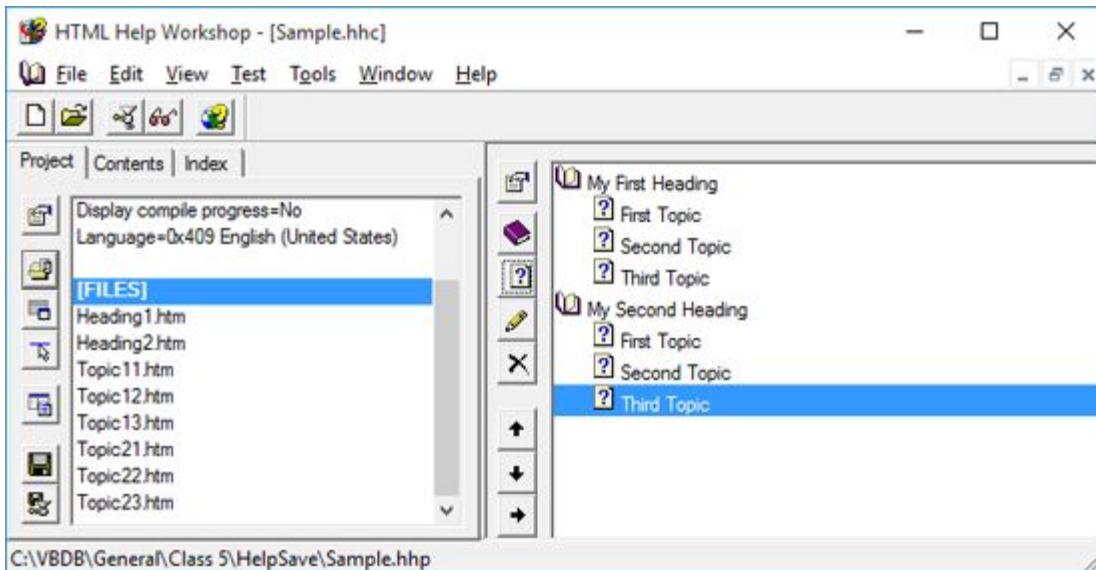


We first need to add our topic files. To do this, choose the **Add/remove topic files** toolbar button. In the window that appears, click **Add**, then select all topics files. You should see:

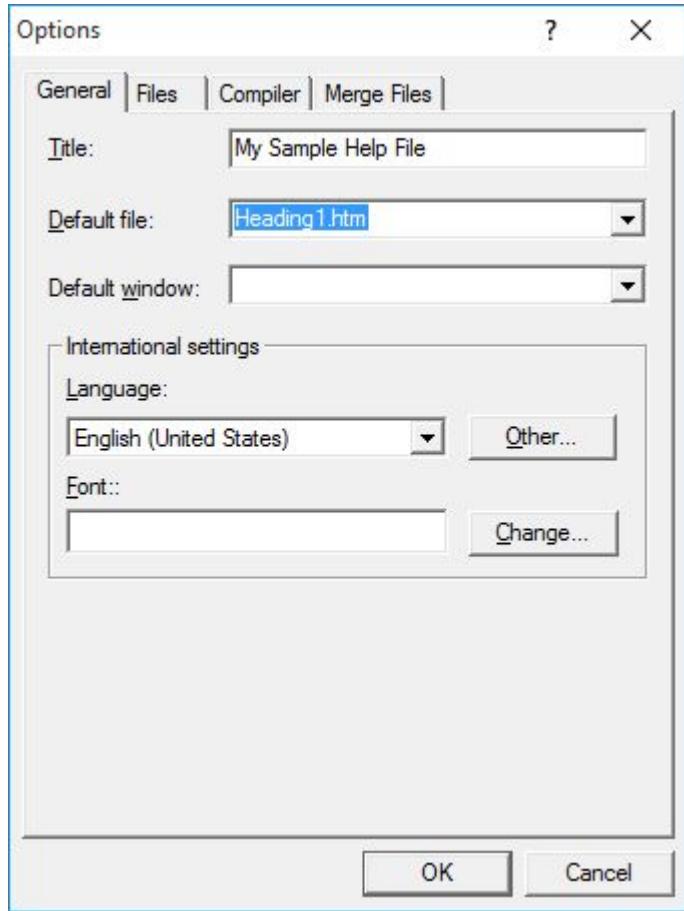


Click OK.

Now, the project file has the topic files added:



Now, we specify the **Table of Contents** file and set a few other properties. Click the **Change project options** toolbar button. Click the **General** tab and type a title for your help system (I used **My Sample Help File**) and specify the default file (**Heading1.htm**):

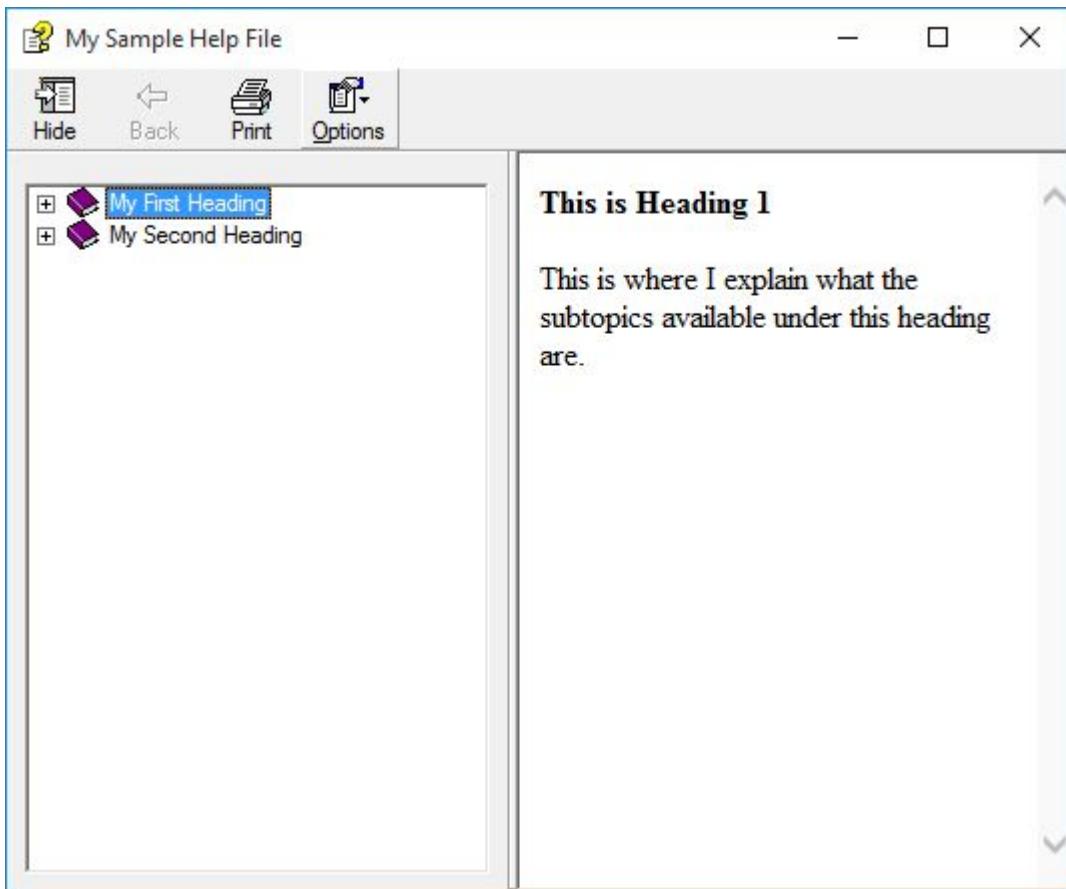


Click on the **Files** tab and select **Sample.hhc** as your contents file. Click **OK** to complete specification of your project file. At this point, save all files by choosing **Save Project** under the **File** menu.

We can now compile our project into the finished product - a complete HTML help system. To do this, click the **Compile HTML file** button (resembles a meat grinder) on the workshop toolbar. Browse so your project file (**Sample.hhp**) is selected. Choose **Compile** in the resulting window and things start 'grinding.' If no errors are reported, you should now have a **CHM** file in your directory. If errors did occur, you need to fix any reported problems.

At long last, we can view our finished product. Click on the **View compiled file** button (a pair of sunglasses) on the workshop toolbar. Browse so your help file (**Sample.chm**) is selected. Choose **View**,

and this will appear (I've expanded the headings to show the topics):



Click to see the various topics and headings displayed.

After all this work, you still only have a simple help file, nothing that rivals those seen in most applications. But, it is a very adequate help system. To improve your help system, you need to add more features. Investigate the HTML Help Workshop for information on tasks such as adding an index file, using context-sensitive help, adding search capabilities and adding graphics to the help system.

HelpProvider Control



Once we have a completed HTML help system, we need to connect our Visual C# application to the help file. You need to decide how you want your application to interact with the help system. We will demonstrate a simple approach. We will have the help system appear when the user presses <F1> or clicks some control related to obtaining help (menu item, button control). The Visual C# **HelpProvider** control provides this connection.

HelpProvider Properties:

Name	Gets or sets the name of the help provider control (three letter prefix for label name is hlp).
HelpNamespace	Complete path to compiled help file (CHM file)

The **HelpNamespace** property is usually established at run-time. The help file is often installed in the application directory (**Bin\Debug** folder). If this is the case, we can use the **Application.StartupPath** parameter to establish **HelpNamespace**. You also must include the help file in any deployment package you build for your application.

To have the help file appear when a user presses <F1>, we set the **HelpNavigator** property of the application form to **TableofContents**. With this setting, the help file will appear displaying the **Table of Contents**, set to the default form.

To have the help file appear in a **Click** event, we use the **ShowHelp** method of the **Help** object. The Visual C# **Help** object allows us to

display HTML help files. To replicate the <F1> functionality above, we use the syntax:

```
Help.ShowHelp(this, HelpProvider.HelpNamespace);
```

This line of code will display the specified help file.

Typical use of **HelpProvider** control:

- Set the **Name** property.
- Set **HelpNameSpace** property in code (file is usually in **Bin** folder of application).
- Set **HelpNavigator** property for form to **TableofContents**.
- Write code for events meant to display the help file (use **Help.ShowHelp**).

The steps above provide minimal, but sufficient, access to an HTML help system. If you need more functionality (context-sensitive help, help on individual controls, pop-up help, adding help to dialog boxes), consult the Visual C# documentation on the **Help Provider** control.

Example 5-8

Authors Table Input Form (On-Line Help)

We will build a simple help system for our Authors Table Input Form and attach it to our application. Refer back to the notes to complete each step listed here.

1. Using FrontPage or similar product, prepare a single topic file (saved as **authors.htm** in the **VCSDB\Code\Class 5\Example 5-8\HelpFile** folder):

Authors Input Form

Available options for managing Authors database table:

Add New Record

Click the **Add New** button to add a record to the Authors database. Type in the Author Name (required), then Year Born (optional). Click **Save** to save the new record; click **Cancel** to ignore the new record.

Edit Record

Click the **Edit** button to edit the displayed record. Make any needed changes. The Author Name is required and the Year Born is optional. Click **Save** to save the changes; click **Cancel** to ignore the changes.

Delete Record

Click the **Delete** button to delete the displayed record.

Exit Program

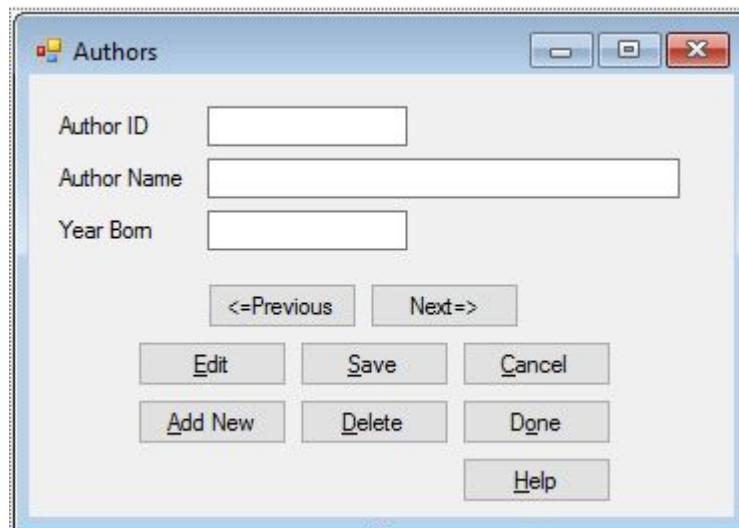
Click the **Done** button to quit the application.

2. Using HTML Help Workshop, build a help project file, adding the topic file (no contents file) (**authors.hhp** in the **VCSDB\Code\Class 5\Example 5-8\HelpFile** folder).
3. Using HTML Help Workshop, compile and build the project file (**authors.chm** in the **VCSDB\Code\Class 5\Example 5-8\HelpFile** folder).
4. Copy **authors.chm** to your application's **Bin\Debug** folder (you may have to create the folder first).
5. Load Example 5-7 completed earlier. We will modify this example to include our help system. Add a help provider control to the project - name it **hlpAuthors**. Set the **HelpNavigator** property of **frmAuthors** to **TableofContents**.
6. Add the shaded code near the top of the **frmAuthors_Load** method. This code points to the help file in the project's application folder:

```
private void frmAuthors_Load(object sender, EventArgs e)
{
    try
    {
        // point to help file
        hlpAuthors.HelpNamespace =
            Application.StartupPath + "\\authors.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        // establish command object
```

•
•
•
}

7. Add a button to the form. Assign a **Text** of **&Help** and a **Name** of **btnHelp**. The form now looks like this:



8. Use this code in the **btnHelp_Click** event to display the help file:

```
private void btnHelp_Click(object sender, EventArgs e)
{
    Help.ShowHelp(this, hlpAuthors.HelpNamespace);
}
```

9. Save (saved in the **Example 5-8** folder in **VCSDB\Code\Class 5** folder) and run the application. Press **<F1>** or click **Help**. With either, you should see the help file:



Help

-

□

X

Authors Input Form

Available options for managing Authors database table:

Add New Record

Click the Add New button to add a record to the Authors database. Type in the Author Name (required), then Year Born (optional). Click Save to save the new record; click Cancel to ignore the new record.

Edit Record

Click the Edit button to edit the displayed record. Make any needed changes. The Author Name is required and the Year Born is optional. Click Save to save the changes; click Cancel to ignore the changes.

[Delete Record](#)

Example 5-8

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Application Testing

Our discussion of Visual C# interface design has, for now, come to an end. And, we have a fairly complete interface for the books database Authors table. We, obviously, still need the remainder of the code that goes behind the buttons. We'll do that in the next chapter.

Once you have completed an application, you need to test it to make sure it performs as expected. If you are careful in building your application, no big surprises should appear in this final testing. In fact, the Visual C# environment helps achieve this goal. The event-driven nature of Visual C# makes it easy to build an application in stages, testing and debugging each stage as it is built. In other words, you don't have to have a complete application before testing can begin. We have done this with the Authors table example.

The event-driven nature of Visual C# also makes it easy to modify an application. We will see in Chapter 6, as we modify the books database example, that we have made some omissions and errors in our design. But these omissions and errors will be easily corrected using the Visual C# environment. These corrections will give you additional insight into application building and testing process.

Let others (particularly potential users) try your application and see if its use is as obvious as you planned it to be. Are the inputs and outputs of the project appropriate? Is application state clear? Implement and retest any necessary changes, based on user feedback. And, keep track of all feedback after you 'release' your application. This information can be used in future updates of your product.

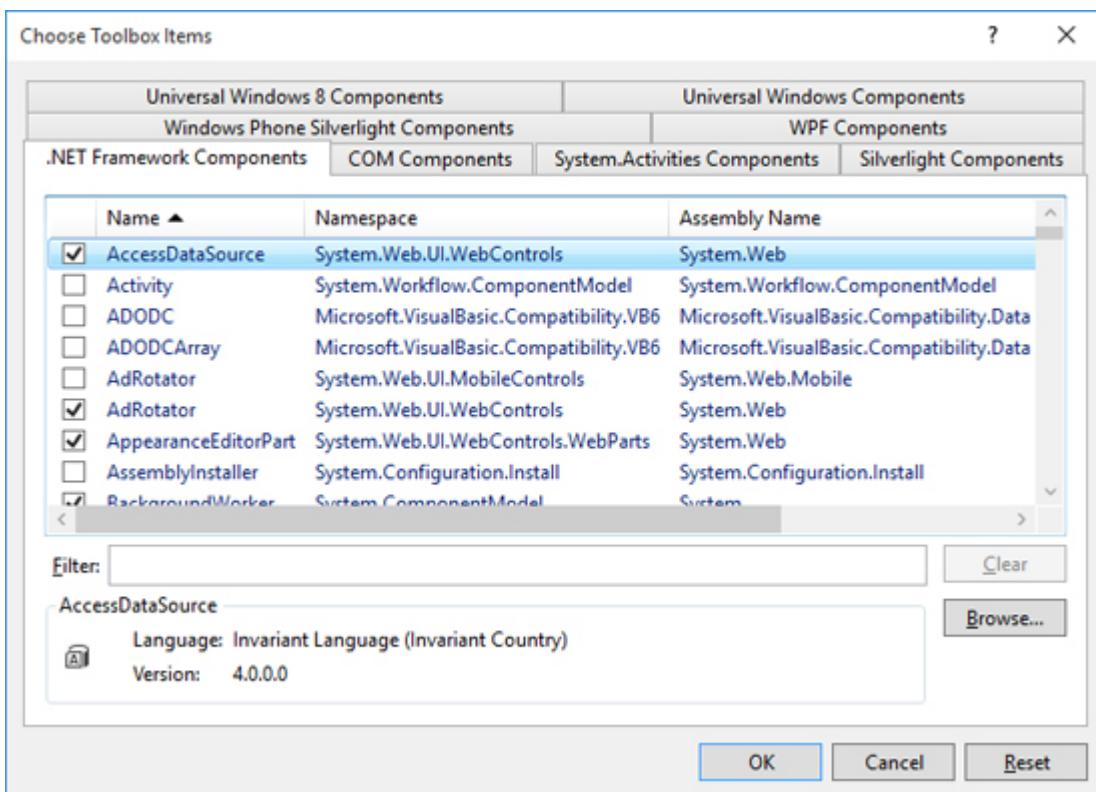
Before leaving this chapter, let's look at some other Visual C# controls that you might like to use in your database interface

arsenal.

Other Controls

In addition to the standard Visual C# controls discussed earlier in this chapter, there are many **other controls** that can be used to build a database interface. If not in the toolbox, these controls will have to be added to the Visual C# toolbox before they can be used.

To load a control, make sure the toolbox is visible in the development environment. Choose **Choose Toolbox Items** from the **Visual C# Tools** menu. Select **.NET Framework Components** in the resulting dialog:



To add a control or controls, select the check box next to the desired selection(s). When done, choose **OK** and the selected control(s) will now appear in the toolbox. The Visual C# on-line help system can provide details for usage.

Here, we look at several other controls (some data bound, some not) and how they can be used with a Visual C# interface.

MaskedTextBox Control



The **masked text box control** is a data bound control used to prompt users for data input using a mask pattern. It works like a text box, but the mask allows you to specify exactly the desired input format. In a **database**, this control could be used to prompt for a date, a time, number, or currency value. Or it could be used to prompt for something that follows a pattern, like a phone number or social security number. Use of this control can eliminate many of the entry validation problems mentioned earlier in the chapter. If needed, to load this control into the toolbox, select **MaskedTextBox** from the **.NET Framework Components** dialog box.

Masked Text Box Properties:

Mask	Determines the type of information that is input into the control. It uses characters to define the type of input. Check on-line help for mask formatting.
PromptChar	Character used for missing information.
Text	Contains data entered into the control (including all prompt characters of the input mask). This is the property bound to the database.
TextMaskFormat	Used to indicate if the Text property includes literal and prompts used.

Masked Text Box Events:

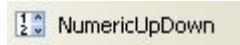
Leave	Event called when the user leaves the control.
LostFocus	Event called when control loses focus.
MaskInputRejected	Event called when the data being entered by the user does not match the input mask.

Typical use of **MaskedTextBox** control:

- Set the **Name** property. Initialize **Text** property to desired string. Set **Mask** property.
- In code, give **Focus** to control when needed. Read **Text** property when **Leave** event occurs.
- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

This control features built-in input validation to lessen your tasks as a programmer. We will use the masked edit control in some of our example applications in later chapters.

NumericUpDown Control



The **NumericUpDown** control is used to obtain a numeric input. It looks like a text box control with two small arrows. Clicking the arrows changes the displayed value, which ranges from a specified minimum to a specified maximum. The user can even type in a value, if desired. Such controls are useful for supplying a date in a month or are used as volume controls in some Windows multimedia applications.

NumericUpDown Properties:

Name	Gets or sets the name of the numeric updown (three letter prefix for numeric updown name is nud).
BackColor	Get or sets the numeric updown background color.
BorderStyle	Gets or sets the border style for the updown control.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
Increment	Gets or sets the value to increment or decrement the updown control when the up or down buttons are clicked.
Maximum	Gets or sets the maximum value for the updown control.
Minimum	Gets or sets the minimum value for the updown control.
ReadOnly	Gets or sets a value indicating whether the text may be changed by the use of

	the up or down buttons only.
TextAlign	Gets or sets the alignment of text in the numeric updown.
Value	Gets or sets the value assigned to the updown control.

NumericUpDown Methods:

DownButton	Decrements the value of the updown control.
UpButton	Increments the value of the updown control.

NumericUpDown Events:

Leave	Occurs when the updown control loses focus.
ValueChanged	Occurs when the Value property has been changed in some way.

The **Value** property can be changed by clicking either of the arrows or, optionally by typing a value. If using the arrows, the value will always lie between **Minimum** and **Maximum**. If the user can type in a value, you have no control over what value is typed. However, once the control loses focus, the typed value will be compared to **Minimum** and **Maximum** and any adjustments made. Hence, if you allow typed values, only check the **Value** property in the **Leave** event.

Typical use of NumericUpDown control:

- Set the **Name**, **Minimum** and **Maximum** properties. Initialize **Value** property. Decide on value for **ReadOnly**.
- Monitor **ValueChanged** (or **Leave**) event for changes in **Value**.

- You may also want to change the **Font**, **Backcolor** and **Forecolor** properties.

The NumericUpDown control is a ‘point-and-click’ type control that can be used in place of a user’s typed input. We will use the NumericUpDown control in some of our example applications in later chapters.

TabControl Control



The **TabControl** control provides an easy way to present several dialogs or screens of information on a single form. This is the same interface seen in many commercial Windows applications. The tab control provides a group of tabs, each of which acts as a container (works just like a group box or panel) for other controls. In particular, groups of radio buttons within a tab ‘page’ operate as an independent group. Only one tab can be active at a time. Using this control is easy. Just build each tab container as a separate group: add controls, set properties, and write code like you do for any application. Navigation from one tab to the next is simple: just click on the corresponding tab.

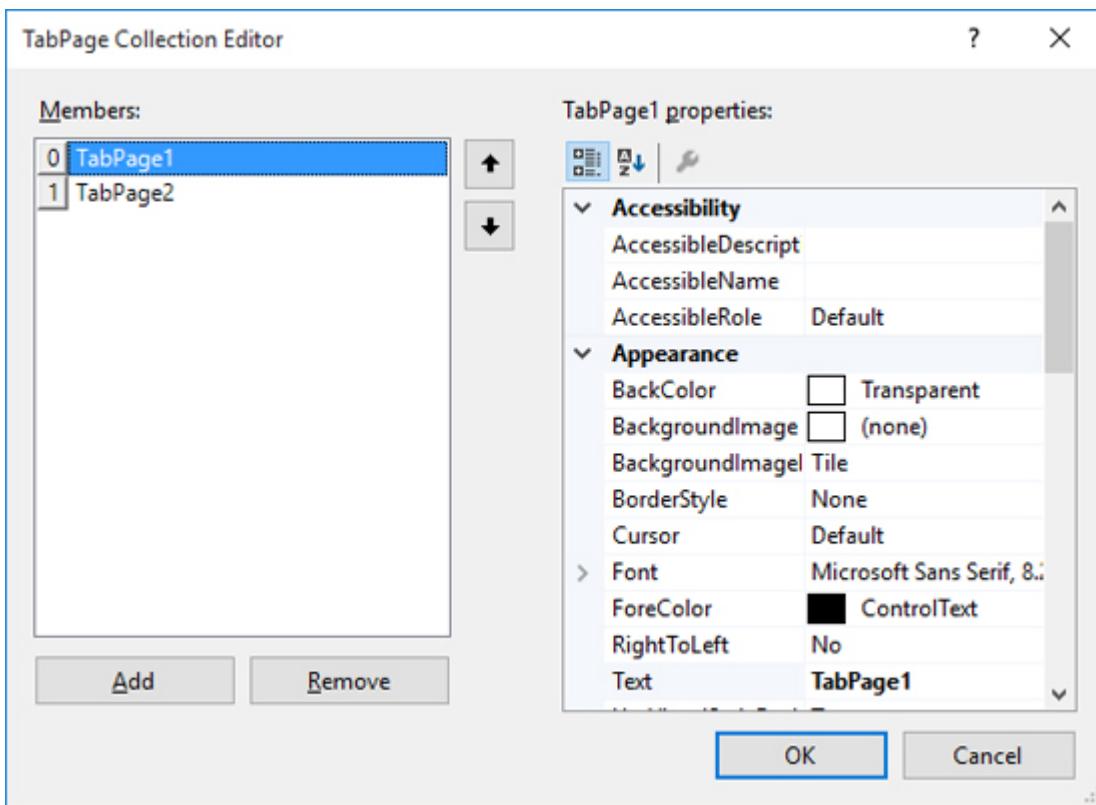
TabControl Properties:

Name	Gets or sets the name of the tab control (three letter prefix for control name is tab).
BackColor	Get or sets the tab control background color.
BorderStyle	Gets or sets the border style for the tab control.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
ItemSize	Size structure determining tab size.
SelectedIndex	Gets or sets the currently displayed tab index.
SizeMode	Determines how tabs are sized.
TabPages	Collection describing each tab page.

TabControl Events:

SelectedIndexChanged Occurs when the **SelectedIndex** property changes.

The most important property for the tab control is **TabPage**s. It is used to design each tab (known as a **TabPage**). Choosing the **TabPage**s property in the Properties window and clicking the ellipsis that appears will display the **TabPage Collection Editor**. With this editor, you can add, delete, insert and move tab pages. To add a tab page, click the **Add** button. A name and index will be assigned to a tab. There are two tabs added initially so the editor appears like this:



Add as many tab pages as you like. The tab page ‘array’ is zero-based; hence, if you have N tabs, the first is index 0, the last index N - 1. You can change any property you desire in the **Properties** area.

TabPage Properties:

Name	Gets or sets the name of the tab page (three letter prefix for control name is tab).
BackColor	Get or sets the tab page background color.
BorderStyle	Gets or sets the border style for the tab page.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
Text	Titling information appearing on tab.

When done, click **OK** to leave the TabPage Collection Editor.

The next step is to add controls to each ‘page’ of the tab control. This is straightforward. Simply display the desired tab page by clicking on the tab. Then place controls on the tab page, treating the page like a group box or panel control. Make sure your controls become ‘attached’ to the tab page. You can still place controls on the form that are not associated with any tab. As the programmer, you need to know which tab is active (**SelectedIndex** property). And, you need to keep track of which controls are available with each tab page.

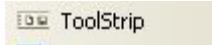
Typical use of **TabControl** control:

- Set the **Name** property and size appropriately.
- Establish each tab page using the **TabPage Collection Editor**.
- Add controls to tabs and form.
- Write code for the various events associated with controls on the tab control and form.

The tab control is becoming a very popular control in Windows applications. It allows you to put a lot of ‘input power’ into a single

form - minimizing the need for multi-form applications. We will use the tab control in a Weather Monitor example in Chapter 10.

ToolStrip (Toolbar) Control



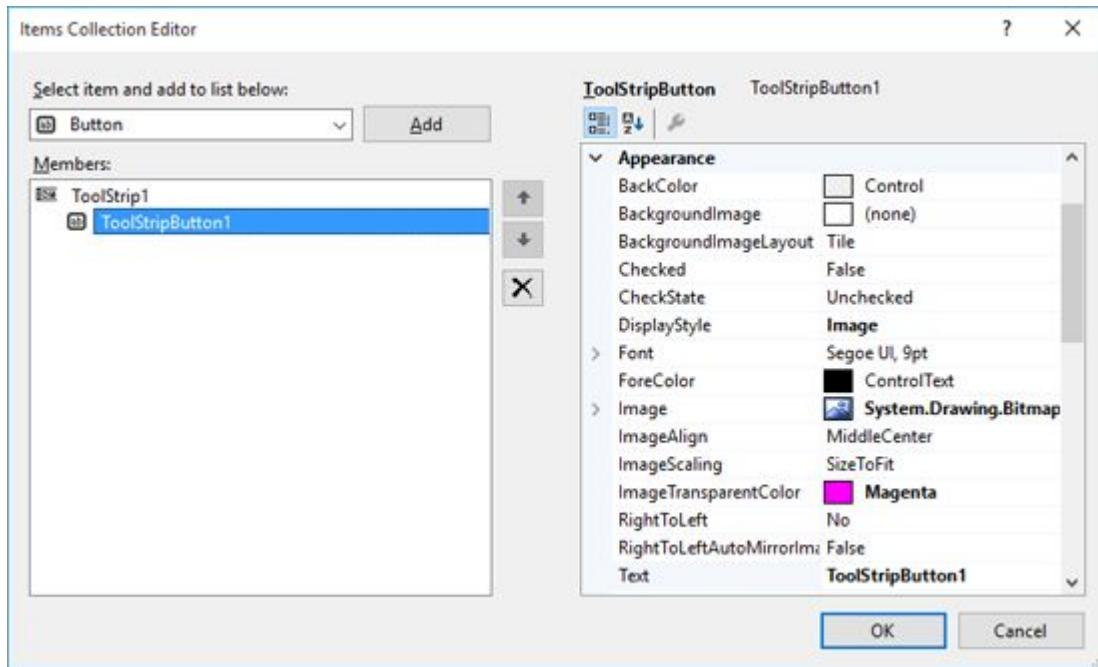
Almost all Windows applications these days use toolbars. A toolbar provides quick access to the most frequently used menu commands in an application. In a database application, it could be used to add, delete, or edit records. It could be used to access database reports or obtain different database views. The **ToolStrip** control (also referred to as the **Toolbar** control) is a mini-application in itself. It provides everything you need to design and implement a toolbar into your application. Possible uses for this control include: provide a consistent interface between applications with matching toolbars, place commonly used functions in an easily-accessed space and provide an intuitive, graphical interface for your application.

ToolStrip Properties:

Name	Gets or sets the name of the toolStrip (toolbar) control (three letter prefix for label name is tlb).
BackColor	Background color of toolStrip.
Items	Gets the collection of controls assigned to the toolStrip control.
LayoutStyle	Establishes whether toolbar is vertical or horizontal.
Dock	Establishes location of toolbar on form.

The primary property of concern is the **Items** collection. This establishes each item in the toolbar. Choosing the **Items** property in the Properties window and clicking the ellipsis that appears will

display the **Items Collection Editor**. With this editor, you can add, delete, insert and move items. We will look at adding just two types of items: **ToolStripButton** and **ToolStripSeparator** (used to separate tool bar buttons). To add a button, make sure **ToolStripButton** appears in the drop-down box and click the Add button. A name will be assigned to a button. After adding one button, the editor will look like this:



Add as many buttons as you like. You can change any property you desire in the **Properties** area.

ToolStripButton Properties:

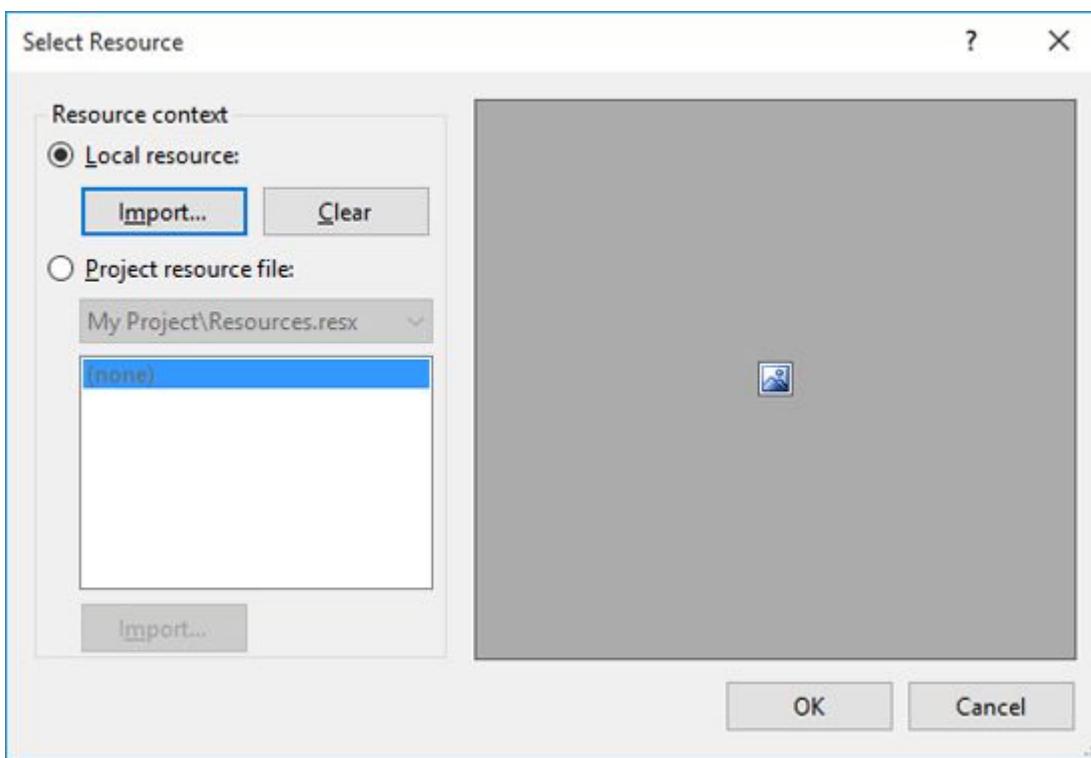
Name	Gets or sets the name of the button (three letter prefix for control name is tlb).
DisplayStyle	Sets whether image, text or both are displayed on button.
Image	Image to display on button.
Text	Caption information on the button, often blank.

TextImageRelation Where text appears relative to image.

ToolTipText Text to display in button tool tip.

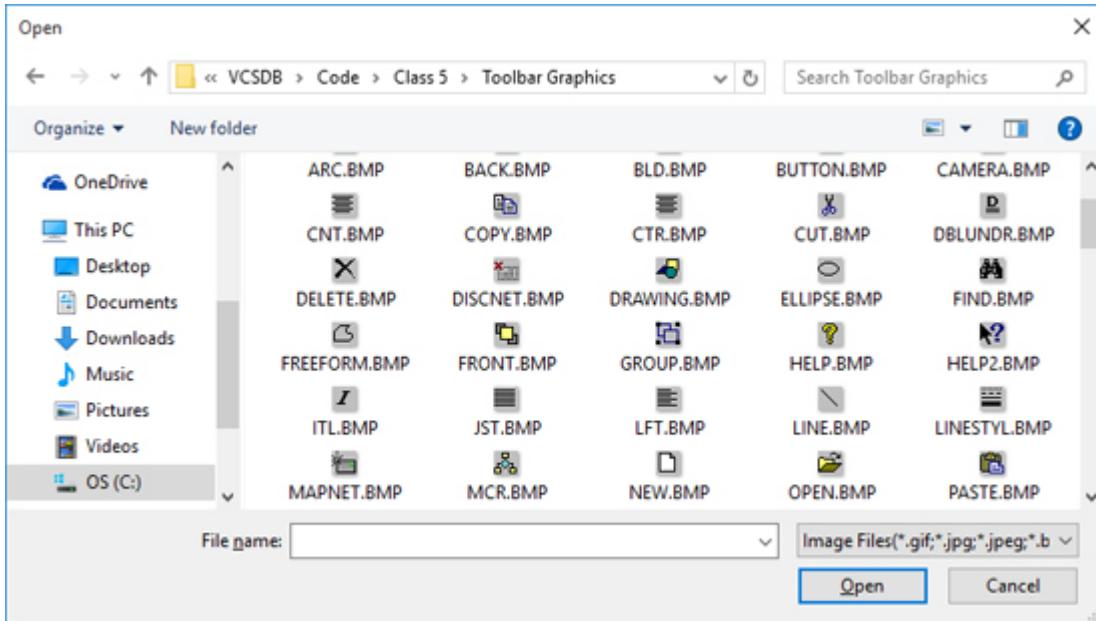
To add a separator, make sure **ToolStripSeparator** appears in drop-down box and click **Add**. When done editing buttons, click **OK** to leave the Items Collection Editor.

Setting the **Image** property requires a few steps (a process similar to that used for the picture box control). First, click the ellipsis next to the **Image** property in the property window. This **Select Resource** window will appear:



The images will be a local resource, so select the **Local resource** radio button and click the **Import** button.

An **Open** window will display graphics files (if you want to see an **ico** file, you must change **Files of type** to **All Files**). In the **VCSDB\Code\Class 5** folder is a folder named **Toolbar Graphics**. In this folder, there are many bitmap files for toolbar use:



Select the desired file and click **Open**. Once an image is selected, click **OK** in the **Select Resource** window. It will be assigned to the **Image** property

After setting up the toolbar, you need to write code for the **Click** event for each toolbar button. This event is the same **Click** event we encounter for button controls.

Typical use of **ToolStrip** control:

- Set the **Name** property and desired location.
- Decide on image, text, and tooltip text for each button.
- Establish each button/sePARATOR using the **Items Collection Editor**.
- Write code for the each toolbar button's **Click** event.

The toolbar is a very powerful and professional tool. And, it's easy to implement and use. Try to use it whenever it fits the design of your interface.

ListBox Control



A **ListBox** control displays a list of items (with as many items as you like) from which the user can select one or more items. If the number of items exceeds the number that can be displayed, a scroll bar is automatically added. Both single item and multiple item selections are supported. For database applications, you can display multiple rows of data (a given field) in the same control (see the **DataSource** and **DisplayMember** properties).

ListBox Properties:

Name	Gets or sets the name of the list box (three letter prefix for list box name is Ist).
BackColor	Get or sets the list box background color.
DataSource	Data table to bind control to.
DisplayMember	Field from data source to display.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text.
Items	Gets the Items object of the list box.
SelectedIndex	Gets or sets the zero-based index of the currently selected item in a list box.
SelectedIndices	Zero-based array of indices of all currently selected items in the list box.
SelectedItem	Gets or sets the currently selected item in the list box.
SelectedItems	SelectedItems object of the list box.
SelectedValue	The value provided by/to the

	ValueMember for data binding.
SelectionMode	Gets or sets the method in which items are selected in list box (allows single or multiple selections).
Sorted	Gets or sets a value indicating whether the items in list box are sorted alphabetically.
Text	Text of currently selected item in list box.
TopIndex	Gets or sets the index of the first visible item in list box.
ValueMember	The data source field corresponding to same record shown by DisplayMember.

ListBox Methods:

ClearSelected	Unselects all items in the list box.
FindString	Finds the first item in the list box that starts with the specified string.
GetSelected	Returns a value indicating whether the specified item is selected.
SetSelected	Selects or clears the selection for the specified item in a list box.

ListBox Events:

SelectedIndexChanged	Occurs when the SelectedIndex property has changed.
-----------------------------	---

One use for the data bound list control is to fill the list (**DisplayMember**) from a database table (**DataSource**), then allow selections. This allows us to list all values of a particular field in a database table. The selections can be used by any control on a form, whether it is data bound or not. For the **BooksDB.accdb**

database **Authors** table we've been using, if we display the **Author** field, a list box will show:



More complex data binding (using the **SelectedValue** and **ValueMember** properties) is possible. We will look at this complex binding as we develop a management system for the books database in later chapters (see Example 6-9).

Some further discussion is need to use the list box **Items** object, **SelectedItems** object and **SelectionMode** property. The **Items** object has its own properties to specify the items in the list box. It also has its own methods for adding and deleting items in the list box. The **Items** object is a zero-based array of the items in the list and **Count** (a property of **Items**) is the number of items in the list. Hence, the first item in a list box named **IstExample** is:

```
lstExample.Items[0]
```

The last item in the list is:

```
lstExample.Items[lstExample.Items.Count - 1]
```

The minus one is needed because of the zero-based array.

To add an item to a list box, use the **Add** method, to delete an item, use the **Remove** or **RemoveAt** method and to clear a list box

use the **Clear** method. For our example list box, the respective commands are:

```
Add 1stExample.Items.Add(ItemToAdd)
Item:
Delete 1stExample.Items.Remove(ItemToRemove)
Item:
    1stExample.Items.RemoveAt(IndexofItemToRemove)
Clear 1stExample.Items.Clear
list
box:
```

List boxes normally list string data types, though other types are possible. Note, when removing items, that indices for subsequent items in the list change following a removal.

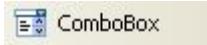
In a similar fashion, the **SelectedItems** object has its own properties to specify the currently selected items in the list box. Of particular use is **Count** which tells you how many items are selected. This value, in conjunction with the **SelectedIndices** array, identifies the set of selected items.

The **SelectionMode** property specifies whether you want single item selection or multiple selections. When the property is **SelectionMode.One**, you can select only one item (works like a group of radio buttons). When the **SelectionMode** property is set to **SelectionMode.MultiExtended**, pressing <Shift> and clicking the mouse or pressing <Shift> and one of the arrow keys extends the selection from the previously selected item to the current item. Pressing <Ctrl> and clicking the mouse selects or deselects an item in the list. When the property is set to **SelectionMode.MultiSimple**, a mouse click or pressing the spacebar selects or deselects an item in the list.

Typical use of **ListBox** control:

- Set **Name** property, **SelectionMode** property and populate **Items** object (usually in **Form_Load** method).
- If using with database, set **DataSource** property to desired data table and **DisplayMember** property to corresponding data table field.
- Monitor **SelectedIndexChanged** event for individual selections.
- Use **SelectedIndex** and **SelectIndices** properties to determine selected items.

ComboBox Control



The **combo box control** is nearly identical to the list box, hence we won't look at a separate set of properties or another example. A primary difference between the two controls is the way data is displayed - the combo control has a list box portion and a text box portion that displays the selected item. And, with the combo control, the user is (optionally) given the opportunity to type in a choice not in the list box.

As mentioned, data display is different with the combo control. Display is established by the **DropDownStyle** property:

Style	Description
DropDown	Drop-down list box, user can change selection
Simple	Displayed list box, user can change selection
DropDownList	Drop-down list box, user cannot change selection

When using the **Simple** style, make sure you sufficiently size the control (so the list box portion appears) when it is placed on the form.

Typical use of **ComboBox** control:

- Set **Name** property, **DropDownStyle** property and populate **Items** object (usually in **Form_Load** method).
- If using with database, set **DataSource** property to desired data table and **DisplayMember** property to corresponding data table field.

- Monitor **SelectedIndexChanged** event for individual selections.
- Use **SelectedIndex** or **Text** properties to determine selected item.

When should you use the combo control instead of the list box control? The combo control is an excellent data entry control. Its advantage over the list box is that it provides experienced users the ability to type in values they know are correct, speeding up the data entry process. The list box control does not allow any typing. It is also a good control when you are short on form space. Using the **DropDownList** style replicates the functionality of the list box control without needing space for the list box.

DataGridView Control



The **data grid view control** tool is one of the most useful data bound controls. It can display an entire database table. The table can then be edited as desired. Recall we used this control in our SQL Tester program in Chapter 4.

The data bound grid control is in a class by itself, when considering its capabilities. It is essentially a separate, highly functional program. It has one primary property:

DataSource Name of the data table to display.

The data grid view control is a collection of **DataColumn** objects, corresponding to fields in the table, and **DataRow** objects, corresponding to records. Cells can be accessed and edited via mouse operations or programmatically.

For the books database, if we display the **Authors** table (**DataSource** property) we've been using in a data grid view, we will see:

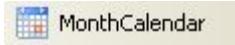
	Au_ID	Author	Year Born
▶	14437	Aaron, Alex	
	9955	Aaron, Bud	
	11165	Aarts, Jan	
	10143	Abas, S.J.	
	3293	Abbey, Michael	
	3125	Abdelguerfi, Mahdi	
	3887	Abel, David	
	1100	Abel, Della	

Typical use of **DataGridView** control:

- Set **Name** property.
- Set **DataSource** property to desired data table.
- Add any desired editing features.

You are encouraged to further study the data grid view control (properties, events, methods) as you progress in your database studies. We will use it in applications studied in later chapters.

MonthCalendar Control



The **MonthCalendar** control allows a user to select a date. It is a very easy to use interface - just point and click. This control is useful for ordering information, making reservations or choosing the current date. It can be used to select a single date or a range of dates.

MonthCalendar Properties:

Name	Gets or sets the name of the month calendar (three letter prefix for label name is cal).
BackColor	Get or sets the month calendar background color.
CalendarDimensions	Gets or sets the number of columns and rows of months displayed.
FirstDayOfWeek	Gets or sets the first day of the week as displayed in the month calendar.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
MaxDate	Gets or sets the maximum allowable date.
MaxSelectionCount	The maximum number of days that can be selected in a month calendar control.
MinDate	Gets or sets the minimum allowable date.
SelectionEnd	Gets or sets the end date of the selected range of dates.

SelectionRange	Retrieves the selected range of dates for a month calendar control.
SelectionStart	Gets or sets the start date of the selected range of dates.
ShowToday	Gets or sets a value indicating whether the date represented by the TodayDate property is shown at the bottom of the control.
ShowTodayCircle	Gets or sets a value indicating whether today's date is circled.
TodayDate	Gets or sets the value that is used by MonthCalendar as today's date.

MonthCalendar Methods:

SetDate Sets date as the current selected date.

MonthCalendar Events:

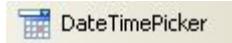
DateChanged Occurs when the date in the MonthCalendar changes.

DateSelected Occurs when a date is selected.

Typical use of MonthCalendar control:

- Set the **Name** property. Set **MaxSelectionCount** (set to 1 if just picking a single date).
- Monitor **DateChanged** and/or **DateSelected** events to determine date value(s). Values are between **SelectionStart** and **SelectionEnd** properties.

DateTImePicker Control



The **DateTimePicker** control works like the MonthCalendar control with a different interface and formatting options. It allows the user to select a single date. The selected date appears in a combo box. The calendar portion is available as a ‘drop down.’ This control can also be used to select a time; we won’t look at that option.

DateTimePicker Properties:

Name	Gets or sets the name of the date/time picker control (three letter prefix for label name is dtp).
BackColor	Get or sets the control background color.
Font	Gets or sets font name, style, size.
ForeColor	Gets or sets color of text or graphics.
Format	Gets or sets the format of the date displayed in the control.
MaxDate	Gets or sets the maximum allowable date.
MinDate	Gets or sets the minimum allowable date.
Value	Gets or sets the date value assigned to the control.

DateTimePicker Events:

ValueChanged	Occurs when the Value property changes.
---------------------	--

Typical use of DateTimePicker control:

- Set the **Name** and **Format** properties.
- When needed, read **Value** property for selected date.

OpenFileDialog Control



In all examples studied in this course, the database name has been assumed to be known at design time (before running the application). There will be times when this is not true. For example, say a schoolteacher uses a database application to keep track of grades. There will database files for each class. When the teacher starts the application, he or she needs to specify which particular database file is being accessed and that file needs to be opened at run-time. Not only do we need the capability to open a user specified file, but we also need to be able to save database files with user specified names.

What we need from the user, whether opening or saving files is a complete path to the filename of interest. We could provide a text box and ask the user to type the path, but that's only asking for trouble. We would have to validate existence of drives, directories, and files! Fortunately, we can use the Windows standard interface for working with files. Visual C# provides this interface through the **common dialog controls**. These controls display the same interface you see when opening or saving a file in any Windows application. Such an interface is familiar to any Windows user and gives your application a professional look. And, some context-sensitive help is available while the interface is displayed. Let's look first at the **open file dialog control**.

OpenFileDialog Properties:

Name	Gets or sets the name of the open file dialog (I usually name this control <code>dlgOpen</code>).
-------------	--

AddExtension	Gets or sets a value indicating whether the dialog box automatically adds an extension to a file name if the user omits the extension.
CheckFileExists	Gets or sets a value indicating whether the dialog box displays a warning if the user specifies a file name that does not exist.
CheckPathExists	Gets or sets a value indicating whether the dialog box displays a warning if the user specifies a path that does not exist.
DefaultExt	Gets or sets the default file extension.
FileName	Gets or sets a string containing the file name selected in the file dialog box.
Filter	Gets or sets the current file name filter string, which determines the choices that appear in "Files of type" box.
FilterIndex	Gets or sets the index of the filter currently selected in the file dialog box.
InitialDirectory	Gets or sets the initial directory displayed by the file dialog box.
Title	Gets or sets the file dialog box title.

OpenFileDialog Methods:

ShowDialog	Displays the dialog box. Returned value indicates which button was clicked by user (OK or Cancel).
-------------------	--

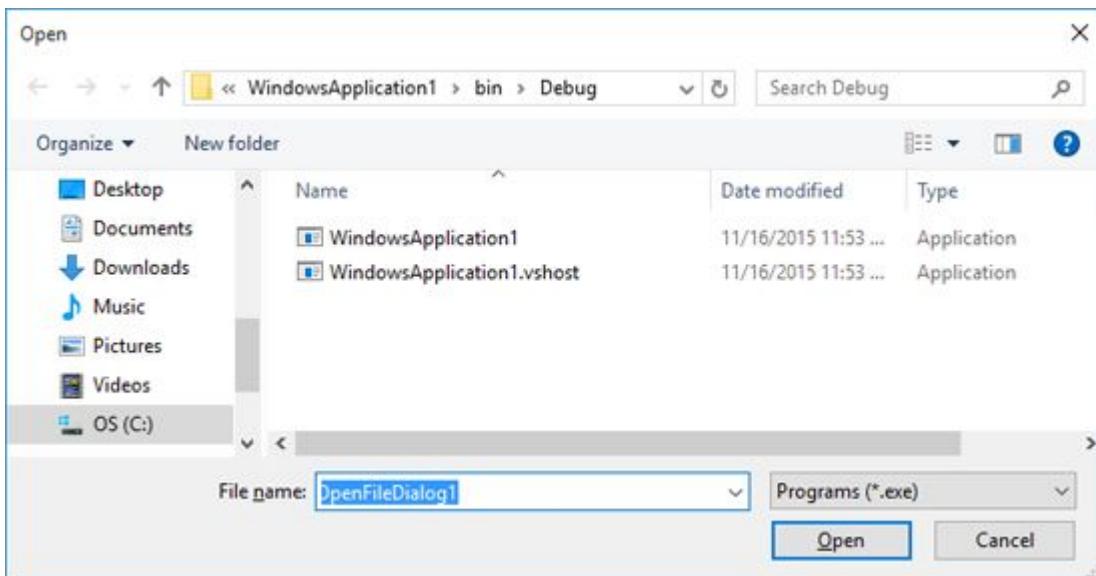
To use the **OpenFileDialog** control, we add it to our application the same as any control. Since the **OpenFileDialog** control has no immediate user interface (you control when it appears), the control does not appear on the form at design time. Such Visual C# appear in a ‘tray’ below the form in the IDE Design window. Once added, we set a few properties. Then, we write code to make the

dialog box appear when desired. The user then makes selections and closes the dialog box. At this point, we use the provided information for our tasks.

The **ShowDialog** method is used to display the **OpenFileDialog** control. For a control named **dlgOpen**, the appropriate code is:

```
dlgOpen.ShowDialog();
```

And the displayed dialog box is similar to this:



The user selects a file using the dialog control (or types a name in the **File name** box). The file type is selected from the **Files of type** box (values here set with the **Filter** property). Once selected, the **Open** button is clicked. **Cancel** can be clicked to cancel the open operation. The **ShowDialog** method returns the clicked button. It returns **DialogResult.OK** if **Open** is clicked and returns **DialogResult.Cancel** if **Cancel** is clicked. The nice thing about this control is that it can validate the file name before it is returned to the application. The **FileName** property contains the complete path to the selected file.

Typical use of **OpenFileDialog** control:

- Set the **Name**, **Filter**, and **Title** properties.
- Use **ShowDialog** method to display dialog box.
- Read **FileName** property to determine selected file

SaveFileDialog Control



To obtain a file name for saving we use the **SaveFileDialog** control. This control insures that any path selected for saving a file exists and that if an existing file is selected, the user has agreed to overwriting that file.

SaveFileDialog Properties:

Name	Gets or sets the name of the save file dialog (I usually name this control dIgSave).
AddExtension	Indicates whether the dialog box automatically adds an extension to a file name if the user omits the extension.
CheckFileExists	Indicates whether the whether the dialog box displays a warning if the user specifies a file name that does not exist. Useful if you want the user to save to an existing file.
CheckPathExists	Indicates whether the dialog box displays a warning if the user specifies a path that does not exist.
CreatePrompt	Indicates whether the dialog box prompts the user for permission to create a file if the user specifies a file that does not exist.
DefaultExt	Gets or sets the default file extension.
FileName	Gets or sets a string containing the file name selected in the file dialog box.

Filter	Gets or sets the current file name filter string, which determines the choices that appear in "Files of type" box.
FilterIndex	Gets or sets the index of the filter currently selected in the file dialog box.
InitialDirectory	Gets or sets the initial directory displayed by the file dialog box.
OverwritePrompt	Indicates whether the dialog box displays a warning if the user specifies a file name that already exists. Default value is True.
Title	Gets or sets the file dialog box title.

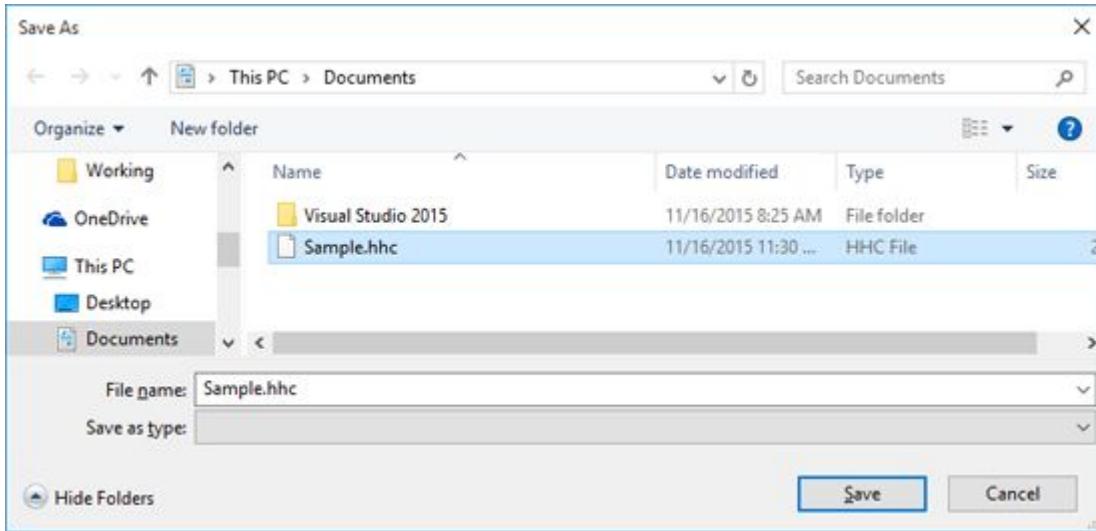
SaveFileDialog Methods:

ShowDialog	Displays the dialog box. Returned value indicates which button was clicked by user (OK or Cancel).
-------------------	--

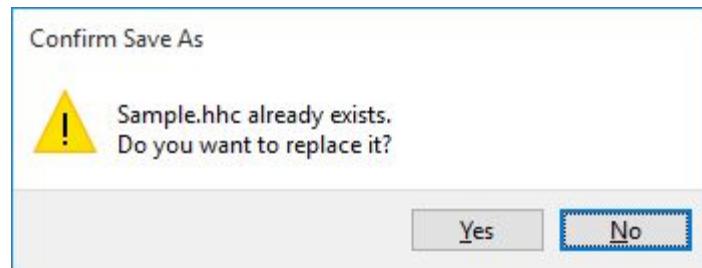
The **SaveFileDialog** control will appear in the tray area of the design window. The **ShowDialog** method is used to display the **SaveFileDialog** control. For a control named **dlgSave**, the appropriate code is:

```
dlgSave.ShowDialog();
```

And the displayed dialog box is similar to this:



The user types a name in the File name box (or selects a file using the dialog control). The file type is selected from the **Files of type** box (values here set with the **Filter** property). Once selected, the **Save** button is clicked. **Cancel** can be clicked to cancel the save operation. If the user selects an existing file and clicks **Save**, the following dialog will appear:



This is the aforementioned protection against inadvertently overwriting an existing file.

The **ShowDialog** method returns the clicked button. It returns **DialogResult.OK** if **Save** is clicked and returns **DialogResult.Cancel** if **Cancel** is clicked. The **FileName** property contains the complete path to the selected file.

Typical use of **SaveFileDialog** control:

- Set the **Name**, **DefaultExt**, **Filter**, and **Title** properties.
- Use **ShowDialog** method to display dialog box.
- Read **FileName** property to determine selected file

Summary

There is wealth of material covered here. You now have a complete reference to the Visual C# toolbox and how those tools can be used for proper interface design. The Visual C# interface is very important and we wanted to make sure you have many tools at your disposal. This will make your (and your user's) task much easier.

Even with all this work, our interface is not complete. We still need code that allows us to edit, add, and delete records from a database. We need to know how to validate and save changes properly. We need to know how to 'undo' unwanted changes. We need to know how to properly exit an application. These topics, and more, are covered in the next chapter where we learn to design the total database management system.

Example 5-9

Publishers Table Input Form

In this chapter, we built the framework for an interface that allows us to maintain the **Authors** table in the books database (**BooksDB.accdb**). This framework will be modified in the next chapter and implemented as part of a complete database management system. This database management system will also need interfaces to maintain the **Publishers** and **Titles** tables. The **Titles** table interface is a little tricky, in that it uses foreign keys to reference information in other tables. We will develop this interface in the next chapter. As an exercise here, we will begin the interface to maintain the **Publishers** table.

We will follow the same steps used in this chapter to build the Authors table input form:

- Build interface
- Add message box(es)
- Code application state
- Perform entry validation
- Perform input validation
- Add error trapping and handling
- Add on-line help system
- Application testing

Rather than starting from scratch, however, we will follow a ‘tried and true’ programming method - adapting an existing application to a new use. The Publishers table interface will essentially be the same as the Authors table interface. It will just have more (and different) input fields. Adapting an existing application saves us programmers a lot of time. You do have to make sure the

modification implements the needs of the new application while at the same time eliminates vestiges of the old application. This exercise illustrates the modification steps followed and crosschecks required. An important step: **Save** your work often. You want to make sure your changes are always there.

Build Interface

1. Make a copy of the **Example 5-8** project folder (the last version of the **Authors** table input form). Rename the newly copied folder to something else (I used **Example 5-9**). We now have a copy of the **Authors** table input form project to modify to a **Publishers** table input form. Open the copied project in Visual C#. The Publishers table has ten (10) fields that must be input:

PubID

Name

Company_Name

Address

City

State

Zip

Telephone

Fax

Comments

The SQL statement needed by the command object to retrieve these fields (sorted by the **Name** field) is:

SELECT * FROM Publishers ORDER BY Name

We need a label and text box for each fields. Resize the form so it is much taller (tall enough to hold ten labels and text boxes). Move the buttons to the bottom of the resized form. Don't worry where things are right now - they can always be resized and/or moved later.

2. Change these properties on the existing form, labels and text box controls as:

frmAuthors (current name):

Name frmPublishers
Text Publishers

Label1 (current name):

Text Publisher ID

txtAuthorID (current name):

Name txtPubID

Label2 (current name):

Text Name

txtAuthorName (current name):

Name txtPubName

Label3 (current name):

Text Company Name

txtYearBorn (current name):

Name txtCompanyName
MaxLength 32767

3. Add seven additional label and text box controls. Set these properties:

Label4:

Text Address

TextBox1:

Name txtPubAddress
BackColor White
ReadOnly True
TabIndex 3

Label5:

Text City

TextBox2:

Name txtPubCity
BackColor White
ReadOnly True
TabIndex 4

Label6:

Text State

TextBox3:

Name txtPubState
BackColor White
ReadOnly True
TabIndex 5

Label7:

Text Zip

TextBox4:

Name txtPubZip
BackColor White
ReadOnly True
TabIndex 6

Label8:

Text Telephone

TextBox5:

Name txtPubTelephone
BackColor White
ReadOnly True
TabIndex 7

Label9:

Text FAX

TextBox6:

Name txtPubFAX
BackColor White
ReadOnly True
TabIndex 8

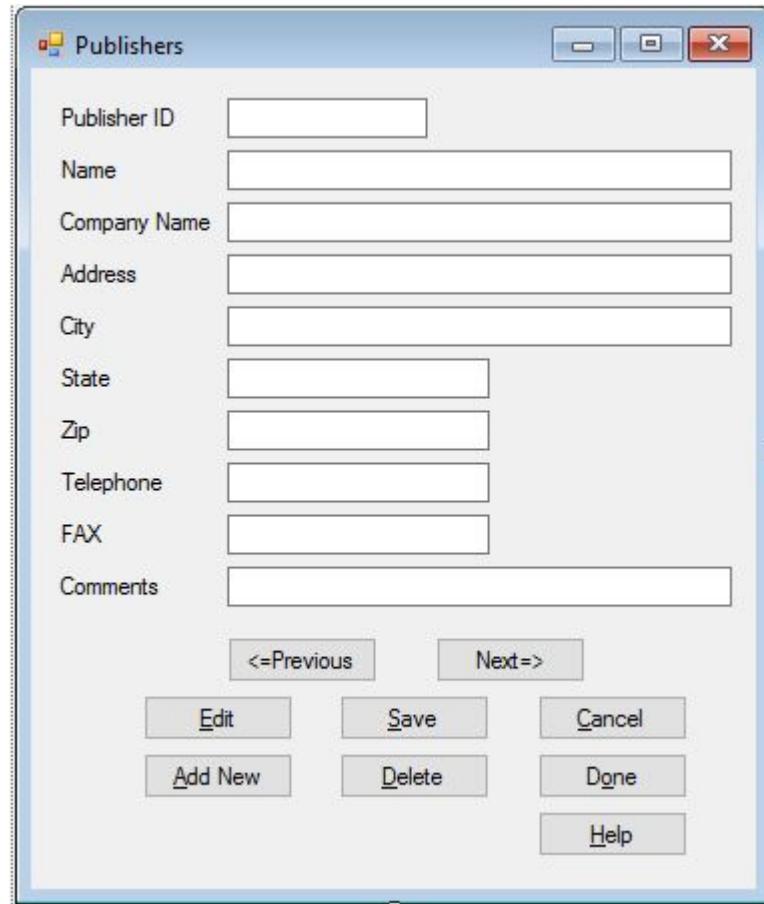
Label10:

Text Comments

TextBox7:

Name txtPubComments
BackColor White
ReadOnly True
TabIndex 9

At this point, my modified form looks like this:



The interface looks good. Let's eliminate the vestiges (old code) from the application and add any needed new code.

4. We rename the data objects to reflect the **Publishers** table. Make the shaded changes to the Form level declarations:

```
OleDbConnection booksConnection;  
OleDbCommand publishersCommand;  
OleDbDataAdapter publishersAdapter;  
DataTable publishersTable;  
CurrencyManager publishersManager;
```

5. Make the shaded changes to the Form Load event method (you will have to reassign this method to the Load event):

```
private void frmPublishers_Load(object sender,
EventArgs e)
{
    try
    {
        // point to help file
        hlpAuthors.HelpNamespace =
        Application.StartupPath + "\\authors.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        // establish command object
        publishersCommand = new OleDbCommand("SELECT *
FROM
Publishers ORDER BY Name", booksConnection);
        // establish data adapter/data table
        publishersAdapter = new OleDbDataAdapter();
        publishersAdapter.SelectCommand =
        publishersCommand;
        publishersTable = new DataTable();
        publishersAdapter.Fill(publishersTable);
        // bind controls to data table
        txtPubID.DataBindings.Add("Text",
publishersTable, "PubID");
        txtPubName.DataBindings.Add("Text",
publishersTable, "Name");
        txtCompanyName.DataBindings.Add("Text",
publishersTable, "Company_Name");
    }
}
```

```

txtPubAddress.DataBindings.Add("Text",
publishersTable, "Address");
txtPubCity.DataBindings.Add("Text",
publishersTable, "City");
txtPubState.DataBindings.Add("Text",
publishersTable, "State");
txtPubZip.DataBindings.Add("Text",
publishersTable, "Zip");
txtPubTelephone.DataBindings.Add("Text",
publishersTable, "Telephone");
txtPubFAX.DataBindings.Add("Text",
publishersTable, "FAX");
txtPubComments.DataBindings.Add("Text",
publishersTable, "Comments");

// establish currency manager
publishersManager =
(CurrencyManager)this.BindingContext[publishersTable];
}

catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error establishing
Publishers table.", MessageBoxButtons.OK,
MessageBoxIcon.Error);
    return;
}
this.Show();
SetState("View");
}

```

These changes reflect the new data object naming, the new SQL string and the proper data binding for the text box controls.

6. Make the shaded name change in the **FormClosing** method (you will have to reassign this method to the **FormClosing** event):

```
private void frmPublishers_FormClosing(object sender,  
FormClosingEventArgs e)  
{  
    // close the connection  
    booksConnection.Close();  
    // dispose of the objects  
    booksConnection.Dispose();  
    publishersCommand.Dispose();  
    publishersAdapter.Dispose();  
    publishersTable.Dispose();  
}
```

7. Make the shaded changes to the **btnPrevious** and **btnNext Click** event methods to reflect new name for currency manager:

```
private void btnPrevious_Click(object sender,  
EventArgs e)  
{  
    if (publishersManager.Position == 0)  
    {  
        Console.Beep();  
    }  
    publishersManager.Position--;  
}  
  
private void btnNext_Click(object sender, EventArgs  
e)  
{  
    if (publishersManager.Position ==
```

```
publishersManager.Count - 1)
{
    Console.Beep();
}
publishersManager.Position++;
}
```

Add Message Box(es)

In its current state, all the message boxes within our code, except one, are generic in nature. These generic message boxes can be left as is. The one exception is the message box we added to inform the user if they typed an invalid date for the old **Year Born** field. This message box will be deleted in the next step.

Code Application State

1. In this step, we modify the code to reflect proper application state. We will eliminate all old code, so when we are done the application will run without errors. The biggest changes are in the **SetState** method. The modification locks and unlocks the text boxes (using the **ReadOnly** property), depending on state. The method is (new code is shaded):

```
private void SetState(string appState)
{
    switch (appState)
    {
        case "View":
            txtPubID.BackColor = Color.White;
            txtPubID.ForeColor = Color.Black;
            txtPubName.ReadOnly = true;
            txtCompanyName.ReadOnly = true;
            txtPubAddress.ReadOnly = true;
            txtPubCity.ReadOnly = true;
            txtPubState.ReadOnly = true;
            txtPubZip.ReadOnly = true;
            txtPubTelephone.ReadOnly = true;
            txtPubFAX.ReadOnly = true;
            txtPubComments.ReadOnly = true;
            btnPrevious.Enabled = true;
            btnNext.Enabled = true;
            btnAddNew.Enabled = true;
            btnSave.Enabled = false;
```

```
    btnCancel.Enabled = false;
    btnEdit.Enabled = true;
    btnDelete.Enabled = true;
    btnDone.Enabled = true;
    txtPubName.Focus();
    break;

default:// Add or Edit if not View
    txtPubID.BackColor = Color.Red;
    txtPubID.ForeColor = Color.White;
    txtPubName.ReadOnly = false;
    txtCompanyName.ReadOnly = false;
    txtPubAddress.ReadOnly = false;
    txtPubCity.ReadOnly = false;
    txtPubState.ReadOnly = false;
    txtPubZip.ReadOnly = false;
    txtPubTelephone.ReadOnly = false;
    txtPubFAX.ReadOnly = false;
    txtPubComments.ReadOnly = false;
    btnPrevious.Enabled = false;
    btnNext.Enabled = false;
    btnAddNew.Enabled = false;
    btnSave.Enabled = true;
    btnCancel.Enabled = true;
    btnEdit.Enabled = false;
    btnDelete.Enabled = false;
    btnDone.Enabled = false;
    txtPubName.Focus();
    break;
}
}
```

2. Eliminate the `txtAuthorName_KeyPress` and `txtYearBorn_KeyPress` event methods since these controls no longer exist. Add this `txtInput_KeyPress` event method (called by all nine editable controls). This implements the code to programmatically move from text box to text box using the <Enter> key (as an alternate to using <Tab>):

```
private void txtInput_KeyPress(object sender,
KeyEventArgs e)
{
    TextBox whichBox = (TextBox) sender;
    if ((int) e.KeyChar == 13)
    {
        switch (whichBox.Name)
        {
            case "txtPubName":
                txtCompanyName.Focus();
                break;
            case "txtCompanyName":
                txtPubAddress.Focus();
                break;
            case "txtPubAddress":
                txtPubCity.Focus();
                break;
            case "txtPubCity":
                txtPubState.Focus();
                break;
            case "txtPubState":
                txtPubZip.Focus();
                break;
            case "txtPubZip":
                txtPubTelephone.Focus();
                break;
        }
    }
}
```

```
        break;
    case "txtPubTelephone":
        txtPubFAX.Focus();
        break;
    case "txtPubFAX":
        txtPubComments.Focus();
        break;
    case "txtPubComments":
        txtPubName.Focus();
        break;
    }
}
}
```

3. Save and run the application. You should now be able to move from record to record and use the other buttons to switch from state to state (don't click **Save** or **Help** yet). Here's what I see for the first record (not all fields will have values):

 Publishers

Publisher ID

Name

Company Name

Address

City

State

Zip

Telephone

FAX

Comments

Perform Entry Validation

We need to eliminate any old entry validations done and add required new ones. The only field that appears to need entry validation is **Zip** (it only uses numbers and hyphens, for 9 digit zips). We won't add any validation, though. Why? Perhaps, in the future, the post office will develop a zip code with letters. We want to be ready for this possibility. And, other countries have a wide variety of zip formats. Since we are doing nothing but displaying this value, validation is not that important. If we were doing math with a value or using it in some other function, validation would take on greater importance.

The old validation we need to eliminate is in the **KeyPress** event method for the **txtYearBorn** control. That method has already been eliminated.

Perform Input Validation

Again, we need to eliminate any old input validations done and add required new ones. All of the inputs here are generic in nature and don't need much validation. We will just insure a publisher Name field is entered.

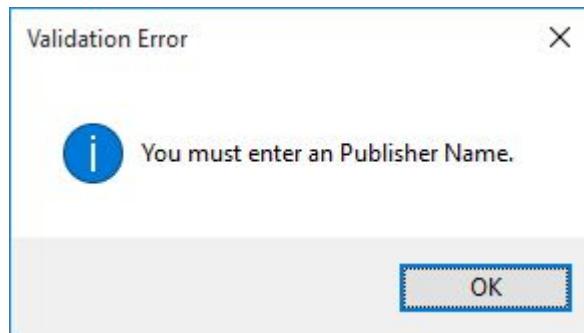
1. Modify the **ValidateData** method to read (just eliminate the **Year Born** validation and modify the old **Author Name** validation a bit with the shaded changes):

```
private bool ValidateData()
{
    string message = "";
    bool allOK = true;
    // Check for name
    if (txtPubName.Text.Trim().Equals(""))
    {
        message = "You must enter an Publisher Name." +
        "\r\n";
        txtPubName.Focus();
        allOK = false;
    }
    if (!allOK)
    {
        MessageBox.Show(message, "Validation Error",
        MessageBoxButtons.OK, MessageBoxIcon.Information);
    }
    return (allOK);
```

}

You may be asking - isn't the **PubID** field important enough to be validated? Well, yes, but being a primary key, it is treated differently. We will see how to handle this in Chapter 6.

2. Save the application and run it. Click **Edit**. Blank out the **Publisher Name** field and click **Save**. This message box should appear:



Stop the application.

Add Error Trapping and Handling

The error trapping and handling code in the old application still applies to the new application, hence no change is needed here. This is often the case in modifying existing applications. For other applications, you may need to modify existing error trapping schemes or add new ones.

Add On-Line Help System

Use the HTML Help Workshop to develop a help system named **Publishers.chm**.

1. In a program like FrontPage, prepare a single HTML topic file (**Publishers.htm**). The topic I used is:

Publishers Input Form

Available options for managing Publishers database table:

Add New Record

Click the **Add New** button to add a record to the Publishers database. Type in the requested fields. The Publisher Name is a required field. Click **Save** to save the new record; click **Cancel** to ignore the new record.

Edit Record

Click the **Edit** button to edit the displayed record. Make any needed changes. The Publisher Name is a required field. Click **Save** to save the changes; click **Cancel** to ignore the changes.

Delete Record

Click the **Delete** button to delete the displayed record.

Exit Program

Click the **Done** button to quit the application.

2. In the HTML Help Workshop, prepare a project file (**Publishers.hhp**). Compile the help file (**Publishers.chm**). All the help files are saved in the **VCSDB\Code\Class 5\Example 5-**

9\HelpFile folder. Copy Publishers.chm to our application's Bin\Debug folder.

3. Go back to your application in Visual C#. Change the Name of the help provider control to hlpPublishers. Make the shaded change near the top of the frmPublishers_Load method:

```
private void frmPublishers_Load(object sender,
EventArgs e)
{
    try
    {
        // point to help file
        hlpPublishers.HelpNamespace =
            Application.StartupPath
        + "\\Publishers.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSD\\Working\\BooksDB.accdb");
        booksConnection.Open();

        .
        .
        .

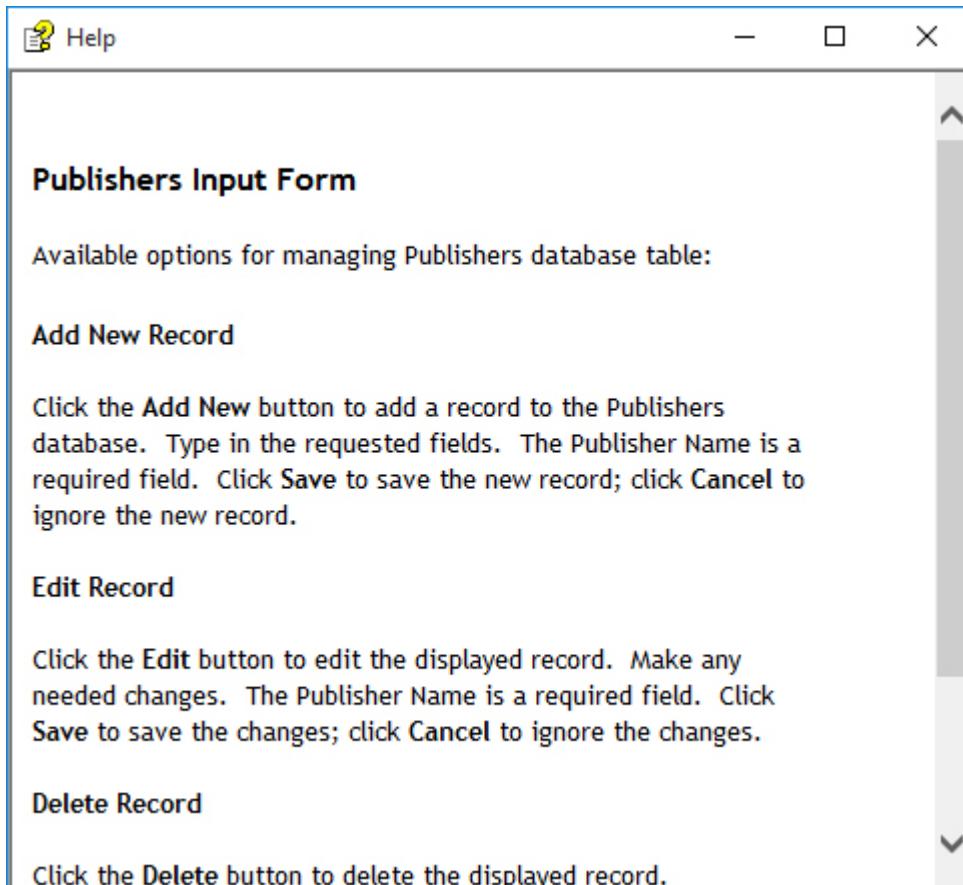
    }
}
```

And make the shaded change to the btnHelp_Click method:

```
private void btnHelp_Click(object sender, EventArgs
e)
{
    Help.ShowHelp(this, hlpPublishers.HelpNamespace);
}
```

}

4. Save the application. Run it. Make sure both the <F1> key and Help button bring up the help system properly:



Application Testing

If you did all the above steps carefully, the application should be running properly. If not, make the changes required to get it running. Here's one of the first records I found with most of the fields:

Publisher ID	9
Name	ADDISON-WESLEY
Company Name	ADDISON-WESLEY PUB CO
Address	Rte 128
City	Reading
State	MA
Zip	01867
Telephone	617-944-3700
FAX	617-964-9460
Comments	

<=Previous Next=>

Edit Save Cancel
Add New Delete Done
Help

As with the Authors form, we still need code to add the database management functions. This is addressed in the next chapter. The final version of this example is saved in the **Example 5-9** folder in **VCSDB\Code\Class 5** folder.

Example 5-9

Using SQL Server Databases

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Copy **SQLBooksDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. In declarations, use these objects:

```
SqlConnection booksConnection;  
SqlCommand authorsCommand;  
SqlDataAdapter authorsAdapter;
```

4. In **frmAuthors_Load** method, use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

5. In **frmAuthors_Load**:

Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

6

Database Management

Review and Preview

After the first five chapters, we have the ability to open databases and obtain any virtual view (using SQL) of the data desired. We have an abundance of tools at our disposal to help in these views. We also have the ability to build a useful, intuitive Visual C# interface. But, we still can't modify the data in the database.

In this chapter, we learn the steps involved in database management. We learn how to edit data, add data, delete data, and search a database. Using this knowledge, we build a complete database management system for the books database.

Database Management Tasks

As mentioned way back in Chapter 1, the tasks of a **database management system (DBMS)** are really quite simple. In concept, there are only a few things you can do with a database:

1. View the data
2. Modify (**edit**) the data
3. Add some data
4. Delete some data
5. Find some data of interest

At this point in our study, we've covered topic 1 (viewing data) in some detail. In this section, we tackle the next three topics. The final topic (finding data) is covered later in the chapter.

The ADO .NET engine that is part of the Visual C# environment simplifies database management techniques significantly. We only need to know a few object methods. Using ADO .NET and the currency manager object, we look at how to edit, add, or delete data. As we implement these database management techniques, we still consider proper interface design methods and intuitive program flow.

Editing Database Records

Database **editing** entails the modification of one or more fields in one or more records within a data table. This data table is formed as a result of the ADO .NET data connection object processing some SQL statement. Editing data is a simple task in Visual C# - there are three steps:

1. Display the record and associated fields to edit.
2. Make desired changes.
3. Save the changes.

Once Steps 1 and 2 are complete, Step 3 is automatic (if you allow it). After editing, when you move to another record, using programmatic navigation or through some other action, ADO .NET (via the currency manager and data adapter) saves the changes. This automatic saving of changes is great for basic applications, but it makes editing a little too simple. We will be more systematic in editing records. This will save us many headaches. The steps we will follow to edit a record are:

1. Display the record and associated fields to edit.
2. Make desired changes.
3. Validate changes.
4. Save the changes (or, optionally, cancel the edit operation).

To display the record, we use programmatic navigation or some search technique. Once the proper record is displayed, it is automatically in edit mode. Once in edit mode, the user can change any and all displayed fields, using whatever Visual C# data bound control is used to represent the field.

After an edit, we need to perform proper input and entry validation to insure all validation rules are met. ADO .NET does not provide any specific event methods for validation. You, the

programmer, need to provide all validation code and decide where to place this code. Just make sure validations are done before any new information is written to the database.

In most cases, you will want to give the user the option of **saving** changes and/or **canceling** any edits. To **save** edits, use the currency manager's **EndCurrentEdit** method. Assume a currency manager named **myManager**, the syntax to save the current record is:

```
myManager.EndCurrentEdit();
```

This will save the values in the data bound controls tied to the currency manager. This does not save the new values in the database (it only saves the local data table copy).

To save changes in the database, we use the data adapter's **Update** method. If the data adapter **myAdapter** is connected to a data table named **myTable**, the syntax to save changes is:

```
myAdapter.Update(myTable);
```

For this line of code to operate properly, it needs an 'update command' that is formed using:

```
OldDbCommandBuilder myAdapterUpdate = new  
OleDbCommandBuilder(myAdapter);
```

This declaration is made before using the **Update** method (it also forms proper delete and insert commands needed by the adapter). This save method is usually done when an application is closed.

To **cancel** any changes made while editing, you use the currency manager's **CancelCurrentEdit** method. The syntax is:

```
myManager.CancelCurrentEdit();
```

After this, the data bound controls are reset to their ‘pre-edit’ values.

Phone Contact Database

For many examples in this chapter, we will use a practice database named **PhoneDB.accdb**, included with the sample code (in the **VCSDB\Datasets** folder). This is a simple database of contacts, containing names and phone numbers with three fields (**ContactID**, **ContactName**, and **ContactNumber**) in a single table named **PhoneTable**. Using this sample lets us edit, add, and delete records without worrying about destroying something important, like the books database.

The phone database **PhoneTable** table has 26 records:

ContactID	ContactName	ContactNum	Aa
1	Adams, Zorro	755-3707	
2	Barber, Yanni	870-8739	
3	Connors, Xavie	809-5705	
4	Dunwiddie, Wir	755-3707	
5	Ewing, Veronica	870-8739	
6	Farrow, Ulysses	809-5705	
7	Gutenberg, Tho	526-2288	
8	Harris, Susan	699-6925	
9	Inarelli, Rando	296-5117	
10	Jacobs, Queenie	302-3994	
11	Keltner, Patricia	311-4473	
12	Lewis, Ophelia	621-0492	
13	Madison, Nancy	832-6640	
14	Norris, Michael	669-0594	

ContactName and **ContactName** are simple string fields. **ContactID** is a **primary key** and is **auto-numbering**, insuring a unique value for each record. The ADO .NET database engine assigns the value and we will not let the user change it.

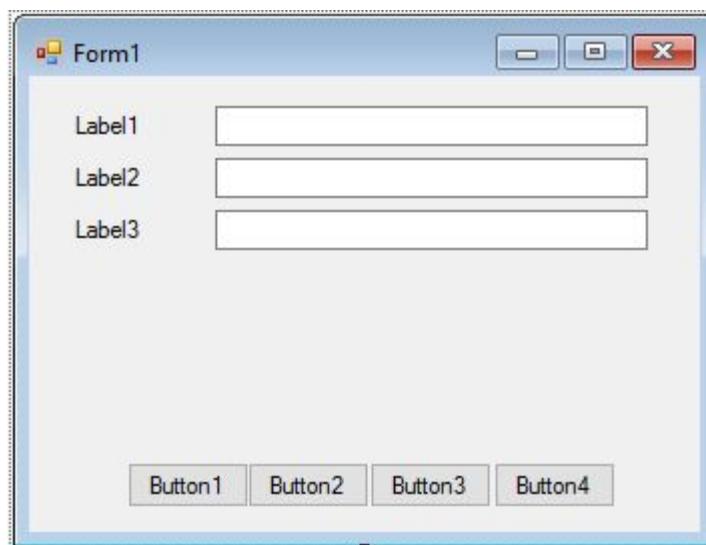
Example 6-1

Editing Database Records

Let's look at some of the coding and considerations used in editing database records. We will use the phone database (**PhoneDB.accdb**) with its single table **PhoneTable**. To retrieve the fields from this table (ordered by **ContactName**), we use this SQL statement:

Select * from PhoneTable ORDER BY ContactName

1. Copy **PhoneDB.accdb** to the same working directory as **BooksDB.accdb** and **NWindDB.accdb** (this lets us keep a 'clean' copy in the code directory). Recall the working directory we've been using is **c:\VCSDB\Working**.
2. Start a new application. Add three labels, three text boxes, and four buttons to the project form. The form should look something like this:



Set the following properties for each control:

Form1:

Name	frmPhoneDB
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Phone DBMS

label1:

Text	ID
------	----

textBox1:

Name	txtID
BackColor	White

label2:

Text	Name
------	------

textBox2:

Name	txtName
BackColor	White

label3:

Text	Number
------	--------

textBox3:

Name	txtNumber
BackColor	White

button1:

Name	btnFirst
Text	<
FontStyle	Bold

button2:

Name	btnPrevious
------	-------------

Text <
FontStyle Bold

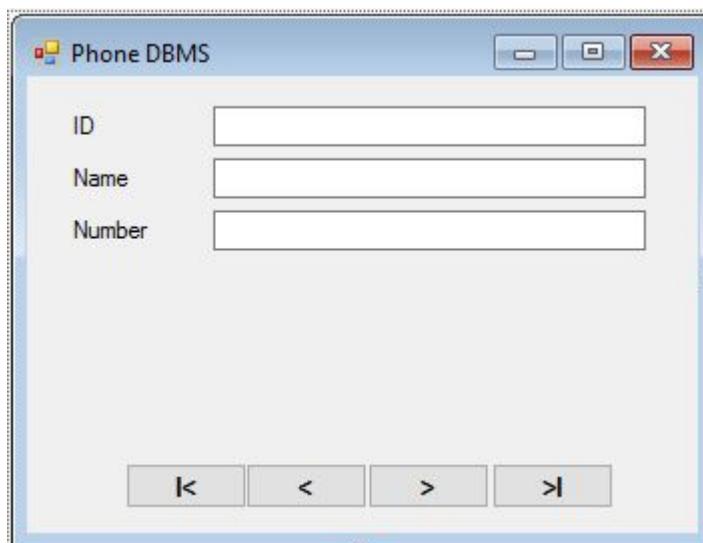
button3:

Name btnNext
Text >
FontStyle Bold

button4:

Name btnLast
Text >|
FontStyle Bold

When done, my form looks like this:



3. Add this line at the top of the code window:

```
using System.Data.OleDb;
```

4. Form level declarations to create data object:

```
OleDbConnection phoneConnection;  
OleDbCommand phoneCommand;
```

```
OleDbDataAdapter phoneAdapter;  
DataTable phoneTable;  
CurrencyManager phoneManager;
```

5. Add this code to the **frmPhoneDB_Load** event method (creates data objects and binds controls):

```
private void frmPhoneDB_Load(object sender, EventArgs e)  
{  
    // connect to Phone database  
    phoneConnection = new OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = c:\\VCSD\\Working\\PhoneDB.accdb");  
    phoneConnection.Open();  
    // establish command object  
    phoneCommand = new OleDbCommand("Select * from  
phoneTable ORDER BY ContactName", phoneConnection);  
    // establish data adapter/data table  
    phoneAdapter = new OleDbDataAdapter();  
    phoneAdapter.SelectCommand = phoneCommand;  
    phoneTable = new DataTable();  
    phoneAdapter.Fill(phoneTable);  
    // bind controls to data table  
    txtID.DataBindings.Add("Text", phoneTable,  
    "ContactID");  
    txtName.DataBindings.Add("Text", phoneTable,  
    "ContactName");  
    txtNumber.DataBindings.Add("Text", phoneTable,  
    "ContactNumber");  
    // establish currency manager
```

```
    phoneManager = (CurrencyManager)
this.BindingContext[phoneTable];
}
```

6. Add this code to the **frmPhoneDB_FormClosing** event method to save any changes to the database and close the connection:

```
private void frmPhoneDB_FormClosing(object sender,
FormClosingEventArgs e)
{
    try
    {
        // save the updated phone table
        OleDbCommandBuilder phoneAdapterCommands = new
OleDbCommandBuilder(phoneAdapter);
        phoneAdapter.Update(phoneTable);
    }
    catch (Exception ex)
    {
        MessageBox.Show("Error saving database to
file:\r\n" +
ex.Message, "Save Error", MessageBoxButtons.OK,
MessageBoxIcon.Error);
    }
    // close the connection
    phoneConnection.Close();
    // dispose of the objects
    phoneConnection.Dispose();
    phoneCommand.Dispose();
    phoneAdapter.Dispose();
    phoneTable.Dispose();
}
```

This code uses command objects (**PhoneAdapterCommands**) and the data adapter **Update** method to save any changes to the database.

7. Lastly, add code for the four navigation buttons **Click** events:

```
private void btnFirst_Click(object sender, EventArgs e)
{
    phoneManager.Position = 0;
}

private void btnPrevious_Click(object sender, EventArgs e)
{
    phoneManager.Position--;
}

private void btnNext_Click(object sender, EventArgs e)
{
    phoneManager.Position++;
}

private void btnLast_Click(object sender, EventArgs e)
{
    phoneManager.Position = phoneManager.Count - 1;
}
```

8. Save the application (saved in the **Example 6-1** folder in **VCSDB\VCSDB Code\Class 6** folder) and run it. Here's the first record:

ID	1
Name	Adams, Zomo
Number	755-3707

< < > >

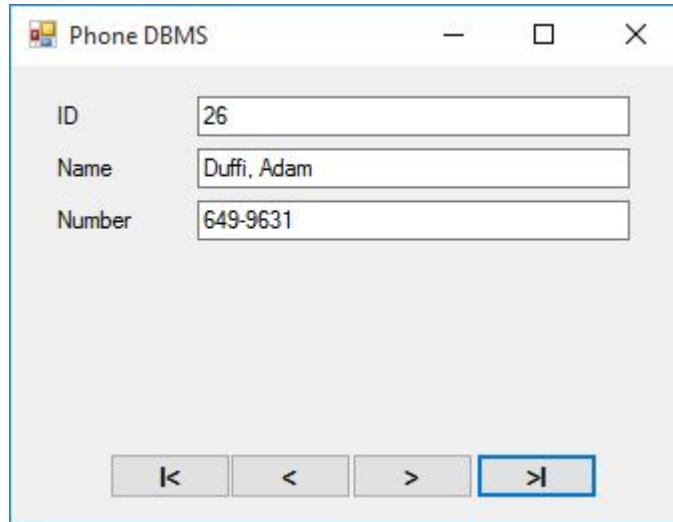
Scroll through the records (using the navigation buttons) to become familiar with the listings. Notice the records are sorted by name.

Go to the last record (click the >| arrow). The **Name** should be **Zuffi, Adam**:

ID	26
Name	Zuffi, Adam
Number	649-9631

< < > >

Change the last name to Duffi. Click to another record. Go back to the last record and you will see the name change is reflected in the displayed record:



If you were to stop the application at this point, the change would be saved to the database. Change the last name back to Zuffi, and then stop the application (click the X in the upper corner of the form).

Do you see how easy it is to edit and save a record? As we mentioned, it's too easy. The user may not be aware any changes are being saved. Recall, when we discussed proper interface design, we decided that all user tasks should be obvious and we should lead the user through these tasks. In this example, the user should tell us when they want to **edit** a record and when they want to **save** it. It should not be possible to change a record until the user decides to change it. Let's put in these modifications.

1. First, set the **ReadOnly** property for all text boxes to **True** (we will decide when to change this to **False**, to allow editing). Now, add three buttons, with these properties:

button1:

Name	btnEdit
Text	Edit

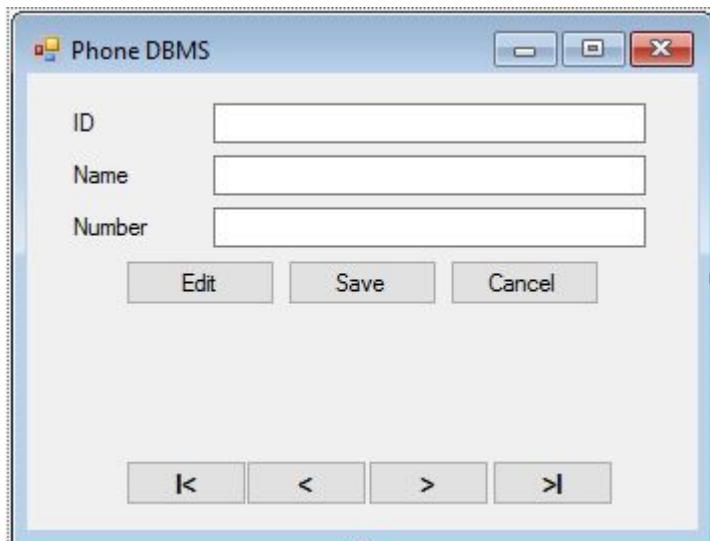
button2:

Name btnSave
Text Save
Enabled False

button3:

Name btnCancel
Text Cancel
Enabled False

Now, the form looks like this:



2. We'll use the concept of **application state** (we often use the term **mode** as a synonym for **state**) introduced in Chapter 5. Insert a method named **SetState** with a string argument **appState**. Place this code in that method:

```
private void SetState(string appState)
{
    switch (appState)
    {
        case "View":
            btnFirst.Enabled = true;
```

```

    btnPrevious.Enabled = true;
    btnNext.Enabled = true;
    btnLast.Enabled = true;
    btnEdit.Enabled = true;
    btnSave.Enabled = false;
    btnCancel.Enabled = false;
    txtID.BackColor = Color.White;
    txtID.ForeColor = Color.Black;
    txtName.ReadOnly = true;
    txtNumber.ReadOnly = true;
    break;

default: // "Edit" mode
    btnFirst.Enabled = false;
    btnPrevious.Enabled = false;
    btnNext.Enabled = false;
    btnLast.Enabled = false;
    btnEdit.Enabled = false;
    btnSave.Enabled = true;
    btnCancel.Enabled = true;
    txtID.BackColor = Color.Red;
    txtID.ForeColor = Color.White;
    txtName.ReadOnly = false;
    txtNumber.ReadOnly = false;
    break;
}

txtName.Focus();
}

```

This method has two modes: **View** and **Edit**. In View mode (default when the form loads), we can just look at the data. In Edit mode (and later Add mode), data can be changed, and then saved (or the

edit operation canceled). Notice we never ‘unlock’ the text box with the ID field (it is red in **Edit** mode). This is a primary database key and we will not allow it to change.

3. Add this line at the end of the **frmPhoneDB_Load** method to put the form in **View** mode initially:

```
SetState("View");
```

This puts the form in **View** mode initially.

4. Place this code in the **btnEdit_Click** event method:

```
private void btnEdit_Click(object sender, EventArgs e)
{
    SetState("Edit");
}
```

This code places the form in **Edit** mode and allows the data table to be edited.

5. Place this code in the **btnSave_Click** event method:

```
private void btnSave_Click(object sender, EventArgs e)
{
    phoneManager.EndCurrentEdit();
    SetState("View");
}
```

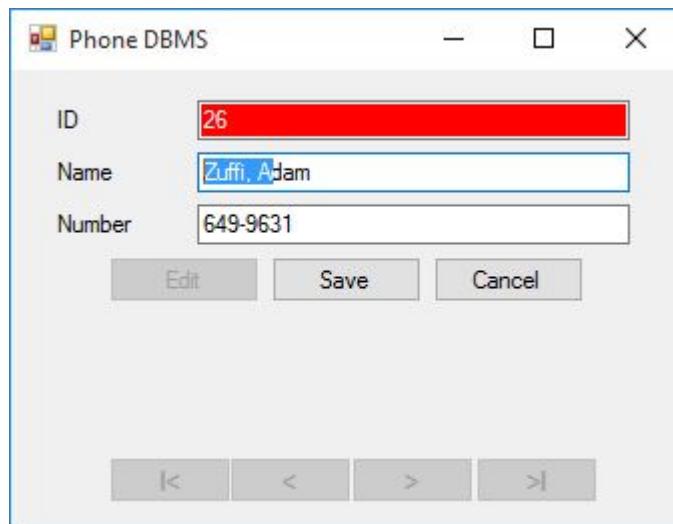
This code saves changes in the bound controls by invoking the currency manager **EndCurrentEdit** method. It resets the application state to **View** mode.

6. Place this code in the `btnCancel_Click` event method:

```
private void btnCancel_Click(object sender, EventArgs e)
{
    phoneManager.CancelCurrentEdit();
    SetState("View");
}
```

This code cancels the edit operation and resets the application state to **View** mode.

7. Resave the modified application. Run it. Go to the last record (remember **Zuffi, Adam?**). Try to change the name - you shouldn't be able to since the text box is locked. Click **Edit**. The form is in **Edit** mode:



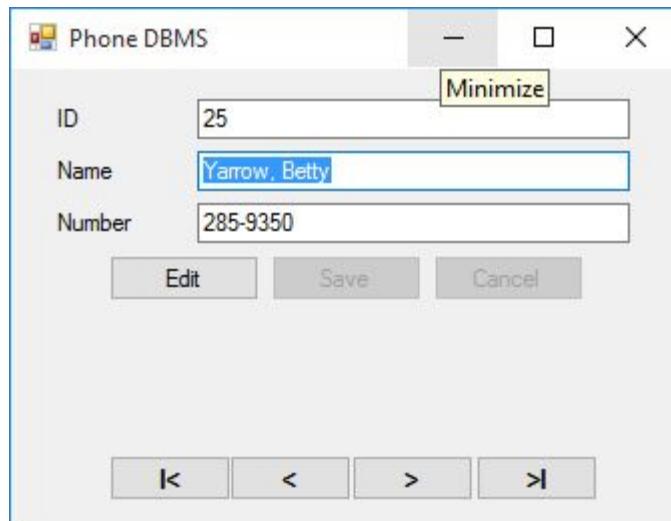
Change the last name to **Duffi**. Click **Cancel**. Notice the Name field is set back to **Zuffi** and the form is restored to viewing mode. Nothing has changed. Click **Edit** again. Change the last name to **Duffi**. Click **Save**. The form returns to viewing mode and the name change is reflected in the displayed record. Do you see how use of this interface is clear? Notice, though, that the

records have not been re-sorted. That is, the ‘Duffi’ entry is still the last record. Stop the application.

8. Re-start the application. Go to the last record. Where’s Adam ‘Duffi’? Scroll through the records to the ‘D’ listings - he should be there. When we reopened the database with the original SQL command (`SELECT * FROM PhoneTable ORDER BY ContactName`), the new name was properly sorted with the other records. Change Duffi back to Zuffi (use **Edit**, then **Save**) and stop the application. To properly sort edits at the time they are made, we use the data table **Sort** method. Stop the application and add this line of code after the ‘`EndCurrentEdit`’ line in the `btnSave_Click` event method:

```
phoneTable.DefaultView.Sort = "ContactName";
```

Run the application. Go to the last record (**Zuffi**). Change **Zuffi** to **Duffi** and click **Save**. The form will show the record preceding the one we changed (**Yarrow, Betty**):



Move to the ‘D’ entries and you’ll see **Duffi** is now in the proper location without having to stop the application). Why was the Yarrow entry shown instead of the Duffi record? After the re-sort, the pointer is left at the end (where it was prior to the edit). If

we want to display the Duffi record after the sort, we need to search the sorted records to see where it was placed. We explain how to do this later in the chapter. Stop and save the application (saved in **Example 6-1** folder of **VCSDB\VCSDB Code\Class 6** folder). Before you leave this example, run it once more and changing Mr. Zuffi's name back.

Example 6-1

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the phone database is **SQLPhoneDB.mdf**. Copy **SQLPhoneDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. In declarations, use these objects:

```
SqlConnection phoneConnection;  
SqlCommand phoneCommand;  
SqlDataAdapter phoneAdapter;
```

4. In **frmPhoneDB_Load** method, use this connection object:

```
phoneConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLPhoneDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

5. In **frmPhoneDB_Load**:

Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

6. In **frmPhoneDB_Closing**:

**Change all instances of `OleDbCommandBuilder` to
`SqlCommandBuilder`**

Adding Database Records

Adding a record to a database data table is closely related to the editing process just discussed. The only difference is we are editing a new empty record. The steps we will follow to add a new record are:

1. Add and display an empty record and associated fields.
2. Place field data in displayed controls.
3. Validate data.
4. Save the data (or, optionally, cancel the add operation).

To add a record to the data table, use the currency manager object's **AddNew** method. For a currency manager named **myManager**, the code is:

```
myManager.AddNew();
```

This statement will add an empty record (all data bound controls are blanked out) at the end of the data table. At this point, the user can enter new values. Once new values are entered, the same validation methods discussed for editing records must be followed.

To **save** the new record in the data table, use the currency manager object's **EndCurrentEdit** method:

```
myManager.EndCurrentEdit();
```

After a new record has been added and saved, the data table should be re-sorted based on whatever criterion you choose. If a re-sort is not done, the new record remains at the end of the data table.

If the user decides to **cancel** the addition of a new record, use the currency manager **CancelCurrentEdit** method. For our example

currency manager, the code to do this is:

```
myManager.CancelCurrentEdit();
```

This removes the new record from the ‘editing buffer.’ We still need to do a little extra work. Why? Prior to adding a record, the user was viewing a particular record. We would like that same record to be displayed after the add operation is canceled. We can do this by storing a record’s **bookmark** prior to the adding a record. A bookmark is a placeholder in database management tasks. Then, if the ‘add operation’ is canceled, we restore the bookmark. The code to store the bookmark (the **Position** property of the currency manager) is:

```
myBookmark = myManager.Position;
```

Note this requires a variable **myBookmark** (of type **int**) to save the bookmark. To restore the bookmark, reverse the sides of the relation:

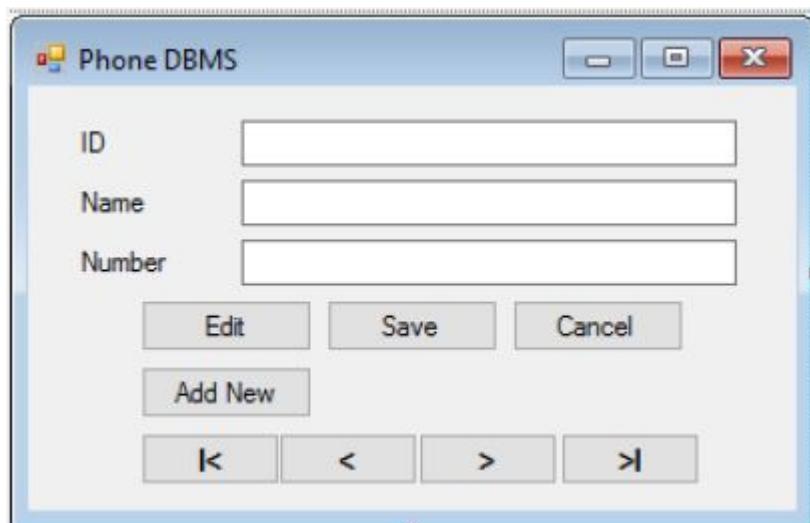
```
myManager.Position = myBookmark;
```


Example 6-2

Adding Database Records

Let's modify the previous example (Example 6-1) to include the ability to add records to the phone number list.

1. Add a button. Set **Name** to **btnAdd** and **Text** to **Add New**. The form should look like this (you may want to resize the form a bit):



2. Place these lines with the form level declarations. These variables will store the application state and any bookmark we use.

```
string myState;  
int myBookmark;
```

3. Place this code in the **btnAdd_Click** event method:

```
private void btnAdd_Click(object sender, EventArgs e)  
{  
    myBookmark = phoneManager.Position;
```

```
    SetState("Add");
    phoneManager.AddNew();
}
```

This code first sets the bookmark in case the operation is later canceled. It then places the application in **AddNew** mode and adds a blank record.

4. Modify the **btnCancel_Click** code to differentiate between canceling during **Edit** mode and **Add** mode (new code is shaded):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    phoneManager.CancelCurrentEdit();
    if (myState.Equals("Add"))
    {
        phoneManager.Position = myBookmark;
    }
    SetState("View");
}
```

In this code, if in **Edit** mode, nothing has changed. If in **Add** mode, the record addition is canceled and the saved bookmark is restored. In either case, the user is returned to the **View** state. **MyState** is a variable defined in the next routine.

5. Modify the **SetState** method so the state is saved in **MyState**, the new **Add** state is recognized, and the enabled property of the **Add New** button is properly toggled (new code is shaded):

```
private void SetState(string appState)
{
    myState = appState;
```

```
switch (appState)
{
    case "View":
        btnFirst.Enabled = true;
        btnPrevious.Enabled = true;
        btnNext.Enabled = true;
        btnLast.Enabled = true;
        btnEdit.Enabled = true;
        btnSave.Enabled = false;
        btnCancel.Enabled = false;
        btnAdd.Enabled = true;
        txtID.BackColor = Color.White;
        txtID.ForeColor = Color.Black;
        txtName.ReadOnly = true;
        txtNumber.ReadOnly = true;
        break;

    default: // "Edit" mode, "Add" mode
        btnFirst.Enabled = false;
        btnPrevious.Enabled = false;
        btnNext.Enabled = false;
        btnLast.Enabled = false;
        btnEdit.Enabled = false;
        btnSave.Enabled = true;
        btnCancel.Enabled = true;
        btnAdd.Enabled = false;
        txtID.BackColor = Color.Red;
        txtID.ForeColor = Color.White;
        txtName.ReadOnly = false;
        txtNumber.ReadOnly = false;
        break;
}
```

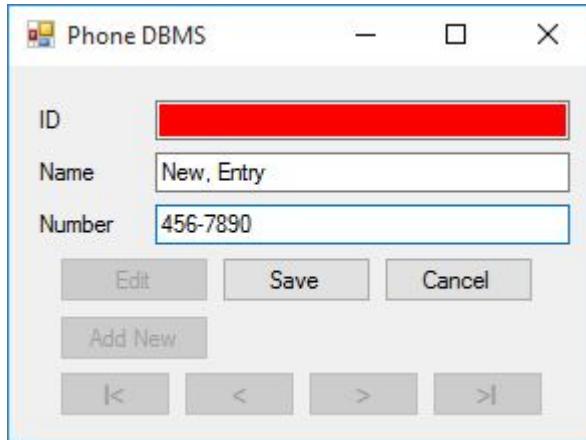
```
        }  
        txtName.Focus();  
    }  
}
```

6. Save the application (saved in the **Example 6-2** folder in **VCSDB\VCSDB Code\Class 6** folder). Run it. Click **Add New**. Note that all three textboxes (**ID**, **Name** and **Number**) are blank:



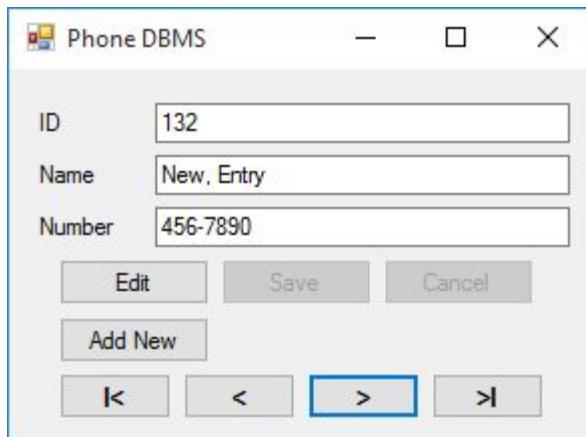
Recall the **ContactID** field is a primary key and is autonumbering. Why, then, isn't an ID value generated and displayed? A 'feature' of ADO .NET is that it does not generate such a value until the modified row is written back to the database (the data adapter is updated). In this example, we don't save the database until we end the application, so these values will not be seen until the database is reopened.

7. Type in a name (Last Name, First Name) and a phone number. (I'm sure that you have realized we should have some input and entry validation for the phone number field, but we're ignoring it for this simple example.) Here's my new record:



Notice there is no ID. Click **Save**. The application returns to **View** state, displaying some other record. As mentioned earlier, we will learn how to display the newly added record later in the chapter. Click **Add New** again. Type in a new record, but this time click **Cancel**. The displayed record should be the same one seen prior to clicking **Add New**. Users like to see such results. Scroll through the records - the canceled record should be nowhere to be found. The added record should still be there. Stop the application.

8. Run the application again and find the newly added entry. The ID (132 in my example) should be there:



Stop and save the application. This lack of ID display when adding a record is not a big problem, just an inconvenience. A

user cannot edit or modify this value in any way (it is used by the database for searching), so there is really no reason to display it.

Example 6-2

Using SQL Server Databases

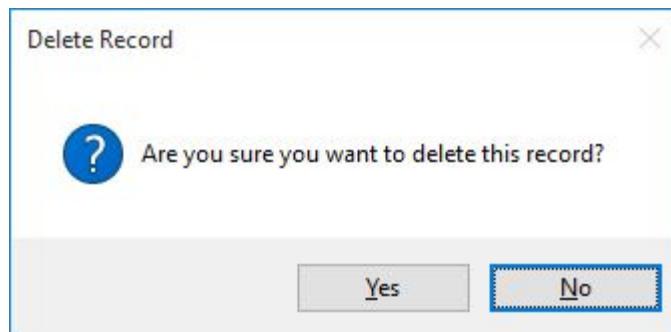
Make the same changes to the SQL Server version of the project.

Deleting Database Records

Deleting a record from a database data table is simple and potentially dangerous. Once a record is deleted, it cannot be recovered (unless you write Visual C# code to do the job). So, be careful when you allow record deletions. The steps we will follow to delete a record are:

1. Display the record to be deleted.
2. Make sure the user wants to delete the record (optional, but crucial).
3. Delete the record.

We want to be sure the user wants to delete a record. We suggest the use of a message box to ask for confirmation. A suggested form for the message box is:



The code snippet to generate this message box is:

```
MessageBox.Show("Are you sure you want to delete this  
record?", "Delete Record", MessageBoxButtons.YesNo,  
MessageBoxIcon.Question,  
MessageBoxDefaultButton.Button2)
```

Note we make the **No** button default. We want the user to have to click **Yes** to delete a record. If the user responds **No** to this box, we

simply exit the method the delete operation is in. If the response is **Yes**, we continue with the deletion.

To delete a record from a data table, use the currency manager object's **RemoveAt** method. For a currency manager named **myManager**, the code is:

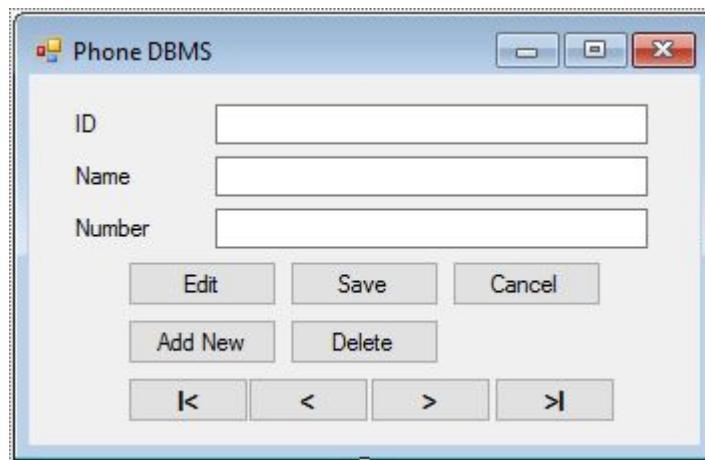
```
myManager.RemoveAt(myManager.Position);
```

This code irrevocably deletes the displayed record (the record at **myManager.Position**).

Example 6-3

Deleting Database Records

1. Let's modify the previous example (Example 6-2) to include the ability to delete records from the phone number list.
2. Add a button. Set **Name** to **btnDelete** and **Text** to **Delete**. The form should look like this:



3. Place this code in the **btnDelete_Click** event method:

```
private void btnDelete_Click(object sender, EventArgs e)
{
    if (MessageBox.Show("Are you sure you want to
        delete
        this record?", "Delete Record",
        MessageBoxButtons.YesNo,
        MessageBoxIcon.Question,
        MessageBoxDefaultButton.Button2)
        == DialogResult.Yes)
    {

```

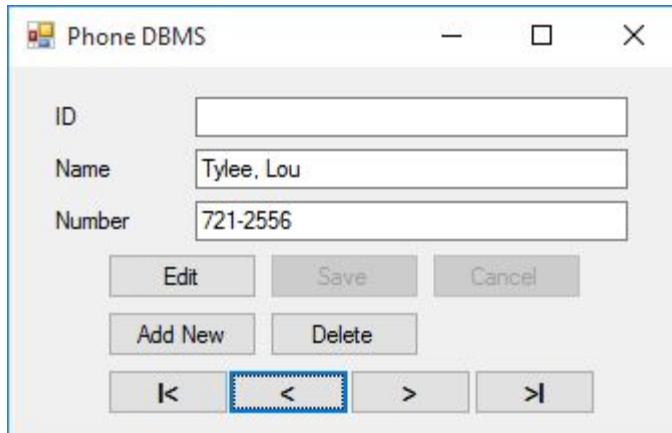
```

        phoneManager.RemoveAt(phoneManager.Position);
    }
    SetState("View");
}

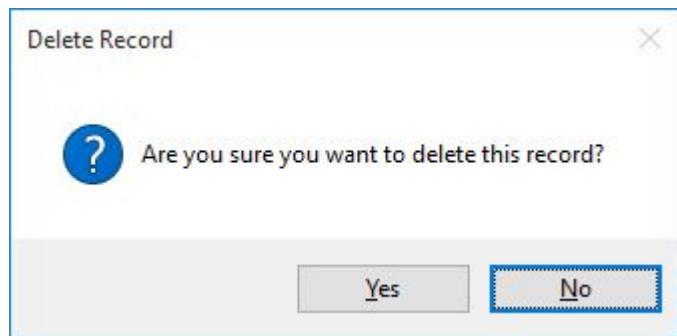
```

This code confirms the deletion using a message box. If user responds with **Yes**, the deletion is done. If **No**, nothing happens. The application is always returned to **View** mode.

4. Modify the **SetState** method to set the **btnDelete** button **Enabled** property to **true** in **View** mode, **false** in **Add/Edit** mode.
5. Save the application (saved in the **Example 6-3** folder in **VCSDB\VCSDB Code\Class 6** folder). Run it. Click **Add New** and add your name and phone number. Click **Save**. Now scroll through the records until your name is displayed. My screen shows:



Click **Delete**. This message box will appear:



Respond **No** to the message box. Your entry is still displayed. Click **Delete** again, but this time respond **Yes** to the message box. You are deleted from the database! Note another record is now displayed. Stop the application.

Example 6-3

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Finding Records in a Database

There are many times in database management tasks you might like to locate certain records in a database. As an example, in the little phone database we've been using a user may want to find a particular person to call. Or, in the books database, a user may need to find all books published by a particular author. Or, after adding a record to and resorting a data table, you would like to find that record and display it.

One way to **find records** in a database is via a SQL query. A SQL query returns all records that match particular criteria and needs a requerying of the database (making it slow for large databases). Such searches were discussed in Chapter 5. In this section, we are concerned with finding a single record in an established data table. There are two ways to accomplish such a task. First, we will use the data table **Find** method.

The data table **Find** method will only perform searches on the column by which the data is sorted. This is exactly what we need for the phone database, since we sort by names and are searching by names. More complex searches require more complex techniques (discussed next).

If we have a data table (**myTable**) sorted on the field **mySortField** and are searching for **myValue**, the syntax for the **Find** method is:

```
int myRow;  
myTable.DefaultView.Sort = mySortField;  
myRow = myTable.DefaultView.Find(myValue);
```

This method returns the first row (**myRow**) in the data table containing the desired field value. If now such row is found, a negative one (-1) is returned. Setting the currency manager **Position** property to **myRow** will properly rebind controls.

The **Find** method is easy to use, but limited. If we want to find a row based on more complex criteria or based on a column other than the one the data is sorted on, we use the data table's **Select** method. The syntax is:

```
DataRow[] myRows;  
myRows = myTable.Select(criteria);
```

where **criteria** is a Boolean expression of the search criteria. The method returns an array of rows (**myRows**) containing each row in the data table that matches the criteria.

The search **criteria** is a string expression like the **WHERE** clause in SQL. It specifies requirements for the search. The usual form is to compare one or more fields to a desired value. As an example, using the phone database, if we want to find a person named **Smith** (**ContactName** field), we would use:

```
criteria = "ContactName = 'Smith'"
```

Note the use of single quotes around the embedded string. If you are unsure of the complete field name, you can use the **LIKE** keyword with the wildcard character (*). Say, in the above example, you are unsure if the name you are looking for is Smith or Smyth. A search criteria to find either is:

```
criteria = "ContactName LIKE 'Sm**'"
```

How do you know if a search is successful? You check the **length** of the returned row array. If, after a **Select** method, that length is greater than 0, the search was successful. One problem with the **Select** method is that it doesn't provide corresponding row numbers within the data table (like the **Find** method did). It only tells us what the rows are that match the search criteria. To find corresponding row numbers (to allow positioning of a currency

manager), we need to do a little work. The code is not difficult, just a bit awkward.

Assuming the returned rows array (**myRows**) is of non-zero length and the default view of the data table is sorted by **mySortField**, the corresponding row number for the first row in the array is:

```
int firstRow;  
firstRow =  
myTable.DefaultView.Find(myRows[0][mySortField]);
```

This code uses the **Find** method to locate the first row (**firstRow**) that contains the **mySortField** value found in **myRows[0]**. As we said, it's awkward, but it works. After finding **firstRow**, you set the currency manager's **Position** property to that value to properly rebind all controls.

Example 6-4

Finding Database Records

In the phone database we have been using, we noted one drawback when editing and adding records to the data table. After saving changes, the currency manager does not necessarily point to the record we just edited or added. We can now correct that drawback using the data table **Find** method.

1. Open Example 6-3 (the phone database example we've been building).
2. Modify the **btnSave_Click** event method to implement a search, following resorting of the saved data table (new code is shaded):

```
private void btnSave_Click(object sender, EventArgs e)
{
    string savedName = txtName.Text;
    int savedRow;
    phoneManager.EndCurrentEdit();
    phoneTable.DefaultView.Sort = "ContactName";
    savedRow = phoneTable.DefaultView.Find(savedName);
    phoneManager.Position = savedRow;
    SetState("View");
}
```

When we enter this method, we have decided to save the displayed information. Before ending the edit, we save the **ContactName** field (contained in the **txtName** text box) in the variable **savedName**. After ending the edit (saving the data table), we search for that saved name using the **Find** method.

The returned row (`savedRow`) is used to reposition the currency manager. Notice we didn't check to see if `savedRow` is valid, since we are guaranteed a successful search. In other searches, you would want to make sure `savedRow` is not -1 before continuing.

3. Save the application (saved in the **Example 6-4** folder in **VCSDB\VCSDB Code\Class 6** folder) and run it. **Edit** a record. Click **Save**. Note the displayed record is now the newly edited record. Try the same thing with **Add New**.

Example 6-4

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Modifying Records in Code

There are times you might like to change information in database records using C# code. As an example, say you want to transfer information from a data file to your database (we do that in the last chapter). Or, perhaps you want to transfer information from one database into another. Or, maybe you need to update some fields in your database. And, in an extreme case, you might want to delete all the records in your database. All of these tasks can be performed with C# code.

To modify a database using code, you simply determine what tasks need to be accomplished and what code you need to accomplish those tasks. What code do you have at your disposal? The same code you have been using for database management tasks:

- ⇒ The currency manager **Position** property can be used to navigate among the database records.
- ⇒ **AddNew** can be used to add a record.
- ⇒ **RemoveAt** can be used to delete a record.
- ⇒ **EndCurrentEdit** can be used to update a data table.
- ⇒ **Find** can be used to locate records.
- ⇒ The data adapter **Update** method can be used to save changes in the database.

Write the code in the same manner you would have a user perform the tasks. And take advantage of any code you might already have in your application. For example, if you add a record in code and want to save it, simply call your **Save** event (if it exists). As you progress in database programming, you will find many places you want to automate database management methods. This is exactly what modifying data in code does for you.

There are many properties and methods that allow us to view, edit and modify a data table without using a currency manager. One

very useful property is the data table's **Rows** collection. This collection contains all rows in the data table. The **DataRow** object allows us to examine (or establish) fields in each row of the data table. To see all values of a field (**myField**) in a table (**myTable**), you could use this code snippet:

```
foreach (DataRow myRow in myTable.Rows)
{
    .
    .
    'Field is available in variable myRow[myField]
    .
}
}
```

In this snippet, **myField** is a string data type. The code uses a special form of the **for** loop (**foreach**) that goes through all elements of the **Rows** collection. Such code could be used to make bulk changes to a database. For example, you could use it to add area codes to all your phone numbers or change the case of particular fields. We do that in the next example.

In addition to direct editing of data rows, you can use the data row object to add a row to a data table. To add a row to **myTable**, use this code:

```
DataRow newRow;
newRow = myTable.NewRow();

'Add fields using
newRow[myField] = fieldValue;

'After adding all fields add row
myTable.Rows.Add(newRow);
```

To delete row **n** from a data table (**MyTable**), simply use:

```
myTable.Rows[n].Delete();
```


Example 6-5

Modifying Records in Code

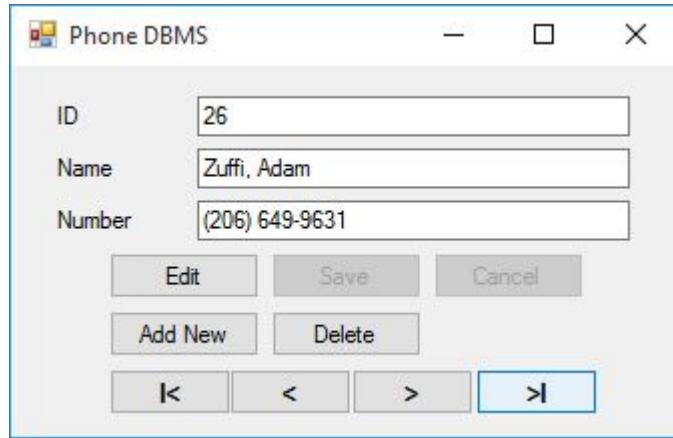
Notice the phone numbers in the phone database we have been using do not have area codes listed. It is for local calls. If we want to expand our database to allow calls outside our area code, we need to add area codes to all the existing numbers. We could run the application and edit all records, one at a time, adding an area code, or we could do it in code. Let's try it.

1. Re-open Example 6-4. Add this code at the bottom of the `frmPhoneDB_Load` method:

```
foreach (DataRow phoneRow in phoneTable.Rows)
{
    phoneRow["ContactNumber"] = "(206) " +
    phoneRow["ContactNumber"].ToString();
}
```

In this code, we go through each row in the data table (`phoneTable`) and change the `ContactNumber` field, adding a (206) area code

2. Save (saved in the Example 6-5 folder in `VCSDB\VCSDB Code\Class 6` folder) and run the application. Notice all the phone numbers now have area codes. Here's our old friend Adam Zuffi:



3. If desired, replace the line of code adding area codes with this one:

```
phoneRow["ContactNumber"] =  
    phoneRow["ContactNumber"].ToString().Substring(6, 8);
```

Run the application again. This line strips off the area codes to restore the database to its original state. Once you are done making all the modifications, remove the code that changes the **ContactNumber**. If you don't, you will get changes each time you run the program.

Example 6-5

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Stopping a Database Application

In all applications we have built in this class, execution can be stopped in one of four ways:

1. Using the Visual C# toolbar **End** button.
2. Clicking the **control box** in the upper left hand corner of the form and choosing **Close**.
3. Pressing **Alt-<F4>**.
4. Clicking the **X** in the upper right corner of the application form.

When others use our applications, the Visual C# **End** button will not be available, the control box may or may not be visible, and all users may not know they can use **Alt-<F4>** or the **X** button to stop. We need a way to clearly indicate to a user how to stop an application.

The most straightforward way to stop an application is to provide a button to click. You choose the caption. Some captions that are used in Windows applications are **Exit**, **Stop**, **Close**, and **Done**. We will use a **Text** property of **Done**. We will **Name** our button **btnDone**. So, all we need is code to put in the **btnDone_Click** event method. The code is very simple:

```
private void btnDone_Click(object sender, EventArgs e)
{
    this.Close();
}
```

How's that for simple? One line of code stops the application. This line tells the form to close itself (**this**).

With regard to application state, the **Done** button should be disabled during any editing. We want to make sure our users have saved any changes made to the database before stopping the application. This is easily controlled using the button's **Enabled** property. But there's a problem. We can keep the user from clicking **Done** at an inappropriate time, but we can't stop the user from using one of the three other ways to stop the application (control box, Alt-<F4>, x). And, we can't prevent the user from completely shutting down the Windows operating system! Fortunately, Visual C# provides a method that allows us to intercept any attempt to close a form and decide if that attempt is appropriate. The method is form's **FormClosing** event.

The **FormClosing** method is invoked prior to closing the form. We have been using this method to save changes to the database and close connections. Now, we'll add capability to insure the user can close the form. The **FormClosing** method has the form:

```
private void MyForm_FormClosing(object sender,  
FormClosingEventArgs e)  
{  
.  
.  
}  
}
```

The **e** argument (of type **FormClosingEventArgs**) has two properties: **e.Cancel** and **e.CloseReason**. If **e.Cancel** is **false**, when the method is exited, the closing continues. If **e.Cancel** is **true**, the closing process is canceled.

e.CloseReason tells us what invoked the closing event:

ApplicationExitCall The Exit method of the Application class was invoked.

FormOwnerClosing The owner form is closing.

None	The cause of the closure was not defined or could not be determined.
TaskManagerClosing	The Microsoft Windows Task Manager is closing the application.
UserClosing	The user is closing the form through the user interface (UI), for example by clicking the Close button on the form window, selecting Close from the window's control menu, or pressing ALT+F4.
WindowsShutDown	The operating system is closing all applications before shutting down.

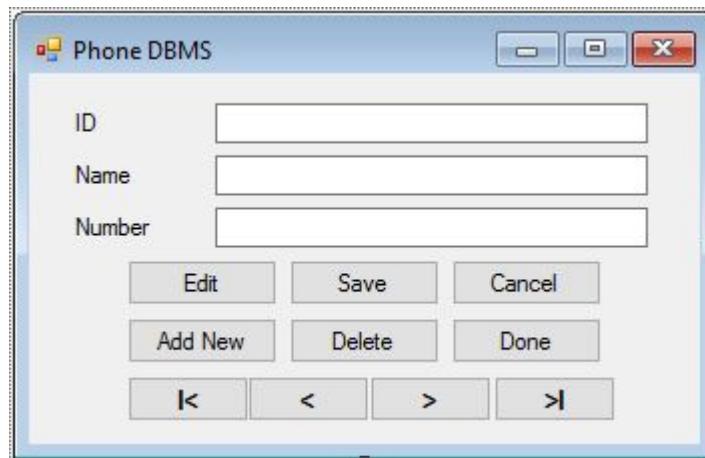
So, how do we use this event method? With regard to database management, we simply check to see if any editing functions are in progress. If so, we inform the user with a message box and cancel the closing process (set `e.Cancel` to `true`). If no editing is being done, we allow the closing to continue. That is, we do nothing. The next example illustrates its use.

Example 6-6

Stopping a Database Application

We add stopping ability to the phone database example we have been using.

1. Re-open Example 6-4 (the project version that doesn't modify the phone numbers). Add a button with a **Name** of **btnDone** and **Text** of **Done**. The form will look like this:



2. Place this code in the **btnDone_Click** method:

```
private void btnDone_Click(object sender, EventArgs e)
{
    this.Close();
}
```

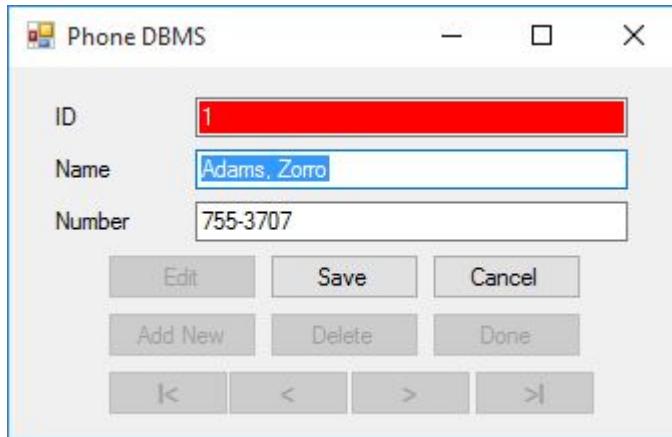
3. Modify the **SetState** method to set the **btnDone** button **Enabled** property to **true** in **View** mode, **false** in **Add/Edit** mode.
4. Add the shaded code to the **frmPhoneDB_Closing** method:

```
private void frmPhoneDB_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (myState.Equals("Edit") ||
    myState.Equals("Add"))
    {
        MessageBox.Show("You must finish the current
        edit
before stopping the application.", "",
MessageBoxButtons.OK, MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save the updated phone table
            OleDbCommandBuilder phoneAdapterCommands =
            new
OleDbCommandBuilder(phoneAdapter);
            phoneAdapter.Update(phoneTable);
        }
        catch (Exception ex)
        {
            MessageBox.Show("Error saving database to
            file:\r\n"
+ ex.Message, "Save Error", MessageBoxButtons.OK,
MessageBoxIcon.Error);
        }
        // close the connection
        phoneConnection.Close();
    }
}
```

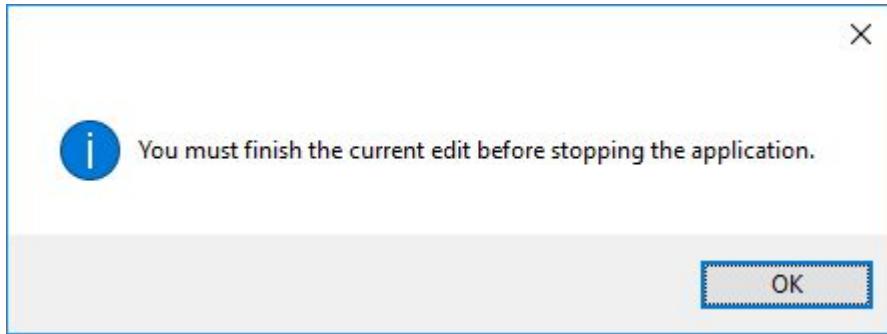
```
// dispose of the objects  
    phoneConnection.Dispose();  
    phoneCommand.Dispose();  
    phoneAdapter.Dispose();  
    phoneTable.Dispose();  
}  
}
```

If the application is in **Edit** or **Add** mode, the user is editing a record and we don't want the application to stop. We inform the user of the problem and cancel the closing process.

5. Save (saved in the **Example 6-6** folder in **VCSDB\VCSDB Code\Class 6** folder) the application and run it. Click **Edit**. Notice the **Done** button is disabled:



Click the **X** in the upper right corner of the form. This should not stop the application. This message box will appear:



Click **OK** to return to the database screen. Click **Cancel**. Now, try **X** again. The application should stop. Try the other ways (including the **Done** button) to stop the application, both in **View** mode and **Edit** mode. Make sure everything works properly.

Example 6-6

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Example 6-7

Authors Table Input Form

At long last, we can use our new database management knowledge to complete the input forms begun in Chapter 6 for the books database. In this example, we tackle the Authors Table. In the next example, we'll complete the Publishers Table. We will do the modifications in stages, testing each stage as we proceed.

Additional Navigation Capabilities

Recall, in Chapter 6, we stated that part of proper interface design was recognizing you might have omitted needed features. And, the Visual C# environment makes correcting these omissions a simple task. The Authors table input form only has two navigation buttons - one to move to the **Previous** record and one to move to the **Next** record. This may limit us. We will add the ability to move to the beginning and end of the data table. Adding these additional navigation capabilities is a good example of correcting an omission.

1. Load Example 5-8 (the last version of the **Authors** table input form). Add two buttons. Set these properties:

button1:

Name	btnFirst
Text	< First

button2:

Name	btnLast
Text	Last >

Change the **btnPrevious** button's **Text** to **< Previous** and **btnNext** button's **Text** to **Next >** (remove the = signs). The form looks like this:



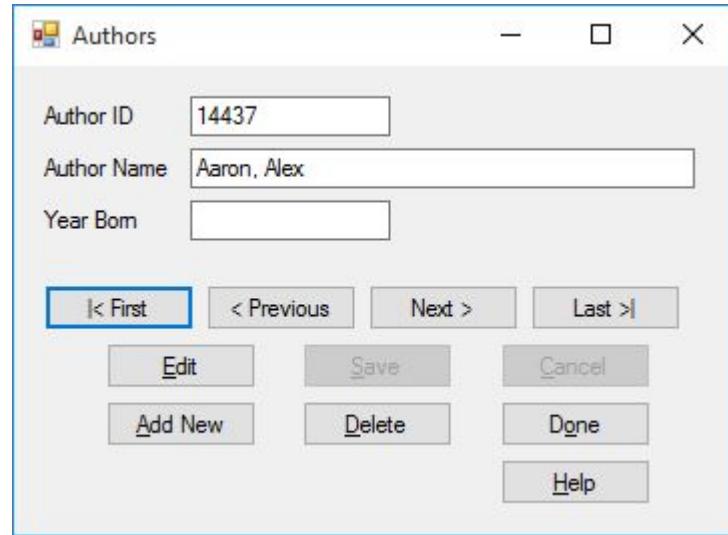
2. Add this code to the **btnFirst_Click** method:

```
private void btnFirst_Click(object sender, EventArgs e)
{
    authorsManager.Position = 0;
}
```

Add this code to the **btnLast_Click** method:

```
private void btnLast_Click(object sender, EventArgs e)
{
    authorsManager.Position = authorsManager.Count - 1;
}
```

3. Go to the **SetState** method. Make sure the **First** and **Last** buttons are enabled in **View** mode and disabled in **Add** and **Edit** mode (the same as the **Previous** and **Next** buttons).
4. Save the application (saved in the **Example 6-7** folder in **VCSDB\Code\Class 6** folder). Run it. You should see:



Make sure the new navigation buttons work correctly (both moving through the records and enabling/disabling as states change).

Editing Records

We now add editing capability and the corresponding abilities to save and/or cancel an edit.

1. Modify the `btnSave_Click` method to save edits and reposition the pointer to the edited record (new lines of code are shaded):

```
private void btnSave_Click(object sender, EventArgs e)
{
    if (!ValidateData())
    {
        return;
    }
    string savedName = txtAuthorName.Text;
    int savedRow;
    try
    {
        authorsManager.EndCurrentEdit();
        authorsTable.DefaultView.Sort = "Author";
        savedRow =
        authorsTable.DefaultView.Find(savedName);
        authorsManager.Position = savedRow;
        MessageBox.Show("Record saved.", "Save",
        MessageBoxButtons.OK, MessageBoxIcon.Information);
        SetState("View");
    }
    catch (Exception ex)
```

```
        {
            MessageBox.Show("Error saving record.", "Error",
                MessageBoxButtons.OK, MessageBoxIcon.Error);
        }
    }
```

2. Modify the **btnCancel_Click** method to restore controls if edit is canceled (new line of code is shaded):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    authorsManager.CancelCurrentEdit();
    SetState("View");
}
```

3. Add the shaded code to **frmAuthors_FormClosing** method to save any changes to the database file:

```
private void frmAuthors_FormClosing(object sender,
    FormClosingEventArgs e)
{
    try
    {
        // save changes to database
        OleDbCommandBuilder authorsAdapterCommands =
            new
        OleDbCommandBuilder(authorsAdapter);
        authorsAdapter.Update(authorsTable);
    }
    catch (Exception ex)
    {
```

```
    MessageBox.Show("Error saving database to file:  
    \r\n"  
+ ex.Message, "Save Error", MessageBoxButtons.OK,  
MessageBoxIcon.Error);  
}  
  
// close the connection  
booksConnection.Close();  
// dispose of the objects  
booksConnection.Dispose();  
authorsCommand.Dispose();  
authorsAdapter.Dispose();  
authorsTable.Dispose();  
}
```

4. Save the application. Run it. Make sure the **Edit** feature works - try changing an author's name. Make sure **Cancel** works properly.

Adding Records

We now implement the ability to add records to the database.

1. Add these lines in the form level declarations:

```
string myState;  
int myBookmark;
```

2. Add this line of code at the top of the **SetState** method:

```
myState = appState;
```

3. Modify the **btnAddNew_Click** method to add records (new code is shaded):

```
private void btnAddNew_Click(object sender, EventArgs e)  
{  
    try  
    {  
        myBookmark = authorsManager.Position;  
        authorsManager.AddNew();  
        SetState("Add");  
    }  
    catch (Exception ex)  
    {  
        MessageBox.Show("Error adding record.", "Error",  
        MessageBoxButtons.OK, MessageBoxIcon.Error);  
    }  
}
```

}

4. Modify the `btnCancel_Click` code to differentiate between canceling during Edit mode and Add mode (new code is shaded):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    authorsManager.CancelCurrentEdit();
    if (myState.Equals("Add"))
    {
        authorsManager.Position = myBookmark;
    }
    SetState("View");
}
```

5. Save the application and run it. Click Add New. Notice all text boxes are blank (including the Author ID box; recall this primary key value will be assigned by ADO .NET when the database is resaved). Type in a name and year (if desired). Click Save. You should see:



Click OK and the new record should be displayed. I added myself:

 Authors

Author ID

Author Name

Year Born

[|< First](#) [< Previous](#) [Next >](#) [Last >|](#)

[Edit](#) [Save](#) [Cancel](#)

[Add New](#) [Delete](#) [Done](#)

[Help](#)

Deleting Records

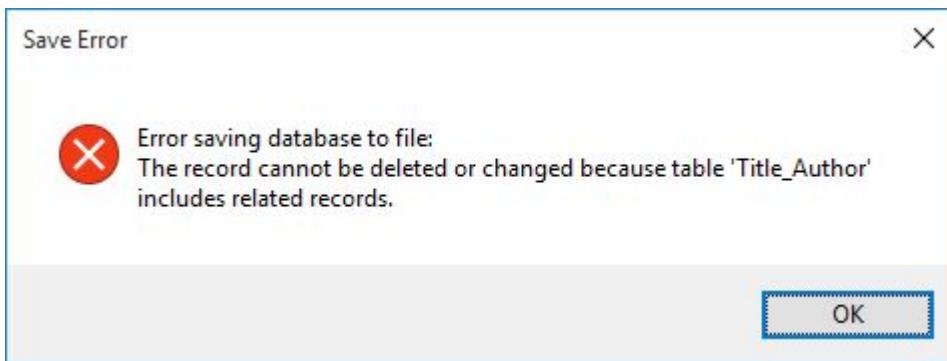
We now add the ability to delete records from the Authors table.

1. Modify the `btnDelete_Click` method to delete the record if the user responds Yes to the message box (new code is shaded):

```
private void btnDelete_Click(object sender, EventArgs e)
{
    DialogResult response;
    response = MessageBox.Show("Are you sure you want
        to
        delete this record?", "Delete",
    MessageBoxButtons.YesNo,
    MessageBoxIcon.Question,
    MessageBoxDefaultButton.Button2);
    if (response == DialogResult.No)
    {
        return;
    }
    try
    {
        authorsManager.RemoveAt(authorsManager.Position
    });
    }
    catch (Exception ex)
    {
        MessageBox.Show("Error deleting record.",
        "Error",
```

```
MessageBoxButtons.OK, MessageBoxIcon.Error);  
}  
}
```

2. Save the application and run it. Make sure both the Yes and No responses to the message box give the proper results. Only delete records you added in testing the Add New function. If you try to delete an original author in the table, you will see this message box when you stop the application (from the FormClosing event):



This is preventing you from deleting an author that is used by other tables. An author record can only be deleted if no other table uses it. This preserves your database's integrity.

Stopping the Application

The final modification step is to implement the correct stopping code.

1. Add the shaded code to the `frmAuthors_FormClosing` method to insure we don't close in the middle of an edit:

```
private void frmAuthors_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (myState.Equals("Edit") ||
    myState.Equals("Add"))
    {
        MessageBox.Show("You must finish the current
edit
before stopping the application.", "",

MessageBoxButtons.OK, MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save changes to database
            OleDbCommandBuilder authorsAdapterCommands =
new
OleDbCommandBuilder(authorsAdapter);
            authorsAdapter.Update(authorsTable);
        }
    }
}
```

```
        }
    catch (Exception ex)
    {
        MessageBox.Show("Error saving database to
file:
\r\n" + ex.Message, "Save Error",
MessageBoxButtons.OK,
MessageBoxIcon.Error);
    }
    // close the connection
    booksConnection.Close();
    // dispose of the objects
    booksConnection.Dispose();
    authorsCommand.Dispose();
    authorsAdapter.Dispose();
    authorsTable.Dispose();
}
}
```

2. Place this code in the `btnDone_Click` method:

```
private void btnDone_Click(object sender, EventArgs
e)
{
    this.Close();
}
```

3. Save the application and run it. Make sure the **Done** button works properly. Make sure you can't exit the application while in **Edit** or **Add** mode. Make sure all functions work properly.

The **Authors** Table Input Form application is now complete (final version is saved in the **Example 6-7** folder in **VCSDB\Code\Class 6**

folder). Hopefully, you see the great advantage in using the Visual C# interface to build and test an application. The event-driven nature allows building of the interface in stages. This greatly simplifies testing and debugging of the application. We will use this form as part of a complete books database management system in the final example of this chapter.

Example 6-7

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. Use the SQL Server version of Example 5-8.
2. In **frmAuthors_FormClosing**:

Change all instances of **OleDbCommandBuilder** to
SqlCommandBuilder

Example 6-8

Publishers Table Input Form

We now add database management capabilities to the Publishers Table Input Form developed in Example 5-9 in Chapter 5. This table, in conjunction with the Authors Table Input Form just completed, will be part of a complete books database management system. You will notice the steps are essentially identical to those followed for the Authors table.

Additional Navigation Capabilities

We add the ability to move to the beginning and end of the data table.

1. Open Example 5-9 (the Publishers table input form). Add two buttons. Set these properties:

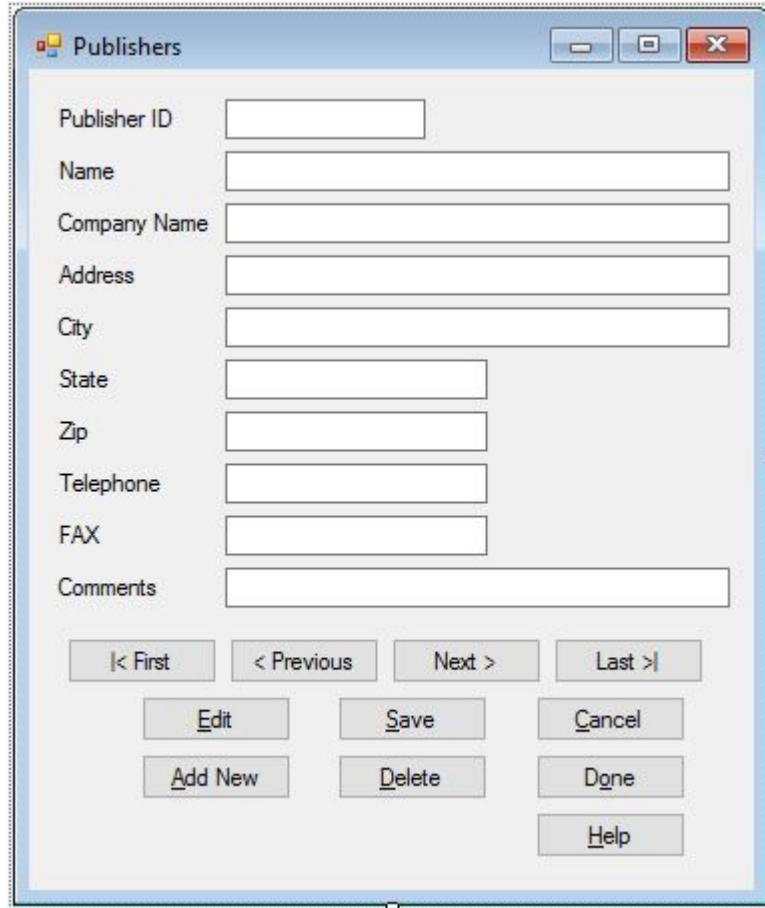
button1:

Name	btnFirst
Text	< First

button2:

Name	btnLast
Text	Last >

Change the **btnPrevious** button's **Text** to **< Previous** and **btnNext** button's **Text** to **Next >** (we just eliminated the = signs). The form looks like this:



2. Add this code to the `btnFirst_Click` method:

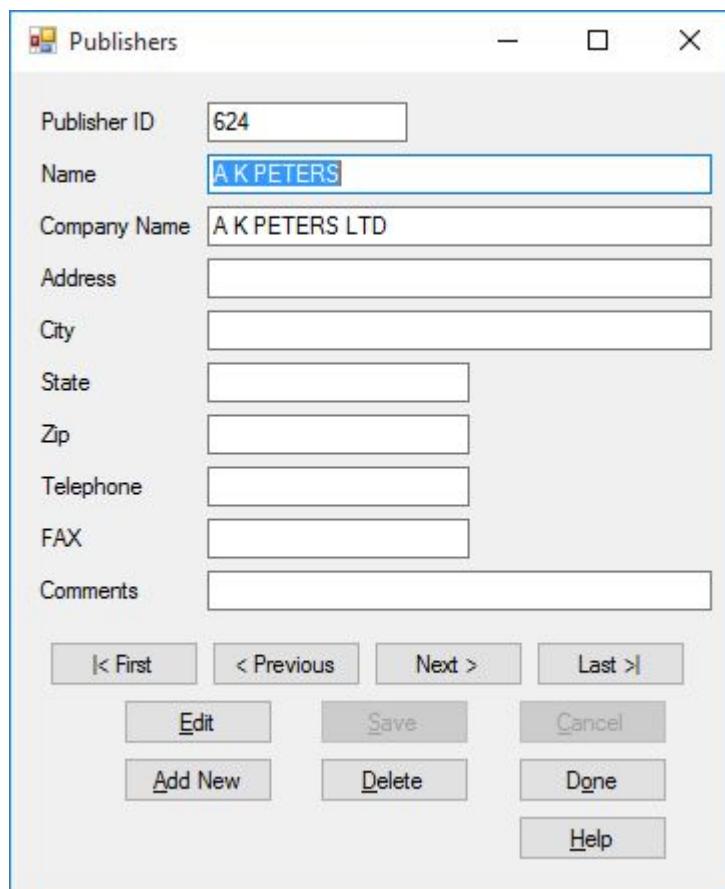
```
private void btnFirst_Click(object sender, EventArgs e)
{
    publishersManager.Position = 0;
}
```

Add this code to the `btnLast_Click` method:

```
private void btnLast_Click(object sender, EventArgs e)
{
    publishersManager.Position =
        publishersManager.Count - 1;
```

}

3. Go to the **SetState** method. Make sure the **First** and **Last** buttons are enabled in **View** mode and disabled in **Add** and **Edit** mode (the same as the **Previous** and **Next** buttons).
4. Save the application (saved in the **Example 6-8** folder in the **VCSDB\Code\Class 6** folder). Run it. You should see:



Make sure the new navigation buttons work correctly (both moving through the records and enabling/disabling as states change).

Editing Records

We now add editing capability and the corresponding abilities to save and/or cancel an edit.

1. Modify the `btnSave_Click` method to save edit and reposition pointer to the edited record (new lines of code are shaded):

```
private void btnSave_Click(object sender, EventArgs e)
{
    if (!ValidateData())
    {
        return;
    }
    string savedName = txtPubName.Text;
    int savedRow;
    try
    {
        publishersManager.EndCurrentEdit();
        publishersTable.DefaultView.Sort = "Name";
        savedRow =
            publishersTable.DefaultView.Find(savedName);
        publishersManager.Position = savedRow;
        MessageBox.Show("Record saved.", "Save",
            MessageBoxButtons.OK, MessageBoxIcon.Information);
        SetState("View");
    }
    catch (Exception ex)
```

```
        {
            MessageBox.Show("Error saving record.", "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error);
        }
    }
```

2. Modify the **btnCancel_Click** method to restore controls if edit is canceled (new line of code is italicized):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    publishersManager.CancelCurrentEdit();
    SetState("View");
}
```

3. Add the shaded code to the **frmPublishers_FormClosing** method to save any changes to the database file:

```
private void frmPublishers_FormClosing(object sender,
FormClosingEventArgs e)
{
    try
    {
        // save changes to database
        OleDbCommandBuilder publishersAdapterCommands =
        new
OleDbCommandBuilder(publishersAdapter);
        publishersAdapter.Update(publishersTable);
    }
    catch (Exception ex)
    {
```

```
        MessageBox.Show("Error saving database to file:  
        \r\n"  
        + ex.Message, "Save Error", MessageBoxButtons.OK,  
        MessageBoxIcon.Error);  
    }  
  
    // close the connection  
    booksConnection.Close();  
    // dispose of the objects  
    booksConnection.Dispose();  
    publishersCommand.Dispose();  
    publishersAdapter.Dispose();  
    publishersTable.Dispose();  
}
```

4. Save the application. Run it. Make sure the **Edit** feature works - try changing a publisher's name. Make sure **Cancel** works properly.

Adding Records

We now implement the ability to add records to the database.

1. Add these lines in the form level declarations:

```
string myState;  
int myBookmark;
```

2. Add this line of code at the top of the **SetState** method:

```
myState = appState;
```

3. Modify the **btnAddNew_Click** method to add records (new code is shaded):

```
private void btnAddNew_Click(object sender, EventArgs e)  
{  
    try  
    {  
        myBookmark = publishersManager.Position;  
        publishersManager.AddNew();  
        SetState("Add");  
    }  
    catch (Exception ex)  
    {  
        MessageBox.Show("Error adding record.", "Error",  
        MessageBoxButtons.OK, MessageBoxIcon.Error);  
    }  
}
```

}

4. Modify the `btnCancel_Click` code to differentiate between canceling during **Edit** mode and **Add** mode (new code is shaded):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    publishersManager.CancelCurrentEdit();
    if (myState.Equals("Add"))
    {
        publishersManager.Position = myBookmark;
    }
    SetState("View");
}
```

5. Save the application and run it. Click **Add New**. Again, all the text boxes are blank. The **Publisher ID** (a non-editable primary key) will be assigned once the database file is saved. Type in some information (add at least a **Name** value). Click **Save** and you will see:



Click **OK** and the new record will be displayed. I added my company (**KIDware**):

 Publishers

Publisher ID

Name

Company Name

Address

City

State

Zip

Telephone

FAX

Comments

Deleting Records

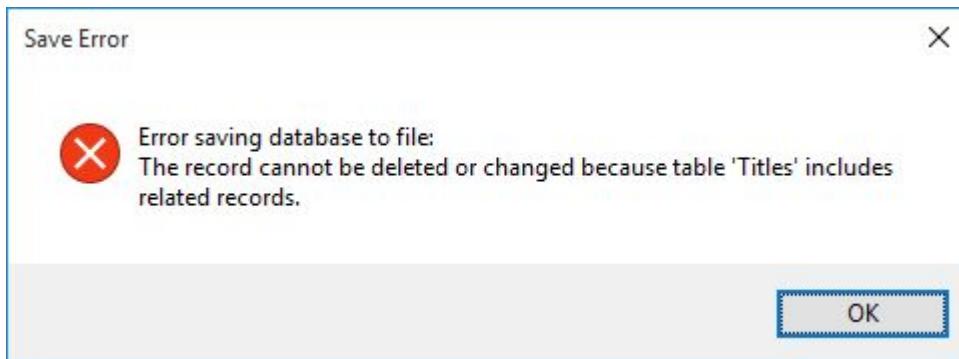
We now add the ability to delete records from the Publishers table.

1. Modify the `btnDelete_Click` method to delete the record if the user responds Yes to the message box (new code is shaded):

```
private void btnDelete_Click(object sender, EventArgs e)
{
    DialogResult response;
    response = MessageBox.Show("Are you sure you want
        to
        delete this record?", "Delete",
    MessageBoxButtons.YesNo,
    MessageBoxIcon.Question,
    MessageBoxButtons.DefaultButton.Button2);
    if (response == DialogResult.No)
    {
        return;
    }
    try
    {
        publishersManager.RemoveAt(publishersManager.Position
    );
    }
    catch (Exception ex)
    {
```

```
        MessageBox.Show("Error deleting record.",  
        "Error",  
        MessageBoxButtons.OK, MessageBoxIcon.Error);  
    }  
}
```

2. Save the application and run it. Make sure both the Yes and No responses to the message box give the proper results. Delete a record. Only delete records you added in testing the Add New function. If you try to delete an original publisher in the table, you will see this message box when you stop the application (from the FormClosing event):



You cannot delete publishers that are used by other tables. This would destroy the integrity of your database.

Stopping the Application

The final modification step is to implement the correct stopping code.

1. Add the shaded code to the `frmPublishers_FormClosing` method to insure we don't close in the middle of an edit:

```
private void frmPublishers_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (myState.Equals("Edit") ||
    myState.Equals("Add"))
    {
        MessageBox.Show("You must finish the current
edit
before stopping the application.", "",

MessageBoxButtons.OK, MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save changes to database
            OleDbCommandBuilder publishersAdapterCommands
            = new
OleDbCommandBuilder(publishersAdapter);
            publishersAdapter.Update(publishersTable);
```

```
        }
    catch (Exception ex)
    {
        MessageBox.Show("Error saving database to
file:
\r\n" + ex.Message, "Save Error",
MessageBoxButtons.OK,
MessageBoxIcon.Error);
    }
    // close the connection
    booksConnection.Close();
    // dispose of the objects
    booksConnection.Dispose();
    publishersCommand.Dispose();
    publishersAdapter.Dispose();
    publishersTable.Dispose();
}
}
```

2. Place this code in the `btnDone_Click` method:

```
private void btnDone_Click(object sender, EventArgs
e)
{
    this.Close();
}
```

3. Save the application and run it. Make sure the **Done** button works properly. Make sure you can't exit the application while in **Edit** or **Add** mode. Make sure all functions work properly.

The Publishers Table Input Form application is now complete (final version is saved in the **Example 6-8** folder in **VCSDB\Code\Class 6**

folder). We will use this form as part of a complete books database management system in the final example of this chapter.

Example 6-8

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. Use the SQL Server version of Example 5-9.
2. In **frmPublishers_FormClosing**:

Change all instances of **OleDbCommandBuilder** to
SqlCommandBuilder

Multiple Table Database Management

We have seen that adding database management capabilities to a single data table form is a straightforward process. There are certain methods for editing, adding, and deleting records. And, the ADO .NET database engine makes implementing these methods a simple task. Most databases, however, contain multiple tables within a single file. New complications arise when adding database management capabilities to these **relational databases**. Some things you need to do are:

- Display information from multiple tables on a single form
- Use a selected record to change information in another table or form
- Coordinate saving updates to many tables
- Handle more than one data adapter
- Provide access to other editing forms

In this section, we provide some general rules for attacking **multiple table database** management. The most important rule to follow in multiple table database management is the same rule followed with single tables. Understand your database application and what you are trying to do. Plan ahead. Be systematic in your application development. Understand how changes in one table may affect other tables. Use the Visual C# environment to your advantage. Do your development in stages and test each stage as you proceed. Try your ideas until things work like you want them to. You'll do lots of iterating on ideas you may have. Make sure the use of your application is obvious and intuitive to the user. As we said, these are the same rules followed with single tables. There are just more things to consider with multiple tables.

Database Keys

Recall **keys** connect tables in a relational database. **Primary** keys are unique one-to-one identifiers. **Foreign** keys are many-to-one identifiers used in various tables to point back to database information. You need to know which fields in your database are keys and whether they are primary or foreign. In our single table examples (the Authors table and Publishers table for the books database), we did not let the user modify the primary key (**Au_ID** and **PubID**) fields. These are numbers automatically assigned by the ADO .NET engine (auto-incrementing) to insure unique values. We continue that restriction here - the user will not be allowed to edit primary keys. In multiple table databases, the user will have the option to change foreign keys. This is acceptable.

Extra care concerning **keys** must be taken when deleting records in multiple table situation. If you delete a record (with a primary key) that foreign key entries in other records need, those ‘foreign’ records would lose the information provided by the deleted record. These are called **orphan** records - they are incomplete. This compromises the **integrity** of your database - not a good thing. For example, in the books database, if you delete a **Publisher** entry, all books in the **Titles** table using that publisher will no longer have access to the publisher’s information. Before you delete a record with a primary key, make sure no other records rely on the information needed by the ‘about to be deleted’ record. Fortunately, the ADO .NET engine helps you avoid orphans by not allowing data adapter updates (saving back to the original database) if needed primary key entries are deleted. We saw this with error message received in the Authors and Publishers table examples.

You may occasionally have ‘primary records’ not referred to by any ‘foreign record’. That’s acceptable; there is no loss of integrity in this case. The database just has an extra entry that may be used at some time.

Database Modifications

Since we are working with many database tables (and, hence, many data tables) at a time, we must always be aware of how changes in one particular data table may affect other data tables. This is where the power of the ADO .NET database engine can help or may come back to haunt you. As an example using the books database (and we'll see this in the next example), say you form a data table (using SQL) displaying book titles and publisher names (connecting two tables using `PubID`). If you change a publisher's name in that data table, the ADO .NET database engine will write that change in the Publishers table for every entry with the same `PubID`. Every book in the database with that particular publisher will be connected with the new publisher name. You may change thousands of records with one little entry! This is good if you really want to change the publisher name, but dangerous if it was an inadvertent change. So, as we said, be careful and systematic in building your interface with multiple tables.

There are also cases where you may have to coordinate changes among various database tables using C# code. This arises if you use controls that are not data bound or if you can't form a complete updateable data table using SQL. An example with the books database (Example 6-9) is related to the fact that there may be multiple authors for a particular book. We would like to display, edit, and update all authors in our data table. This cannot be done solely with SQL; we must also use code. There are no general rules for coordinating table modifications - every case is different. Just decide what you need to do and try to do it. If it works, great! If not, try again, using the Visual C# environment as your virtual test bench.

Final Application

The final application in this chapter will illustrate many of the operations just outlined for multiple table database management. This final application completes our books database application by incorporating the **Titles** and **Title_Author** table to tie everything together. It will make use of the Authors and Publishers forms built in earlier examples. Pay close attention to the steps followed to attack the application. You will encounter similar problems and operations in database applications you build in the future.

Be aware this is not the only possible way to incorporate the books database tables into a management system. We have our ways of doing things and you will develop your own ways. All programmers have their styles. Feel free to modify this example to fit your style.

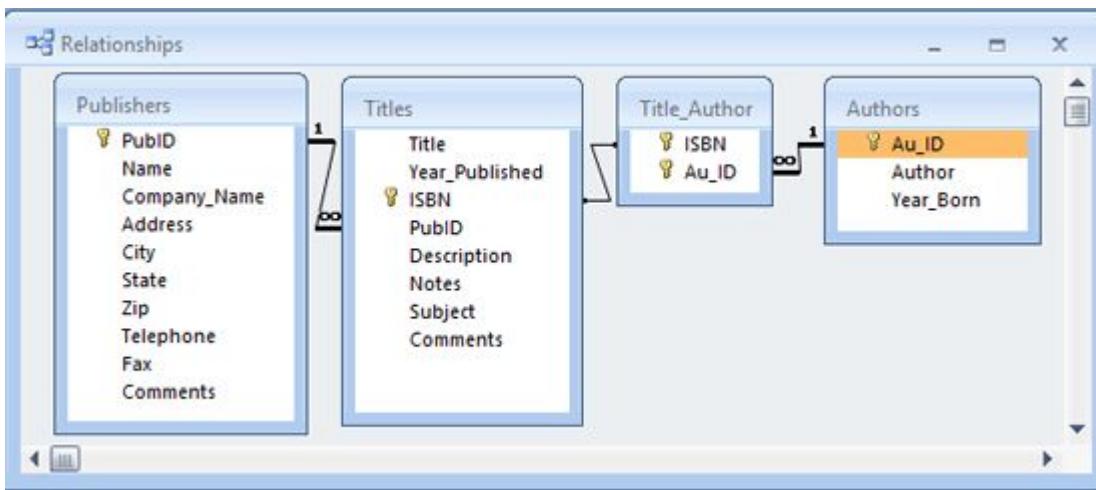
Example 6-9

Books Database Management System

In previous examples in this chapter, we have developed Visual C# forms (interfaces) that allow management of the **Authors** and **Publishers** tables in the books database. To complete this database management system, we need a form (it will rely on the Authors and Publishers forms) to allow a user to edit, add, and delete information about individual book titles. This involves using multiple tables (not only the **Authors** and **Publishers** tables, but also the **Titles** and **Title_Author** tables). We develop that final form in this example.

This is not a simple project. As such, we will proceed in stages checking our work as we go. This is very typical of the process followed in building complicated Visual C# projects. As we proceed, we will try to explain not only what we are doing, but also why we are doing it. We believe you will find this pedagogical approach is of benefit to you, the student trying to learn database management techniques.

As an aid in developing this database management system, we repeat a diagram first viewed in Chapter 2 that illustrates the four tables of the books database:



This table shows the fields for each table and how the database keys connect the tables. Referring to this table throughout this example will help you understand the steps we take.

Basic Book Titles Input Form

We begin by constructing and testing a basic input form for book titles. What information would we want to input about a book? Such basic information as title, date of publication, author, and publisher would be a start. Much of this information can be gleaned from the books database **Titles** table. Recall this is a table we haven't dealt with yet in building our application. This table has eight fields:

Title
Year_Published
ISBN
PubID
Description
Notes
Subject
Comments

The SQL statement needed by the command object to retrieve the fields (sorted by the **Title** field) is:

SELECT * FROM Titles ORDER BY Title

If this field's list had the author's name(s) and publisher name, it would be a complete list for an input form. But, it doesn't.

How do we get the author and publisher? We could use SQL to form a virtual view of the data using all of the tables in the books database. The **PubID** field, in conjunction with the **Publishers** table, will give us the Publisher's name. The **ISBN** field, in

conjunction with the **Title_Author** table (another one we haven't used yet) and the **Authors** table, can provide author information. We will ignore these omissions for now and just build a basic input form for the information in the **Titles** table. This will be a good first step.

Recall how (in Example 5-9) we built the **Publishers** input form by modifying the **Authors** input form, rather than starting from scratch. We'll follow that same approach here. We'll take a copy of the **Publishers** input form application and modify it to become the new **Titles** input form. You'll see how quick and easy such a modification is.

1. Make a copy of the Example 6-8 project folder (our final version of the **Publishers** input form). Rename the copied folder something else (I used **Example 6-9**). Open this resaved project. Rename the single form in the project **TitleForm.cs**. We now have a renamed copy of the **Publishers** input form to modify. Our first iteration on the **Titles** form will allow the input of seven fields:

Title, Year_Published, ISBN, Description, Notes, Subject, Comments

We have purposely not included **PubID** in this list. We will add it when we discuss obtaining a Publisher name in the next section of this example.

2. Open the form. Delete the label and text box controls for **Telephone**, **FAX**, and **Comments**. Change these properties on the existing form labels and text box controls:

frmPublishers (current name):

Name	frmTitles
Text	Titles

Label1 (current name):

Text Title

txtPubID (current name):

Name txtTitle
TabIndex 0
TabStop True

Label2 (current name):

Text Title

txtPubName (current name):

Name txtYear
TabIndex 1
TabStop True

Label3 (current name):

Text ISBN

txtCompanyName (current name):

Name txtISBN
TabIndex 2
TabStop True

Label4 (current name):

Text Description

txtPubAddress (current name):

Name txt Description
TabIndex 3
TabStop True

Label5 (current name):

Text Notes

txtPubCity (current name):

Name txtNotes
TabIndex 4
TabStop True

Label6 (current name):

Text Subject

txtPubState (current name):

Name txtSubject
TabIndex 5
TabStop True

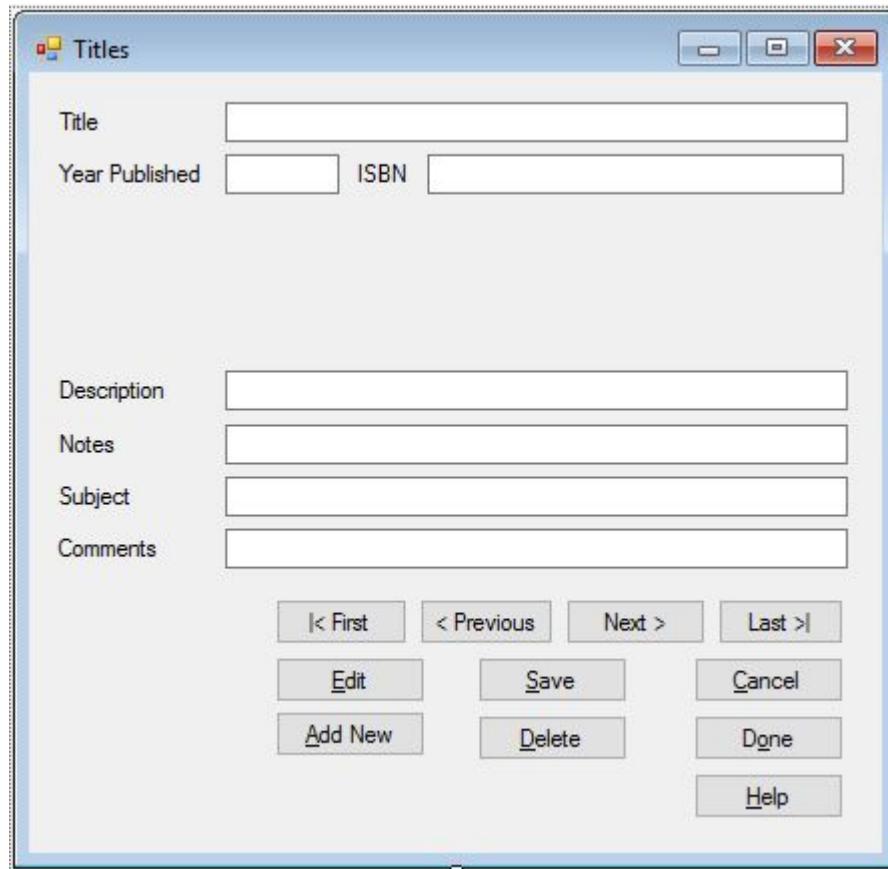
Label7 (current name):

Text Comments

txtPubZip (current name):

Name txtComments
TabIndex 6
TabStop True

3. Move the controls around and resize the form until it looks something like this:



I've moved the buttons at the bottom of the form too. We're saving space to add author and publisher information and a search capability at a later time.

4. We rename the data objects to reflect the **Titles** table. Make the shaded changes to the form level declarations:

```
OleDbConnection booksConnection;  
OleDbCommand titlesCommand;  
OleDbDataAdapter titlesAdapter;  
DataTable titlesTable;  
CurrencyManager titlesManager;  
string myState;  
int myBookmark;
```

5. Make the shaded changes to the form Load event method (you will have to reassign this method to the Load event):

```
private void frmTitles_Load(object sender, EventArgs e)
{
    try
    {
        // point to help file
        hlpPublishers.HelpNamespace =
            Application.StartupPath
        + "\\publishers.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        // establish command object
        titlesCommand = new OleDbCommand("SELECT * FROM
Titles
ORDER BY Title", booksConnection);
        // establish data adapter/data table
        titlesAdapter = new OleDbDataAdapter();
        titlesAdapter.SelectCommand = titlesCommand;
        titlesTable = new DataTable();
        titlesAdapter.Fill(titlesTable);
        // bind controls to data table
        txtTitle.DataBindings.Add("Text", titlesTable,
"Title");
        txtYear.DataBindings.Add("Text", titlesTable,
"Year_Published");
```

```

txtISBN.DataBindings.Add("Text", titlesTable,
    "ISBN");
txtDescription.DataBindings.Add("Text",
titlesTable, "Description");
txtNotes.DataBindings.Add("Text", titlesTable,
    "Notes");
txtSubject.DataBindings.Add("Text",
titlesTable, "Subject");
txtComments.DataBindings.Add("Text",
titlesTable, "Comments");
// establish currency manager
titlesManager =
(CurrencyManager)this.BindingContext[titlesTable];
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error establishing
Titles
table.", MessageBoxButtons.OK, MessageBoxIcon.Error);
    return;
}
this.Show();
SetState("View");
}

```

These changes reflect the new data object naming, the new SQL command string and the proper data binding for the text box controls. Yes, we know we're still pointing to the Publishers help system - we'll fix this later.

6. Make similar changes to the form **FormClosing** method (you will have to reassign this method to the **Load** event):

```
private void frmTitles_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (myState.Equals("Edit") ||
myState.Equals("Add"))
    {
        MessageBox.Show("You must finish the current
edit
before stopping the application.", "",
MessageBoxButtons.OK,
MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save changes to database
            OleDbCommandBuilder titlesAdapterCommands =
new
OleDbCommandBuilder(titlesAdapter);
            titlesAdapter.Update(titlesTable);
        }
        catch (Exception ex)
        {
            MessageBox.Show("Error saving database to
file:
\r\n" + ex.Message, "Save Error",
MessageBoxButtons.OK,
MessageBoxIcon.Error);
        }
    }
}
```

```

        // close the connection
        booksConnection.Close();
        // dispose of the objects
        booksConnection.Dispose();
        titlesCommand.Dispose();
        titlesAdapter.Dispose();
        titlesTable.Dispose();
    }
}

```

7. Make the shaded changes to the four methods for navigation:

```

private void btnFirst_Click(object sender, EventArgs e)
{
    titlesManager.Position = 0;
}

private void btnPrevious_Click(object sender,
EventArgs e)
{
    if (titlesManager.Position == 0)
    {
        Console.Beep();
    }
    titlesManager.Position--;
}

private void btnNext_Click(object sender, EventArgs e)
{
    if (titlesManager.Position == titlesManager.Count - 1)

```

```

{
    Console.Beep();
}
titlesManager.Position++;
}

private void btnLast_Click(object sender, EventArgs e)
{
    titlesManager.Position = titlesManager.Count - 1;
}

```

8. Eliminate code in the `txtInput_KeyPress` event (for now). We'll add code here when we're further along in the application development.
9. Change the `ValidateData` function to just three lines of code (for now):

```

private bool ValidateData()
{
    string message = "";
    bool allOK = true;
    return (allOK);
}

```

10. Modify the `SetState` method (new code is shaded):

```

private void SetState(string appState)
{
    myState = appState;
    switch (appState)
    {

```

```
case "View":  
    txtTitle.ReadOnly = true;  
    txtYear.ReadOnly = true;  
    txtISBN.ReadOnly = true;  
    txtISBN.BackColor = Color.White;  
    txtISBN.ForeColor = Color.Black;  
    txtDescription.ReadOnly = true;  
    txtNotes.ReadOnly = true;  
    txtSubject.ReadOnly = true;  
    txtComments.ReadOnly = true;  
  
    btnFirst.Enabled = true;  
    btnPrevious.Enabled = true;  
    btnNext.Enabled = true;  
    btnLast.Enabled = true;  
    btnAddNew.Enabled = true;  
    btnSave.Enabled = false;  
    btnCancel.Enabled = false;  
    btnEdit.Enabled = true;  
    btnDelete.Enabled = true;  
    btnDone.Enabled = true;  
  
    txtTitle.Focus();  
    break;  
  
default: // Add or Edit if not View  
    txtTitle.ReadOnly = false;  
    txtYear.ReadOnly = false;  
    txtISBN.ReadOnly = false;  
    if (myState.Equals("Edit"))  
    {  
        txtISBN.BackColor = Color.Red;  
        txtISBN.ForeColor = Color.White;
```

```

        txtISBN.ReadOnly = true;
        txtISBN.TabStop = false;
    }
else
{
    txtISBN.TabStop = true;
}
txtDescription.ReadOnly = false;
txtNotes.ReadOnly = false;
txtSubject.ReadOnly = false;
txtComments.ReadOnly = false;

btnFirst.Enabled = false;
btnPrevious.Enabled = false;
btnNext.Enabled = false;
btnLast.Enabled = false;
btnAddNew.Enabled = false;
btnSave.Enabled = true;
btnCancel.Enabled = true;
btnEdit.Enabled = false;
btnDelete.Enabled = false;
btnDone.Enabled = false;
txtTitle.Focus();
break;
}
}

```

This code reflects the new names on the text boxes. Also, we set **ReadOnly** to **true** for the **txtISBN** control **Edit** mode (and change it to red). This is the box where ISBN (a primary key identifying a book) is entered. Recall we will not allow editing of primary keys. We only want to enter a value here in **Add** mode.

11. Make the shaded changes to the `btnAddNew_Click`, `btnDelete_Click` and `btnCancel_Click` methods to reflect data object names:

```
private void btnAddNew_Click(object sender, EventArgs e)
{
    try
    {
        myBookmark = titlesManager.Position;
        titlesManager.AddNew();
        SetState("Add");
    }
    catch (Exception ex)
    {
        MessageBox.Show("Error adding record.", "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}

private void btnDelete_Click(object sender, EventArgs e)
{
    DialogResult response;
    response = MessageBox.Show("Are you sure you want
to
delete this record?", "Delete",
MessageBoxButtons.YesNo,
MessageBoxIcon.Question,
MessageBoxDefaultButton.Button2);
    if (response == DialogResult.No)
    {
```

```

        return;
    }
    try
    {
        titlesManager.RemoveAt(titlesManager.Position);
    }
    catch (Exception ex)
    {
        MessageBox.Show("Error deleting record.",
            "Error",
            MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}

private void btnCancel_Click(object sender, EventArgs e)
{
    titlesManager.CancelCurrentEdit();
    if (myState.Equals("Add"))
    {
        titlesManager.Position = myBookmark;
    }
    SetState("View");
}

```

12. Modify the `btnSave_Click` event method to reflect the new data objects and search the `Titles` table for the new record (we search on the first field, `Title`) following a save (new code is shaded):

```

private void btnSave_Click(object sender, EventArgs e)
{

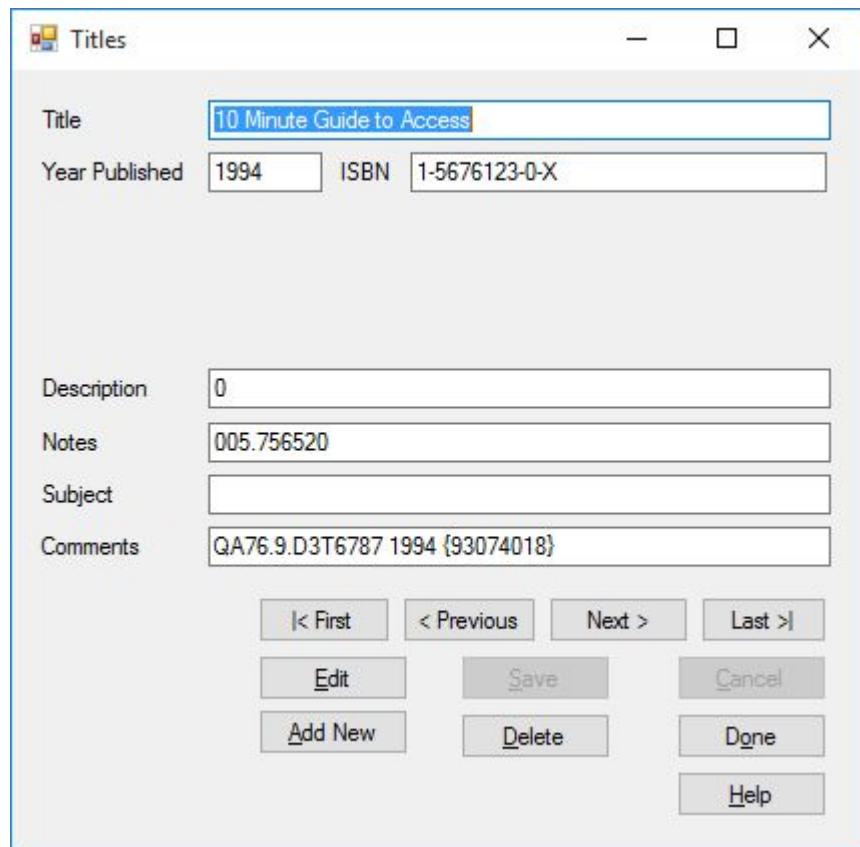
```

```

if (!ValidateData())
{
    return;
}
string savedName = txtTitle.Text;
int savedRow;
try
{
    titlesManager.EndCurrentEdit();
    titlesTable.DefaultView.Sort = "Title";
    savedRow =
        titlesTable.DefaultView.Find(savedName);
    titlesManager.Position = savedRow;
    MessageBox.Show("Record saved.", "Save",
        MessageBoxButtons.OK, MessageBoxIcon.Information);
    SetState("View");
}
catch (Exception ex)
{
    MessageBox.Show("Error saving record.", "Error",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
}

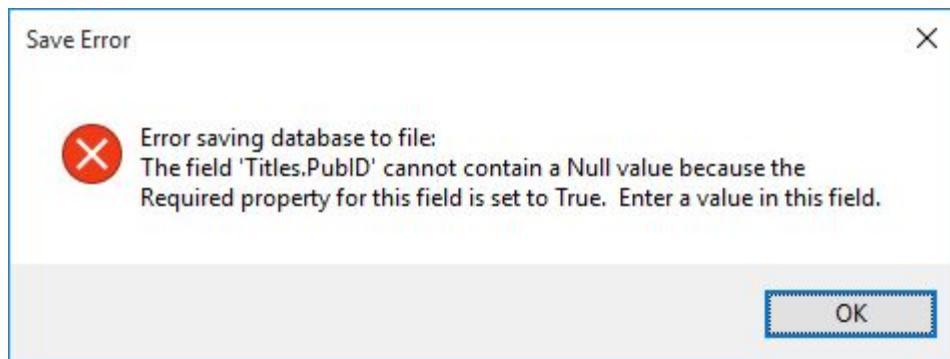
```

13. Save the application (saved in the **Example 6-9** folder in the **VCSDB\Code\Class 6** folder). Run it. You should see this form:



Scroll through the records using the navigation buttons. Try **editing** a record (make sure both the **Save** and **Cancel** functions work).

Try **adding** a record. Type a title and click **Save**. Then exit the application. You should see this error message:



This is our error trapping code telling us the new record can't be saved to the database because we haven't supplied a valid

Publisher ID. We'll fix this soon.

Finding Records

The **Titles** table has over 8,500 entries. If we wanted to edit an entry that began with the letter ‘N’, we would need to use the **Next** arrow about 4,000 times before we found the desired record! This is not acceptable. We need a faster way to locate records. We will add the ability to search for book titles that begin with certain letters. This will let a user get close to a title they might be looking for. And, while we are at it, we will add the ability to display the number of records in our data table. Users like to know how many records they are working with.

1. Add a group box at the lower left corner of the **Titles** input form. Place a label, a text box and button in the group box. Set these properties:

groupBox1:

Name	grpFindTitle
Text	Find Title

label1:

AutoSize	False
Text	Type first few letters of Title
TextAlign	TopCenter

text1:

Name	txtFind
TabStop	False

button1:

Name	btnFind
------	---------

Text	Find
TabStop	False

When done, the modified form should look like this:



2. In the **SetState** method, enable the **Find Title** group box in **View** mode, disable it in **Add** and **Edit** mode. Use the **grpFindTitle Enabled** property.
3. Add this code to the **btnFind_Click** event method:

```
private void btnFind_Click(object sender, EventArgs e)
{
    if (txtFind.Text.Equals(""))
    {
```

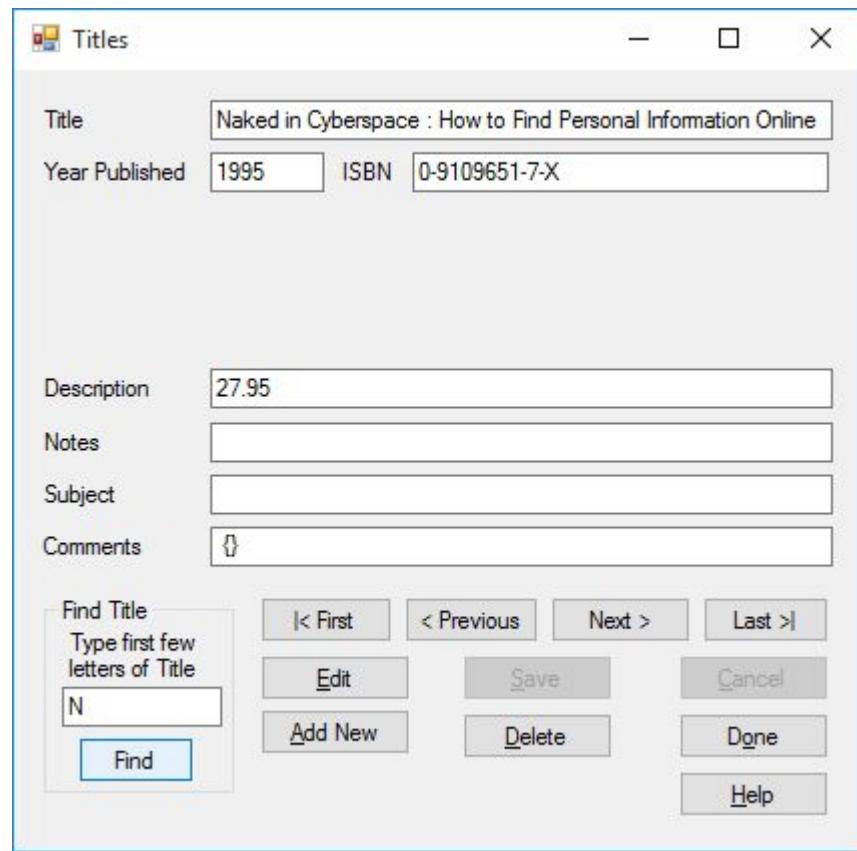
```

    return;
}
int savedRow = titlesManager.Position;
DataRow[] foundRows;
titlesTable.DefaultView.Sort = "Title";
foundRows = titlesTable.Select("Title LIKE '" +
txtFind.Text + "*'");
if (foundRows.Length == 0)
{
    titlesManager.Position = savedRow;
}
else
{
    titlesManager.Position =
titlesTable.DefaultView.Find(foundRows[0]["Title"]);
}
}

```

This routine first saves the position of the currency manager. It then uses the **Select** method of the data table to find all rows with a **Title** field **LIKE** the input letter(s) (we append the wild card character, *). If the search is not successful, the saved position is restored.

4. Save the application and run it. Type **N** in text box of the **Find Title** group box. Click **Find**. You should see the first N title:



Try other searches. Notice what happens when a search is not successful. Stop the application.

Navigation Information

We'll now add code to keep track of and display which record you are viewing and the total number of records in the **Titles** data table.

1. Add a general method named **SetText** to your application. Use this code:

```
private void SetText()
{
    this.Text = "Titles - Record " +
        (titlesManager.Position
        + 1).ToString() + " of " +
        titlesManager.Count.ToString()
        + " Records";
}
```

This sets the form **Text** property to reflect the current record (**Position**) and the total number of records (**Count**).

2. Add this single line of code at the bottom of the **frmTitles_Load** to initialize the display of the number of records:

```
SetText();
```

3. When we move to a new record, the currency manager position changes so we need to update the title bar information. Add this line of code at the end of the **btnFind_Click**, **btnFirst_Click**, **btnPrevious_Click**, **btnNext_Click** and **btnLast_Click** event methods:

```
SetText();
```

4. When we add, save or delete a record, the number of records and current position may change. Also, if we cancel adding a record, there will be changes. Add this line of code at the end of the `btnAddNew_Click`, `btnSave_Click`, `btnCancel_Click` and `btnDelete_Click` event methods to reflect this change:

```
SetText();
```

5. Save the application. Run it. Note navigation information is now displayed in the form's title bar area:



Later, when we add publisher and author information, we can see how adding records and deleting records changes the number of records.

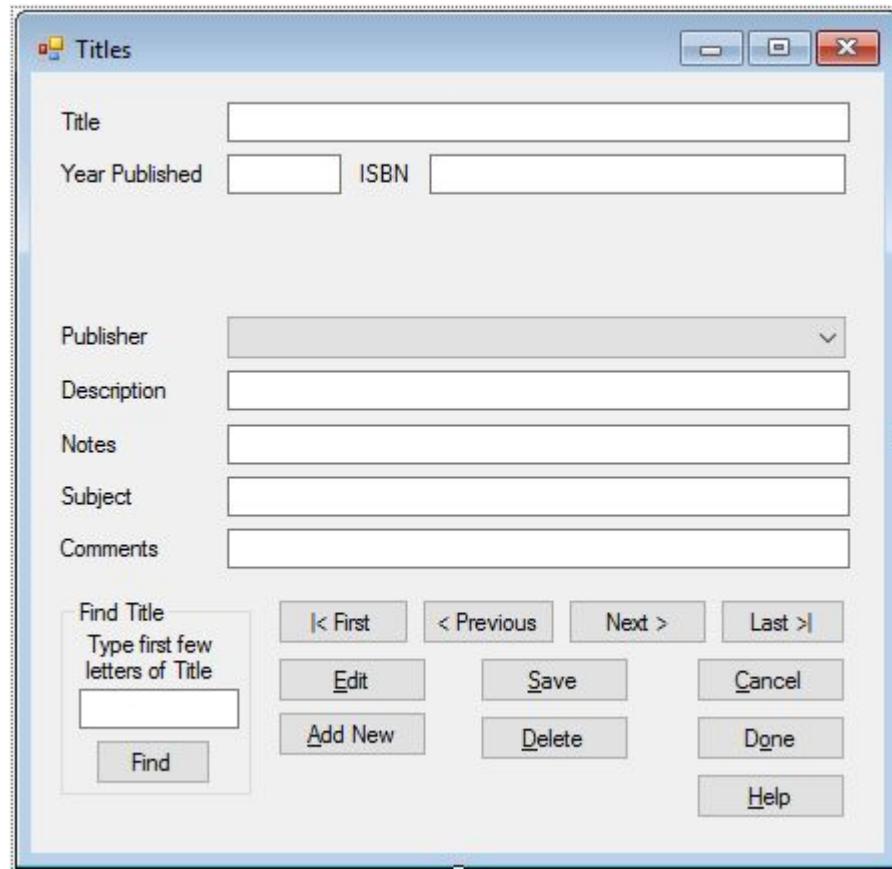
Adding Publisher Name

Earlier, when we tried to add and save a record to the **Titles** table, we received an error message stating no **PubID** field was supplied. We will correct that problem now. As indicated, each title in the books database requires a **PubID** (or Publisher identification) number. This is a foreign key related to the primary key in the **Publishers** table. This key tells us who the publisher of the book is.

For existing records, the **PubID** value is known and can be changed, since it is a foreign key. For added records, the user must supply a value. But, how does a user know the **PubID** value for a book's publisher? He or she probably doesn't. But, the user should know the name of the publisher. Rather than ask the user to supply a **PubID**, it would be preferable to have the user supply the name of the publisher and let the database engine supply the corresponding **PubID**. Similarly, when a user navigates to an existing record, we would prefer to see the publisher name rather than the corresponding **PubID** value.

Can we do this? Of course. Recall this is just what the **combo box**, studied in Chapter 5, can do for us. Go back and review that material. The basic idea is that we use the **Name** field of the **Publishers** table to fill the list portion of the combo box. When the user picks a name, we want the combo box to pass the corresponding **PubID** to the **Titles** table. Then, when a user navigates to a record, we want the corresponding **PubID** sent to the combo box to display the corresponding publisher name. Let's try it.

1. Add another label control and a combo box to the **Titles** input form. The form should look like this:



2. The new controls have these properties:

label1:

Text Publisher

comboBox1:

Name cboPublisher
BackColor White (changed so we can see values
 when Enabled is false)
DropDownStyle DropDownList

3. Add these lines in the form level declarations:

```
OleDbCommand publishersCommand;  
OleDbDataAdapter publishersAdapter;
```

```
DataTable publishersTable;
```

These are the objects we will use to populate the combo box with publishers.

4. Add the shaded code to the frmTitles_Load method to establish the proper binding of the combo box:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    try
    {
        // point to help file
        hlpPublishers.HelpNamespace =
            Application.StartupPath + "\\publishers.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        // establish command object
        titlesCommand = new OleDbCommand("SELECT * FROM
Titles
ORDER BY Title", booksConnection);
        // establish data adapter/data table
        titlesAdapter = new OleDbDataAdapter();
        titlesAdapter.SelectCommand = titlesCommand;
        titlesTable = new DataTable();
        titlesAdapter.Fill(titlesTable);
        // bind controls to data table
```

```
txtTitle.DataBindings.Add("Text", titlesTable,
"Title");
txtYear.DataBindings.Add("Text", titlesTable,
"Year_Published");
txtISBN.DataBindings.Add("Text", titlesTable,
"ISBN");
txtDescription.DataBindings.Add("Text",
titlesTable, "Description");
txtNotes.DataBindings.Add("Text", titlesTable,
"Notes");
txtSubject.DataBindings.Add("Text", titlesTable,
"Subject");
txtComments.DataBindings.Add("Text",
titlesTable, "Comments");
// establish currency manager
titlesManager =
(CurrencyManager)this.BindingContext[titlesTable];
// establish publisher table/combo box to pick
publisher
publishersCommand = new OleDbCommand("Select *
from Publishers ORDER BY Name",
booksConnection);
publishersAdapter = new OleDbDataAdapter();
publishersAdapter.SelectCommand =
publishersCommand;
publishersTable = new DataTable();
publishersAdapter.Fill(publishersTable);
cboPublisher.DataSource = publishersTable;
cboPublisher.DisplayMember = "Name";
cboPublisher.ValueMember = "PubID";
cboPublisher.DataBindings.Add("SelectedValue",
titlesTable, "PubID");
}
```

```

    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error establishing
        Titles
        table.", MessageBoxButtons.OK, MessageBoxIcon.Error);
        return;
    }
    this.Show();
    SetState("View");
    SetText();
}

```

Let's review what we did here in the added code. The first few lines are used to get a **publishersTable** object (the **Publishers** table in the books database) to bind the combo box to (**DataSource** property). These should be familiar steps by now. The drop-down list portion of the combo box will display the **Name** field (**DisplayMember** property) from the **Publisher** table. The displayed names in the combo box correspond to the **PubID** field (**ValueMember** property). The last line in the added code is the key to everything:

```

cboPublisher.DataBindings.Add("SelectedValue",
titlesTable, "PubID");

```

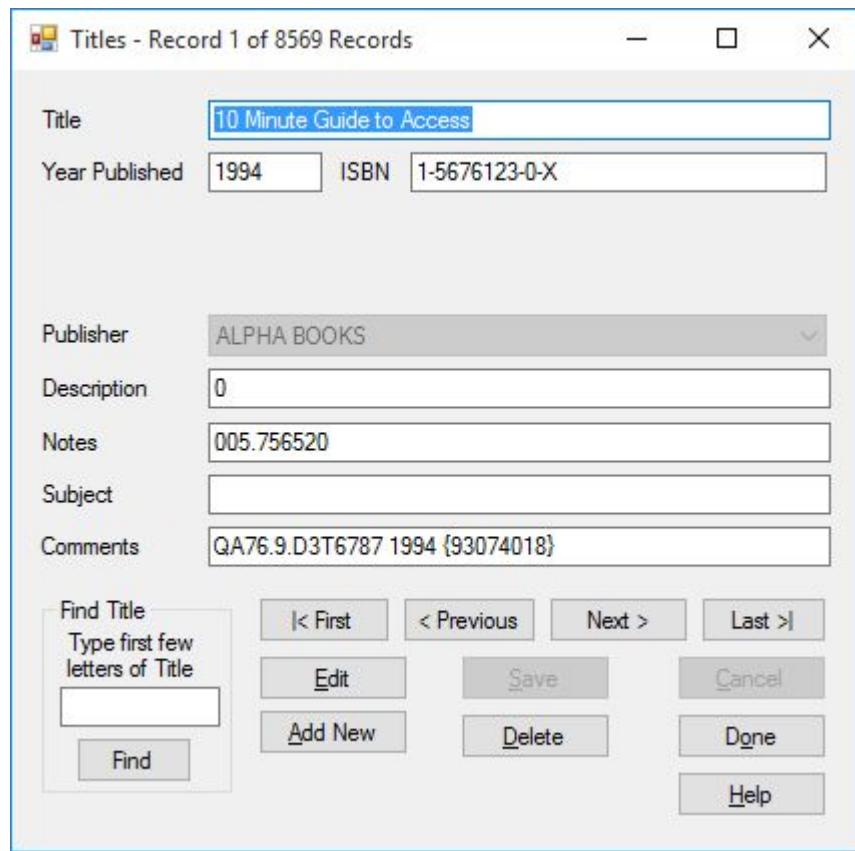
This statement binds the **SelectedValue** property of the combo box (which holds the value of the **PubID**) to the **PubID** field in the **titlesTable** object. This insures that when a title is displayed, the proper publisher is displayed and when the user picks a publisher name, the **Titles** table will get the proper **PubID** value.

5. Add the shaded lines to the **frmTitles_Closing** event method to dispose of the newly added objects:

```
private void frmTitles_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (myState.Equals("Edit") ||
myState.Equals("Add"))
    {
        MessageBox.Show("You must finish the current
edit
before stopping the application.", "",
MessageBoxButtons.OK, MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save changes to database
            OleDbCommandBuilder titlesAdapterCommands =
new
OleDbCommandBuilder(titlesAdapter);
            titlesAdapter.Update(titlesTable);
        }
        catch (Exception ex)
        {
            MessageBox.Show("Error saving database to
file:
\r\n" + ex.Message, "Save Error",
MessageBoxButtons.OK,
MessageBoxIcon.Error);
        }
        // close the connection
    }
}
```

```
        booksConnection.Close();
        // dispose of the objects
        booksConnection.Dispose();
        titlesCommand.Dispose();
        titlesAdapter.Dispose();
        titlesTable.Dispose();
        publishersCommand.Dispose();
        publishersAdapter.Dispose();
        publishersTable.Dispose();
    }
}
```

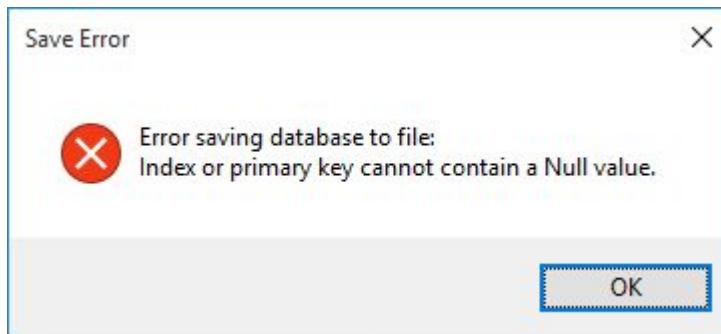
6. Modify the **SetState** method so the combo box is disabled in **View** mode and enabled in **Add** and **Edit** modes.
7. Save the application and run it. You should now see a **Publisher** listed (it is ‘grayed out’ since it can’t be edited in **View** mode):



Scroll through the records and notice how the combo box properly displays the publisher name. Click the drop-down arrow in the combo box and notice that the displayed name is highlighted (selected) among the order choices. Press **<Esc>** to make the drop-down box go away.

8. Let's try changing a publisher. Write down the name of the publisher for the displayed record. Click **Edit**. Click the drop-down arrow for the combo box. (When the drop-down box is displayed, you can press the first letter of the name, if you know it, for faster navigation among the names. This only works in **Edit** mode, the list is disabled in **View** mode.) Click on a new publisher. Click **Save**. Your book now has a new publisher - it's that easy. Change the name back to the correct one. You should make sure the **Cancel** option operates correctly too.
9. Let's try adding a title (including publisher) to the database. Click **Add New**. Type in a **Title** and select a **Publisher**. Click

Save. Close the application, trying to write the changes back to the database. Did this show up?

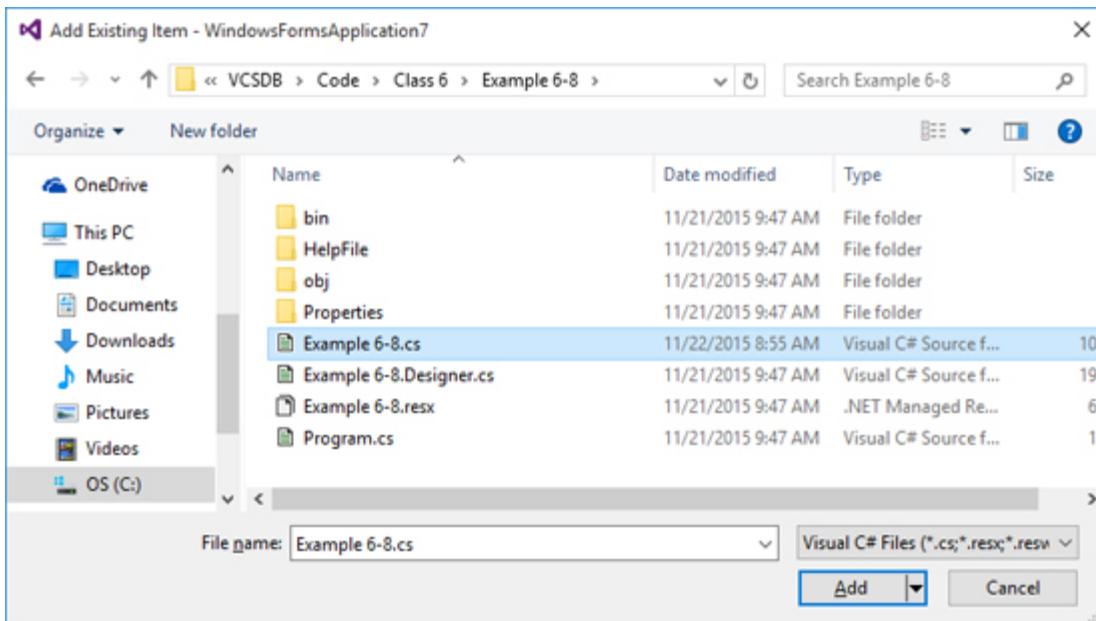


The primary key it is referring to is the **ISBN** field. This is the primary key identifying every title in the **Titles** table. We must supply a value. Start the application again. Click **Add New**. Type in some value for **ISBN** (don't worry what it is). Click **Save**. Your new book has been added to the database. Notice, too, that the number of records (in the title bar) has increased by one. Delete the book you just added. Use the **Find Title** feature, if needed. Stop the application

Adding Publisher Editing

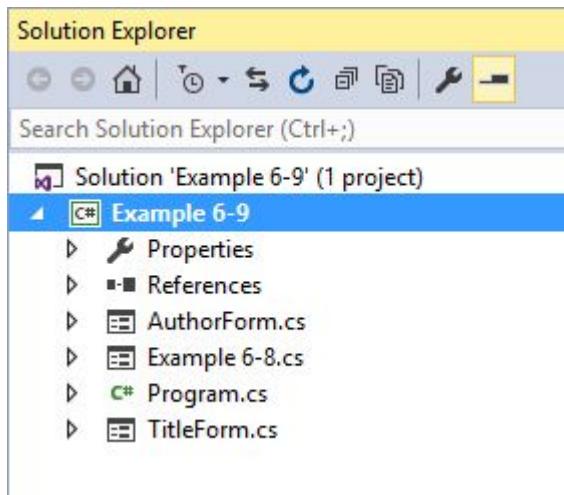
What if the user can't find the publisher they want in the drop-down list? This could often happen when adding new titles to the database. If the desired publisher name is not in the list, we need to either edit a current entry or add a new entry to the **Publishers** table. Once the new publisher name is in the Publishers table, it will be available for use in the **Titles** input form. And, guess what? We've already built the form that lets us edit the **Publishers** table in Example 6-8.

1. Add the form built in Example 6-8 to the current project. To do this, click the **Project Menu** item and choose **Add Existing Item**. This dialog should appear:



As shown, navigate to the **Example 6-8** project folder (you may have named it something else) and select the **cs** file (not the **Designer.cs** file) in that folder. Click **Add**.

The file will appear in the **Solution Explorer** window as part of the project:



Rename this form **PublisherForm.cs**.

2. In the **PublisherForm.cs** and **PublisherForm.Designer.cs** files, change **namespace Example_6_8** to **namespace Example_6_9**. This allows us to properly reference this file.
3. On the **Titles** input form, add a button to the left of the **Help** button. Give it a **Name** property of **btnPublishers** and a **Text** property of **&Publishers**. Add this code to the **btnPublishers_Click** event:

```
private void btnPublishers_Click(object sender,
EventArgs e)
{
    frmPublishers pubForm = new frmPublishers();
    string pubSave = cboPublisher.Text;
    pubForm.ShowDialog();
    pubForm.Dispose();
    // need to regenerate publishers data
    booksConnection.Close();
    booksConnection = new
```

```

OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSD\\Working\\BooksDB.accdb");
booksConnection.Open();
publishersAdapter.SelectCommand =
publishersCommand;
publishersTable = new DataTable();
publishersAdapter.Fill(publishersTable);
cboPublisher.DataSource = publishersTable;
cboPublisher.Text = pubSave;
}

```

This code displays the **Publishers** input form to allow any editing necessary. Before displaying the form, the current publisher choice is saved (**pubSave**). When the **Titles** form becomes active again, there may be new values in the database (from editing the **Publishers** table). To see these changes, we close our connection to the database, then reopen it, recreating the **publishersTable** object bound to the publisher combo box. We then reset the combo box to the saved value.

4. Save the application and run it. Click **Add New**. A blank record appears. Type a book **Title** and an **ISBN**. Assume the publisher name you want is not in the drop-down list. Click the **Publishers** button. The **Publishers** input form appears. Click **Add New**. Add a publisher using this input form. Click **Save**. Click **Done**. The **Titles** form reappears. You should still be in **Add** mode with your new title displayed. Click the drop-down button and pick your new publisher. Click **Save**. Your new book title is saved and your newly added publisher will be available for all future users. The database engine does all the saving work. Here's my form after adding a new book with a new publisher:

Screenshot of a Windows application window titled "Titles - Record 4792 of 8570 Records". The window contains fields for "Title" (containing "My New Book"), "Year Published" (empty), and "ISBN" (empty). Below these are fields for "Publisher" (set to "Super KIDware"), "Description" (empty), "Notes" (empty), "Subject" (empty), and "Comments" (empty). At the bottom left is a "Find Title" search interface with a text input field ("Type first few letters of Title") and a "Find" button. To the right are navigation buttons: "< First", "< Previous", "Next >", and "Last >". Below these are buttons for "Edit", "Save", "Cancel", "Add New", "Delete", "Done", "Publishers", and "Help".

Don't try using the Publisher Input Form **Help** button yet. It may not work, but we'll fix that at the end of this chapter. And, there is one other problem with the **Publishers** input form you may or may not have noticed. We earlier noted the same problem with the **Titles** form. The **Publishers** form has many entries. If you want to find a particular one, the only tools at your disposal are the four navigation buttons. Let's add a find capability identical to that used in the **Titles** table. That is, if the user types the first few letters of a Publishers name, the program will find the record. And, while we're at it, let's also add the ability to display the navigational information (current record and number of records). And, since we'll need the same capabilities for the **Authors** input form, we'll make the same changes on that form, too.

Modify Publishers Input Form

1. Make sure the Publishers (saved as `frmPublisher.cs`) input form is in the Visual C# design window. Add a group box to the lower left corner of the form. Place a label, a text box and button in the group box. Set these properties:

groupBox1:

Name grpFindPublisher
Text Find Publisher

label1:

AutoSize False
Text Type first few letters of Publisher Name

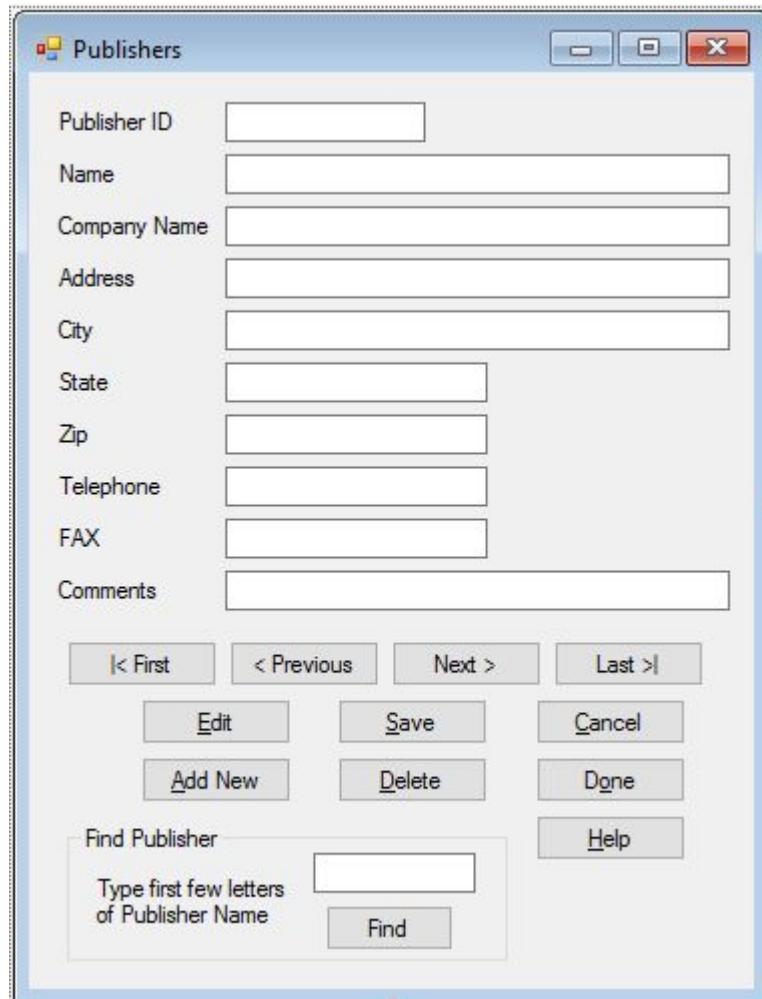
textBox1:

Name txtFind
TabStop False

button1:

Name btnFind
Text Find
TabStop False

When done, the modified form should look like this (I had to make my form a little longer):



2. In the **SetState** method, enable the **Find Publisher** group box in **View** mode, disable it in **Add** and **Edit** mode. Use the **grpFindPublisher Enabled** property.
3. Add this code to the **btnFind_Click** event method:

```
private void btnFind_Click(object sender, EventArgs e)
{
    if (txtFind.Text.Equals(""))
    {
        return;
    }
```

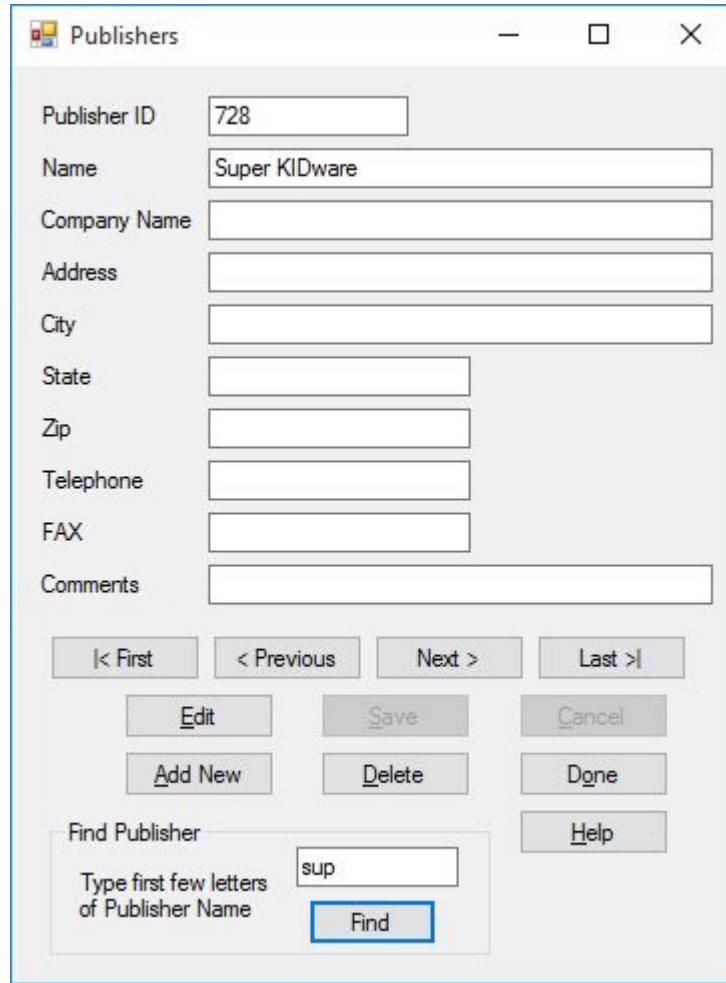
```

int savedRow = publishersManager.Position;
DataRow[] foundRows;
publishersTable.DefaultView.Sort = "Name";
foundRows = publishersTable.Select("Name LIKE '" +
txtFind.Text + "*'");
if (foundRows.Length == 0)
{
    publishersManager.Position = savedRow;
}
else
{
    publishersManager.Position =
publishersTable.DefaultView.Find(foundRows[0]
["Name"]);
}
}

```

This code is identical to that used in the **Titles** table. It first saves the position of the currency manager. It then uses the **Select** method of the data table to find all rows with a **Name** field **LIKE** the input letter(s) (we append the wild card character, *****). If the search is not successful, the saved position is restored.

4. Save the form. Rerun the **Titles** table application. Click **Publishers**. Try out the **Find** function. Make sure it works properly. Here, I found KIDware:



Click **Done**. Stop and save the application.

We'll now add code to keep track of and display the number of records in the **Publishers** data table.

1. Add a general method named **SetText** to your application. Use this code:

```
private void SetText()
{
    this.Text = "Publishers - Record " +
    (publishersManager.Position + 1).ToString() + " of "
    +
    publishersManager.Count.ToString() + " Records";
```

```
}
```

This sets the form **Text** property to reflect the current record (**Position**) and the total number of records (**Count**).

2. Add this single line of code at the bottom of the **frmPublishers_Load** to initialize the display of the number of records:

```
SetText();
```

3. When we move to a new record, the currency manager position changes so we need to update the title bar information. Add this line of code at the end of the **btnFind_Click**, **btnFirst_Click**, **btnPrevious_Click**, **btnNext_Click** and **btnLast_Click** event methods:

```
SetText();
```

4. When we add, save or delete a record, the number of records and current position may change. Also, if we cancel adding a record, there will be changes. Add this line of code at the end of the **btnAddNew_Click**, **btnSave_Click**, **btnCancel_Click** and **btnDelete_Click** event methods to reflect this change:

```
SetText();
```

5. Save the form and run the application. Click **Publishers**. Note navigation information is now displayed in the form's title bar area:



As you add or delete publishers, this number will change. Add a phony publisher, then delete it to make sure this feature works. When done, stop and save the application.

Modify Authors Input Form

We will soon need the ability to edit, add, and delete authors in the books database **Authors** table. We will want the ability to search using the Authors input form and know how many records there are. So, we'll now modify the Authors input form in the same manner we just modified the Publishers input form. Then, the modified form will be available for author editing.

1. Add the form from Example 6-7 (the last incarnation of the Authors input form; you may have saved it in a different location) to the current project. Save this form as **AuthorForm.cs**.
2. In the **AuthorForm.cs** and **AuthorForm.Designer.cs** files, change namespace **Example_6_7** to namespace **Example_6_9**. This allows us to properly reference this file.
3. Add a group box to the lower left corner of the form. Place a label, a text box and button in the group box. Set these properties:

groupBox1:

Name	grpFindAuthor
Text	Find Author

label1:

AutoSize	False
Text	Type first few letters of Author Name

textBox1:

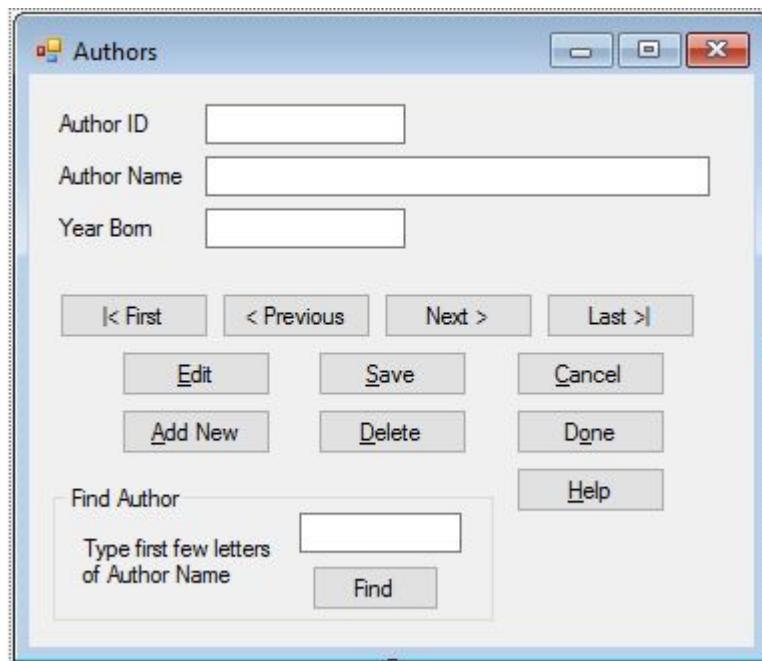
Name	txtFind
------	---------

TabStop False

button1:

Name btnFind
Text Find
TabStop False

When done, the modified form should look like this (I had to make my form a little longer):



4. In the **SetState** method, enable the **Find Author** group box in **View** mode, disable it in **Add** and **Edit** mode. Use the **grpFindAuthor Enabled** property.
5. Add this code to the **btnFind_Click** event method:

```
private void btnFind_Click(object sender, EventArgs e)
{
    if (txtFind.Text.Equals(""))
    {
```

```

    return;
}
int savedRow = authorsManager.Position;
DataRow[] foundRows;
authorsTable.DefaultView.Sort = "Author";
foundRows = authorsTable.Select("Author LIKE '" +
txtFind.Text + "*'");
if (foundRows.Length == 0)
{
    authorsManager.Position = savedRow;
}
else
{
    authorsManager.Position =
authorsTable.DefaultView.Find(foundRows[0]
["Author"]);
}
}

```

This code is identical to that used in the **Titles** and **Publishers** table. It first saves the position of the currency manager. It then uses the **Select** method of the data table to find all rows with a **Author** field **LIKE** the input letter(s) (we append the wild card character, *). If the search is not successful, the saved position is restored.

6. Save the form. Go to the Solution Explorer window and open the **Program.cs** file. Make the shaded change in the **Main** method:

```

static void Main()
{
    Application.EnableVisualStyles();

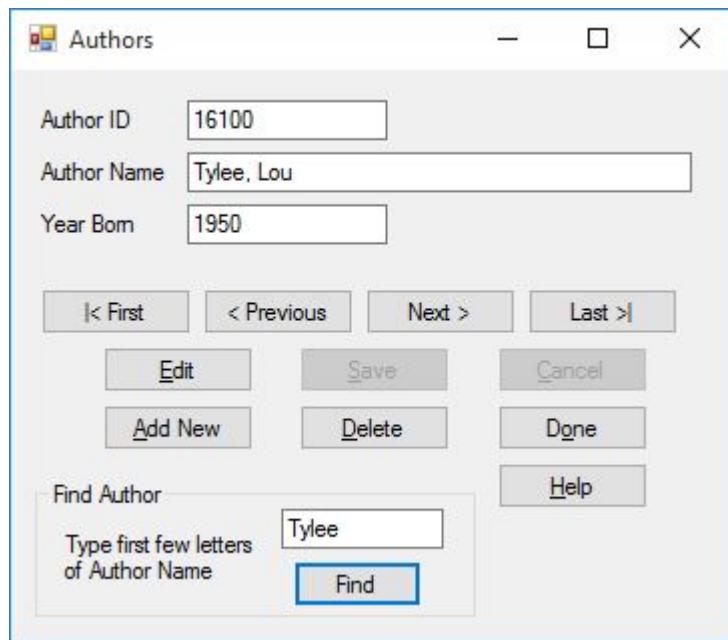
```

```

Application.SetCompatibleTextRenderingDefault(false);
Application.Run(new frmAuthors ());
}

```

We are temporarily changing the startup form to test our changes to the **Authors** input form. Run the application. The Authors form should appear. Try out the **Find** function. Make sure it works properly. Here, I found myself (added a while back):



Click **Done**. Stop and save the application. Like the Publisher form, the Author form's **Help** button may not work yet, but it will before we finish the application.

We'll now add code to keep track of and display the number of records in the **Authors** table.

1. Add a general method named **SetText** to your application. Use this code:

```
private void SetText()
```

```
{  
    this.Text = "Authors - Record " +  
    (authorsManager.Position + 1).ToString() + " of " +  
    authorsManager.Count.ToString() + " Records";  
}
```

This sets the form **Text** property to reflect the current record (**Position**) and the total number of records (**Count**).

2. Add this single line of code at the bottom of the **frmAuthors_Load** to initialize the display of the number of records:

```
SetText();
```

3. When we move to a new record, the currency manager position changes so we need to update the title bar information. Add this line of code at the end of the **btnFind_Click**, **btnFirst_Click**, **btnPrevious_Click**, **btnNext_Click** and **btnLast_Click** event methods:

```
SetText();
```

4. When we add, save or delete a record, the number of records and current position may change. Also, if we cancel adding a record, there will be changes. Add this line of code at the end of the **btnAddNew_Click**, **btnSave_Click**, **btnCancel_Click** and **btnDelete_Click** event methods to reflect this change:

```
SetText();
```

5. Save the form and run the application. Note navigation information is now displayed in the form's title bar area:



As you add or delete Authors, this number will change. Add a phony Author, then delete it to make sure this feature works. When done, stop the application. In **Program.cs**, reset the **startup form to frmTitles**. Make sure it is saved. We leave this example for a bit, while we build a little ‘helper’ project.

Adding Author Names

This marathon example continues. We're ready to add **author names** to the **Titles** input form. Notice we say author names, not name. That is, books may have more than one author. This fact makes managing author names a difficult task. Difficult, but not impossible. Let's begin to tackle the problem.

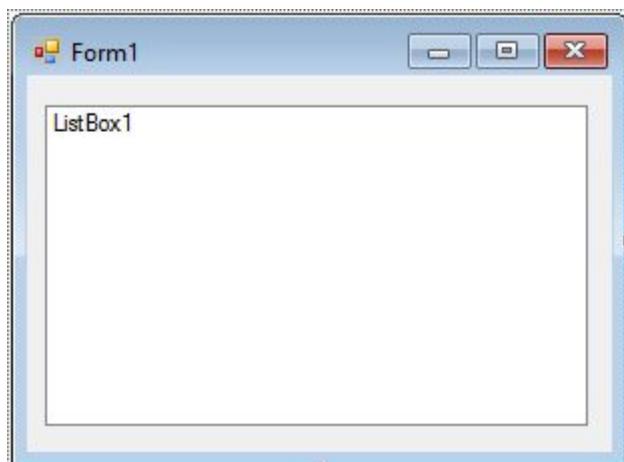
First, you might be asking how do we know there may be more than one author listed for a particular book title? If you go way back to Chapter 2, where we took our first look at the books database, note there were **8,569** titles in the **Titles** table, meaning there are 8,569 unique **ISBN** values (the primary key). Yet, in the **Title_Author** table, matching **ISBN** values with author identification numbers (**Au_ID**), there are **16,056** entries! This means there is not a unique **Au_ID** value for each **ISBN** value. This database obviously allows multiple **Au_ID** values for each **ISBN** value.

The next question is: how many authors could be listed for each title? We need to know this to build our input form. Unfortunately, the answer to this question is not obvious, unless the person who built the database is around to ask. But, using our Visual C# database programming skills, we can play detective and find out the answer. We build a little project that opens the books database and goes through the **Title_Author** table counting how many authors are listed for each title (**ISBN** value). You might think this is a daunting task, but Visual C# makes it simple.

Example 6-10

Database Detective - Author Search

1. Again, make sure the Books DBMS Project ([Example 6-9](#)) is saved. Start a new project. Add a list box control (ListBox1). We won't worry about setting proper properties. My form looks like this:



2. Add this line at the top of the code window:

```
using System.Data.OleDb;
```

3. Put this code in the `Form1_Load` event method:

```
private void Form1_Load(object sender, EventArgs e)
{
    OleDbConnection booksConnection;
    OleDbCommand ISBNCommand;
    OleDbDataAdapter ISBNAdapter;
    DataTable ISBNTable;
```

```
// connect to books database
booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSD\\Working\\BooksDb.accdb");
booksConnection.Open();
// establish command object
ISBNCommand = new OleDbCommand("Select * from
Title_Author ORDER BY ISBN", booksConnection);
// establish data adapter/data table
ISBNAdapter = new OleDbDataAdapter();
ISBNAdapter.SelectCommand = ISBNCommand;
ISBNTable = new DataTable();
ISBNAdapter.Fill(ISBNTable);
// Count authors
int author;
int[] authorCount = new int[11];
string lastISBN = "";
// Allow for up to 10 authors per title
for (author = 1; author <=10; author++)
{
    authorCount[author] = 0;
}
author = 1;
// Check each listing for repeated ISBN
foreach (DataRow myRow in ISBNTable.Rows)
{
    if (myRow["ISBN"].Equals(lastISBN))
    {
        // If ISBN repeated, additional author
        author++;
    }
}
```

```

        }
    else
    {
        // No more authors for this ISBN
        authorCount[author]++;
        author = 1;
        lastISBN = myRow["ISBN"].ToString();
    }
}

// display results
for (author = 1; author <=10; author++)
{
    listBox1.Items.Add(authorCount[author].ToString()
        ) +
Books with " + author.ToString() + " Authors");
}
// dispose
booksConnection.Close();
booksConnection.Dispose();
ISBNCommand.Dispose();
ISBNAdapter.Dispose();
ISBNTable.Dispose();
}

```

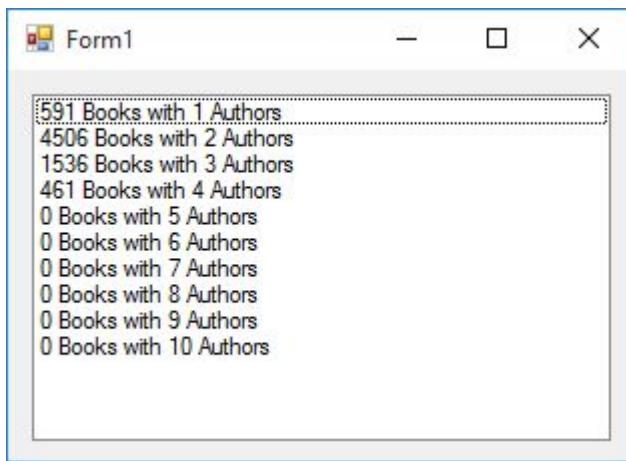
The idea behind this code is simple. Using familiar code, we load the **Title_Author** table into a data table object (**ISBNTable**) ordered by ISBN. The SQL statement that does this is:

SELECT * FROM Title_Author ORDER BY ISBN

We then go through the data table, one record at a time. If the current ISBN value is the same as the one before (**lastISBN**), we

have an additional author. If not, we are looking at a new book. The index of the array `authorCount[]` keeps track of how many books have that number of authors. We allow for up to 10 authors per book (we ignore the 0th element of the array). We initially set all array elements to zero. Once, we check all the records, we present the summary in the list box.

4. Save and run the example. You should see (after a bit of disk whirring):



This table shows that, at most, there are four authors for a book. We will allow for that. It's a good check in examples like this to make sure the reported math is correct.

Can you see that this table covers all 16,056 entries in the **Title_Author** table? (Hint: multiply the number of authors by the number of books and add.) Note this code cannot show us how many books have zero authors, since such a book would not have a listing in the **Title_Author** table. To find this information, note there are 7,094 books ($591 + 4506 + 1536 + 461$) with 1 to 4 authors. Recall the **Titles** table has 8569 listings, hence 1,475 books ($8,569 - 7,094$) have zero authors. All of these numbers assume you have not modified any entries in the original **Titles** or **Title_Author** tables in the **BooksDB.accdb** file.

Example 6-10

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Copy **SQLBooksDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. In **Form1_Load** method, use these objects:

```
SqlConnection booksConnection;  
SqlCommand ISBNCommand;  
SqlDataAdapter ISBNAdapter;
```

4. Use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```

5. Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

Viewing Author Selections

Our quick example shows that we need to be able to handle up to four authors on the **Titles** input form. But, notice the books database **Titles** table has no author information. So, if we input authors on the **Titles** input form, what do we do with the information? We need to somehow connect the **Titles** table (via the **ISBN** field) to the **Title_Author** table (which matches **ISBN** to **Au_ID**) to the **Authors** table (which has author information, particularly the **Author**). Perhaps, a true SQL expert could construct a query where the **Titles** input form displays all the book title information along with the corresponding author(s). Then, all database management tasks would be automated via the database engine. But, I, not being a SQL expert, don't know how to do that. If you do, give it a try. Here, we will use a more ad hoc approach using our Visual C# programming skills to develop a solution. We'll go slow, taking it in small steps.

The basic requirement from the user is up to four author identification numbers (**Au_ID** fields) for each title in the **Titles** table. These values will be matched with the corresponding title **ISBN** field in the **Title_Author** table. Like the Publisher information we added earlier in this example, we would not expect a user to know a particular author's identification number, but we would expect him or her to know the author's name. Hence, it looks like data bound combo boxes (listing author names to choose from) would be a good place to start.

1. Re-open the BOOKS DBMS application we have been working on (Example 6-9). Open the **Titles** form. Add four label controls and four combo boxes to the form. Set these properties:

label1:

Text Author 1

label2:

Text Author 2

label3:

Text Author 3

label4:

Text Author 4

comboBox1:

Name cboAuthor1
BackColor White (changed so we can see values
when Enabled is false)
DropDownStyle DropDownList

comboBox2:

Name cboAuthor2
BackColor White (changed so we can see values
when Enabled is false)
DropDownStyle DropDownList

comboBox3:

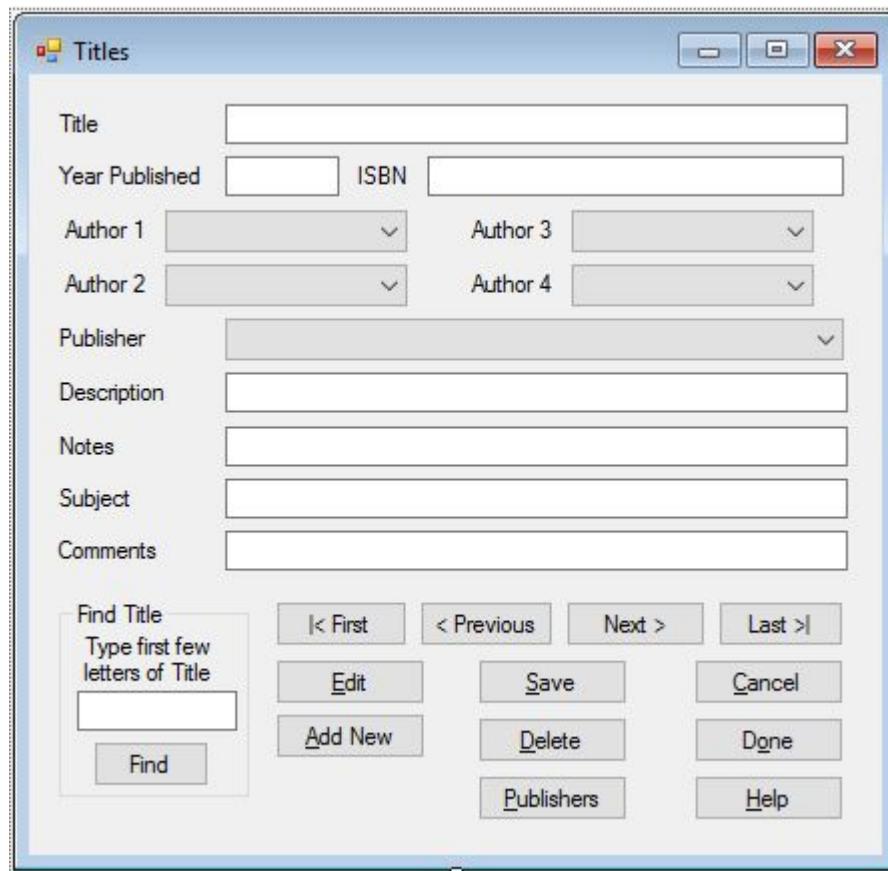
Name cboAuthor3
BackColor White (changed so we can see values
when Enabled is false)
DropDownStyle DropDownList

comboBox4:

Name cboAuthor4
BackColor White (changed so we can see values
when Enabled is false)

DropDownStyle DropDownList

My completed form looks like this:



We will add four data table objects to provide a list of author names for the user to choose from in each of the four combo boxes.

2. Add these declarations at the form level:

```
ComboBox[] authorsCombo = new ComboBox[4];
OleDbCommand authorsCommand;
OleDbDataAdapter authorsAdapter;
DataTable[] authorsTable = new DataTable[4];
```

Putting the combo boxes in an array (**authorsCombo**) will make our coding a little simpler. The array of data tables (**authorsTable**) will be used to populate these combo boxes with author names.

3. Add the shaded code to the **frmTitles_Load** event to create the needed data tables and set up the combo box binding (nearly identical to what we did for publisher information with no binding information):

```
private void frmTitles_Load(object sender, EventArgs e)
{
    try
    {
        // point to help file
        hlpPublishers.HelpNamespace =
            Application.StartupPath + "\\publishers.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        // establish command object
        titlesCommand = new OleDbCommand("SELECT * FROM
Titles
ORDER BY Title", booksConnection);
        // establish data adapter/data table
        titlesAdapter = new OleDbDataAdapter();
        titlesAdapter.SelectCommand = titlesCommand;
        titlesTable = new DataTable();
        titlesAdapter.Fill(titlesTable);
```

```
// bind controls to data table
txtTitle.DataBindings.Add("Text", titlesTable,
"Title");
txtYear.DataBindings.Add("Text", titlesTable,
"Year_Published");
txtISBN.DataBindings.Add("Text", titlesTable,
"ISBN");
txtDescription.DataBindings.Add("Text",
titlesTable, "Description");
txtNotes.DataBindings.Add("Text", titlesTable,
"Notes");
txtSubject.DataBindings.Add("Text", titlesTable,
"Subject");
txtComments.DataBindings.Add("Text",
titlesTable, "Comments");
// establish currency manager
titlesManager =
(CurrencyManager)this.BindingContext[titlesTable];
// establish publisher table/combo box to pick
publisher
publishersCommand = new OleDbCommand("Select *
from
Publishers ORDER BY Name", booksConnection);
publishersAdapter = new OleDbDataAdapter();
publishersAdapter.SelectCommand =
publishersCommand;
publishersTable = new DataTable();
publishersAdapter.Fill(publishersTable);
cboPublisher.DataSource = publishersTable;
cboPublisher.DisplayMember = "Name";
cboPublisher.ValueMember = "PubID";
cboPublisher.DataBindings.Add("SelectedValue",
```

```
titlesTable, "PubID");

        // set up combo box array
        authorsCombo[0] = cboAuthor1;
        authorsCombo[1] = cboAuthor2;
        authorsCombo[2] = cboAuthor3;
        authorsCombo[3] = cboAuthor4;
        authorsCommand = new OleDbCommand("Select * from Authors ORDER BY Author", booksConnection);
        authorsAdapter = new OleDbDataAdapter();
        authorsAdapter.SelectCommand = authorsCommand;
        for (int i = 0; i < 4; i++)
        {
            // establish author table/combo boxes to pick author
            authorsTable[i] = new DataTable();
            authorsAdapter.Fill(authorsTable[i]);
            authorsCombo[i].DataSource = authorsTable[i];
            ;
            authorsCombo[i].DisplayMember = "Author";
            authorsCombo[i].ValueMember = "Au_ID";
            // set all to no selection
            authorsCombo[i].SelectedIndex = -1;
        }
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error establishing Titles table.", MessageBoxButtons.OK, MessageBoxIcon.Error);
        return;
    }
}
```

```
        }

        this.Show();
        SetState("View");
        SetText();
    }
}
```

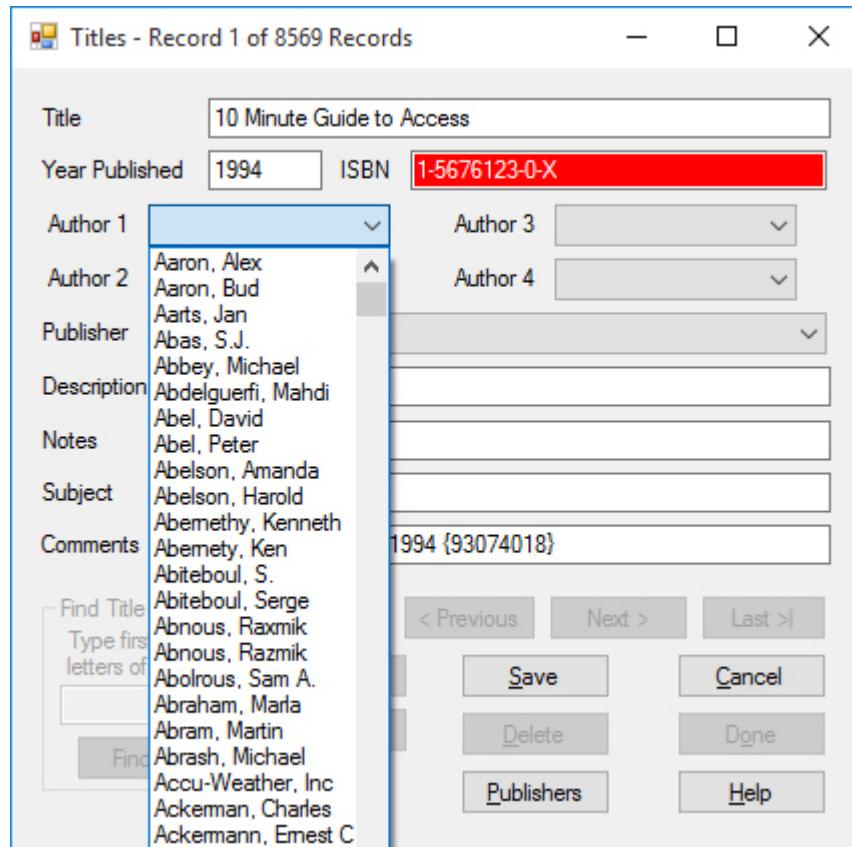
4. Add these lines near the bottom of the `frmTitles_Closing` method to dispose of our new objects:

```
authorsCommand.Dispose();
authorsAdapter.Dispose();
authorsTable[0].Dispose();
authorsTable[1].Dispose();
authorsTable[2].Dispose();
authorsTable[3].Dispose();
```

5. Modify the `SetState` method to disable the four combo boxes in **View** mode. Enable the combo boxes in **Add** and **Edit** mode.
6. Save the application and run it. There's a chance the **Authors** form will appear instead of the **Titles** form. This will happen if you forgot to reset the startup form when testing the Authors form. To get the proper startup form, open the `Program.cs` file and make the shaded change in the `Main` method:

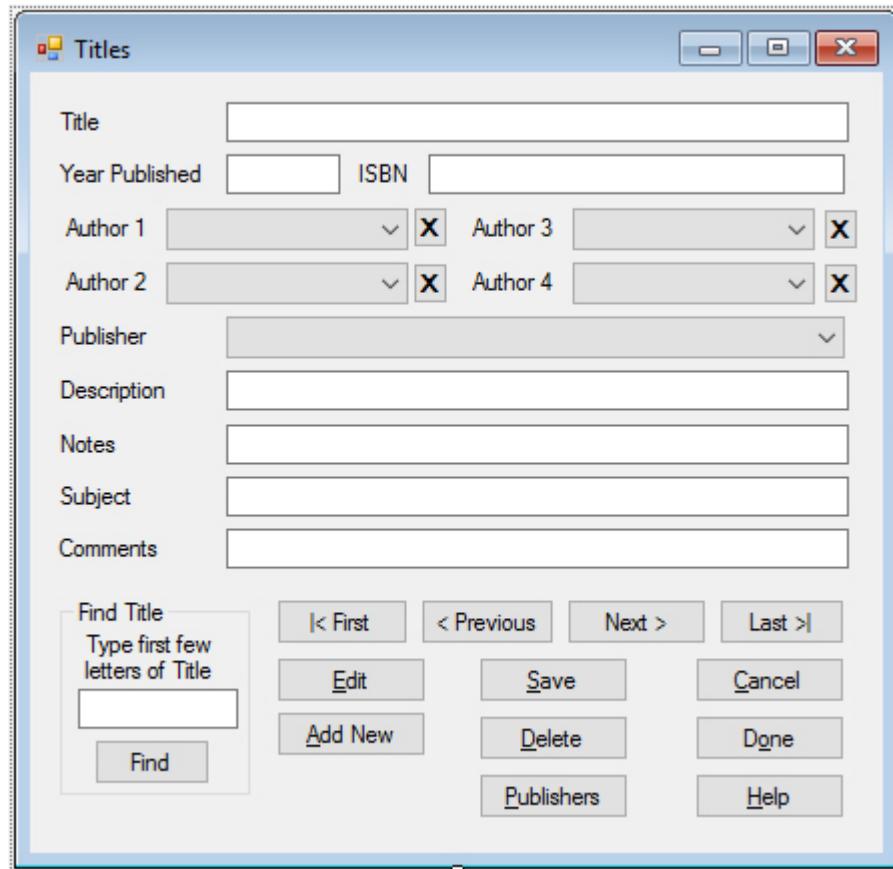
```
static void Main()
{
    Application.EnableVisualStyles();
    Application.SetCompatibleTextRenderingDefault(false);
    Application.Run(new frmTitles());
}
```

Once the proper form appears, no authors will be listed - we need some code to do that. Click **Edit**. Click a combo box to see the drop down author lists:



Change one of the authors (any changing won't be saved) just to see how the interface works. When the drop-down box is displayed, you can press the first letter of the last name, if you know it, for faster navigation among the names. This only works in **Edit** mode, the list is disabled in **View** mode. Notice you can't delete a selected author. We'll correct that now. Stop the application.

7. Next to each combo box, place a small button control. Name the buttons **btnXAuthor1**, **btnXAuthor2**, **btnXAuthor3**, **btnXAuthor4** and give each button a **Text** of X (use a bold font). Set each button's **TabStop** to **False**. The form looks like this now:



8. In the **SetTitle** method, **Enable** these buttons in **Add** and **Edit** mode, disable them in **View** mode. Add this code to the **btnXAuthor_Click** method (handles the click on any of the four buttons):

```
private void btnXAuthor_Click(object sender,
EventArgs e)
{
    Button whichButton = (Button) sender;
    switch (whichButton.Name)
    {
        case "btnXAuthor1":
            cboAuthor1.SelectedIndex = -1;
            break;
        case "btnXAuthor2":
```

```
        cboAuthor2.SelectedIndex = -1;
        break;
    case "btnXAuthor3":
        cboAuthor3.SelectedIndex = -1;
        break;
    case "btnXAuthor4":
        cboAuthor4.SelectedIndex = -1;
        break;
    }
}
```

When a button is clicked, the corresponding combo box selection is cleared.

9. Save the application and run it. Click **Edit**. Choose an author. Then, click the X button to delete it. The deletion won't be saved. We need some code to do that.

Viewing Author Names

As a next step, we want the proper author(s) to appear as each title is listed on the **Titles** form. This is where some tricky coding and paying attention to details comes into play. For a particular title, we would like to form a small version of the **Title_Author** table (using another data adapter) like this that shows the author identifications for the title (referenced by its ISBN value):

ISBN	Au_ID

The **ISBN** value will be the same for each row with up to four **Au_ID** values. To form the table, we use our old friend SQL. For our example, assume the displayed record has an ISBN value of **SearchString**. The SQL statement to form the above table is:

```
SELECT Title_Author.* FROM Title_Author  
WHERE Title_Author.ISBN = 'SearchString'
```

After processing this SQL statement, we determine how many records (if any) are in the resulting data table. For each record, we set the **ValueSelected** property of the corresponding combo box control to **Au_ID**. By doing this, the author name will magically appear! Let's write this code.

1. Return to the BOOKS DBMS application. Add this code in the form level declarations to create the objects we need:

```
OleDbCommand ISBNAuthorsCommand;
OleDbDataAdapter ISBNAuthorsAdapter;
DataTable ISBNAuthorsTable;
```

2. Add the general method **GetAuthors** to retrieve the authors for the current record:

```
private void GetAuthors()
{
    string SQLStatement = "SELECT Title_Author.* FROM
Title_Author WHERE Title_Author.ISBN = '" +
txtISBN.Text + "'";
    for (int i = 0; i < 4; i++)
    {
        authorsCombo[i].SelectedIndex = -1;
    }
    // establish author table/combo boxes to pick
    // author
    ISBNAuthorsCommand = new
    OleDbCommand(SQLStatement,
booksConnection);
    ISBNAuthorsAdapter = new OleDbDataAdapter();
    ISBNAuthorsAdapter.SelectCommand =
    ISBNAuthorsCommand;
    ISBNAuthorsTable = new DataTable();
    ISBNAuthorsAdapter.Fill(ISBNAuthorsTable);
    if (ISBNAuthorsTable.Rows.Count == 0)
    {
        return;
    }
    for (int i = 0; i < ISBNAuthorsTable.Rows.Count;
i++)
```

```

{
    authorsCombo[i].SelectedValue =
ISBNAuthorsTable.Rows[i]["Au_ID"].ToString();
}
}

```

In this code, we form the SQL statement for the given ISBN value, blank out the combo boxes and form the data table. For each author, we set the combo box **SelectedValue** property to the **Au_ID** value.

3. Add these lines near the bottom of the **frmTitles_Closing** event method to dispose of our new objects when done:

```

ISBNAuthorsCommand.Dispose();
ISBNAuthorsAdapter.Dispose();
ISBNAuthorsTable.Dispose();

```

4. Add this single line of code at the bottom of the **frmTitles_Load** to initialize the author display:

```
GetAuthors();
```

5. When we move to a new record, the currency manager position changes so we need to update the authors. Add this line of code at the end of the **btnFind_Click**, **btnFirst_Click**, **btnPrevious_Click**, **btnNext_Click** and **btnLast_Click** event methods:

```
GetAuthors();
```

6. When we delete a record, the displayed information changes. Add this line of code at the end of the **btnDelete_Click** event method to reflect this change:

```
GetAuthors();
```

7. When we cancel an edit, the author combo boxes need to be returned to their ‘unedited values.’ Add this line of code at the end of the **btnCancel_Click** event method:

```
GetAuthors();
```

8. When adding a new title to the database (clicking **Add New**), we need to blank out the author combo boxes. Add this code at the top of the **btnAddNew_Click** method:

```
cboAuthor1.SelectedIndex = -1;  
cboAuthor2.SelectedIndex = -1;  
cboAuthor3.SelectedIndex = -1;  
cboAuthor4.SelectedIndex = -1;
```

9. Save the application and run it. Scroll through the records. Notice for each title, the author(s) can be seen. Here’s a record we looked at way back in Chapter 2 (when we looked at relational databases):

Titles - Record 6 of 8569 Records

Title	10 Minute Guide to Lotus Notes for Windows		
Year Published	1993	ISBN	1-5676117-6-1
Author 1	Neuhold, Erich J.	X	Author 3
Author 2	Barnes, Kate	X	Author 4
Publisher	ALPHA BOOKS		
Description	10.95		
Notes	650.02854620		
Subject			
Comments	HF5548.4.L692B37 1993 {93070250}		

Find Title
Type first few letters of Title

The author names appear shaded because they cannot be edited in **View** mode. It may take a while to display each record, depending on the speed of processing the SQL statement. Click **Edit**. Click one of the author drop-down boxes. Notice the listed author is selected.

Saving Author Names

We can now list and modify any author(s) associated with a particular book, but we don't have the capability to save any modifications. How do we know if the user has changed any book authors, requiring a **Save**? We don't, but we could write code to determine if any author names have been changed, added or deleted. We'll take a simpler approach. When a **Save** is invoked, we create a new author data table populated with the displayed author names (actually the **Au_ID** values and corresponding **ISBN** values needed by the **Title_Author** table). The ADO .NET engine will then incorporate these changes into the database. This is another good example of using Visual C# to automate database management tasks.

1. Return to the DBMS project. Add the shaded code to the **btnSave_Click** event method:

```
private void btnSave_Click(object sender, EventArgs e)
{
    if (!ValidateData())
    {
        return;
    }
    string savedName = txtTitle.Text;
    int savedRow;
    try
    {
        titlesManager.EndCurrentEdit();
        OleDbCommandBuilder ISBNCommandUpdate = new
```

```
OleDbCommandBuilder(ISBNAuthorsAdapter);
    // delete all rows of data table then
    repopulate
    if (ISBNAuthorsTable.Rows.Count != 0)
    {
        for (int i = 0; i <
        ISBNAuthorsTable.Rows.Count; i++)
        {
            ISBNAuthorsTable.Rows[i].Delete();
        }
        ISBNAuthorsAdapter.Update(ISBNAuthorsTable);
    }
    for (int i = 0; i < 4; i++)
    {
        if (authorsCombo[i].SelectedIndex != -1)
        {
            ISBNAuthorsTable.Rows.Add();
            ISBNAuthorsTable.Rows[ISBNAuthorsTable.Rows.Count - 1]["ISBN"] =
                txtISBN.Text;
            ISBNAuthorsTable.Rows[ISBNAuthorsTable.Rows.Count - 1]["Au_ID"] =
                authorsCombo[i].SelectedValue;
        }
    }
    ISBNAuthorsAdapter.Update(ISBNAuthorsTable);
titlesTable.DefaultView.Sort = "Title";
savedRow =
titlesTable.DefaultView.Find(savedName);
titlesManager.Position = savedRow;
MessageBox.Show("Record saved.", "Save",
    MessageBoxButtons.OK,
    MessageBoxIcon.Information);
```

```
        SetState("View");
    }
    catch (Exception ex)
    {
        MessageBox.Show("Error saving record.", "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    SetText();
}
```

The new code first deletes all records. It then looks at all four combo boxes for author names. If a combo box holds a name, a record is added to the data table and proper field values (**ISBN**, **Au_ID**) established. The data adapter holding the data table is then updated to save the changes to the database.

2. Save the project. Run it. Try all functions. Add a title, fill in the fields and save it. Here's a listing for this book (**Visual C# and Databases**):

Titles - Record 8137 of 8570 Records

Title	Visual Basic and Databases		
Year Published	2015	ISBN	11-11-1111-1111
Author 1	Tabaka, Jean	X	Author 3
Author 2		X	Author 4
Publisher	Super KIDware		
Description			
Notes			
Subject			
Comments			
<input type="button" value="Find Title"/> <input type="button" value="Type first few letters of Title and Databases"/> <input type="button" value="Find"/>			
<input type="button" value="< First"/> <input type="button" value="< Previous"/> <input type="button" value="Next >"/> <input type="button" value="Last >"/>			
<input type="button" value="Edit"/>		<input type="button" value="Save"/>	<input type="button" value="Cancel"/>
<input type="button" value="Add New"/>		<input type="button" value="Delete"/>	<input type="button" value="Done"/>
<input type="button" value="Authors"/>		<input type="button" value="Publishers"/>	<input type="button" value="Help"/>

I made up an author since I'm not listed - we'll fix that next. Return to that record to see how the author(s) were saved. Make sure the **Cancel** function works with both **Add** and **Edit** modes.

Adding Author Editing

We readdress a problem encountered earlier with the **Publisher** entry. What if the user can't find the author they want in the drop-down list? This could often happen when adding new titles to the database. If the desired author name is not in the list, we need to either edit a current entry or add a new entry to the **Authors** table. Once the new author name is in the Authors table, it will be available for use in the **Titles** input form. Editing is done using the **Authors** input form modified and saved earlier as **AuthorForm.cs**.

1. On the **Titles** input form, add a button to the left of the **Publishers** button. Give it a **Name** property of **btnAuthors** and a **Text** property of **A&uthors**. Add this code to the **btnAuthors_Click** event:

```
private void btnAuthors_Click(object sender,
EventArgs e)
{
    frmAuthors authorsForm = new frmAuthors();
    string[] authorsSave = new string[4];
    authorsSave[0] = authorsCombo[0].Text;
    authorsSave[1] = authorsCombo[1].Text;
    authorsSave[2] = authorsCombo[2].Text;
    authorsSave[3] = authorsCombo[3].Text;
    authorsForm.ShowDialog();
    authorsForm.Dispose();
    // need to regenerate authors data
    booksConnection.Close();
    booksConnection = new
```

```

OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
booksConnection.Open();
authorsAdapter.SelectCommand = authorsCommand;
for (int i = 0; i < 4; i++)
{
    authorsTable[i] = new DataTable();
    authorsAdapter.Fill(authorsTable[i]);
    authorsCombo[i].DataSource = authorsTable[i];
    if (!authorsSave[i].Equals(""))
    {
        authorsCombo[i].Text = authorsSave[i];
    }
    else
    {
        authorsCombo[i].SelectedIndex = -1;
    }
}
}

```

This code displays the **Authors** input form to allow any editing necessary. Before displaying the form, the current author choices are saved (**authorsSave** array). When the **Titles** form becomes active again, there may be new values in the database (from editing the **Authors** table). To see these changes, we close our connection to the database, then reopen it, recreating the **authorsTable[]** objects bound to the author combo boxes. The saved values are then used to reestablish author choices.

2. Save the application and run it. Click **Add New**. A blank record appears. Type a book **Title**, an **ISBN**, and select a **Publisher**. Assume the author name you want is not in the drop-down list.

Click the Authors button. The Authors input form appears. Click Add New. Add an author using this input form. Click Save. Click Done. The Titles form reappears (it may take a while to rebuild). You should still be in Add mode with your new title displayed. Click the drop-down button and pick your new author. Click Save. Your new book title is saved and your newly added author will be available for all future users. The database engine does all the saving work. Here's my form after editing the listing built for this book (**Visual C# and Databases**) after adding me to the Authors table:

Screenshot of the "Titles - Record 8137 of 8570 Records" window.

Title	Visual Basic and Databases			
Year Published	2015	ISBN	11-11-1111-1111	
Author 1	Tylee, Lou	X	Author 3	X
Author 2		X	Author 4	X
Publisher	Super KIDware			
Description				
Notes				
Subject				
Comments				

Buttons at the bottom:

- Find Title
Type first few letters of Title
visual basic a
- Find
- < First
- < Previous
- Next >
- Last >
- Edit
- Add New
- Delete
- Cancel
- Done
- Authors
- Publishers
- Help

Input Control Navigation

As the user enters data on the **Titles** form, there should be logical movement from one control to the next. This is easily accomplished using the control **TabIndex** property and a little code in **KeyPress** events.

1. Return to the DBMS application. Establish the following **TabIndex** values for each control used for input (this will set a logical progression from one control to the next):

Control Name TabIndex

txtTitle	0
txtYear	1
txtISBN	2
cboAuthor1	3
cboAuthor2	4
cboAuthor3	5
cboAuthor4	6
cboPublisher	7
txtDescription	8
txtNotes	9
txtSubject	10
txtComments	11

2. Save the application and run it. Tab through the controls and notice the sequencing in **View**, **Edit** and **Add** modes.
3. Add this code to the **cboPublisher_KeyPress** event method:

```
private void cboPublisher_KeyPress(object sender,
```

```
KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
    {
        txtDescription.Focus();
    }
}
```

Add this code to the `cboAuthor_KeyPress` event method (invoked by all four author combo boxes):

```
private void cboAuthor_KeyPress(object sender,
KeyPressEventArgs e)
{
    ComboBox whichComboBox = (ComboBox) sender;
    switch (whichComboBox.Name)
    {
        case "cboAuthor1":
            cboAuthor2.Focus();
            break;
        case "cboAuthor2":
            cboAuthor3.Focus();
            break;
        case "cboAuthor3":
            cboAuthor4.Focus();
            break;
        case "cboAuthor4":
            cboPublisher.Focus();
            break;
    }
}
```

Add this code to the `txtInput_KeyPress` event method (invoked by all text box inputs):

```
private void txtInput_KeyPress(object sender,
KeyPressEventArgs e)
{
    TextBox whichTextBox = (TextBox) sender;
    if ((int) e.KeyChar == 13)
    {
        switch (whichTextBox.Name)
        {
            case "txtTitle":
                txtYear.Focus();
                break;
            case "txtYear":
                if (myState.Equals("Add"))
                {
                    txtISBN.Focus();
                }
                else
                {
                    cboAuthor1.Focus();
                }
                break;
            case "txtISBN":
                cboAuthor1.Focus();
                break;
            case "txtDescription":
                txtNotes.Focus();
                break;
            case "txtNotes":
```

```
txtSubject.Focus();
break;
    case "txtSubject":
txtComments.Focus();
break;
    case "txtComments":
txtTitle.Focus();
break;
}
}
}
```

All of the above code detects if <Enter> is clicked and moves the focus accordingly. This adds another way to move from control to control. Note ISBN (txtISBN) can only be accessed in Add mode.

4. Save the application and run it. Note how pressing <Enter> moves you from control to control in a logical order.

Entry and Input Validation

In earlier work, we implemented entry and input validation for the Authors and Authors input forms. We now need similar validation for the Titles input form. The validation rules we will apply are:

- A **Title** must be entered.
- If a **Year Published** is entered, it must be valid.
- An **ISBN** value must be entered and have a specified format.
- A **Publisher** must be entered.

We will develop a method that checks these validation rules. The method will be called prior to saving a record. We first validate the **Title** field.

1. Return to the BOOKS DBMS application. Make sure you are working with the **Titles** table. Modify the **ValidateData** method to check for existence of a **Title** (**txtTitle**; new code is shaded):

```
private bool ValidateData()
{
    string message = "";
    bool allOK = true;
    if (txtTitle.Text.Equals(""))
    {
        message = "You must input a Title.\r\n";
        txtTitle.Focus();
        allOK = false;
    }
    if (!allOK)
```

```

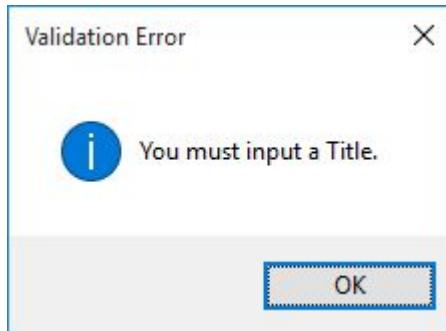
    {
        MessageBox.Show(message, "Validation Error",
        MessageBoxButtons.OK, MessageBoxIcon.Information);
    }

    return (allOK);
}

```

Recall this method is invoked prior to saving a record permanently. If a **false** is returned, the data is not valid.

2. Save the application. Run it. Click Add New, then Save. Make sure the message box appears:



Click **OK**. Click **Cancel**. Click **Add New** and type in a **Title**. Click **Save**. You may get a message concerning the lack of a **PubID** field. This is coming from our error-trapping routine. We will fix the problem soon. Stop the application.

We'll now validate the **Year Published** field (**txtYear**).

1. Set the **MaxLength** property for **txtYear** to 4. Add this code to the end of the **txtInput_KeyPress** event to insure only numbers are typed in this box.

```

if (whichTextBox.Name.Equals("txtYear"))
{

```

```

if ((e.KeyChar >= '0' && e.KeyChar <= '9') ||
(int) e.KeyChar == 8)
{
    e.Handled = false;
}
else
{
    Console.Beep();
    e.Handled = true;
}
}

```

2. Modify the code added earlier in the **ValidateData** method to check for a valid date value (most borrowed from the **Authors** form code). Changes are shaded:

```

private bool ValidateData()
{
    string message = "";
    bool allOK = true;
    if (txtTitle.Text.Equals(""))
    {
        message = "You must input a Title.\r\n";
        txtTitle.Focus();
        allOK = false;
    }
    int inputYear, currentYear;
    // Check length and range on Year Published
    if (!txtYear.Text.Trim().Equals(""))
    {
        inputYear = Convert.ToInt32(txtYear.Text);
        currentYear = DateTime.Now.Year;
    }
}

```

```

        if (inputYear > currentYear || inputYear <
        currentYear - 150)
        {
            message += "Year published must be between "
            +
            (currentYear - 150).ToString() + " and " +
            currentYear.ToString() + "\r\n";
            txtYear.Focus();
            allOK = false;
        }
    }

    if (!allOK)
    {
        MessageBox.Show(message, "Validation Error",
        MessageBoxButtons.OK, MessageBoxIcon.Information);
    }
    return (allOK);
}

```

3. Save the application and run it. Click **Add New**. Type in a Title. Type in valid years and invalid years. Click **Save**. Make sure the **Year Published** validation works correctly. You may still get the missing PubID error. Stop the application.

Next, we validate the **ISBN** field (**txtISBN**). This value is fixed length, with a specific format. The ISBN is always a 13-character string with hyphens at positions 2, 10, and 12. The other positions are assumed to have either numbers or upper case letters. Those who know more about ISBN values may want to implement different rules about what characters can be used in different positions. Remember the masked text box control described back in Chapter 5? This is an excellent place to use such a control. We need to replace the existing text box, but the work is worth it. This happens all the time in building applications. At some point, you

may discover one control does a better job than the one you have been using and you need to do a replacement.

1. Return to the project. Delete the **txtISBN** textbox control. Add a masked text box control to the form and resize it to fit the position held by the previous control. Set these properties:

Name **txtISBN**

Mask >A-AAAAAAA-A-A (allows numbers and upper case letters)

TabIndex 2

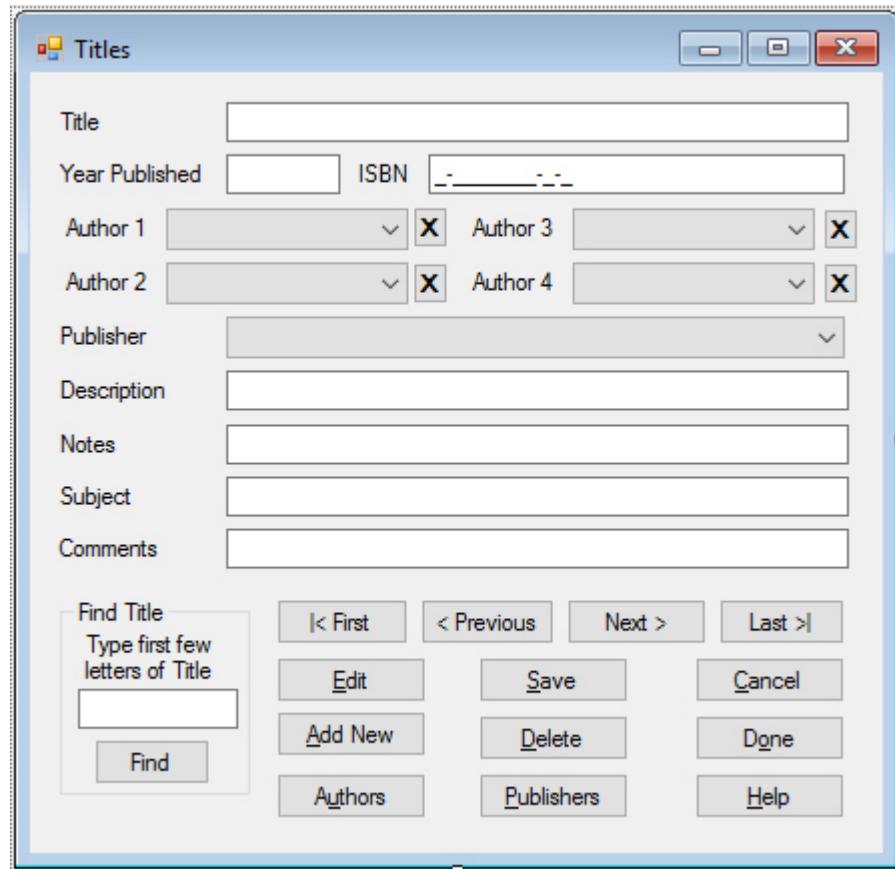
By giving the control the same name, we can use the existing code.

2. Add this **txtISBN_KeyPress** event method:

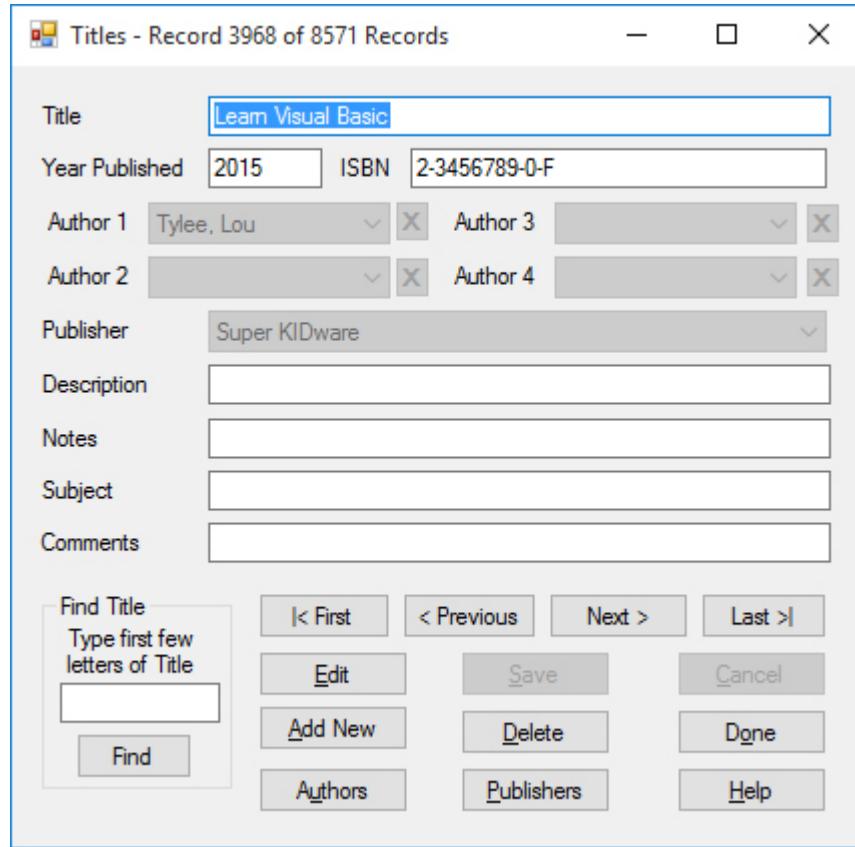
```
private void txtISBN_KeyPress(object sender,  
KeyPressEventArgs e)  
{  
    if ((int)e.KeyChar == 13)  
    {  
        cboAuthor1.Focus();  
    }  
}
```

We can't use the existing **txtInput_KeyPress** method since it only works with text box controls, not masked text box controls.

The form with the new control will look like this (note the mask):



3. Save the application and run it. Make sure the navigation among the controls works under all application states (View, Edit, Add). Click Add New. Type in a Title and Year Published. Tab to the ISBN field. Type in a value. Notice how the masked control makes entry simple. Here's a value I entered for the book I've been editing:



Stop the application.

How do we validate the value in the masked edit control? The control insures valid characters are typed and that they are positioned correctly. The only validation we need to do is check that all characters are filled in. To do this, we check the length of the **Text** property. If the length of the **Text** property is 13 characters (includes the three hyphens), it is assumed to be valid.

1. Add this validation code near the bottom of the **ValidateData** method (before checking to see if a message box is needed):

```
if (txtISBN.Text.Length != 13)
{
    message += "Incomplete ISBN entry.\r\n";
    txtISBN.Focus();
    allOK = false;
```

}

2. Save and run the application. Click **Add New**. Type a Title and Year Published value. Try out the ISBN masked text box control. Type an incomplete entry. Click **Save**. Complete the entry. Click **Save**. Did it work properly? Yeah, I know, the **PubID** error may still show up. We'll fix that now.

As a last step, we validate the **Publisher** name. We just want to make sure a publisher is entered to get rid of that annoying error we keep getting.

1. Add this code near the bottom of the **ValidateData** event (before checking to see if a message box is needed):

```
if (cboPublisher.Text.Equals(""))
{
    message += "You must select a Publisher.";
    cboPublisher.Focus();
    allOK = false;
}
```

2. Save and run the application. You should now test all four of the validation rules. When satisfied they are working properly, we'll do one more thing to wrap up this mammoth example.

Titles Form On-Line Help

Recall that the **Help** buttons on the **Authors** input form and the **Publishers** input form may not work. And, the **Help** button on the main **Titles** input form definitely won't work because we haven't developed an on-line help system for that form yet. Let's solve all these problems now and finish the **Books Database Management System**.

Every Visual C# application can have just one help file. We need to combine the Authors and Publishers help files with one developed here for the Titles table. This complete file, properly divided into topics, will form the books database help system. Refer back to the Chapter 5 notes to complete each step listed here.

1. Using FrontPage or a similar product, write a topic file for the Titles form (saved as `titles.htm` in the `VCSDB\Code\Class 6\Example 6-9\HelpFile` folder). The topics and text I used are:

Titles Input Form

Available options for managing Titles database table:

Edit Record

Click the **Edit** button to edit the displayed record. Make any needed changes. The Title, ISBN and Publisher fields are required, all others are optional. Click **Save** to save the changes; click **Cancel** to ignore the changes.

Add New Record

Click the **Add New** button to add a record to the Titles database. Type in a Title (required), Year Published, ISBN (required), Description, Notes, Subject, and Comments. Use the drop-down boxes to select up to four authors. Use the drop-down box to also select a Publisher (required). Click **Save** to save the new record; click **Cancel** to ignore the new record.

Delete Record

Click the **Delete** button to delete the displayed record.

Find

Type a few starting letters in the text box and click **Find** to help locate a particular title.

Authors

Click the **Authors** button to display the Authors input form if you need to change, add, or delete entries in the Authors database table.

Publishers

Click the **Publishers** button to display the Publishers input form if you need to change, add, or delete entries in the Publishers database table.

Exit Program

Click the **Done** button to quit the application.

2. Copy the **authors.htm** (Example 6-7) and **publishers.htm** (Example 6-8) topic files into the same folder as **titles.htm**.
3. Using the HTML Help Workshop, create a project file for this example. Name it **books.hhp**.
4. Using the HTML Help Workshop, create a contents file for this example. Name it **books.hhc**. Have one topic for each of the three input forms.

- Using the HTML Help Workshop, save and compile your help file (named **books.chm** in the the **VCSDB\Code\Class 6\Example 6-9\HelpFile** folder). Copy this file to the Books DBMS project **Bin\Debug** folder.
- Load the books database application (**Example 6-9**). Display the **Titles** form. Rename the help provider control **hlpBooks**. Make the shaded change near the top of the **frmTitles_Load** method:

```
private void frmTitles_Load(object sender, EventArgs
e)
{
    try
    {
        // point to help file
        hlpBooks.HelpNamespace =
            Application.StartupPath +
        "\\books.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        .
        .
    }
```

And make the shaded change to the **btnHelp_Click** method:

```
private void btnHelp_Click(object sender, EventArgs
e)
{
    Help.ShowHelp(this, hlpBooks.HelpNamespace);
```

```
}
```

7. Display the **Authors** form. We need to point it to the new help file. Make the shaded change near the top of the **frmAuthors_Load** method:

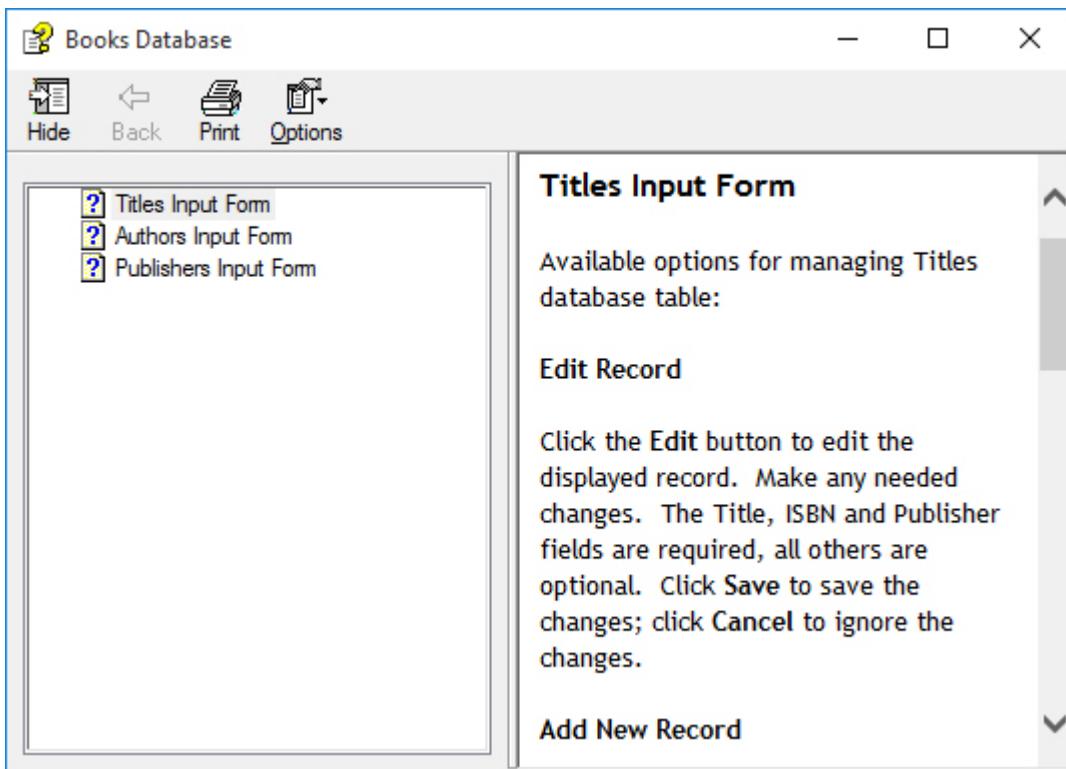
```
private void frmAuthors_Load(object sender, EventArgs e)
{
    try
    {
        // point to help file
        hlpAuthors.HelpNamespace =
            Application.StartupPath +
        "\\books.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
        booksConnection.Open();
        .
        .
    }
}
```

8. Display the **Publishers** form. We also need to point it to the new help file. Make the shaded change near the top of the **frmPublishers_Load** method:

```
private void frmPublishers_Load(object sender,
EventArgs e)
{
    try
```

```
{  
    // point to help file  
    hlpPublishers.HelpNamespace =  
        Application.StartupPath +  
    "\\books.chm";  
    // connect to books database  
    booksConnection = new  
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = c:\\VCSD\\Working\\BooksDB.accdb");  
    booksConnection.Open();  
    .  
    .  
}
```

9. Save and run the application (final version saved in VCSD\Code\Class 6\Example 6-9 folder). Click Help. You should see:



Make sure help works with the Authors and Publishers forms. And, guess what the Books Database Management System is complete!

Example 6-9

Using SQL Server Databases

Apply specified modifications to the SQL Server version of Example 6-8 making sure to:

Change all instances of **OleDbCommand** to **SqlCommand**

Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

Change all instances of **OleDbCommandBuilder** to
SqlCommandBuilder

Summary

In this chapter, you built a very large application. You learned how to edit, add, and delete records in both single table and multiple table databases. You learned how to find records of interest. The books database management system you built would rival a mid-size commercial application, regarding its capabilities. Congratulations if you worked through this detailed example.

In this chapter, you learned that, though building a database management system is a long and detailed process, it is relatively straightforward. There is a set method to follow in implementing any database management task. The Visual C# environment, with its event-driven nature, allows us to build an application in stages. This ability lets us build part of the application, test it, and proceed. There is no need to build an entire application before it can be tested.

Still remaining in our database studies are the topics of database reports, distributing applications, and database design. And, later on in the course, we'll build three complete database projects.

7

Database Reports

Review and Preview

We have seen that using the ADO .NET data objects, in conjunction with Visual C#, allows us to build a solid, well-functioning database management system. We are able to edit, add, delete, and/or find records within any database.

Once you have gone to all the trouble of managing a database, it is nice to have the ability to obtain printed or displayed information from your data. The vehicle for obtaining such information is known as a **database report**. In this chapter, we look at how to use Visual C# code to obtain database reports.

PrintDocument Object

Users expect to have the ability to obtain printed copies of information contained within a database. This information is in the form of **database reports**. Generating reports is a straightforward task. You just need to determine what information you want in the report and how you want it to be presented. We look at using the Visual C# **PrintDocument** object for database reports. . Objects used in printing are found in the **Drawing.Printing** namespace. For any application with printing, add this using declaration at the top of the code window:

```
using System.Drawing.Printing;
```

The Visual C# **PrintDocument** object provides a virtual space where you can place information to be printed. This information is placed in the space using Visual C# properties and methods. You just write code to put information where you want it. The **PrintDocument** object does not take advantage of any data bound controls or database access techniques. You need to do that in code. The **PrintDocument** object is good for quick data report generation and allows lots of flexibility in what can be displayed. It also allows you to take advantage of several print-related common dialog controls. And, you don't have to learn anything new. Using it only requires your Visual C# knowledge.

The **PrintDocument** object (in the **Drawing.Printing** namespace) controls the printing process and has four important properties:

Property	Description
DefaultPageSettings	Indicates default page settings for the document.
DocumentName	Indicates the name displayed while the document is printing.
PrintController	Indicates the print controller that

	guides the printing process.
PrinterSettings	Indicates the printer that prints the document.

The steps to print a document (which may include text and graphics) using the **PrintDocument** object are:

- Declare a **PrintDocument** object
- Create a **PrintDocument** object
- Set any properties desired.
- Print the document using the **Print** method of the **PrintDocument** object.

The first three steps are straightforward. To declare and create a **PrintDocument** object named **myDocument**, use:

```
PrintDocument myDocument;
.
.
myDocument = new PrintDocument();
```

Any properties needed usually come from print dialog boxes we'll examine in a bit.

The last step poses the question: how does the **PrintDocument** object print with the **Print** method? Printing is done in a general Visual C# method associated with the **PrintDocument.PrintPage** event. This is a method you must create and write. The method tells the **PrintDocument** object what goes on each page of your document. Once the method is written, you need to add the event handler in code so the **PrintDocument** object knows where to go when it's ready to print a page. It may sound confusing now, but once you've done a little printing, it's very straightforward.

The general Visual C# method for printing your pages (**MyPrintPage** in this case) must be of the form:

```
private void MyPrintPage(object sender,  
PrintPageEventArgs e)  
{  
    .  
    .  
    .  
}
```

In this method, you ‘construct’ each page that the **PrintDocument** object is to print. And, you’ll see the code in this method is familiar.

In the **MyPrintPage** method, the argument **e** (of type **PrintPageEventArgs**) has many properties with information about the printing process. The most important property is the **graphics** object:

e.Graphics

PrintDocument provides us with a **graphics** object to ‘draw’ each page we want to print. We can draw lines, rectangles, images and even text! We’ll look at how to do this in detail next. But, first, let’s review how to establish and use the **PrintDocument** object.

Here is an annotated code segment that establishes a **PrintDocument** object (**myDocument**) and connects it to a method named **MyPrintPage** that provides the pages to print via the **graphics** object:

```
// Declare the document  
PrintDocument myDocument;  
.  
.
```

```
// Create the document and name it
myDocument = new PrintDocument();
myDocument.DocumentName = "My Document";

    .
    .

// You could set other properties here

    .
    .

// Add code handler
myDocument.PrintPage += new
PrintPageEventHandler(this.MyPrintPage);
// Print document
myDocument.Print();
// Dispose of document when done printing
myDocument.Dispose();
```

This code assumes the method **MyPrintPage** is available. Let's see how to build such a method.

Printing Document Pages

The **PrintDocument** object provides (in its **PrintPage** event) a graphics object (**e.Graphics**) for ‘drawing’ our pages. And, that’s just what we do using graphics methods. For each page in our printed document, we draw the desired text information (**DrawString** method), any lines (**DrawLine** method), rectangles (**DrawRectangle** method) or images (**DrawImage** method).

Once a page is completely drawn to the graphics object, we ‘tell’ the **PrintDocument** object to print it. We repeat this process for each page we want to print. This does require a little bit of work on your part. You must know how many pages your document has and what goes on each page. I usually define a page number variable to help keep track of the current page being drawn.

Once a page is complete, there are two possibilities: there are more pages to print or there are no more pages to print. The **e.HasMorePages** property (Boolean) is used specify which possibility exists. If a page is complete and there are still more pages to print, use:

```
e.HasMorePages = true;
```

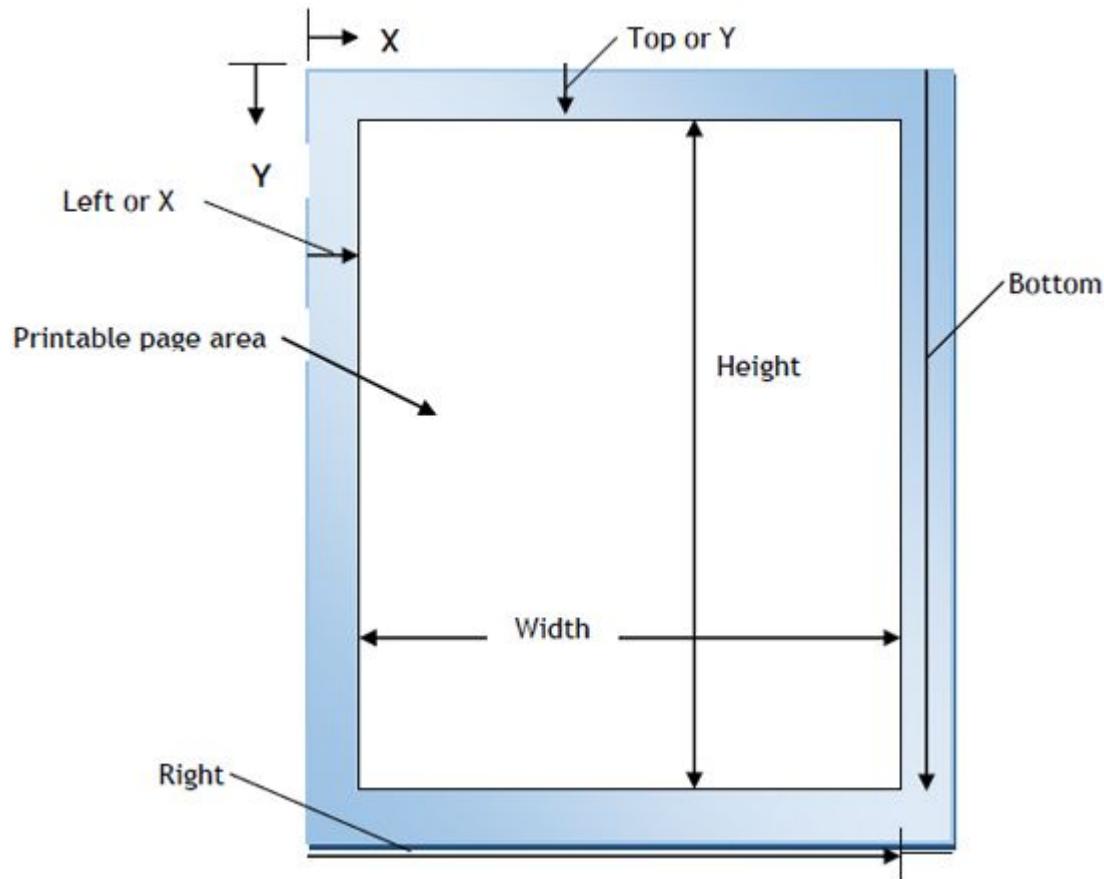
In this case, the **PrintDocument** object will return to the **PrintPages** event for the next page. If the page is complete and printing is complete (no more pages), use:

```
e.HasMorePages = false;
```

This tells the **PrintDocument** object its job is done. At this point, you should dispose of the **PrintDocument** object.

Let’s look at the graphics object for a single page. The boundaries of the printed page are defined by the **e.MarginBounds** properties

(these are established by the **PrinterSettings** property):



This becomes our palette for positioning items on a page. All properties are in $1/100^{\text{th}}$ of an inch. Horizontal position is governed by **x** (increases from 0 to the right) and vertical position is governed by **y** (increases from 0 to the bottom).

The process for each page is to decide “what goes where” and then position the desired information using the appropriate graphics method. There are many Visual C# graphics methods. Here, we limit the discussion to printing text, lines, rectangles and images. Before discussing the graphics methods, we need to provide information on two useful objects: **Pen** and **Brush**.

Pen Object

Some of the printing graphics methods require a **Pen** object. This virtual pen is just like the pen you use to write and draw. You can choose color and width of the pen. You can use pens built into Visual C# or create your own pen.

In many cases, the pen objects built into Visual C# are sufficient. The **Pens** class will draw a line 1 pixel wide in a color you choose. If the selected color is **ColorName**, the syntax to refer to such a pen is:

Pens.ColorName

To create your own **Pen** object (in **Drawing** namespace), you first declare the pen using:

```
Pen myPen;
```

The pen is then created using the **Pen** constructor:

```
myPen = new Pen(color, width);
```

where **color** is the color your new pen will draw in and **width** is the integer width of the line (in pixels) drawn. This pen will draw a solid line. The **color** argument can be one of the built-in colors or one generated with the **FromArgb** function.

Once created, you can change the color and width at any time using the **Color** and **Width** properties of the pen object. The syntax is:

```
myPen.Color = newColor;  
myPen.Width = newWidth;
```

Here, **newColor** is a newly specified color and **newWidth** is a new integer pen width.

When done drawing with a pen object, it should be disposed using the **Dispose** method:

```
myPen.Dispose();
```


Brush Object

Filling of regions and printing text in Visual C# is done with a **Brush** object. Like the **Pen** object, a brush is just like a brush you use to paint - just pick a color. You can use brushes built into Visual C# or create your own brush.

In most cases, the brush objects built into Visual C# are sufficient. The **Brushes** class provides brush objects that paint using one of the 141 built-in colors. The syntax to refer to such a brush is:

```
Brushes.ColorName
```

To create your own **Brush** object (from the **Drawing** namespace), you first declare the brush using:

```
Brush myBrush;
```

The solid color brush is then created using the **SolidBrush** constructor:

```
myBrush = new SolidBrush(color);
```

where **color** is the color your new brush will paint with. This color argument can be one of the built-in colors or one generated with the **FromArgb** function.

Once created, you can change the color of a brush any time using the **Color** property of the brush object. The syntax is:

```
myBrush.Color = newColor;
```

where **newColor** is a newly specified color.

When done painting with a brush object, it should be disposed using the **Dispose** method:

```
myBrush.Dispose();
```


Graphics Methods

To place text on the graphics object (`e.Graphics`), use the **DrawString** method. To place the string `myString` at position `(x, y)`, using the font object `myFont` and brush object `myBrush`, the syntax is:

```
e.Graphics.DrawString(myString, myFont, myBrush, x,  
y);
```

With this statement, you can place any text, anywhere you like, with any font, any color and any brush style. You just need to make the desired specifications. Each line of text on a printed page will require a **DrawString** statement.

There are two methods for determining the size of strings. This is helpful for both vertical and horizontal placement of text on a page. To determine the height (in pixels) of a particular font, use:

```
myFont.GetHeight(e.Graphics)
```

If you need width and height of a string use:

```
e.Graphics.MeasureString(myString, myFont)
```

This method returns a **SizeF** structure with two properties: **Width** and **Height** (both in hundredths of an inch). These two properties are useful for justifying (left, right, center, vertical) text strings.

Many times, you use lines in a document to delineate various sections. To draw a line on the graphics object, use the **DrawLine** method:

```
e.Graphics.DrawLine(myPen, x1, y1, x2, y2);
```

This statement will draw a line from (x1, y1) to (x2, y2) using the pen object **myPen**.

To draw a rectangle (used with tables or graphics regions), use the **DrawRectangle** method:

```
e.Graphics.DrawRectangle(myPen, x1, y1, x2, y2);
```

This statement will draw a rectangle with upper left corner at (x1, y1) and lower right corner at (x2, y2) using the pen object **myPen**.

The **DrawImage** method is used to position an image (**myImage**) object on a page. The syntax is:

```
e.Graphics.DrawImage(myImage, x, y, width, height);
```

The upper left corner of **myImage** will be at (x, y) with the specified **width** and **height**. Any image will be scaled to fit the specified region.

If **DrawImage** is to be used to print the contents of a panel control hosting a graphics object (we'll do this in Chapter 10), you must insure the graphics are persistent. We review those steps. For a panel named **pnlExample**, establish the **BackgroundImage** as an empty bitmap:

```
pnlExample.BackgroundImage = new  
Drawing.Bitmap(pnlExample.ClientSize.Width,  
pnlExample.ClientSize.Height,  
Drawing.Imaging.PixelFormat.Format24bppRgb);
```

Then, establish the drawing object **myObject** using:

```
myObject =  
Graphics.FromImage(pnlExample.BackgroundImage);
```

Now, any graphics methods applied to this object will be persistent. To maintain this persistence, after each drawing operation to this object, use:

```
myObject.Refresh();
```

The image in this object can then be printed with the **DrawImage** method:

```
e.Graphics.DrawImage(pnlExample.BackgroundImage, x,  
y, width, height);
```

The upper left corner of the image will be at **(x, y)** with the specified **width** and **height**. The image will be scaled to fit the specified region.

The use of each graphics method (and the **Pen** and **Brush** objects) will be illustrated in this chapter's examples. The best way to learn how to print in Visual C# is to do lots of it. You'll develop your own approaches and techniques as you gain familiarity. You might want to see how some of the other graphics methods (**DrawEllipse**, **DrawLines**, **DrawCurves**) might work with printing. Or, look at different brush and pen objects.

Many print jobs just involve the user clicking a button marked ‘Print’ and the results appear on printed page with no further interaction. If more interaction is desired, there are three dialog controls that help specify desired printing job properties: **PageSetupDialog**, **PrintDialog**, and **PrintPreviewDialog**. Using these controls adds more code to your application. You must take any user inputs and implement these values in your program. We'll show what each control can do and let you decide if you want to use them in your work. The **PrintPreviewDialog** control is especially cool!!

PageSetupDialog Control



The **PageSetupDialog** control allows the user to set various parameters regarding a printing task. This is the same dialog box that appears in most Windows applications. Users can set border and margin adjustments, headers and footers, and portrait vs. landscape orientation.

PageSetupDialog Properties:

Name	Gets or sets the name of the page setup dialog (I usually name this control dlgSetup).
AllowMargins	Gets or sets a value indicating whether the margins section of the dialog box is enabled.
AllowOrientation	Gets or sets a value indicating whether the orientation section of the dialog box (landscape vs. portrait) is enabled.
AllowPaper	Gets or sets a value indicating whether the paper section of the dialog box (paper size and paper source) is enabled.
AllowPrinter	Gets or sets a value indicating whether the Printer button is enabled.
Document	Gets or sets a value indicating the PrintDocument to get page settings from.
MinMargins	Gets or sets a value indicating the minimum margins the user is allowed to select, in hundredths of an inch.
PageSettings	Gets or sets a value indicating the page settings to modify.
PrinterSettings	Gets or sets the printer settings the dialog box is to modify when the user

clicks the Printer button

FontDialog Methods:

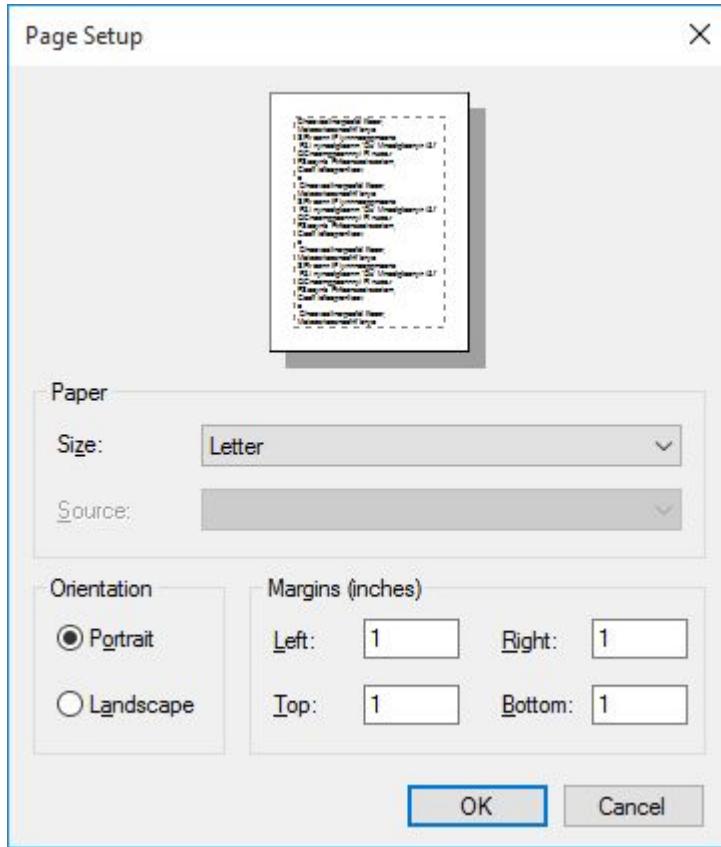
ShowDialog	Displays the dialog box. Returned value indicates which button was clicked by user (OK or Cancel).
-------------------	--

To use the **PageSetupDialog** control, we add it to our application the same as any control. It will appear in the tray below the form. Once added, we set a few properties. Then, we write code to make the dialog box appear when desired. The user then makes selections and closes the dialog box. At this point, we use the provided information for our tasks.

The **ShowDialog** method is used to display the **PageSetupDialog** control. For a control named **dlgSetup**, the appropriate code is:

```
dlgSetup.ShowDialog();
```

And the displayed dialog box is:



The user makes any desired choices. Once complete, the **OK** button is clicked. At this point, various properties are available for use (namely **PageSettings** and **PrinterSettings**). **Cancel** can be clicked to cancel the changes. The **ShowDialog** method returns the clicked button. It returns **DialogResult.OK** if **OK** is clicked and returns **DialogResult.Cancel** if **Cancel** is clicked.

Typical use of **PageSetupDialog** control:

- Set the **Name** property. Decide what options should be available.
- Use **ShowDialog** method to display dialog box, prior to printing.
- Use **PageSettings** and **PrinterSetting** properties to change printed output.

PrintDialog Control



The **PrintDialog** control allows the user to select which printer to use, choose page orientation, printed page range and number of copies. This is the same dialog box that appears in many Windows applications.

PrintDialog Properties:

Name	Gets or sets the name of the print dialog (I usually name this control dlgPrint).
AllowPrintToFile	Gets or sets a value indicating whether the Print to file check box is enabled.
AllowSelection	Gets or sets a value indicating whether the From... To... Page option button is enabled.
AllowSomePages	Gets or sets a value indicating whether the Pages option button is enabled.
Document	Gets or sets a value indicating the PrintDocument used to obtain PrinterSettings.
PrinterSettings	Gets or sets the PrinterSettings the dialog box is to modify.
PrintToFile	Gets or sets a value indicating whether the Print to file check box is checked

PrintDialog Methods:

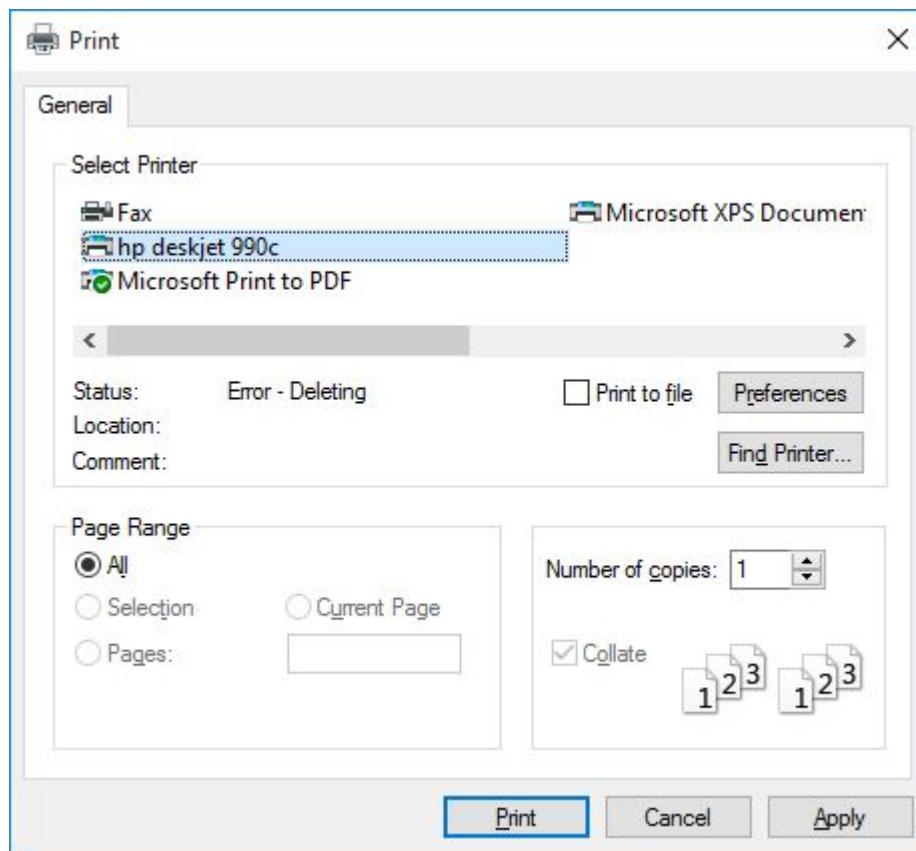
ShowDialog	Displays the dialog box. Returned value indicates which button was clicked by user (OK or Cancel).
-------------------	--

To use the **PrintDialog** control, we add it to our application the same as any control. It will appear in the tray below the form. Once added, we set a few properties. Then, we write code to make the dialog box appear when desired. The user then makes selections and closes the dialog box. At this point, we use the provided information for our tasks.

The **ShowDialog** method is used to display the **PrintDialog** control. For a control named **dlgPrint**, the appropriate code is:

```
dlgPrint.ShowDialog();
```

And the displayed dialog box is:



The user makes any desired choices. Once complete, the **OK** button is clicked. At this point, various properties are available for use (namely **PrinterSettings**). **Cancel** can be clicked to cancel the

changes. The `ShowDialog` method returns the clicked button. It returns `DialogResult.OK` if `OK` is clicked and returns `DialogResult.Cancel` if `Cancel` is clicked.

Typical use of `PrintDialog` control:

- Set the `Name` property. Decide what options should be available.
- Use `ShowDialog` method to display dialog box, prior to printing with the `PrintDocument` object.
- Use `PrinterSettings` properties to change printed output.

PrintPreviewDialog Control



The **PrintPreviewDialog** control is a great addition to Visual C#. It lets the user see printed output in preview mode. They can view all pages, format page views and zoom in on or out of any. The previewed document can also be printed from this control. This is also a useful “temporary” control for a programmer to use while developing printing routines. By viewing printed pages in a preview mode, rather than on a printed page, many trees are saved as you fine tune your printing code.

PrintPreviewDialog Properties:

Name	Gets or sets the name of the print preview dialog (I usually name this control dlgPreview)
AcceptButton	Gets or sets the button on the form that is clicked when the user presses the <Enter> key.
Document	Gets or sets the document to preview.
Text	Gets or sets the text associated with this control.

PrintPreviewDialog Methods:

ShowDialog	Displays the dialog box. Returned value indicates which button was clicked by user (OK or Cancel).
-------------------	--

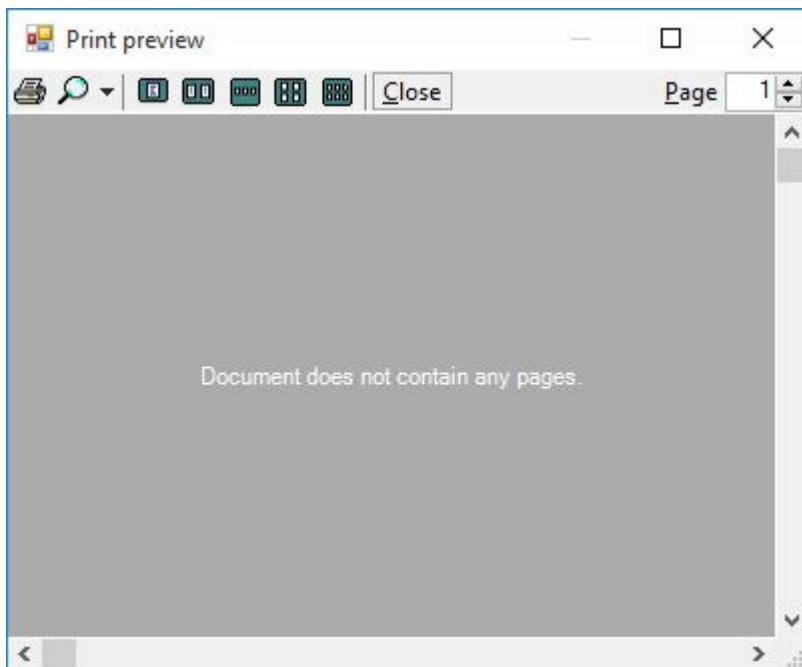
To use the **PrintDialog** control, we add it to our application the same as any control. It will appear in the tray below the form. Once added, we set a few properties, primarily **Document**. Make sure the **PrintPage** event is properly coded for the selected

Document. Add code to make the dialog box appear when desired. The document pages will be generated and the user can see it in the preview window.

The **ShowDialog** method is used to display the **PrintPreviewDialog** control. For a control named **dlgPreview**, the appropriate code is:

```
dlgPreview.ShowDialog();
```

And the displayed dialog box (with no document) is:



The user can use the various layout, zoom and print options in previewing the displayed document. When done, the user closes the dialog control.

Typical use of **PrintPreviewDialog** control:

- Set the **Name** property. Set the **Document** property.
- Use **ShowDialog** method to display dialog box and see the previewed document.

PrintDocument Object with Databases

You may be asking yourself, how does all this **PrintDocument** object information work with **database** management systems? It's really pretty simple. It's just a matter of following a few straightforward (though, many times, detailed) steps.

First, determine what information from the database you want in your database report. Do you want to print all fields and all records? If so, you need to develop code to cycle through the records of interest. Do you want just individual records? Determine, where in your Visual C# application, this information is located. Usually, it's found in properties of the controls on your form(s).

Second, determine the layout for each page of your database report. My approach is to sketch it out on a piece of standard-sized graph paper. This is a good reference when writing the code - the next step.

Third, add control(s) and code to your Visual C# application to access the database report printing routine. This is usually a button with a **Click** event containing the printing code.

Lastly, write the Visual C# code that establishes each page of your database report. This code usually goes in its own method. Use positioning properties (the **e** argument in the **PrintPage** event method) to place all information in desired positions. A nice thing about the **PrintDocument** object is that there is no need to place information sequentially. That is, you don't have to start at the top and work your way down. You can place information anywhere on the page in any order. When the page is complete, it is sent to the printer using the **e.HasMorePages** property. You will find that you

need to write lots of code, but it's very easy code to write. Let's look at each of these steps with an example.

The first example (Example 7-1) we build here is simple, printing a single page. When the user clicks a button to print, the report goes directly to their default printer. With large database reports, spanning many pages, this is not a good idea. The user should be given an interface that allows him or her to know how big a print job is ahead. Based on this information, the user should be able to decide whether to continue printing the entire report or select portions of the report. The **PrintPreviewDialog** control provides such utility. In Examples 7-2 and 7-3, we give an example using this control as a printing interface.

Example 7-1

Database Report

In this example, we use the books database management system built in Chapter 6. We will add the capability to print any book title's displayed record.

1. If you like, make a copy of the books database management system built in **Example 6-9** before starting this example. Open that project. Make sure the **Titles** form is active. Add a button and a picture box control. Set these properties:

button 1:

Name	btnPrintRecord
Text	Print &Record

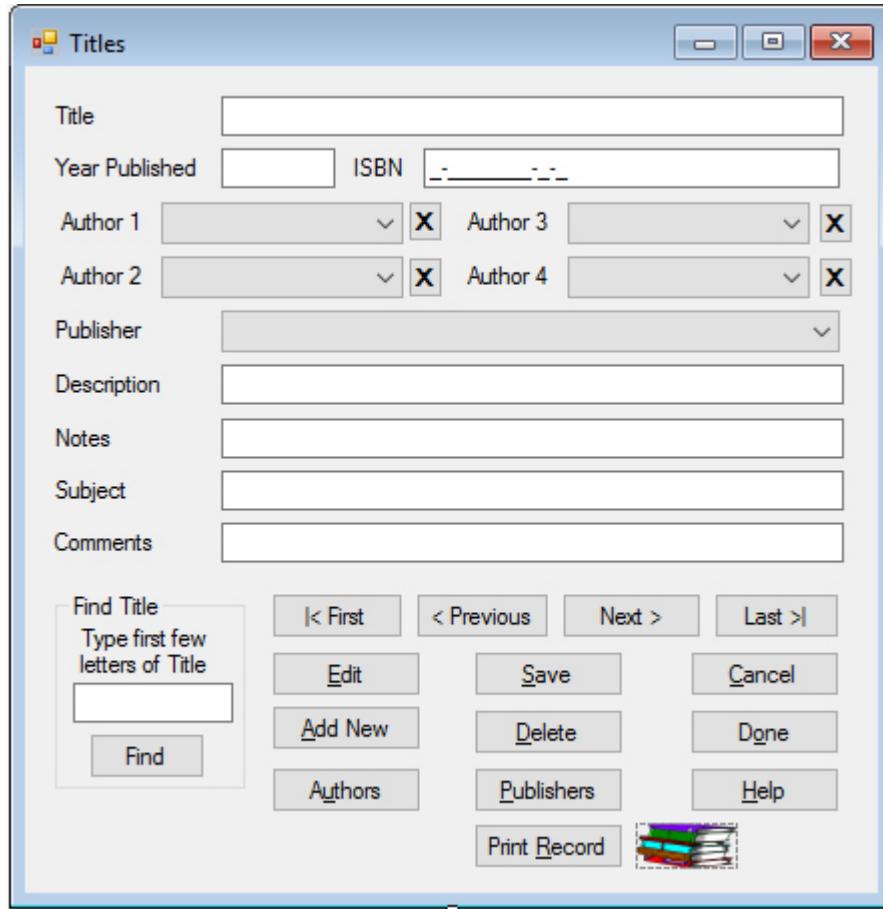
pictureBox1:

Name	picBooks
Image	Books.wmf (in VCSDB\Code\Class 7\Example 7-1 folder)
SizeMode	StretchImage
Visible	False

2. Add this line at the top of the code window:

```
using System.Drawing.Printing;
```

The picture box will provide a graphic to print on the database report. My form looks like this:



3. Put this code in the `btnPrintRecord_Click` event:

```
private void btnPrintRecord_Click(object sender,
EventArgs e)
{
    // Declare the document
    PrintDocument recordDocument;
    // Create the document and name it
    recordDocument = new PrintDocument();
    recordDocument.DocumentName = "Titles Record";
    // Add code handler
    recordDocument.PrintPage += new
    PrintPageEventHandler(this.PrintRecordPage);
    // Print document
```

```

    recordDocument.Print();
    // Dispose of document when done printing
    recordDocument.Dispose();
}

```

This code sets up the **PrintDocument** object (**recordDocument**) to print using the information in the **PrintRecordPage** method.

4. Add this code to the **PrintRecordPage** event method:

```

private void PrintRecordPage(object sender,
PrintPageEventArgs e)
{
    // print graphic and heading (1 inch in height)
    Pen myPen = new Pen(Color.Black, 3);
    e.Graphics.DrawRectangle(myPen,
    e.MarginBounds.Left,
    e.MarginBounds.Top, e.MarginBounds.Width, 100);
    e.Graphics.DrawImage(picBooks.Image,
    e.MarginBounds.Left
    + 10, e.MarginBounds.Top + 10, 80, 80);
    // print heading
    string s = "BOOKS DATABASE";
    Font myFont = new Font("Arial", 24,
    FontStyle.Bold);
    SizeF sSize = e.Graphics.MeasureString(s, myFont);
    e.Graphics.DrawString(s, myFont, Brushes.Black,
    e.MarginBounds.Left + 100 + Convert.ToInt32(0.5 *
    (e.MarginBounds.Width - 100 - sSize.Width)),
    e.MarginBounds.Top + Convert.ToInt32(0.5 * (100 -
    sSize.Height)));
    myFont = new Font("Arial", 12, FontStyle.Regular);
}

```

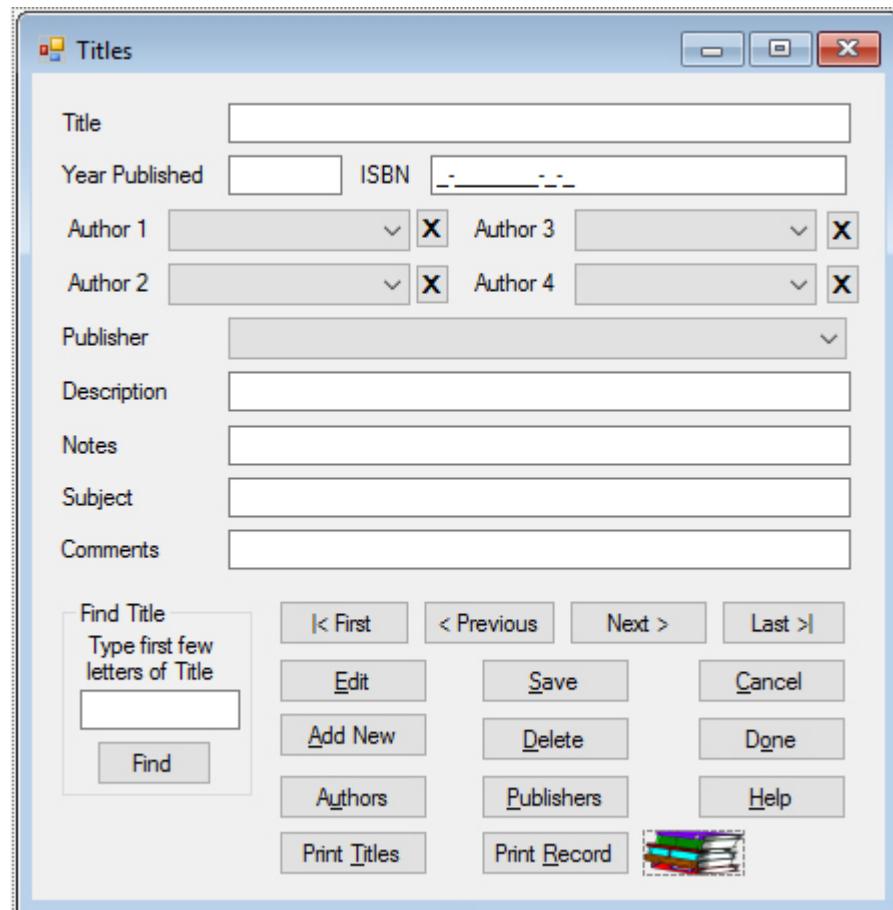
```
int y = 300;
int dy =
Convert.ToInt32(e.Graphics.MeasureString("S",
myFont).Height);
// print title
e.Graphics.DrawString("Title: " + txtTitle.Text,
myFont,
Brushes.Black, e.MarginBounds.Left, y);
// print authors
y += 2 * dy;
e.Graphics.DrawString("Author(s): ", myFont,
Brushes.Black, e.MarginBounds.Left, y);
int x = e.MarginBounds.Left +
Convert.ToInt32(e.Graphics.MeasureString("Author(s):",
myFont).Width);
if (ISBNAuthorsTable.Rows.Count != 0)
{
    for (int i = 0; i < ISBNAuthorsTable.Rows.Count;
i++)
    {
        e.Graphics.DrawString(authorsCombo[i].Text,
myFont, Brushes.Black, x, y);
        y += dy;
    }
}
else
{
    e.Graphics.DrawString("None", myFont,
Brushes.Black, x, y);
    y += dy;
}
x = e.MarginBounds.Left;
```

```
    y += dy;
    // Print other fields
    e.Graphics.DrawString("ISBN: " + txtISBN.Text,
myFont, Brushes.Black, x, y);
    y += 2 * dy;
    e.Graphics.DrawString("Year Published: " +
txtYear.Text,
myFont, Brushes.Black, x, y);
    y += 2 * dy;
    e.Graphics.DrawString("Publisher: " +
.cboPublisher.Text,
myFont, Brushes.Black, x, y);
    y += 2 * dy;
    e.Graphics.DrawString("Description: " +
txtDescription.Text,
myFont, Brushes.Black, x, y);
    y += 2 * dy;
    e.Graphics.DrawString("Notes: " + txtNotes.Text,
myFont, Brushes.Black, x, y);
    y += 2 * dy;
    e.Graphics.DrawString("Subject: " +
txtSubject.Text,
myFont, Brushes.Black, x, y);
    y += 2 * dy;
    e.Graphics.DrawString("Comments: " +
txtComments.Text,
myFont, Brushes.Black, x, y);
    e.HasMorePages = false;
}
```

Yes, this is a lot of code, but you should see that it is very easy to follow what's going on. First a header is printed within a rectangle

(the width of the page margins). The `DrawImage` method puts the graphic in the header. Every field is printed in sequence. We determine position and print the field. Note how `MeasureString` is used to position the heading and line up the author names. The numbers I used in the above code were determined by trial-and-error, something you do a lot with the `PrintDocument` object.

5. Save (saved in **Example 7-1** folder in **VCSDB\Code\Class 7** folder) and run the application. Select a title using the navigation buttons. Here's one I picked:



Click **Print Record**. Your printer should start making noise and a page will pop out. Here's the top of the page printed for the displayed record:



BOOKS DATABASE

Title: 1-2-3 Database Techniques

Author(s): Stern, Nancy
Weil, Bill
Anderson, Dick

ISBN: 0-8802234-6-4

Year Published: 1990

Publisher: QUE CORP

Description: 29.95

Notes: 650.0285536920

Subject:

Comments: HF5548.4.L67A52 1989 {88060617}

As mentioned, you can add a **PrintPreviewDialog** control to this application to view the page before printing (we'll use one in the next example). That's how I got the above graphic. Try it if you are adventurous.

Example 7-1

Using SQL Server Databases

Make the same changes to the SQL Server version of Example 6-9.

Example 7-2

Titles Listing

A single page document with one record is not that exciting. Let's add the capability of printing out every title in our database (including the first author). This will be a very large printout, so we'll use a **PrintPreviewDialog** control to allow the user to decide just what to print.

1. Return to Example 7-1. Display the **Titles** form. Add a button and a print preview dialog control to the project (the dialog control will be below the form). Set these properties:

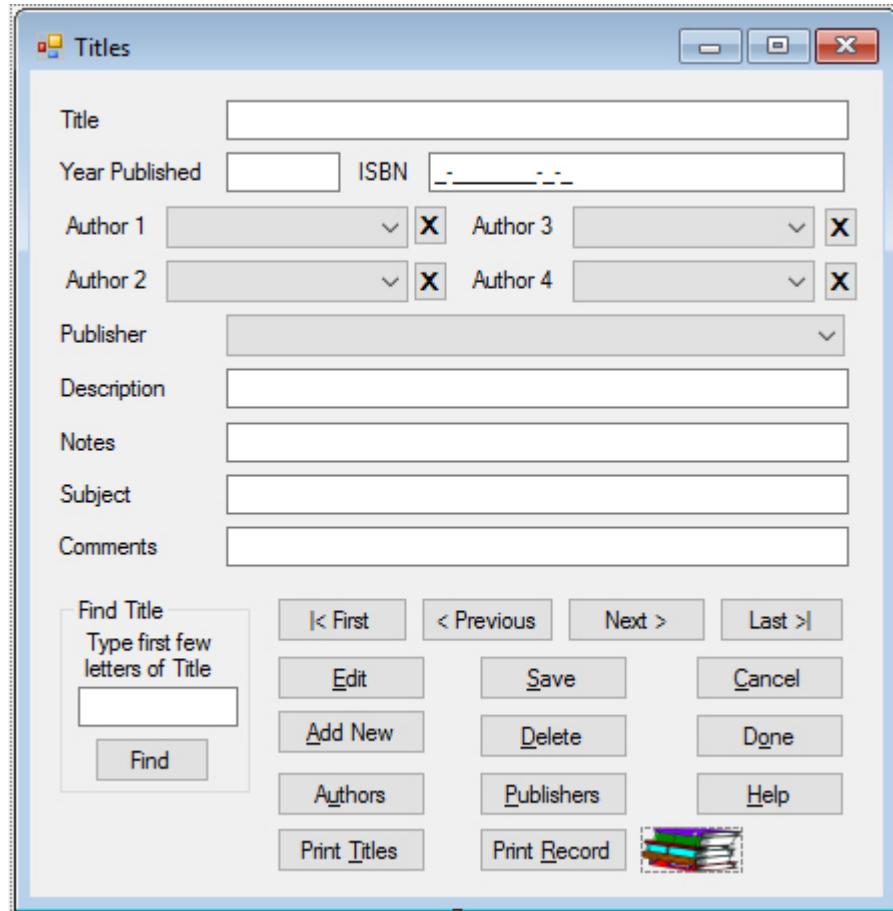
button1:

Name	btnPrintTitles
Text	Print &Titles

printPreviewDialog1:

Name	dlgPreview
------	------------

The form now looks like this:



2. Add these two lines in the form level declarations to store page number information:

```
int pageNumber;
const int titlesPerPage = 45;
```

3. Put this code in the **btnPrintTitles_Click** event:

```
private void btnPrintTitles_Click(object sender,
EventArgs e)
{
    // Start printing process at first record
    pageNumber = 1;
    btnFirst.PerformClick();
    PrintDocument titlesDocument;
```

```
// Create the document and name it
titlesDocument = new PrintDocument();
titlesDocument.DocumentName = "Titles Listing";
// Add code handler
titlesDocument.PrintPage += new
PrintPageEventHandler(this.PrintTitlesPage);
// Print document
dlgPreview.Document = titlesDocument;
dlgPreview.ShowDialog();
// Dispose of document when done printing
titlesDocument.Dispose();
}
```

This code sets up the `PrintDocument` object (`titlesDocument`) to print using the information in the `PrintTitlesPage` method. The document object is opened with the print preview dialog control (`dlgPreview`).

6. Add this code to the `PrintTitlesPage` event method:

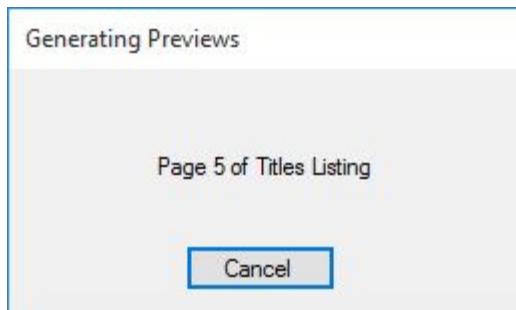
```
private void PrintTitlesPage(object sender,
PrintPageEventArgs e)
{
    // here you decide what goes on each page and draw
    // it there
    // print headings
    Font myFont = new Font("Courier New", 14,
    FontStyle.Bold);
    e.Graphics.DrawString("Titles - Page " +
pageNumber.ToString(), myFont, Brushes.Black,
e.MarginBounds.Left,
e.MarginBounds.Top);
```

```
myFont = new Font("Courier New", 12,
FontStyle.Underline);
int y = Convert.ToInt32(e.MarginBounds.Top + 50);
e.Graphics.DrawString("Title", myFont,
Brushes.Black,
e.MarginBounds.Left, y);
e.Graphics.DrawString("Author", myFont,
Brushes.Black,
e.MarginBounds.Left + Convert.ToInt32(0.6 *
(e.MarginBounds.Width)), y);
y += Convert.ToInt32(2 * myFont.GetHeight());
myFont = new Font("Courier New", 12,
FontStyle.Regular);
int iEnd = titlesPerPage * pageNumber;
if (iEnd > titlesTable.Rows.Count)
{
    iEnd = titlesTable.Rows.Count;
    e.HasMorePages = false;
}
else
{
    e.HasMorePages = true;
}
for (int i = 1 + titlesPerPage * (pageNumber - 1);
i <= iEnd; i++)
{
    // programmatically move through all the records
    if (txtTitle.Text.Length < 35)
    {
        e.Graphics.DrawString(txtTitle.Text, myFont,
Brushes.Black, e.MarginBounds.Left, y);
```

```
        }
        else
        {
            e.Graphics.DrawString(txtTitle.Text.Substring
                (0, 35),
myFont, Brushes.Black, e.MarginBounds.Left, y);
        }
        if (cboAuthor1.Text.Length < 20)
        {
            e.Graphics.DrawString(cboAuthor1.Text,
myFont,
Brushes.Black, e.MarginBounds.Left +
Convert.ToInt32(0.6 *
(e.MarginBounds.Width)), y);
        }
        else
        {
            e.Graphics.DrawString(cboAuthor1.Text.Substring(0, 20),
myFont, Brushes.Black, e.MarginBounds.Left +
Convert.ToInt32(0.6 *
(e.MarginBounds.Width)), y);
        }
        btnNext.PerformClick();
        y += Convert.ToInt32(myFont.GetHeight());
    }
    if (e.HasMorePages)
        pageNumber++;
    else
        pageNumber = 1;
}
```

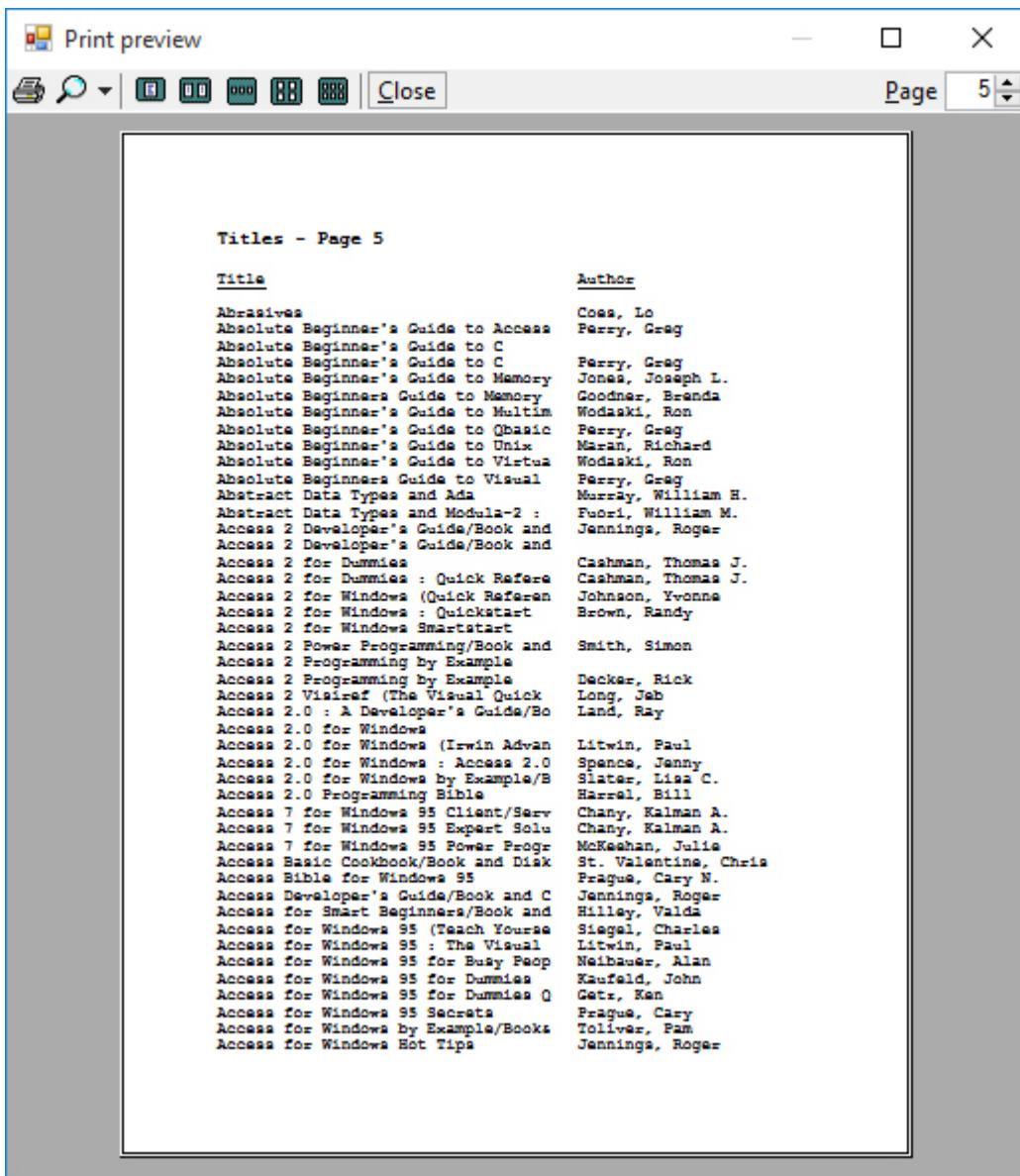
This code puts a header on each page. It programmatically moves through all the records (by simulated clicks on the `btnNext` button). As control moves through the records, the corresponding title and author values are printed (they are truncated using the `Substring` method so they fit on a line). When done, we need to reset `pageNumber` to 1 to allow for correct printing (if you really want to print out all these pages). If we didn't do this, only the last page would print.

7. Save (saved in **Example 7-2** folder in `VCSDB\Code\Class 7` folder) and run the application. Click **Print Titles** and sit back. You should see a status box indicating progress:



It would take a while to wait for all pages (nearly 200 of them!) to appear in the preview control. At some point, click **Cancel**.

The pages can be previewed in the displayed control. Here's the fifth page:



The `PrintDocument` object, with a need to programmatically move through all the records, slows us down. You could let the user somehow limit how many pages to print. We'll look at a way to do that in the final example.

Example 7-2

Using SQL Server Databases

Make the same changes to the SQL Server version of the project.

Example 7-3

Book Publishers Listing

For more practice in developing database reports and designing Visual C# interfaces, we build a database report for the **Publishers** table in the books database. This will be a multiple page report listing publisher name and mailing address information. The following fields will be in the report for each publisher:

Name
Address
City
State
Zip

Each page will have multiple publishers (seven to a page). Since this is a large table (over 700 records), the user will be able to limit the number of available printed records by specifying the first letter of the Publisher name.

User Interface

The interface we build for the book publishers listing will be simple, consisting of twenty-seven buttons (each representing a single letter of the alphabet). Wait, you say, there are only 26 letters in the alphabet! You're right. The 27th button will be used for publisher names beginning with non-alphabetic characters. When the user clicks a button, the application will display the publisher pages in a print preview control. Then, the user can choose to print any, or all, pages. The finished interface will be built in code. Let's do it.

1. Start a new Visual C# application with just a form and a print preview dialog control. Set these properties:

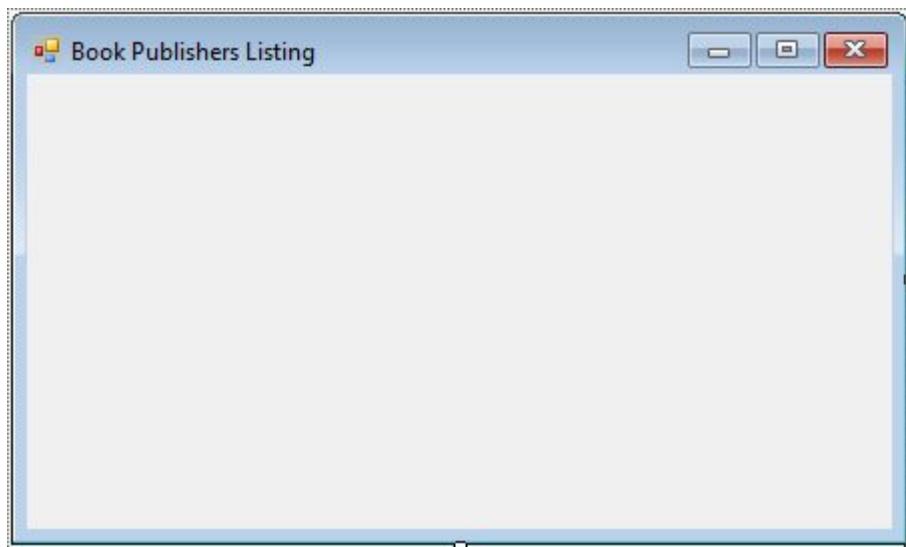
Form1:

Name	frmPubs
BorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Book Publishers Listing

printPreviewDialog1:

Name	dlgPreview
------	------------

Size the form so it looks similar to this:



2. Use this code in the frmPubs_Load method:

```
private void frmPubs_Load(object sender, EventArgs e)
{
    // Build interface
    Button[] btnLetter = new Button[27];
    int l = 0;
    int w = Convert.ToInt32(this.ClientRectangle.Width / 3);
    int t = 0;
    int h =
        Convert.ToInt32(this.ClientRectangle.Height / 9 );
    // resize form to fit buttons exactly
    this.ClientSize = new Size(3 * w, 9 * h);
    for (int i = 0; i < 27; i++)
    {
        btnLetter[i] = new Button();
        btnLetter[i].Name = i.ToString();
        btnLetter[i].Left = l;
        btnLetter[i].Width = w;
        btnLetter[i].Top = t;
```

```
btnLetter[i].Height = h;
btnLetter[i].Text = (char) (i + 65) + "
Publishers";
this.Controls.Add(btnLetter[i]);
t += h;
if (i == 8 || i == 17)
{
    l += w;
    t = 0;
}
btnLetter[26].Text = "Other Publishers";
}
```

This code creates the needed buttons and places them on the form (computing the button width and height based on form size; there are three rows of buttons with nine buttons in each row). It also places the proper **Text** property on each button. The buttons are given very simple numeric names to allow easy identification in later code.

3. Save the application (saved in **Example 7-3** folder in **VCSDB\Code\Class 7** folder). Run it and you'll see the buttons appear as they should. My form at run-time looks like this:



The screenshot shows a Windows application window titled "Book Publishers Listing". The window has standard minimize, maximize, and close buttons at the top right. The main content is a grid of nine cells arranged in three rows and three columns. The first column is labeled "A Publishers", the second column "J Publishers", and the third column "S Publishers". The first row contains "B Publishers", "K Publishers", and "T Publishers". The second row contains "C Publishers", "L Publishers", and "U Publishers". The third row contains "D Publishers", "M Publishers", and "V Publishers". The fourth row contains "E Publishers", "N Publishers", and "W Publishers". The fifth row contains "F Publishers", "O Publishers", and "X Publishers". The sixth row contains "G Publishers", "P Publishers", and "Y Publishers". The seventh row contains "H Publishers", "Q Publishers", and "Z Publishers". The eighth row contains "I Publishers", "R Publishers", and "Other Publishers". The cell for "A Publishers" is highlighted with a blue border.

A Publishers	J Publishers	S Publishers
B Publishers	K Publishers	T Publishers
C Publishers	L Publishers	U Publishers
D Publishers	M Publishers	V Publishers
E Publishers	N Publishers	W Publishers
F Publishers	O Publishers	X Publishers
G Publishers	P Publishers	Y Publishers
H Publishers	Q Publishers	Z Publishers
I Publishers	R Publishers	Other Publishers

This completes the interface framework. Notice this is a cute little way to get a letter input from a user. You may find other applications where similar interfaces may be useful.

Database Connection and Printing

Now, we'll connect to the **Publishers** table in **BooksDB.accdb** and use the **PrintDocument** object to print the **Publishers** database report.

1. Add these lines at top of the code window:

```
using System.Data.OleDb;
using System.Drawing.Printing;
```

2. Add these lines in the form level declarations to declare the needed data objects and establish print parameters:

```
OleDbConnection booksConnection;
OleDbCommand publishersCommand;
OleDbDataAdapter publishersAdapter;
DataTable publishersTable;
int pageNumber;
const int recordsPerPage = 6;
```

3. Add the shaded code to the **frmPubs_Load** method to attach the buttons to a **Click** event method (**btnLetter_Click**) and to open the books database:

```
private void frmPubs_Load(object sender, EventArgs e)
{
    // Build interface
    Button[] btnLetter = new Button[27];
    int l = 0;
```

```
int w = Convert.ToInt32(this.ClientRectangle.Width / 3);
int t = 0;
int h =
Convert.ToInt32(this.ClientRectangle.Height / 9 );
// resize form to fit buttons exactly
this.ClientSize = new Size(3 * w, 9 * h);
for (int i = 0; i < 27; i++)
{
    btnLetter[i] = new Button();
    btnLetter[i].Name = i.ToString();
    btnLetter[i].Left = l;
    btnLetter[i].Width = w;
    btnLetter[i].Top = t;
    btnLetter[i].Height = h;
    btnLetter[i].Text = (char) (i + 65) + " Publishers";
    this.Controls.Add(btnLetter[i]);
    btnLetter[i].Click += new
EventHandler(this.btnLetter_Click);
    t += h;
    if (i == 8 || i == 17)
    {
        l += w;
        t = 0;
    }
}
btnLetter[26].Text = "Other Publishers";
// connect to books database
booksConnection = new
```

```
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDB\\Working\\BooksDB.accdb");
booksConnection.Open();
}
```

4. Add this code to the **frmPubs_FormClosing** event to dispose of the data objects:

```
private void frmPubs_FormClosing(object sender,
FormClosingEventArgs e)
{
    // dispose of objects
    booksConnection.Close();
    booksConnection.Dispose();
    publishersCommand.Dispose();
    publishersAdapter.Dispose();
    publishersTable.Dispose();
}
```

5. Add this code to the **btnLetter_Click** event method (handles a click on any of the 27 buttons):

```
private void btnLetter_Click(object sender, EventArgs e)
{
    Button whichButton = (Button) sender;
    // Retrieve records
    string sql = "SELECT * FROM Publishers ";
    int i = Convert.ToInt32(whichButton.Name);
    if (i >= 0 && i <= 24) // A to Y
    {
```

```
    sql += "WHERE Name >= '" + (char) (i + 65) + "'  
    AND  
    Name < '" + (char) (i + 65 + 1) + "'";  
}  
else if (i == 25) // Z  
{  
    sql += "WHERE Name >= 'Z'";  
}  
else // Other  
{  
    sql += "WHERE Name < 'A'";  
}  
sql += " ORDER BY Name";  
publishersCommand = new OleDbCommand(sql,  
booksConnection);  
// establish data adapter/data table  
publishersAdapter = new OleDbDataAdapter();  
publishersAdapter.SelectCommand =  
publishersCommand;  
publishersTable = new DataTable();  
publishersAdapter.Fill(publishersTable);  
// set up printdocument  
PrintDocument publishersDocument;  
// Create the document and name it  
publishersDocument = new PrintDocument();  
publishersDocument.DocumentName = "Publishers  
Listing";  
// Add code handler  
publishersDocument.PrintPage += new  
PrintPageEventHandler(this.PrintPublishersPage);  
// Print document
```

```

pageNumber = 1;
dlgPreview.Document = publishersDocument;
dlgPreview.ShowDialog();
// Dispose of object when done printing
publishersDocument.Dispose();
}

```

This code forms a SQL statement based on the button clicked. For example, if the user clicks 'M Publishers', the SQL statement formed is:

```
SQL = "SELECT * FROM Publishers WHERE Name >= 'M' AND Name < 'N' ORDER BY Name"
```

The data table object (**publishersTable**) containing the corresponding records is formed. This is the table that provides the printed results in **publishersDocument**.

6. Add this code to the PrintPublishersPage general method.

```

private void PrintPublishersPage(object sender,
PrintPageEventArgs e)
{
    // print headings
    Font myFont = new Font("Arial", 18,
    FontStyle.Bold);
    int y = Convert.ToInt32(e.MarginBounds.Top);
    e.Graphics.DrawString("Book Publishers Listing - "
    +
    DateTime.Now.ToString(), myFont, Brushes.Black,
    e.MarginBounds.Left, y);
    y += Convert.ToInt32(myFont.GetHeight());
    e.Graphics.DrawString("Page " +
    pageNumber.ToString(),

```

```
myFont, Brushes.Black, e.MarginBounds.Left, y);
y += Convert.ToInt32(myFont.GetHeight()) + 10;
e.Graphics.DrawLine(Pens.Black,
e.MarginBounds.Left, y,
e.MarginBounds.Right, y);
y += Convert.ToInt32(myFont.GetHeight());
myFont = new Font("Courier new", 12,
FontStyle.Regular);
int iEnd = recordsPerPage * pageNumber;
if (iEnd > publishersTable.Rows.Count)
{
    iEnd = publishersTable.Rows.Count;
    e.HasMorePages = false;
}
else
{
    e.HasMorePages = true;
}
for (int i = recordsPerPage * (pageNumber - 1); i
< iEnd; i++)
{
    // display current record
    e.Graphics.DrawString("Publisher: " +
publishersTable.Rows[i]["Name"].ToString(), myFont,
Brushes.Black, e.MarginBounds.Left, y);
    y += Convert.ToInt32(myFont.GetHeight());
    e.Graphics.DrawString("Address: " +
publishersTable.Rows[i]["Address"].ToString(),
myFont,
Brushes.Black, e.MarginBounds.Left, y);
    y += Convert.ToInt32(myFont.GetHeight());
```

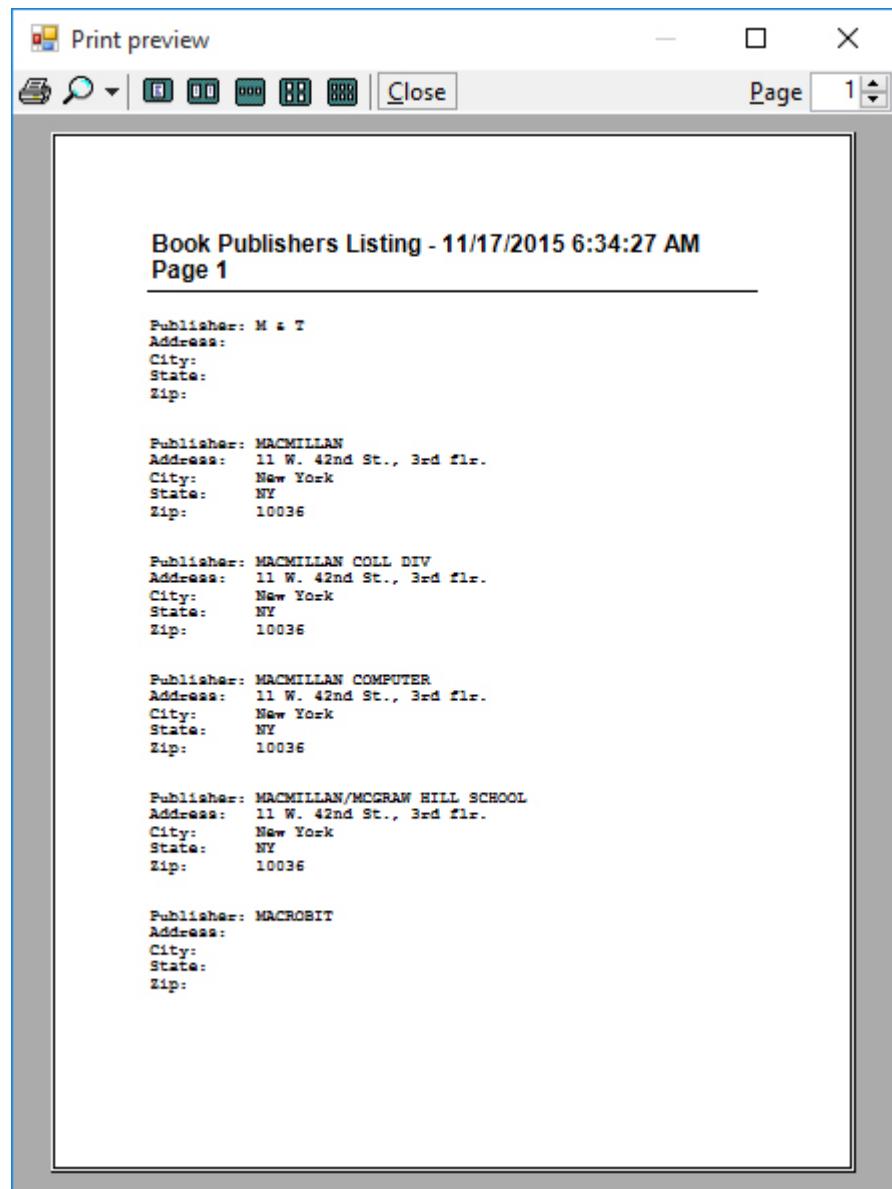
```

e.Graphics.DrawString("City: " +
publishersTable.Rows[i]["City"].ToString(), myFont,
Brushes.Black, e.MarginBounds.Left, y);
y += Convert.ToInt32(myFont.GetHeight());
e.Graphics.DrawString("State: " +
publishersTable.Rows[i]["State"].ToString(), myFont,
Brushes.Black, e.MarginBounds.Left, y);
y += Convert.ToInt32(myFont.GetHeight());
e.Graphics.DrawString("Zip: " +
publishersTable.Rows[i]["Zip"].ToString(), myFont,
Brushes.Black, e.MarginBounds.Left, y);
y += Convert.ToInt32(myFont.GetHeight());
y += 2 * Convert.ToInt32(myFont.GetHeight());
}
if (e.HasMorePages)
    pageNumber++;
else
    pageNumber = 1;
}

```

Here, we print some header information, then we cycle through the records, placing `recordsPerPage` entries on each page. You should be able to identify what is going on in this code. Again, when done, we reset `pageNumber` to 1 to allow for correct printing (if desired).

7. Save (saved in **Example 7-3** folder in `VCSDB\Code\Class 7` folder) and run the application. Click **M Publishers** - 11 pages should appear:



Try printing some records if you like.

Example 7-3

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Copy **SQLBooksDB.mdf** to your working directory
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. Change all instances of **OleDbConnection** to **SqlConnection**
Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**
4. Use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS;  
AttachDbFilename=c:\\VCSDB\\Working\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30; User  
Instance=True");
```


Other Approaches to Database Reports

Though straightforward, using the **PrintDocument** object for developing database reports is tedious and the resulting print process is, at times, slow. There are two other possibilities available for building reports you might want to consider.

Visual C# has a built-in database reporting capability. The **ReportViewer** works with the data objects to build reports with a graphical interface. Its capabilities are excellent, with future upgrades and support guaranteed.

CrystalReportViewer is a third-party product that generates data reports using a structured system. CrystalReportViewer is included with Visual C#. CrystalReportViewer provides extensive connections to database structure. The big disadvantage to CrystalReportViewer is its complexity. And, there's the question of support. If it is not included with future Visual C# upgrades, you would need to purchase a copy to support your legacy code.

The internet offers several tutorials for using **ReportViewer** and **CrystalReportViewer**. We suggest you look into these other tools if you are interested.

Summary

In this chapter, we have looked using the **Visual C# PrintDocument** object for developing database reports.

Using the **PrintDocument** object is easy and doesn't require any knowledge beyond Visual C#. But, lots of code is required and performance is slow for large databases, such as our books database.

We will see more examples of database reports in Chapter 10.

8

Distributing a Database Application

Review and Preview

At this point in the course, you have the skills to create a complete database management system, including printed reports. It's time to share your capabilities and products with others. The applications you have built have been executed within the Visual C# environment.

In this chapter, you learn the steps of developing a stand-alone application that can be run on any Windows-based machine - even machines without Visual C#.

Several topics are covered: accessing database files in code, adding an icon to an application, creating a stand-alone executable, and creating a distribution package (which can be distributed via CD-ROM or downloaded files).

Accessing Database Files in Code

When we develop a Visual C# application, all files used (including project, form, code and database files) are saved in directories (folders) we specify in our computing environment. To distribute our applications, we need to make them independent of the directory structure used. A first step in achieving this independence is to delete any directory structure used within our code.

In these notes, we have placed database files in our working directory. And, we have ‘hard-wired’ that location in code when we develop the connection object. We can’t expect a user to be so kind as to place their copy of the database in a directory with the same path name we use. We need some way to determine database location. And, once we know this location, we need to use that location to open the database in code. That is, we must delete the ‘hard-wiring’ we have been using.

We look at two ways of determining the location of a database file: (1) placing the database in the application directory and (2) allowing the user to specify the location using an open file dialog box. Once location is known, we look at how to open the database (and establish associated connection objects tables) in Visual C# code.

Important: In each case, do not delete directory structure from your application until you are sure it works in your design environment. Then, make the changes provided in these notes to properly locate and open database files in code.

Database File in Application Path

The easiest way to solve the problem of finding a database file is to place it in the same path (directory) as the application itself. That directory is the **Bin\Debug** folder in a project, specified by **Application.StartupPath**. We have used this before to specify the location of help files needed by an application.

Access Database:

To create a connection object (**myConnection**) connected to an Access database (**myDataBase.accdb**) located in the application folder, we would use:

```
myConnection = new  
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = " + Application.StartupPath +  
"\\"myDataBase.accdb");
```

Everything else in the code remains the same. It's that easy. The additional slash (\\\) is needed because the **Application.StartupPath** property does not have a terminating slash. You do need to remember to copy your database to the proper folder.

SQL Server Database:

To create a connection object (**myConnection**) connected to an Access database (**mySQLDataBase.mdf**) located in the application folder, we would use:

```
myConnection = new SqlConnection("Data  
Source=SQLInstance;  
AttachDbFilename= " + Application.StartupPath +
```

```
"\\mySQLDataBase.mdf; Integrated Security=True;  
Connect  
Timeout=30; User Instance=True");
```

where **SQLInstance** is the name of your SQL Server instance (set when installed; if using default SQL Server Express settings, name is **.\\SQLEXPRESS**). Everything else in the code remains the same. It's that easy. The additional slash (\) is needed because the **Application.StartupPath** property does not have a terminating slash. You do need to remember to copy your database to the proper folder.

Example 8-1

Opening Database Files in Application Directory

In this example, we will modify the Books Database Management System (including the **Titles**, **Authors**, and **Publishers** input forms) developed in Chapter 6 and modified in Chapter 7, to open the books database file from the application directory. These modifications will make our application independent of the directories we used to build the application. This is a needed step to make our application distributable

1. Open the latest version of the books database management system in **Example 7-2**. Place a working copy of **BooksDB.accdb** into the **Bin\Debug** folder for the application.
2. Make the **Publishers** form active. In the **frmPublishers_Load** method, make the shaded modification:

```
private void frmPublishers_Load(object sender,
EventArgs e)
{
    try
    {
        // point to help file
        hlpPublishers.HelpNamespace =
            Application.StartupPath +
        "\\books.chm";
        // connect to books database
        booksConnection = new
```

```

OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + Application.StartupPath +
"\BooksDB.accdb");

        booksConnection.Open();
        // establish command object
        publishersCommand = new OleDbCommand("SELECT *
FROM
Publishers ORDER BY Name", booksConnection);

        .
        .
    }

```

This removes the directory dependency from the code.

3. Save application (saved in the Example 8-1 folder in VCSDB\Code\Class 8 folder) and run the application. When the Titles form appears, click the Publishers button and make sure the database file opens properly. Stop the application.
4. Make the Authors form active. In the frmAuthors_Load method, make the same shaded modification:

```

private void frmAuthors_Load(object sender, EventArgs
e)
{
    try
    {
        // point to help file
        hlpAuthors.HelpNamespace =
        Application.StartupPath +
"\books.chm";
        // connect to books database

```

```

        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + Application.StartupPath +
"\BooksDB.accdb");

        booksConnection.Open();
        // establish command object
        authorsCommand = new OleDbCommand("Select * from
Authors ORDER BY Author", booksConnection);

        .
        .
    }

```

5. Save and run the application. When the **Titles** form appears, click the **Authors** button and make sure the database file opens properly. Stop the application.
6. Finally, make the **Titles** form active and make the same change to the **frmTitles_Load** event method:

```

private void frmTitles_Load(object sender, EventArgs
e)
{
    try
    {
        // point to help file
        hlpBooks.HelpNamespace = Application.StartupPath
        +
        "\books.chm";
        // connect to books database
        booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data

```

```
Source = " + Application.StartupPath +
"\BooksDB.accdb");

    booksConnection.Open();
    // establish command object
    titlesCommand = new OleDbCommand("SELECT * FROM
    Titles
ORDER BY Title", booksConnection);

    .
    .
}
```

7. Save and run the application (saved in the **Example 8-1** folder in **VCSDB\Code\Class 8** folder) one last time. Operation should remain the same as before. The only difference is the books database is now assumed to be in the project's startup folder. We have removed the 'hard-wired' directory structure used in program development.

Example 8-1

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. The SQL Server version of the books database is **SQLBooksDB.mdf**. Place a working copy of **SQLBooksDB.mdf** into the **Bin\Debug** folder for the application.
2. In each case, use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS; AttachDbFilename= " +  
Application.StartupPath + "\\SQLBooksDB.mdf;  
Integrated Security=True; Connect Timeout=30;  
User Instance=True");
```


Database File Location with OpenFile Dialog Control

An alternate to placing the database file in the application directory is to allow the user to tell us where the database is. We actually do this a lot. An example was referred to way back in Chapter 5, where we first looked at the **open file dialog control**. The example we used was a schoolteacher using a database application to keep track of grades. The teacher would have database files for each class. When the application starts, the teacher needs to specify which database file is to be opened and where it is located. The Visual C# open file dialog control is perfect for this use.

We need to open the database file before generate any other data objects and the associated data bound controls. Hence, the best place to use the open file dialog control is in the application's form **Load** method. The user chooses the database file at this point. This selected file is then used to establish the connection object used by the other data objects.

Here is a code segment the displays an open file dialog control (**dlgOpen**). If the user clicks **OK**, the connection object (**myConnection**) is created using the selected file. If the user clicks **Cancel**, nothing happens. In this case, you would need code to decide what to do (continue, try again, abort):

Access Database:

```
if (dlgOpen.ShowDialog() == DialogResult.OK)
{
    myConnection = new
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
```

```
Source = " + dlgOpen.FileName);
}
else
{
    // do something if user clicks Cancel
}
```

SQL Server Database:

```
if (dlgOpen.ShowDialog() == DialogResult.OK)
{
    myConnection = new SqlConnection("Data
Source=SQLInstance; AttachDbFilename= " +
dlgOpen.FileName
+ "; Integrated Security=True; Connect Timeout=30;
User
Instance=True");
}
else
{
    // do something if user clicks Cancel
}
```

One other thing to consider. What if our application requires a database with the structure of the books database, but the user selects some other database that our application can't use? This is a place where error trapping code (using a **try** block) will come in handy. When we try to open the database and create the data tables, errors will fly! Based on error codes, we relay this information to the user and give them another chance.

Example 8-2

Opening Database Files with OpenFile Dialog Control

We build a little example to illustrate the use of the open file dialog control to open a database file. We will open the **BooksDB.accdb** file and display the **Titles** table.

1. Start a new application. Add a data grid view and an open file dialog control. Set these properties:

Form1:

Name	frmTitles
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Titles Table

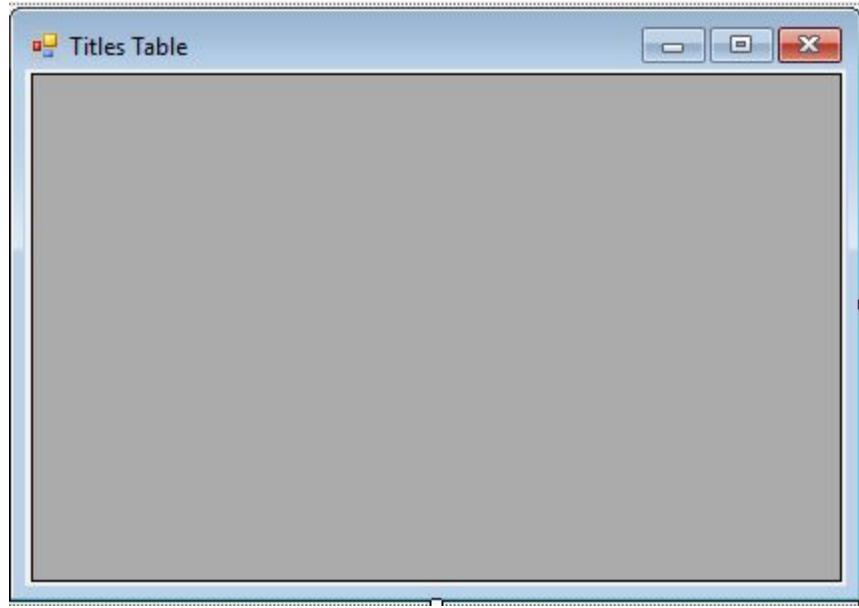
dataGridView1:

Name	grdTitles
------	-----------

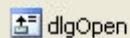
openFileDialog1:

Name	dlgOpen
FileName	[blank]
Filter	Access Databases (*.accdb) *.accdb

The finished form looks like this:



Below the form is:



2. Add this line at the top of the code window:

```
using System.Data.OleDb;
```

3. Add these form level declarations to declare data objects:

```
OleDbConnection booksConnection;  
OleDbCommand titlesCommand;  
OleDbDataAdapter titlesAdapter;  
DataTable titlesTable;
```

4. Dispose of these objects in the `frmTitles_FormClosing` method:

```
private void frmTitles_FormClosing(object sender,  
FormClosingEventArgs e)  
{  
    booksConnection.Dispose();
```

```
titlesCommand.Dispose();
titlesAdapter.Dispose();
titlesTable.Dispose();
}
```

5. The crucial code is in the frmTitles_Load event method:

```
private void frmTitles_Load(object sender, EventArgs e)
{
    if (dlgOpen.ShowDialog() == DialogResult.OK)
    {
        try
        {
            // connect to books database
            booksConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + dlgOpen.FileName);
            booksConnection.Open();

            // establish command object
            titlesCommand = new OleDbCommand("Select *
from
Titles ORDER BY Title", booksConnection);

            // establish data adapter/data table
            titlesAdapter = new OleDbDataAdapter();
            titlesAdapter.SelectCommand = titlesCommand;
            titlesTable = new DataTable();
            titlesAdapter.Fill(titlesTable);
            // bind grid to data table
            grdTitles.DataSource = titlesTable;
        }
    }
}
```

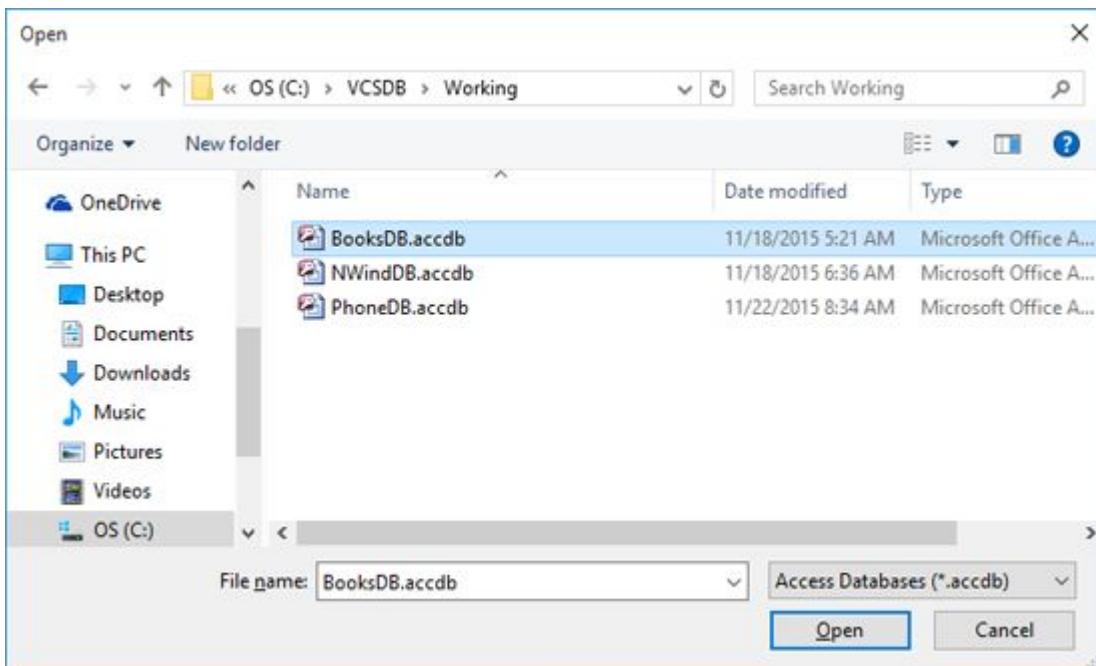
```

        catch (Exception ex)
        {
            MessageBox.Show(ex.Message, "Error
                establishing
                Titles table.", MessageBoxButtons.OK,
                MessageBoxIcon.Error);
            return;
        }
    }
    else
    {
        MessageBox.Show("No file selected", "Program
            stopping", MessageBoxButtons.OK,
            MessageBoxIcon.Information);
        this.Close();
    }
}

```

In this code, we obtain the database filename, create the needed data objects and bind the grid to the resulting data table object (all fields in the **Titles** table). If the user doesn't select a file, a message box appears. If an error occurs, error trapping prints a message.

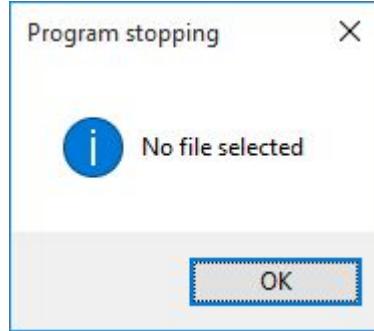
6. Save (saved in the **Example 8-2** folder in **VCSDB\Code\Class 8** folder) and run the application. The open file dialog box will appear:



Note the **Filter** property is set so only Access databases (accdb files) can be opened. Find your working copy of BooksDB.accdb and click **Open**. The file is opened and the data grid filled with the **Titles** table:

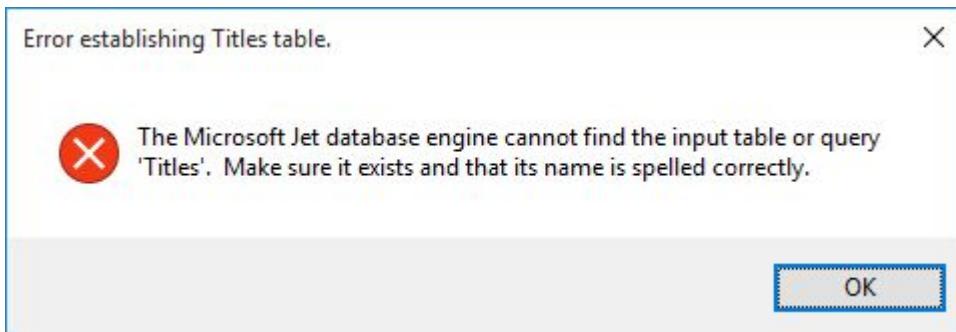
	Title	Year_Published	ISBN	PubID
▶	10 Minute Guide ...	1994	1-5676123-0-X	192
	10 Minute Guide ...	1994	1-5676145-0-7	192
	10 Minute Guide ...	1995	0-7897055-5-9	45
	10 Minute Guide ...	1995	1-5676153-9-2	192
	10 Minute Guide ...	1994	1-5676140-7-8	192
	10 Minute Guide ...	1993	1-5676117-6-1	192
	10 Minute Guide ...	1992	1-5676102-7-7	192
	10 Minute Guide ...	1994	1-5676149-4-9	192
	10 Minute Guide ...	1991	0-6722283-2-7	721
	10 Minute Guide ...	1991	0-6723003-5-4	721

7. Stop the application and run it again. When the open file dialog box appears, click **Cancel** and you will see:



This is one option if a file is not selected - just stop the program. You may want to give the user another chance.

8. Re-run the application, but this time select some other database file (not a books database, for example the **NWindDB.accdb** file). Click **Open** and you should see:



The **Titles** table cannot be located. With this error, we would give the user another try at locating a proper database file.

Example 8-2

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. Set these open file dialog properties:

openFileDialog1:

Name dlgOpen
FileName [blank]
Filter SQL Server Databases (*.mdf)|*.mdf

2. Use this using statement:

```
using System.Data.SqlClient;
```

3. Change all instances of **OleDbConnection** to **SqlConnection**
Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

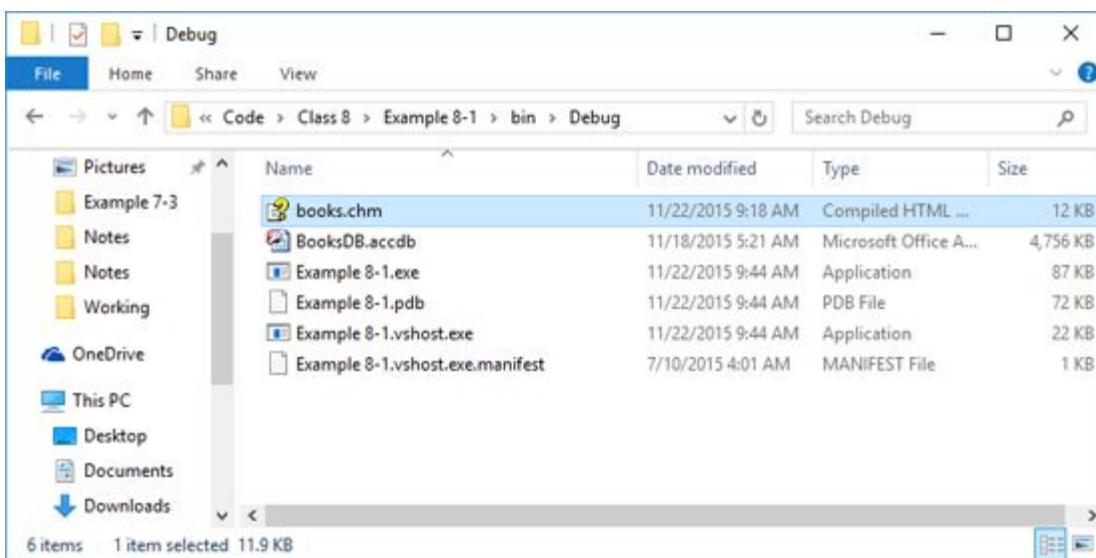
4. Use this connection object:

```
booksConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS; AttachDbFilename=" +  
dlgOpen.FileName + "; Integrated Security=True;  
Connect  
Timeout=30; User Instance=True");
```


Distribution of a Visual C# Database Application

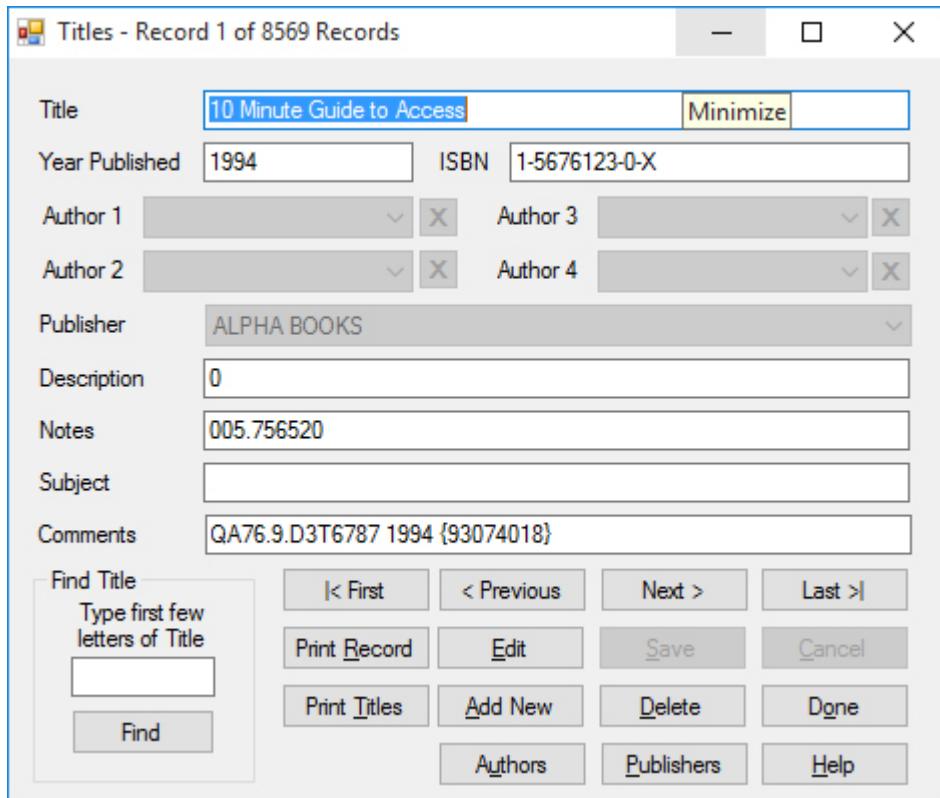
I bet you're ready to show your friends and colleagues some of the database applications you have built using Visual C#. Just give them a copy of all your project files and databases, ask them to buy and install Visual C# and learn how to open and run a project. Then, have them open your project and run the application. I think you'll agree this is asking a lot of your friends, colleagues, and, ultimately, your user base. We need to know how to run an application **without** Visual C#.

To run an application without Visual C#, you need to create an **executable** version of the application. So, how is an executable created? A little secret ... Visual C# builds an executable version of an application every time we run the application! The executable file is in the **Bin\Debug** folder. Open the **Bin\Debug** folder for any project you have built and you'll see a file with your project name of type **Application**. For example, using Windows Explorer to open the **Bin\Debug** folder for **Example 8-1** shows:



Notice the database file (**BooksDB.accdb**) is there.

The file named **Example 8-1.exe** is the executable version of the application. If I make sure Visual C# is not running and double-click this file, the following appears:



Voila! The Books DBMS application is running outside of the Visual C# IDE!

So distributing a Visual C# database application is as simple as giving your user a copy of the executable file, having them place it in a folder on their computer and double-clicking the file to run it? Maybe. This worked on my computer (and will work on yours) because I have a very important set of files known as the **.NET Framework** installed (they are installed when Visual C# is installed). Every Visual C# application needs the .NET Framework to be installed on the hosting computer. The .NET Framework is central to Microsoft's .NET initiative. It is an attempt to solve the problem of first determining what language (and version) an application was developed in and making sure the proper run-time files were installed. The .NET Framework supports all Visual Studio

languages, so it is the only runtime software need by Visual Studio applications.

The next question is: how do you know if your user has the .NET Framework installed on his or her computer? And, if they don't, how can you get it installed? These are difficult questions. For now, it is best to assume your user does not have the .NET Framework on their computer. It is new technology that will take a while to get disseminated. Once the .NET Framework is included with new Windows operating systems, most users will have the .NET Framework and it can probably be omitted from any distribution package.

So, in addition to our application's executable file, we also need to give a potential user the Microsoft .NET Framework files and inform them how to install and register these files on their computer. Things are getting complicated. Further complications for application distribution are inclusion and installation of database files, ancillary data files, graphics files and configuration files. Fortunately, Visual C# offers help in distributing, or **deploying**, applications.

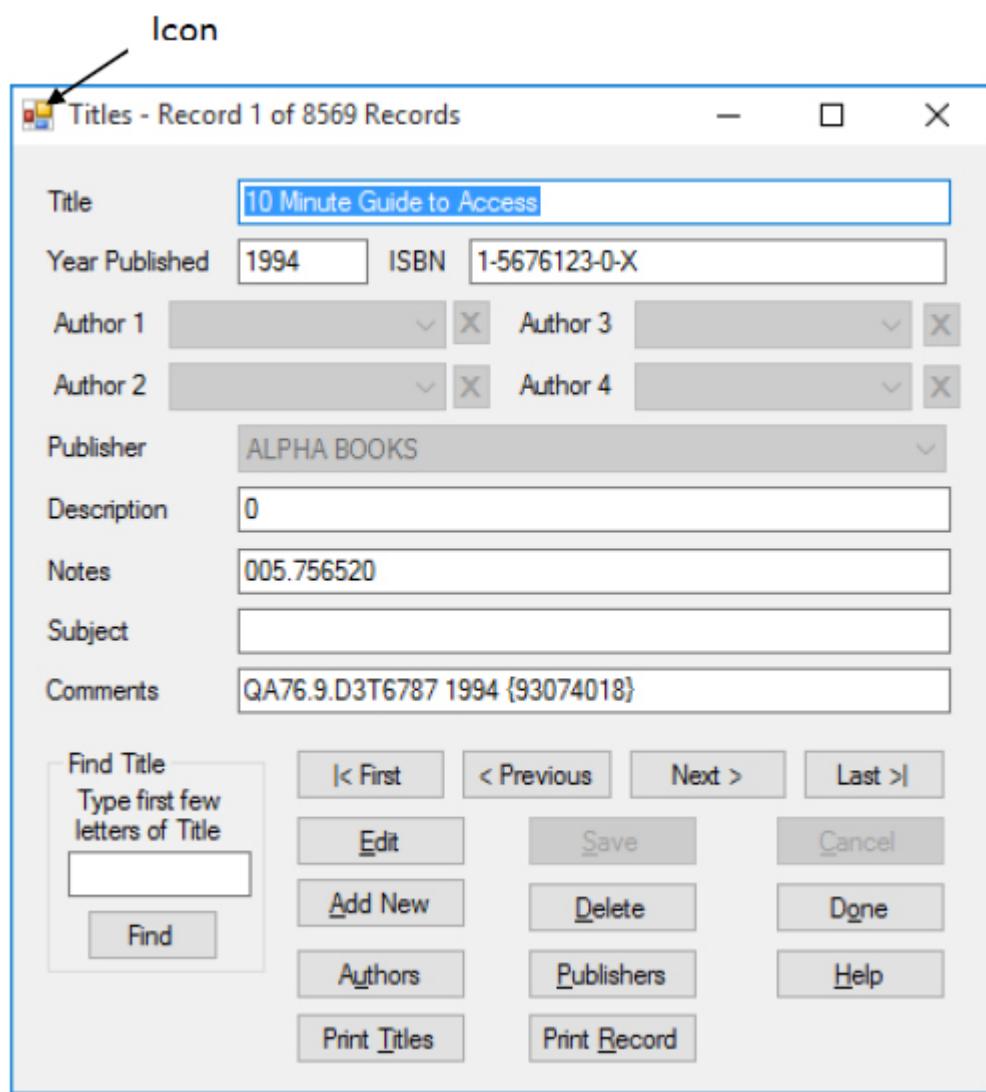
Visual C# uses **Setup Wizard** for deploying applications. **Setup Wizard** will identify all files needed by your application and bundle these files into a **Setup** program. You distribute this program to your user base (usually on a CD-ROM). Your user then runs the resulting **Setup** program. This program will:

- Install the application (and all needed files) on the user's computer.
- Add an entry to the user's **Start/Programs** menu to allow execution of your application.
- Add an icon to the user's desktop to allow execution of your application.

We'll soon look at use of **Setup Wizard** to build a deployment package for a Visual C# application. First, let's quickly look at the topic of icons.

Application Icons

Notice there is an icon file that looks like a little, blank Windows form associated with the application executable. And, notice that whenever you design a form in the Visual C# IDE (and run it), a small icon appears in the upper left hand corner of the form. Here's the **Titles** form from our DBMS:

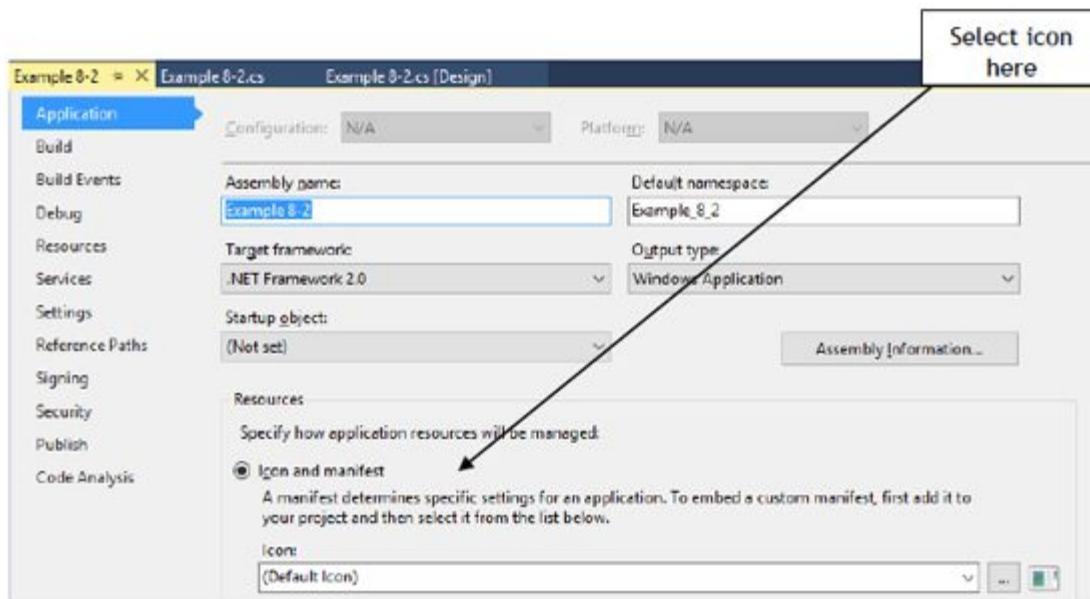


Icons are used in several places in Visual C# applications: to represent files in Windows Explorer, to represent programs in the Programs menu, to represent programs on the desktop and to

identify an application removal tool. Icons are used throughout applications. The default icons are ugly! We need the capability to change them.

Changing the icon connected to a form is simple. The idea is to assign a unique icon to indicate the form's function. To assign an icon, click on the form's **Icon** property in the properties window. Click on the ellipsis (...) and a window that allows selection of icon files will appear. The icon file you load must have the .ico filename extension and format.

A different icon can be assigned to the application. This will be the icon that appears next to the executable file's name in Windows Explorer, in the Programs menu and on the desktop. To choose this icon, first make sure the project file is highlighted in the **Solution Explorer** window of the IDE. Choose the **View** menu item and select **Property Pages**. Select the **Application** page and this window will appear:



The icon is selected in the **Icon** drop-down box. You can either choose an icon already listed or click the ellipsis (...) that allows you to select an icon using a dialog box. Once you choose an icon,

two things will happen. The icon will appear on the property pages and the icon file will be added to your project's folder. This will be seen in the Solution Explorer window.

The Internet and other sources offer a wealth of icon files from which you can choose an icon to assign to your form(s) and applications. But, it's also fun to design your own icon to add that personal touch.

Custom Icons

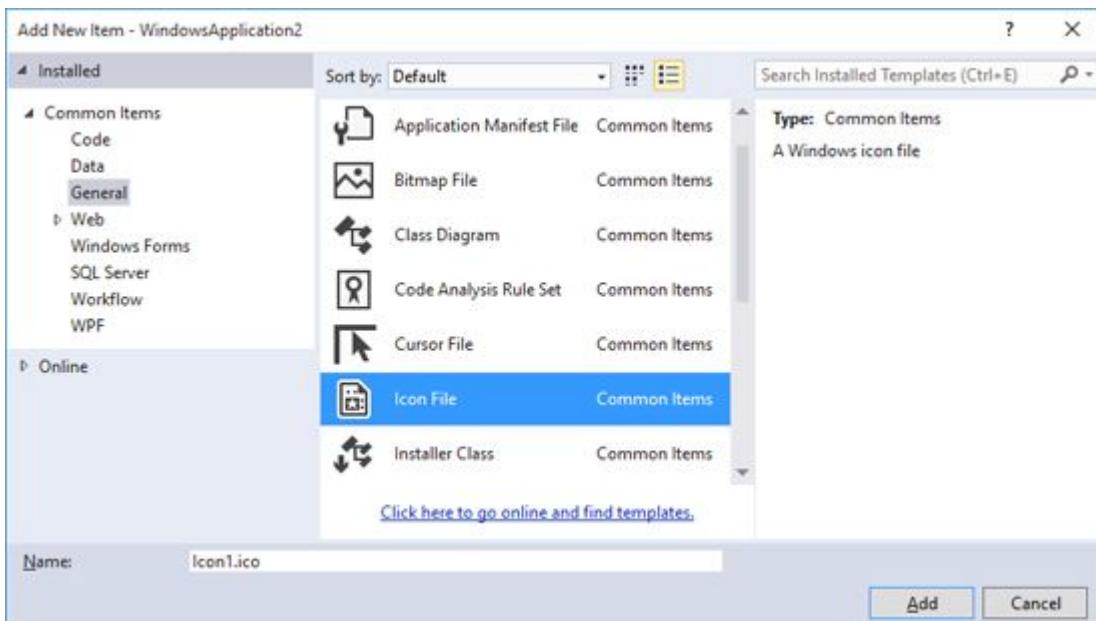
An icon is a special type of graphics file with an **ico** extension. It is a picture with a specific size of 32 by 32 pixels. The internet has a wealth of free icons you can download to your computer and use. Do a search on ‘free 32 x 32 ico files’. You will see a multitude of choices. One site we suggest is:

<http://www.softicons.com/toolbar-icons/32x32-free-design-icons-by-aha-soft/>

At such a site, you simply download the ico file to your computer and save it.

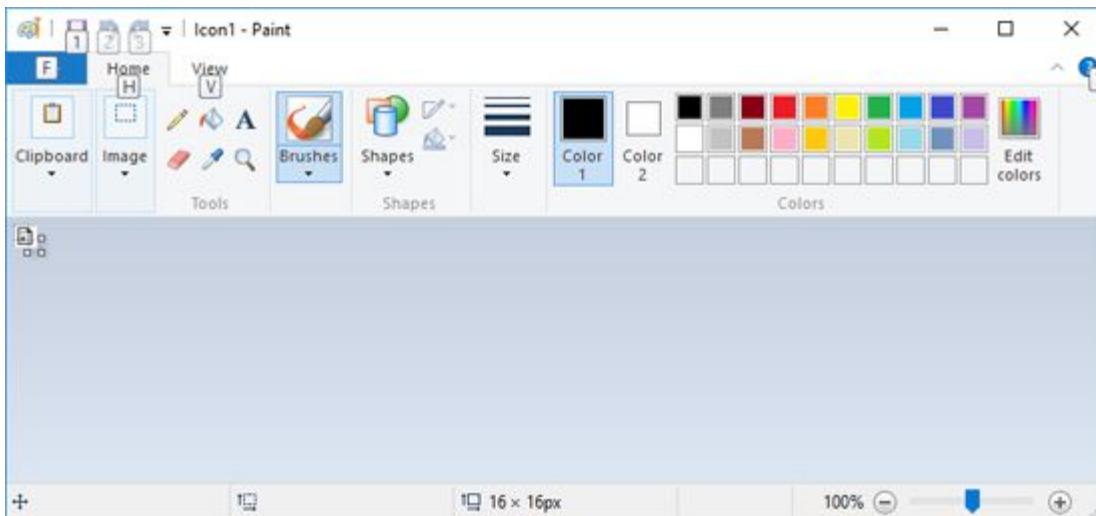
It is possible to create your own icon using Visual Studio. To do this, you need to understand use of the **Microsoft Paint** tool. We will show you how to create a template for an icon and open and save it in Paint. To do this, we assume you have some basic knowledge of using Paint. For more details on how to use Paint, go to the internet and search for tutorials.

To create an icon for a particular project, in **Solution Explorer**, right-click the project name, choose **Add**, then **New Item**. This window will appear:

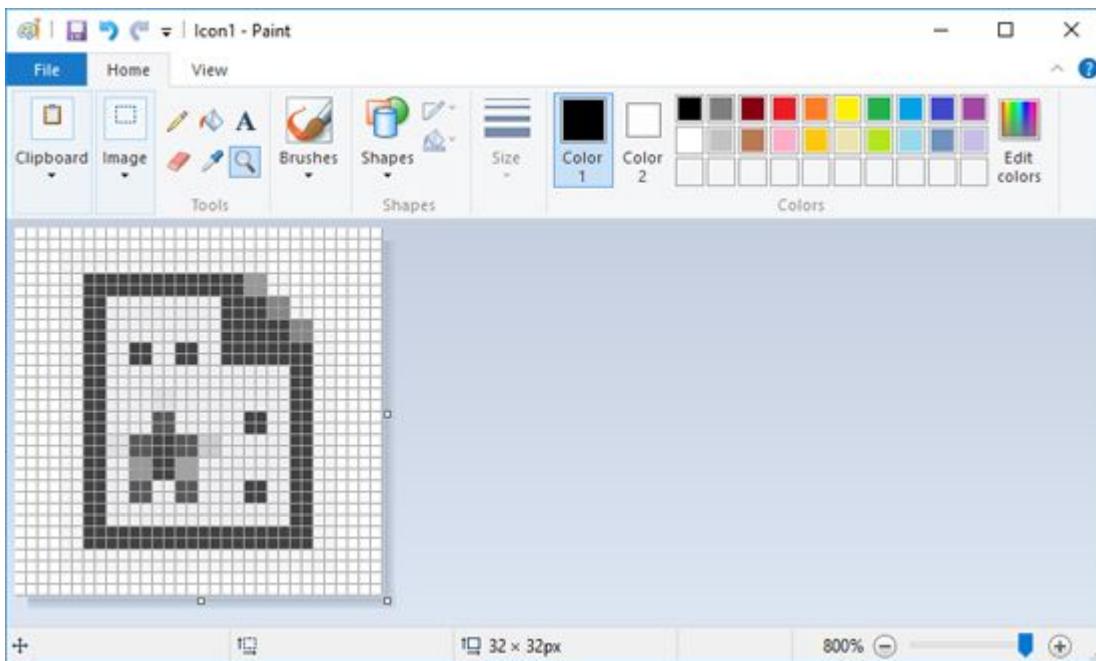


As shown, expand **Common Items** and choose **General**. Then, pick **Icon File**. Name your icon and click **Add**.

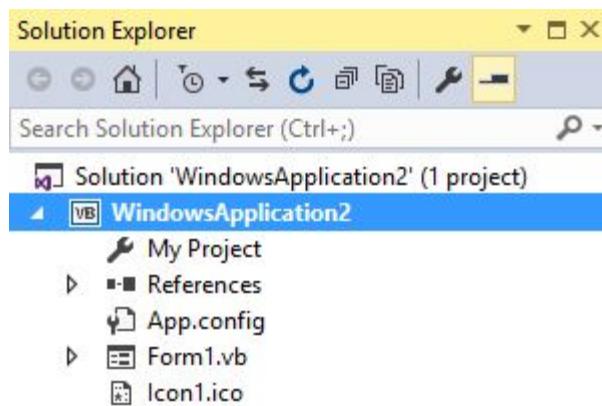
A generic icon will open in the **Microsoft Paint** tool:



The icon is very small. Let's make a few changes to make it visible and editable. First, resize the image to 32 x 32 pixels. Then, use the magnifying tool to make the image as large as possible. Finally, add a grid to the graphic. When done, I see:



At this point, we can add any detail we need by setting pixels to particular colors. Once done, the icon is saved by using the **File** menu. The icon will be saved in your project file and can be used by your project. The icon file (**Icon1.ico** in this case) is also listed in **Solution Explorer**:



Example 8-3

Visual C# Setup Wizard

As mentioned earlier, to allow someone else to install and run your Visual C# database application requires more than just a simple transfer of the executable file. Visual C# provides **Setup Wizard** that simplifies this task of application deployment.

Note: **Setup Wizard** must be a part of your Visual Studio installation. To download and install **Setup Wizard**, use the following link:

<https://visualstudiogallery.msdn.microsoft.com/f1cc3f3e-c300-40a7-8797-c509fb8933b9>

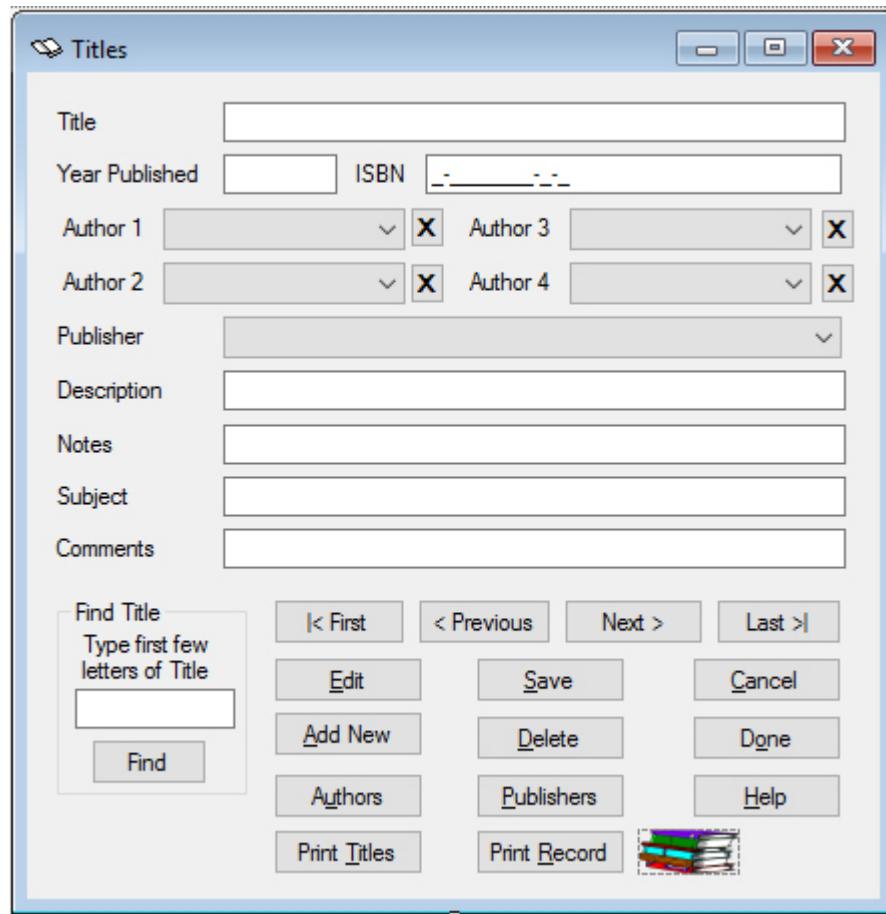
Setup Wizard will build a **Setup** program that lets the user install the application (and other needed files) on their computer. At the same time, **Program** menu entries, desktop icons and application removal programs are placed on the user's computer.

The best way to illustrate use of **Setup Wizard** is through an example. In these notes, we will build a Setup program for our Books DBMS example. Follow the example closely to see all steps involved. All results of this example for an Access database will be found in the **Example 8-3** and **Books DBMS** folders of the **VCSDB\Code\Class 8** folder. Let's start.

This example uses the Access database (**BooksDB.accdb**). If using SQL Server, use the SQL Server version of the project and follow the same steps using the SQL Server database (**SQLBooksDB.mdf**).

Open the Books DBMS project (**Example 8-1**). Make sure **books.chm** (the help file) and **BooksDB.accdb** (the database) are in the

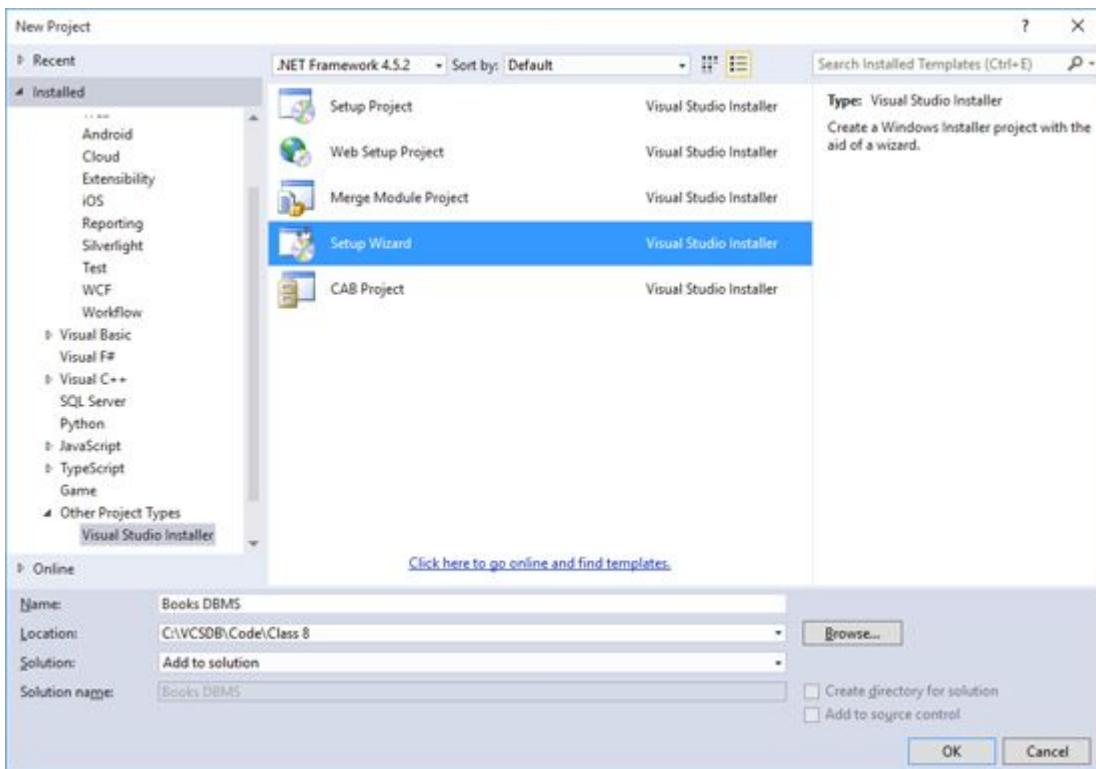
project Bin\Debug folder. Attach an icon to the **Titles** form (one possible icon, **BOOKS.ICO**, is included in the project folder). The form should look like this with its new icon:



Assign this same icon to the application using the steps mentioned earlier:

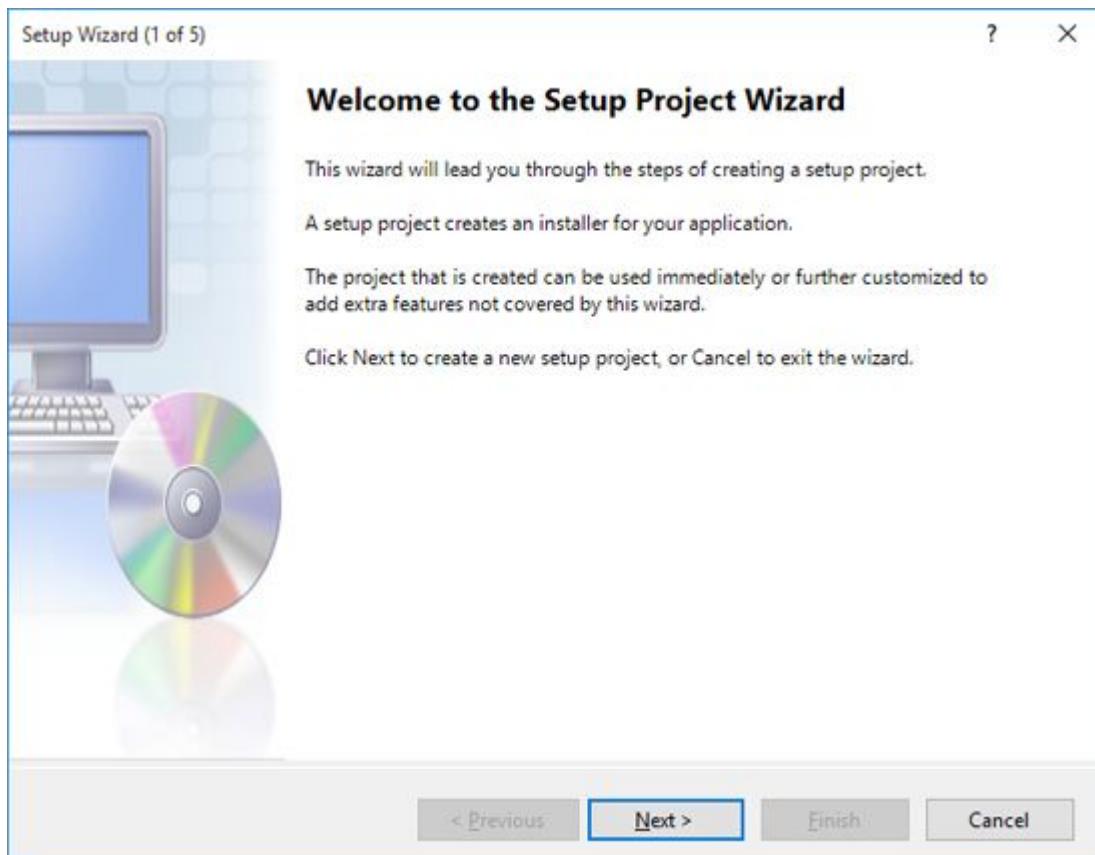


Setup Wizard is a separate project you add to your application solution. Choose the **File** menu option, then **New** then **Project**. In the window that appears, expand the **Other Project Types**, select **Visual Studio Installer** and this window appears:



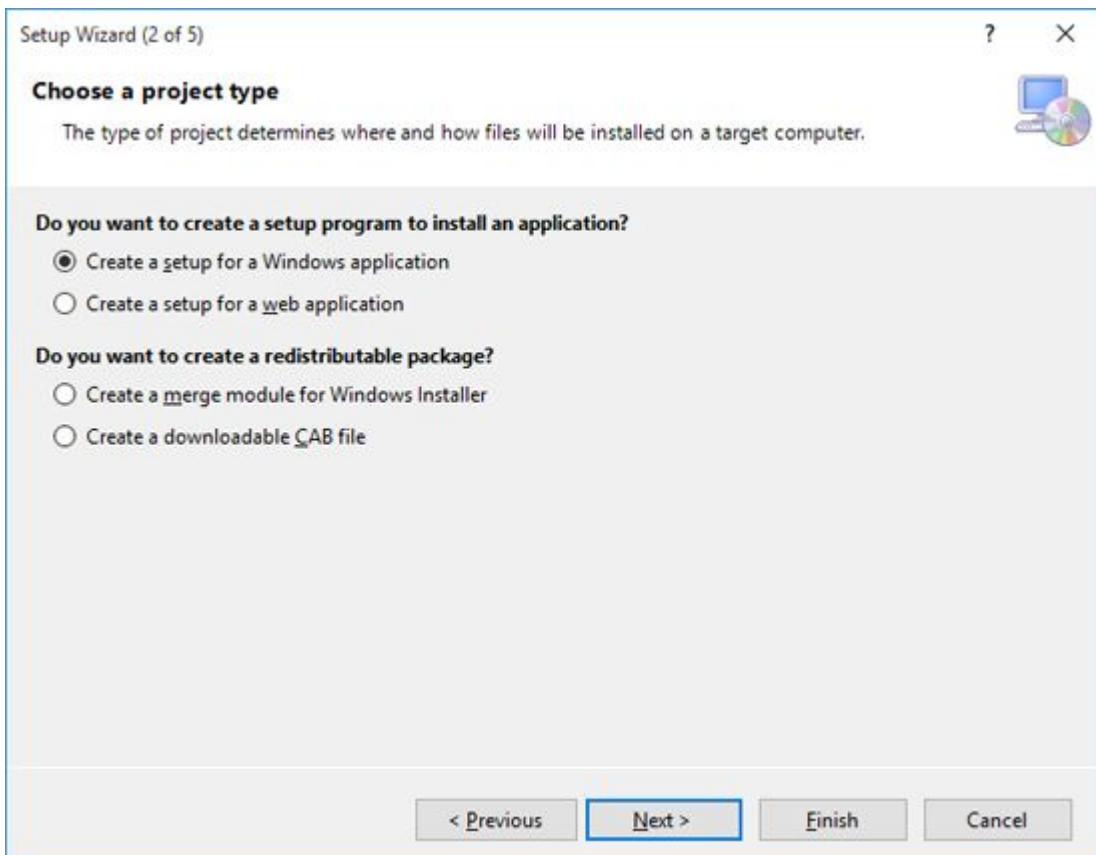
As shown, choose **Setup Wizard** on the right. Under **Solution**, choose **Add to Solution**. Name the project **Books DBMS** and click **OK**. Notice I have put the project folder in the **VCSDB\Code\Class 8** folder.

The **Setup Wizard** will begin with Step 1 of 5.



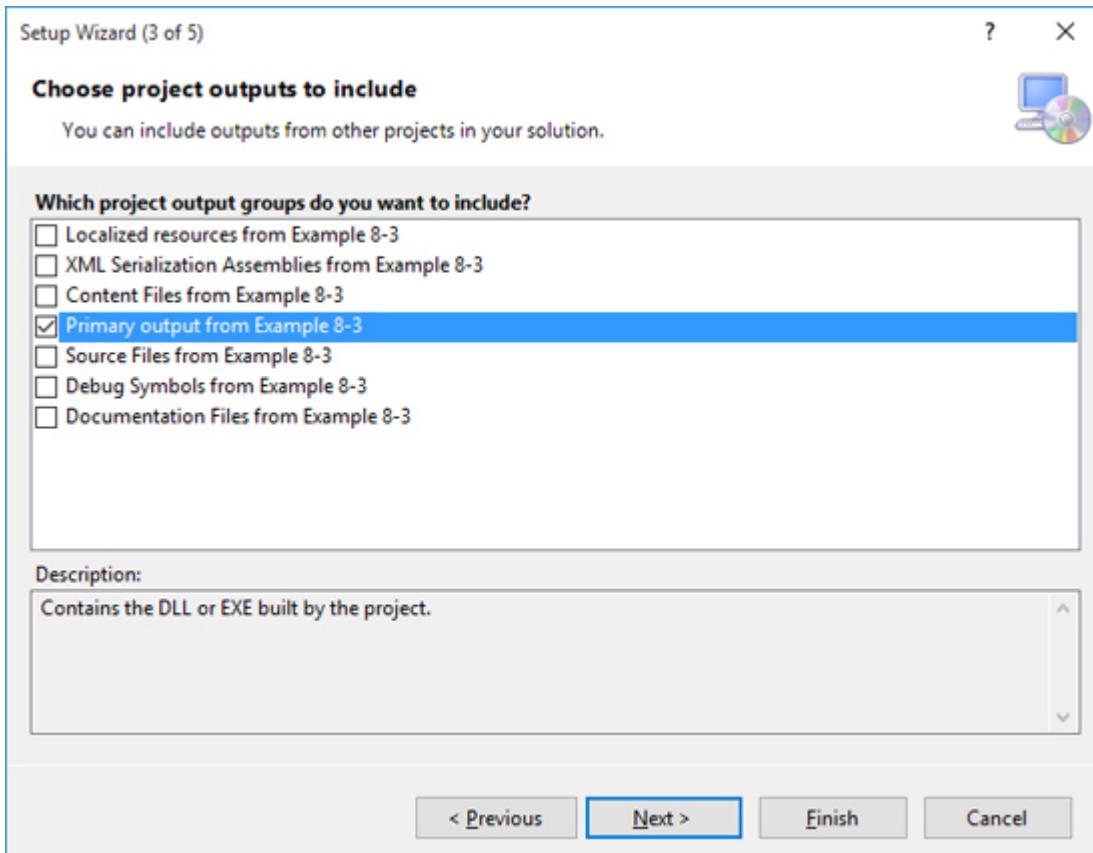
Continue from step to step, providing the requested information. Here, just click **Next**.

Step 2.



Choose **Create a setup for a Windows application**. Click **Next**.

Step 3.

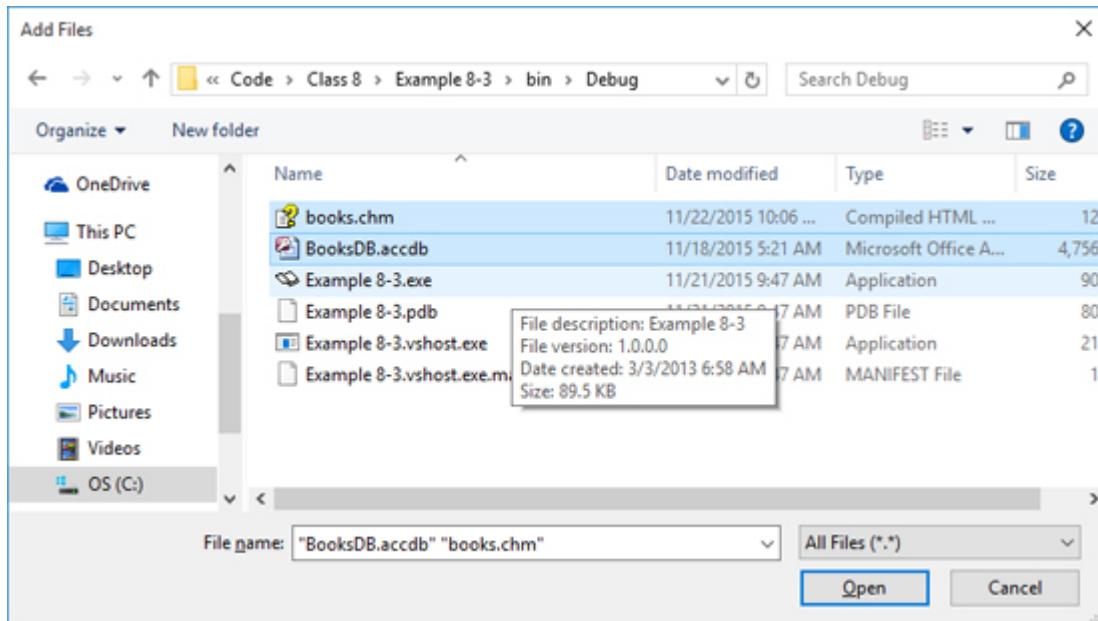


Here you choose the files to install. The main one is the executable file (known here as the **primary output file**). Place a check next to **Primary ouput from Example 8-3** and click **Next**.

Step 4.

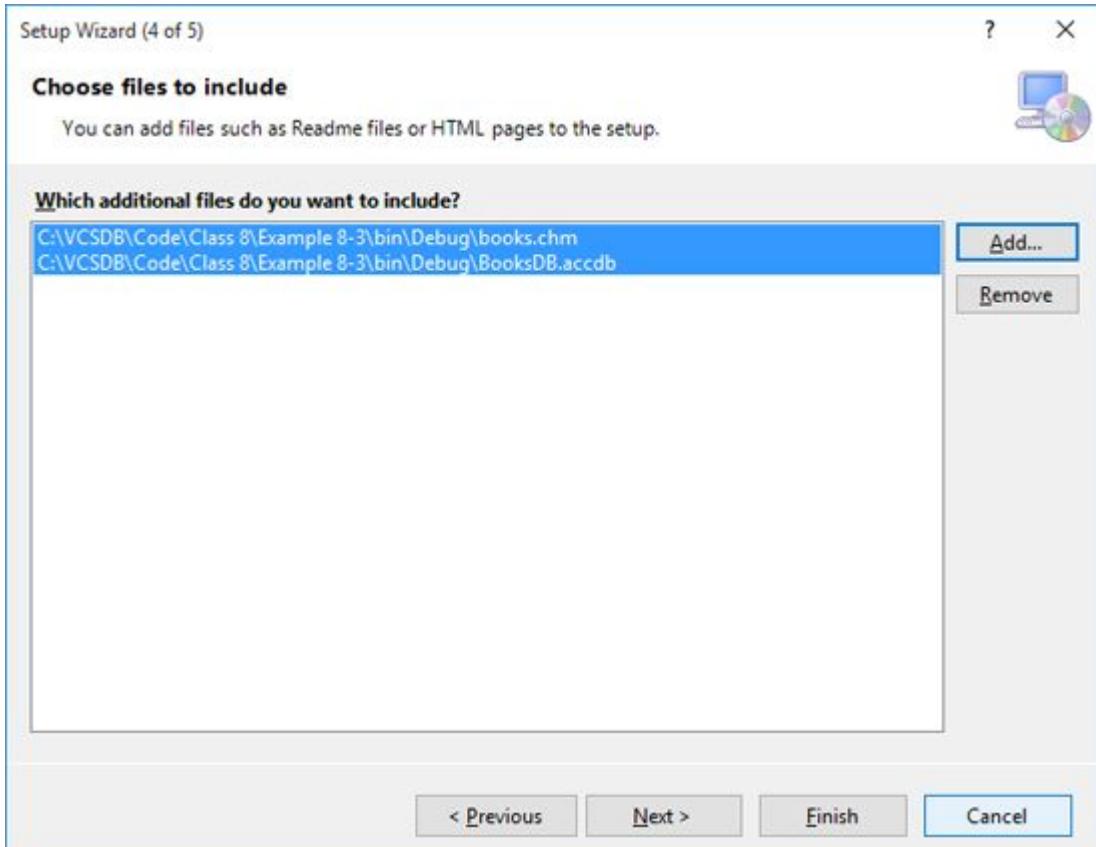
Here you can add additional files with your deployment package. You could specify ReadMe files, configuration files, help files, data files, sound files, graphic files or any other files your application needs. Our application needs two such files: the help file (**books.chm**) and the database file (**BooksDB.accdb**).

Click **Add**. A dialog box will appear:



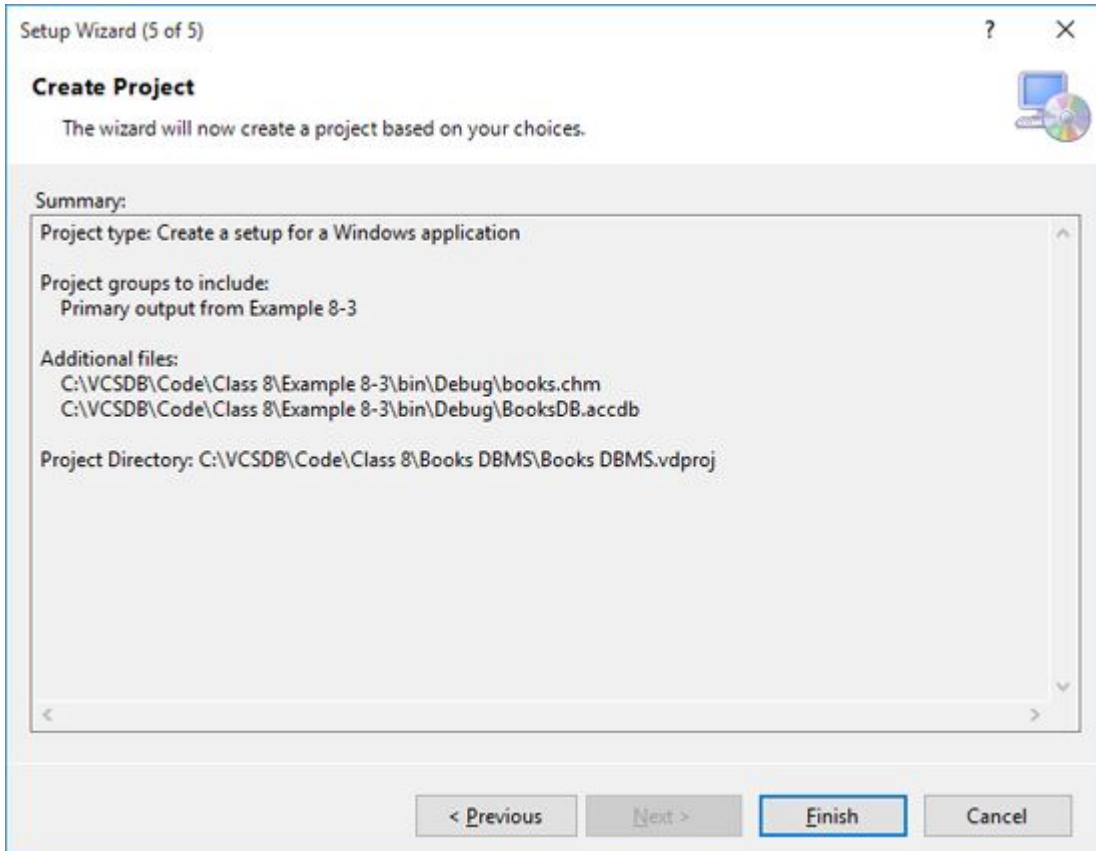
Navigate to the project's **Bin\Debug** folder and select the two files as shown.

Click **Open**. The two files should now appear in the window:

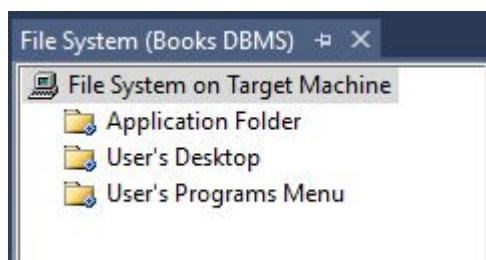


Move to the next step (click **Next**).

Step 5.



Click **Finish** to see the resulting **File System**:



We also want shortcuts to start the program both on the **Desktop** and the **Programs Menu**. First, we do the **Desktop** shortcut. To do this, open the **Application Folder** to see:

File System on Target Machine	Name	Type
Application Folder	books.chm	File
User's Desktop	BooksDB.accdb	File
User's Programs Menu	Primary output fro...	Output

Right-click **Primary output from ...** and choose **Create Shortcut to Primary output** Cut the resulting shortcut from the Application Folder and paste it into the User's Desktop folder:

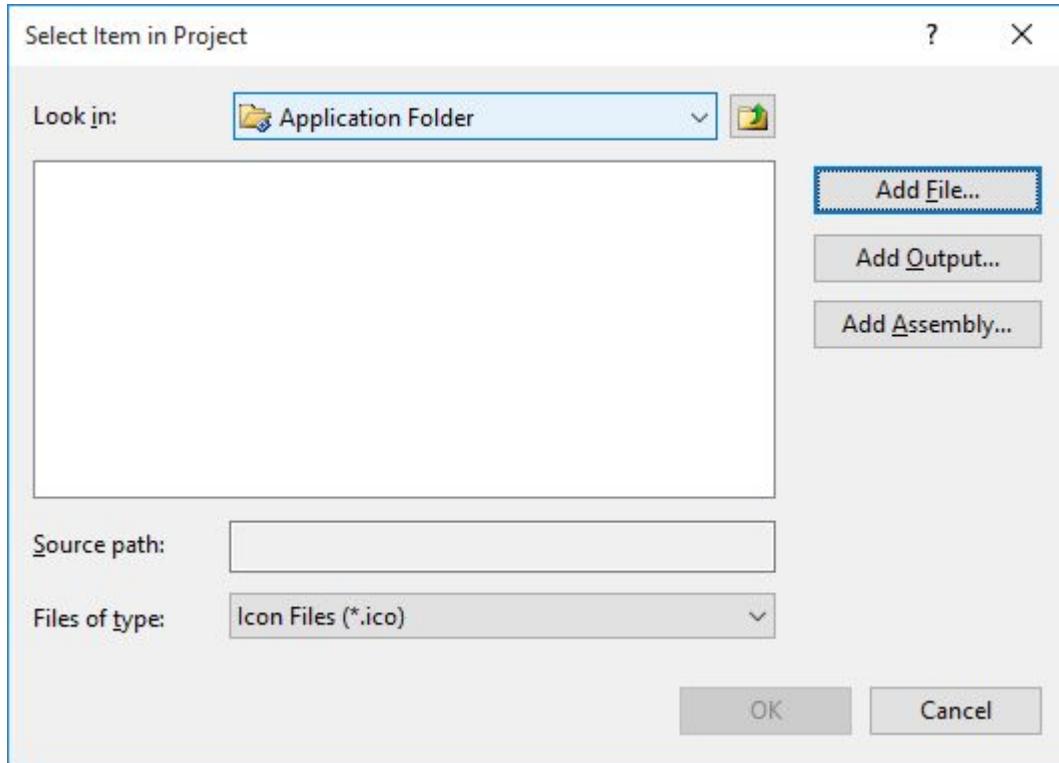
File System on Target Machine	Name	Type
Application Folder	Shortcut to Primary...	Shortcut

Rename the shortcut **Books DBMS** to yield

File System on Target Machine	Name	Type
Application Folder	Books DBMS	Shortcut

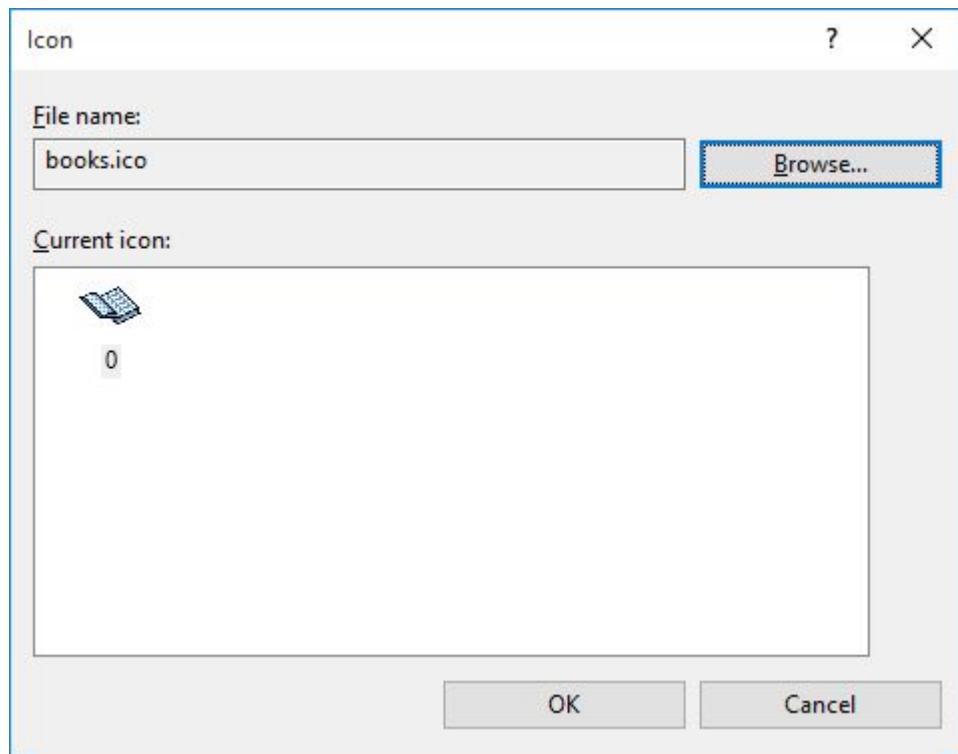
Lastly, we want to change the icon associated with the shortcut. This is a little tricky. The steps are:

- Highlight the shortcut and choose the **Icon** property in the Properties window
- Choose **Browse**.
- When the **Icon** dialog box appears, click **Browse**. You will see



As shown, look in the **Application Folder** and click **Add File**.

- Locate and select the icon file (there is one in the **VCSDB\Code\Class 8\Example 8-3** folder), then click **OK**. The **Icon** window will appear:

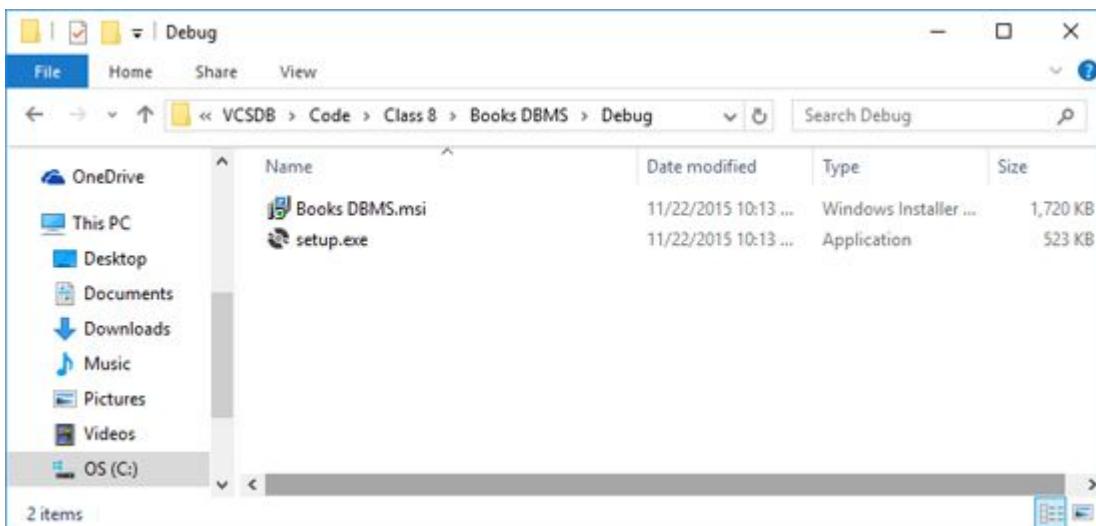


Select the desired icon and click **OK**.

Next, follow nearly identical steps to put a shortcut in the **User's Programs Menu** folder. The **Setup Wizard** has completed its job.

Building the Setup Program

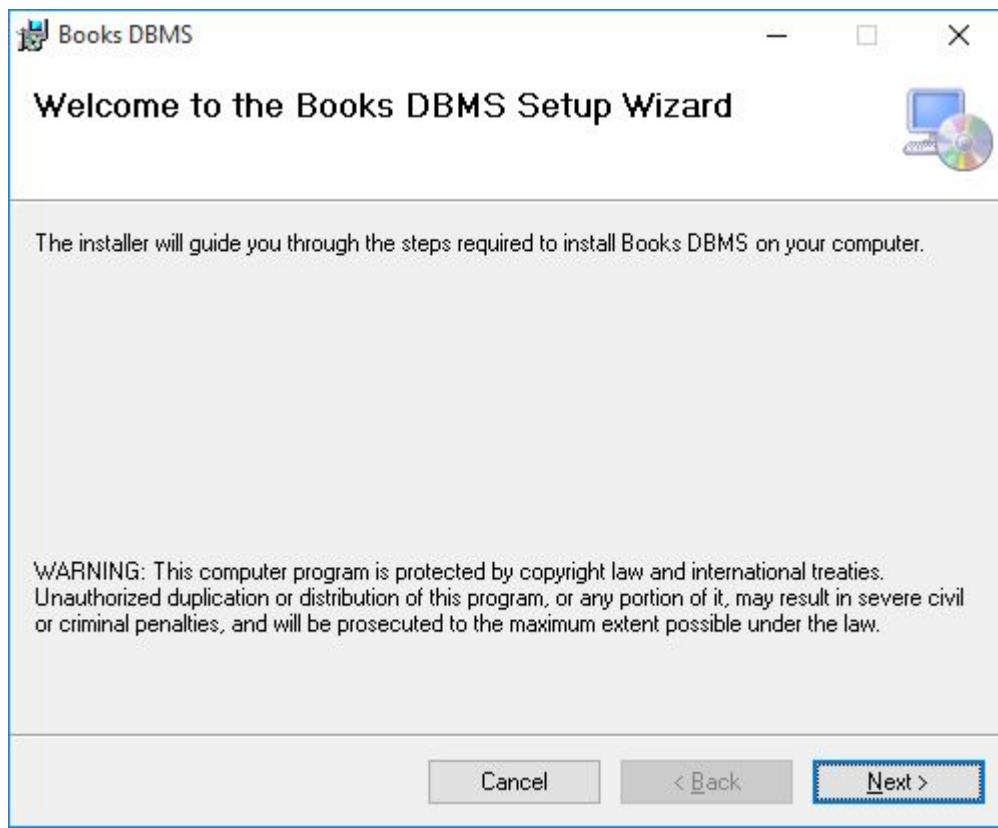
Now, let's build the **Setup** program. In the Solution Explorer window, right-click the **Books DBMS** project and choose **Build** from the menu. After a short time, the **Setup** program and an **msi** (Microsoft Installer) file will be written. They will be located in the executable folder of the **Books DBMS** project folder (**VCSDB\Code\Class 8\Books DBMS\Bin**). The **Setup** program is small. A look at the resulting directory shows:



Use some media (zip disk, CD-ROM or downloaded files) to distribute these files your user base. Provide the user with the simple instruction to run the **Setup.exe** program and installation will occur.

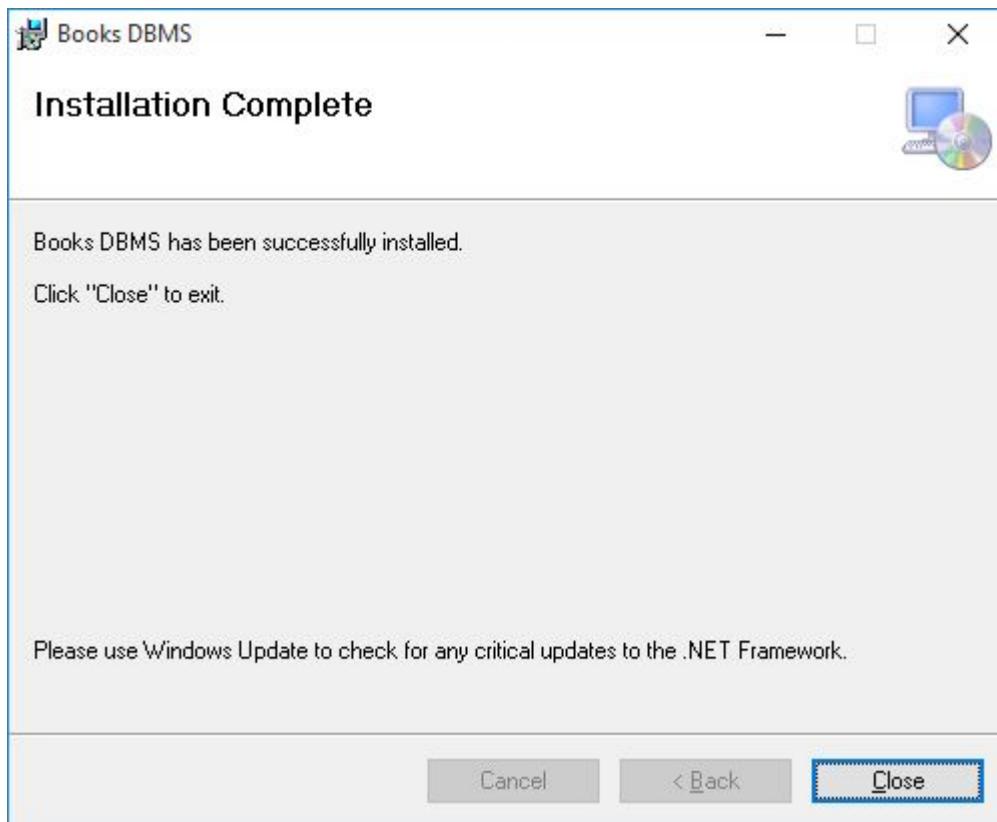
Installing a Visual C# Application

To install the program, simply run the **Setup.exe** program. These are the same brief instructions you need to provide a user. Users have become very familiar with installing software and running Setup type programs. Let's try the example just created and see what a nice installation interface is provided. Double-click the **Setup.exe** program from Example 8-3 and this introduction window should appear:



Click **Next** and you will be asked where you want the application installed.

After a few clicks, installation is complete and you will see:



After installing, look on your desktop. There should be an icon named **Books DBMS**. Double-click that icon and the program will run. Similarly, the program can be accessed by clicking **Start** on your taskbar, then choosing **All Apps**. Click the **Books DBMS** entry and the program runs. I think you'll agree the installer does a nice job.

Summary

In this chapter, we gained the skills needed to be able to run a database application outside the Visual C# design environment. Steps needed to open a database file were outlined. Creation of an executable version of an application was discussed, as was attaching a unique icon to each form.

The **Visual C# Setup Wizard** was introduced. The steps required to create an application distribution package using the wizard were illustrated.

9

Database Design Considerations

Review and Preview

All work done in this course so far has involved using existing databases. I'm sure you are intimately familiar with the books database by now! Many times, as a database programmer, this may be the only task you are involved in - building database management systems for so-called legacy systems.

If, however, you embark on a new database project, suggested by others or developed by yourself, you will need to design the database structure and contents. In this chapter, we address some of the considerations you must make in designing a database from scratch. We also look at available tools for building databases.

Database Design

A key step in developing a **database** is proper **design**. If you take the time to design your database properly, you will save yourself many headaches in developing and maintaining the associated database management system. We will follow several steps in database design:

1. Database modeling
2. Information requirements
3. Table requirements
4. Field requirements
5. Database implementation
6. Database testing
7. Design refinements

It is difficult to discuss database design philosophy in general. As we discuss each of these steps, we will use, as an example, a modified version of the database used by our company to track its product sales. We will name this database **KWSALES** (for KIDware sales). This sample database design should help guide you in any designs you take on. And, yes, KIDware's database management system is written entirely in Visual C# - what else would we use? This brings up an interesting point. For a while, we searched for a product to handle our sales invoicing, but couldn't find a product that did what we wanted at a price we wanted to pay. The solution was to use our Visual C# skills to build the exact product we wanted. You may find your Visual C# skills will help you out in a similar, future, dilemma.

Database Modeling

Database modeling is the task of determining just what you want your database to do. Is it a mailing list to contact clients, a complete sales tracking system, a room reservation process or a school membership list? Create some functional specifications for your database. It is best to write all this information down to have a list to work from. And, such a list helps in drawing up a schedule for task development.

A good place to start in modeling your database could be the existing process for maintaining the same data. Many times, a database is developed to replace a ‘less automatic’ method for data management. For example, perhaps a small company has always tracked its sales using a three-ring binder with columns to store all the data. This is just a ‘paper and pencil’ version of a database table. Replacing an existing data management process with a new automatic database is sometimes a straightforward task. You simply model the existing process.

If you are creating a database for others to use, go talk to those people. Ask them how they would like things to work. After all, these are the people who have to be happy with your work, so including them early on helps maximize those chances of happiness. See if they have a system to replace or particular reports they need to produce. Ask lots of questions to understand your user’s objectives.

In the KWSALES example we will use here, the database must contain all information about each sale that comes into the company. We want to know “who bought what and when they bought it.” We want to track customer information and each order a particular customer makes. We want to know what each customer bought. And, we would like to know which products in our inventory are the most popular. Each of these functional

specifications determines what information is needed in the database.

Information Requirements

After modeling your database requirements, you can begin to determine what **information** is needed in the database. The end-result is a shopping list of all information you want to store and have access to.

This may seem like a trivial step, but it's one of the most important. You have seen in your studies that a database is highly structured. This structure is what allows us to efficiently process SQL queries and to find information within the database. Once a database structure (tables, fields) is defined, it is difficult to change. Hence, if you omit an important piece of information from your database design, many times you have to throw out all your work and start over to include the new information. Such rework and modifications can be costly.

So, take lots of time in planning your information requirements. Check with those who will use the database to make sure you haven't forgotten anything. Is there an existing **information model**? With new databases, I will sometimes allow for a few 'empty fields' that can be used for account for possible omissions. Yes, I know this is a waste of storage space if they are never used, but they have also saved me lots of headaches.

For the KWSALES database, we had a model to work with - our previous sales tracking system written using a predecessor to Visual C#. The basic information needed in this database is:

- Customer Name
- Customer Mailing Address
- Customer Phone
- Order Date
- Product(s) Ordered

Realize that your first set of information requirements may lead to additional requirements as you continue your database design. That is, your information list will grow. As an example, in the KWSALES database, when database fields are specified, the Customer Name will be separated into two pieces of information - a first name and a last name. The Customer Address will be broken into City, State, and Zip. When the database design is complete, the information list should also be complete and separated into its smallest components. So this first set of requirements can be general, but it must be complete. If, at a later time, we decide we also need the customer's e-mail address, a redesign would be necessary.

Table Requirements

At this point in the database design process, we know what we want the database to do and what general information is to be in the database. Now, we begin the detailed design of deciding what tables and fields will be available in the database. In this section, we address the problem of separating the information into **tables**.

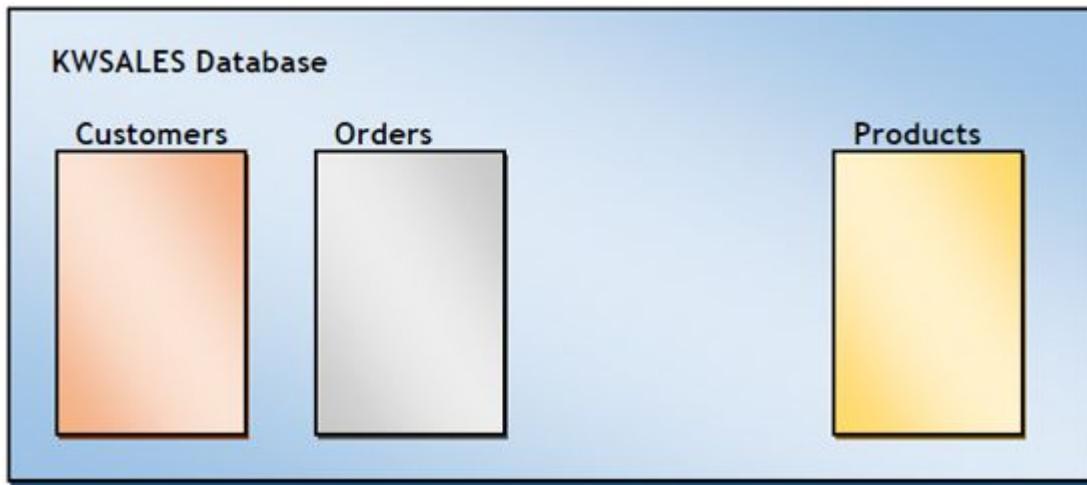
Recall a **table** is a collection of information related to a particular topic. Databases use multiple tables to minimize and, hopefully eliminate, redundant data. The books database (**BooksDB.accdb**) we have been using is a good example of the separation of information into tables. The topics used by **BooksDB.accdb** for separation are: **Titles**, **Authors**, and **Publishers**. These are very logical groupings. And, most of the time, a grouping of information into tables is very logical. You just have to realize what the logic is!

The process of separating database information into individual tables is known as **database normalization**. The ultimate goal of proper normalization is to try to make sure each piece of information in the database appears just once. This is just a goal, not a requirement. Such complete elimination of redundancies is not always practical or desirable. Let's see how normalization works with the KWSALES database.

In KWSALES, for each sale, we need information about the buyer and details on what the buyer purchased. If we put all this information in a single table (a flat database), there would be a lot of repeated data. For example, if a particular buyer had ordered with our company ten times, that buyer's contact information would be repeated 10 times. If a particular product were purchased 1,000 times, that product's detailed description information would be repeated 1,000 times!

Repeated, or redundant, data presents two problems. The first is wasted space. The second is a problem of accuracy and maintenance. If a product's price changed, we would have to make sure we changed this pricing information everywhere it is listed in the single table. This presents a real potential for error - it would be easy to miss several entries. The solution to the redundancy problem is to place like information in like tables.

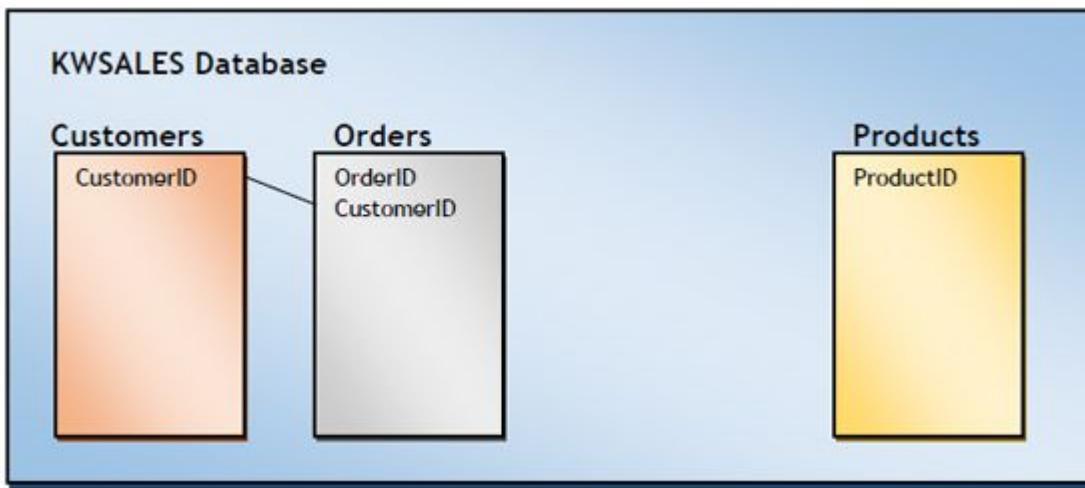
For KWSALES, a logical grouping would be to put all the customer information in a unique table. We'll call that table **Customers**. Here, each record in the table will have information about a single KIDware customer. This way, if a customer's phone number changes, we only need to change it in one location. A second table will be named **Orders**. Each record in this table will represent a single KIDware order. And, a third logical grouping is **Products**. This table contains information describing each product in our inventory. At this point, our database design is:



A couple of words on naming conventions. In our database experience, we have found that it is best to have no embedded spaces in table or field names. They only cause problems. If you like the readability of multi-word names, use the underscore character (_) to separate the words, rather than spaces. Recall such characters were used for table and field names in the books database.

Also table and field names cannot duplicate reserved words in Visual C#, ADO .NET, SQL or Access. Try to use unique sounding names. Names I've used and encountered problems with (because they are reserved) are: Number, Date, Size. Don't use such simple names!

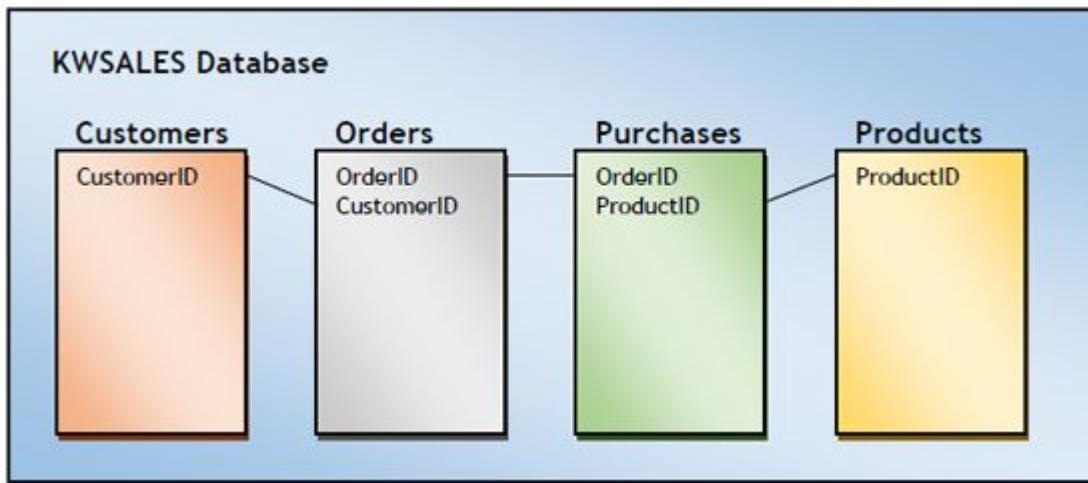
Once database information is separated into tables, we need a way to relate one table to another. Data keys provide these relationships. Each entry (or record) in a table will usually have a unique identification value (a primary key). And then, foreign keys in other tables can reference primary keys. In the **Customers** table, we will have a **CustomerID** field, in the **Orders** table, an **OrderID** field, and in the **Products** table, a **ProductID** field. The **Orders** table will also have a **CustomerID** field (a foreign key) so we can associate an order with a customer.



In database terminology, we call the **Orders** table a **child table** and the **Customers** table a **parent table**. A child table shares common information that is stored in the parent table. Parent table information is specified once. Then, the child table can refer to a particular parent table record as many times as necessary, saving storage.

Another table used in database normalization is a **lookup table**. An example of a lookup table would be a list of zip codes related to

the corresponding city and state. In such a case, once the user entered a valid zip code, the city and state would appear on the data input form, saving the user typing steps, and saving you validation steps. Lookup tables are also used as **bridges** between database tables, relating foreign keys. Remember the **Title_Author** table in **BooksDB.accdb**. It is a lookup table. It relates ISBN values (corresponding to a book title) to a particular author (**Au_ID**). This table acts as a bridge between the **Titles** table and the **Authors** table. We will use a lookup table in **KWSALES** to bridge the **Orders** and **Products** table. This table will be called **Purchases**. This table will relate each order with the products purchased. The completed table structure for **KWSALES** is then:



Notice table relationships are complete. We can move from one table to another via the identified keys.

The next step in database design gets down to the details of deciding what each data field should be.

Field Requirements

At this point in the database design process, we have specified, in general terms, what information is to be stored in the database and have developed the table structure. To relate the tables, we have defined the initial fields - primary and foreign keys. Now, we need to determine what additional **fields** are needed in the database so that all the required information is available. Each field added to the database requires some thought. Spending some time in properly defining the database fields will save you lots of time and trouble when you design the database management system.

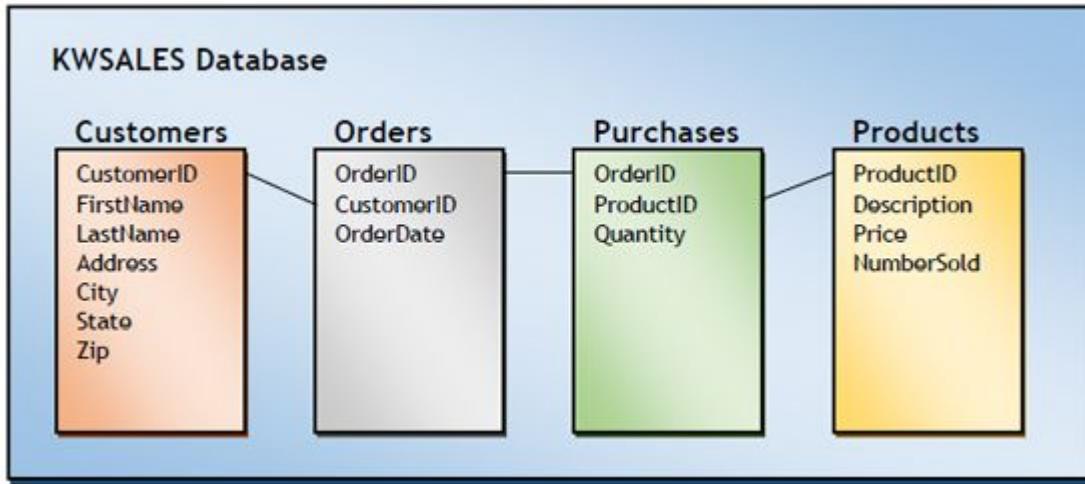
Several questions should be answered in choosing fields for your database:

- Which table?
- Field name?
- Field type?
- Field size?
- Fixed or variable length field?

Before answering each of these questions about a field, you need to decide what information the field will hold. Fields should break required database information into the smallest desired units. For example, you should have fields for both first and last names, not a single field for name. This makes searching a database for a particular last name an easier task.

Let's specify the fields for our **KWSALES** example and place them in tables. The **Customers** table holds information on each particular customer. In addition to the **CustomerID** field, the fields will be: **FirstName**, **LastName**, **Address**, **City**, **State**, and **Zip**. The **Orders** table will have one additional field, **OrderDate**. The **Purchases** table will have one additional field, **Quantity**. Finally,

the **Products** table will add a **Description** field, a **Price** field, and a **NumberSold** field. The completed table and field structure is:



We now address the other questions for each field.

Field Types

Each field in a database must have a defined type. This is similar to typing variables in a Visual C# application. The **field types** are:

Field Type	Description
Variable length text	String that takes up as much space as needed.
Fixed length text	String that takes up defined amount of space.
Date/Time	Stores a date and/or a time (see Example 10-2 in Chapter 10 for specifics on this field type).
Integer	Integer variable
Long	Larger integer variable type
Single	Single precision decimal number
Double	Double precision decimal number
Currency	Stores numbers with two decimal points
Yes/No	True or False Boolean variable type
Memo	Very large text field

Once your fields have been defined, it is usually a simple task to assign data types. A good way to determine data type is to look at types other databases use. This is especially important if you might ever need to exchange data with another database. In these cases, you need to make sure data types (especially string lengths) match.

There are some other considerations you should keep in mind when defining fields. In particular, pay attention to which fields are **primary keys** and **foreign keys**. We need to make sure primary keys have unique values for proper multi-table relations. Another thing to remember is that for quick and efficient searching of databases, **indexes** must be assigned when defining the database.

Knowing which fields will be searched on will determine what indexes must be assigned.

Now, for our example database - **KWSALES**. These are the types used for the fields in each table:

Table	Field	Type
Customers	CustomerID	Long
	FirstName	Text (40 Characters)
	LastName	Text (40 Characters)
	Address	Text (40 Characters)
	City	Text (40 Characters)
	State	Text (20 Characters)
	Zip	Text (10 Characters)
Orders	OrderID	Text (10 Characters)
	CustomerID	Long
	OrderDate	Date/Time
Purchases	OrderID	Text (10 Characters)
	ProductID	Text (10 Characters)
	Quantity	Integer
Products	ProductID	Text (10 Characters)
	Description	Text (40 Characters)
	Price	Currency
	NumberSold	Integer

In this database, we recognize **CustomerID**, **OrderID**, and **ProductID** will be primary keys and searchable fields. In addition, we will search on the customer's **LastName**, a common query.

Null Values

Related to the concept of Field types is the idea of a **null** value. Whenever a database is designed, the empty database is filled with null values (unless you assign a default value or specify Null values are not allowed). We looked at null values briefly way back in Chapter 4 when we studied the use of SQL with databases.

Just what is a **null** value? It means a particular database field's value is unknown. A numeric field with a zero value is not null. A blank string field is not null. An empty string is not null. Null means null!

As you progress in your database programming skills, you need to know how to work with null values. Why? A major reason is that if you attempt to modify a field that does not allow null values, the database engine will reject the modification. We need techniques to identify null values and to establish null values. The Visual C# constant **DBNull.Value** can be used to see if a field is null or to set a variable to a null value.

Primary key fields can never be null. This is obvious. Any mathematical functions performed on your data using SQL aggregate functions will ignore null values. For example, if you are averaging a column of numbers, any nulls will not be included. If you want to include the null values in the average, they must be replaced by zeroes.

In the **Weather Monitor** example in Chapter 10, we will examine ways of working with null values in a database.

Database Design Implementation

Once your database design is complete (or at least the preliminary design is complete), you need to create the database. The method used to create the database depends on the type of database you are building. In this course, we have worked with Microsoft Access (ACE type) databases and SQL Server databases. There are different ways to create such databases.

For an Access database, you can:

- Use Microsoft Access
- Use Visual C# ADOX data objects
- Use a third-party product (requiring purchase of that product)

Microsoft Access is the most widely used tool for creating ACE databases. It has many powerful features, including drag and drop interfaces. But, you need to purchase or own Access to use it. Fortunately, most users of products like Visual C# also have Access. We will look at how to create the **KWSALES** database using Access. It is also possible to create an Access database using just Visual C# and extended ADO .NET (ADOX) objects. We will show you how to use such objects to create the **KWSALES** database.

For a SQL Server database, you can:

- Use Microsoft Visual Studio's Server Explorer
- Use Visual C# and SQL
- Use a third-party product (requiring purchase of that product)

Notice you already have the tools needed to build a SQL Server database since you have Visual Studio. We will create a SQL Server version of the **KWSALES** database using **Server Explorer**. And, we'll

outline the steps needed to create the same database using just **Visual C# and SQL**.

It is also possible to populate a database (add actual field values) at the same time you design the database. We will not do that here - we only create an empty database. It will be populated using a Visual C# application in Chapter 10.

Building Databases with Microsoft Access

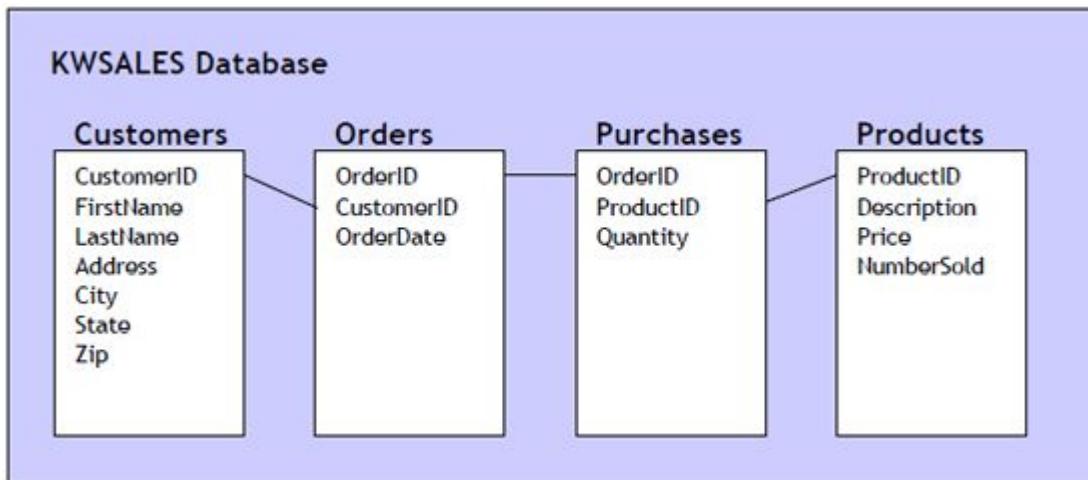
To build a database using **Microsoft Access**, you obviously need to have Access installed on your computer. This product is part of the Microsoft Office Suite. If you don't have Access or don't want to use Access, skip ahead to the notes on creating a database using Visual Basic.

As with many programs, the use of **Access** is best illustrated with an example. Here, we use Access to build our **KWSALES** database. The file will be named **KWSalesDB.accdb**. The process is straightforward. You define a table and then the fields within each table.

Example 9-1

KWSALES Database with Microsoft Access

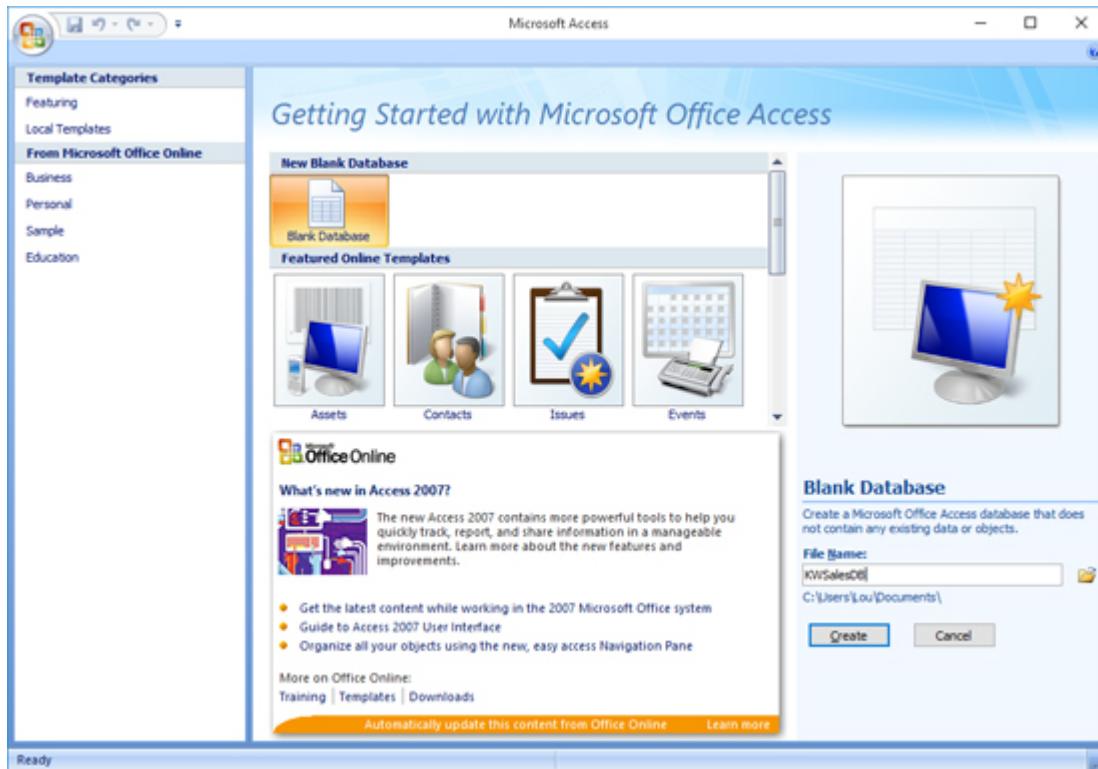
In this example, we go through all the steps necessary to build the 4-table KWSALES database using **Microsoft Access**. We will build each table and add the associated data fields (along with any necessary keys and indexes) individually. For reference, the table and field structure is:



In this example, we use **Access 2007**.

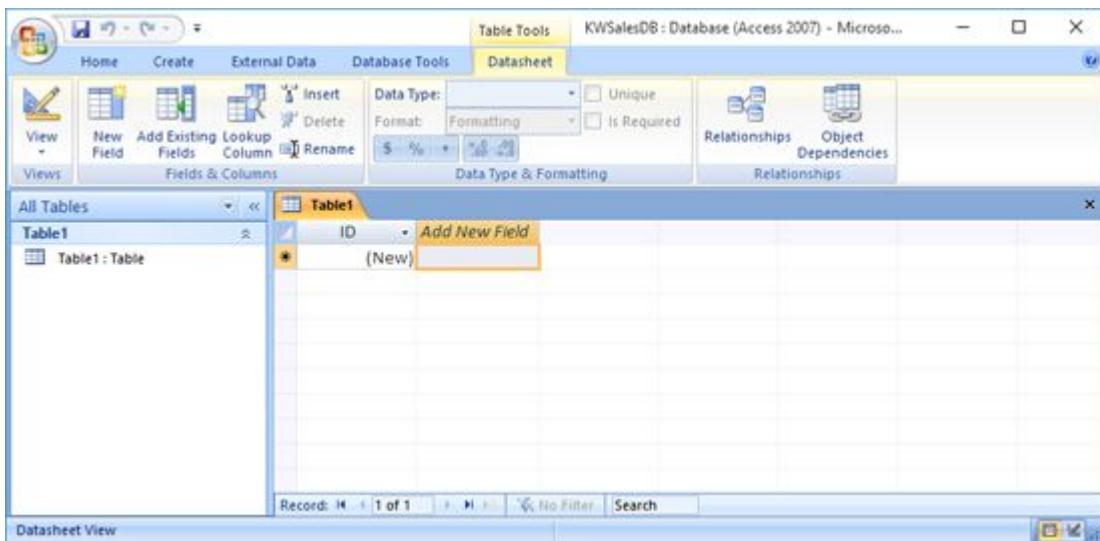
Getting Started

Start Access. When the program appears, click the **Office** button and choose **New**. A screen with entries like this should appear:



Choose **Blank Database**. Choose the desired directory, name your database **KWSALES** and click **Create**.

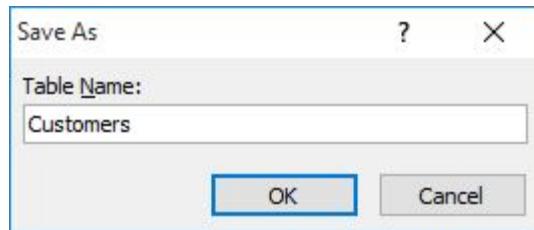
This window will appear, allowing us to design our **KWSALES** database tables:



We follow the same steps for each table.

Customers Table

1. Click the View toolbar button and choose Design View. You will see:



Name the table **Customers** as shown. You will then be taken to design view:

A screenshot of the Microsoft Access 'Design View' for the 'Customers' table. The table has one visible field named 'ID'. The 'Data Type' for 'ID' is set to 'AutoNumber'. The 'Field Properties' pane is open, showing the 'General' tab with the following settings:

Field Size	Long Integer
New Values	Increment
Format	
Caption	
Indexed	Yes (No Duplicates)
Smart Tags	
Text Align	General

A tooltip in the bottom right corner of the properties pane states: "A field name can be up to 64 characters long, including spaces. Press F1 for help on field names."

This is the grid used to define each field, so let's look at all that's here. You supply a **Field Name** for the field and define its **Data Type**. A special Data Type is **AutoNumber**. This is used for primary keys to insure unique values. Other options (appear on the **General** tab) include **AllowZeroLength** to allow an empty field and **Required** to make sure a particular field has a value. Each of these options is directly related to your database design.

2. The first field in the **Customers** table is **CustomerID**. Enter that for a **Field Name** and select **AutoNumber** for **Data Type**. Continue adding the other fields using these choices:

Name	DataType	FieldSize
FirstName	Text	40
LastName	Text	40
Address	Text	40
City	Text	40
State	Text	20
Zip	Text	10

Make all of the fields **Required** (we want to make sure we have a complete address).

At this point, the design grid should look like this:

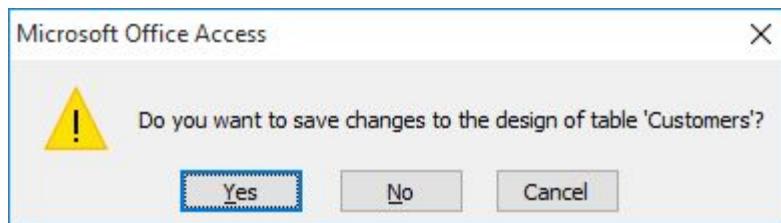
The screenshot shows the Microsoft Access 'Customers' table in design view. The table has six columns: CustomerID (Primary Key), FirstName, LastName, Address, City, State, and Zip. The Zip column is currently selected, indicated by a yellow border around its row.

Customers		
	Field Name	Data Type
!	CustomerID	AutoNumber
	FirstName	Text
	LastName	Text
	Address	Text
	City	Text
	State	Text
	Zip	Text

Now, we define the primary key and any indexes to allow quick searching. **CustomerID** is a primary field. If a little key doesn't appear next to the **CustomerID** row, we need to put one there. Right-click the **CustomerID** row and choose **Primary Key**. A small key now appears next to that entry indicating it is a primary key. We want **LastName** to be an index. Select the **LastName** row. On the **General** tab, set the **Indexed** property to **Yes (Duplicates OK)**. Here is the final table structure:

	Field Name	Data Type
CustomerID	AutoNumber	
FirstName	Text	
LastName	Text	
Address	Text	
City	Text	
State	Text	
Zip	Text	

3. The table definition is now complete. Click the close button (X) in the upper right corner of the window. You will be asked to save the table:



Click **Yes**. You will be returned to the Access design window where you will see the table has been added to the database:

All Tables
Customers : Table

You can now add the next table.

Orders Table

1. Click the **Create** tab then select the **Table Design** toolbar button. This lets us create a new table in design view. Add the following fields:

Name	DataType
OrderID	Text (FieldSize = 10)
CustomerID	Number (Long Integer, no default value)
OrderDate	Date/Time

We will use Visual Basic code to make sure **OrderID** is a unique value for each order (in Chapter 10). Make all fields **Required**.

2. Make the **OrderID** a primary key. Make the other two fields indexes (allow repeating values). The resulting table structure is:

Table1		
	Field Name	Data Type
!	OrderID	Text
	CustomerID	Number
	OrderDate	Date/Time

3. Close the design window and save the table as **Orders**. There are now two tables in the database:

All Tables	
Customers	
<table border="1"><tr><td>Customers : Table</td></tr></table>	Customers : Table
Customers : Table	
Orders	
<table border="1"><tr><td>Orders : Table</td></tr></table>	Orders : Table
Orders : Table	

Purchases Table

1. Create another table in design view. Add the following fields:

Name	DataType
OrderID	Text (FieldSize = 10)
ProductID	Text (FieldSize = 10)
Quantity	Number (Integer, no default value)

Make only **OrderID** a **Required** field (we won't make someone order something!).

2. Add two indexes to the table, one for **OrderID** and one for **ProductID**. Here is the resulting table:

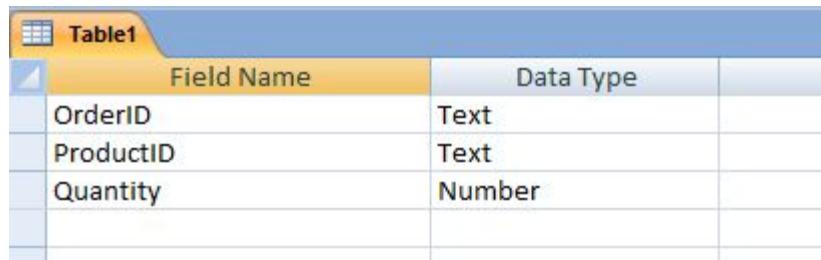
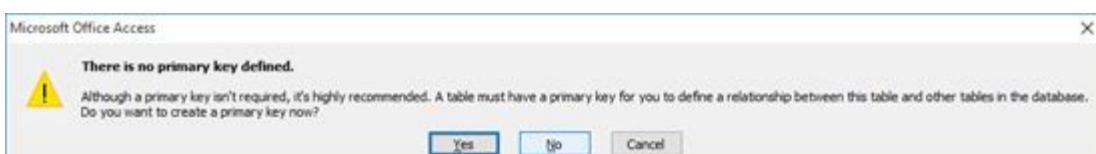


Table1	
	Field Name
	OrderID
	ProductID
	Quantity

3. Close the window. Save the table as **Purchases**. You will see this message asking if you want to define a product key:



We don't need a primary key in this table since it acts as a lookup table. Click **No**.

There are now three tables in the **KWSALES** database:

All Tables			
Customers	˄		
<table border="1"><tr><td>grid icon</td><td>Customers : Table</td></tr></table>	grid icon	Customers : Table	
grid icon	Customers : Table		
Orders	˄		
<table border="1"><tr><td>grid icon</td><td>Orders : Table</td></tr></table>	grid icon	Orders : Table	
grid icon	Orders : Table		
Purchases	˄		
<table border="1"><tr><td>grid icon</td><td>Purchases : Table</td></tr></table>	grid icon	Purchases : Table	
grid icon	Purchases : Table		

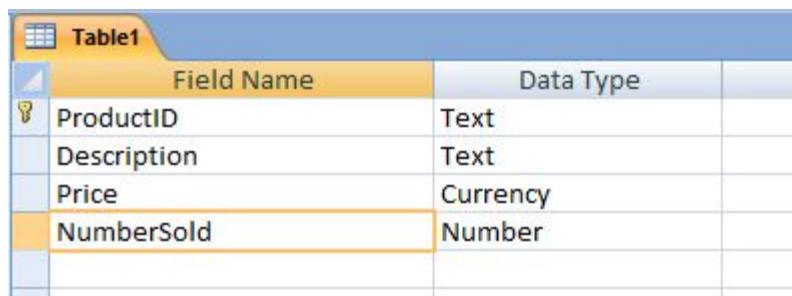
Products Table

1. Create the final table in design view. Add the following fields:

Name	DataType
ProductID	Text (FieldSize = 10)
Description	Text (FieldSize = 40)
Price	Currency
NumberSold	Number (Integer, no default value)

ProductID is our product SKU (and, I forget what SKU stands for), a unique manufacturer serial number for each product. Make all fields **Required**.

2. Make **ProductID** a primary key. Here is the resulting structure:



Field Name	Data Type
ProductID	Text
Description	Text
Price	Currency
NumberSold	Number

Close the window, saving the table as **Products**.

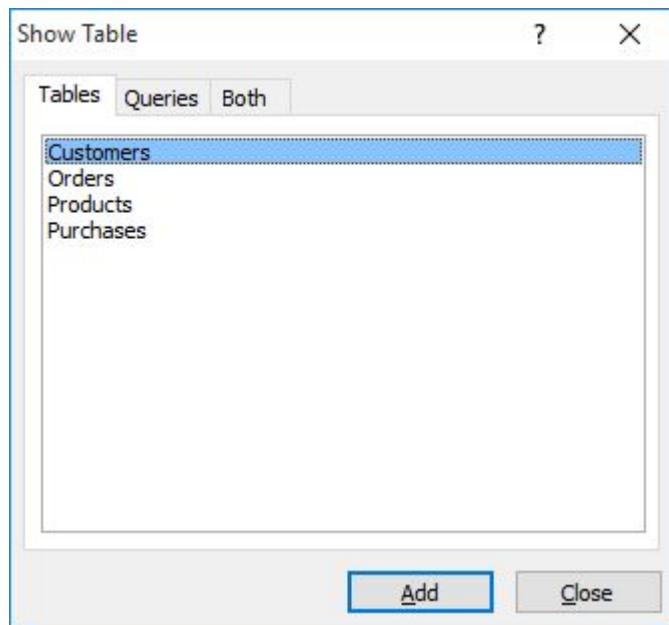
We now have all four tables needed by the **KWSALES** database:

All Tables		
Customers	˄	
<table border="1"><tr><td>Customers : Table</td></tr></table>	Customers : Table	
Customers : Table		
Orders	˄	
<table border="1"><tr><td>Orders : Table</td></tr></table>	Orders : Table	
Orders : Table		
Purchases	˄	
<table border="1"><tr><td>Purchases : Table</td></tr></table>	Purchases : Table	
Purchases : Table		
Products	˄	
<table border="1"><tr><td>Products : Table</td></tr></table>	Products : Table	
Products : Table		

Define Relationships

We have the four tables in the **KWSALES** database, but they are independent entities. A last step is to define the relationships between primary and/or foreign keys. Be aware you can only define relationships between two fields if they are the same data type.

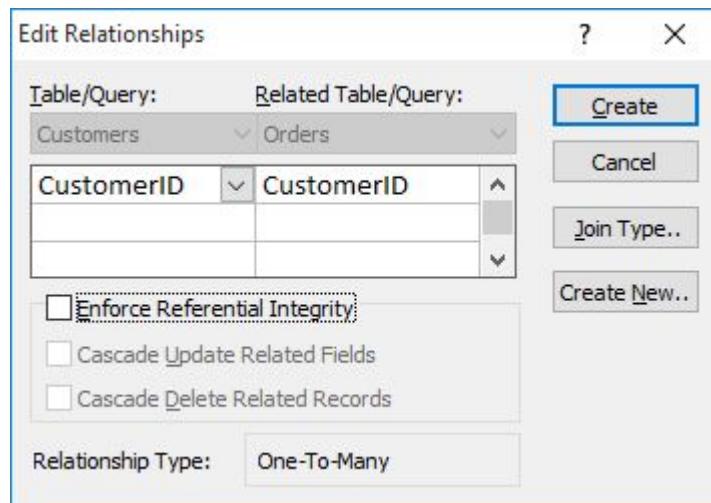
1. Select the **Database Tools** tab from the **Access** main menu, then choose **Relationships**. The **Show Table** dialog will appear:



Select all the tables listed and click **Add**. Then close this dialog. The four tables will appear in the **Relationships** window (the primary keys are shown with little keys):



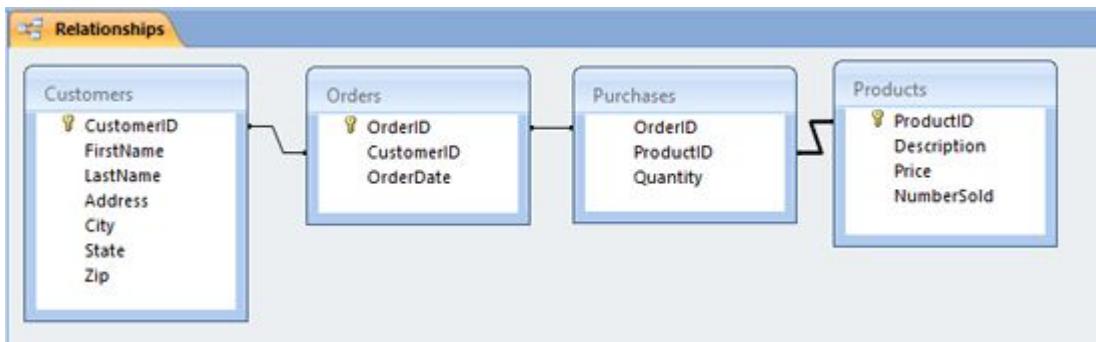
- To relate a key from one table to the next, simply drag that key from one table to the corresponding key in another table. For example, drag the **CustomerID** (primary key) from the **Customers** table to **CustomerID** (foreign key) in the **Orders** table. You will see:



Click **Create** and the link is formed:



3. Create two more links. Link OrderID (primary key) in the Orders table to OrderID (foreign key) in the Purchases table. And, link ProductID (foreign key) in the Purchases table to ProductID (primary key) in the Products table. The Relationships window should now show:



All of the key relationships are clearly defined. Make sure to save these when closing the window.

The definition of the **KWSALES** database is now complete. This version of the database is saved as **KWSalesDB.accdb** in the **VCSDB\Datasets** folder. It is possible to add values to the tables at this point, if desired. Simply open a table and fill the result grid with values. For example, if you open the **Customers** table, you will see:

Customers						
CustomerID	FirstName	LastName	Address	City	State	Zip
*	(New)					

We will not populate the tables here. That will be done in code in Chapter 10.

Building SQL Server Databases with Server Explorer

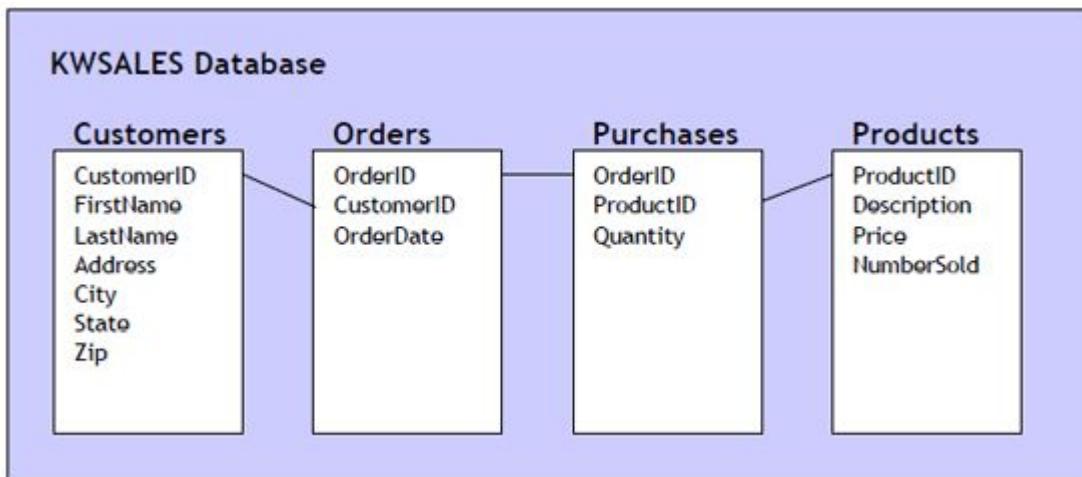
Microsoft **Visual Studio** can be used to build a **SQL Server** database. The **Server Explorer** tool aids in this construction.

Like the Access version of KWSALES, building a SQL Server version (named **SQLKWSalesDB.mdf**) is best illustrated with an example. Here, we use **Visual Studio** to build our **KWSALES** database. You will notice Server Explorer uses a different vocabulary for building a database. For example, **fields** are called **columns** and many of the data types have different names (**varchar** is used for a **Text** field). These differences should be easy to follow.

Example 9-2

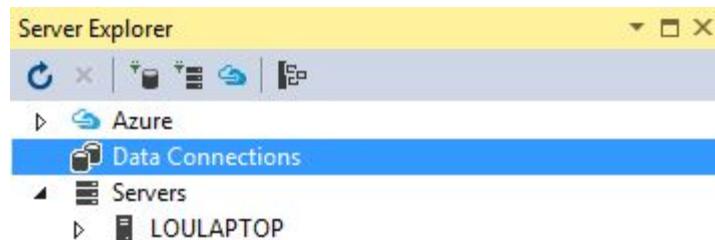
KWSALES Database with Server Explorer

In this example, we go through all the steps necessary to build a SQL Server version (SQLKWSalesDB.mdf) of the 4-table KWSALES database using Microsoft Visual Studio. We will build each table and add the associated data fields (along with any necessary keys and indexes) individually. For reference, the table and field structure is:

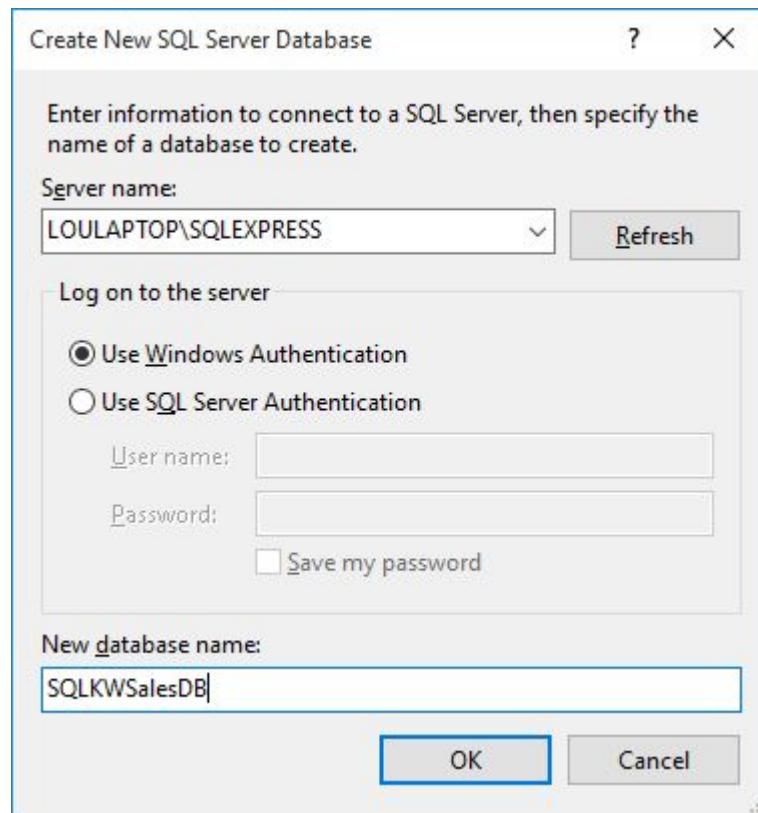


Getting Started

1. Start **Visual Studio**. Bring up **Server Explorer** by choosing the **View** menu option and selecting **Server Explorer**. Find this window:

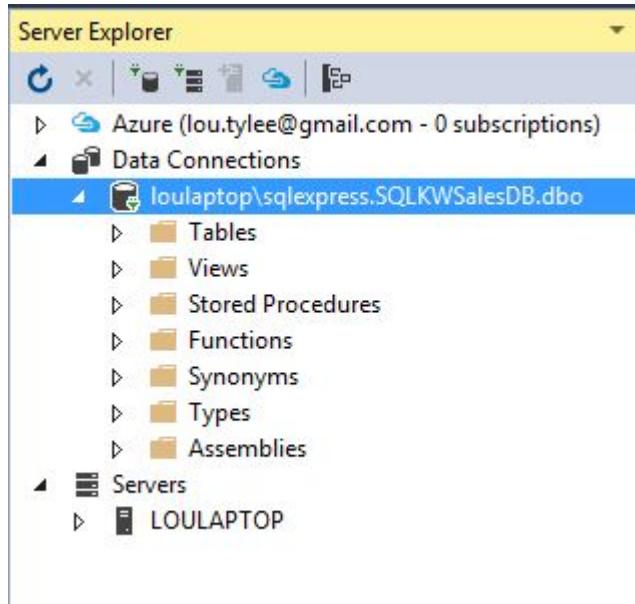


Right-click **Data Connections** and choose **Create New SQL Server Database**. This window appears:



Enter your **Server name** (your computer name followed by a backslash and **SQLEXPRESS**). Enter **SQLKWSalesDB** for the **New database name** and click **OK**.

2. The new database (I've expanded the connection to show included folders) will appear in the **Server Explorer** window under **Data Connections**:

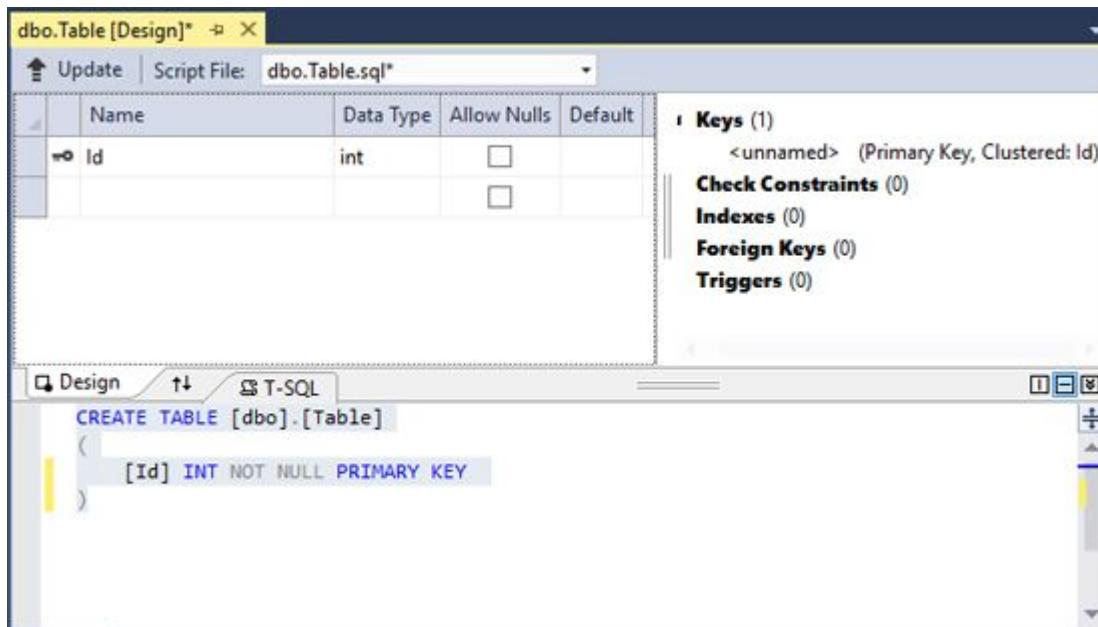


For each table you want to create, right-click the **Tables** folder and choose **Add New Table**. Once you do this, a design window will open allowing you to enter the fields in your table.

3. We will now do this for each table in the **KWSALES** database.

Customers Table

1. Create a new table in design view. You will see:



4. There is a grid to define each field (referred to as a column here). You supply a **Column Name** for the field and define its **Data Type**. You also decide if the field can be null. For each field, you set field (column) properties using the **Properties Window**. A special property is **Identity Specification**. This is used for primary keys to insure unique values (set **Is Identity** to **True**). To the right of the grid is where keys and indexes are defined. Below the grid is a **Design** window where the actual script language to create the table is written. Name the **Customers** table by changing the first line in the script pane to:

```
CREATE TABLE [dbo].[Customers]
```

5. The first field in the **Customers** table is **CustomerID**. Enter that for a **Column Name**, use a **bigint** **Data Type** and set the **Is**

Identity property to **True**. Continue adding the other fields using these choices (the dimension indicates the length of the field):

Name	DataType
FirstName	varchar(40)
LastName	varchar(40)
Address	varchar(40)
City	varchar(40)
State	varchar(20)
Zip	varchar(10)

Make sure all of the fields do not allow **Null** values (we want to make sure we have a complete address).

At this point, the design grid should look like this:

	Name	Data Type	Allow Nulls	Default
CustomerID	bigint	<input type="checkbox"/>		
FirstName	varchar(40)	<input type="checkbox"/>		
LastName	varchar(40)	<input type="checkbox"/>		
Address	varchar(40)	<input type="checkbox"/>		
City	varchar(40)	<input type="checkbox"/>		
State	varchar(20)	<input type="checkbox"/>		
Zip	varchar(10)	<input type="checkbox"/>		

Now, we define the primary key and any indexes to allow quick searching. **CustomerID** is a primary field. If a small key does not appear next to that field, we need to put one there. Right-click the **CustomerID** row and choose **Set Primary Key**. A small key now appears next to that entry indicating it is a primary key.

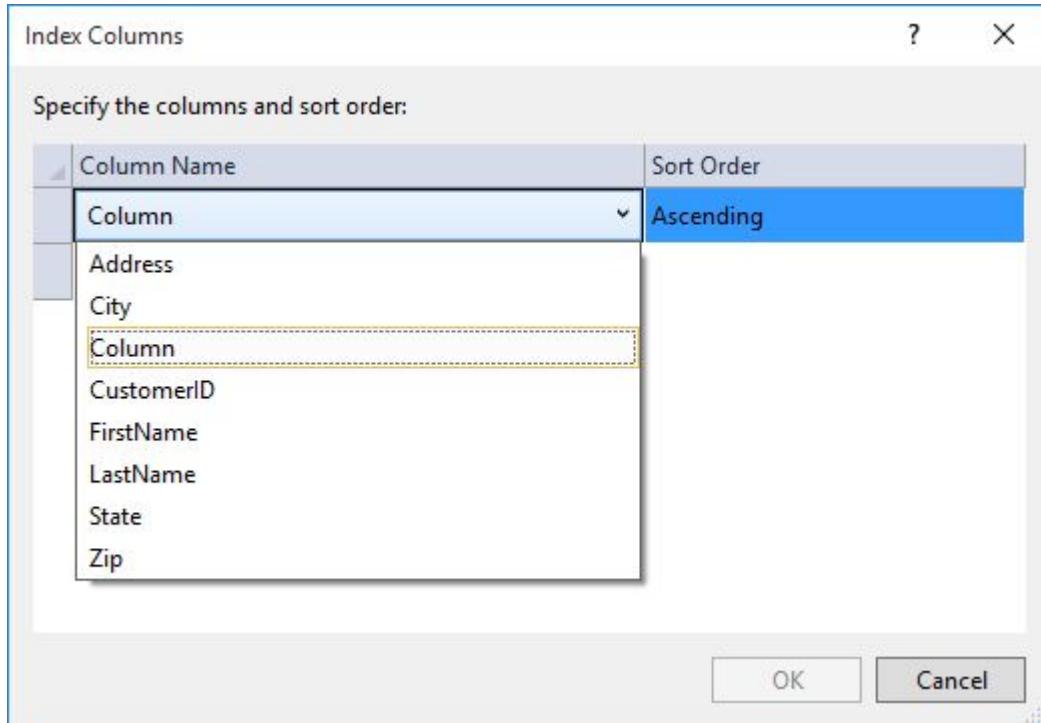
We want **LastName** to be an index. Look for this pane:

▲ **Keys** (1)
 <unnamed> (Primary Key, Clustered: CustomerID)
 Check Constraints (0)
 Indexes (0)
 Foreign Keys (0)
 Triggers (0)

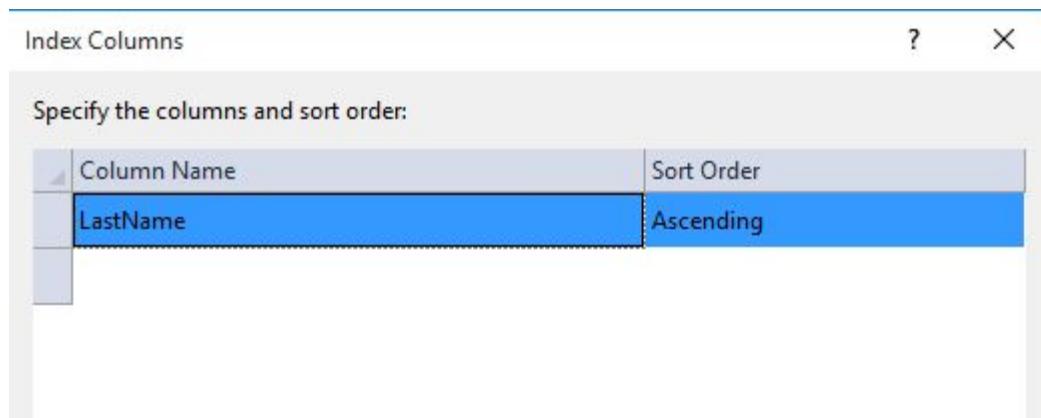
Right-click **Indexes** and choose **Add New**, then **Index**. You will see an added index (**IX_Customers_Column**)

▲ **Keys** (1)
 <unnamed> (Primary Key, Clustered: CustomerID)
 Check Constraints (0)
▲ **Indexes** (1)
 IX_Customers_Column (Column)
 Foreign Keys (0)
 Triggers (0)

Highlight the index that appears and go to the **Properties Window**. Choose the **Columns** property and click the ellipsis to see (I have expanded the column selections)



Choose the **LastName** column and have **Ascending Sort Order**



Click **OK**.

Here is the final table design pane:

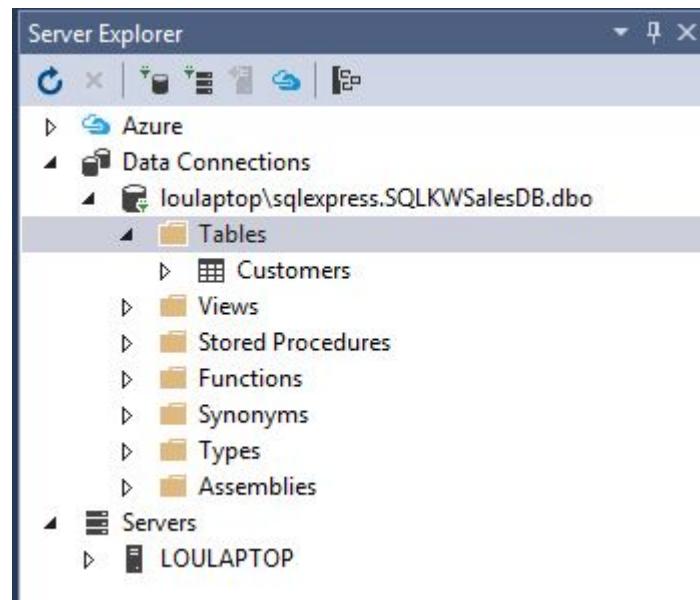
	Name	Data Type	Allow Nulls	Default
CustomerID	bigint	<input type="checkbox"/>		
FirstName	varchar(40)	<input type="checkbox"/>		
LastName	varchar(40)	<input type="checkbox"/>		
Address	varchar(40)	<input type="checkbox"/>		
City	varchar(40)	<input type="checkbox"/>		
State	varchar(20)	<input type="checkbox"/>		
Zip	varchar(10)	<input type="checkbox"/>		

Keys (1)
<unnamed> (Primary Key, Clustered: CustomerID)
Check Constraints (0)
Indexes (1)
IX_Customers_Column (LastName)
Foreign Keys (0)
Triggers (0)

```
CREATE TABLE [dbo].[Customers] (
    [CustomerID] BIGINT NOT NULL,
    [FirstName] VARCHAR (40) NOT NULL,
    [LastName] VARCHAR (40) NOT NULL,
    [Address] VARCHAR (40) NOT NULL,
    [City] VARCHAR (40) NOT NULL,
    [State] VARCHAR (20) NOT NULL,
```

6. The table definition is now complete. In the upper-left corner of the **Table Designer**, choose the **Update** button. In the **Preview Database Updates** dialog box, choose the **Update Database** button. Your changes are saved to the local database file.

Return to the **Server Explorer** window. Right-click the window and choose **Refresh**. You will see the table has been added to the database:



You can now add the next table.

Orders Table

1. Create a new table in the **Server Explorer** window. Follow the same steps we did for the Customers table to create this **Orders** table. Add the following fields:

Name	DataType
OrderID	varchar(10)
CustomerID	bigint
OrderDate	datetime

We will use Visual Basic code to make sure **OrderID** is a unique value for each order (in Chapter 10). Make sure none of the fields allow nulls.

2. Make the **OrderID** a primary key. Make the other two fields indexes. The resulting design pane is (don't forget to modify the first line in the design script to save the table as **Orders**).

The screenshot shows the SQL Server Object Explorer with the 'dbo.Orders' table selected. The table has three columns: OrderID (varchar(10)), CustomerID (bigint), and OrderDate (datetime). The OrderID column is defined as NOT NULL and PRIMARY KEY. There is one index, IX_Orders_Column, on the CustomerID column, and another index, IX_Orders_Column_1, on the OrderDate column. The T-SQL pane at the bottom shows the CREATE TABLE statement.

Name	Data Type	Allow Nulls	Default
OrderID	varchar(10)	<input type="checkbox"/>	
CustomerID	bigint	<input type="checkbox"/>	
OrderDate	datetime	<input type="checkbox"/>	

Keys (1)
<unnamed> (Primary Key, Clustered: OrderID)
Check Constraints (0)
Indexes (2)
IX_Orders_Column (CustomerID)
IX_Orders_Column_1 (OrderDate)
Foreign Keys (0)
Triggers (0)

```
CREATE TABLE [dbo].[Orders]
(
    [OrderID] VARCHAR(10) NOT NULL PRIMARY KEY,
    [CustomerID] BIGINT NOT NULL,
    [OrderDate] DATETIME NOT NULL
)
```

3. In the upper-left corner of the Table Designer, choose the **Update** button. In the Preview Database Updates dialog box, choose the **Update Database** button. Your changes are saved to the local database file (after refreshing the Server Explorer window).

The screenshot shows the Server Explorer with the 'loulaptop\sqlexpress.SQLKWSalesDB.dbo' database selected. Under the 'Tables' node, the 'Customers' and 'Orders' tables are listed. Other objects like Views, Stored Procedures, Functions, Synonyms, Types, and Assemblies are also visible under the main database node.

Purchases Table

1. Create another table in design view. Add the following fields:

Name	DataType
OrderID	varchar(10)
ProductID	varchar(10)
Quantity	int

Set **Allow Nulls** to **Yes** for **ProductID** and **Quantity** (we won't make someone order something!).

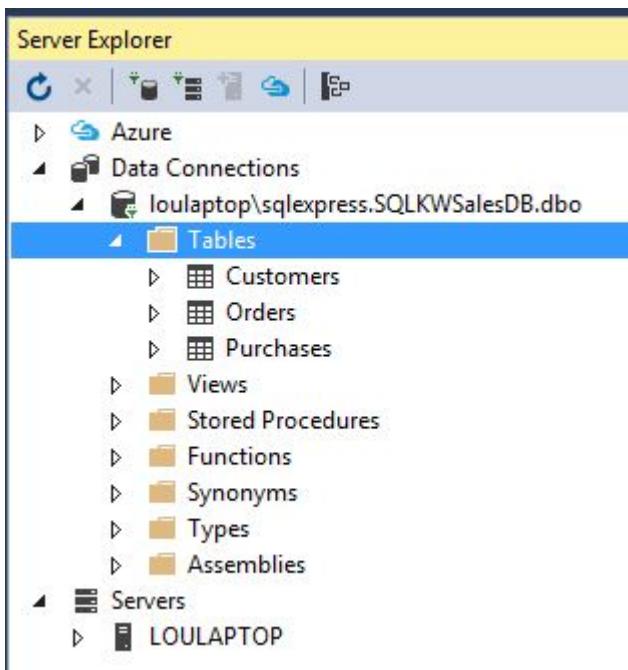
2. We don't need a primary key in this table since it acts as a lookup table. Add two indexes to the table, one for **OrderID** and one for **ProductID**. Here is the resulting design pane:

The screenshot shows the SSMS Table Designer for the 'Purchases' table. The table has three columns: 'OrderID' (varchar(10), NOT NULL), 'ProductID' (varchar(10), NULL), and 'Quantity' (int, NULL). The 'Allow Nulls' checkbox is checked for 'ProductID' and 'Quantity'. The 'Indexes' section shows two indexes: IX_Purchases_Column (OrderID) and IX_Purchases_Column_1 (ProductID). The T-SQL script pane shows the CREATE TABLE statement:

```
CREATE TABLE [dbo].[Purchases]
(
    [OrderID] VARCHAR(10) NOT NULL ,
    [ProductID] VARCHAR(10) NULL,
    [Quantity] INT NULL
)
```

Note the table is saved as **Purchases**.

In the upper-left corner of the **Table Designer**, choose the **Update** button. In the **Preview Database Updates** dialog box, choose the **Update Database** button. There are now three tables in the **KWSALES** database:



Products Table

1. Create the final table in design view. Add the following fields:

Name	DataType
ProductID	varchar(10)
Description	varchar(40)
Price	money
NumberSold	int

ProductID is our product SKU (and, I forget what SKU stands for), a unique manufacturer serial number for each product. Do not allow any fields to accept a Null value.

2. Make ProductID a primary key. Here is the design pane (table saved as Products):

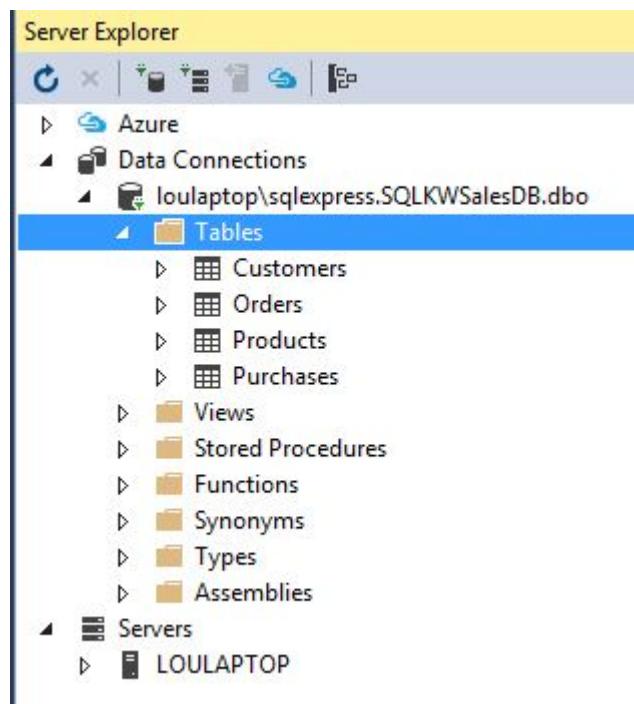
The screenshot shows the SSMS design pane for the `dbo.Products` table. The table structure is as follows:

Name	Data Type	Allow Nulls	Default
ProductID	varchar(10)	<input type="checkbox"/>	
Description	varchar(40)	<input type="checkbox"/>	
Price	money	<input type="checkbox"/>	
NumberSold	int	<input type="checkbox"/>	

The **Keys** section on the right indicates that the `ProductID` column is the primary key, clustered. The T-SQL pane displays the following create table statement:

```
CREATE TABLE [dbo].[Products]
(
    [ProductID] VARCHAR(10) NOT NULL PRIMARY KEY,
    [Description] VARCHAR(40) NOT NULL,
    [Price] MONEY NOT NULL,
    [NumberSold] INT NOT NULL
)
```

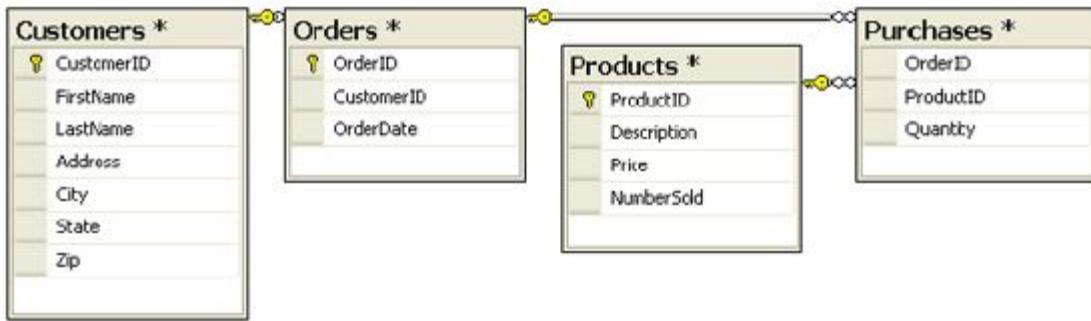
In the upper-left corner of the **Table Designer**, choose the **Update** button. In the **Preview Database Updates** dialog box, choose the **Update Database** button. We now have all four tables needed by the **KWSALES** database:



Define Relationships

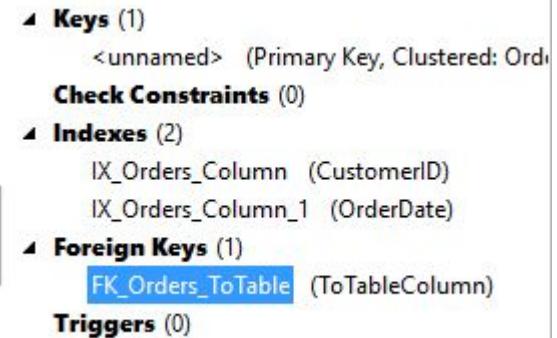
We have the four tables in the **KWSALES** database, but they are independent entities. A last step is to define the relationships between primary and/or foreign keys. Be aware you can only define relationships between two fields if they are the same data type.

Here is a graphic depiction of the relationships we want to define



To define these, we need to modify script code in the table designers.

1. To relate a foreign key from one table with a primary key in another table, right-click the table holding the foreign key and choose **Open Table Definition**. As an example, we want to relate the **CustomerID** field (foreign key) in **Orders** with the **CustomerID** (primary key) in **Customers**. To do this, right-click the **Orders** table in Server Explorer and choose **Open Table Definition**. In the right-side of the design pane, right-click **Foreign Keys** then choose **Add New Foreign Key**. A default key will be formed - You will see:



Click the script pane (**Design** tab) under the table definition, and replace the default definition of the foreign key reference with the following:

```
CONSTRAINT [FK_Orders_CustomerID] FOREIGN KEY ([CustomerID]) REFERENCES [dbo].[Customers] ([CustomerID])
```

This says we have a constraint (relationship) named **FK_Orders_CustomerID** that relates the **CustomerID** field in the **Orders** table with the **CustomerID** field in the **Customers** table.

The finished script pane for **Orders** appears as:

```
CREATE TABLE [dbo].[Orders] (
    [OrderID] VARCHAR (10) NOT NULL,
    [CustomerID] BIGINT NOT NULL,
    [OrderDate] DATETIME NOT NULL,
    PRIMARY KEY CLUSTERED ([OrderID] ASC),
    CONSTRAINT [FK_Orders_CustomerID] FOREIGN KEY ([CustomerID]) REFERENCES [dbo].[Customers]
```

We need two more relationships using foreign keys in the **Purchases** table. We follow the same steps.

2. We want to relate the **OrderID** field (foreign key) in **Purchases** with the **OrderID** (primary key) in **Orders**. To do this, right-click the **Purchases** table in Server Explorer and choose **Open Table Definition**. In the right-side of the design pane, right-click **Foreign Keys** then choose **Add New Foreign Key**. A default key will be formed.

Click the script pane (**Design** tab) under the table definition, and replace the default definition of the foreign key reference with the following:

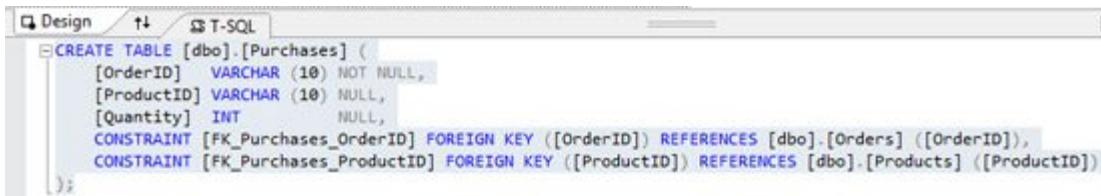
```
CONSTRAINT [FK_Purchases_OrderID] FOREIGN KEY  
([OrderID])  
REFERENCES [dbo].[Orders] ([OrderID]),
```

3. Lastly, we want to relate the **ProductID** field (foreign key) in **Purchases** with the **ProductID** (primary key) in **Products**. The **Purchases** table should still be displayed. In the right-side of the design pane, right-click **Foreign Keys** then choose **Add New Foreign Key**. A default key will be formed.

Click the script pane (**Design** tab) under the table definition, and replace the default definition of the foreign key reference with the following:

```
CONSTRAINT [FK_Purchases_ProductID] FOREIGN KEY  
([ProductID])  
REFERENCES [dbo].[Products] ([ProductID]),
```

The finished script pane for **Purchases** appears as:

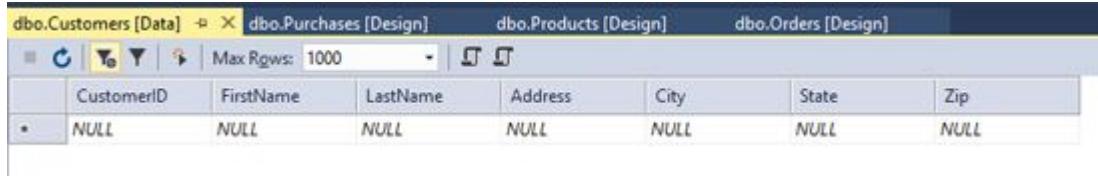


```
CREATE TABLE [dbo].[Purchases] (  
    [OrderID]  VARCHAR (10) NOT NULL,  
    [ProductID] VARCHAR (10) NULL,  
    [Quantity]  INT      NULL,  
    CONSTRAINT [FK_Purchases_OrderID] FOREIGN KEY ([OrderID]) REFERENCES [dbo].[Orders] ([OrderID]),  
    CONSTRAINT [FK_Purchases_ProductID] FOREIGN KEY ([ProductID]) REFERENCES [dbo].[Products] ([ProductID])  
);
```

All of the key relationships are clearly defined. Click **Update**, then choose **Update Database**.

The definition of the **KWSALES** database is now complete. This SQL Server version of the database is saved as **SQLKWSalesDB.mdf** in the **VCSDB\Datasets** folder. It is possible to populate the database using Server Explorer, if desired. To do this, right-click a table and

choose **Show Table Data**. A window will open allowing you to add values to a grid. For example, if you choose the **Customers** table, you will see:



A screenshot of the SQL Server Management Studio interface. The title bar shows 'dbo.Customers [Data]'. Below it is a toolbar with icons for New Query, Refresh, and Save. A dropdown menu shows 'Max Rows: 1000'. The main area displays a data grid for the 'Customers' table. The columns are: CustomerID, FirstName, LastName, Address, City, State, and Zip. There is one row with all fields set to NULL.

	CustomerID	FirstName	LastName	Address	City	State	Zip
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL

We will not populate the tables here. That will be done in code in Chapter 10.

You may wonder where SQL Server stores this database on your computer. If you used default settings, it will be in a folder something like this:

C:\Program Files\Microsoft
Server\MSSQL12.SQLEXPRESS\MSSQL\Data SQL

Building Access Databases with Visual C#

If you don't have Access or don't want to use Access to create a database, don't despair. An Access type database can be created and populated using Visual C# programming. To do this, we use something called the ADO Extensions (ADOX) library. ADOX is related to a predecessor to ADO .NET technology, but it is very useful for the task at hand.

Actually there are times when you need or want to use Visual C# to create your database. An example would be an application where a user chooses what fields he/she would want included in a particular table. In such a case, the database table structure is not known until run-time necessitating the use of Visual C# to build the database. Or maybe your application requires a blank database to start. In such a case, if the user wanted to start a new file, we would need to copy a saved database file into a new file. When we build the distribution package for such an application, we need to remember to include that empty file or problems will result. Rather than trust our memory, we could just build the empty file in Visual C# using the ADOX.

The steps followed are nearly identical to those followed using Access:

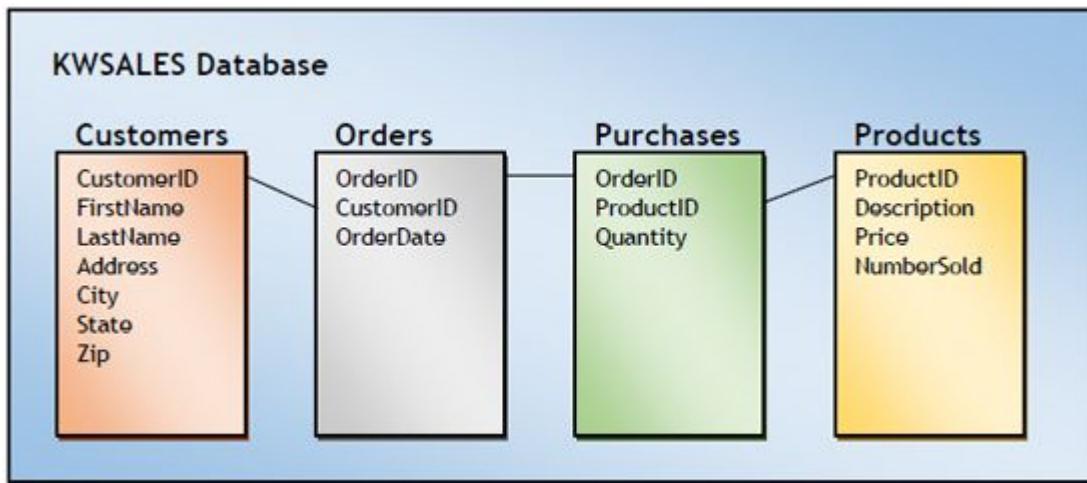
- Create the database
- Create the table(s)
- Add fields to the table(s)
- Define primary key for the table(s)
- Define indexes for the table(s)
- Once all tables are created, define relationships between tables

Each of the above steps will be discussed as we work through the example of building the **KWSALES** database using Visual C#. As you build a database file in code, you should check the structure as it is built. In the example to follow, we use Access to check the structure. We suggest you do the same. If you don't have Access, there are several free products available on the Internet that allow viewing of Access-type database files.

Example 9-3

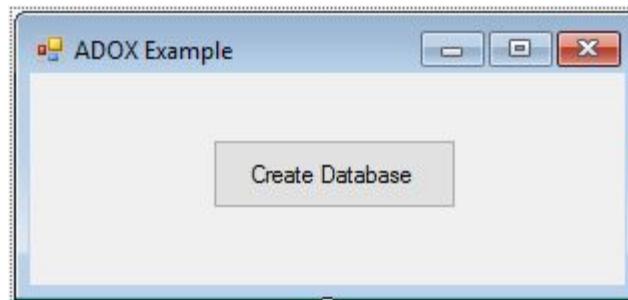
KWSALES Database with Visual C#

In this example, we go through all the steps necessary to build the 4-table KWSALES database using Visual C#. We will build each table and add the associated data fields (along with any necessary keys and indexes) individually. For reference, the table and field structure is:

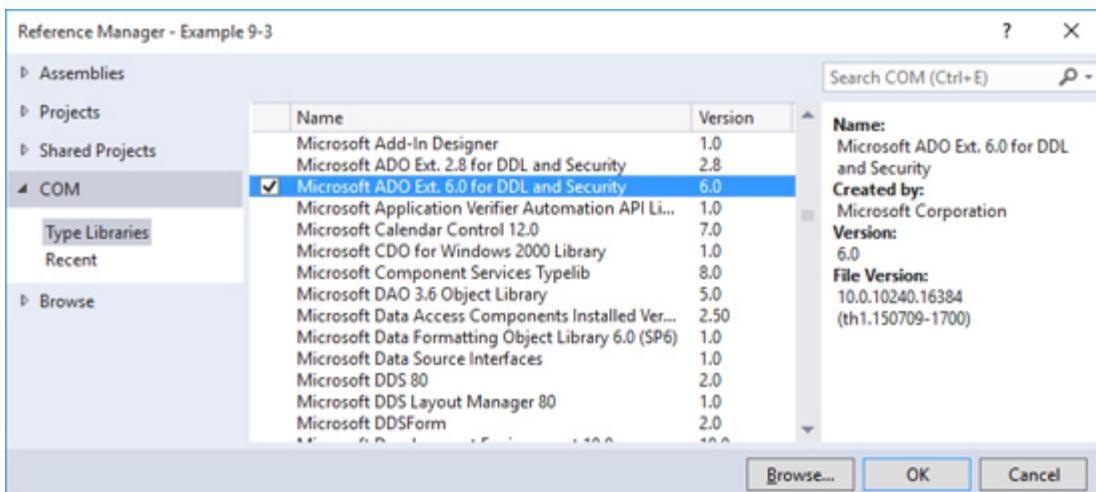


Add Reference to ADOX Library

1. Start a new project in Visual C#. This project will have a single button (**Name** property `btnCreate`, **Text** property `Create Database`). We will simply write code in the `btnCreate_Click` event method to build the database. My form looks like this:



2. To use ADOX, we must add a reference to the component. Go to the **Solution Explorer** window for your new project. Right-click the project name and choose **Add Reference**. The **Add Reference** window will appear:



As shown, select the **COM** tab and select the latest version (here **2.8**) of the **Microsoft ADO Ext** library. Click **OK**. This step makes

the ADOX library available to our project.

3. Go to your project code window and add a single line to the top of code window:

```
using ADOX;
```

Create a Database

A first step is to create the empty database. This uses the ADOX **Catalog** object and its **Create** method. The code syntax for an Access database is:

```
Catalog myDatabase = new Catalog();
myDatabase.Create("Provider=Microsoft.ACE.OLEDB.12.0;Da
ta
Source = " + databaseName);
```

where **databaseName** is a complete path to the database filename. This name should have an **accdb** extension (for Access). The file cannot already exist or an error will occur.

1. Add this code to the **btnCreate_Click** event method:

```
private void btnCreate_Click(object sender, EventArgs
e)
{
    Catalog salesDatabase = new Catalog();
    try
    {

salesDatabase.Create("Provider=Microsoft.ACE.OLEDB.12
.0;
Data Source = " + Application.StartupPath +
"\KWSalesDB.accdb");
    }
    catch (Exception ex)
```

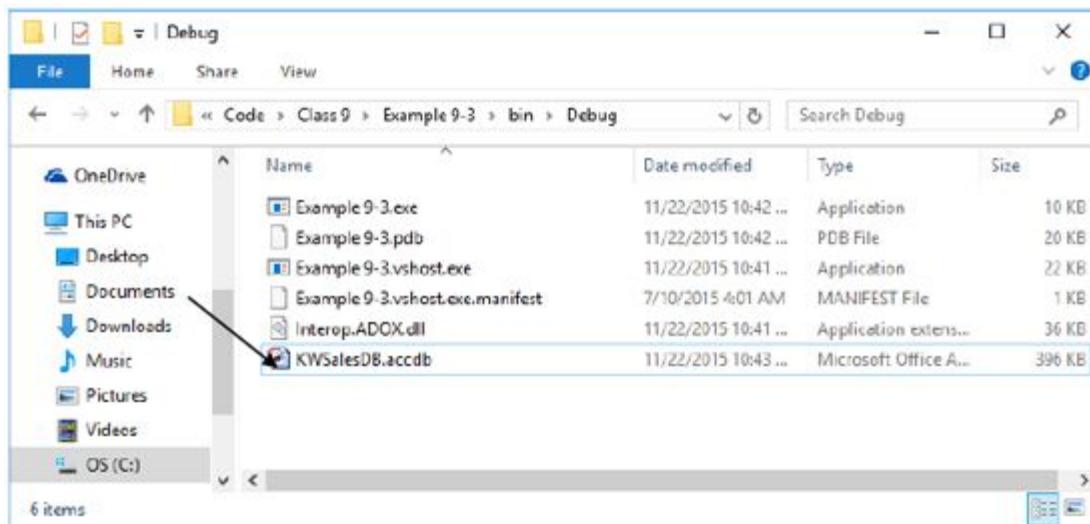
```

    {
        MessageBox.Show(ex.Message, "Error",
    MessageBoxButtons.OK, MessageBoxIcon.Error);
}
finally
{
    salesDatabase = null;
}
}

```

This creates an empty database named **KWSalesDB**. in the application's **Bin\Debug** (**Application.StartupPath**) folder. We use error trapping (Try block) in case something goes wrong.

2. Save (saved in **Example 9-3** folder of **VCSDB\Code\Example 9-3** folder) the application and run it. Click **Create Database**. Go to the **Bin\Debug** folder for your project and you should see a copy of the database you just created. Here is mine:



Create a Table

A table is created using the ADOX **Table** object. You must provide a **Name** (a **string** type) for the table. The code to create a table object (**myTable**) with **Name myTableName** and add it to an existing catalog object (**myDatabase**) is:

```
Table myTable;  
myTable = new Table();  
myTable.Name = myTableName;  
myDatabase.Tables.Append(myTable);
```

Let's create the **Customers** table.

1. Return to your project. Add the shaded code to the **btnCreate_Click** method:

```
private void btnCreate_Click(object sender, EventArgs e)  
{  
    Catalog salesDatabase = new Catalog();  
    Table databaseTable;  
    try  
    {  
  
        salesDatabase.Create("Provider=Microsoft.ACE.OLEDB.12  
.0;  
        Data Source = " + Application.StartupPath +  
        "\\\\KWSalesDB.accdb");  
        // Create Customers table
```

```

        databaseTable = new Table();
        databaseTable.Name = "Customers";
        salesDatabase.Tables.Append(databaseTable);

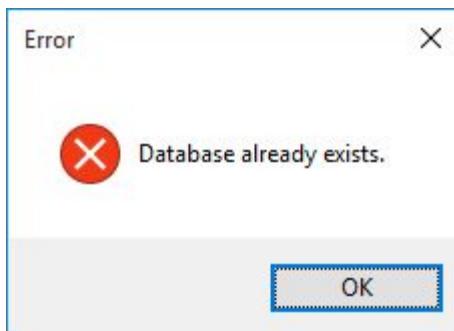
    }

    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }

    finally
    {
        salesDatabase = null;
    }
}

```

2. Save and run the application. Click **Create Database**. You should see:



Recall you cannot create a database with ADOX if the name selected already exists. We already have a database named **KWSALES.**, so we can't create it again. This is a continuous problem as you design a new database. You must always remember to delete the old version before trying some change. Fortunately, you can do this at run-time. Just find the file and delete it, then continue running your program. Try it. Delete **KWSALES.** from your project's **Bin\Debug** folder, then click **Create Database** again. The

file will reappear in the folder (now with the added, albeit empty, **Customers** table).

3. If you have Access, open the created file. You should see that there really is a **Customers** table:



Add Fields to Table

Once a table is created, we need to add fields to the table. Fields are referred to as columns. For each field added, we need to know the field name (`myFieldName`), the data type (`myFieldType`), and width (`myFieldWidth`, an `int` type). To add this field (column) to a table object (`myTable`), use:

```
myTable.Columns.Append(myFieldName, myFieldType,  
myFieldWidth);
```

Field types we use in our work are:

FieldType	Description
<code>DataTypeEnum.adSmallInt</code>	Integer
<code>DataTypeEnum.adInteger</code>	Long integer
<code>DataTypeEnum.adCurrency</code>	Currency type (two decimal places)
<code>DataTypeEnum.adDate</code>	Date
<code>DataTypeEnum.adSingle</code>	Single precision decimal numbers
<code>DataTypeEnum.adDouble</code>	Double precision decimal numbers
<code>DataTypeEnum.adWChar</code>	Fixed width string

By default, added fields are **required** entries. For our sales database, that is desired. In many cases, it is not. To remove this restriction from a field, use:

```
myTable.Columns(myFieldName).Attributes =  
ColumnAttributesEnum.adColNullable;
```

Let's add fields to the `Customers` table. Recall the field specifications are (all required fields):

Name	DataType	FieldSize
CustomerID	Long	10
FirstName	Text	40
LastName	Text	40
Address	Text	40
City	Text	40
State	Text	20
Zip	Text	10

1. Return to your project. Add the shaded code to the **btnCreate_Click** event method:

```
private void btnCreate_Click(object sender, EventArgs e)
{
    Catalog salesDatabase = new Catalog();
    Table databaseTable;
    try
    {

salesDatabase.Create("Provider=Microsoft.ACE.OLEDB.12
.0;
Data Source = " + Application.StartupPath +
"\KWSalesDB.accdb");
        // Create Customers table
        databaseTable = new Table();
        databaseTable.Name = "Customers";
        // Add fields
        databaseTable.Columns.Append("CustomerID",
        DataTypeEnum.adInteger, 10);
        databaseTable.Columns.Append("FirstName",
        DataTypeEnum.adWChar, 40);
```

```
        databaseTable.Columns.Append("LastName",
    DataTypeEnum.adWChar, 40);
        databaseTable.Columns.Append("Address",
    DataTypeEnum.adWChar, 40);
        databaseTable.Columns.Append("City",
    DataTypeEnum.adWChar, 40);
        databaseTable.Columns.Append("State",
    DataTypeEnum.adWChar, 20);
        databaseTable.Columns.Append("Zip",
    DataTypeEnum.adWChar, 10);

    salesDatabase.Tables.Append(databaseTable);
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error",
MessageBoxButtons.OK, MessageBoxIcon.Error);
}
finally
{
    salesDatabase = null;
}
}
```

2. Save and run the application. Click **Create Database**. The **Customers** table will now have fields. If I open my file in Access and view the **Customers** table in **Design View**, I see:

Field Name	Data Type
CustomerID	Number
FirstName	Text
LastName	Text
Address	Text
City	Text
State	Text
Zip	Text

Recall that the **CustomerID** needs to be an ‘autonumber’ field meaning it is automatically generated. Let’s make that change.

- After the line of code creating and appending the **CustomerID** field, add this code:

```
databaseTable.Columns["CustomerID"].ParentCatalog =
salesDatabase;
databaseTable.Columns["CustomerID"].Properties["Autoi
ncrement"].Value = true;
```

Now, if you rerun the application and view the table in Access, you see the field is the proper type:

Field Name	Data Type
CustomerID	AutoNumber
FirstName	Text
LastName	Text
Address	Text
City	Text
State	Text
Zip	Text

Define Table Primary Key

We want to be able to define a primary key for a table. To do this, we use the **Keys** collection of an ADOX Table object. The syntax for a table object named **myTable** is:

```
myTable.Keys.Append(myKeyName,  
KeyTypeEnum.adKeyPrimary, myFieldName, null, null);
```

where **myKeyName** is a name assigned to the key and **myFieldName** is the field designated as a primary key. The two **null** arguments are used to define foreign keys and are not used here.

Our **Customers** table has a single primary key, **CustomerID**. Let's define that key.

1. Return to the project. Add the shaded line of code to the **btnCreate_Click** event method:

```
private void btnCreate_Click(object sender, EventArgs  
e)  
{  
    Catalog salesDatabase = new Catalog();  
    Table databaseTable;  
    try  
    {  
  
        salesDatabase.Create("Provider=Microsoft.ACE.OLEDB.12  
.0;  
        Data Source = " + Application.StartupPath +
```

```
"\\KWSalesDB.accdb");
    // Create Customers table
    databaseTable = new Table();
    databaseTable.Name = "Customers";
    // Add fields
    databaseTable.Columns.Append("CustomerID",
        DataTypeEnum.adInteger, 10);
    databaseTable.Columns["CustomerID"].ParentCatalog =
        salesDatabase;

    databaseTable.Columns["CustomerID"].Properties["Autoincrement"].Value = true;
    databaseTable.Columns.Append("FirstName",
        DataTypeEnum.adWChar, 40);
    databaseTable.Columns.Append("LastName",
        DataTypeEnum.adWChar, 40);
    databaseTable.Columns.Append("Address",
        DataTypeEnum.adWChar, 40);
    databaseTable.Columns.Append("City",
        DataTypeEnum.adWChar, 40);
    databaseTable.Columns.Append("State",
        DataTypeEnum.adWChar, 20);
    databaseTable.Columns.Append("Zip",
        DataTypeEnum.adWChar, 10);

    // Add keys
    databaseTable.Keys.Append("PK_Customers",
        KeyTypeEnum.adKeyPrimary, "CustomerID", null, null);
    salesDatabase.Tables.Append(databaseTable);
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error",
```

```

        MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    finally
    {
        salesDatabase = null;
    }
}

```

2. Resave and run the application. Click **Create Database**. Examining the **Customers** table now shows **CustomerID** as a primary key (note the key icon in the first column):

	Field Name	Data Type
.PrimaryKey	CustomerID	AutoNumber
	FirstName	Text
	LastName	Text
	Address	Text
	City	Text
	State	Text
	Zip	Text

Define Table Indexes

Lastly, we want to be able to define indexes for tables. To do this, we use the **Indexes** collection of a ADOX **Table** object. The syntax for a table object named **myTable** is:

```
myTable.Indexes.Append(myIndexName, myFieldName);
```

where **myIndexName** is a name assigned to the index and **myFieldName** is the field designated as an index. These two names can have the same value.

Our **Customers** table has two indexed fields, **CustomerID** and **LastName**. Let's define them.

1. Return to the project. Add the shaded code to the **btnCreate_Click** event method:

```
Private Sub btnCreate_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btnCreate.Click
    Dim SalesDatabase As New Catalog
    Dim DatabaseTable As Table
    Try

        SalesDatabase.Create("Provider=Microsoft.ACE.OLEDB.12
        .0; Data Source = " + Application.StartupPath +
        "\KWSalesDB.accdb")
        ' Create Customers table
        DatabaseTable = New Table
        DatabaseTable.Name = "Customers"
```

```

' Add fields
DatabaseTable.Columns.Append("CustomerID",
    DataTypeEnum.adInteger)
DatabaseTable.Columns("CustomerID").ParentCatalog = SalesDatabase

DatabaseTable.Columns("CustomerID").Properties("Autoincrement").Value = True

DatabaseTable.Columns.Append("FirstName",
    DataTypeEnum.adWChar, 40)
DatabaseTable.Columns.Append("LastName",
    DataTypeEnum.adWChar, 40)
DatabaseTable.Columns.Append("Address",
    DataTypeEnum.adWChar, 40)
DatabaseTable.Columns.Append("City",
    DataTypeEnum.adWChar, 40)
DatabaseTable.Columns.Append("State",
    DataTypeEnum.adWChar, 20)
DatabaseTable.Columns.Append("Zip",
    DataTypeEnum.adWChar, 10)

' Add keys
DatabaseTable.Keys.Append("PK_Customers",
    KeyTypeEnum.adKeyPrimary, "CustomerID")

' Add indexes
DatabaseTable.Indexes.Append("CustomerID",
    "CustomerID")
DatabaseTable.Indexes.Append("LastName",
    "LastName")

SalesDatabase.Tables.Append(DatabaseTable)

Catch ex As Exception
    MessageBox.Show(ex.Message, "Error",
        MessageBoxButtons.OK, MessageBoxIcon.Error)
Finally

```

```

    SalesDatabase = Nothing
End Try
End Sub

```

2. Resave and run the application. Click **Create Database**. If you examine the **CustomerID** and **Lastname** fields in the **Customers** table (using Access), you will see that they are indexes. The **Customers** table is now complete. Let's create the other three tables.
3. The **Orders** table has three fields:

Name	DataType
OrderID	Text (FieldSize = 10)
CustomerID	Number (Long Integer, no default value, FieldSize = 10)
OrderDate	Date/Time (FieldSize = 20)

The primary key is **OrderID**. All three fields are indexed fields. The code that creates this table structure is:

```

// Create Orders table
databaseTable = new Table();
databaseTable.Name = "Orders";
// Add fields
databaseTable.Columns.Append("OrderID",
    DataTypeEnum.adWChar, 10);
databaseTable.Columns.Append("CustomerID",
    DataTypeEnum.adInteger, 10);
databaseTable.Columns.Append("OrderDate",
    DataTypeEnum.adDate, 20);
// Add keys
databaseTable.Keys.Append("PK_OrderID",

```

```

KeyTypeEnum.adKeyPrimary, "OrderID", null, null);
// Add indexes
databaseTable.Indexes.Append("OrderID", "OrderID");
databaseTable.Indexes.Append("CustomerID",
"CustomerID");
databaseTable.Indexes.Append("OrderDate",
"OrderDate");
salesDatabase.Tables.Append(databaseTable);

```

Add this code to the **btnCreate_Click** method following creation of the **Customers** table. Save the application once again and run it. Click **Create Database**. Viewing the **Orders** table in Access shows the fields are correct and the primary index is identified:

	Field Name	Data Type
▼	OrderID	Text
	CustomerID	Number
	OrderDate	Date/Time

4. The **Purchases** table has three fields:

Name	DataType
OrderID	Text (FieldSize = 10)
ProductID	Text (FieldSize = 10)
Quantity	Number (Integer, FieldSize = 10)

There is no primary key. **OrderID** and **ProductID** are indexed fields. The code that creates this table structure is:

```

// Create Purchases table
databaseTable = new Table();
databaseTable.Name = "Purchases";
// Add fields

```

```

databaseTable.Columns.Append("OrderID",
    DataTypeEnum.adWChar, 10);
databaseTable.Columns.Append("ProductID",
    DataTypeEnum.adWChar, 10);
databaseTable.Columns.Append("Quantity",
    DataTypeEnum.adSmallInt, 10);
// Add indexes
databaseTable.Indexes.Append("OrderID", "OrderID");
databaseTable.Indexes.Append("ProductID",
    "ProductID");
salesDatabase.Tables.Append(databaseTable);

```

Add this code to the **btnCreate_Click** method following creation of the **Orders** table. Save the application once again and run it. Click **Create Database**. Viewing the **Purchases** table in Access shows the fields are correct:

	Field Name	Data Type
	OrderID	Text
	ProductID	Text
	Quantity	Number

5. And, lastly, the **Products** table has four fields:

Name	DataType
ProductID	Text (FieldSize = 10)
Description	Text (FieldSize = 40)
Price	Currency (FieldSize = 20)
NumberSold	Number (Integer, FieldSize = 10)

ProductID is a primary key. There are no indexes. The code that creates this table structure is:

```
// Create Products table
```

```

databaseTable = new Table();
databaseTable.Name = "Products";
// Add fields
databaseTable.Columns.Append("ProductID",
    DataTypeEnum.adWChar, 10);
databaseTable.Columns.Append("Description",
    DataTypeEnum.adWChar, 40);
databaseTable.Columns.Append("Price",
    DataTypeEnum.adCurrency, 20);
databaseTable.Columns.Append("NumberSold",
    DataTypeEnum.adSmallInt, 10);
// Add keys
databaseTable.Keys.Append("PK_ProductID",
    KeyTypeEnum.adKeyPrimary, "ProductID", null, null);
salesDatabase.Tables.Append(databaseTable);

```

Add this code to the **btnCreate_Click** method following creation of the **Purchases** table. Save the application once again and run it. Click **Create Database**. Viewing the **Products** table in Access shows the fields are correct and the primary index is identified:

	Field Name	Data Type
PK	ProductID	Text
	Description	Text
	Price	Currency
	NumberSold	Number

We now have all four tables in the **KWSALES** database.

Define Table Relationships

The last step in creating a database using Visual C# is to define the relationships between keys in the various tables. The process involves first creating needed foreign keys. Each foreign key is then related to the corresponding primary key in another table.

Say we have **field1** in **table1** that is a primary key. Now, say **field2** in **table2** is a foreign key object (named **myForeignKey**) related to that primary key. The steps to create such a relationship are (assuming both tables are part of an ADOX catalog **myCatalog**):

```
myCatalog.Tables[table2].Keys.Append(myForeignKeyName,  
KeyTypeEnum.adKeyForeign, field2, table1, field1);
```

where **myForeignKeyName** is a named assign to the key. This code adds **field2** to the foreign key, then relates it to **field1** in **table1**. The key is then appended to **table2**.

There are three foreign keys in the KWSALES database. Let's define each one.

1. Return to the project. The first foreign key (name is **FK_CustomerID**) is **CustomerID** in the **Orders** table. It is related to the **CustomerID** (primary key) in the **Customers** table. The code to make this relation is:

```
// Define relationships  
// Relate CustomerID field in Customers to CustomerID  
// in Orders (Foreign key)  
salesDatabase.Tables["Orders"].Keys.Append("FK_CustomerID" ,  
KeyTypeEnum.adKeyForeign, "CustomerID",
```

```
"Customers", "CustomerID");
```

Place this code in the **btnCreate_Click** method after creation of the **Products** table.

2. The second foreign key (name is **FK_OrderID**) is **OrderID** in the **Purchases** table. It is related to the **OrderID** (primary key) in the **Orders** table. The code to create this relation is:

```
// Relate OrderID field in Orders to OrderID in
// Purchases (Foreign key)
salesDatabase.Tables["Purchases"].Keys.Append("FK_OrderID", KeyTypeEnum.adKeyForeign, "OrderID",
    "Orders", "OrderID");
```

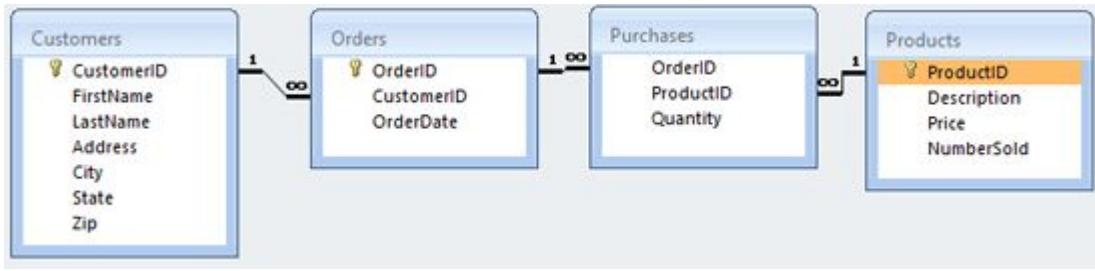
Place this code in the **btnCreate_Click** method after creation of the **CustomerID** foreign key.

3. The final foreign key (name is **FK_ProductID**) is **ProductID** in the **Purchases** table. It is related to the **ProductID** (primary key) in the **Products** table. The code to create this relation is:

```
// Relate ProductID field in Products to ProductID in
// Purchases (foreign key)
salesDatabase.Tables["Purchases"].Keys.Append("FK_ProductID", KeyTypeEnum.adKeyForeign, "ProductID",
    "Products", "ProductID");
```

Place this code in the **btnCreate_Click** method after creation of the **OrderID** foreign key.

4. Save the application one last time (saved in **Example 9-3** folder of **VCSDB\Code\Example 9-3** folder). Run it. Click **Create Database**. The database and all relationships should now be created. If you open the database in Access and view the relationships (click **Tools**, then **Relationships**) you see:



All of the key relationships are clearly defined.

Like the Access example, it is possible to add values to the tables at this point, if desired. You would use the data objects discussed in previous chapters. Once the objects are created, you could programmatically add rows to tables and update the database. We will not populate the tables here. It will be done in the examples in Chapter 10.

Example 9-4

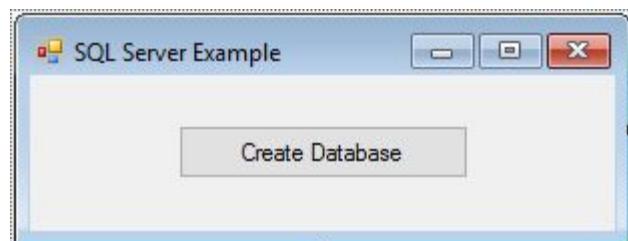
SQL Server Databases with Visual C#

It is also possible to create SQL Server databases using Visual C#. The process involves executing SQL statements to perform each step in the development:

- Create the database
- Create the table(s)
- Add fields to the table(s)
- Define primary key for the table(s)
- Define indexes for the table(s)
- Define relationships between tables

In this example, we will perform just the first step - create a SQL server database. The remaining steps involve using some fairly complicated SQL statements which are beyond the scope of this course. We direct the reader to SQL references (and the Internet) for further information.

1. Start a new project in Visual C#. This project will have a single button (**Name** property `btnCreate`, **Text** property `Create Database`). We will simply write code in the `btnCreate_Click` event procedure to create the database. My form looks like this:



2. Go to your project code window and add the usual line:

```
using System.Data.SqlClient;
```

3. Add this code to the **btnCreate_Click** event procedure:

```
private void btnCreate_Click(object sender, EventArgs e)
{
    SqlConnection myConnection = new
SqlConnection("Server=.\SQLEXPRESS;
Trusted_Connection=Yes");
    SqlCommand myCommand = new SqlCommand("CREATE
DATABASE
SQLDatabase", myConnection);
    myConnection.Open();
    myCommand.ExecuteNonQuery();
    myConnection.Close()
}
```

This creates an empty database named **SQLDatabase.mdf** on your SQL Server instance (named **.SQLEXPRESS** on my computer). The database is created by executing the SQL command:

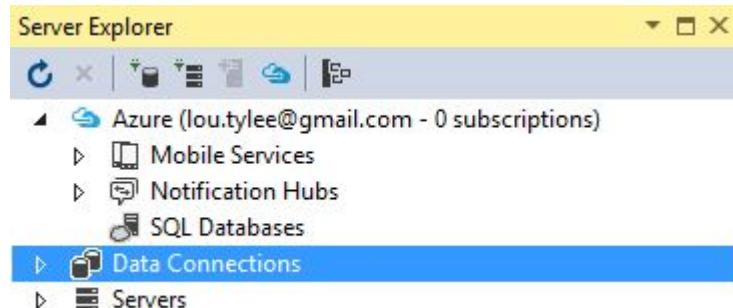
CREATE DATABASE SQLDatabase

against the open connection object **myConnection**.

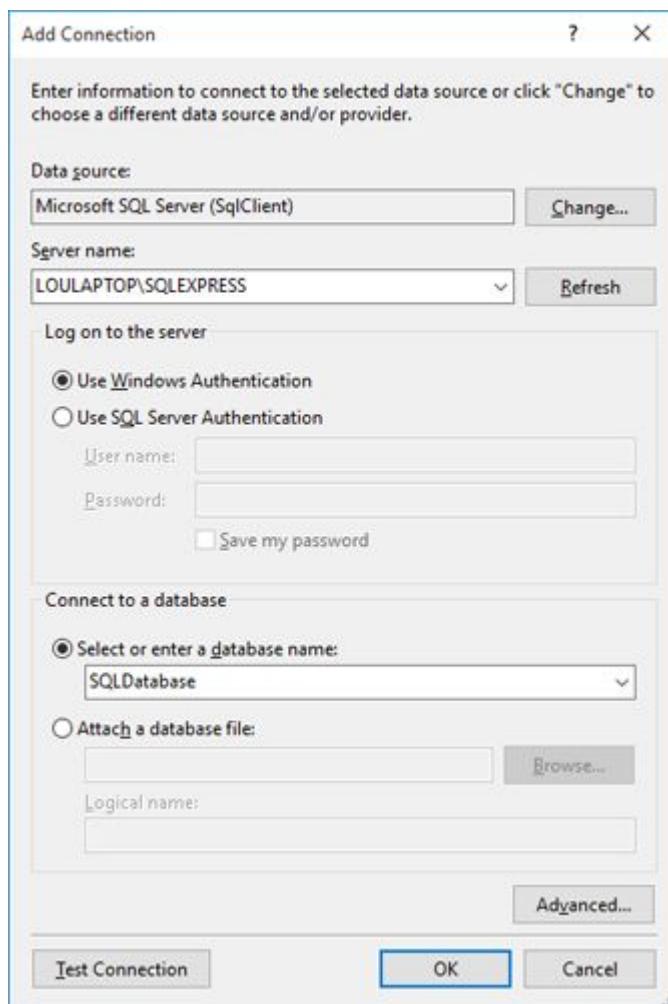
4. Save the application and run it. Click **Create Database**. If there are no errors, the database is created. But, just where is the database?

The newly created database is located on your SQL Server instance. Start a new Visual C# project. Click the **View** menu and select

Server Explorer. You should see:

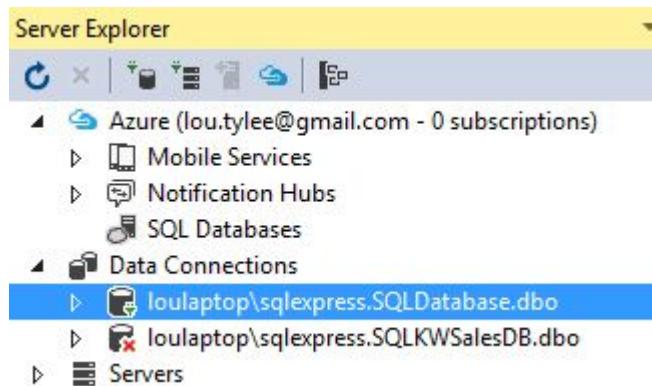


Right-click **Data Connections** and choose **Add Connection**. This form appears:



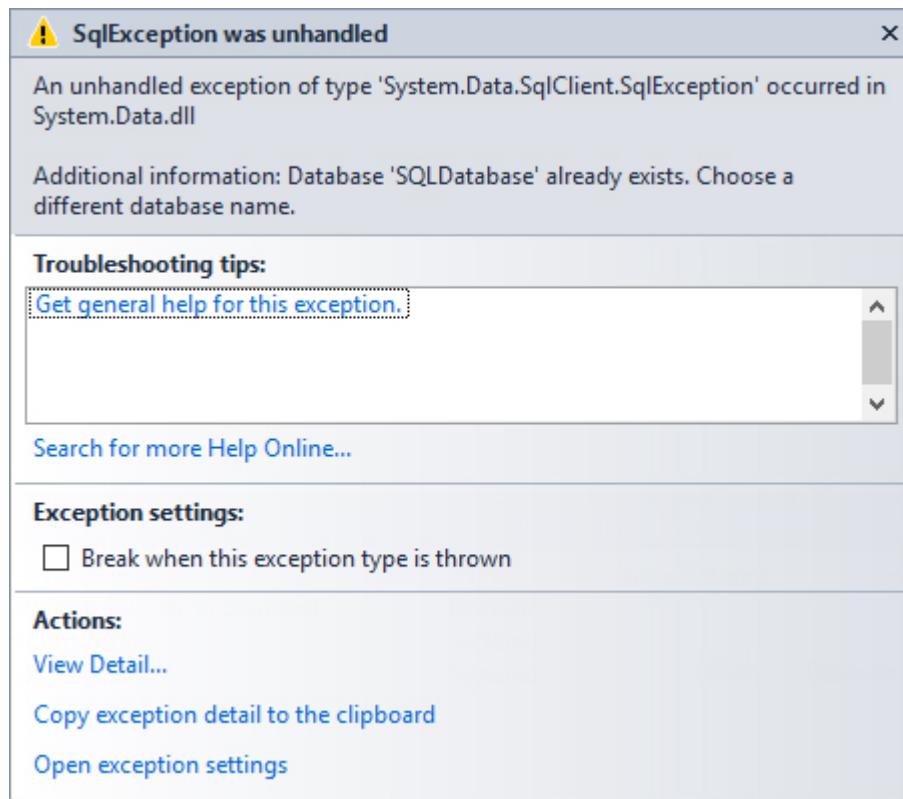
Make the shown entries (use your server name) and click OK.

In the Server Explorer, you will now see:



Listed under the **Data Connections** is **SQLDatabase**. It is an empty database with no tables. As mentioned, adding tables, fields, and relationships requires additional SQL statements to be executed against the connection object. We will not cover such statements here.

If you do continue development of a SQL Server database with Visual C#, be aware when you run your application again, you will probably get an error message like this:



You cannot create a database if the name selected already exists. We already have a database named **SQLDatabase**, so we can't create it again. This is a continuous problem as you design a new database. You must always remember to delete the old version before trying some change. This deletion is done by right-clicking the database in the **Server Management** tool and choosing **Delete**.

Database Design Refinement

The database design is complete and the database has been built (using one of the two methods discussed). Before building the database management system (using Visual C#, of course), you should re-examine your database design. This will make any shortcomings immediately apparent.

Things you should check include:

- Are the fields the proper type?
- Are text fields long enough, too long?
- Are there missing fields?
- Are any additional fields needed?

You may find you need to redesign your database. And, yes, you may need to start over. A database structure is usually permanent and cannot be easily changed. But, modifying your database now, before you build a complete management system to work with it, is much easier than changing things further down the development road.

Summary

In this chapter, we discussed several steps for developing a well-designed database for use in a database management system (like the one built in Chapter 6 and modified in Chapter 7). The major considerations in designing a database are to be complete, thorough, and accurate. Later modification of a database project can be a major undertaking.

The use of the Access and the Visual C# ADOX library to build an Access database were examined. Building a SQL Server database using Server Explorer was also covered. The empty database built can be connected to a Visual Basic front-end interface to form a complete database management system. In the next chapter, we look at three case studies that do just that.

10

Sample Database Projects

Review and Preview

We have completed our introduction (a long introduction) into database programming with Visual C#. We have learned about database structure, proper interface design, database management techniques, database reports, and how to create a database.

In this chapter, we put all our skills to work and look at some sample projects. These projects are typical database applications. The applications studied are a program using the KWSALES database just built in Chapter 9, a home inventory tracking system, and a weather monitor.

Overview of Database Projects

We will build three projects in this chapter. The first is a sales order form for the KWSALES database built in the previous chapter. The second application allows a user to keep track of items in their homes or other locations, for possible insurance claim use. And, the final application is a weather-monitoring program that records and plots temperatures and precipitation over time.

Each project will be built in stages. And, the steps followed in each stage are explained in detail. This will give you an idea of how to use Visual C# to build a database management system. Visual C# is an ideal environment for building applications in this way. Suggestions for improving each application are also provided.

One other suggestion - when building your applications, make a copy of your database before starting. Many errors can occur when developing a project and you wouldn't want any of these errors to destroy needed data. So, always build with a working copy of your database. When you are sure the project is working correctly, you can use a 'clean' copy.

Example 10-1

Sales Order Form Project

In Chapter 9, we built a database similar to the one we use here at our company (KIDware) to track orders and sales. In this application, we build a Visual C# interface for that database. The interface will be used to enter new orders into the database.

The order form should allow entry of the following information into the database:

Order ID

Order Date

Customer ID

Customer first and last name

Customer address information

Product(s) ordered information

The form should have the ability to add new orders, find past customers, and add new customers. Completed order invoices should be available as printed reports. Before starting this project, we suggest a quick review of Chapter 9 to get reacquainted with the structure of the KWSALES database.

Preliminaries

Start a new project in Visual C#. Copy **KWSalesDB.accdb** into your project's **Bin\Debug** folder (you may have to create it first). One option is to use the blank database from Chapter 9 in the **VCSDB\Datasets** folder. Or, you might like to use the copy included with this example's course code (in **Example 10-1** folder of the **VCSDB\Code\Class 10** folder). Product information is included in this database and there are a few customers and orders you can look at. We use the latter in this example.

Order Information

We'll begin this project by developing the ability to submit an order or exit the program. The order submission capability will not be coded now, but the interface for access will be begun.

1. Near the top of the displayed form, place a group box, two buttons, and four label controls. The top of the form should look something like this:



2. Set these properties:

Form1:

Name	frmKWSales
ControlBox	False
FormBorderStyle	Fixed Single
StartPosition	CenterScreen
Text	KWSales Order Form

groupBox1:

Name	grpOrder
Text	Order
FontSize	10
FontBold	True

button1:

Name	btnSubmitOrder
Text	Submit
FontSize	10

button2:

Name	btnExit
Text	Exit
FontSize	10

label1:

Text	KIDware Order
FontSize	10

label2:

Name	lblOrderID
Text	[Blank]
FontSize	10

label3:

Text	Order Date
FontSize	10

label4:

Name	lblDate
Text	[Blank]
FontSize	10

The top of my finished form looks like this:



When the application begins, the form will be in a mode to accept a new order. In this mode, we want a new order number and the current date. (Later, we will insure the customer information is also blank.)

1. Place this line at the top of the code window to allow use of data objects:

```
using System.Data.OleDb;
```

2. Place this code in the form level declarations:

```
int orderNumber;  
OleDbConnection KWSalesConnection;  
OleDbCommand ordersCommand;  
OleDbDataAdapter ordersAdapter;  
DataTable ordersTable;
```

The variable **orderNumber** tells us how many orders have been entered on a particular day. The remaining declarations are the data objects needed to look at the **Orders** table in the database.

3. Place this code in the **frmKWSales_Load** event method:

```
private void frmKWSales_Load(object sender, EventArgs e)  
{  
    // connect to sales database
```

```

KWSalesConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + Application.StartupPath +
"\KWSalesDB.accdb");
KWSalesConnection.Open();
// establish Orders command object
ordersCommand = new OleDbCommand("SELECT * FROM
Orders
ORDER BY OrderID", KWSalesConnection);
// establish Orders data adapter/data table
ordersAdapter = new OleDbDataAdapter();
ordersAdapter.SelectCommand = ordersCommand;
ordersTable = new DataTable();
ordersAdapter.Fill(ordersTable);
orderNumber = 0;
NewOrder();
}

```

This code connects to the **KWSALES** database file (in the application folder) and creates the data objects needed to view the **Orders** table. It initializes the **orderNumber** and starts a new order (**NewOrder** method will be seen soon).

4. Place this code in the **frmKWSales_FormClosing** event method to clean up objects:

```

private void frmKWSales_FormClosing(object sender,
FormClosingEventArgs e)
{
    // close the connection
    KWSalesConnection.Close();
    // dispose of the objects
}

```

```
    ordersCommand.Dispose();
    ordersAdapter.Dispose();
    ordersTable.Dispose();
}
```

5. Add a general method named **NewOrder** and use this code:

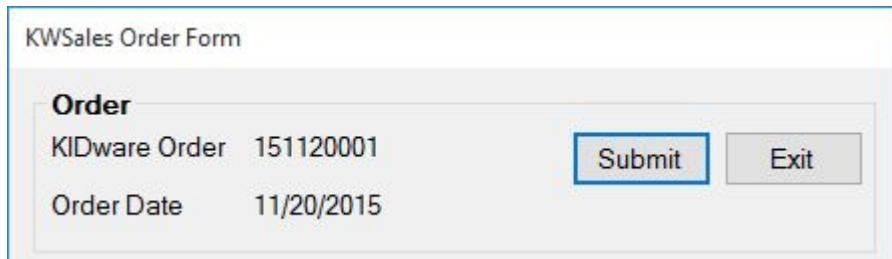
```
private void NewOrder()
{
    string IDString;
    DateTime thisDay = DateTime.Now;
    lblDate.Text = thisDay.ToShortDateString();
    // Build order ID as string
    orderNumber++;
    IDString = thisDay.Year.ToString().Substring(2);
    if (thisDay.Month < 10)
        IDString += "0" + thisDay.Month.ToString();
    else
        IDString += thisDay.Month.ToString();
    if (thisDay.Day < 10)
        IDString += "0" + thisDay.Day.ToString();
    else
        IDString += thisDay.Day.ToString();
    if (orderNumber < 10)
        IDString += "00" + orderNumber.ToString();
    else if (orderNumber < 100)
        IDString += "0" + orderNumber.ToString();
    else
        IDString += orderNumber.ToString();
    lblOrderID.Text = IDString;
}
```

This code places today's date in the **lblDate** control, and generates a new **orderID** value. In our work, we establish our own format for **orderID**. It has nine characters: the first two are the last two numbers in the year, the next two the month, the next two the day, and the final three unique digits incremented with each order. For example, if this is the third order on October 8, 2006, the **orderID** is: **061008003**.

6. Place this code in the **btnExit_Click** event:

```
private void btnExit_Click(object sender, EventArgs e)
{
    this.Close();
}
```

7. Save the application (saved in **Example 10-1** folder in **VCSDB\Code\Class 10** folder) and run it. You should see this (assuming it's January 1, 2007 today!) at the top of the form:

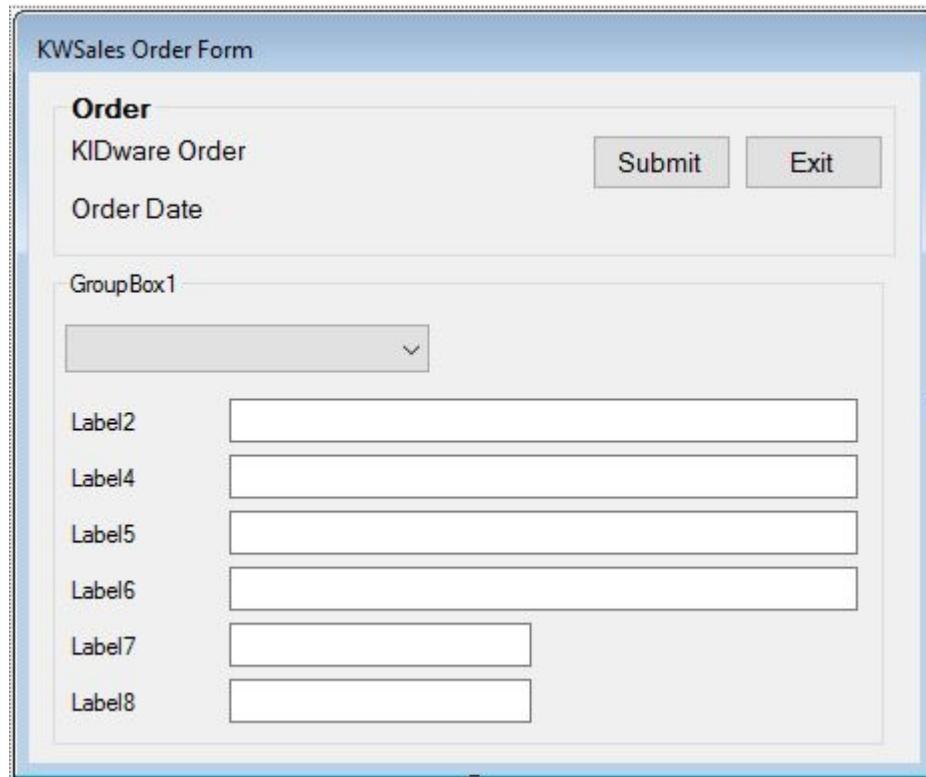


Next we look at adding customer information. We have not coded the **Submit Order** button yet - this is intentional.

Existing Customer Information

We now add the ability to find an existing customer in our database and display the corresponding information on our order form. We want to display the customer name and address information.

1. Add another group box, a combo box control, 6 labels and 6 text box controls to the form under the **Order** group box. The form should look like this:



2. Use these properties (note the default names may differ depending on where you placed controls):

groupBox1:

Name grpCustomer

Text Customer
FontSize 10
FontBold True

comboBox1:

Name cboCustomers
FontSize 10
Sorted True
DropDownStyle DropDownList

label2:

Text First Name:
FontSize 10

textBox1 :

Name txtFirstName
BackColor White
FontSize 10
ReadOnly True

label4:

Text Last Name:
FontSize 10

textBox2:

Name txtLastName
BackColor White
FontSize 10
ReadOnly True

label5:

Text Address:
FontSize 10

textBox3:

Name	txtAddress
BackColor	White
FontSize	10
ReadOnly	True

label6:

Text	City:
FontSize	10

textBox4:

Name	txtCity
BackColor	White
FontSize	10
ReadOnly	True

label7:

Text	State:
FontSize	10

textBox5:

Name	txtState
BackColor	White
FontSize	10
ReadOnly	True

label8:

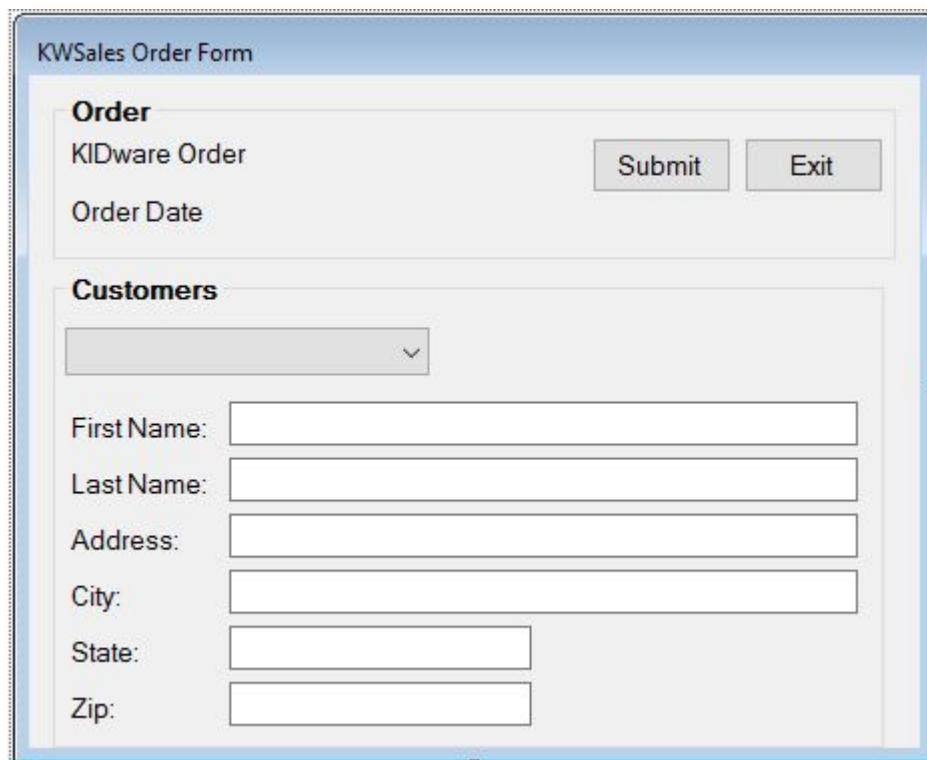
Text	Zip:
FontSize	10

textBox6:

Name	txtZip
BackColor	White

```
FontSize      10  
ReadOnly     True
```

The form should now look like this:



3. We add another set of data objects that connect to the **Customers** table in the database. Add these form level declarations:

```
OleDbCommand customersCommand;  
OleDbDataAdapter customersAdapter;  
DataTable customersTable;  
CurrencyManager customersManager;
```

4. Add the shaded code to the **frmKWSales_Load** event method to create the new objects and bind the label controls:

```
private void frmKWSales_Load(object sender, EventArgs e)
```

```
{  
    // connect to sales database  
    KWSalesConnection = new  
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
    Data  
    Source = " + Application.StartupPath +  
    "\\KWSalesDB.accdb");  
    // establish Orders command object  
    ordersCommand = new OleDbCommand("SELECT * FROM  
    Orders  
    ORDER BY OrderID", KWSalesConnection);  
    // establish Orders data adapter/data table  
    ordersAdapter = new OleDbDataAdapter();  
    ordersAdapter.SelectCommand = ordersCommand;  
    ordersTable = new DataTable();  
    ordersAdapter.Fill(ordersTable);  
    // establish Customers command object  
    customersCommand = new OleDbCommand("SELECT * FROM  
    Customers", KWSalesConnection);  
    // establish Customers data adapter/data table  
    customersAdapter = new OleDbDataAdapter();  
    customersAdapter.SelectCommand = customersCommand;  
    customersTable = new DataTable();  
    customersAdapter.Fill(customersTable);  
    // bind controls to data table  
    txtFirstName.DataBindings.Add("Text",  
    customersTable, "FirstName");  
    txtLastName.DataBindings.Add("Text",  
    customersTable, "LastName");  
    txtAddress.DataBindings.Add("Text",  
    customersTable, "Address");
```

```

txtCity.DataBindings.Add("Text", customersTable,
"City");
txtState.DataBindings.Add("Text", customersTable,
"State");
txtZip.DataBindings.Add("Text", customersTable,
"Zip");
// establish currency manager
customersManager = (CurrencyManager)
this.BindingContext[customersTable];
orderNumber = 0;
NewOrder();
}

```

5. Add the shaded code to the frmKWSales_FormClosing method:

```

private void frmKWSales_FormClosing(object sender,
FormClosingEventArgs e)
{
    // close the connection
    KWSalesConnection.Close();
    // dispose of the objects
    ordersCommand.Dispose();
    ordersAdapter.Dispose();
    ordersTable.Dispose();
    customersCommand.Dispose();
    customersAdapter.Dispose();
    customersTable.Dispose();
}

```

6. We will use the combo box to list existing customers in the following format:

LastName, FirstName (CustomerID)

This will let us easily locate an existing customer based on unique **CustomerID**. When a user selects a name, the name and address fields will be filled in. Add this general method (**FillCustomers**) to the project (this code initializes the listings in the combo box):

```
private void FillCustomers()
{
    if (customersTable.Rows.Count != 0)
    {
        for (int nRec = 0; nRec <
customersTable.Rows.Count; nRec++)
        {

cboCustomers.Items.Add(CustomerListing(customersTable
.Rows [nRec]["LastName"].ToString(),
customersTable.Rows[nRec]["FirstName"].ToString(),
customersTable.Rows[nRec]["CustomerID"].ToString()));
        }
    }
}
```

This uses a little method (**CustomerListing**) to generate the proper format:

```
private string CustomerListing(string lastName,
string firstName, string ID)
{
    return (lastName + ", " + firstName + " (" + ID +
")");
}
```

Now add this to the **frmKWSales_Load** event method right after the code establishing the **Customers** table data objects (before the **orderNumber = 0** line):

```
// Fill customers combo box  
FillCustomers();
```

7. Place this code in the `cboCustomers_SelectedIndexChanged` event (this code fills the customer address information based on the selected customer):

```
private void cboCustomers_SelectedIndexChanged(object  
sender,  
EventArgs e)  
{  
    string ID;  
    int pl;  
    string s = cboCustomers.SelectedItem.ToString();  
    try  
    {  
        pl = s.IndexOf("(");  
        if (pl == -1)  
            return;  
        // extract ID from selected item  
        ID = s.Substring(pl + 1, s.Length - pl - 2);  
        customersTable.DefaultView.Sort = "CustomerID";  
        customersManager.Position =  
        customersTable.DefaultView.Find(ID);  
    }  
    catch (Exception ex)  
    {  
        MessageBox.Show("Could not find customer",  
        "Search Error",  
        MessageBoxButtons.OK, MessageBoxIcon.Information);  
    }  
}
```

8. Place this code at the bottom of the `NewOrder` method to initialize customer information:

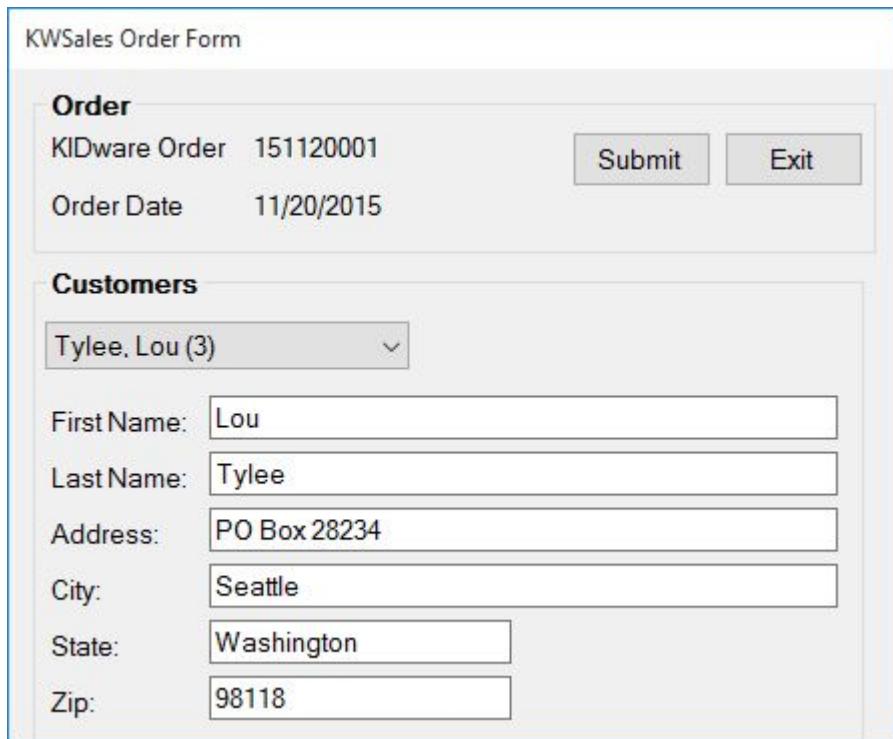
```
if (cboCustomers.Items.Count != 0)
{
    cboCustomers.SelectedIndex = 0;
}
```

9. Save and run the application. Choose a customer (assuming there are some in your database - the sample has a few). Here's what I get when I choose myself:

KWSales Order Form

Order	
KIDware Order	151120001
Order Date	11/20/2015
Customers	
Tylee, Lou (3)	
First Name:	Lou
Last Name:	Tylee
Address:	PO Box 28234
City:	Seattle
State:	Washington
Zip:	98118

Submit Exit



Adding a New Customer

What if the customer placing an order is new and has no information on file? We need to modify the project to account for this possibility. The coding is a little tricky. Recall from our work with the books database that autonumber fields (like the **CustomerID** field) are not generated by ADO .NET until the database is written back to file. We need the **CustomerID** for any new customers we add to our database. Hence, when names are added, we need to close, then reopen the database to retrieve the **CustomerID** value. See the **btnSave_Click** event method for details.

1. Add a three buttons to the right of the combo box in the **Customer** area of the **KWSales** form:

KWSales Order Form

Order

KIDware Order

Order Date

Customers

First Name:

Last Name:

Address:

City:

State:

Zip:

2. Use these properties:

button1:

Name btnNew
FontSize 8
Text New

button2:

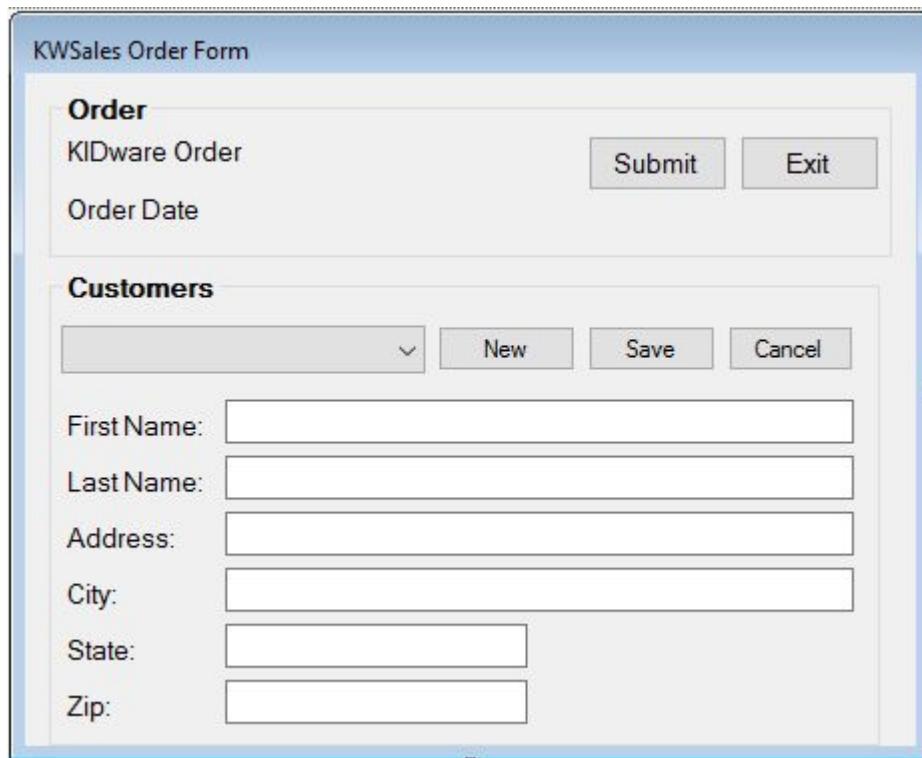
Name btnSave
Enabled False
FontSize 8
Text Save

button3:

Name btnCancel

Enabled False
FontSize 8
Text Cancel

When the **New** button is clicked, the user can type in new customer information. This can then be saved in the database. The form now looks like this:



3. Add two variables in the form level declarations:

```
bool newCustomer = false;  
int savedIndex;
```

newCustomer is used to indicate if we are adding a customer.
savedIndex is used to return to the currently displayed customer if adding a new customer is cancelled.

4. Add this code to the **btnNew_Click** event method:

```

private void btnNew_Click(object sender, EventArgs e)
{
    // enable text boxes for editing and add row
    newCustomer = true;
    txtFirstName.ReadOnly = false;
    txtLastName.ReadOnly = false;
    txtAddress.ReadOnly = false;
    txtCity.ReadOnly = false;
    txtState.ReadOnly = false;
    txtZip.ReadOnly = false;
    btnNew.Enabled = false;
    btnSave.Enabled = true;
    btnCancel.Enabled = true;
    savedIndex = cboCustomers.SelectedIndex;
    cboCustomers.SelectedIndex = -1;
    cboCustomers.Enabled = false;
    customersManager.AddNew();
    txtFirstName.Focus();
}

```

This sets the form in proper state and adds an empty record to the customer list.

5. Add this code to the top of the **cboCustomers_SelectedIndexChanged** event method (to keep the search from occurring while entering a new customer):

```

if (newCustomer)
    return;

```

6. Code the **KeyPress** event for each text box to let the <Enter> key change focus:

```
private void txtFirstName_KeyPress(object sender,
.KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
        txtLastName.Focus();
}

private void txtLastName_KeyPress(object sender,
.KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
        txtAddress.Focus();
}

private void txtAddress_KeyPress(object sender,
.KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
        txtCity.Focus();
}

private void txtCity_KeyPress(object sender,
.KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
        txtState.Focus();
}

private void txtState_KeyPress(object sender,
.KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
```

```
    txtZip.Focus();
}

private void txtZip_KeyPress(object sender,
KeyEventArgs e)
{
    if ((int)e.KeyChar == 13)
        btnSave.Focus();
}
```

7. Add this code to the **btnCancel_Click** event method (this returns the screen to the previous customer without changing anything):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    // return to previous customer
    newCustomer = false;
    txtFirstName.ReadOnly = true;
    txtLastName.ReadOnly = true;
    txtAddress.ReadOnly = true;
    txtCity.ReadOnly = true;
    txtState.ReadOnly = true;
    txtZip.ReadOnly = true;
    btnNew.Enabled = true;
    btnSave.Enabled = false;
    btnCancel.Enabled = false;
    customersManager.CancelCurrentEdit();
    cboCustomers.Enabled = true;
    cboCustomers.SelectedIndex = savedIndex;
}
```

8. Use this code in the `btnSave_Click` event method:

```
private void btnSave_Click(object sender, EventArgs e)
{
    bool allOK = true;
    // make sure there are entries
    if (txtFirstName.Text.Equals(""))
        allOK = false;
    if (txtLastName.Text.Equals(""))
        allOK = false;
    if (txtAddress.Text.Equals(""))
        allOK = false;
    if (txtCity.Text.Equals(""))
        allOK = false;
    if (txtState.Text.Equals(""))
        allOK = false;
    if (txtZip.Text.Equals(""))
        allOK = false;
    if (!allOK)
    {
        MessageBox.Show("All text boxes require an
entry.",
"Information Missing", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        txtFirstName.Focus();
        return;
    }
    customersManager.EndCurrentEdit();
    // save to database then reopen to retrieve
    assigned CustomerID
```

```
string savedFirstName = txtFirstName.Text;
string savedLastName = txtLastName.Text;
OleDbCommandBuilder customersAdapterCommands = new
OleDbCommandBuilder(customersAdapter);
customersAdapter.Update(customersTable);
KWSalesConnection.Close();
// reconnect to sales database
KWSalesConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + Application.StartupPath +
"\KWSalesDB.accdb");
customersCommand = new OleDbCommand("SELECT * FROM
Customers", KWSalesConnection);
customersAdapter = new OleDbDataAdapter();
customersAdapter.SelectCommand = customersCommand;
customersTable = new DataTable();
customersAdapter.Fill(customersTable);
// rebind controls to data table
txtFirstName.DataBindings.Clear();
txtLastName.DataBindings.Clear();
txtLastName.DataBindings.Clear();
txtAddress.DataBindings.Clear();
txtCity.DataBindings.Clear();
txtState.DataBindings.Clear();
txtZip.DataBindings.Clear();
txtFirstName.DataBindings.Add("Text",
customersTable, "FirstName");
txtLastName.DataBindings.Add("Text",
customersTable, "LastName");
txtAddress.DataBindings.Add("Text",
customersTable, "Address");
```

```
txtCity.DataBindings.Add("Text", customersTable,
"City");
txtState.DataBindings.Add("Text", customersTable,
"State");
txtZip.DataBindings.Add("Text", customersTable,
"Zip");
customersManager = (CurrencyManager)
this.BindingContext[customersTable];
// Find added customer
string ID = "";
for (int i = 0; i < customersTable.Rows.Count;
i++)
{
    if
(customersTable.Rows[i]
["FirstName"].ToString().Equals(saved FirstName) &&
customersTable.Rows[i]
["LastName"].ToString().Equals(saved LastName))
    {
        ID =
customersTable.Rows[i]["CustomerID"].ToString();
        break;
    }
}
cboCustomers.Enabled = true;
// refill customers combo box
FillCustomers();
// display new customer
newCustomer = false;
txtFirstName.ReadOnly = true;
txtLastName.ReadOnly = true;
txtAddress.ReadOnly = true;
```

```

txtCity.ReadOnly = true;
txtState.ReadOnly = true;
txtZip.ReadOnly = true;
btnNew.Enabled = true;
btnSave.Enabled = false;
btnCancel.Enabled = false;
cboCustomers.SelectedItem =
CustomerListing(savedLastName, savedFirstName, ID);
}

```

This is a lot of code, but actually pretty easy to follow. This code first checks to make sure all text boxes are filled. It then ends the edit and saves the changes to the database. This allows us to retrieve the needed **CustomerID** field (an autonumber field not available until the database is saved). We then reopen the database file, recreate the Customers data objects, rebind the controls and add the new customer. A lot of work, but necessary.

9. Add the shaded code to the **frmKWSales_FormClosing** event method. This code saves any changes made back to the database file.

```

private void frmKWSales_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (newCustomer)
    {
        MessageBox.Show("You must finish the current
edit
before stopping.", "", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        e.Cancel = true;
    }
}

```

```
        else
        {
            try
            {
                // save the tables to the database file
                OleDbCommandBuilder ordersAdapterCommands =
                    new
                OleDbCommandBuilder(ordersAdapter);
                ordersAdapter.Update(ordersTable);
                OleDbCommandBuilder customersAdapterCommands =
                    new
                OleDbCommandBuilder(customersAdapter);
                customersAdapter.Update(customersTable);
            }
            catch (Exception ex)
            {
                MessageBox.Show("Error saving database",
                    "Save Error",
                    MessageBoxButtons.OK, MessageBoxIcon.Error);
            }

            // close the connection
            KWSalesConnection.Close();
            // dispose of the objects
            ordersCommand.Dispose();
            ordersAdapter.Dispose();
            ordersTable.Dispose();
            customersCommand.Dispose();
            customersAdapter.Dispose();
            customersTable.Dispose();
        }
    }
```

10. Save and run the application. Make sure you can add new customers and make sure they appear in the combo box for selection after addition. Check to insure they are saved to database after closing the application. Make sure the **Cancel** button works correctly. Here's an entry I added:

KWSales Order Form

Order

KIDware Order 151120001

Order Date 11/20/2015

Customers

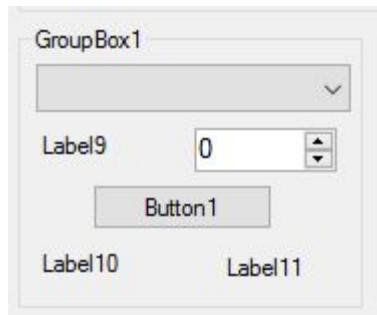
Smith, Bobby (46)

First Name:	Bobby
Last Name:	Smith
Address:	1234 Main Street
City:	Eugene
State:	Oregon
Zip:	88888

Product Selection

Now, we're ready to add the ability to select products for ordering. We'll use the popular 'shopping cart' approach. A user will select the quantity of product(s) desired. These will be added to a shopping cart (list box) so it is clear what has been ordered. A running total of the cost of the order will be kept. The user will be able to add and remove items from the shopping cart at will.

1. In the lower left corner of the form (make the form taller), add a group box, a combo box, three label controls, a numeric updown control, and a button. The layout should resemble this:



2. Set these properties:

groupBox1:

Name	grpProducts
Text	Products
FontSize	10
FontBold	True

comboBox1:

Name	cboProducts
DropdownStyle	DropDownList

label9:

Text	Quantity
FontSize	10

label10:

Text	Total:
FontSize	10

label11:

Name	lblTotal
AutoSize	False
BackColor	White
BorderStyle	Fixed3D
Text	0.00
TextAlign	MiddleCenter
FontSize	10

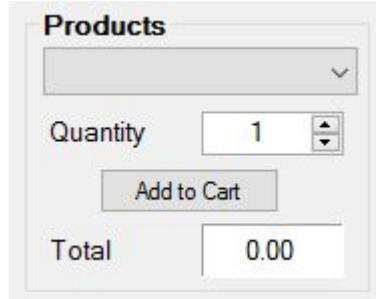
numericUpDown1:

Name	nudQuantity
Minimum	1
Maximum	99
TextAlign	Center
Value	1

button1:

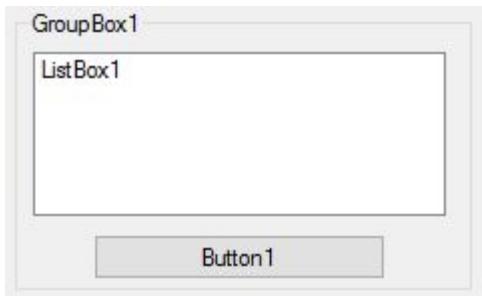
Name	btnAdd
FontSize	8
Text	Add to Cart

At this point, the new group box appears like:



This will work as follows: the user selects a product using the combo box and sets the quantity using the numeric updown control. The purchase is added to the shopping cart by clicking Add to Cart. The Total box will indicate the current cost of the order. Let's build the shopping cart, and then do the coding.

1. Add a group box next to the Products group box. Place a list box and a button in the group box. The additions should resemble this:



2. Set these properties:

groupBox1:

Name	grpCart
Text	Shopping Cart
FontSize	10
FontBold	True

listBox1:

Name	lstCart
------	---------

FontSize 8
Sorted True

button1:

Name btnRemove
FontSize 8
Text Remove from Cart

The completed **Order Form** with the added Products and Shopping Cart group boxes now looks like this:

KWSales Order Form

Order	<input type="button" value="Submit"/> <input type="button" value="Exit"/>
KIDware Order	
Order Date	
Customers	
First Name:	<input type="text"/>
Last Name:	<input type="text"/>
Address:	<input type="text"/>
City:	<input type="text"/>
State:	<input type="text"/>
Zip:	<input type="text"/>
Products	Shopping Cart
<input type="text"/>	IstCart
Quantity <input type="button" value="1"/> <input type="button" value="▲"/> <input type="button" value="▼"/>	
<input type="button" value="Add to Cart"/>	<input type="button" value="Remove from Cart"/>
Total <input type="text" value="0.00"/>	

3. We add another set of data objects that connect to the **Products** table in the database. Add these form level declarations:

```
OleDbCommand productsCommand;  
OleDbDataAdapter productsAdapter;  
DataTable productsTable;
```

4. Add the shaded code to the **frmKWSales_Load** event method to create the new objects and bind the combo box control:

```
private void frmKWSales_Load(object sender, EventArgs e)  
{  
    // connect to sales database  
    KWSalesConnection = new  
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
    Data  
    Source = " + Application.StartupPath +  
    "\\KWSalesDB.accdb");  
    // establish Orders command object  
    ordersCommand = new OleDbCommand("SELECT * FROM  
    Orders  
    ORDER BY OrderID", KWSalesConnection);  
    // establish Orders data adapter/data table  
    ordersAdapter = new OleDbDataAdapter();  
    ordersAdapter.SelectCommand = ordersCommand;  
    ordersTable = new DataTable();  
    ordersAdapter.Fill(ordersTable);  
    // establish Customers command object  
    customersCommand = new OleDbCommand("SELECT * FROM  
    Customers", KWSalesConnection);  
    // establish Customers data adapter/data table  
    customersAdapter = new OleDbDataAdapter();
```

```
customersAdapter.SelectCommand = customersCommand;
customersTable = new DataTable();
customersAdapter.Fill(customersTable);
// bind controls to data table
txtFirstName.DataBindings.Add("Text",
customersTable, "FirstName");
txtLastName.DataBindings.Add("Text",
customersTable, "LastName");
txtAddress.DataBindings.Add("Text",
customersTable, "Address");
txtCity.DataBindings.Add("Text", customersTable,
"City");
txtState.DataBindings.Add("Text", customersTable,
"State");
txtZip.DataBindings.Add("Text", customersTable,
"Zip");
// establish currency manager
customersManager = (CurrencyManager)
this.BindingContext[customersTable];
// establish Products command object
productsCommand = new OleDbCommand("SELECT * FROM
Products ORDER BY Description", KWSalesConnection);
// establish Products data adapter/data table
productsAdapter = new OleDbDataAdapter();
productsAdapter.SelectCommand = productsCommand;
productsTable = new DataTable();
productsAdapter.Fill(productsTable);
// bind combobox to data table
cboProducts.DataSource = productsTable;
cboProducts.DisplayMember = "Description";
cboProducts.ValueMember = "ProductID";
```

```
// Fill customers combo box  
FillCustomers();  
orderNumber = 0;  
NewOrder();  
}
```

5. Add these three lines near the bottom of the **frmKWSales_FormClosing** method (where the other objects are disposed):

```
productsCommand.Dispose();  
productsAdapter.Dispose();  
productsTable.Dispose();
```

6. Put this code at the bottom of the **NewOrder** method (this will initialize the **Purchases** and **Shopping Cart** group boxes):

```
// Clear purchase information  
cboProducts.SelectedIndex = -1;  
nudQuantity.Value = 1;  
lblTotal.Text = "0.00";  
lstCart.Items.Clear();
```

7. Put this code in the **btnAdd_Click** method:

```
private void btnAdd_Click(object sender, EventArgs e)  
{  
    float unitPrice = 0.00F;  
    if (cboProducts.SelectedIndex == -1)  
    {  
        MessageBox.Show("You must select a product.",  
"Purchase Error", MessageBoxButtons.OK,  
MessageBoxIcon.Information);
```

```

    return;
}
// Find unit price of selected product
for (int nRec = 0; nRec <
productsTable.Rows.Count; nRec++)
{
    if
(productsTable.Rows[nRec]
["Description"].ToString().Equals
(cboProducts.Text.ToString()))
    {
        unitPrice =
Convert.ToSingle(productsTable.Rows[nRec]["Price"]);
        break;
    }
}
lstCart.Items.Add(nudQuantity.Value.ToString() + " "
" +
cboProducts.SelectedValue.ToString() + "-" +
cboProducts.Text.ToString() + " $" +
unitPrice.ToString());
// Adjust total price
lblTotal.Text = string.Format("{0:f2}",
Convert.ToSingle(lblTotal.Text) +
Convert.ToSingle(nudQuantity.Value) * unitPrice);
}

```

This code finds the price and description of the selected product and adds the item to the **Shopping Cart** list box. The format of the listing is:

Quantity ProductID-Description Price

The code also adjusts the displayed total price.

8. Add this code to the `btnRemove_Click` event method (this removes a selected object and adjusts the displayed price):

```
private void btnRemove_Click(object sender, EventArgs e)
{
    int q, i;
    float p;
    if (lstCart.SelectedIndex != -1)
    {
        // Adjust total before removing
        // find Q (quantity) and P (price)
        i = lstCart.Text.IndexOf(" ");
        q = Convert.ToInt32(lstCart.Text.Substring(0,
        i));
        i = lstCart.Text.IndexOf("$");
        p = Convert.ToSingle(lstCart.Text.Substring(i +
        1, lstCart.Text.Length - i - 1));
        lblTotal.Text = String.Format("{0:f2}",
        Convert.ToSingle(lblTotal.Text) - q * p);
        lstCart.Items.RemoveAt(lstCart.SelectedIndex);
    }
}
```

3. Save and run the application. Try selecting and adding items to the shopping cart. Try removing items. Make sure everything works as it should. Here's what the form looks like after selecting a customer and a few items:

KWSales Order Form

Order

KIDware Order 151120001

Order Date 11/20/2015

Customers

Smith, Bobby (46)

First Name:

Last Name:

Address:

City:

State:

Zip:

Products

Logic Games for Kids

Quantity

Total

Shopping Cart

2 ITW199-Beginning Visual Basic \$19.95
1 ITW197-Visual Basic for Kids \$19.95
1 ITW180-Logic Games for Kids \$14.95

Submitting an Order

We now have the ability to specify what to order. A final step is to commit all order information to the database. The method is a bit complicated but straightforward. When the user clicks the **Submit** button, the following will occur:

Cycle through each item in the shopping cart. For each:

- Add a new row to **ordersTable**. Set values for **OrderID**, **CustomerID**, **OrderDate** fields.
- Add a new row to **purchasesTable** (not created yet; the data table representing the Purchases table).
- Parse the shopping cart listing to obtain quantity purchased and product identification.
- Update **purchasesTable** with **OrderID**, **Quantity** and **ProductID** fields.
- Update **NumberSold** field in **ProductsTable** (use **Quantity** and **ProductID** for reference).

Start a new order.

Let's implement these steps.

1. We add a final set of data objects that connect to the **Purchases** table in the database and a variable to store the Customer ID. Add these form level declarations:

```
OleDbCommand purchasesCommand;  
OleDbDataAdapter purchasesAdapter;  
DataTable purchasesTable;
```

```
long customerID;
```

2. Add the shaded code to the frmKWSales_Load event method to create the new objects:

```
private void frmKWSales_Load(object sender, EventArgs e)
{
    // connect to sales database
    KWSalesConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + Application.StartupPath +
"\KWSalesDB.accdb");
    // establish Orders command object
    ordersCommand = new OleDbCommand("SELECT * FROM
Orders
ORDER BY OrderID", KWSalesConnection);
    // establish Orders data adapter/data table
    ordersAdapter = new OleDbDataAdapter();
    ordersAdapter.SelectCommand = ordersCommand;
    ordersTable = new DataTable();
    ordersAdapter.Fill(ordersTable);
    // establish Customers command object
    customersCommand = new OleDbCommand("SELECT * FROM
Customers", KWSalesConnection);
    // establish Customers data adapter/data table
    customersAdapter = new OleDbDataAdapter();
    customersAdapter.SelectCommand = customersCommand;
    customersTable = new DataTable();
    customersAdapter.Fill(customersTable);
    // bind controls to data table
```

```
txtFirstName.DataBindings.Add("Text",
customersTable, "FirstName");
txtLastName.DataBindings.Add("Text",
customersTable, "LastName");
txtAddress.DataBindings.Add("Text",
customersTable, "Address");
txtCity.DataBindings.Add("Text", customersTable,
"City");
txtState.DataBindings.Add("Text", customersTable,
"State");
txtZip.DataBindings.Add("Text", customersTable,
"Zip");
// establish currency manager
customersManager = (CurrencyManager)
this.BindingContext[customersTable];
// establish Products command object
productsCommand = new OleDbCommand("SELECT * FROM
Products ORDER BY Description", KWSalesConnection);
// establish Products data adapter/data table
productsAdapter = new OleDbDataAdapter();
productsAdapter.SelectCommand = productsCommand;
productsTable = new DataTable();
productsAdapter.Fill(productsTable);
// bind combobox to data table
cboProducts.DataSource = productsTable;
cboProducts.DisplayMember = "Description";
cboProducts.ValueMember = "ProductID";
// establish Purchases command object
purchasesCommand = new OleDbCommand("SELECT * FROM
Purchases ORDER BY OrderID", KWSalesConnection);
// establish Purchases data adapter/data table
purchasesAdapter = new OleDbDataAdapter();
```

```
purchasesAdapter.SelectCommand = purchasesCommand;
purchasesTable = new DataTable();
purchasesAdapter.Fill(purchasesTable);

// Fill customers combo box
FillCustomers();
orderNumber = 0;
NewOrder();

}
```

3. Add the shaded code to the `frmKWSales_FormClosing` method to save the remaining data tables and dispose of the newly added objects:

```
private void frmKWSales_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (newCustomer)
    {
        MessageBox.Show("You must finish the current
edit
before stopping.", "", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save the tables to the database file
            OleDbCommandBuilder ordersAdapterCommands =
new
OleDbCommandBuilder(ordersAdapter);
```

```
    ordersAdapter.Update(ordersTable);
    OleDbCommandBuilder customersAdapterCommands
        = new
    OleDbCommandBuilder(customersAdapter);
    customersAdapter.Update(customersTable);
    OleDbCommandBuilder productsAdapterCommands =
        new
    OleDbCommandBuilder(productsAdapter);
    productsAdapter.Update(productsTable);
    OleDbCommandBuilder purchasesAdapterCommands
        = new
    OleDbCommandBuilder(purchasesAdapter);
    purchasesAdapter.Update(purchasesTable);
}
catch (Exception ex)
{
    MessageBox.Show("Error saving database",
    "Save
Error", MessageBoxButtons.OK, MessageBoxIcon.Error);
}
// close the connection
KWSalesConnection.Close();
// dispose of the objects
ordersCommand.Dispose();
ordersAdapter.Dispose();
ordersTable.Dispose();
customersCommand.Dispose();
customersAdapter.Dispose();
customersTable.Dispose();
productsCommand.Dispose();
productsAdapter.Dispose();
```

```
    productsTable.Dispose();
    purchasesCommand.Dispose();
    purchasesAdapter.Dispose();
    purchasesTable.Dispose();
}
}
```

4. Add the single shaded line to the `cboCustomers_SelectedIndexChanged` method to establish the `CustomerID` variable:

```
private void cboCustomers_SelectedIndexChanged(object
sender, EventArgs e)
{
    if (newCustomer)
        return;
    string ID;
    int pl;
    string s = cboCustomers.SelectedItem.ToString();
    try
    {
        pl = s.IndexOf("(");
        if (pl == -1)
            return;
        // extract ID from selected item
        ID = s.Substring(pl + 1, s.Length - pl - 2);
        customersTable.DefaultView.Sort = "CustomerID";
        customersManager.Position =
customersTable.DefaultView.Find(ID);
        customerID = Convert.ToInt64(ID);
    }
}
```

```
        catch (Exception ex)
    {
        MessageBox.Show("Could not find customer",
                      "Search
Error", MessageBoxButtons.OK,
MessageBoxIcon.Information);
    }
}
```

5. Place this code in the `btnSubmitOrder_Click` event method:

```
private void btnSubmitOrder_Click(object sender,
EventArgs e)
{
    int j, q;
    string ID;
    // Make sure there is customer information
    if (cboCustomers.SelectedIndex == -1)
    {
        MessageBox.Show("You need to select a
customer.",
                      "Submit Error", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        return;
    }
    if (lstCart.Items.Count == 0)
    {
        MessageBox.Show("You need to select some
items.",
                      "Submit Error", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        return;
```

```
}

// Submit purchases to database
DataRow newRow;
newRow = ordersTable.NewRow();
newRow[ "OrderID" ] = lblOrderID.Text;
newRow[ "CustomerID" ] = customerID;
newRow[ "OrderDate" ] = lblDate.Text;
ordersTable.Rows.Add(newRow);
for ( int i = 0; i < lstCart.Items.Count; i++)
{
    newRow = purchasesTable.NewRow();
    string s = lstCart.Items[i].ToString();
    j = s.IndexOf(" ");
    q = Convert.ToInt32(s.Substring(0, j));
    ID = s.Substring(j + 1, 6);
    newRow[ "OrderID" ] = lblOrderID.Text;
    newRow[ "ProductID" ] = ID;
    newRow[ "Quantity" ] = q;
    purchasesTable.Rows.Add(newRow);
    // Update number sold
    // find row with correct productid
    int pr;
    for (pr = 0; pr < productsTable.Rows.Count;
    pr++)
    {
        if
(productsTable.Rows[pr]
["ProductID"].ToString().Equals(ID) )
        {
            break;
        }
    }
}
```

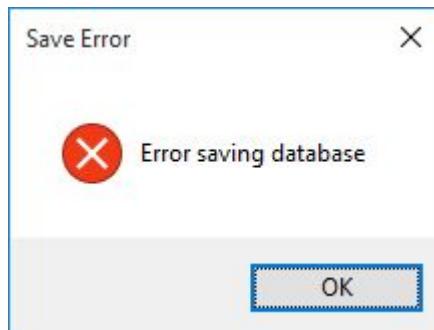
```

        }
        productsTable.Rows[pr]["NumberSold"] =
Convert.ToInt32(productsTable.Rows[pr]["NumberSold"])
+ q;
    }
    NewOrder();
}

```

Notice how this code implements the previously specified steps.

6. Save and run the application. You now have complete order taking and saving capabilities. When running this application for a second time in the same day, you will probably receive this error message when you stop the application:



The **OrderID** field is based on the date. The second time you run the application in the same day, duplicate **OrderID** values will be generated. To avoid this, you can do one of two things. In **frmKWSales_Load**, change the **orderNumber** variable to the last order number used (remember to change it back to zero, eventually, though). Or, start each running of the application with a new copy of the database. I know this is a headache, but it is one of the typical headache's programmers must endure in testing their applications.

Printing an Invoice

As a last step, let's add the ability to print an invoice for each order. We will make this an option. And, we will use the Visual C# **PrintDocument** object to create this database report. Pay close attention to the printing code in the **PrintInvoicePage** method - it's long, but straightforward. It just goes through the form and pulls out the information it needs. The complicated part is parsing the list box contents to obtain quantities, product identification, description, and price information. Make sure you know what all the string manipulation methods are doing. The easiest way to do this is write out a string on paper and try the methods.

1. Add this line at the top of the code window:

```
using System.Drawing.Printing;
```

2. Add this code before the **NewOrder()** line in **btnSubmitOrder_Click**:

```
if (MessageBox.Show("Do you want a printed invoice?",  
    "Print Inquiry", MessageBoxButtons.YesNo,  
    MessageBoxIcon.Question) == DialogResult.Yes)  
{  
    PrintInvoice();  
}
```

3. Add a method named **PrintInvoice**. This creates the **PrintDocument** object which prints the invoice using the **PrintInvoicePage** method:

```
private void PrintInvoice()
```

```

{
    // Declare the document
    PrintDocument recordDocument;
    // Create the document and name it
    recordDocument = new PrintDocument();
    recordDocument.DocumentName = "KWSales Invoice";
    // Add code handler
    recordDocument.PrintPage += new
    PrintPageEventHandler(this.PrintInvoicePage);
    // Print document
    recordDocument.Printer();
    // Dispose of document when done printing
    recordDocument.Dispose();
}

```

4. Add this code to the `PrintInvoicePage` method:

```

private void PrintInvoicePage(object sender,
PrintPageEventArgs e)
{
    int y = 100;
    string s, ti, q, id, desc, unit, t;
    int j;
    Font myFont = new Font("Courier New", 14,
    FontStyle.Bold);
    // Print Heading
    e.Graphics.DrawString("KIDware Order " +
    lblOrderID.Text, myFont, Brushes.Black, 100, y);
    y += Convert.ToInt32(myFont.GetHeight(e.Graphics));
    e.Graphics.DrawString("Order Date " +
    lblDate.Text, myFont, Brushes.Black, 100, y);
}

```

```
y += 2 *
Convert.ToInt32(myFont.GetHeight(e.Graphics));
// Print buyer address
myFont = new Font("Courier new", 12,
FontStyle.Regular);
e.Graphics.DrawString(txtFirstName.Text + " " +
txtLastName.Text, myFont, Brushes.Black, 100, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString(txtAddress.Text, myFont,
Brushes.Black, 100, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString(txtCity.Text + ", " +
txtState.Text + " " + txtZip.Text, myFont,
Brushes.Black,
100, y);
y += 2 *
Convert.ToInt32(myFont.GetHeight(e.Graphics));
// Print items purchased and totals
e.Graphics.DrawString("Qty ProductID Description
UnitTotal", myFont, Brushes.Black, 100, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString("-----" +
-----", myFont,
Brushes.Black, 100, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
// Parse the shopping cart listings
for (int i = 0; i < lstCart.Items.Count; i++)
{
    ti = lstCart.Items[i].ToString();
```

```
j = ti.IndexOf(" ");
q = ti.Substring(0, j);
id = ti.Substring(j + 1, 6);
desc = ti.Substring(j + 8, ti.Length - (j + 8));
j = desc.IndexOf("$");
unit = desc.Substring(j + 1, desc.Length - (j + 1));
desc = desc.Substring(0, j - 1);
if (desc.Length > 25)
    desc = desc.Substring(0, 25);
s = BlankLine(56); s = MidLine(q, s, 3 -
q.Length);
s = MidLine(id, s, 7);
s = MidLine(desc, s, 15);
s = MidLine(unit, s, 47 - unit.Length);
t = String.Format("{0:f2}", Convert.ToSingle(q)
* Convert.ToSingle(unit));
s = MidLine(t, s, 56 - t.Length);
e.Graphics.DrawString(s, myFont, Brushes.Black,
100, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
}
e.Graphics.DrawString("-----",
"-----", myFont,
Brushes.Black, 100, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
s = BlankLine(56);
s = MidLine("Total", s, 41);
s = MidLine("$" + lblTotal.Text, s, 55 -
lblTotal.Text.Length);
```

```

        e.Graphics.DrawString(s, myFont, Brushes.Black,
        100, y);
        e.HasMorePages = false;
    }
}

```

5. Add these two general methods (**BlankLine** and **MidLine**) used to help with the print formatting:

```

public string BlankLine(int n)
{
    string s = "";
    for (int i = 0; i < n; i++)
    {
        s += " ";
    }
    return (s);
}

```

The **BlankLine** method simply concatenates **n** spaces to form a returned string variable **s**.

```

public string MidLine(string string1, string string2,
int p)
{
    string s = "";
    // convert big string to character array
    char[] sArray = string2.ToCharArray();
    // put string1 in string2
    for (int i = p; i < p + string1.Length; i++)
    {
        sArray[i] = string1[i - p];
    }
}

```

```

// put array in string variable
for (int i = 0; i < string2.Length; i++)
{
    s += sArray[i].ToString();
}
return (s);
}

```

This method takes the contents of **string1** and places it in **string2**, starting at position **p**. The result is returned in the string **s**. It is used for positioning strings in desired columns.

6. Save and run the application (you may need a clean copy of the database to do this). Enter orders and print them. Here's the top of a printed invoice:

KIDware Order 151120001
Order Date 11/20/2015

Bobby Smith
1234 Main Street
Eugene, Oregon 88888

Qty	ProductID	Description	Unit	Total
2	ITW199	Beginning Visual Basic	19.95	39.90
1	ITW197	Visual Basic for Kids	19.95	19.95
1	ITW180	Logic Games for Kids	14.95	14.95
<hr/>				Total \$74.80

The application is now complete.

Suggested Improvements

Even though the **Sales Order Form Project** is complete (the final version is saved in **Example 10-1** folder in **VCSDB\Code\Class 10** folder), there is always room for improvement. We'll give you some of our ideas. I'm sure you have some ideas too.

When running the application for the second time in a day, we noted problems with generated duplicate **OrderID** values. This would not be a problem if we start the application early in the day and leave it running all day. If we need to stop the application and restart it, we need some way of knowing what the last assigned **orderNumber** was. The best way to do this is to establish a simple configuration file that reads the last **orderNumber** when the application begins and writes it back to disk when the application ends. Try adding this ability to the application. You will also need logic to recognize a new day to allow restarting the counter at zero.

As written, the application can only take orders. This is suitable for a strictly ordering environment. A more complete system would allow the review of past orders (and perhaps the editing of past orders). Try adding the ability to find and display old orders. This should be a straightforward modification - you just need some way to indicate what order you are looking for. Do you want to search by order number, order date, customer name, or some combination? Your SQL skills will come in handy here.

For practice, try creating a distribution package for this application. Design an icon to represent the application. Make sure you include a clean copy of the database with your package.

Example 10-1

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. Copy **SQLKWSalesDB.mdf** into your project's **Bin\Debug** folder (you may have to create it first). One option is to use the blank database from Chapter 9 in the **VCSDDB\Datasets** folder. To use this, you would first need to add some entries in the **Products** table. Or, you might like to use the copy included with this example's course code (in **Example 10-1** folder of the **VCSDDB\Code\Class 10** folder - if you downloaded these notes, as opposed to having a CD-ROM copy, you should have already downloaded this version of the database from our website as explained in Chapter 2). Product information is included in this database and there are a few customers and orders you can look at. We use the latter in this example.
2. Use this using statement:

```
using System.Data.SqlClient;
```

3. Change all instances of **OleDbConnection** to **SqlConnection**
Change all instances of **OleDbCommand** to **SqlCommand**
Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**
Change all instances of **OleDbCommandBuilder** to
SqlCommandBuilder

4. Use this connection object:

```
KWSalesConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS; AttachDbFilename=" +
```

```
Application.StartupPath + "\\SQLKWSalesDB.mdf;  
Integrated  
Security=True; Connect Timeout=30; User  
Instance=True");
```


Example 10-2

Home Inventory Project

In this project, we build a database management system that lets you store information about valuables around your home. The database will have seven fields:

Item (description of item)

Location (where item is located)

Store (where item was purchased)

Date Purchased (when item was purchased)

Purchase Cost (how much we paid)

Serial Number (item serial number)

Photo File (path to photo of item)

Engraved (indicates whether item is engraved with identifying information)

Development of the **Home Inventory Project** will proceed in the usual, logical sequence. We first create the database. Next, the interface is built which allows the user to view, edit, add, or delete records from the database. Lastly, we add some code to create a printable list of information in the database.

Home Inventory Database

In this application, the user enters specific information about each item in the database. A single table will be used to hold the data. We will give the steps to use Microsoft Access to create a database named **InventoryDB.accdb** (refer to Chapter 9 for further details). If you don't have Access, you can try to create the database using ADOX as described in the previous chapter. Or, you can just use the copy of **InventoryDB.accdb** found in the **VCSDB\Datasets** folder.

1. Start a new database (**InventoryDB.accdb**) in Access. Add a table in design view. Add seven fields to the database. The information needed to build the database is:

Field Name	Field Type
Item	Text (50 characters)
Location	Text (50 characters)
Store	Text (50 characters)
DatePurchased	Date/Time
PurchaseCost	Currency
SerialNumber	Text (50 characters)
PhotoFile	Text (200 characters)
Engraved	Yes/No (Boolean)

Only the **Item** field is required.

2. Make the **Item** field a Primary key.

When done, the **Table Structure** appears as:

	Field Name	Data Type
◆	Item	Text
	Location	Text
	Store	Text
	DatePurchased	Date/Time
	PurchaseCost	Currency
	SerialNumber	Text
	PhotoFile	Text
	Engraved	Yes/No

3. Close the table design view and name the database table **Inventory**. Close Access to complete the database design.

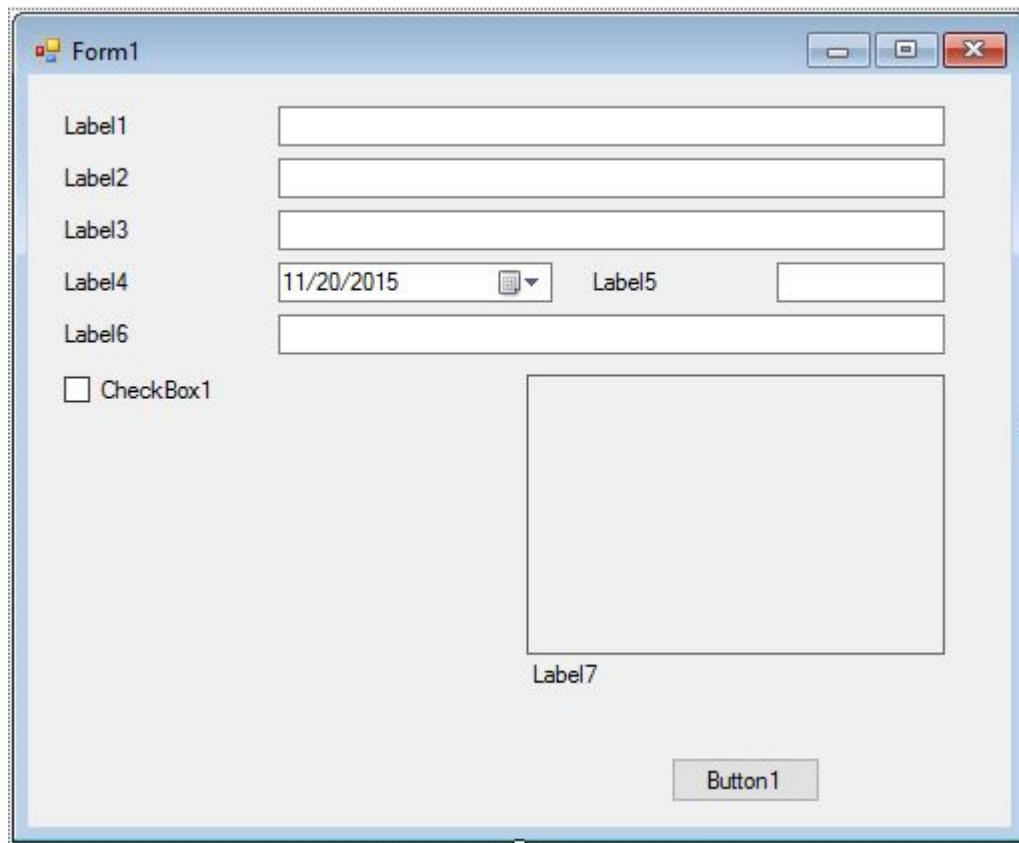
Preliminaries

Start a new project in Visual C#. Copy **InventoryDB.accdb** into your project's **Bin\Debug** folder (you may have to create it first). Use either the one just created in Access or the one found in the **VCSDB\atabases** folder. Or, you might like to use the copy included with this example's course code (in **Example 10-2** folder of the **VCSDB\Code\Class 10** folder). Some inventory information is included in this database to give you some things to look at. We use the latter in this example.

Home Inventory Interface

The home inventory interface will let the user view, edit, delete, or add records to the database. Each field will be displayed on the interface form.

1. Place six labels, five text box controls, a check box and a date time picker (used to select purchase date) on the form. Also, add a picture box control with a label and button under it. The form should look something like this:



2. Set these properties:

Form1:

Name frmlInventory
FormBorderStyle Fixed Single
StartPosition CenterScreen
Text Home Inventory

label1:

Text Item:

textBox1:

Name txtItem
BackColor White
MaxLength 50

label2:

Text Location:

textBox2:

Name txtLocation
BackColor White
MaxLength 50

label3:

Text Store:

textBox3:

Name txtStore
BackColor White
MaxLength 50

label4:

Text Date Purchased:

dateTimePicker1:

Name dtpDatePurchased

Format Short

label5:

Text Purchase Cost:

textBox4:

Name	txtPurchaseCost
BackColor	White

label6:

Text Serial Number:

textBox5:

Name	txtSerialNumber
BackColor	White
MaxLength	50

checkBox1:

Name	chkEngraved
Text	Engraved

pictureBox1:

Name	picItem
BorderStyle	FixedSingle
SizeMode	Zoom

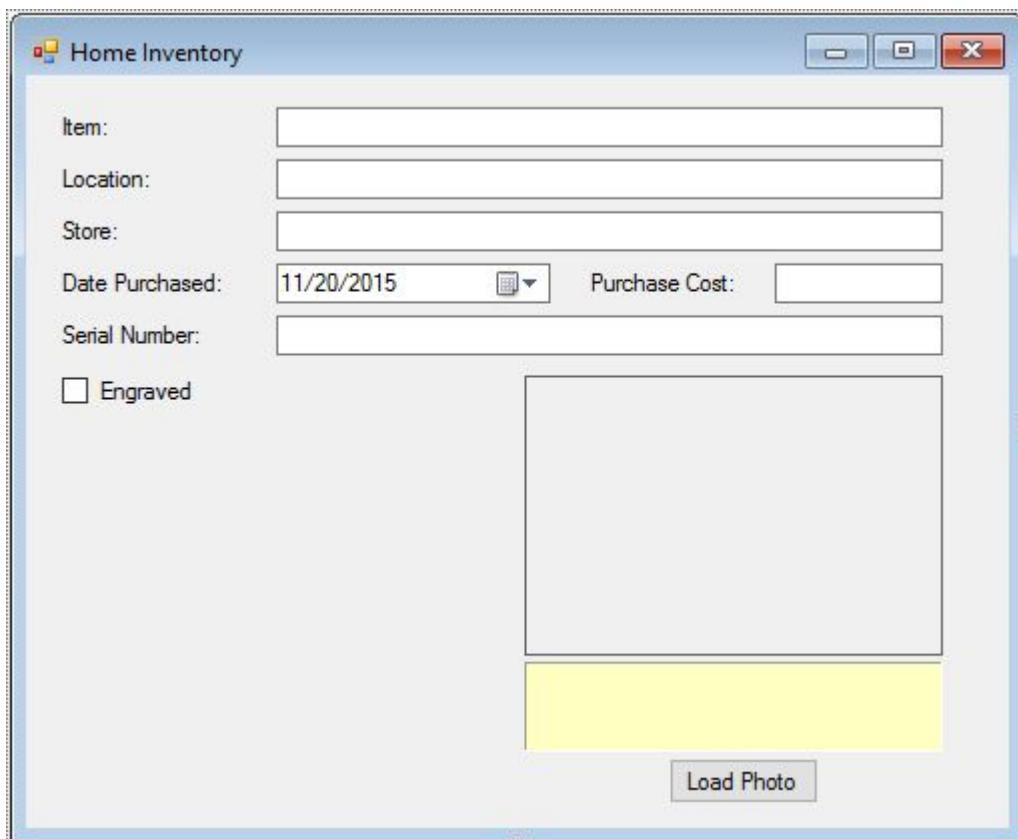
label7:

Name	lblPhotoFile
AutoSize	False
BackColor	LightYellow
BorderStyle	Fixed3D
Text	[Blank]

button1:

Name	btnLoadPhoto
Text	Load Photo

My finished form looks like this:



We'll add more controls as we continue.

Database Connection

We need to open the inventory database and bind the controls to the corresponding fields.

1. Place this line at the top of the code window to allow use of data objects:

```
using System.Data.OleDb;
```

2. Place this code in the form level declarations to create the needed data objects:

```
OleDbConnection inventoryConnection;  
OleDbCommand inventoryCommand;  
OleDbDataAdapter inventoryAdapter;  
DataTable inventoryTable;  
CurrencyManager inventoryManager;
```

3. Place this code in the frmInventory_Load event method:

```
private void InventoryForm_Load(object sender,  
EventArgs e)  
{  
    // connect to sales database  
    inventoryConnection = new  
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data  
Source = " + Application.StartupPath +  
"\\"InventoryDB.accdb");  
    inventoryConnection.Open();
```

```

// establish inventory command object
inventoryCommand = new OleDbCommand("SELECT * FROM
Inventory ORDER BY Item", inventoryConnection);
// establish inventory data adapter/data table
inventoryAdapter = new OleDbDataAdapter();
inventoryAdapter.SelectCommand = inventoryCommand;
inventoryTable = new DataTable();
inventoryAdapter.Fill(inventoryTable);
// bind controls
txtItem.DataBindings.Add("Text", inventoryTable,
"Item");
txtLocation.DataBindings.Add("Text",
inventoryTable, "Location");
txtStore.DataBindings.Add("Text", inventoryTable,
"Store");
dtpDatePurchased.DataBindings.Add("Text",
inventoryTable, "DatePurchased");
txtPurchaseCost.DataBindings.Add("Text",
inventoryTable, "PurchaseCost");
txtSerialNumber.DataBindings.Add("Text",
inventoryTable, "SerialNumber");
chkEngraved.DataBindings.Add("Checked",
inventoryTable, "Engraved");
lblPhotoFile.DataBindings.Add("Text",
inventoryTable, "PhotoFile");
// establish currency manager
inventoryManager = (CurrencyManager)
this.BindingContext[inventoryTable];
}

```

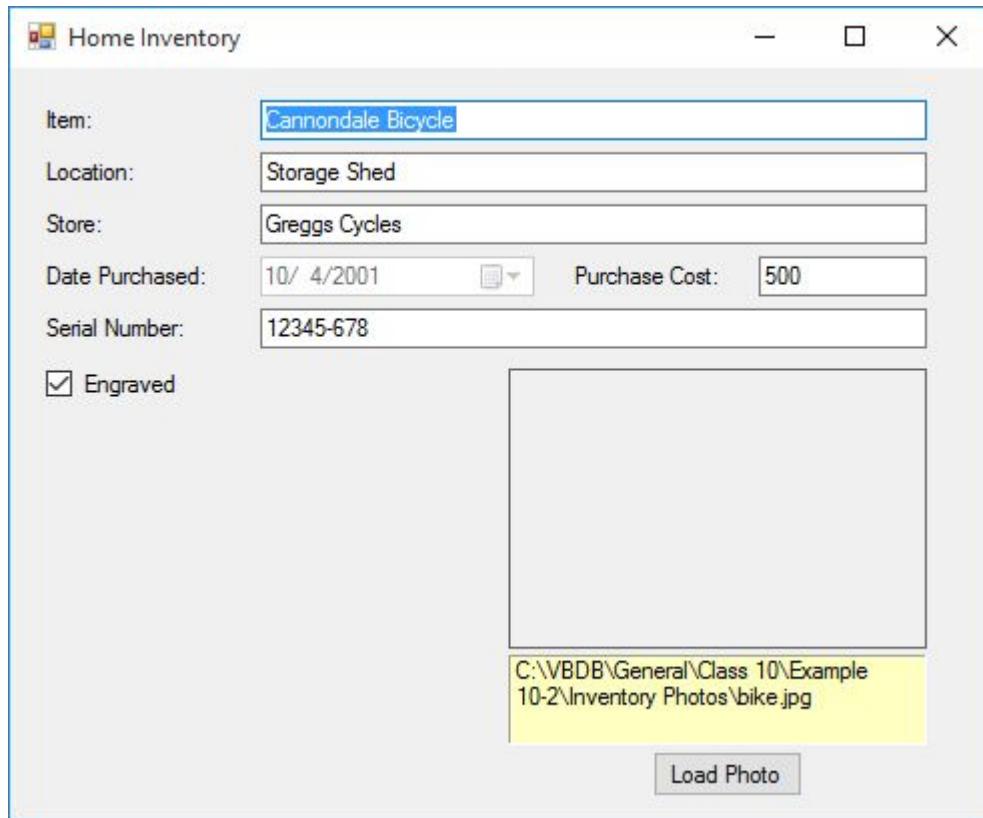
This code connects to the INVENTORY database file (in the application folder) and creates the data objects needed to view

the **Inventory** table. It also binds the controls to the fields. Note in particular binding of the date time picker and check box controls.

4. Place this code in the **frmInventory_FormClosing** event method to save any changes back to the database and to clean up objects:

```
private void frmInventory_FormClosing(object sender,
FormClosingEventArgs e)
{
    try
    {
        // save the update Inventory table
        OleDbCommandBuilder inventoryAdapterCommands =
            new
OleDbCommandBuilder(inventoryAdapter);
        inventoryAdapter.Update(inventoryTable);
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Saving
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    // close the connection
    inventoryConnection.Close();
    // dispose of the objects
    inventoryCommand.Dispose();
    inventoryAdapter.Dispose();
    inventoryTable.Dispose();
}
```

5. Save the application (saved in **Example 10-2** folder in **VCSDB\Code\Class 10** folder) and run it. If you used the example database included with the notes, you should see (if you used the empty database, you'll see nothing but blanks):



This is the first record in the sample database listing all the fields. The photo doesn't display. We need some code for this - we'll do that now.

Display Photo

The database doesn't store the actual photos of items in the inventory, but a path to the file with the photo. In this example, all photos are stored in the **VCSDB\Code\Class 10\Example 10-2\InventoryPhotos** folder. As we continue with the interface, we will add the ability for a user to specify where photos are located.

1. Add this general method (**ShowPhoto**) to display a photo based on the **PhotoFile** field in the database. We use error trapping in case the file cannot be opened:

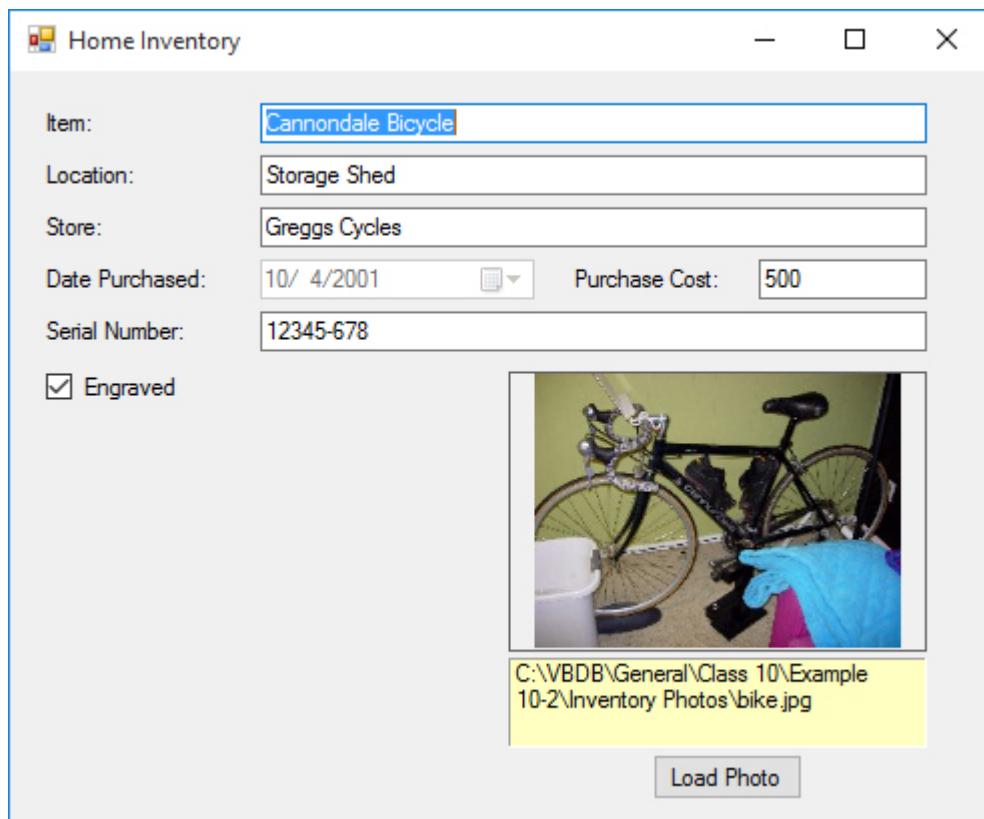
```
private void ShowPhoto()
{
    // display photo
    if (!lblPhotoFile.Text.Equals(""))
    {
        try
        {
            picItem.Image =
                Image.FromFile(lblPhotoFile.Text);
        }
        catch (Exception ex)
        {
            MessageBox.Show(ex.Message, "Error Loading
Photo",
                MessageBoxButtons.OK, MessageBoxIcon.Error);
        }
    }
    else
```

```
{  
    picItem.Image = null;  
}  
}
```

2. Add this single line at the end of the `frmInventory_Load` method to display the initial photo:

```
ShowPhoto();
```

3. Resave and rerun the application. The photo of the bicycle should now appear:



At this point, we are able to display all the fields in our database. The interface still needs work, but it's a beginning. We need to add navigational abilities, editing capability, and the ability to add and delete records.

Database Navigation

As a first step, we need to ability to move from one record to another in the home inventory database. This is something we've done many times before.

1. Add four buttons to the form. Set these properties:

button1:

Name	btnFirst
Text	<
FontSize	10
TabStop	False

button2:

Name	btnPrevious
Text	<
FontSize	10
TabStop	False

button3:

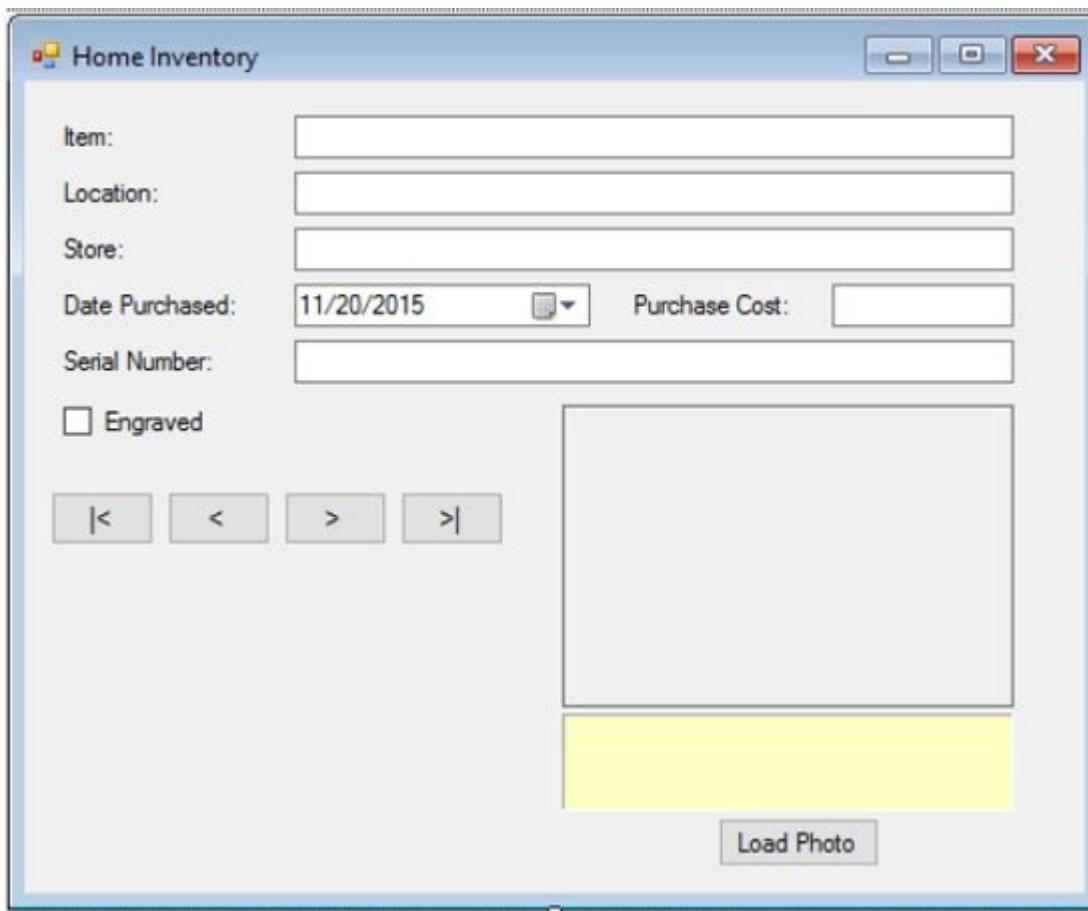
Name	btnNext
Text	>
FontSize	10
TabStop	False

button4:

Name	btnLast
Text	>
FontSize	10

TabIndex False

The form looks like this:



2. Add this code to the Click event methods for each of the new buttons (notice that anytime a new record is displayed, we need to reload the photo):

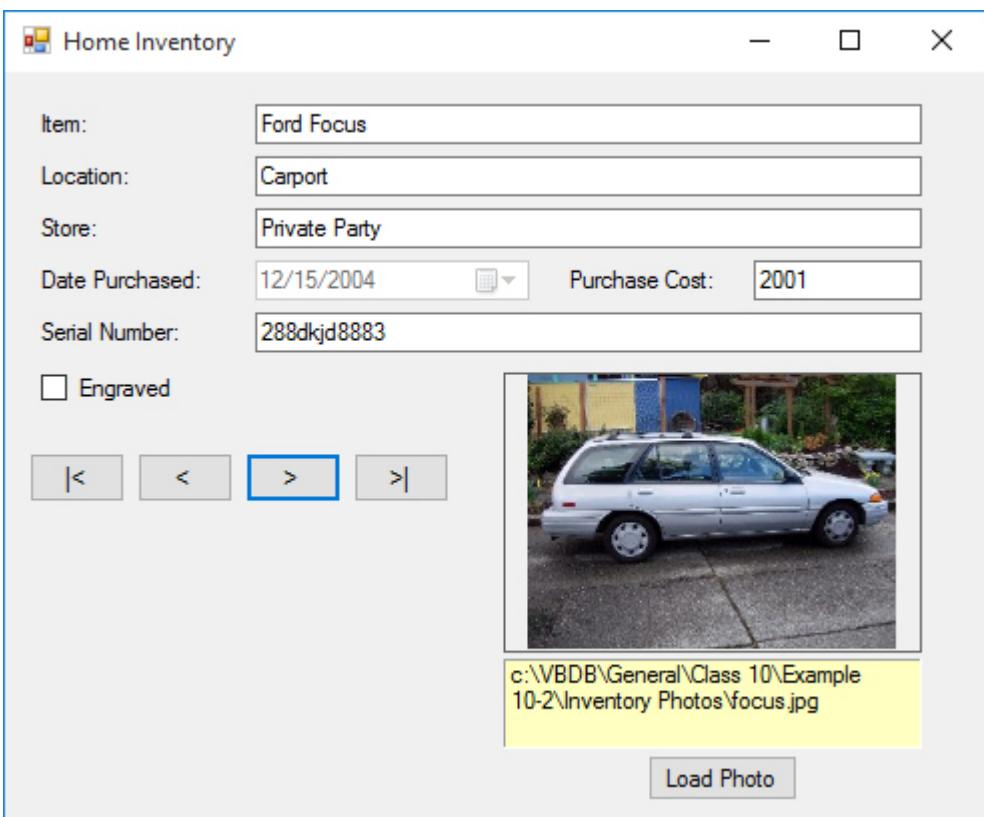
```
private void btnFirst_Click(object sender, EventArgs e)
{
    inventoryManager.Position = 0;
    ShowPhoto();
}
```

```
private void btnPrevious_Click(object sender,
EventArgs e)
{
    inventoryManager.Position--;
    ShowPhoto();
}

private void btnNext_Click(object sender, EventArgs
e)
{
    inventoryManager.Position++;
    ShowPhoto();
}

private void btnLast_Click(object sender, EventArgs
e)
{
    inventoryManager.Position = inventoryManager.Count
- 1;
    ShowPhoto();
}
```

3. Save and run the application. Make sure the navigation buttons work correctly. Here's another listing in the sample included with the notes:



Editing Records

We now add the ability to edit records in the home inventory database.

1. Lock all text boxes (**ReadOnly** = true) on the form (we will decide when editing is allowed). Also disable the date time picker and the button to load photos (**Enabled** = false).
2. Add three buttons to the form. Use these properties:

button1:

Name	btnEdit
Text	Edit
TabStop	False

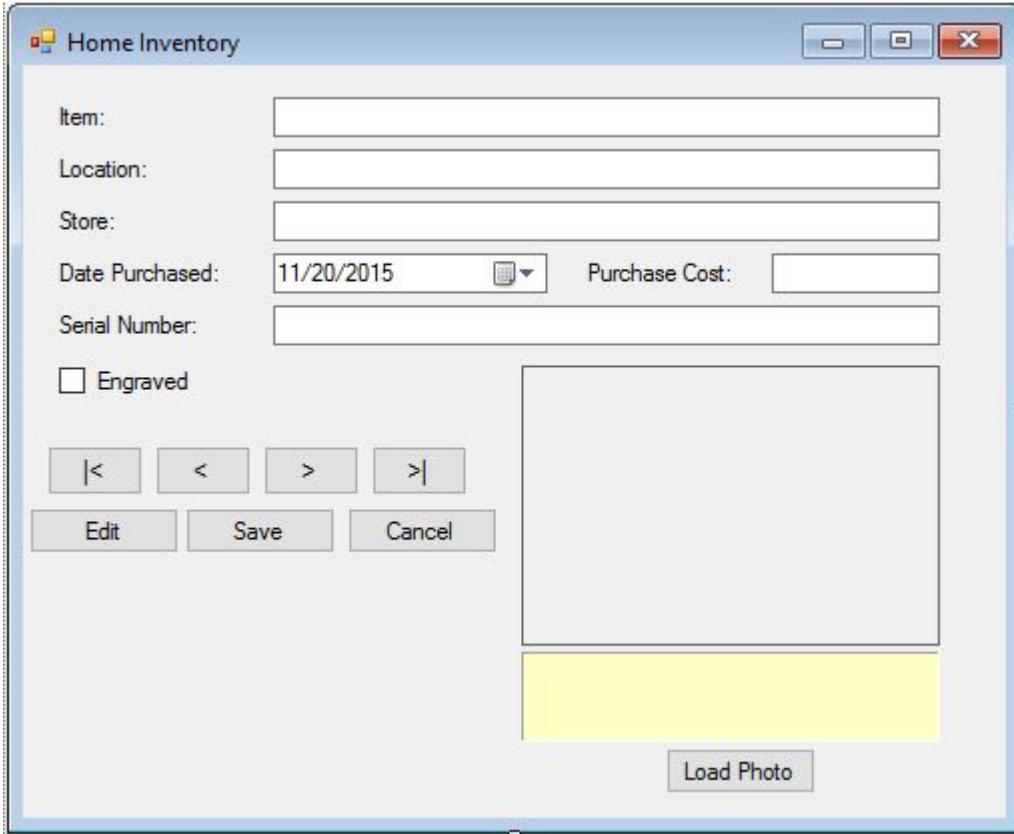
button2:

Name	btnSave
Text	Save
Enabled	False
TabStop	False

button3:

Name	btnCancel
Text	Cancel
Enabled	False
TabStop	False

The form now looks like this:



3. Add a variable to the form level declarations to track system state:

```
string myState;
```

4. Add a method named **SetState** to establish the application state:

```
private void SetState(string appState)
{
    myState = appState;
    switch (myState)
    {
        case "View":
            btnFirst.Enabled = true;
            btnPrevious.Enabled = true;
            btnNext.Enabled = true;
```

```
    btnLast.Enabled = true;
    btnEdit.Enabled = true;
    btnSave.Enabled = false;
    btnCancel.Enabled = false;
    txtItem.ReadOnly = true;
    txtLocation.ReadOnly = true;
    txtStore.ReadOnly = true;
    dtpDatePurchased.Enabled = false;
    txtPurchaseCost.ReadOnly = true;
    txtSerialNumber.ReadOnly = true;
    chkEngraved.Enabled = false;
    btnLoadPhoto.Enabled = false;
    break;

default: // "Edit"
    btnFirst.Enabled = false;
    btnPrevious.Enabled = false;
    btnNext.Enabled = false;
    btnLast.Enabled = false;
    btnEdit.Enabled = false;
    btnSave.Enabled = true;
    btnCancel.Enabled = true;
    txtItem.ReadOnly = false;
    txtLocation.ReadOnly = false;
    txtStore.ReadOnly = false;
    dtpDatePurchased.Enabled = true;
    txtPurchaseCost.ReadOnly = false;
    txtSerialNumber.ReadOnly = false;
    chkEngraved.Enabled = true;
    btnLoadPhoto.Enabled = true;
    break;
}
```

```
    txtItem.Focus();  
}
```

This method has two modes: **View** and **Edit**. In View mode (mode when the form loads), we can just look at the data. In Edit mode, data can be changed, and then saved (or the edit operation canceled).

5. Place this line of code at the end of the **frmInventory_Load** event method:

```
SetState("View");
```

This puts the form in **View** mode initially.

6. Place this code in the **btnEdit_Click** event method:

```
private void btnEdit_Click(object sender, EventArgs e)  
{  
    SetState("Edit");  
}
```

This places the form in **Edit** mode and allows the data table to be edited.

7. Place this code in the **btnSave_Click** event method:

```
private void btnSave_Click(object sender, EventArgs e)  
{  
    string savedItem = txtItem.Text;  
    int savedRow;  
    inventoryManager.EndCurrentEdit();  
    inventoryTable.DefaultView.Sort = "Item";
```

```
    savedRow =  
    inventoryTable.DefaultView.Find(savedItem);  
    inventoryManager.Position = savedRow;  
    SetState("View");  
}
```

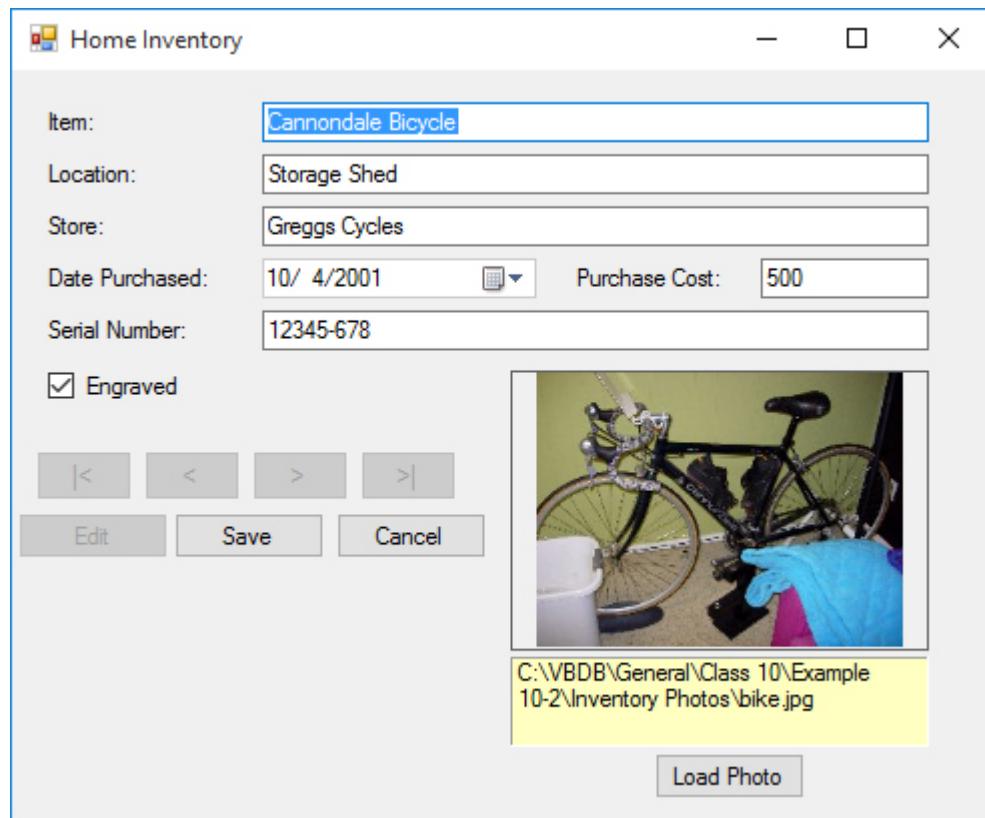
This code saves any changes and returns to **View** mode. It sets the currency manager position to the saved record when done.

8. Place this code in the **btnCancel_Click** method:

```
private void btnCancel_Click(object sender, EventArgs e)  
{  
    inventoryManager.CancelCurrentEdit();  
    ShowPhoto();  
    SetState("View");  
}
```

This code cancels the edit operation, displays the correct photo and resets the application state to **View** mode.

9. Save and run the application. Make sure the **Edit** function works, as it should. Also, test the **Save** and **Cancel** functions. Here's the form in **Edit** mode:



Try changing and saving information. Notice how the date time picker control works.

Load Photo

We can edit any fields on the form except the displayed photo. Let's add that capability.

1. Add an open file dialog control to the project. Use these properties:

openFileDialog1:

Name	dlgOpen
DefaultExtension	jpg
FileName	[blank]
Filter	Photos (*.jpg) *.jpg

2. When the user clicks the **Load Photo** button, the open file dialog box will appear allowing choice of a photo to display. Add this code to the **btnLoadPhoto_Click** event method:

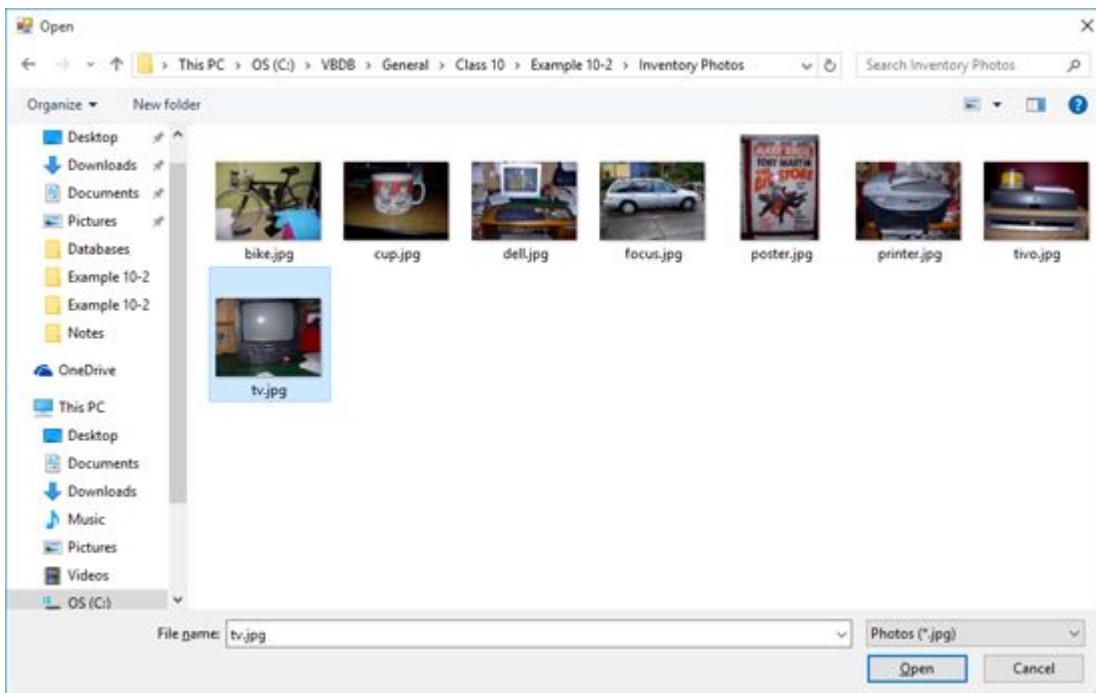
```
private void btnLoadPhoto_Click(object sender,  
EventArgs e)  
{  
    try  
    {  
        if (dlgOpen.ShowDialog() == DialogResult.OK)  
        {  
            lblPhotoFile.Text = dlgOpen.FileName;  
            ShowPhoto();  
        }  
    }  
    catch (Exception ex)
```

```

    {
        MessageBox.Show(ex.Message, "Error Opening
Photo",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}

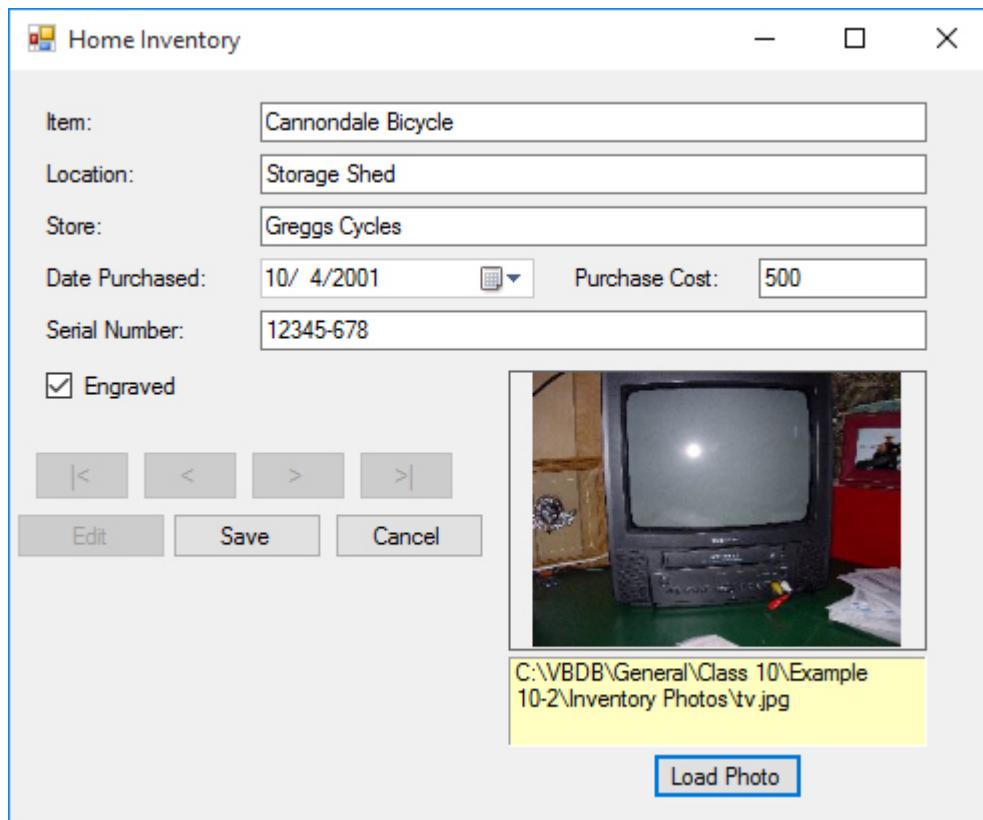
```

3. Save and run the application. Click Edit. Then, click Load Photo; this dialog appears:



Select a photo and click Open.

Here I changed the bike to a television:



When I click **Cancel**, it returns to the bike.

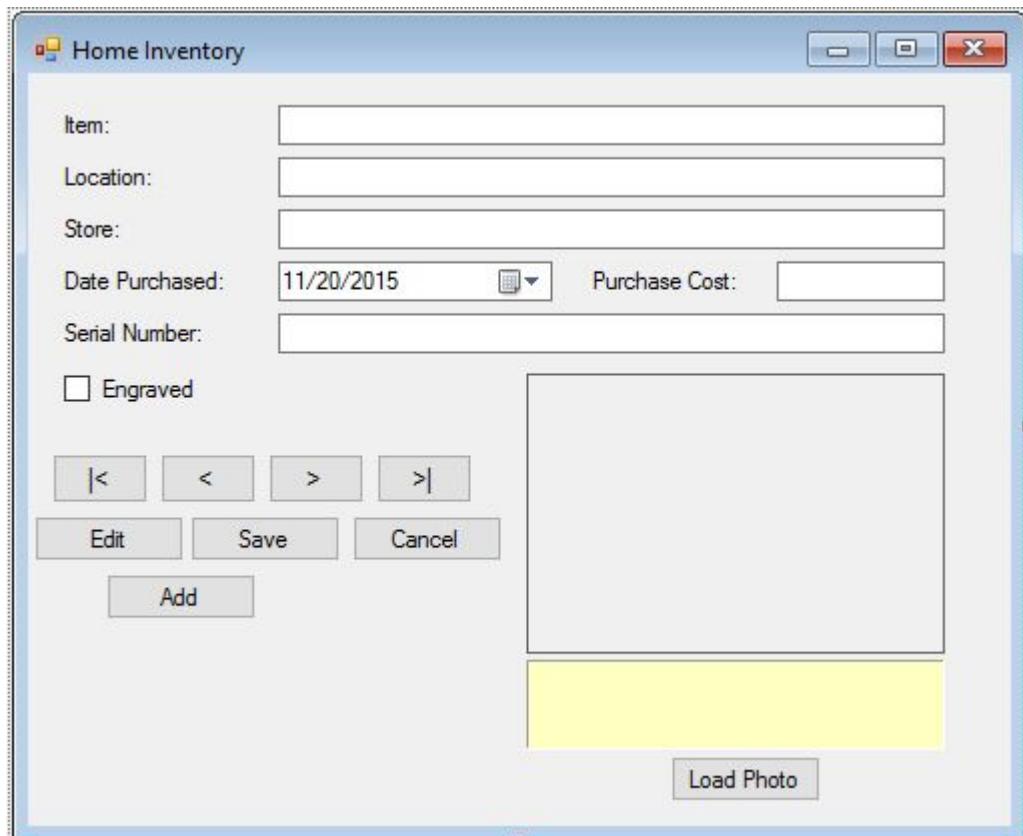
Adding Records

Now, we add the capability of adding new records to the home inventory database.

1. Add a button to the form under the **Edit** button. Use these properties:

Name	btnAdd
Text	Add
TabStop	False

The form will look like this:



2. Add this line to the form level declarations to save the current record (in case the **Add** operation is cancelled):

```
int myBookmark;
```

3. Place this code in the **btnAdd_Click** event method:

```
private void btnAdd_Click(object sender, EventArgs e)
{
    myBookmark = inventoryManager.Position;
    // clear picture
    picItem.Image = null;
    SetState("Add");
    inventoryManager.AddNew();
}
```

The code first saves the bookmark. It then clears the picture, places the application in **Add** mode and adds a record.

4. Modify the **btnCancel_Click** method to differentiate canceling while editing from canceling while adding a record (the new code is shaded):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    inventoryManager.CancelCurrentEdit();
    if (myState.Equals("Add"))
    {
        inventoryManager.Position = myBookmark;
    }
    ShowPhoto();
    SetState("View");
```

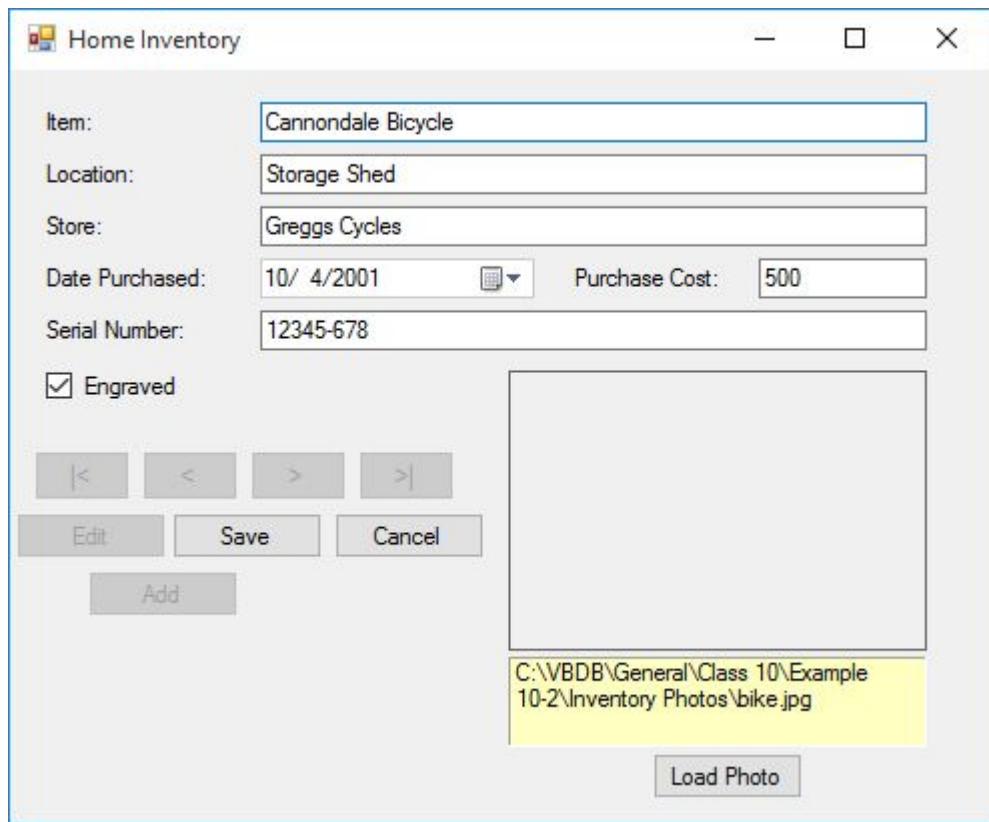
}

5. Modify the **SetState** event method to account for the new Add mode (identical to Edit mode, new code is shaded):

```
private void SetState(string appState)
{
    myState = appState;
    switch (myState)
    {
        case "View":
            btnFirst.Enabled = true;
            btnPrevious.Enabled = true;
            btnNext.Enabled = true;
            btnLast.Enabled = true;
            btnEdit.Enabled = true;
            btnSave.Enabled = false;
            btnCancel.Enabled = false;
            btnAdd.Enabled = true;
            txtItem.ReadOnly = true;
            txtLocation.ReadOnly = true;
            txtStore.ReadOnly = true;
            dtpDatePurchased.Enabled = false;
            txtPurchaseCost.ReadOnly = true;
            txtSerialNumber.ReadOnly = true;
            chkEngraved.Enabled = false;
            btnLoadPhoto.Enabled = false;
            break;
        default: // "Edit", "Add"
            btnFirst.Enabled = false;
            btnPrevious.Enabled = false;
```

```
    btnNext.Enabled = false;
    btnLast.Enabled = false;
    btnEdit.Enabled = false;
    btnSave.Enabled = true;
    btnCancel.Enabled = true;
    btnAdd.Enabled = false;
    txtItem.ReadOnly = false;
    txtLocation.ReadOnly = false;
    txtStore.ReadOnly = false;
    dtpDatePurchased.Enabled = true;
    txtPurchaseCost.ReadOnly = false;
    txtSerialNumber.ReadOnly = false;
    chkEngraved.Enabled = true;
    btnLoadPhoto.Enabled = true;
    break;
}
txtItem.Focus();
}
```

6. Save the application and run it. Click Add. You will see this:



Notice the fields are not cleared as they should be when adding a new record to the database. What's wrong? As of this writing, this is a documented bug in Visual C#. It occurs when binding a check box to a currency manager. The relevant link is:

<http://support.microsoft.com/kb/326440>

We need to work our way around this bug. This is something we must often do in programming -find ways around bugs and problems. Since the problem lies with the binding of the check box, we will remove this binding when adding a record, then rebind after the addition is saved. Stop the application.

7. Add the shaded code to the **btnAdd_Click** event procedure (removes the binding from the check box and removes any check mark):

```
private void btnAdd_Click(object sender, EventArgs e)
```

```
{  
    myBookmark = inventoryManager.Position;  
    // clear picture  
    picItem.Image = null;  
    // remove binding from checkbox  
    chkEngraved.DataBindings.Clear();  
    chkEngraved.Checked = false;  
    SetState("Add");  
    inventoryManager.AddNew();  
}
```

Add this shaded code to the `btnSave_Click` event procedure (manually sets database field and re-establishes data binding):

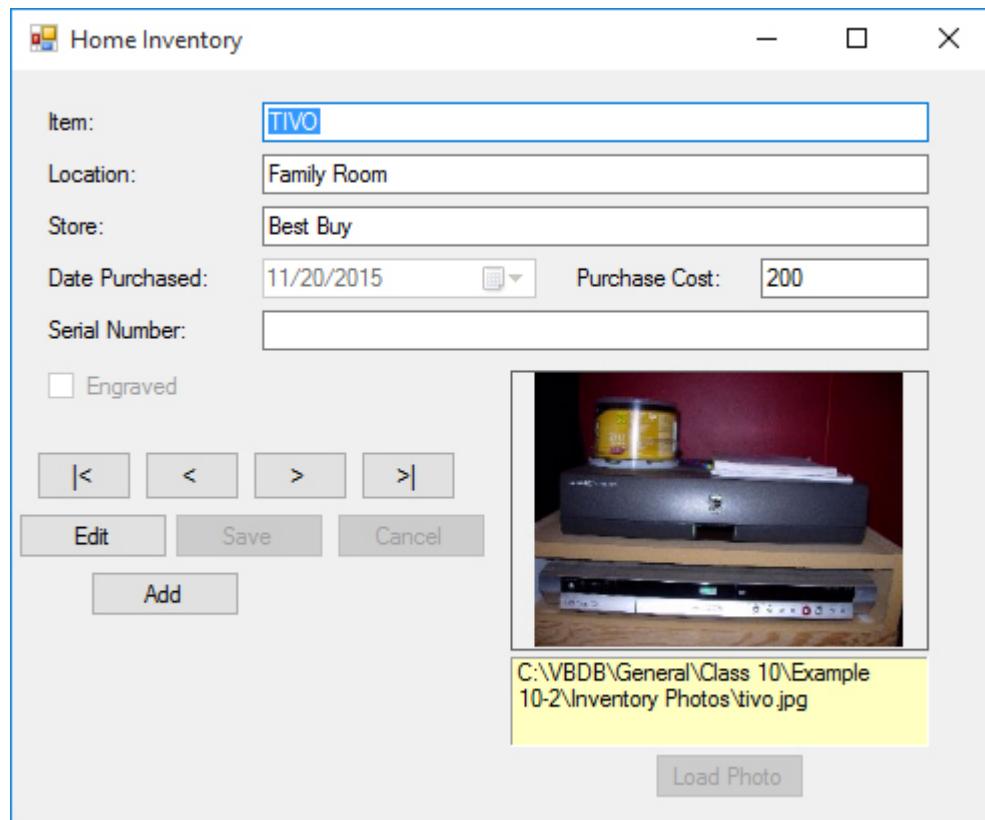
```
private void btnSave_Click(object sender, EventArgs e)  
{  
    string savedItem = txtItem.Text;  
    int savedRow;  
    inventoryManager.EndCurrentEdit();  
    if (myState.Equals("Add"))  
    {  
        inventoryTable.Rows[inventoryManager.Count - 1]  
        ["Engraved"] = chkEngraved.Checked;  
        chkEngraved.DataBindings.Add("Checked",  
        inventoryTable, "Engraved");  
    }  
    inventoryTable.DefaultView.Sort = "Item";  
    savedRow =  
    inventoryTable.DefaultView.Find(savedItem);  
    inventoryManager.Position = savedRow;  
    SetState("View");  
}
```

```
}
```

Lastly, add this shaded code to the `btnCancel_Click` event procedure (reestablishes data bindings if cancelled while adding a record):

```
private void btnCancel_Click(object sender, EventArgs e)
{
    inventoryManager.CancelCurrentEdit();
    if (myState.Equals("Add"))
    {
        inventoryManager.Position = myBookmark;
        chkEngraved.DataBindings.Add("Checked",
            inventoryTable, "Engraved");
    }
    ShowPhoto();
    SetState("View");
}
```

8. Save and run the application again. The fields will now be blank as desired. Type in new values (make sure you type a valid cost or you'll receive an error message). Click **Save**. The new record will appear. I've added my TIVO unit to the inventory:



Make sure the **Cancel** function works as it should.

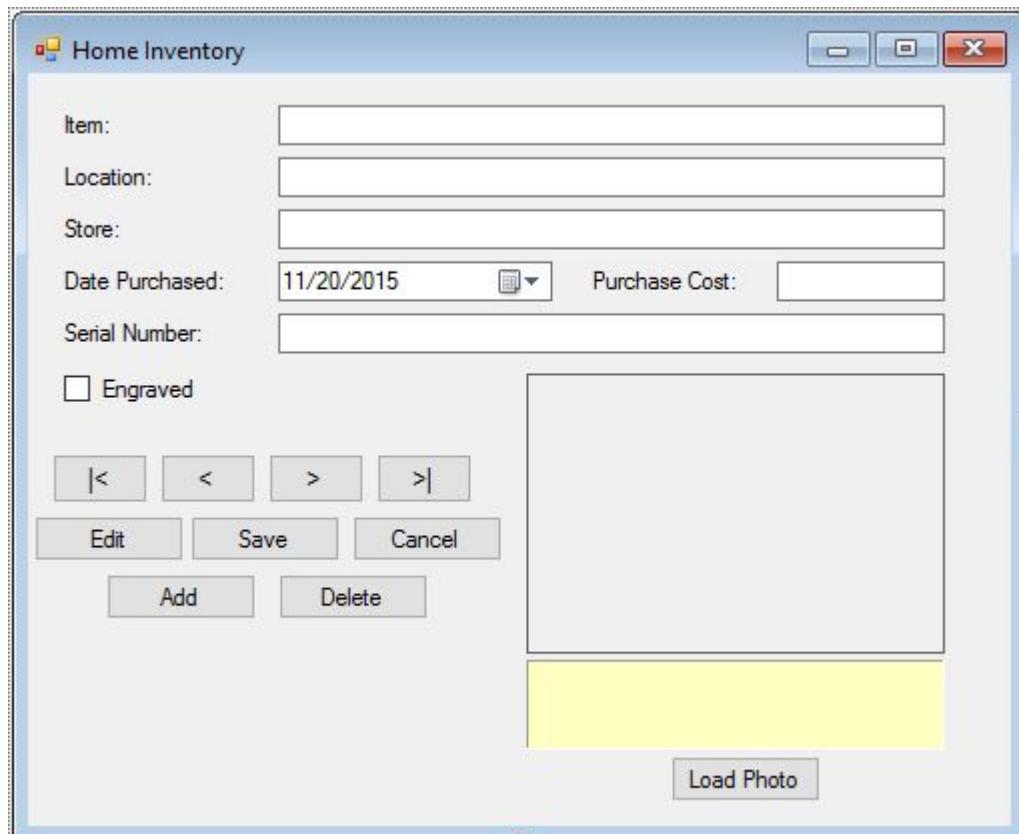
Deleting Records

The final management function needed is the ability to delete records from the home inventory database.

1. Add a button to the form next to the **Add** button. Use these properties:

Name	btnDelete
Text	Delete
TabStop	False

The form will look like this:

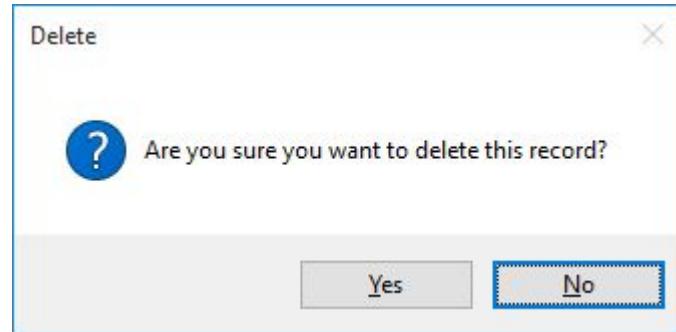


2. Add this code to the `btnDelete_Click` event method:

```
private void btnDelete_Click(object sender, EventArgs e)
{
    if (MessageBox.Show("Are you sure you want to
        delete
    this record?", "Delete", MessageBoxButtons.YesNo,
    MessageBoxIcon.Question,
    MessageBoxDefaultButton.Button2)
    == DialogResult.Yes)
    {
        inventoryManager.RemoveAt(inventoryManager.Position);
        ShowPhoto();
    }
    SetState("View");
}
```

This code confirms the deletion. If **Yes**, the deletion is done and the controls are bound to another record, necessitating loading the appropriate photo. If **No**, nothing happens.

3. Add code to the `SetState` method to set the `btnDelete` `Enabled` property to `true` in `View` mode and `false` in `Add/Edit` mode.
4. Save the application and run it. Click **Add**. Add a record. Click **Save**. Now try deleting the record. You should see:



Test your application, responding both **Yes** and **No** to the message box. Make sure everything works properly.

Entry Validation

Recall entry validation checks for proper characters in the data fields. In this database, most of the fields can contain any characters. There is only one exception: **PurchaseCost** field can only contain numeric characters and a decimal point. Here we implement this restriction. And, we'll also implement the ability to allow pressing <Enter> to move us from one field to the next. We'll start at the top and work our way down.

1. Add this code to the **txtItem_KeyPress** event:

```
private void txtItem_KeyPress(object sender,  
    KeyPressEventArgs e)  
{  
    if ((int) e.KeyChar == 13)  
        txtLocation.Focus();  
}
```

When the user presses <Enter>, focus is set on the next text box control (**txtLocation**).

2. Add this code to the **txtLocation_KeyPress** event:

```
private void txtLocation_KeyPress(object sender,  
    KeyPressEventArgs e)  
{  
    if ((int)e.KeyChar == 13)  
        txtStore.Focus();  
}
```

When the user presses <Enter>, focus is set on the next text box control (**txtStore**).

3. Add this code to the **txtStore_KeyPress** event:

```
private void txtStore_KeyPress(object sender,
    KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
    {
        if (dtpDatePurchased.Enabled)
            dtpDatePurchased.Focus();
        else
            txtPurchaseCost.Focus();
    }
}
```

When the user presses <Enter>, focus is set on the date time picker (**dtpDatePurchased**), if it is enabled. Otherwise, focus is set on the next text box control (**txtPurchaseCost**).

4. Add this code to the **dtpDatePurchased_KeyPress** event:

```
private void dtpDatePurchased_KeyPress(object sender,
    KeyPressEventArgs e)
{
    if ((int)e.KeyChar == 13)
        txtPurchaseCost.Focus();
}
```

When the user presses <Enter>, focus is set on the next text box control (**txtPurchaseCost**).

5. Add this code to the **txtPurchaseCost_KeyPress** event:

```

private void txtPurchaseCost_KeyPress(object sender,
KeyPressEventArgs e)
{
    if ((e.KeyChar >= '0' && e.KeyChar <= '9') ||
(int)e.KeyChar == 8)
        e.Handled = false;
    else if ((int)e.KeyChar == 13)
    {
        txtSerialNumber.Focus();
        e.Handled = false;
    }
    else if (e.KeyChar == '.')
    {
        if (txtPurchaseCost.Text.IndexOf(".") == -1)
            e.Handled = false;
        else
            e.Handled = true;
    }
    else
    {
        e.Handled = true;
    }
}

```

When the user presses <Enter>, focus is set on the next text box control (txtSerialNumber). It also restricts inputs to numbers, the backspace and a single decimal point.

6. Add this code to the txtSerialNumber_KeyPress event:

```

private void txtSerialNumber_KeyPress(object sender,
KeyPressEventArgs e)

```

```
{  
    if ((int)e.KeyChar == 13)  
    {  
        if (btnLoadPhoto.Enabled)  
            btnLoadPhoto.Focus();  
        else  
            txtItem.Focus();  
    }  
}
```

When the user presses <Enter>, focus is set on the **Load Photo** button (**btnLoadPhoto**) if it is enabled. If the button is not enabled, focus returns to the top control (**txtItem**).

7. Save and run the application. Try moving from field to field with the <Enter> key in both **View** and **Edit** modes. Test the key trapping implemented in the **Purchase Cost** field.

Input Validation

There is only one validation rule: the **Item** field cannot be empty since it is a primary key.

1. Add the shaded lines of code to the **btnSave_Click** method to check that a value for **Item** has been entered:

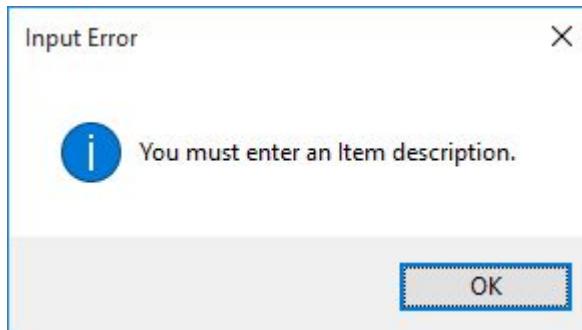
```
private void btnSave_Click(object sender, EventArgs e)
{
    // Check for Item
    if (txtItem.Text.Trim().Equals(""))
    {
        MessageBox.Show("You must enter an Item
description.",
"Input Error", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        txtItem.Focus();
        return;
    }

    string savedItem = txtItem.Text;
    int savedRow;
    inventoryManager.EndCurrentEdit();
    if (myState.Equals("Add"))
    {
        inventoryTable.Rows[inventoryManager.Count - 1]
        ["Engraved"] = chkEngraved.Checked;
```

```
    chkEngraved.DataBindings.Add("Checked",
        inventoryTable, "Engraved");
}
inventoryTable.DefaultView.Sort = "Item";
savedRow =
inventoryTable.DefaultView.Find(savedItem);
inventoryManager.Position = savedRow;
SetState("View");
}
```

If the **Item** field is blank, the user is given a message to that effect.

2. Save and run the application. Click **Add New**. Click **Save**. A message box saying the **Item** field is blank should appear:



Type an item description. Click **Save** again. The entry should be accepted.

Inventory Report

We have a great interface to get data into our home inventory database. Now, let's add the ability to get data out of the database. We need a database report. The report will be simple. For each record, a listing of all fields will be displayed. The listing can be previewed before printing.

1. Open the home inventory application and add a button and a print preview dialog control to the project. Set these properties.

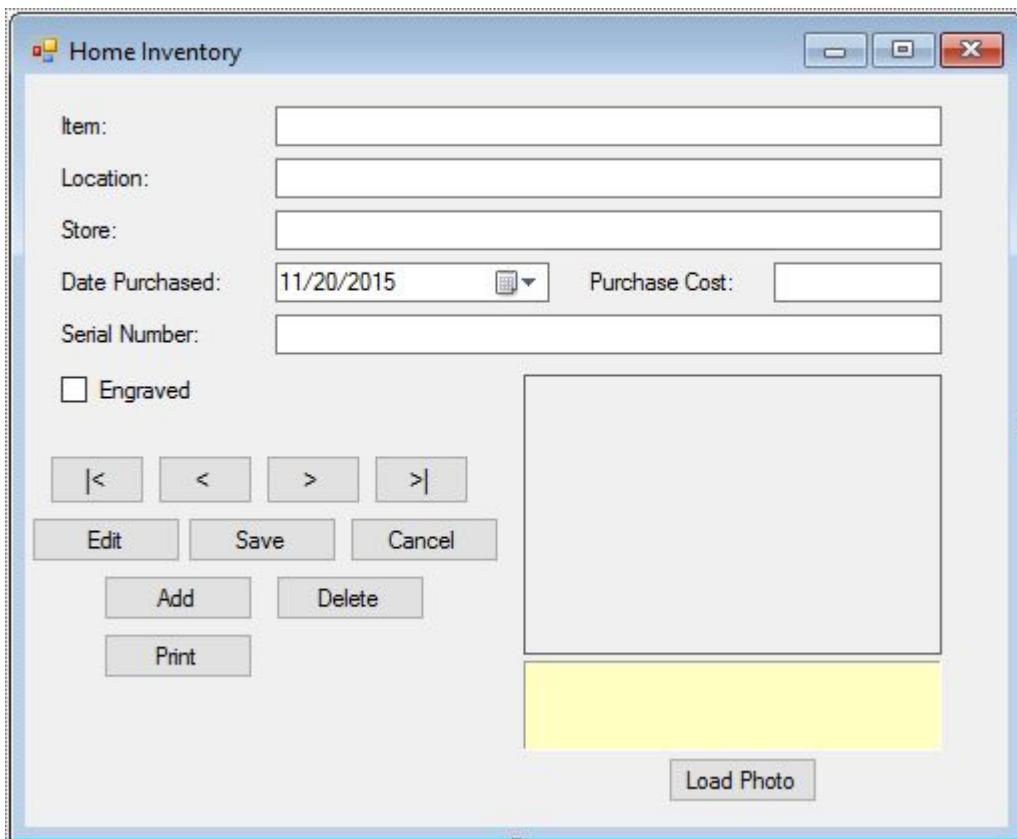
button1:

Name	btnPrint
Text	Print
TabStop	False

printPreviewDialog1:

Name	dlgPreview
------	------------

The form will look like this:



2. Add this line at the top of the code window:

```
using System.Drawing.Printing;
```

3. Add the **PageNumber** variable to the form level declarations:

```
int pageNumber;
```

4. Add code to the **SetState** method to set the **btnPrint Enabled** property to **true** in **View** mode and **false** in **Add/Edit** mode.

5. Add this code to the **btnPrint_Click** event method:

```
private void btnPrint_Click(object sender, EventArgs e)
{
    // Declare the document
```

```

PrintDocument inventoryDocument;
// Create the document and name it
inventoryDocument = new PrintDocument();
inventoryDocument.DocumentName = "Home Inventory";
// Add code handler
inventoryDocument.PrintPage += new
PrintPageEventHandler(this.PrintInventory);
// Print document in preview control
pageNumber = 1;
int savedPosition = inventoryManager.Position;
dlgPreview.Document = inventoryDocument;
dlgPreview.ShowDialog();
// Dispose of document when done printing
inventoryDocument.Dispose();
inventoryManager.Position = savedPosition;
ShowPhoto();
}

```

This code sets up the **PrintDocument** (using the **PrintInventory** method; developed next) and displays it in the print preview control.

6. Add this code to the **PrintInventory** method:

```

private void PrintInventory(object sender,
PrintPageEventArgs e)
{
    // move through records, printing each one
    inventoryManager.Position = pageNumber - 1;
    ShowPhoto();
    // print header

```

```
Font myFont = new Font("Arial", 14,
FontStyle.Bold);
int y = e.MarginBounds.Top + 50;
e.Graphics.DrawString("Home Inventory (" +
DateTime.Now.ToShortDateString() + ") - Page " +
pageNumber.ToString(), myFont, Brushes.Black,
e.MarginBounds.Left, y);
y += 2 *
Convert.ToInt32(myFont.GetHeight(e.Graphics));
// 'print text information
myFont = new Font("Arial", 12, FontStyle.Regular);
e.Graphics.DrawString("Item:", myFont,
Brushes.Black, e.MarginBounds.X, y);
e.Graphics.DrawString(txtItem.Text, myFont,
Brushes.Black, e.MarginBounds.X + 150, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString("Location:", myFont,
Brushes.Black,
e.MarginBounds.X, y);
e.Graphics.DrawString(txtLocation.Text, myFont,
Brushes.Black, e.MarginBounds.X + 150, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString("Store:", myFont,
Brushes.Black, e.MarginBounds.X, y);
e.Graphics.DrawString(txtStore.Text, myFont,
Brushes.Black, e.MarginBounds.X + 150, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString("Date Purchased:", myFont,
Brushes.Black, e.MarginBounds.X, y);
```

```
e.Graphics.DrawString(dtpDatePurchased.Text,
myFont,
Brushes.Black, e.MarginBounds.X + 150, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString("Purchase Cost:", myFont,
Brushes.Black, e.MarginBounds.X, y);
e.Graphics.DrawString("$" + String.Format(
{0:f2}",
txtPurchaseCost.Text), myFont, Brushes.Black,
e.MarginBounds.X + 150, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString("Serial Number:", myFont,
Brushes.Black, e.MarginBounds.X, y);
e.Graphics.DrawString(txtSerialNumber.Text,
myFont,
Brushes.Black, e.MarginBounds.X + 150, y);
y += 50;
// print picture (4 inches wide, height based on
height/width ratio of image)
int h = Convert.ToInt32(400 * picItem.Image.Height
/
picItem.Image.Width);
e.Graphics.DrawImage(picItem.Image,
e.MarginBounds.X, y,
400, h);
pageNumber++;
if (pageNumber <= inventoryManager.Count)
e.HasMorePages = true;
else
{
```

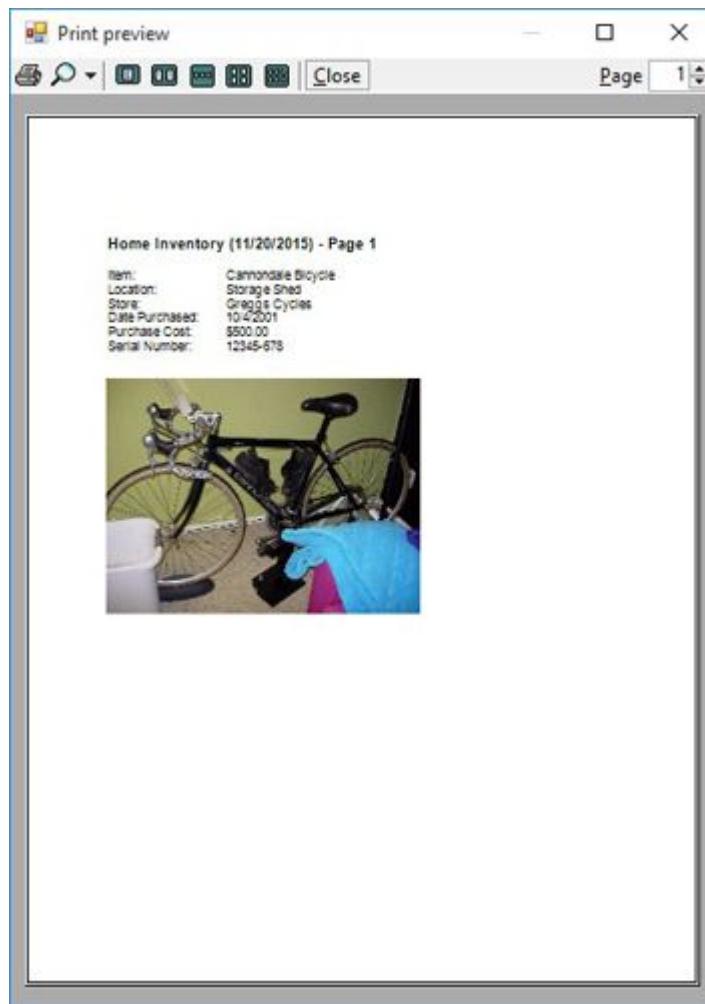
```

    e.hasMorePages = false;
    pageNumber = 1;
}
}

```

On each page, a header is printed along with a listing of the fields and the item picture.

7. Save and run the application. Click Print. The print preview control will appear with all pages of the inventory:



At this point, the user can choose to obtain a hard copy of the report if desired. Here's the top of the Ford Focus page:

Home Inventory (11/20/2015) - Page 3

Item: Ford Focus
Location: Carport
Store: Private Party
Date Purchased: 12/15/2004
Purchase Cost: \$2001.00
Serial Number: 288dkjd8883



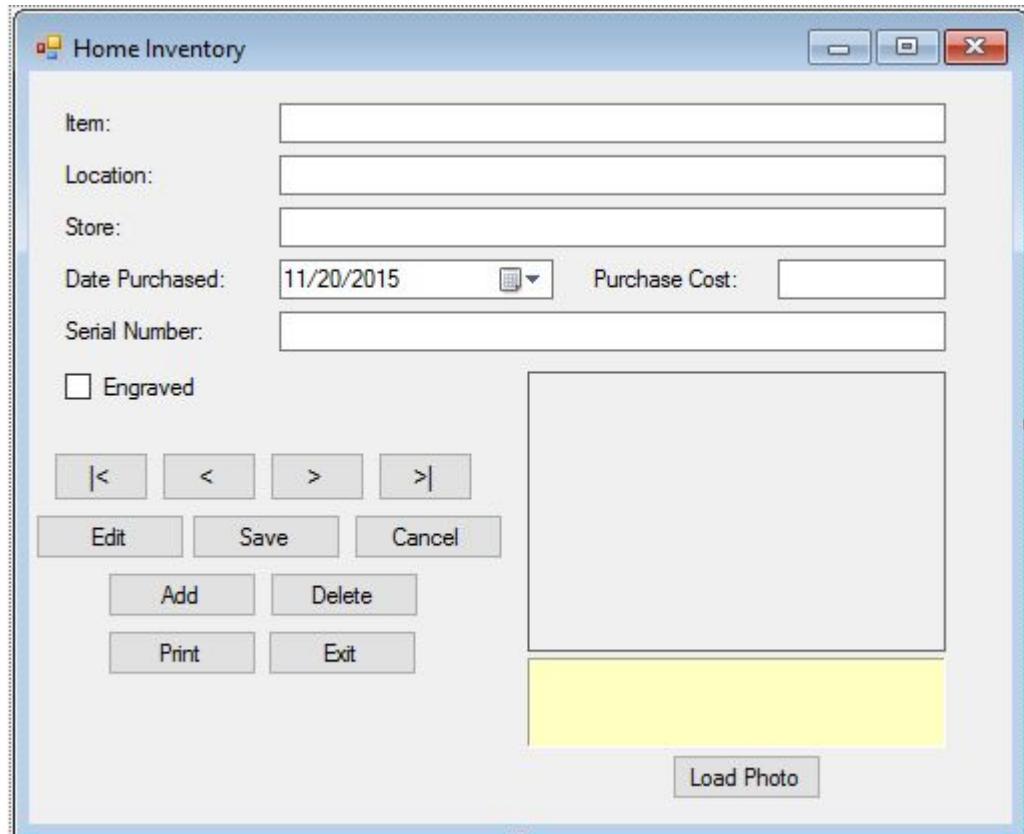
Stopping the Application

Lastly, we add controls and code to allow us to elegantly exit from the home inventory application.

1. Add a button to the form next to the Print button. Use these properties:

Name	btnExit
Text	Exit
TabStop	False

The form will look like this:



2. Add code to the **SetState** method to set the **btnExit Enabled** property to **true** in **View** mode and **false** in **Add/Edit** mode.

3. Add this code to the **btnExit_Click** event method:

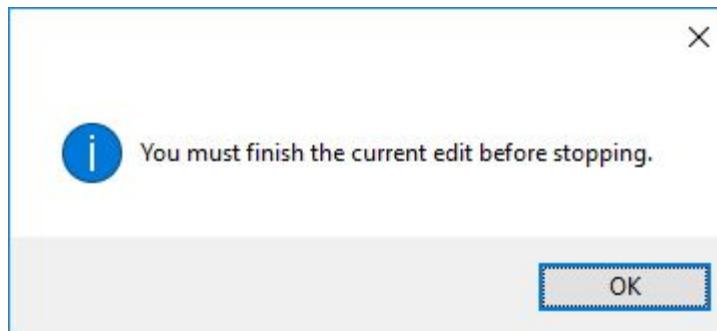
```
private void btnExit_Click(object sender, EventArgs e)
{
    this.Close();
}
```

4. Add the shaded code to the **frmInventory_FormClosing** event method (we won't stop the application if editing a record):

```
private void frmInventory_FormClosing(object sender,
FormClosingEventArgs e)
{
    if (myState.Equals("Edit") ||
    myState.Equals("Add"))
    {
        MessageBox.Show("You must finish the current
        edit
before stopping.", "", MessageBoxButtons.OK,
MessageBoxIcon.Information);
        e.Cancel = true;
    }
    else
    {
        try
        {
            // save the update Inventory table
            OleDbCommandBuilder inventoryAdapterCommands
            = new
```

```
OleDbCommandBuilder(inventoryAdapter);
    inventoryAdapter.Update(inventoryTable);
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error Saving
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
}
// close the connection
inventoryConnection.Close();
// dispose of the objects
inventoryCommand.Dispose();
inventoryAdapter.Dispose();
inventoryTable.Dispose();
}
}
```

5. Save and run the application. Try exiting (click the X in the upper right corner of the form) the application while editing a record. This should appear:



Make sure the **Exit** button works too.

Suggested Improvements

The Home Inventory Project is now complete (the final version is saved in **Example 10-2** folder in **VCSDB\Code\Class 10** folder). It was fun and easy to build. And, there is still room for improvement. Some of our ideas follow.

The database file (**InventoryDB.accdb**) is built into the application. Users might like to have separate inventory files for separate locations. Perhaps they have rental properties they would like to keep track of. You could modify the application to allow the user to specify the database file they want to work with. We do this in the Weather Monitor application (Example 10-3). The steps would be the same here.

Add some search capabilities to the application. For very large inventories, it might be helpful to search for particular items or serial numbers. You have the ability to add this feature.

For very small databases, there's a chance the user might accidentally delete the last remaining record in the database. We have nothing in our code to prevent such an occurrence and if a user tries it, an error message will appear. Can you modify the application to handle deletion of all records?

Add an icon to the form, develop on-line help, create a distribution package and pass the program out to your friends and neighbors. Everyone could use a home inventory program. Their feedback could help you improve the application into a commercially viable program.

Example 10-2

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. Use Server Explorer to create a database named **SQLInventoryDB.mdf**. Or, you can just use the copy of **SQLInventoryDB.mdf** found in the **VCSDDB\Datasets** folder. Start Server Explorer in Visual Studio. Create a new SQL Server database (**SQLInventoryDB.mdf**). Add a new table. Add seven fields (columns) to the database. The information needed to build the database is:

Column Name	Field Type
Item	varchar(50)
Location	varchar(50)
Store	varchar(50)
DatePurchased	datetime
PurchaseCost	money
SerialNumber	varchar(50)
PhotoFile	varchar(200)
Engraved	bit (Boolean)

Only the **Item** field cannot allow a null.

2. Make the **Item** field a **Primary** key. When done, the **Table Structure** appears as:

Column Name	Data Type	Allow Nulls
Item	varchar(50)	<input type="checkbox"/>
Location	varchar(50)	<input checked="" type="checkbox"/>
Store	varchar(50)	<input checked="" type="checkbox"/>
DatePurchased	datetime	<input checked="" type="checkbox"/>
PurchaseCost	money	<input checked="" type="checkbox"/>
SerialNumber	varchar(50)	<input checked="" type="checkbox"/>
PhotoFile	varchar(200)	<input checked="" type="checkbox"/>
Engraved	bit	<input checked="" type="checkbox"/>
		<input type="checkbox"/>

3. Close the table design view and name the database table **Inventory**. Close **Server Explorer** to complete the database design. If you installed SQL Server using default settings, the finished file will be found in:

**C:\Program Files\Microsoft SQL
Server\MSSQL12.SQLEXPRESS\MSSQL\DATA**

4. Copy **SQLInventoryDB.mdf** into your project's **Bin\Debug** folder (you may have to create it first). Use either the one just created in with Server Explorer or the one found in the **VCSDB\Datasets** folder. Or, you might like to use the copy included with this example's course code (in **Example 10-2** folder of the **VCSDB\Code\Class 10** folder - if you downloaded these notes, as opposed to having a CD-ROM copy, you should have already downloaded this version of the database from our website as explained in Chapter 2). Some inventory information is included in this database to give you some things to look at. We use the latter in this example.

5. Use this using statement:

```
using System.Data.SqlClient;
```

6. Change all instances of **OleDbConnection** to **SqlConnection**
 Change all instances of **OleDbCommand** to **SqlCommand**
 Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

**Change all instances of `OleDbCommandBuilder` to
`SqlCommandBuilder`**

7. Use this connection object:

```
inventoryConnection = new SqlConnection("Data
Source=.\SQLEXPRESS; AttachDbFilename=" +
Application.StartupPath + "\\SQLInventoryDB.mdf;
Integrated Security=True; Connect Timeout=30; User
Instance=True");
```


Example 10-3

Weather Monitor Project

In this last sample project, we build an application that lets you track daily high and low temperatures and precipitation amounts (if any). We will follow many steps in building the application, from development of the database to creation of a distribution package. The steps followed are similar to those you would use to develop a commercial database application.

The steps followed to build the **Weather Monitor** are:

- Building and testing of the Visual C# interface
- Creation of an empty database using code
- Database reports
- Development of a help system
- Designing a project icon
- Creation of a distribution package

The interface will allow the user to enter high and low temperatures and precipitation for any dates they choose within a particular year. This information will be saved in the database. Plotted results will be available, as will summary information regarding maximum, minimum, and average values.

Weather Monitor Interface

In this application, for each day in a single year, the user enters a high temperature, a low temperature, a precipitation amount, and any comment. The database manager will automatically provide the date. Unlike the other sample projects, we do not need a database structure to begin this project. When the user starts a new weather monitoring file, we will build the new empty database file using Visual C# code and ADOX technology (like in Chapter 9). We will use a tab control as the major component of the Weather Monitor interface. The control will have three tabs: one to view and edit the weather data, one to view a temperature data graph, and one to view a precipitation data graph. Each tab in this control operates like the Visual C# panel control. Each tab's control must be drawn in the appropriate tab region.

1. Start a new application. Add a tab control to the form. Set these properties:

Form1:

Name	frmWeather
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Weather Monitor

tabControl1:

Name	tabWeather
Dock	Fill
FontSize	10

tabPage1:

Name	tabPageData
Text	Record Weather Data

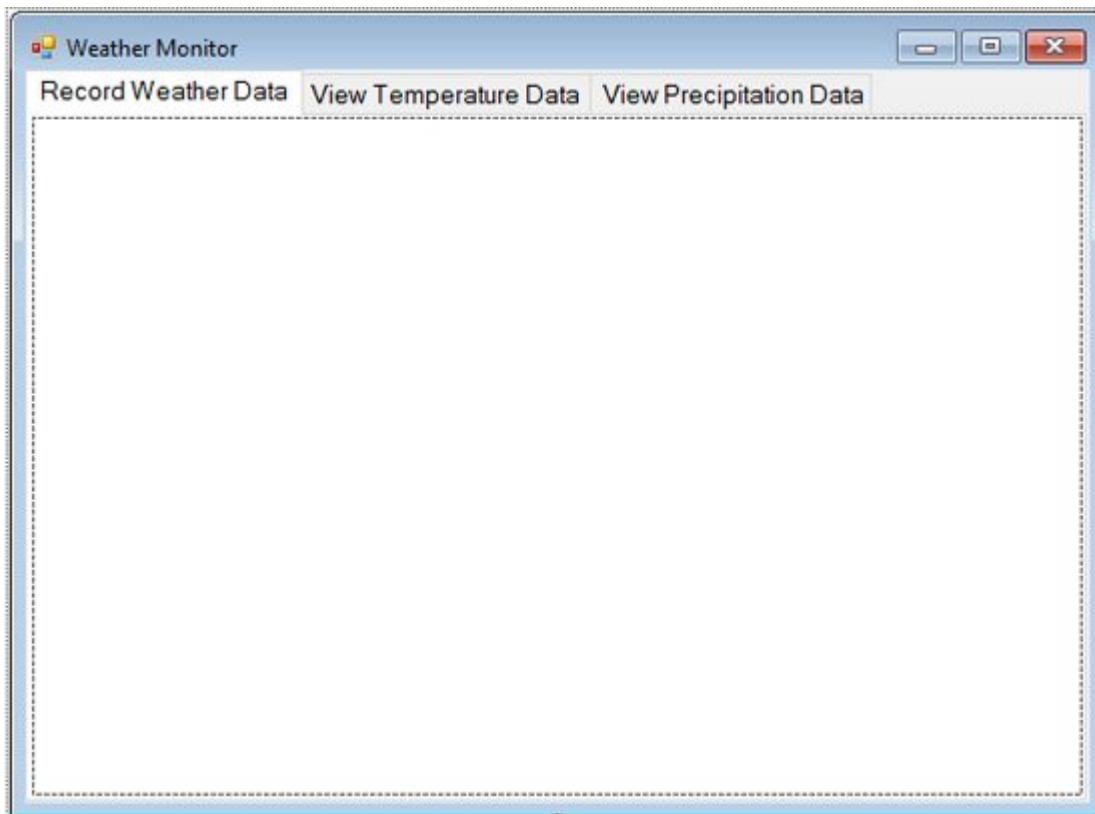
tabPage2:

Name	tabPageTemp
Text	View Temperature Data

tabPage3:

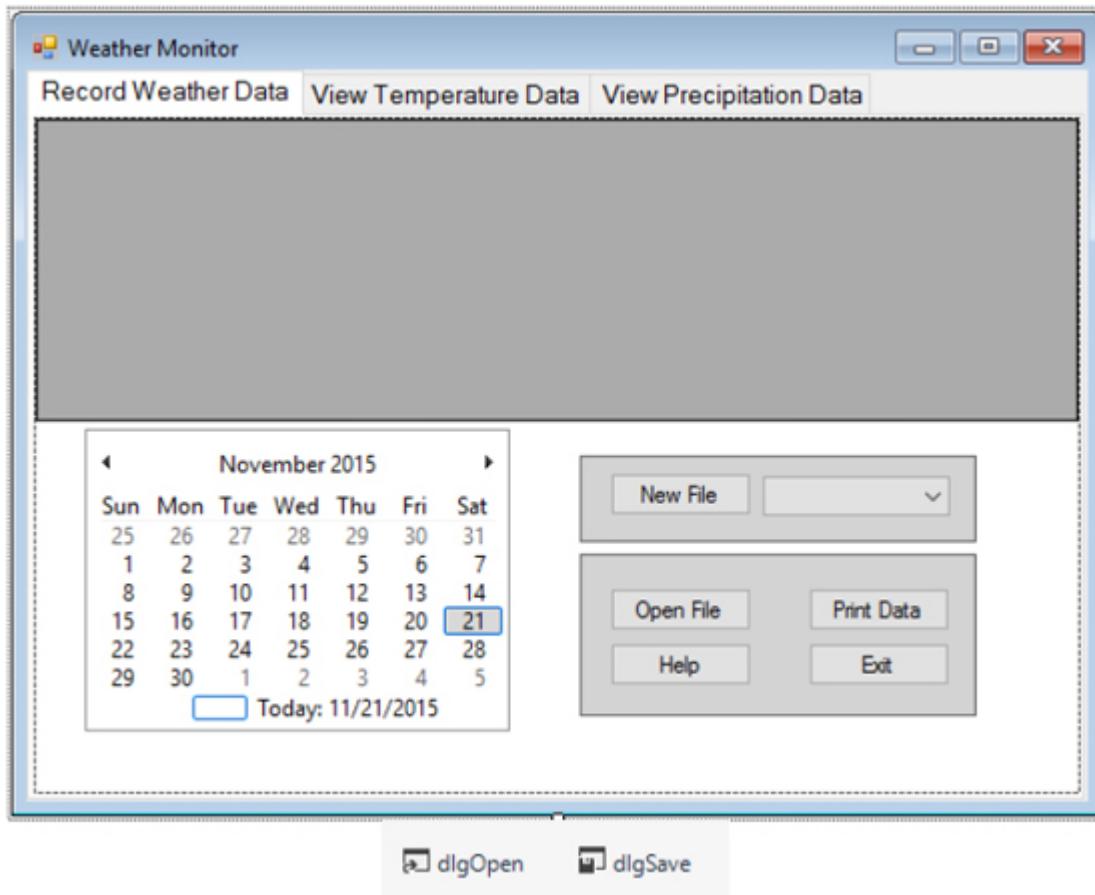
Name	tabPagePrecip
Text	View Precipitation Data

2. Save the application (saved in **Example 10-3** folder in **VCSDB\Code\Class 10** folder) - you can run it to see how the tab switching works. The form looks like this when running (to give you an idea of how large it should be):



Record Weather Data Tab

On this tab, we will have the ability to start a new file or open an existing file. The data will be displayed in a grid control for viewing and editing. Here's what the finished tab will look like (this should guide you while placing controls and setting properties):



1. Make sure the **Record Weather Data** tab is active. Add a data grid view, a month calendar control, an open file dialog control, a save file dialog control and two panel controls. Set these properties:

dataGridView1:

Name	grdWeather
------	------------

monthCalendar1:

Name	calDate
MaxSelectionCount	1

openFileDialog1:

Name	dlgOpen
DefaultExt	accdb
FileName	[blank]
Filter	Access Files (*.accdb) *.accdb

saveFileDialog1:

Name	dlgSave
DefaultExt	accdb
Filter	Access Files (*.accdb) *.accdb
OverwritePrompt	False

panel1:

Name	pnlNew
BackColor	Light Gray
BorderStyle	FixedSingle

panel2:

Name	pnlFiles
BackColor	Light Gray
BorderStyle	FixedSingle

2. In the **pnlNew** panel, add a button and a combo box. Set these properties:

button1:

Name btnNew
FontSize 8
Text New File

comboBox1:

Name cboYear
FontSize 8
FontBold True
DropdownStyle DropDownList

3. In the pnlFiles panel, add four buttons. Set these properties:

button1:

Name btnOpen
FontSize 8
Text Open File

button2:

Name btnPrintData
FontSize 8
Text Print Data

button3:

Name btnHelpData
FontSize 8
Text Help

button4:

Name btnExitData
FontSize 8
Text Exit

4. Save and run the application. Make sure all controls are on first tab and not just floating around somewhere on the form.

Weather Monitor Database

Let's explain how this will all work. The grid will display the weather data and the calendar control will provide a visual representation of the current date. The user will be able to start a new weather file or open an existing file. If starting a new file (click **New File**), the user selects the year using the displayed combo box control. The user then chooses a name for that file using the save file dialog. An empty Access database with that name will be built in code. If using Access, we will build the empty database in code using ADOX technology. If working with SQL Server databases, we could do something similar (using advanced SQL statements) but that is beyond the scope of this particular course. For SQL Server databases, we will copy a provided empty database to the database named by the user (see the section **Using SQL Server Databases**).

Let's write that code using ADOX technology.

1. Referring back to Example 9-2, add a reference to the ADOX library. Add this line at the top of the code window to allow use of this library:

```
using ADOX;
```

2. Add this code to the **btnNew_Click** event method:

```
private void btnNew_Click(object sender, EventArgs e)
{
    Catalog weatherDatabase = new Catalog();
    Table databaseTable;
    try
```

```

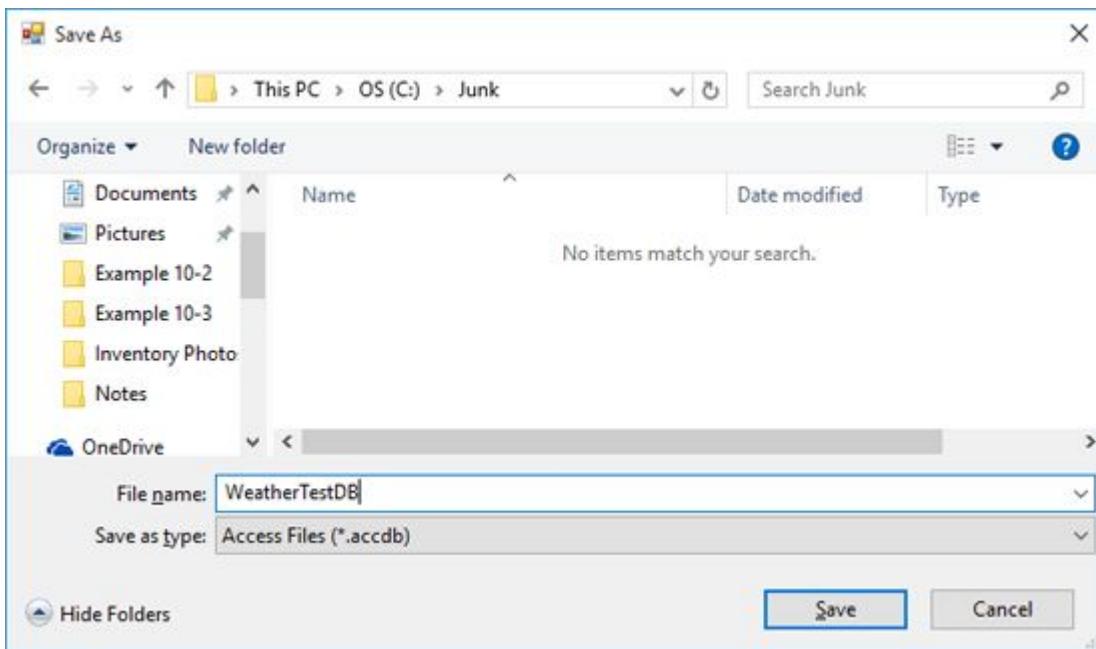
{
    // get filename
    if (dlgSave.ShowDialog() == DialogResult.OK)
    {

weatherDatabase.Create("Provider=Microsoft.ACE.OLEDB.
12.0; Data Source = " + dlgSave.FileName);
        // create table
        databaseTable = new Table();
        databaseTable.Name = "Weather";
        weatherDatabase.Tables.Append(databaseTable);
    }
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error Creating
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
}
finally
{
    weatherDatabase = null;
}
}

```

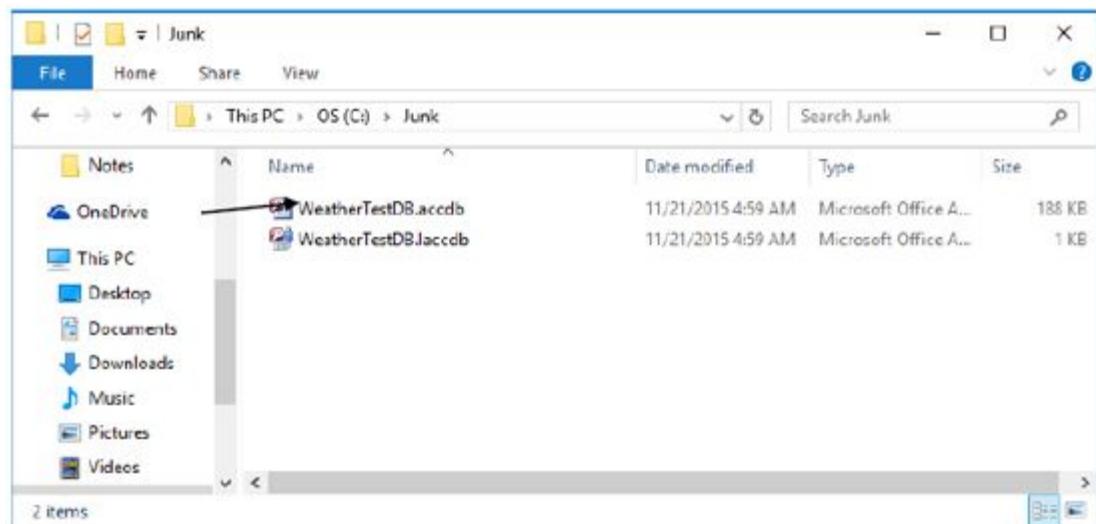
This code creates an empty database (user selected name) with a table named **Weather**.

3. Save and run the project. Click **New File** - the save file dialog appears:



Choose a location and name (it can't be a name already used for a database). I chose **WeatherTestDB** in my c:\junk folder. Click **Save**. Stop the application.

Go to the directory you selected and your new database should be there. Here's mine:



This is an empty database. We'll use our programming skills to add information - defining the fields and pre-populating the date

information.

Database Fields

Let's add the fields. There are five fields in the database. They are:

Field Name	Field Type	FieldSize
WeatherDate	Date/Time	20
HighTemp	Single	10
LowTemp	Single	10
Precip	Single	10
Comment	Text	50

Only the **WeatherDate** field is required (it is the primary key).

1. Add the shaded code to the **btnNew_Click** event method. This code adds each field, removes the requirement field from all but the **WeatherDate** field, then defines the primary key and index.

```
private void btnNew_Click(object sender, EventArgs e)
{
    Catalog weatherDatabase = new Catalog();
    Table databaseTable;
    try
    {
        // get filename
        if (dlgSave.ShowDialog() == DialogResult.OK)
        {

weatherDatabase.Create("Provider=Microsoft.ACE.OLEDB.
12.0; Data Source = " + dlgSave.FileName);
```

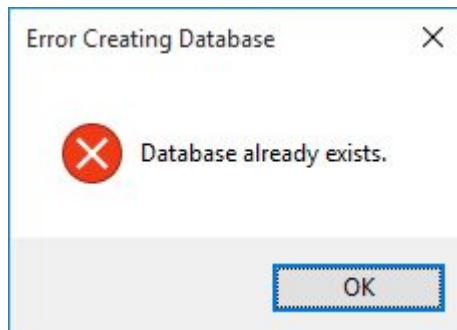
```
// create table
databaseTable = new Table();
databaseTable.Name = "Weather";
// add fields
databaseTable.Columns.Append("WeatherDate",
(DataTypeEnum.adDate, 20);
databaseTable.Columns.Append("HighTemp",
(DataTypeEnum.adSingle, 10);
databaseTable.Columns.Append("LowTemp",
(DataTypeEnum.adSingle, 10);
databaseTable.Columns.Append("Precip",
(DataTypeEnum.adSingle, 10);
databaseTable.Columns.Append("Comment",
(DataTypeEnum.adWChar, 50);
databaseTable.Columns["HighTemp"].Attributes =
ColumnAttributesEnum.adColNullable;
databaseTable.Columns["LowTemp"].Attributes =
ColumnAttributesEnum.adColNullable;
databaseTable.Columns["Precip"].Attributes =
ColumnAttributesEnum.adColNullable;
databaseTable.Columns["Comment"].Attributes =
ColumnAttributesEnum.adColNullable;
// primary key
databaseTable.Keys.Append("PK_Weather",
(KeyTypeEnum.adKeyPrimary, "WeatherDate", null, null);
databaseTable.Indexes.Append("WeatherDate",
"WeatherDate");
weatherDatabase.Tables.Append(databaseTable);
}
```

```

        catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Creating
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    finally
    {
        weatherDatabase = null;
    }
}

```

2. Save and run the application. Create a new database. You must choose a unique name. If you don't you will see:



Each time you create a database, you have to use a different name - this is a protective mechanism to keep you from completely wiping out any previously created database. If I open a newly created weather database in Access (using design view), I see all the fields of the **Weather** table have been correctly defined:

	Field Name	Data Type
!	WeatherDate	Date/Time
	HighTemp	Number
	LowTemp	Number
	Precip	Number
	Comment	Text

We now have a complete Access database we can use with our weather monitoring project. To use this database, we open it and manage it using the same ADO .NET objects we've used throughout these notes. We begin by pre-populating the date field with fixed values.

Adding Date Values and Editing Features

We continue our database design by pre-populating the date field using the year selected in the combo box control. We use the familiar ADO .NET data objects to accomplish this task. We also add editing features incorporating key trapping in the data grid view.

1. Place this code in the **frmWeather_Load** event method:

```
private void frmWeather_Load(object sender, EventArgs e)
{
    for (int y = 1900; y <= 2100; y++)
    {
        cboYear.Items.Add(y.ToString());
    }
    cboYear.Text =
        calDate.SelectionStart.Year.ToString();
    tabWeather.SelectedTab = tabPageData;
    grdWeather.AutoSizeColumnsMode =
        DataGridViewAutoSizeColumnsMode.Fill;
    grdWeather.AllowUserToAddRows = false;
}
```

This places years we need in the combo box control and displays the first tab. We also set some grid control properties.

2. Add the usual line at the top of the code window:

```
using System.Data.OleDb;
```

3. Add these general declarations for the needed data objects:

```
OleDbConnection weatherConnection;  
OleDbCommand weatherCommand;  
OleDbDataAdapter weatherAdapter;  
DataTable weatherTable;
```

4. Add the shaded code to the `btnNew_Click` event method to fill in the `Date` column with each day of the selected year:

```
private void btnNew_Click(object sender, EventArgs e)  
{  
    Catalog weatherDatabase = new Catalog();  
    Table databaseTable;  
    // close any open database  
    CloseConnection();  
    try  
    {  
        // get filename  
        if (dlgSave.ShowDialog() == DialogResult.OK)  
        {  
  
            weatherDatabase.Create("Provider=Microsoft.ACE.OLEDB.  
12.0;  
Data Source = " + dlgSave.FileName);  
            // create table  
            databaseTable = new Table();  
            databaseTable.Name = "Weather";  
            // add fields  
            databaseTable.Columns.Append("WeatherDate",
```

```
    DataTypeEnum.adDate, 20);
        databaseTable.Columns.Append("HighTemp",
    DataTypeEnum.adSingle, 10);
        databaseTable.Columns.Append("LowTemp",
    DataTypeEnum.adSingle, 10);
        databaseTable.Columns.Append("Precip",
    DataTypeEnum.adSingle, 10);
        databaseTable.Columns.Append("Comment",
    DataTypeEnum.adWChar, 50);
        databaseTable.Columns["HighTemp"].Attributes =
=
ColumnAttributesEnum.adColNullable;
        databaseTable.Columns["LowTemp"].Attributes =
ColumnAttributesEnum.adColNullable;
        databaseTable.Columns["Precip"].Attributes =
ColumnAttributesEnum.adColNullable;
        databaseTable.Columns["Comment"].Attributes =
ColumnAttributesEnum.adColNullable;
        // primary key
        databaseTable.Keys.Append("PK_Weather",
KeyTypeEnum.adKeyPrimary, "WeatherDate", null, null);
        databaseTable.Indexes.Append("WeatherDate",
"WeatherDate");
        weatherDatabase.Tables.Append(databaseTable);
        // connect to database
        OpenConnection(dlgSave.FileName);
        // fill dates
        DateTime tableDate = new
DateTime(Convert.ToInt32(cboYear.Text), 1, 1);
        DateTime nextYear = new
DateTime(Convert.ToInt32(cboYear.Text) + 1, 1, 1);
```

```

        int nDays = (nextYear - tableDate).Days;
        DataRow newRow;
        for (int n = 1; n <= nDays; n++)
        {
            newRow = weatherTable.NewRow();
            newRow["WeatherDate"] = tableDate;
            weatherTable.Rows.Add(newRow);
            tableDate += new TimeSpan(1, 0, 0, 0);
        }
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Creating
Database",
        MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
    finally
    {
        weatherDatabase = null;
    }
}

```

The new code first disconnects from any current database (using **CloseConnection**). The code then connects to the newly created database and forms all the data objects (**OpenConnection**). Rows are added to the **weatherTable** object filling in the **WeatherDate** field. After each row is added, the corresponding adapter is updated to save the new row to the database.

5. Add the general method **CloseConnection** that closes the any open database and saves changes prior to creating another database:

```

private void CloseConnection()
{
    try
    {
        if (!(weatherConnection == null))
        {
            if (weatherConnection.State ==
                ConnectionState.Open)
            {
                OleDbCommandBuilder weatherAdapterCommand = new
OleDbCommandBuilder(weatherAdapter);
                weatherAdapter.Update(weatherTable);
                weatherConnection.Close();
                weatherConnection.Dispose();
                weatherCommand.Dispose();
                weatherAdapter.Dispose();
                weatherTable.Dispose();
                weatherAdapterCommand.Dispose();
            }
        }
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Saving
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}

```

6. Add the general method **OpenConnection** that connects to the database, creates the data objects and binds the data grid control (**grdWeather**) to the table object.

```

private void OpenConnection(string fName)
{
    try
    {
        weatherConnection = new
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = " + fName);
        weatherConnection.Open();
        // establish command object
        weatherCommand = new OleDbCommand("SELECT * FROM
Weather ORDER BY WeatherDate", weatherConnection);
        // establish data adapter/data table
        weatherAdapter = new OleDbDataAdapter();
        weatherAdapter.SelectCommand = weatherCommand;
        weatherTable = new DataTable();
        weatherAdapter.Fill(weatherTable);
        grdWeather.DataSource = weatherTable;
        grdWeather.Columns[0].ReadOnly = true;
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Opening
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}

```

7. Add this code to the **frmWeather_FormClosing** event method to save an open database when exiting the program:

```
private void frmWeather_FormClosing()
```

```
{  
    // close connection  
    CloseConnection();  
}
```

8. Handling key trapping with the data grid view control is a little tricky. First, add this code to the **grdWeather_EditingControlShowing** event method:

```
private void grdWeather_EditingControlShowing(object sender,  
DataGridViewEditingControlShowingEventArgs e)  
{  
    this.grdWeather.EditngControl.KeyPress -= new  
KeyPressEventHandler(this.grdWeather_KeyPress);  
    this.grdWeather.EditngControl.KeyPress += new  
KeyPressEventHandler(this.grdWeather_KeyPress);  
}
```

This code attaches the current cell to a **KeyPress** method (named **grdWeather_KeyPress**).

9. Add this code to the **grdWeather_KeyPress** event:

```
private void grdWeather_KeyPress(object sender,  
KeyPressEventArgs e)  
{  
    // numeric entries only in first three columns  
    int currentColumn =  
        grdWeather.CurrentCell.ColumnIndex;  
    if (currentColumn > 0 && currentColumn < 4)  
    {  
        if ((e.KeyChar >= '0' && e.KeyChar <= '9') ||
```

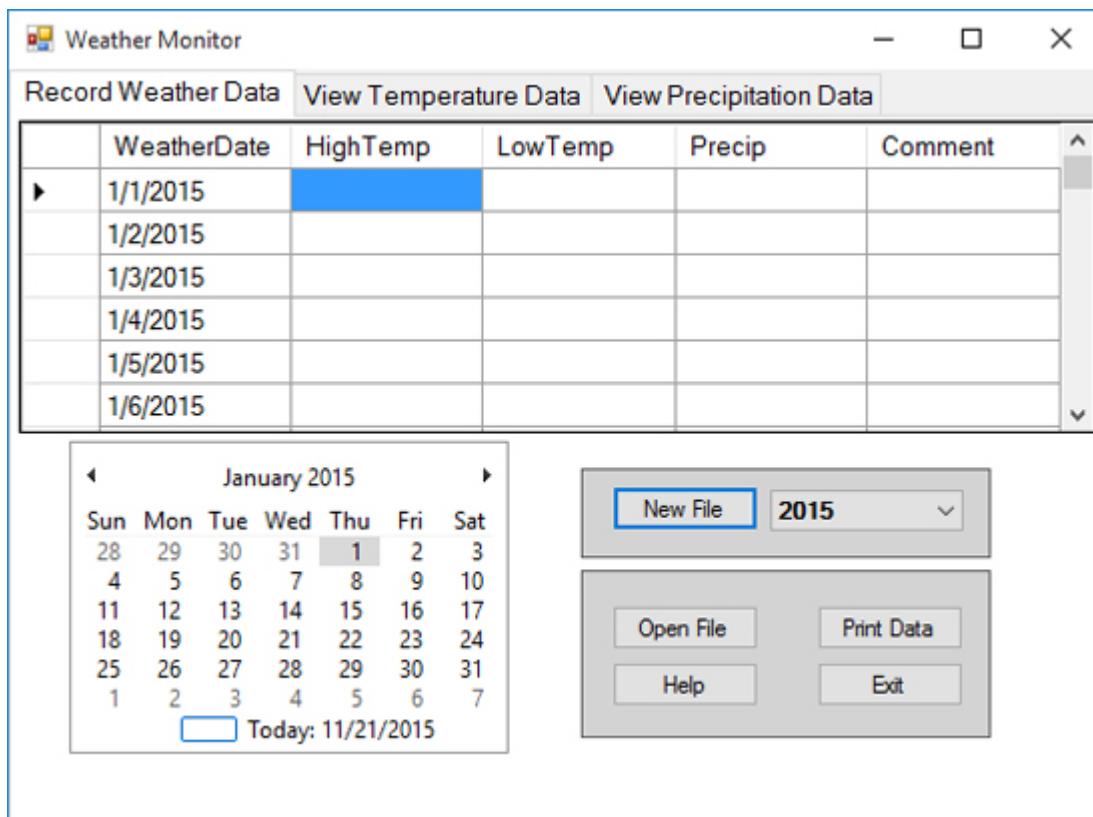
```

e.KeyChar == '-' || e.KeyChar == '.' || (int)
e.KeyChar == 8)
    e.Handled = false;
else
    e.Handled = true;
}
}

```

This insures only numbers, a decimal point, or a minus sign can be entered into the temperature and precipitation fields (columns 1 through 3).

10. Save and run the application. Start a **New File**. You should see the grid now appears with the date values filled in:



Try inputting some values. Check out the key trapping code. Notice how the grid navigation works. Once you exit the program, your

changes will be saved to the newly formed database. Now, of course, you need some way to open the saved file.

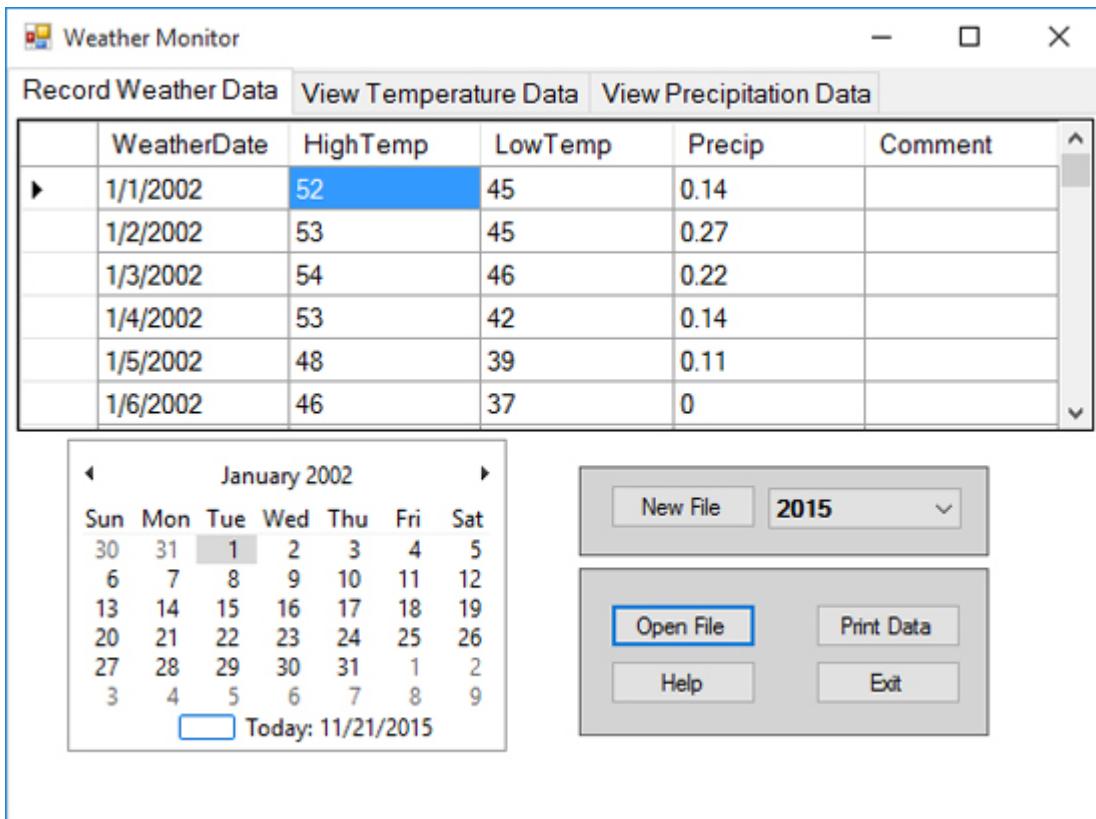
Opening Database Files

1. Place the code to open an existing database file in the `btnOpen_Click` event method:

```
private void btnOpen_Click(object sender, EventArgs e)
{
    try
    {
        // close connection if open
        CloseConnection();
        // get filename
        if (dlgOpen.ShowDialog() == DialogResult.OK)
        {
            // connect to database
            OpenConnection(dlgOpen.FileName);
        }
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Opening
File",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}
```

Here, we close a connection if it exists. Then, we retrieve a filename from the user and open the selected file.

2. Save and run the application. Try to open a file. There are two example databases in the VCSDB\Code\Class 10\Example 10-3 folder. The files are **Sea02DB.accdb** and **Sea03DB.accdb** and contain weather for my hometown of Seattle for the years 2002 and 2003. Opening **Sea02DB.accdb** reveals:



We're almost done with this tab - one more change is needed. It would be nice to be able to select a date on the calendar and have the corresponding entry appear in the data grid. Likewise, if we select a grid row, that date should be displayed on the calendar. That is, we want the date displays to be coordinated with each other.

Date Display Coordination

1. Place this code in the `calDate_DateChanged` event method:

```
private void calDate_DateChanged(object sender,
DateRangeEventArgs e)
{
    // match selected date to grid (if possible)
    if (!(weatherConnection == null))
    {
        weatherTable.DefaultView.Sort = "WeatherDate";
        int dateRow =
weatherTable.DefaultView.Find(calDate.SelectionStart)
;
        if (dateRow != -1)
            grdWeather.CurrentCell = grdWeather[1,
dateRow];
    }
}
```

When the date changes on the calendar control, the corresponding grid row will be displayed (assuming there is a grid and the date is in the grid).

2. Use this code in the `grdWeather_CellClick` event method:

```
private void grdWeather_CellClick(object sender,
DataGridViewCellEventArgs e)
{
    calDate.SelectionStart =

```

```
Convert.ToDateTime(grdWeather[0,
grdWeather.CurrentCell.RowIndex].Value);
}
```

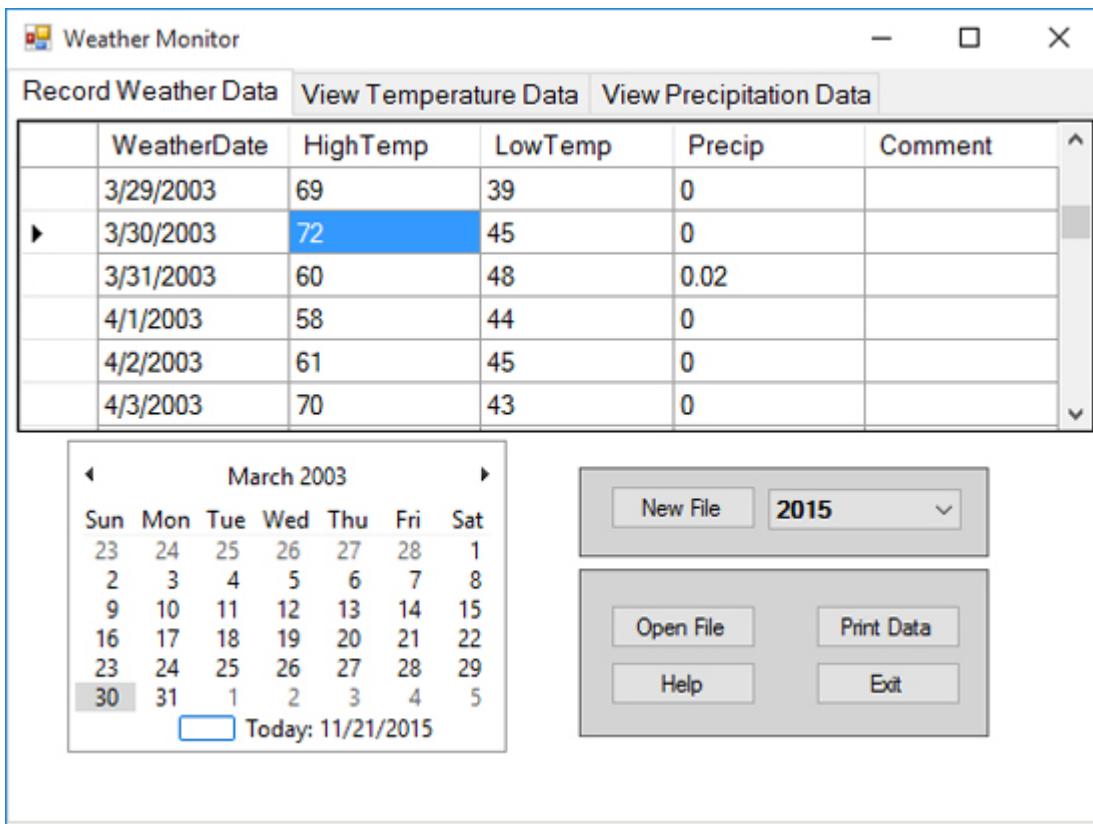
This code coordinates the date shown in a selected row in the grid with the calendar control.

4. We need to make sure the dates are coordinated initially. Place this line of code:

```
grdWeather_CellClick(null, null);
```

in two places: (1) after the `OpenConnection()` line in the `btnOpen_Click` event method, (2) after the for loop adding dates in the `btnNew_Click` event method.

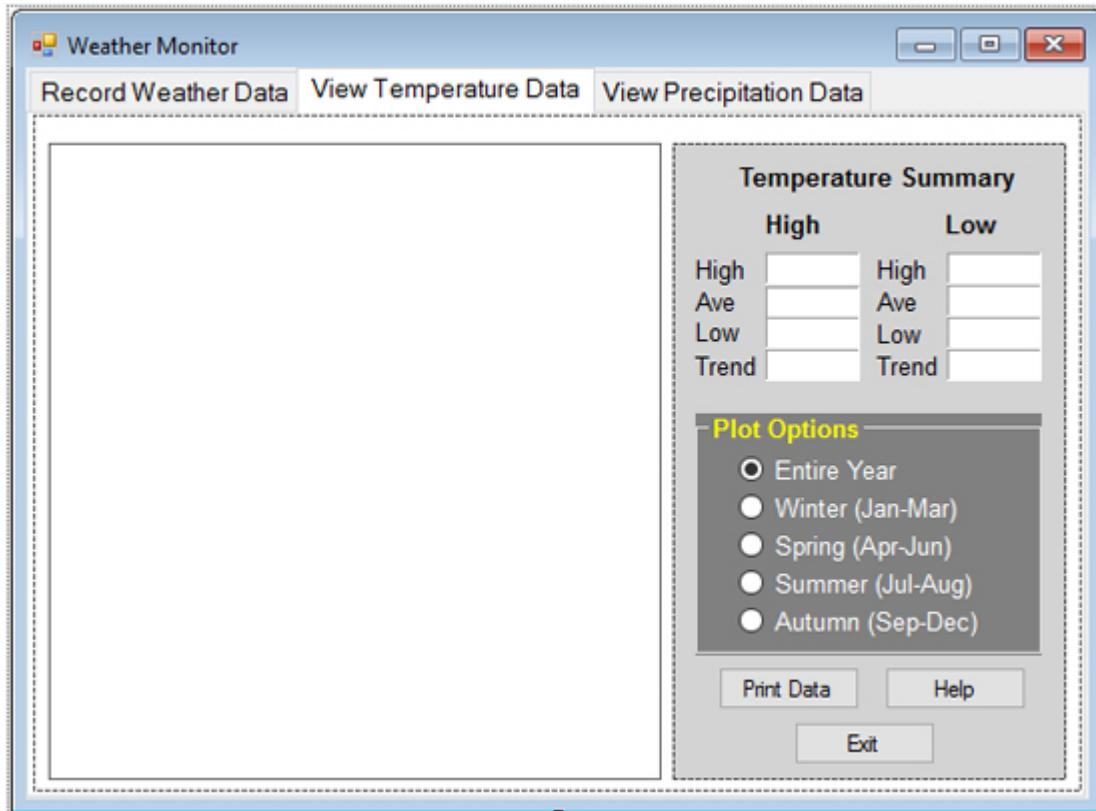
3. Save and run the application. Open an existing database or one of the samples. Notice how the date displayed in the grid matches the calendar. Here's what I see when I load `Sea03DB.accdb` and scroll down the grid a bit:



We have not coded the **Print Data**, **Help** or **Exit** buttons. This will be done later. Let's now look at the other two tabs in the project.

View Temperature Data Tab

When this tab is clicked, we will provide a plot of the high and low temperatures and some summary statistics. You can choose what season of the year to plot temperatures for. Here's the finished tab layout to assist you in building the interface:



1. In design mode, select the **View Temperature Data** tab. Place a panel control on the form. It will be used to hold a plot of temperature data - it should take up a little more than one-half the width of the tab. Set these properties:

panel1:

Name pnlTempPlot

BackColor White
BorderStyle FixedSingle

2. On the same tab, add another panel, and in the panel control, add 19 label controls (yes, I said 19!), a group box, and three buttons. Set these properties (default names may differ - refer to the finished form for each control)

panel1:

BackColor Light Gray

label1:

Text Temperature Summary
Font Arial, Bold, Size 10

label2:

Text High
Font Arial, Bold, Size 10

label3:

Text Low
Font Arial, Bold, Size 10

label4:

Text High
Font Arial, Size 10

label5:

Name lblTHH
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10

Text [Blank]
TextAlign MiddleCenter

label6:

Text Ave
Font Arial, Size 10

label7:

Name lblTHA
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
TextAlign MiddleCenter

label8:

Text Low
Font Arial, Size 10

label9:

Name lblTHL
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
TextAlign MiddleCenter

label10:

Text Trend

Font Arial, Size 10

label11:

Name lblTHT
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
 TextAlign MiddleCenter

label12:

Text High
Font Arial, Size 10

label13:

Name lblTLH
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
 TextAlign MiddleCenter

label14:

Text Ave
Font Arial, Size 10

label15:

Name lblTLA
AutoSize False

BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
TextAlign MiddleCenter

label16:

Text Low
Font Arial, Size 10

label17:

Name lblTLL
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
TextAlign MiddleCenter

label18:

Text Trend
Font Arial, Size 10

label19:

Name lblTLT
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]

TextAlign MiddleCenter

button1:

 Name btnPrintTemp
 FontSize 8
 Text Print Data

button2:

 Name btnHelpTemp
 FontSize 8
 Text Help

button3:

 Name btnExitTemp
 FontSize 8
 Text Exit

groupBox1:

 Text Plot Options
 BackColor Dark Gray
 Font Arial, Bold, Size 10
 ForeColor Yellow

3. In the group box, place five radio buttons. Use these properties:

radioButton1:

 Name rdoTempYear
 Text Entire Year
 Checked True
 Font Arial, Size 10
 ForeColor White

radioButton2:

Name rdoTempWinter
Text Winter (Jan-Mar)
Font Arial, Size 10
ForeColor White

radioButton3:

Name rdoTempSpring
Text Spring (Apr-Jun)
Font Arial, Size 10
ForeColor White

radioButton4:

Name rdoTempSummer
Text Summer (Jul-Sep)
Font Arial, Size 10
ForeColor White

radioButton5:

Name rdoTempAutumn
Text Autumn (Oct-Dec)
Font Arial, Size 10
ForeColor White

The tab layout is complete. Time for coding! When the tab is selected, we will form the required plot and compute the needed summary statistics. We will do the summaries first.

Temperature Summary Statistics

1. Add a general method `TemperatureData` to the project and use this code:

```
private void TemperatureData()
{
    // make sure there is a data table
    if(weatherConnection == null)
        return;
    float temp;
    int xStart = 0, xEnd = 0, nDays, isLeap;
    float tempHH, tempHL;
    float tempLH, tempLL;
    float sumH, sumL;
    int nH, nL;
    double sxH, sx2H, sxyH;
    double sxL, sx2L, sxyL;
    float a1H, a1L;
    bool noData;
    float[] highTemp = new float[366];
    float[] lowTemp = new float[366];
    if (weatherTable.Rows.Count == 365)
        isLeap = 0;
    else
        isLeap = 1;
    switch (tempPlot)
    {
```

```
    case 0:
        xStart = 0;
        xEnd = 364 + isLeap;
        break;
    case 1:
        xStart = 0;
        xEnd = 89 + isLeap;
        break;
    case 2:
        xStart = 90 + isLeap;
        xEnd = 180 + isLeap;
        break;
    case 3:
        xStart = 181 + isLeap;
        xEnd = 272 + isLeap;
        break;
    case 4:
        xStart = 273 + isLeap;
        xEnd = 364 + isLeap;
        break;
    }
nDays = xEnd - xStart + 1;
// temperature data
tempHH = -1000; tempHL = 1000;
tempLH = -1000; tempLL = 1000;
sumH = 0; nH = 0;
sumL = 0; nL = 0;
sxH = 0; sx2H = 0; sxyH = 0;
sxL = 0; sx2L = 0; sxyL = 0;
for (int x = xStart; x <= xEnd; x++)
{
```

```

if (weatherTable.Rows[x]["HighTemp"] != DBNull.Value)
{
    temp =
Convert.ToSingle(weatherTable.Rows[x]["HighTemp"]);
    highTemp[x - xStart] = temp;
    if (temp > tempHH)
        tempHH = temp;
    if (temp < tempHL)
        tempHL = temp;
    sumH += temp;
    nH++;
    sxH += x;
    sx2H += x * x;
    sxyH += x * temp;
}
else
{
    highTemp[x - xStart] = -1000.0F;
}
if (weatherTable.Rows[x]["LowTemp"] != DBNull.Value)
{
    temp =
Convert.ToSingle(weatherTable.Rows[x]["LowTemp"]);
    lowTemp[x - xStart] = temp;
    if (temp > tempLH)
        tempLH = temp;
    if (temp < tempLL)
        tempLL = temp;
    sumL += temp;
}

```

```

nL++;
sxL += x;
sx2L += x * x;
sxyL += x * temp;
}
else
{
    lowTemp[x - xStart] = -1000.0F;
}
}

if (tempLL >= tempHH)
    noData = true;
else
    noData = false;
if (!noData)
{
    lblTHH.Text = String.Format("{0:f1}", tempHH);
    lblTHL.Text = String.Format("{0:f1}", tempHL);
    lblTLH.Text = String.Format("{0:f1}", tempLH);
    lblTLL.Text = String.Format("{0:f1}", tempLL);
    if (nH > 1)
    {
        a1H = Convert.ToSingle((nH * sxyH - sxH *
sumH) /
(nH * sx2H - sxH * sxH));
        if (a1H >= 0)
            lblTHT.Text = "+" + String.Format(
                "{0:f1}", (nDays - 1) * a1H);
        else
            lblTHT.Text = String.Format("{0:f1}",
                (nDays - 1) * a1H);
    }
}

```

```

        }

        if (nL > 1)
        {
            a1L = Convert.ToSingle((nL * sxyL - sxL *
sumL) /
(nL * sx2L - sxL * sxL));
            if (a1L >= 0)
                lblTLT.Text = "+" + String.Format(
                "{0:f1}", (nDays - 1) * a1L);
            else
                lblTLT.Text = String.Format("{0:f1}",
                (nDays - 1) * a1L);
        }
        lblTHA.Text = String.Format("{0:f1}", sumH /
nH);
        lblTLA.Text = String.Format("{0:f1}", sumL /
nL);
    }
    else
    {
        lblTHH.Text = "----";
        lblTLH.Text = "----";
        lblTHL.Text = "----";
        lblTLL.Text = "----";
        lblTHA.Text = "----";
        lblTLA.Text = "----";
        lblTHT.Text = "----";
        lblTLT.Text = "----";
    }
}

```

This code goes through every record in the database table and stores temperature values for plotting in the **HighTemp** and **LowTemp** arrays. The code computes summary information (highs, lows, averages). Notice how the **IsDBNull** function is used to only include records with actual numeric values. If there is no value, the plot value is set to -1000.0 as a flag for the plotting code. Don't worry about the equations for the 'trend' value (the **A1H** and **A1L** values). If you want to impress your friends, you can tell them it uses a linear least squares computation to determine the slope of the values.

2. To bring up this screen, add this code to the **tabWeather_SelectedIndexChanged** event method:

```
private void tabWeather_SelectedIndexChanged(object sender, EventArgs e)
{
    switch (tabWeather.SelectedIndex)
    {
        case 1:
            TemperatureData();
            break;
    }
}
```

3. Add this variable to the form level declarations (it tells us which plot option is selected):

```
int tempPlot = 0;
```

4. Place this code in the **rdoTempPlot_CheckedChanged** event method (handles clicks on all radio buttons):

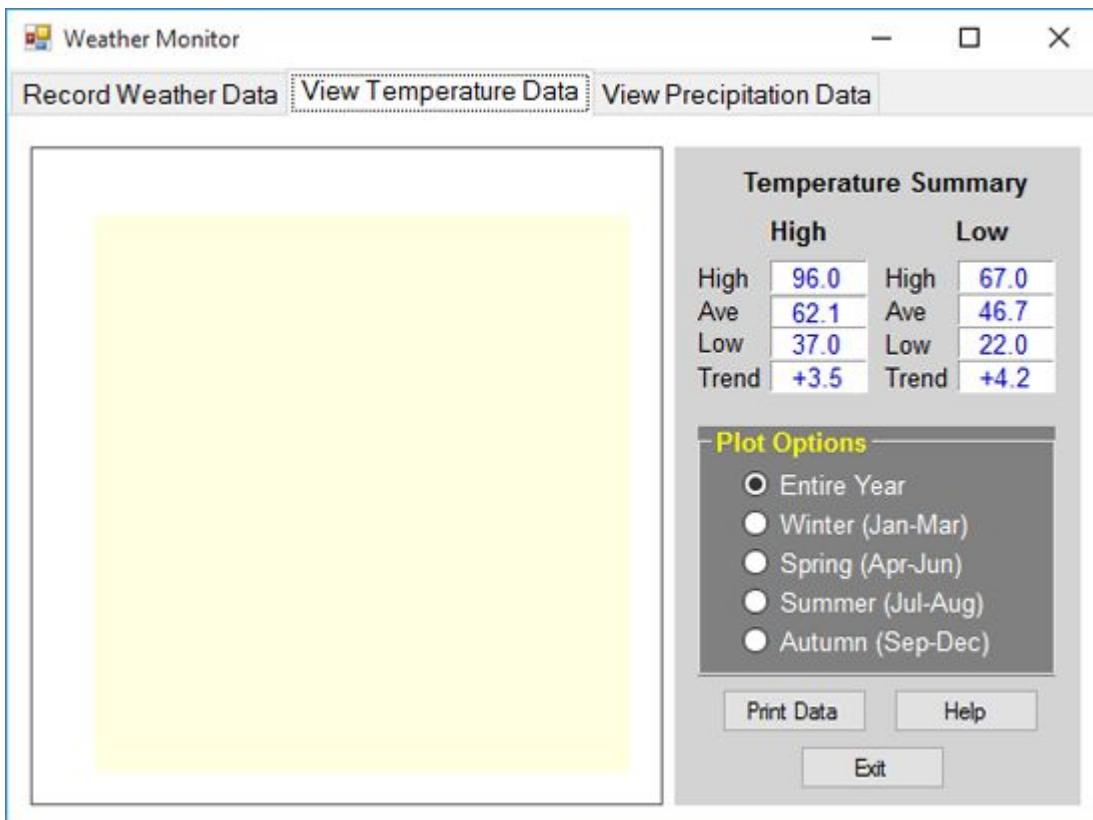
```
private void rdoTempPlot_CheckedChanged(object sender,
```

```

EventArgs e)
{
    RadioButton whichButton = (RadioButton) sender;
    switch (whichButton.Name)
    {
        case "rdoTempYear":
            tempPlot = 0;
            break;
        case "rdoTempWinter":
            tempPlot = 1;
            break;
        case "rdoTempSpring":
            tempPlot = 2;
            break;
        case "rdoTempSummer":
            tempPlot = 3;
            break;
        case "rdoTempAutumn":
            tempPlot = 4;
            break;
    }
    TemperatureData();
}

```

5. Save the application. Run it. Try entering some data to plot. When I load **Sea03DB.accdb** and choose the **Entire Year** option, here's what I get:



Now, let's tackle the missing data plot.

Temperature Plot

Older versions of Visual Studio had a control called the **Chart Control**. It allowed plotting of data in several formats. This control is no longer included with Visual C#. There are third party tools available for plotting, but cost money. So, how do we get a plot of the temperature values in our project? We'll write the code ourselves! Well, actually, I'll give you the code.

Included in the **VCSDB\Code\Class 10\Example 10-3** is a file (a Visual C# class) named **TempPlot.cs**. This file contains the code to do our plotting task using a **TempPlot** object. The **TempPlot** object will draw line charts of the high and low temperatures in the blank panel on the **View Temperature Data** tab. It uses several Visual C# graphics methods to draw the plot and save it to a bitmap to allow printing. We won't go into the details of the routine - you can look through the code if you'd like. Just use it like any other object we've used in this course. The techniques used to develop the code are taught in a course named **Learn Visual C#** which is available on our website (<http://www.kidwaresoftware.com>).

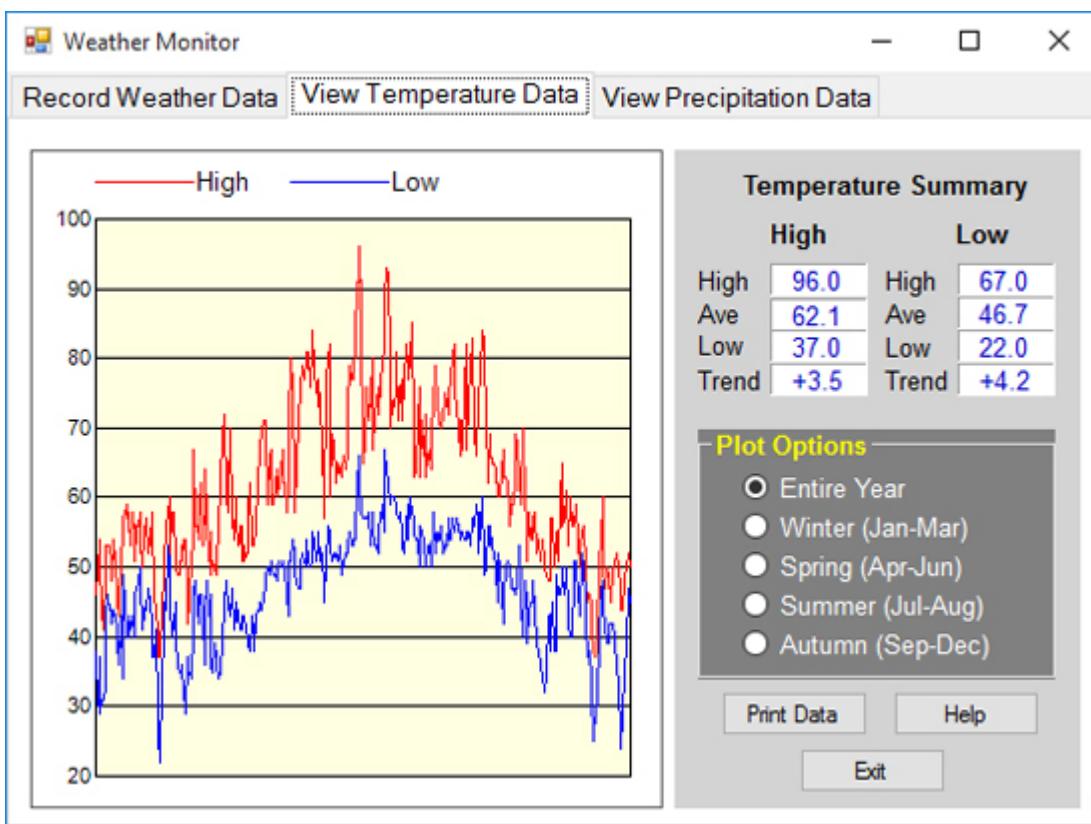
1. Add the **TempPlot.cs** class to your project. To do this, right-click the weather monitor project name in the Solution Explorer window. Select **Add**, then **Existing Item**. Navigate to the **TempPlot.cs** file and click **Add**. The file will now appear in your project's Solution Explorer window.
2. Add these four lines of code at the bottom of the **TemperatureData** general method:

```
TempPlot temperaturePlot = new TempPlot(pnlTempPlot);
if (!noData)
```

```
temperaturePlot.Draw(nDays, highTemp, lowTemp);
```

These lines first create a **TempPlot** object named **temperaturePlot** using the panel control **pnlTempPlot**. If there is data, it is then plotted (using the **highTemp** and **lowTemp** arrays) with the **Draw** method. It's that simple!

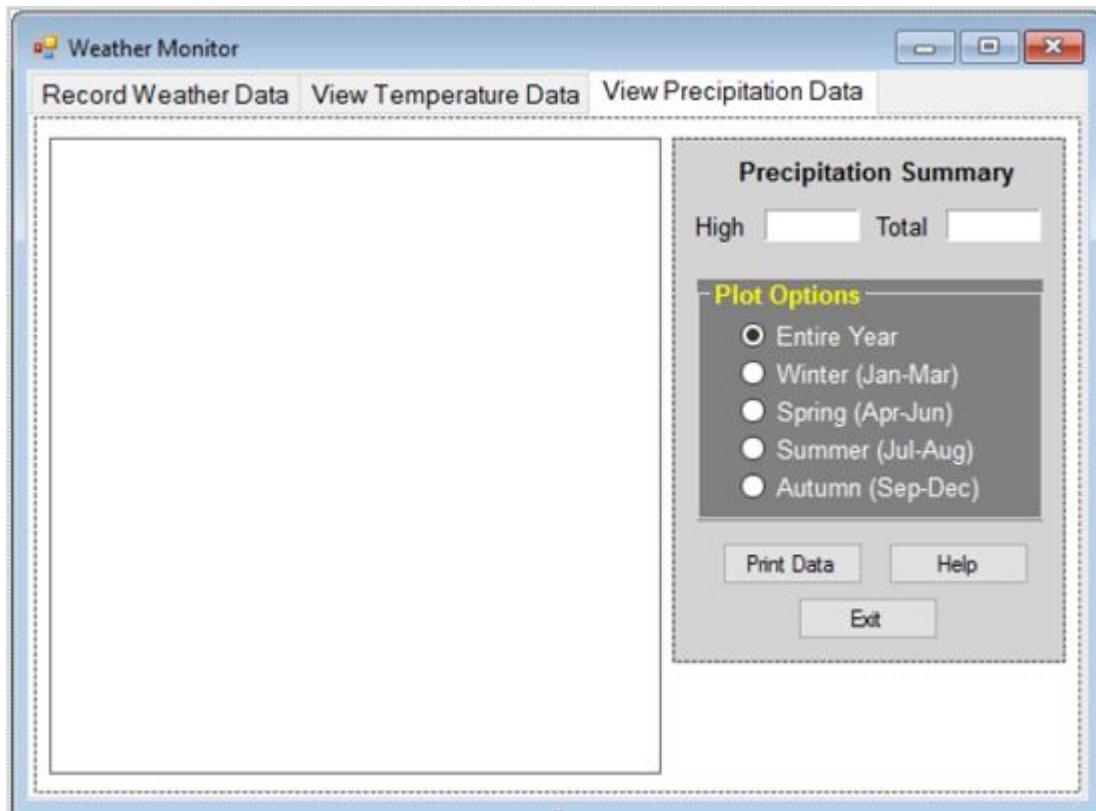
3. Save and run the application. Create a file and enter some data or open an existing file. Click the **View Temperature Data** tab. Here's the plotted data for the **Sea03DB.accdb** file:



Now, let's create a very similar tab for the precipitation data.

View Precipitation Data Tab

When this tab is clicked, we will provide a plot of precipitation amounts and some summary statistics. You can choose what season of the year to plot precipitation for. Here's the finished tab layout to assist you in building the interface:



1. In design mode, select the **View Precipitation** tab. Like we did for the temperature tab, place a panel control on the form for the plot. It should take up a little more than one-half the tab width. Set these properties:

panel1:

Name pnlPrecipPlot

BackColor White
BorderStyle FixedSingle

2. On the same tab, add another panel, and in the panel control, add four label controls, a group box, and three buttons. Set these properties (default names may differ - refer to the finished form for each control)

panel1:

BackColor Light Gray

label1:

Text Precipitation Summary
Font Arial, Bold, Size 10

label1:

Text High
Font Arial, Size 10

label2:

Name lblPH
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
 TextAlign MiddleCenter

label3:

Text Total
Font Arial, Size 10

label4:

Name lblPT
AutoSize False
BorderStyle Fixed3D
BackColor White
ForeColor Blue
Font Arial, Size 10
Text [Blank]
 TextAlign MiddleCenter

button1:

Name btnPrintPrecip
FontSize 8
Text Print Data

button2:

Name btnHelpPrecip
FontSize 8
Text Help

button3:

Name btnExitPrecip
FontSize 8
Text Exit

groupBox1:

Text Plot Options
BackColor Dark Gray
Font Arial, Bold, Size 10

4. In the group box, place five radio buttons. Use these properties:

radioButton1:

Name rdoPrecipYear

Text Entire Year
Checked True
Font Arial, Size 10
ForeColor White

radioButton2:

Name rdoPrecipWinter
Text Winter (Jan-Mar)
Font Arial, Size 10
ForeColor White

radioButton3:

Name rdoPrecipSpring
Text Spring (Apr-Jun)
Font Arial, Size 10
ForeColor White

radioButton4:

Name rdoPrecipSummer
Text Summer (Jul-Sep)
Font Arial, Size 10
ForeColor White

radioButton5:

Name rdoPrecipAutumn
Text Autumn (Oct-Dec)
Font Arial, Size 10
ForeColor White

The tab layout is complete. When the tab is selected, we will form the required plot and compute the needed summary statistics. We will do the summaries first.

Precipitation Summary Statistics

1. Add a general method named **PrecipitationData** to the project and use this code:

```
private void PrecipitationData()
{
    // make sure there is a data table
    if (weatherConnection == null)
        return;
    float prec;
    int xStart = 0, xEnd = 0, nDays, isLeap;
    float precH, precT;
    bool noData;
    float[] precip = new float[366];
    if (weatherTable.Rows.Count == 365)
        isLeap = 0;
    else
        isLeap = 1;
    switch (precipPlot)
    {
        case 0:
            xStart = 0;
            xEnd = 364 + isLeap;
            break;
        case 1:
            xStart = 0;
            xEnd = 89 + isLeap;
    }
}
```

```
        break;
    case 2:
        xStart = 90 + isLeap;
        xEnd = 180 + isLeap;
        break;
    case 3:
        xStart = 181 + isLeap;
        xEnd = 272 + isLeap;
        break;
    case 4:
        xStart = 273 + isLeap;
        xEnd = 364 + isLeap;
        break;
    }
nDays = xEnd - xStart + 1;
// precipitation data
precH = -1000; precT = 0;
noData = true;
for (int x = xStart; x <= xEnd; x++)
{
    if (weatherTable.Rows[x]["Precip"] != DBNull.Value)
    {
        prec =
Convert.ToSingle(weatherTable.Rows[x]["Precip"]);
        noData = false;
    }
    else
    {
        prec = 0.0F;
    }
}
```

```

precip[x - xStart] = prec;
if (prec > precH)
    precH = prec;
precT += prec;
}
if (!noData)
{
    lblPH.Text = String.Format("{0:f2}", precH);
    lblPT.Text = String.Format("{0:f1}", precT);
}
else
{
    lblPH.Text = "---";
    lblPT.Text = "---";
}
}

```

Similar to the temperature plot, this code simply goes through every record in the database and stores points for plotting in the `precip` array. Any null value is assigned a value of zero. It also computes summary information.

2. To bring up the information on this tab, modify the `tabWeather_SelectedIndexChanged` event method (new code is shaded):

```

private void tabWeather_SelectedIndexChanged(object
sender, EventArgs e)
{
    switch (tabWeather.SelectedIndex)
    {
        case 1:

```

```
        TemperatureData();
        break;
    case 2:
        PrecipitationData();
        break;
    }
}
```

3. Add this variable to the form level declarations (it tells us which plot option is selected):

```
int precipPlot = 0;
```

4. Place this code in the `rdoPrecipPlot_CheckedChanged` event method (handles click on all precipitation radio buttons):

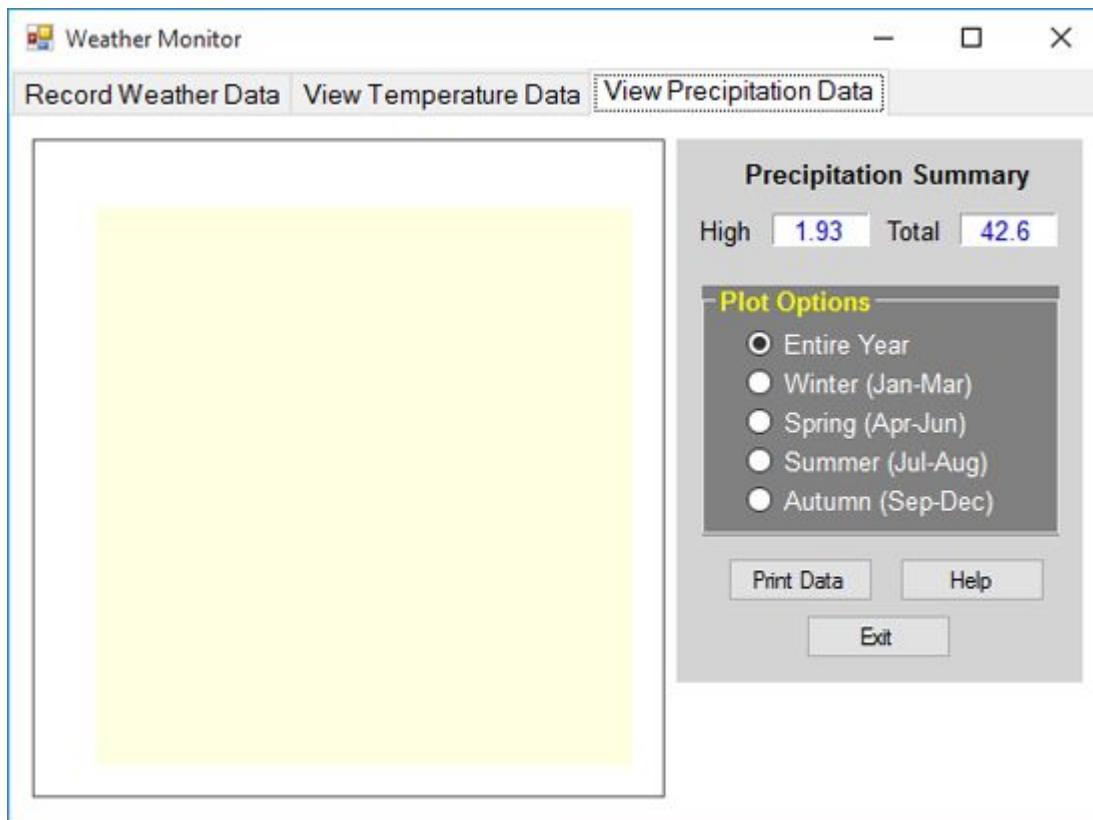
```
private void rdoPrecipPlot_CheckedChanged(object
sender,
EventArgs e)
{
    RadioButton whichButton = (RadioButton)sender;
    switch (whichButton.Name)
    {
        case "rdoPrecipYear":
            precipPlot = 0;
            break;
        case "rdoPrecipWinter":
            precipPlot = 1;
            break;
        case "rdoPrecipSpring":
            precipPlot = 2;
            break;
    }
}
```

```

        case "rdoPrecipSummer":
            precipPlot = 3;
            break;
        case "rdoPrecipAutumn":
            precipPlot = 4;
            break;
    }
    PrecipitationData();
}

```

5. Save the application. Run it. Try entering some data to plot. When I load **Sea03DB.accdb**, here's what I get for a year's worth of precipitation:



We complete the tab by adding a bar chart of the precipitation.

Precipitation Plot

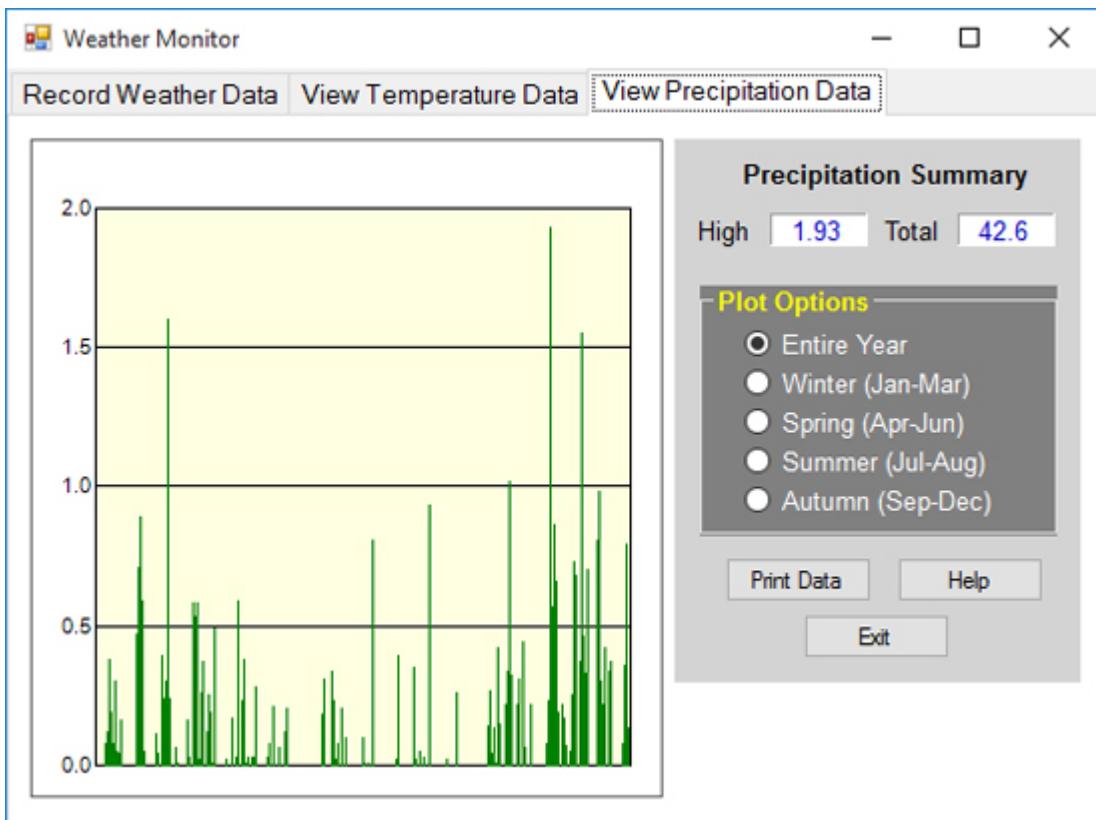
Like the Temperature Plot, we'll give you the code to draw the **Precipitation Plot**. Included in the **VCSDB\Code\Class 10\Example 10-3** is a file (a Visual C# class) named **PrecipPlot.cs**. This file contains the code to do our plotting task using a **PrecipPlot** object. The **PrecipPlot** object will draw a bar chart of the precipitation data in the blank panel on the **View Precipitation Data** tab

1. Add the **PrecipPlot.cs** class to your project. To do this, right-click the project name in the Solution Explorer window. Select **Add**, then **Existing Item**. Navigate to the **PrecipPlot.cs** file and click **Add**. The file will now appear in your project's Solution Explorer window.
2. Add these two lines of code at the bottom of the **PrecipitationData** general method:

```
PrecipPlot precipitationPlot = new  
PrecipPlot(pnlPrecipPlot);  
if (!noData)  
    precipitationPlot.Draw(nDays, precip);
```

These lines first create a **PrecipPlot** object named **precipitationPlot** using the panel control **pnlPrecipPlot**. If there is data to plot, it is done (using the **precip** array) with the **Draw** method.

3. Save and run the application. Create a file and enter some data or open an existing file. Click the **View Precipitation Data** tab. Here's the plotted data for the **Sea02DB.accdb** file:



Weather Monitor Printed Reports

Each of the tabs in the Weather Monitor application has a **Print Data** tab. On the first tab, we want a printed listing of all temperatures, precipitation, and any comment. On the other tabs, we want a copy of the displayed plot and summary information. Here, we develop those reports, doing the data listing report first. But first, let's build some boilerplate.

1. Add a print preview dialog control. Name it **dlgPreview**.
2. Add a variable to the form level declarations to keep track of page number:

```
int pageNumber;
```

3. Add this line at the top of the code window:

```
using System.Drawing.Printing;
```

4. Add this code to the **btnPrint_Click** event method (handles clicking on all three print buttons):

```
private void btnPrint_Click(object sender, EventArgs e)
{
    // make sure there is a data table
    if (weatherConnection == null)
        return;
    // Declare the document
    PrintDocument recordDocument;
    // Create the document and name it
```

```

recordDocument = new PrintDocument();
recordDocument.DocumentName = "Weather Data";
// Add code handler based on button pressed
Button whichButton = (Button) sender;
switch (whichButton.Name)
{
    case "btnPrintData":
        recordDocument.PrintPage += new
PrintPageEventHandler(this.PrintDataReport);
        break;
    case "btnPrintTemp":
        recordDocument.PrintPage += new
PrintPageEventHandler(this.PrintTemperatureReport);
        break;
    case "btnPrintPrecip":
        recordDocument.PrintPage += new
PrintPageEventHandler(this.PrintPrecipitationReport);
        break;
}
// Preview document
pageNumber = 1;
dlgPreview.Document = recordDocument;
dlgPreview.ShowDialog();
// Dispose of document when done printing
recordDocument.Dispose();
}

```

Depending on which button is clicked, the corresponding print document is formed and attached to the proper method for printing (PrintDataReport, PrintTemperatureReport, or PrintPrecipitationReport).

Weather Data Report

In this report, we will print a multiple page listing of all the data in the database in a tabulated form.

1. Add this code to the `PrintDataReport` method:

```
private void PrintDataReport(object sender,
PrintPageEventArgs e)
{
    Font myFont;
    int y;
    const int daysPerPage = 40;
    myFont = new Font("Courier New", 14,
FontStyle.Bold);
    y = e.MarginBounds.Top + 50;
    // Print header
    e.Graphics.DrawString("Weather Data - Page " +
pageNumber.ToString(), myFont, Brushes.Black,
e.MarginBounds.Left, y);
    y += 2 *
Convert.ToInt32(myFont.GetHeight(e.Graphics));
    myFont = new Font("Courier New", 12,
FontStyle.Bold |
FontStyle.Underline);
    e.Graphics.DrawString("Date", myFont,
Brushes.Black,
e.MarginBounds.Left, y);
    e.Graphics.DrawString("HighTemp", myFont,
Brushes.Black,
```

```
e.MarginBounds.Left + 125, y);
    e.Graphics.DrawString("LowTemp", myFont,
    Brushes.Black,
e.MarginBounds.Left + 225, y);
    e.Graphics.DrawString("Precip", myFont,
    Brushes.Black,
e.MarginBounds.Left + 325, y);
    e.Graphics.DrawString("Comment", myFont,
    Brushes.Black,
e.MarginBounds.Left + 425, y);
    myFont = new Font("Courier New", 12,
    FontStyle.Regular);
    y +=
    Convert.ToInt32(myFont.GetHeight(e.Graphics));
    int n1 = 1 + (pageNumber - 1) * daysPerPage;
    int n2 = n1 + daysPerPage - 1;
    if (n2 > weatherTable.Rows.Count)
        n2 = weatherTable.Rows.Count;
    string s;
    for (int n = n1; n <= n2; n++)
    {
        e.Graphics.DrawString(Convert.ToDateTime(weatherTable
        .Rows
        [n - 1]["WeatherDate"]).ToShortDateString(), myFont,
        Brushes.Black, e.MarginBounds.X, y);
        if (weatherTable.Rows[n - 1]["HighTemp"] !=
        DBNull.Value)
            s = String.Format("{0:f1}",
            weatherTable.Rows[n - 1]["HighTemp"]);
        else
            s = "";
    }
}
```

```
        e.Graphics.DrawString(s, myFont, Brushes.Black,
e.MarginBounds.X + 200 - e.Graphics.MeasureString(s,
myFont).Width, y);
        if (weatherTable.Rows[n - 1]["LowTemp"] !=
DBNull.Value)
            s = String.Format("{0:f1}",
weatherTable.Rows[n - 1]["LowTemp"]);
        else
            s = "";
        e.Graphics.DrawString(s, myFont, Brushes.Black,
e.MarginBounds.X + 300 - e.Graphics.MeasureString(s,
myFont).Width, y);
        if (weatherTable.Rows[n - 1]["Precip"] !=
DBNull.Value)
            s = String.Format("{0:f1}",
weatherTable.Rows[n - 1]["Precip"]);
        else
            s = "";
        e.Graphics.DrawString(s, myFont, Brushes.Black,
e.MarginBounds.X + 375 - e.Graphics.MeasureString(s,
myFont).Width, y);
        s = weatherTable.Rows[n - 1]
["Comment"].ToString();
// limit length of comment to 20 characters
        if (s.Length > 20)
            s = s.Substring(0, 20);
        e.Graphics.DrawString(s, myFont, Brushes.Black,
e.MarginBounds.X + 425, y);
        y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
    }
```

```
if (n2 != weatherTable.Rows.Count)
{
    pageNumber++;
    e.hasMorePages = true;
}
Else
{
    e.hasMorePages = false;
    pageNumber = 1;
}
}
```

This goes through each record in the database table and formats a single line listing. Blanks are inserted if fields are null. The report is over 10 pages for a full year of data.

2. Save and run the application. Click **Print Data** on the **Record Weather Data** tab. Here's the first page of a report for the **Sea03DB.accdb** sample database shown in the print preview dialog control:

Print preview

Close

Page 1

Weather Data - Page 1					
Date	HighTemp	LowTemp	Precip	Comment	
1/1/2003	46.0	38.0	0.0		
1/2/2003	50.0	30.0	0.0		
1/3/2003	54.0	37.0	0.0		
1/4/2003	51.0	29.0	0.0		
1/5/2003	44.0	31.0	0.0		
1/6/2003	41.0	31.0	0.0		
1/7/2003	50.0	33.0	0.1		
1/8/2003	53.0	43.0	0.1		
1/9/2003	53.0	46.0	0.4		
1/10/2003	53.0	44.0	0.2		
1/11/2003	51.0	44.0	0.2		
1/12/2003	48.0	42.0	0.1		
1/13/2003	54.0	44.0	0.3		
1/14/2003	51.0	43.0	0.2		
1/15/2003	46.0	41.0	0.1		
1/16/2003	45.0	39.0	0.0		
1/17/2003	43.0	36.0	0.2		
1/18/2003	52.0	43.0	0.1		
1/19/2003	54.0	34.0	0.0		
1/20/2003	57.0	49.0	0.0		
1/21/2003	58.0	45.0	0.0		
1/22/2003	59.0	40.0	0.0		
1/23/2003	55.0	43.0	0.0		
1/24/2003	58.0	40.0	0.0		
1/25/2003	53.0	42.0	0.0		
1/26/2003	58.0	43.0	0.0		
1/27/2003	55.0	40.0	0.0		
1/28/2003	51.0	46.0	0.5		
1/29/2003	56.0	47.0	0.5		
1/30/2003	56.0	48.0	0.7		
1/31/2003	58.0	50.0	0.9		
2/1/2003	54.0	48.0	0.6		
2/2/2003	50.0	41.0	0.0		
2/3/2003	55.0	44.0	0.1		
2/4/2003	57.0	45.0	0.0		
2/5/2003	57.0	44.0	0.0		
2/6/2003	52.0	47.0	0.0		
2/7/2003	54.0	45.0	0.0		
2/8/2003	58.0	42.0	0.0		
2/9/2003	57.0	37.0	0.0		

Temperature Data Report

Here, we want to obtain a printed copy of the information displayed in the **View Temperature Data** tab. The information we want to print is: the summary information on all temperatures and the graphs in the panel control.

1. Put this code in the **PrintTemperatureReport** method:

```
private void PrintTemperatureReport(object sender,
PrintPageEventArgs e)
{
    Font myFont = new Font("Courier New", 12,
FontStyle.Regular);
    int y = 125;
    e.Graphics.DrawString("Weather Monitor", myFont,
Brushes.Black, e.MarginBounds.X, y);
    y += Convert.ToInt32(2 *
myFont.GetHeight(e.Graphics));
    myFont = new Font("Courier New", 12,
FontStyle.Regular |
FontStyle.Underline);
    e.Graphics.DrawString("Temperatures:", myFont,
Brushes.Black, e.MarginBounds.X, y);
    y += Convert.ToInt32(2 *
myFont.GetHeight(e.Graphics));
    myFont = new Font("Courier New", 12,
FontStyle.Regular);
    e.Graphics.DrawString("High Temperature", myFont,
Brushes.Black, 150, y);
```

```
e.Graphics.DrawString("Low Temperature", myFont,
Brushes.Black, 400, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString(" High = " + lblTHH.Text,
myFont,
Brushes.Black, 150, y);
e.Graphics.DrawString(" High = " + lblTLH.Text,
myFont,
Brushes.Black, 400, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString(" Ave = " + lblTHA.Text,
myFont,
Brushes.Black, 150, y);
e.Graphics.DrawString(" Ave = " + lblTLA.Text,
myFont,
Brushes.Black, 400, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString(" Low = " + lblTHL.Text,
myFont,
Brushes.Black, 150, y);
e.Graphics.DrawString(" Low = " + lblTLL.Text,
myFont,
Brushes.Black, 400, y);
y +=
Convert.ToInt32(myFont.GetHeight(e.Graphics));
e.Graphics.DrawString(" Trend = " + lblTHT.Text,
myFont,
Brushes.Black, 150, y);
e.Graphics.DrawString(" Trend = " + lblTLT.Text,
myFont,
```

```
Brushes.Black, 400, y);
    if (pn1TempPlot.BackgroundImage != null)
        e.Graphics.DrawImage(pn1TempPlot.BackgroundImage
            , 150,
            300, 500, Convert.ToInt32(500 *
pn1TempPlot.ClientSize.Height /
pn1TempPlot.ClientSize.Height));
    e.HasMorePages = false;
}
}
```

The summary information is printed first. Then the **DrawImage** method is used to print the graph (the height to width ratio is maintained).

2. Save and run the application. Load a database. Go to the **View Temperature Data** tab. Click **Print Data**. The report for **Sea03DB.accdb** looks like this (full year of data):

Weather Monitor

Temperatures:

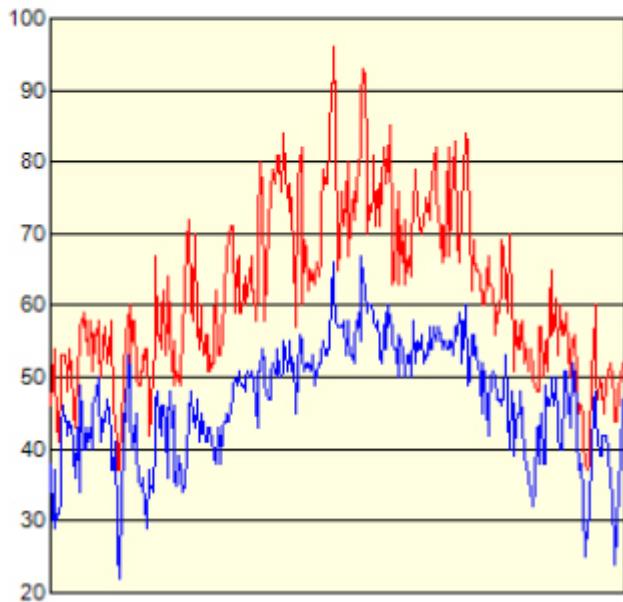
High Temperature

High = 96.0
Ave = 62.1
Low = 37.0
Trend = +3.5

Low Temperature

High = 67.0
Ave = 46.7
Low = 22.0
Trend = +4.2

— High — Low



Precipitation Data Report

Lastly, we need to obtain a printed copy of the information displayed in the **View Precipitation Data** tab. The information we want to print is: the summary information on precipitation and the graph in the panel control.

1. Put this code in the **PrintPrecipitationReport** method:

```
private void PrintPrecipitationReport(object sender,
PrintPageEventArgs e)
{
    Font myFont = new Font("Courier New", 12,
FontStyle.Regular);
    int y = 125;
    e.Graphics.DrawString("Weather Monitor", myFont,
Brushes.Black, e.MarginBounds.X, y);
    y += Convert.ToInt32(2 *
myFont.GetHeight(e.Graphics));
    myFont = new Font("Courier New", 12,
FontStyle.Regular |
FontStyle.Underline);
    e.Graphics.DrawString("Precipitation:", myFont,
Brushes.Black, e.MarginBounds.X, y);
    y += Convert.ToInt32(2 *
myFont.GetHeight(e.Graphics));
    myFont = new Font("Courier New", 12,
FontStyle.Regular);
    e.Graphics.DrawString(" High = " + lblPH.Text,
myFont,
```

```
Brushes.Black, 150, y);
e.Graphics.DrawString(" Total = " + lblPT.Text,
myFont,
Brushes.Black, 400, y);
if (pn1PrecipPlot.BackgroundImage != null)
    e.Graphics.DrawImage(pn1PrecipPlot.BackgroundImage,
150, 250, 500, Convert.ToInt32(500 *
pn1TempPlot.ClientSize.Height /
pn1TempPlot.ClientSize.Height));
e.HasMorePages = false;
}
```

The summary information is printed first. Then the `DrawImage` method is used to print the graph (the height to width ratio is maintained).

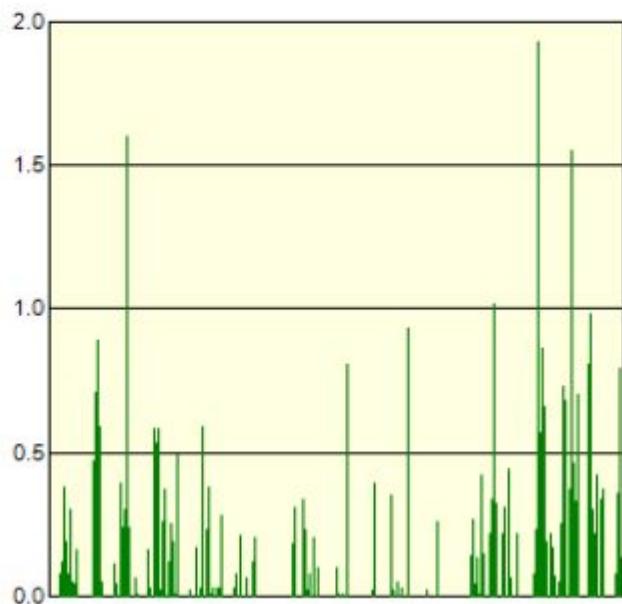
2. Save and run the application. Load a database. Go to the **View Precipitation Data** tab. Click **Print Data**. The report for `Sea03DB.accdb` looks like this (full year of data):

Weather Monitor

Precipitation:

High = 1.93

Total = 42.6



Weather Monitor Help System

The last thing left to code in the Weather Monitor application is the **Help** button. We will develop a simple help system for our application and write the code necessary to access it. We will use the **HTML Help Workshop** discussed in Chapter 5. Review that material if needed.

1. Create a help topic file using FrontPage or similar product (saved as **weather.htm** in the **VCSDB\Code\Class 10\Example 10-3\HelpFile** folder). The file I developed is:

Record Weather Data

When you choose this option, you have three choices: New File, Open File, and Print Data.

If you click New File, the data input grid is cleared and filled with days for the corresponding year. You need to pick a name and directory for your new file using the common dialog box that appears. Enter data in the resulting grid (high temperature, low temperature, precipitation, comment) for any days you choose. The displayed calendar can be used to find specific days in the grid.

Click Open File to open a previously saved file. A file list box will appear - click on the desired file, then click OK. Or, simply double-click the file name. The file will be opened and the saved data will appear in the grid. At this point, make any changes or additions needed. The displayed calendar can be used to find specific days in the grid.

To obtain a printed copy of the displayed data file, click Print Data. This printed copy can contain data or be blank to allow you to record your data on paper, occasionally transferring the values to the computer.

View Temperature Data

Choose this option to obtain a graphical view of the temperature data entered under Record Weather Data. Also see summaries of the data. The line plot shows the high and low temperatures. Also shown on the form are various data summaries. You are given the high, average, and low values for both the high and low temperatures and their trend values. You can obtain a printed copy of these summary values and the plots by clicking on Print Data.

View Precipitation Data

Choose this option to obtain a graphical view of the precipitation data entered under Record Weather Data. Also see summaries of the data. The bar plot shows the daily precipitation. Also shown on the form are various data summaries. You are given the high and total measured precipitation. You can obtain a printed copy of these summary values and the plot by clicking on Print Data.

2. In the HTML Help Workshop, prepare a project file (**weather.hhp**) including the topic file just created. Compile the help file (**weather.chm**). All these files are saved in the **VCSDB\Code\Class 10\Example 10-3\HelpFile** folder. Copy **weather.chm** to the Weather Monitor projects' **Bin\Debug** folder.
3. Load the Weather Monitor application. Add a help provider control. Name it **hlpWeather**. Set the **HelpNavigator** property of **frmWeather** to **TableofContents**.

4. Add the shaded code to the `frmWeather_Load` method. This points to the help file:

```
private void frmWeather_Load(object sender, EventArgs e)
{
    // point to help file
    hlpWeather.HelpNamespace = Application.StartupPath +
    "\\weather.chm";
    for (int y = 1900; y <= 2100; y++)
    {
        cboYear.Items.Add(y.ToString());
    }
    cboYear.Text =
    calDate.SelectionStart.Year.ToString();
    tabWeather.SelectedTab = tabPageData;
    grdWeather.AutoSizeColumnsMode =
    DataGridViewAutoSizeColumnsMode.Fill;
    grdWeather.AllowUserToAddRows = false;
}
```

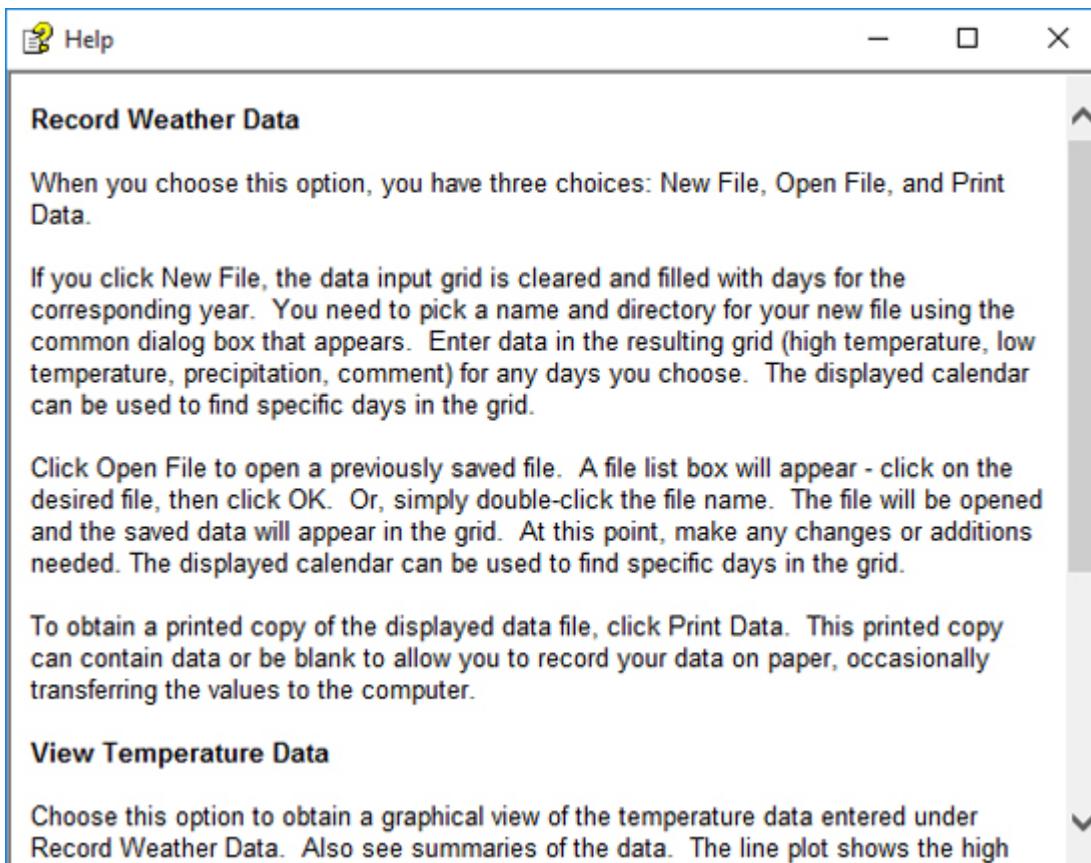
5. Use this code in the `btnHelp_Click` event method. All three help buttons are handled by this method:

```
private void btnHelp_Click(object sender, EventArgs e)
{
    Help.ShowHelp(this, hlpWeather.HelpNamespace);
}
```

6. Lastly, add this code to the `btnExit_Click` event method, which handles the Click event for any of the three help buttons:

```
private void btnExit_Click(object sender, EventArgs e)
{
    this.Close();
}
```

7. Save and run the application. Make sure the **Help** button works in all three tabs of the tab control. Make sure <F1> brings up help. Here's what you should see:



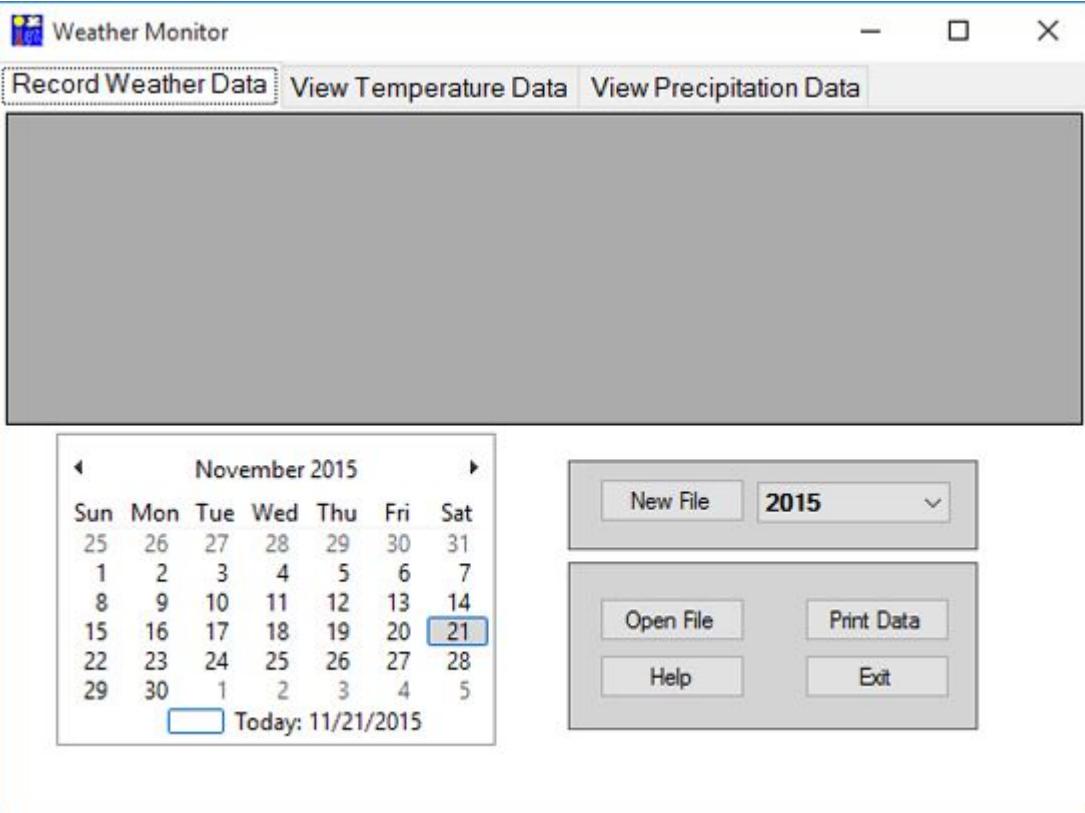
Make sure all the **Exit** buttons work too.

Weather Monitor Icon

The coding for the Weather Monitor application is now complete. A goal is to distribute this application to other users for their comments. Before doing that, let's get rid of the rather ugly Visual Basic icon stuck on our form.

Find an icon on the internet or design your own using the Microsoft Paint program. We include one you might like. It is saved as **weather.ico** in the **VBDB\General\Class 10\Example 10-3** folder.

Go to Visual Basic and load your application. Go to the **Properties** window and click the form's **Icon** property. Select your new icon. The icon should now appear in the upper left hand corner of your form when you run the program. It's much nicer than the default icon, don't you agree?



Weather Monitor Distribution Package

We're now ready to send our Weather Monitor program out into the world. But, first we need to build a distribution package. We will use the **Visual Basic Setup Wizard** discussed in Chapter 8. You may like to review this material before proceeding.

1. Add a **Setup Wizard** project to the **Weather Monitor** solution. The Access version of the project developed here is **Weather Monitor** in the **VCSDB\Code\Class 10** folder. Follow the wizard steps. It is important to remember to add the **weather.chm** file in Step 4 where you are asked what additional files to include
2. Create shortcuts and associated icons for installation in the User's Desktop and User's Program Menu.
3. Try installing the application on your computer. Better yet, take the files (use a CD-ROM) to another Windows-based machine, preferably without Visual Basic installed. Install the application using the distribution package and test its operation. To run the newly installed application, click **Start** on the Windows task bar. Choose **All Apps** and click your application. It will begin executing like any Windows program! If desired, try removing your application.

The **Weather Monitor** is now complete - a long, educational journey.

Suggested Improvements

Even though the **Weather Monitor Project** is complete (the final version is saved in **Example 10-3** folder in **VCSDB\Code\Class 10** folder), there are some possible changes we could make. We'll give you some of our ideas. I'm sure you have some ideas too.

We make sure the user can only type numbers, decimal points, or the negative sign in the temperature and precipitation fields. But, there is no way to prevent the user from typing multiple decimal points and negative signs. Can you think of a way to modify the entry validation code to limit each field to (at most) one decimal point and one negative sign?

In its current implementation, we plot temperature and precipitation data from a single file. It would be interesting to be able to plot another file on the same grids. This would allow a user to compare one year with another or compare weather files from two different locations. You would need additional data objects for each file you wanted to add. Editing of multiple files could also get tricky.

The plotted data is static - no user interaction is possible. It would be nice to have the ability to 'zoom' in on certain plot areas. See if this is possible with the panel we use.

Add more labels to plots and printed reports. For example, the printed plots do not indicate any time period. Add this information by indicating which radio button is clicked.

Add other fields to the database and modify the application. Perhaps add barometric pressure. Performing such a modification will point out the importance of thinking through your database

design correctly the first time. Adding a field, though increasing the usability of your application, also causes many headaches in later modifications.

Add the ability to automatically convert external data files to a format usable by the application. For example, the US Weather Service makes temperature and precipitation files available for download on the Internet. Can you adapt this application to read those files and load the data into an Access database file? We'll look at one way to do this in Chapter 11.

Example 10-3

Using SQL Server Databases

Differences in the SQL Server version of the example:

1. Change these properties:

OpenFileDialog1:

Name	dlgOpen
DefaultExt	mdf
FileName	[blank]
Filter	SQL Server Files (*.mdf) *.mdf

SaveFileDialog1:

Name	dlgSave
OverwritePrompt	True
DefaultExt	mdf
Filter	SQL Server Files (*.mdf) *.mdf

2. In the VCSDB/Databases folder is an empty weather database named **SQLWeatherDBBlank.mdf**. This was created using Server Explorer. It has a single table (**Weather**) with the following fields (Columns):

	Column Name	Data Type	Allow Nulls
1	WeatherDate	datetime	<input type="checkbox"/>
2	HighTemp	float	<input checked="" type="checkbox"/>
3	LowTemp	float	<input checked="" type="checkbox"/>
4	Precip	float	<input checked="" type="checkbox"/>
5	Comment	varchar(50)	<input checked="" type="checkbox"/>
6			<input type="checkbox"/>

Copy this file to your application's Bin\Debug folder (you may have to create it). When a user selects **New File**, we will copy this database file to the name selected by the user with the save dialog control.

3. Use this code for the initial **btnNew_Click** event method (later modifications are the same as the Access version):

```
private void btnNew_Click(object sender, EventArgs e)
{
    try
    {
        // get filename
        if (dlgSave.ShowDialog() == DialogResult.OK)
        {
            // create table
            FileCopy(Application.StartupPath +
"\\SQLWeatherDBBlank.mdf", dlgSave.FileName)
        }
    }
    catch (Exception ex)
    {
        MessageBox.Show(ex.Message, "Error Creating
Database",
MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}
```

This code creates an empty weather database using the selected name, **dlgSave.FileName**. Note this code assumes the empty file (**SQLWeatherDBBlank.mdf**) is in the application startup directory.

4. Use this using statement:

```
using System.Data.SqlClient;
```

5. Change all instances of **OleDbConnection** to **SqlConnection**

Change all instances of **OleDbCommand** to **SqlCommand**

Change all instances of **OleDbDataAdapter** to **SqlDataAdapter**

Change all instances of **OleDbCommandBuilder** to
SqlCommandBuilder

6. In **OpenConnection** method, use this connection object:

```
WeatherConnection = new SqlConnection("Data  
Source=.\SQLEXPRESS; AttachDbFilename=" + fName + ";  
Integrated Security=True; Connect Timeout=30; User  
Instance=True"); 7. Sample SQL Server databases  
(SQLSea02DB.mdf and SQLSea03DB.mdf) are in the  
VCSDB\Code\Class 10\Example 10-3 folder.
```

If you build a distribution package, be sure to include **SQLWeatherDBBlank.mdf** (the empty database).

Summary

In this chapter, we developed three different database applications. Each application addressed some typical concerns you may encounter in developing your own applications.

At this point in your studies, you should have a good understanding of the Visual C# data objects. You are fluent in the development of well-designed Visual C# database interfaces. And, you know how to create databases and database reports. In the final course chapter, we address a few final topics that can serve as springboards into making you an advanced database programmer.

11

Other Database Topics

Review and Preview

You have essentially completed the **Visual C# and Databases** course. At this point, you have a good intermediate understanding of using Visual C# with Access databases. But, even after 700 pages of notes, there is still much to learn.

In this last chapter, we look at several unrelated topics. This information is provided to help you progress in your skills as a Visual C# database programmer. We discuss exporting and importing database data, working with other database types, multi-user considerations, and web applications. The examples in this chapter only use Access databases. If you are using SQL Server databases, you should now have the skills to modify the examples to work with your databases.

Exporting Database Data

A common task in any application, and not just database applications, is to have the ability to move information from one application to another. In this section, we discuss **exporting** data from a database. And, in the next, we will cover the related **importing** problem. Data can be transferred in a variety of formats. Here, we only discuss how to transfer data via **sequential disk files**. An increasingly popular format is XML files for Internet use - this is something you might like to investigate if you will be using your applications on the Internet.

A sequential file is a line-by-line list of data. You can view a sequential file with any text editor. We will use a particular type of a sequential file - a **comma-delimited** file. This file has a Windows extension of **csv** (comma separated variables) and is the most common format for exporting and importing data between applications. When working with a database, we simply go through our data table and, for each record, write the desired field values on a single line of the file, separating them by commas.

The method followed to export data from a database to a sequential file is:

1. Open the database and establish the database table using the ADO .NET data objects.
2. Open the desired output sequential file (use a **csv** extension with its name).
3. For each record in the data table, write the desired fields (separated by commas) to the output file.
4. Close and save the sequential file.

We know how to establish the data table. Let's look at the other steps.

The methods used for exporting and importing data are in the **System.IO** namespace. Hence, we add this line to the top of our code window:

```
using System.IO;
```

Opening a Sequential File for Output

The Visual C# syntax to open a sequential file for output is:

```
StreamWriter outputFile;  
outputFile = new StreamWriter(myFile);
```

where **myFile** is the name (a **string**) of the file to open and **outputFile** is the returned **StreamWriter** object used to write information to disk. Make sure **myFile** has an extension of **csv**. Be aware if the file being opened already exists, the first thing the Windows operating system does is erase the existing file! So, put in any protections you might want to avoid wiping out a needed file. Once the file is opened, it is ready for writing data to it.

If the data export feature is to be an integral part of your database application, an open file dialog box should be used to obtain the path to the sequential file. Use a **DefaultExt** of **csv** and check for overwrite permissions. If you are using files for just a quick export job, we suggest putting the sequential file in your application directory. Recall the **Application.StartupPath** property provides this path. As an example, to open **test.csv** in our application directory as **outputFile**, we would use:

```
outputFile = new StreamWriter(Application.StartupPath  
+ "\\test.csv");
```

Writing Data to a Sequential File

Once opened, writing data to the file is a simple task. Information (variables or text) is written to a sequential file in an appended fashion. Separate Visual C# statements are required for each appending.

For a file opened as **outputFile**, the syntax is to save a variable named **MyVariable** is:

```
outputFile.WriteLine(myVariable);
```

This statement will append the specified variable (a field from our database) to the current line in the sequential file. With **Write** for output, everything will be written in one very long line. For **csv** files, we append a comma to the line after each piece of information.

Example for three fields **field1**, **field2**, **field3**:

```
StreamWriter outputFile;
outputFile = new
StreamWriter("c:\\junk\\TestOut.csv");
outputFile.WriteLine(field1);
outputFile.WriteLine(",");
outputFile.WriteLine(field2);
outputFile.WriteLine(",");
outputFile.WriteLine(field3);
```

After this code runs, the file **c:\junk\TestOut.txt** will have a single line with all three fields separated by commas.

To move to a new line once a line is complete, use:

```
outputFile.WriteLine(outputFile.NewLine);
```

You should know that we are not restricted to only exporting data in comma-delimited format. With Visual C#, we can write data to files in any format we want. In fact, there are instances where applications may require a file that is not comma-delimited. We won't do that here, however.

Saving a Sequential File

When done writing to the file, it is closed using the **Close** method.
For our example, the syntax is:

```
outputFile.Close();
```

Once a file is closed, it is saved on the disk under the path and filename used to open the file.

Example 11-1

Exporting Database Data

In this example, we will export the customer data from the **KWSalesDB.accdb** database studied in Chapters 9 and 10 to a comma-delimited file. We will then load the resulting **csv** file into Microsoft Excel for viewing. This is typical of export tasks. Recall the customers table has seven fields: **CustomerID**, **FirstName**, **LastName**, **Address**, **City**, **State** and **Zip**.

1. Start a new application. Place a button on the form. Set these properties:

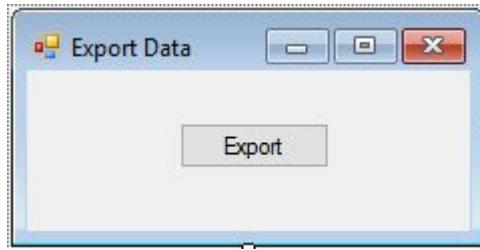
Form1:

Name	frmExport
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Export Data

button1:

Name	btnExport
Text	Export

My little form looks like this:



2. Copy **KWSalesDB.accdb** from the **VCSDDB\Code\Class 10\Example 10-1** folder to your working directory. This copy has some customers to look at.
3. Add these lines at the top of the code window:

```
using System.Data.OleDb;
using System.IO;
```

4. Form level declarations to create data objects:

```
OleDbConnection KWSalesConnection;
OleDbCommand customersCommand;
OleDbDataAdapter customersAdapter;
DataTable customersTable;
```

5. Add this code to the **frmExport_Load** event method (creates data objects assuming the **KWSalesDB.accdb** database is in your working directory):

```
private void frmExport_Load(object sender, EventArgs e)
{
    // connect to database
    KWSalesConnection = new
    OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;
Data
Source = c:\\VCSDDB\\Working\\KWSalesDB.accdb");
    KWSalesConnection.Open();
```

```
// establish command object
customersCommand = new OleDbCommand("Select * from
Customers", KWSalesConnection);
// establish data adapter/data table
customersAdapter = new OleDbDataAdapter();
customersAdapter.SelectCommand = customersCommand;
customersTable = new DataTable();
customersAdapter.Fill(customersTable);
}
```

6. Add this code to the `frmExport_FormClosing` event method to dispose of objects:

```
private void frmExport_FormClosing(object sender,
FormClosingEventArgs e)
{
    // close the connection
    KWSalesConnection.Close();
    // dispose of the objects
    KWSalesConnection.Dispose();
    customersCommand.Dispose();
    customersAdapter.Dispose();
    customersTable.Dispose();
}
```

7. Place this code in the `btnExport_Click` event method:

```
private void btnExport_Click(object sender, EventArgs
e)
{
    StreamWriter outputFile;
    outputFile = new
    StreamWriter(Application.StartupPath +
```

```

"\\customer.csv");
// write headers
for (int n = 0; n < customersTable.Columns.Count;
n++)
{
    outputFile.WriteLine(customersTable.Columns[n]);
    if (n < customersTable.Columns.Count - 1)
        outputFile.Write(",");
}
outputFile.WriteLine(outputFile.NewLine);
// write all fields
foreach (DataRow myRow in customersTable.Rows)
{
    for (int n = 0; n <
customersTable.Columns.Count; n++)
    {
        if (myRow[n] != null)
            outputFile.WriteLine(myRow[n].ToString());
        if (n < customersTable.Columns.Count - 1)
            outputFile.Write(",");
    }
    outputFile.WriteLine(outputFile.NewLine);
}
outputFile.Close();
}

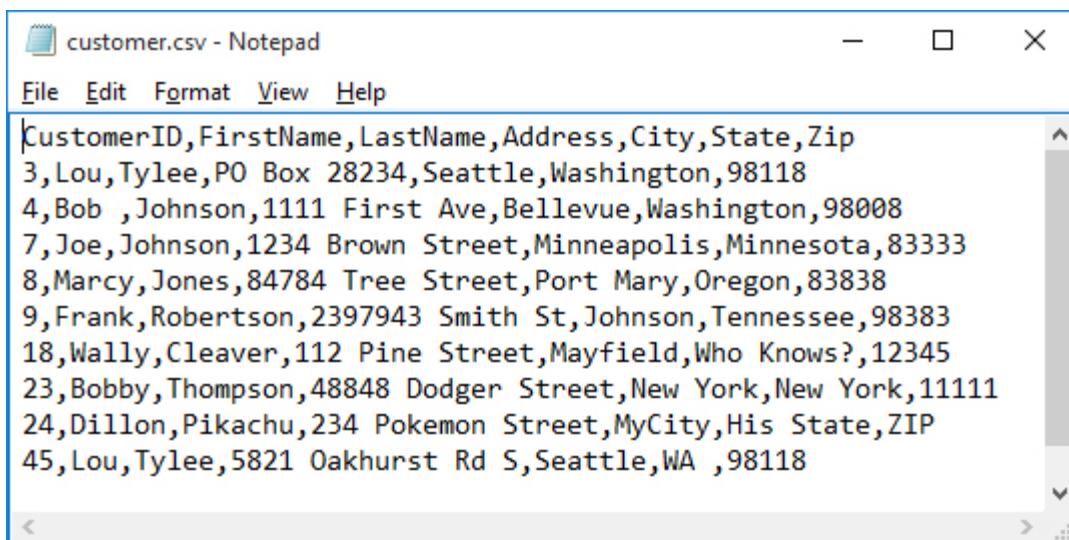
```

In this code, we first open the sequential file **customer.csv**. We write the column headers to the file. We then cycle through each row in the data table. For each record, we write the seven fields to the file. When done the file is closed (and saved).

8. Save (saved in **Example 11-1** folder in the **VCSDB\Code\Class 11** folder) and run the application. Click **Export**. Stop the application. Go to Windows Explorer and you should see **customer.csv** saved in your application directory (the project's **Bin\Debug** folder). Double-click the file. **Excel** should fire up and you'll see:

	A	B	C	D	E	F	G	H
1	Customer	FirstName	LastName	Address	City	State	Zip	
2	3	Lou	Tylee	PO Box 2834	Seattle	Washington	98118	
3	4	Bob	Johnson	1111 First Ave	Bellevue	Washington	98008	
4	7	Joe	Johnson	1234 Brown Street	Minneapolis	Minnesota	83333	
5	8	Marcy	Jones	84784 Tree Street	Port Mary	Oregon	83838	
6	9	Frank	Robertson	2397943 Smith St	Johnson	Tennessee	98383	
7	18	Wally	Cleaver	112 Pine Street	Mayfield	Who Knows?	12345	
8	23	Bobby	Thompson	48848 Dodger Street	New York	New York	11111	
9	24	Dillon	Pikachu	234 Pokemon Street	MyCity	His State	ZIP	
10	45	Lou	Tylee	5821 Oakhurst Rd S	Seattle	WA	98118	

The data has been moved out of the database into Excel. We could now use this (in conjunction with Microsoft Word) to generate mailing labels. The **csv** file can also be opened using **Notepad**. Do this and you'll see the comma-delimited nature of the file:



customer.csv - Notepad

File Edit Format View Help

```
CustomerID,FirstName,LastName,Address,City,State,Zip
3,Lou,Tylee,PO Box 2834,Seattle,Washington,98118
4,Bob ,Johnson,1111 First Ave,Bellevue,Washington,98008
7,Joe,Johnson,1234 Brown Street,Minneapolis,Minnesota,83333
8,Marcy,Jones,84784 Tree Street,Port Mary,Oregon,83838
9,Frank,Robertson,2397943 Smith St,Johnson,Tennessee,98383
18,Wally,Cleaver,112 Pine Street,Mayfield,Who Knows?,12345
23,Bobby,Thompson,48848 Dodger Street,New York,New York,11111
24,Dillon,Pikachu,234 Pokemon Street,MyCity,His State,ZIP
45,Lou,Tylee,5821 Oakhurst Rd S,Seattle,WA ,98118
```


Importing Database Data

Another common task is to take data from some other source and put it in a database. This is the **data import** problem. We assume that the data is available in a sequential file of some kind. It is not necessary that the file be comma-delimited. As long as we know what the file looks like, we can write the Visual C# code to read it. Here, however, we will assume a comma-delimited file.

The method followed to import data from a sequential file to a database is:

1. Establish the empty database data table using Access or ADOX code.
2. Open the desired input sequential file (will have a **csv** extension).
3. For each desired record in the data table, read the needed fields (separated by commas) from the input file and commit them to the database.
4. Close the sequential file.

Again, we know how (or should know how) to do the required database tasks. Let's look at the other steps.

Opening a Sequential File for Input

The Visual C# syntax to open a sequential file for input is:

```
StreamReader inputFile;  
inputFile = new StreamReader(myFile);
```

where **myFile** is a complete path (drive, directory, file name) to the file being opened and **inputFile** is the returned **StreamReader** object used to read information from disk. . **myFile** may or may not have an extension of **csv** - it depends on how the file was created.

If the data import feature is to be an integral part of your database application, an open file dialog box should be used to obtain the path to the sequential file. If you are using files for just a quick export job, we suggest putting the sequential file in your application directory. Recall the **Application.StartupPath** property provides this path. To open **test.csv** in our application path, write:

```
inputFile = new StreamReader(Application.StartupPath  
+ "\\test.csv")
```

Reading Data from a Sequential File

Once opened, data is read from the sequential file one line at a time. Each line of input requires a separate statement. A line of data (**myLine**) is read from the file using:

```
myLine = inputFile.readLine();
```

For a **csv** file, **myLine** is a list of variables, separated by commas. To determine the individual variables, this line is ‘parsed’ using commas as delimiters.

Once the variables are parsed (read), they can be committed to the database by simply equating the database fields to their corresponding value from the sequential file. Sometimes, we may have to generate the field based on some function of the file variables. This is easy to do in code. For example, if the variables include first and last name, but the database wants a full name, we could concatenate the name variables before committing them to the database.

Once we have the line (**myLine**) to parse, what we do with it depends on what we know. The basic idea is to determine the bounding character positions of each variable within the line. Character location is zero-based, hence the first character in a string is character 0. If the first position is **fp** and the last position is **lp**, the substring representation of this variable (**variableString**) can be found using the Visual C# **Substring** method:

```
variableString = myLine.Substring(fp, lp - fp + 1);
```

This says return the **Substring** in **myLine** that starts at position **fp** and is **lp - fp + 1** characters long. Once we have extracted **variableString**, we convert it to the proper data type.

So, how do you determine the starting and ending positions for a variable in a line? For a **csv** file, you search for commas using the **IndexOf** method. For example,

```
myLine.IndexOf(",")
```

returns the position of the first comma encountered in **myLine**.

As variables are extracted from the input data line, we shorten the line (excluding the extracted substring) before looking for the next variable. To do this, we use again use the **Substring** method. If **lp** was the last position of the substring removed from left side of **myLine**, we shorten this line using:

```
myLine = myLine.Substring(lp + 1, myLine.Length - lp  
- 1).Trim();
```

This removes the first **lp** characters from the left side of **myLine**. The **Trim** method removes any leading and/or trailing spaces and **myLine** is replaced by the shortened line. Notice by shortening the string in this manner, the first position for finding each extracted substring will always be 0 (**fp = 0**). Parsing may seem confusing, but it's really not. Look at the example.

Closing a Sequential File

When all values have been read from the sequential file, it is closed using the **Close** method. For our example, use:

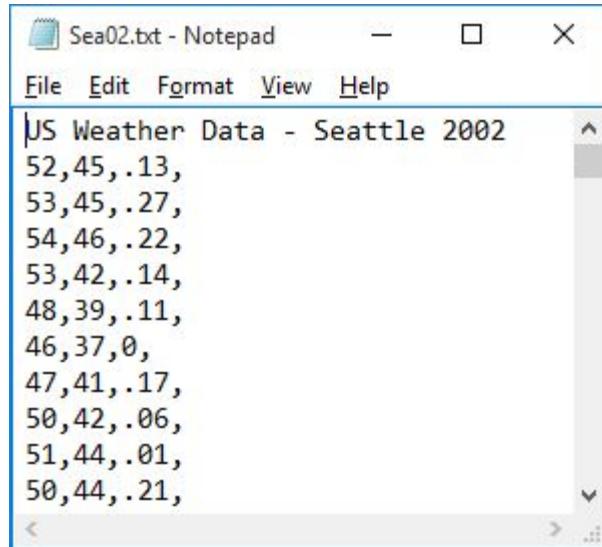
```
inputFile.Close();
```

Example 11-2

Importing Database Data

Look back at Example 10-1, our **Weather Monitor** example. Note we included two weather databases with this example. These files, **Sea02DB.accdb** and **Sea03DB.accdb**, include weather information recorded in Seattle, Washington, in 2002 and 2003, respectively. We did not type this information into the database table. It was imported from a file supplied by the National Weather Service. In this example, we show how we took the Weather Service sequential file and loaded it into an Access database.

1. First, let's look at the sequential file. Open **Sea02.txt**, included in the **VCSDB\Code\Class 11\Example 11-2** folder. Using **Notepad**, this file appears as:



Note the file has a single line of header information (we'll skip this line). Then, each line after this has the high temperature, the low temperature, precipitation amount, and any comment that might

be added. These four values will be loaded into the corresponding database fields. Recall the database has five fields are: **WeatherDate**, **HighTemp**, **LowTemp**, **Precip**, and **Comment**. Obviously, we'll have to generate the **WeatherDate** field in code (not a tough job, given we know the year is 2002).

2. Start a new application. Place a button on the form. Set these properties:

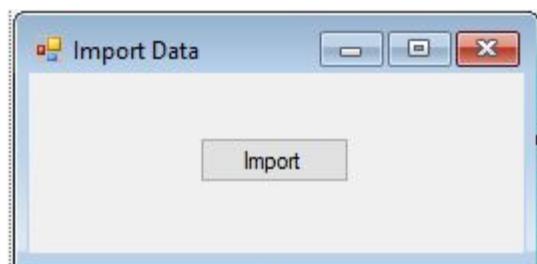
Form1:

Name	frmImport
FormBorderStyle	FixedSingle
StartPosition	CenterScreen
Text	Import Data

button1:

Name	btnImport
Text	Import

My little form looks like this:



3. Add a reference to ADOX library to your project. Add these lines at the top of the code window:

```
using ADOX;  
using System.Data.OleDb;  
using System.IO;
```

4. Add these form level declarations for the data objects:

```
OleDbConnection weatherConnection;  
OleDbCommand weatherCommand;  
OleDbDataAdapter weatherAdapter;  
DataTable weatherTable;
```

5. Place this code in the `btnImport_Click` event method:

```
private void btnImport_Click(object sender, EventArgs e)  
{  
    Catalog weatherDatabase = new Catalog();  
    Table databaseTable;  
    string databaseFile = Application.StartupPath +  
        "\\Sea02DB.accdb";  
    string dataFile = Application.StartupPath +  
        "\\Sea02.txt";  
    string dataYear = "2002";  
    // create empty database  
    try  
    {  
  
        weatherDatabase.Create("Provider=Microsoft.ACE.OLEDB.  
        12.0; Data Source = " + databaseFile);  
        // create table  
        databaseTable = new Table();  
        databaseTable.Name = "Weather";  
        // add fields  
        databaseTable.Columns.Append("WeatherDate",  
            DataTypeEnum.adDate, 20);  
        databaseTable.Columns.Append("HighTemp",  
            DataTypeEnum.adSingle, 10);  
    }  
}
```

```
    databaseTable.Columns.Append("LowTemp",
        DataTypeEnum.adSingle, 10);
    databaseTable.Columns.Append("Precip",
        DataTypeEnum.adSingle, 10);
    databaseTable.Columns.Append("Comment",
        DataTypeEnum.adWChar, 50);
    databaseTable.Columns["HighTemp"].Attributes =
        ColumnAttributesEnum.adColNullable;
    databaseTable.Columns["LowTemp"].Attributes =
        ColumnAttributesEnum.adColNullable;
    databaseTable.Columns["Precip"].Attributes =
        ColumnAttributesEnum.adColNullable;
    databaseTable.Columns["Comment"].Attributes =
        ColumnAttributesEnum.adColNullable;
    // primary key
    databaseTable.Keys.Append("PK_Weather",
        KeyTypeEnum.adKeyPrimary, "WeatherDate", null,
        null);
    databaseTable.Indexes.Append("WeatherDate",
        "WeatherDate");
    weatherDatabase.Tables.Append(databaseTable);
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message, "Error Creating
        Database",
    MessageBoxButtons.OK, MessageBoxIcon.Error);
}
finally
{
    weatherDatabase = null;
}
// connect to database
```

```
weatherConnection = new  
OleDbConnection("Provider=Microsoft.ACE.OLEDB.12.0;  
Data Source = " + databaseFile);  
weatherConnection.Open();  
weatherCommand = new OleDbCommand("SELECT * FROM  
Weather  
ORDER BY WeatherDate", weatherConnection);  
weatherAdapter = new OleDbDataAdapter();  
weatherAdapter.SelectCommand = weatherCommand;  
weatherTable = new DataTable();  
weatherAdapter.Fill(weatherTable);  
// fill dates and other fields  
StreamReader inputFile = new  
StreamReader(dataFile);  
// skip first line  
inputFile.ReadLine();  
DateTime tableDate = new  
DateTime(Convert.ToInt32(dataYear), 1, 1);  
DateTime nextYear = new  
DateTime(Convert.ToInt32(dataYear) + 1, 1, 1);  
int nDays = (nextYear - tableDate).Days;  
DataRow newRow;  
string myLine, myVariable;  
int cl;  
for (int n = 1; n <= nDays; n++)  
{  
    newRow = weatherTable.NewRow();  
    newRow["WeatherDate"] = tableDate;  
    // read data line and parse out four fields  
    myLine = inputFile.ReadLine();  
    // high temperature
```

```
    c1 = myLine.IndexOf(",");
    myVariable = myLine.Substring(0, c1);
    newRow["HighTemp"] =
        Convert.ToSingle(myVariable);
    myLine = myLine.Substring(c1 + 1, myLine.Length
        - c1 - 1).Trim();
    // low temperature
    c1 = myLine.IndexOf(",");
    myVariable = myLine.Substring(0, c1);
    newRow["LowTemp"] =
        Convert.ToSingle(myVariable);
    myLine = myLine.Substring(c1 + 1, myLine.Length
        - c1 - 1).Trim();
    // precip
    c1 = myLine.IndexOf(",");
    myVariable = myLine.Substring(0, c1);
    if (!myVariable.Equals(""))
        newRow["Precip"] =
            Convert.ToSingle(myVariable);
    else
        newRow["Precip"] = 0.0;
    myLine = myLine.Substring(c1 + 1, myLine.Length
        - c1 - 1).Trim();
    // comment
    newRow["Comment"] = myLine;
    weatherTable.Rows.Add(newRow);
    tableDate += new TimeSpan(1, 0, 0, 0);
}
inputFile.Close();
// save database and dispose of objects
OleDbCommandBuilder weatherAdapterCommand = new
OleDbCommandBuilder(weatherAdapter);
```

```
    weatherAdapter.Update(weatherTable);
    weatherConnection.Close();
    weatherConnection.Dispose();
    weatherCommand.Dispose();
    weatherAdapter.Dispose();
    weatherTable.Dispose();
    weatherAdapterCommand.Dispose();
}

}
```

Most of this code was borrowed from Example 10-3 (the Weather Monitor project). We use ADOX to create the empty **Sea02DB.accdb** database and create the fields. We then create the data objects needed to add rows to the database.

Next, the data file (**Sea02.txt**) is opened and the date is initialized. Note we skip the header line. Each data line in the file has four values. As each line is read, a new record is added and the proper values (after parsing using comma positions) are placed in the five database fields. Once done, the sequential file is closed and the data table is saved to the database.

6. Save (saved in **Example 11-2** folder in the **VCSDB\Code\Class 11** folder) and run the application. Make sure **Sea02.txt** is in your project's **Bin\Debug** folder (you may have to create it first). If no errors occur, the database file was successfully written and will be in your project's **Bin\Debug** folder (make sure **Sea02.txt** is also in this folder). Here's the **Weather** table from the newly created **Sea02DB.accdb** file opened in Access:

WeatherDat	HighTemp	LowTemp	Precip	Comment	A
1/2/2002	53	45	0.27		
1/3/2002	54	46	0.22		
1/4/2002	53	42	0.14		
1/5/2002	48	39	0.11		
1/6/2002	46	37	0		
1/7/2002	47	41	0.17		
1/8/2002	50	42	0.06		
1/9/2002	51	44	0.01		
1/10/2002	50	44	0.21		
1/11/2002	50	46	0		
1/12/2002	50	47	0.11		
1/13/2002	55	46	0.01		
1/14/2002	48	39	0		
1/15/2002	50	44	0		
1/16/2002	50	43	0		
1/17/2002	50	38	0		

Notice all the data is in the proper places. If you change the **DatabaseFile**, **DataFile** and **DataYear** variables in the code, you can also create the **Sea03DB.accdb** database.

Other Database Types

Every example we have built in this course has used the Microsoft Access database format (OLE DB data model). Visual C# also supports other database formats including: ODBC (Open Database Connectivity) and Oracle.

Fortunately, since all databases use the same concept of records (rows) and fields (columns), all the techniques discussed in this course for editing, adding, and deleting records apply no matter what type of database you are working with. The only change you need to make is to use the ADO .NET data objects associated with your particular database type. The website:

[http://msdn.microsoft.com/en-us/library/32c5dh3b\(v=vs.71\).aspx](http://msdn.microsoft.com/en-us/library/32c5dh3b(v=vs.71).aspx)

provides current links to pages to explain connections to various database types.

As you study other database types, you will see that the various data objects are similar, but there are differences. We suggest you check other references to see if particular properties, methods, or events are supported by your particular database.

One other note: the **OLE DB** technology we've used in these notes can also be used to connect to ODBC, SQL Server, and Oracle databases. You just need a database specific connection string. This makes any application built with OLE DB **database-independent**. If however, you want to use database-specific data objects, we provide a brief overview.

ODBC Data Objects

ODBC is a technology that predates OLE DB (the technology used by Access). As such, it is used by many older databases. ODBC data objects are contained within the `System.Data.Odbc` namespace.

The data connection object is `OdbcConnection`.

The data adapter object is `OdbcDataAdapter`.

The command object is `OdbcCommand`.

Oracle Data Objects

Oracle is perhaps the most widely used large scale database management tool. It is produced by the Oracle Corporation. The ADO .NET data objects for Oracle databases provide the most efficient access. These objects can be used with Oracle Version 8.1.7 and later. If you are using an older version, use the ODBC data objects. Oracle data objects are contained within the **System.Data.OracleClient** namespace.

The data connection object is **OracleConnection**.

The data adapter object is **OracleDataAdapter**.

The command object is **OracleCommand**.

Multi-User Considerations

Every example we've studied in this course has assumed a single user will be accessing the database at any one time. This is appropriate for many Visual C# applications. But, eventually, you will encounter an application that is constructed for use in a **networked** environment. The database file will be on a file server and shared by many users. This allows centralized data collection and querying.

Supporting **multiple users** with simultaneous access to a single database requires special consideration. Fortunately, Visual C# provides us with several tools to handle multiple users. The ADO .NET database engine works well in a multiple-user environment. To use a database in such environment, you need to:

- Place the database file in a shared directory.
- Make sure the file server is configured so each user has read and write access to the directory containing the database file.
- Configure all data sources in your application so it points to the shared database file.

Multiple users can cause problems when trying to access the same data. Typical problems include:

- Two users try to update the same record.
- One user updates a record while the other is viewing it, making the visible data out of date.
- One user deletes a record while the other is using it.

The concept of **locking** is used to try to mitigate these, and other, problems. And, lots of error trapping is required in multiple user environments, but these are skills you have.

Database Web Applications

We all know the Internet has become part of everyday life. A great new feature of Visual C# is the idea of web forms. With web forms, we can build applications that run on the Internet - **web applications**. Web applications differ from the Windows applications we have been building. A user (**client**) makes a request of a **server** computer. The server generates a web page (in HTML) and returns it to the client computer so it can be viewed with browser software.

Web applications are built in Visual C# using something called **ASP .NET (Active Server Pages .NET)**. ASP .NET is an improved version of previous technologies used to build web applications. In the past, to build a dynamic web application, you needed to use a mishmash of programming technologies. Web pages were generated with HTML (yes, the same HTML we used to write help files) and programming was done with ASP (Active Server Pages) and VCS Script (a Visual C# scripting language).

With ASP .NET, the process for building **web applications** is the same process used to build Windows applications. To build a web application, we start with a form, add web controls and write code for web control events. There is a visual project component that shows the controls and a code component with event methods and general methods and functions.

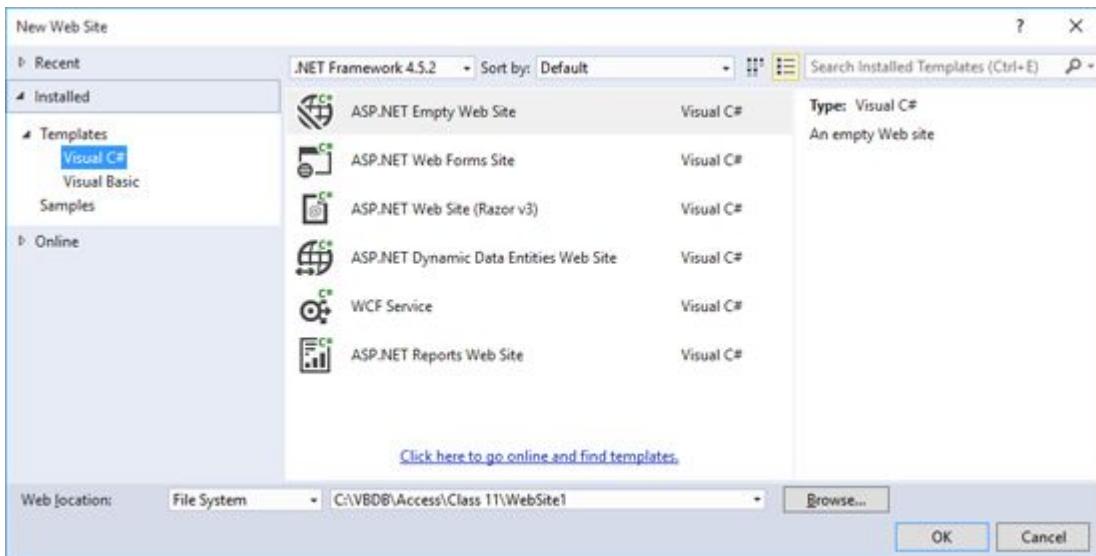
In these notes, we introduce the idea of web applications with databases. You can use your new programming skills to delve into more advanced references on ASP .NET and web applications. Here, we cover a few web applications topics:

- Address the approaches used to build web applications using **web forms**.

- Discuss the **web form controls** and how they differ from their Windows counterparts.
- Demonstrate the process of building web applications with a simple database example.

Starting a New Web Application

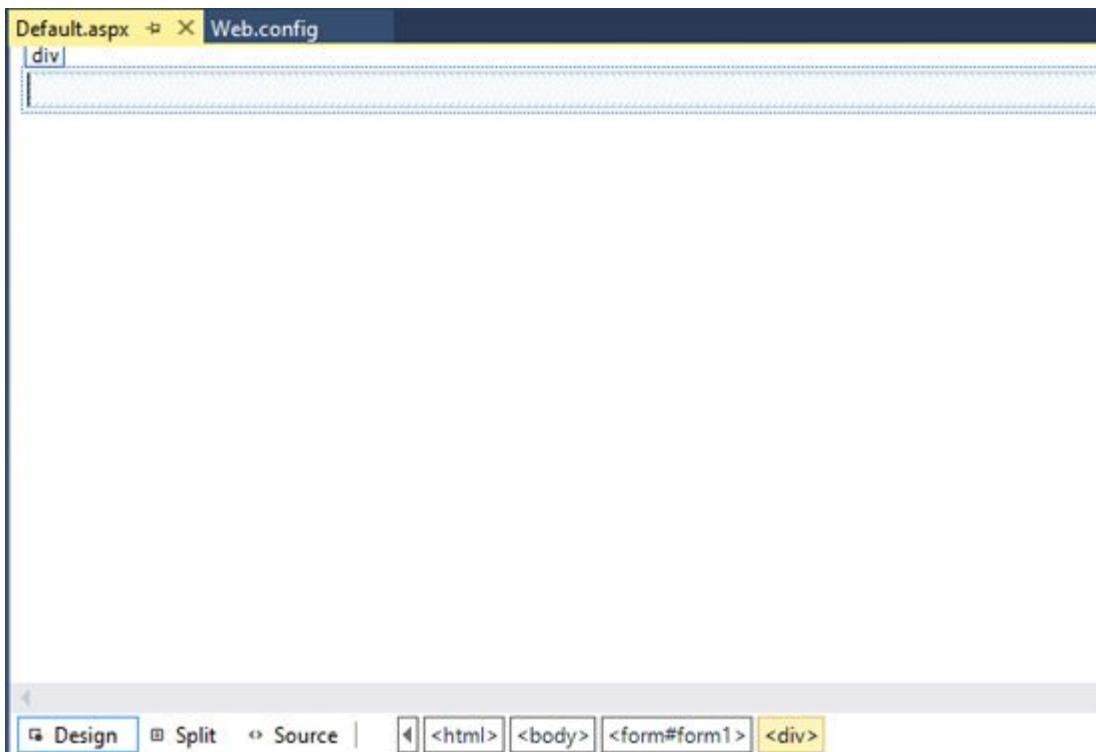
To start the process of building a web application, you select the **File** menu option in Visual C#. Then, click **New Web Site**. This window appears:



Select **ASP .NET Empty Web Site** from the **Templates** list. In the drop-down box to the left of the **Browse** button, either select or type the name of a folder to hold your new web site. Make sure the selected **Language** is **Visual C#**. Click **OK** to create the application.

Once created, right-click the web site name in the **Solution Explorer** window and select **Add**, then **Web Form**. A blank web form appears (with extension **aspx**).

At this point, we can start building our first web application by placing controls on the web form and writing code for various events. A blank form will appear in the design window:

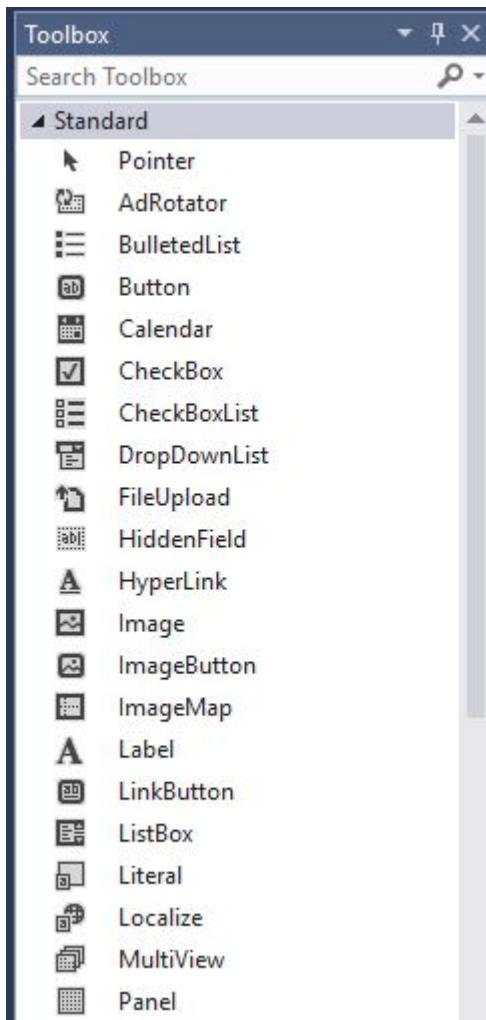


(If the form does not appear, right click the project name, choose **Add**, then **Web Form**). There are two views of the form: **Design** (the graphical display) and **Source** (the HTML code behind the form).

Let's look at the controls available and how to place them on the form.

Web Form Controls

When a web form is being edited, the controls available for placing on a web form are found in the Visual C# toolbox. A view showing some of the resulting controls is:



The names in this menu should be familiar. The controls are similar to the Windows form controls we've used throughout this course. There are differences, however. The major differences are in the names of some properties (for example, the **ID** property is used in place of a **Name** property) and web form controls usually have far fewer events than their Windows counterparts. Let's look at some

of the controls - feel free to study other controls for your particular needs.

Label Control:



The label control allows placement of formatted text information on a form (**Text** property). Font is established with the **Font** property.

TextBox Control:



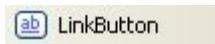
The text box controls allows placement of text information on a form (**Text** property). This is probably the most commonly used web form control. There is no **KeyPress** event for key trapping. Validation with web controls can be done using **validator** controls.

Button Control:



The button control is nearly identical to the Windows counterpart. Code is written in the **Click** event.

LinkButton Control:



The link button control is clicked to follow a web page hyperlink (set with **Text** property). This is usually used to move to another web page. Code is added to the **Click** event.

ImageButton Control:



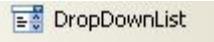
This control works like a button control - the user clicks it and code in the **Click** event is executed. The difference is the button displays an image (**ImageUrl** property) rather than text.

HyperLink Control:



The control works like the link button control except there is no **Click** event. Clicking this control moves the user to the link in the **Text** property.

DropDownList Control:



Drop down list controls are very common in web applications. Users can choose from a list of items (states, countries, product). The listed items are established using an **Items** collection and code is usually written in the **SelectedIndexChanged** event (like the Windows counterpart).

ListBox Control:



A list box control is like a drop down list with the list portion always visible. Multiple selections can be made with a list box control.

GridView Control:



The grid view control is used to list a table of data (whether a data set from a database or data generated in your web application).

CheckBox Control:



The check box control is used to provide a yes or no answer to a question. The **Checked** property indicates its state. Code is usually added to the **CheckedChanged** event.

CheckBoxList Control:



The check box list control contains a series of independent check box controls. It is a useful control for quickly adding a number of check boxes to a form. It can be used in place of a list box control for a small (less than 10) number of items. The individual controls are defined in an **Items** collection (**Text** property specifies the caption, **Selected** specifies its status).

RadioButton Control:



The radio button control is identical to the Windows radio button control. It is used to select from a mutually exclusive group of options. The **Checked** property indicates its state. Code is usually added to the **CheckedChanged** event.

RadioButtonList Control:



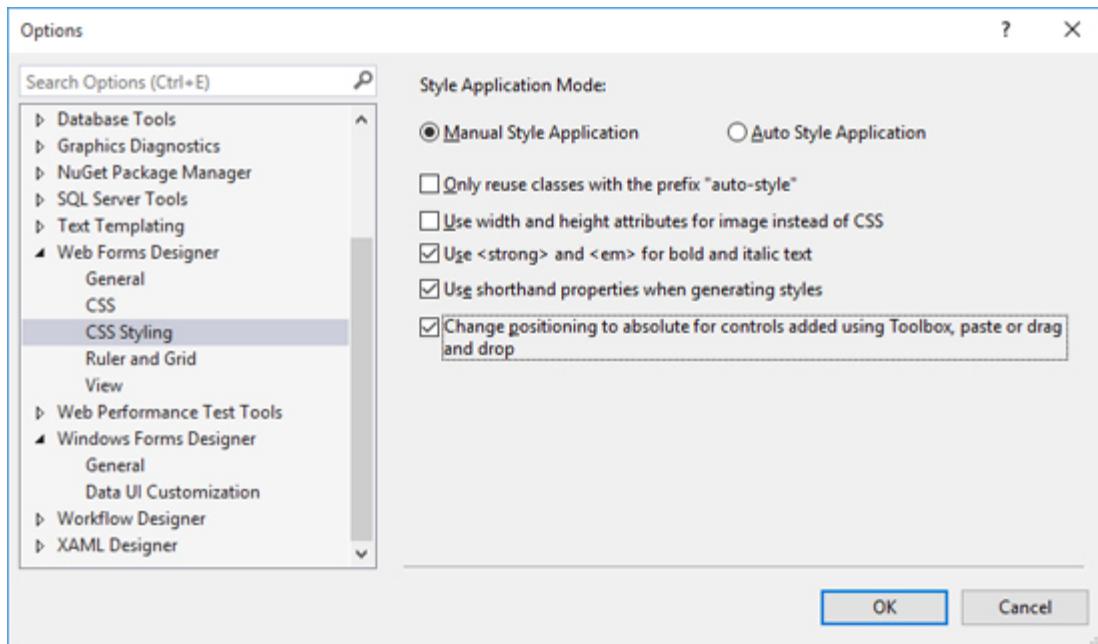
The radio button list control provides an easy way to place a group of dependent radio buttons in a web application. The individual controls are defined in an **Items** collection (**Text** property specifies the caption, **Selected** specifies its status).

Image Control:



Images are useful in web applications. They give your application a polished look. The image control holds graphics. The image (set with **ImageUrl** property) is usually a gif or jpg file.

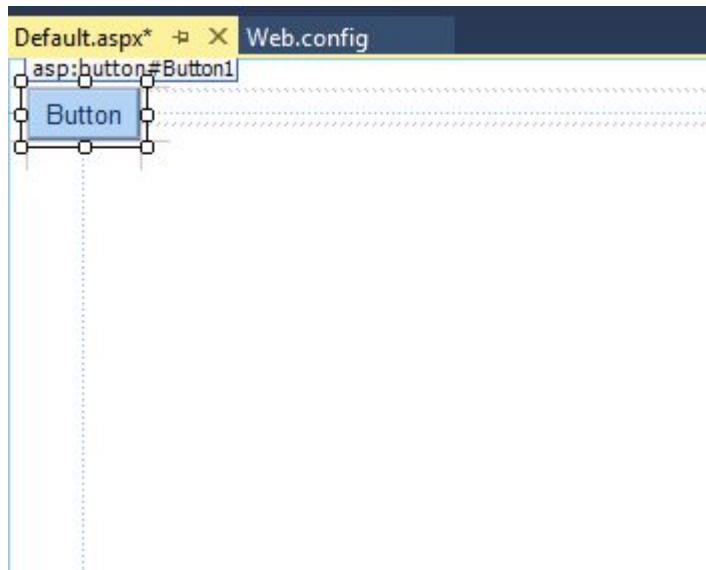
By default, web controls are placed on the form in **flow mode**. This means each element is placed to the right of the previous element. This is different than the technique used in building Windows forms. We want to mimic the Windows forms behavior. To do this, choose the **Tools** menu option in the development environment and choose **Options**.



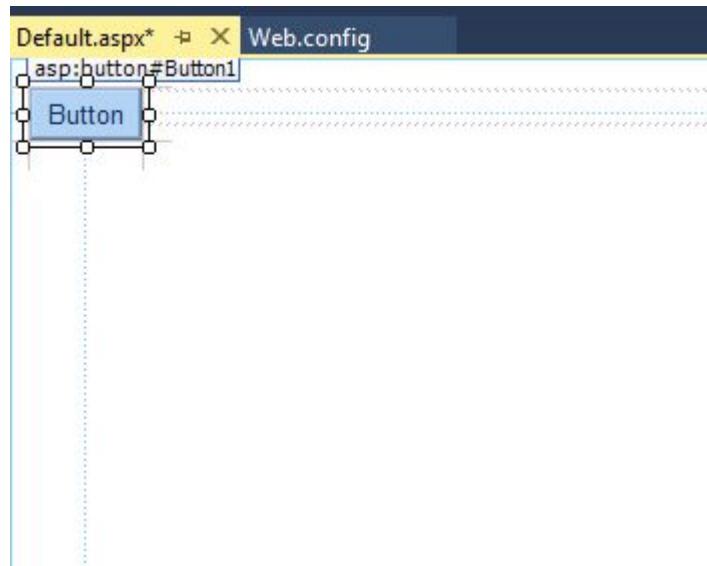
Choose the **Web Forms Designer** and **CSS Styling**. Place check next to “**Change position to absolute for controls ...**”. Then click **OK**.

With this change, there are two ways to move a web control from the toolbox to the web form:

1. Click the tool in the toolbox and hold the mouse button down. Drag the selected tool over the form. When the mouse button is released, the default size control will appear in the upper left corner of the form. This is the classic “drag and drop” operation. For a button control, we would see:

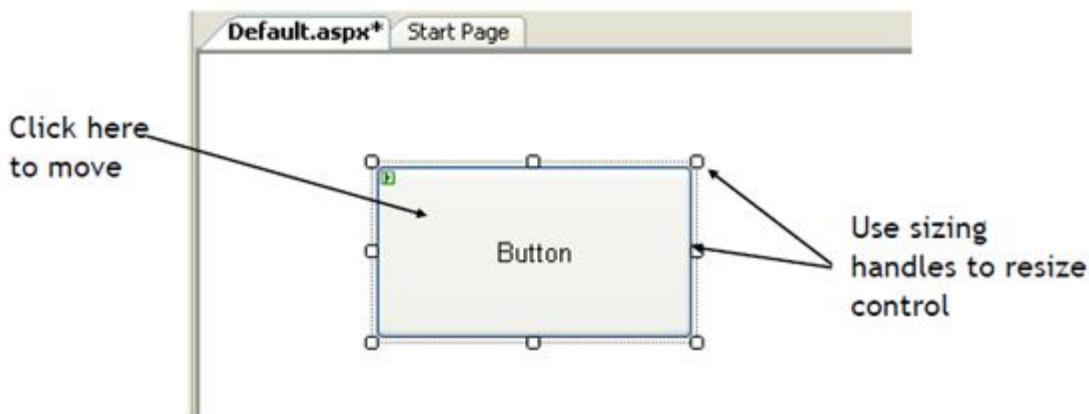


2. Double-click the tool in the toolbox and it is created with a default size on the form. It will be in the upper left corner of the form. You can then move it or resize it. Here is a button control placed on the form using this method:



To **move** a control you have drawn, click the object in the form (a cross with arrows will appear). Now, drag the control to the new location. Release the mouse button.

To **resize** a control, click the control so that it is selected (active) and sizing handles appear. Use these handles to resize the object.



To **delete** a control, select that control so it is active (sizing handles will appear). Then, press **<Delete>** on the keyboard. Or, right-click the control. A menu will appear. Choose the **Delete** option. You can change your mind immediately after deleting a control by choosing the **Undo** option under the **Edit** menu.

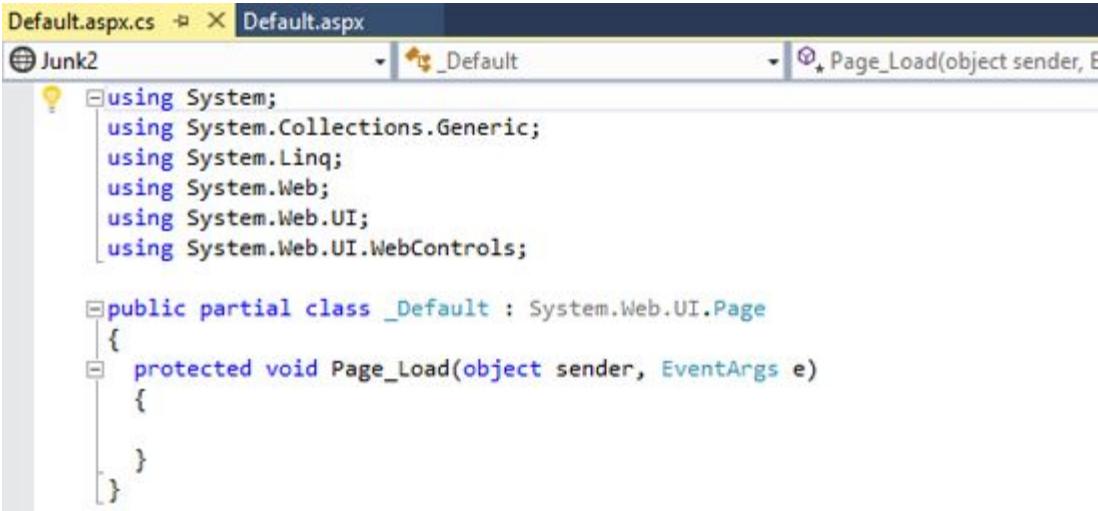
Building a Web Application

To build a web application, we follow the same three steps used in building a Windows application:

1. Draw the user interface by placing controls on a web form
2. Assign properties to controls
3. Write code for control events (and perhaps write other methods)

We've seen the web controls and how to place them on the web form. Let's see how to write code. You'll see the process is analogous to the approach we use for Windows applications.

Code is placed in the **Code Window**. Typing code in the code window is just like using any word processor. You can cut, copy, paste and delete text (use the **Edit** menu or the toolbar). You access the code window using the menu (**View**), toolbar, or by pressing **<F7>** (and there are still other ways - try double clicking a control) while the form is active. Here is the Code window for a 'blank' web application:



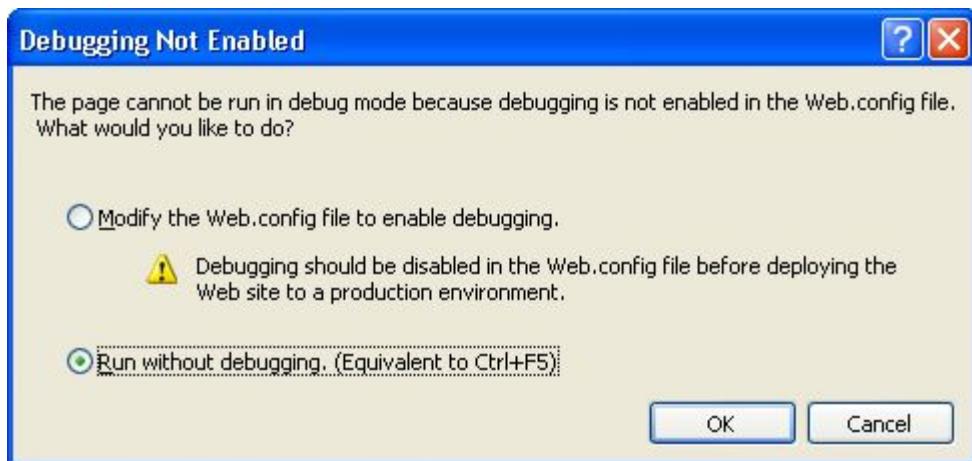
```
Default.aspx.cs  Default.aspx
Junk2  _Default
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;

public partial class _Default : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
    }
}
```

The header begins with **partial class**. Any web form scope level declarations are placed after this line. There is a **Page_Load** event. This is similar to the Windows form **Load** event where any needed initializations are placed.

Like in Windows applications, the box on the top, right of the code window is the **method list**, showing all methods in the code window. Double-clicking the control of interest will access default event methods. Or, events can be defined using the properties window. This is the same as we saw for Windows applications. That's the beauty of web forms - there is little new to learn about building an application.

Once your controls are in place and code is written, you can run your web application. Before running, it is a good idea to make sure your browser is up and running. Click the **Start** button in the Visual C# toolbar and your browser should display your application (the **aspx** file). You may see this window once started:



Special steps need to be taken to use the debugger with web applications. We will not take these steps. So, if this window appears, just select **Run without debugging** and click **OK**. Once running in the browser, select the **View** menu and choose **View Source** to see the actual HTML code used to produce the displayed web page.

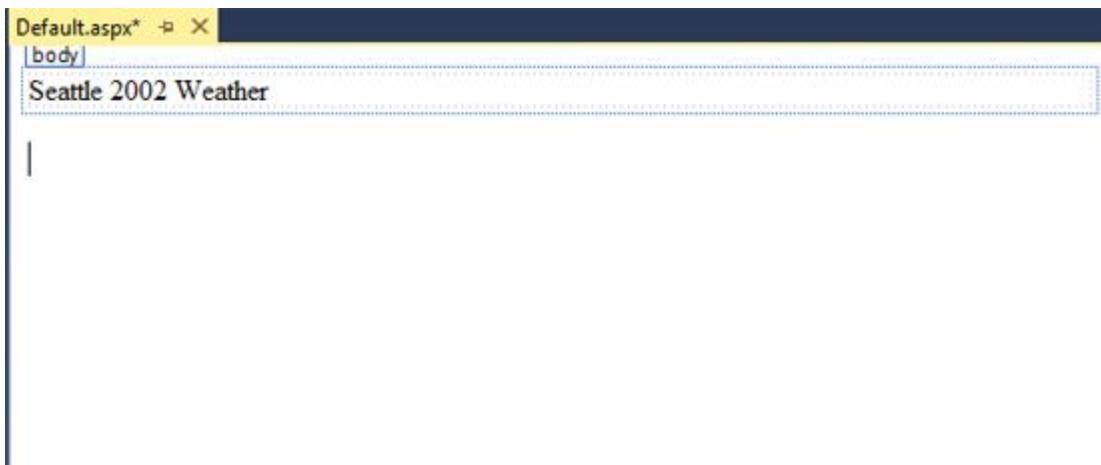
We conclude this brief examination of web applications with a simple database example.

Example 11-3

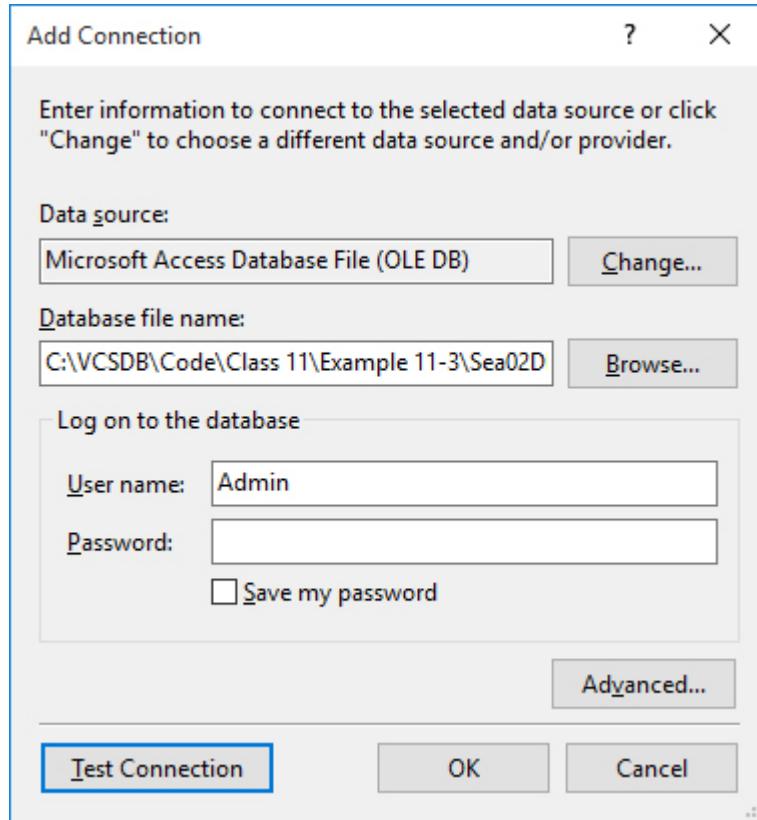
Viewing Weather Data

We will build a simple web application that displays the **Sea02DB.accdb** data in a grid view control. A copy of this database is saved in the **VCSDB\Code\Class 11\Example 11-3** folder. The entire example is built without writing any code.

1. Start a new web application. Place a single label control on the form. Set its **Text** property to **Seattle 2002 Weather**. It should look like this:

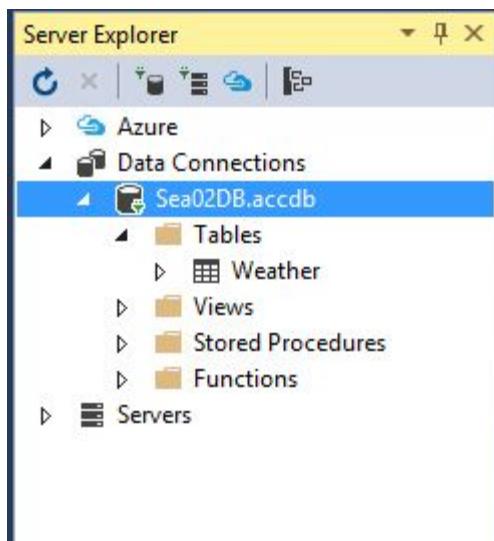


2. We will create a data source using the database file, then use a drag and drop feature to create a data grid that will display the **Weather** table in the database. Display the **Server Explorer** window (click the **View** menu item, then select **Server Explorer**). Right-click the **Data Connections** item and select **Add Connection**. This window should appear:



Browse to **Sea02DB.accdb** and click **OK**.

3. The data connection (I've expanded it a bit) is now shown in the Server Explorer window:



4. Drag and drop the **Weather** table from the Server Explorer window to the web form. Two things will happen. A data source will be added, as will a data grid. My web form looks like this (I've moved the grid down):

The screenshot shows a web page titled "Default.aspx". The content area has a header "Seattle 2002 Weather". Below the header is a table with the following data:

WeatherDate	HighTemp	LowTemp	Precip	Comment
11/23/2015 12:00:00 AM	0	0	abc	
11/23/2015 12:00:00 AM	0.1	0.1	0.1	abc
11/23/2015 12:00:00 AM	0.2	0.2	0.2	abc
11/23/2015 12:00:00 AM	0.3	0.3	0.3	abc
11/23/2015 12:00:00 AM	0.4	0.4	0.4	abc

5. Save your web application. (This application is saved in the **Example 11-3** folder in the **VCSDB\Code\Class 11** folder.) At this point, if things all work well, you can click the **Start** button (remember to run without debugging) and see your first web application appear in your default browser:



Seattle 2002 Weather

WeatherDate	HighTemp	LowTemp	Precip	Comment
1/2/2002 12:00:00 AM	53	45	0.27	
1/3/2002 12:00:00 AM	54	46	0.22	
1/4/2002 12:00:00 AM	53	42	0.14	
1/5/2002 12:00:00 AM	48	39	0.11	
1/6/2002 12:00:00 AM	46	37	0	
1/7/2002 12:00:00 AM	47	41	0.17	
1/8/2002 12:00:00 AM	50	42	0.06	
1/9/2002 12:00:00 AM	51	44	0.01	
1/10/2002 12:00:00 AM	50	44	0.21	
1/11/2002 12:00:00 AM	50	46	0	
1/12/2002 12:00:00 AM	50	47	0.11	
1/13/2002 12:00:00 AM	55	46	0.01	
1/14/2002 12:00:00 AM	48	39	0	
1/15/2002 12:00:00 AM	50	44	0	
1/16/2002 12:00:00 AM	50	43	0	
1/17/2002 12:00:00 AM	50	38	0	
1/18/2002 12:00:00 AM	43	33	0	

We did this all with no code!

Obviously, this is a very brief introduction to web applications with databases, but it should give you some idea of the power of such applications.

Summary

The Visual C# and Databases course is complete. At this point, you have significant programming skills for using Visual C# with desktop (single-user) applications. Yet, we've only just begun to look at all the capabilities of Visual C# in working with databases.

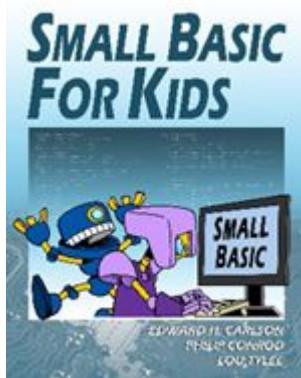
Good programmers never stop learning. Study the material in this course until you are comfortable with it. Throughout this course, suggestions were given for extending your knowledge base. Do it! Extend your knowledge to multiple-user, networked environments. The new world out there is the Internet. Study how to deploy database applications on the Internet. There are lots of good advanced books available addressing these topics and more. And, perhaps, some day we'll have another course delving deeper into the world of database programming with Visual C#.

Example 11-4

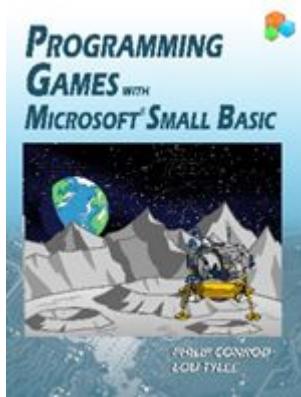
The Last Database Project

We end all of our courses with this same general project. Design a database management application in Visual C# that everyone on the planet wants to buy. Build a world-class interface. Thoroughly debug and test your application. Create a distribution package. Find a distributor or distribute it yourself through your newly created ‘dot-com’ company. Become fabulously wealthy. Remember those who made it all possible by rewarding them with jobs and stock options.

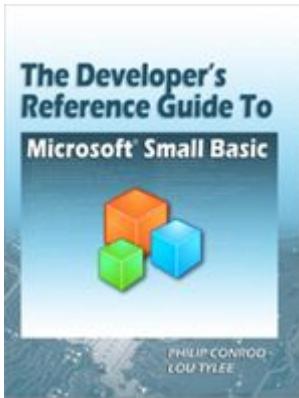
More Self-Study or Instructor-Led Computer Programming Tutorials by Kidware Software



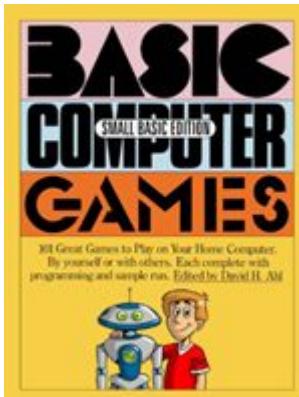
Small Basic For Kids is an illustrated introduction to computer programming that provides an interactive, self-paced tutorial to the new Small Basic programming environment. The book consists of 30 short lessons that explain how to create and run a Small Basic program. Elementary students learn about program design and many elements of the Small Basic language. Numerous examples are used to demonstrate every step in the building process. The tutorial also includes two complete games (Hangman and Pizza Zapper) for students to build and try. Designed for kids ages 8+.



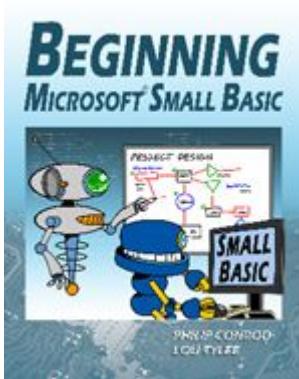
Programming Games with Microsoft Small Basic is a self-paced second semester "intermediate" level programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to write video games in Microsoft Small Basic. The games built are non-violent, family-friendly, and teach logical thinking skills. Students will learn how to program the following Small Basic video games: Safecracker, Tic Tac Toe, Match Game, Pizza Delivery, Moon Landing, and Leap Frog. This intermediate level self-paced tutorial can be used at home or school.



The Developer's Reference Guide to Microsoft Small Basic While developing all the different Microsoft Small Basic tutorials we found it necessary to write The Developer's Reference Guide to Microsoft Small Basic. The Developer's Reference Guide to Microsoft Small Basic is over 500 pages long and includes over 100 Small Basic programming examples for you to learn from and include in your own Microsoft Small Basic programs. It is a detailed reference guide for new developers.



Basic Computer Games - Small Basic Edition is a re-make of the classic BASIC COMPUTER GAMES book originally edited by David H. Ahl. It contains 100 of the original text based BASIC games that inspired a whole generation of programmers. Now these classic BASIC games have been re-written in Microsoft Small Basic for a new generation to enjoy! The new Small Basic games look and act like the original text based games. The book includes all the original spaghetti code and GOTO commands!



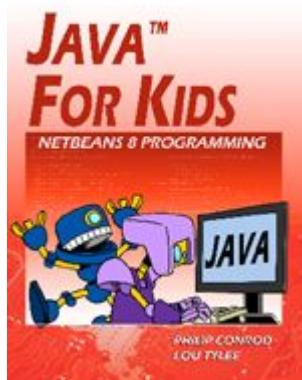
The **Beginning Microsoft Small Basic** Programming Tutorial is a self-study first semester "beginner" programming tutorial consisting of 11 chapters explaining (in simple, easy-to-follow terms) how to write Microsoft Small Basic programs. Numerous examples are used to demonstrate every step in the building process. The last chapter of this tutorial shows you how four different Small Basic games could port to Visual Basic, Visual C# and Java. This beginning level self-paced tutorial can be used at home or at school. The tutorial is simple enough for kids ages 10+ yet engaging enough for adults.



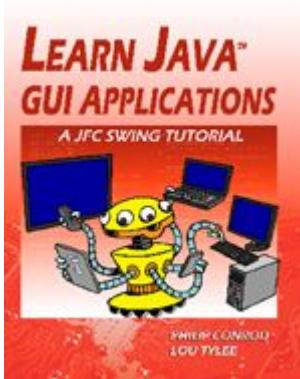
Programming Home Projects with Microsoft Small Basic is a self-paced programming tutorial explains (in simple, easy-to-follow terms) how to build Small Basic Windows applications. Students learn about program design, Small Basic objects, many elements of the Small Basic language, and how to debug and distribute finished programs. Sequential file input and output is also introduced. The projects built include a Dual-Mode Stopwatch, Flash Card Math Quiz, Multiple Choice Exam, Blackjack Card Game, Weight Monitor, Home Inventory Manager and a Snowball Toss Game.



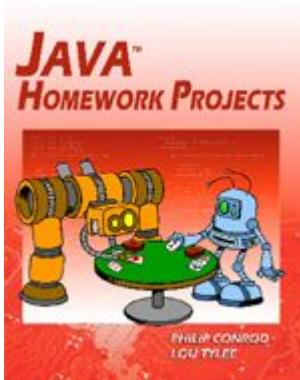
David Ahl's Small Basic Computer Adventures is a Microsoft Small Basic re-make of the classic *Basic Computer Games* programming book originally written by David H. Ahl. This new book includes the following classic adventure simulations; Marco Polo, Westward Ho!, The Longest Automobile Race, The Orient Express, Amelia Earhart: Around the World Flight, Tour de France, Subway Scavenger, Hong Kong Hustle, and Voyage to Neptune. Learn how to program these classic computer simulations in Microsoft Small Basic.



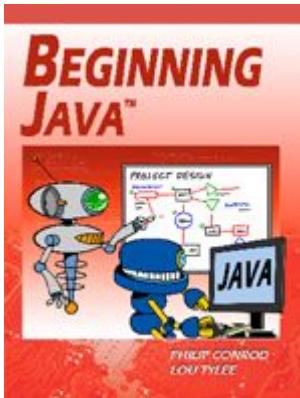
Java™ For Kids is a beginning programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Java application. Students learn about project design, object-oriented programming, console applications, graphics applications and many elements of the Java language. Numerous examples are used to demonstrate every step in the building process. The projects include a number guessing game, a card game, an allowance calculator, a state capitals game, Tic-Tac-Toe, a simple drawing program, and even a basic video game. Designed for kids ages 12 and up.



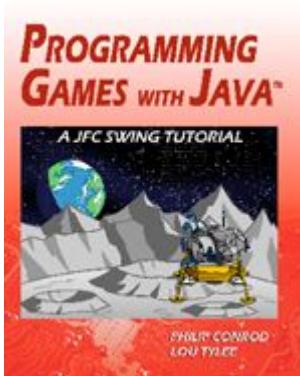
Learn Java™ GUI Applications is a 9 lesson Tutorial covering object-oriented programming concepts, using an integrated development environment to create and test Java projects, building and distributing GUI applications, understanding and using the Swing control library, exception handling, sequential file access, graphics, multimedia, advanced topics such as printing, and help system authoring. Our **Beginning Java or Java For Kids** tutorial is a pre-requisite for this tutorial.



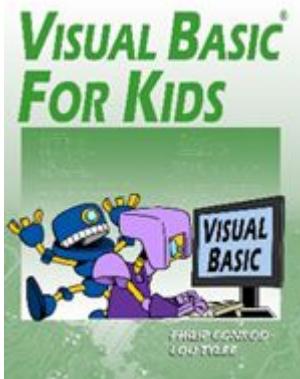
Java™ Homework Projects is a Java GUI Swing tutorial covering object-oriented programming concepts. It explains (in simple, easy-to-follow terms) how to build Java GUI project to use around the home. Students learn about project design, the Java Swing controls, many elements of the Java language, and how to distribute finished projects. The projects built include a Dual-Mode Stopwatch, Flash Card Math Quiz, Multiple Choice Exam, Blackjack Card Game, Weight Monitor, Home Inventory Manager and a Snowball Toss Game. Our **Learn Java GUI Applications** tutorial is a pre-requisite for this tutorial.



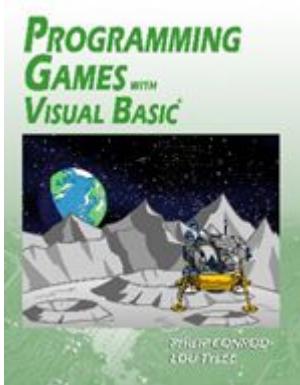
Beginning Java™ is a semester long "beginning" programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Java application. The tutorial includes several detailed computer projects for students to build and try. These projects include a number guessing game, card game, allowance calculator, drawing program, state capitals game, and a couple of video games like Pong. We also include several college prep bonus projects including a loan calculator, portfolio manager, and checkbook balancer. Designed for students age 15 and up.



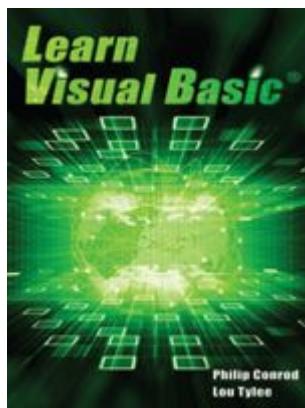
Programming Games with Java™ is a semester long "intermediate" programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Visual C# Video Games. The games built are non-violent, family-friendly and teach logical thinking skills. Students will learn how to program the following Visual C# video games: Safecracker, Tic Tac Toe, Match Game, Pizza Delivery, Moon Landing, and Leap Frog. This intermediate level self-paced tutorial can be used at home or school. The tutorial is simple enough for kids yet engaging enough for beginning adults. Our **Learn Java GUI Applications** tutorial is a required pre-requisite for this tutorial.



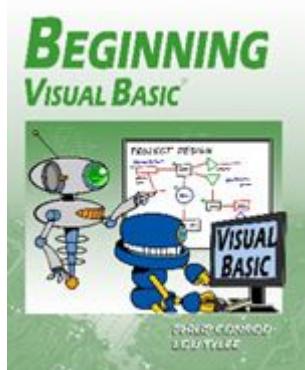
Visual Basic® For Kids is a beginning programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Visual Basic Windows application. Students learn about project design, the Visual Basic toolbox, and many elements of the BASIC language. The tutorial also includes several detailed computer projects for students to build and try. These projects include a number guessing game, a card game, an allowance calculator, a drawing program, a state capitals game, Tic-Tac-Toe and even a simple video game. Designed for kids ages 12 and up.



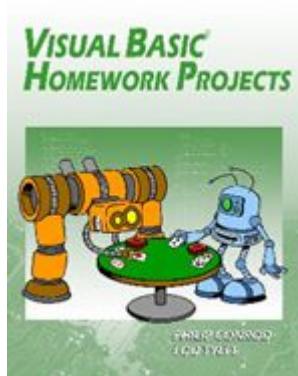
Programming Games with Visual Basic® is a semester long "intermediate" programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build Visual Basic Video Games. The games built are non-violent, family-friendly, and teach logical thinking skills. Students will learn how to program the following Visual Basic video games: Safecracker, Tic Tac Toe, Match Game, Pizza Delivery, Moon Landing, and Leap Frog. This intermediate level self-paced tutorial can be used at home or school. The tutorial is simple enough for kids yet engaging enough for beginning adults.



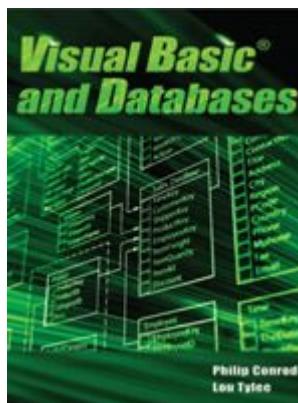
LEARN VISUAL BASIC is a comprehensive college level programming tutorial covering object-oriented programming, the Visual Basic integrated development environment, building and distributing Windows applications using the Windows Installer, exception handling, sequential file access, graphics, multimedia, advanced topics such as web access, printing, and HTML help system authoring. The tutorial also introduces database applications (using ADO .NET) and web applications (using ASP.NET).



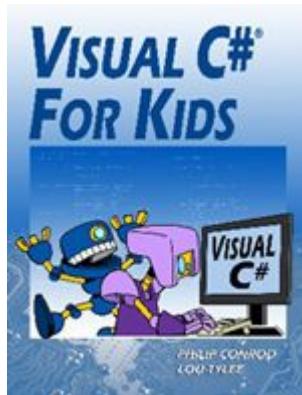
Beginning Visual Basic® is a semester long self-paced "beginner" programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Visual Basic Windows application. The tutorial includes several detailed computer projects for students to build and try. These projects include a number guessing game, card game, allowance calculator, drawing program, state capitals game, and a couple of video games like Pong. We also include several college prep bonus projects including a loan calculator, portfolio manager, and checkbook balancer. Designed for students age 15 and up.



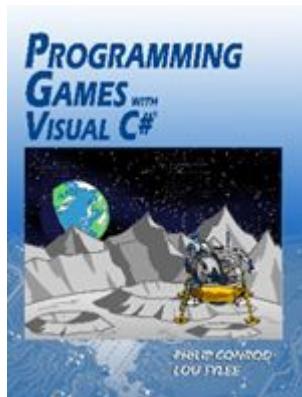
Visual Basic® Homework Projects is a semester long self-paced programming tutorial that explains (in simple, easy-to-follow terms) how to build a Visual Basic Windows project. Students learn about project design, the Visual Basic toolbox, many elements of the Visual Basic language, and how to debug and distribute finished projects. The projects built include a Dual-Mode Stopwatch, Flash Card Math Quiz, Multiple Choice Exam, Blackjack Card Game, Weight Monitor, Home Inventory Manager and a Snowball Toss Game.



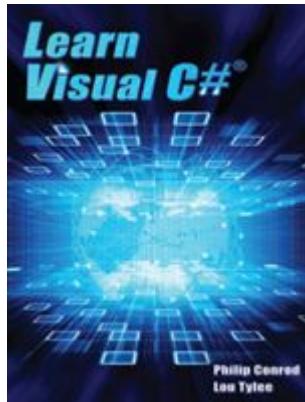
VISUAL BASIC AND DATABASES is a tutorial that provides a detailed introduction to using Visual Basic for accessing and maintaining databases for desktop applications. Topics covered include: database structure, database design, Visual Basic project building, ADO .NET data objects (connection, data adapter, command, data table), data bound controls, proper interface design, structured query language (SQL), creating databases using Access, SQL Server and ADOX, and database reports. Actual projects developed include a book tracking system, a sales invoicing program, a home inventory system and a daily weather monitor.



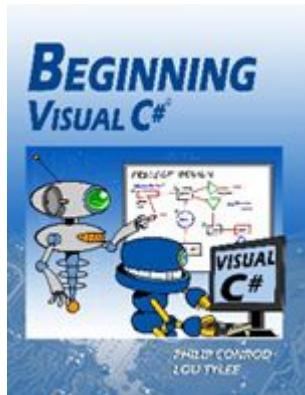
Visual C#® For Kids is a beginning programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Visual C# Windows application. Students learn about project design, the Visual C# toolbox, and many elements of the C# language. Numerous examples are used to demonstrate every step in the building process. The projects include a number guessing game, a card game, an allowance calculator, a drawing program, a state capitals game, Tic-Tac-Toe and even a simple video game. Designed for kids ages 12+.



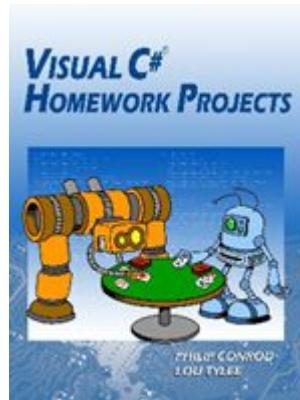
Programming Games with Visual C#® is a semester long "intermediate" programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a Visual C# Video Games. The games built are non-violent, family-friendly and teach logical thinking skills. Students will learn how to program the following Visual C# video games: Safecracker, Tic Tac Toe, Match Game, Pizza Delivery, Moon Landing, and Leap Frog. This intermediate level self-paced tutorial can be used at home or school. The tutorial is simple enough for kids yet engaging enough for beginning adults



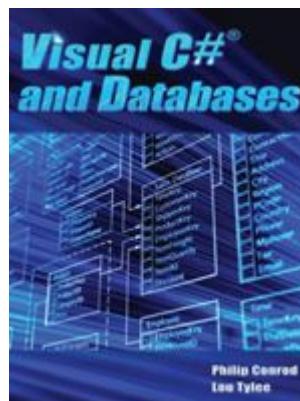
LEARN VISUAL C# is a comprehensive college level computer programming tutorial covering object-oriented programming, the Visual C# integrated development environment and toolbox, building and distributing Windows applications (using the Windows Installer), exception handling, sequential file input and output, graphics, multimedia effects (animation and sounds), advanced topics such as web access, printing, and HTML help system authoring. The tutorial also introduces database applications (using ADO .NET) and web applications (using ASP.NET).



Beginning Visual C#® is a semester long “beginning” programming tutorial consisting of 10 chapters explaining (in simple, easy-to-follow terms) how to build a C# Windows application. The tutorial includes several detailed computer projects for students to build and try. These projects include a number guessing game, card game, allowance calculator, drawing program, state capitals game, and a couple of video games like Pong. We also include several college prep bonus projects including a loan calculator, portfolio manager, and checkbook balancer. Designed for students ages 15+.



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