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Introduction

For years, during my teaching of database programming and Visual Basic.NET programming at the college level, I found it so difficult to find a good textbook for these topics that I had to combine a few different professional books together as references to teach my course. Most of those books are specially designed for programmers or software engineers, cover a lot of programming strategies, and include huge blocks of code, which cause terrible headaches for college students or beginning programmers who are new to Visual Basic.NET and database programming. I had to prepare my class presentations and figure out all the homework and exercises for my students. I dreamed that one day I would find a good textbook that would be suitable for college students or beginning programmers to help them learn and master database programming with Visual Basic.NET easily and conveniently. Finally I decided that I needed to do something about this dream myself after a long period of waiting.

Another reason I had the idea for this book is the job market. As you know, most industrial and commercial companies in the United States are database application businesses, such as manufacturers, banks, hospitals, and retail stores. A majority of them need professional people to develop and build database-related applications, but not database management and design systems. To enable our students to become good candidates for those companies, we need a book like this one.

Unlike most of the database programming books in the current market, which discuss and present database programming techniques with huge blocks of programming code from the first page to the last page, this book uses a new writing style to show readers, especially college students, how to develop professional and practical database programs in Visual Basic.NET by using Visual Basic.NET 2005 Design Tools and Wizards related to ADO.NET 2.0 and how to apply code that is autogenerated by using Wizards. With this new style, the headache caused by those huge blocks of programming code is eliminated. Instead, a simple and easy way to create database programs using the Design Tools can be developed to attract students'

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interest and enable students to build professional and practical databases in more efficient and interesting ways.

There are so many different database programming books available in the market, but one can rarely find a book like this one, which implements a new writing style to hold students' interest. To meet the needs of experienced or advanced students and software engineers, the book contains two programming methods: the fundamental database programming method using Visual Basic.NET 2005 Design Tools and Wizards and the advanced database programming method using the runtime object method. In the second method, all database-related objects are created and applied while the project is running by utilizing a few blocks of code.

1.1 OUTSTANDING FEATURES OF THIS BOOK

1. A new writing style is adopted to increase students' or beginning programmers' interest in learning and developing practical database programs and to avoid the headache caused by the huge blocks of code found in traditional database programming books.
2. A real, completed sample database, CSE_DEPT, with three versions (Microsoft Access, SQL Server 2005, and Oracle Database 10*g* XE), is provided and used throughout the book. A detailed illustration and description of how to design and build a practical relational database is provided step by step.
3. The book covers both fundamental and advanced database programming techniques for the convenience of both beginning students and experienced programmers.
4. Three types of popular databases are covered and discussed in detail, with practical examples: Microsoft Access, Microsoft SQL Server 2005, and Oracle Database 10*g* Express Edition (XE).
5. Various actual data providers are discussed and implemented in the sample projects, such as SQL Server and Oracle data providers. Instead of using OLE DB to access the SQL Server or Oracle databases, real SQL Server and Oracle data providers are utilized to connect to Visual Basic.NET 2005 directly to perform data operations.
6. The book provides homework and exercises, which allow users to practice what they have learned by doing some exercises themselves.
7. It is a good textbook for college students and a good reference book for programmers, software engineers, and academic researchers.

1.2 WHOM THIS BOOK IS FOR

This book is designed for college students and software programmers who want to develop practical and commercial database programming with Visual Basic.NET and relational databases such as Access, SQL Server 2005, and Oracle Database 10*g* XE. A fundamental knowledge and understanding of Visual Basic.NET and Visual Studio.NET IDE is assumed.

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1.3 WHAT THIS BOOK COVERS

Eight chapters are included in this book. The contents of each chapter can be summarized as follows:

- Chapter 1 provides an introduction to and summary of the whole book.
- Chapter 2 provides a detailed discussion and analysis of the structure and components of relational databases. Some key technologies in developing and designing a database are also discussed in this part. The procedure and components used to develop a practical relational database with three database versions, namely, Access, SQL Server 2005, and Oracle Database 10*g* XE, are analyzed in detail with real data tables in the sample database CSE_DEPT.
- Chapter 3 provides an introduction to ADO.NET that includes the architecture, organization, and components of ADO.NET. It also includes detailed discussions and descriptions to give readers both fundamental and practical ideas and pictures of how to use components in ADO.NET to develop professional data-driven applications. Two ADO.NET architectures are discussed to enable users to design and build their preferred projects on the basis of the different organizations of ADO.NET. Four popular data providers, OLE DB, ODBC, SQL Server, and Oracle, are discussed in detail. The basic ideas of DataTable and DataSet are also analyzed and described with some real coding examples.
- Starting with Chapter 4, actual database programming techniques of Visual Basic.NET 2005, such as data selection queries, are provided and discussed. This chapter comprises two parts: Part I contains detailed descriptions of how to develop professional data-driven applications with the help of Visual Basic.NET design tools and wizards and includes two real projects as examples. This part contains a lot of hidden code that is created by Visual Basic.NET automatically when using the design tools and wizards. Therefore the coding in this part is very simple and easy. Part II covers an advanced technique, the runtime object method, for developing and building professional data-driven applications. Detailed discussions and descriptions of how to build professional and practical database applications using the runtime method are provided, along with four real projects.
- Chapter 5 provides detailed discussions and analyses of three popular data insertion methods with three different databases: Access, SQL Server 2005, and Oracle.

  1. Using TableAdapter's DBDirect and TableAdapter.Insert() methods
  2. Using the TableAdapter's Update() method to insert new records that have already been added to the DataTable in the DataSet
  3. Using the Command object's ExecuteNonQuery() method

  This chapter is divided into two parts. Methods 1 and 2 are related to Visual Basic.NET design tools and wizards and therefore are covered in Part I. The third method is related to runtime objects and therefore is covered in Part II.

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Nine real projects are used to illustrate how to perform data insertion in three different databases: Access, SQL Server 2005, and Oracle Database 10*g* XE. Some professional and practical data validation methods are also discussed in this chapter to confirm the data insertion.

- Chapter 6 provides discussions and analyses of three popular data updating and deleting methods:

  1. Using TableAdapter DBDirect methods, such as TableAdapter.Update() and TableAdapter.Delete(), to update and delete data directly from the database
  2. Using the TableAdapter.Update() method to update and execute the associated TableAdapter' properties, such as UpdateCommand and DeleteCommand, to save changes made in the table in the DataSet to the table in the database
  3. Using the runtime object method to develop and execute the Command class's ExecuteNonQuery() method to update or delete data from the database directly

  This chapter is also divided into two parts. Methods 1 and 2 are related to Visual Basic.NET design tools and wizards and therefore are covered in Part I. The third method is related to runtime objects and is covered in Part II. Seven real projects are used to illustrate how to perform data updating and deleting in three different databases: Access, SQL Server 2005, and Oracle Database 10*g* XE. Some professional and practical data validation methods are also discussed in this chapter to confirm the data updating and deleting actions. The key points to remember when updating and deleting data in a relational database, such as the order in which to execute data updating and deleting in parent and child tables, are also discussed and analyzed.
- Chapter 7 provides introductions to and discussions about the development and implementation of ASP.NET Web applications in the Visual Basic.NET 2005 environment. At the beginning of Chapter 7, detailed and complete descriptions ASP.NET and Microsoft .NET Framework are provided. This part is especially useful and important to students or programmers who do not have any knowledge of or background in Web application development and implementation. Following the introduction section, a detailed discussion of how to install and configure the environment to develop ASP.NET Web applications is provided. Some essential tools, such as the Web server, Internet Information Services (IISs), and FrontPage Server Extension 2000 or 2002, and the installation process for these tools are introduced and discussed in detail. Starting with Section 7.3, the detailed development and building processes of ASP.NET Web applications to access databases are discussed with six real Web application projects. Two popular databases, SQL Server and Oracle, are utilized as the target databases for these development and building processes.
- Chapter 8 provides introductions to and discussions about the development and implementation of ASP.NET Web services in the Visual Basic.NET 2005 environment. A detailed discussion and analysis of the structure and

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components of Web services is provided at the beginning of this chapter. Two popular databases, SQL Server and Oracle, are discussed and used for three pairs of example Web service projects:

1. WebServiceSQLSelect and WebServiceOracleSelect
2. WebServiceSQLInsert and WebServiceOracleInsert
3. WebServiceSQLUpdateDelete and WebServiceOracleUpdateDelete

Each Web service contains different Web methods that can be used to access different databases and perform the desired data actions, such as Select, Insert, Update, and Delete, via the Internet. To consume those Web services, different Web service client projects are also developed in this chapter. Both Windows-based and Web-based Web service client projects are discussed and built for each kind of Web service listed above. In all, eighteen projects, including the Web service projects and the associated Web service client projects, are developed in this chapter. All projects have been debugged and tested and can be run in Windows-compatible operating systems such as Windows 95, 98, 2000, XP, and Vista.

1.4 HOW THIS BOOK IS ORGANIZED AND HOW TO USE THIS BOOK

This book is designed for both college students who are new to database programming with Visual Basic.NET and professional database programmers who have experience with this topic.

Chapters 2 and 3 provide the fundamentals of database structures and components of ADO.NET. Chapters 4, 5, and 6 are each divided into two parts, a fundamental part and an advanced part. The data-driven applications developed with design tools and wizards provided by Visual Basic.NET in the fundamental part have less coding, and therefore are more suitable for students or programmers who are new to database programming with Visual Basic.NET. Part II contains the runtime object method and covers the development of code to perform different data actions on the database. This method is more flexible and convenient for experienced programmers because a lot of coding is required.

Chapters 7 and 8 give a full discussion and analysis the development and implementation of ASP.NET Web applications and Web services. These technologies are necessary for students and programmers who want to develop and build Web applications and Web services to access and manipulate data through the Internet.

This book is organized so that it can be used at two levels, which are shown in Figure 1.1.

It is highly recommended that undergraduate college students and beginning programmers learn and understand the contents of Chapters 2 and 3 and Part I of Chapters 4, 5, and 6 since those provide fundamental knowledge and techniques of database programming with Visual Basic.NET 2005. Chapters 7 and 8 are optional for instructors and depend on the time and schedule.

Step by step, a detailed description is given to illustrate how to design and set up relationships between parent and child tables using the primary key and foreign

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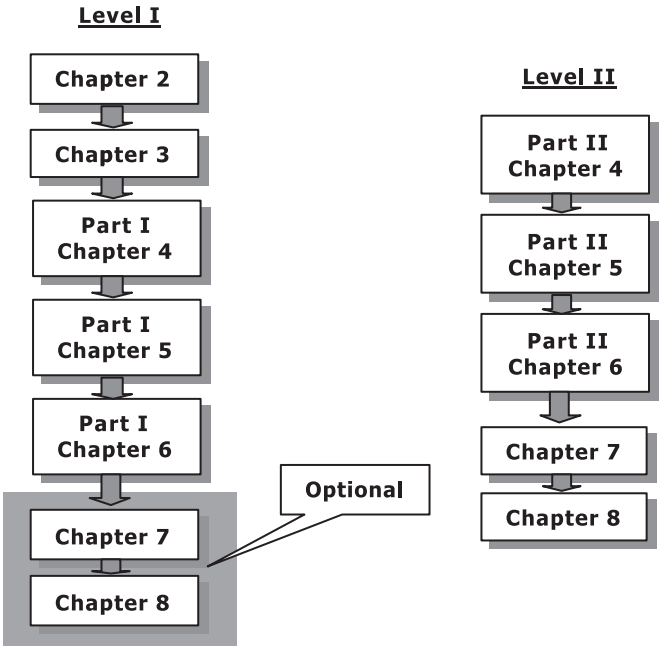

Figure 1.1. Two levels in this book.

keys for Access, SQL Server 2005, and Oracle Database 10g XE databases. In Part I of Chapters 4–6, Visual Basic.NET design tools and wizards are discussed and analyzed in detail to show readers how to use them to easily and conveniently design and build professional database programs with Visual Basic.NET.

For experienced college students or software programmers who already have some knowledge of database programming, it is recommended to learn and understand the contents of Part II of Chapters 4–6 as well as Chapters 7 and 8 since the runtime data object method and some sophisticated database programming techniques, such as joined-table query, nested stored procedures, and Oracle Package, are discussed and illustrated with real examples. Also, ASP.NET Web applications and ASP.NET Web services are discussed and analyzed with twenty-four real database program examples for SQL Server 2005 and Oracle Database 10*g* XE.

1.5 HOW TO USE THE SOURCE CODE AND SAMPLE DATABASES

All source code for each real project developed in this book is available. All projects are categorized by chapter in the folder **DBProjects**, which is available at www.cambridge.org/9780521712354. (See Figure 1.2.)

You can copy or download the code onto your computer and run each project as you like. To successfully run these projects on your computer, the following conditions must be met:

- Visual Studio.NET 2005 or later must be installed on your computer.

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- Three databases management systems, Access (Microsoft Office), SQL Server 2005 Management Studio Express, and Oracle Database 10*g* XE, must be installed on your computer.
- Three versions of the sample database, CSE_DEPT.mdb, CSE_DEPT.mdf, and the Oracle version of CSE_DEPT, must be installed on your computer in appropriate folders.
- To run the projects developed in Chapters 7 and 8, in addition to the conditions listed above, Internet Information Services (IIS) such as FrontPage Server Extension 2000 or 2002 must be installed on your computer and must work as a pseudo server for those projects.

The following appendixes provide useful references and practical knowledge to install database management systems and develop actual database application projects:

- **Appendix A**: Provides a complete SQL commands reference
- **Appendix B**: Provides detailed descriptions of downloading and installing Microsoft SQL Server 2005 Express
- **Appendix C**: Provides detailed descriptions of downloading and installing Oracle Database 10*g* XE
- **Appendix D**: Provides detailed discussions of how to create a user database in Oracle Database 10*g* XE and how to duplicate the Oracle 10*g* user database using Unload and Load methods
- **Appendix E**: Provides detailed discussions of how to add and connect the Oracle 10*g* XE database into Visual Basic.NET applications using Visual Basic Design Tools and Wizards
- **Appendix F**: Provides detailed discussions of how to use the three sample databases: CSE_DEPT.mdb, CSE_DEPT.mdf, and the Oracle version of CSE_DEPT

All these appendixes can be found in the **appendix** folder available at www.cambridge.org/9780521712354.

Three sample databases, CSE_DEPT.mdb, CSE_DEPT.mdf, and the Oracle version of CSE_DEPT, are located in the **database** folder available at www.cambridge.org/9780521712354. To use these databases for your applications or sample projects, refer to Appendix F.

1.6 INSTRUCTOR AND CUSTOMER SUPPORT

The teaching materials for all chapters are available in a sequence of Microsoft PowerPoint files, one file for each chapter. Interested instructors can find these teaching materials in the folder **Teaching-PPT** www.cambridge.org/9780521712354.

E-mail support is available to readers of this book. When you send an e-mail message, please provide the following information:

- A detailed description of your problem, including the error message and debug message as well as the error or debug number if it is provided
- Your name, job title, and company name

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Please send all questions to the e-mail address bai_db_book@bellsouth.net. Questions will be answered as quickly as possible.

1.7 HOMEWORK SOLUTIONS

Selected home work solutions are available for instructors at www.cambridge.org/9780521712354.

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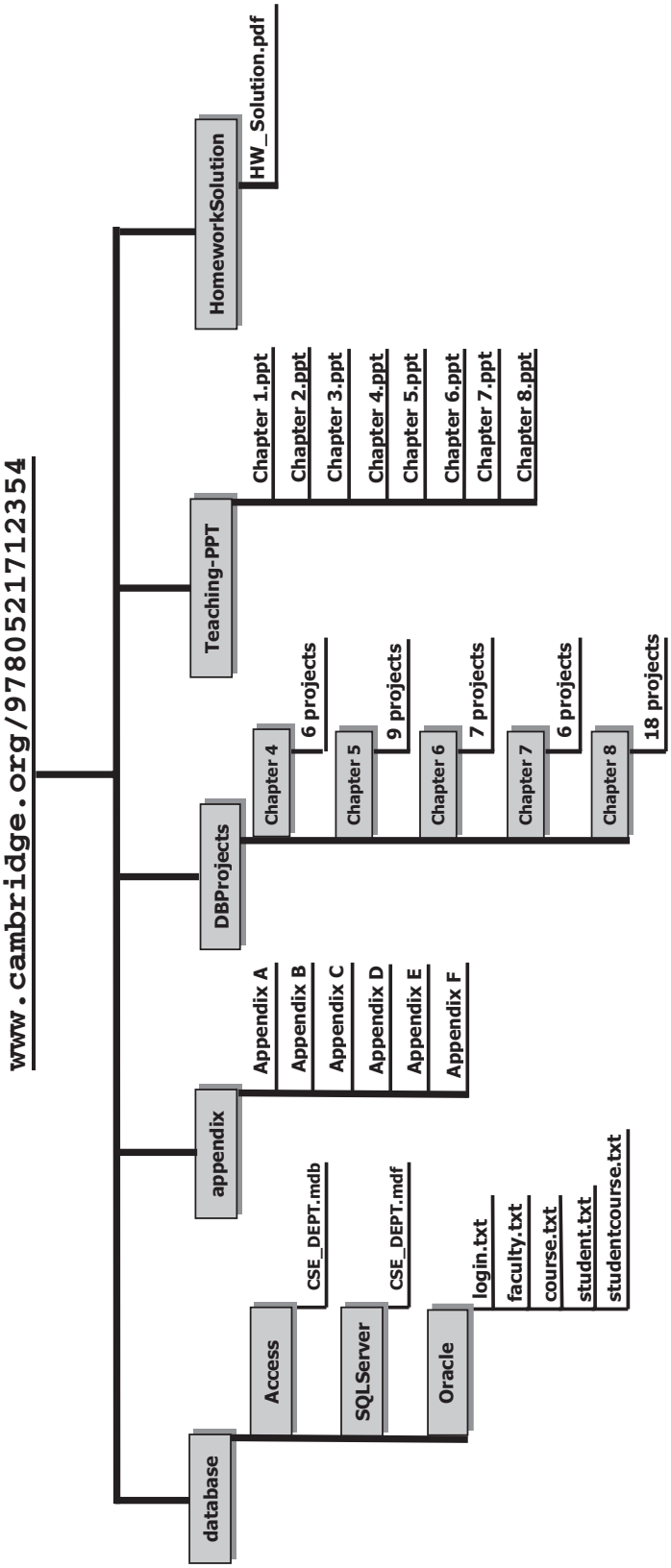

Figure 1.2. Book-Related Materials on the Web Site.

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Introduction to Databases

Databases have become an integral part of our modern-day life. We are an information-driven society. We generate large amounts of data that are analyzed and converted into information. A recent example of biological data generation is the Human Genome Project that was jointly sponsored by the Department of Energy and the National Institutes of Health. Many countries in the world participated in this venture for ten years. The project was a tremendous success. It was completed in 2003 and resulted in huge amounts of genome data, currently stored in databases around the world. Scientists will be analyzing this data in the years to come.

Database technology has a direct impact on our daily lives. Decisions are routinely made by organizations based on information collected and stored in databases. A record company may decide to market certain albums in selected regions based on the music preferences of teenagers. Grocery stores display more popular items at eye level, and reorders are based on inventories taken at regular intervals. Other examples include book orders by libraries, club memberships, auto part orders, winter clothing stock in department stores, and many more.

Database management programs have been in existence since the sixties. However, it was not until the seventies, when E. F. Codd proposed the then revolutionary relational data model, that database technology really took off. In the early eighties it received a further boost with the arrival of personal computers (PCs) and microcomputer-based data management programs like dBase II (later followed by dBase III and dBase IV). Today, we have a plethora of vastly improved programs for PCs and mainframe computers, including Microsoft Access, IBM DB2, Oracle, SQL Server, MySQL, and others.

This chapter covers the basic concepts of database design, followed by implementation of a specific relational database to illustrate the concepts discussed here. The sample database CSE_DEPT is used as a running example. The database creation is shown in detail using Microsoft Access, SQL Server, and Oracle. The topics discussed in this chapter include the following:

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