

# Chapter 1

## Introduction

For years while teaching database programming, I found it difficult to find a good textbook for this topic, so I had to combine a few different books together in order to teach the course. Most of those books are designed for programmers or software engineers, which cover a lot of programming strategies and huge blocks of coding, a headache to college students or beginning programmers who are new to programming. I dreamed that one day I would find a good textbook that is suitable for college students or beginning programmers, and that would help them to learn and master database programming easily and conveniently. Finally, I decided to realize this dream myself.

Another reason to write this book was the job market. Most companies in the United States, such as manufacturers, retailers, banks, and hospitals, use database applications extensively. The majority need professionals to develop and build database-related applications, but not necessarily database management and design. To enable our students to be good candidates for those jobs, a book such as this one is needed.

Unlike most database programming books on the current market, which discuss and present database programming techniques with huge blocks of programming codes from the first page to the last page, this book uses a new writing style to show readers, especially the college students, how to develop professional and practical database programs with Java, by using Java Persistence API (JAPI), Java Enterprise Edition (J2EE), Enterprise Java Beans (EJB), and plug-in tools related to NetBeans IDE, and to apply codes that are autogenerated by using those tools. Thus, the huge blocks of programming codes can be removed, and, instead, a simple and easy way to create database programs using plug-in tools can be developed to attract students' interests, and furthermore to enable students to build professional and practical database programming in more efficient and interesting ways.

To meet the needs of some experienced or advanced students or software engineers, the book contains two programming methods: the interesting fundamental database programming method (JAPI and plug-in tools method) and the advanced database programming method (runtime object method). In the second method, all database-related objects are created and applied during or when your project is running by utilizing quite a few blocks of codes.

## WHAT THIS BOOK COVERS

The contents of each chapter can be summarized as follows. Chapter 1 provides an introduction to the book. Chapter 2 provides a detailed discussion and analysis of the structure and components about relational databases. Some key technologies in developing and designing databases are also given and discussed. The procedure and components used to develop a practical relational database with three database versions, such as Microsoft Access, SQL Server 2008, and Oracle Database 10g XE, are analyzed in detail with some real data tables in our sample database CSE\_DEPT.

Chapter 3 provides an introduction to JDBC APIs and JDBC drivers. A detailed introduction to components and architecture of JDBC is given with step-by-step illustrations. Four popular types of JDBC drivers are discussed and analyzed with their advantages and disadvantages in actual database applications. The working structure and operational principle of using JDBC drivers to establish a valid database connection, build a SQL statement, and process the query results are discussed and presented in detail. JDBC RowSet, a useful tool, is also discussed and analyzed with some example codes.

Chapter 4 provides a detailed discussion and analysis of JDBC design and actual application considerations. The fundamentals of using JDBC to access and manipulate data against databases are discussed and introduced with example codes. Different JDBC interfaces, including the `ResultSet`, `ResultSetMetaData`, `DatabaseMetaData`, and `ParameterMetaData`, are introduced and discussed with example codes.

Chapter 5 provides a detailed description of the NetBeans IDE, including the components and architecture. This topic is necessary for college students who have no knowledge of NetBeans IDE. Starting with an introduction to installing NetBeans IDE, this chapter goes through each aspect of NetBeans IDE, including the NetBeans Platform, NetBeans Open Source, and all plug-in tools. Different projects built with NetBeans IDE are discussed and presented in detail with 14 example projects.

Starting with Chapter 6, the real database programming techniques with Java, query data from database, are provided and discussed. Two parts are covered in this chapter: Part I contains detailed descriptions of how to develop professional data-driven applications with the help of the JAPI and plug-in tools with some real projects, and this part contains a lot of hiding codes that are created by NetBeans IDE automatically when using those tools and wizards. Therefore, the coding for this part is very simple and easy. Part II covers an advanced technique, the runtime object method, in developing and building professional data-driven applications. Detailed discussions and descriptions of how to build professional and practical database applications using this runtime method are provided combined with two real projects. In addition to basic query techniques, advanced query methods, such as `PreparedStatement`, `CallableStatement`, and stored procedure, are also discussed and implemented in this chapter with some real sample projects.

Chapter 7 provides detailed discussions and analyses of how to insert, update, and delete data from three popular databases: Microsoft Access, SQL Server 2008, and Oracle.

This chapter is also divided into two parts: In Part I, JAPI and plug-in tools to perform data manipulations are discussed. Part II covers the technique to manipulate data in our sample database using the runtime object method. Four real projects illustrate how to perform the data manipulations against three different databases: Microsoft Access, SQL Server 2008, and Oracle Database 10g XE. Professional and practical data validation

methods are also discussed in this chapter to confirm the data manipulations. Some advanced data manipulation techniques, such as using Updatable ResultSet and Callable Statements to perform data actions, are also discussed with some real sample projects.

Chapter 8 discusses the developments and implementations of three-tier Java Web applications in the NetBeans IDE environment. At the beginning of this chapter, a detailed historical review of Java Web application development is provided, which is especially useful to students or programmers who lack knowledge or background in Java Web application development and implementation. Then different techniques used in building Java Web applications are introduced and discussed in detail. Starting with Section 8.4, the detailed development and building process of Java Web applications using J2EE and EJB to access databases is discussed with six real Web application projects. Two popular databases, SQL Server and Oracle, are utilized as the target databases for those development and building processes. JavaServer Pages and JavaServer Faces techniques are also discussed and involved in those real Web application projects.

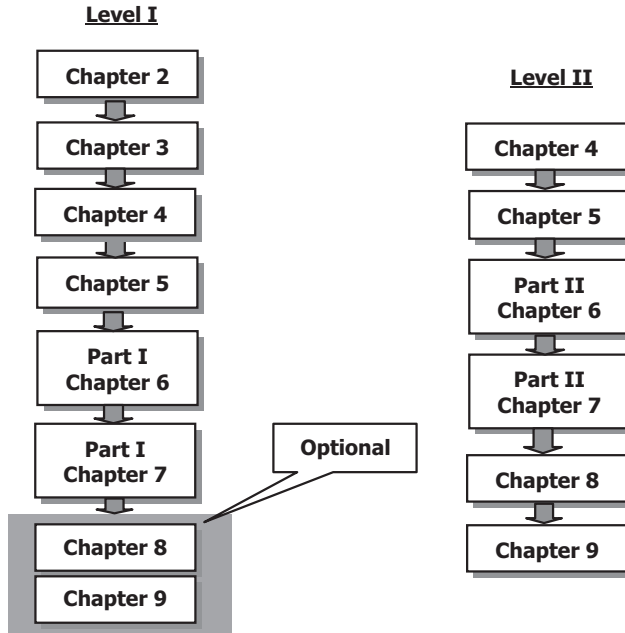
Chapter 9 discusses the development and implementation of Java Web services in the NetBeans IDE environment. A detailed analysis of the structure and components of Java Web services is provided. Two popular databases, SQL Server and Oracle, are discussed and used for two example Web service projects, which include WebServiceSQLApp and WebServiceOracleApp. Each Web service contains different operations 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. Eight projects in total, including the Web service projects and the associated Web service client projects, are developed. All projects have been debugged and tested and can be run in any Windows compatible operating system, such as Windows 95, 98, 2000, XP, and Windows 7.

## **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 Java and professional database programmers who have experience in this topic.

Chapters 2 and 3 provide the fundamentals on database structures and components, JDBC API and components it covered. Chapter 4 covers an introduction to JDBC design and application considerations. Chapter 5 provides a detailed introduction to NetBeans IDE and its working environment. Chapters 6 and 7 are divided into two parts: a fundamental part and an advanced part. The data-driven applications developed with JAPI and plug-in tools provided by NetBeans IDE, which can be considered as the fundamental part, have less coding loads and therefore are more suitable to students or programmers who are new to the database programming with Java. Part II contains the runtime object method and covers many coding developments to perform the different data actions against the database; this method is more flexible and convenient to experienced programmers when a lot of coding is involved.

Chapters 8 and 9 give a full discussion and analysis of the development and implementation of Java Web applications and Web services. These technologies are necessary



**Figure 1.1.** Two levels in this book.

to students and programmers who want to develop and build Web applications and Web services to access and manipulate data via the Internet.

Based on the organization of this book as described above, this book can be used in two ways, Level I or Level II, as shown in Figure 1.1. For undergraduate college students or beginning software programmers, it is highly recommended to learn and understand the contents of Chapters 2–5 and Part I of Chapters 6 and 7, since those are fundamental to database programming with Java. Chapters 8 and 9 are optional.

In Chapter 2, a detailed introduction about how to design and build a practical relational sample database, CSE\_DEPT, with three database versions, is provided. A step-by-step detailed description is given to illustrate how to design and set up relationships between parent and child tables using the primary and foreign keys for Microsoft Access 2007, SQL Server 2008, and Oracle Database 10g XE Release 2 databases. In Part I of Chapters 6 and 7, JAPI, plug-in tools, and wizards are discussed and analyzed to show readers how to use them to design and build professional database programs with Java easily and conveniently.

For experienced college students or software programmers who have already some knowledge and technique in database programming, it is recommended to learn and understand the contents of Part II of Chapters 6 and 7, as well as Chapters 4, 5, 8, and 9, since the runtime data objects method and some sophisticated database programming techniques such as Java RowSet object, Callable Statements, stored procedures, and Oracle Package are discussed and illustrated with real examples. Also, the Java Web applications and Java Web services are discussed and analyzed with eight real data-

base program examples for SQL Server 2008 and Oracle Database 10g XE database systems.

## HOW TO USE THE SOURCE CODE AND SAMPLE DATABASES

All source codes of each real project developed in this book are available on the Web. All projects are categorized into the associated chapters that are located in the folder DBProjects, on the site [ftp://ftp.wiley.com/public/sci\\_tech\\_med/practical\\_database\\_java](ftp://ftp.wiley.com/public/sci_tech_med/practical_database_java). You can copy or download those codes into your computer and run each project as you like. To successfully run those projects on your computer, the following conditions must be met:

- NetBeans IDE 6.8 or higher versions must be installed in your computer.
- Three database management systems, Microsoft Access 2007 (Microsoft Office 2007), Microsoft SQL Server 2008 Management Studio, and Oracle Database 10g Express Edition (XE) must be installed in your computer.
- Three versions of sample databases, CSE\_DEPT.accdb, CSE\_DEPT.mdf, and Oracle version of CSE\_DEPT, must be installed in your computer in the appropriate folders.
- To run projects developed in Chapters 8 and 9, in addition to conditions listed above, a Web server such as Glassfish v3 and J2EE must be installed in your computer.

The following appendixes are useful when one needs some references and practical knowledge to install database management systems and develop actual database application projects:

**Appendix A:** Data Type Mappings between SQL Statements and Java Applications.

**Appendix B:** Basic java.sql Package Class Reference.

**Appendix C:** Basic java.sql Package Interface References.

**Appendix D:** Download and Install SQL Server 2008 Database Express and SQL Server 2008 Management Studio.

**Appendix E:** Download and Install Oracle Database 10g Express Edition.

**Appendix F:** Build Oracle Databases Using Load and Unload Methods.

**Appendix G:** How to Use Sample Databases Provided with the Book.

**Appendix H:** Build a SQL Server 2008 Stored Procedure dbo.FacultyInfo.

**Appendix I:** Install Java EE 6 SDK Software and Configure GlassFish v3 Server.

**Appendix J:** A Complete SQL Commands Reference.

**Appendix K:** Build a Java EE 6 Database Application with SQL Server Database.

All of these appendixes can be found in the folder named **Appendix** that is located at the site [ftp://ftp.wiley.com/public/sci\\_tech\\_med/practical\\_database\\_java](ftp://ftp.wiley.com/public/sci_tech_med/practical_database_java).

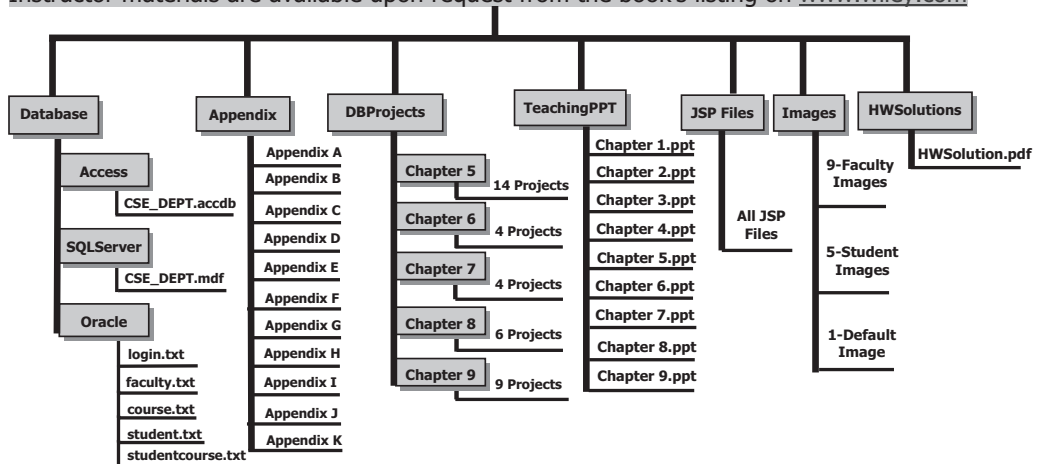
Three sample database files, **CSE\_DEPT.accdb**, **CSE\_DEPT.mdf**, and the Oracle version of **CSE\_DEPT**, are located in the different folders, such as **Access**, **SQLServer**, and **Oracle**, which are sub-folders and under the folder **Database** at the site [ftp://ftp.wiley.com/public/sci\\_tech\\_med/practical\\_database\\_java](ftp://ftp.wiley.com/public/sci_tech_med/practical_database_java). To use these databases for your applications or sample projects, refer to Appendix G.

## INSTRUCTOR AND CUSTOMER SUPPORT

The teaching materials for all chapters have been extracted and represented by a sequence of Microsoft Power Point files, one file for each chapter. Interested instructors can find those teaching materials in the folder TeachingPPT that is located at the site <http://www.wiley.com>, and those instructor materials are available on request from the book's listing on <http://www.wiley.com> (see Fig. 1.2).

### FOR INSTRUCTORS:

Instructor materials are available upon request from the book's listing on [www.wiley.com](http://www.wiley.com)



### FOR STUDENTS:

[ftp://ftp.wiley.com/public/sci\\_tech\\_med/practical\\_database\\_Java](ftp://ftp.wiley.com/public/sci_tech_med/practical_database_Java)

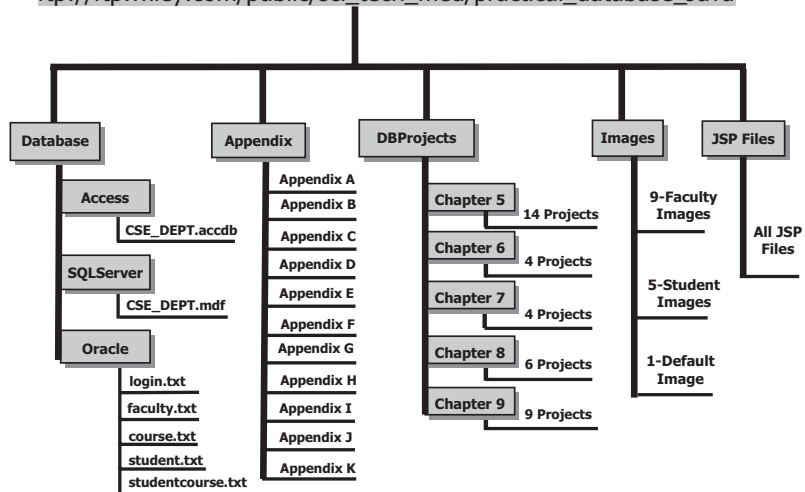


Figure 1.2. Book related materials on the Web sites.

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

A detailed description about 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.

Please send all questions to the email address: [baidbbook@bellsouth.net](mailto:baidbbook@bellsouth.net).

## **HOMEWORK SOLUTIONS**

A selected homework solution is available on request from the book's listing on <http://www.wiley.com>.

