CHAPTER 1 JDBC TODAY

Introduction 1
JDBC Design 2
The Relational Database 2
Java and Relational Databases 2
Object Databases 3
Object-Relational Mapping Tools and JDO 3
Limitations of OR-Mapping and JDO 4
Relational Databases and SQL 4
The JDBC API 5
Programming for Today 7
JDBC Code in N-Tiered Architectures 8
Java Technologies for Distributed Programming 8
Java Design Patterns 9
Summary 11
Coming Up Next 12
CONTENTS

CHAPTER 2 THE RELATIONAL DATABASE AND SQL 13

Introduction 13
Relational Database Concepts 14
Entities, Attributes, and Relationships 14
Normalization 17
Creating the Database Tables 17
Relational Database Terminology 18
  Relation 18
  Domain 19
  Join 19
  Tuples 19
  Unions 19
  Master–Detail Relationships 19
Structured Query Language 20
  SQL Standards 21
  The Call Level Interface (CLI) 21
  SQL Statements 22
Transactions, Database Logging and Isolation Levels, and Concurrency 30
  Isolation Levels and Concurrency 31
  Committed-Read Isolation 32
  Cursor-Stability Isolation 32
  Repeatable-Read Isolation 33
  Dirty-Read Isolation 33
  Choosing Isolation Levels 34
SQL Query Optimization 34
Dynamic SQL Execution 35
Summary 36
Coming Up Next 36
CHAPTER 3  THE JDBC API EXPLAINED

Introduction  37
Purpose  38
The Structure of JDBC  38
History of JDBC Revisions  39
SQL Escape Syntax  40
   Stored Procedures, Time and Date Literals, and Scalar Functions  40
   Scalar Functions  41
The JDBC Code Structure  41
   The DriverManager Class  43
   The Connection Class  43
   The Statement Class  44
   The PreparedStatement Class  44
   The ResultSet Class  44
   The javax.sql Package  45
   The DataSource Class  46
Using Connection Pooling  46
   Distributed Transactions with XADataSource  46
   JavaBean Wrapper Support (Rowsets)  46

JDBC Example  47
Summary  51
Coming Up Next  51

CHAPTER 4  GETTING CONNECTED

Introduction  53
Loading the Database Driver  53
JNDI and Name Spaces  56
JNDI and DataSources  59
Loading JDBC Drivers with the DriverManager  60
Contents

Creating a Connection Using a DataSource 66

The javax.sql.DataSource Class 69

Adding Functionality through the DataSource 70

The javax.sql.ConnectionPoolDataSource Interface 71

How Connection Pooling Works 72

The XADataSource Interface 73

Summary 74

Coming Up Next 75

Chapter 5 Using the Connection 77

Introduction 77

The java.sql.Connection Class 78

The close Method 81

The getAutoCommit and setAutoCommit Methods 83

The commit and rollback Methods 84

The clearWarnings and getWarnings Methods 86

The createStatement Method 88

The getCatalog and setCatalog Methods 92

The getMetaData Method 92

The getTypeMap and setTypeMap Methods 93

The getTransactionIsolation and setTransactionIsolation Methods 94

The isClosed Method 95

The isReadOnly and setReadOnly Methods 96

The prepareCall Method 97

The prepareStatement Method 98
Introduction 103
Processing Data 104
A Program Example 104
The Statement Class 110
Executing the Query 113
Working with Batches 115
Examining Query Results 117
Controlling and Tuning Results Processing 119
Controlling Query Processing 121
Miscellaneous and Utility 122
Controlling JDBC Escape Processing 123
The getConnection Method 124
Processing Statement Warnings 125
The cancel Method and the close Method 125
Exceptions and Errors and Warnings 126
The SQLException Class 126
The SQLWarning Class 127
The DataTruncation Class 128
The BatchUpdateException Class 129
Summary 130
Coming Up Next 131
CHAPTER 7 THE PREPAREDSTATEMENT AND CALLABLESTATEMENT CLASSES

Introduction 133
The PreparedStatement Class 134
  Setting Parameters 142
  A PreparedStatement Example 143
  PreparedExample.java: main Program Block 149
  The doPrepares Method 150
  The getRentalsbyUserID Method 151
  The getRentalsbyDate Method 151
  The getRentalsbyCustName Method 152
  The printResults Method 152
  The formatString Method 154
  The clearAllParams Method 154
  PreparedExample2.java: Program Output 154
  Executing Queries with the PreparedStatement Class 155
  Working with Batches and PreparedStatements 156
  Miscellaneous and Informational Methods 159

The CallableStatement Class 159
Summary 163
Coming Up Next 163

CHAPTER 8 THE RESULTSET CLASS

Introduction 165
Using a ResultSet for Serial Access 166
  General Purpose ResultSet Methods 170
  The ResultSet getXXXX Methods 172

Moving in the ResultSet 178
  Methods for the Scroll Cursor ResultSet 184

Using Updateable ResultSets 186
  The updateXXXX Methods of the ResultSet Class 192

ResultSet Constants 197
CONTENTS

Data Type Mapping  197
  SQL char Data Type  199
  SQL DECIMAL and NUMERIC  199
  SQL BINARY, VARBINARY, and LONGVARBINARY Data Types  200
  BIT Data Types  200
  TINYINT, SMALLINT, INTEGER and BIGINT Data Types  200
  REAL, FLOAT, and DOUBLE Data Types  200
  DATE, TIME, and TIMESTAMP Data Types  200

Summary  201

Coming Up Next  201

CHAPTER 9  TRANSACTIONS IN JDBC  203

Introduction  203

The ACID Principle  203
  Atomicity  204
  Consistency  204
  Isolation  204
  Durability  204

Using Transactions in JDBC  204
  A Transaction Example  205

Distributed Transactions in J2EE  210

Declarative Transactions with J2EE  213

Distributed Transactions Under the Covers  214

Summary  216

Coming Up Next  216

CHAPTER 10  JDBC AND DYNAMIC QUERIES  217

Introduction  217

Using Dynamic Queries  218
A Sample Dynamic Query Application: DynamicQuery.java 218
The DynamicQuery.java Program: Class Declaration and the main Program Block 219
The DynamicQuery.java Application: The Constructor 223
The DynamicQuery.java Application: The processQuery Method 223
DynamicQuery.java: The outputResultSet Method 225
The DynamicQuery.java Application: The getQuery Method 226
The DynamicQuery.java Application: The getRows Method 228
The DynamicQuery.java Application: The convertResultSet Method 229
The DynamicQuery.java Application: The getColumnNames Method 230
The DynamicQuery.java Application: The outputData Method 231
The JDBCTypeMapper Class: JDBC to Java Type Mapping 232
The JDBCTypeMapper.java Application: The getColumnDataString Method 233
The ResultSetMetaData Class 236
The ResultSetMetaData Class Methods: General Information about the Column 240
The Column Type Methods 240
Column Name and Display Size Methods 241
Methods to Evaluate Writing to a Column 241
Searching on a Column 243
ResultSet Constants 243
Summary 243
Coming Up Next 244

CHAPTER 11 THE DATABASEMETAData INTERFACE 245

Introduction 245

DatabaseMetaData Interface: Demonstration Application 246
The DBInfoGUI Application: main Program Block 249

The DBInfoGUI Application: Constructor and buildGUI Method 251
The DBInfoGUI Application: The getConnected Method 252
The DBInfoGUI Application: The getTables Method 253
The DBInfoGUI Application: The getIndices Method 254
The DBInfoGUI Application: The getGeneralInfo Method 256
The DBInfoGUI Application: The parseFunctionsFromString Method 258
The DBInfoGUI Application: The getNumFunctions Method  259
The DBInfoGUI Application: The getSysFunctions Method  260
The DBInfoGUI Application: The getStrFunctions Method  260
The DBInfoGUI Application: The loadPanel Method  261
The DBInfoGUI Application: The output Method  262

Summary  265
Coming Up Next  265

CHAPTER 12 DATABASEMetaData METHODS  267

Introduction  267
Driver Product and Database General Information  268
Database Table Lists and General Table Information  270
Stored Procedure Information  273
Table Column Information  274
Data Type Information  275
Identifier Name Support and Limitations  276
Catalog and Schema Information  278
Keywords, Extensions, and Functions Available  278
Behavior and Support of Null Values  280
Behavior and Visibility of Updates  282
Transaction Behavior  284
SQL Statement Syntax and Support  288
ResultSet Behavior  293
DatabaseMetaData Constants  295

Summary  298
Coming Up Next  298

CHAPTER 13 ADVANCED TOPICS JDBC IN ACTION: INTRODUCTION TO JDBC DESIGN PATTERNS  299

Introduction  299
Using Java Design Patterns with JDBC  300
Client Tier  301
Contents

Presentation Tier 302
Business Tier 302
Resource Tier 303

Design Patterns 303
Business Tier Patterns 304

Two-Tiered Example: The Table Browser Application 307
Table Browser Application: Design Approach 309

The Data Access Object: The GeneralDAO Class 309
The GeneralDAO Class: The Class Declaration and the executeQuery Method 310
The GeneralDAO Class: The Constructor 312
The GeneralDAO Class: The getQuery Method 313
The GeneralDAO Class: The setAggregateVO Methods 314
The GeneralDAO Class: The loadAggregateVO and deleteRow Methods 316
The GeneralDAO Class: The applyUpdates Method 317
The GeneralDAO Class: The loadResults Method 319
The GeneralDAO Class: The clearUpdates and getGeneralAggregateVO Methods 321

The GeneralAggregateVO Class 321
The GeneralAggregateVO Class: Instance Members 322
The GeneralAggregateVO Class: The setXXXX Methods 324
The GeneralAggregateVO Class: The addObject and addRow Methods 325
The GeneralAggregateVO Class: Row Action Methods 326
The GeneralAggregateVO Class: The updateObject Method 328
The GeneralAggregateVO Class: Get Status Information 330
The GeneralAggregateVO Class: Get Internal Counts and getObject Methods 332
The GeneralAggregateVO Class: Positioning Methods 334
The GeneralAggregateVO Class: Output Contents 335
The GeneralAggregateVO Class: Clear Contents 335

Extending GeneralDAO and GeneralAggregateVO to Create Specific Implementations 337

Summary 337

Coming Up Next 338
CHAPTER 14 TABLE BROWSER APPLICATION 339

Introduction 339
The Table Browser Application 339

Technical Approach 341
  Enter Query and Execute Query 341
  Insert, Update, and Delete Functions 341
  Apply Changes 342
  Clear Updates and Exit 343
  The TableBrowser Class: Class Declaration and Instance Members 343
  TableBrowser.java: main Program Block 344
  The TableBrowser Class: The getData Method 345
  The TableBrowser Class: The buildGUI Method 347
  The TableBrowser Class: The createButtonsHandlers Method 349

The TableBrowser.java Application: the dataTableModel Inner Class 356
  The dataTableModel Inner Class: The setValueAt Method 357

Three-Tiered RMI Example: The Table Browser Remote Application 358
  The RemoteTableBrowser Class: The applyUpdates Method 361
  RMI Binding 363

Summary 364

Coming Up Next 364

CHAPTER 15 PERSISTING DATA OBJECTS WITH JDBC 365

Introduction 365

Why Persist Standard Java Objects 366

The Object Persistence Example 367

The ObjectExample1 Class 368
  The ObjectExample1 Class: The main Program Block 371
  The ObjectExample1 Class: The getConnected Method 374
  The ObjectExample1 Class: The getCustomerPurchases Method 375
CHAPTER 16 JDBC DESIGN PATTERNS: DATA ACCESS
OBJECTS AND VALUE OBJECTS 379

Introduction 379
DAOs Description 380
Code Example: The Simple DAO—CategoryDAO 380
Import Statements and Declarations 381
DAO Example: CategoryDAO get and set Methods 382
DAO Example: CategoryDAO—Preparing the Statements 383
DAO Example: CategoryDAO—Update, Insert, Delete, and Select Operations 384
CategoryDAO: Using Value Objects—The setVO Method 388
CategoryDAO: Producing a List of Records—The getCategoryList Method 388
CategoryDAO: The DAO Constructor 390

Value Object Examples 391
A Database Utility Class: DBUtil 392
DBUtil Class Code Description: Imports and Class Member Declarations 394
DBUtil Class Code Description: loadDriver and getConnected Methods 394
DBUtil Class Code Description: createPreparedStatement Method 396
DBUtil Class Code Description: The executePreparedStatement and executePreparedStmtUpd Methods 396
DBUtil Class Code Description: executeQuery Method 397
DBUtil Class Code Description: The executeUpdDBQuery Method 398
DBUtil Class Code Description: get and set Methods 398

A Complex DAO: The Knowledge_baseDAO Class 400
Complex DAO Example: The Knowledge_baseDAO Class 400
Complex DAO Example: The Knowledge_baseDAO Class—get Methods 401
Complex DAO Example: The Knowledge_baseDAO Class—set Methods 402
Complex DAO Example: The Knowledge_baseDAO Class—createPreparedStatement Method 403
Complex DAO Example: The Knowledge_baseDAO Class—updateDAO Method 407
Contents

Complex DAO Example: The Knowledge_baseDAO Class—
deleteDAO Method 408
Complex DAO Example: The Knowledge_baseDAO Class—
loadDAO Method 409
Complex DAO Example: The Knowledge_baseDAO Class—
The Overloaded loadDAO Method 411
Complex DAO Example: The Knowledge_baseDAO Class—
setVO Method 412
Database Access: Retrieving Multiple Rows with the getAll Method 412
Complex DAO Example: The Knowledge_baseDAO Class—
generateDoc_key Method 414
Complex DAO Example: The Knowledge_baseDAO Class—
getFilteredList Method 415
Complex DAO Example: The Knowledge_baseDAO Class—Constructor 417
The Value Object in the DAO 417
The Value Object in the DAO: The Message_userDAO Example 418
The Value Object in the DAO: The Message_userDAO Example—
createPreparedStatements 419
The Value Object in the DAO: The Message_userDAO Example—
updateDAO Method 420
The Value Object in the DAO: The Message_userDAO Example—
insertDAO Method 421
The Value Object in the DAO:
The Message_userDAO Example—deleteDAO Method 421
The Value Object in the DAO: The Message_userDAO Example—
loadDAO Method 422
The Value Object in the DAO: The Message_userDAO Example—
setVO and getVO Methods 423
The Value Object in the DAO: The Message_userDAO Example—
Constructor 424
Summary 424
Coming Up Next 425

Chapter 17  JSP Basics 427

Introduction 427
Some JSP Examples 428
Java Software Components: JavaBeans and EJBs 431
CHAPTER 18  JSP AND JDBC IN DEVELOPMENT:  
A DISCUSSION GROUP SYSTEM  457

Introduction  457
Discussion Group System: Application Description  458
The Message  458
   Message Threads  459
   Message Categories  460
   Database Structure  461
Application Flow for the Message System  461
   Login Page  462
   The Main Menu  464
The Message System: Technical Description  470
   Message System Component Design  472
Message System Database Design  474
   The knowledge_base Table  475
   The knowledge_messages Table  476
   The message_user Table  477
   The base_keys Table  477
   The categories Table  478
CHAPTER 19  JSP AND JDBC
IN DEVELOPMENT: CODING
THE DISCUSSION GROUP SYSTEM  481

Introduction  481

The Organization of the Discussion Group System  481
  The JSPCal Package  482
  The db Utility Package  482
  The knowledgebase Package  484

The Rest of the Story: JSP Pages and JavaBeans
Code Explained  494
  Managing the Login Process: The login.jsp and loginSubmit.jsp Pages  494
  Building Dynamic HTML Tables with JSP: The Posted Messages Page  508
  Building the Dynamic Table  514
  Performing Input with JSP: The Message Update Page  521

Summary  544

Coming Up Next  544

CHAPTER 20  TRANSFORMING JDBC DATA TO XML  545

Introduction  545

Why Perform Transformation  546

JDBC to XML: The Conversion Class  546

JDBC to XML: The Servlet  551
  The ServletExample1 Class: The doGet Method  551
CHAPTER 21  JDBC AND BLOBs 565

Introduction 565
The Benefits of the BLOB 565
The BlobView Servlet 566
The BlobWriter Class 569
The BlobWriter Class: The Class Declaration and the main Program Block 569
The BlobWriter Class: The writeBlob Method 571
The BlobWriter Class: The prepareStatement Method 572
The BlobWriter Class: The getConnected Method 573
The BlobWriter Class: The Constructor 574

The ListMovies JSP Page 574

The MoviesBean JavaBean 577
The MovieBean Class: The Class Declaration and Constructor 578
The MovieBean Class: The loadBean Method 579

Summary 581
Coming Up Next 581

CHAPTER 22  ENTERPRISE JAVABeans ARCHITECTURE 583

Introduction 583
EJBs Defined 584
Scalability and Failover 584
CHAPTER 23  JDBC AND ENTERPRISE JAVA BEANS  

Introduction 601

JDBC in EJBs 601
    Entity Beans and JDBC 602

Connecting EJBs to Presentation Tier Components 603

The ServletExample2 Class Declaration 604
    The ServletExample2 Class: doGet Method 606
    ServletExample2 Class: The getQueryResults Method 607
    The ServletExample2 Class: The init Method 607

The MoviesFacadeBean Class 610
    The MoviesFacadeBean Class: Method Declarations 611
    The MoviesFacadeBean Helper Objects: The StatusDAO 612
    The MoviesFacadeHome and MoviesRemote Interfaces 615
Thread Safety and Concurrency Management  652
Servlet Exception Handling  653
Application Security  653

Servlet Example  655
JDBC to XML: The servlet  655
The ServletExample1 Class: The doGet Method  656
The ServletExample1 Class: The getQueryResults Method  660
The ServletExample1 Class: The init Method  661

The ServletExample1 Class: The web.xml File  663

APPENDIX C  XML BASICS AND PROCESSING WITH JAXP  667

Introduction  667
Uses of XML  668
What It is and What It Isn’t  668
XML: Applying Order to Data  669
XML Standards  673
Java XML Packages  674
The XML Document  675
XML Names  675
XML Document Parts  675

Elements in an XML Document  676
Well-Formed Documents  679
XML Parsers  680

Describing the XML Document: The DTD  680
The Element Tag  681
The ATTLIST Tag  682

JAXP Overview  683
XML Parsing and Transformations  687
Parsing an XML Document  687
Using the DOM Parser API  688
Processing an XML Document with DOM  689
CONTENTS

The XMLDemo1 Class: Declarations and main Program Block 689
The XMLDemo1 Class: getConnected and processQuery Methods 692
The XMLDemo1 Class: The parseNode Method 693

APPENDIX D MATH FUNCTIONS 697

INDEX 701