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Database: SQL, MySQL, ADO.NET 2.0 and Java DB



*It is a capital mistake to theorize
before one has data.*

— Arthur Conan Doyle

*Now go, write it before them in a table,
and note it in a book, that it may be for
the time to come for ever and ever.*

— The Holy Bible, Isaiah 30:8



Get your facts first, and then you can distort them as much as you please.

— Mark Twain

*I like two kinds of men:
domestic and foreign.*

— Mae West



OBJECTIVES

In this chapter you will learn:

- Relational database concepts.
- To use Structured Query Language (SQL) to retrieve data from and manipulate data in a database.
- To install and configure MySQL.
- To create a MySQL database.
- The ADO.NET 2.0 object model.



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| | Number | Name | Department | Salary | Location |
|-------|-------------|----------|------------|--------|-------------|
| | 23603 | Jones | 413 | 1100 | New Jersey |
| | 24568 | Kerwin | 413 | 2000 | New Jersey |
| Row { | 34589 | Larson | 642 | 1800 | Los Angeles |
| | 35761 | Myers | 611 | 1400 | Orlando |
| | 47132 | Neumann | 413 | 9000 | New Jersey |
| | 78321 | Stephens | 611 | 8500 | Orlando |
| | Primary key | | Column | | |

Fig. 22.1 | Employee table sample data.



| Department | Location |
|------------|-------------|
| 413 | New Jersey |
| 611 | Orlando |
| 642 | Los Angeles |

Fig. 22.2 | Result of selecting distinct Department and Location data from table Employee.



| Column | Description |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| authorID | Author's ID number in the database. In the books database, this integer column is defined as autoincremented —for each row inserted in this table, the authorID value is increased by 1 automatically to ensure that each row has a unique authorID. This column represents the table's primary key. |
| firstName | Author's first name (a string). |
| lastName | Author's last name (a string). |

Fig. 22.3 | authors table from the books database.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 3 | Andrew | Goldberg |
| 4 | David | Choffnes |

Fig. 22.4 | Sample data from the authors table.



| Column | Description |
|----------|-------------------------------------------------------------|
| authorID | The author's ID number, a foreign key to the authors table. |
| i s b n | The ISBN for a book, a foreign key to the ti t l e s table. |

Fig. 22.5 | authorI SBN table from the books database.



| authorID | i_sbn | authorID | i_sbn |
|----------|------------|----------|------------|
| 1 | 0131869000 | 2 | 0131450913 |
| 2 | 0131869000 | 1 | 0131828274 |
| 1 | 0131483986 | 2 | 0131828274 |
| 2 | 0131483986 | 3 | 0131450913 |
| 1 | 0131450913 | 4 | 0131828274 |

Fig. 22.6 | Sample data from the authorI SBN table of books.



| Column | Description |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| i s b n | ISBN of the book (a string). The table's primary key. ISBN is an abbreviation for "International Standard Book Number"—a numbering scheme that publishers use to give every book a unique identification number. |
| t i t l e | Title of the book (a string). |
| e d i t i o n N u m b e r | Edition number of the book (an integer). |
| c o p y r i g h t | Copyright year of the book (a string). |

Fig. 22.7 | t i t l e s table from the books database.



| i s b n | t i t l e | e d i t i o n N u m b e r | c o p y r i g h t |
|------------|-----------------------------------------------|---------------------------|-------------------|
| 0131869000 | Visual Basic How to Program | 3 | 2006 |
| 0131525239 | Visual C# How to Program | 2 | 2006 |
| 0132222205 | Java How to Program | 7 | 2007 |
| 0131857576 | C++ How to Program | 5 | 2005 |
| 0132404168 | C How to Program | 5 | 2007 |
| 0131450913 | Internet and World Wide Web How to Program | 3 | 2004 |

Fig. 22.8 | Sample data from the `ti t l e s` table of the `books` database.



Common Programming Error 22.1

Not providing a value for every column in a primary key breaks the Rule of Entity Integrity and causes the DBMS to report an error.



Common Programming Error 22.2

Providing the same value for the primary key in multiple rows causes the DBMS to report an error.





Fig. 22.9 | Table relationships in the books database.



Common Programming Error 22.3

Providing a foreign-key value that does not appear as a primary-key value in another table breaks the Rule of Referential Integrity and causes the DBMS to report an error.



| SQL keyword | Description |
|-------------|---------------------------------------------------------------------------------------------------------------------------------|
| SELECT | Retrieves data from one or more tables. |
| FROM | Tables involved in the query. Required in every SELECT. |
| WHERE | Criteria for selection that determine the rows to be retrieved, deleted or updated. Optional in a SQL query or a SQL statement. |
| GROUP BY | Criteria for grouping rows. Optional in a SELECT query. |
| ORDER BY | Criteria for ordering rows. Optional in a SELECT query. |
| INNER JOIN | Combine rows from multiple tables. |
| INSERT | Insert rows into a specified table. |
| UPDATE | Update rows in a specified table. |
| DELETE | Delete rows from a specified table. |

Fig. 22.10 | SQL query keywords.



Software Engineering Observation 22.1

For most queries, the asterisk (*) should not be used to specify column names. In general, you process results by knowing in advance the order of the columns in the result—for example, selecting authorID and lastName from table authors ensures that the columns will appear in the result with authorID as the first column and lastName as the second column. Programs typically process result columns by specifying the column number in the result (starting from number 1 for the first column). Selecting columns by name also avoids returning unneeded columns and protects against changes in the actual order of the columns in the table(s).



Common Programming Error 22.4

If you assume that the columns are always returned in the same order from a query that uses the asterisk (*), the program may process the results incorrectly. If the column order in the table(s) changes or if additional columns are added at a later time, the order of the columns in the result changes accordingly.



| authorID | lastName |
|----------|----------|
| 1 | Deitel |
| 2 | Deitel |
| 3 | Goldberg |
| 4 | Choffnes |

Fig. 22.11 | Sample authorID and lastName data from the authors table.



Portability Tip 22.1

See the documentation for your database system to determine whether SQL is case sensitive on your system and to determine the syntax for SQL keywords (i.e., should they be all uppercase letters, all lowercase letters or some combination of the two?).



| ti t l e | edi ti onNumber | copyri ght |
|----------------------------------|-----------------|------------|
| Visual C# How to Program | 2 | 2006 |
| Visual Basic 2005 How to Program | 3 | 2006 |
| Java How to Program | 7 | 2007 |
| C How to Program | 5 | 2007 |

Fig. 22.12 | Sampling of titles with copyrights after 2005 from table ti t l es.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |

Fig. 22.13 | Authors whose last name starts with D from the authors table.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 3 | Andrew | Goldberg |

Fig. 22.14 | The only author from the authors table whose last name contains o as the second letter.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 4 | David | Choffnes |
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 3 | Andrew | Goldberg |

Fig. 22.15 | authors sample data in ascending order by lastName.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 3 | Andrew | Goldberg |
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 4 | David | Choffnes |

Fig. 22.16 | authors sample data in descending order by lastName.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 4 | David | Choffnes |
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 3 | Andrew | Goldberg |

Fig. 22.17 | authors sample data in ascending order by lastName and firstName.



| i s b n | t i t l e | e d i t i o n N u m b e r | c o p y r i g h t |
|------------|-----------------------------------------------|---------------------------|-------------------|
| 0132404168 | C How to Program | 5 | 2007 |
| 0131857576 | C++ How to Program | 5 | 2005 |
| 0131450913 | Internet and World Wide Web How to Program | 3 | 2004 |
| 0132222205 | Java How to Program | 7 | 2007 |
| 0131869000 | Visual Basic 2005 How to Program | 3 | 2006 |
| 0131525239 | Visual C# How to Program | 2 | 2006 |

Fig. 22.18 | Sampling of books from table `ti t l e s` whose titles end with `How to Program` in ascending order by `ti t l e`.



Software Engineering Observation 22.2

If a SQL statement includes columns with the same name from multiple tables, the statement must precede those column names with their table names and a dot (e.g., authors.authorID).



Common Programming Error 22.5

Failure to qualify names for columns that have the same name in two or more tables is an error.



| fi rstName | I astName | i sbn | fi rstName | I astName | i sbn |
|------------|-----------|------------|------------|-----------|------------|
| David | Choffnes | 0131828274 | Paul | Deitel | 0131869000 |
| Harvey | Deitel | 0131869000 | Paul | Deitel | 0131525239 |
| Harvey | Deitel | 0131525239 | Paul | Deitel | 0132222205 |
| Harvey | Deitel | 0132222205 | Paul | Deitel | 0131857576 |
| Harvey | Deitel | 0131857576 | Paul | Deitel | 0132404168 |
| Harvey | Deitel | 0132404168 | Paul | Deitel | 0131450913 |
| Harvey | Deitel | 0131450913 | Paul | Deitel | 0131869000 |
| Harvey | Deitel | 0131869000 | Paul | Deitel | 0131828274 |
| Harvey | Deitel | 0131828274 | Andrew | Goldberg | 0131450913 |

Fig. 22.19 | Sampling of authors and ISBNs for the books they have written in ascending order by I astName and fi rstName.



Good Programming Practice 22.1

Always explicitly list the columns when inserting rows. If the table's column order changes or a new column is added, omitting the columns list may cause an error.



Common Programming Error 22.6

It is normally an error to specify a value for an autoincrement column.



Common Programming Error 22.7

SQL uses the single-quote (') character as a delimiter for strings. To specify a string containing a single quote (e.g., O'Malley) in a SQL statement, the string must have two single quotes in the position where the single-quote character appears in the string (e.g., ' O' ' Mal l ey'). The first of the two single-quote characters acts as an escape character for the second. Not escaping single-quote characters in a string that is part of a SQL statement is a SQL syntax error.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 3 | Andrew | Goldberg |
| 4 | David | Choffnes |
| 5 | Sue | Smith |

Fig. 22.20 | Sample data from table **Authors** after an **INSERT** operation.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 3 | Andrew | Goldberg |
| 4 | David | Choffnes |
| 5 | Sue | Jones |

Fig. 22.21 | Sample data from table `authors` after an `UPDATE` operation.



| authorID | firstName | lastName |
|----------|-----------|----------|
| 1 | Harvey | Deitel |
| 2 | Paul | Deitel |
| 3 | Andrew | Goldberg |
| 4 | David | Choffnes |

Fig. 22.22 | Sample data from table authors after a DELETE operation.

