30. Database Concepts

Java

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- Entity-relationship (ER) diagram
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Introduction

Introduction

- **Database**
  - Collection of data
- **Database Management System (DBMS)**
  - Provides mechanisms for storing, organizing, retrieving and modifying data
- **Structured Query Language (SQL)**
  - Pronounced “sequel”
  - The international standard language used with **relational databases** to perform **queries** (i.e., to request information that satisfies given criteria) and to manipulate data.

Introduction

- **Relational Database Management System (RDBMS)**
  - Today's most popular database systems
  - Microsoft SQL Server, Oracle, Sybase, IBM DB2, Informix, PostgreSQL and MySQL

- **Java Database Connectivity (JDBC)**
  - Java programs communicate with databases and manipulate their data using the **JDBC**™API
  - **JDBC driver**
    - Enable Java applications to connect to database
    - Enable programmers to manipulate databases using JDBC

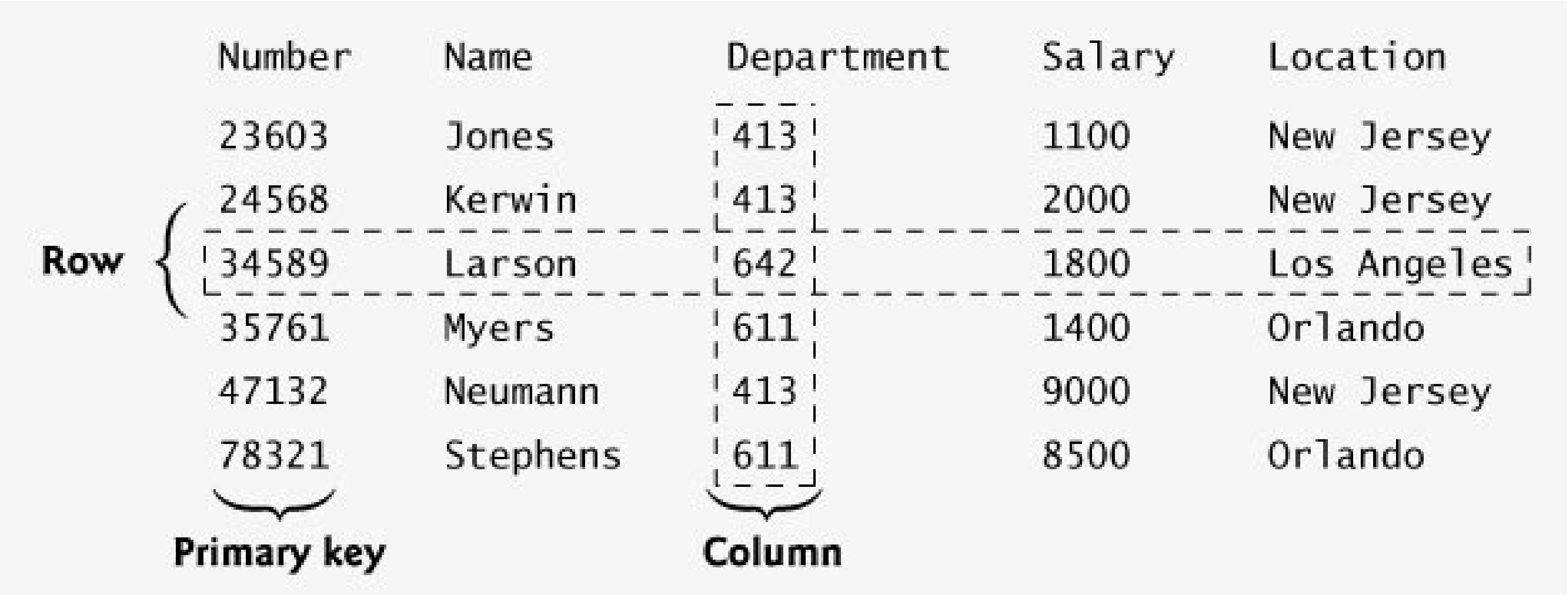
Relational Databases

Relational Databases

- **Tables**
  - A relational database stores data in **tables**
- **Rows**
  - Tables are composed of **rows**
- **Columns**
  - Rows are composed of **columns** in which values are stored
- **Primary key**
  - A column (or group of columns) in a table with a unique value that cannot be duplicated in other rows

Employee table sample data

- The table name is Employee, and its primary purpose is to store the attributes of an employee.

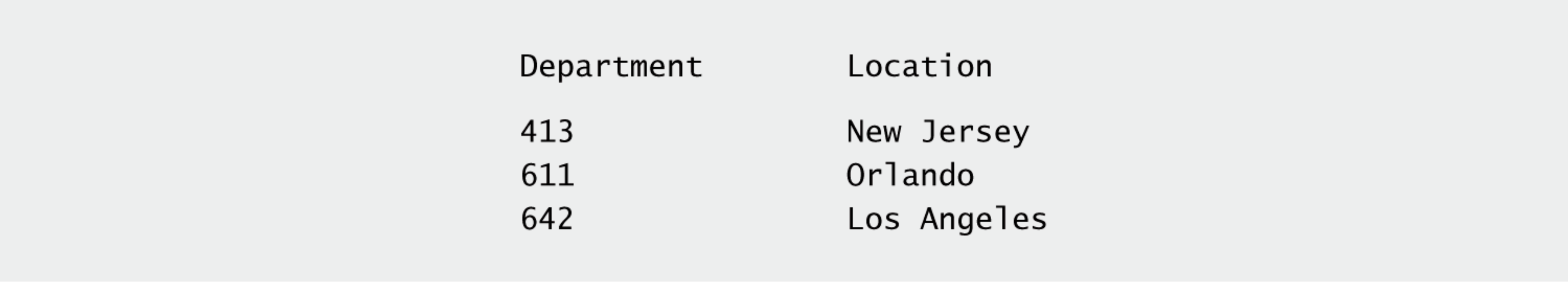


Number	Name	Department	Salary	Location
23603	Jones	413	1100	New Jersey
24568	Kerwin	413	2000	New Jersey
34589	Larson	642	1800	Los Angeles
35761	Myers	611	1400	Orlando
47132	Neumann	413	9000	New Jersey
78321	Stephens	611	8500	Orlando

Row
Primary key
Column

Relational Databases

- **SQL queries**
  - Specify which rows and columns to select from a table
- For example, result of selecting distinct Department and Location data from table Employee



```
Department        Location

413               New Jersey
611               Orlando
642               Los Angeles
```

The **books** Database

The books Database

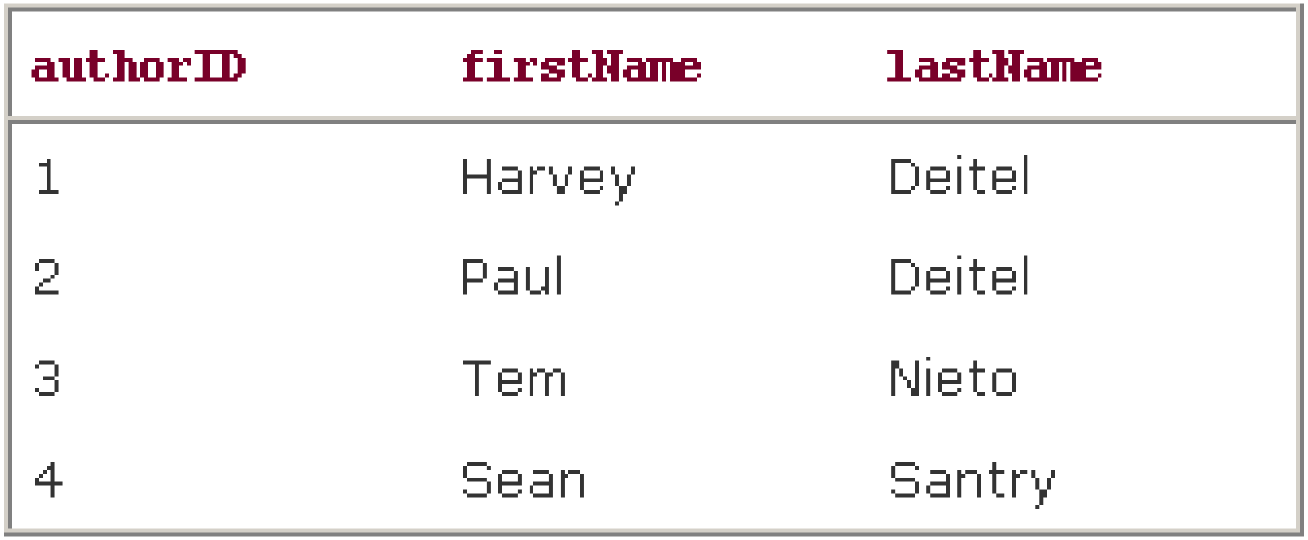
- The database consists of four tables:
  - `authors`
    - consists of each author's data
  - `publishers`
    - contains the data of publishers
  - `titles`
    - contains the data of book titles
  - `authorISBN`
    - consists of each author's data

The books Database

- authors table:
  - 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).

The books Database

- Sample data from the authors table:



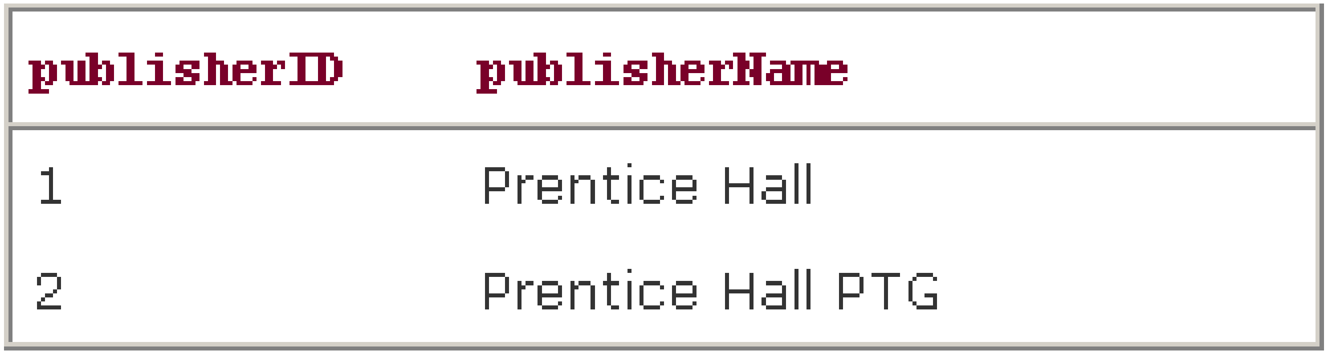
authorID	firstName	lastName
1	Harvey	Deitel
2	Paul	Deitel
3	Tem	Nieto
4	Sean	Santry

The books Database

- **publishers table:**
  - publisherID
    - The publisher's ID number in the database.
    - This autoincremented integer is the table's primary key.
  - publisherName
    - The name of the publisher (a string).

The books Database

- Data from the publishers table:



publisherID	publisherName
1	Prentice Hall
2	Prentice Hall PTG

The books Database

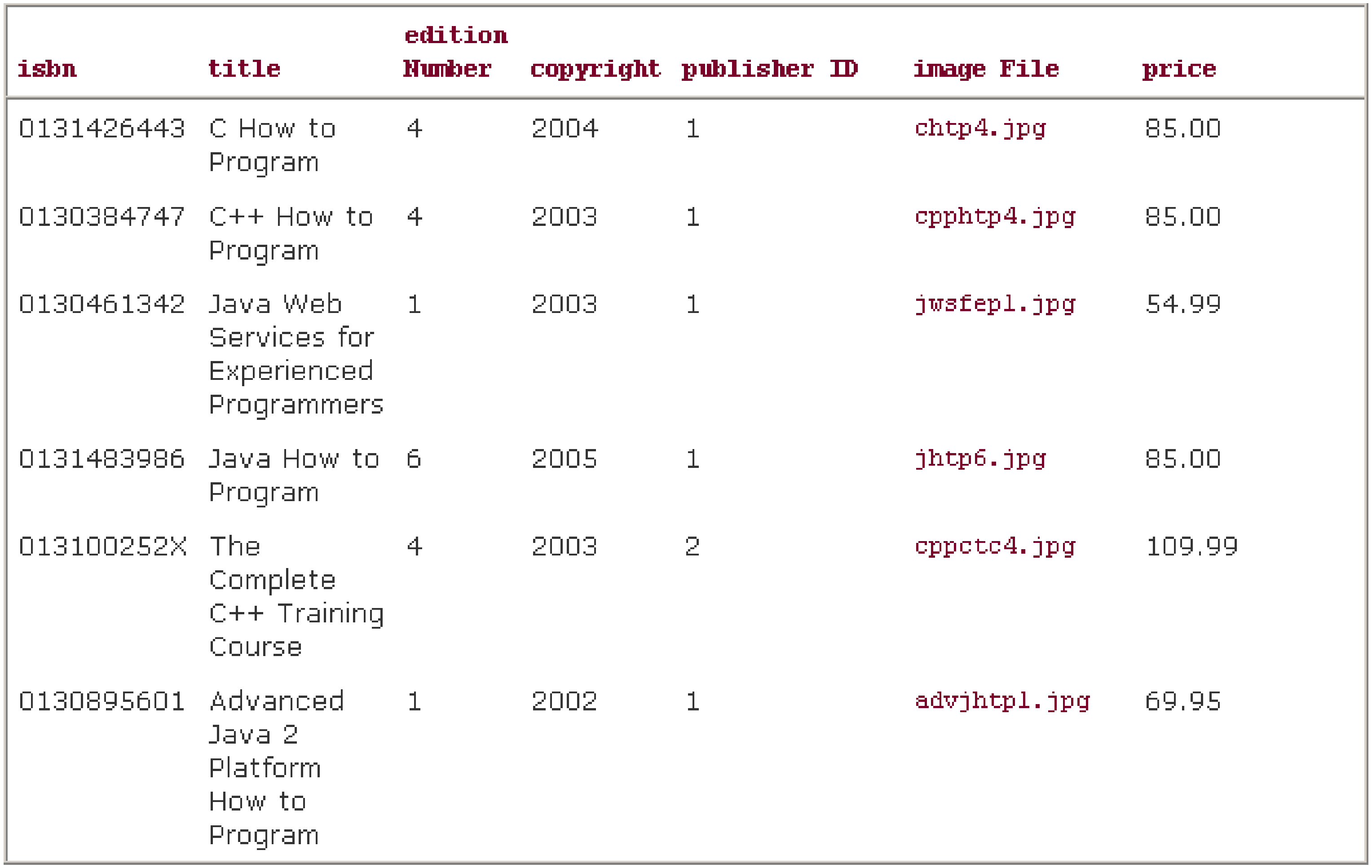
- **titles table:**
  - isbn
    - ISBN of the book (a string). The table's primary key.
    - ISBN is an abbreviation for "International Standard Book Number"a numbering scheme that publishers worldwide use to give every book a unique identification number.
  - title
    - Title of the book (a string).
  - editionNumber
    - Edition number of the book (an integer).
  - copyright
    - Copyright year of the book (a string).

The books Database

- **titles table: (cont.)**
  - publisherID
    - Publisher's ID number (an integer).
    - A foreign key that relates this table to the publishers table.
  - imageFile
    - Name of the file containing the book's cover image (a string).
  - price
    - Suggested retail price of the book (a real number).

The books Database

- Sample data from the titles table:



isbn	title	edition Number	copyright	publisher ID	image File	price
0131426443	C How to Program	4	2004	1	chtp4.jpg	85.00
0130384747	C++ How to Program	4	2003	1	cpphtp4.jpg	85.00
0130461342	Java Web Services for Experienced Programmers	1	2003	1	jwsfep1.jpg	54.99
0131483986	Java How to Program	6	2005	1	jhtp6.jpg	85.00
013100252X	The Complete C++ Training Course	4	2003	2	cppctc4.jpg	109.99
0130895601	Advanced Java 2 Platform How to Program	1	2002	1	advjhtp1.jpg	69.95

The books Database

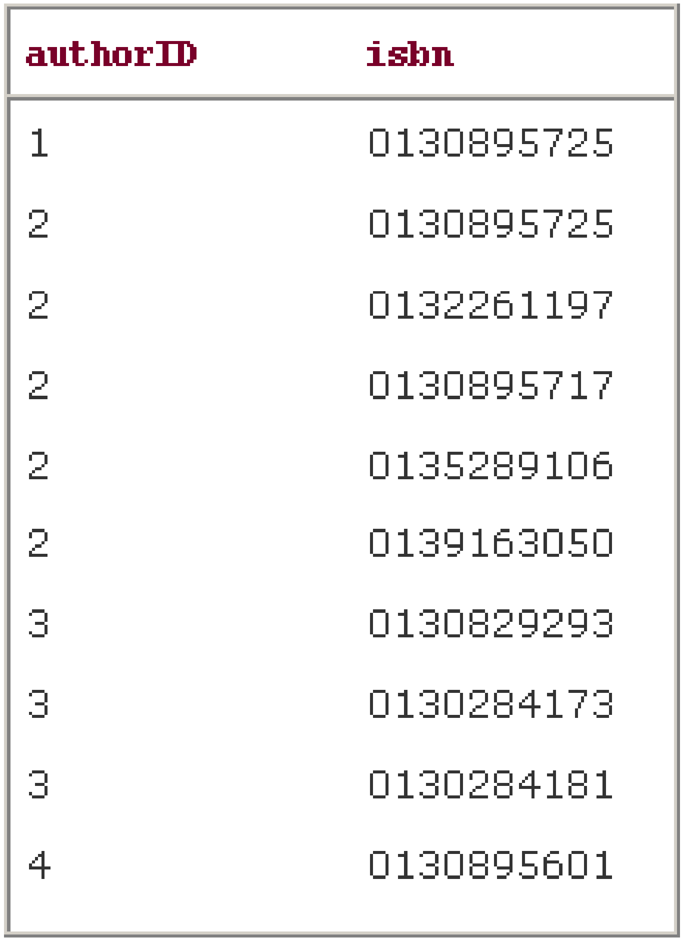
- **Foreign key**
  - A column
    - matches the primary key column in another table
  - Helps maintain the **Rule of Referential Integrity**
    - Every foreign key value must appear as another table's primary key value
  - Foreign keys also allow related data in multiple tables to be selected from those tables for analytic purposes this is known as joining the data.
  - There is a one-to-many relationship between a primary key and a corresponding foreign key (e.g., one publisher can publish many books).

The books Database

- **authorISBN table:**
  - authorID
    - The author's ID number, a foreign key to the authors table.
  - isbn
    - The ISBN for a book, a foreign key to the titles table.
- Both columns are foreign keys that represent the relationship between the tables authors and titles
- One row in table authors may be associated with many rows in table titles, and vice versa.

The books Database

- Sample data from the authorISBN table:



authorID	isbn
1	0130895725
2	0130895725
2	0132261197
2	0130895717
2	0135289106
2	0139163050
3	0130829293
3	0130284173
3	0130284181
4	0130895601

Entity-relationship (ER) diagram

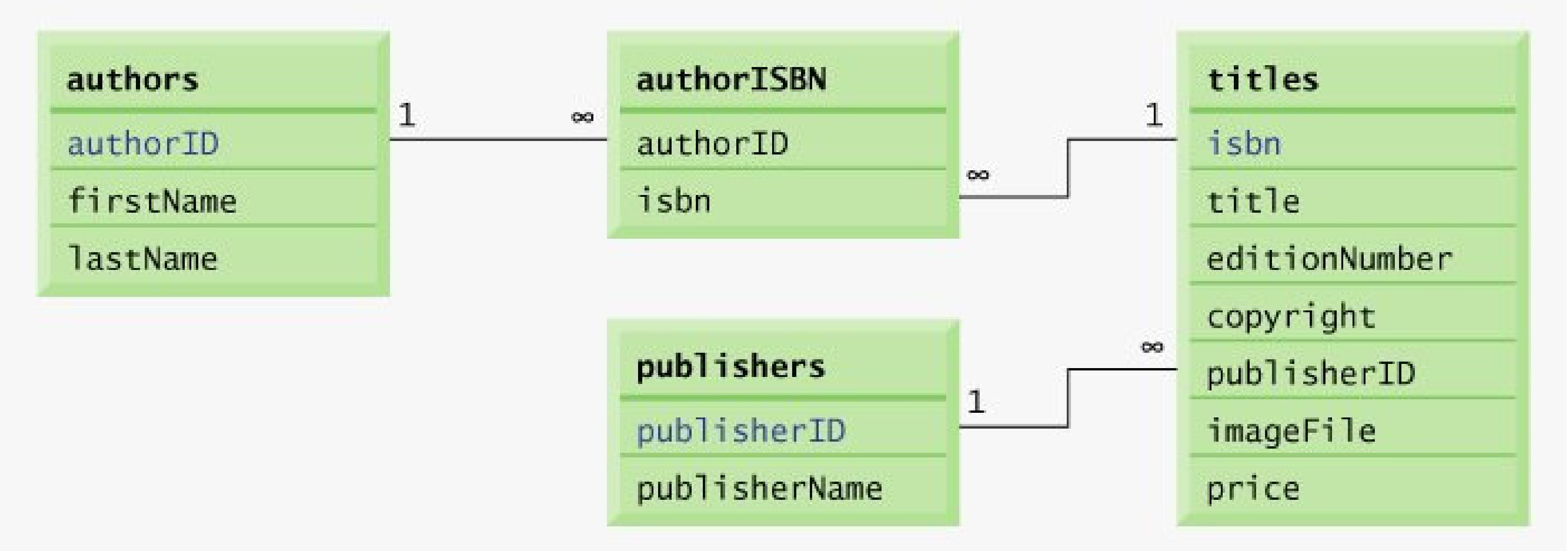
Entity-relationship (ER) diagram

- **Entity-relationship (ER) diagram** shows the tables in the database and the relationships among them.

- **Rule of Entity Integrity**
  - Primary key uniquely identifies each row
  - Every row must have a value for every column of the primary key
  - Value of the primary key must be unique in the table

Entity-relationship (ER) diagram

- **Table relationships in books:**



Common Programming Errors

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

- 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.

References

References

- H. M. Deitel and P. J. Deitel, **Java™ How to Program**, Sixth Edition, Prentice Hall, 2005. (Chapter 25)

The End