Database Applications (2)

Han-fen Hu

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Outline

- ResultSet Navigation Methods
- Data Access Object Pattern
- Database Transactions

Scrollable Result Sets (1)

- By default, a **`ResultSet`** object is created with a read-only concurrency level and the cursor is limited to forward movement
- A *scrollable result set* can be created with the **`Connection`** object's method

```
conn.createStatement(type, concur);

conn.prepareStatement(sql, type, concur);
```

  - ***`sql`*** is the SQL command with parameters
  - ***`type`*** is a constant for the scrolling type
  - **`concur`** is a constant for the concurrency level

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The `ResultSet` Scrolling Types

- **`ResultSet.TYPE_FORWARD_ONLY`**
  - Default scrolling type
  - Cursor moves forward only
- **`ResultSet.TYPE_SCROLL_INSENSITIVE`**
  - Cursor moves both forward and backward
  - Changes made to the database do not appear
- **`ResultSet.TYPE_SCROLL_SENSITIVE`**
  - Cursor moves both forward and backward
  - Changes made to the database appear as soon as they are made

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The `ResultSet` Concurrency Levels

- **`ResultSet.CONCUR_READ_ONLY`**
  - Default concurrency level
  - Read-only version of data from the database
  - Cannot change database by altering result set
- **`ResultSet.CONCUR_UPDATEABLE`**
  - Result set is updateable
  - Changes can be made to the result set and saved to the database
  - Uses methods that allow changes to be made to the database without issuing SQL statements

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Scrollable Result Sets (2)

- Example 1:
  - Creates a scrollable result set that is read-only and insensitive to database changes

```
Statement stmt =
   conn.createStatement(ResultSet.TYPE_SCROLL_INSENSITIVE,
                        ResultSet.CONCUR_READ_ONLY);
```

- Example 2:
  - Creates a scrollable result set that is updatable and insensitive to database changes

```
PreparedStatement prepStmt =
             conn.prepareStatement(sql,
             ResultSet.TYPE_SCROLL_INSENSITIVE,
             ResultSet.CONCUR_UPDATABLE);
```

`ResultSet` Navigation Methods (1)

- **`first()`**
  - Moves the cursor to the first row
- **`last()`**
  - Moves the cursor to the last row
- **`next()`**
  - Moves the cursor to the next row
- **`previous()`**
  - Moves the cursor to the previous row

`ResultSet` Navigation Methods (2)

- **`relative(`*`rows`*`)`**
  - Moves the cursor the number specified by the ***`rows`*** argument relative to the current row
    - A positive ***`rows`*** value will move the cursor forward
    - A negative ***`rows`*** value will move the cursor backward
- **`absolute(`*`rows`*`)`**
  - Moves the cursor to the row number specified by the ***`rows`*** argument
    - A **`rows`** value of 1 will move the cursor to the first row
    - A **`rows`** value of 2 will move cursor to the second row
    - And so on until the last row

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Application of `ResultSet` Navigation Methods

- **`ResultSet`** navigation methods can be used to determine the number of rows in a result set
- Example:

```
resultSet.last();                    // Move to the last row
int numRows = resultSet.getRow();    // Get the current row number
resultSet.first();                   // Move back to the first row
```

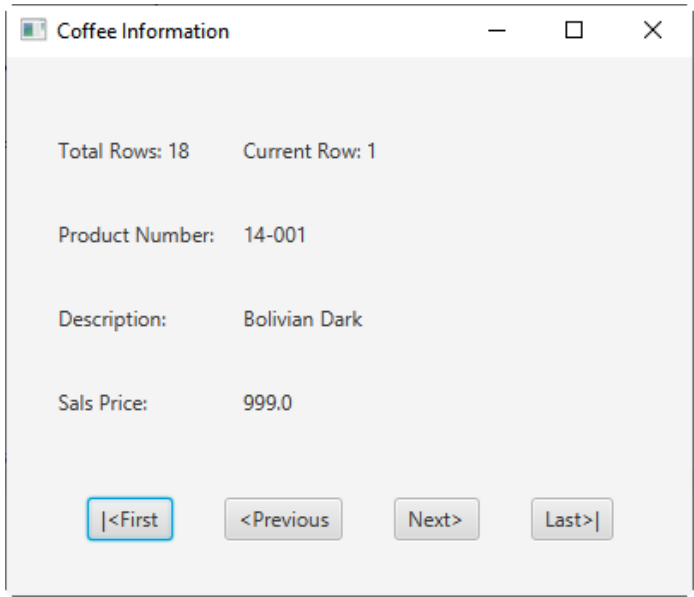
  - Move cursor to last row
  - Get the last row's number and store the value
  - Move back to the first row

Database Application in JavaFX

- Option 1: Whenever a JavaFX application is launched:
  - Calls the start (javafx.stage.Stage) method
    - Open the database connection
  - Waits for the application to finish
  - Calls the stop() method
    - Close the database connection
- Option 2: Open and close the database connect in each event listener

Lab (1)

- CoffeeBrowser.fxml
- CoffeeBrowserController.java
- CoffeeBrowser.java
  - The application will display the database query result one record at a time. The four buttons can be used to switch records.



Data Access Object (DAO) Pattern

- Access to persistent storage varies by the type of storage (relational databases, object-oriented databases, flat files, and so forth) and the vendor implementation
  - Access to data varies depending on the source of the data.
- Data Access Object Pattern or DAO pattern is used to separate low level data accessing API or operations from high level business services

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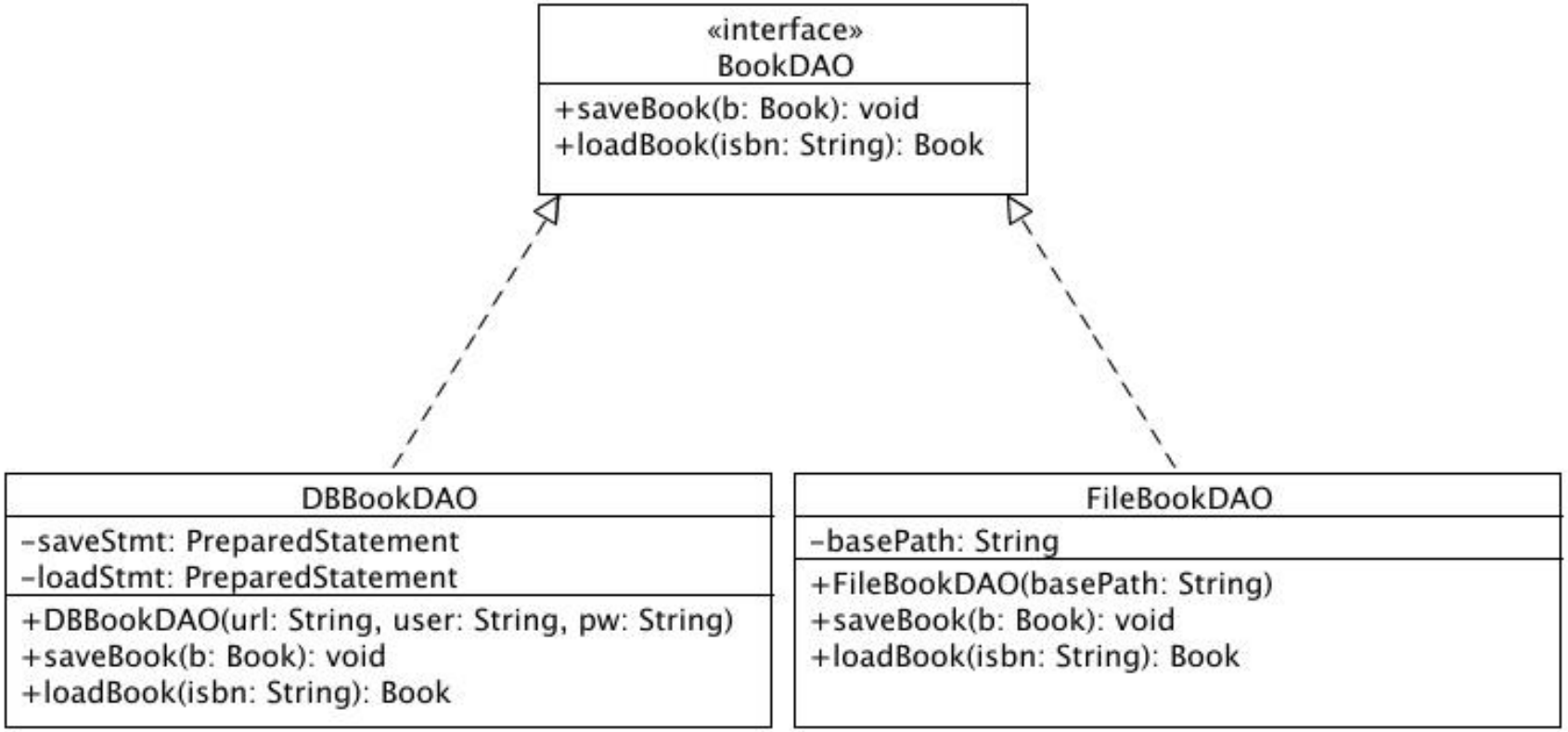
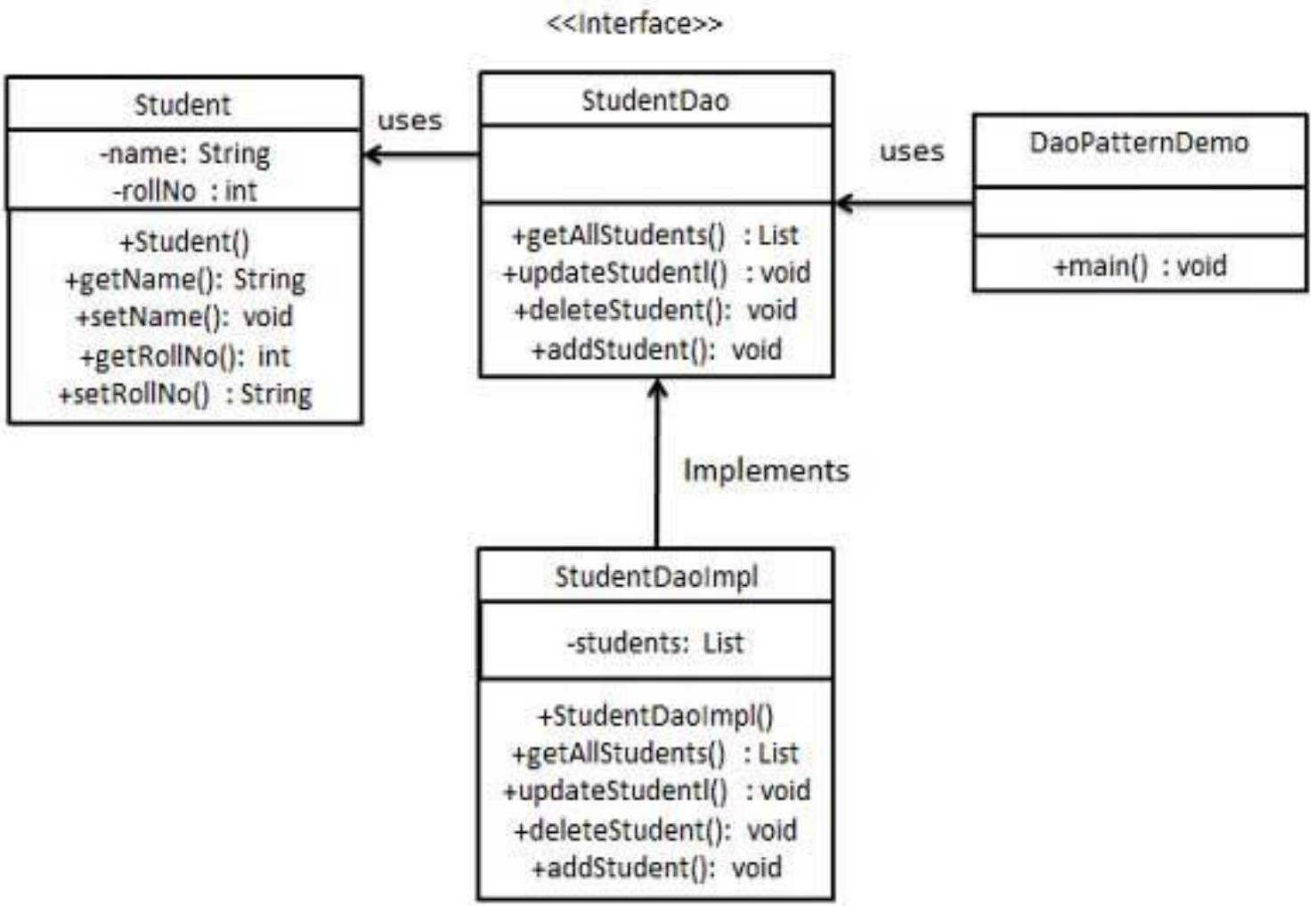
DAO for Different Data Sources



Why DAO?

- Use a Data Access Object (DAO) to abstract and encapsulate all access to the data source.
  - DAO manages the connection with the data source to obtain and store data.
  - DAO implements the access mechanism required to work with the data source.
- The Data Access Object (DAO) pattern provides an abstraction layer between the business logic tier and the persistent storage tier
  - Changes made to the data source should not modify the business objects; only the data access objects themselves would need to change.

DAO Components (1): Example



http://www.tutorialspoint.com/design_pattern/data_access_object_pattern.htm

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DAO Components (2)

- Data Model
  - Contains get/set methods to store data retrieved using DAO class
- Data Access Object Interface
  - Defines the standard operations to be performed on a model object(s)
- Data Access Object concrete class
  - Implements above interface.
  - Get data from a data source which can be database / xml or any other storage mechanism.

Steps of Implementing DAO Pattern

- Create Data Model (model class)
- Create DAO Interface
- Create concrete class implementing above interface
  - Either retrieve the data from databases or files
- Use the DAO in applications

Lab (2)

- CoffeeDBConstants.java
- CoffeeDBUtil.java
- Customer.java
- CustomerDAO.java
- CustomerDAOImpl.java

Use DAO Pattern in JavaFX (1)

- The JavaFX application does not have to deal with database connection and operations
- In the action listener methods, instantiate object of the DAO concrete class, and then call the methods to insert, update, delete, and query.

Lab (3)

- CustomerInserter.java
- CustomerInserter.fxml
- CustomerInserterController.java
  - It allows the user to enter and save the data.

Use DAO Pattern in JavaFX (2)

- To display the list of object in a TableView, the ArrayList need to be converted into a ObservableList first

```
List<Customer> customerList =
        new ArrayList<Customer>();
ObservableList<Customer> observableCustomers =
        FXCollections.observableArrayList(customerList);
```

Lab (4)

- CustomerQuery.java
- CustomerQuery.fxml
- CustomerQueryController.java
  - It allows user to enter a state and displays customer in the state

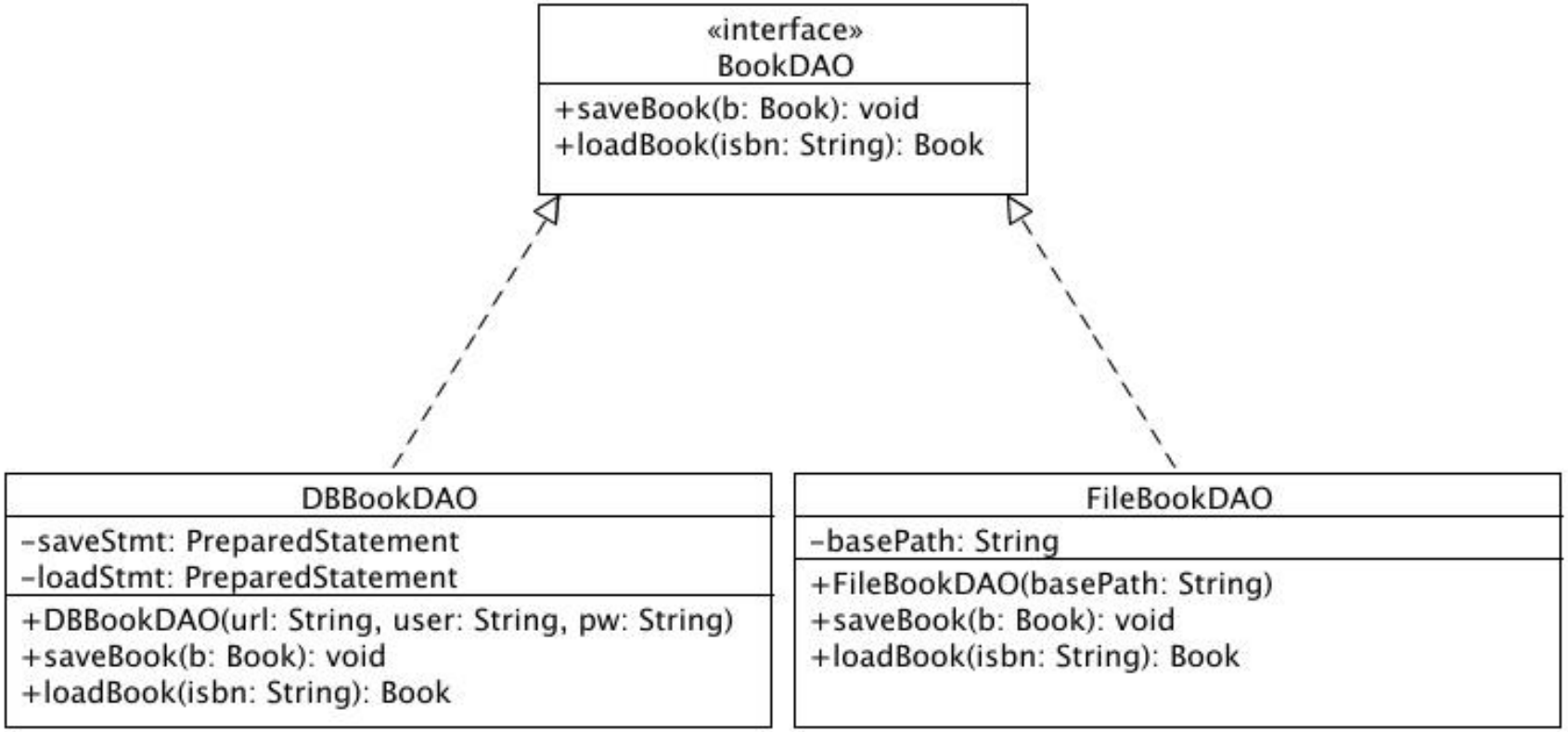
When to Use DAO?

- Need to access a persistent storage more than one time
- Want to separate a data resource's client interface from its data access mechanisms
- Want to provide a generic interface
- In a larger project, different teams work on different parts of the application: the DAO pattern allows clean separation of concerns.

MVC Design Pattern

- Model
  - Data Model (model class)
  - DAO
- Visual
  - fxml
- Control
  - Controller and application class

DAO for Different Data Sources



How to Plan a DAO?

- Insertion, update, and deletion
  - Insert a record
  - Update a record
  - Delete by the primary key (e.g., ID)
  - Delete by other columns
- Data retrieval
  - Get all records
  - Find by the primary key (e.g., ID)
  - Find by other columns

Exercise

- Design a DAO structure for the table Coffee of the CoffeeShopData
  - Data Model: Coffee
  - Data Access Object Interface: CoffeeDAO
  - Data Access Object Implementation: CoffeeDAOImpl
- Create a program to demonstrate the use of the DAO pattern, you can consider a program for
  - Inserting a record,
  - Query the coffee by a certain column,
  - Or any other applications that you can think of

Transactions

- An operation that requires multiple database updates is known as a *transaction*.
  - For a transaction to be complete, all of the steps involved in the transaction must be performed.
  - If any single step within a transaction fails, none of the steps in the transaction should be performed.
- When you write transaction-processing code, there are two concepts you must understand:
  - Commit: making a permanent change to a database
  - Rollback: refers to undoing changes to a database

JDBC Auto Commit Mode

- By default, the JDBC **`Connection`** class operates in auto commit mode.
- In *auto commit* mode
  - All updates that are made to the database are made permanent as soon as they are executed.
- When auto commit mode is turned off
  - Changes do not become permanent until a commit command is executed
  - A rollback command can be used to undo changes

JDBC Transaction Methods

- To turn auto commit mode off
  - Call the **`Connection`** class's **`setAutoCommit`** method
  - Pass the argument **`false`**

```
conn.setAutoCommit(false);
```

- To execute a commit command
  - Call the **`Connection`** class's **`commit`** method

```
conn.commit();
```

- To execute a rollback command
  - Call the **`Connection`** class's **`rollback`** method

```
conn.rollback();
```

JDBC Transaction Example

```
conn.setAutoCommit(false);
// Attempt the transaction
try {
    // Update the inventory records.
    stmt.executeUpdate(updateStatement);
    // Add the order to the UnpaidOrder table.
    stmt.executeUpdate(insertStatement);
……..
    // Commit all these updates.
    conn.commit();
}
catch (SQLException ex) {
    // Roll back the changes
    conn.rollback();
}
```

The `commit` method is called in the `try` block

The `rollback` method is called in the `catch` block

References

- Data Access Object Pattern
  http://www.tutorialspoint.com/design_pattern/data_access_object_pattern.htm
- Write once, persist anywhere
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