Experiment 2.4

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Aim: Create Java applications with JDBC for database connectivity, CRUD operations, and MVC architecture.

Objective: To Create Java applications with JDBC for database connectivity, CRUD operations, and MVC architecture.

Easy Level:

Create a Java program to connect to a MySQL database and fetch data from a single table. The program should:

Use DriverManager and Connection objects.

Retrieve and display all records from a table named Employee with columns EmpID, Name, and Salary.

Code:

```
import java.sql.*; import
java.util.Scanner;


public class EmployeeDatabase {     private static final String DB_URL =
"jdbc:mysql://localhost:3808/test";     private static final String
USERNAME = "root";     private static final String PASSWORD =
"******";


   public static void main(String[] args) {
      Scanner scanner = new Scanner(System.in);
```

```
        while (true) {
            System.out.println("\n=== Employee Management System ===");
            System.out.println("1) View Employee List");
            System.out.println("2) Exit");
            System.out.print("Select an option: ");

            int option = scanner.nextInt();
             if (option == 1)
{
fetchEmployees();
            } else if (option == 2) {
                System.out.println("Goodbye!");
                break;
            } else {
                System.out.println("Invalid choice! Please try again.");
            }
        }

        scanner.close();
    }

    private static void fetchEmployees() {
        String query = "SELECT EmpID, Name, Salary FROM Employee";

        try (Connection conn = DriverManager.getConnection(DB_URL, USERNAME, PASSWORD);
             Statement stmt = conn.createStatement();
             ResultSet rs = stmt.executeQuery(query)) {
```

```
        System.out.println("\nEmployee Details:");
System.out.println("ID | Name | Salary");
        System.out.println("--------------------");

        while (rs.next()) {
            System.out.printf("%d | %s | %.2f%n", rs.getInt("EmpID"), rs.getString("Name"),
rs.getDouble("Salary"));
        }
    } catch (SQLException ex) {
        System.err.println("Database connection error: " + ex.getMessage());
    }
  }
}
```

Medium Level:

Build a program to perform CRUD operations (Create, Read, Update, Delete) on a database table Product with columns:

ProductID, ProductName, Price, and Quantity.

The program should include:

Menu-driven options for each operation.

Transaction handling to ensure data integrity.

Code:

```
import java.sql.*; import
java.util.Scanner;

public class ProductManager {    private static final String DB_URL =
"jdbc:mysql://localhost:3808/test";    private static final String USER = "root";
private static final String PASSWORD = "********";
```

```
    public static void main(String[] args) {        Scanner
scanner = new Scanner(System.in);        boolean
running = true;


        while (running) {
            System.out.println("\n===== Product Management =====");
            System.out.println("1) Add Product");
            System.out.println("2) View Products");
            System.out.println("3) Update Product");
            System.out.println("4) Delete Product");
            System.out.println("5) Exit");
            System.out.print("Choose an option: ");

            int choice = scanner.nextInt();
scanner.nextLine(); // Clear newline buffer

            switch (choice) {               case 1 >
addProduct(scanner);               case 2 ->
viewProducts();               case 3 ->
updateProduct(scanner);               case 4 >
deleteProduct(scanner);               case 5
-> {
                System.out.println("Exiting application...");                    running
= false;
                }
                default -> System.out.println("Invalid option! Try again.");
            }
        }
scanner.close();
```

```
    }

    private static void addProduct(Scanner scanner) {
        System.out.print("Enter product name: ");
        String name = scanner.nextLine();
System.out.print("Enter price: ");
double price = scanner.nextDouble();
System.out.print("Enter quantity: ");        int
quantity = scanner.nextInt();

        String sql = "INSERT INTO Product (ProductName, Price, Quantity) VALUES (?, ?, ?)";

        try (Connection conn = DriverManager.getConnection(DB_URL, USER, PASSWORD);
PreparedStatement stmt = conn.prepareStatement(sql)) {

            stmt.setString(1, name);
stmt.setDouble(2,            price);
stmt.setInt(3, quantity);

            int rowsInserted = stmt.executeUpdate();
if (rowsInserted > 0) {
                System.out.println("Product added successfully!");
            } else {
                System.out.println("Failed to add product.");
            }
        } catch (SQLException ex) {
            System.err.println("Error adding product: " + ex.getMessage());
        }
    }
```

```
    private static void viewProducts() {
        String sql = "SELECT * FROM Product";

        try (Connection conn = DriverManager.getConnection(DB_URL, USER, PASSWORD);
             Statement stmt = conn.createStatement();
             ResultSet rs = stmt.executeQuery(sql)) {

            System.out.println("\nProduct List:");
            System.out.println("ID | Name | Price | Quantity");
            System.out.println("--------------------------------");

            while (rs.next()) {
                System.out.printf("%d | %s | %.2f | %d%n",
rs.getInt("ProductID"),
rs.getString("ProductName"),
rs.getDouble("Price"),                    rs.getInt("Quantity"));

            }
        } catch (SQLException ex) {
            System.err.println("Error retrieving products: " + ex.getMessage());
        }
    }

    private static void updateProduct(Scanner scanner)
{       System.out.print("Enter product ID to update:
");       int id = scanner.nextInt();       scanner.nextLine();
// Clear buffer
        System.out.print("Enter new product name: ");
        String name = scanner.nextLine();
System.out.print("Enter new price: ");
```

```
double price = scanner.nextDouble();
System.out.print("Enter new quantity: ");        int
quantity = scanner.nextInt();

      String sql = "UPDATE Product SET ProductName=?, Price=?, Quantity=? WHERE ProductID=?";

      try (Connection conn = DriverManager.getConnection(DB_URL, USER, PASSWORD);
PreparedStatement stmt = conn.prepareStatement(sql)) {

          stmt.setString(1, name);
stmt.setDouble(2, price);
stmt.setInt(3, quantity);            stmt.setInt(4,
id);

          int rowsUpdated = stmt.executeUpdate();
if (rowsUpdated > 0) {
              System.out.println("Product updated successfully!");
          } else {
              System.out.println("Product ID not found.");
          }
      } catch (SQLException ex) {
          System.err.println("Error updating product: " + ex.getMessage());
      }
  }

  private static void deleteProduct(Scanner scanner) {
System.out.print("Enter product ID to delete: ");        int
id = scanner.nextInt();
```

```
        String sql = "DELETE FROM Product WHERE ProductID=?";


        try (Connection conn = DriverManager.getConnection(DB_URL, USER, PASSWORD);
PreparedStatement stmt = conn.prepareStatement(sql)) {
             stmt.setInt(1, id);
int
rowsDeleted = stmt.executeUpdate();


            if (rowsDeleted > 0) {
                System.out.println("Product deleted successfully!");
            } else {
                System.out.println("Product ID not found.");
            }
        } catch (SQLException ex) {
            System.err.println("Error deleting product: " + ex.getMessage());
        }
    }
}
```

Hard Level:

Develop a Java application using JDBC and MVC architecture to manage student data. The application should:

Use a Student class as the model with fields like StudentID, Name, Department, and Marks.

Include a database table to store student data.

Allow the user to perform CRUD operations through a simple menu-driven view.

Implement database operations in a separate controller class.

Code:

Model

```
public class Student {
private int id;     private
String fullName;     private
String dept;     private int
score;

   public Student(int id, String fullName, String dept, int score) {
       this.id = id;
this.fullName = fullName;
this.dept = dept;         this.score
= score;
   }

   // Getters and Setters     public int getId()
{ return id; }     public void setId(int id) {
this.id = id; }

   public String getFullName() { return fullName; }     public void
setFullName(String fullName) { this.fullName = fullName; }

   public String getDept() { return dept; }     public
void setDept(String dept) { this.dept = dept; }

   public int getScore() { return score; }     public void setScore(int
score) { this.score = score; }
@Override     public String toString() {         return
"Student ID: " + id + ", Name: " + fullName + ",
Department: " + dept + ", Score: " + score;
   }
}
```

View

```
import java.util.List;

import java.util.Scanner;


public class StudentView {     private final StudentController studentController
= new StudentController();     private final Scanner inputScanner = new
Scanner(System.in);


   public void showMenu() {
      int option;
do {
         System.out.println("\n=== Student Management Portal ===");
         System.out.println("1. Register Student");
         System.out.println("2. Display All Students");
         System.out.println("3. Modify Student Details");
         System.out.println("4. Remove Student");
         System.out.println("5. Exit");
System.out.print("Select an option: ");            option
= inputScanner.nextInt();
inputScanner.nextLine(); // Consume newline
switch (option) {              case 1:
registerStudent();                 break;
case 2:
listStudents();                 break;
case 3:
modifyStudent();                 break;
case 4:
removeStudent();                 break;
case 5:
```

```
                System.out.println("Closing application...");
                break;              default:
                System.out.println("Invalid option, please try again.");
            }
        } while (option != 5);
    }

    private void registerStudent() {
        System.out.print("Enter Student Name: ");
        String fullName = inputScanner.nextLine();
        System.out.print("Enter Department: ");
String department = inputScanner.nextLine();
System.out.print("Enter Marks: ");        int score
= inputScanner.nextInt();

        Student newStudent = new Student(0, fullName, department, score);
studentController.addStudent(newStudent);
    }

    private void listStudents() {
        List<Student> studentList = studentController.getAllStudents();        if
(studentList.isEmpty()) {
            System.out.println("No student records available.");
        } else {
            System.out.println("\n--- Student Records ---");            for
(Student student : studentList) {
                System.out.println(student);
            }
        }
```

```
    }

    private void modifyStudent() {
        System.out.print("Enter Student ID to update: ");        int
studentId = inputScanner.nextInt();
inputScanner.nextLine(); // Consume newline
System.out.print("Enter Updated Name: ");
        String updatedName = inputScanner.nextLine();
        System.out.print("Enter Updated Department: ");
String updatedDepartment = inputScanner.nextLine();
System.out.print("Enter Updated Marks: ");           int
updatedScore = inputScanner.nextInt();

        Student updatedStudent = new Student(studentId, updatedName, updatedDepartment, updatedScore);
studentController.updateStudent(updatedStudent);
    }

    private void removeStudent() {
        System.out.print("Enter Student ID to remove: ");        int
studentId = inputScanner.nextInt();
studentController.deleteStudent(studentId);
    }
}
```

Controller

```
import java.sql.*; import
java.util.ArrayList; import
java.util.List;
```

```
public class StudentController {     private static final String DB_URL =
"jdbc:mysql://localhost:3306/javadb";     private static final String
DB_USER = "root";     private static final String DB_PASSWORD = "karan.111";


   public void insertStudent(Student student) {
      String sql = "INSERT INTO Students (Name, Department, Marks) VALUES (?, ?, ?)";


      try (Connection connection = DriverManager.getConnection(DB_URL, DB_USER, DB_PASSWORD);
          PreparedStatement preparedStatement = connection.prepareStatement(sql)) {


         connection.setAutoCommit(false);              preparedStatement.setString(1,
student.getName());           preparedStatement.setString(2,
student.getDepartment());           preparedStatement.setInt(3,
student.getMarks());


         preparedStatement.executeUpdate();
connection.commit();
         System.out.println("Student successfully registered!");

      } catch (SQLException ex) {           ex.printStackTrace();
      }
   }


   public List<Student> fetchAllStudents() {
      List<Student> studentList = new ArrayList<>();
      String sql = "SELECT * FROM Students";


      try (Connection connection = DriverManager.getConnection(DB_URL, DB_USER, DB_PASSWORD);
          Statement statement = connection.createStatement();
          ResultSet resultSet = statement.executeQuery(sql)) {
```

```
            while (resultSet.next()) {                studentList.add(new
Student(resultSet.getInt("StudentID"),
resultSet.getString("Name"),
resultSet.getString("Department"),                        resultSet.getInt("Marks")));
            }

        } catch (SQLException ex) {            ex.printStackTrace();
        }         return studentList;
    }

    public void modifyStudent(Student student) {
        String sql = "UPDATE Students SET Name=?, Department=?, Marks=? WHERE StudentID=?";

        try (Connection connection = DriverManager.getConnection(DB_URL, DB_USER, DB_PASSWORD);
             PreparedStatement preparedStatement = connection.prepareStatement(sql)) {
connection.setAutoCommit(false);            preparedStatement.setString(1, student.getName());
preparedStatement.setString(2, student.getDepartment());            preparedStatement.setInt(3, student.getMarks());
preparedStatement.setInt(4, student.getStudentID());

            int affectedRows = preparedStatement.executeUpdate();
if (affectedRows > 0) {

                connection.commit();
                System.out.println("Student details updated!");
            } else {
                System.out.println("No record found with the given Student ID.");
            }

        } catch (SQLException ex) {            ex.printStackTrace();
```

```
        }
    }

    public void removeStudent(int studentID) {
        String sql = "DELETE FROM Students WHERE StudentID=?";

        try (Connection connection = DriverManager.getConnection(DB_URL, DB_USER, DB_PASSWORD);
             PreparedStatement preparedStatement = connection.prepareStatement(sql)) {

            connection.setAutoCommit(false);
preparedStatement.setInt(1, studentID);

            int affectedRows = preparedStatement.executeUpdate();
if (affectedRows
> 0) {                connection.commit();
                System.out.println("Student record deleted!");
            } else {
                System.out.println("No record found with the given Student ID.");
            }

        } catch (SQLException ex) {            ex.printStackTrace();
        }
    }
}
```

Main

```
public class StudentApplication {
public static void main(String[] args) {
        StudentView studentView = new StudentView();        studentView.showMenu();
```

```
    }
}
```

Output:

```
C:\Users\123sa\Desktop\Coding\JAVA\Class\exp 7>javac -cp ".;mysql-connector-j-9.2.0.jar" MySQLConnectionCode.java

C:\Users\123sa\Desktop\Coding\JAVA\Class\exp 7>java -cp ".;mysql-connector-j-9.2.0.jar" MySQLConnectionCode

Menu:
1. Display Employees
2. Exit
Enter your choice: 1

EmpID | Name | Salary
----------------------
1 | Saket Agarwal | 55000.0
2 | Ram | 32000.5
3 | Dam | 41000.75
4 | Pam | 53000.25

Menu:
1. Display Employees
2. Exit
Enter your choice: 2
Exiting...
```

1.1 Easy Problem

```
C:\Users\123sa\Desktop\Coding\JAVA\Class\exp 7>javac -cp ".;mysql-connector-j-9.2.0.jar" ProductCRUD.java

C:\Users\123sa\Desktop\Coding\JAVA\Class\exp 7>java -cp ".;mysql-connector-j-9.2.0.jar" ProductCRUD

--- Product Management System ---
1. Add Product
2. View Products
3. Update Product
4. Delete Product
5. Exit
Enter your choice: 2

ProductID | ProductName | Price | Quantity
-----------------------------------------
1 | Laptop | 75000.0 | 10
2 | Mouse | 1500.0 | 50
3 | Keyboard | 2500.0 | 30

--- Product Management System ---
1. Add Product
2. View Products
3. Update Product
4. Delete Product
5. Exit
Enter your choice: 4
Enter Product ID to delete: 3
Product deleted successfully!

--- Product Management System ---
1. Add Product
2. View Products
3. Update Product
4. Delete Product
5. Exit
Enter your choice: 2

ProductID | ProductName | Price | Quantity
-----------------------------------------
1 | Laptop | 75000.0 | 10
2 | Mouse | 1500.0 | 50

--- Product Management System ---
1. Add Product
2. View Products
3. Update Product
4. Delete Product
5. Exit
Enter your choice: 5
Exiting...
```

1.2 Medium Problem

```
C:\Users\123sa\Desktop\Coding\JAVA\Class\exp 7>java -cp ".;mysql-connector-j-9.2.0.jar" StudentMain

--- Student Management System ---
1. Add Student
2. View Students
3. Update Student
4. Delete Student
5. Exit
Enter your choice: 2

Student List:
ID: 1, Name: Saket, Dept: Computer Science, Marks: 95
ID: 2, Name: Ram, Dept: Electronics, Marks: 78
ID: 3, Name: Dam, Dept: Mechanical, Marks: 92

--- Student Management System ---
1. Add Student
2. View Students
3. Update Student
4. Delete Student
5. Exit
Enter your choice: 5
Exiting...
```

1.3 Hard Probem

COMPUTER SCIENCE & ENGINEERING

Learning Outcomes:

1. Integrating Java with Databases – Learn how Java applications interact with databases to store and retrieve data efficiently.
2. Enhancing Data Security – Explore best practices for securing database connections and preventing SQL injection attacks in Java applications.
3. Optimizing Query Performance – Understand how to write efficient SQL queries and use indexing to improve database performance.
4. Building Scalable Applications – Learn how to design a Java-based system that can handle increasing data loads while maintaining performance.