EXERCISE 1: PROJECT SETUP & MODEL LAYER (15 points)

Estimated Time: 25 minutes

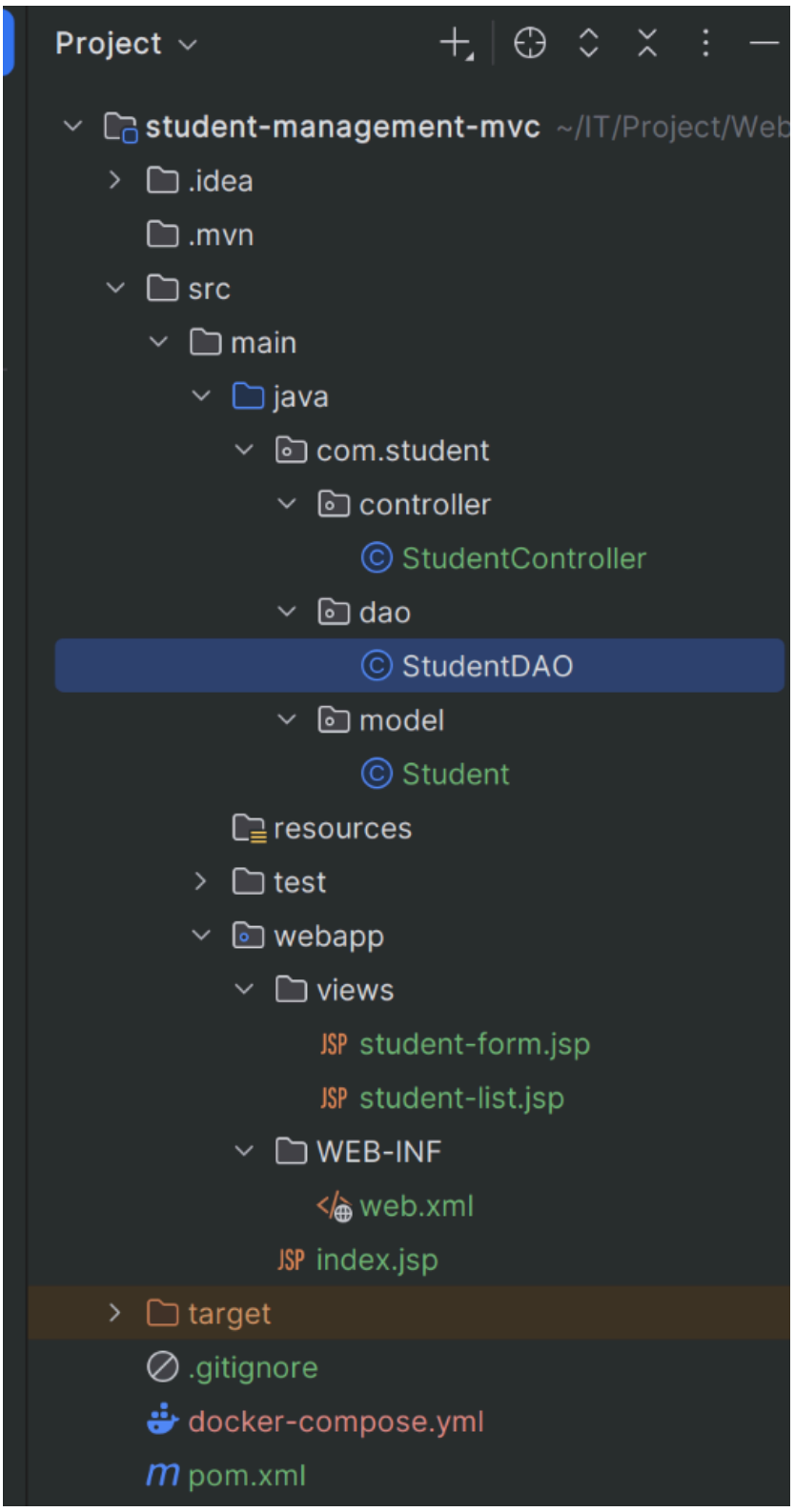
Task 1.1: Create Project Structure (5 points)

Create proper MVC folder structure:

```
StudentManagementMVC/
├── Source Packages/
│   ├── model/
│   ├── dao/
│   └── controller/
└── Web Pages/
    └── views/
```

Steps:

1. Create new Web Application project: StudentManagementMVC
2. Create Java packages: model, dao, controller
3. Create views folder inside Web Pages
4. Add MySQL Connector/J library



Task 1.2: Create Student JavaBean (5 points)

File: src/model/Student.java

Requirements:

- Private attributes: id, studentCode, fullName, email, major, createdAt
- Public no-arg constructor
- Public parameterized constructor (without id)
- Public getters and setters for all attributes
- Override toString() method

```
public class Student {
  private int id;
  private String studentCode;
  private String fullName;
  private String email;
  private String major;
  private Timestamp createdAt;

  // No-arg constructor (required for JavaBean)
  public Student() {
  }

  // Constructor for creating new student (without ID)
  public Student(String studentCode, String fullName, String email, String major) {
     this.studentCode = studentCode;
     this.fullName = fullName;
     this.email = email;
     this.major = major;
  }

  // Getters and Setters
  public int getId() {
     return id;
  }

  public void setId(int id) {
     this.id = id;
  }

  public String getStudentCode() {
     return studentCode;
  }

  public void setStudentCode(String studentCode) {
     this.studentCode = studentCode;
  }

  public String getFullName() {
     return fullName;
  }

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

  public String getEmail() {
```

```
    return email;
}

public void setEmail(String email) {
    this.email = email;
}

public String getMajor() {
    return major;
}

public void setMajor(String major) {
    this.major = major;
}

public Timestamp getCreatedAt() {
    return createdAt;
}

public void setCreatedAt(Timestamp createdAt) {
    this.createdAt = createdAt;
}

@Override
public String toString() {
    return "Student{" +
            "id=" + id +
            ", studentCode='" + studentCode + '\'' +
            ", fullName='" + fullName + '\'' +
            ", email='" + email + '\'' +
            ", major='" + major + '\'' +
            '}';
}
}
```

1. Private attributes

All core data fields are declared private to ensure robust encapsulation:

+ private int id;
+ private String studentCode;
+ private String fullName;
+ private String email;
+ private String major;
+ private Timestamp createdAt;

2. Public no-arg constructor

A default, public no-argument constructor is included, fulfilling the JavaBean requirement for easy object instantiation by frameworks:

```
public Student() {

}
```

3. Public parameterized constructor (without id)

A specific public constructor is provided for creating new records, excluding the auto-generated id and createdAt:

```
public Student(String studentCode, String fullName, String email, String major) {
  this.studentCode = studentCode;
  this.fullName = fullName;
  this.email = email;
  this.major = major;
}
```

4. Public getters and setters for all attributes

Standard public accessor methods are implemented for all fields, ensuring data can be read and written externally (e.g., getter for id and setter for fullName):

```
public int getId() {
  return id;
}


public void setId(int id) {
  this.id = id;
}


public String getStudentCode() {
```

```
    return studentCode;
}

public void setStudentCode(String studentCode) {
    this.studentCode = studentCode;
}

public String getFullName() {
    return fullName;
}

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

public String getEmail() {
    return email;
}

public void setEmail(String email) {
    this.email = email;
}

public String getMajor() {
    return major;
}

public void setMajor(String major) {
```

```
  this.major = major;
}

public Timestamp getCreatedAt() {
  return createdAt;
}

public void setCreatedAt(Timestamp createdAt) {
  this.createdAt = createdAt;
}
```

5. Override toString() method

The toString() method is overridden to provide a clear string representation of the object's state for debugging and logging purposes:

```
@Override
public String toString() {
  return "Student{" +
        "id=" + id +
        ", studentCode='" + studentCode + '\'' +
        ", fullName='" + fullName + '\'' +
        ", email='" + email + '\'' +
        ", major='" + major + '\'' +
        '}';
}
```

Task 1.3: Create StudentDAO (5 points)

File: src/dao/StudentDAO.java

Requirements:

- Constants for database configuration
- getConnection() method
- getAllStudents() method - returns List<Student>
- Use try-with-resources
- Proper exception handling

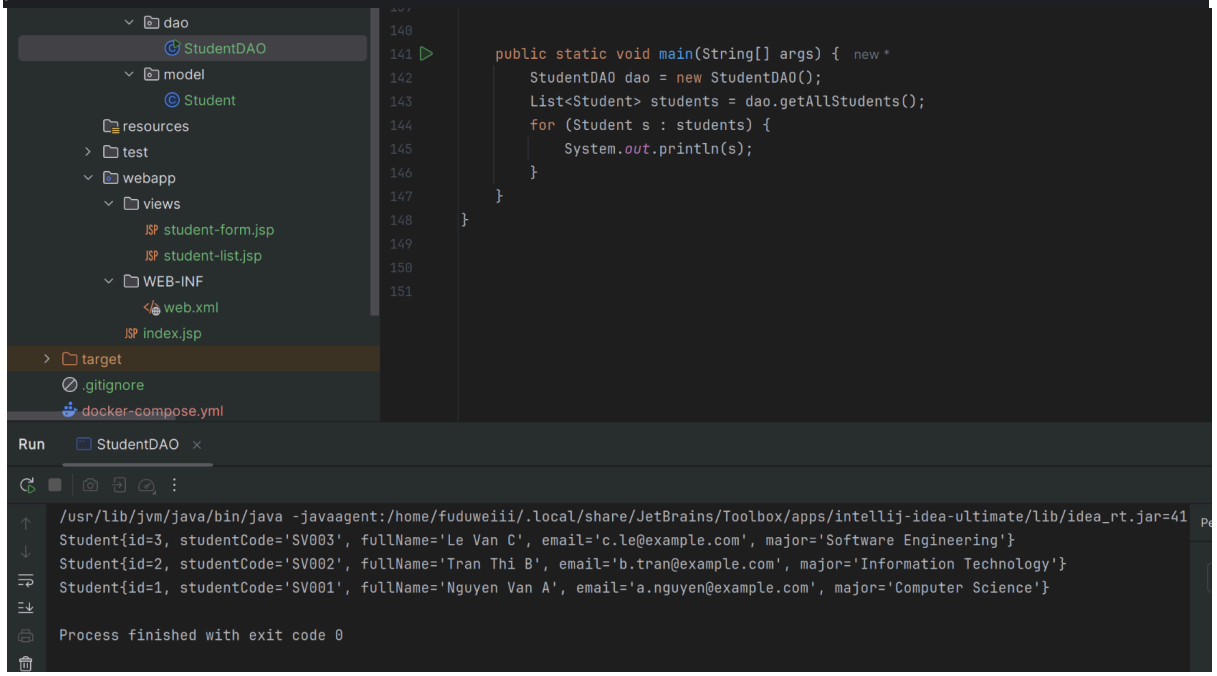
Test Your DAO:

```
// Add this main method to test (remove after testing)
public static void main(String[] args) {
    StudentDAO dao = new StudentDAO();
    List<Student> students = dao.getAllStudents();
    for (Student s : students) {
        System.out.println(s);
    }
}
```

Checkpoint #1: Show instructor that Student model and DAO work correctly.

```
private Connection getConnection() throws SQLException {
    try {
        Class.forName("com.mysql.cj.jdbc.Driver");
        return DriverManager.getConnection(DB_URL, DB_USER, DB_PASSWORD);
    } catch (ClassNotFoundException e) {
        throw new SQLException("MySQL Driver not found", e);
    }
}

// Get all students
public List<Student> getAllStudents() {
    List<Student> students = new ArrayList<>();
    String sql = "SELECT * FROM students ORDER BY id DESC";

    try (Connection conn = getConnection();
         Statement stmt = conn.createStatement();
         ResultSet rs = stmt.executeQuery(sql)) {

        while (rs.next()) {
            Student student = new Student();
            student.setId(rs.getInt("id"));
```

```
        student.setStudentCode(rs.getString("student_code"));
        student.setFullName(rs.getString("full_name"));
        student.setEmail(rs.getString("email"));
        student.setMajor(rs.getString("major"));
        student.setCreatedAt(rs.getTimestamp("created_at"));
        students.add(student);
    }

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

return students;
}
```



EXERCISE 2: CONTROLLER LAYER (20 points)

Estimated Time: 40 minutes

Task 2.1: Create Basic Servlet (10 points)

File: src/controller/StudentController.java

Requirements:

- Extend HttpServlet
- Use @WebServlet("/student") annotation
- Override init() to initialize StudentDAO
- Override doGet() to handle GET requests
- Implement listStudents() method
- Forward to JSP view

Evaluation Criteria:

Criteria	Points
Servlet properly configured	2
init() initializes DAO	2
doGet() routes correctly	2
listStudents() gets data from DAO	2
Sets request attribute	1
Forwards to JSP	1

Extend HttpServlet and Use @WebServlet("/student")

The servlet is properly configured by extending the base class and using the correct annotation for URL mapping:

```
@WebServlet("/student")

public class StudentController extends HttpServlet {
```

Override init() to initialize StudentDAO

The init() method is overridden to ensure the StudentDAO is initialized and ready for use upon servlet loading:

```
@Override

public void init() {

   studentDAO = new StudentDAO();

}
```

Override doGet() to route correctly

The doGet() method correctly handles the default action ("list") when no specific action parameter is provided:

```
@Override

protected void doGet(HttpServletRequest request, HttpServletResponse
response)

       throws ServletException, IOException {



   String action = request.getParameter("action");



   if (action == null) {

       action = "list";

   }



   switch (action) {

       case "new":

           showNewForm(request, response);

           break;

       case "edit":

           showEditForm(request, response);

           break;

       case "delete":

           deleteStudent(request, response);
```

```
            break;

        default:

            listStudents(request, response);

            break;

    }

}
```

Implement listStudents(): Get Data, Set Attribute, and Forward

The listStudents() method performs the three essential steps for displaying the view: retrieving data, storing it in the request scope, and forwarding to the JSP view:

```
private void listStudents(HttpServletRequest request, HttpServletResponse
response)

        throws ServletException, IOException {



    List<Student> students = studentDAO.getAllStudents();

    request.setAttribute("students", students);



    RequestDispatcher dispatcher =
request.getRequestDispatcher("/views/student-list.jsp");

    dispatcher.forward(request, response);

}
```

Task 2.2: Add More CRUD Methods (10 points)

Add these methods to StudentController:

Required Methods:

1. showNewForm() - Display add form
2. showEditForm() - Display edit form
3. doPost() - Handle POST requests
4. insertStudent() - Add new student
5. updateStudent() - Update student

6. deleteStudent() - Delete student

Evaluation Criteria:

Criteria	Points
showNewForm() forwards to form	2
showEditForm() loads student and forwards	2
doPost() routes correctly	2
insertStudent() creates student	2
updateStudent() modifies student	1
deleteStudent() removes student	1

Checkpoint #2: Show instructor that all controller methods work.

```
@Override
protected void doPost(HttpServletRequest request, HttpServletResponse
response)
        throws ServletException, IOException {

    String action = request.getParameter("action");

    switch (action) {
        case "insert":
            insertStudent(request, response);
            break;
        case "update":
            updateStudent(request, response);
            break;
    }
}

// List all students
private void listStudents(HttpServletRequest request, HttpServletResponse
response)
        throws ServletException, IOException {

    List<Student> students = studentDAO.getAllStudents();
    request.setAttribute("students", students);

    RequestDispatcher dispatcher =
request.getRequestDispatcher("/views/student-list.jsp");
    dispatcher.forward(request, response);
}

// Show form for new student
```

```
private void showNewForm(HttpServletRequest request, HttpServletResponse
response)
       throws ServletException, IOException {

   RequestDispatcher dispatcher =
request.getRequestDispatcher("/views/student-form.jsp");
   dispatcher.forward(request, response);
}

// Show form for editing student
private void showEditForm(HttpServletRequest request, HttpServletResponse
response)
       throws ServletException, IOException {

   int id = Integer.parseInt(request.getParameter("id"));
   Student existingStudent = studentDAO.getStudentById(id);

   request.setAttribute("student", existingStudent);

   RequestDispatcher dispatcher =
request.getRequestDispatcher("/views/student-form.jsp");
   dispatcher.forward(request, response);
}

// Insert new student
private void insertStudent(HttpServletRequest request, HttpServletResponse
response)
       throws IOException {

   String studentCode = request.getParameter("studentCode");
   String fullName = request.getParameter("fullName");
   String email = request.getParameter("email");
   String major = request.getParameter("major");

   Student newStudent = new Student(studentCode, fullName, email, major);

   if (studentDAO.addStudent(newStudent)) {
       response.sendRedirect("student?action=list&message=Student added
successfully");
   } else {
       response.sendRedirect("student?action=list&error=Failed to add
student");
   }
}

// Update student
private void updateStudent(HttpServletRequest request, HttpServletResponse
response)
       throws IOException {

   int id = Integer.parseInt(request.getParameter("id"));
   String studentCode = request.getParameter("studentCode");
   String fullName = request.getParameter("fullName");
```

```
    String email = request.getParameter("email");
    String major = request.getParameter("major");

    Student student = new Student(studentCode, fullName, email, major);
    student.setId(id);

    if (studentDAO.updateStudent(student)) {
        response.sendRedirect("student?action=list&message=Student updated
successfully");
    } else {
        response.sendRedirect("student?action=list&error=Failed to update
student");
    }
}

// Delete student
private void deleteStudent(HttpServletRequest request, HttpServletResponse
response)
        throws IOException {

    int id = Integer.parseInt(request.getParameter("id"));

    if (studentDAO.deleteStudent(id)) {
        response.sendRedirect("student?action=list&message=Student deleted
successfully");
    } else {
        response.sendRedirect("student?action=list&error=Failed to delete
student");
    }
}
```

EXERCISE 3: VIEW LAYER WITH JSTL (15 points)

Estimated Time: 35 minutes

Task 3.1: Create Student List View (8 points)

File: `WebContent/views/student-list.jsp`

Requirements:

- Add JSTL taglib directive
- No scriptlets (no `<% %>`)
- Use `<c:if>` for messages
- Use `<c:forEach>` for student list
- Use EL `${}` for all data access
- Handle empty list case

Evaluation Criteria:

Criteria	Points
JSTL taglib included	1
No scriptlets used	2
c:if for messages	1
c:forEach for students	2
EL for data access	1
Empty list handled	1

JSTL taglib included

The correct taglib directive for Jakarta EE is included at the top to enable JSTL functionality:

```
<%@ taglib uri="jakarta.tags.core" prefix="c" %>
```

No scriptlets used & EL for data access

No Java code blocks (<% %>) are used. All data is accessed using **Expression Language (${})**, ensuring clean presentation logic:

```
<td>${student.id}</td>
```

```
<td><strong>${student.studentCode}</strong></td>

<td>${student.fullName}</td>

<td>${student.email}</td>

<td>${student.major}</td>
```

c:if for messages

The JSTL **<c:if>** tags are used to conditionally display success or error messages based on URL parameters (param):

```
<c:if test="${not empty param.message}">
   <div class="message success">
       ✅ ${param.message}
   </div>
</c:if>
```

c:forEach for students

The <c:forEach> tag iterates over the list of students set by the Controller (${students}), rendering the table rows dynamically:

```
<c:forEach var="student" items="${students}">
   <tr>
       <td>${student.id}</td>
       <td><strong>${student.studentCode}</strong></td>
       <td>${student.fullName}</td>
       <td>${student.email}</td>
       <td>${student.major}</td>
       <td>
           <div class="actions">
               <a href="student?action=edit&id=${student.id}" class="btn
btn-secondary">
                   ✏️ Edit
               </a>
               <a href="student?action=delete&id=${student.id}"
                  class="btn btn-danger"
                  onclick="return confirm('Are you sure you want to delete
this student?')">
                   🗑️ Delete
               </a>
           </div>
       </td>
   </tr>
</c:forEach>
```

Empty list handled

A <c:choose> structure handles the conditional rendering, displaying the table only if the students list is not empty, and showing an empty state message otherwise:

```
<c:otherwise>
    <div class="empty-state">
        <div class="empty-state-icon">📭</div>
        <h3>No students found</h3>
        <p>Start by adding a new student</p>
    </div>
</c:otherwise>
```

Task 3.2: Create Student Form View (7 points)

File: `WebContent/views/student-form.jsp`

Requirements:

- Single form for both Add and Edit
- Use `<c:choose>` for dynamic title
- Use `<c:if>` to show/hide fields conditionally
- Pre-fill values for edit mode
- No scriptlets

Evaluation Criteria:

Criteria	Points
c:choose for title	1
c:if for heading	1
Dynamic action field	1
Conditional id field	1
Pre-filled values	2
No scriptlets	1

Checkpoint #3: Show instructor complete MVC application working.

c:choose for title and c:if for heading

The file uses <c:choose> to dynamically set the page title and the main heading based on the presence of the student object in the request scope:

```
<c:choose>
 <c:when test="${student != null}">
   ✏️ Edit Student
 </c:when>
 <c:otherwise>
   ➕ Add New Student
 </c:otherwise>
</c:choose>
```

Dynamic action field

A hidden input field correctly determines the submission action (update or insert) using a simple EL ternary operator, eliminating the need for separate forms:

```
<input type="hidden" name="action"
      value="${student != null ? 'update' : 'insert'}">
```

Conditional id field

The hidden id field, which is required only for updating an existing record, is correctly included using a <c:if> tag:

```
<c:if test="${student != null}">
 <input type="hidden" name="id" value="${student.id}">
</c:if>
```

Pre-filled values and No scriptlets

All input fields are pre-filled using EL (${student.attribute}), and the selection for the major dropdown is correctly set using a ternary operator within the option tag. No scriptlets (<% %>) were used:

```
<option value="Computer Science"
${student.major == 'Computer Science' ? 'selected' : ''}>
 Computer Science
</option>
```

EXERCISE 4: COMPLETE CRUD OPERATIONS (10 points)

Estimated Time: 20 minutes

Task 4.1: Complete DAO Methods (5 points)

Add remaining methods to `StudentDAO.java`:

Evaluation Criteria:

Criteria	Points
getStudentById works	1
addStudent works	1.5
updateStudent works	1.5
deleteStudent works	1

```
// Get student by ID
public Student getStudentById(int id) {
    String sql = "SELECT * FROM students WHERE id = ?";

    try (Connection conn = getConnection();
         PreparedStatement pstmt = conn.prepareStatement(sql)) {

        pstmt.setInt(1, id);
        ResultSet rs = pstmt.executeQuery();

        if (rs.next()) {
            Student student = new Student();
            student.setId(rs.getInt("id"));
            student.setStudentCode(rs.getString("student_code"));
            student.setFullName(rs.getString("full_name"));
            student.setEmail(rs.getString("email"));
            student.setMajor(rs.getString("major"));
            student.setCreatedAt(rs.getTimestamp("created_at"));
            return student;
        }

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

    return null;
}

// Add new student
public boolean addStudent(Student student) {
    String sql = "INSERT INTO students (student_code, full_name, email, major)
VALUES (?, ?, ?, ?)";
```

```
    try (Connection conn = getConnection();
         PreparedStatement pstmt = conn.prepareStatement(sql)) {

        pstmt.setString(1, student.getStudentCode());
        pstmt.setString(2, student.getFullName());
        pstmt.setString(3, student.getEmail());
        pstmt.setString(4, student.getMajor());

        int rowsAffected = pstmt.executeUpdate();
        return rowsAffected > 0;

    } catch (SQLException e) {
        e.printStackTrace();
        return false;
    }
}

// Update student
public boolean updateStudent(Student student) {
    String sql = "UPDATE students SET student_code = ?, full_name = ?, email =
?, major = ? WHERE id = ?";

    try (Connection conn = getConnection();
         PreparedStatement pstmt = conn.prepareStatement(sql)) {

        pstmt.setString(1, student.getStudentCode());
        pstmt.setString(2, student.getFullName());
        pstmt.setString(3, student.getEmail());
        pstmt.setString(4, student.getMajor());
        pstmt.setInt(5, student.getId());

        int rowsAffected = pstmt.executeUpdate();
        return rowsAffected > 0;

    } catch (SQLException e) {
        e.printStackTrace();
        return false;
    }
}

// Delete student
public boolean deleteStudent(int id) {
    String sql = "DELETE FROM students WHERE id = ?";

    try (Connection conn = getConnection();
         PreparedStatement pstmt = conn.prepareStatement(sql)) {

        pstmt.setInt(1, id);
        int rowsAffected = pstmt.executeUpdate();
        return rowsAffected > 0;

    } catch (SQLException e) {
```

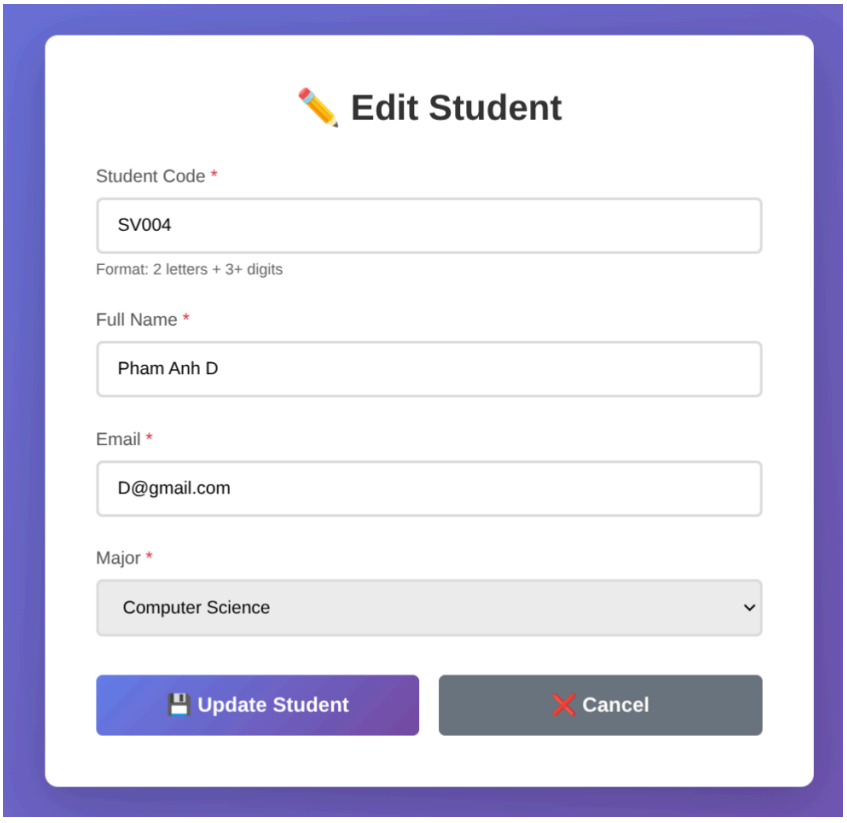
```
        e.printStackTrace();
        return false;
    }
}
```

Scenario: User clicks the "Edit" link for a specific student.

1. Browser → GET /student?action=edit&id=5
2. Controller receives request
3. Extracts action=edit and id=5 parameters
4. Calls StudentDAO.getStudentById(5)
5. DAO executes SELECT * FROM students WHERE id = ?
6. Maps ResultSet to a single Student object
7. Returns the Student object
8. Controller sets the Student object as a request attribute
9. Forwards to student-form.jsp
10. View (JSP) populates the form fields using the student's data

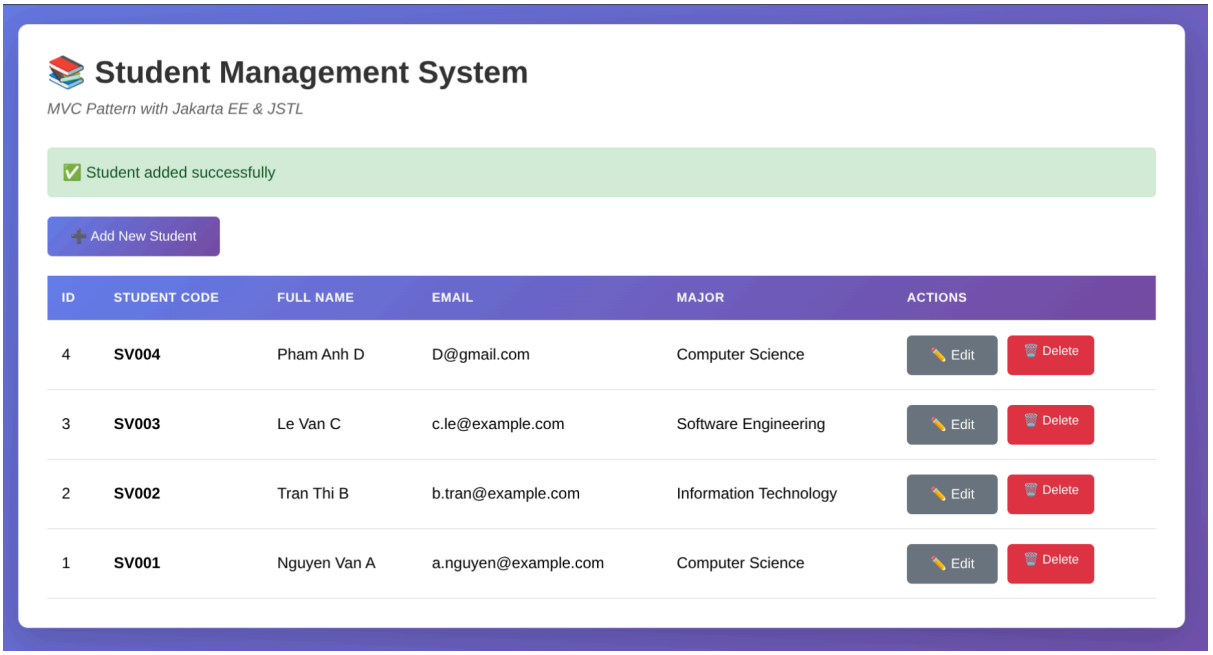
    <input type="text" name="fullName" value="${student.fullName}">

11. Browser receives HTML response with the pre-filled form



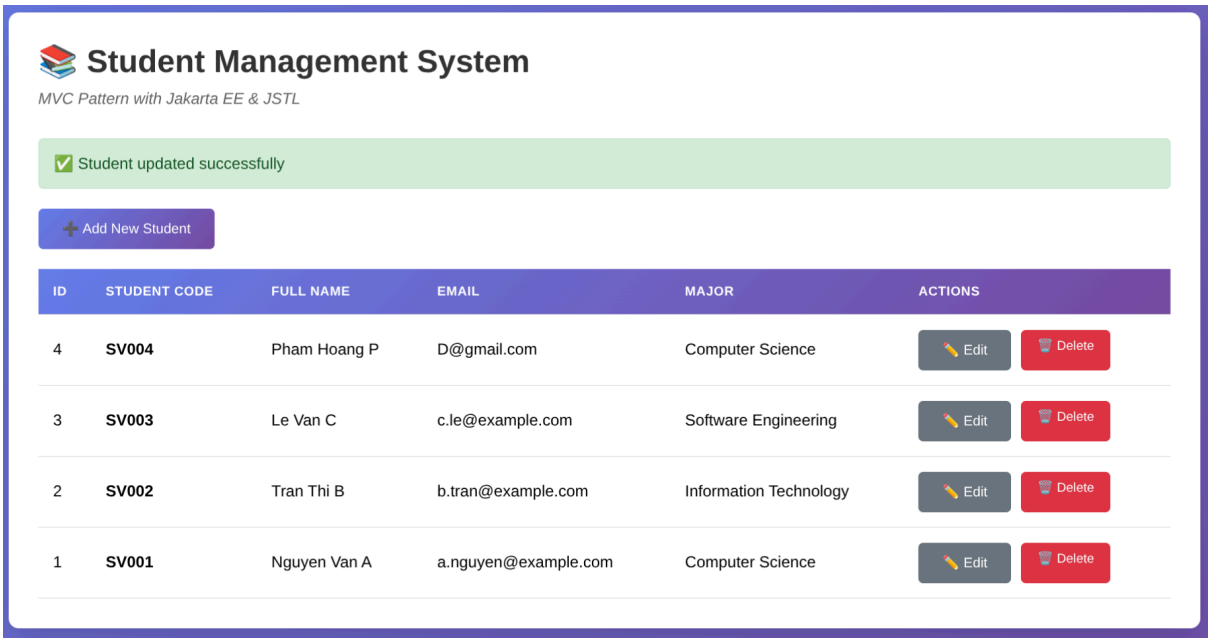
Scenario: User fills out the "Add New Student" form and clicks "Save".

1. Browser → POST /student?action=insert (with form data in the body)
2. Controller receives request
3. Creates a new Student object from form parameters
4. Calls StudentDAO.addStudent(newStudent)
5. DAO executes INSERT INTO students (...) VALUES (...)
6. Returns true on success
7. Controller checks the boolean result and redirects
8. Browser receives a redirect response to GET /student?action=list



Scenario: User modifies data on the "Edit Student" form and clicks "Update".

1. Browser → POST /student?action=update (with form data, including student ID)
2. Controller receives request
3. Creates a Student object (with ID) from form parameters
4. Calls StudentDAO.updateStudent(updatedStudent)
5. DAO executes UPDATE students SET ... WHERE id = ?
6. Returns true on success
7. Controller checks the boolean result and redirects
8. Browser receives a redirect response to GET /student?action=list



Scenario: User clicks the "Delete" button for a specific student.

1. Browser → GET /student?action=delete&id=5
2. Controller receives request
3. Extracts action=delete and id=5 parameters
4. Calls StudentDAO.deleteStudent(5)
5. DAO executes DELETE FROM students WHERE id = ?
6. Returns true on success
7. Controller checks the boolean result and redirects
8. Browser receives a redirect response to GET /student?action=list