Student Management System

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Problem Statement

Design and implement a **Student Management System** in Java that allows users to **store**, **manage**, and **retrieve** student records and their **examination results** efficiently.

The system should:

- Maintain student personal details like name, roll number, date of birth, email, student ID, and course.
- Allow entering of marks for multiple subjects for each student.
- Calculate individual subject grades and overall performance (percentage and grade).
- Retrieve and display student details and their corresponding exam results based on roll number.

The application should be menu-driven and user-friendly, supporting core operations such as adding new students, entering examination details, and viewing student or examination information.

Introduction

The **Student Management System** is a simple, console-based Java application developed to manage and organize student academic records in an efficient manner. In any educational institution, keeping track of student information and examination performance is crucial. This project provides a structured approach to handle such data.

This system allows users to store essential **student details** such as their name, roll number, date of birth, email, student ID, and course. It also facilitates the input of **examination marks** for various subjects, calculates individual **grades**, and computes the **overall percentage and performance** of each student.

Built using **object-oriented programming principles**, the project uses Java collections (ArrayList and HashMap) for dynamic data handling and modular design. This system is designed to be **extensible**, **readable**, and easy to use by institutions or academic administrators.

The primary objective of this project is to demonstrate how Java can be used to develop real-world applications that involve **data storage**, **processing**, and **retrieval**, with a strong focus on **clean code structure** and **logical flow**.

Objectives

The main objectives of the **Student Management System** are:

1. **Efficient Data Management**
   To store and manage student information such as name, roll number, date of birth, email, student ID, and enrolled course in an organized manner.

2. **Academic Record Maintenance**
   To provide a structured way to record marks of multiple subjects for each student and maintain their academic performance data.

3. **Automated Grade Calculation**
   To automatically calculate subject-wise grades and overall performance (percentage and grade) based on predefined grading criteria.

4. **Quick Information Retrieval**
   To allow users to search for and display student details and examination results using the student's roll number.

5. **User-Friendly Interface**
   To offer a simple and intuitive text-based menu interface for smooth interaction with the system.

6. **Modular and Scalable Design**
   To develop the system using Object-Oriented Programming (OOP) principles, ensuring that it is modular, easy to maintain, and scalable for future enhancements.

7. **Error Handling and Validation**
   To validate user input (e.g., marks range, roll number uniqueness) and handle errors gracefully to avoid incorrect data entries.

Features

The **Student Management System** provides the following key features:

1. **Add New Student**

   - Capture and store student details: name, roll number, date of birth, email, student ID, and course.
   - Ensures user input is correctly formatted and complete.

2. **Add Examination Details**

   - Allows entry of marks for **five subjects** per student.
   - Automatically calculates **subject-wise grades**, **percentage**, and **overall performance**.

- Validates that marks are within the 0–100 range.

3. **View Student Details**
    - Search and display complete information of a student using their roll number.
    - Useful for quick access to a student's profile.
4. **View Examination Results**
    - Displays subject-wise marks, grades, percentages, and overall grade for a student.
    - Helps in evaluating academic performance instantly.
5. **Grade Evaluation System**
    - Grades are assigned based on marks using a standardized scale:
        - A+ (90–100), A (80–89), B+ (70–79), B (60–69), C (50–59), D (40–49), F (below 40)
6. **Menu-Driven Console Interface**
    - Easy navigation with numbered menu options.
    - Clear prompts guide the user at every step.
7. **Data Stored Using Collections**
    - Uses ArrayList to store students and HashMap to associate roll numbers with exam records.
    - Enables dynamic data handling during runtime.
8. **Input Validation and Error Handling**
    - Prevents invalid entries for marks or roll numbers.
    - Notifies users about missing or incorrect data inputs.
9. **Exit Option**
    - Allows users to exit the application safely with a farewell message.

System Design

The **Student Management System** is designed using the **Object-Oriented Programming (OOP)** approach in Java. The design ensures separation of concerns, modularity, and reusability of code. The system is organized into multiple classes, each responsible for a specific part of the functionality.

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1. Class Design

a. Student Class

- **Responsibilities**: Holds student personal information.
- **Attributes**: name, rollNumber, dob, email, studentId, course
- **Methods**:
    - Getters for each attribute
    - displayDetails() – displays all student info

b. Subject Class

- **Responsibilities**: Represents an academic subject and calculates individual performance.
- **Attributes**: name, marks, grade, percentage
- **Methods**:
    - calculateGradeAndPercentage() – computes grade & percentage
    - displaySubjectDetails() – prints subject-wise result

c. Examination Class

- **Responsibilities**: Manages a collection of subjects for a student and calculates overall performance.
- **Attributes**: ArrayList<Subject> subjects, overallPercentage, overallGrade
- **Methods**:
    - addSubject(Subject) – adds a subject
    - calculateOverallPerformance() – computes total result
    - displayExamResults() – shows results for all subjects and overall score

d. StudentManagementSystem Class (Main Class)

- **Responsibilities**: Acts as the controller. Handles user interaction and coordinates between classes.

- **Attributes**:
    - ArrayList<Student> students – stores all students
    - HashMap<Integer, Examination> examinations – links roll numbers to exam results
    - Scanner scanner – for user input
- **Methods**:
    - addStudent()
    - addExaminationDetails()
    - viewStudentDetails()
    - viewExaminationResults()
    - findStudentByRollNumber()

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2. Data Flow Design

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User Input

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Menu Interface (StudentManagementSystem)

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→ Add Student → Student Object → Store in ArrayList

→ Add Exam Details → Subject Objects → Add to Examination → Store in HashMap

→ View Details → Fetch by roll number → Display Info

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3. Data Structures Used

- ArrayList<Student> – To store dynamic list of students.
- HashMap<Integer, Examination> – Maps each student's roll number to their examination record for quick lookup.

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4. Workflow Diagram (Text-Based)

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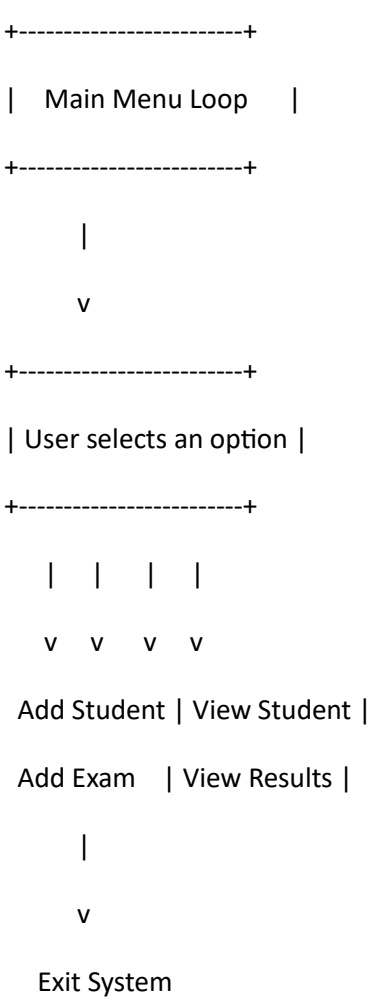
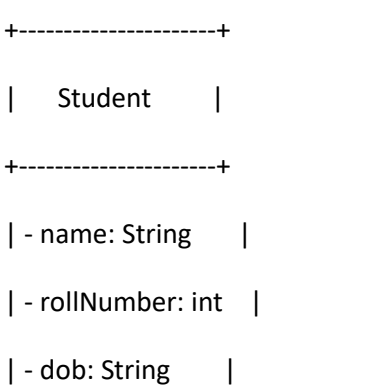


Class Diagrams



| - email: String |

| - studentId: String |

| - course: String |

+----------+

| + getName(): String |

| + getRollNumber():int|

| + getDob(): String |

| + getEmail(): String |

| + getStudentId():String|

| + getCourse(): String|

| + displayDetails(): void |

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+----------+

| Subject |

+----------+

| - name: String |

| - marks: int |

| - grade: String |

| - percentage: double |

+----------+

| + getName(): String |

| + getMarks(): int |

| + getGrade(): String |

| + getPercentage(): double |

| + displaySubjectDetails(): void |

+-------------------------+

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| Examination |

+------------------------------+

| - subjects: ArrayList<Subject>|

| - overallPercentage: double |

| - overallGrade: String |

+------------------------------+

| + addSubject(s: Subject): void|

| + displayExamResults(): void |

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| StudentManagementSystem |

+---------------------------------------+

| - students: ArrayList<Student> |

| - examinations: HashMap<Integer, Examination> |

| - scanner: Scanner |

+---------------------------------------+

| + main(String[]): void |

| + addStudent(): void |

| + addExaminationDetails(): void |

| + viewStudentDetails(): void |

| + viewExaminationResults(): void |

| + findStudentByRollNumber(int): Student|

+--+

Relationships:

StudentManagementSystem uses instances of Student and Examination.

Examination has a collection of Subject objects.

Each Student can be associated with an Examination through roll number.

Implementation Details

- **Language**: Java (OOP-based)
- **Interface**: Console-based menu using Scanner

Classes:

- **Student**: Stores personal info (name, roll, DOB, etc.)
- **Subject**: Holds subject name, marks, grade, percentage
- **Examination**: Manages multiple Subject objects and computes overall performance
- **StudentManagementSystem**: Main class with menu to add/view student and exam data

Data Structures:

- ArrayList<Student> – Stores student records
- HashMap<Integer, Examination> – Maps roll numbers to exams

Features:

- Add new student
- Add subject marks
- Calculate grades & overall percentage
- View student details & results

Logic:

- Grade & percentage calculated based on marks
- Input validation for marks (0–100) and roll numbers

Limitations

- **No data saving** (data lost after exit)
- **No duplicate roll number check**
- **Fixed to 5 subjects only**
- **No edit/delete options**
- **No GUI interface**
- **No login/authentication**
- **Basic input validation only**

Future Enhancements

- **Add database or file storage** for saving data permanently
- **Allow editing/deletion** of student and exam records
- **Support for more/flexible subjects**
- **Develop a GUI** using JavaFX or Swing
- **Add login/authentication system**
- **Generate PDF/printable report cards**
- **Add analytics** like class average, toppers list, etc.

Conclusion

The Student Management System is a functional and well-structured Java application that demonstrates how object-oriented programming can be applied to solve real-world problems. It effectively manages student records and examination performance using simple, interactive menus and logical class design.

Though basic in nature, the system lays a solid foundation for more complex academic management systems. With future enhancements like data persistence, GUI, and authentication, it can be scaled into a fully-featured educational software.

This project showcases key programming concepts such as data encapsulation, modularity, collections, and user interaction—making it a great learning experience and a useful tool for small educational setups.