Final Consolidated Report

Object-Oriented Analysis and Design – Fall 2025

Online Course Registration System

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GitHub Repository:
https://github.com/RanaDief/OOAD_Project

1. System Overview

The Online Course Registration System (OCRS) is a university-wide platform that enables students to browse available courses, register for classes, and manage their academic schedules. The system also supports instructors who manage their courses and administrators who oversee academic terms, user accounts, and course configurations.

The system aims to streamline the registration process, enforce academic rules (e.g., prerequisites, capacity limits, schedule conflicts), and ensure that all users interact with an efficient, secure, and user-friendly environment.

2. Project Objectives

The objectives of the OCRS are to:

- Provide students with a clear and accessible interface to register, drop, and review courses.
- Enable instructors to manage course information and view enrolled students.
- Support administrators in managing course offerings, user accounts, and registration regulations.
- Ensure validation of enrollment rules such as capacity, prerequisites, and scheduling.
- Enhance usability, reliability, and overall efficiency of the university registration workflow.

3. Actors and Their Roles

Actor	Description
Student	Browses courses, registers/drops courses, views personal schedule.
Instructor	Updates course details and views enrolled students.
Administrator	Manage courses, users, academic terms, and system rules.

4. Functional Requirements

FR1: Student can browse the course catalog.

FR2: Student can search/filter courses by department, level, instructor, etc.

FR3: Student can register for a course.

FR4: System validates prerequisites before registration.

FR5: System checks course capacity.

FR6: System detects scheduling conflicts.

FR7: Student can drop a course.

FR8: Student can view their weekly schedule.

FR9: Instructor can modify course information.

FR10: Instructor can view enrolled students.

FR11: Administrator can create, edit, or delete courses.

FR12: Administrator can manage user accounts.

FR13: System sends notifications for successful/failed registrations.

FR14: System logs all registration activities.

5. Non-Functional Requirements

NFR1 — Usability: Interface should be user-friendly and easy to navigate.

NFR2 — Performance: Course search and registration validation must respond within 3 seconds.

NFR3 — Reliability: The system must be available during all registration periods with minimal downtime.

NFR4 — Security: Only authenticated users can access the system; sensitive data must be protected.

NFR5 — Scalability: The system should support high user volume during peak times.

NFR6 — Maintainability: Code and system structure must be easily maintainable for future upgrades.

6. System Constraints & Assumptions

Constraints:

Registration actions must follow academic regulations.

Course data must be accurate and updated by administrators.

Assumptions:

Users have valid university accounts.

Internet connection is available.

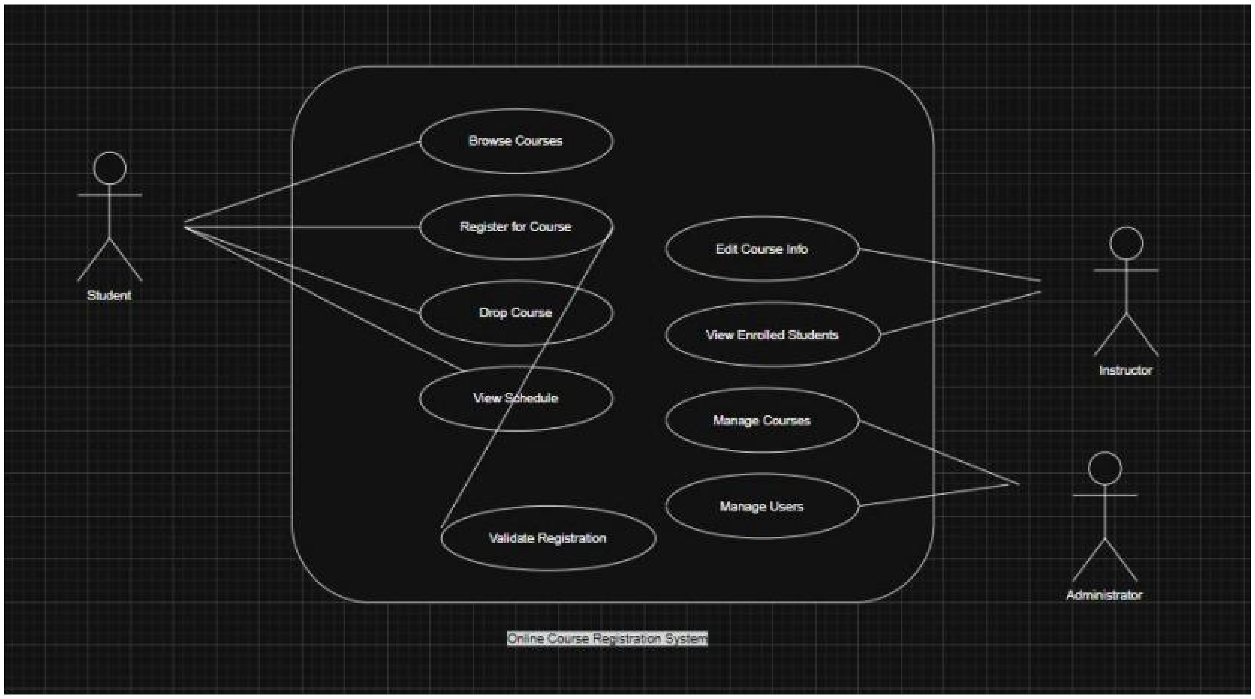
Course schedules and prerequisites are predefined.

7. Use Case List (Brief Descriptions)

Use Case	Description
UC-1 Browse Courses	Student views the available course catalog.
UC-2 Register for Course	Student registers for a chosen course after validations.
UC-3 Drop Course	The student removes an enrolled course.
UC-4 View Schedule	Students view their weekly course schedule.
UC-5 Edit Course Information	The instructor updates course details.
UC-6 View Enrolled Students	The instructor views list of enrolled students.

UC-7 Manage Courses	The administrator manages course creation, editing, and removal

8. Use Case Diagram



1. Detailed Use Case Scenarios:

UC1 — Browse Courses

Actor: Student

Preconditions: Student is logged in.

Main Flow:

1. Student opens the “Course Catalog”.

2. System displays all available courses.

3. Student may filter by department, level, day, or instructor.

4. Student selects any course to view details.

Postconditions: None (view-only).

Exceptions: None.

UC2 — Register for Course

Actor: Student
Preconditions:

· Student is logged in.

· Registration period is open.

Main Flow:

1. Student selects a course from the catalog.

2. System retrieves course info.

3. System validates prerequisites.

4. System checks for schedule conflicts.

5. System checks course capacity.

6. If all validations pass → System registers the student.

7. System updates the student schedule.

8. System sends confirmation message.

Postconditions:

· Course added to student's schedule.

· Course capacity decreases.

Exceptions:

· Missing prerequisites → Registration denied.

· Time conflict → Registration denied.

· Course full → Registration denied.

UC3 — Drop Course

Actor: Student
Preconditions:

· Student is logged in.

· Add/Drop period is open.

Main Flow:

1. Student opens list of registered courses.

2. Student selects a course to drop.

3. System removes the course from schedule.

4. System updates capacity.

5. System sends confirmation.

Postconditions:

· Course removed from schedule.

Exceptions:

· Drop period closed → Denied.

UC4 — View Schedule

Actor: Student

Preconditions: Student is logged in.

Main Flow:

1. Student opens “My Schedule”.
2. System retrieves all registered courses.
3. System displays the full weekly schedule.
4. Postconditions: None (view-only).

Exceptions: None.

UC5 — Edit Course Information

Actor: Instructor
Preconditions:

· Instructor teaches the selected course.

Main Flow:

1. Instructor selects a course.

2. System displays current course details.
3. Instructor modifies description/materials/requirements.
4. System saves updates.

Postconditions:

· Course information updated.

Exceptions:

· Instructor attempts editing unrelated course → Denied.

UC6 — View Enrolled Students

Actor: Instructor

Preconditions: Instructor teaches the course.

Main Flow:

1. Instructor chooses one of their courses.
2. System retrieves list of enrolled students
3. Instructor views names, IDs, and emails.
4. **Postconditions:** None (view-only).

Exceptions: Instructor views a course not assigned to them → denied.

UC7 — Manage Courses

Actor: Administrator
Preconditions:

· Admin is logged in.

Main Flow:

1. Admin opens course management dashboard.
2. Admin chooses Add/Edit/Delete.
3. System performs the requested operation.
4. System updates database.
5. System displays confirmation.

Postconditions:

· Course catalog updated.

Exceptions:

Removing a course during active registration → Warning.

2. Conceptual Classes

- **Student:** Registers for courses, views schedule.
- **Instructor:** Manages course content and views enrolled students.
- **Administrator:** Manages courses, users, and terms.
- **Course:** Contains title, description, capacity, schedule, and instructor.
- **Registration:** Represents enrollment of a student in a course.
- **Schedule:** Student’s organized weekly plan of courses.
- **Prerequisite:** Required course that must be completed before enrollment.

- **Semester/Term:** Defines the academic period.
- **Notification:** Communicates confirmation or failure messages.
- **TimeSlot:** Represents meeting time(s) for a course.
- **UserAccount:** General user attributes inherited by Student, Instructor, Admin.

3. Class Relationships

Associations

- Student ↔ Registration (1 student has many registrations)
- Course ↔ Registration (1 course can have many students)
- Course ↔ Instructor (1 instructor teaches many courses)
- Course ↔ TimeSlot (1..* time slots)
- Student ↔ Schedule (1 schedule per student)
- Administrator ↔ Course (manages courses)
- Administrator ↔ UserAccount (creates/edits accounts)

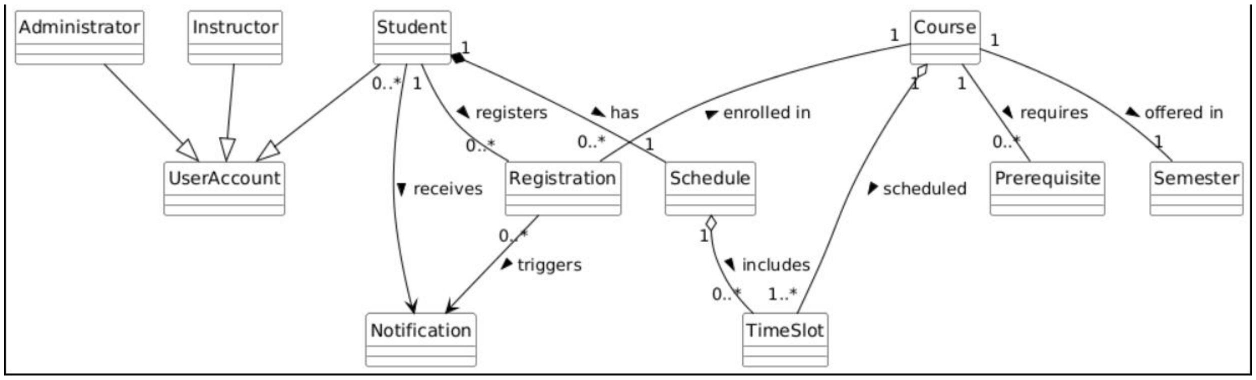
Aggregations

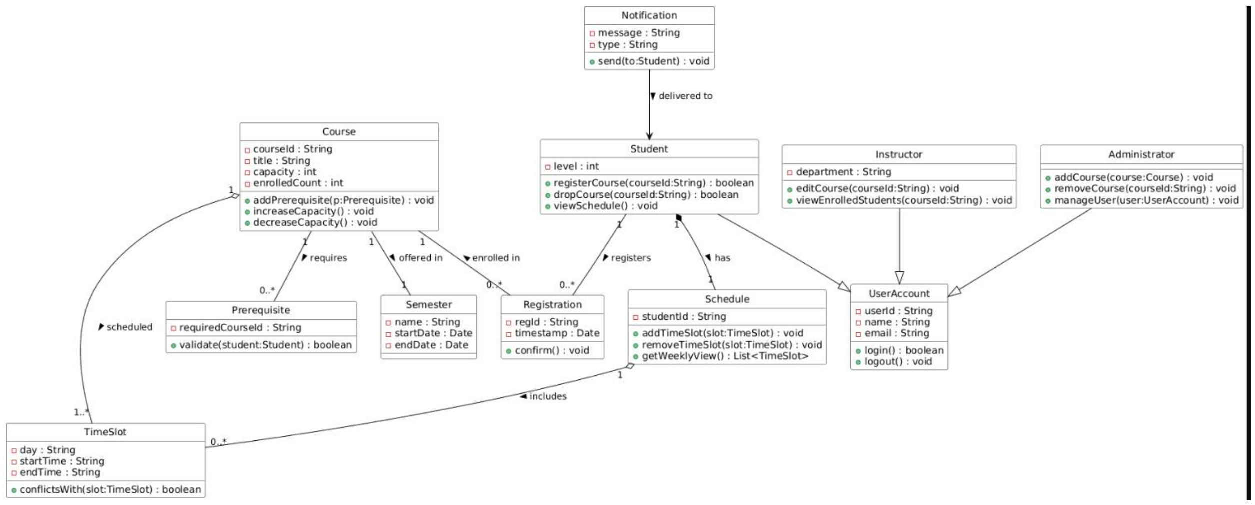
- Schedule contains TimeSlots
- Course contains CourseMaterials

Inheritance

- UserAccount
  ↳ Student
  ↳ Instructor
  ↳ Administrator

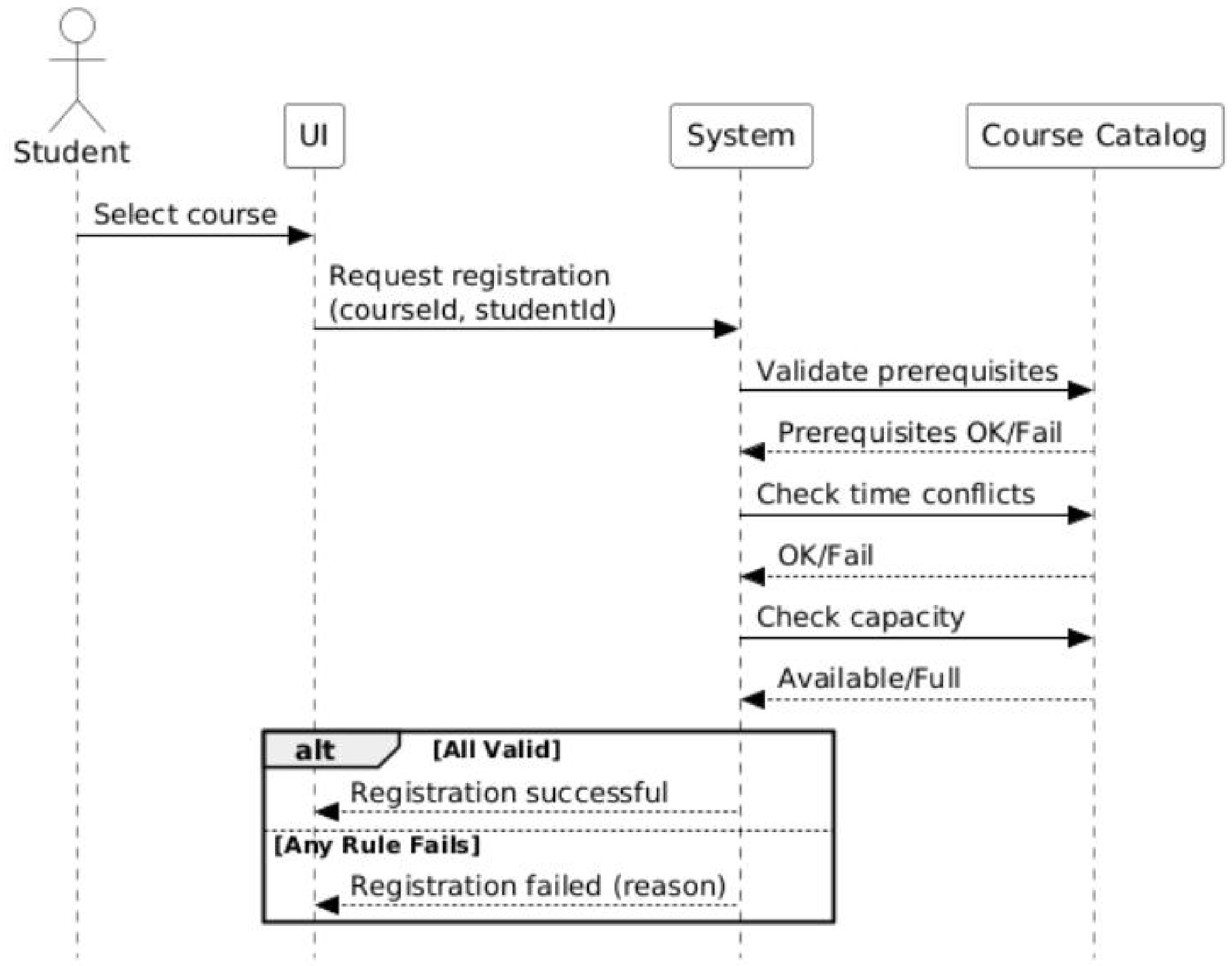
4. Analysis-Level Class Diagram



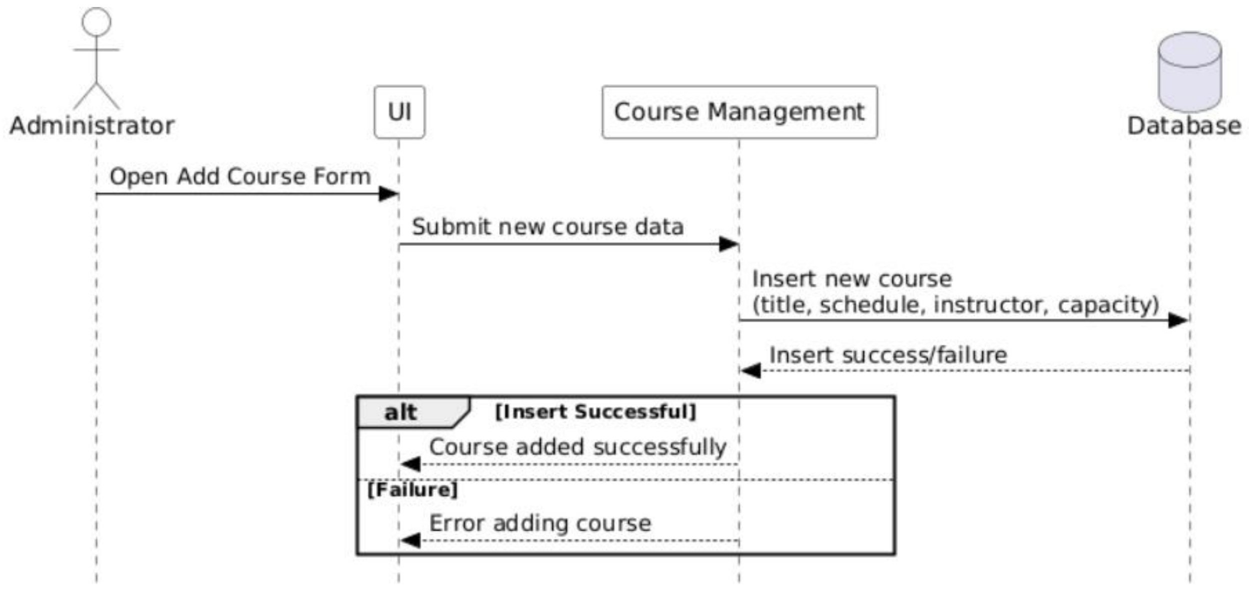


5. Sequence Diagrams

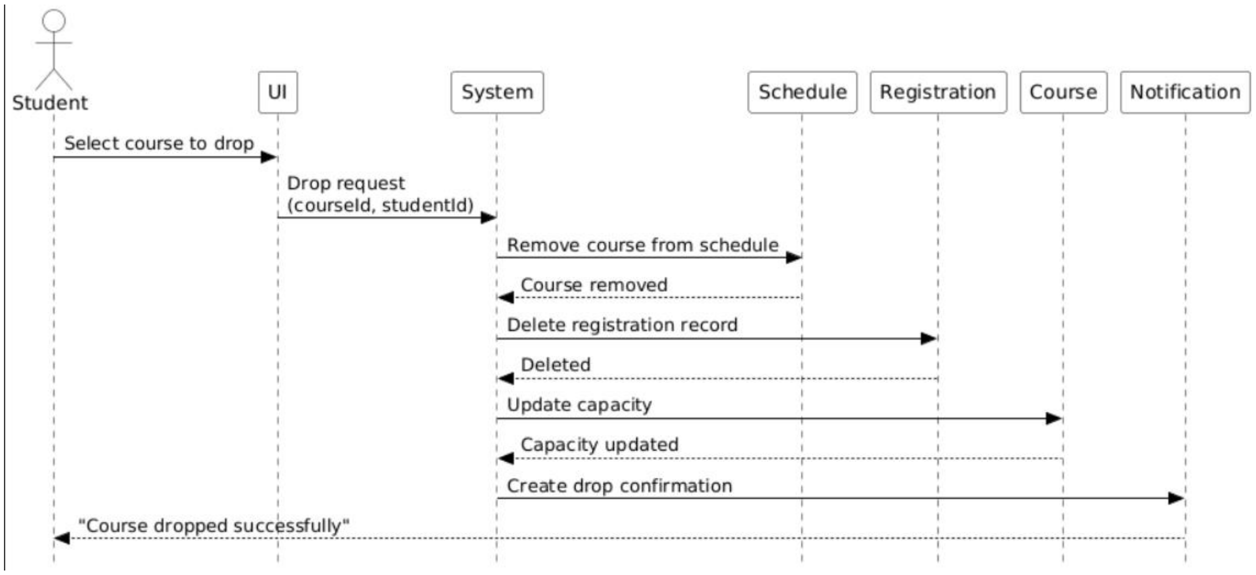
SEQUENCE DIAGRAM 1 (Register for Course)



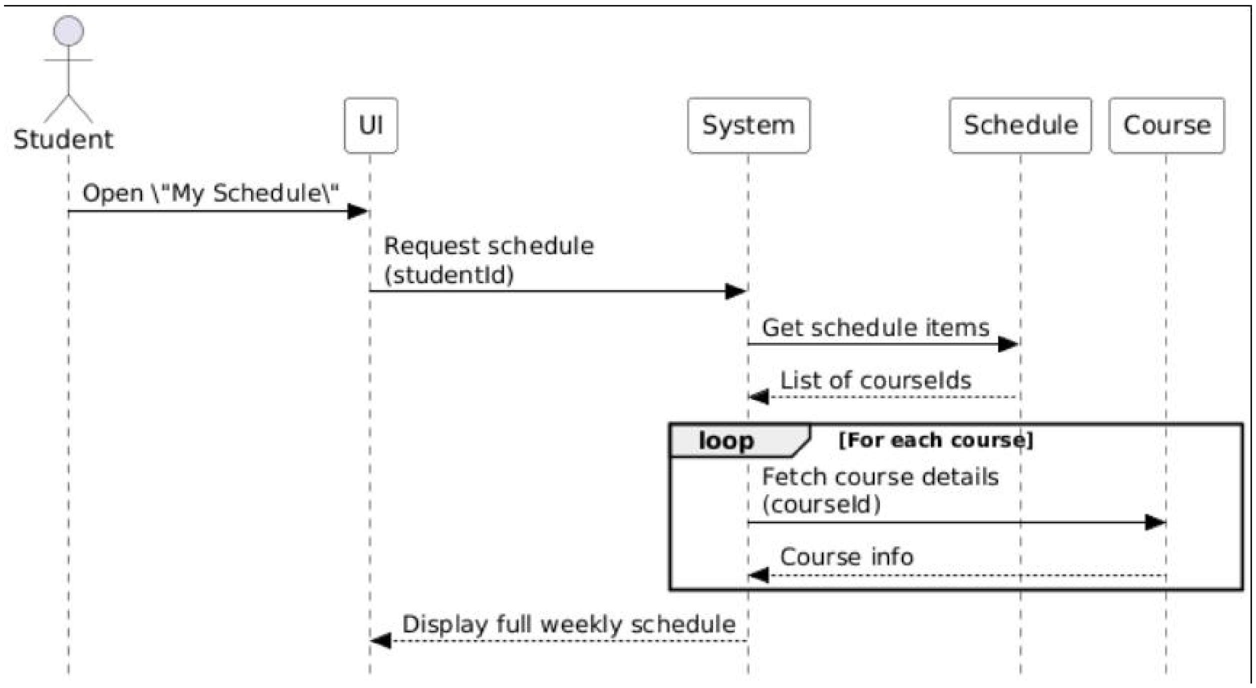
SEQUENCE DIAGRAM 2 (Add New Course)



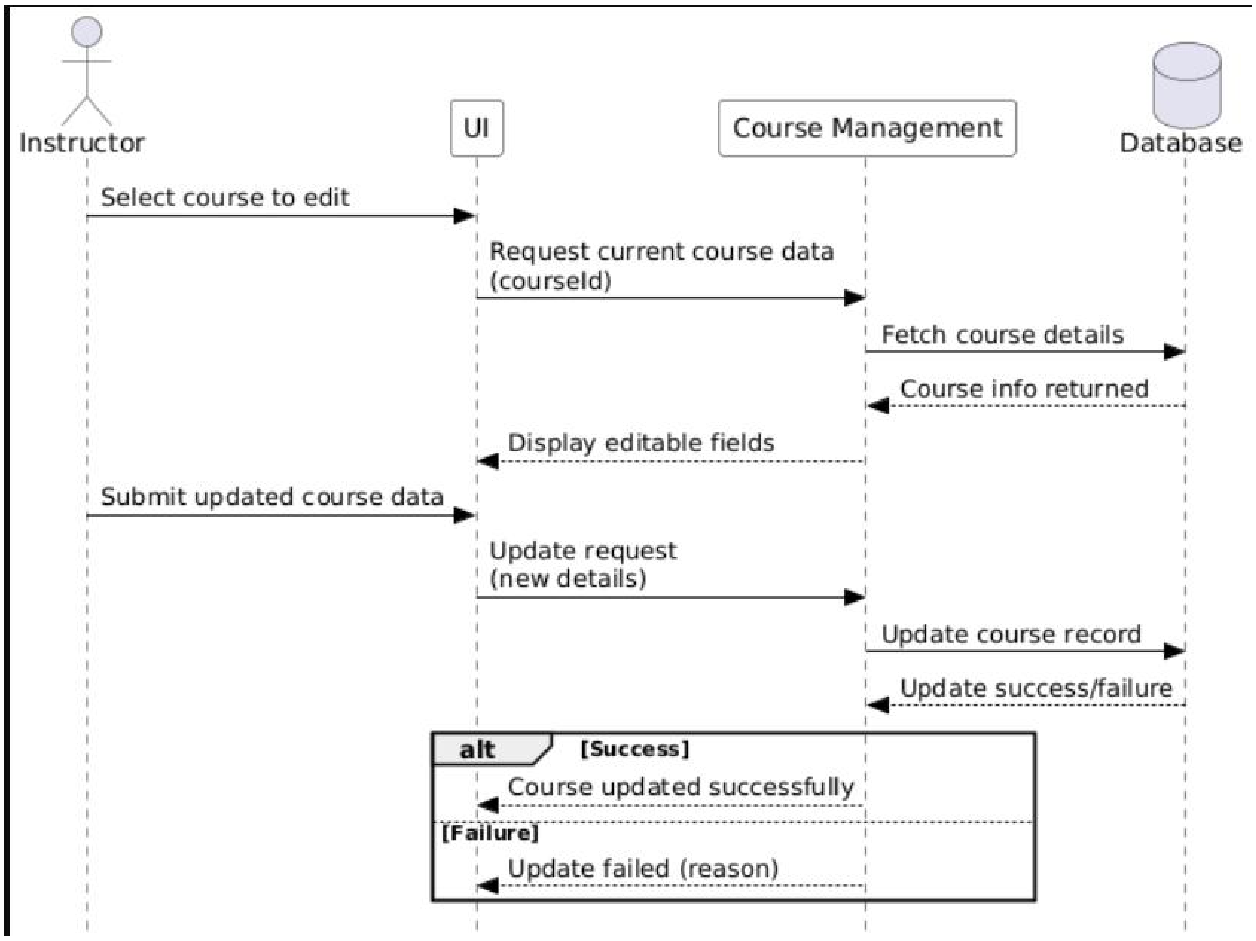
SEQUENCE DIAGRAM 3 (Drop Course)



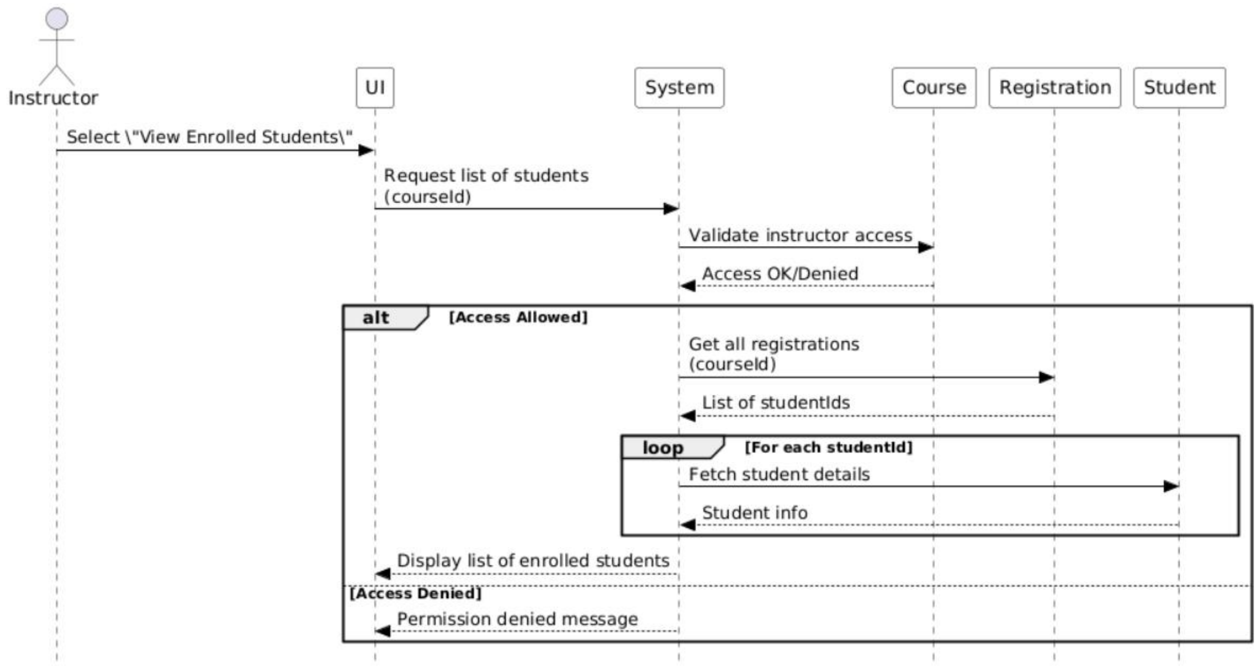
Sequence Diagram 4—View Schedule



Sequence Diagram 5—Edit Course Information (Instructor)



Sequence Diagram 6—View Enrolled Students (Instructor)



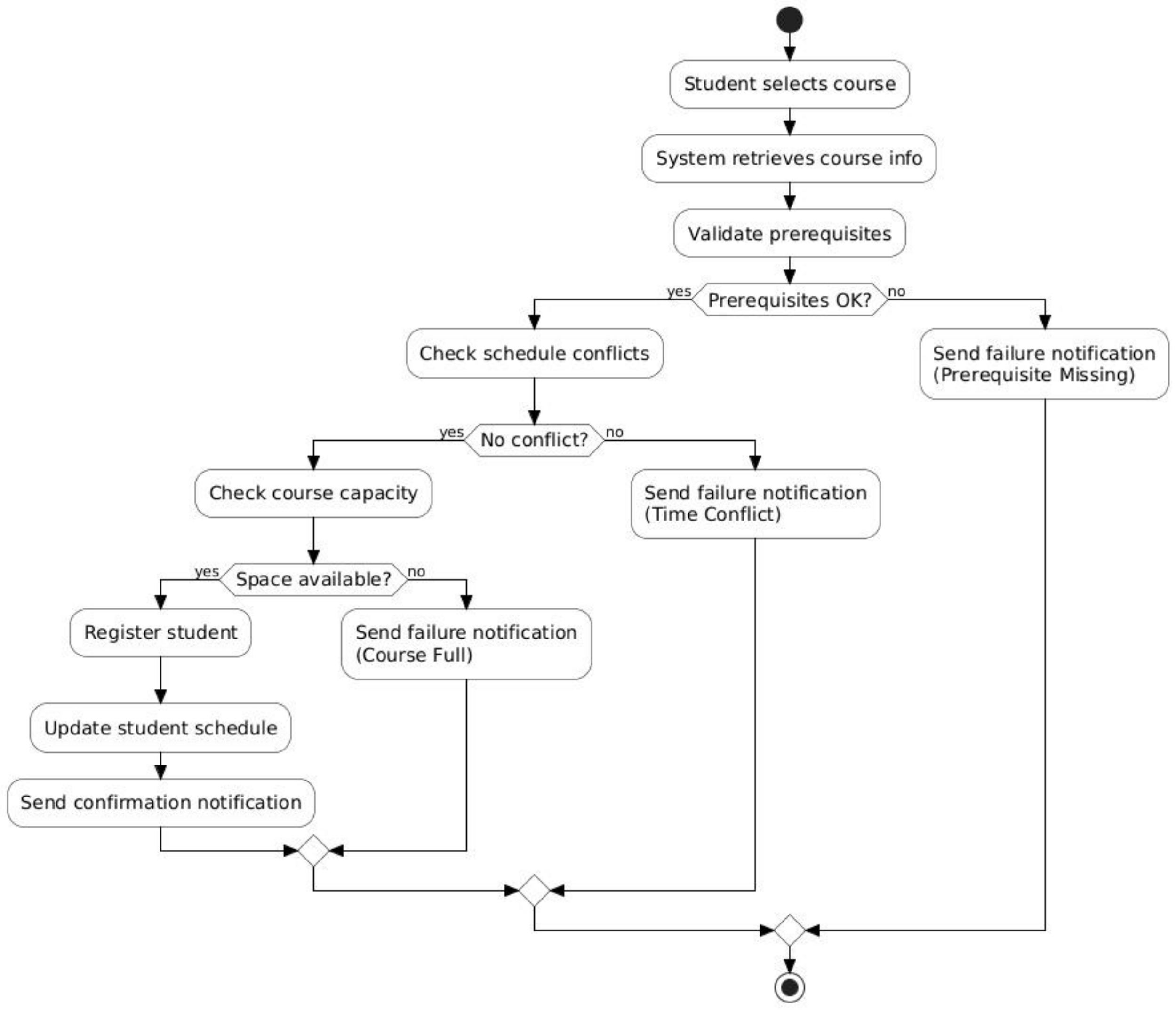
Instructor
UI
System
Course
Registration
Student
Select \"View Enrolled Students\"
Request list of students (courseId)
Validate instructor access
Access OK/Denied
alt [Access Allowed]
Get all registrations (courseId)
List of studentIds
loop [For each studentId]
Fetch student details
Student info
Display list of enrolled students
[Access Denied]
Permission denied message

6. Activity Diagram—Course Registration Process

Include the workflow:

1. Student selects course
2. System retrieves course info
3. Validate prerequisites
4. Validate schedule conflict
5. Validate capacity
6. If all pass → register student
7. Update schedule
8. Send notification

9. End



7. Expanded Notes & Modeling Decisions

1. Inheritance & User Hierarchy

The **UserAccount** class is used as a *generalized superclass* for all user types in the system.

This design decision is based on the observation that:

- Student, Instructor, and Administrator all share common attributes (Name, Email, UserID).
- They also share similar authentication behaviors (login/logout).
- Using inheritance avoids duplication, increases maintainability, and supports polymorphism if needed later in the design.

Thus:

- **Student**, **Instructor**, and **Administrator** extend **UserAccount**.
- This aligns with OO principles of *generalization and specialization*.

2. Registration as a Separate Entity

Registration is modeled as an independent **conceptual class** rather than an attribute inside Student or Course.

Justification:

- Students can register for *multiple* courses.
- Courses contain *multiple* students.
- This creates a **many-to-many relationship**.
- A dedicated **Registration** class resolves this many-to-many relation cleanly.

It also enables:

- Adding timestamps
- Tracking registration status
- Logging operations

- Supporting notifications
- Extending features in future semesters

This follows strong database and OO modeling conventions.

3. Schedule Modeled as a Composition

A Student owns exactly one **Schedule**, and deleting a student should remove their schedule.

Therefore:

- The relationship is modelled as **composition**.
- The schedule cannot exist without its owner.
- It helps visualize the student's weekly timetable.

This ensures a cohesive representation of the student's academic workload.

4. TimeSlot as an Independent Reusable Concept

The **TimeSlot** class is created to represent course meeting times (e.g., Monday 8–10am).

Reasons:

- Scheduling conflict detection requires comparing day/time periods.
- Multiple courses may share the same time slots.
- TimeSlots can be reused or mapped without duplicating data.

This supports clean scheduling validation.

5. Course Aggregation with Time Slots

The relationship between Course and TimeSlot is modeled as **aggregation**:

- A course consists of one or more time slots.
- TimeSlots can exist independently of the course creation or deletion.

Example:
A time slot model can be reused across different courses.

This choice improves modularity and prevents unnecessary deletion dependencies.

6. Course Prerequisites

Prerequisites are modeled using a **Prerequisite** class instead of a simple list of course IDs.

Why:

- A course may require multiple prerequisites.
- Prerequisites may evolve into more complex validation rules (e.g., minimum grade).
- This design supports extension and improves flexibility.

This follows the OO principle of "anticipating change."

7. Semester as a Separate Class

The **Semester** class exists to:

- Assign courses to academic terms
- Support future features such as overlapping semesters
- Enable filtering courses by semester
- Facilitate future reporting requirements

This makes the model more future-proof.

8. Notification Added for Confirmation & Feedback

Notifications are used for essential user feedback:

- Successful registration
- Failed registration
- Drop confirmations
- Administrative updates

Having a dedicated **Notification** class allows:

- Logging messages
- Categorizing message types
- Future expansion (email/SMS)

9. Clear Separation of Responsibilities

The model reflects proper OO separation:

- **Course** handles academic content and capacity
- **Registration** handles enrollment linking
- **Schedule** manages weekly structure
- **Notification** handles system messages
- **UserAccount** hierarchy manages user roles

This separation improves readability, maintainability, and modularity.

10. Avoiding Premature Design Complexity

Phase 2 focuses on analysis-level modeling:

- Minimal attributes
- No data types unless necessary
- No method bodies
- Focus on conceptual understanding

This aligns strictly with UML analysis principles and avoids mixing design-level decisions prematurely.

Fully Detailed Class Descriptions

Package: user

2.1 UserAccount (Superclass)

Purpose: General identity and authentication information for all system users.

Attributes

userId : String — Unique identifier for the user

name : String — Full user name

email : String — Official contact email

password : String — Encrypted login password

Methods

login(email:String, password:String) : boolean — Validates user credentials

logout() : void — Ends the user session

Role in System

Parent class for Student, Instructor, and Administrator

Avoids duplication of shared data fields

Supports polymorphism (UserAccount references)

2.2 Student (extends UserAccount)

Purpose: Represents a student who registers for courses and maintains a schedule.**Attributes**

studentLevel : int — Year/level of the student (e.g., 1, 2, 3, 4)

Methods

registerForCourse(courseId:String) : boolean — Attempts registration and returns status

dropCourse(courseId:String) : boolean — Removes a registered course

viewSchedule() : Schedule — Retrieves the student's weekly schedule

Relationships

Has **one Schedule** (composition)

Has **many Registration records**

Receives **Notifications**

2.3 Instructor (extends UserAccount)

Purpose: Manages academic course information and views student lists.

Attributes

department : String — Department responsible for instructor's courses

Methods

editCourseInfo(courseId:String, data:Map) : boolean — Modify course description, materials, etc.

viewEnrolledStudents(courseId:String) : List<Student> — Retrieves student details

Relationships

Teaches multiple courses

2.4 Administrator (extends UserAccount)

Purpose: Manages courses, users, and registration rules for the system.

Methods

addCourse(course:Course) : boolean

editCourse(courseId:String, data:Map) : boolean

deleteCourse(courseId:String) : boolean

manageUser(user:UserAccount) : boolean

Relationships

Interacts with **Course**, **UserAccount**, and system configurations.

Package: course

2.5 Course

Purpose: Represents an academic course available for registration.

Attributes

courseId : String — Unique course identifier

title : String — Course name

description : String — Course summary and content

capacity : int — Maximum students allowed

currentEnrollment : int — Current number of enrolled students

Methods hasSpace() : boolean — Checks if enrollment < capacity

incrementEnroll() : void — Increase student count

decrementEnroll() : void — Decrease student count

Relationships

1 Instructor teaches the course

1 Semester defines when it is offered

1..* TimeSlots represent when it meets

0..* Prerequisites required for registration

0..* Registration records link students to the course

2.6 Prerequisite

Purpose: Encapsulates course prerequisite information.

Attributes

requiredCourseId : String — Course ID that must be completed first

Relationships

Multiple prerequisites may exist per course.

2.7 TimeSlot

Purpose: Represents the scheduled meeting time(s) of a course.

Attributes

day : String — Day of the week   startTime : Time — Start time

endTime : Time — End time

Relationships

Aggregated by Course

Used by Schedule for conflict checking

2.8 Semester

Purpose: Identifies the academic term.

Attributes

name : String — e.g., “Fall 2025”

startDate : Date

endDate : Date

Relationships

Each course belongs to exactly one semester

Package: registration

2.9 Registration

Purpose: Represents an attempt or completion of course registration.

Attributes

registrationId : String — Unique registration ID

studentId : String   courseId : String

timestamp : DateTime — When the request was made

status : RegistrationStatus — Pending, Approved, Rejected

Methods

confirm() : void — Sets status to APPROVED

fail(reason:String) : void — Sets status to REJECTED

Relationships

Links Student ↔ Course

Triggers Notifications

Logged in the system for auditing

2.10 RegistrationStatus (Enum)

PENDING

APPROVED

REJECTED

Package: schedule

2.11 Schedule

Purpose: Holds all registered courses for a student.

Attributes

studentId : String — The owner of this schedule**Methods**

addCourse(course:Course) : void

removeCourse(course:Course) : void

checkConflict(timeslot:TimeSlot) : boolean — Ensures no overlap

Relationships

Composition with Student (Schedule cannot exist without Student)

Contains many TimeSlots

Package: notification

2.12 Notification

Purpose: Communicates registration outcomes and updates.

Attributes

message : String

type : String — success, failure, warning

timeSent : DateTime — Time sent

Methods

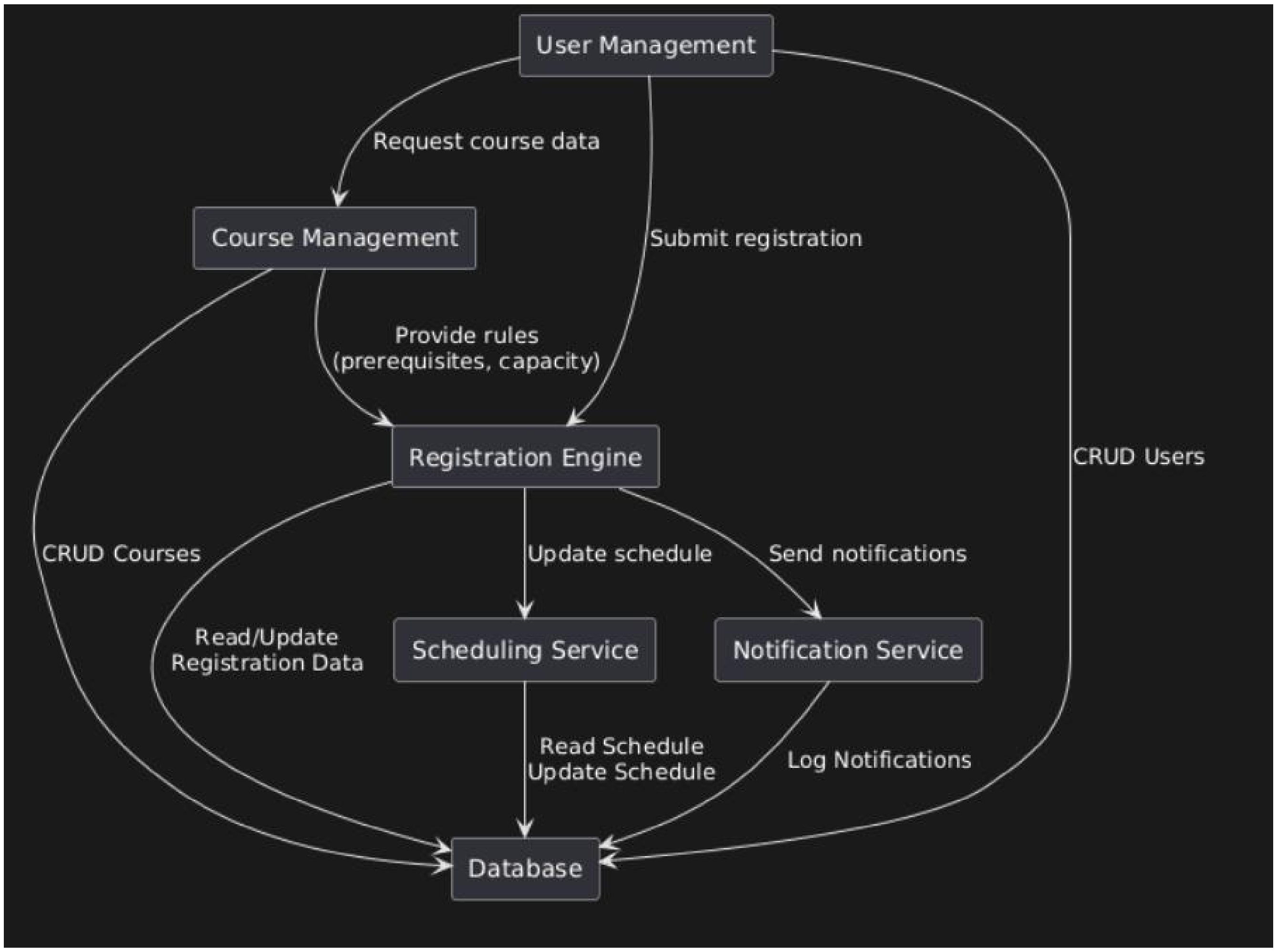
send(toUserId:String) : void — Delivers the notification

Relationships

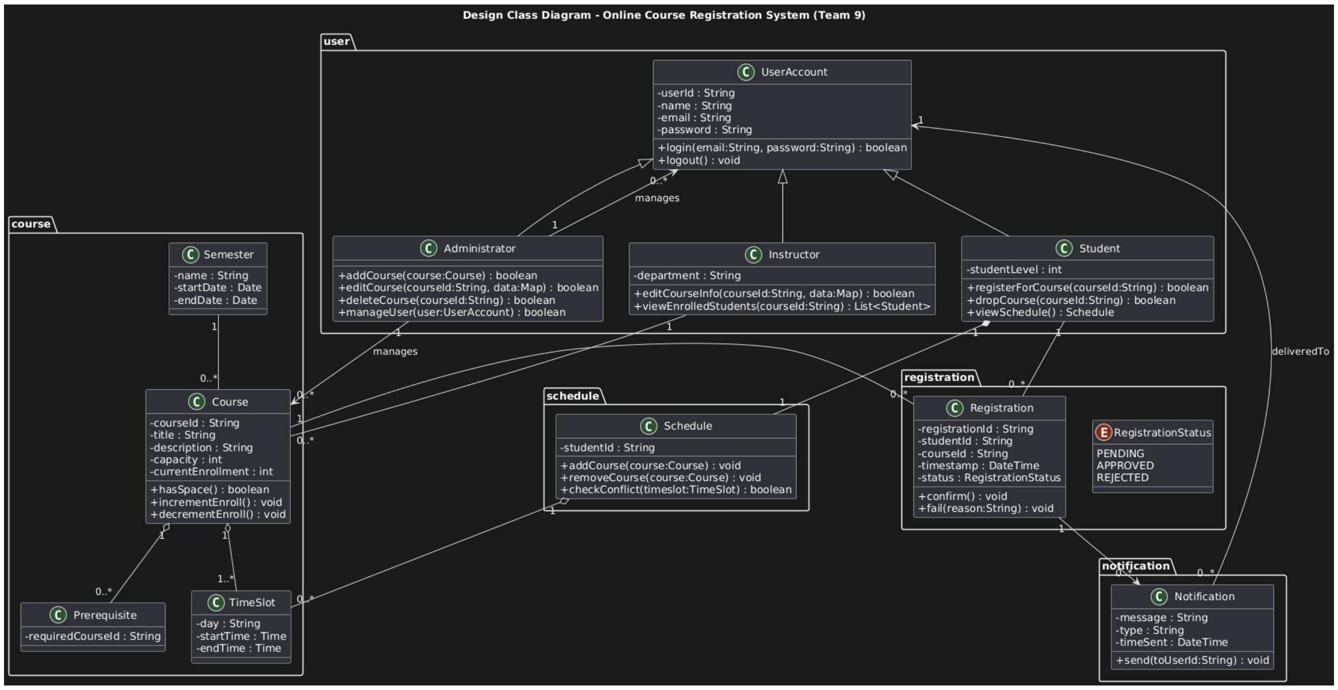
Created by Registration engine or Admin operations

Delivered to Student, Instructor, or Admin

Component Diagram:

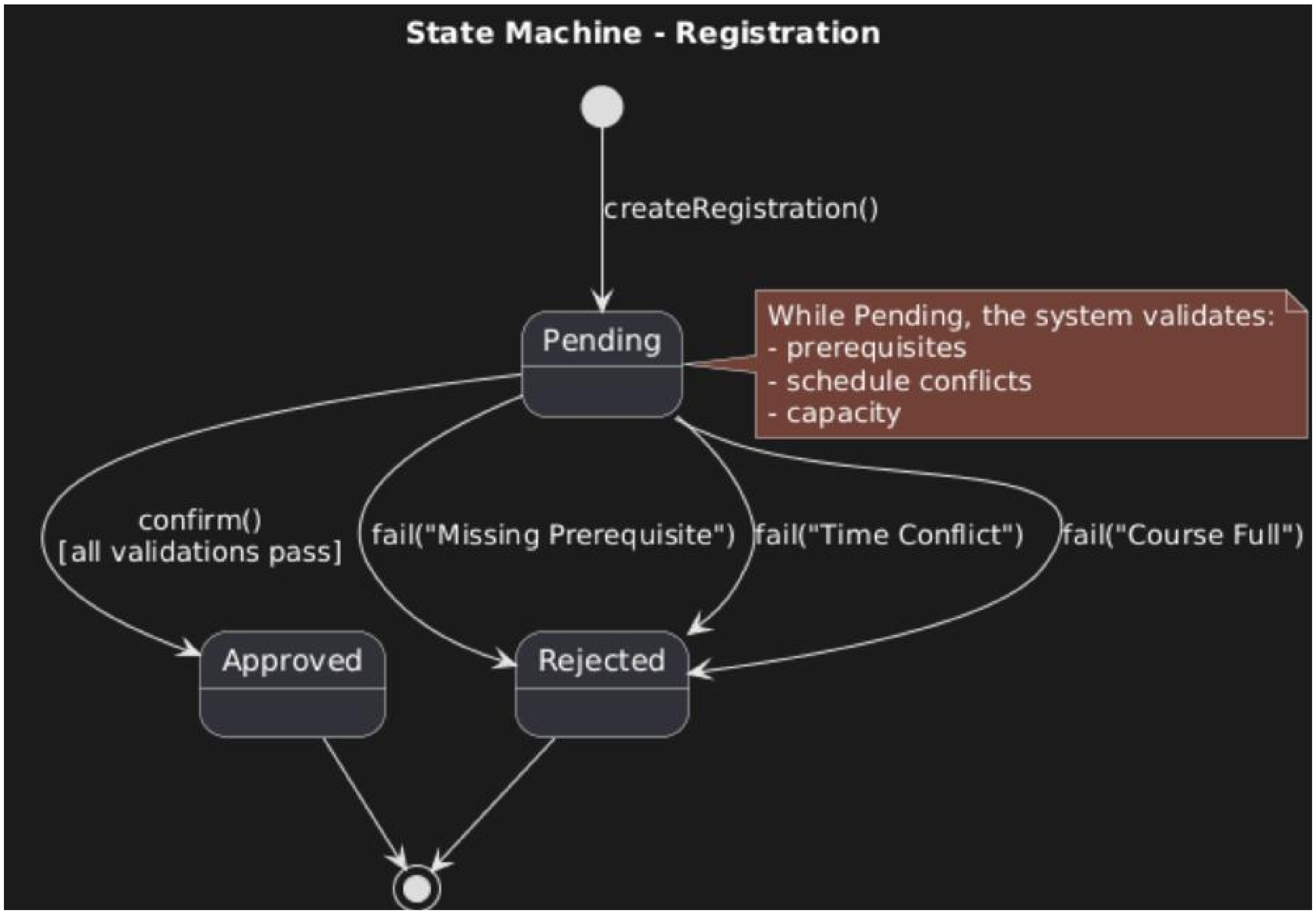


Class Design Diagram:

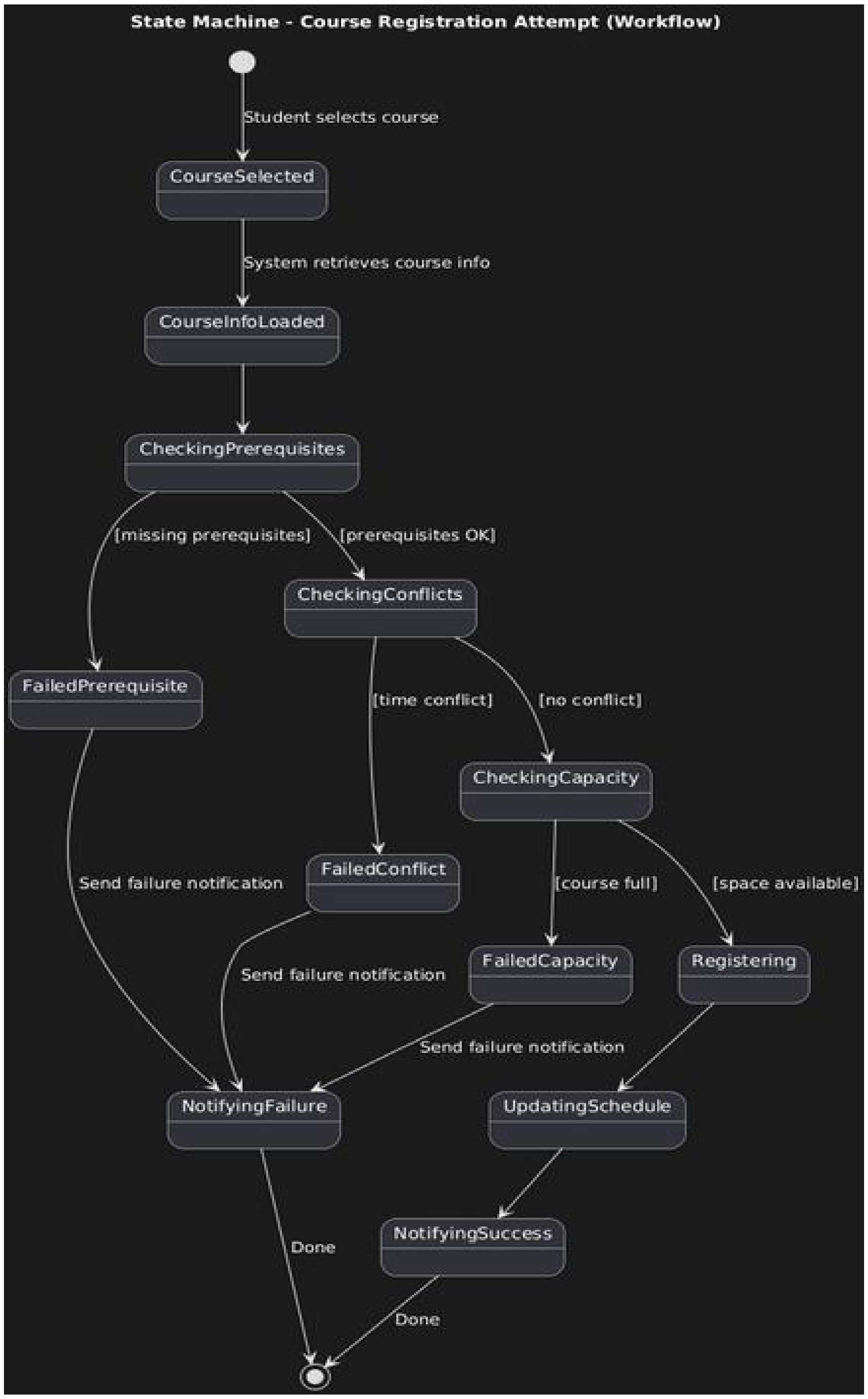

Design Class Diagram - Online Course Registration System (Team 9)
user
UserAccount
-userId : String
-name : String
-email : String
-password : String
+login(email:String, password:String) : boolean
+logout() : void
Administrator
+addCourse(course:Course) : boolean
+editCourse(courseId:String, data:Map) : boolean
+deleteCourse(courseId:String) : boolean
+manageUser(user:UserAccount) : boolean
Instructor
-department : String
+editCourseInfo(courseId:String, data:Map) : boolean
+viewEnrolledStudents(courseId:String) : List<Student>
Student
-studentLevel : int
+registerForCourse(courseId:String) : boolean
+dropCourse(courseId:String) : boolean
+viewSchedule() : Schedule
manages
manages
deliveredTo
course
Semester
-name : String
-startDate : Date
-endDate : Date
Course
-courseId : String
-title : String
-description : String
-capacity : int
-currentEnrollment : int
+hasSpace() : boolean
+incrementEnroll() : void
+decrementEnroll() : void
Prerequisite
-requiredCourseId : String
TimeSlot
-day : String
-startTime : Time
-endTime : Time
schedule
Schedule
-studentId : String
+addCourse(course:Course) : void
+removeCourse(course:Course) : void
+checkConflict(timeslot:TimeSlot) : boolean
registration
Registration
-registrationId : String
-studentId : String
-courseId : String
-timestamp : DateTime
-status : RegistrationStatus
+confirm() : void
+fail(reason:String) : void
RegistrationStatus
PENDING
APPROVED
REJECTED
notification
Notification
-message : String
-type : String
-timeSent : DateTime
+send(toUserId:String) : void

State Machine Diagram:

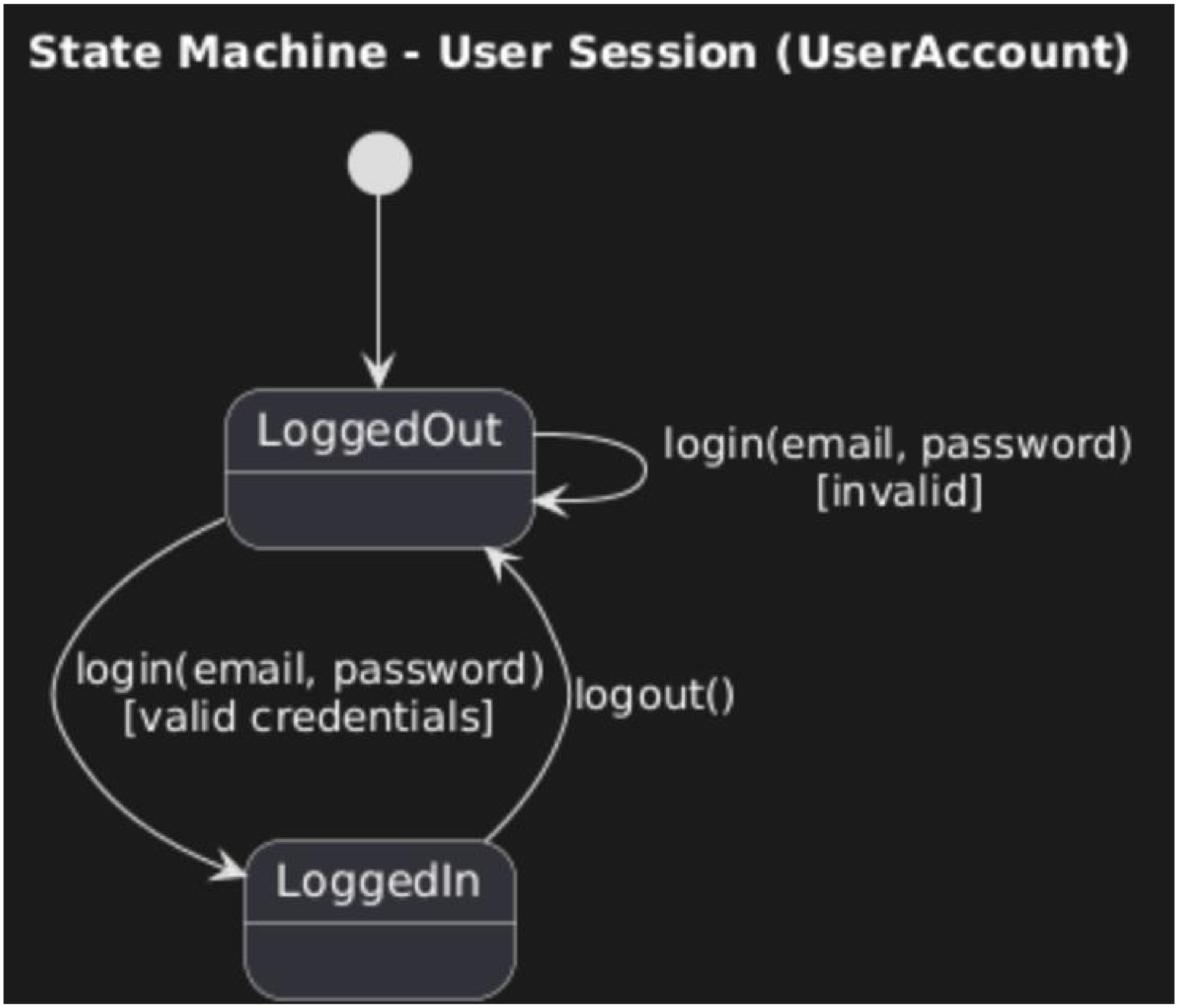
1) Registration State Machine:



2) Course Registration Attempt (Process State Machine):



3) User Session State Machine:


State Machine - User Session (UserAccount)
LoggedOut
login(email, password) [invalid]
login(email, password) [valid credentials]
logout()
LoggedIn