

Binghamton University

Project Report: E-Learning Platform

**FINAL PROJECT: INFO 542 OBJECT ORIENTED PROGRAMMING WITH
DESIGN PATTERNS**

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ACKNOWLEDGEMENT

“We have done this assignment completely on our own except for the tools/software acknowledged in the project report. We have not copied it, nor have we given our solution to anyone else. We understand that if we are involved in plagiarism or cheating, we will have to sign an official form that we have cheated and that this form will be stored in our official university records. We also understand that we will receive a grade of 0 for the involved assignment and our grades will be reduced by one level (e.g., from A to A- or from B+ to B) for our first offense, and that we will receive a grade of “F” for the course for any additional offense of any kind.”

INTRODUCTION

The E-Learning Platform is a web-based educational system designed to facilitate the creation, management, and interaction within virtual courses. The platform supports both professors and students, allowing professors to create courses with diverse content such as modules, video lessons, and quizzes, while students can enroll in courses and interact with course content. The system features a command-line interface (CLI) for user interactions and incorporates various design patterns for scalability and flexibility.

BACKGROUND

In today's fast-paced world, traditional educational methods are complemented by online learning platforms. The E-Learning Platform caters to the growing demand for flexible, accessible, and interactive online education. It provides a structured environment for professors to share knowledge and for students to engage with educational materials remotely. The platform supports a dynamic and collaborative learning experience, enabling users to enroll in diverse courses and access a range of educational resources.

OBJECTIVES

The primary objectives of the E-Learning Platform include:

1. **Facilitate Course Creation:** Professors can create courses with modules, video lessons, and quizzes.
2. **User Registration:** Users (professors and students) can register with the platform.
3. **Course Enrollment:** Students can enroll in courses based on their preferences.
4. **Interaction with Course Content:** Students can interact with course content, such as watching video lessons, completing quizzes, and viewing modules.
5. **Badge Assignment:** Users receive badges based on their achievements, enhancing the gamification aspect of learning.

SCOPE

User Interactions:

Professors:

- Register with the platform.
- Create courses with modules, video lessons, and quizzes.
- View and manage enrolled students.
- View and manage all courses.

Students:

- Register with the platform.
- Enroll in available courses.
- Interact with course content (modules, video lessons, quizzes, rate course).
- Receive badges upon course completion and quizzes(above 60%).

Displayed Content:

Course Information:

- Title, description, and author details.
- Modules, video lessons, and quizzes associated with a course.

User Profiles:

- Display user information, enrolled courses, and badges.

IMPLEMENTATION

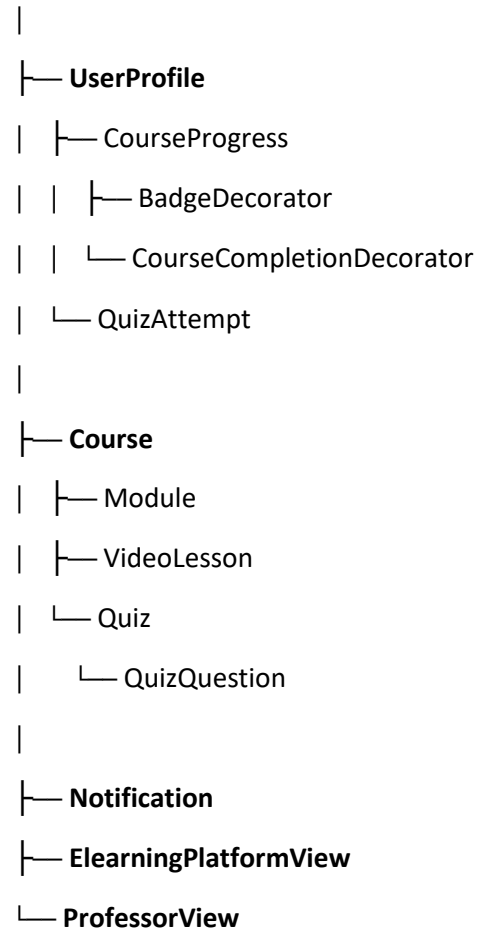
Key Features

Components:

- **User Profiles:** UserProfile class represents user profiles with details such as username, BU_ID, and courses enrolled.
- **Courses:** Course class encapsulates course details, including modules, video lessons, and quizzes.
- **Interactions:** CourseProgress and QuizAttempt classes manage user progress and quiz attempts.
- **Design Patterns:** Observer, Decorator, Factory Method, and Strategy patterns enhance scalability, maintainability, and flexibility.

CODE STRUCTURE

ElearningPlatform



Class Relationships:

ElearningPlatform:

- Manages users, courses, interactions, notifications.
- Implements registration, course creation, and user interactions.

UserProfile:

- Represents user profiles.
- Holds details such as username, BU_ID, courses enrolled.
- Associated with *CourseProgress* and *QuizAttempt*.

Course:

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- Represents a course with modules, video lessons, and quizzes.
- Associated with *Module*, *VideoLesson*, and *Quiz*.

Module:

- Represents a module within a course.

VideoLesson:

- Represents a video lesson within a course.

Quiz:

- Represents a quiz within a course.
- Contains multiple *QuizQuestion* instances.

QuizQuestion:

- Represents a question within a quiz.

CourseProgress:

- Manages the progress of a user within a course.
- Associated with badges through *BadgeDecorator* and *CourseCompletionDecorator*.

BadgeDecorator:

- Decorator pattern for assigning badges to users.

CourseCompletionDecorator:

- Specific decorator for the completion badge.

QuizAttempt:

- Manages quiz attempts by users.

Notification:

- Represents notifications to users.

ElearningPlatformView:

- Handles the presentation layer, displaying information to users.

ProfessorView:

- Extends *ElearningPlatformView* with additional features for professor-specific views.

Design Patterns:

❖ **Creational Patterns:**

- **Factory Pattern:**
 - ◆ VideoCourseFactory: Generates instances of Course objects based on parameters.
- **Factory Method Pattern:**
 - ◆ create_video_lesson method in ProfessorView: Creates VideoLesson objects.

❖ **Structural Patterns:**

- **Composite Pattern:**
 - ◆ Course class: Contains multiple content types (modules, video lessons, quizzes) treated uniformly.
- **Composite Pattern (Partial):**
 - ◆ Methods (view_courses_created, view_student_details, view_student_quiz_grades, view_courses_and_students, view_classlist): Operate on Course objects and their relationships.
- **Singleton Pattern (Implicit):**
 - ◆ UserProfile class maintaining one instance of CourseProgress for each user.
 - ◆ ElearningPlatform class encapsulating the entire e-learning platform.

❖ **Behavioral Patterns:**

- **Command Pattern:**
 - ◆ view_courses_created_with_edit_option method: Provides options and executes corresponding actions based on user input.
- **Strategy Pattern:**
 - ◆ ModuleCompletionStrategy and DefaultModuleCompletion: Defines algorithms for completing modules dynamically.
 - ◆ CustomEncoder: Implements serialization strategies for different object types.
 - ◆ complete_quiz method: Encapsulates strategies for grading quizzes and handling completion.
- **Template Method Pattern (Implicit):**
 - ◆ Structured methods (create_course, edit_course, register_user): Follow a template where specific steps are executed in a specific order.
- **Observer Pattern:**
 - ◆ ObservableCourse and CourseObserver classes: Manages observers and notifies about course updates.

- ◆ notify method: Notifies users about events they're interested in.

❖ **Decorative Patterns:**

- **Decorator Pattern:**

- ◆ BadgeDecorator and CourseCompletionDecorator: Dynamically add badges to user profiles upon certain actions.

Implemented features as compare to existing E-Learning platforms:

1. User roles – Different profiles and access given to professor and user based on their registration.
2. Professor is able to create and manage courses, view enrollments, view student quiz grades.
3. Student is able to register and enroll in courses, interact with the course, rate the course and achieve badges on completion.
4. Admin email which is set in the code will get a notification whenever a new student enrolls in a course.
5. Save JSON responses similar to Google form as it can be used further for development purposes.

As compared to the several existing e-learning platforms we were able to implement almost 11-12 features using the design pattern principles.

SNAPSHOTS OF WORKING PROJECT

❖ *Professor Registration*

```
=== E-Learning Platform ===
```

1. Professor Registration
2. Student Registration
3. Quit

```
Enter the number of your choice: 1
```

```
=== Professor Registration ===
```

```
Enter your username: pchaudh3
```

```
Enter your email address: pchaudh3@binghamton.edu
```

```
Are you a Professor (1) or a Student (2)?: 1
```

```
Enter the admin password: admin123
```

```
Enter your BU_ID: B00980199
```

```
pchaudh3, you can now manage courses.
```

1. Create a course
2. View created courses
3. Quit

❖ *Course creation and management*

```
Enter the number of your choice: 1
Enter the title of the course: Intro to Python
Enter the description of the course: Python Basics
Course 'Intro to Python' created successfully.
```

```
=== Course Management Options ===
1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup
```

```
Enter the number of your choice: 1
Enter the title of the module: Introduction to Python Programming
Enter the content of the module: Overview of Python
Module 'Introduction to Python Programming' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup
```

```
Enter the number of your choice: 1
Enter the title of the module: Python Fundamentals
Enter the content of the module: Variables, Data Types, and Operators
Module 'Python Fundamentals' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
```

```
=== Course Management Options ===
1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup
```

```
Enter the number of your choice: 1
Enter the title of the module: Control Structures (if statements, loops)
Enter the content of the module: Conditional statements, if-else statements, for and while loops.
Module 'Control Structures (if statements, loops)' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup
```

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```
Enter the number of your choice: 1
Enter the title of the module: Functions and Built-in Functions
Enter the content of the module: Creating functions, parameters, return statements, and common built-in functions.
Module 'Functions and Built-in Functions' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
```

1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup

```
Enter the number of your choice: 2
Enter the title of the video lesson: Python Basics: Getting Started with Python Programming
Enter the video URL: https://www.example.com/python-basics-getting-started
Video lesson 'Python Basics: Getting Started with Python Programming' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
```

```
=== Course Management Options ===
```

1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup

```
Enter the number of your choice: 2
Enter the title of the video lesson: Python Fundamentals for Beginners
Enter the video URL: https://www.example.com/python-fundamentals-beginners
Video lesson 'Python Fundamentals for Beginners' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
```

1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup

```
Enter the number of your choice: 2
Enter the title of the video lesson: Functions and Modules in Python Explained
Enter the video URL: https://www.example.com/python-functions-modules
Video lesson 'Functions and Modules in Python Explained' added successfully to 'Intro to Python'.
```

```
=== Course Management Options ===
```

1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup

```
Enter the number of your choice: 3
```

```
Enter the title of the quiz: Python Basics Quiz
Enter the number of questions for the quiz: 5
Enter the question 1: What is the primary purpose of Python?
Enter option 1: Web development
Enter option 2: Data analysis
Enter option 3: General-purpose programming
Enter option 4: Game development
Enter the correct option number: 3
Enter the question 2: How do you denote comments in Python?
Enter option 1: // This is a comment
Enter option 2: /* This is a comment */
Enter option 3: # This is a comment
Enter option 4: <!-- This is a comment -->
Enter the correct option number: 3
```

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```
Enter the question 3: Which of the following data types is mutable?
Enter option 1: int
Enter option 2: float
Enter option 3: list
Enter option 4: tuple
Enter the correct option number: 3
Enter the question 4: What will bool("False") return?
Enter option 1: True
Enter option 2: False
Enter option 3: Error
Enter option 4: None of the above
Enter the correct option number: 1
Enter the question 5: What is the output of 3 + 4.0 in Python?
Enter option 1: 7
Enter option 2: 7.0
Enter option 3: 34
Enter option 4: Error
Enter the correct option number: 2
```

Quiz 'Python Basics Quiz' added successfully to 'Intro to Python'.

=== Course Management Options ===

1. Add Module
2. Add Video Lesson
3. Add Quiz
4. View Enrollments
5. Finish Course Setup

Enter the number of your choice: 5

Setup for 'Intro to Python' completed.

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```
pchaudh3, you can now manage courses.
```

1. Create a course
2. View created courses
3. Quit

```
Enter the number of your choice: 2
```

```
Courses Created by pchaudh3:
```

1. Intro to Python

```
Select a course number to manage:
```

```
Enter the number of the course: 1
```

```
Selected Course: Intro to Python
```

1. View Enrolled Students
2. View Student Quiz Grades
3. Edit Course
4. Back to Courses Menu

```
Enter your choice: 4
```

```
pchaudh3, you can now manage courses.
```

1. Create a course
2. View created courses
3. Quit

```
Enter the number of your choice: 3
```

```
=== E-Learning Platform ===
```

1. Professor Registration
2. Student Registration
3. Quit

❖ *Student registration*

```
Enter the number of your choice: 2
```

```
=== Student Registration ===
```

```
Enter your username: ngadade1
```

```
Enter your email address: ngadade1@binghamton.edu
```

```
Are you a Professor (1) or a Student (2)?: 2
```

```
Enter the student password: student123
```

```
Enter your BU_ID: B00988764
```

```
=== Available Courses ===
```

1. Intro to Python - Python Basics

```
Enter the number of the course you want to enroll in: 1
```

```
Recipient pchaudh3 not found or does not have a valid email.
```

```
ngadade1, you are now enrolled in Intro to Python.
```

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```
ngadade1, you are now enrolled in Intro to Python.
```

```
=== Course Interaction Options ===
```

1. Show Course Modules
2. Take Quizzes
3. Watch Video Lessons
4. Rate the Course
5. Quit

```
Enter the number of your choice: 1
```

```
=== Course Modules ===
```

```
Introduction to Python Programming: Overview of Python
```

```
Python Fundamentals: Variables, Data Types, and Operators
```

```
Control Structures (if statements, loops): Conditional statements, if-else statements, for and while loops.
```

```
Functions and Built-in Functions: Creating functions, parameters, return statements, and common built-in functions.
```

❖ *Student's course interaction*

```
=== Course Interaction Options ===
```

1. Show Course Modules
2. Take Quizzes
3. Watch Video Lessons
4. Rate the Course
5. Quit

```
Enter the number of your choice: 3
```

```
=== Course Video Lessons ===
```

```
ngadade1 watched video lesson: Python Basics: Getting Started with Python Programming
```

```
ngadade1 watched video lesson: Python Fundamentals for Beginners
```

```
ngadade1 watched video lesson: Functions and Modules in Python Explained
```

```
=== Course Interaction Options ===
```

1. Show Course Modules
2. Take Quizzes
3. Watch Video Lessons
4. Rate the Course
5. Quit

```
Enter the number of your choice: 2
```

```
=== Course Quizzes ===
```

```
Question: What is the primary purpose of Python?
```

1. Web development
2. Data analysis
3. General-purpose programming
4. Game development

```
Enter the number of your answer: 3
```

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Question: How do you denote comments in Python?

1. // This is a comment
2. /* This is a comment */
3. # This is a comment
4. <!-- This is a comment -->

Enter the number of your answer: 3

Question: Which of the following data types is mutable?

1. int
2. float
3. list
4. tuple

Enter the number of your answer: 3

Question: What will bool("False") return?

1. True
2. False

Question: What will bool("False") return?

1. True
2. False
3. Error
4. None of the above

Enter the number of your answer: 1

Question: What is the output of 3 + 4.0 in Python?

1. 7
2. 7.0
3. 34
4. Error

Enter the number of your answer: 1

❖ *Completion of course and earned Batch.*

Your Quiz Grade: 80.0%

Congratulations! You have completed the course 'Intro to Python'.

Congratulations, ngadade1! You have earned the 'Course Completion' badge.

Badge 'Course Completion' assigned to ngadade1!

=== Course Interaction Options ===

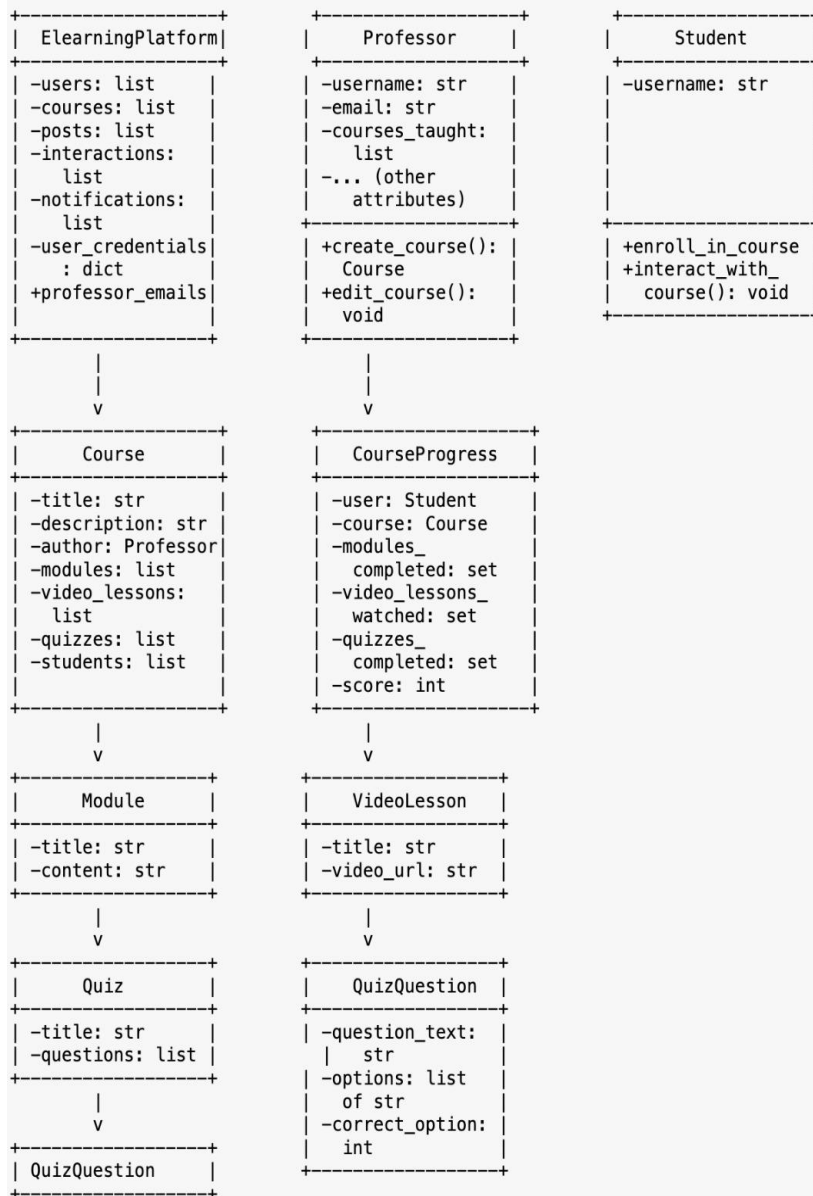
1. Show Course Modules
2. Take Quizzes
3. Watch Video Lessons
4. Rate the Course
5. Quit

Enter the number of your choice: 4

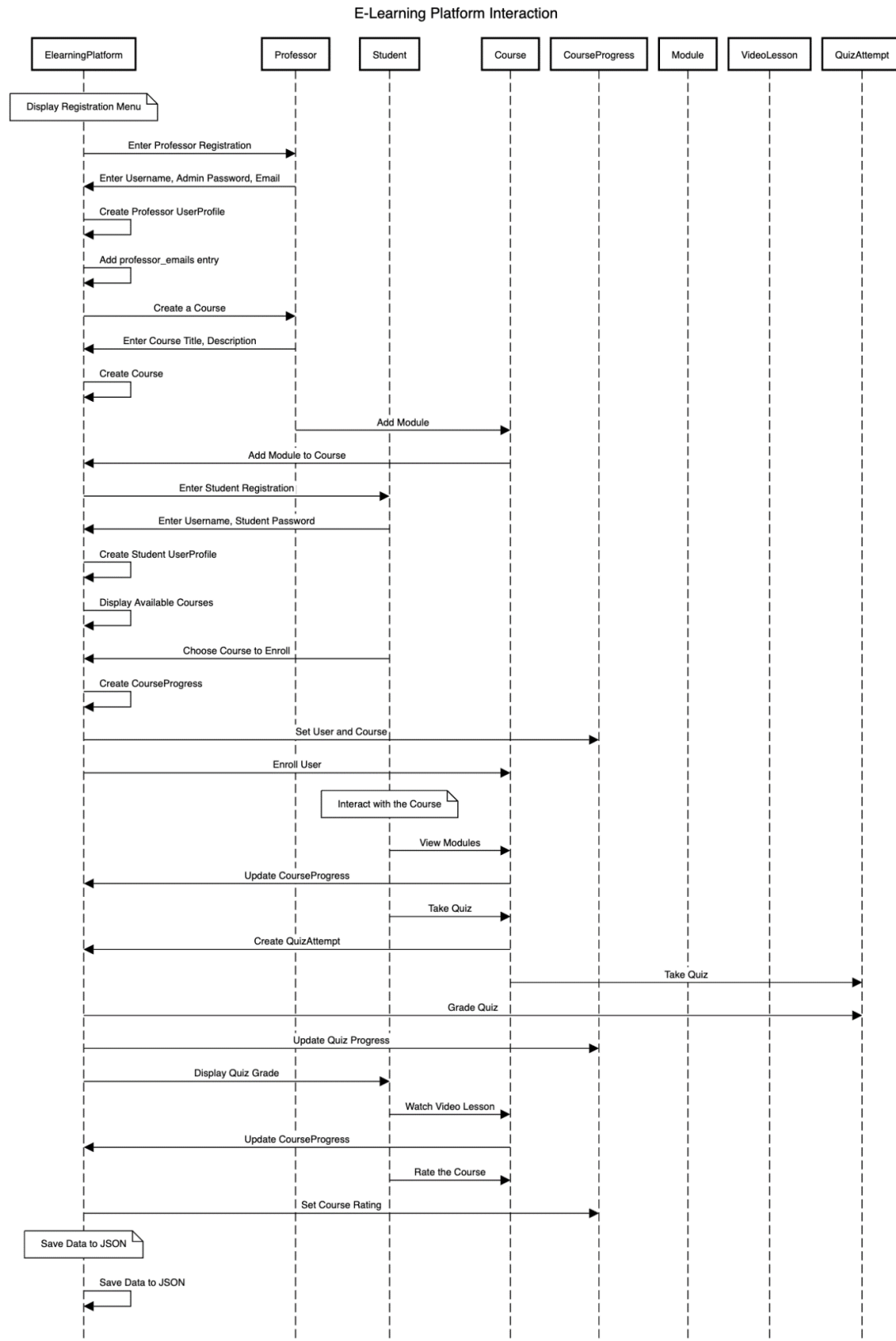
Rate the course on a scale of 1 to 5: 4

ngadade1 rated the course 'Intro to Python' with 4/5.

UML DIAGRAM



SEQUENCE DIAGRAM



CONCLUSION

The E-Learning Platform provides an effective and interactive online learning environment. It caters to the diverse needs of professors and students, fostering collaborative learning experiences.

The integration of design patterns, including the decorator pattern for badge assignment, showcases a commitment to scalable and flexible software architecture. The separation of concerns into classes such as UserProfile, Course, and Notification contributes to a robust and understandable system design.

Furthermore, the incorporation of user interactions, email alerts, and course progression tracking adds a layer of sophistication to the platform. The utilization of the Observer pattern for notifications and the Strategy pattern for quiz grading reflects a thoughtful approach to problem-solving and design.

In summary, the E-Learning Platform not only fulfills the core objectives of facilitating online education but also serves as a testament to the effective application of software design principles and patterns. As technology continues to shape the landscape of education, this platform stands as a versatile foundation, ready for potential expansions and enhancements.

Source Code for this Project – [Github link](#)

How to run this program –

- Start the Application: Run the Python script.
- Main Menu:
The main menu provides options to register Professor, Student or Exit
- User Registration:
 - For Professor:
Choose "Professor Registration" from the main menu.
Provide a username to register.
Provide a email address for the professor role
Under "Are you a Professor(1) or Student(2) select 1 as professor is being registered
Next it will prompt for the admin password : admin password only works for professor "admin123"
Provide a BU id (Professor ID)
Next, the professor can create and manage courses based on the given options

1. Create Courses – Create new courses

=== Course Management Options ===

- a. 1. Add Module – Add new modules to the course
- b. 2. Add Video Lesson – Add video lessons
- c. 3. Add Quiz – Add quizzes by providing the number of questions, quiz questions and correct options
- d. 4. View Enrollments – Show enrolled students
- e. 5. Finish Course Setup – Finish and go back to previous menu

2. View Created Courses – View and manage previously created courses

3. Quit – Select to go back to main menu

- For Student:

Choose " Student Registration" from the main menu.

Provide a username to register.

Provide a email address for the Student role

Under "Are you a Professor(1) or Student(2) select 2 as professor is being registered

Next it will prompt for the Student password : Student password only works for professor "student123"

Provide a BU ID(For Student)

Next, the Student will be able to see the available courses can enroll and interact with the courses based on the given options

Select the course number that the student wants to enroll in

=== Course Interaction Options ===

1. Show Course Modules – View the course modules added by the professor in that particular course
2. Take Quizzes – Take quizzes added by the student
3. Watch Video Lessons – Watch video lessons
4. Rate course – Rate the course
5. Quit – Go back to the main menu

SCOPE OF IMPROVEMENT

- **User Interface:** Enhance the user interface for a more intuitive and visually appealing experience.
- **Course Analytics:** Integrate analytics features for tracking user engagement and course effectiveness.
- **Extended Content Types:** Expand content types, such as assignments and discussion forums, to enrich the learning experience.