Mini Project

EEX4347

Software Engineering Concepts

By

D.W.P.D.BANDARA

422518807

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Department of Electrical and Computer Engineering

Faculty of Engineering Technology

The Open University of Sri Lanka

at

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1.Introduction

In the modern era of education, the importance of technology in bridging geographical and logistical gaps cannot be overstated. Open and Distance Learning (ODL) systems have emerged as a revolutionary approach to education, offering flexibility and accessibility to learners worldwide. However, these systems often face challenges such as isolation, lack of peer interaction, and reduced opportunities for collaborative learning. Recognizing these challenges, the **Open University of Sri Lanka (OUSL)** has embarked on a mission to enhance the ODL experience through the development of an innovative virtual learning environment called **OU Sphere**.

OU Sphere is a comprehensive Learning Management System (LMS) designed to transform the way students, lecturers, and administrators engage with the ODL platform. It leverages modern technologies to create an interactive, collaborative, and inclusive virtual learning ecosystem that fosters academic excellence and community building. By integrating advanced features such as virtual study groups, peer mentoring, gamified learning experiences, and robust communication tools, OU Sphere aims to eliminate the barriers of distance education, offering students a sense of belonging and empowerment.

The platform is meticulously designed to cater to the diverse needs of its users:

- **Students** benefit from features like course tracking, study group participation, discussion forums, and assignment submission, ensuring an engaging and supportive academic journey.
- **Lecturers** can manage courses, host interactive classes, review student progress, and create collaborative learning opportunities through virtual study groups and discussions.
- **Administrators** are equipped with powerful tools to oversee system operations, manage users, handle support queries, and generate insightful reports.

Beyond its functional offerings, OU Sphere emphasizes accessibility, security, and a user-friendly interface. Developed using state-of-the-art web technologies like HTML, CSS, JavaScript for the frontend, Python Flask for the backend, and MySQL for database management, the system is both robust and scalable. It incorporates role-based access control, ensuring a tailored experience for every user while maintaining high standards of security and privacy.

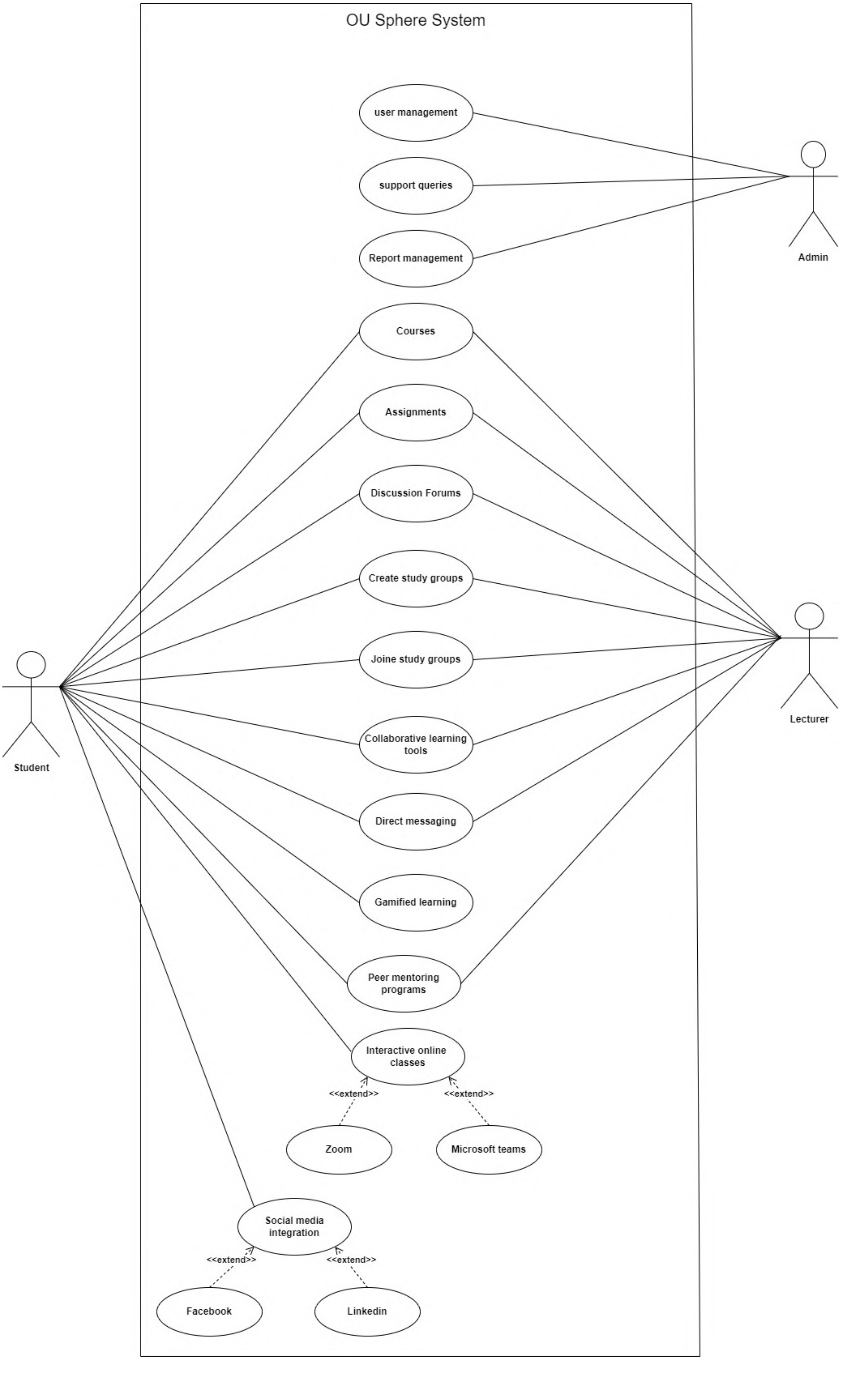
By seamlessly blending academic rigor with technological innovation, OU Sphere serves as a beacon of what is possible in the realm of distance education. It embodies the vision of the Open University of Sri Lanka to make quality education accessible, interactive, and impactful for learners across the nation. With OU Sphere, OUSL is not only addressing the challenges of ODL but also setting a benchmark for future advancements in virtual learning platforms.

This report outlines the comprehensive journey of OU Sphere, from conceptualization to implementation, detailing its objectives, design, features, and future potential in transforming education.

2.Requirement Analysis

Effective requirement analysis is the cornerstone of any successful project. For the development of **OU Sphere**, a robust and inclusive approach to understanding user needs and system functionalities was adopted. This section outlines the requirement elicitation methodology employed, along with the system's use case diagram to visualize the interaction between users and the system.

Use Case Diagram



Requirement Elicitation Methodology

Requirement elicitation is the process of gathering and analyzing the needs of stakeholders to define the system's functionality and scope. For **OU Sphere**, a combination of diverse methodologies was utilized to ensure a comprehensive understanding of user expectations and system requirements.

1. Stakeholder Identification

Key stakeholders were identified as:

- **Students**: End users of the system who will access courses, submit assignments, and participate in discussions.
- **Lecturers**: Facilitators who will manage courses, monitor student progress, and conduct online classes.
- **Administrators**: Managers responsible for system maintenance, user management, and support query resolution.

2. Requirement Elicitation Techniques

Several techniques were employed to gather requirements effectively:

1. **Interviews:**

   - Conducted one-on-one and group interviews with students, lecturers, and administrators.
   - Gathered insights into challenges faced in Open and Distance Learning (ODL) and desired features for the LMS.
   - Example Questions:
     - "What challenges do you face in collaborative learning?"
     - "What tools do you find most useful in managing courses or assignments?"

2. **Surveys and Questionnaires:**

   - Distributed structured surveys to a larger pool of stakeholders.
   - Captured quantitative data about feature priorities, such as gamified learning, virtual study groups, and discussion forums.

3. **Observation:**

   - Analyzed the workflows of existing LMS platforms used at OUSL.
   - Identified gaps and inefficiencies to be addressed in OU Sphere.

4. **Brainstorming Sessions:**

- Conducted brainstorming workshops with students and lecturers to explore innovative features like peer mentoring and gamified learning.

5. **Document Analysis:**

- Reviewed academic policies and existing system documentation at OUSL to ensure compliance and alignment with institutional goals.

6. **Prototyping:**

- Presented initial mockups and wireframes to stakeholders to gather iterative feedback on the proposed design and functionalities.

Functional Requirements

Based on the elicitation activities, the following key functional requirements were identified:

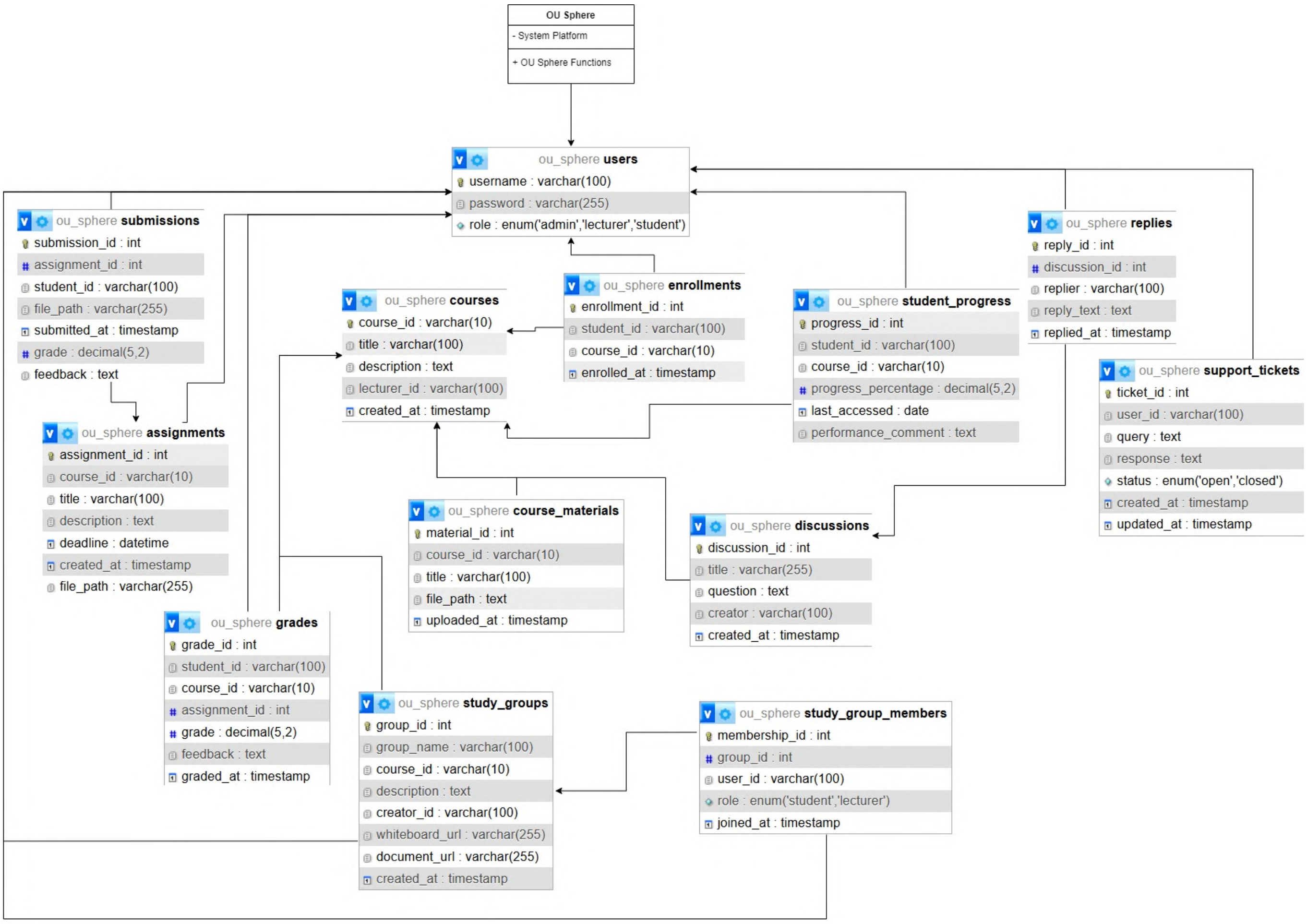
- **User Authentication and Authorization:** Secure login and role-based access control.
- **Course Management:** Creation, editing, and deletion of courses by lecturers.
- **Study Groups:** Virtual collaboration spaces for students and lecturers.
- **Assignment Handling:** Upload, submission, and review functionalities.
- **Discussion Forums:** Topic-based academic discussions with threaded replies.
- **Gamified Learning:** Integration of interactive quizzes and leaderboards.
- **Peer Mentoring:** Matching experienced students with new learners.
- **Support System:** Submission and resolution of support queries.

Non-Functional Requirements

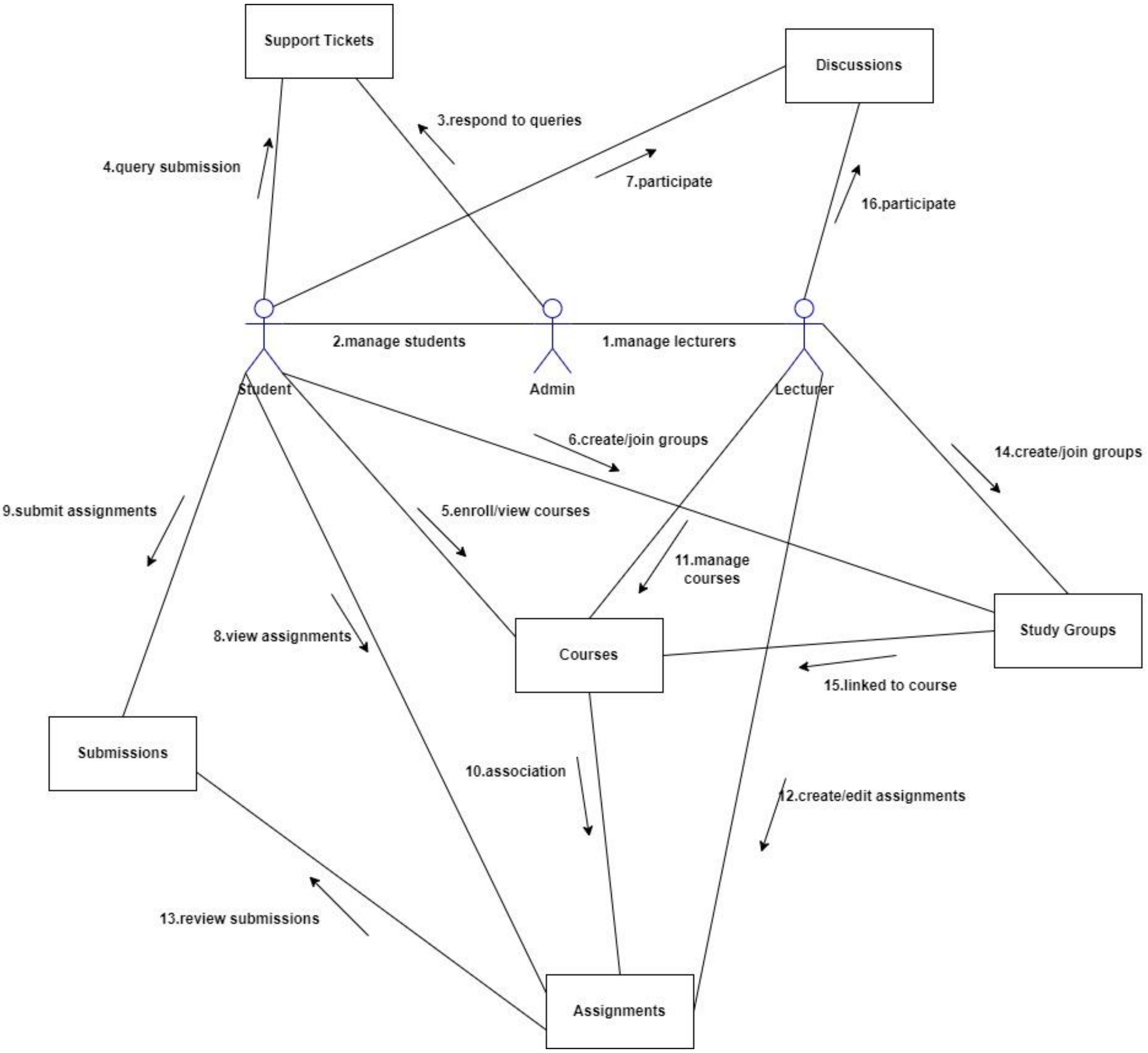
- **Scalability:** Ability to handle a growing number of users and courses.
- **Security:** Data protection through encryption and secure password handling.
- **Usability:** Intuitive and accessible interface for users with varying technical expertise.
- **Performance:** Minimal latency and high availability for seamless user experience.
- **Interoperability:** Integration with tools like Zoom, Microsoft Teams, and Kahoot!.

3. High-Level Design

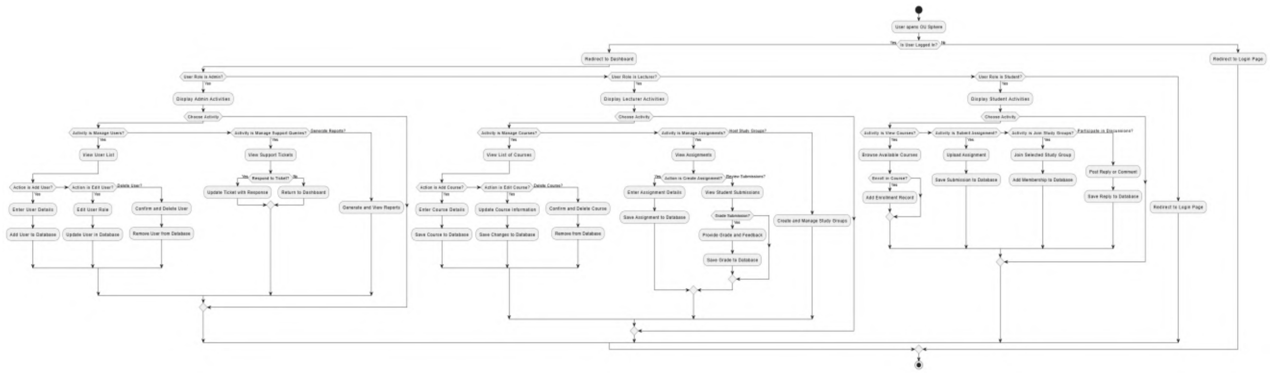
Class Diagram



Collaboration Diagram



Activity Diagram



4.Data Modeling

Data modeling is a critical step in the development of any system, as it ensures that the underlying database structure is efficient, scalable, and aligned with the requirements of the application. For **OU Sphere**, a relational database approach is adopted, ensuring seamless integration of data across various functionalities. This section covers the **relational database design** and the **normalization process** to achieve a streamlined and optimized data model.

Relational Database

The database for **OU Sphere** is designed to manage the complex relationships between entities such as users, courses, assignments, discussions, and study groups. It incorporates primary keys, foreign keys, and constraints to enforce data integrity and facilitate efficient queries.

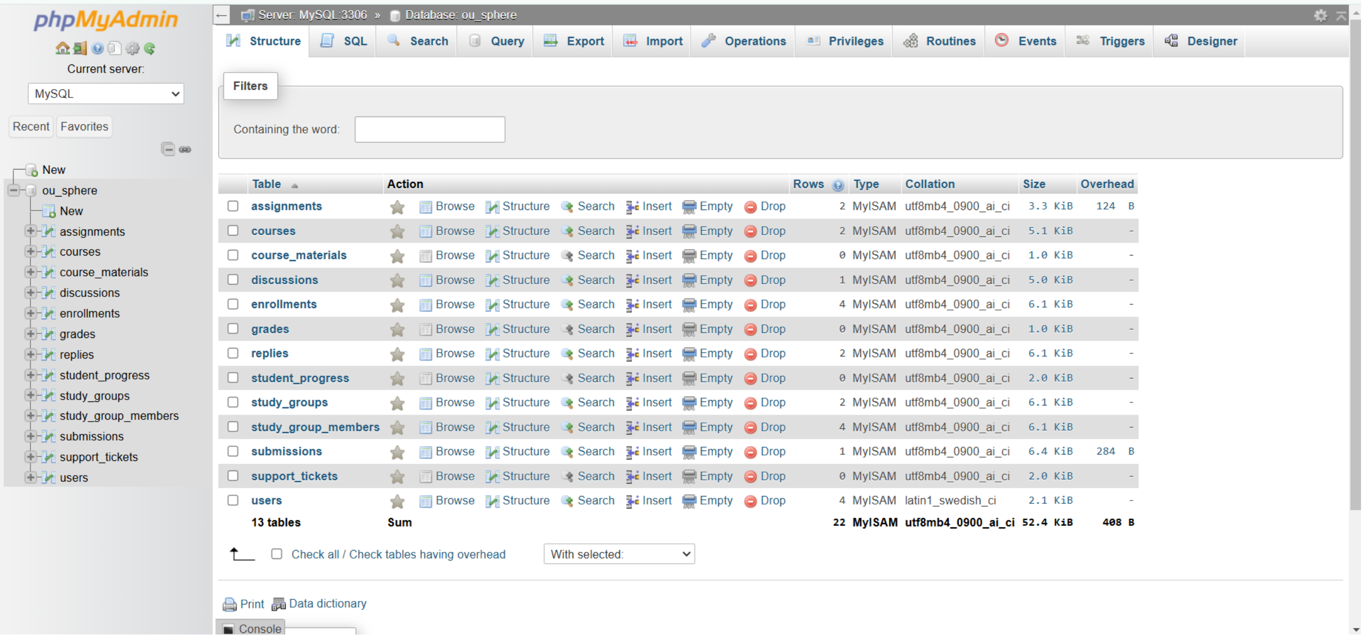
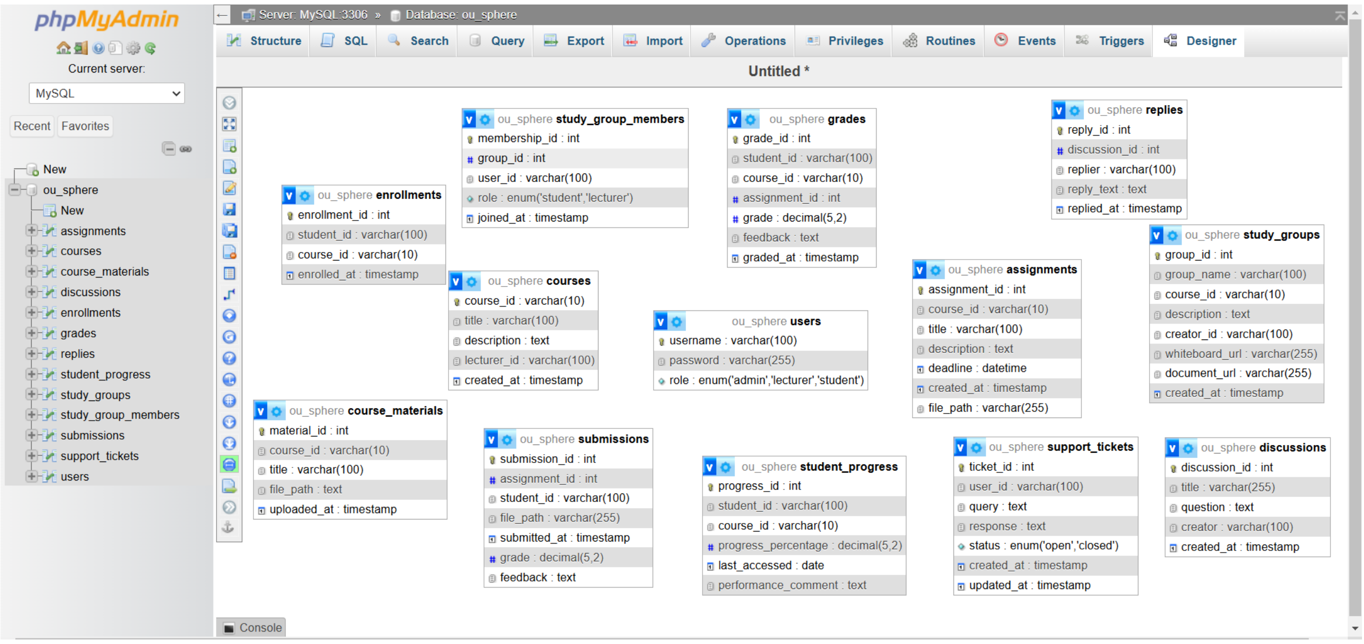


	Table	Action	Rows	Type	Collation	Size	Overhead
□	assignments	Browse Structure Search Insert Empty Drop	2	MyISAM	utf8mb4_0900_ai_ci	3.3 KiB	124 B
□	courses	Browse Structure Search Insert Empty Drop	2	MyISAM	utf8mb4_0900_ai_ci	5.1 KiB	-
□	course_materials	Browse Structure Search Insert Empty Drop	0	MyISAM	utf8mb4_0900_ai_ci	1.0 KiB	-
□	discussions	Browse Structure Search Insert Empty Drop	1	MyISAM	utf8mb4_0900_ai_ci	5.0 KiB	-
□	enrollments	Browse Structure Search Insert Empty Drop	4	MyISAM	utf8mb4_0900_ai_ci	6.1 KiB	-
□	grades	Browse Structure Search Insert Empty Drop	0	MyISAM	utf8mb4_0900_ai_ci	1.0 KiB	-
□	replies	Browse Structure Search Insert Empty Drop	2	MyISAM	utf8mb4_0900_ai_ci	6.1 KiB	-
□	student_progress	Browse Structure Search Insert Empty Drop	0	MyISAM	utf8mb4_0900_ai_ci	2.0 KiB	-
□	study_groups	Browse Structure Search Insert Empty Drop	2	MyISAM	utf8mb4_0900_ai_ci	6.1 KiB	-
□	study_group_members	Browse Structure Search Insert Empty Drop	4	MyISAM	utf8mb4_0900_ai_ci	6.1 KiB	-
□	submissions	Browse Structure Search Insert Empty Drop	1	MyISAM	utf8mb4_0900_ai_ci	6.4 KiB	284 B
□	support_tickets	Browse Structure Search Insert Empty Drop	0	MyISAM	utf8mb4_0900_ai_ci	2.0 KiB	-
□	users	Browse Structure Search Insert Empty Drop	4	MyISAM	latin1_swedish_ci	2.1 KiB	-
	13 tables	**Sum**	**22**	**MyISAM**	**utf8mb4_0900_ai_ci**	**52.4 KiB**	**408 B**

□ Check all / Check tables having overhead   With selected:



ou_sphere **enrollments**
enrollment_id : int
student_id : varchar(100)
course_id : varchar(10)
enrolled_at : timestamp

ou_sphere **study_group_members**
membership_id : int
group_id : int
user_id : varchar(100)
role : enum('student','lecturer')
joined_at : timestamp

ou_sphere **grades**
grade_id : int
student_id : varchar(100)
course_id : varchar(10)
assignment_id : int
grade : decimal(5,2)
feedback : text
graded_at : timestamp

ou_sphere **replies**
reply_id : int
discussion_id : int
replier : varchar(100)
reply_text : text
replied_at : timestamp

ou_sphere **study_groups**
group_id : int
group_name : varchar(100)
course_id : varchar(10)
description : text
creator_id : varchar(100)
whiteboard_url : varchar(255)
document_url : varchar(255)
created_at : timestamp

ou_sphere **courses**
course_id : varchar(10)
title : varchar(100)
description : text
lecturer_id : varchar(100)
created_at : timestamp

ou_sphere **users**
username : varchar(100)
password : varchar(255)
role : enum('admin','lecturer','student')

ou_sphere **assignments**
assignment_id : int
course_id : varchar(10)
title : varchar(100)
description : text
deadline : datetime
created_at : timestamp
file_path : varchar(255)

ou_sphere **course_materials**
material_id : int
course_id : varchar(10)
title : varchar(100)
file_path : text
uploaded_at : timestamp

ou_sphere **submissions**
submission_id : int
assignment_id : int
student_id : varchar(100)
file_path : varchar(255)
submitted_at : timestamp
grade : decimal(5,2)
feedback : text

ou_sphere **student_progress**
progress_id : int
student_id : varchar(100)
course_id : varchar(10)
progress_percentage : decimal(5,2)
last_accessed : date
performance_comment : text

ou_sphere **support_tickets**
ticket_id : int
user_id : varchar(100)
query : text
response : text
status : enum('open','closed')
created_at : timestamp
updated_at : timestamp

ou_sphere **discussions**
discussion_id : int
title : varchar(255)
question : text
creator : varchar(100)
created_at : timestamp

Normalization

Normalization is the process of organizing the database to reduce redundancy and improve data integrity. The OU Sphere database follows the principles of normalization.

First Normal Form (1NF):

- Each table has a unique primary key.
- All columns contain atomic values, ensuring no repeating groups or arrays.

Second Normal Form (2NF):

- The database is in 1NF.
- All non-key attributes are fully dependent on the primary key.

Third Normal Form (3NF):

- The database is in 2NF.
- No transitive dependencies exist between non-key attributes.

Users Table

Column	Data Type	Constraints
username	VARCHAR(100)	PRIMARY KEY

password	VARCHAR(255)	NOT NULL
role	ENUM(admin,lecturer,student)	NOT NULL

Courses Table

Column	Data Type	Constraints
course_id	VARCHAR(10)	PRIMARY KEY
title	VARCHAR(100)	NOT NULL
description	TEXT	NOT NULL
lecturer_id	VARCHAR(100)	FOREIGN KEY

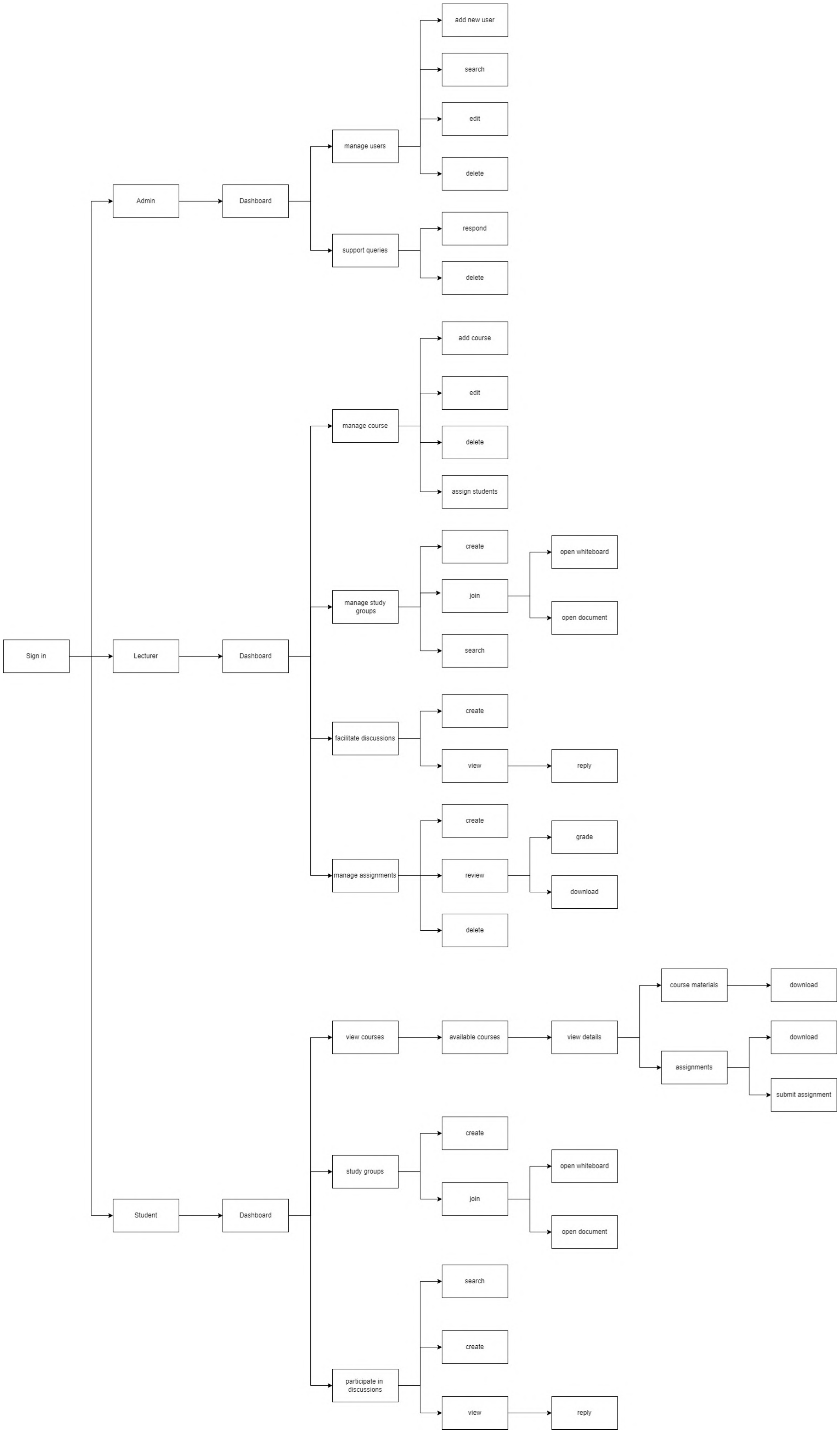
Assignments Table

Column	Data Type	Constraints
assignment_id	INT	PRIMARY KEY
course_id	VARCHAR(10)	FOREIGN KEY
title	VARCHAR(100)	NOT NULL
description	TEXT	NULLABLE
deadline	DATETIME	NOT NULL

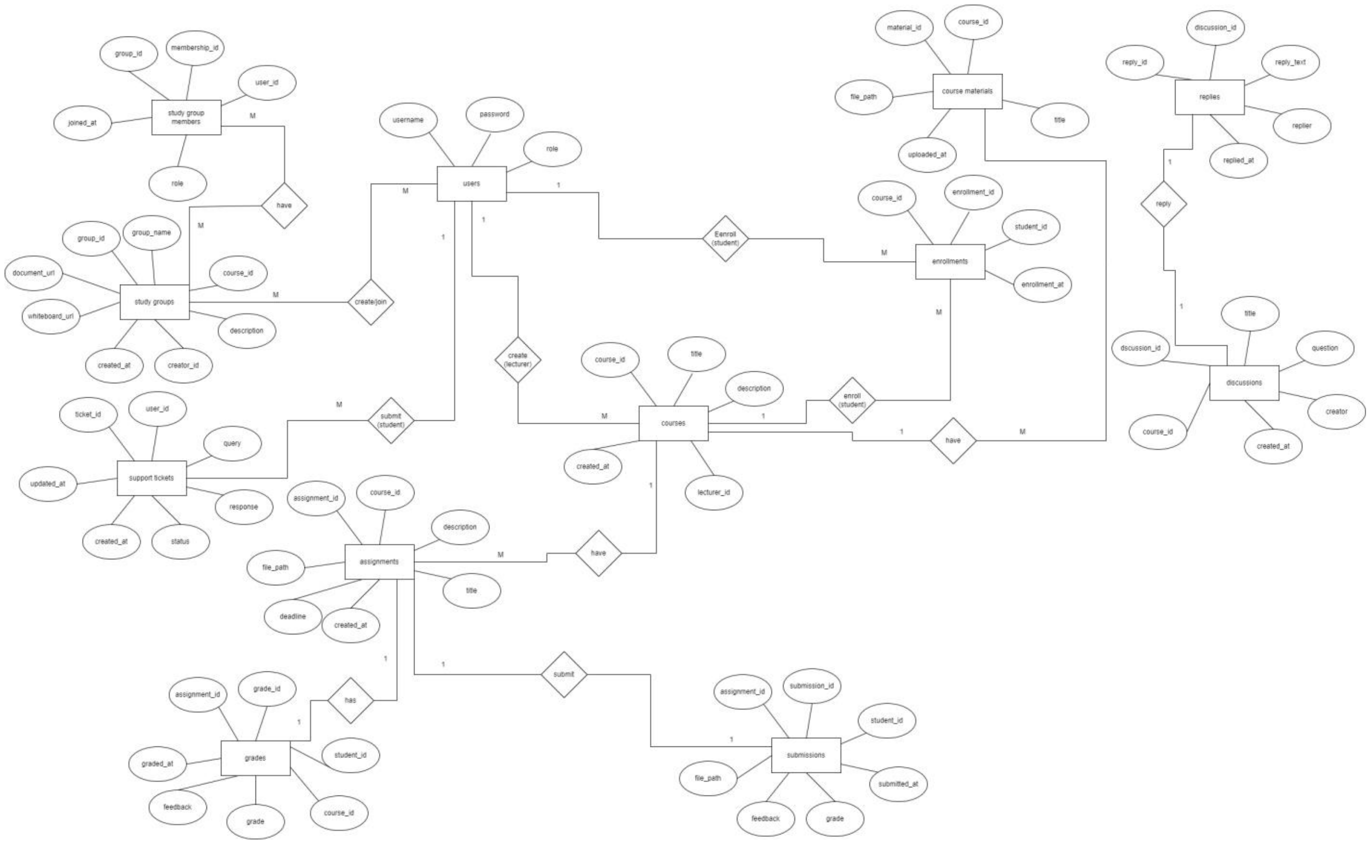
5. Detailed Design

The **Detail Design** phase of the **OU Sphere** project focuses on providing a comprehensive view of the user interface and system workflows. This section includes the **Screen Flow Diagram**, illustrating how users navigate through the system, and other necessary diagrams that provide a deeper understanding of the interactions and processes.

Screen Flow Diagram



Other Necessary Diagrams



6. Testing Plan and Results

Testing Plan

1. Objectives

The primary goals of the testing phase are:

- To ensure that the system meets functional requirements.
- To validate the system's performance under different loads.
- To identify and resolve any security vulnerabilities.
- To confirm that the platform works seamlessly across different user roles.

2. Testing Scope

The following components of the system were tested:

1. **User Authentication and Authorization**
   - Secure login and role-based dashboard access.
2. **Course Management**
   - Creation, modification, and deletion of courses by lecturers.
3. **Assignment Workflow**
   - Uploading, submission, review, and grading of assignments.
4. **Study Groups**
   - Creation, joining, and collaboration within study groups.
5. **Discussion Forum**
   - Posting and replying to discussions.
6. **Support System**
   - Submission and resolution of support tickets.

3. Types of Testing

1. **Functional Testing**
   - Verifies that each feature operates according to the requirements.
2. **Performance Testing**

- Assesses the system's responsiveness under varying loads.

3. **Security Testing**
   - Checks for vulnerabilities such as SQL injection and XSS attacks.
4. **Usability Testing**
   - Ensures a seamless user experience for different roles.
5. **Compatibility Testing**
   - Confirms compatibility across browsers and devices.

Functionality	Test Scenario	Expected Result	Actual Result	Status
Login	Login with valid credentials	User is redirected to the respective dashboard	Passed	✅
Login	Login with invalid credentials	Error message is displayed	Passed	✅
Logout	User logs out of the session	Session is cleared, redirected to login page	Passed	✅
Manage Users	Admin adds a new user	New user is created and listed in the user management dashboard	Passed	✅
Manage Users	Admin edits a user role	User role is updated in the database	Passed	✅
Manage Users	Admin deletes a user	User is removed from the database	Passed	✅
Manage Courses	Lecturer creates a new course	Course is created and listed in the course management dashboard	Passed	✅
Manage Courses	Lecturer edits an existing course	Course details are updated in the database	Passed	✅
Manage Courses	Lecturer deletes a course	Course is removed from the database	Passed	✅
Assign Students	Lecturer assigns students to a course	Selected students are added to the enrollment table	Passed	✅
View Enrollments	Lecturer views enrolled students for a course	List of students is displayed	Passed	✅

Create Assignments	Lecturer creates an assignment for a course	Assignment is saved and listed in the dashboard	Passed	✅
Delete Assignments	Lecturer deletes an assignment	Assignment is removed from the database	Passed	✅
Submit Assignment	Student submits an assignment	Assignment submission is saved in the database	Passed	✅
Grade Assignment	Lecturer grades a student’s submission	Grade and feedback are recorded and displayed to the student	Passed	✅
Study Groups	User creates a study group	Study group is saved and listed for others to join	Passed	✅
Study Groups	User joins a study group	User is added as a member in the database	Passed	✅
Discussions Forum	User posts a new discussion	Discussion is saved and displayed in the forum	Passed	✅
Discussions Forum	User replies to a discussion	Reply is saved and associated with the discussion	Passed	✅
Discussions Forum	User edits a discussion	Updated discussion is reflected in the forum	Passed	✅
Support Queries	Admin responds to a support query	Response is saved, and query status is updated	Passed	✅
Support Queries	User submits a support ticket	Ticket is saved and displayed in the admin dashboard	Passed	✅
File Upload	User uploads a file (assignment/materials)	File is saved to the specified location	Passed	✅
SQL Injection Prevention	Attempt SQL injection in login form	System blocks the attempt and displays an error message	Passed	✅
High Concurrent Access	Multiple users access the dashboard simultaneously	System remains responsive	Passed	✅

Results

Summary of Testing

1. **Functional Tests:** All functional test cases passed successfully, ensuring that the system meets the defined requirements.

2. **Performance Tests:** The system demonstrated responsiveness with up to 500 concurrent users during load testing.

3. **Security Tests:** The platform successfully blocked SQL injection, XSS, and other potential vulnerabilities.

4. **Usability Tests:** Users reported positive feedback during usability testing, with minor suggestions for interface improvements.

Defects Identified and Resolved

- **Issue:** Slow performance during assignment submission with large files.
  - **Resolution:** Optimized file upload handling and server-side processing.

Final Status

The system is fully operational and ready for deployment. All critical issues were addressed, and the platform meets the quality standards for a robust Learning Management System.

7. Conclusion or Discussion

The **OU Sphere** platform represents a significant step forward in addressing the challenges of Open and Distance Learning (ODL). Designed to foster collaboration, engagement, and efficiency, the platform combines modern technologies with user-centric features, offering a comprehensive solution for administrators, lecturers, and students. By reducing the isolation often associated with ODL, **OU Sphere** bridges the gap between learners and educators, creating a vibrant and interactive virtual learning community.

Key Achievements

- The platform integrates core functionalities such as course management, assignment workflows, discussion forums, and study groups, effectively meeting the needs of all user roles.
- Enhanced security measures, including SQL injection prevention and robust authentication, ensure data integrity and user safety.
- The inclusion of interactive features like gamified learning and peer mentoring has transformed traditional ODL into a more engaging experience.
- Scalability and modular design ensure the system is prepared for future enhancements and larger user bases.

Strengths

The platform excels in delivering a tailored experience for its users:

- **User-Centric Design:** Role-based dashboards provide intuitive navigation and access to relevant tools.
- **Collaborative Features:** Study groups, shared resources, and discussion forums promote interaction and knowledge sharing.
- **Scalability:** The architecture supports seamless expansion and integration of new features.
- **Security:** A focus on robust data protection enhances user trust and system reliability.

Despite these strengths, the development process faced challenges, such as:

- **Database Optimization:** Ensuring efficiency while managing relationships among 13 interconnected tables.
- **File Handling:** Overcoming performance issues with large file uploads through optimized server-side processing.
- **Usability Refinements:** Iterative testing to create a seamless user interface for diverse users.

Future Enhancements

To build on its success, **OU Sphere** can explore:

- **Advanced Analytics:** Providing data-driven insights for students and lecturers.
- **Mobile Integration:** Developing a mobile app for enhanced accessibility.
- **AI-Powered Features:** Offering personalized learning paths and course recommendations.
- **Multilingual Support:** Expanding accessibility for a wider audience by adding language options.

Broader Impact

The deployment of **OU Sphere** showcases how technology can transform education by overcoming geographical and logistical barriers. This platform serves as a model for other institutions aiming to modernize ODL systems, paving the way for more inclusive and effective educational practices.

By combining innovative features with robust architecture, **OU Sphere** has established itself as a vital tool for the Open University of Sri Lanka. Its ongoing development and adaptability will ensure that it continues to empower students and educators, setting a benchmark for excellence in virtual learning environments.

8. References

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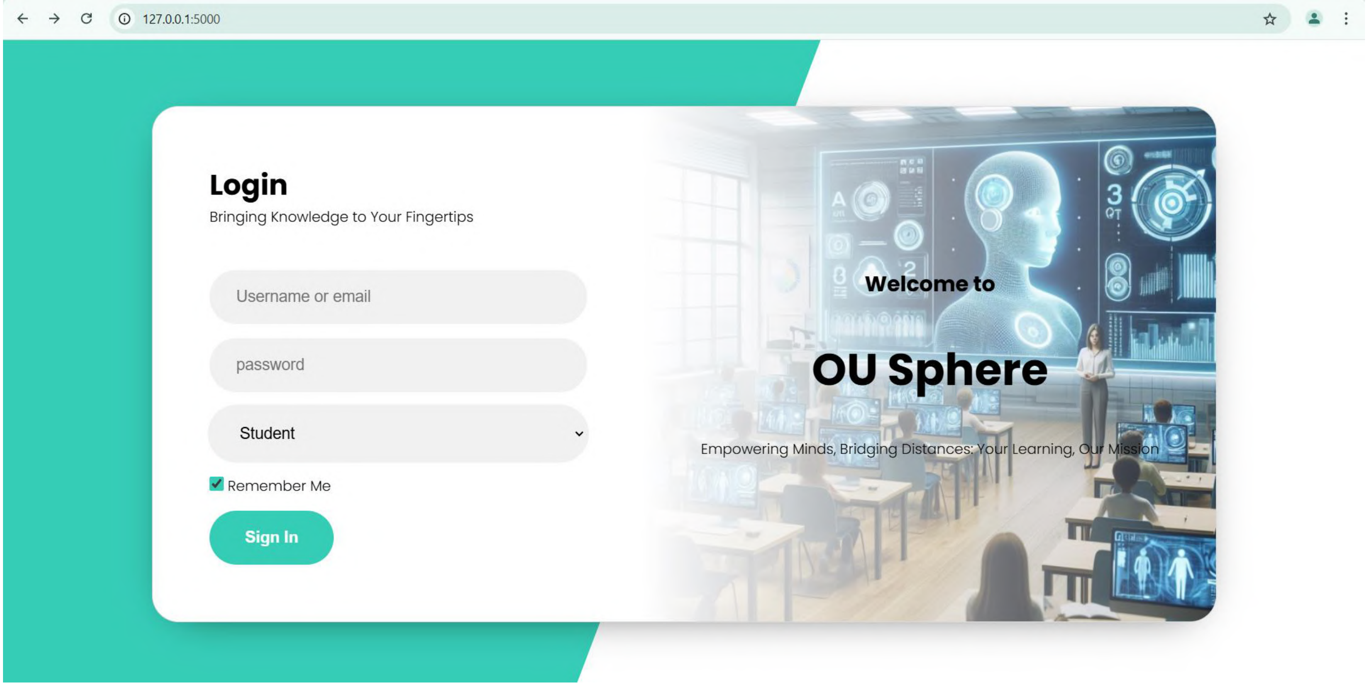
- https://www.geeksforgeeks.org
- Software engineering concepts block 2

GitHub link:

https://github.com/Pubudu2074/My-project-OU-Sphere.git

9. Appendix



127.0.0.1:5000

Login

Bringing Knowledge to Your Fingertips

Username or email

password

Student

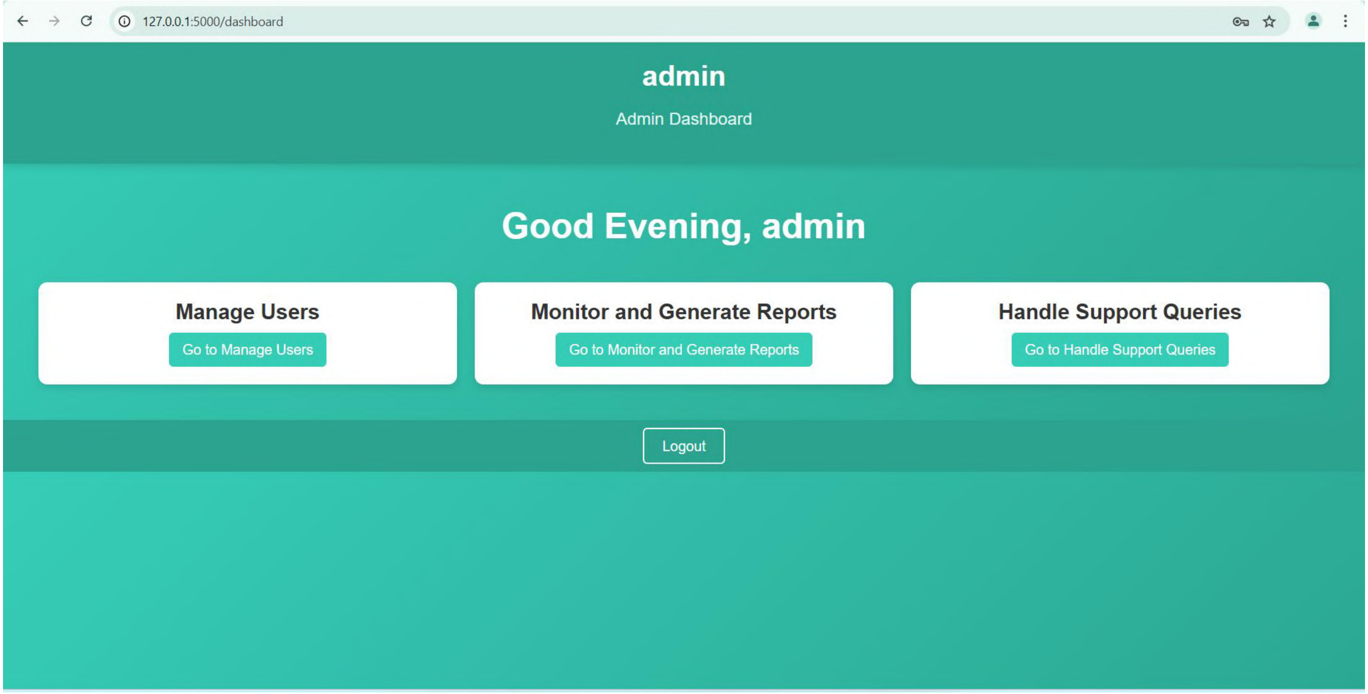
☑ Remember Me

Sign In

Welcome to

OU Sphere

Empowering Minds, Bridging Distances: Your Learning, Our Mission



127.0.0.1:5000/dashboard

admin

Admin Dashboard

Good Evening, admin

Manage Users

Go to Manage Users

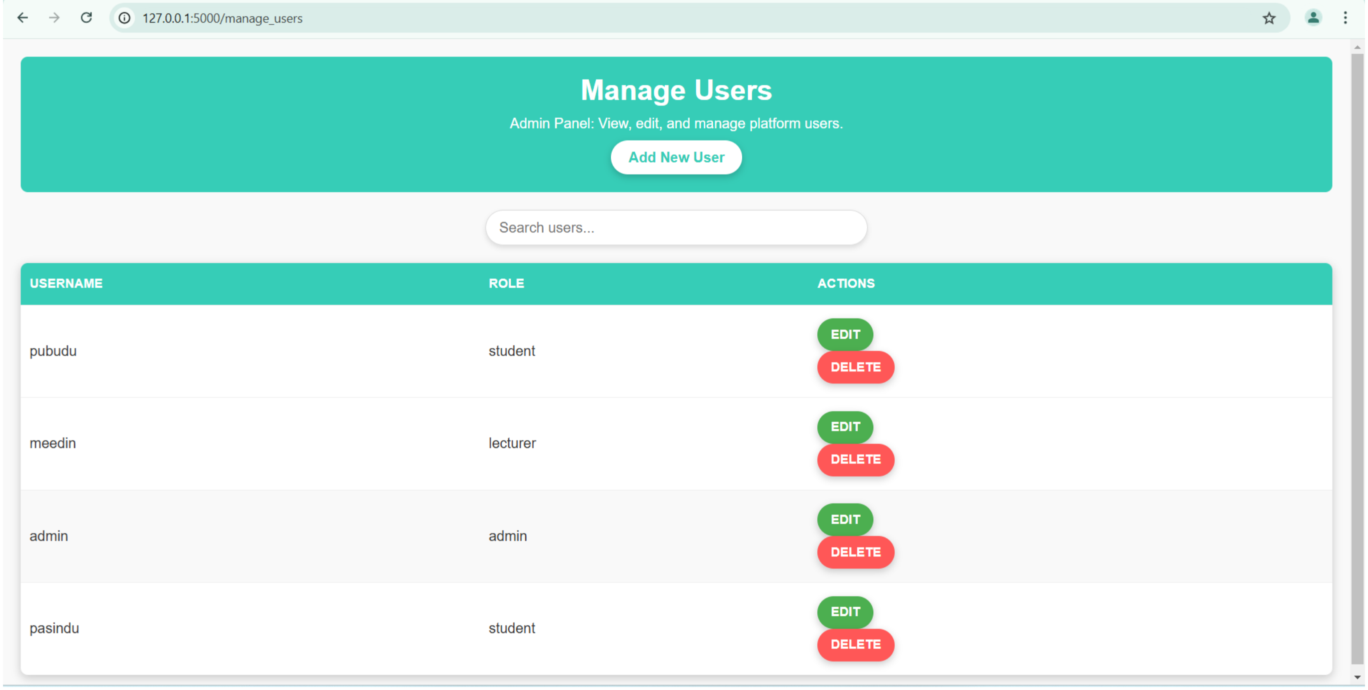
Monitor and Generate Reports

Go to Monitor and Generate Reports

Handle Support Queries

Go to Handle Support Queries

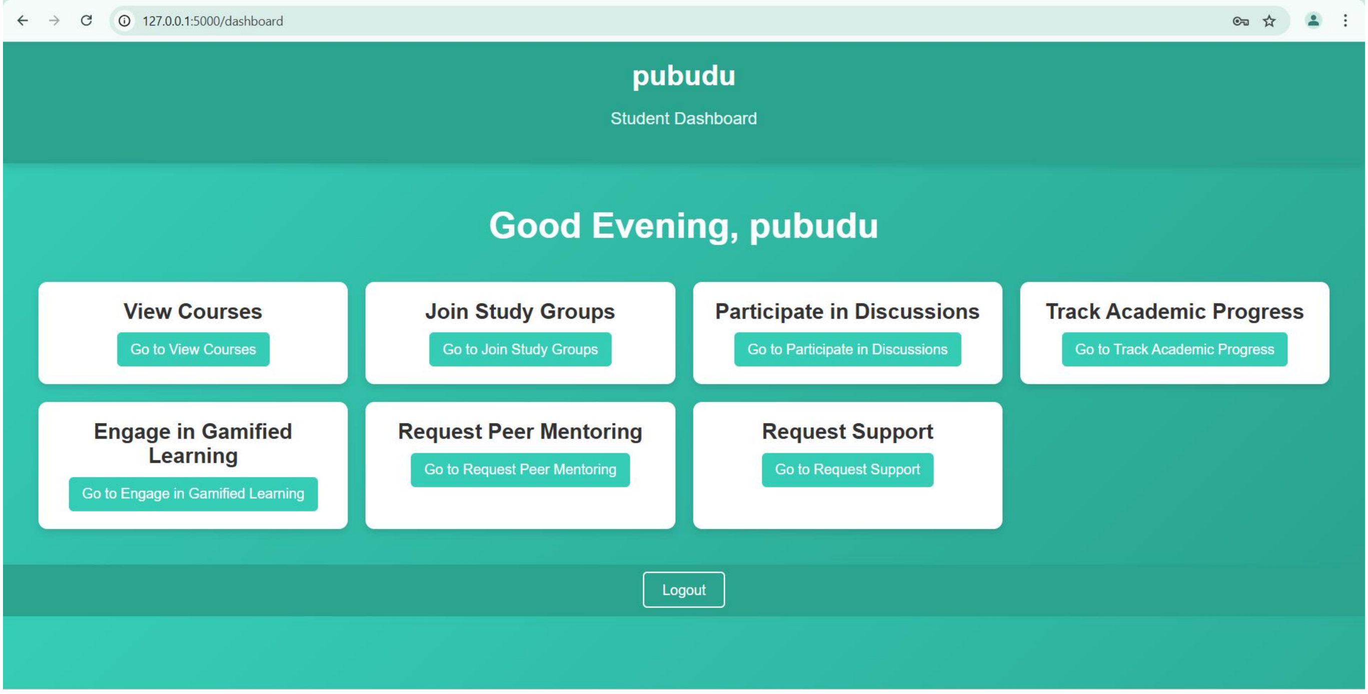
Logout



Manage Users

Admin Panel: View, edit, and manage platform users.

USERNAME	ROLE	ACTIONS
pubudu	student	EDIT DELETE
meedin	lecturer	EDIT DELETE
admin	admin	EDIT DELETE
pasindu	student	EDIT DELETE



pubudu

Student Dashboard

Good Evening, pubudu

View Courses

Join Study Groups

Participate in Discussions

Go to Participate in Discussions

Track Academic Progress

Go to Track Academic Progress

Engage in Gamified Learning

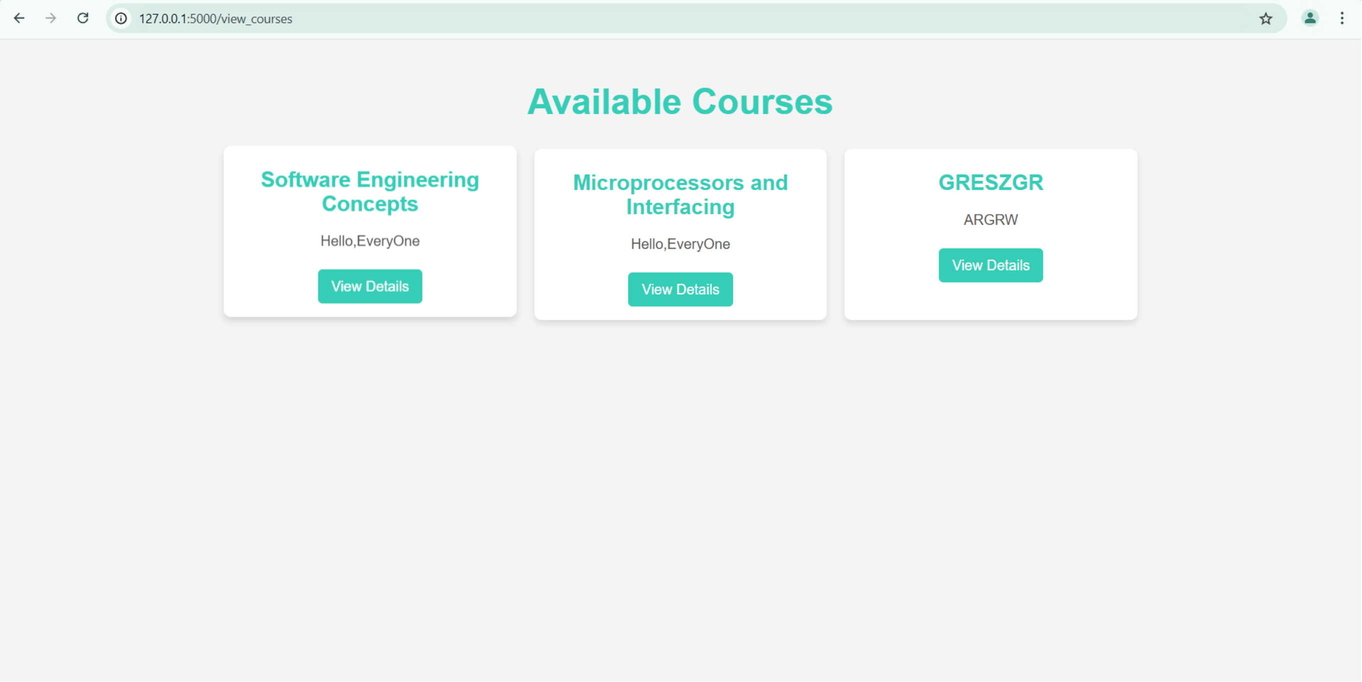
Go to Engage in Gamified Learning

Request Peer Mentoring

Go to Request Peer Mentoring

Request Support

Go to Request Support
Logout



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Available Courses

Software Engineering Concepts

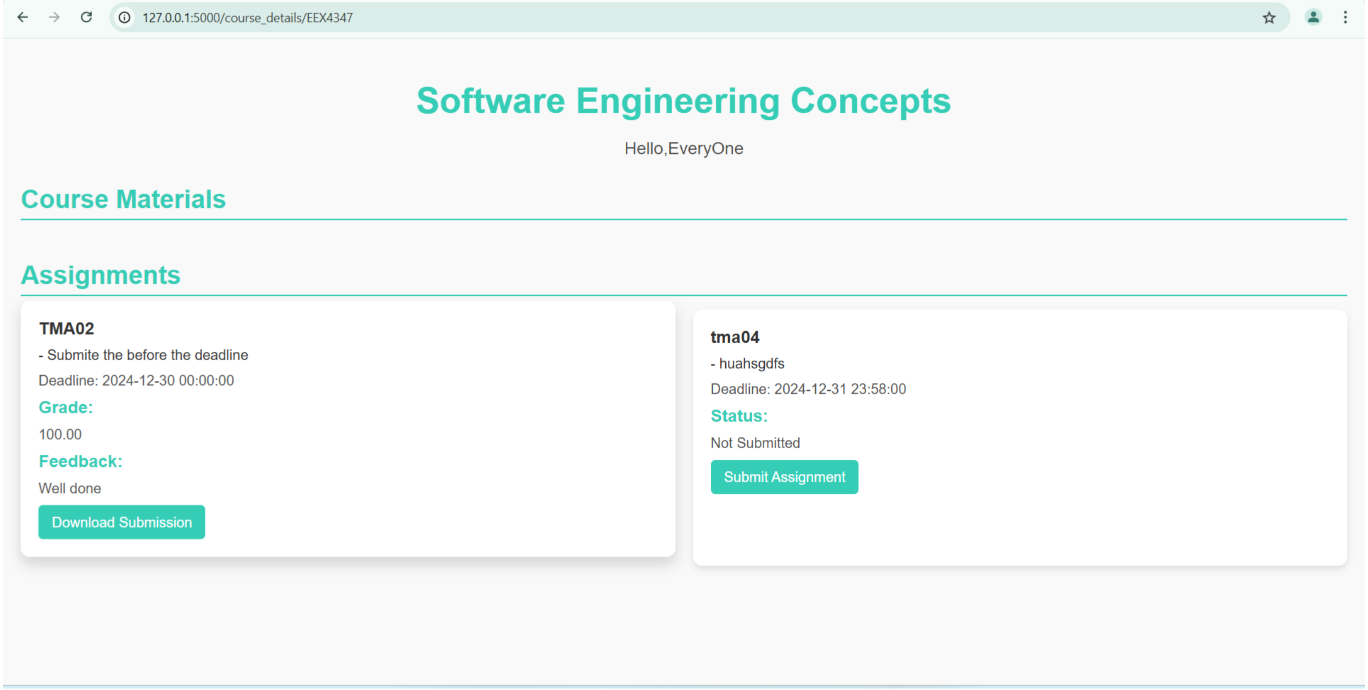
Hello,EveryOne

Microprocessors and Interfacing

Hello,EveryOne

GRESZGR

ARGRW



127.0.0.1:5000/course_details/EEX4347

Software Engineering Concepts

Hello,EveryOne

Course Materials

Assignments

TMA02

- Submite the before the deadline

Deadline: 2024-12-30 00:00:00

Grade:

100.00

Feedback:

Well done

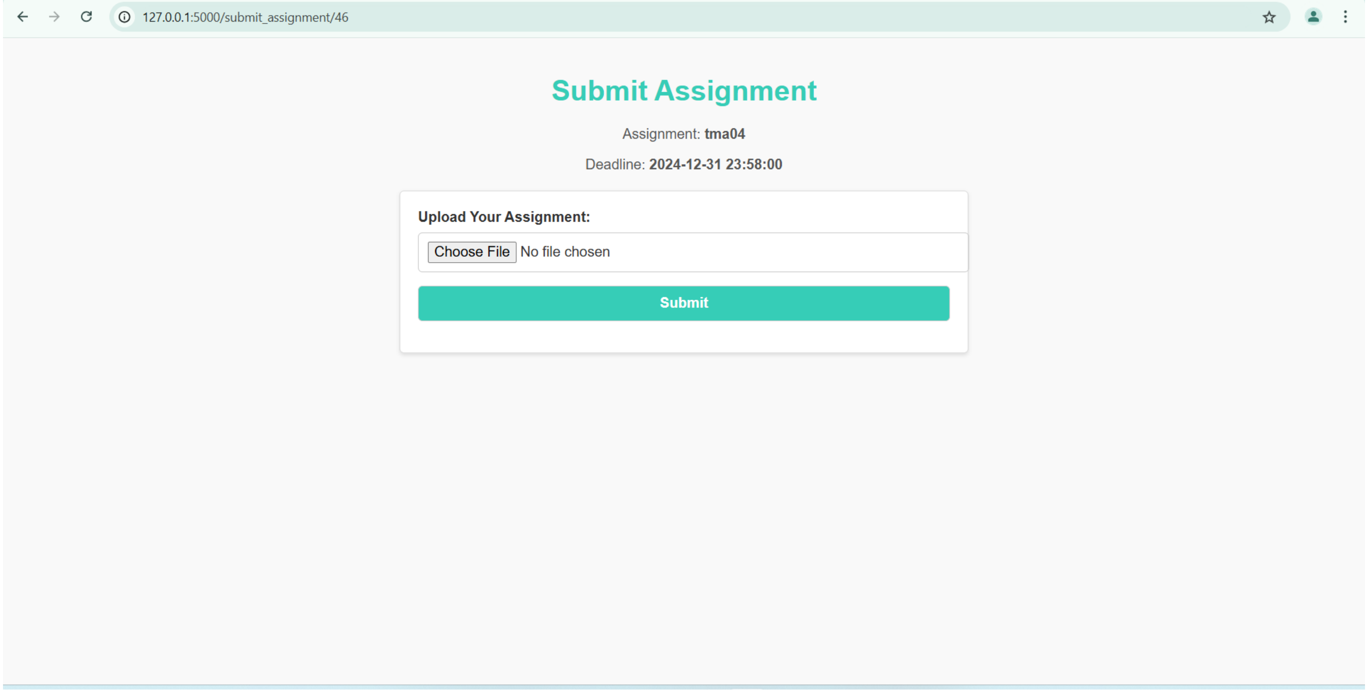
tma04

- huahsgdfs

Deadline: 2024-12-31 23:58:00

Status:

Not Submitted



Submit Assignment

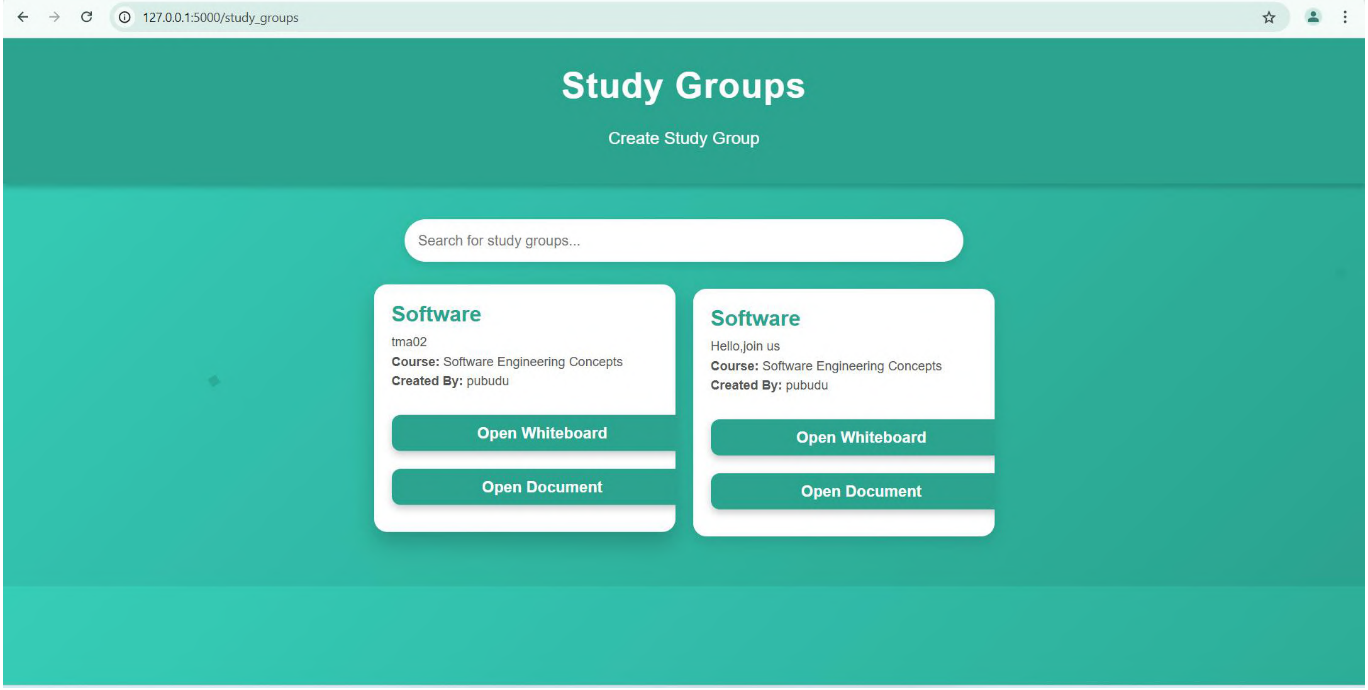
Assignment: **tma04**

Deadline: **2024-12-31 23:58:00**

Upload Your Assignment:

Choose File No file chosen

Submit



Study Groups

Create Study Group

Search for study groups...

Software

tma02

Course: Software Engineering Concepts

Created By: pubudu

Open Whiteboard

Open Document

Software

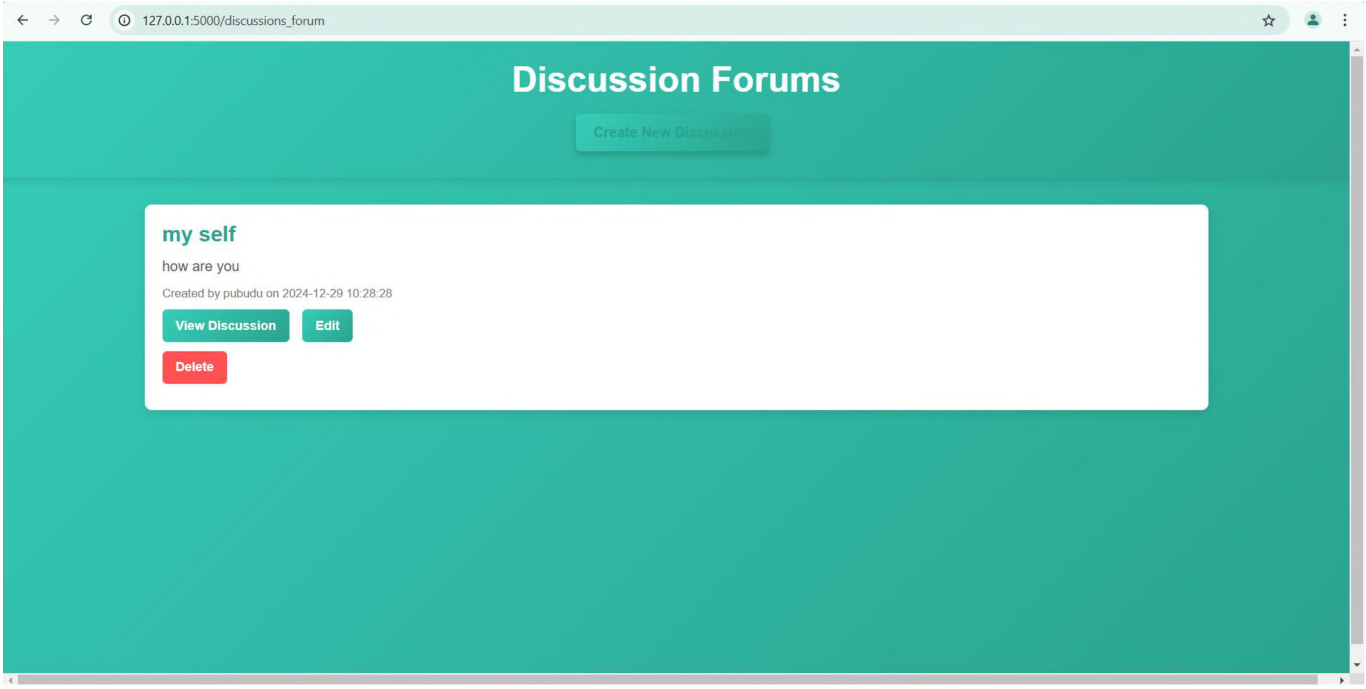
Hello,join us

Course: Software Engineering Concepts

Created By: pubudu

Open Whiteboard

Open Document



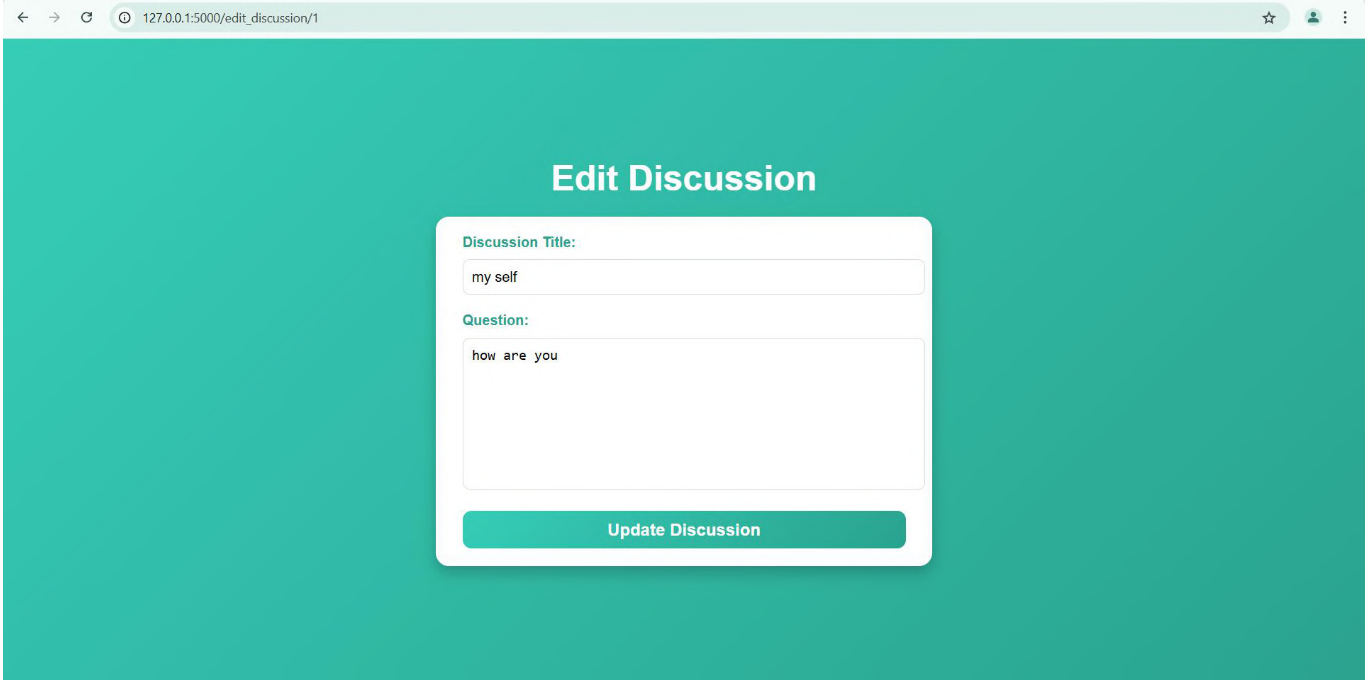
127.0.0.1:5000/discussions_forum

Discussion Forums

my self

how are you

Created by pubudu on 2024-12-29 10:28:28

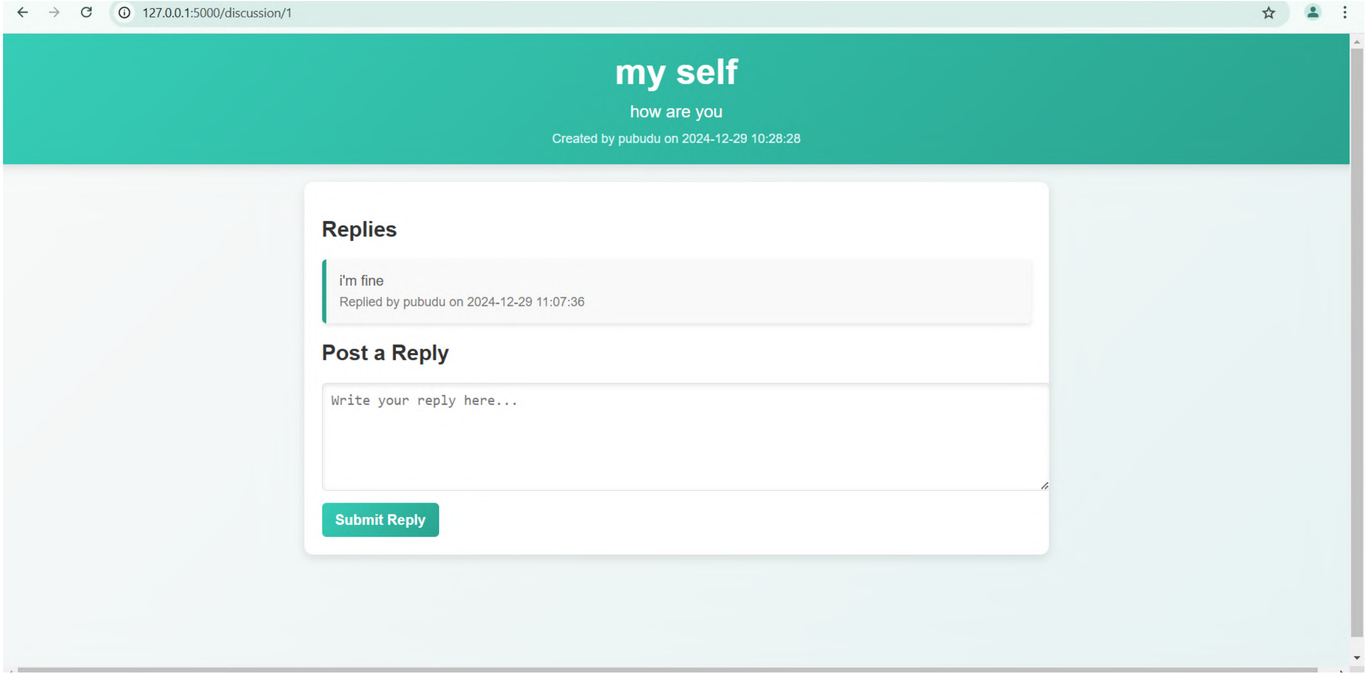


127.0.0.1:5000/edit_discussion/1

Edit Discussion

Discussion Title: my self

Question: how are you



127.0.0.1:5000/discussion/1

my self

how are you

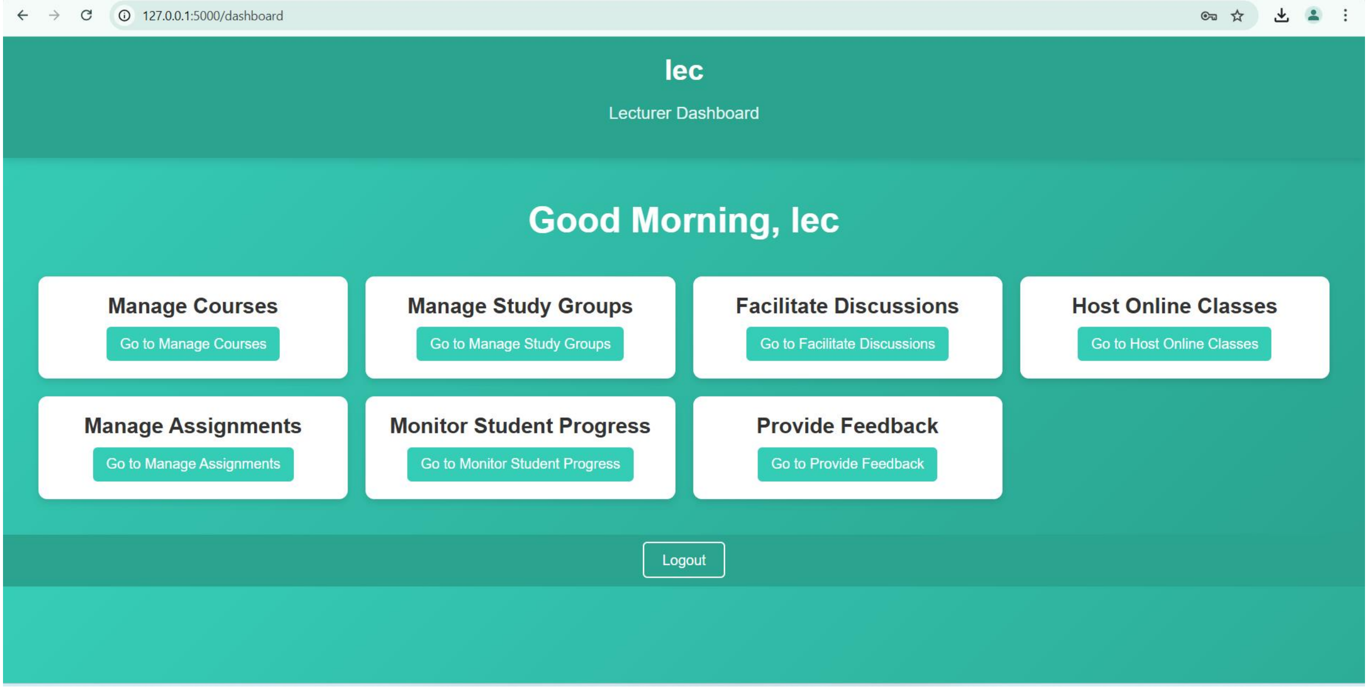
Created by pubudu on 2024-12-29 10:28:28

Replies

i'm fine

Replied by pubudu on 2024-12-29 11:07:36

Post a Reply



127.0.0.1:5000/dashboard

lec

Lecturer Dashboard

Good Morning, lec

Manage Courses

Manage Study Groups

Go to Manage Study Groups

Facilitate Discussions

Go to Facilitate Discussions

Host Online Classes

Go to Host Online Classes

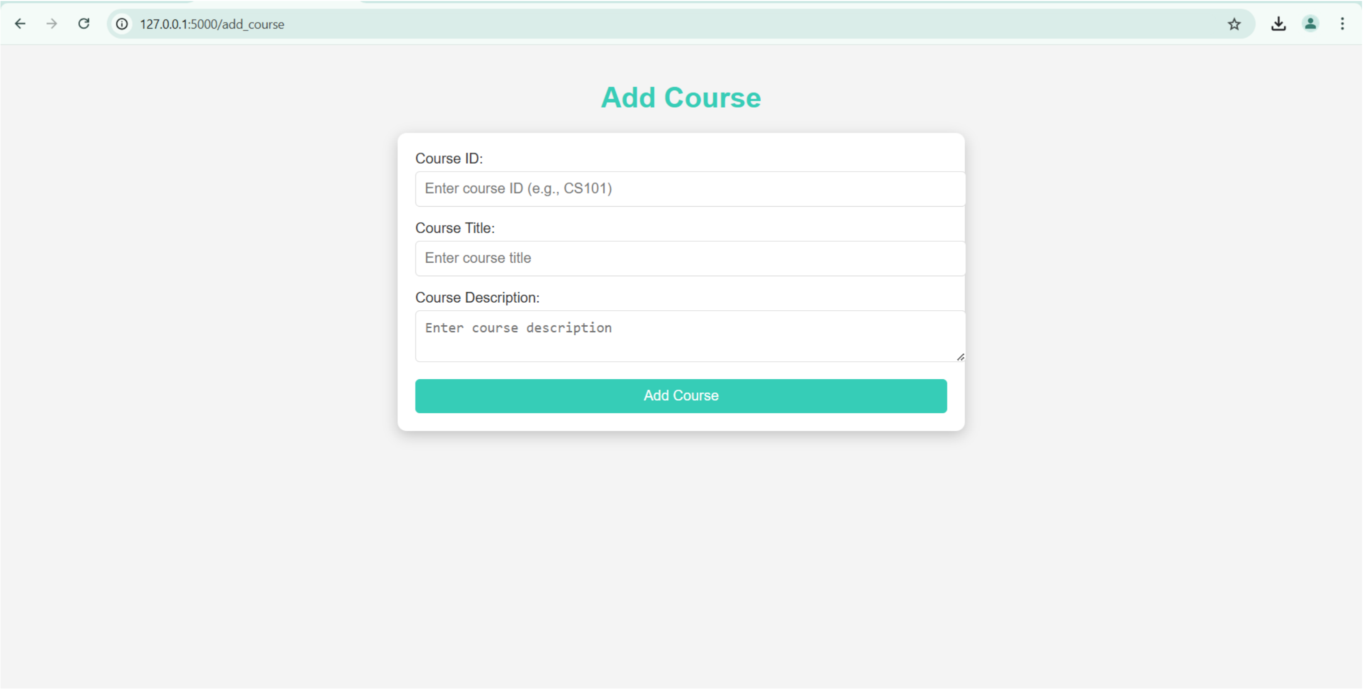
Manage Assignments

Monitor Student Progress

Go to Monitor Student Progress

Provide Feedback

Go to Provide Feedback
Logout



Add Course

Course ID:

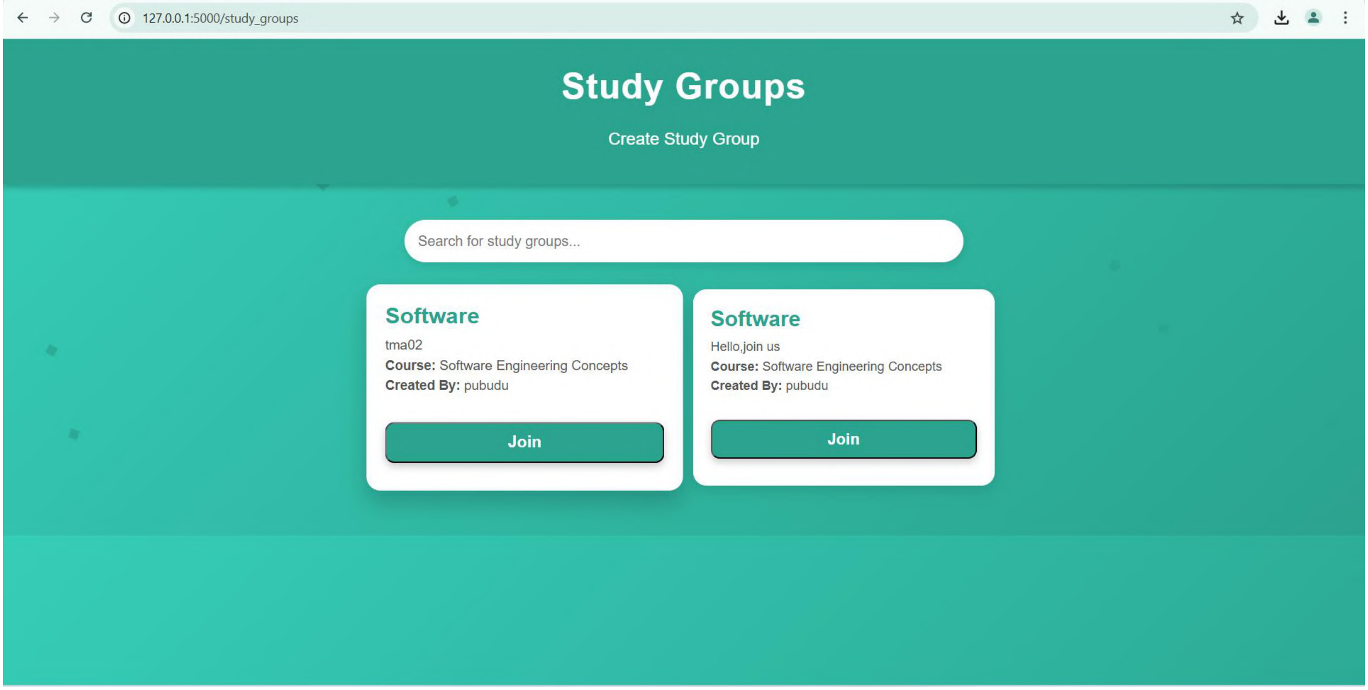
Enter course ID (e.g., CS101)

Course Title:

Enter course title

Course Description:

Enter course description



Study Groups

Search for study groups...

Software

tma02

Course: Software Engineering Concepts

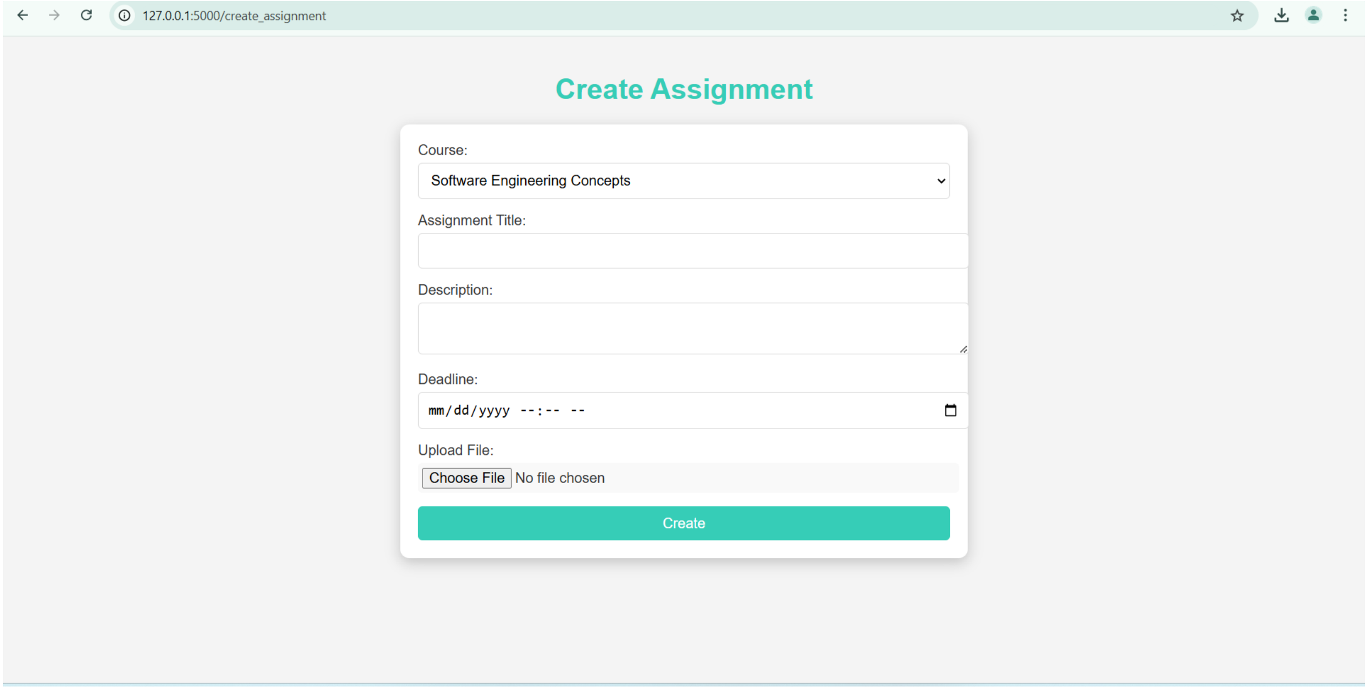
Created By: pubudu

Software

Hello,join us

Course: Software Engineering Concepts

Created By: pubudu



127.0.0.1:5000/create_assignment

Create Assignment

Course:

Software Engineering Concepts

Assignment Title:

Description:

Deadline:

mm/dd/yyyy --:-- --

Upload File: