ClassNest

Your Secure Hub for Seamless Learning

SOFTWARE DESIGN AND IMPLEMENTATION ENPM - 613

REQUIREMENT ANALYSIS

TEAM -11

Balakrishna Nair

Aanchal Pandey

Anantha Sridhar

Trishan Koyedi

Piyush Anand

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BRIEF INTRODUCTION AND DESCRIPTION OF OUR CLASSNEST

ClassNest is an eLearning Management System (eLMS) that serves as a "nest" for both students and instructors, bringing together all course-related materials, discussions, assignments, and resources in one secure and structured platform. The application is easy to use and offers a variety of features that support student learning in the form of engaging course modules, discussion boards, assessment tools and instructor support.

The platform name "ClassNest" conveys a sense of security, comfort, and structure, implying that the platform is a central hub where everything related to the class is nurtured and easily accessible for both students and teachers. It's a welcoming and organized space for educational activities.

The platform offers three distinct roles—**Admins**, **Instructors**, and **Students**—each with clearly defined privileges and responsibilities to streamline course management and learning.

Key Features:

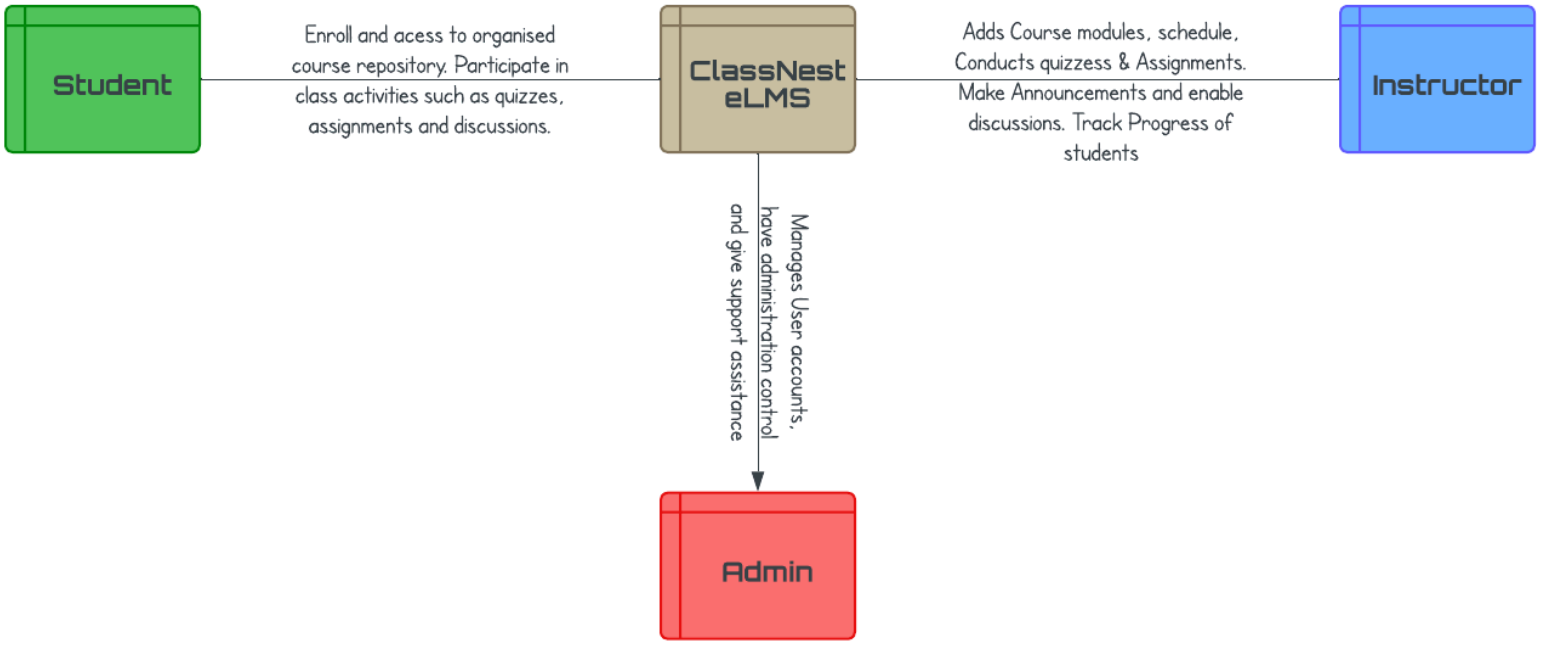
Structured Learning: Students can enroll in courses, access comprehensive learning modules, follow detailed schedules, complete assignments, take quizzes, and track their progress through a visually intuitive progress bar and ranking system.

Interactive Engagement: ClassNest creates an engaging, collaborative atmosphere with features like discussion boards and anonymous weekly feedback surveys, promoting an open learning environment.

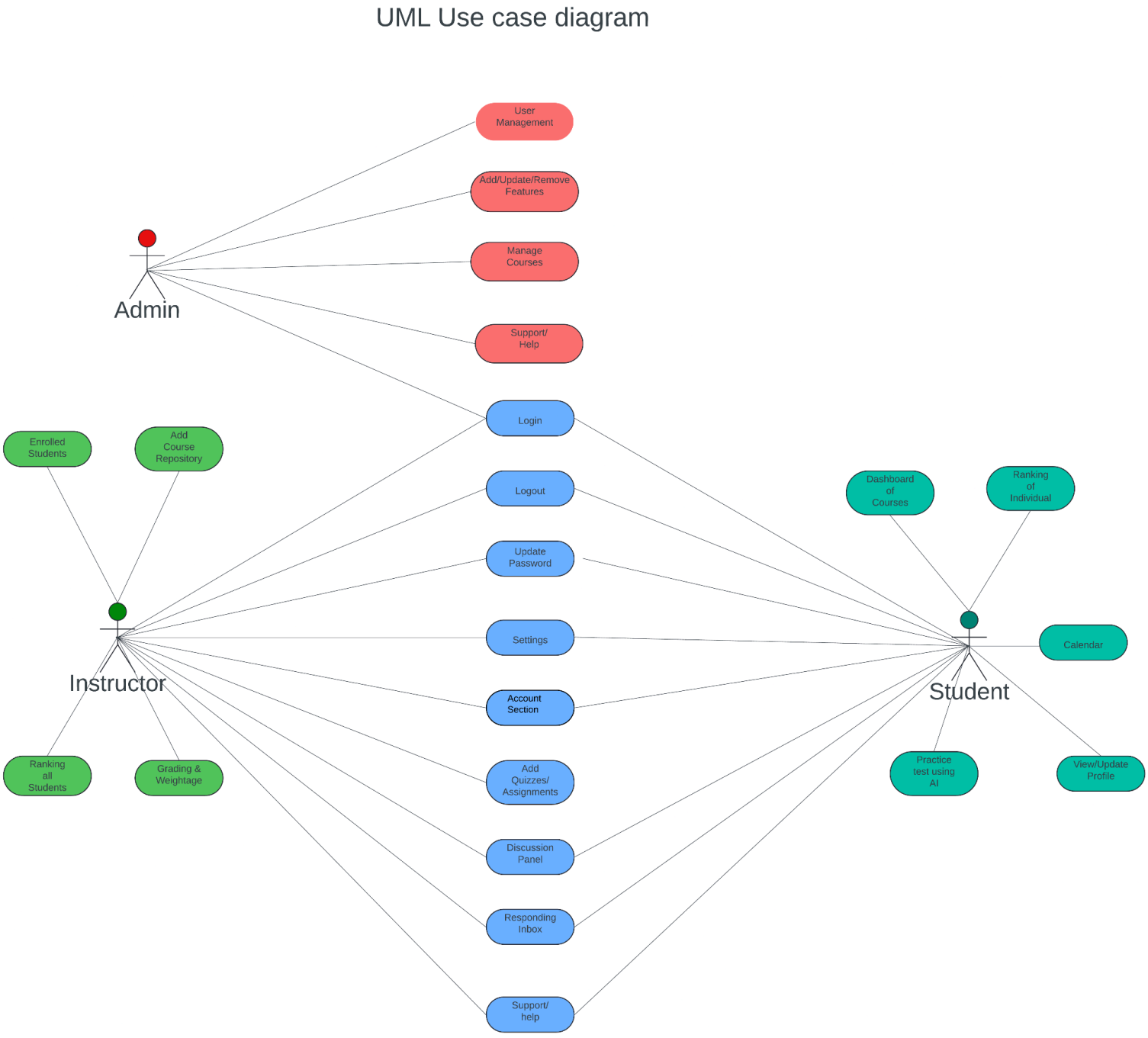
Instructor Empowerment: Instructors can customize course content, set quiz deadlines, address student queries, and track learner progress with real-time analytics.

AI Quiz Generator: This feature enhances ClassNest by automatically creating quizzes from the transcripts of recorded lectures. This AI-driven tool streamlines the quiz creation process by generating questions directly from lecture content, allowing instructors to focus more on teaching while ensuring that assessments are aligned with the material covered in class. This feature aims to provide a personalized learning experience by adapting quizzes to the specific content delivered in lectures.

LMS CONTEXT MODEL USING UML CLASS DIAGRAM NOTATION



UML USE CASE DIAGRAM



LIST OF FUNCTIONAL FEATURES DERIVED FROM THE USE CASES

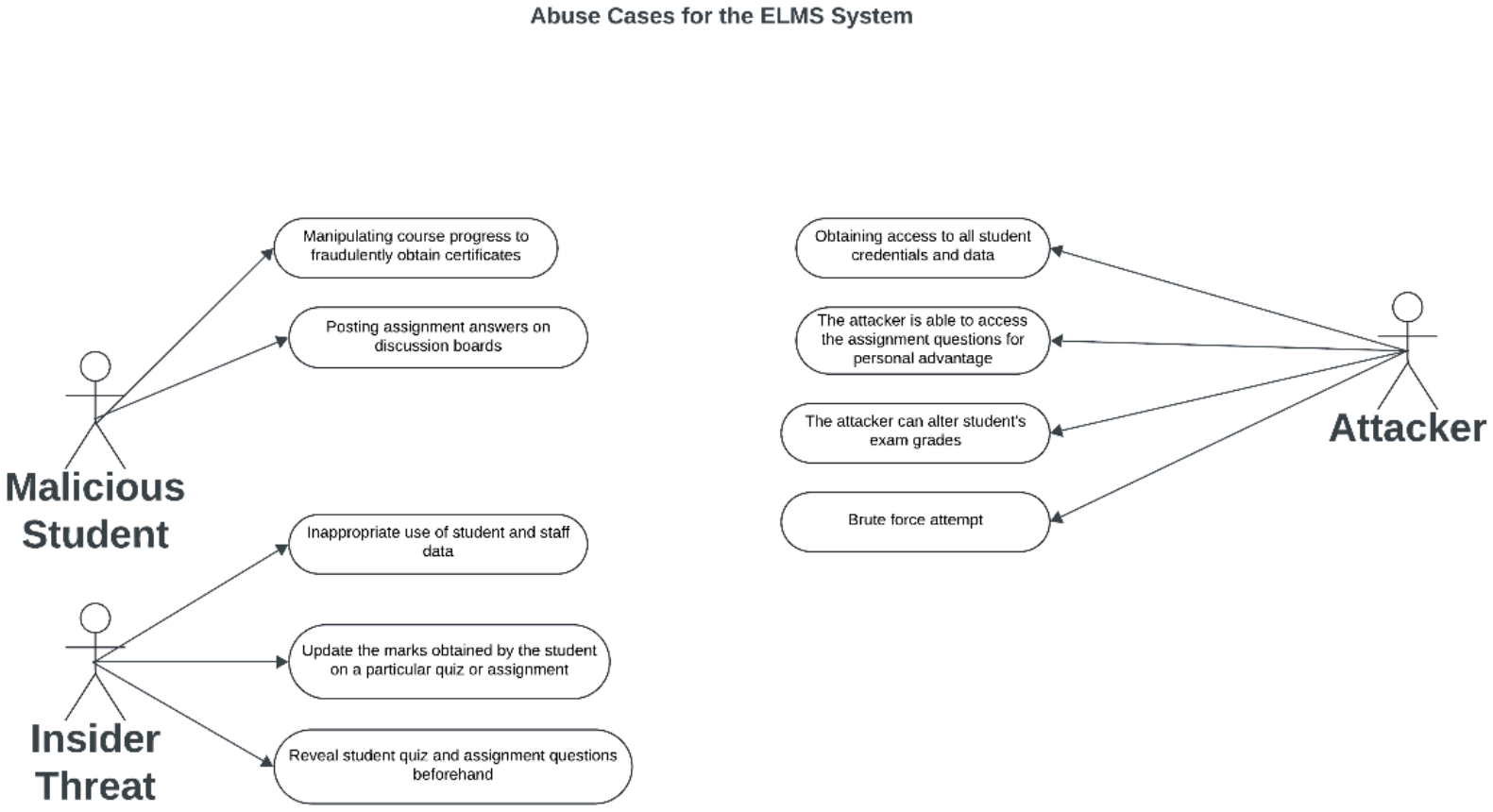
User roles	Feature Name	Feature brief description	Feature utility (importance) to the users (Low = 1, Medium = 2, High = 3)	Estimated Feature development difficulty (high= 3)	Feature priority score (utility * difficulty)
Student	User registration	Users enter their personal details, such as their name, email address, and password, to set up an account on the eLMS. This process establishes their identity and allows them to access the system using a username and password.	3	3	9
	Login	This function enables registered users to verify their identity, securely access their accounts, and utilize the features and content available on the eLMS platform.	3	3	9
	Logout	An action that lets users securely exit their eLMS account, ensuring that their session is closed and protecting their account from unauthorized access.	3	2	6
	Update password	Allows users to change their account password, enhancing security and enabling them to update their login credentials as needed.	3	2	6
	Forgot Password	This feature helps users recover access to their accounts if they have forgotten their password.	2	2	4
	Dashboard of Courses	displays a list of courses in which the user is currently enrolled. It helps users keep track of their ongoing educational activities.	3	3	9
	Enroll in courses	Course Enrollment functionality will allow students to browse available courses and enroll based on eligibility or prerequisites set by instructors	3	2	6
	Settings	This feature allows users to customize their eLMS experience by adjusting various preferences and configurations, such as notification settings, display options, and account information.	3	2	6
	Calendar	A specific feature within the eLMS platform that enables students to see a list of their forthcoming assignments, along with their due dates. This helps learners organize their coursework by giving a quick overview of pending tasks.	3	2	6
	Course flow	These are segments within a course that present educational content to assist learners in progressing through the course materials.	3	2	6
	Progress Bar - grades, content, time	A visual indicator that shows a user's advancement through a course. It displays the percentage of course completion, helping users track their learning progress.	2	2	4
	Inbox - notifications	A messaging feature that typically includes a message box for students to compose messages and a "send message" button, facilitating communication within the platform without needing external email services.	2	2	4
	Take Quiz or Assignment	An evaluative activity at the end of a module designed to assess the learner's understanding of the course content.	3	3	9
	View/Update account Profile	The Profile section allows users to view or update their profile picture, contact information, and other pertinent details.	2	2	4
	Support/help with admin	The Support section offers users access to assistance and customer support. It may include FAQs, contact details, and a helpdesk for users to seek help or report platform-related issues.	2	2	4

	Discussion panel	An area where learners can participate in discussions, pose questions, and interact with instructors within the course.	2	2	4
	AI Quiz generator	An AI-powered feature that generates practice tests for users based on the recent modules and lecture recording transcripts, providing an adaptive learning experience.	3	3	9
	Ranking of individual	A feature that displays a user's performance ranking within a course or among peers, offering insights into their standing based on completed assignments, quizzes, and participation.	1	2	2
Instructors	Settings	Allows users to personalize their eLMS experience by adjusting various preferences and configurations, such as notifications and display options.	3	2	6
	Login	Enables users to securely access their accounts by verifying their identity with a username and password.	3	3	9
	Logout	Provides a secure way for users to exit their accounts, ensuring that their session is terminated to prevent unauthorized access.	3	2	6
	Change Password	Allows users to update their account password, enhancing security by enabling them to modify their login credentials when needed.	3	1	3
	Add content to course repository	This feature allows instructors to create new modules, modify existing ones, and update course content within their courses, enhancing course materials by adding resources such as readings, videos, documents, or external links.	3	2	6
	Enrolled Students	Instructors can view the names and profiles of students who are currently participating in their course.	3	2	6
	Add quizzes, Assignments	A feature where instructors can upload a set of quizzes or assignment that were designed to enhance students understanding of the concepts	3	3	9
	discussion panel	Instructors can use this panel to engage with students by answering questions, providing explanations, and facilitating discussions.	2	2	4
	Responding Inbox	This feature allows instructors to address individual concerns sent by students through the platform's messaging system.	3	2	6
	Grading and weightage	Enables instructors to assign grades and set the weightage of different assessments, helping to calculate final course scores.	3	2	6
	Ranking all students	Displays a performance ranking of all students within a course, providing insights into each student's standing based on their academic achievements.	2	2	4
	Support/help with admin		2	2	4
Admin	User management	This feature enables administrators to manage the user base on the eLMS platform, ensuring that only authorized individuals are enrolled in courses.	3	3	9
	Adding Courses	Administrators can create and manage courses on the eLMS platform, defining course details such as name, description, content structure, and enrollment criteria.	3	3	9
	Adding/updating Features	Administrators can introduce new features or modules to enhance the learning experience on the platform.	2	2	4
	Support/help with admin	This feature allows administrators to address technical issues, respond to inquiries, and provide guidance to students or instructors encountering challenges on the platform.	3	2	6

BIDIRECTIONAL TRACE MATRIX B/W FEATURES & USE CASES

Use Case name --> Feature name | v	User registration	Login	Profile	Enroll	Dash board	Mod ules	Adding Quizzes and Assignments	Cours e Info	Discuss ions & Messag es	Support & Admin Activity
User registration	X									
Login		X								
Update Password			X							
Logout		X								
Dashboard of Courses					X					
Enroll in courses				X						
Account Section			X							
Settings			X							
Calendar					X					
Course flow								X		
Progress Bar								X		
Inbox - notifications									X	
Take Quiz or Assignment						X				
View/Update Profile			X							
Support/help with admin										X
Discussion panel									X	
delete Account -			X							
*Ranking of individual										
Add course repository								X		
Enrolled Students						X				
Add quizzes, Assignments							X			
discussion panel									X	
Responding Inbox									X	
Grading & weightage										
Ranking all students					X					
User management										X
Adding Courses										X
Adding Features										X
Support/help with admin										X

ABUSE CASE MODEL USING UML USE CASE DIAGRAM



BI-DIRECTIONAL TRACES MATRIX B/W THESE SECURITY SCENARIOS AND ABUSE CASES

Abuse Case Name -> Security Scenario Name |	Denial of Service Attack	SQL Injection	Phishing	Unauthorized Access	Data Manipulation	Malware Infection	Eavesdropping	Account Duplication
Preventing legitimate users from accessing the system and its functionalities	x							
Obtaining access to all student credentials and data	x	x						
The attacker can alter student's exam grades		x			x			
The attacker is able to access the assignment questions for personal advantage	x	x						
Inappropriate use of students/teacher data			x		x			
Posting assignment answers on discussion boards								x
Leakage of course Content								
Off-topic discussions in forums								
Manipulating course progress to fraudulently obtain certificates				x				
Brute force attempt	x			x				
Insider Threat			x				x	

TWO MOST CRITICAL ABUSE CASES IDENTIFIED

1.

Name: Student1 Attempts to Log In to Student2's Account

Actors: Student1, Student2

Trigger: Student1 obtains Student2’s login credentials by accessing Student2’s email on the LMS.

Preconditions: Student1 has eavesdropped on Student2 to acquire their login information.

Postconditions:

- **Success Postcondition**: Student1 fails to access Student2's account.
- **Failure Postcondition**: Student1 successfully gains access to Student2's account.

Basic Flow:

1. Student1 overhears Student2 to obtain their username and password.
2. Student1 attempts to log into Student2's account using the acquired credentials.
3. After three unsuccessful login attempts, Student1 is subjected to a rate-limiting feature and cannot log in.
4. In an attempt to bypass the rate limit, Student1 tries to execute a brute force attack. He receives three warnings for being rate-limited, leading to Student2’s account being blocked, which can only be unblocked by an admin.
5. Ultimately, Student1 gives up on accessing Student2's account.

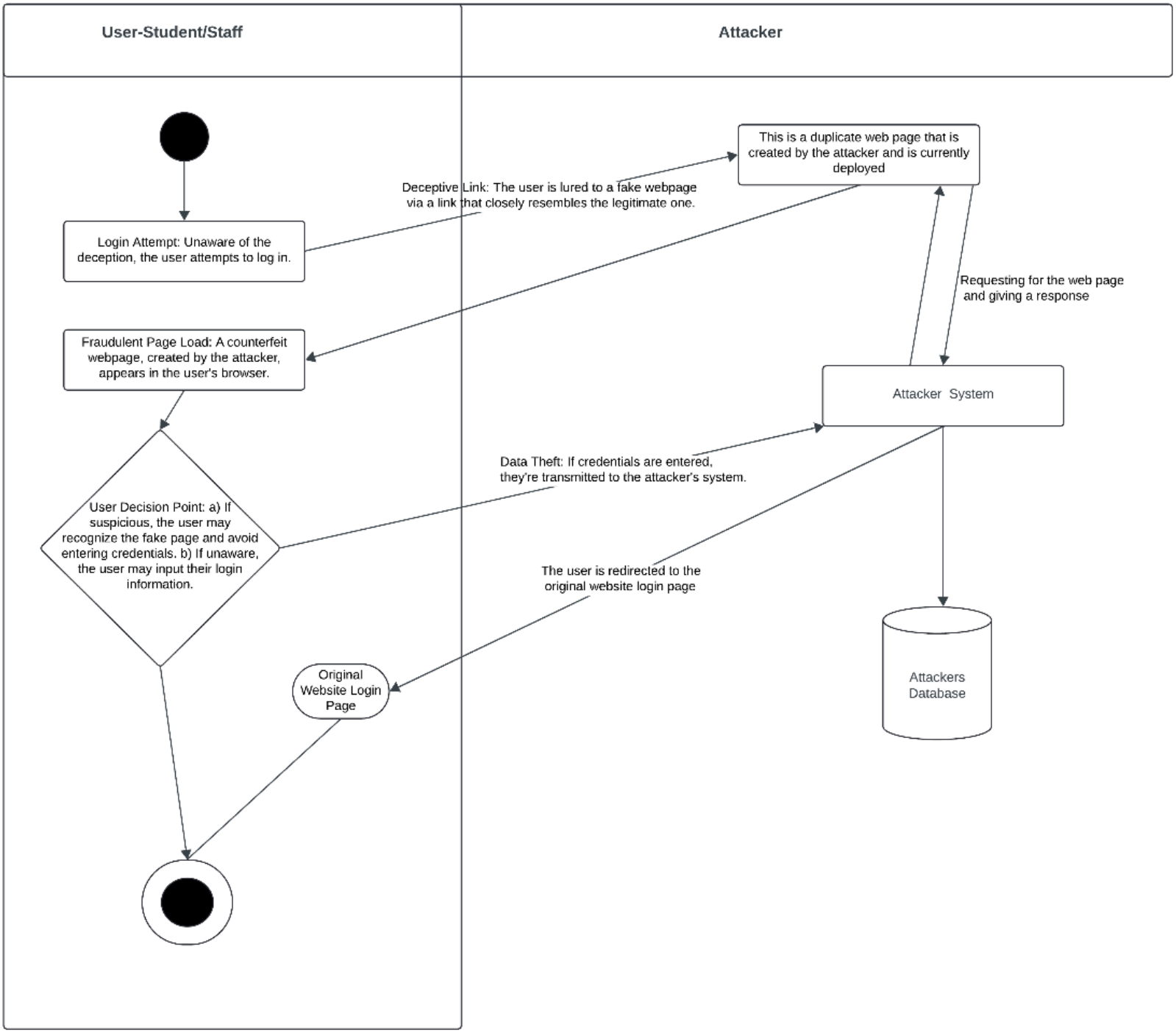
Alternative Flow:

- After receiving one or two rate-limit warnings, Student1 tries software designed to circumvent rate-limiting.
- The system is equipped to prevent such software from bypassing the rate-limiting mechanism.

Exception Flow:

- Student1 successfully cracks Student2’s password before reaching the maximum allowed attempts and before the account is blocked.
- Student1 accesses all desired information and then logs out of the account.
- The system fails to enforce the rate-limiting feature, allowing Student1 to succeed due to Student2's weak password or effective eavesdropping.

2ND ABUSE CASE [USING UML ACTIVITY DIAGRAM



QUALITY UTILITY TREE

Quality attribute	Quality Scenario name	Quality Scenario brief description	Quality Scenario utility (importance) to the users (Low = 1, High = 3)	Estimated Quality Scenario development difficulty (high difficult= 1, low = 3)	Scenario priority score (utility * difficulty)
PERFORMANCE	Low Response Time	The software should provide a smooth and efficient user experience by minimizing the time it takes to process user requests, such as logging in, accessing course materials, submitting assignments, or navigating between pages. The system must quickly handle user interactions, ensuring that delays do not disrupt the learning process	2	2	4
SCALABILITY	System Scalability	The software must be able to scale efficiently as the number of users, courses, and concurrent activities increases, especially during peak times such as exam periods or course launches. The system should ensure that performance remains stable without degradation, regardless of the load.	2	2	4
USEABILITY	User-Friendly Interface	The software should provide an intuitive and easy-to-navigate interface, enabling users of all skill levels to access features and complete tasks such as enrolling in courses, submitting assignments, and viewing grades without confusion. The interface design should enhance the overall learning experience and reduce the learning curve for new users.	3	3	9
RELIABILITY	Low Failure Rate	The software must consistently perform without unexpected errors or interruptions, ensuring reliability during critical activities such as exams, assignments submissions, or accessing course materials. The system should minimize downtime and failures to maintain a stable learning environment.	3	2	6
RELIABILITY	Data Integrity	The software must ensure that all data, including student records, grades, course materials, and assignment submissions, remains accurate, consistent, and protected from corruption or loss. This applies across all user actions, system operations, and potential disruptions such as crashes or network failures.	3	2	6
MAINTAINABILITY	Easy Bug Fixes and Updates	The software should be designed in a way that makes it easy for developers and administrators to identify, fix bugs, and implement updates without causing significant disruptions to the users. This ensures the system remains up-to-date with minimal downtime during maintenance activities.	2	2	4
SECURITY	User Authentication	The software must ensure secure and reliable user authentication, allowing only authorized users (students, teachers, and administrators) to access the platform's content and features. The system should implement strong password policies and account lockout mechanisms to protect against unauthorized access and ensure the integrity of user accounts.	3	2	6

SECURITY	Data Protection and Privacy	The software must keep all user data, such as personal information, grades, and course materials, safe and private. The system should use encryption to protect data when it is being transmitted and while it is stored, ensuring that only authorized users can access sensitive information.	3	1	6
TESTABILITY	Comprehensive Testing	The software should support thorough and efficient testing processes, allowing developers and QA teams to validate new features, identify bugs, and ensure system stability before deployment. The system should provide clear interfaces for automated testing and allow easy creation of test cases and scenarios.	3	2	6
PORTABILITY	Cross-Platform Accessibility	The software should function seamlessly across various platforms and devices, including desktops, laptops, tablets, and smartphones. This ensures that users can access their courses and materials from any device without compatibility issues, providing a consistent and flexible learning experience.	3	2	6
CONFIGURABILITY	Customizable User Settings	The software should allow users to customize their profiles and settings to enhance their learning experience according to their preferences.	2	3	6
COMPATIBILITY	Cross-Platform Compatibility	The software should function seamlessly across various platforms and devices, including desktops, laptops, tablets, and smartphones. This ensures that users can access their courses and materials from any device without compatibility issues, providing a consistent and flexible learning experience.	3	2	6

LIST OF FUNCTIONAL FEATURES & QUALITY SCENARIOS WITH HIGH PRIORITY THAT WILL BE FURTHER DESIGNED AND DEVELOPED.

1. **User Registration (User-Friendly Interface):**

   This is a high priority feature that has a lot of scope to further design and develop to ensure a seamless and secure user registration and login process, prioritizing ease of use and flexibility through multiple authentication options. It will support traditional email/password credentials, Google account login, passkeys, and biometric login (fingerprint and facial recognition). This feature is essential for providing a smooth onboarding experience while maintaining robust security.

2. **Course Management:**

   Course Creation and Management is a high priority feature which will enable instructors to seamlessly create, update courses and set specific course requirements. Alongside this, the Course Enrollment functionality will allow students to browse available courses and enroll based on eligibility or prerequisites set by instructors. This feature has the potential for further design and development to include enhanced content organization, automated assessment grading, more personalized course recommendations, and deeper progress analytics for instructors to better understand student performance trends.

3. **Communication and Collaboration:**

   The Communication & Collaboration feature can be further developed to include discussion forums for course-specific interactions, enhanced discussion moderation, group messaging, expanded integration with various video conferencing platforms to improve collaboration and live sessions with integrated video conferencing tools for real-time lectures and seminars.

4. **Security:**

   In the Security quality scenario, data encryption will protect sensitive information, including user credentials, both in transit and at rest. Two-Factor Authentication (2FA) will be introduced as an optional feature to enhance login security. Role-based access control (RBAC) will be implemented to manage access according to user roles, such as administrators, instructors, and students. Future development will focus on advanced encryption protocols, adaptive authentication mechanisms, and dynamic role management to strengthen system security.

TOP THREE HIGHEST PRIORITY QUALITY SCENARIOS USING THE SEI TEMPLATE

1. Usability Scenario - Intuitive User Interface

Source of Stimulus: Users (Students and Educators) interact with the LMS to access course materials, participate in discussions, complete assignments, and manage courses.

Stimulus: Navigation and engagement within the LMS.

Environment: Operating under standard conditions.

Artifact: The LMS User Interface, which includes the homepage, course pages, login screen, navigation menu, and content pages.

Response: To fulfill usability criteria, the LMS user interface should exhibit the following qualities:
- i) Users should find navigation within the LMS clear and simple, with well-organized menus and links.

- ii) Design elements and layouts should maintain consistency throughout the interface, ensuring predictable interactions.

- iii) Course materials and information should be presented in an accessible manner, with suitable headings, formatting, and multimedia integration when necessary.

Response Measure: The LMS should deliver fast and responsive interactions, minimizing significant delays during navigation. A post-survey should show that over 95% of users find the user interface highly satisfactory.

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2. Maintainability Scenario - Knowledge Management and Documentation Transfer

Source of Stimulus: The Software Development Team, along with Instructors and Administrators responsible for the ongoing maintenance of the system.

Stimulus: The necessity to access and convey knowledge regarding the LMS's architecture, design, configurations, and optimal maintenance practices.

Environment: The LMS functions under normal operational conditions or during maintenance tasks.

Artifact: The knowledge repository and documentation, which encompasses architecture diagrams, design specifications, code documentation, configuration manuals, and maintenance protocols.

Response: To adhere to maintainability standards, the LMS should incorporate the following elements:
- i) Maintain current and thorough documentation that encompasses system architecture, design principles, codebase, configurations, deployment methods, and maintenance procedures.

- ii) Ensure all documentation and expertise are housed in an easily navigable knowledge management system for team access.

- iii) Promote knowledge transfer among team members through effective communication strategies, such as regular meetings, information-sharing sessions, and mentorship initiatives.

Response Measure: Evaluate the documentation coverage across various areas of the LMS by calculating the completion percentage, aiming for over 95%. Additionally, track the frequency of documentation updates to ensure they remain current. Efficient knowledge management should decrease the onboarding time for new team members to about 1 day under typical circumstances.

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3. Modifiability Scenario - Modular System Design

Source of Stimulus: Users, including students and instructors, interact with the Learning Management System (LMS) to update course content, address shifting educational requirements, complete assignments and quizzes, and modify course structures.

Stimulus: The need arises to adapt or improve the LMS to meet evolving requirements, integrate new features, or boost system performance.

Environment: The system operates under normal conditions while accommodating increasing stakeholder demands for future changes or during routine maintenance.

Artifact: The software architecture, emphasizing its modular design, codebase, and accompanying documentation.

Response: To satisfy modifiability requirements, the LMS should display these attributes:
i) A modular architecture that allows individual components to be altered, added, or replaced independently, without disrupting other parts of the system.

ii) Clearly defined, well-documented interfaces that ensure smooth communication and interaction between modules.

iii) Instructors and administrators should be able to easily adjust course structures and layouts to improve educational outcomes.
Response Measure: The time required to implement changes or enhancements. A well-structured modular design should enable modifications to be completed within 1 hour.