REQUIREMENT ANALYSIS

SOFTWARE DESIGN AND IMPLEMENTATION

ENPM - 613

TEAM - 4

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BRIEF INTRODUCTION AND DESCRIPTION OF OUR PROJECT

Skillsberg is an eLMS platform that provides students with the opportunity to learn new language skills with the guidance of experienced instructors. The platform offers a variety of features that make it easy for students to stay on track and achieve their learning goals. 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 Skillsberg eLMS platform has the following features:

- **Three Distinct Roles:** Admins, Instructors, and Students, each with their unique roles and privileges.

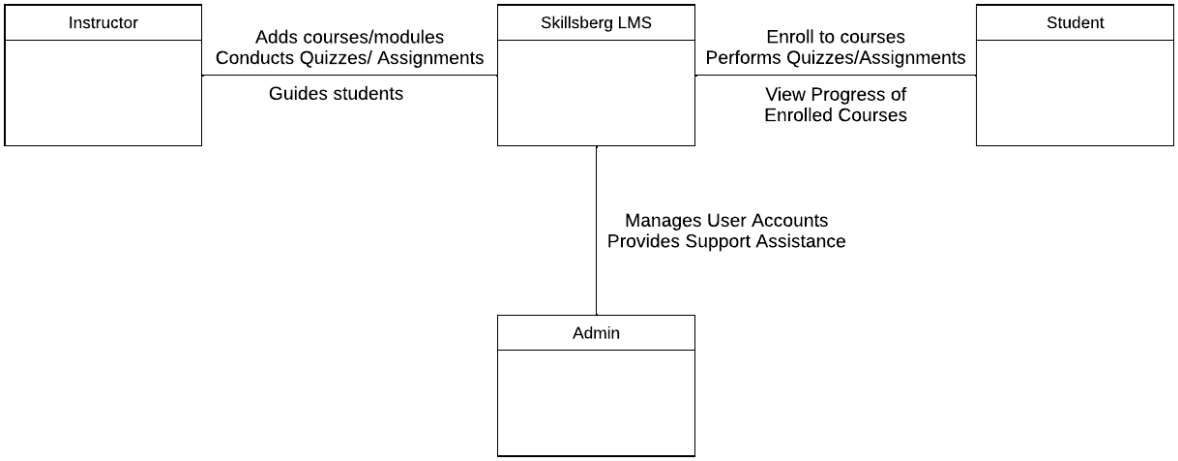
- **Structured Learning:** Students can enroll in courses, access modules sequentially, and complete quizzes to progress.

- **Interactive Engagement:** The courses feature engaging modules, quizzes, assignments, discussion panels, and messaging capabilities to foster a rich learning environment.

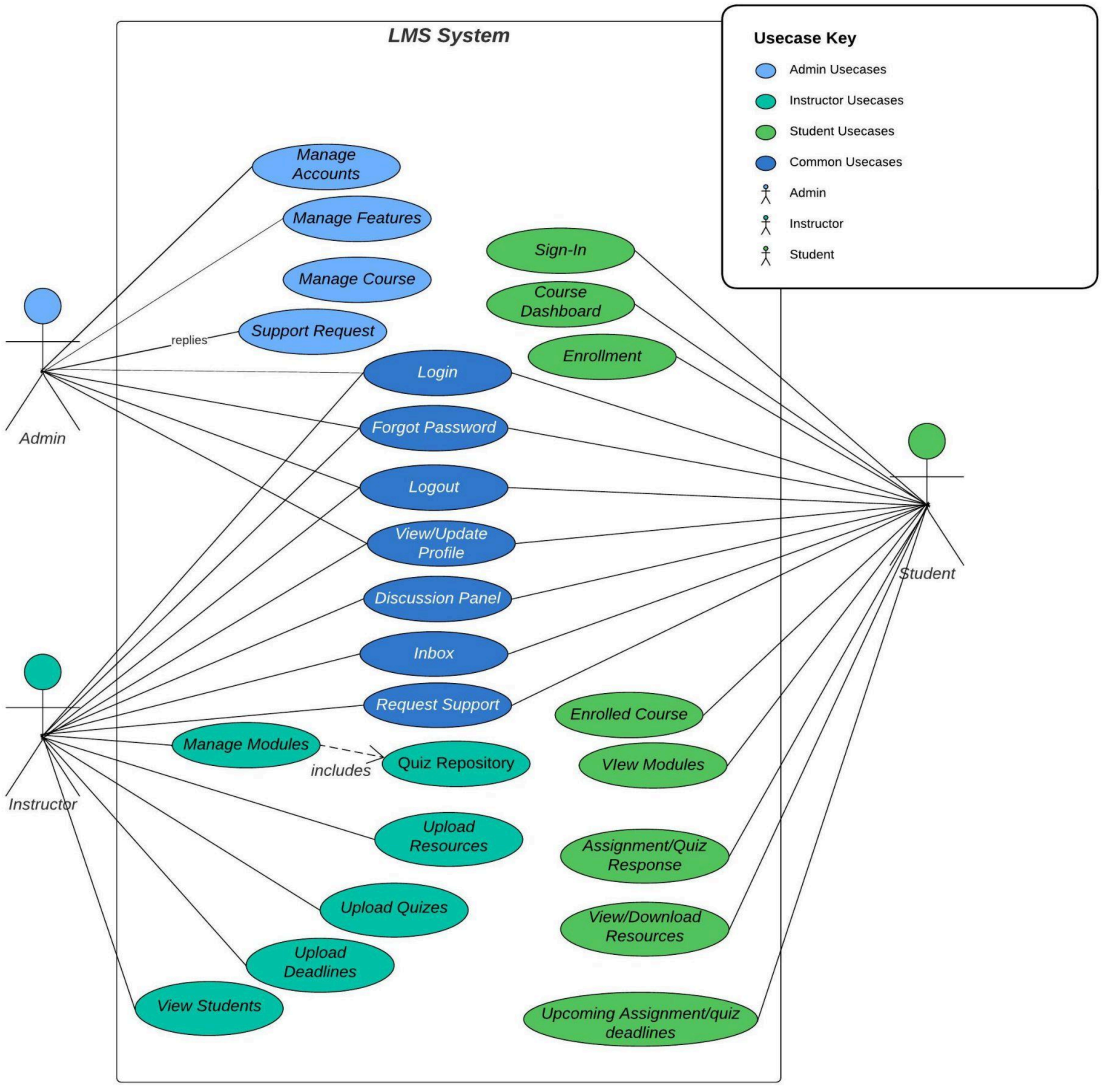
- **Instructor Empowerment:** Instructors can shape their courses, set quiz deadlines, address queries, and monitor student progress.

- **Certification:** Upon successful completion of all modules and the final quiz, students receive a course completion certificate, proof of their language proficiency.

LMS CONTEXT MODEL USING UML CLASS DIAGRAM NOTATION



UML USE CASE DIAGRAM



LIST OF FUNCTIONAL FEATURES DERIVED FROM THE USE CASES

User Role/ Perspective	Feature Name	Feature brief description	Feature Utility [Low = 1, Medium =2, High = 3]	Estimated Feature Difficulty [Dificult = 1, Medium = 2, Easy = 3]	Feature priority score [Utility * Difficulty]
Student	User Registration	Users provide their personal information, such as name, email, and password, to create an account on the eLMS establish their identity and gain access to the system with a username and password	3	3	9
	Login	This feature allows registered users to authenticate themselves, access their accounts securely, and gain access to the eLMS platform's features and content.	3	3	9
	Forgot Password	Assists users in regaining access to their accounts if they have forgotten their password.	3	2	6
	About Us	The About section provides information about the eLMS platform, including its mission, vision, goals, and background. It helps users understand the purpose and objectives of the platform.	2	3	6
	Course Dashboard	Course Dashboard is a section of the platform where users can browse and explore the complete catalogue of available courses. It typically includes course titles, descriptions, instructors, # of hours to invest and enrollment options.	3	2	6
	Enroll button	The Enroll Button is a clickable element associated with each course in the catalogue. Users can click on it to enroll in a course they are interested in. It initiates the enrollment process for the selected course.	3	3	9
	Accessing Enrolled Courses	Enrolled Courses is a section that displays a list of courses in which the user is currently enrolled. It helps users keep track of their active learning pursuits.	3	2	6
	Course Modules	Segments within a course that present educational content, to help learners progress through the course materials.	3	2	6

	Progress Bar	A Progress Bar visually represents a user's progress within a course. It shows the percentage of completion of the entire course, allowing users to monitor their learning journey.	2	2	4
	Additional Resources	Supplementary materials, such as readings/ documents are provided to enhance the learning experience and provide additional information to learners.	2	2	4
	Check Upcoming Assignments	A dedicated feature within our eLMS platform that allows students to view a list of their upcoming assignments, including due dates. This feature helps learners plan their coursework effectively by providing a quick overview of their impending tasks.	2	2	4
	Take Quiz/Assignment	An assessment or evaluation activity at the end of a module to test the learner's comprehension of the course material.	3	2	6
	Discussion Panel	A space where learners can engage in discussions, ask questions, and interact with instructors within the course.	2	2	4
	Inbox	This feature typically includes a message box where students can compose messages and a "send message" button to facilitate communication within the platform, eliminating the need to use external email services.	2	2	4
	Raise Support request	The Support section provides users with access to assistance and customer support. It may include FAQs, contact information, and a helpdesk where users can seek help or report issues related to the platform.	3	3	9
	View/Update Profile	The Profile section allows users to view/update their profile picture, contact details, and other relevant information.	3	2	6
	Update Password	Enables users to change their account password. It enhances security and allows users to modify their login credentials when necessary.	3	2	6
	Logout	Logout is an action that users can take to securely exit their eLMS account. It ensures that the user's session is terminated and they are logged out of the platform, protecting their account from unauthorized access.	3	2	6
Instructor	Edit/Add/Update Modules	This feature allows adding new modules, editing existing ones, and updating the course materials within their course	2	2	4

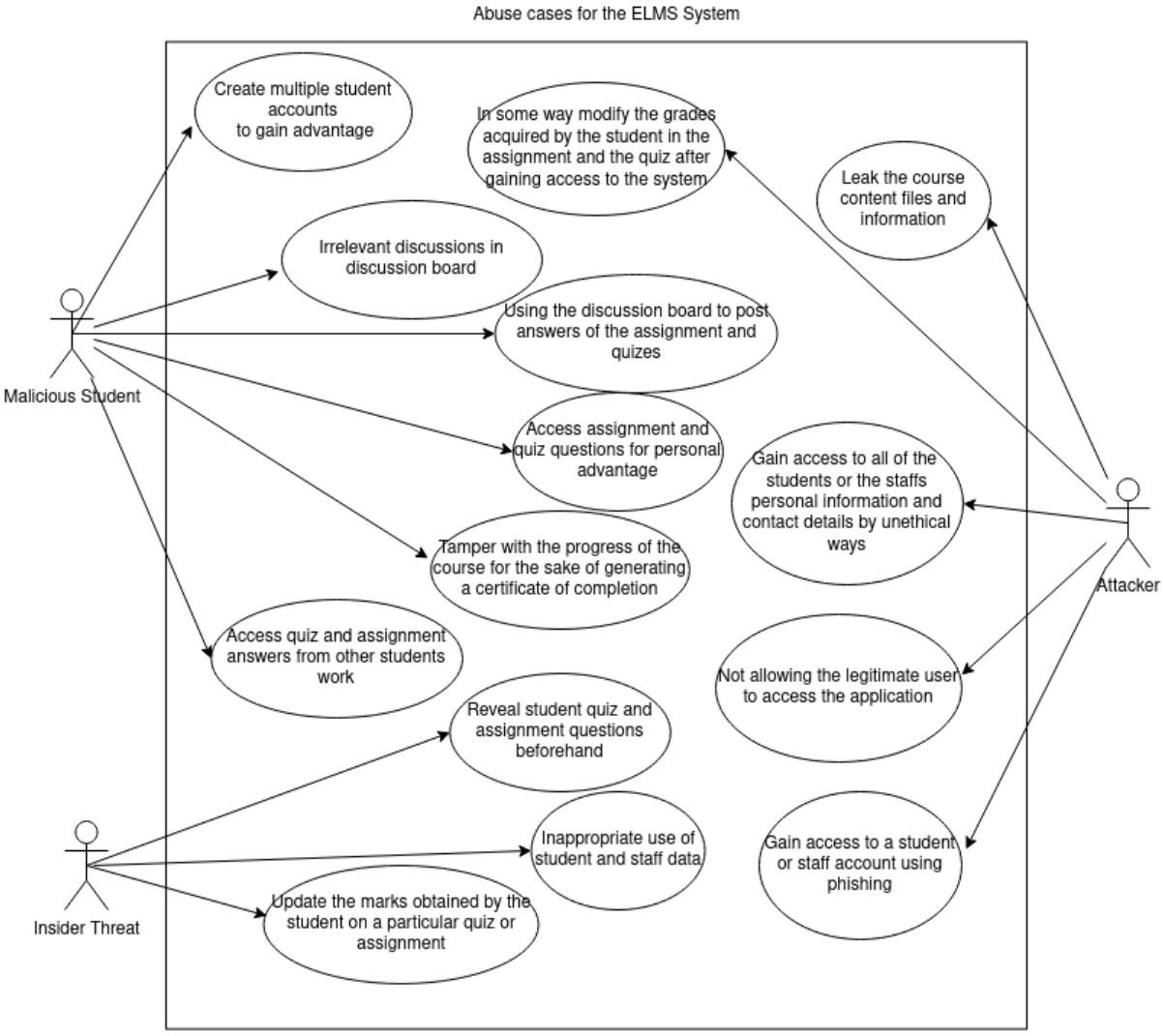
	Adding Additional Resources	This feature enables Instructors to supplement the core course materials with supplementary resources such as readings, videos, documents, or external links.	1	3	3
	Enrolled Students	This view allows instructors to see the names and profiles of students who are participating in their course.	1	3	3
	Add Upcoming Deadlines	This feature allows instructors to specify due dates for assignments, making it clear when assignments are expected to be completed by students.	2	2	4
	Quiz Repository	It refers to a place where instructors can input a pool or superset of questions that can be randomly selected for quizzes within the course.	3	2	6
	Discussion Panel	Instructors can actively engage with this panel to address student questions, provide explanations, and facilitate discussions.	3	2	6
	Respond to Inbox Messages	This feature allows instructors to address individual concerns sent by students through the platform's messaging system	3	2	6
Admin	User Management	This feature enables the Admin to oversee and control the user base within the eLMS platform. User Management ensures that only authorized individuals are enrolled in courses.	3	2	6
	Add Features*	Admins can introduce new features or modules to improve the learning experience.	2	2	4
	Add Courses	Admins can create and manage courses within the eLMS platform using the "Add Courses" feature. They have the ability to define course details, such as the course name, description, content structure, and enrollment criteria.	2	2	4
	Support Assistance	This feature allows admins to address technical issues, answer inquiries, and offer guidance to students/ instructors who may encounter challenges while using the platform.	3	2	6

BIDIRECTIONAL TRACE MATRIX B/W FEATURES & USE CASES

Use Case name --> Feature name | v	User Registration	Login	Profile	About	All Courses	Enroll	Enrolled courses Dashboard	Modules	Upcoming Assignments/ Announcemnets	Course Info	Resoure Page	Quiz Page	Inbox	Discu ssion Panel	Support System	Add Course	Manage Students	Instruc Manag ement	Add features	Add Course Cards	Remove Bugs	Logout
User Registration to the account	X																					
Login to the Account		X																				
Forgot Password		X																				
About us				X																		
Accessing the All Courses					X																	
Enroll button						X																
Access the Enrolled Courses							X															
Modules in the course								X														
Quizes to take												X										
Syllabus to know										X												
Inbox													X									
Resources to access											X											
Discussion Panel to discuss														X								
Raise Support Request															X							
Check Upcoming Assignments									X													
Check Profile			X																			
Update Password			X																			
Logout by Sudent																						X
Login by Instructor		X																				
Profile			X																			
Edit/Add/Update Modules								X														
Edit Course Info										X												
Adding of Resources											X											
Add Upcoming Deadlines									X													
Access Discussion Panel														X								
Inbox													X									
Create Quiz												X										
Logout by Instructor																						X
Login By the Admin		X																				

Support assistance															X								
User Management																	X						
Add Features																			X				
Add Courses Cards															X					X			
Instructor Management																		X					
Remove Bugs																					X		
Logout by 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 | v	Create multiple student accounts to gain advantage among other students	Gain Access of another students or staffs account and data	Not allowing the legitimate user to access the application and its features	Gain access to all student credentials and data	The attacker is able to modify a students exam grades	The attacker is able to access the assignment questions for personal advantage	Course Content Leakage	Course progress tampering for the sake of certificate generation	Inappropriate use of students/ teacher data	Using Discussion board to post answers to assignments	Irrelevant discussions in discussion board
Brute force attempt		X			X	X			X		
Denial Of Service Attack			X								
Insider Threat		X		X			X		X		
SQL Injection		X		X							
Phishing		X				X			X		
Unauthorized Access		X	X		X	X	X		X	X	X
Data Manipulation					X			X			
Malware Infection											
EavesDropping		X			X	X					
Account Duplication	X									X	X

TWO MOST CRITICAL ABUSE CASES IDENTIFIED:

1ST ABUSE CASE [TEXTUAL DESCRIPTION]

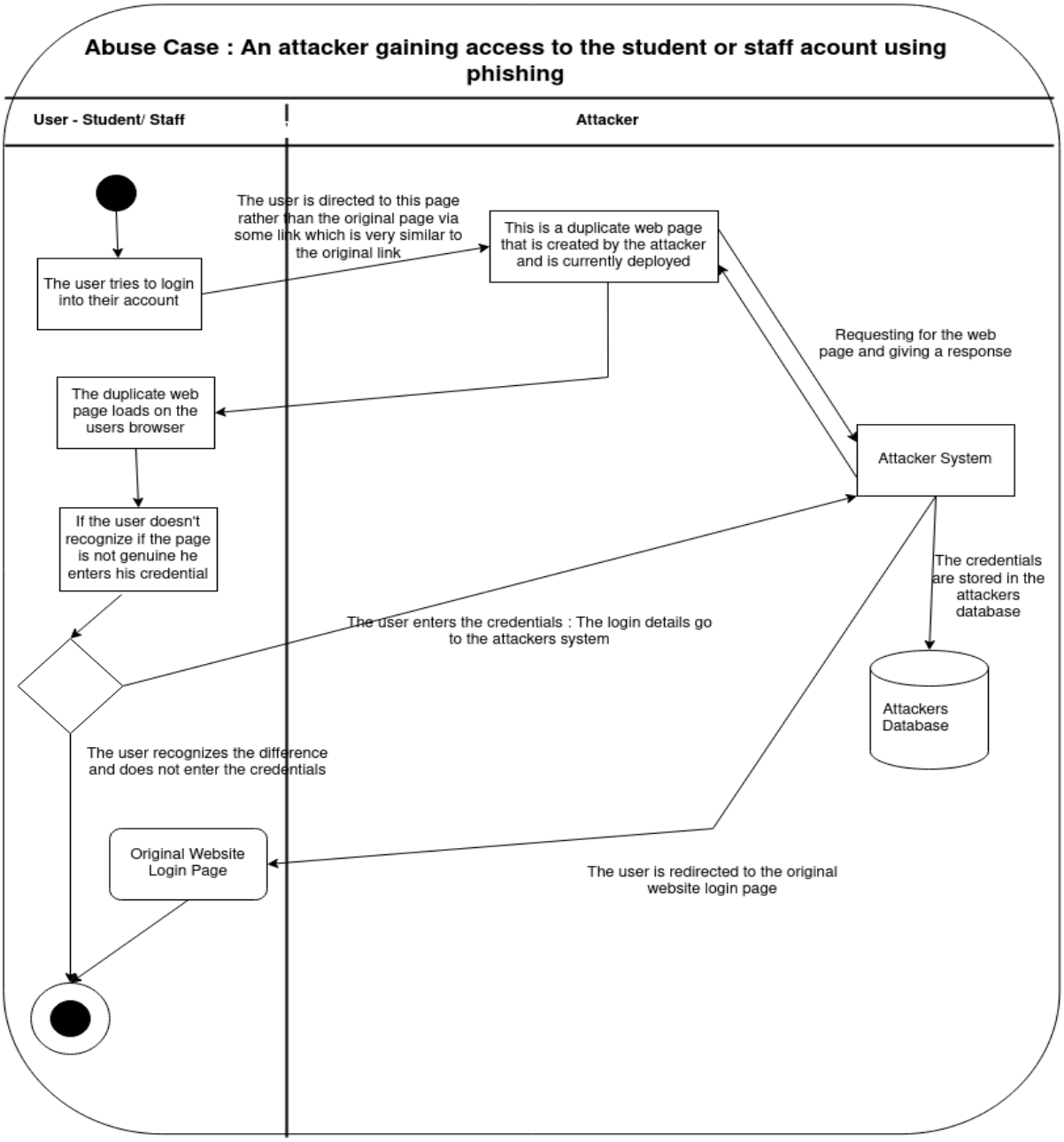
Name:
Student1 wants to log in to some other student2 account to access his assignments
Actors:
Student1, Student 2
Trigger:
Student1 got Student2 account login details by checking student2 email on LMS
Preconditions:
Student1 eavesdropped on student2 to get his login and password.
Postconditions:
Success postconditions: Student1 doesn't succeed in accessing the student2 account
Failure postconditions: Student1 succeeds in getting access to the student2 account.

Basic flow
1. Student1 eavesdrops on Student2 to get student2 password and login id.
2. Student1 tries accessing the student2 account with the login information he has.
3. Student1 is not able to log in to the account of student2 after 3 tries, as he is being rate-limited now.
4. Student1 tries to brute force attack the password in an attempt to access the student2 account. He gets 3 rate-limited warnings and the student2 account is blocked and can be unblocked by admin.
5. Student1 fails to access student2 account and gives up.

Alternative flow
4.a After 1 or 2 rate-limited warning, in the third attempt he tries some software that has the capability to overcome rate-limited errors
4.b The system is designed in such a way that can handle such software and still blocks the software from bypassing rate-limiting error.

Exception flow
4.a Student1 cracks the password of student2 before the rate-limiting error is hit a maximum number of times and before the student2 account is blocked.
4.b Student1 gets every information he wants and he logs out of the account.
4.c System fails to block student1 with the rate-limited feature too as student1 was lucky to crack the password, due to the poor password setting of student2 or because of eavesdropping.

2ND ABUSE CASE [USING UML ACTIVITY DIAGRAM



QUALITY UTILITY TREE

Quality attribute	Quality Scenario name	Quality Scenario brief description	Quality Scenario utility to users [Low = 1, Medium = 2, High = 3]	Estimated Quality Scenario development difficulty or risk (Dificult or high risk = 1, Medium difficulty or risk = 2, Rather easy and low risk = 3)	Scenario priority score (utility * difficulty)
RELIABILITY	Low Failure Rate	It is critical to ensure that the LMS is reliable and operational for a significant amount of time. Allow failure rate means less disruption for students and educators.	3	2	6
RELIABILITY	Data Integrity and Backup	It is critical to safeguard the integrity of the data within the LMS. Data backups and recovery methods are to be performed on a regular basis to guarantee to ensure that critical information is not lost.	3	2	6
PERFORMANCE	Low Response Time	Users anticipate a responsive system as well as a pleasant hassle-free learning experience. Low Response Time means better performance as the server/application takes less time to respond to user commands.	2	2	4
SCALABILITY	System Scalability	To support growing user enrollment and increasing number of courses, scalability is required. LMS should efficiently be able to handle the projected increase and ensure that the response time is reasonable and it does not significantly affect other features of the LMS System	2	2	4

USEABILITY	User-Friendly Interface	A user-friendly design makes it easier to navigate and interact with the LMS. It improves both students and educators' overall user experience.	3	3	9
MODIFIABILITY	Modular System Design	The system should be modular in design to meet changing requirements	3	3	9
AVAILIBILITY	High Availibility of Content	Evaluating the LMS's availability to ensure that it is accessible to users reliably and consistently. This will enhance the users learning experience	2	3	6
MAINTAINABILITY	Modularity and Componentization	A well-structured, flexible design with simple categorization enables for quicker upgrades, maintenance, and enhancements without causing system disruption. This will enable smoother learning without disturbing other components.	2	2	4
MAINTAINABILITY	Documentation and Knowledge Transfer	Extensive documentation and effective communication practices allow knowledge transfer among team members and ensure continuity in system management.	3	3	9
TESTABILITY	Test Data Management	Efficient test data management ensures that test scenarios may run with realistic and diverse data, revealing potential data handling errors.	3	2	6
PORTABILITY	Content and Data Portability Across Platforms	The LMS's ability to effortlessly fit with numerous platforms increases its utility in a diversified educational setting.	3	2	6
SECURITY	User Authentication	Authentication verifies the identity of the user, ensuring they are who they claim to be. Common authentication methods include passwords	3	2	6

SECURITY	Role Authorization	Different users will possess different authorization based on students, teachers, or admin roles	3	1	3
SECURITY	Protection of User Data	Protecting user data, including personal information and academic records, is paramount. Robust security measures safeguard sensitive data.	2	1	2

LIST OF FUNCTIONAL FEATURES & QUALITY SCENARIOS WITH HIGH PRIORITY.

The Functional features and quality Scenarios can be divided into the basis of Priority. This list of features and scenarios will be further designed and developed and carries the potential to be upgraded further.

1. **User-Friendly Interface (Usability)**: With the possibility to enhance and improve the LMS's user interface, the LMS team remains committed to offering an extraordinary user experience. User suggestions and inputs will help in making it even more intuitive and user-friendly.

2. **Modular System Design (Modifiability**): In case there is a need that arises to modify the system to meet the growing demands or requirements it is possible to manage the increasing number of students, instructors and even courses, to provide sufficient learning and various options to the users. Similarly, it is possible to modify and streamline future enhancements and upgrades by modifying the codebase, design and architecture

3. **Documentation and Knowledge Transfer (Maintainability)**: This system's efficient operation is based on effective knowledge transfer and communication. It is critical to keep the documentation current and easily accessible and to look forward to knowledge-sharing efforts, such as mentorship programs, to broaden the collective expertise.

4. **Low Failure Rate (Reliability)**: The importance of reliability cannot be overstated. To reduce disruptions even further, investing more in proactive monitoring and automated issue management is possible. This will help to further minimize the failure rate and assure continuous functioning.

5. **Data Integrity and Backup (Reliability)**: One of the top objectives is to protect the integrity of data. To maintain data security, it is necessary to improve the data backup and recovery processes, adopting robust disaster recovery solutions.

TOP THREE HIGHEST PRIORITY QUALITY SCENARIOS USING THE SEI TEMPLATE

1. Modifiability Scenario - Modularity in System Design

Source of the stimulus: Users (Students and Instructors) interact with the LMS to change course materials,Changing educational requirements, complete assignments and quizzes, and modify the courses.

Stimulus: Modifying or enhancing the LMS to address changing requirements, integrate new features, or improve performance.

Environment: Normal operating conditions/satisfying the growing demands of modifications of the stakeholders in the future/fulfilling the demand of changing requirements OR during maintenance.

Artifact: The system's software architecture, including its modular design, codebase, and documentation.

Response: The LMS should exhibit the following characteristics to meet the modifiability requirements:

> i) The system should be developed with a modular architecture that allows components to be modified, added, or replaced separately without affecting other aspects of the system.
> ii) Clear and well-documented interfaces should be built between modules to allow for simple communication and interaction between components.
> iii)The Instructors and Administrators should be able to successfully modify the course structure and design as per their requirements in making learning more effective.

Response measure: the amount of time required to implement a desired change or enhancement. Modular designs that are efficient should result in shorter modification times. Within 1 hour.

2. Maintainability Scenario - Documentation and Knowledge Transfer

Source of the stimulus: Software Development Team, Instructors and Administrators who may maintain the system later.

Stimulus: The stimulus is the need to access and transfer knowledge related to the LMS's architecture, design, configurations, and best practices for maintenance and enhancements.

Environment: The LMS operates under normal conditions or under maintenance.

Artifact: The knowledge repository and documentation, including architecture diagrams, design specifications, codebase documentation, configuration guides, and maintenance procedures.

Response: To achieve maintainability standards, the LMS user interface should include the following characteristics:

> i) Maintain updated and thorough documentation on system architecture, design concepts, codebase, configurations, deployment processes, and maintenance procedures.
> ii) Ensure that documents and expertise are saved in an accessible repository or knowledge management system that team members may easily access.
> iii)To encourage knowledge transfer among team members, establish effective communication practices such as regular team meetings, information-sharing sessions, and mentorship programs..

Response measure: Determine the extent to which various parts of the LMS are recorded. This can be measured by calculating the percentage of covered areas (for example, architecture, code, and configurations) that will exceed more than 95%.
Assess the currency of documentation by tracking the frequency of updates to documentation materials. Up-to-date documentation is a sign of effective knowledge management and measures the time it takes to onboard new team members and make them productive. Effective knowledge transfer should reduce onboarding time and it should take approximately 1 day(under normal circumstances) to transfer knowledge and to understand the procedures.

3. Usability Scenario - User-Friendly Interface

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

Stimulus: Navigation and interaction with the LMS

Environment: Normal operating conditions

Artifact: LMS User Interface, including the homepage, course pages, login page, navigation menu and content page, etc.

Response: To achieve usability standards, the LMS user interface should include the following characteristics:

> i) Users should find it simple to navigate through the LMS, with clear and properly organized menus and links.
> ii) Design elements and layouts should be consistent throughout the interface to ensure predictability in interaction.
> iii)Course materials and information should be provided in an easy-to-understand way, with clear headings, formatting, and multimedia integration when required.

Response measure: The LMS should provide responsive and fast interactions, ensuring that users do not experience significant delays or slowdowns when navigating and interacting with the interface and ensure that in the post-survey conducted amongst users, more than 95% of the users found the user interface extremely satisfying.