ELO Learning

REQUIREMENTS DOCUMENT

ZERO DAY

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1 Introduction

1.1 Purpose of the Document

The purpose of this document is to define the user stories, use cases, functional and non-functional requirements for the ELO Learning platform. It outlines the objectives of the system, describes the features and interactions expected from users, and sets the foundation for system design and development. This document serves as a point of reference for our development team, project stakeholders, and any future maintenance efforts.

1.2 Scope of the System

ELO Learning is a gamified math app designed to help students from Grade 8 to first-year university level improve their mathematical proficiency. Using an ELO-based rating system inspired by competitive games, the platform matches students with questions that reflect their skill level.

Students begin by filling in their profile and completing a baseline test, which dynamically adjusts in difficulty using a decision tree structure. Based on their performance, the system assigns them an initial ELO score. The platform includes features such as secure user authentication, gamification elements (badges, leaderboards), and personalised analytics to promote engagement and continuous learning.

1.3 Intended Audience

This document is intended for:

- **Developers and Designers:** To understand the system functionality and implement the design accordingly.
- **Project Stakeholders (Proking Solutions):** To ensure the platform meets business and user goals.
- **COS 301 Supervisors and Evaluators:** To assess the completeness and feasibility of the project.
- **Testers:** To develop test plans and verify the system against requirements.
- **Future Maintenance Teams:** To provide a clear reference for enhancements or troubleshooting.

2. User Stories

The user stories are discussed from 2 different perspectives, that of students, and general users.

1. Students (Primary Users)

Grade 8 to first-year university students.

1. As a student, I want to sign up and create my profile by providing my personal (name, surname, username, email address) and academic details (age, grade, and confidence level) so that the platform can tailor the experience to my level.

2. As a student, I want to take a baseline math test that adapts in difficulty depending on my answers so that the system can accurately determine my skill level and assign an ELO rating.

3. As a student, I want to see one question at a time during the baseline test so that I can focus without distractions.

4. As a student, I want to answer questions using a math keyboard so that I can input notation like fractions and exponents correctly.

5. As a student, I want to face easier questions when I get one wrong, and harder ones when I get one right so that the system adjusts to my ability during the baseline test and ranked matches.

6. As a student, I want my ELO rating to be determined based on how I perform during the baseline test so that my learning journey is personalized.

7. As a student, I want to view my current ELO rating and performance stats (such as accuracy and progress over time) so that I can track my improvement.

8. As a student, I want to choose between different game modes– Ranked Matches, Practice Rounds, and Timed Rounds– so that I can learn in a way that suits my goal (be it to progress or speed).

9. As a student, I want to solve math problems in Ranked Matches based on my ELO so that I can improve my rating and feel challenged.

10. As a student, I want to enter Practice mode with questions at my current level or a level of my choice so that I can improve at my own pace.

11. As a student, I want to attempt Timed matches where I solve as many questions as possible under a time limit so that I can sharpen my speed and accuracy.

12. As a student, I want to view a full memorandum (correction and explanation) for each practice or test question at the end so that I can learn from my mistakes.

12. As a student, I want to retake problems I previously got wrong so that I can reinforce learning and improve on my weaknesses.

13. As a student, I want to earn badges and rewards as I complete goals and milestones so that I stay motivated.

14. As a student, I want to earn XP for correctly solving questions (especially in practice and timed modes) so that I feel rewarded for my effort.

15. As a student, I want to appear on a leaderboard ranked by XP, so that I can compare myself to others and engage in healthy competition.

16. As a student, I want to access the platform on both my phone and desktop so that I can practice anytime, anywhere.

2. System

Adaptive Testing & ELO Calculation

1. As the system, I want to use a decision tree to guide the baseline test so that each question adapts based on the student's previous response.

2. As the system, I want to assign difficulty levels to questions from 1 to 10 so that I can measure user performance accurately.

3. As the system, I want to determine the student's initial ELO rating based on the most consistently correct difficulty level during the baseline test so that the learning level is accurate.

4. As the system, I want to update a student's ELO rating after each problem submission (especially in ranked mode) so that future challenges reflect their current skill level.

5. As the system, I want to select problems based on a student's ELO and topic history so that they receive appropriate and varied challenges.

6. As the system, I want to adapt question difficulty dynamically based on recent performance trends so that the challenge remains balanced.

7. As the system, I want to store and track each student's ELO history over time so that trends and improvement can be visualized.

Submission Evaluation & Feedback

8. As the system, I want to parse and evaluate math expressions submitted in LaTeX format so that I can accurately assess correctness.

9. As the system, I want to provide immediate visual feedback (correct/incorrect, color indicators) after a submission so that students can learn effectively.

10. As the system, I want to suggest short tutorials or hints when a student fails a problem multiple times so that they don't feel stuck.

11. As the system, I want to recommend a review topic when a student repeatedly struggles in a specific area so that they can focus their improvement.

Tracking & Analytics

12. As the system, I want to log every problem attempt with metadata (time taken, number of attempts, type of answer) so that analytics remain comprehensive.

13. As the system, I want to track the time of day and session duration so that I can optionally suggest breaks when students seem fatigued (wellness feature).

Leaderboard and Abuse Prevention

14. As the system, I want to update the leaderboard in real-time when a user's XP/ELO changes so that rankings are always current.

15. As the system, I want to detect abnormal behavior (e.g, spamming submissions, solving too fast) so that abuse or misuse of the platform can be flagged.

Notifications & Engagement

16. As the system, I want to send push notifications reminding students to complete their daily lesson so that they stay consistent in their learning routine.

17. As the system, I want to notify students when new badges or achievements are unlocked so that they feel recognised and motivated.

18. As the system, I want to remind students if they haven't logged in for several days so that they do not fall behind or forget to practice.

19. As the system, I want to notify students when their leaderboard position changes so that they stay engaged and motivated to keep progressing.

3. Admin (Developers and Stakeholders)

Content & Question Management

1. As an admin, I want to upload, manage, and categorize math problems by topic and difficulty so that the problem pool stays educational, relevant, and diverse.

2. As an admin, I want to update or delete outdated questions so that users always receive accurate content.

User Account Management

3. As an admin, I want to view and manage user accounts so that I can maintain the platform's integrity and respond to user requests.

4. As an admin, I want to delete a user from the system if they choose to delete their account so that personal data is fully removed.

5. As an admin, I want to deactivate or suspend user accounts in case of misconduct or policy violations so that the platform remains safe and compliant.

6. As an admin, I want to send a notification to students when their account is deleted so that they are informed of changes to their access.

Data Protection & Compliance

7. As an admin, I want to ensure all student data is stored securely and in compliance with POPIA and other data protection regulations so that users' privacy is protected.

8. As an admin, I want to manage access control for platform roles so that only authorized personnel can handle sensitive data.

Analytics & Trends

9. As an admin, I want to view anonymized student performance trends and ELO progression data so that I can monitor educational impact and content effectiveness.

10. As an admin, I want to receive usage reports (active users, session length, engagement levels) so that I can analyze platform health and retention.

11. As an admin, I want to explore topic-based performance analytics (common mistakes, frequently attempted topics) so that I can improve content and strategy.

3. System Requirements

FR1: User Registration and Profile Creation

- **FR1.1** The system must provide a registration form for students to input name, surname, age, email address, grade and math confidence level.
    - FR1.1.1: If a username that is already selected is chosen, prevent the student from selecting that username.
- **FR1.2** The system shall validate and securely store user information.
- **FR1.3** The system shall allow students to edit their profile data after registration.

FR2: Secure Login and Authentication

- **FR2.1** The system shall allow students to log in using their username and password.
- **FR2.2** The system shall implement password hashing and secure authentication mechanisms.
- **FR2.3** The system shall provide error messages for incorrect login attempts and allow password resets.

FR3: Baseline Testing & Adaptive Questioning

- **FR3.1** The system shall show one math question at a time to reduce cognitive load.
- **FR3.2** The system shall determine whether to branch left (easier) or right (harder) in the decision tree based on correctness of the student's answer.
- **FR3.3** The system shall use question difficulty levels ranging from 1 to 10.
- **FR3.4** The system shall compute an initial ELO rating based on consistent performance at a given level.

FR4: Game Modes and Math Practice

- **FR4.1** The system shall allow students to choose from three modes: Ranked Matches, Practice Rounds, and Timed Rounds.
- **FR4.2** The system shall deliver Ranked Match questions based on the user’s current ELO.
- **FR4.3** The system shall limit Timed Rounds to a predefined time and track the number of correct answers within that period.
- **FR4.4** The system shall update the student’s ELO rating after every ranked match.
- **FR4.5** The system shall allow students to retake previously incorrect problems from their practice history.

FR5: Math Keyboard Input

- **FR5.1** The system shall include a math keyboard supporting symbols like fractions, exponents, square roots, and Greek letters.

FR6: Feedback and Memorandum

- **FR6.1** The system shall display immediate visual feedback (correct/incorrect) after every answer.
- **FR6.2** The system shall display a full memorandum or worked solution after each practice or test session.
- **FR6.3** The system shall recommend review topics or hints when a student struggles repeatedly.

FR7: XP, Badges, and Leaderboards

- **FR7.1** The system shall award XP for correct answers in Practice and Timed Rounds.
- **FR7.2** The system shall assign badges for milestone achievements.
- **FR7.3** The system shall maintain a real-time leaderboard ranked by XP.
  FR7.4 The system shall allow filtering of the leaderboard by ELO ranking.

FR8: ELO & Performance Analytics

- **FR8.1** The system shall display the student's current ELO rating and progress chart over time.
- **FR8.2** The system shall store a history of ELO changes and match data.
- **FR8.3** The system shall allow students to view accuracy, number of questions attempted, and topic mastery.

FR9: Push Notifications

- **FR9.1** The system shall notify students to complete their daily lesson or activity.
- **FR9.2** The system shall notify students when badges or achievements are unlocked.
- **FR9.3** The system shall notify inactive users after a predefined period.
- **FR9.4** The system shall notify users when their leaderboard rank changes.
- **FR9.5** The system shall notify students when their account is deleted or deactivated by admin.

FR10: User Accessibility

- **FR10.1** The system shall be accessible on desktop and mobile browsers.
- **FR10.2** The interface shall be responsive and support input from touchscreens and keyboards.

FR11: Admin – Content & Question Management

- **FR11.1** The system shall allow admins to upload, edit, delete, and categorize math problems by topic and difficulty.

FR12: Admin – User Management

- **FR12.1** The system shall allow admins to view, suspend, or deactivate user accounts.
- **FR12.2** The system shall allow admins to delete user accounts upon request, permanently removing all associated data.
- **FR12.3** The system shall send a confirmation notification to the user upon account deletion or suspension.

FR13: Admin – Compliance and Data Security

- **FR13.1** The system shall store all user data in an encrypted and secure format.
- **FR13.2** The system shall ensure role-based access control for all admin functions.
- **FR13.3** The system shall anonymize user data in reports to protect identities.

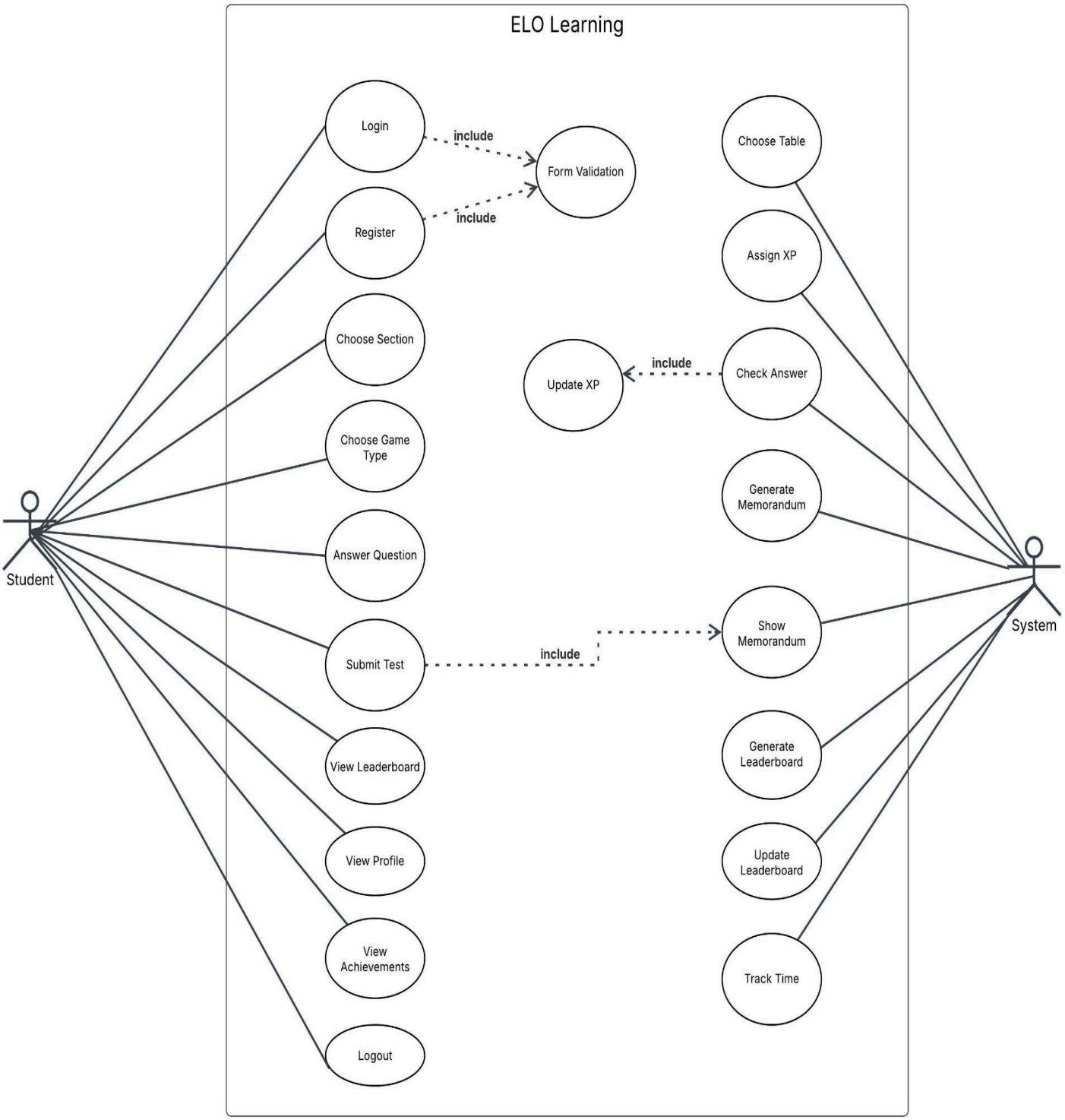
FR14: Admin – Reporting and Analytics

- **FR14.1** The system shall generate reports on student activity, performance trends, and engagement.

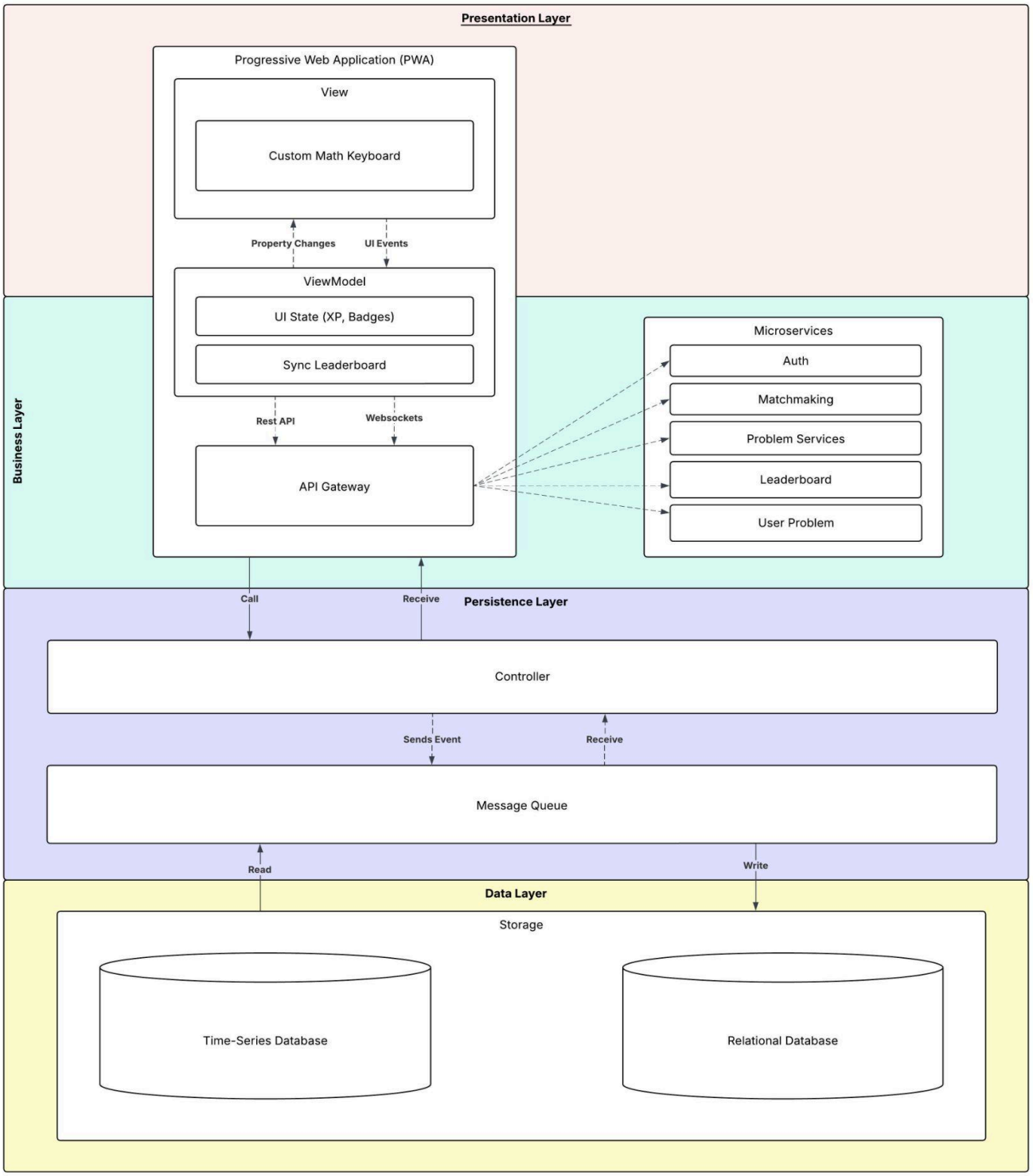
- **FR14.2** The system shall provide dashboards showing ELO progression, topic weaknesses, and common user errors.

- **FR14.3** The system shall allow filtering of analytics by grade level, activity type, and time frame.

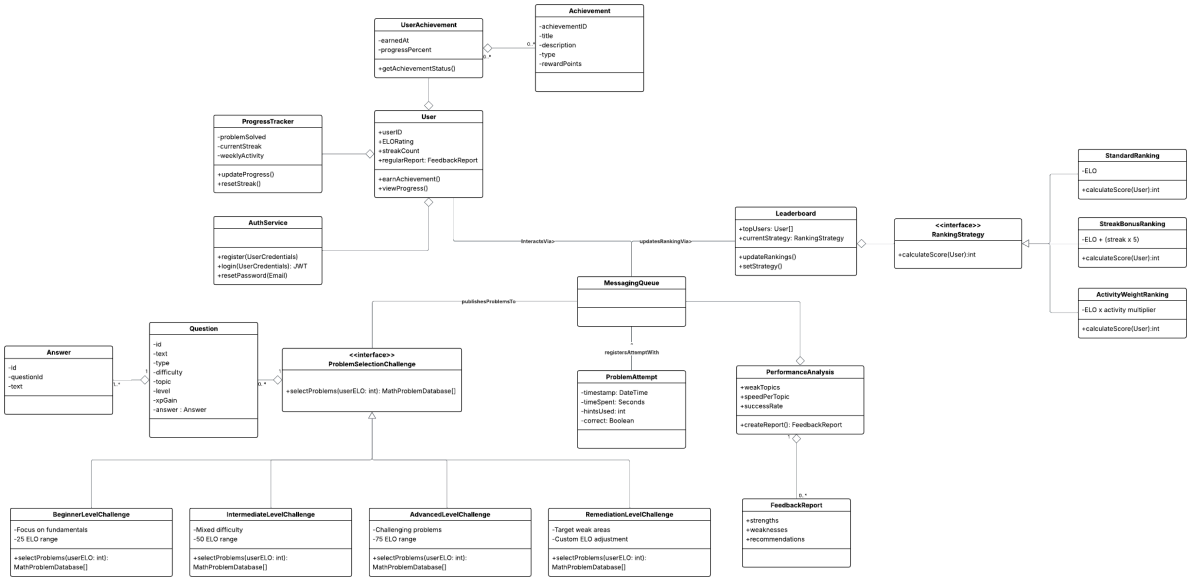
4. Use Cases


ELO Learning
Login
include
Form Validation
Register
include
Choose Section
Choose Game Type
Answer Question
Submit Test
View Leaderboard
View Profile
View Achievements
Logout
Update XP
include
Check Answer
include
Choose Table
Assign XP
Generate Memorandum
Show Memorandum
Generate Leaderboard
Update Leaderboard
Track Time
Student
System

5. Architectural Diagram



5. Domain Model



6. Math Sections

Grade 8:

Paper 1	Paper 2
Fractions	Construction of Geometric Figures
Integers	Geometry of 2D Shapes
Exponents	Geometry of Straight Lines
Numeric and Geometric Patterns	
Functions and Relationships	
Algebraic Expressions	
Algebraic Equations	

Grade 9:

Paper 1	Paper 2
Fractions	Construction of Geometric Figures
Integers	Geometry of 2D Shapes
Exponents	Geometry of Straight Lines
Numeric and Geometric Patterns	Pythagoras' Theorem
Functions and Relationships	Area and Perimeter of 2D Shapes
Algebraic Expressions	
Equations	

Grade 10:

Paper 1	Paper 2
Fractions	Construction of Geometric Figures
Integers	Geometry of 2D Shapes
Exponents	Geometry of Straight Lines
Numeric and Geometric Patterns	Pythagoras' Theorem

Functions and Relationships	Area and Perimeter of 2D Shapes
Algebraic Expressions	
Equations	

Grade 11 + 12:

Paper 1	Paper 2
Algebra & equations	Statistics
Patterns & Sequences	Analytical geometry
Financial Mathematics	Trigonometry
Functions and Graphs	Euclidean geometry (Circle Geometry)
Probability	Measurement
Introduction to Calculus	