Software Requirements Specification

for

MathStack

Version 2.0 approved

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Revision History

Name	Date	Reason For Changes	Version
Fremont Teng	13/02/2020	Added Dialog Map, Use Case Diagram	1.0.0
Shiny Gladdys	13/02/2020	Added Decision Table	1.0.1
Teo Kai Jie, Germaine Kwek, Shiny Gladdys, Marcus Tham, Sun Jinghan	07/04/2020	Added descriptions	2.0.0
Teo Kai Jie, Germaine Kwek, Shiny Gladdys, Marcus Tham	23/04/2020	Final vetting	2.1.0

1. Introduction

1.1 Purpose

The purpose of this document is to provide a comprehensive outline on the usage and development of the MathStack application, a social game that gamifies the learning of mathematics. In this document, we will explain the requirements and planning of the application development.

1.2 Document Conventions

The following document conventions are followed in preparing this SRS document:

- This document is created based on the IEEE template for System Requirement Specification documents.
- All body text is formatted in the Arial font with font size 11 and a line spacing of 1.5.

1.3 Intended Audience and Reading Suggestions

This document is intended for:

- Software Development Team : To implement the code, the requirements and the features intended for the game.
- Documentation Team : To create the requirements in written forms through diagrammatic models and texts. This is so that they can better comprehend the information from this report.
- Software Testing Team : To ensure the quality and standard of the game product is upheld before release.
- Course Instructors : To review and monitor the progress of the game development, as well as deployment.

1.4 Product Scope

The scope of the to-be-developed MathStack game application will be:

- To allow students to learn and play competitively to improve their knowledge in discrete mathematics.
- To expose students to a wide array of topics from basic to advanced.
- To let students challenge one another for competitive leaderboard ranks and be able to assess their own mastery of Mathematics.
- To facilitate teachers to track the learning progress of their added students through quiz statistics.

1.5 References

The application is conceptualised and created based on the lab requirements of CZ3003, Software Systems Analysis and Design lab project.

The following are the reference links used to construct this SRS document:

- Software Requirements Specification (SRS) Template
- Software Requirements Specification document with example

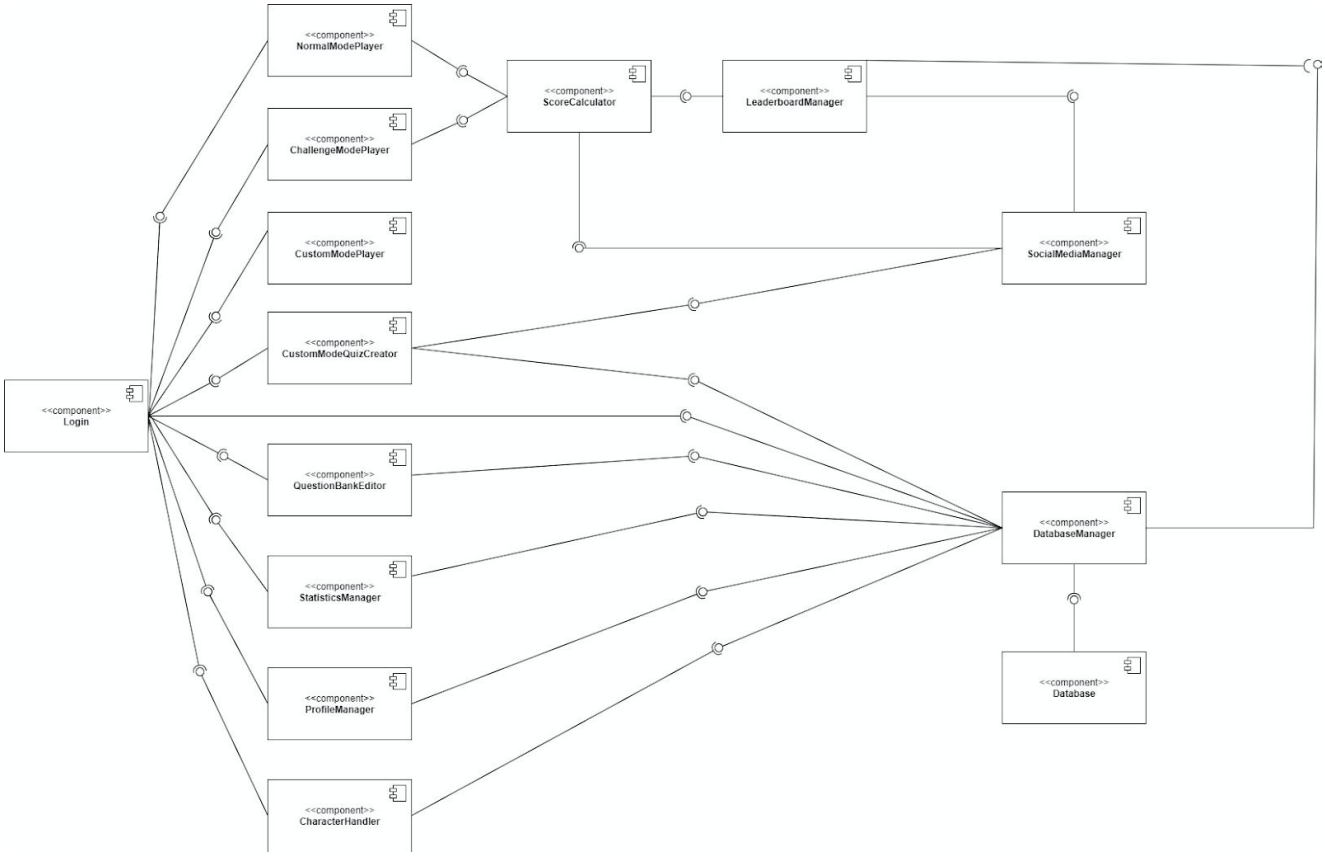
2. Overall Description

2.1 Product Perspective

Discrete mathematics can be a challenging subject to teach in universities today. In the university context, it can prove difficult for professors and teachers to effectively gauge the proficiency of students due to limited assessments and contact time. Creating an interactive game will provide the practice and feedback needed by students.

Our application is a game that allows students to practise questions and move on to different levels based on their real time performance in the game. That is to say, if the student does well, he/she will get more difficult questions.

The following diagram illustrates the black box component diagram of our game, MathStack. It shows the main components and interactions between components.



2.2 **Product Functions**

The list of features of Mathstack is summarised below:

- Create Account
    - The user is able to create a new account.
- Login
    - User authentication to check if a user has an existing account.
- Edit Profile
    - User is able to edit his/her profile information
- Choose Character
    - User is able to select his/her character to be used in Challenge Mode
- Play Normal Mode
    - User is able to play Normal Mode
- Play Challenge Mode
    - User is able to play Challenge Mode

    - View Leaderboard
        - User is able to view his/her leaderboard
        - Share to Social Media
            - User is able to share the leaderboard to his/her social media account
- Play Custom Mode
    - User is able to play Custom Mode
    - Contribute questions
        - User is able to add his/her questions in Custom Mode
- Manage Database
    - Administrator is able to access and manage the database information
- View Statistics
    - Teacher is able to view the statistics of students' playing history, percentage completion and scores
- Edit Question Bank
    - Teacher and administrator are able to add and remove questions in the question bank

2.3 User Classes and Characteristics

The following are user classes that are involved in the use of the MathStack application.

Class	Characteristic(s)
Student	● Student refers to any user of the application, that are the undergraduate students of the registered course(s) in the application. ● Students will have a higher frequency in using the application, because they will participate in the quizzes, view their progress and view administrative details of the course. ● The access to the application by students will only be restricted to participating in the assigned quizzes and viewing their information and course details. ● Students will select the 'Student' domain when signing in.

Instructor/ Teacher	● Instructors/ Teacher refers to the user of the application that provides the teaching content and teaches in the assigned course(s). ● Instructors/ Teachers have a high frequency access to the application as they will need to track the progress of the students and update the course content in the application. ● Instructors/ Teachers will require high access to the application as they need to know the information of the students enrolled in the course(s) and the teachable and examinable content. ● Instructors/ Teachers will select the 'Staff' domain when signing in.
Administrators	● Administrators refer to the individuals assisting the course instructors with technical issues and updating of course content if necessary. ● The administrators will hence require a similar access level with the instructors to facilitate the assistance, even though the access frequency of the application is at medium level as they will only access the application when necessary. ● Administrators will select the 'Staff' domain when signing in.

2.4 **Operating Environment**

Our MathStack game application is expected to run in the following atmosphere:

- Operating System - Windows 7 or later, Internet Connection
- Database - Firebase online server database
- Dependencies - Godot IDE, Facebook, Twitter, Reddit and Whatsapp APIs, Java Runtime

2.5 **Design and Implementation Constraints**

Mathstack is designed with the following constraints:

- Social media APIs such as Facebook and Twitter APIs.
- Language is only limited to the English Language.
- Game is only tested on Windows 10 OS.
- All security and authentication information will be stored in the database only.
- Game development time is only limited to 8 weeks.

2.6 User Documentation

- This game software package will come with a user manual as a guide to the interface actions.
- This game software package will come with a demonstration video as a guide to the interface actions.
- This game software package will come with a powerpoint presentation to demonstrate the sequence of use of our game.
- The details of a) analysis , b) Design and c) Test Cases of our game will be delivered with the final product.

2.7 Assumptions and Dependencies

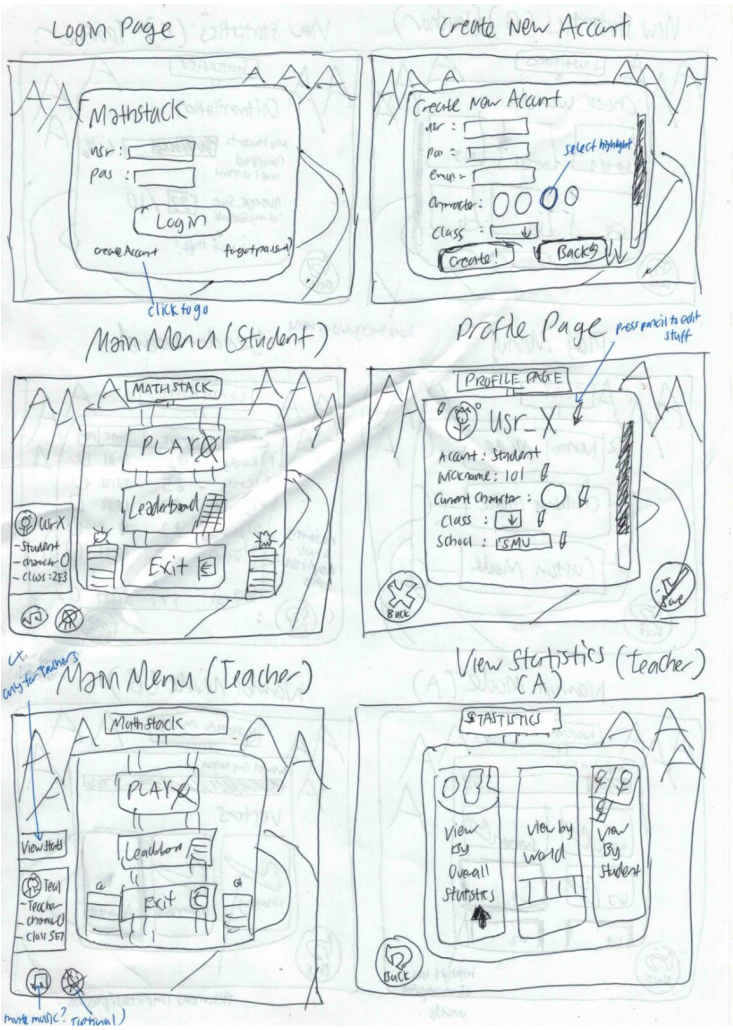
The following assumptions are made during the development of MathStack:

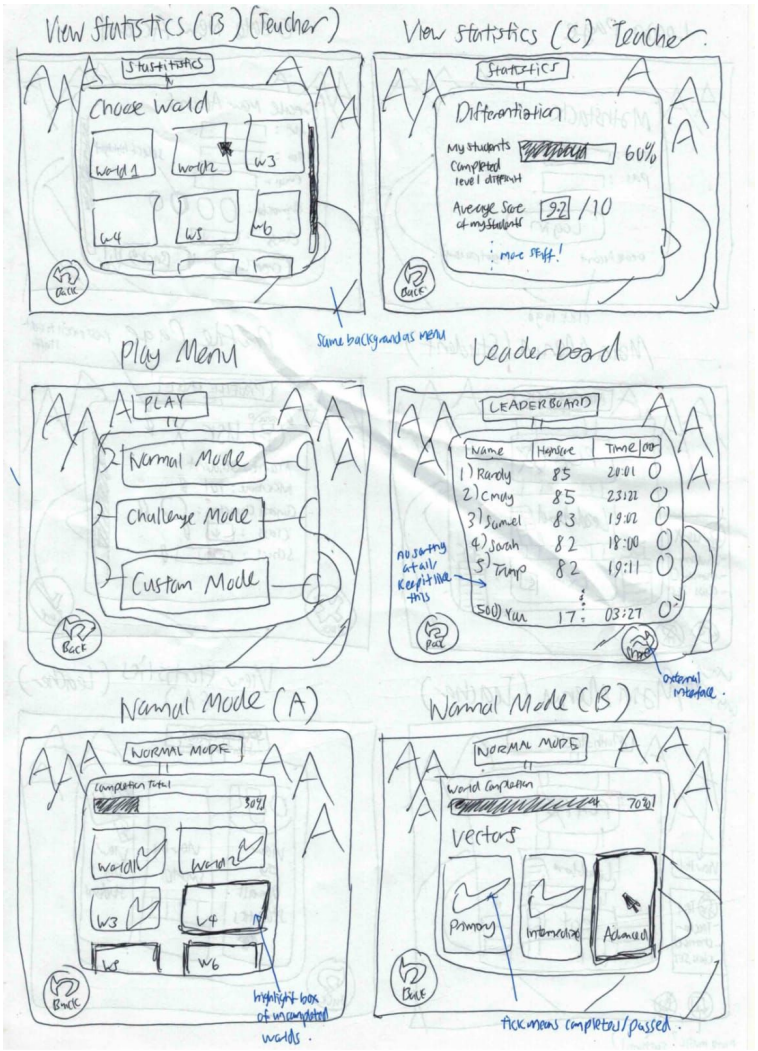
- User is running on a computer with Windows 7 or newer
- User has access to internet connection
- User is an NTU student with a valid NTU account.

3. External Interface Requirements

3.1 User Interfaces

The following screenshots include the various user interface screens as part of our Low-fidelity prototype.

<table>
<tr>
<td> 
</td>
<td>Login page
• The system will first begin with the login page for the user to login.
Create new account
• If the user does not have an account, he or she can create a new account. The user enters his or her particulars in the page.
Main Menu (Student)
• The student can play the activity, enter leaderboard, view his or her information and exit the application.
Main Menu (Teacher)
• The teacher has access to the question bank, no normal mode, and an additional ‘View Statistics’ option.
View Statistics
• The teacher can view statistics of students’ performance (Figure A).</td>
</tr>
</table>



View Statistics (Teacher)

- The teacher can view statistics by World (Figure B) and view summary results (Figure C).

Play Menu

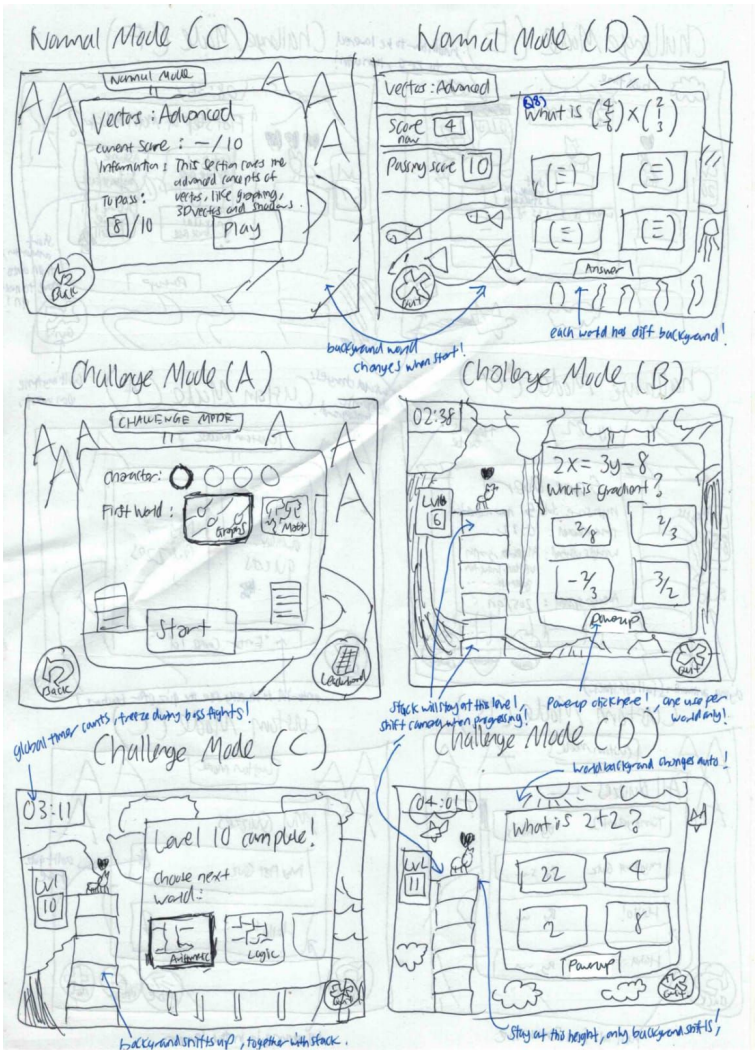
- The student can choose the gameplay mode prior to playing.

Leaderboard

- The user can view his or her standings in the leaderboard after attempting the Challenge Mode.

Normal Mode

- The user will select from the available worlds to attempt while in Normal Mode (Figure A), and each mode is further classified based on its difficulty (Figure B).

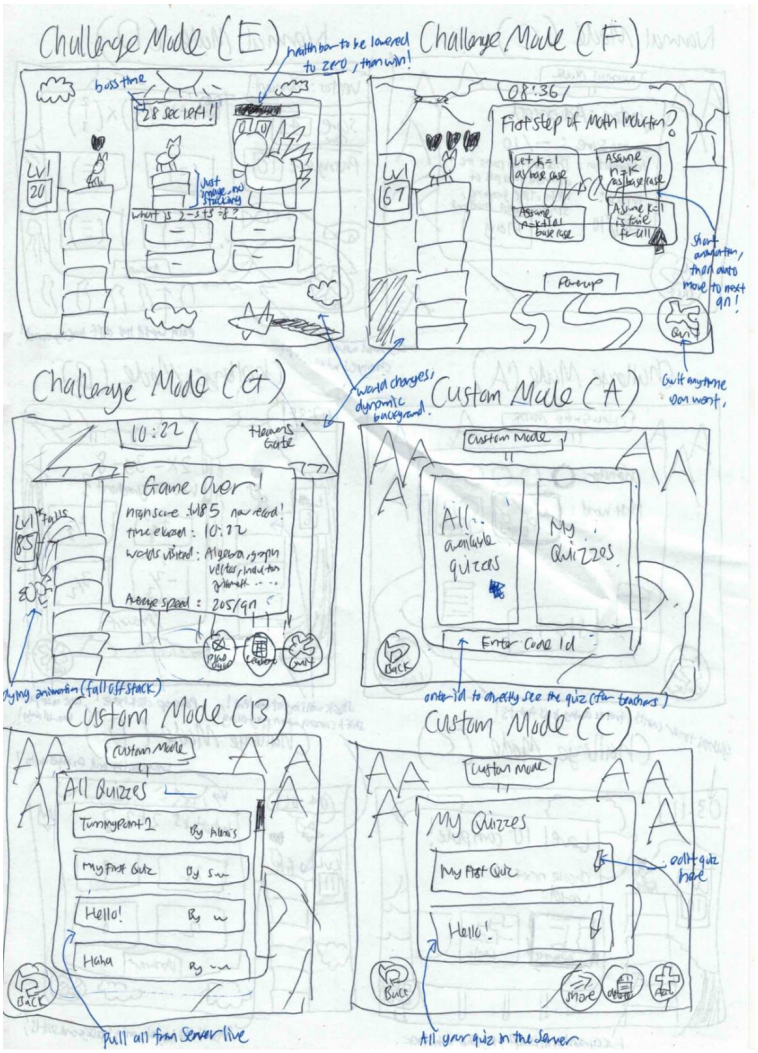


Normal Mode

- As the user selects a difficulty, he or she can view details relating to the difficulty level and begin to play (Figure C). The quiz is conducted in a multiple choice format (Figure D).

Challenge Mode

- The user will first select his or her desired character and the world that he or she wants to begin first (Figure A).
- Similarly to Normal mode, the game is conducted in multiple choice (Figure B). Each time the user got a correct answer, the character jumps up by a tile.
- Once a level is completed, the user can choose another world to play next (Figure C).
- The format of questions is the same across all the Worlds in Challenge mode (Figure D).

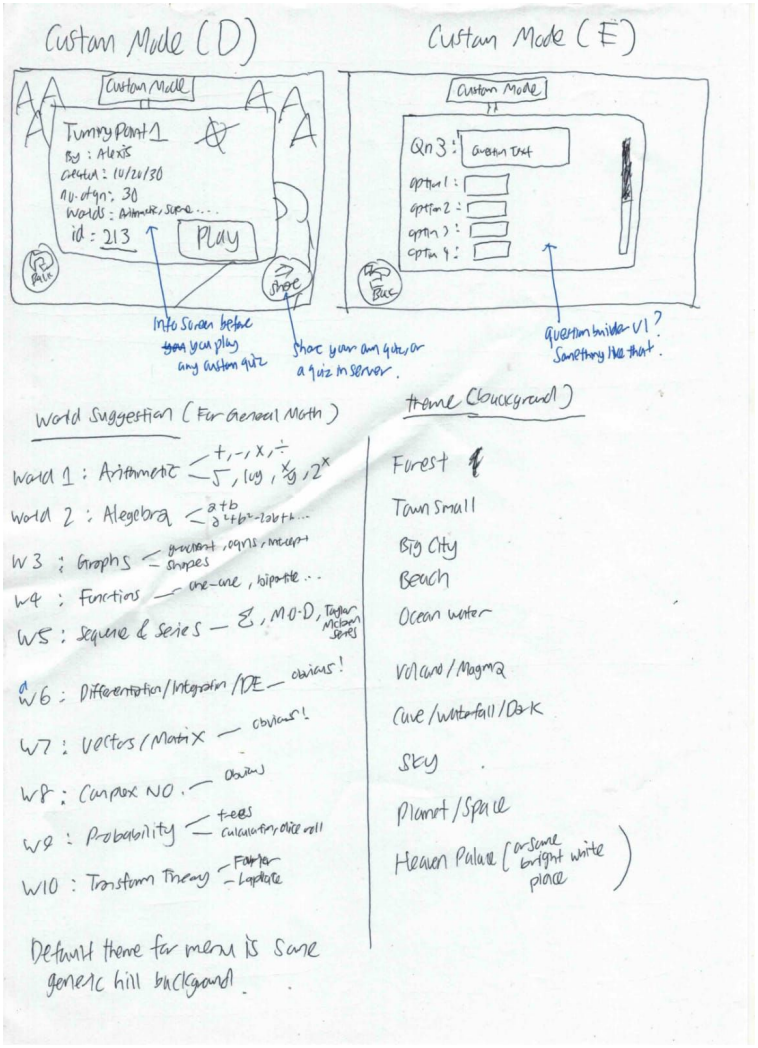


Challenge Mode

- At the end of every ten levels in Challenge mode, the user faces off with a Boss battle which is multiple choice format as well.
- A correct question answered will show the word ‘Correct’ (Figure F).
- If the user gets a question wrongly, he or she will lose the game (Figure G).

Custom Mode

- In Custom mode, the user can see all the available quizzes and the quizzes set by him or her (Figure A).
- All the quizzes contributed by the users will be displayed (Figure B) when the user wants to view them, as well as quizzes created by the user himself or herself (Figure C).



Custom Mode

- The user can attempt the quizzes contributed by fellow users (Figure D) and the questions are set in multiple choice too (Figure E).

3.2 **Software Interfaces**

Windows operating system

Godot IDE

Godot Emulator

Firebase database by Google

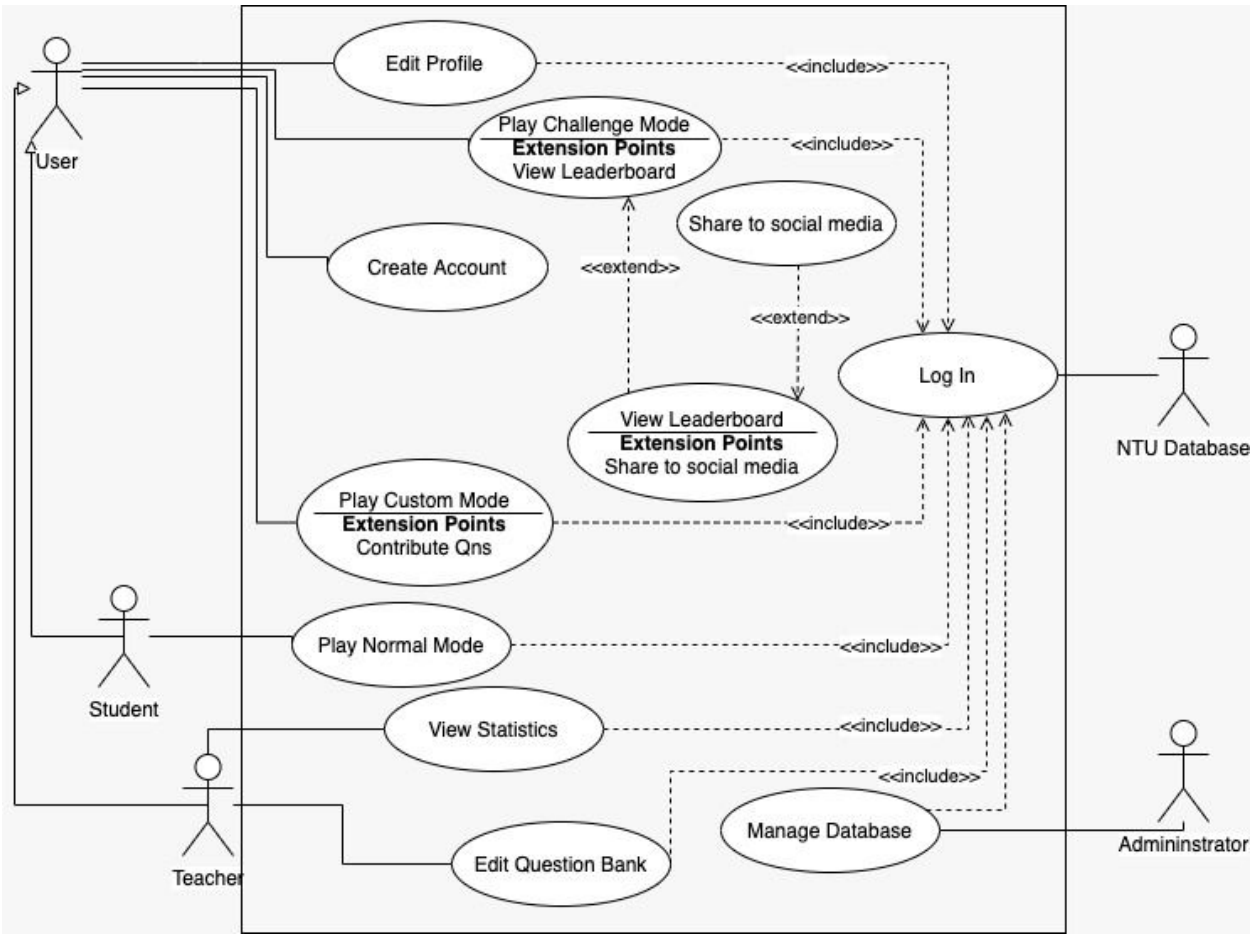
3.3 **Communications Interfaces**

Our MathStack application makes use of the following interfaces for communication:

- HTTP connection with Facebook
- HTTP connection with Twitter
- HTTP connection with NTU servers

4. System Features

4.1 Use Case Diagrams



4.2 Use Case Descriptions

Use Case ID:	UC001		
Use Case Name:	Log In		
Created By:	Jinghan	**Last Updated By:**	Marcus
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher/Administrator
Description:	Student/Teacher/Administrator logs in to the game system via NTU email address. This use case is a precondition for all the other use cases.
Preconditions:	The user has successfully started the application.
Postconditions:	The user has logged in to the game system with a NTU account.
Priority:	High
Frequency of Use:	High
Flow of Events:	1. The user opens the application. 2. The system displays the login page. 3. The user enters his or her username and password. 4. The user clicks the login button. 5. The system verifies the input username and password. 6. The user successfully logs in to the system.
Alternative Flows:	AF-S6: If the authentication fails: 1. The system displays “Incorrect username or password”. 2. The system returns to Step 2.

	AF-S3: If they forgot password: 1. The user clicks on “Forgot Password”. 2. The system displays the email verification page. 3. The user enters their NTU email address into text field. 4. The system checks the email validity, and displays email sent. 5. The user will go to their inbox to reset password.
Exceptions:	EX1: If there is no internet connection: 1. The system displays “No internet connection, please try again later.” 2. The system returns to Step 2.
Includes:	-
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	UC002		
Use Case Name:	Create Account		
Created By:	Kai Jie	**Last Updated By:**	Shiny
Date Created:	22 Apr 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher/Administrator
Description:	The user can create his/her account.
Preconditions:	The user does not have an existing account.
Postconditions:	The user has created his/her account.
Priority:	Medium
Frequency of Use:	Low
Flow of Events:	1. The user clicks on “Register Account”. 2. The user indicates his/her nickname, email address, password, school and class. 3. If the user is a student, he/she leaves the “For Teachers” field empty. 4. The user clicks on “Create Account”. 5. A message indicating, “Account successfully created”, shows on the screen.
Alternative Flows:	AF-S5: If the password is already taken: 1. The system displays “Password is taken”. 2. The system returns to step 2. AF-S3: If the user is a teacher: 1. The user indicates ‘T’ at the “For Teachers” field. AF-S3: If the user is an administrator: 1. The user indicates ‘A’ at the “For Teachers” field.
Exceptions:	-

Includes:	-
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	UC003		
Use Case Name:	Edit Profile		
Created By:	Jinghan	**Last Updated By:**	Jinghan
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher/Administrator
Description:	The user can edit his/her profile in the game system.
Preconditions:	The user has logged in to the system.
Postconditions:	1. The user has edited his/her profile. 2. The new profile has been updated in the system's database.
Priority:	Low
Frequency of Use:	Low
Flow of Events:	1. The user chooses to view his profile. 2. The system displays the profile page with information including profile photo, nickname, school, class and NTU email address. 3. The user chooses the "Edit Profile" button on the profile page. 4. The system displays data fields including nickname and class. 5. The user edits the fields he/she wants to change. 6. The user clicks the "Save" button. 7. The system updates the profile in the database.
Alternative Flows:	AF-S6: If the user doesn't click "Save" and goes back : 1. Input information in the data fields will not be saved. The profile remains the same. 2. The system goes back to step 2.
Exceptions:	-

Includes:	Log In
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	UC004		
Use Case Name:	Play Normal Mode		
Created By:	Jinghan	**Last Updated By:**	Germaine
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student
Description:	The user chooses the Normal Mode to play the game.
Preconditions:	The user has logged in.
Postconditions:	-
Priority:	High
Frequency of Use:	High
Flow of Events:	1. The student chooses Normal Mode. 2. The system displays a list of worlds to be explored in the Normal Mode. 3. The student chooses a world to enter by clicking on it. 4. If the user is playing the world for the first time, the system displays only the beginner section. 5. For each section, the system displays 10 MCQ questions one by one. 6. For each question, the student chooses his/her answer and submits. 7. The system will display the correct answer and detailed explanations for each question after the student attempts it. 8. When all 10 questions are attempted, the system updates the score in the database. 9. If the user has obtained a score of at least 8/10, he/she will see a green tick and is able to move on to the next section.

Alternative Flows:	AF-S4-1: If the user has completed a section in the world previously: 1. He/she will see a green tick at the section, and can see the next section displayed to be attempted. AF-S4-2: If the student wants to try the same section again: 1. The student chooses to replay the section he has completed. 2. The system refreshes the questions. 3. The system returns to step 5. AF-S9: If the student's score is below 8/10: 1. The system shows failure for this section. 2. The student can try this section again. 3. The system returns to step 5.
Exceptions:	-
Includes:	Log In
Special Requirements:	-
Assumptions:	-
Notes and Issues:	1. If the student plays the same section again which he/she has already completed, the new attempt, regardless of the score, doesn't affect his/her completion status. If a higher score is achieved in new attempts, the database records the new score. 2. The student can try as many times as he/she wants if they fail a section.

Use Case ID:	UC005		
Use Case Name:	Play Challenge Mode		
Created By:	Fremont	**Last Updated By:**	Kai Jie

Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher
Description:	The user chooses the challenge mode to play the game.
Preconditions:	The user has logged into the game system with an NTU account.
Postconditions:	1. The scores achieved in the challenge mode have been saved in the database. 2. The leaderboard has been updated based on the new scores and rankings.
Priority:	High
Frequency of Use:	High
Flow of Events:	1. The user chooses challenge mode. 2. The system displays different characters for the user to choose. 3. The user chooses a character. 4. The system shows the chosen character along with the game. 5. The system displays a list of worlds to be explored. 6. The user chooses a world. 7. The system starts the game with 1 life. 8. The system displays the first level question of the current world. 9. The user chooses his/her answer. 10. If the answer is correct, the system verifies the answer and shows a congratulation message. 11. The system adds a concrete block to the stack and moves to the question one level higher. 12. The user repeats steps 8 to 11 until they complete the tenth level of the world. 13. The system shows completion of the current world. 14. The system prompts the user to select the next world. Past completed worlds from the current game will not be shown. 15. The user chooses their next world.

	16. The system displays the question for the first level of that world. 17. Repeating steps 8 to 11 until the user completes the tenth level. 18. The system shows a boss fight menu, and the global time will be stopped. 19. The user must answer as many questions as they can in a stipulated amount of time, and hit more than the required threshold in order to beat the boss. 20. The system adds one life to the user if he/she beats the boss. 21. The system proceeds to the first level of the next chosen world. 22. The game repeats steps 8 to 11 for each world, repeats steps 13 to 15 for completion of each world, and repeats steps 18 to 20 for every 20 level intervals(completion of 2 worlds).
Alternative Flows:	AF-S10-1: If the user's answer is wrong and he still has remaining lives: 1. The system shows the right answer. 2. The user loses one life. 3. The system displays a new question of the same level again. 4. The system returns to step 9. AF-S10-2: If the user's answer is wrong and he has zero lives left: 1. The system displays a "Game Over" animation. 2. System shows the leaderboard with the latest ranking. 3. The user can choose to "Try Again", "Share to Social Media" or "Exit" the game. AF-S20: If the user loses the boss fight: 1. The system shows a failure message. 2. The user loses one life. 3. The system returns to step 6.
Exceptions:	-
Includes:	Log In

Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	UC006		
Use Case Name:	Play Custom Mode		
Created By:	Kai Jie	**Last Updated By:**	Marcus
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher
Description:	The user chooses the custom mode to play the game.
Preconditions:	The user has logged into the system with his NTU account.
Postconditions:	-
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	1. The user chooses custom mode. 2. The user is able to attempt the existing quizzes created by all users or create a new quiz. 3. If the user chooses to attempt the existing quizzes, he/she clicks “View quizzes”. 4. The user can select a quiz from the list of available quizzes to play. 5. The user attempts a quiz. 6. The user shall be able to view the answer to the quiz question after the attempt.
Alternative Flows:	AF-S3-1: If the user chooses to create a quiz: 1. The user selects “Create custom quiz”. 2. The user adds the question text, up to 4 answer options, the correct answer and the explanation, where the explanation is optional. 3. The quiz will be added to the database. 4. The user can also share an announcement of the created quiz on social media.

	AF-S3-2: If the user chooses to delete a quiz that he/she has created: 1. The user clicks “View quizzes”. 2. The user selects the quiz contributed by him/her to be deleted. 3. The quiz is deleted from the database. AF-S3-3: If the user chooses to edit a quiz that he/she has created: 1. The user clicks “View quizzes”. 2. The user selects the quiz contributed by him/her to be edited. 3. The user can edit the question text, answer options, the correct answer and the explanation. 4. The quiz will be updated in the database.
Exceptions:	-
Includes:	Log In
Special Requirements:	-
Assumptions:	-
Notes andIssues:	-

Use Case ID:	UC007		
Use Case Name:	View Leaderboard		
Created By:	Marcus	**Last Updated By:**	Shiny
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher
Description:	The user views the leaderboard of rankings in the challenge mode.
Preconditions:	This use case extends [UC005 Play Challenge Mode].
Postconditions:	-
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	1. The user clicks on “View leaderboard”. 2. The system displays a leaderboard showing the rankings of all players in the challenge mode.
Alternative Flows:	-
Exceptions:	-
Includes:	-
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	UC008		
Use Case Name:	Share to social media		
Created By:	Shiny	**Last Updated By:**	Marcus
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Student/Teacher
Description:	The user can share his/her leaderboard score to social media platforms.
Preconditions:	This use case extends [UC007 View Leaderboard]. It is initiated when the user wants to share his/her leaderboard score to their social media platform.
Postconditions:	-
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	1. The user clicks 'Share Leaderboard'. 2. The system displays a menu of social media platforms. 3. The user selects the platform that he/she wants to share it on. 4. The system directs to the external interface of the social media platform.
Alternative Flows:	-
Exceptions:	-
Includes:	-
Special Requirements:	-
Assumptions:	-

Notes and Issues:	-

Use Case ID:	UC009		
Use Case Name:	View Statistics		
Created By:	Marcus	**Last Updated By:**	Kai Jie
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Teacher
Description:	The teacher views statistics to assess the mastery of students for the course. The statistics include: 1. The students' individual completion percentage 2. Completion percentage of the worlds in the Normal Mode 3. Completion percentage of the entire Normal Mode 4. Records set by students in the challenge mode
Preconditions:	The teacher has logged in to the system.
Postconditions:	-
Priority:	Medium
Frequency of Use:	Medium
Flow of Events:	1. The teacher clicks "View Statistics" on the main interface. 2. The system displays a menu with three options: "View overall statistics", "View by World" and "View by student". 3. The teacher clicks on " View overall statistics". 4. The system displays a table showing: a. average completion percentage for the normal mode of all students. b. average quiz score in the normal mode of all students. c. average highest score in the challenge mode of all students.

Alternative Flows:	AF-S4-1: If the teacher chooses to view statistics by world: 1. The system presents a list of worlds. 2. The teacher chooses a world to view the statistics. 3. The system shows for that world, the average score of students, the average completion rate of students. AF-S4-2: If the teacher chooses to view statistics by student: 1. The system presents a list of students. 2. The teacher chooses a student to view the statistics. 3. The system shows the student's profile, the percentage completion of each world, the scores of each world, and the highest score in challenge mode.
Exceptions:	-
Includes:	Log In
Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

Use Case ID:	UC0010		
Use Case Name:	Manage Database		
Created By:	Kai Jie	**Last Updated By:**	Germaine
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Administrator
Description:	The user can have access to the system database and manage the database.
Preconditions:	The user has been authorized with access to the database.
Postconditions:	-
Priority:	Low
Frequency of Use:	Low
Flow of Events:	1. The user opens the Database Management System (DBMS). 2. The user accesses the system database with authentication. 3. The user chooses to manage users' profiles. 4. The user selects a user to view and manage their profile.
Alternative Flows:	AF-S3-1: If the user chooses to view users' playing history: 1. The user selects a user to view his/her playing history. 2. The user shall be able to see information such as the player ID, the list of all activities and modes played, and the list of all the worlds and sections completed in Normal Mode. AF-S3-2: If the user chooses to manage users' access to the game: 1. The user selects a user.

	2. The user shall be able to view and manage his/her access to the game.
Exceptions:	-
Includes:	Log In
Special Requirements:	-
Assumptions:	We assume that we can have an API to fetch data from NTU database, from where we can get the information related to students, teachers, and course enrollments. So we don't need to store this information in our database again.
Notes and Issues:	-

Use Case ID:	UC0011		
Use Case Name:	Edit Question Bank		
Created By:	Kai Jie	**Last Updated By:**	Shiny
Date Created:	13 Feb 2020	**Date Last Updated:**	22 Apr 2020

Actor:	Teacher/Administrator
Description:	The user can amend the question bank. The amendments include adding, editing and removing questions.
Preconditions:	The user has logged in to the system.
Postconditions:	The question bank in the database has been updated.
Priority:	Low
Frequency of Use:	Low
Flow of Events:	1. The user chooses to edit the question bank. 2. The user chooses to add new questions. 3. The user enters the new question with answers. 4. The user chooses the world and section to add the question to. 5. The user saves the change. 6. The database updates the change.
Alternative Flows:	AF-S2: If the teacher chooses to remove questions: 1. The teacher chooses the world and section. 2. The teacher chooses the question to remove. AF-S5: If the teacher doesn't save the changes: 1. The database doesn't update the change.
Exceptions:	-
Includes:	Log In

Special Requirements:	-
Assumptions:	-
Notes and Issues:	-

4.3 Functional Requirements

1. The user shall be able to **log in** to the game system with a registered NTU email address.
   - 1.1 The user shall be able to input their NTU email address when logging into the system.
   - 1.2 The user shall be able to input the password which matches the username when logging in to the system.
   - 1.3 The user shall be able to recover their password if they have forgotten it.
     - 1.3.1 The user shall be able to input their email address into the password recovery page.
     - 1.3.2 The user shall be able to receive a recovery email inside their email inbox.
     - 1.3.3 The user shall be able to change their own password using a browser link.
   - 1.4 The user shall be able to create a new account.
     - 1.4.1 The user shall be able to input their NTU email address when registering for an account.
     - 1.4.2 The user shall be able to input their desired password when registering for an account.
       - 1.4.2.1 The password should be at least 8 characters and should not contain invalid characters.
     - 1.4.3 The user can specify the type of account they want to create.
       - 1.4.3.1 The user shall complete the ‘For Teachers’ field.
         - 1.4.3.1.1 If the user is a teacher, they shall indicate ‘T’.
         - 1.4.3.1.1 If the user is an administrator, they shall indicate ‘A’.

2. The user shall be able to **manage their profile** information.
   - 2.1 The profile information shall include a profile photo.
   - 2.2 The profile information shall include a nickname.
   - 2.3 The profile information shall include the user’s email address.

2.4 The profile information shall include the user's full name.
2.5 The profile information shall include the user's chosen character.
2.6 The user shall be able to change their profile information.
2.6.1 The user shall be able to change their profile photo.
2.6.2 The user shall be able to change their nickname.
2.6.3 The user shall be able to change their chosen character.
2.6.4 The user shall be able to change their current password.
2.7 The user shall be able to share their profile information to their social media.

3. The user shall be able to **connect with social media accounts** in the game.
3.1 The user shall be able to connect to at least two social media platforms.
3.2 The user shall be able to post a message on at least two social media platforms.
3.3 The user shall be able to post an announcement about a new assignment on at least 2 social media platforms.

4. The game shall **have three playing modes**, which are Normal Mode, Challenge Mode and Custom Mode.
4.1 The student shall be able to access all three modes.
4.2 The teacher shall be able to access only challenge and custom mode.
4.3 The system shall scale the difficulty of questions according to player history.
4.3.1 In Challenge Mode, difficulty of questions will increase with each level.
4.3.1.1 The user shall be able to advance to the next level in Challenge Mode if they answer the questions correctly.
4.3.2 In Normal Mode, there are three difficulty levels according to player's proficiency.
4.3.2.1 The user shall be able to advance to the next quiz with a higher difficulty level if they meet the passing criteria in Normal Mode (Requirement 5).

5. The user shall be able to **play Normal Mode**.
5.1 The user shall be able to view all worlds available.
5.1.1 Each world shall consist of a single topic of the course.
5.1.2 Each world shall consist of 3 sections with increasing difficulty.
5.1.2.1 The primary section has 5 questions and is of the lowest difficulty level.
5.1.2.2 The intermediate section has 3 questions and is of the middle difficulty level.

5.1.2.3 The advanced section has 2 questions and is of the highest difficulty level.

5.1.2.4 Each section shall consist of 10 MCQ questions displayed sequentially.

5.1.2.4.1 The user shall be able to submit answers for the questions sequentially.

5.1.2.4.2 The user shall be able to view the correct answer for each question after he or she submits an answer to that question.

5.1.2.4.3 The user shall be able to view the detailed explanation for the correct answer after he or she submits an answer to that question.

5.1.3 Each world shall consist of a different background.

5.1.4 Each world shall consist of a different background music.

5.2 The user shall be able to choose a world to play.

5.2.1 The user shall start playing from the primary section.

5.2.2 The system shall display a tick if the user has met the section passing score of 8/10.

5.2.3 The user shall be able to attempt the next section with a higher difficulty level after passing a section.

5.2.4 The system shall display a quiz fail if the user did not meet the section passing score of 8/10.

5.2.4.1 The user shall be able to retry the section until he or she passes it.

5.2.5 The user shall be able to play a completed section again.

5.2.6 The user's highest score on a quiz will be recorded regardless of the number of attempts.

6. The user shall be able to **play Challenge Mode**.

6.1 The user shall be able to view the starting selection menu.

6.1.1 The user shall be able to choose a character.

6.1.2 The user shall be able to choose a starting world.

6.2 The user shall be displayed the starting world interface.

6.2.1 The system shall display questions sequentially, starting from the lowest level in the world towards increasing difficulty.

6.2.2 The user shall be displayed the first question which comes from the lowest level of the selected world.

6.2.3 The user shall be able to advance to the next level.

6.2.3.1 Each level shall consist of 1 question.

6.2.3.2 Each level shall consist of 4 answer options.

6.2.3.3 Each level shall consist of 1 correct answer.

6.2.3.3.1 If the user answers the question correctly, they will elevate by one level, and stay in the game.

6.2.3.3.2 If the user answers the question wrongly, they will fall to the bottom level, and end the game.

6.2.4 The user shall be able to advance to the next world after completing 10 levels.

6.2.4.1 The system shall display a menu selection of all worlds that have yet to be completed.

6.2.4.2 The user shall be able to select a world to attempt next.

6.3 The user shall be able to speed up their progress of stacking to a higher level.

6.3.1 The user shall be able to use the character power-ups anytime during the game.

6.3.2 The power-ups shall be restored at every 2 mins interval.

6.3.3 The power-ups shall not be shown during the cooldown period.

6.4 The user shall be able to view the leaderboard after Challenge Mode has ended.

6.4.1 The leaderboard shall display all rankings of players who attempted Challenge Mode.

6.4.1.1 Each ranking shall consist of the user's nickname.

6.4.1.2 Each ranking shall consist of the user's chosen character.

6.4.1.3 Each ranking shall consist of the user's highest level reached.

6.4.1.4 Each ranking shall consist of the user's total time elapsed.

6.4.2 The leaderboard shall display a live score table.

6.4.2.1 The table shall be sorted in descending order of the highest level reached.

6.4.2.1.1 In the event if the same highest level is reached, the table shall be further sorted in ascending order of total time elapsed.

6.4.2.2 The table shall consist of at least 3 columns displaying the highest level reached, total time elapsed and character used.

6.4.2.3 The table shall be updated and synchronised to the database live.

6.4.3 The user shall be able to share their leaderboard scores to their connected social media platforms.

6.4.4 The user shall be able to restart the game.

6.4.5 The user shall be able to go back to the main menu.

6.5 The system shall display a boss battle fight at every 20 levels interval.

6.5.1 The boss shall be different for every 20 levels.

6.5.2 The boss shall have a health point.

6.5.2.1 The aim of the battle is for the boss's health point to be completely depleted.

6.5.2.2 The user shall have a series of questions to be completed within 2 minutes.

6.5.2.3 The number of questions correctly answered by the user will determine how much of the boss's health points will be depleted.

6.6 The user shall be able to view the number of lives they have left.

6.6.1 Lives shall be represented by the number of hearts above the player's character.

6.6.2 Lives shall be reduced by 1 if the player answers a question incorrectly.

6.6.3 Lives shall be increased by 1 when the player completes the 10th level of every world.

6.6.4 Lives shall also be increased by 1 when the player wins in the boss fight(depletes the boss's health points).

6.6.5 The system shall terminate the game mode when the user answers a question wrongly and has zero lives left.

7. The user shall be able to **play Custom Mode**.

7.1 The user shall be able to create their own quizzes.

7.1.1 The user shall be able to add their own explanations for questions.

7.1.2 The user shall be able to add up to 4 options for selection for each question.

7.1.3 The user shall be able to add the question text for each question.

7.1.4 The user shall be able to add the correct answer for each question.

7.1.5 The user shall be able to share an announcement of their newly-created quiz on social media.

7.2 The user shall be able to edit any quiz or quiz question that they created.

7.3 The user shall be able to delete any quiz or quiz question that they created.

7.4 The user shall be able to see all quizzes created by the users.

7.5 The user shall be able to select any quiz to attempt.

7.6 The user shall be able to view all answers of the quiz attempted.

8. The teacher shall be able to **view statistics** of the game.

8.1 The teacher shall be able to view statistics sorted by class.

8.1.1 Statistics for each class shall contain the average percentage completion for each world in the Normal Mode of all students enrolled in that class.

8.1.2 Statistics for each class shall contain the average highest score in the Challenge Mode of all students enrolled in that class.

8.2 The teacher shall be able to view statistics of individual students.

8.2.1 Statistics for each student shall contain the student's playing history in a timeline.

8.2.2 Statistics for each student shall contain the student's completion status for each world in the Normal Mode.

8.2.3 Statistics for each student shall contain the student's highest level reached in the Challenge Mode.

8.3 The teacher shall be able to view statistics sorted by world.

8.3.1 The statistics for each world shall contain the average percentage completion for each class in the Normal Mode.

8.3.2 The statistics for each world shall contain the average quiz marks for each class in the Normal Mode.

8.4 The teacher shall be able to view overall statistics**.**

8.4.1 The overall statistics shall contain the average percentage completion for all worlds in the Normal Mode of all students enrolled in the course.

8.4.2 The overall statistics shall contain the average highest score in the Challenge Mode of all students enrolled in the course.

8.5 The system shall generate an analysis report.

8.5.1 The report shall give suggestions to the teacher on the students' overall mastery of the course.

9. The user shall be able to **edit the question bank.**

9.1 Only Teachers and Administrators shall be able to edit the question bank.

9.1.1 The user shall be able to add their own explanations for questions.

9.1.2 The user shall be able to add up to 4 options for selection for each question.

9.1.3 The user shall be able to add the question text for each question.

9.1.4 The user shall be able to add the correct answer for each question.

9.2 The user shall be able to delete questions from the question bank.

9.3 The user shall be able to edit questions in the question bank.

10. The user shall be able to **manage the system database**.

10.1 Only Administrators shall be able to manage the system database.

10.2 The user shall be able to manage users' profiles.
10.3 The user shall be able to view users' playing history.
10.3.1 The playing history shall consist of the player ID.
10.3.2 The playing history shall consist of a list of all activities and modes played by the user.
10.3.3 The playing history shall consist of a list of all worlds and sections completed by the user in Normal Mode.
10.4 The user shall be able to manage users' access to the game.

5. Other Nonfunctional Requirements

5.1 Security Requirements

1. The game shall require email confirmation upon new account creation.
2. The game shall require players to log in each time the application is launched.
3. The game will log out player accounts whenever the game application is closed.
4. Student accounts will not be allowed to use functions dedicated for Teacher and Administrator accounts, vice versa.

5.2 Business Rules

No business rules.

6. Other Requirements

None.

Appendix A: Glossary

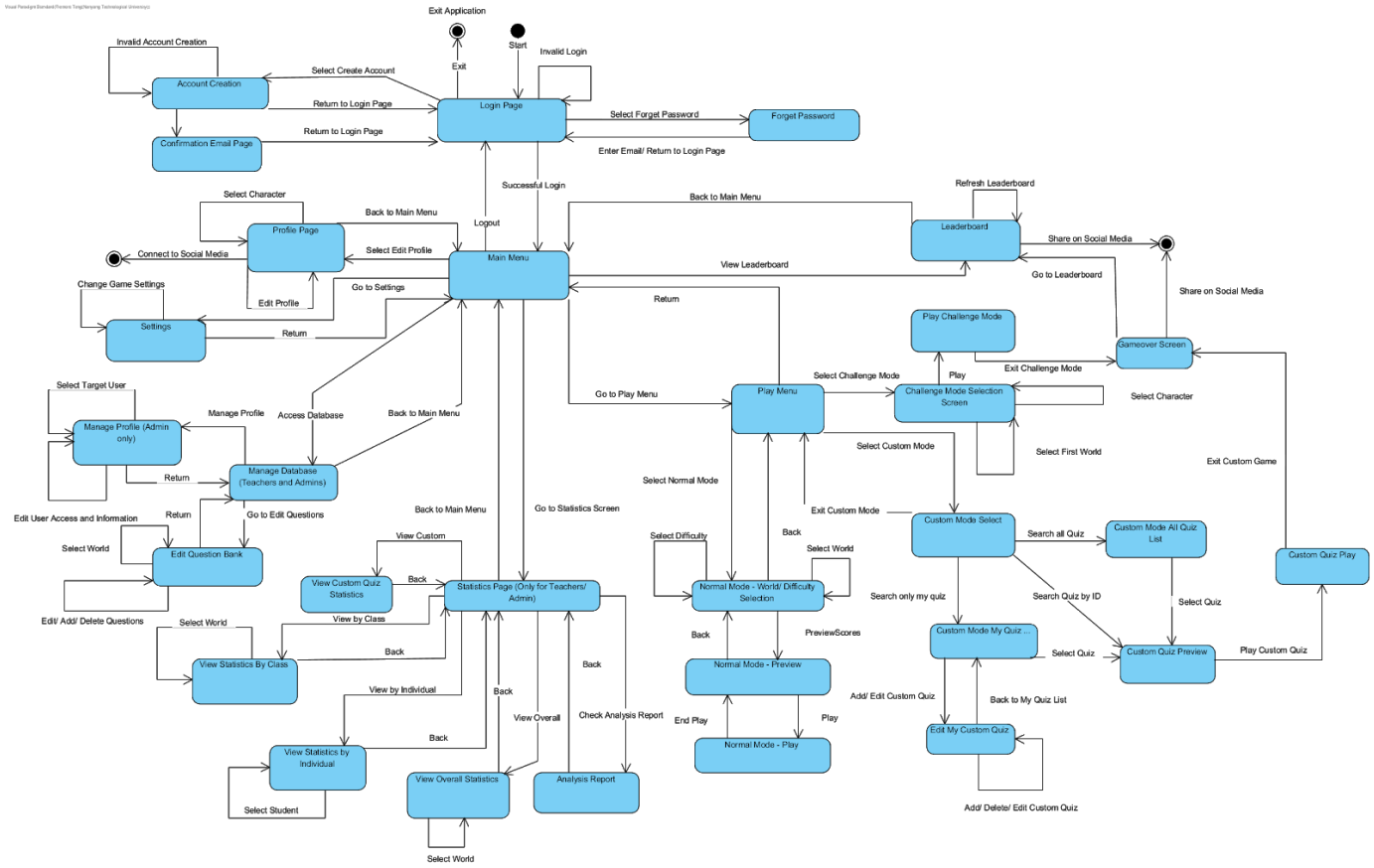
Data Dictionary

Term	Description
Normal Mode	The game mode that users will play all levels in all worlds to have a mastery of the topic concept.
Challenge Mode	The game mode that users will play from level 1 all the way until the maximum level that the player can reach. The score from this mode will be reflected at the leaderboard.
Custom Mode	This is the game mode that users will play for user-contributed questions for their own self-practice and fun.
World	World refers to the topic of the course. 
Section	Section refers to the level of difficulty, beginner, intermediate and hard.
Level	Level refers to the level based on the 3 sections of difficulty.
Character	Character refers to the chosen character by the user to represent them in the program.
Leaderboard	Leaderboard refers to the table of ranking of the players'

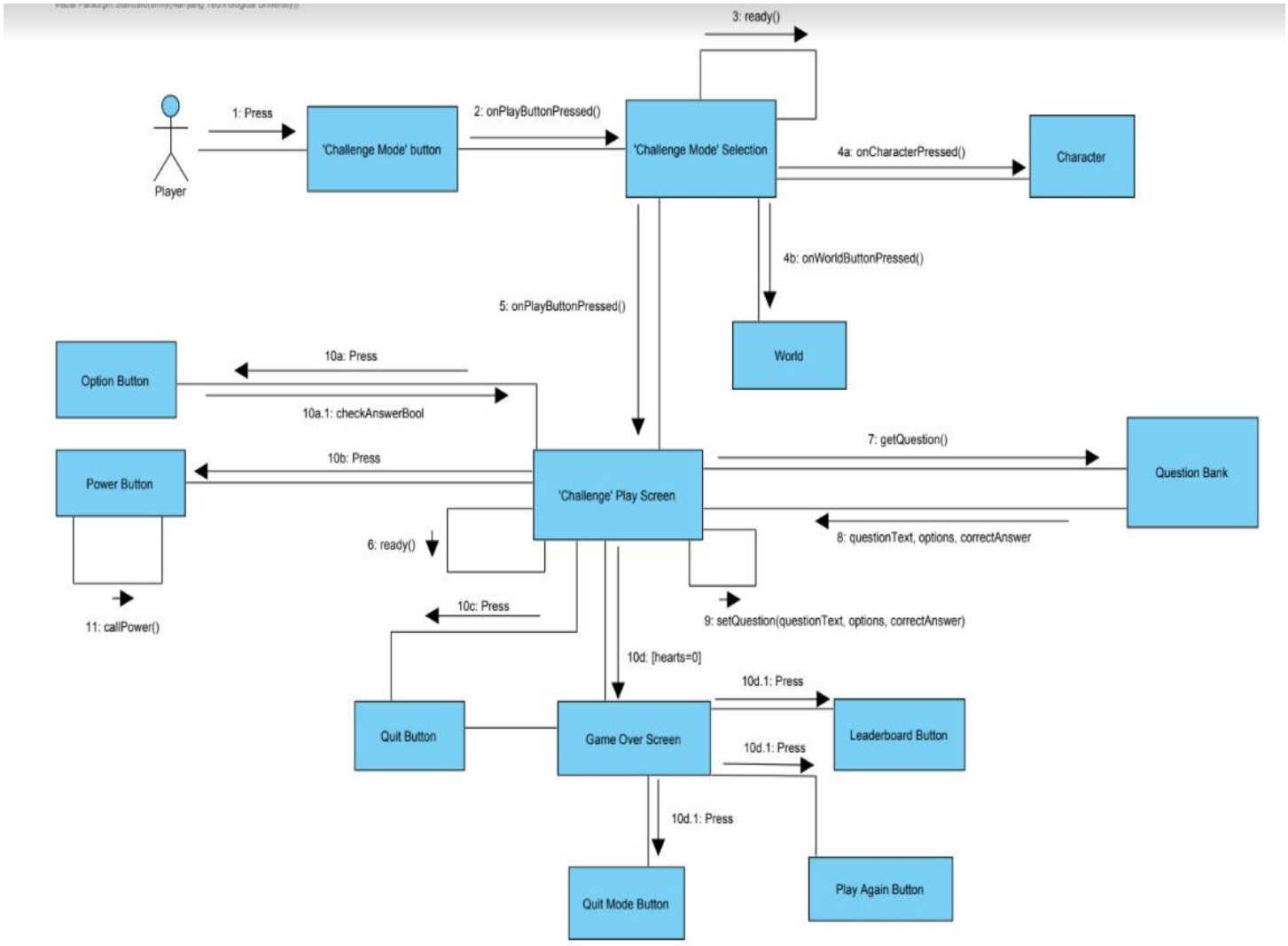
	performance in the challenge mode.
Game Mode	This refers to the various modes of normal, challenge and custom.
Question bank	This refers to the pool of questions that is collated.

Appendix B: Analysis Models

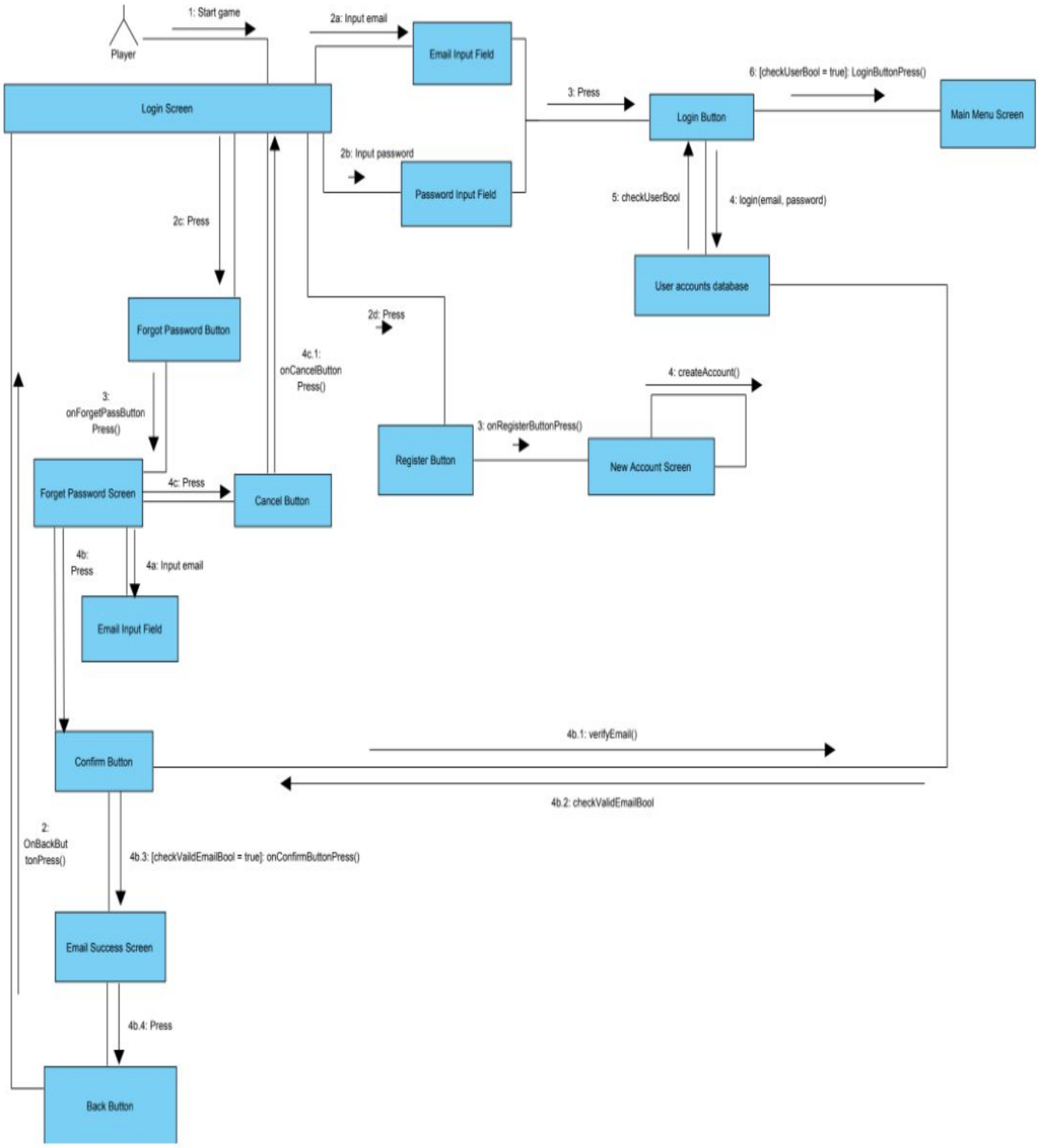
Note: For better image quality, please refer to the SVN/Wiki.



Dialog Map



Communication Diagram for Play Challenge Mode



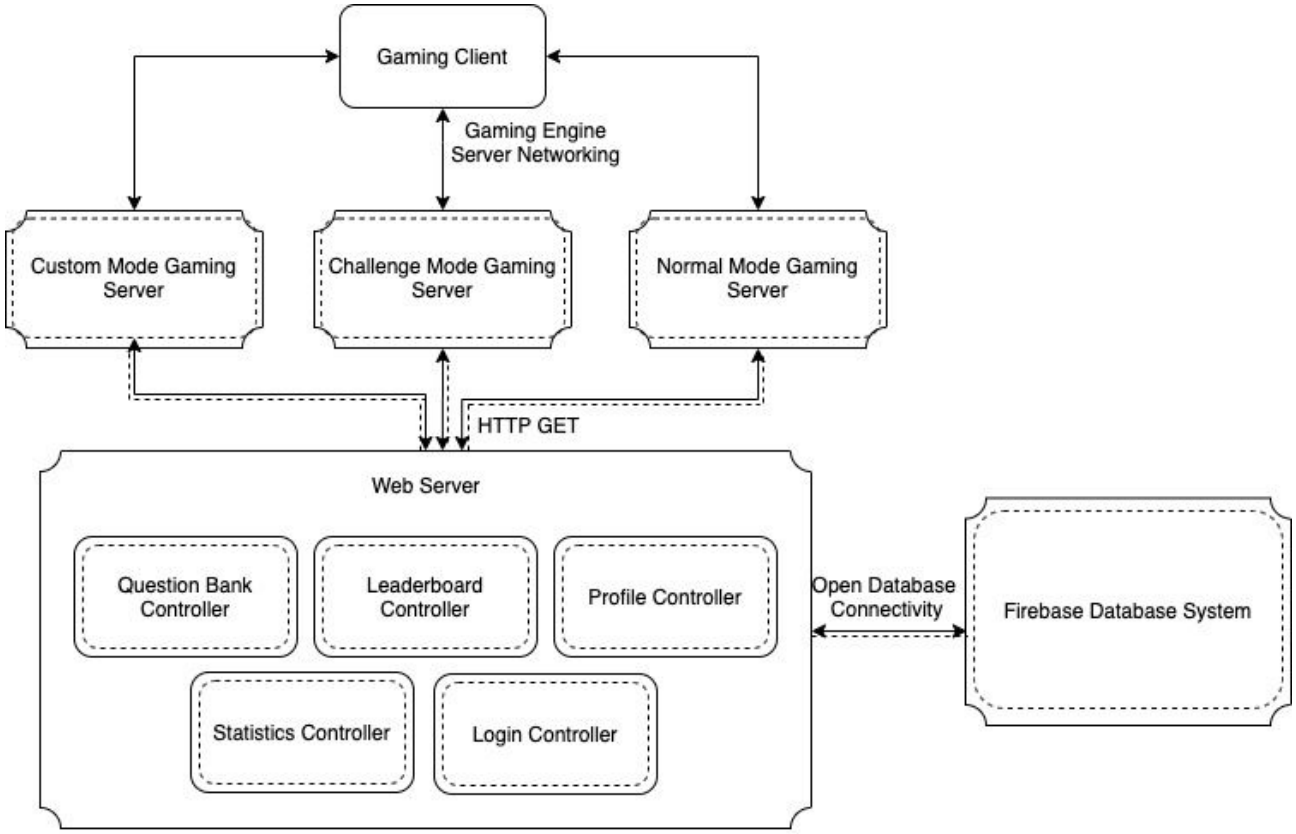
Communication Diagram for Login

The decision table follows the functional requirements.

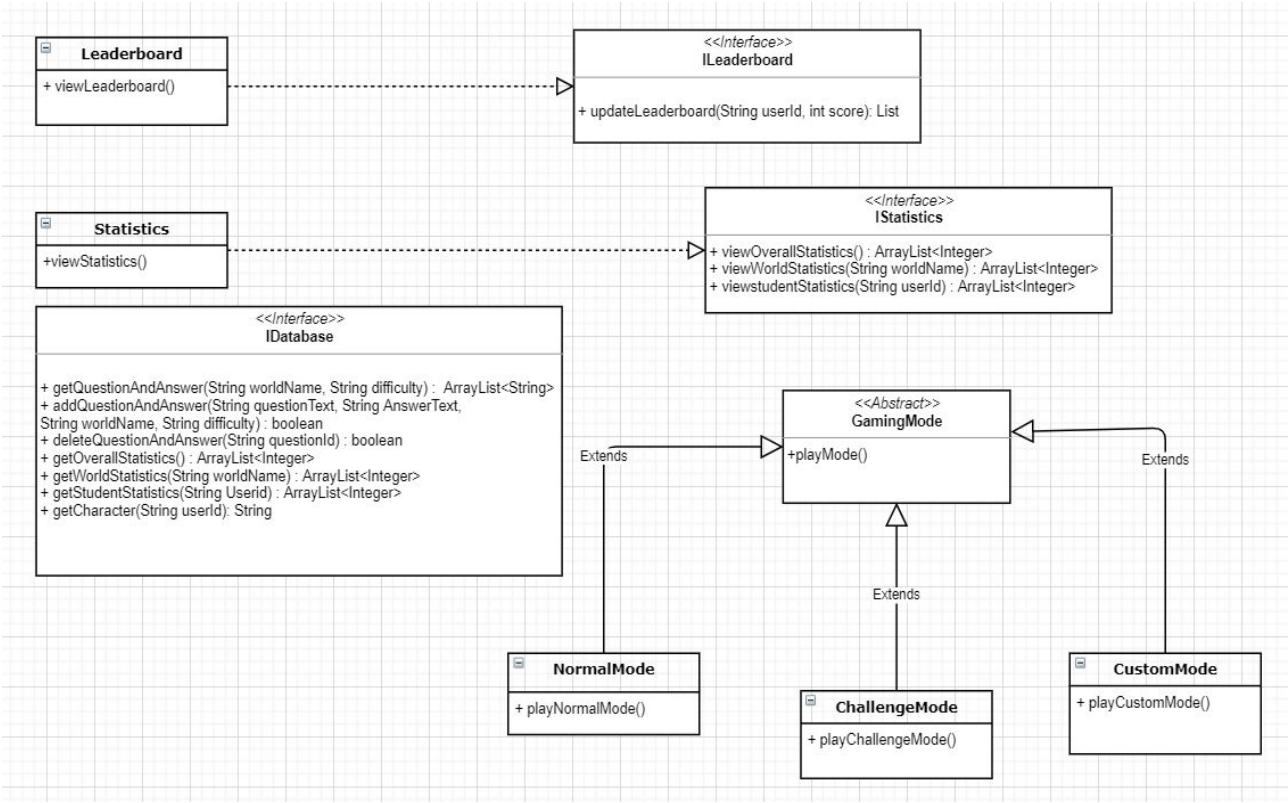
	Requirement Number							
Condition	1	2	5	6	7	8	9	10
User has an NTU account	T	T	T	T	T	T	T	T
User is a student/teacher			T	T	T			
User is a student						F	F	F
User is a teacher						T		F
User is an administrator			F	F	F	F		T
User is a teacher/administrator							T	
User is student/teacher/administrator	T	T						
User has a social media account	-	-	-	-	-	-	-	-
Action								
Successfully Login	X							
Manage Profile		X						
Play Normal Mode			X					
Play Challenge Mode				X				
Play Custom Mode					X			
View Statistics						X		
Edit Question Bank							X	
Manage System Database								X

Decision Table

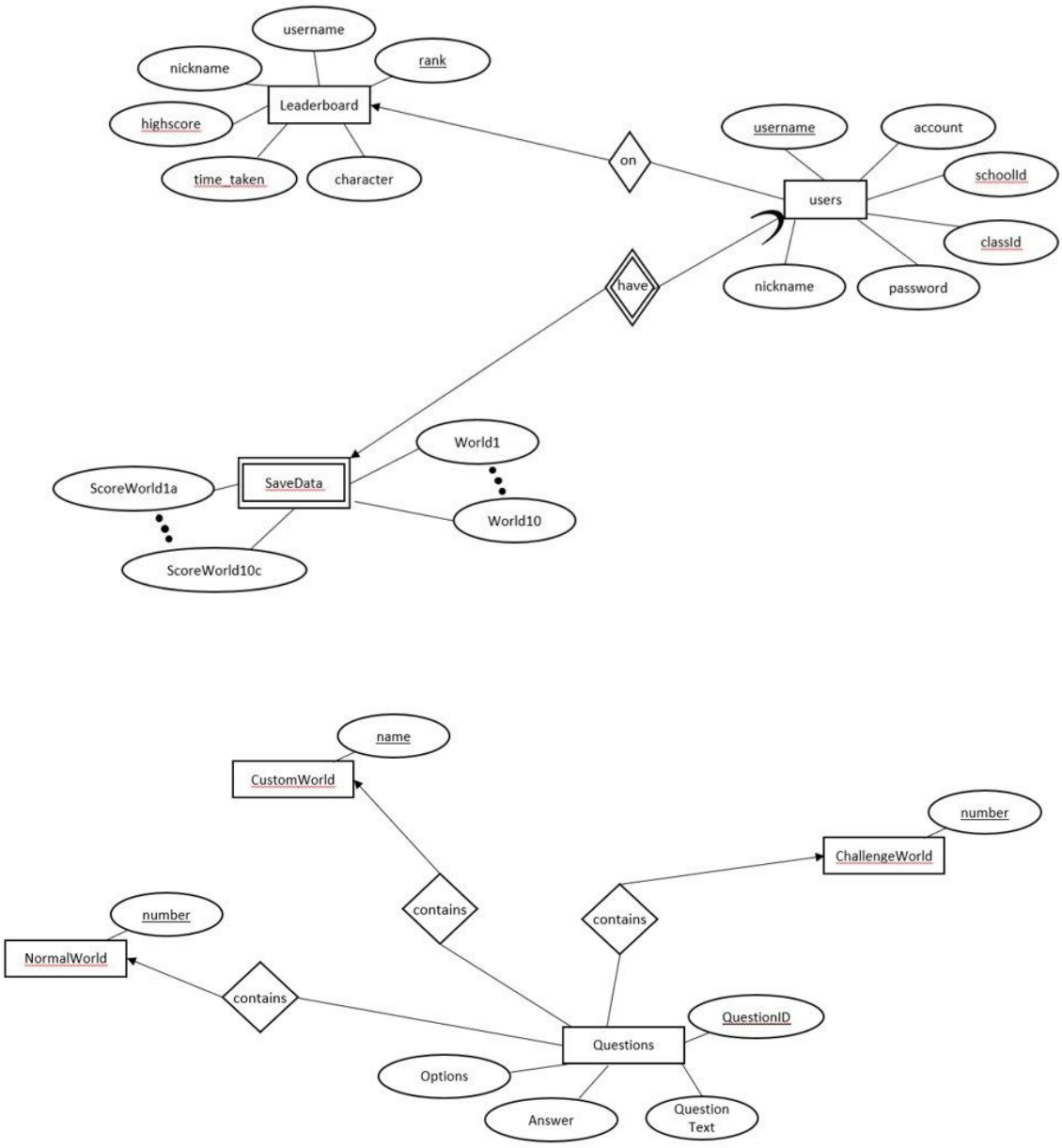
Note: denotes non-applicable fields.



Architecture Diagram



Subsystem Interface Design



Entity Relationship Diagrams