RadiantIQ

UNIVERSITÀ DI TRENTO
Department of Information Engineering and Computer Science

Project's acronym:	RADIANTIQ
Project's title:	RadiantIQ
Start date:	08/03/2024
Finish date:	DD/MM/YYYY

D1 - RadiantIQ Software Specification

WP1:	Software Specification
Task 1.1:	Define Software Specification
Submission date:	09/04/2024
Responsible:	RadiantIQ
Version:	1.0
Status:	Completed
Author(s):	Lorenzo Cattai, Gabriele Pernici, Anh Tu Duong, Lorenzo Negut
Deliverable type:	DOCUMENT

Version list:

Version	Authors	Date	Description
0.1	Anh Tu Duong	09/04/2024	Define the scheme of the document
1.0	Anh Tu Duong	11/04/2024	Complete domain analysis and objectives

Contents

Acronyms

Acronym	Description
FRS	Functional Requirement Specification
FSD	Functional Specification Document
LLMs	Large Language Models

1 Introduction

The project consists in a platform providing a better learning experience for scientific subjects. The idea is to include standard formal explanations of topics (with associated exercises) accompanied by a small number of interactive minigames. To better involve the students, each exercise will be put in an AI generated context (e.i. a phisics problem related to speeds and distances could be told using the story of Achilles and the turtoise). Moreover, the formal explanations can be genrated by an AI, uploaded by a professor or by a combination of the two. Lastly, AI is used to suggest which topics should be revised for the students using the platform.

2 Domain Analysis

2.1 Domain: Interactive Education

We want to create an application in the education domain and try to make it extremely interactive.

2.2 SWOT analysis

- **Strengths:**
  - (1) Use of AI to generate basic information in the articles, with the supervision of admins.
  - (1) Use of AI to generate more advanced information from user's customized necessities and weaknesses
  - (2) Use a more fun and interactive approach in the education process
  - (2) Learn by trying with minigames with immediate feedback or in a more standard way with articles
  - (3) Possibility for experts to contribute with their own articles
  - FLOSS Education Platform
- **Weaknesses:**
  - Developing effective mini-games' experiences might be time consuming from a developer perspective
  - Making fun and yet instructive experiences is hard
  - Careful management of the AI generated information is needed
  - Quality check on article uploaded must be implemented
  - Costs of using LLMs
- **Opportunities:**
  - (1) Using AI in education is an emerging idea that has not yet spread widely and can make this system unique
  - (2) Various studies show the positive effect of interaction and hands-on experiences in the learning process
  - Large demand of easy and complete ways to learn science
  - (3) Lack of effective and proficient communication/cooperation/interaction between students and teachers which creates an ample improvement margin to be enhanced
- **Threats:**
  - Possible limitations of AI technologies from government entities
  - Minigames must be entertaining to be successful
  - Brilliant is a direct competitor (tho it does not currently use AI nor personalize its exercises and lectures)
  - Hard to find funding

3 Project Objectives

3.1 Use of minigames in interactive learning

Create some minigames to make learning more interactive and more intriguing for students.

3.2 Use AI to help develop a more compelling learning experience

Use AI to generate compelling descriptions of the topics, to make learning funnier.

3.3 Make learning science more approachable and enjoyable

Make the platform an accessible starting point in the learning of science, to allow everyone to learn science using intuition and reason.

3.4 Provide single-topic focused content

Providing single topic courses means the possibility to create a learning path specific for the interests of the user.

3.5 Provide private classes as instances of a course

Create classes, from the general courses, to allow teachers/professors to integrate the platform in their standard lectures.

3.6 Allow better student-professor interaction

Using the classes the professors can understand which topics are clearer and then provide feedback. Moreover students can easily determine the level of comprehension of each topic before a test.

3.7 Provide quality guarantees on the material published

Have personnel checking the validity of the published material, while not interfering with the private resources.

3.8 Collect data and provide a progress history

For the learning user, having feedback on the level of comprehension is fundamental and will help them focus more on the less understood topics.

4 Actors

5 Functional Requirements

6 Non-functional Requirements

7 Use Cases

We created both the tables for each use case and the complete diagram. Moreover, we created some partial diagrams containing some use cases and organized logically.

7.1 Tables

The following are the 42 use case tables.

7.1.1 Login

Login	
ID	UC1 - UC_LOGIN
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and has credentials
Sequence	1. The actor selects the login option 2. The actor inserts its credentials 2.1 If the actor uses an external authentication system it's redirected 3. Credentials are verified
Postconditions	The user is authenticated and can access its roles' privileges
Alternative sequence 1	1. The actor inputs the wrong password for the first, second or third time
Postconditions	The user is not authenticated and a notification is sent to the user registered with the inserted username
Alternative sequence 2	1. The actor inputs the wrong password for the fifth time
Postconditions	The user is not allowed to login for a significant time and a notification is sent to the user registered with the inserted username
Alternative sequence 3	1. The actor inputs the wrong username
Postconditions	The user is not authenticated

7.1.2 Logout

Logout	
ID	UC2 - UC_LOGOUT
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the logout option 2. The actor confirms their choice
Postconditions	The user is logged out

7.1.3 Credential recovery

Credential recovery	
ID	UC3 - UC_CREDENTIAL_REC
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and has forgotten credentials
Sequence	1. The actor has forgotten their credentials 2. The actor requires new credentials
Postconditions	The user acquires new credentials on the previously specified recovery channel

7.1.4 Registration

Registration	
ID	UC4 - UC_REGISTRATION
Actors	Unregistered users
Preconditions	The actor decides to register
Sequence	1. The actor selects the registration option 2. The actor decides their credentials, core settings and which roles they want to apply for 2.1 The credentials' compliance with security policies is asserted
Postconditions	The user is registered and has now one or more roles assigned
Alternative sequence 1	1. The actor wants to apply for the Course Supervisor role 2. The actor provides the apposite proof of identity
Postconditions	The user is registered as a Course Supervisor
Alternative sequence 2	1. The actor inputs incomplete, incorrect or unacceptable credentials/proof
Postconditions	The user is not registered

7.1.5 Delete Account

Delete Account	
ID	UC5 - UC_ACC_DEL
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered, logged in and decides to delete the account
Sequence	1. The actor selects the unregistration option 2. The actor confirms their choice 3. The actor confirms their identity by inserting the account's password
Postconditions	The user is unregistered

7.1.6 Modify account's core settings

Modify account's core settings	
ID	UC6 - UC_MOD_CORE_SETT
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered, logged in and decides to change one or more of the core settings (e.g. password, username, recovery channel, personal information, . . .)
Sequence	1. The actor selects the modify core settings option 2. The actor confirms their identity by inserting the account's password 3. The actor changes the selected settings 4. The actor confirms the choice
Postconditions	The change in settings is saved
Alternative sequence 1	1. The actor doesn't confirm their changes or cancels the modification
Postconditions	The settings stay the same

7.1.7 Modify account's secondary settings

Modify account's secondary settings	
ID	UC7 - UC_MOD_SEC_SETT
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered, logged in and decides to change one or more of the secondary settings (e.g. theme, layout, . . .)
Sequence	1. The actor selects the modify secondary settings option 2. The actor changes the selected settings 3. The actor confirms the choice
Postconditions	The change in settings is saved
Alternative sequence 1	1. The actor doesn't confirm their changes or cancels the modification
Postconditions	The settings stay the same

7.1.8 Modify AI theming

Modify AI theming	
ID	UC8 - UC_MOD_AI_THEMING
Actors	Students, AI supervisors, Tech Supports
Preconditions	The user is registered and logged in
Sequence	1. The user selects the AI theming option 2. The user inputs a prompt for the AI theming 3. The user confirms the modification
Postconditions	The theming prompt is modified
Alternative sequence 1	1. The user doesn't confirm the modification
Postconditions	AI theming continues with the previous prompt

7.1.9 Access profile and statistics

Access profile and statistics	
ID	UC9 - UC_ACCESS_PROFILE
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the account display option
Postconditions	The profile with all its statistics is displayed

7.1.10 Change user role

Change user role	
ID	UC10 - UC_USER_ROLE
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and logged in
Sequence	1. The actor selects “User Role” panel 2. The actor selects the one of the user role from the list
Postconditions	The user role changed following by his dashboard role

7.1.11 Create course

Create course	
ID	UC11 - UC_COURSE_CREATE
Actors	Publishers
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the course panel 2. The actor selects the “Create new course” option 3. The actor fills all the mandatory sections for creating a new course 4. The actor confirms to create new course
Postconditions	The course is created successfully
Alternative sequence 1	1. The actor doesn’t fill all the mandatory sections for creating a new course 2. The actor confirms to save the unfinished work
Postconditions	The course is saved as draft

7.1.12 Modify course

Modify course	
ID	UC12 - UC_COURSE_MOD
Actors	Professors, Publishers, AI supervisors, Course Supervisors, System Admins
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the course 2. The actor selects the “Modify course” option 3. The actor modifies the course 4. The actor confirms the modification
Postconditions	The course is updated successfully
Alternative sequence 1	1. The actor doesn’t confirm the modification
Postconditions	The course keeps its previous state

7.1.13 Delete course

Delete course	
ID	UC13 - UC_DEL_COURSE
Actors	Publishers, Course Supervisors, System Admins
Preconditions	The user is registered and logged in
Sequence	1. The actor selects “Delete course” 2. The actor confirms the deletion
Postconditions	The course is deleted

7.1.14 Archive course

Archive course	
ID	UC14 - UC_ARC_COURSE
Actors	Publishers, Course Supervisors, System Admins
Preconditions	The user is registered and logged in
Sequence	1. The actor selects “Archive course” 2. The actor confirms the modification
Postconditions	The course is moved to archive

7.1.15 View course

View course	
ID	UC15 - UC_COURSE_VIEW
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins) and Unregistered users
Preconditions	The user is registered, logged in and has the right to enter the course
Sequence	1. The actor select a course from the dashboard or from a library
Postconditions	The course is displayed, along with the global ranking if any minigame is present

7.1.16 Review course

Review course	
ID	UC16 - UC_COURSE_REV
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered, logged in and has has the right to enter the course. Moreover the course is public and opened
Sequence	1. The actor leave a review (comment) for the course
Postconditions	The review is added to the course

7.1.17 Create class

Create class	
ID	UC17 - UC_CLASS_CREATE
Actors	Professors
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the class panel 2. The actor selects the “Create new class” option 3. The actor fills all the mandatory sections for creating a new class 4. The actor has possibility to invite Student(s) to the class 5. The actor confirms to create new class
Postconditions	The class is created successfully

7.1.18 Modify class

Modify class	
ID	UC18 - UC_CLASS_MOD
Actors	Professors, System Admins
Preconditions	The user is registered, logged in and has sufficient permissions (owns the class or is admin)
Sequence	1. The actor selects the class 2. The actor selects the “Modify class” option 3. The actor modifies the class 4. The actor has possibility to invite Student(s) to the class 5. The actor confirms the modification
Postconditions	The class is updated successfully
Alternative sequence 1	1. The actor doesn’t confirm the modification
Postconditions	The class remains its previous state

7.1.19 Terminate class

Terminate class	
ID	UC19 - UC_CLASS_TERM
Actors	Professors, System Admins
Preconditions	The user is registered, logged in and has sufficient permissions (owns the class or is admin)
Sequence	1. The actor selects “Terminate class” 2. The actor confirms the termination
Postconditions	The class is terminated, but all the information about the class remains public

7.1.20 Archive class

Archive class	
ID	UC20 - UC_ARC_CLASS
Actors	Professors, System Admins
Preconditions	The user is registered, logged in and has sufficient permissions (owns the class or is admin)
Sequence	1. The actor selects “Archive class” 2. The actor confirms the modification
Postconditions	The class is moved to archive and all the information about the class is accessible only for Professors and System admins

7.1.21 View class

View class	
ID	UC21 - UC_CLASS_VIEW
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and logged in
Sequence	1. The actor selects a class from the dashboard or from an invitation
Postconditions	The public information of the class is displayed

7.1.22 Display class’ attendees

Display class’ attendees	
ID	UC22 - UC_CLASS_ATTENDEES
Actors	Students, Professors
Preconditions	The user is registered, logged in and enrolled in a class
Sequence	1. The actor selects a class they are enrolled into
Postconditions	The list of people attending the class is displayed

7.1.23 Display class' statistics

Display class' statistics	
ID	UC23 - UC_CLASS_PERFORMANCE
Actors	Professors
Preconditions	The user is registered, logged in and manages a class
Sequence	1. The actor selects a class they manage
Postconditions	The performance and statistics of all the attendees is displayed

7.1.24 Join class

Join class	
ID	UC24 - UC_CLASS_JOIN
Actors	Students
Preconditions	The user is registered, logged in and has the right to join the class. Moreover the class is opened and public
Sequence	1. The actor selects "Join class" option
Postconditions	The actor now joined the class. The actor's information, statistics and progresses for the class is initialized and is public for the class's owner

7.1.25 Leave class

Leave class	
ID	UC25 - UC_CLASS_LEAVE
Actors	Students
Preconditions	The user is registered, logged in and is part of a class
Sequence	1. The actor selects "Leave class" option 2. The actor confirm their choice
Postconditions	The actor leaves the class, but their information, statistics and progresses for the class is saved and is still public for the class's owner

7.1.26 Publish article

Publish article	
ID	UC26 - UC_ART_PUB
Actors	Publisher
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the article panel 2. The actor selects the “Publish new article” option 3. The actor fills all the mandatory sections for publishing a new article 4. The actor confirms to publish new article
Postconditions	The article is published successfully

7.1.27 Modify article

Modify article	
ID	UC27 - UC_ART_MOD
Actors	Publisher, Course Supervisors, System Admins
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the article 2. The actor selects the “Modify article” option 3. The actor modifies the article or its visibility 4. The actor confirms the modification
Postconditions	The article is updated successfully
Alternative sequence 1	1. The actor doesn’t confirm the modification
Postconditions	The article remains in its previous state

7.1.28 Delete article

Delete article	
ID	UC28 - UC_ART_DEL
Actors	Publisher, Course Supervisors, System Admins
Preconditions	The user is registered, logged in and has ownership of the article (or is admin)
Sequence	1. The actor selects “Delete article” 2. The actor confirms the deletion
Postconditions	The article is deleted

7.1.29 Archive article

Archive article	
ID	UC29 - UC_ART_ARC
Actors	Publisher, Course Supervisors, System Admins
Preconditions	The user is registered, logged in and has ownership of the article (or is admin)
Sequence	1. The actor selects “Archive article” 2. The actor confirms the modification
Postconditions	The article is moved to archive

7.1.30 View article

View article	
ID	UC30 - UC_ART_VIEW
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins) and Unregistered users
Preconditions	The user is registered and logged in
Sequence	1. The actor selects an article from the dashboard
Postconditions	The article is opened

7.1.31 Review article

Review article	
ID	UC31 - UC_ART_REV
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered and logged in. The article is opened and public
Sequence	1. The actor leave a review (comment) for the article
Postconditions	The review is added to the article

7.1.32 Create minigame

Create minigame	
ID	UC32 - UC_MINIGAME_CREATE
Actors	Developers
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the developer panel 2. The actor selects the “Create new minigame” option 3. The actor uses the environment to create the minigame 4. The actor confirms to create new minigame
Postconditions	The minigame is created successfully and saved to minigame storage

7.1.33 Modify minigame

Modify minigame	
ID	UC33 - UC_MINIGAME_MOD
Actors	Developers, Course Supervisors, System Admin, Tech Supports
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the minigame 2. The actor selects the “Modify minigame” option 3. The actor modifies the minigame 4. The actor confirms the modification
Postconditions	The minigame is updated successfully
Alternative sequence 1	1. The actor doesn’t confirm the modification
Postconditions	The minigame remains in its previous state

7.1.34 Delete minigame

Delete minigame	
ID	UC34 - UC_MINIGAME_DEL
Actors	Developers, Course Supervisors, System Admin
Preconditions	The user is registered, logged in and owns the minigame (or is admin)
Sequence	1. The actor selects “Delete minigame” 2. The actor confirms the deletion
Postconditions	The minigame is deleted from memory and from all the courses containing it

7.1.35 Archive minigame

Archive minigame	
ID	UC35 - UC_MINIGAME_ARC
Actors	Developers, Course Supervisors, System Admin
Preconditions	The user is registered, logged in and owns the minigame (or is admin)
Sequence	1. The actor selects “Archive minigame” 2. The actor confirms the modification
Postconditions	The minigame is moved to archive and is deleted from all the courses containing it

7.1.36 Register minigame from developer

Register minigame from developer	
ID	UC36 - UC_MINIGAME_REG_DEV
Actors	Developers
Preconditions	The user is registered and logged in
Sequence	1. The actor selects the minigame 2. The actor selects “Register minigame to course” 3. The actor chooses the course(s) to register (add) minigame into 4. The actor fills all the mandatory sections for registering a new minigame to course 5. The actor confirms to register minigame
Postconditions	The minigame is register successfully to the course(s)

7.1.37 Register minigame from observer

Register minigame from observer	
ID	UC37 - UC_MINIGAME_REG
Actors	Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins
Preconditions	The user is registered, logged in and has authorization from minigame owner
Sequence	1. The actor selects the course 2. The actor selects the “Modify course” option 3. The actor selects “Register minigame to course” 4. The actor chooses the minigame to add to course 5. The actor fills all the mandatory sections for registering a new minigame to course 6. The actor confirms to register minigame
Postconditions	The minigame is register successfully to the course(s)

7.1.38 Pay developer

Pay developer	
ID	UC38 - UC_PAY
Actors	Publishers
Preconditions	The user is registered, logged in and has tasked a developer with a minigame
Sequence	1. The actor selects the payment option 2. The user selects the external payment method they want to use 3. The actor follows the external payment system iter
Postconditions	The actor has paid the developer

7.1.39 Use tech support chat

Use tech support chat	
ID	UC39 - UC_SUPPORT_CHAT
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins)
Preconditions	The user is registered, logged in and has a technical problem
Sequence	1. The actor opens the tech support chat 2. The user sends/receives a message on the chat
Postconditions	The actor interacts with Tech Supports and starts solving the technical problem

7.1.40 Use development chat

Use development chat	
ID	UC40 - UC_DEV_CHAT
Actors	Publishers, Developers
Preconditions	The user is registered, logged in and has the need to discuss about minigame creation
Sequence	1. The actor opens the development chat 2. The actor communicates with the commissioner/developer
Postconditions	The actor interacts with Developer/commissioner and starts the minigame development process

7.1.41 Search element

Search element	
ID	UC41 - UC_SEARCH
Actors	Registered users (Students, Professors, Publishers, Developers, AI supervisors, Tech Supports, Course Supervisors, System Admins) and Unregistered users
Preconditions	The user wants to find some material on the platform (course, class, mini-game, lecture, . . .)
Sequence	1. The actor selects the search option 2. The actor inputs the possible search parameters (name, subject, type, . . .)
Postconditions	A list of resources adhering to the parameters is displayed

7.1.42 Remove review

Remove review	
ID	UC42 - UC_DEL_REV
Actors	System Admins
Preconditions	The user is registered and logged in. The chosen review violates some policies of the platform
Sequence	1. The actor removes review from any material
Postconditions	The review is removed entirely

7.2 Diagrams

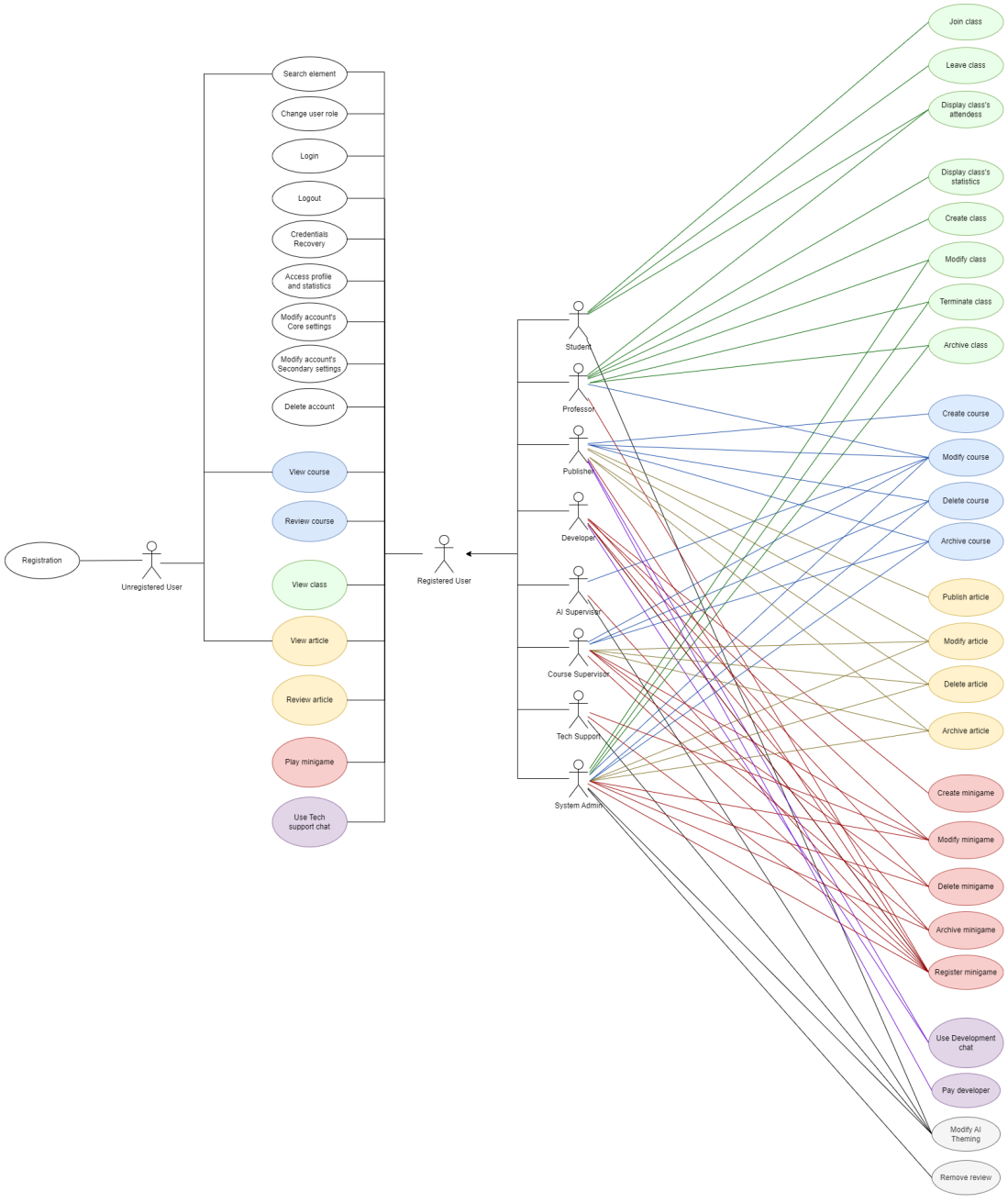


Figure 2: Complete use case diagram

7.2.1 Account and general purpose

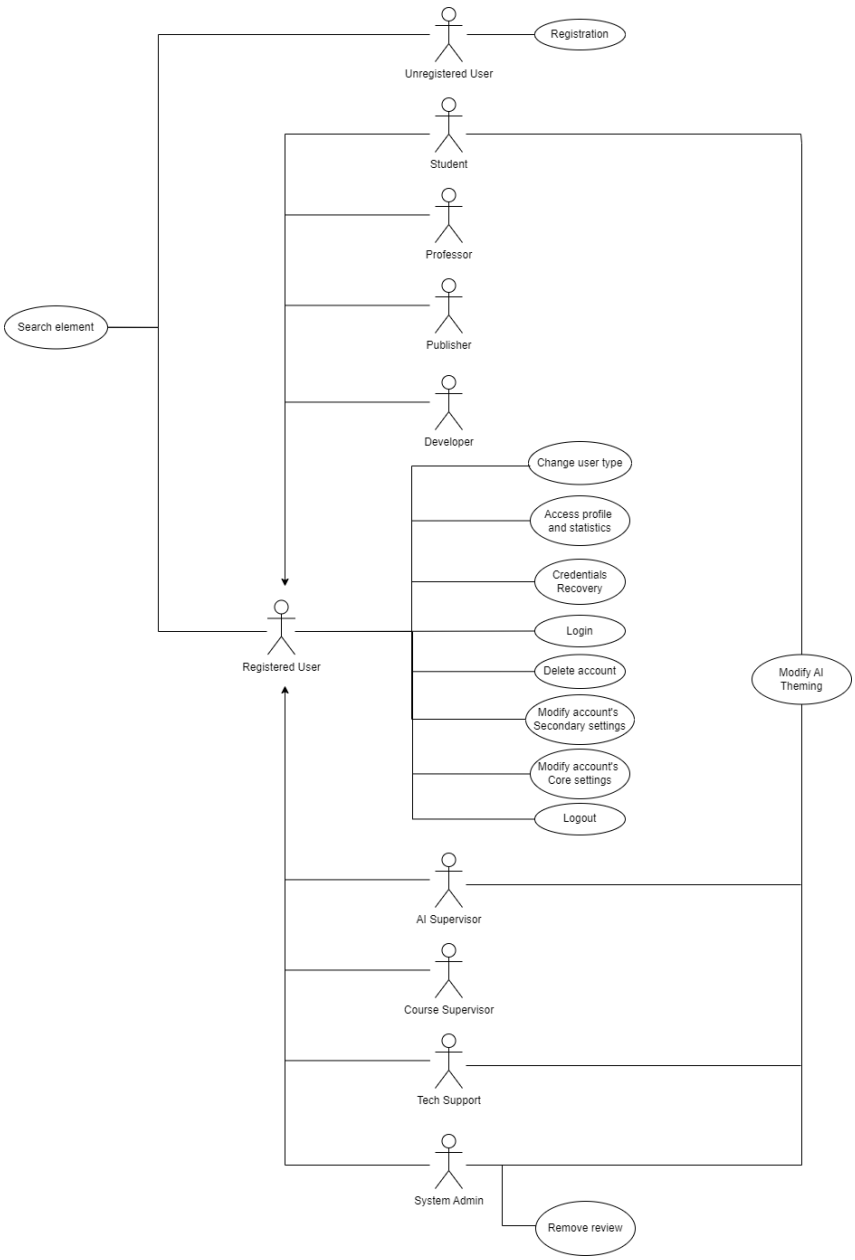


Figure 3: Use case diagram for account system

7.2.2 Article

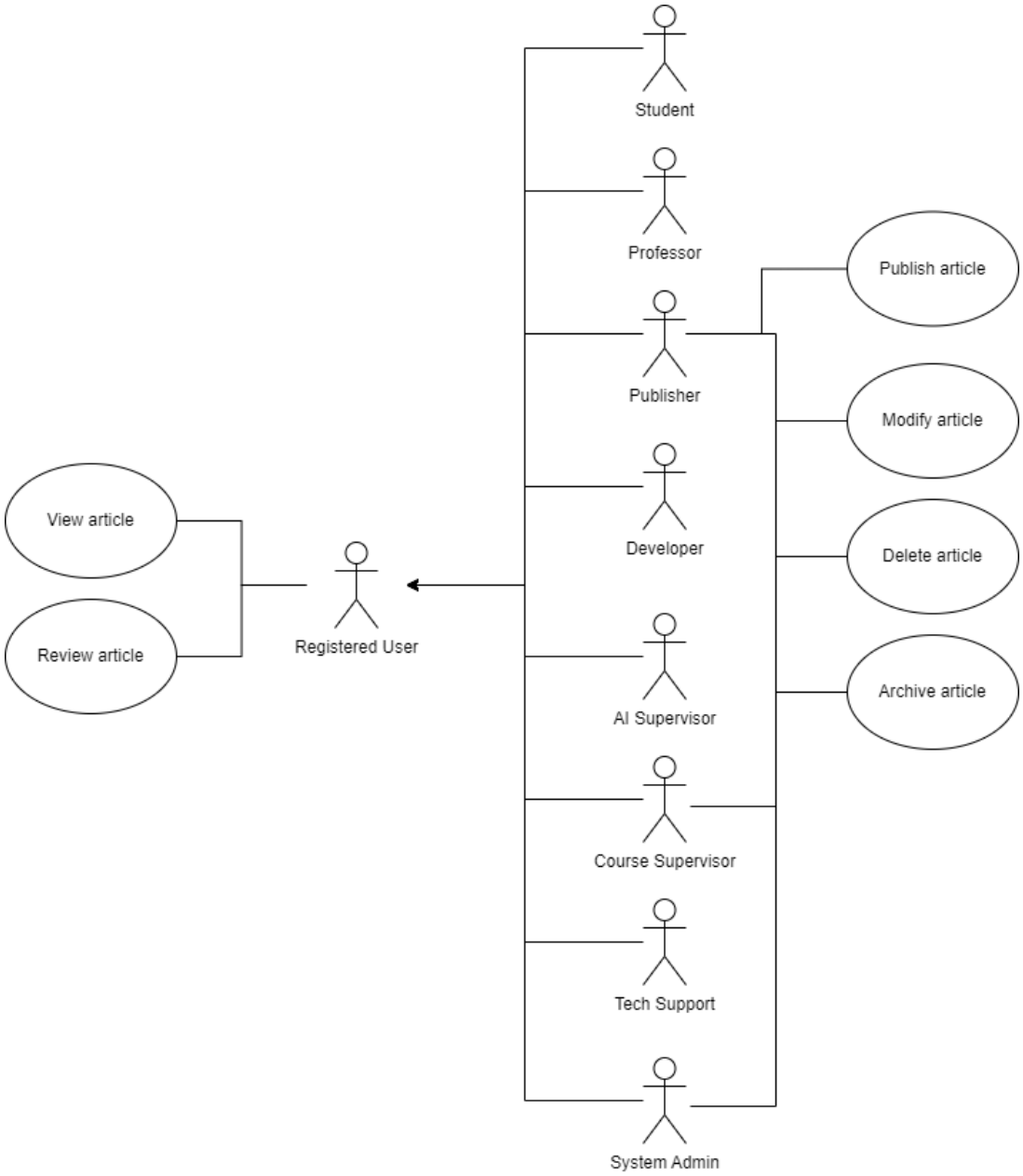


Figure 4: Use case diagram for article system

7.2.3 Chat

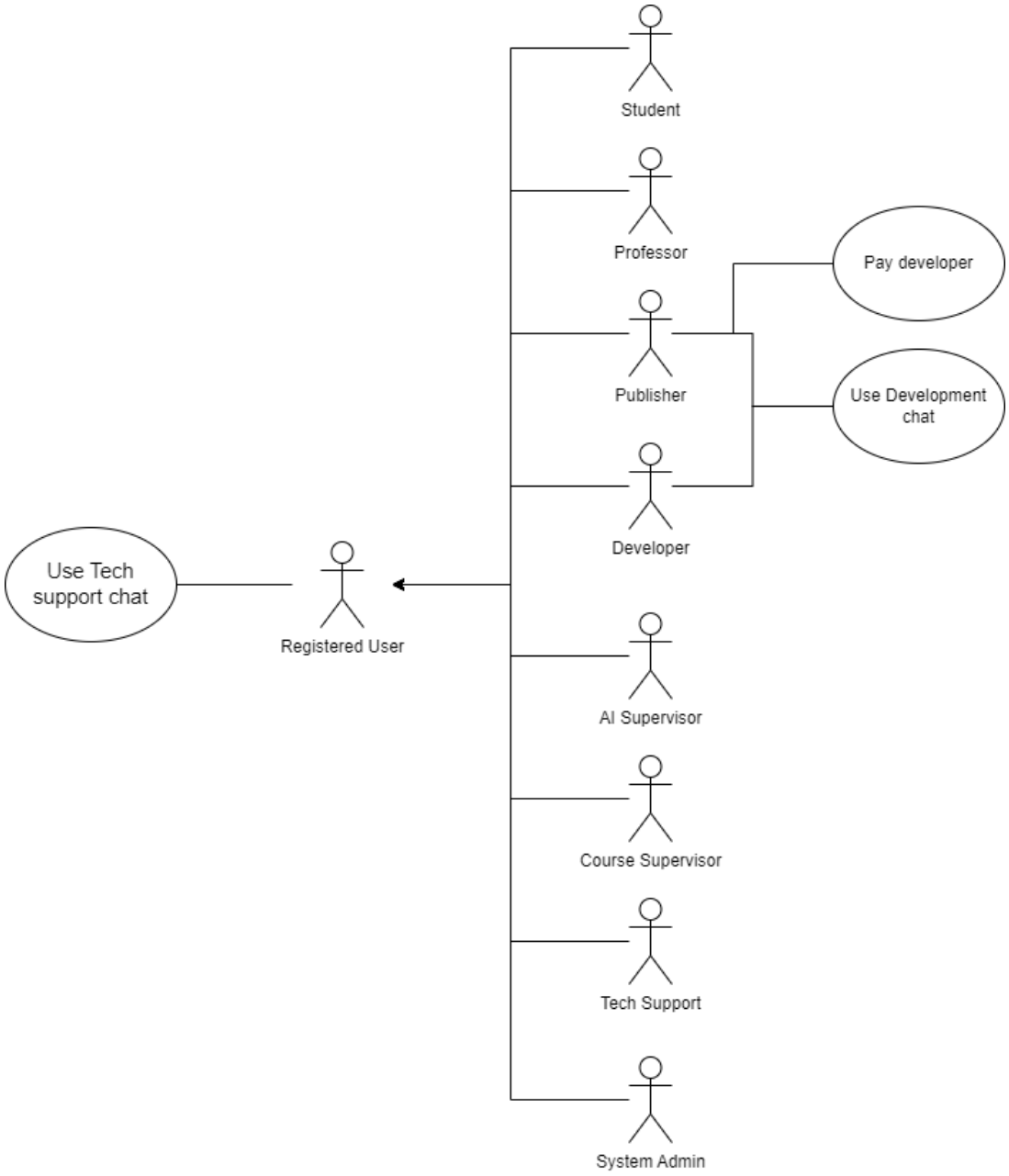


Figure 5: Use case diagram for chat system

7.2.4 Class

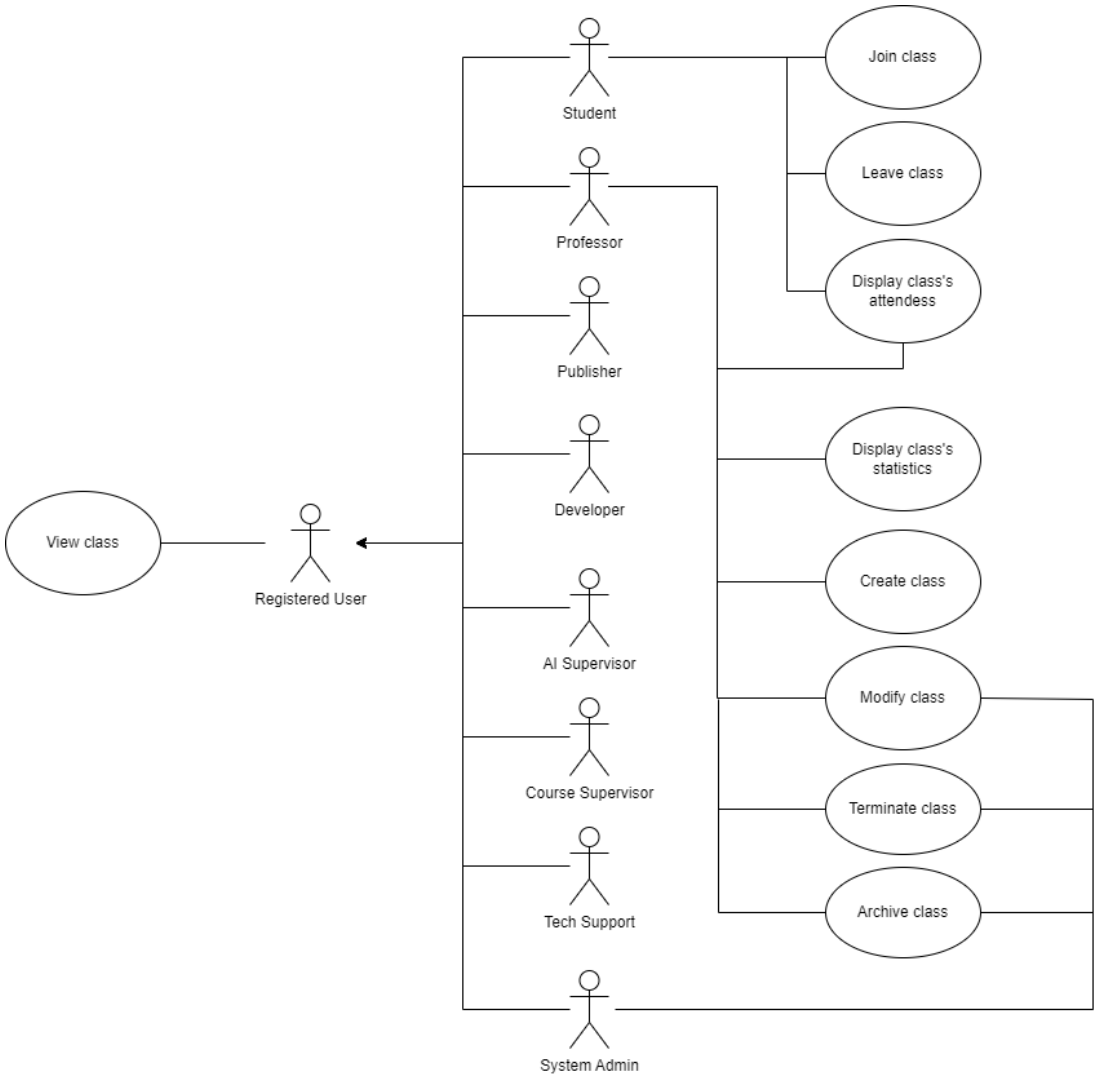


Figure 6: Use case diagram for class system

7.2.5 Course

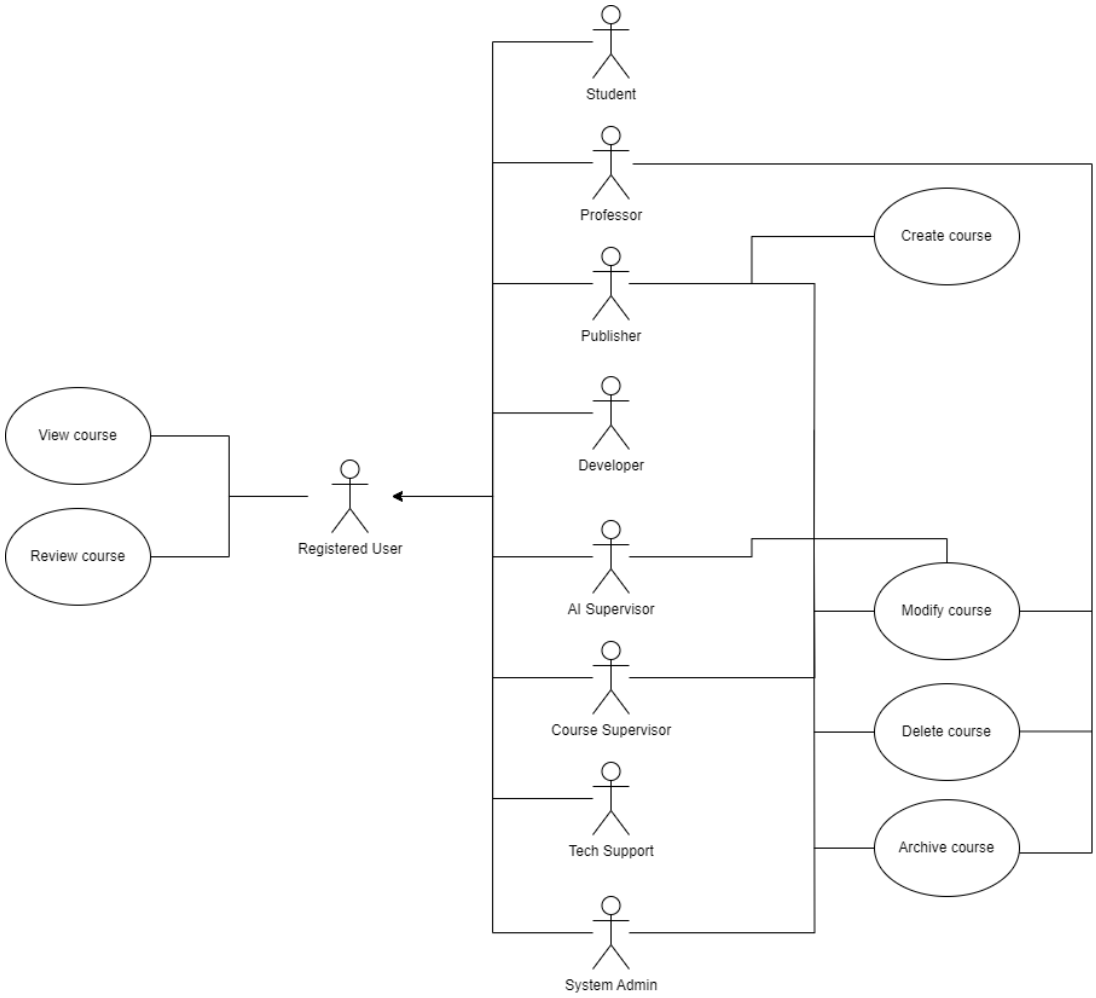


Figure 7: Use case diagram for course system

7.2.6 Minigame

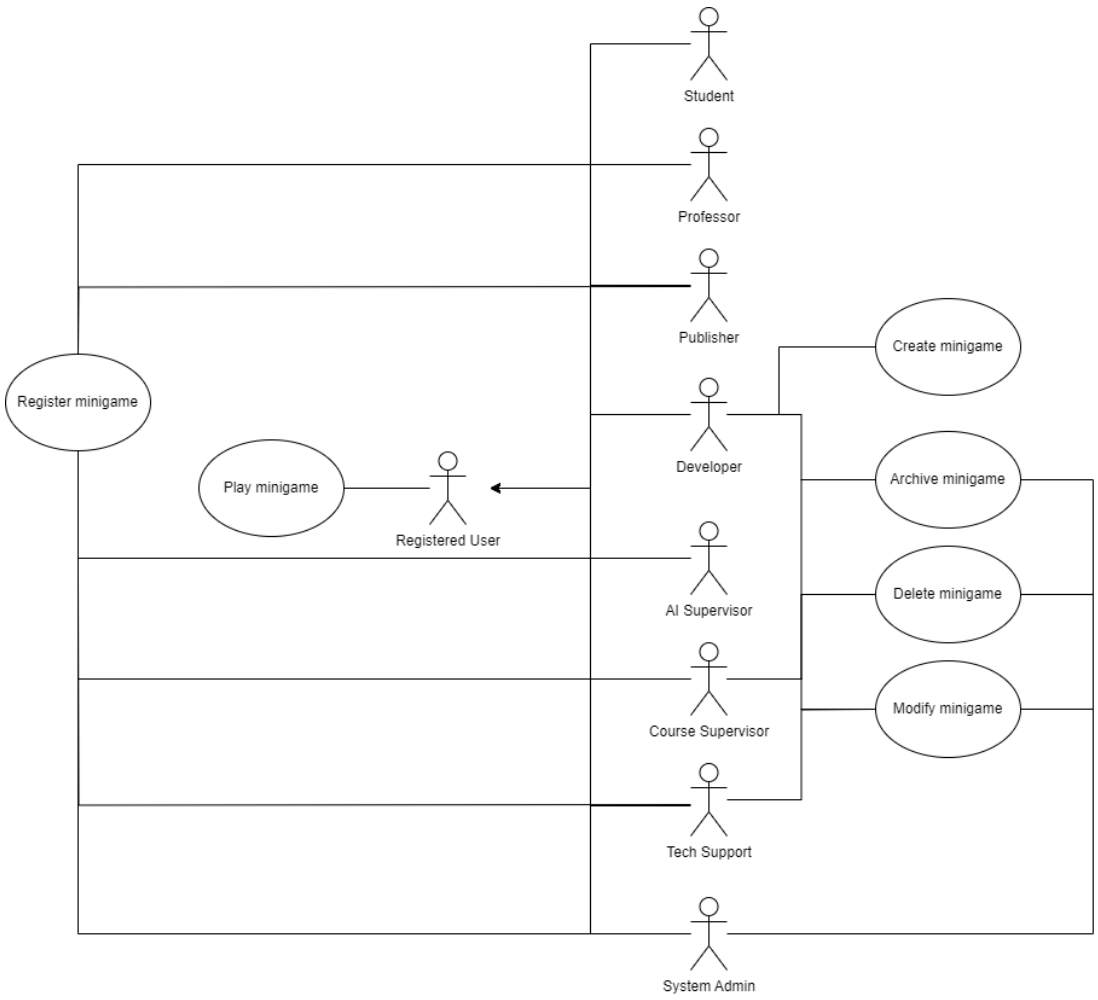
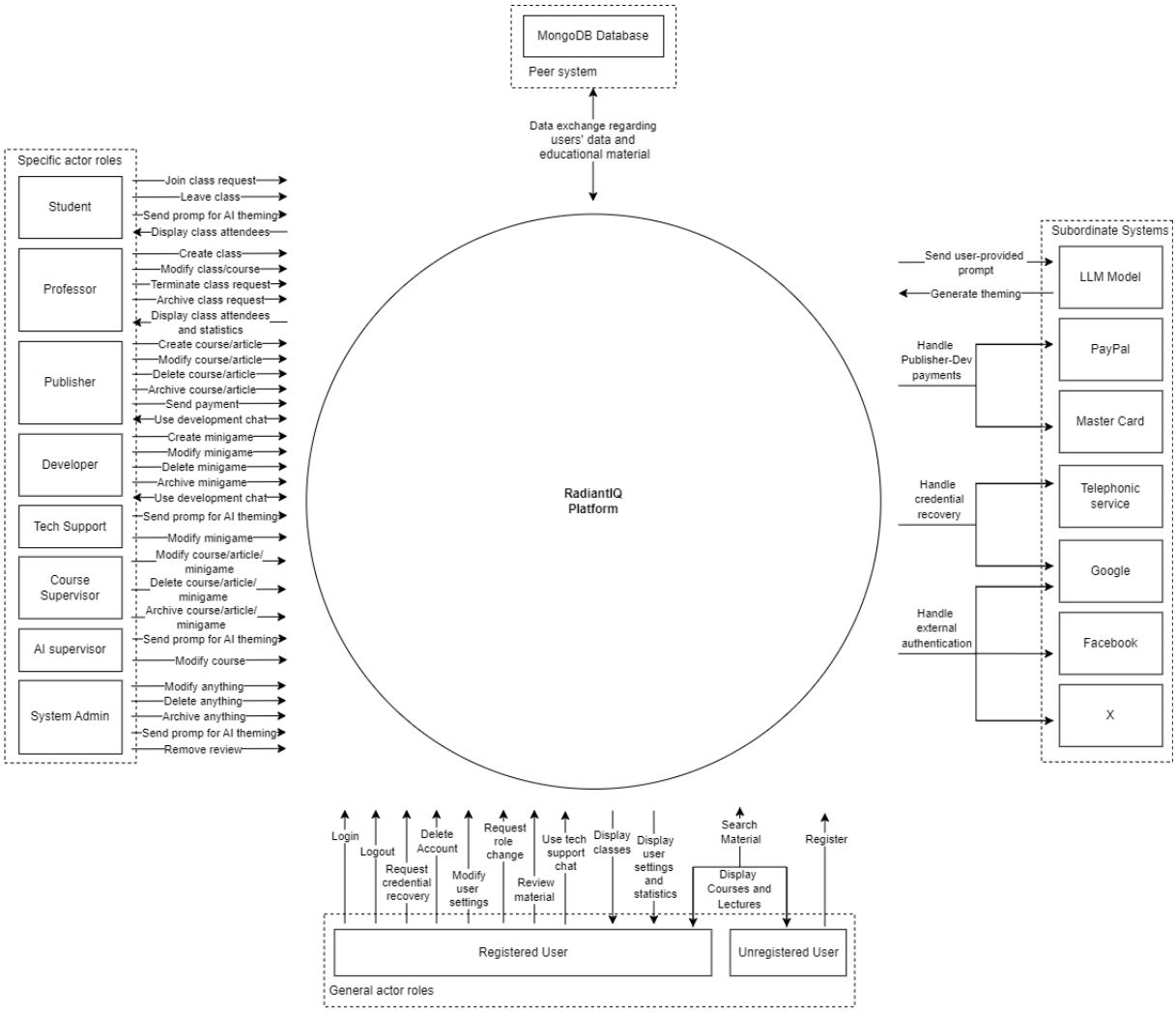


Figure 8: Use case diagram for minigame system

8 Context Diagram

We created a context diagram separating the general roles (registered and unregistered users), the specific roles (all the others), the subsystems (payment, authentication, credential recovery, LLM) and the peer system (database).



9 Components Diagram

A components diagram was create for better visualization about all the main components of the system.

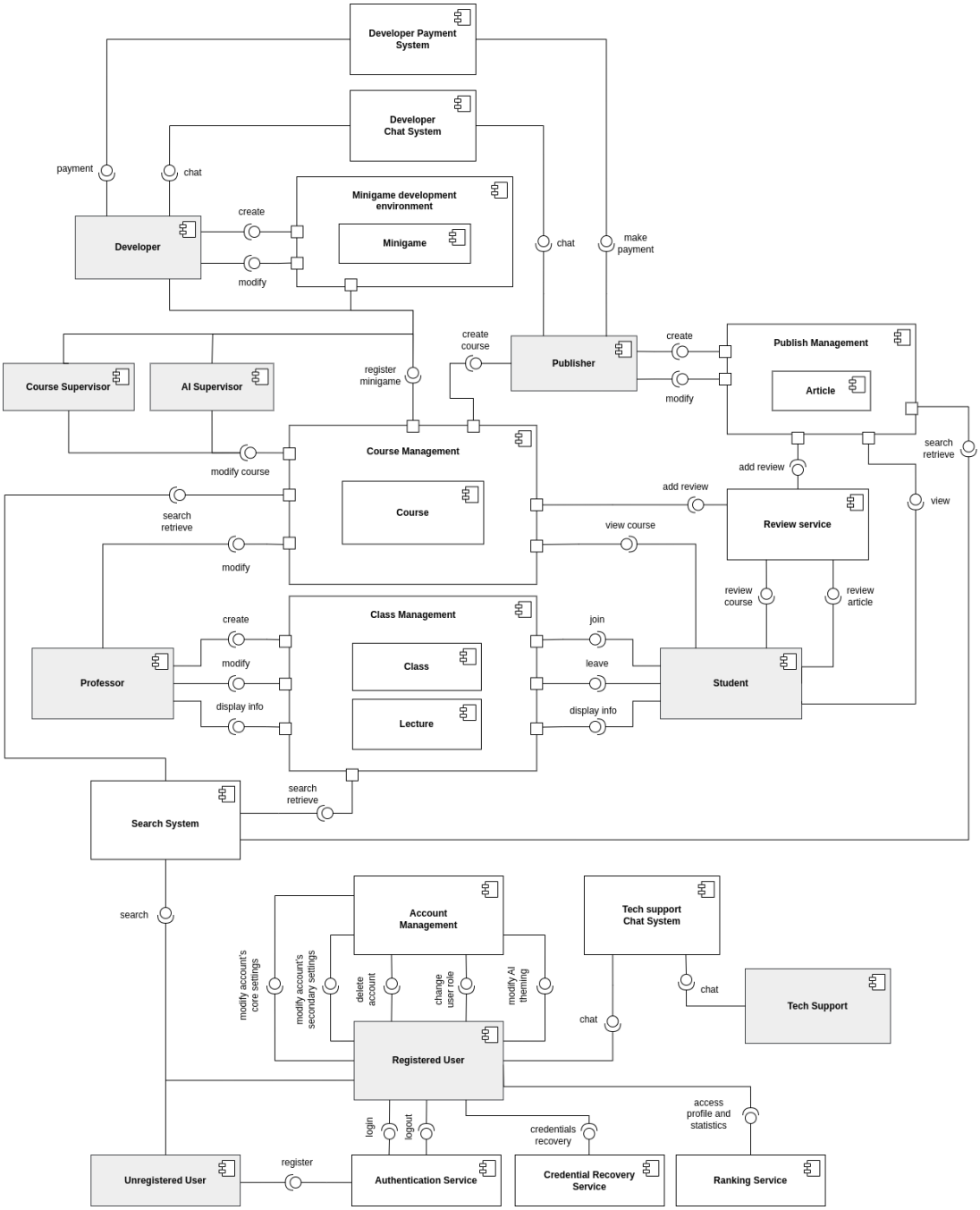


Figure 9: RadiantIQ - Components diagram

10 Class Diagram

11 Conclusion