Accademic Year: 2023-2024

# Design Document

## CodeKataBattle

SOFTWARE ENGINEERING 2

PROFESSOR DI NITTO ELISABETTA

| | | |
|---|---|---|
| CONTI ALESSANDRO | CODICE PERSONA: 10710583 | MATRICOLA: 252665 |
| DI PAOLA ANTONIO | CODICE PERSONA: 10717589 | MATRICOLA: 956038 |

## Contents

# 1. INTRODUCTION

## 1.1. Overview

This Document is intended to provide a comprehensive overview of the CodeKataBattle project. This documentation will be a guide for the reader, enabling them to understand the decisions regarding the design of the application. In particular, the architectural structure and design choices will be detailed, allowing developers, stakeholders, and other team members to gain a clear understanding of how all the features previously outlined informally in the RASD will be implemented.

## 1.2. Purpose

The purpose of our project, named CodeKataBattle (abbreviated as CKB), is to provide a digital platform that enables students to develop and refine their skills in software development through a collaborative experience. The CKB platform allows students to practice in a programming language of their choice. The exercises offered on this platform are created by educators and require students to complete the code or parts of it, adding the missing components they deem appropriate. The code is then executed and subjected to specific tests created by educators to verify its correctness.

Exercises are organized into tournaments by educators, within which 'battles' are held to evaluate the performance of the students. This process culminates in the creation of performance rankings among all students involved in the battles and tournaments. In this way, CKB encourages friendly competition and the growth of students' skills in the field of software development.

## 1.3. Scope

The CKB application, as defined in the RASD document, is a web application focused to enhancing software development skills for users enrolled in the Students category. Educators, Educators, who have in-depth expertise in the topic, will manage tournaments and battles within the platform to facilitate the improvement of students' skills. Through detailed rankings of battles and tournaments, students can assess their level and monitor progress in enhancing their skills.

## 1.4. Definitions, Acronyms, Abbreviations

### 1.4.1. Definitions

- *Commit*: Commits are the core building block units of a Git project timeline. Commits can be thought of as snapshots or milestones along the timeline of a Git project. Commits are created with the `git commit` command to capture the state of a project at that point in time.

- *Fork*: A fork is a new repository that shares code and visibility settings with the original "upstream" repository.
- *Code kata*: Code kata contains the description of a battle and the software project on which the student will have to work, including also test cases and build automation scripts
- *Test Case*: A test case is a singular set of actions or instructions that the Educator wants to perform to verify a specific aspect of the project pushed by the students. If the test fails, the result might be a software defect that students might have not found.
- *Upload*: Upload in which the educator sends to the platform database the code kata for a specific battle.
- *Repository*: A Git repository is the .git/folder inside a project. This repository tracks all changes made to files in your project, building a history over time. Meaning, if you delete the .git/folder, then you delete your project's history.
- *Branch*: In Git, a branch is a new/separate version of the main repository. Branches allows users to work on different parts of a project without impacting the main branch. That main branch is the one seen as the default one.
- *Push*: The `git push` command is used to upload local repository content to a remote repository. Pushing is how you transfer commits from your local repository to a remote repo.
- *Pull*: The git pull command is used to fetch and download content from a remote repository and immediately update the local repository to match that content. Merging remote upstream changes into your local repository is a common task in Git-based collaboration work flows.
- *Demilitarized Zone*: A demilitarized zone is a physical or logical subnet that contains and exposes services to an external network that is not considered secure, such as the Internet. The purpose of a DMZ is to protect an organization's LAN.

### 1.4.2. Acronyms

- CKB: CodeKataBattle
- CK: CodeKata, Code Kata
- GH: GitHub
- GHA: GitHub Action
- GDPR: General Data Protection Regulation
- DMZ: Demilitarized Zone
- RASD: Requirements Analysis and Specification Document
- DD: Design Document

### 1.4.3. Abbreviations

- [Gn]: the n-th goal of the system
- [WPn]: the n-th world phenomena
- [SPn]: the n-th shared phenomena
- [Sn]: the n-th scenario
- [DAn]: the n-th domain assumption
- [Dn]: the n-th dependency
- [Cn]: the n-th constraint
- [Rn]: the n-th functional requirement
- [UCn]: the n-th use case
- [SDn]: the n-th sequence diagram
- Repo: Git repository

## *1.5. Revision history*

- Version 1 ()

## *1.6. Reference documents*

This document is strictly based on:

- The specification of the RASD and DD assignment of the Software Engineering 2 course, held by professor Matteo Rossi, Elisabetta Di Nitto and Matteo Camilli at the Politecnico di Milano, A.Y 2022/2023.
- Slides of Software Engineering 2 course on WeBeep.
- Official link of CodeKata: http://codekata.com/.

## *1.7. Documents Structure*

The rest of the document is organized as follows:

- *Architectural Design* (Section 2) contains a detailed description of the system architecture, the definition of the main components and the relationships between them.
  The last part of the section will describe the design choices, models and paradigms used in the implementation.
- *User Interface Design* (Section 3) contains a detailed description of the user interfaces, which are presented in the RASD in the form of an overview.
- *Requirement Traceability* (Section 4) shows the relations between the requirements from the RASD and the design choices of the DD and how they are satisfied by the latter.
- *Implementation, Integration and Test Planning* (Section 5) provides a road-mapping of the implementation and integration process of all components and explains how the integration will be tested

# 2. ARCHITECTURAL DESIGN

## *2.1. Overview*

In this section we will explain what components will compose our system, the interaction between them, and the replication mechanisms chosen to make the system distributed.

### 2.1.1. High level view

The CKB application will be implemented following the idea of a three-tier architecture as shown in Figure 1.

The three tiers are the follow:

1. *Presentation Tier*: This tier allows interaction between the user and the application through a user interface based on web pages. These pages dynamically adapt to user requests and application responses.
2. *Application Tier*: This tier handles user requests, retrieves and, if necessary, modifies information in the database.
3. *Data Tier*: This tier constitutes the main database. Its primary function is to store data securely and make it available when requested by the user.

The three-tiered distributed architecture allows efficient division of responsibilities, making it easier to scale and manage components.

The Presentation Tier handles the user interface, the Application Tier handles the application logic, and the Data Tier handles persistence and data access. This subdivision facilitates maintenance, scalability, and optimization of overall system performance.

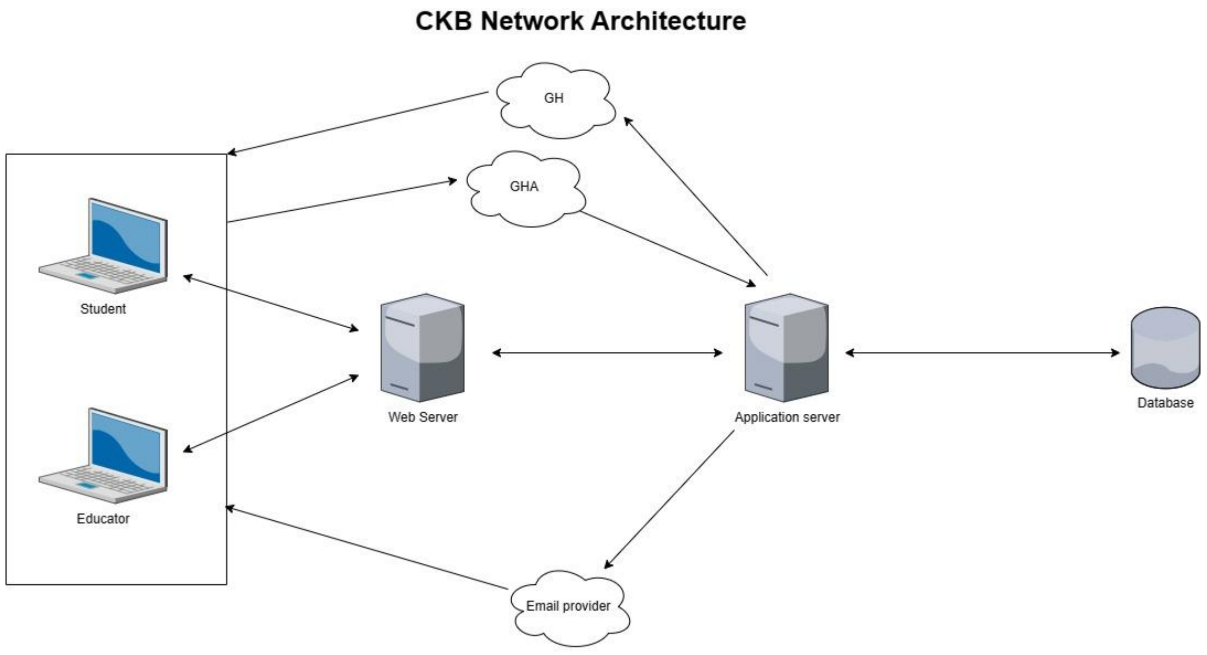


*Figure 1 High Level View*

### 2.1.2. Distributed view

The CKB application will be implemented following the idea of distributed system architecture as shown in Figure 2

The components that make it possible to have this programming paradigm are the follow:

- *Firewall*: a network security device that monitors incoming and outgoing traffic through a predefined set of security rules, deciding whether to allow or block certain events. The firewall then acts as a filter for all user requests, allowing only those authorized according to specific access permissions to pass through.
- *Load Balancing*: a system that fairly distributes the workload it receives among various hardware resources in order to optimize system performance. Load balancing aims to ensure fair allocation of user requests across different machines, thus helping to improve service availability so that it is more efficient.

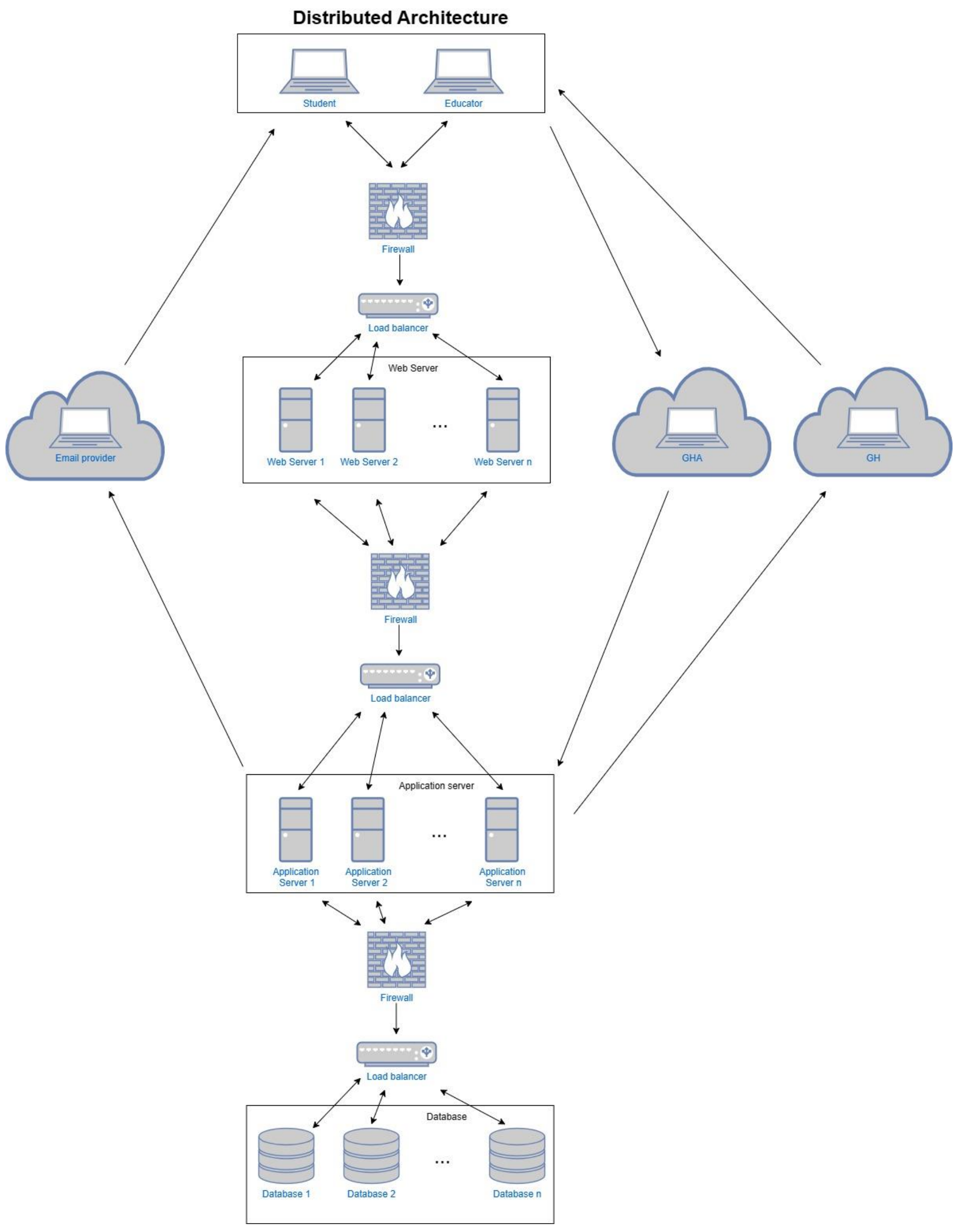


*Figure 2 Distributed View*

## 2.2. Component view

This section will show the component view of the system representing the internal architecture of the CKB application.

The diagram we see in figure 2 allows us to identify the three architectural levels of the application, as described above.

1. The presentation tier, represented by our *Web Site*, deals with dynamic interaction with the user. Whenever a change to the web page occurs, this layer of the architecture communicates with the *Web Server*. This interaction ensures a timely and accurate response to user requests, helping to provide a dynamic web experience aligned with user interactions. In this process, the presentation tier acts as a key interface between the user and the system, ensuring that changes made to the page are reflected consistently and immediately on the website that the user views.
2. The application tier, jointly represented by the *Web Server* and the *Application Server*, handles requests from users and interacts with the database containing the application data.
   When a user sends a notification to the server, the *Web Server*, via the web page displayed to the user, forwards the request to the *Application Server* in the appropriate format. The *Application Server* is the key component that, upon receiving the request in the correct format, forwards it to the database to retrieve and/or modify the data within. This process constitutes an effective communication flow that allows user requests to be fulfilled efficiently and consistently, while ensuring proper access and manipulation of data in the database.
3. The data tier is represented by the *database*, which is responsible for storing and making accessible the data essential to the proper functioning of the application.
   The *database* ensures that the information stored in it can be accessed by the *Application Server* whenever it is necessary to retrieve and/or modify data.

All the components that will compose the system will be explained in detail below.

- Web Site

  This component takes care of user interaction.
- Web Server

  All of these components handle the pages that user sees and can interface with.
  - Home Page

    On this page, the user is given a choice between two options: registration or access to the application. Selecting one of these options automatically causes the corresponding page to change.
  - Login Page

    This component handles the login page.
  - Sign In Page

    This component handles the sign in page.
  - Personal Home Page

This component is responsible for managing the home page.
This page shows the specific home page of each specific user.

- Tournament Page

  This component handles the tournament page.

- Battle Page

  This component handles the battle page.

- Application Server

  This component takes care of the interaction between the user and the database.

  - Servlet Login Manager

    This component handles the login process of a user. It checks whether the user is registered in the database and, if so, redirects the web page to its designated home page.

  - Servlet Sign In Manager

    This component handles the registration process of a user. It checks whether the user is not registered in the database and, if so, saves the user.

  - Servlet Show Tournament Educator

    This component is responsible for searching the database in order to retrieve all the tournaments associated with the educator who logged in. It then displays those tournaments on the home page.

  - Servlet Show Tournament Student

    This component is responsible for searching the database in order to retrieve all the tournaments associated with the student who logged in. It then displays those tournaments on the home page.

  - Servlet Create Tournament

    This component is responsible for creating a tournament and saving it to the database.

  - Servlet Show Notification

    This component is responsible for showing notifications in the application.

  - Servlet Search Tournament

    This component is responsible for searching the database for tournaments that meet the characteristics entered by the user.

  - Servlet Log Out

    This component handles the logout of the user who had logged in.

  - Servlet Modify Personal Information

This component is responsible for modifying the user's personal data in the database.

- Servlet Show Tournament Information

  This component is responsible for searching the database for tournament information and displaying it to the user.
- Servlet Create Battle

  This component is responsible for creating a battle and saving it to the database.
- Servlet Close Tournament

  This component is responsible for closing a tournament and to modify the tournament in the database.
- Servlet Show Battle Information

  This component is responsible for searching the database for battle information and displaying it to the user.
- Servlet Join Battle

  This component is responsible for adding a team to the selected battle, to do this the database is modified.
- Servlet Join Team

  This component is responsible for adding a student to the selected team, to do this the database is modified.
- User DAO

  This component handles all interactions with the database that require access to user information.
- Tournament DAO

  This component handles all interactions with the database that require access to tournament information.
- Battle DAO

  This component handles all interactions with the database that require access to battle information.
- Team DAO

  This component handles all interactions with the database that require access to team information.
- Evaluation

  This component is responsible for grading the work of a team of students according to the requests of the educator who created the battle.
- Send Notification

This component is responsible for interacting with the email provider in order to send notifications to interested users.

The notifications it needs to send are created by the following components: *Servlet Create Tournament*, *Servlet Create Battle*, *Servlet Close Tournament* and *Servlet Join Battle*.

- Database

  This component is responsible for saving the data and making it accessible to each user request.

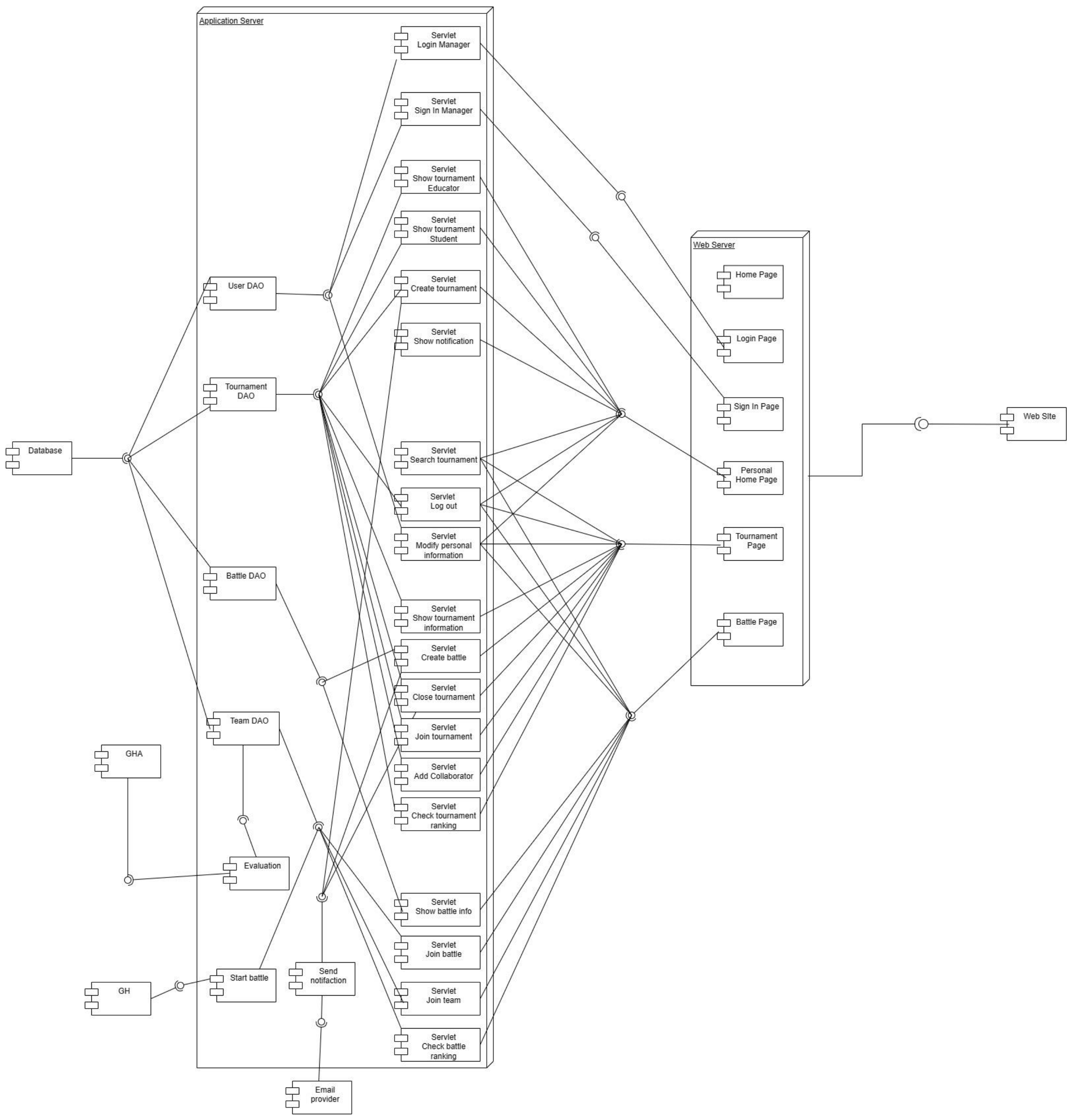


Figure 2 Component View

## 2.3. Deployment view

In this chapter is described the deployment view for CKB. This view describes the execution environment of the system and the geographical distribution of the hardware components that executes the software composing the application.

Following this, all the components displayed in the figure 3 will be explained in detail.

- *PC Student* and PC *Educator* represent a computer used by a Student and a Educator. The two devices must have a web browser capable of interpreting the Javascript language. This browser is indispensable for browsing the Internet, enabling access to the CKB web page and fluid interaction with the application.
- *Firewall* is a device that monitors packets entering the system, if a packet is potentially dangerous it is not is potentially dangerous it is not forwarded. These components are placed before load balancers, with the goal of carefully filtering all packets entering the network. This configuration ensures that only packets deemed safe are allowed to enter the application's network environment. Through this implementation, a DMZ is established in which security is maximized through strict access control, thus helping to protect the LAN's application from potential external threats.
- *Load Balancer* is a device which performs the load balancing. This component deals with dividing a group of requests among several machines that specialize in their execution. This approach aims to optimize the overall performance and increase the scalability of the system. Through the intelligent distribution of requests, the component helps ensure efficient use of available resources, greatly improving the responsiveness of the system and its ability to handle increasing workloads in a flexible manner.
- *Web Server* is the component that receives all user requests and passes them to the *Application Server* to execute and return a response. This component is the one responsible for changing the pages or content that the user sees on the screen.
- *Application Server* is the component that receives all user request, processes a response and sends it to the *Web Server* to display. This component is the only one that can process the data, read it and modify it on the database.
- *Database Server* is the component that saves and accessibility the data.

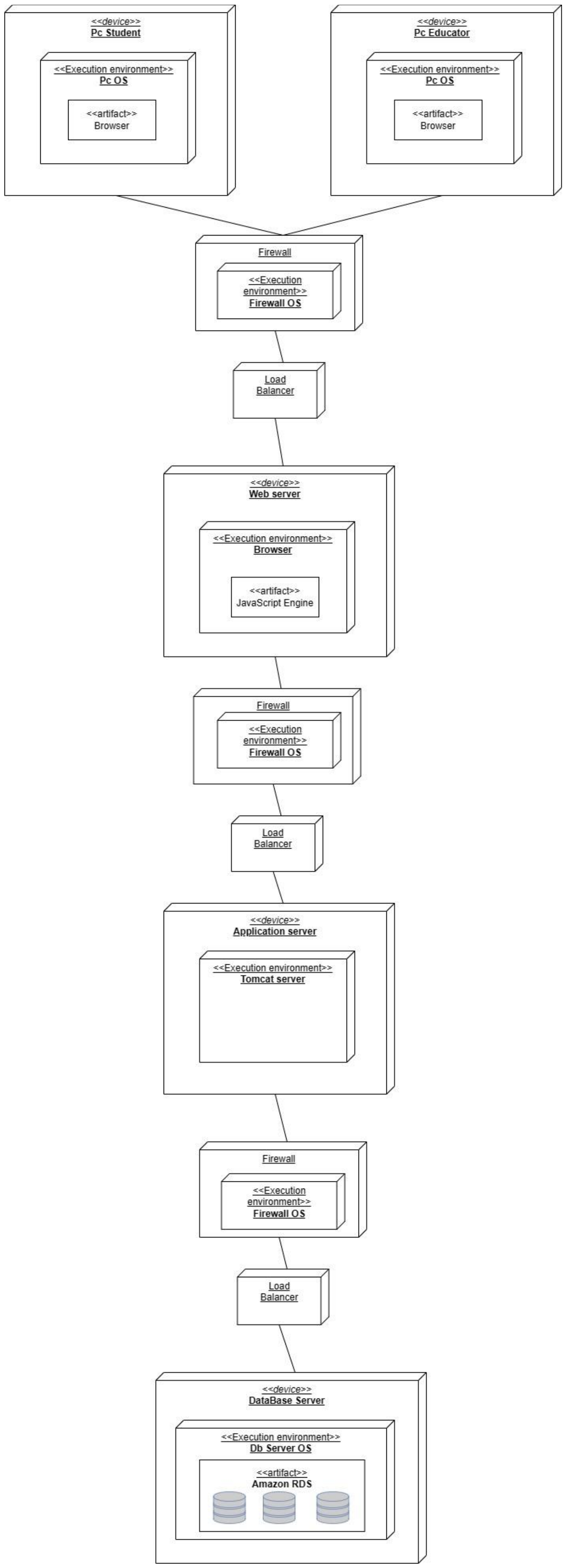


*Figure 3 Deployment View*

## *2.4. Runtime view*

## *2.5. Component Interface*

## 2.6. *Architectural styles and patterns*

### 2.6.1. Architectural style

The implementation of CKB will take place following a three-tier architecture; this structure confers numerous advantages due to the modular division of the system into three distinct and autonomous layers.

1. *Presentation Tier*: the tier responsible for interfacing with the client, by changing or replacing the displayed pages, will receive the data sent by the *Business Logic Tier*. This data will be adapted so that it is visible and understandable to the user.
2. *Business Logic Tier*: this tier includes the application of business logic, which is responsible for performing calculations and making decisions based on the data stored in the data tier. Later, the results will be shown in the presentation tier.
3. *Data Tier*: this tier is responsible for storing, managing, and making accessible the data that will be used by the business logic tier.

By adopting this architecture, it is possible to modify one part of the system without involving the others. Using an intermediate tier to manage the data in the database provides an additional layer of security because users cannot directly modify the saved data. To modify the data in the database they must necessarily interact with the Business Logic Tier which imposes specific formats on the data.

### 2.6.2. Patterns

#### 2.6.2.1. Model-View-Controller Pattern

We will adopt the Model-View-Controller (MVC) pattern to organize and structure the code. In the context of MVC, the Model assumes the crucial role of storing essential objects during computation and decision making, with responsibilities given to *Data Access Objects* (DAOs). These components ensure the accurate management of the underlying data. On the other hand, *web pages* constitute the components dedicated to presenting information resulting from decisions made by servlets in a clear and understandable way to the user. *Servlets*, grouped under the Controller category, emerge as key figures responsible for reading data from the Model and orchestrating changes in the View. This functional subdivision, typical of MVC, facilitates maintenance, scalability and code comprehensibility, contributing to effective management of business logic and user interactions within the application.

#### 2.6.2.2. Observer Pattern

We will adopt the Observer design pattern to notify users about relevant changes in the application, such as the creation or the closure of a tournament and creation of a battle. Each class responsible for issuing notifications will send its own messages to the *SendNotification* class, which, acting as an intermediary, will interface with the email API to send notifications to interested clients. The *SendNotification* class acts as a coordination point, playing a key role in orchestrating communication between the application and users, thus ensuring an efficient and effective flow of relevant information.

#### 2.6.2.3. Command Pattern

We will adopt the Command pattern so that each individual action or command is encapsulated in an object that can be handled by distinct classes. This approach offers a significant advantage: the invoker, or caller of the action, does not need to know the implementation details of the command it is calling, only its interface. This separation allows the calling functions to remain independent of the classes involved in creating and handling the commands. In this way, the interface between the invoker and the command remains stable, facilitating code maintenance and allowing new commands to be introduced without modifying existing parts of the system. This design pattern is particularly beneficial in ensuring a clear separation of responsibilities and helps make the code more modular, flexible, and easily extensible.

## *2.7. Others design decision*

In this section are presented some of the design decisions made for the system to make work as expected.

### *2.7.1.* Availability

We opted to implement load balancing and server replication in order to enhance system availability and reliability. The adoption of load balancing allows our system to respond more promptly by distributing requests among less stressed servers. This results in higher operational efficiency which ensures faster response to users. In parallel, through server replication, we are able to improve system resilience: if one server fails, service can be maintained unaffected by using operational replicas on other servers. This replication strategy helps to ensure continuity of service without significant interruptions, improving the robustness of our system in the face of any hardware failure.

### *2.7.2.* Notification timed

The role of managing the sending of all notifications from the application to users is entrusted to the *SendNotification* component. This component interacts directly with the email API, facilitating the sending of notifications to the specified recipients.

### *2.7.3.* Data storage

The decision to adopt a relational database, rather than a nonrelational one, was driven by the need to efficiently represent the inherent relationships present in the data to be stored. A relational database offers a structured model that lends itself well to the representation and management of connections between different entities. In addition, the use of a relational database greatly simplifies complex operations, such as joining multiple tables and updates within the database itself. The tabular structure of the relational database provides a clear organization of the data, making it easier to navigate and manipulate information. This choice results in more efficient management of complex data relationships, contributing to the consistency and optimal structuring of our storage system.

### *2.7.4.* Security

Our system is provided with three firewalls, which are crucial for the protection of the different components of the application. Given the shared nature of the system, which will not be limited to a single machine, the implementation of these firewalls is essential. The external network, deemed untrusted, could pose a potential threat to the application LAN. The introduction of firewalls creates a demilitarized zone (DMZ), providing security and protection within the application environment. This configuration helps mitigate risks from unauthorized access and provides an additional layer of security, protecting the internal network from potential threats from outside.

# 3. USER INTERFACE DESIGN

## *3.1. External interface*

### 3.1.1. User interface

In this paragraph, we will provide an overview of the graphical interface of the application.

- This image represents an overview of how we will then go about developing the Home Page of the application. This page allows you to choose whether you want to register or access the application

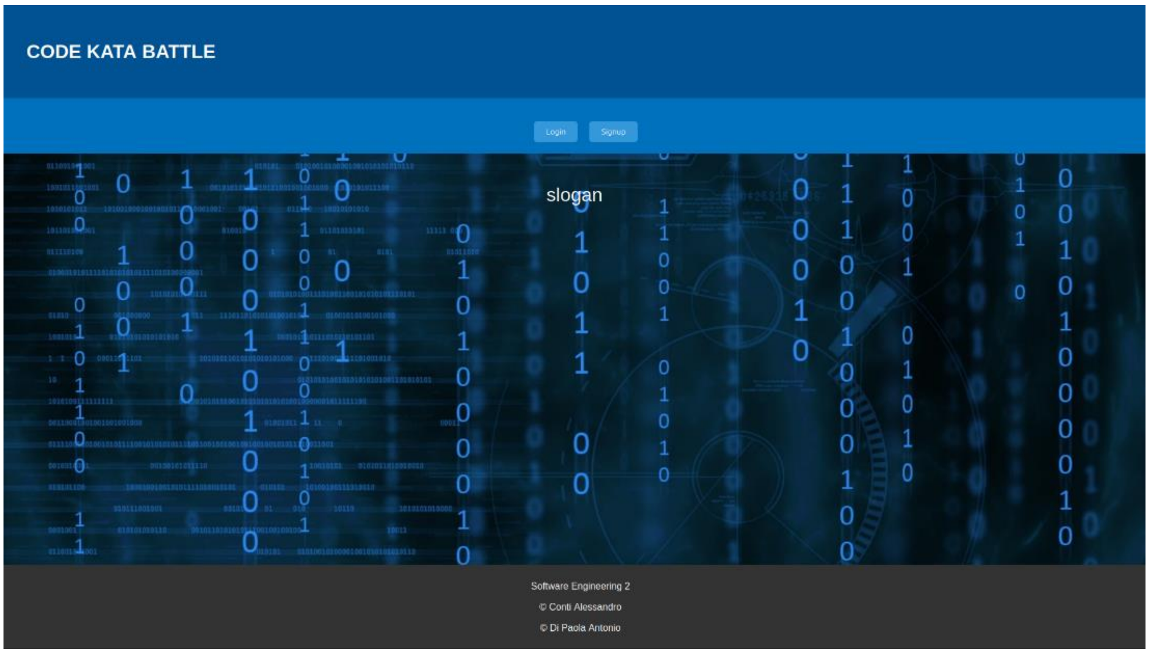


*Figure 4 Main Page*

- After logging into the application, users will be presented with two similar pages, but with differences based on their roles as Educators or Students. Whether you are an Educator or a Student, the page will always display a search bar, allowing you to search for new tournaments and view all the tournaments you are enrolled in. In the case of a user logging in as an Educator, there is an additional option compared to Students—an extra button that, when clicked, directs them to the page dedicated to creating a new tournament.

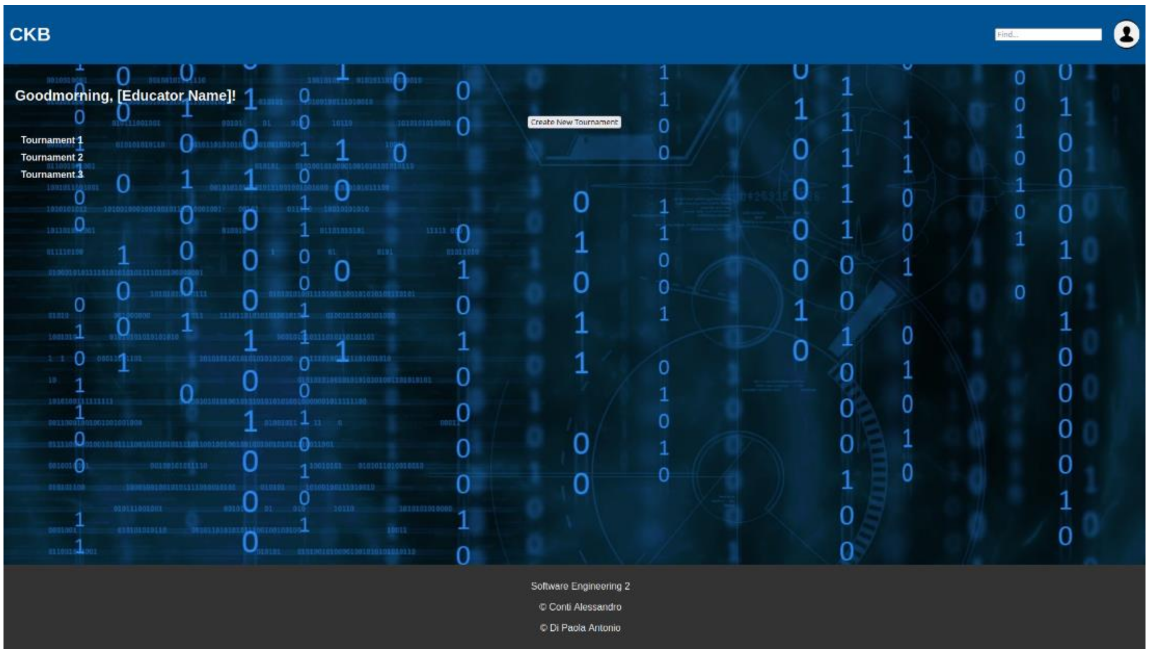


*Figure 5 Educator's Home Page*

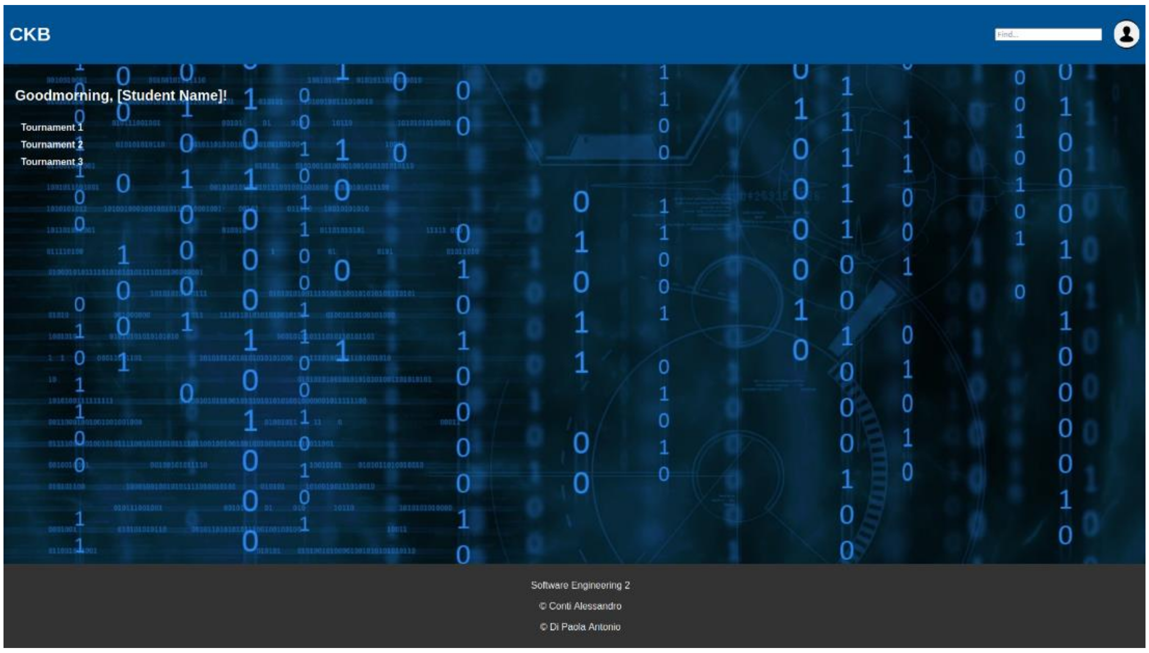
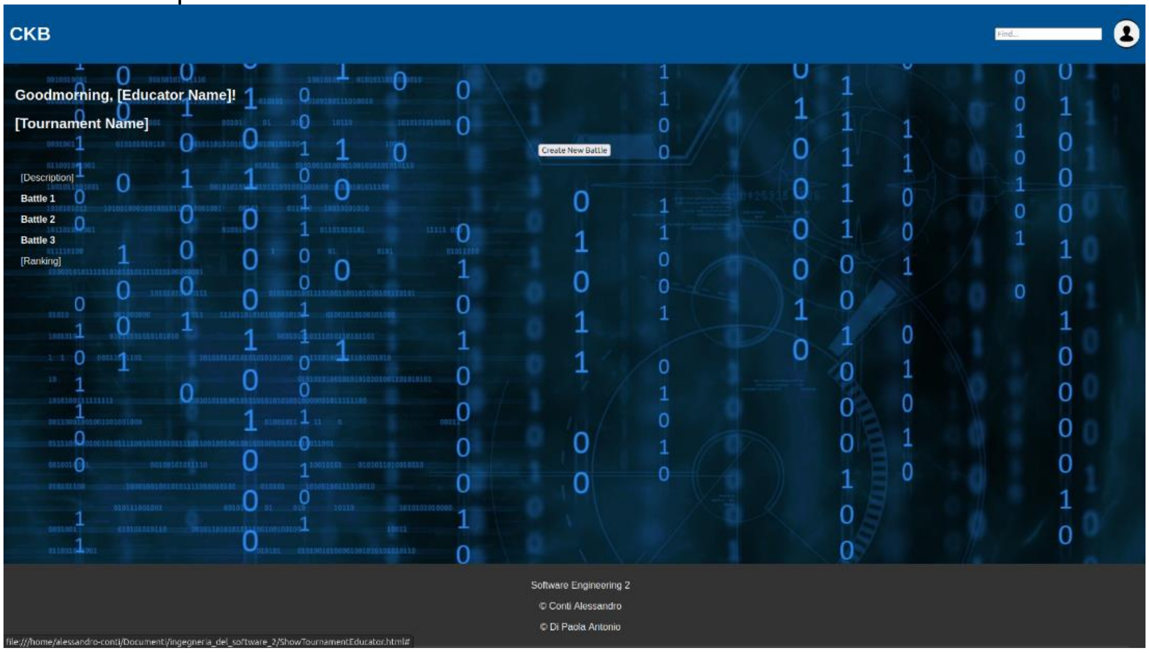


*Figure 6 Student's Home Page*

- Once a user selects a tournament to view, either through the search bar or via links to tournaments they are enrolled in, they will be redirected to a page displaying all relevant details about that tournament. In the event that the user is an Educator responsible for managing the tournament, their page will include a button enabling the creation of new battles; otherwise, this option will not be available.
  If the user is a Student who has not yet enrolled in the tournament and the registration deadline has not expired, the page will display a button allowing them to sign up.

In other scenarios, the page will only provide details about the tournament without additional options.


CKB

Find...

Goodmorning, [Educator Name]!

[Tournament Name]

[Description]

Battle 1

Battle 2

Battle 3

[Ranking]

Create New Battle

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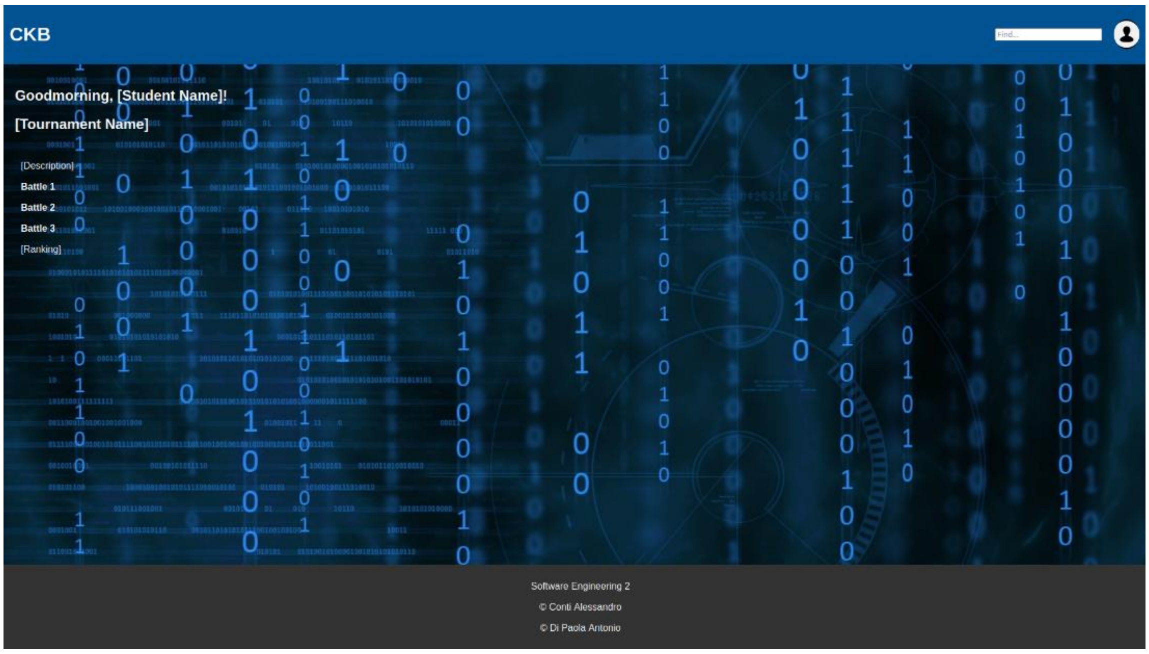
file:///home/alessandro-conti/Documenti/ingegneria_del_software_2/ShowTournamentEducator.html#

*Figure 7 Page that shows a tournament to which the Educator is responsible for managing.*


CKB

Find...

Goodmorning, [Student Name]!

[Tournament Name]

[Description]

Battle 1

Battle 2

Battle 3

[Ranking]

Software Engineering 2

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*Figure 8 Page that shows a tournament in which the Student is registered.*

- Once a user selects a battle to view through its link within their tournament, they will be redirected to a page presenting all the details related to that battle. In the event that the user is a Student enrolled in the tournament but not yet in that specific battle, the page will display the registration button as long as the registration deadline has not passed. In other scenarios, the page will only provide details about the battle without additional options.

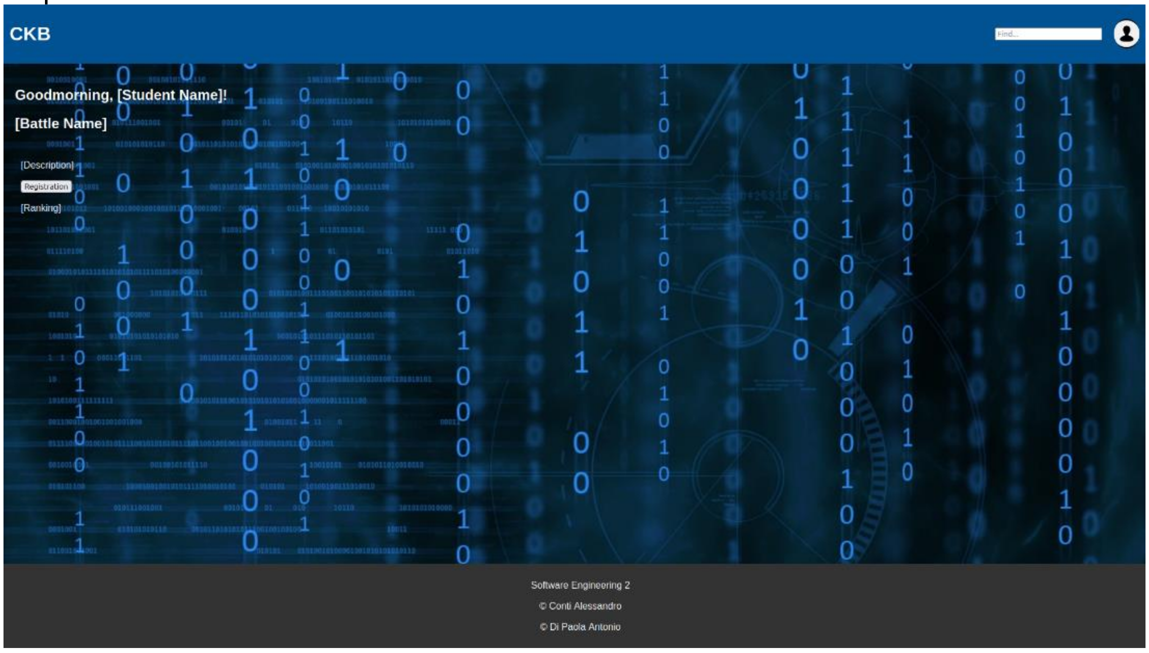


*Figure 9 Page showing a battle that the Student can join.*

- The page that shows the tournament and/or battle rankings is accessible when a user clicks on the ranking link found on the tournament and/or battle details page.

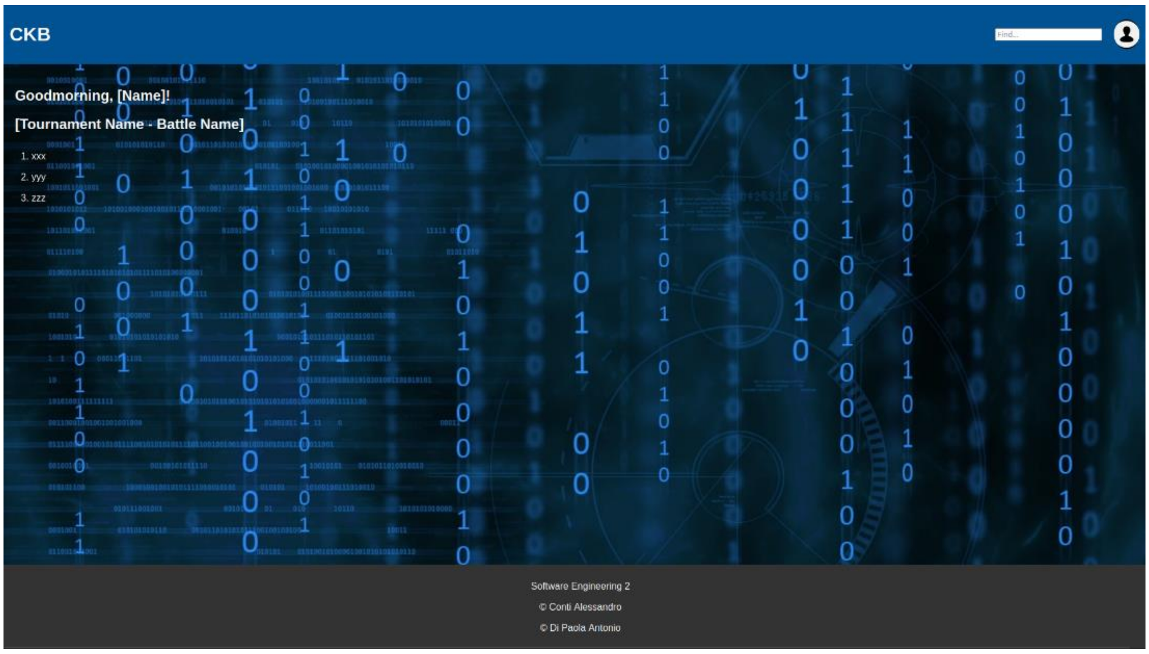


*Figure 10 Page showing a tournament or a battle ranking.*

### 3.1.2. Hardware interface

The application does not require any specific hardware interface as long as you have a computer that connects to an Internet network and a browser that can read and run JavaScript.

### 3.1.3. Software interface

The only software interface that the application requires is the email API.

### 3.1.4. Communication interface

The communication protocol we use is the HTTPS protocol; it is important to use it so that we have secure communication through the Internet.

## *3.2. Functional requirements*

In the following are specified all the requirements that the system has to fulfill. In order to work properly, the system should:

[R1]. System allows students to sign up
[R2]. System allows educators to sign up
[R3]. System allows students to login
[R4]. System allows educators to login
[R5]. System allows educator to create a new tournament and to add all the needed information
[R6]. System allows educator to grant the permission to other colleagues to create battle in a specific tournament
[R7]. System allows educator to create a battle inside a particular tournament by adding CK and the deadlines
[R8]. System allows educator to see rankings of each tournament, which he created or in which he has been nominated collaborator
[R9]. System allows educator to see ranking of a specific battle
[R10]. System allows educator to modify the evaluation manually of a specific group in a battle
[R11]. System allows educator to close a tournament
[R12]. System notifies students about the creation of a new tournament
[R13]. System notifies students about the creation of a new battle in a specific tournament in which they have subscribed
[R14]. System notify student about publication of final ranking of a specific battle
[R15]. System notify student about publication of final ranking of a specific tournament
[R16]. System allow student to join a tournament
[R17]. System allow student to join a battle
[R18]. System allows students to see rankings of each tournament, which they are sub scripted
[R19]. System allows students to see ranking of a specific battle
[R20]. System, at end of the registration period of a battle, create a GH repo and send invitation to all member of the group
[R21]. System automatically evaluates the code in the main branch of the repo after each commit in it
[R22]. System allows students to search tournament by key words

### 3.2.1. Use cases diagram

The diagram of use cases derived from the scenarios described above is shown below. These diagrams are useful to show the actors interacting with the system and to understand their roles.

### 3.2.1.1. Student use case diagram

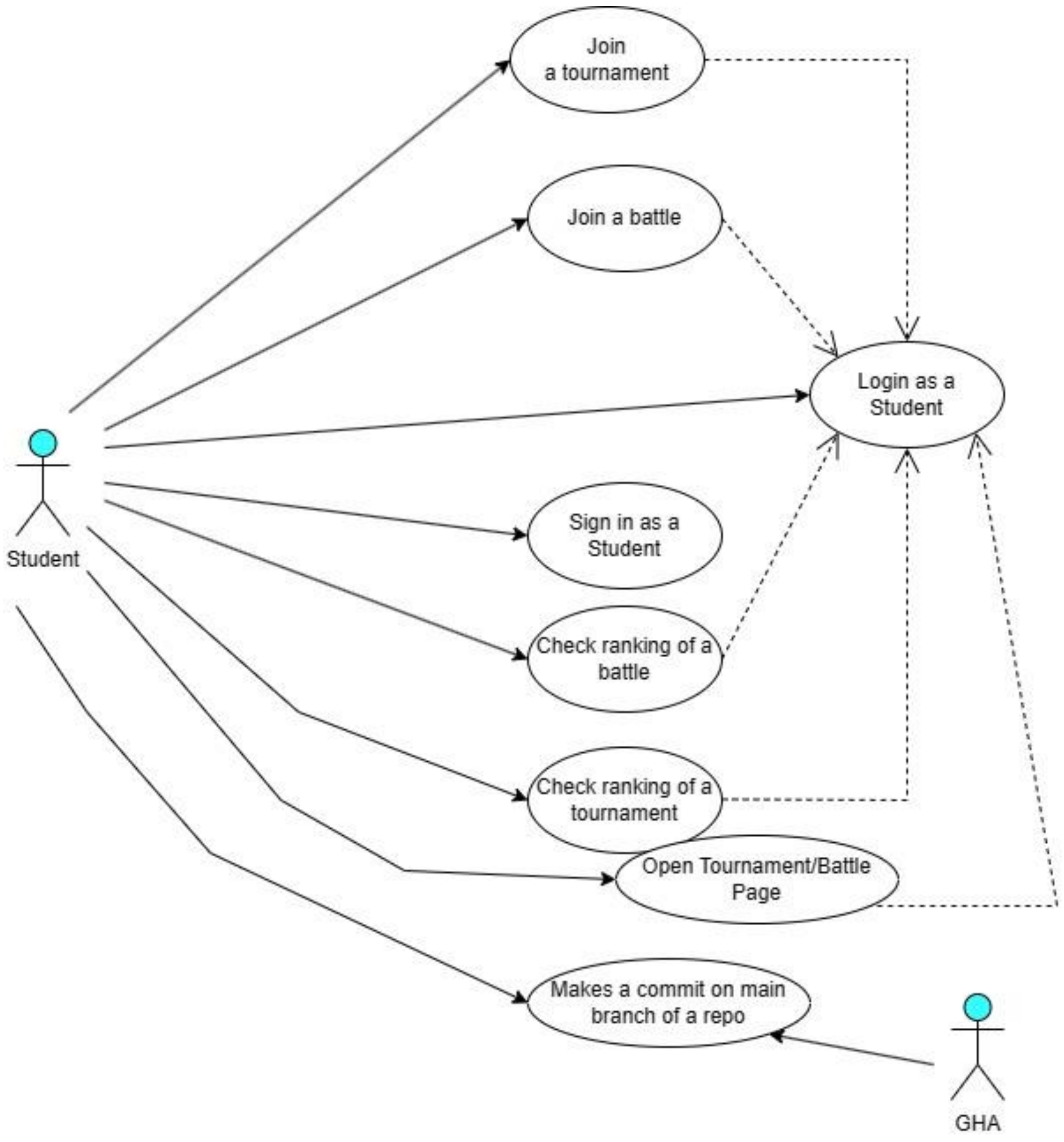

Join a tournament
Join a battle
Login as a Student
Student
Sign in as a Student
Check ranking of a battle
Check ranking of a tournament
Open Tournament/Battle Page
Makes a commit on main branch of a repo
GHA

*Figure 11 Student Use Case Diagram*

### 3.2.1.2. Educator use case diagram

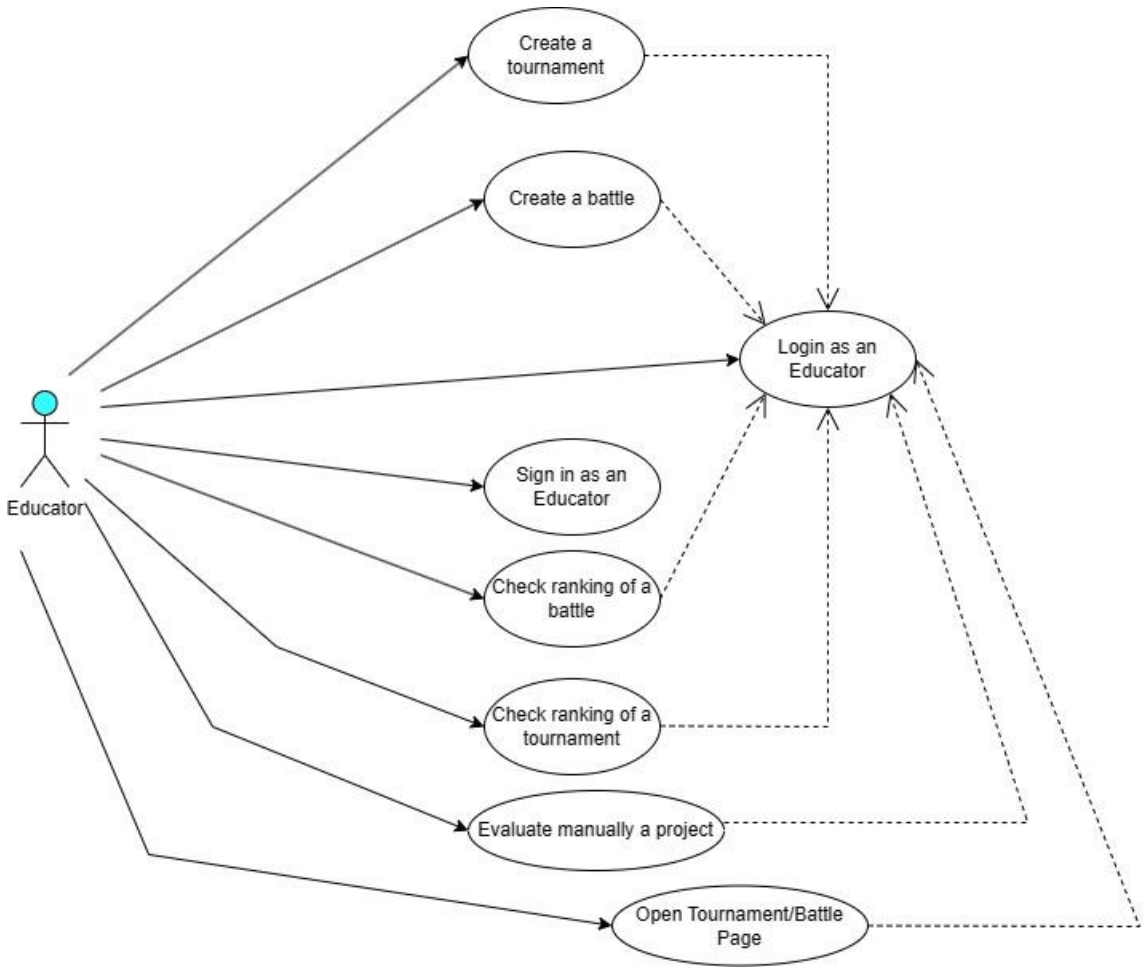

Create a tournament
Create a battle
Login as an Educator
Educator
Sign in as an Educator
Check ranking of a battle
Check ranking of a tournament
Evaluate manually a project
Open Tournament/Battle Page

*Figure 12 Educator Use Case*

### 3.2.2. Use cases

[UC1]. Sign in of a new student

| | |
|---|---|
| *Name* | Sign in of a new student |
| *Actors* | Student |
| *Entry Condition* | A student opens the site |
| *Event Flow* | 1. Student opens the site<br>2. System shows the home page<br>3. Student clicks the "Sign in as a student"<br>4. System shows the sign in page<br>5. Student inserts their personal data<br>6. Student press the "Sign in" button<br>7. System checks if the credential inserted in the previous step are not already used by another account<br>8. System sends a confirmation email to the user<br>9. Student confirms the registration by clicking the link received by email |
| *Exit Condition* | Registration has been successful. The student data is stored into the system's database. The student then will be able to login in the system by using their credentials |
| *Exception* | 7. The username or the email are already used.<br>The system comes back to point 3 adding an error message |

[UC2]. Sign in of a new educator

| | |
|---|---|
| *Name* | Sign in of a new educator |
| *Actors* | Educator |
| *Entry Condition* | An educator opens the site |
| *Event Flow* | 1. Educator opens the site<br>2. System shows the home page<br>3. Educator clicks the "Sign in as an educator"<br>4. System shows the sign in page<br>5. Educator inserts their personal data<br>6. Educator press the "Sign in" button<br>7. System checks if the credential inserted in the previous step are not already used by another account<br>8. System sends a confirmation email to the user<br>9. Student confirms the registration by clicking the link received by email |
| *Exit Condition* | Registration has been successful. The educator data is stored into the system's database. The educator then will be able to login in the system by using their credentials |
| *Exception* | 7. The username or the email are already used.<br>The system comes back to point 3 adding an error message |

[UC3]. Login of a student

| | |
|---|---|
| *Name* | Login of a student |
| *Actors* | Student |
| *Entry Condition* | A student opens the site |
| *Event Flow* | 1. Student opens the site<br>2. System shows the home page<br>3. Student clicks the “Log in as a student” button<br>4. System shows the login page<br>5. Student inserts their credential<br>6. Student press the “Login” button<br>7. System checks the credentials<br>8. System shows the student’s home page |
| *Exit Condition* | Student has accessed to his personal home page |
| *Exception* | 7. Student inserted invalid credentials.<br>The system comes back to point 3 adding an error message |

[UC4]. Login of an educator

| | |
|---|---|
| *Name* | Login of an educator |
| *Actors* | Educator |
| *Entry Condition* | An educator opens the site |
| *Event Flow* | 1. Educator opens the site<br>2. System shows the home page<br>3. Educator clicks the “Log in as an educator” button<br>4. System shows the login page<br>5. Educator inserts their credential<br>6. Educator press the “Login” button<br>7. System checks the credentials<br>8. System shows the educator’s home page |
| *Exit Condition* | Educator has accessed to his personal home page |
| *Exception* | 7. Educator inserted invalid credentials.<br>The system comes back to point 3 adding an error message |

[UC5]. Creation of a tournament

| | |
|---|---|
| *Name* | Creation of a tournament |
| *Actors* | Educator and student |
| *Entry Condition* | Educator opens the site |
| *Event Flow* | 1. Educators open the site<br>2. System shows the home page<br>3. Educator logs in<br>4. System shows the educator's home page<br>5. Educator fills the form for the creation of a new tournament<br>6. Educator clicks the "Create a new tournament" button<br>7. System saves the tournament<br>8. System shows the tournament details page<br>9. System notifies all students subscribed to CKB about the creation of the tournament<br>10. Educator clicks the "Adds another educator as a collaborator" button<br>11. System shows a form to fill<br>12. Educator fills the form with the username of the educator to add<br>13. System saves the modification at the tournament |
| *Exit Condition* | Tournament has been successful created. The tournament data is stored into the system's database.<br>Now student can join the tournament whenever they want until the registration deadline expires. |
| *Exception* | 9. If the educator does not want to add collaborators. The steps 10 through 13 are skipped |

[UC6]. Creation of a battle

| | |
|---|---|
| *Name* | Creation of a battle |
| *Actors* | Educator and student |
| *Entry Condition* | An educator opens the site |
| *Event Flow* | 1. Educator opens the site<br>2. System shows the home page<br>3. Educator logs in<br>4. System shows the educator's home page<br>5. Educator clicks on the tournament in which he wants to create a battle<br>6. System shows the tournament details page<br>7. Educator press the "Create a new battle" button<br>8. System shows the page for creating the battle<br>9. Educator fills the form<br>10. Educator clicks the "Create" button<br>11. System saves the battle<br>12. System notifies all students that are subscribed to the tournament that a new battle has been created |
| *Exit Condition* | Battle has been successful created. The battle data is stored into the system's database.<br>Now student can join the battle whenever they want until the registration deadline expires. |

[UC7]. Student joins a tournament

| | |
|---|---|
| *Name* | Student joins a tournament |
| *Actors* | Student |
| *Entry Condition* | A student opens the site |
| *Event Flow* | 1. Student opens the site<br>2. System shows the home page<br>3. Student logs in<br>4. System shows the student's home page<br>5. Student searches for a tournament they want to enter<br>6. System shows details about selected tournament<br>7. Student clicks on a specific tournament<br>8. System shows the tournament details page<br>9. Student click the "Join tournament" button |
| *Exit Condition* | Registration has been successful. The subscription is stored into the system's database.<br>Now student will have to wait until the registration deadline expires and the educator creates a new battle. |

[UC8]. Student joins a battle

| | |
|---|---|
| *Name* | Student joins a battle |
| *Actors* | Student |
| *Entry Condition* | A student opens the site |
| *Event Flow* | 1. Student opens the site<br>2. System shows the home page<br>3. Student logs in<br>4. System shows the student's home page<br>5. Student searches for a tournament in which they are registered<br>6. Student clicks on specific tournament<br>7. System shows the tournament details page<br>8. Student click on the battle which he is interested too<br>9. System shows the battle details page<br>10. Student click the "Join battle" button<br>11. Student selects if they participate alone or with a group<br>12. Student invites all mates to the groups<br>13. System waits until registration deadline expires<br>14. System creates a repository for the group<br>15. Student forks the repository and activate GHA |
| *Exit Condition* | Registration has been successful. The subscription is stored into the system's database.<br>Now student is able to modify the project and receive an evaluation by committing the modification into the main branch of the repo. |
| *Exception* | 9. If the deadline for tournament registration has passed.<br>The steps 10 through 15 are skipped.<br>11. If the student decides to participate alone<br>The step 12 is skipped |

[UC9]. Closing a tournament

| | |
|---|---|
| *Name* | Closing a tournament |
| *Actors* | Educator and student |
| *Entry Condition* | And educator opens the site |
| *Event Flow* | 1. Educator opens the site<br>2. System shows the home page<br>3. Educator logs in<br>4. System shows the educator's home page<br>5. Educators clicks on the tournament which he wants to close<br>6. System shows the tournament details page<br>7. Educator clicks the "Close the tournament" button<br>8. System publishes final ranking of the tournament<br>9. System notifies all students subscribed in the tournament the closing of the tournament |
| *Exit Condition* | Tournament has been successful closed. The data is stored into the system's database. |

[UC10]. Evaluation of a code

| | |
|---|---|
| *Name* | Evaluation of a code |
| *Actors* | Student, GHA and educator |
| *Entry Condition* | A student pushes a commit into the main branch of the repo |
| *Event Flow* | 1. Student pushes a commit into the main branch of the repo<br>2. GHA notify the system about the push<br>3. System clones the project in a protected environment<br>4. System tests the code based on the test case and the properties chosen by the educator<br>5. Educator manually evaluates the code and modifies the evaluation made by the system |
| *Exit Condition* | Evaluation has been successful. New data and new ranking are stored in the system database.<br>Now everyone can check the updated ranking |
| *Exception* | 5. This step may not happen because is an optional step. |

[UC11]. Check ranking of a tournament

| | |
|---|---|
| *Name* | Check ranking of a tournament |
| *Actors* | User |
| *Entry Condition* | A user opens the site |
| *Event Flow* | 1. User opens the site<br>2. System shows the home page<br>3. User logs in<br>4. System shows the user's home page<br>5. User searches for the tournament he is interested<br>6. User clicks the interested tournament<br>7. System shows the tournament details page<br>8. User clicks the "Ranking" button<br>9. System shows ranking of the tournament |
| *Exit Condition* | Now user can check the ranking of the tournament |

[UC12]. Check ranking of a battle

| | |
|---|---|
| *Name* | Check ranking of a battle |
| *Actors* | User |
| *Entry Condition* | A user opens the site |
| *Event Flow* | 1. User opens the site<br>2. System shows the home page<br>3. User logs in<br>4. System shows the user's home page<br>5. User searches for the tournament he is interested<br>6. User clicks the interested tournament<br>7. System shows the tournament details page<br>8. User clicks the battle in the tournament that they are interested too<br>9. System shows the battle details page<br>10. User click the "ranking" button<br>11. System shows the ranking of the battle |
| *Exit Condition* | Now user can check the ranking of the battle |

[UC13]. Show tournament details page

| | |
|---|---|
| *Name* | Show tournament details page |
| *Actors* | User |
| *Entry Condition* | A user opens the site |
| *Event Flow* | 1. User opens the site<br>2. System shows the home page<br>3. User logs in<br>4. System shows the user home page<br>5. User searches for the tournament they are interested<br>6. User clicks the tournament they are interested<br>7. System shows the tournament details page |
| *Exit Condition* | Now user has access to all tournament information and functionality |

[UC14]. Show battle details page

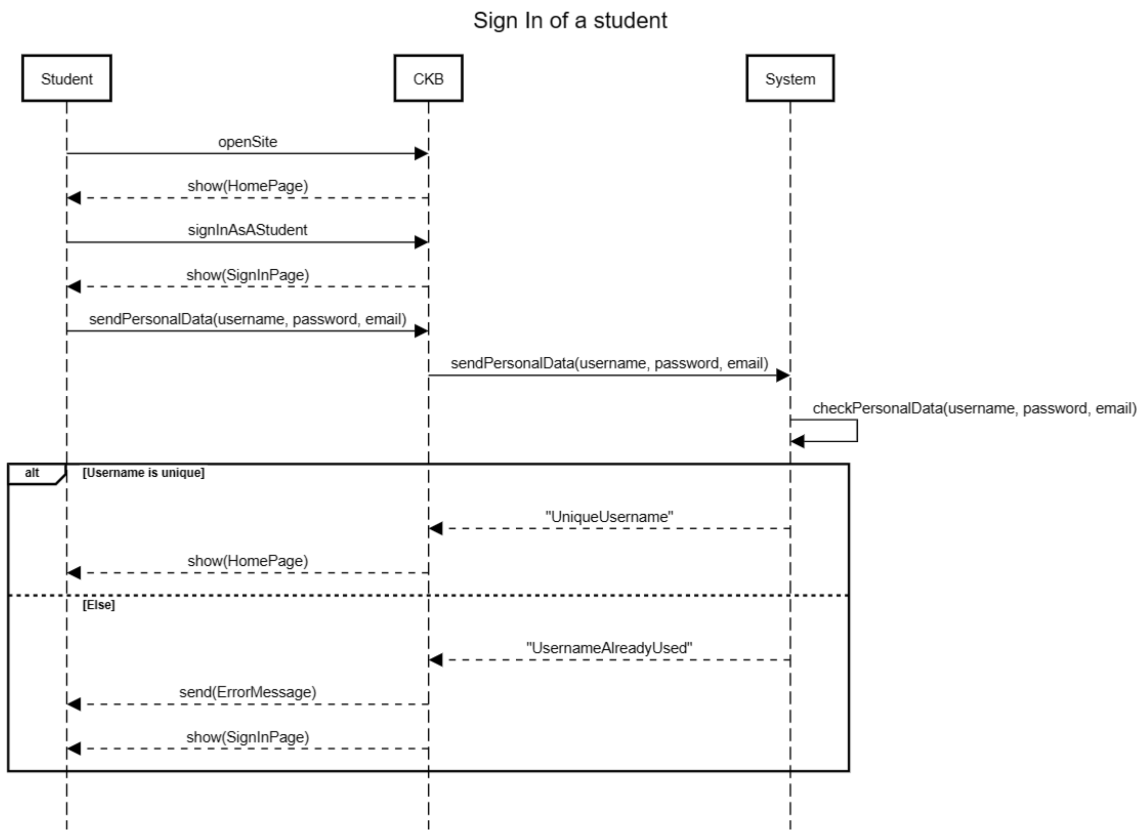
| | |
|---|---|
| *Name* | Show battle details page |
| *Actors* | User |
| *Entry Condition* | A user opens the site |
| *Event Flow* | 1. User opens the site<br>2. System shows the home page<br>3. User logs in<br>4. System shows the user home page<br>5. User searches for the tournament they are interested<br>6. User clicks the tournament they are interested<br>7. System shows the tournament details page<br>8. User clicks the battle in the tournament that they are interested too<br>9. System shows the battle details page |
| *Exit Condition* | Now user has access to all battle information and functionality |

[UC15]. Student accepts an invite for a battle

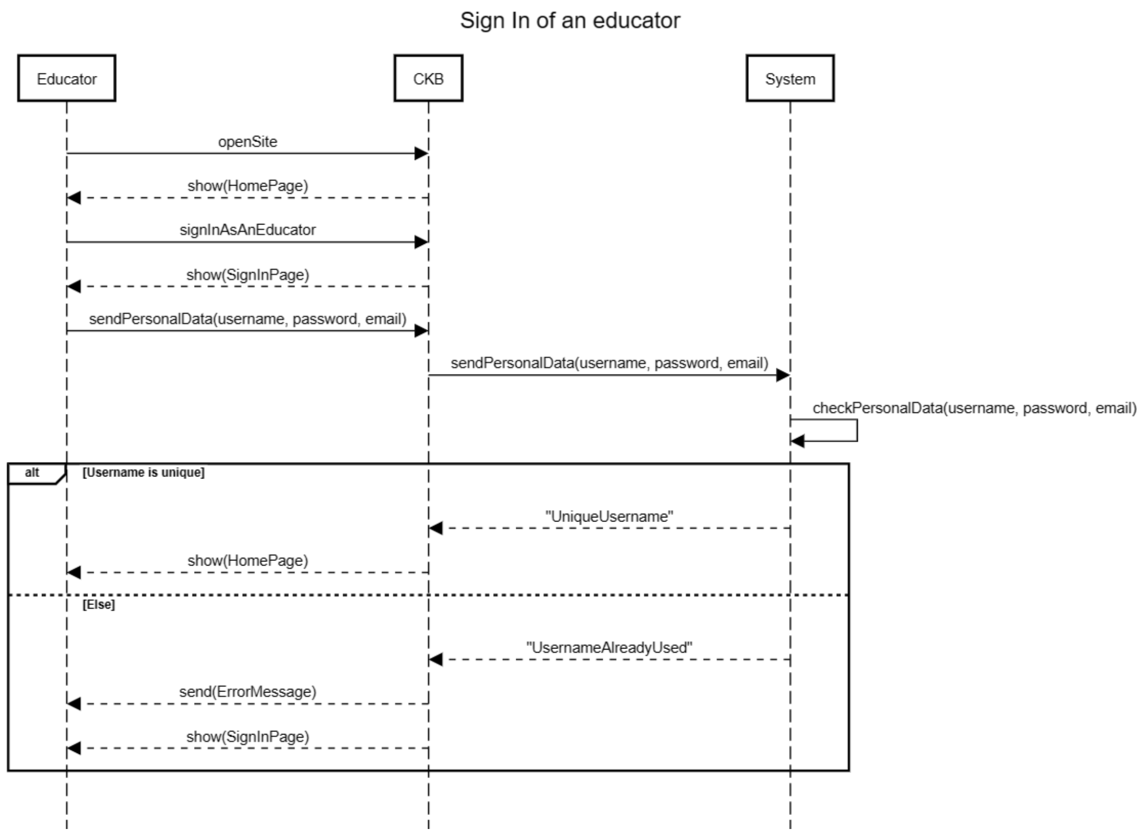
| | |
|---|---|
| *Name* | Student accepts an invite for a battle |
| *Actors* | Student |
| *Entry Condition* | A student opens the site |
| *Event Flow* | 1. Student opens the site<br>2. System shows the home page<br>3. Student logs in<br>4. System shows the student home page<br>5. Student search for a tournament<br>6. Student clicks on a specific tournament<br>7. System shows the tournament details page<br>8. Student clicks on the battle which he is interested too<br>9. System shows the battle details page<br>10. Student clicks on the invitation for the battle<br>11. System shows all the invitation received<br>12. Student clicks “Join with this group” button<br>13. System waits until registration deadline expires<br>14. System creates a repository for the group<br>15. Student fork the repository and activates GHA |
| *Exit Condition* | Registration has been successful. The subscription is stored into the system’s database.<br>Now student is able to modify the project and receive an evaluation by committing the modification into the main branch of the repo. |
| *Exception* | 11. System shows an empty page in case they have not received any invite |

## 3.2.3. Sequence diagram

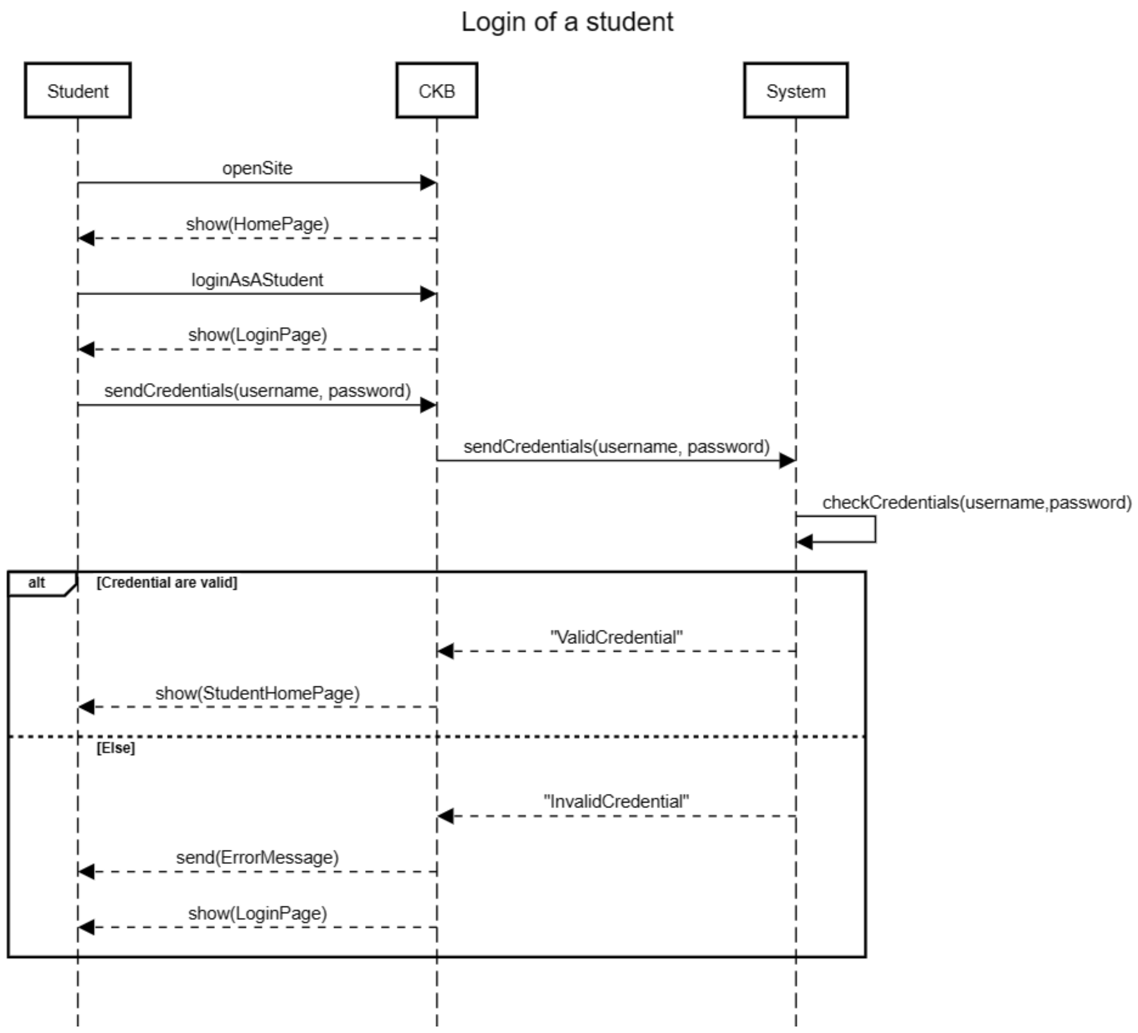
### [SD1]. Sign in of a new student



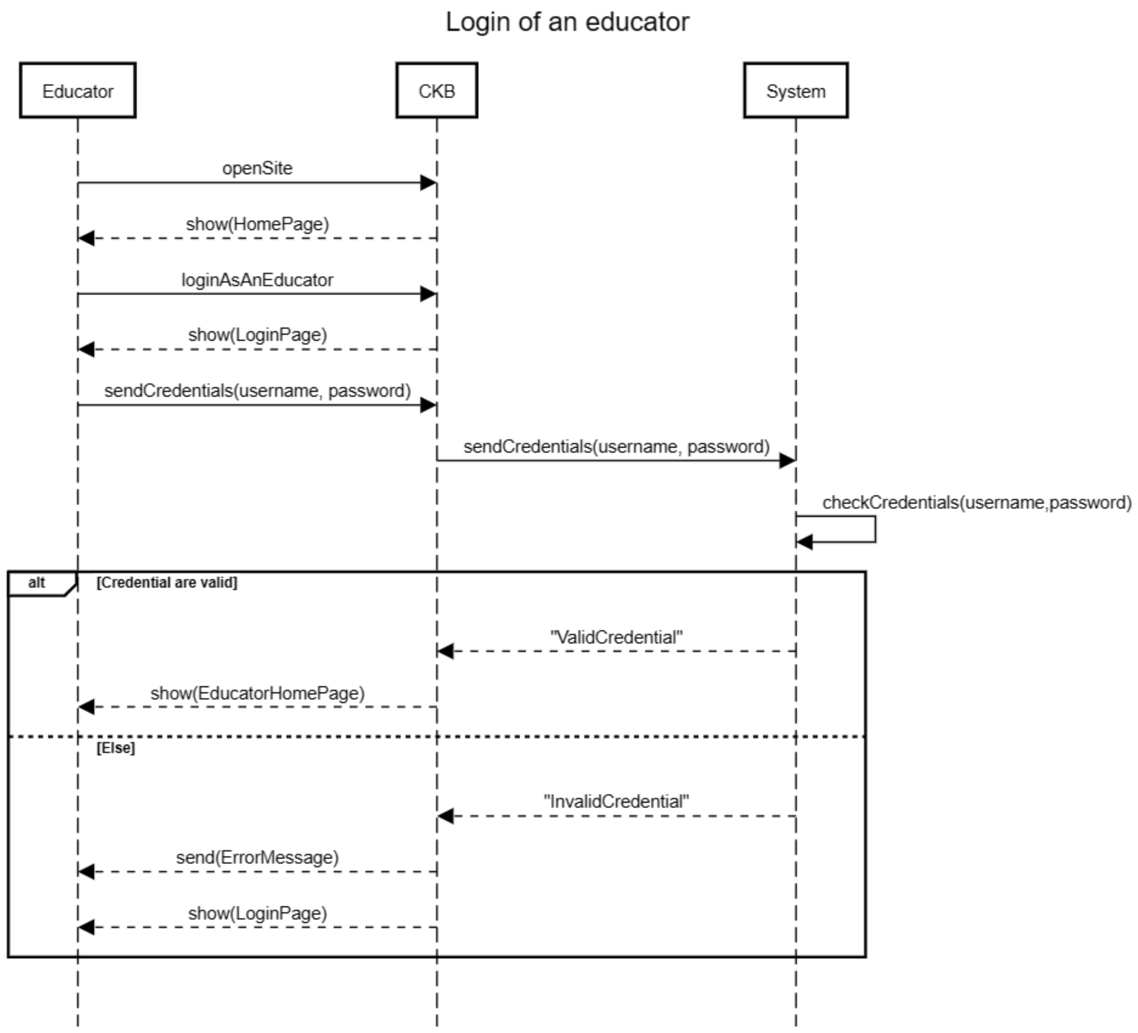
### [SD2]. Sign in of a new educator



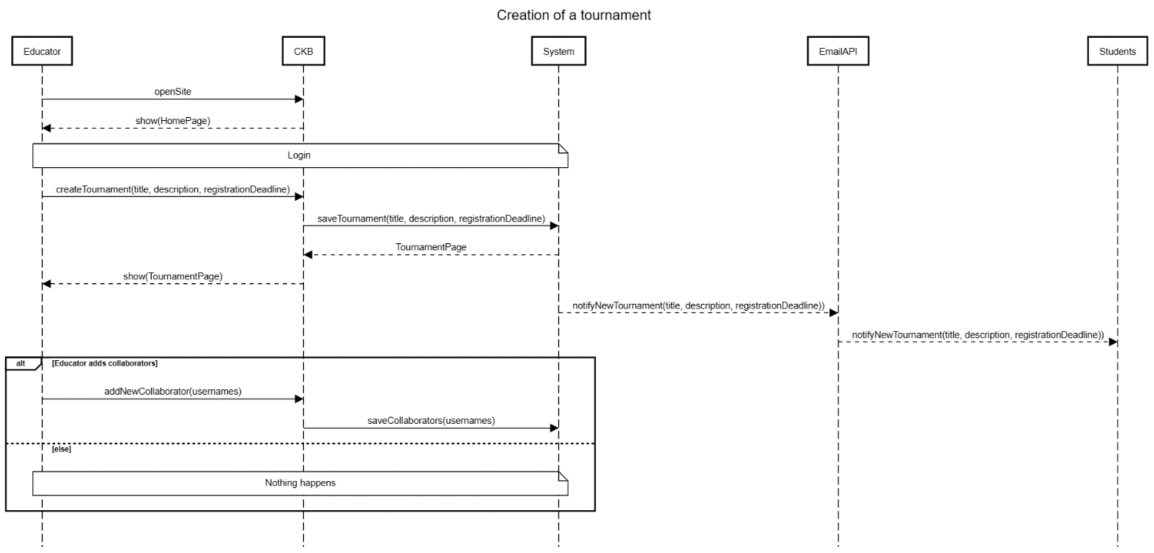
## [SD3]. Log in of a student



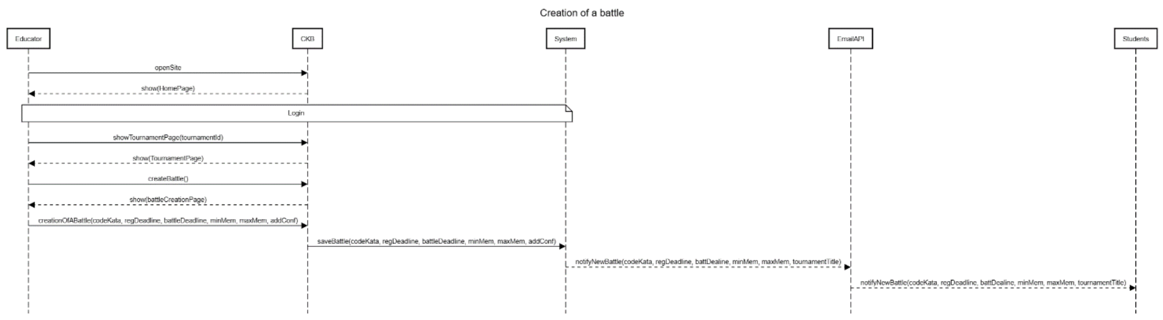
## [SD4]. Log in of an educator



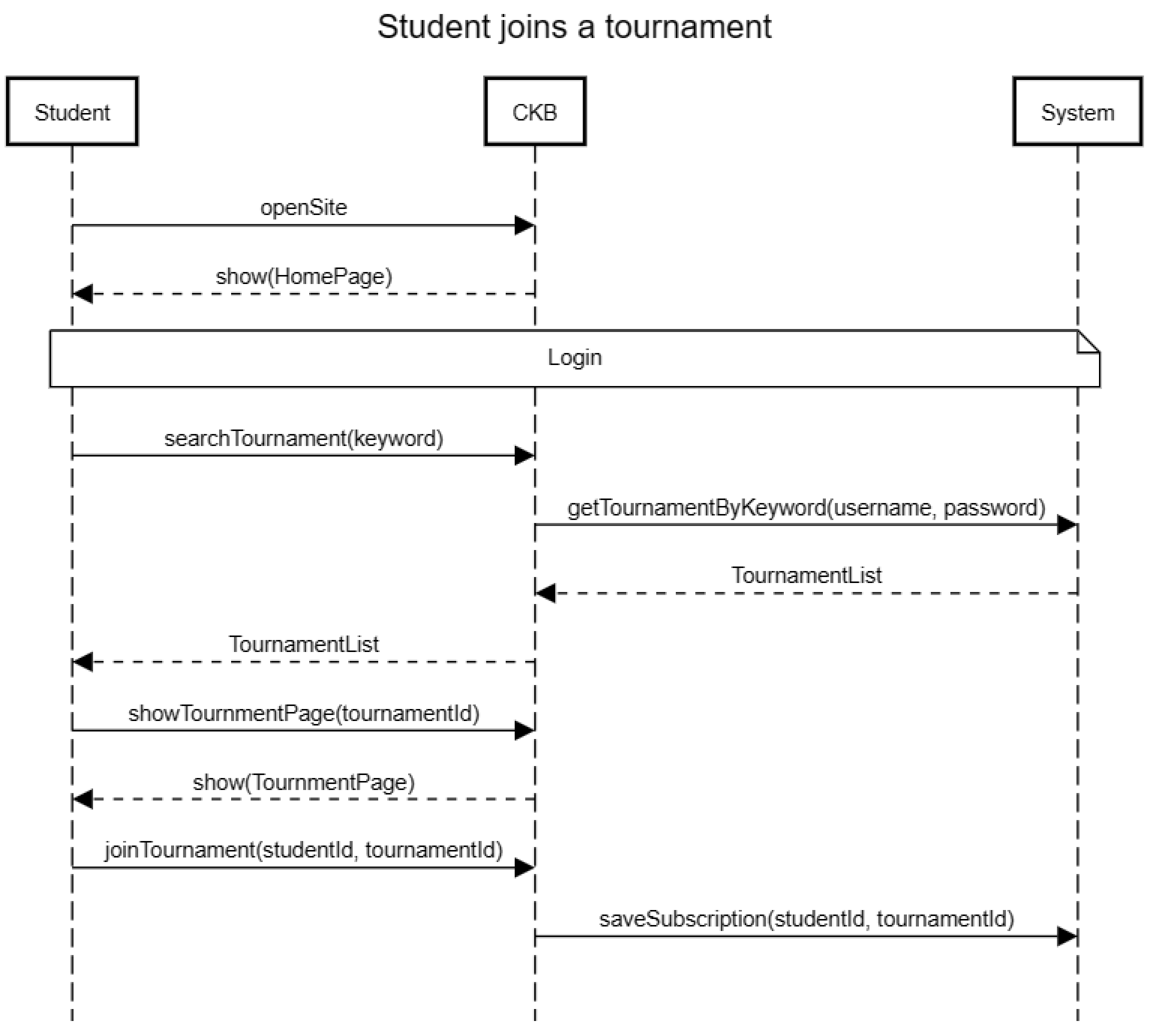
## [SD5]. Creation of a tournament


Creation of a tournament
Educator
CKB
System
EmailAPI
Students
openSite
show(HomePage)
Login
createTournament(title, description, registrationDeadline)
saveTournament(title, description, registrationDeadline)
TournamentPage
show(TournamentPage)
notifyNewTournament(title, description, registrationDeadline))
notifyNewTournament(title, description, registrationDeadline))
alt
[Educator adds collaborators]
addNewCollaborator(usernames)
saveCollaborators(usernames)
[else]
Nothing happens

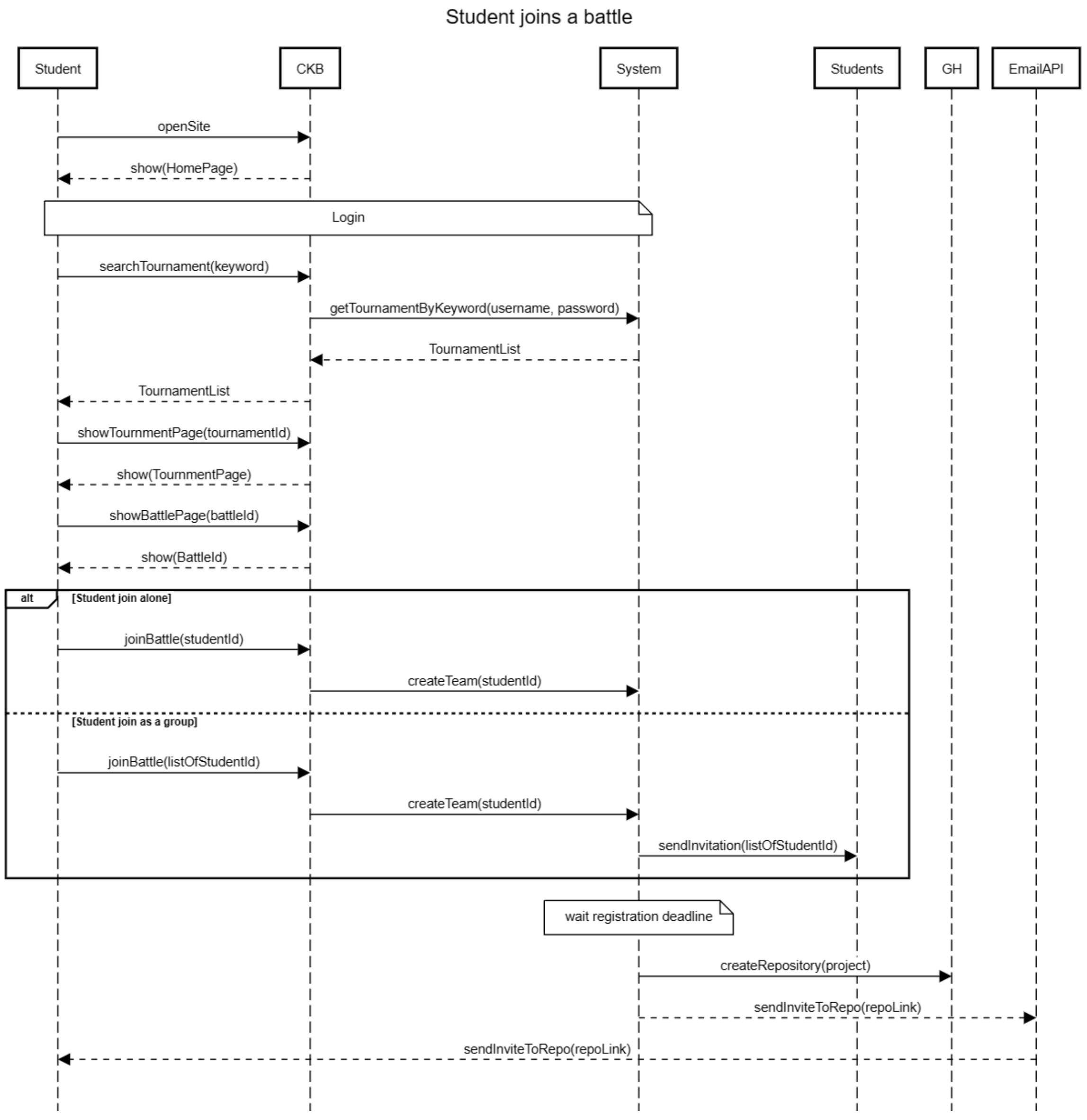
## [SD6]. Creation of a battle


Creation of a battle
Educator
CKB
System
EmailAPI
Students
openSite
show(HomePage)
Login
showTournamentPage(tournamentId)
show(TournamentPage)
createBattle()
show(battleCreationPage)
creationOfABattle(codeKata, regDeadline, battleDeadline, minMem, maxMem, addConf)
saveBattle(codeKata, regDeadline, battleDeadline, minMem, maxMem, addConf)
notifyNewBattle(codeKata, regDeadline, battDealine, minMem, maxMem, tournamentTitle)
notifyNewBattle(codeKata, regDeadline, battDealine, minMem, maxMem, tournamentTitle)

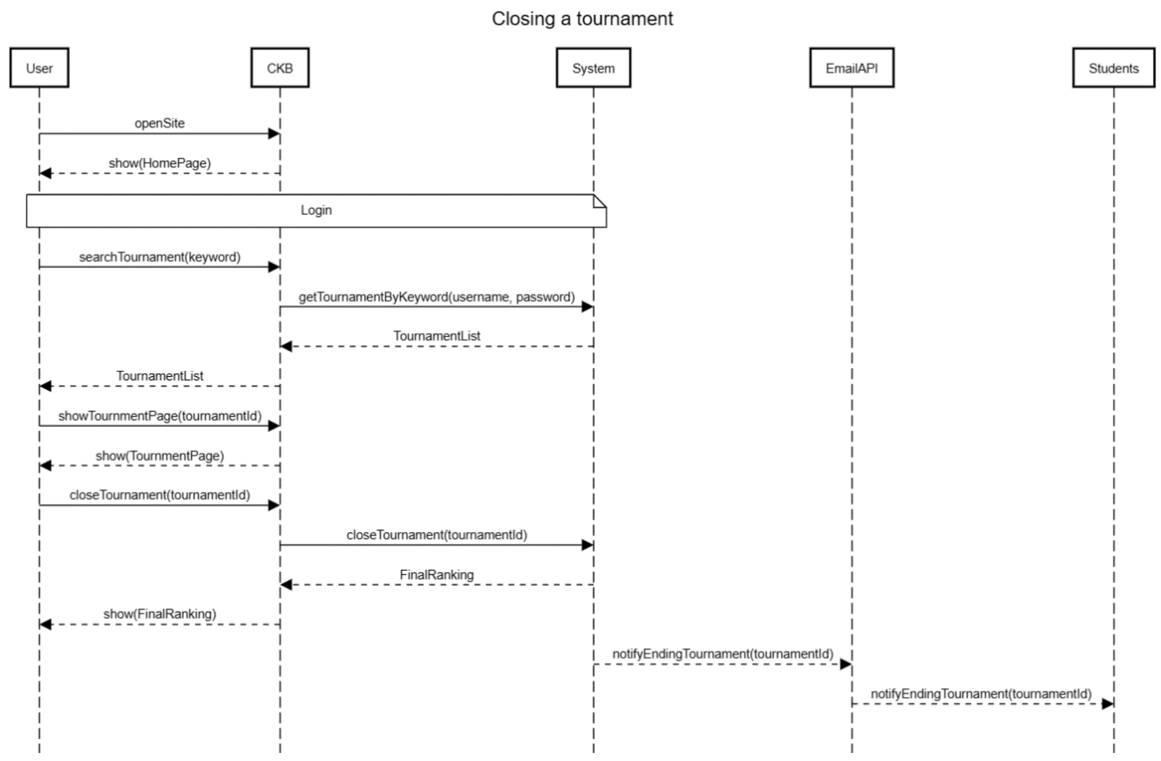
## [SD7]. Student joins a tournament


Student joins a tournament
Student
CKB
System
openSite
show(HomePage)
Login
searchTournament(keyword)
getTournamentByKeyword(username, password)
TournamentList
TournamentList
showTournmentPage(tournamentId)
show(TournmentPage)
joinTournament(studentId, tournamentId)
saveSubscription(studentId, tournamentId)

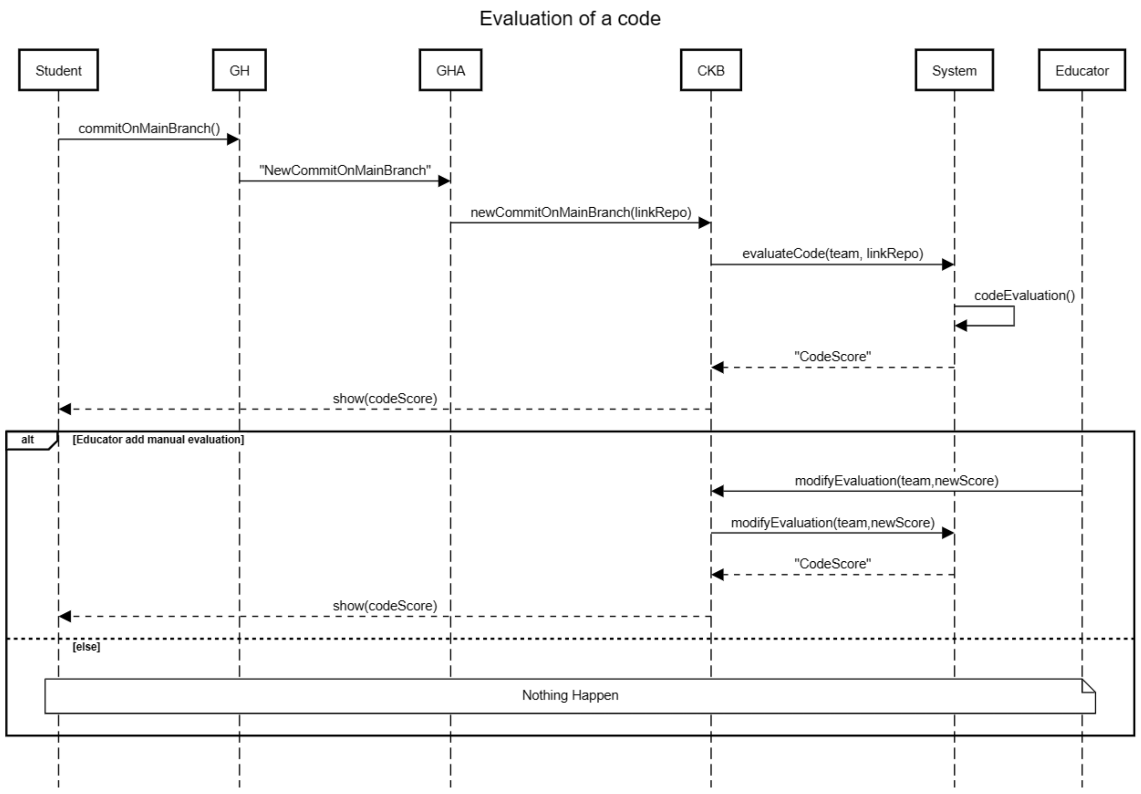
## [SD8]. Student joins a battle


Student joins a battle
Student
CKB
System
Students
GH
EmailAPI
openSite
show(HomePage)
Login
searchTournament(keyword)
getTournamentByKeyword(username, password)
TournamentList
TournamentList
showTournmentPage(tournamentId)
show(TournmentPage)
showBattlePage(battleId)
show(BattleId)
alt
[Student join alone]
joinBattle(studentId)
createTeam(studentId)
[Student join as a group]
joinBattle(listOfStudentId)
createTeam(studentId)
sendInvitation(listOfStudentId)
wait registration deadline
createRepository(project)
sendInviteToRepo(repoLink)
sendInviteToRepo(repoLink)

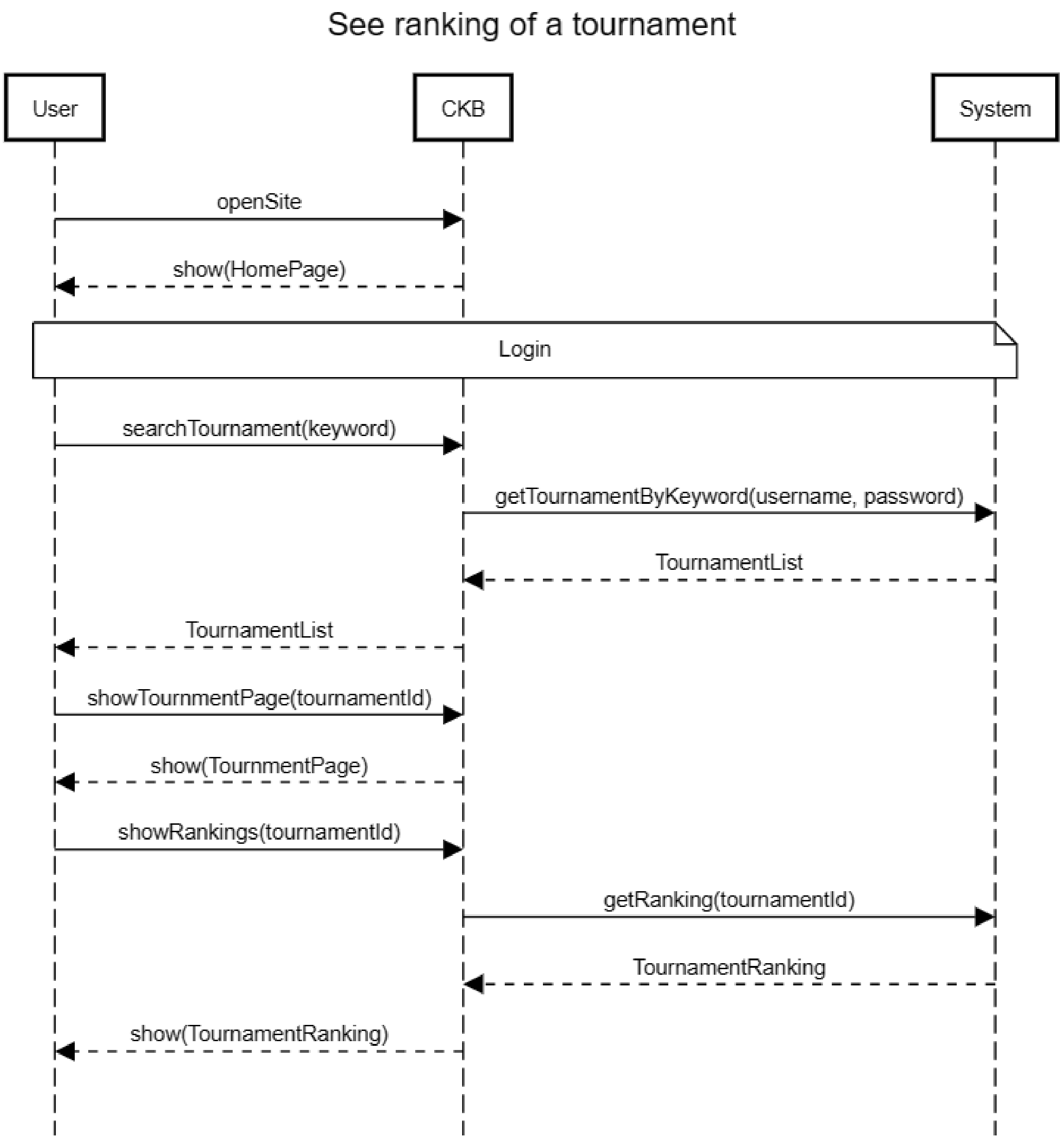
## [SD9]. Closing a tournament


Closing a tournament
User
CKB
System
EmailAPI
Students
openSite
show(HomePage)
Login
searchTournament(keyword)
getTournamentByKeyword(username, password)
TournamentList
TournamentList
showTournmentPage(tournamentId)
show(TournmentPage)
closeTournament(tournamentId)
closeTournament(tournamentId)
FinalRanking
show(FinalRanking)
notifyEndingTournament(tournamentId)
notifyEndingTournament(tournamentId)

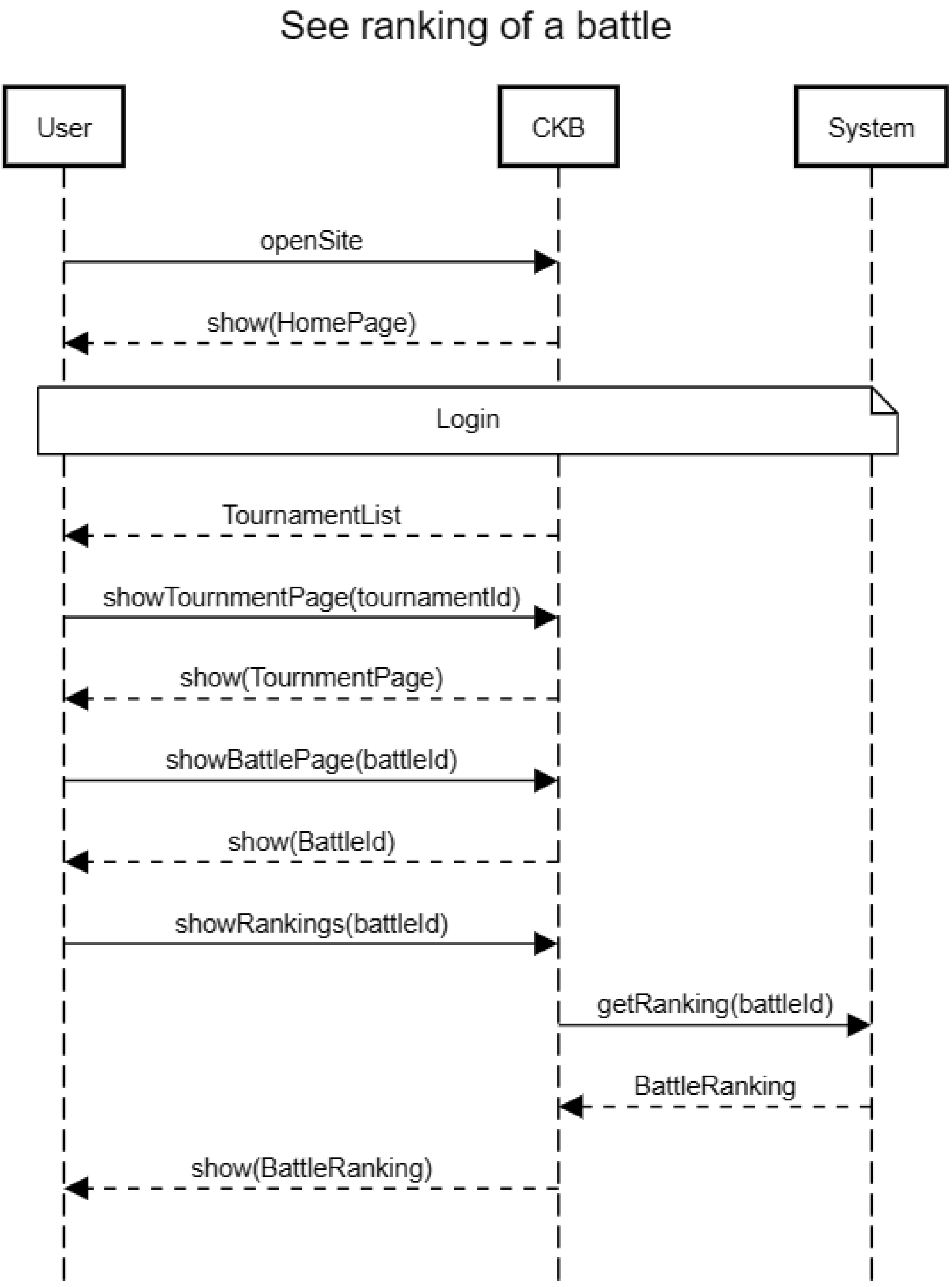
## [SD10]. Evaluation of a code



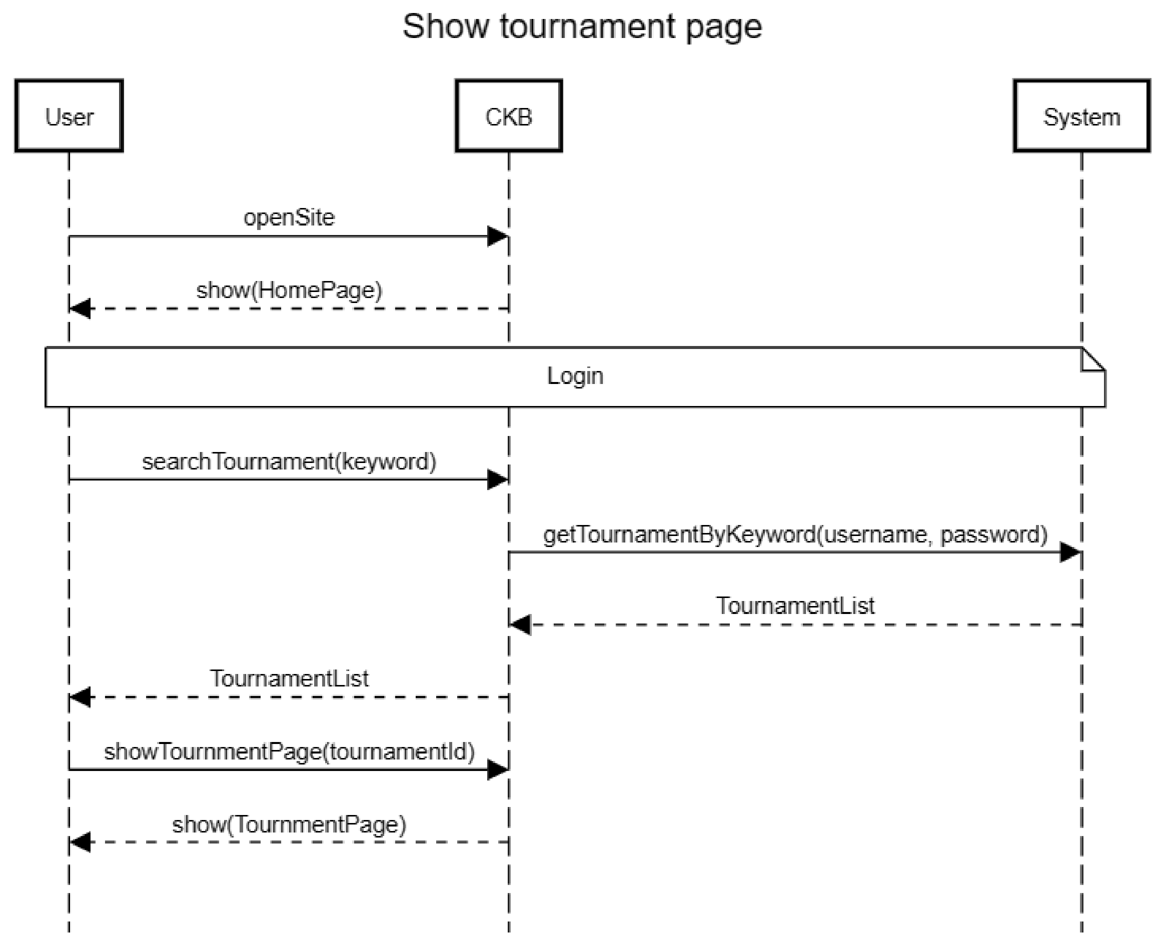
[SD11]. Check ranking of a tournament


See ranking of a tournament
User
CKB
System
openSite
show(HomePage)
Login
searchTournament(keyword)
getTournamentByKeyword(username, password)
TournamentList
TournamentList
showTournmentPage(tournamentId)
show(TournmentPage)
showRankings(tournamentId)
getRanking(tournamentId)
TournamentRanking
show(TournamentRanking)

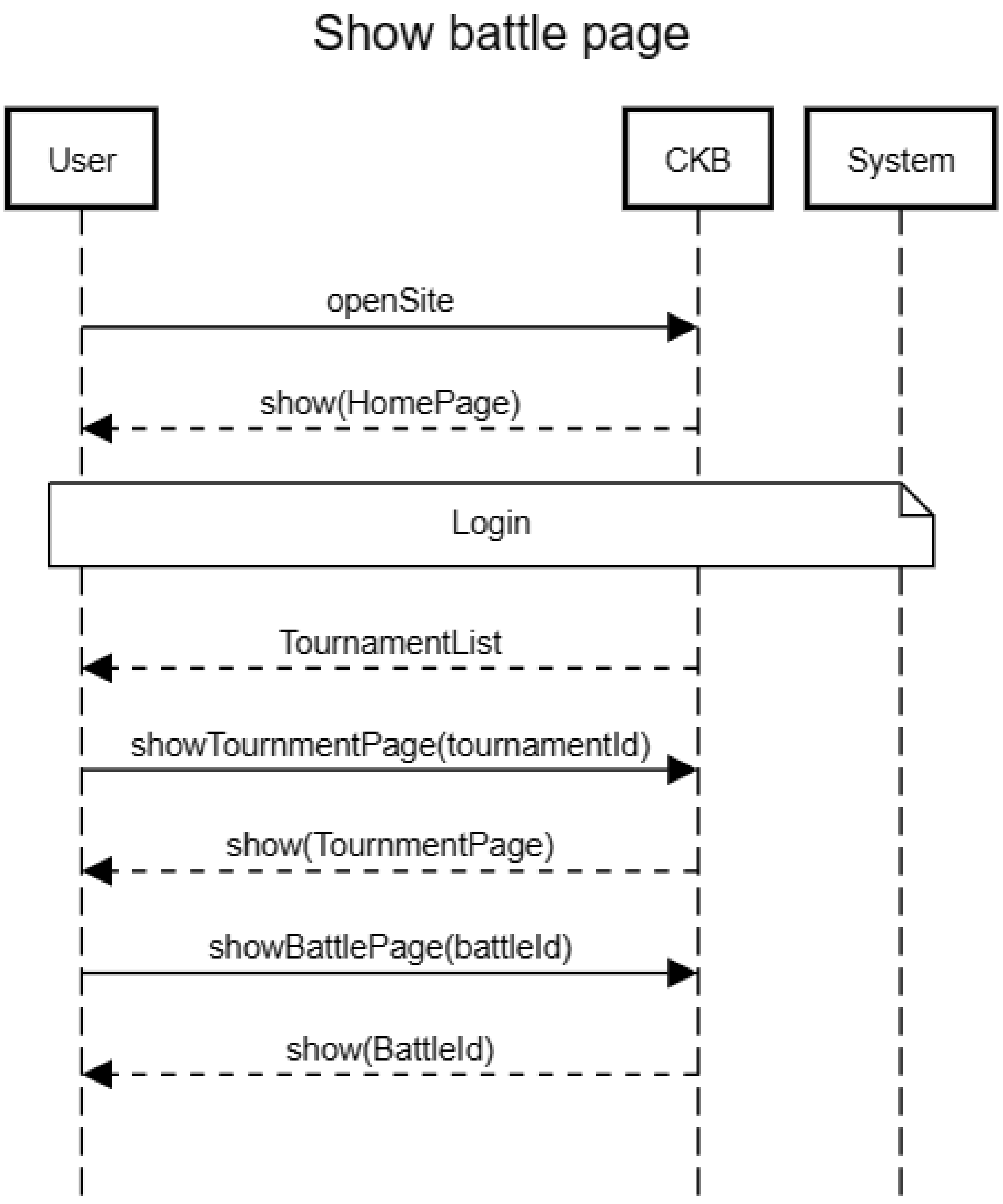
[SD12]. Check ranking of a battle



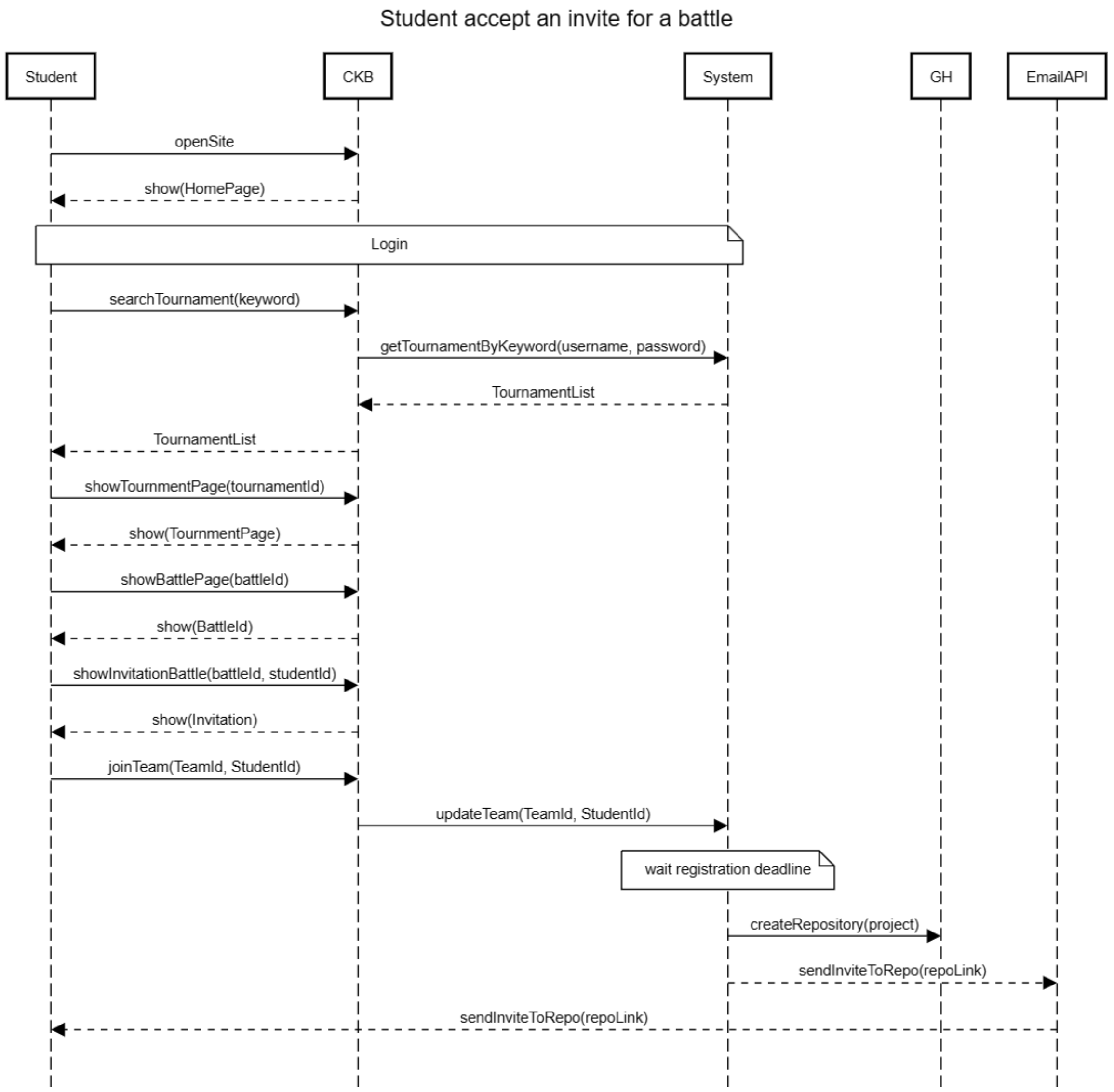
[SD13]. Show tournament details page



[SD14]. Show battle details page



### [SD15]. Student accepts an invite for a battle


Student accept an invite for a battle
Student
CKB
System
GH
EmailAPI
openSite
show(HomePage)
Login
searchTournament(keyword)
getTournamentByKeyword(username, password)
TournamentList
TournamentList
showTournmentPage(tournamentId)
show(TournmentPage)
showBattlePage(battleId)
show(BattleId)
showInvitationBattle(battleId, studentId)
show(Invitation)
joinTeam(TeamId, StudentId)
updateTeam(TeamId, StudentId)
wait registration deadline
createRepository(project)
sendInviteToRepo(repoLink)
sendInviteToRepo(repoLink)

## 3.2.4. Requirement mapping

- Educator creates a tournament and within it, he creates one or more battle.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R2]. System allows educators to sign up<br>[R4]. System allows educators to login<br>[R5]. System allows educator to create a new tournament and to add all the needed information<br>[R6]. System allows educator to grant the permission to other colleagues to create battle in a specific tournament<br>[R7]. System allows educator to create a battle inside a particular tournament by adding CK and the deadlines | [DA1]. Users must have a valid email address<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true<br>[DA6]. User must have an internet connection<br>[DA7]. Educator must upload the correct CK |

- Student registers for a tournament and will receive all notifications related to it.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R1]. System allows students to sign up<br>[R3]. System allows students to login<br>[R12]. System notifies students about the creation of a new tournament<br>[R13]. System notifies students about the creation of a new battle in a specific tournament in which they have subscribed<br>[R15]. System notify student about publication of final ranking of a specific tournament<br>[R16]. System allow student to join a tournament<br>[R22]. System allows students to search tournament by key words | [DA1]. Users must have a valid email address<br>[DA2]. Students must have a GH profile<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true<br>[DA6]. User must have an internet connection |

- Student joins a battle within a tournament they are register for and invite some friends to participate with them, thus creates a team for the battle.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R1]. System allows students to sign up<br>[R3]. System allows students to login<br>[R14]. System notify student about publication of final ranking of a specific battle<br>[R17]. System allow student to join a battle<br>[R20]. System, at end of the registration period of a battle, create a GH repo and send invitation to all member of the group | [DA1]. Users must have a valid email address<br>[DA2]. Students must have a GH profile<br>[DA3]. Students need to know how to access GitHub, how to fork a repository and how to enable GitHub Actions<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true<br>[DA6]. User must have an internet connection |

- Student receives an evaluation for the code he pushed to their GitHub repository.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R21]. System automatically evaluates the code in the main branch of the repo after each commit in it | [DA1]. Users must have a valid email address<br>[DA2]. Students must have a GH profile<br>[DA3]. Students need to know how to access GitHub, how to fork a repository and how to enable GitHub Actions<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true<br>[DA6]. User must have an internet connection |

- Educator reviews all the evaluated code, and if they deem it necessary, he can modify the evaluation they have received.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R2]. System allows educators to sign up<br>[R4]. System allows educators to login<br>[R10]. System allows educator to modify the evaluation manually of a specific group in a battle. | [DA1]. Users must have a valid email address<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true |

- Educator closes a tournament and the platform publishes the ranking.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R2]. System allows educators to sign up<br>[R4]. System allows educators to login<br>[R11]. System allows educator to close a tournament<br>[R15]. System notify student about publication of final ranking of a specific tournament | [DA1]. Users must have a valid email address<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true<br>[DA6]. User must have an internet connection |

- Both students and educators check the update ranking of the battle and the tournament.

| *Requirements* | *Domain Assumption* |
|---|---|
| [R1]. System allows students to sign up<br>[R2]. System allows educators to sign up<br>[R3]. System allows students to login<br>[R4]. System allows educators to login<br>[R8]. System allows educator to see rankings of each tournament, which he created or in which he has been nominated collaborator<br>[R9]. System allows educator to see ranking of a specific battle<br>[R18]. System allows students to see rankings of each tournament, which they are sub scripted<br>[R19]. System allows students to see ranking of a specific battle | [DA1]. Users must have a valid email address<br>[DA2]. Students must have a GH profile<br>[DA3]. Students need to know how to access GitHub, how to fork a repository and how to enable GitHub Actions<br>[DA4]. Each user will create only 1 account<br>[DA5]. Personal data given by User during the registration process are assumed true<br>[DA6]. User must have an internet connection |

## *3.3. Performance requirements*

Our application, designed to enhance software programming skills, commits to ensuring a timely and reliable response at every stage of the process. Notifications regarding the creation of new tournaments will be sent in real-time to all subscribers, while notifications related to battles will be limited to participants in the corresponding tournament. This selection will occur swiftly, allowing all users to have an ample time frame to register.

User interactions with rankings, tournament registrations, and battles will proceed seamlessly, even in high-load situations, ensuring an optimal user experience.

A crucial aspect is the efficient management of the creation of repositories on GitHub, occurring at the end of the registration period for a battle. The system must create these repositories swiftly and efficiently, adapting to simultaneously manage various battles without negative impacts on overall performance.

Commit monitoring and automatic code testing are critical phases in our system. It is essential to ensure that notifications are timely whenever a commit is made to the battle repositories and that code testing occurs swiftly and efficiently, providing immediate feedback to students.

During tournaments, the system will maintain high performance, simultaneously managing communications, rankings, and repository creation. The display of results and rankings for ongoing tournaments will occur with rapid response times.

Furthermore, our platform will guarantee high reliability and availability. During critical phases, such as repository creation and the execution of automatic tests, the system will minimize downtime. In case of spikes in participation or high loads, it will dynamically adapt to maintain optimal performance levels, preserving the quality of service offered to users.

## *3.4. Design constraints*

### 3.4.1. Standards compliace

Regarding data privacy, the CKB adheres to the GDPR, a European Union regulation establishing rules for the protection of personal data and privacy for individuals within the European Union and the European Economic Area. Therefore, users' personal data and information will not be used for commercial purposes.

The system will be fully compliant with the D0-178C standard. This implies that all software tests will be conducted in accordance with specified requirements, enabling the association of each requirement with a dedicated test case used to verify whether it has been satisfied.

Additionally, the system must adopt international standards concerning the use and representation of date and time. This will ensure consistency and international compatibility in interpreting temporal information, contributing to a coherent and accurate management of temporal data within the system.

### 3.4.2. Hardware limitations

The system requires a robust hardware infrastructure to ensure reliable and timely performance during daily activities and potential usage spikes. The server's processing capacity must be sufficiently scaled to handle large volumes of data, ensuring smooth operations even during high-traffic situations. Resilience to peak requests is crucial to ensure the application can concurrently manage a significant number of users and activities without compromising performance.

Simultaneously, the server's storage capacity must be adequate to efficiently handle user data, including details related to tournaments and battles. Efficient data management necessitates a solid storage capacity to ensure the availability and accessibility of information at all times. This aspect is critical to support daily operations and provide a strong foundation for future expansion.

On the user's end, it is essential to use a browser enabled for JavaScript management. This technological dependency is necessary to fully leverage the interactive and dynamic features of the application, offering an optimal user experience. Ensuring that the user has a JavaScript-compatible browser is therefore a fundamental prerequisite for the proper functioning of the system and accessing all its advanced features.

## 3.5. *Software system attributes*

### 3.5.1. Reliability

To ensure high reliability, the system will implement advanced mechanisms for real-time error detection and management. Clear and contextualized alerts will be adopted, providing users with precise information in case of any issues. This approach ensures immediate and targeted intervention to resolve problems, preserving the integrity and reliability of operations.

Furthermore, the system's architecture will be designed with a distribution across multiple servers and the implementation of data replication strategies. This design aims to prevent single points of failure that could compromise the system's integrity as a whole. Distribution across multiple servers and data replication will contribute to ensuring operational continuity even in the presence of hardware failures or malfunctions.

To reduce the risk of errors during data-saving operations in the database, the system will use dedicated triggers for error management. These triggers will provide active control during critical phases, intervening promptly to correct any inconsistencies and ensure the coherence of stored data.

Additionally, if a comprehensive traceability of system activities and in-depth analysis of errors are desired, it will be possible to implement a logging system. This tool will allow for detailed recording of all operations, facilitating the understanding and resolution of any issues. Overall, this integrated strategy of active error management, distribution across multiple servers, data replication, and detailed logging of activities will contribute to ensuring high reliability of the application over time.

### 3.5.2. Availability

System availability is a fundamental requirement to ensure uninterrupted operation over time. To optimize availability and ensure operational continuity even in the face of failures, the server implementation will be designed with a distributed approach. This means that the system will be deployed across multiple machines that constitute the server, allowing load balancing and mitigating potential impacts from hardware failures or malfunctions in a single machine.

Data replication will be implemented to ensure redundancy of critical information. In the event of machine malfunctions or data loss, data replicas will be readily available, ensuring service continuity without significant interruptions. This approach will help minimize the risk of data loss and maintain high availability standards, even in scenarios of unforeseen failures.

Additionally, the system will be designed to automatically detect faults and respond accordingly, activating failover mechanisms to ensure that user requests can be handled without interruptions. Efficient management of distribution, replication, and data redundancy is essential to ensure high system availability, minimizing downtime, and overall enhancing user experience.

### 3.5.3. Security

In accordance with security practices, the system will take several measures to safeguard sensitive information and maintain data integrity.

All communication between the client and the server, as well as with the database management system (DBMS), will be via HTTPS, so that there will be a secure, encrypted transfer of data.

Passwords will be hashed before being stored in the database, thus reducing the risk associated with storing passwords in plain text. In addition, data transmission from client to server will be encrypted to protect against potential eavesdropping and unauthorized access.

To further enhance data security, sensitive information will be encrypted before storage, minimizing the impact of potential data leaks. In addition, strict access controls will be implemented to prevent third parties from accessing sensitive data through group requests, strengthening the overall resilience of the system against unauthorized access and potential security breaches.

### 3.5.4. Maintainability

Code maintainability is a fundamental cornerstone in our approach to software development.

To ensure a code structure that is easily manageable and adaptable over time, we will adopt well-known and established design patterns. The use of these patterns provides a coded architecture that reflects best practices and promotes an intuitive understanding of the code by developers.

Simultaneously, our focus on maintainability is reflected in extensive documentation detailing the implemented functions. This documentation not only provides clarity on the behaviour of functions but also on the broader context in which they are integrated into the system's architecture.

Comprehensive documentation facilitates the work of developers making changes, aiding in understanding the relationships between different parts of the code and thus contributing to the long-term maintainability and improvement of our software.

### 3.5.5. Portability

The developed CKB application is designed to run on any operating system, ensuring significant flexibility in access across various platforms.

The only required condition is the presence of a browser capable of running JavaScript. This design choice aims to maximize the accessibility of the application, enabling users to enjoy its features regardless of the operating system used. Thanks to this approach, users will experience a seamless and comprehensive interface, irrespective of their chosen device or operating system, ensuring greater adaptability and accessibility of the application.

# 4. REQUIREMENT TRACEABILITY

# 5. IMPLEMENTATION, INTEGRATION AND TEST PLANNING

## *5.1. Signatures*

- sig DateTime {} //it represents a couple <data, time>
- sig CodeKata {} //it represents a CK
- abstract sig User {} //it represents a user
- sig Student extends User {} //it represents a student
- sig Educator extends User {} //it represents an educator
- sig Tournament { //it represents a tournament
```
  registrationDeadline: one DateTime, //the tournament's registration deadline
  students: some Student, //the students registered for the tournament
  educators: some Educator //the educators that are responsible for managing
}
```
- sig Battle { //it represents a battle
```
  registrationDeadline: one DateTime, //the battle's registration deadline
  submissionDeadline: one DateTime, //the deadline by which possible solutions to the
battle must be administered
  tournament: one Tournament, //the tournament of which the battle is a part
  code: one CodeKata //it represents the battle's CK
} {
  registrationDeadline != submissionDeadline and
  registrationDeadline != tournament.registrationDeadline and
  submissionDeadline != tournament.registrationDeadline
}
```
- sig Team { //it represents a team
```
  students: some Student, //students make up the team
  battleT: one Battle //the battle in chich the team is enrolled
}
```
- sig Evaluation { //it represents an evaluation
```
  time: one DateTime, //the time at which the assessment was made
  team: one Team, //the team that received the evaluation
  battleE: one Battle, //the battle in which the team that received the evaluation is enrolled
  grade: one Int, //the team grade
  code: one CodeKata //it represents the evaluation's CK
} {
  time != battleE.registrationDeadline and
  time != battleE.submissionDeadline and
  time != battleE.tournament.registrationDeadline and
  grade > 0
}
```

## 5.2. Facts

-
  ```
  fact EachBattleHasAnEvaluation { //each battle has an evaluation
         all e1, e2: Evaluation |
         (e1 != e2) implies ((e1.battleE !=e2.battleE) or (e1.team!= e2.team))
      }
  ```

-
  ```
  fact EachTeamInABattleHasDifferentStudent { //each team in a battle has different student
         all t1, t2: Team,
         b: Battle |
         (((t1 != t2) and (b in t1.battleT) and (b in t2.battleT)) implies
         (all s: Student |
           (s in t1.students and s not in t2.students) or (s not in t1.students and s in t2.students)
           or (s not in t1.students and s not in t2.students)))
      }
  ```

-
  ```
  fact EachStudentInABattleIsInTheTournament { //each student in a battle is in the tournament
         all t:Team,
         s:Student |
         (s in t.students) implies (s in t.battleT.tournament.student)
         }
  ```

-
  ```
  fact BattleAndEvaluationHasSomeCodeKata { //each evaluation with its corresponding battle have the same CodeKata
         all e: Evaluation |
         e.battleE.code = e.code
      }
  ```

-
  ```
  fact TeamAndEvaluationHasSomeBattle { //each evaluation with its relative team have the same battle
         all e: Evaluation |
         e.team.battleT = e.battleE
      }
  ```

-
  ```
  fact EachTeamHasAnEvaluation{ //each team has an evaluation
         all t:Team |
         #team.t = 1
      }
  ```

-
  ```
  fact EachBattleHasDifferentCodeKata{ //each battle has different CodeKata
         all b1, b2: Battle |
         (b1 != b2) implies (b1.code != b2.code)
      }
  ```

## 5.3. Predicate

-
  ```
  pred show {
         #Battle = 2
         #Team = 4
         #Student = 6
         #Tournament = 2
      }
  ```

-
  ```
  run show for 8
  ```

Below we find two representations of the system as specified above.

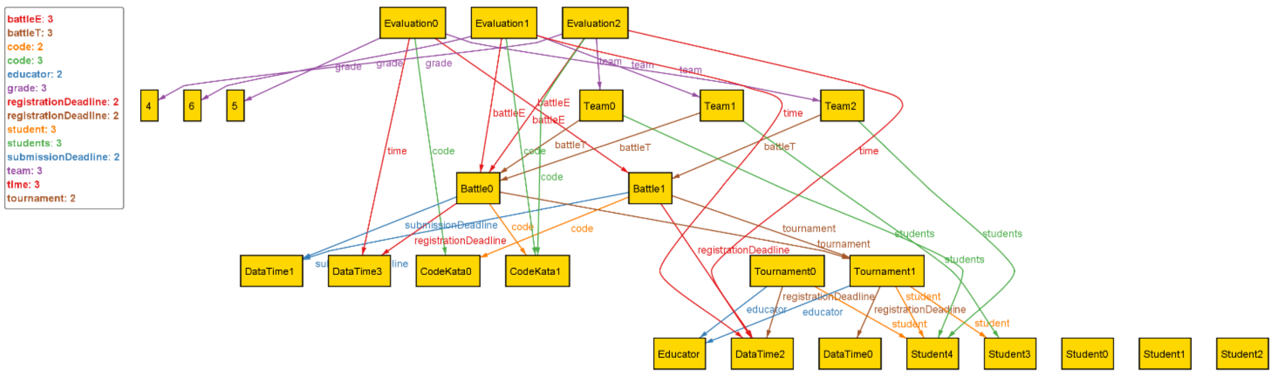


*Figure 13 Alloy Static Model*

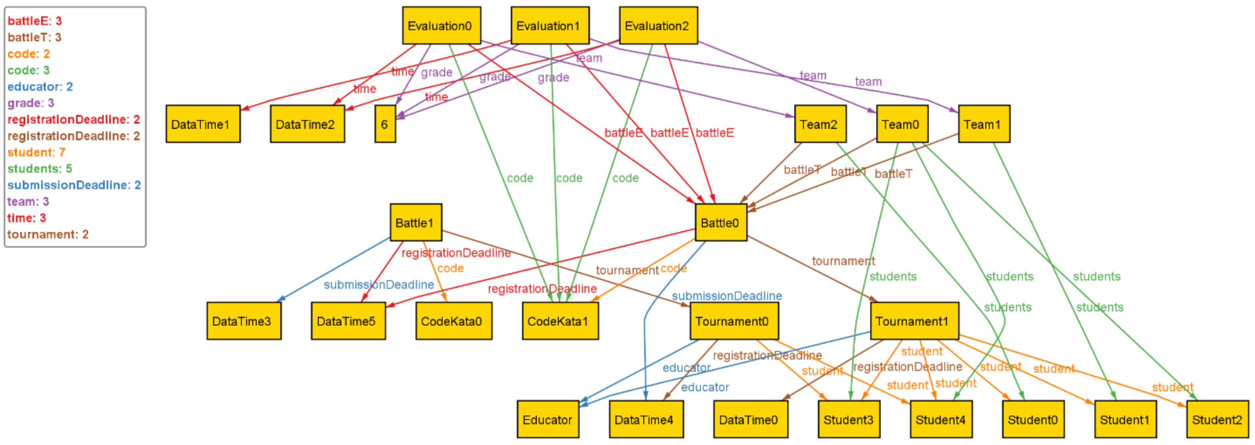


*Figure 14 Alloy Static Model*

# 6. EFFORT SPENT

In the following tables we will summarize the effort spent by each member of the team on the RASD Document

- Conti Alessandro

| *Chapter* | *Effort (in hours)* |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |

- Di Paola Antonio

| *Chapter* | *Effort (in hours)* |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |

# 7. REFERENCES

- State Diagrams made with: *draw.io*
- Class Diagrams made with: *StarUML*
- Sequence Diagrams made with: *SequenceDiagram.org*
- Alloy models made, ran and checked with: *Alloy 6*
- The User Interface overview was written in HTML with: *Visual Studio Code*