

Politecnico di Milano  
Computer Science and Engineering  
Software Engineering II

## **Design Document - CodeKataBlade**

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# 1 INTRODUCTION

## 1.1 Purpose

The purpose of this document is to provide a detailed description of the architecture of the system to be, CodeKataBlade, and to show how the requirements presented in the RASD document are met by the architecture. The document also contains the implementation, integration and test plan for the system.

## 1.2 Scope

CodeKataBlade is a software system designed to facilitate and enhance the practice of code katas, which are small coding exercises aimed at improving programming skills. The system provides a platform where educators can create tournaments and battles, and students can register, form teams, and submit their solutions to coding problems.

CodeKataBlade allows educators to create tournaments, which serve as spaces for organizing multiple battles. Educators can invite other educators to participate in tournaments and perform manual evaluations on the submissions of battles they own. The system also provides a leaderboard that is updated in real-time, displaying the rankings of participants based on their performance in the battles.

Students can register to tournaments and battles, either individually or as part of a team. They can submit their solutions to coding problems within the specified deadlines. The system automatically evaluates the submissions using build automation scripts and provides feedback to the students. A set of test cases is used to assess the correctness and efficiency of the solutions.

CodeKataBlade integrates with GitHub, a popular code hosting platform, allowing students to fork repositories and work on their solutions using version control. GitHub Actions, a CI/CD tool, is utilized to automate the evaluation process and provide continuous integration and delivery capabilities.

## 1.3 Definitions, Acronyms, Abbreviations

### 1.3.1 Definitions

- **Tournament:** A tournament is a space where educators can create battles and students can register to them. It has a registration deadline and a leaderboard that is updated every time a battle ends.
- **Battle:** A battle is a space where students can register to and submit their solutions to a problem. It has a registration deadline, a final submission deadline, a leaderboard that is updated every time a new evaluation is performed and a set of test cases that will be used to evaluate the submissions.

- **GitHub:** GitHub is a code hosting platform for version control and collaboration. It lets you and others work together on projects from anywhere.
- **GitHub Actions:** GitHub Actions is a CI/CD tool that allows you to automate your software development workflows in the same place you store code and collaborate on pull requests and issues.
- **Educator:** An educator, in the context of the system, is a user of the platform that can create tournaments and battles, invite other educators to tournaments, perform manual evaluations on the submissions of a battle they own and consolidate the results of a battle.
- **Student:** A student, in the context of the system, is a user of the platform that can register to tournaments and battles, create teams and submit their solutions to a battle.
- **Build Automation Scripts:** Build automation scripts are scripts that are run automatically by the system every time a commit is pushed to the main branch of the forked repository of a battle. They are used to evaluate the submissions of the students.
- **Test Case:** A test case is a set of conditions under which a tester will determine whether an application, software system or one of its features is working as it was originally established for it to do.
- **Timeliness:** Timeliness is the quality of doing something or producing something at the right time. In the context of the system, it refers to the time in which a student submits their solution to a battle with respect to the start of the battle and the final submission deadline.

### 1.3.2 Acronyms

- **CKB:** CodeKataBattle
- **S2B:** System to Be
- **TDD:** Test-Driven Development
- **CI/CD:** Continuous Integration/Continuous Delivery
- **UI:** User Interface
- **API:** Application Programming Interface
- **UML:** Unified Modeling Language

### 1.3.3 Abbreviations

- **Gn:** Goal number n
- **Wn:** World Phenomena number n
- **SPn:** Shared Phenomena number n

- **Dn:** Domain Assumption number n
- **Rn:** Requirement number
- **UCn:** Use Case number n

## 1.4 Revision history

## 1.5 Reference Documents

The specification of the RASD and DD assignment of the Software Engineering II course, held by professor Matteo Rossi, Elisabetta Di Nitto and Matteo Camilli at the Politecnico di Milano, A.Y 2023/2024.

## 1.6 Document Structure

- **1. Introduction:** This section provides an overview of the entire document. It describes the purpose and scope of the system, the definitions, acronyms and abbreviations used in the document, the revision history and the reference documents.
- **2. Architectural Design:** This section describes the architecture of the system. It provides an overview of the high-level components and their interaction, the component view, the deployment view, the runtime view, the component interfaces, the selected architectural styles and patterns and other design decisions.
- **3. User Interface Design:** This section provides a mockup of the user interface of the system.
- **4. Requirements Traceability:** This section describes how the requirements defined in the RASD map to the design elements defined in this document.
- **5. Implementation, Integration and Test Plan:** This section describes the order in which the components of the system will be implemented, integrated and tested.
- **6. Effort Spent:** This section describes the amount of time spent by each group member to redact this document.
- **7. References:** This section provides a list of the reference documents used to redact this document.

## 2 ARCHITECTURAL DESIGN

### 2.1 Overview: High-level components and their interaction

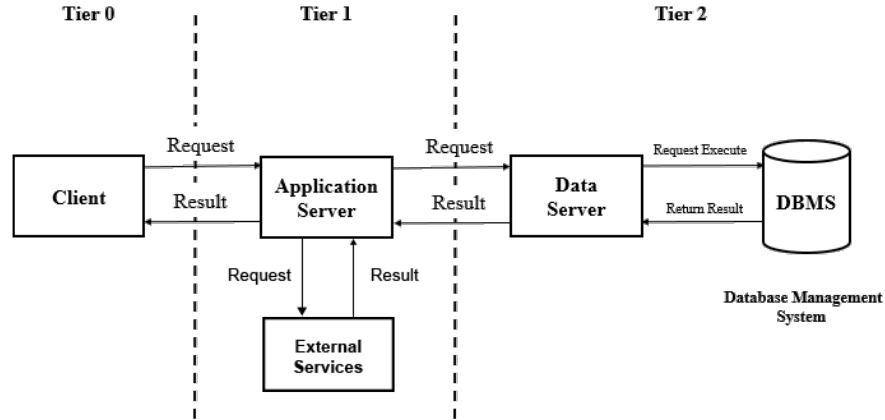


Figure 1: Three-tier Architecture

The chosen architecture for the system is a three-tier architecture, a widely adopted model for developing scalable and maintainable web applications. This architectural style divides the application into three interconnected layers: presentation, application, and data, with the addition of the external services like GitHub and email services. The rationale behind selecting this architecture is to achieve separation of concerns, modularity, and scalability.

#### Presentation Layer

The presentation layer constitutes the user interfaces for both students and educators, encompassing web or mobile interfaces. It is responsible for user interactions, displaying data, and triggering actions within the system.

#### Application Layer

The application layer serves as the business logic layer, managing core functionalities such as user authentication, tournament and battle processes, submissions, and evaluations. It facilitates bidirectional communication with both the presentation layer and the data layer.

## **Data Layer**

The data layer, comprising the database and external services, handles the storage and retrieval of persistent data. It communicates with the application layer to respond to data requests, ensuring efficient data management.

### **2.1.1 Interaction**

The interaction between the components is as follows:

#### **Presentation Layer and Application Layer**

The presentation layer communicates with the application layer through well-defined APIs. This interaction handles user inputs and actions, ensuring a smooth user experience.

#### **Application Layer and Data Layer**

The application layer interacts with the data layer to fetch or store information in the database. This interaction ensures that the platform has access to the necessary data for its operation.

#### **Application Layer and External Components**

External services, such as the GitHub API for code repositories and an email service for notifications, are integrated into the application layer. This interaction enhances the platform's functionality by incorporating external features.

### **2.1.2 Advantages of Three-Tier Architecture**

- **Loose Coupling:** Separation of layers promotes loose coupling, enhancing modularity and ease of maintenance.
- **Scalability:** Each layer can be independently scaled based on specific requirements, allowing for better performance and resource utilization.

## 2.2 Component view

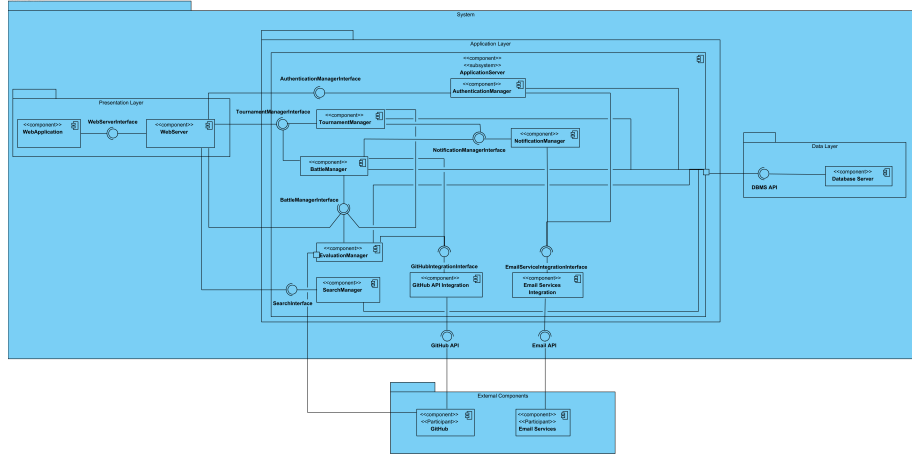


Figure 2: Component Diagram

### 2.2.1 Presentation Layer

#### Web Application:

- Represents the web application that will be used by educators and students.
- Allows educators to create tournaments and battles, invite other educators to tournaments, and perform manual evaluations on the submissions of battles they own.
- Allows students to register to tournaments and battles, create teams, and submit their solutions to battles.
- Provides a leaderboard that is updated in real-time, displaying the rankings of participants based on their performance in the battles.
- Provides a search functionality that allows users to search for tournaments and battles.
- Interfaces with the Web Server for communication with the Application Layer.

#### Web Server:

- Represents the component responsible for hosting the web application.
- Handles requests and responses from all users, including educators and students.



- Invokes APIs for communication with the Application Layer.

### 2.2.2 Application Layer

#### **AuthenticationManager:**

- Manages user authentication for educators and students.
- Generates and validates authentication tokens.
- Interfaces with email services for account confirmation and recovery.
- Interfaces with the Data Layer for user authentication.

#### **TournamentManager:**

- Manages the creation, moderation, and deletion of tournaments.
- Handles tournament-related processes and rules.
- Interfaces with the NotificationManager for tournament-related notifications.
- Interfaces with the Data Layer for tournament data.

#### **BattleManager:**

- Manages the creation, moderation, and deletion of battles within tournaments.
- Handles battle-related processes such as registrations, its deadlines, its GitHub repository creation, and its leaderboard.
- Interfaces with the TournamentManager for tournament-related processes such as tournament leadeboard updating.
- Interfaces with the NotificationManager for battle-related notifications.
- Interfaces with GitHub API Integration for repository creation.
- Interfaces with the Data Layer for battle data.

#### **EvaluationManager:**

- Handles the evaluation of code submissions based on set criteria.
- Utilizes build automation scripts and test cases for evaluation.
- Interfaces with GitHub API Integration for repository pulling.
- Interfaces with the Data Layer for storage of evaluation results.
- Has a port through which it receives messages from GitHub which are called during GitHub Actions on submissions and evaluations.

**NotificationManager:**

- Manages the sending of notifications to users.
- Interfaces with Email Services Integration for sending notifications via email.

**SearchManager:**

- Manages the search functionality of the platform.
- Allows users to search for tournaments and battles.
- Interfaces with the Data Layer for tournament and battle data.

**External Components Integration****GitHub API Integration:**

- Interacts with the EvaluationManager to notify of new submissions.
- Communicates with the external GitHub API for repository creation and pulling.

**Email Services Integration:**

- Integrates with Email Services for sending notifications.
- Sends notifications for tournament invitations, submission updates, etc.
- Communicates with the external Email Services API for sending emails.

**2.2.3 Data Layer****Database:**

- Manages the storage and retrieval of persistent data.
- Stores information related to tournaments, battles, users, submissions, etc.

## 2.3 Deployment view

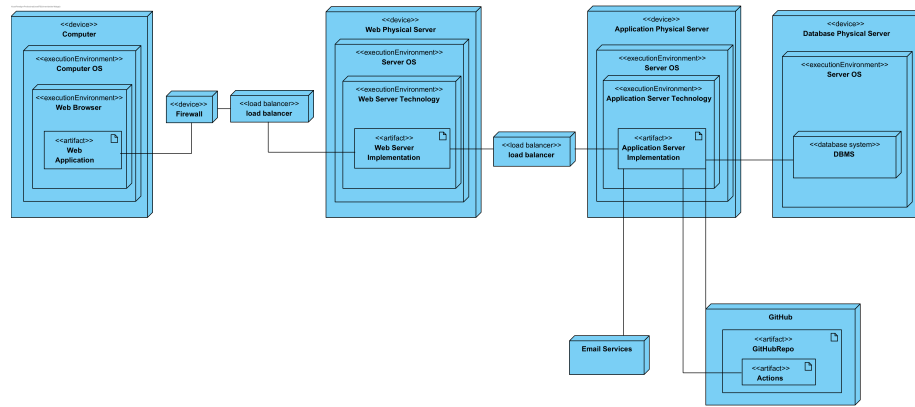


Figure 3: Deployment Diagram

On the deployment diagram, we can see the different components of the system and how they are deployed on the different nodes. The web application runs on the users' PC which communicates with the web server, which runs on a Web Server Technology which could be Apache Tomcat, Nginx or other. This two elements represent the presentation layer. The web server is connected to the application server, which runs on a Java EE Application Server. This element represents the application layer. The application server is connected to the database and to the external components. The database is managed by a Database Management System such as MySQL, PostgreSQL or other.

## 2.4 Runtime view

In the following diagrams we can see the sequence diagrams of the main functionalities of the system. These are more fleshed out versions of the use case diagrams presented in the RASD document.

### UC1 - Login

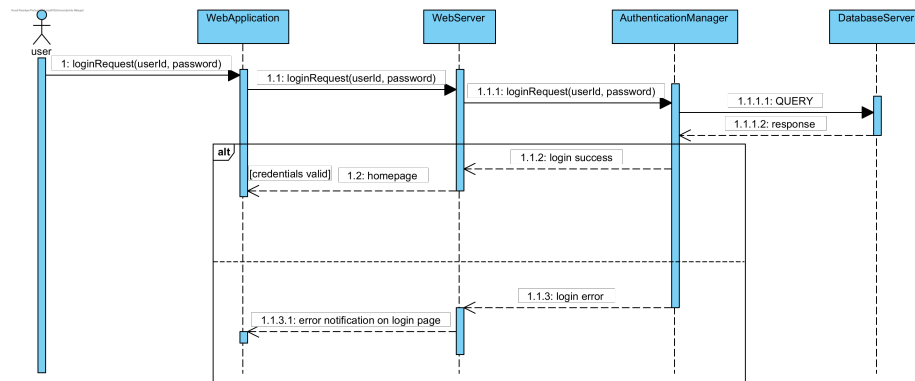


Figure 4: Use Case 1

### UC2 - Retrieve Password

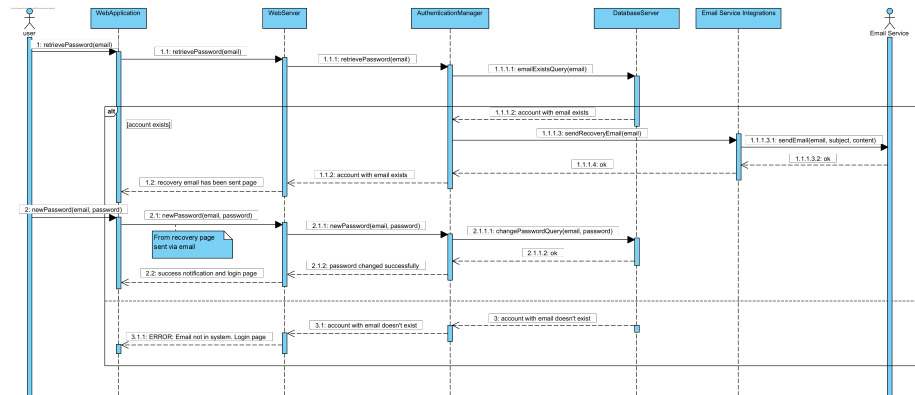


Figure 5: Use Case 2

### UC3 - Register

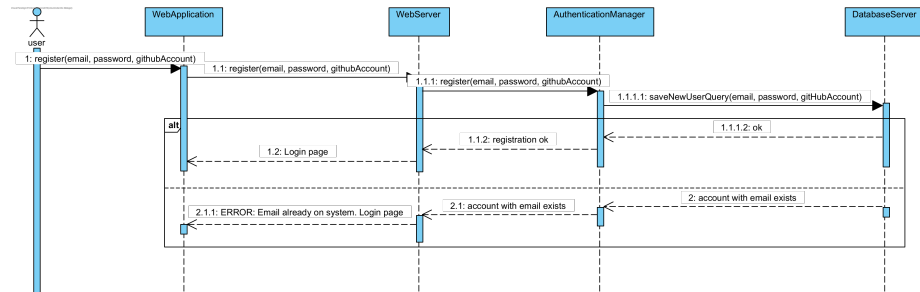


Figure 6: Use Case 3

### UC4 - Educator Creates Tournament

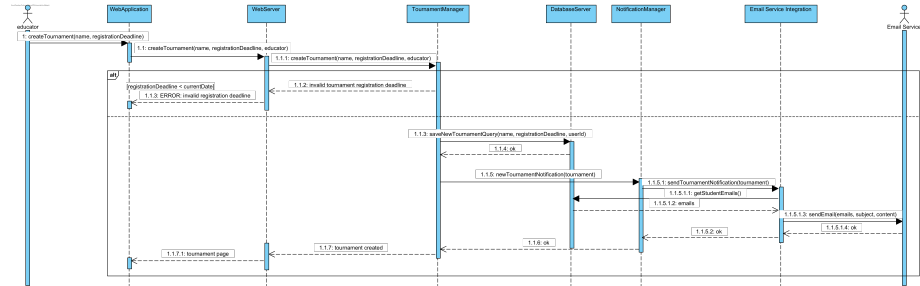


Figure 7: Use Case 4

### UC5 - Educator invites other educator to tournament

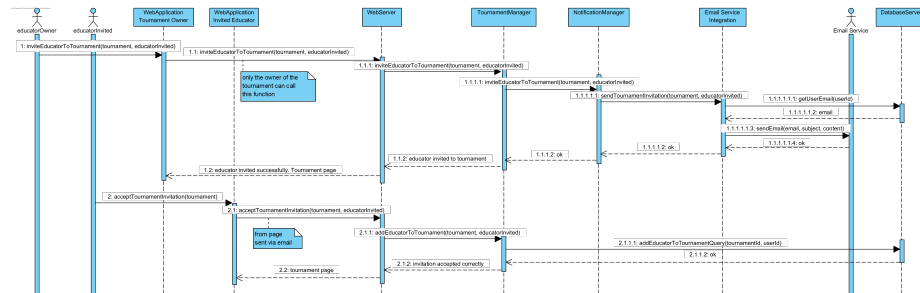


Figure 8: Use Case 5

## UC6 - Educator creates battle

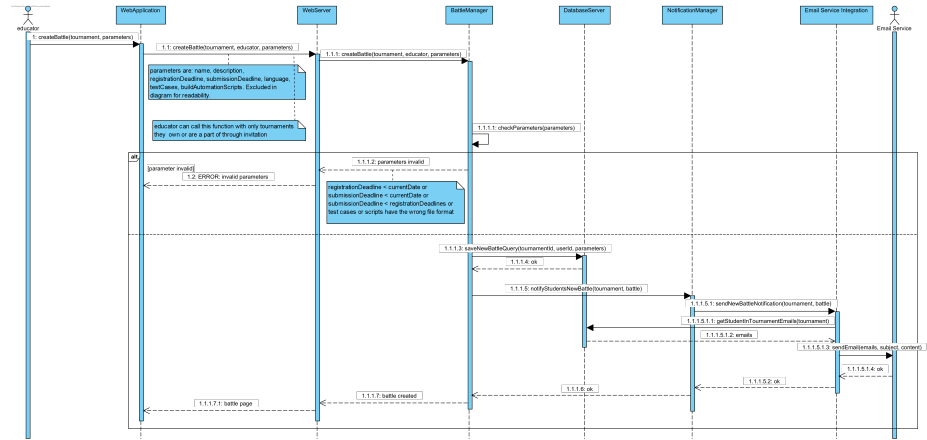


Figure 9: Use Case 6

## UC7 - Tournament Registration

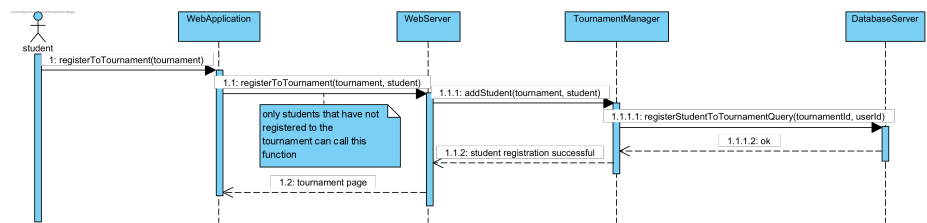


Figure 10: Use Case 7

## UC8 - Tournament Unregistration

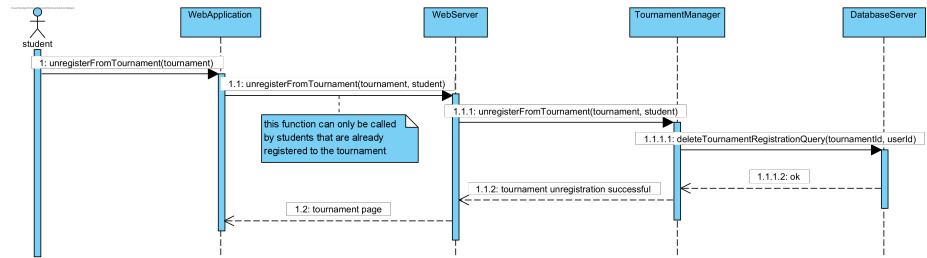


Figure 11: Use Case 8

## UC9 - Battle Registration

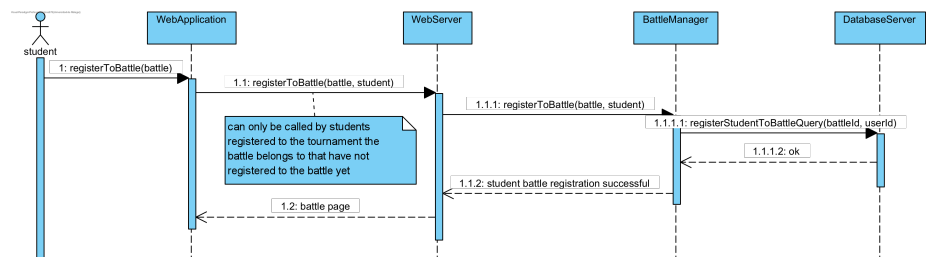


Figure 12: Use Case 9

## UC10 - Student joins battle via invite

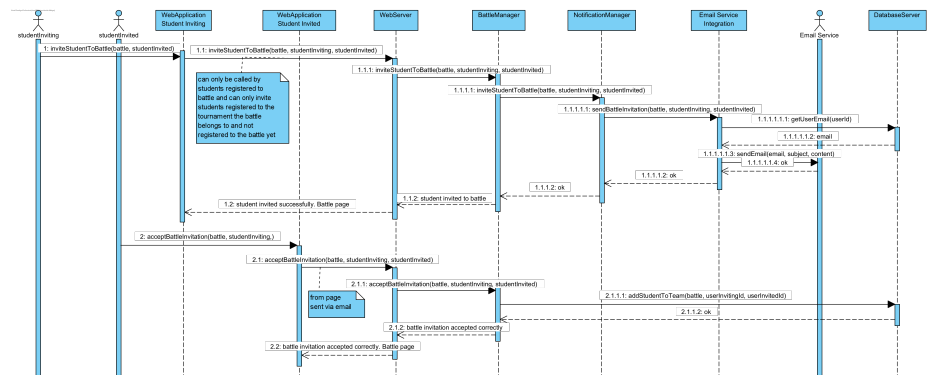


Figure 13: Use Case 10

## UC11 - Battle Unregistration

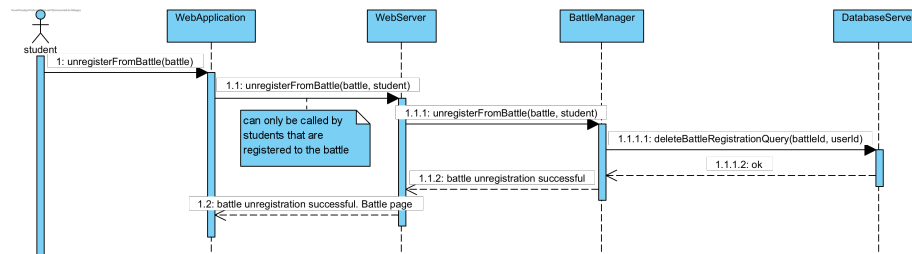


Figure 14: Use Case 11

## UC12 - Students makes submission

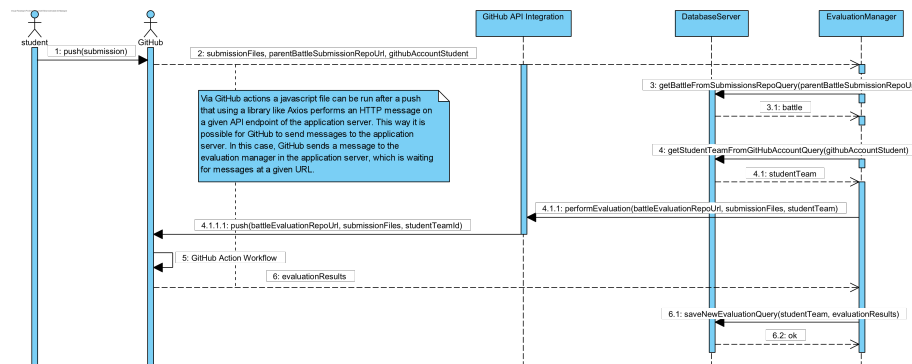
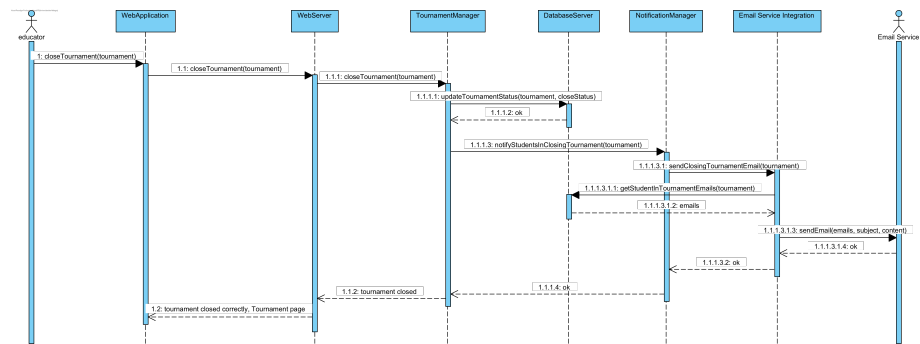


Figure 15: Use Case 12



[illegible]

## UC14 - Educator Closes Tournament



16

## UC15 - Find Tournament via search

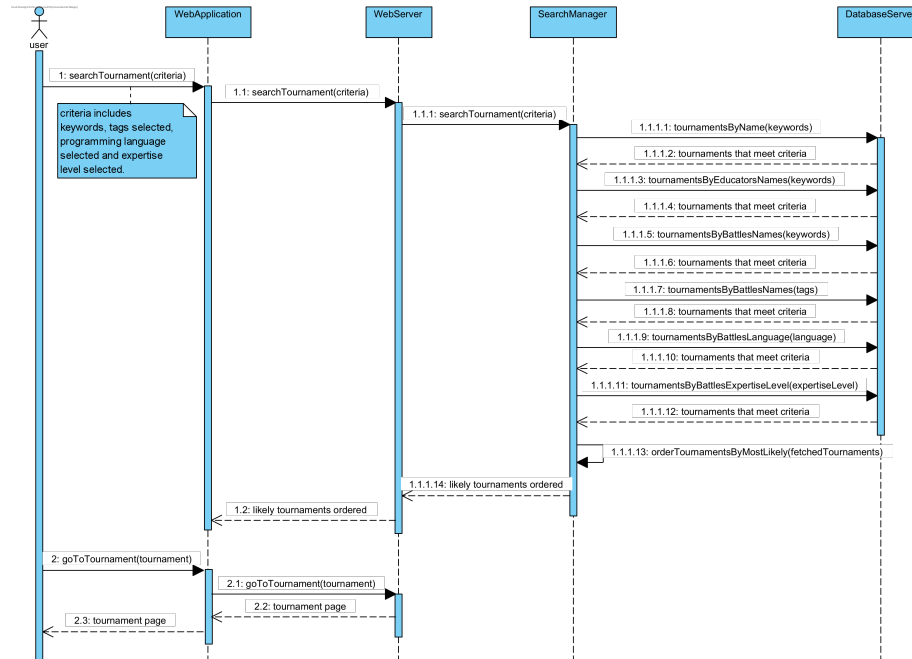


Figure 18: Use Case 15

## UC16 - Find Tournament on main page

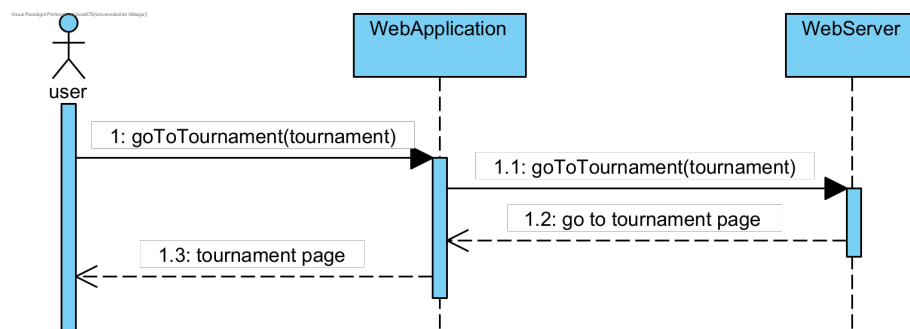


Figure 19: Use Case 16

### UC17 - Find Battle on main page or on tournament page

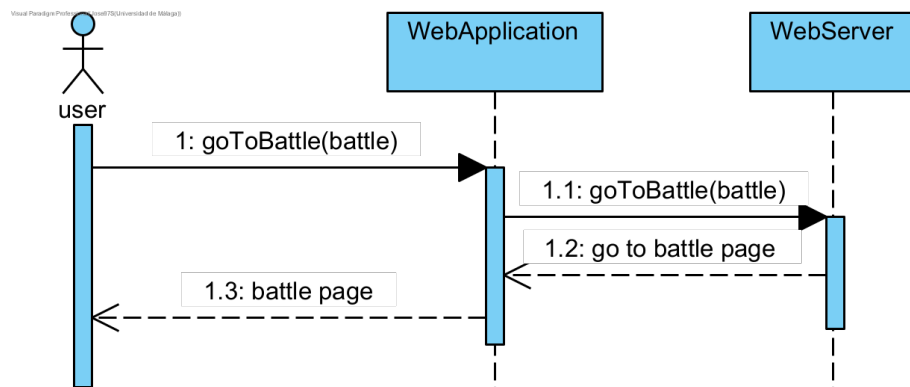


Figure 20: Use Case 17 and 18

## 2.5 Component interfaces

BattleManager:

- 

## 2.6 Selected architectural styles and patterns

## 2.7 Other design decisions

# 3 USER INTERFACE DESIGN

# 4 REQUIREMENTS TRACEABILITY

# 5 IMPLEMENTATION, INTEGRATION AND TEST PLAN

# 6 EFFORT SPENT

# 7 REFERENCES