Requirements Definition *version 1*

(November 7th, 2022)

Project Code Defenders - Robo Tournament

Team Codebenders

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- Project background *(refer to Project Plan document for details)*
  - Project Vision, about Code Defenders
- Project requirements
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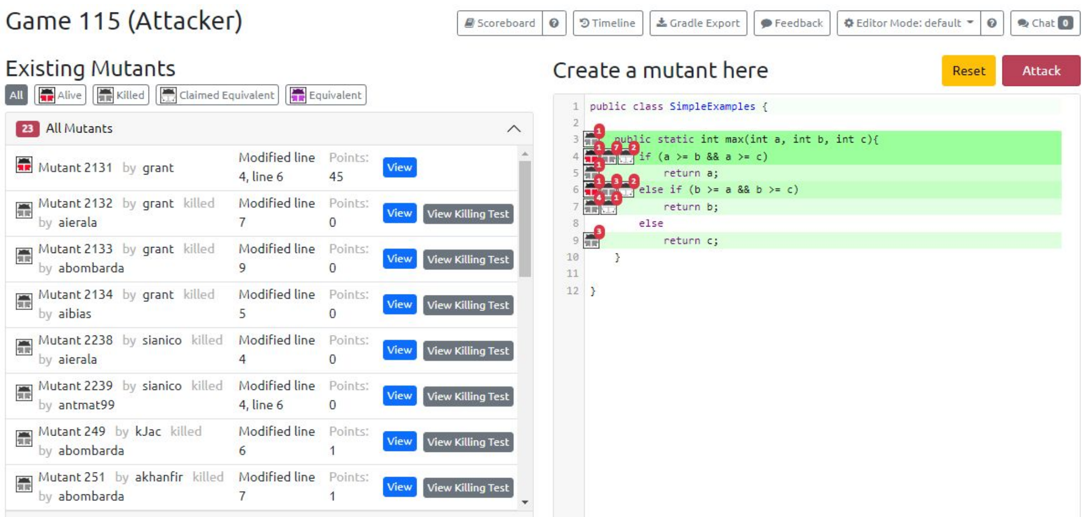
Project vision

Code Defenders

- Software quality and testing are at the heart of software engineering, but they may not always get enough attention from software engineering education.
- CodeDefenders (web game) proposes the use of **gamification** to teach **mutation testing** and to strengthen code writing and testing skills.
- The game supports **team play and competition** by having Attackers - Defenders teams whose goal is to inject errors into code or write unit tests to catch them.
- The **“CodeDefenders: RoboTournament”** project aims at enriching the game by adding support for students tournaments and games against bots.



Game 115 (Attacker)

Existing Mutants

23 All Mutants

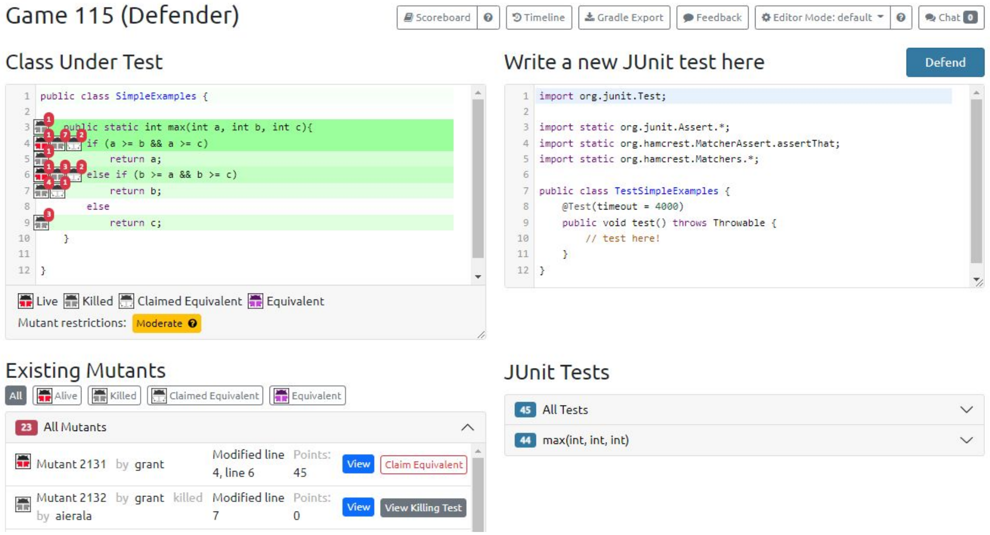
Mutant 2131 by grant	Modified line 4, line 6	Points: 45	View	
Mutant 2132 by grant killed by aierala	Modified line 7	Points: 0	View	View Killing Test
Mutant 2133 by grant killed by abombarda	Modified line 9	Points: 0	View	View Killing Test
Mutant 2134 by grant killed by aibias	Modified line 5	Points: 0	View	View Killing Test
Mutant 2238 by sianico killed by aierala	Modified line 4	Points: 0	View	View Killing Test
Mutant 2239 by sianico killed by antmat99	Modified line 4, line 6	Points: 0	View	View Killing Test
Mutant 249 by kJac killed by abombarda	Modified line 6	Points: 1	View	View Killing Test
Mutant 251 by akhanfir killed by abombarda	Modified line 7	Points: 1	View	View Killing Test

Create a mutant here

```
public class SimpleExamples {

    public static int max(int a, int b, int c){
        if (a >= b && a >= c)
            return a;
        else if (b >= a && b >= c)
            return b;
        else
            return c;
    }

}
```



Game 115 (Defender)

Class Under Test

```
public class SimpleExamples {

    public static int max(int a, int b, int c){
        if (a >= b && a >= c)
            return a;
        else if (b >= a && b >= c)
            return b;
        else
            return c;
    }

}
```

Mutant restrictions: Moderate

Write a new JUnit test here

```
import org.junit.Test;

import static org.junit.Assert.*;
import static org.hamcrest.MatcherAssert.assertThat;
import static org.hamcrest.Matchers.*;

public class TestSimpleExamples {
    @Test(timeout = 4000)
    public void test() throws Throwable {
        // test here!
    }
}
```

Existing Mutants

23 All Mutants

Mutant 2131 by grant	Modified line 4, line 6	Points: 45	View	Claim Equivalent
Mutant 2132 by grant killed by aierala	Modified line 7	Points: 0	View	View Killing Test

JUnit Tests

45 All Tests

44 max(int, int, int)

Project requirements

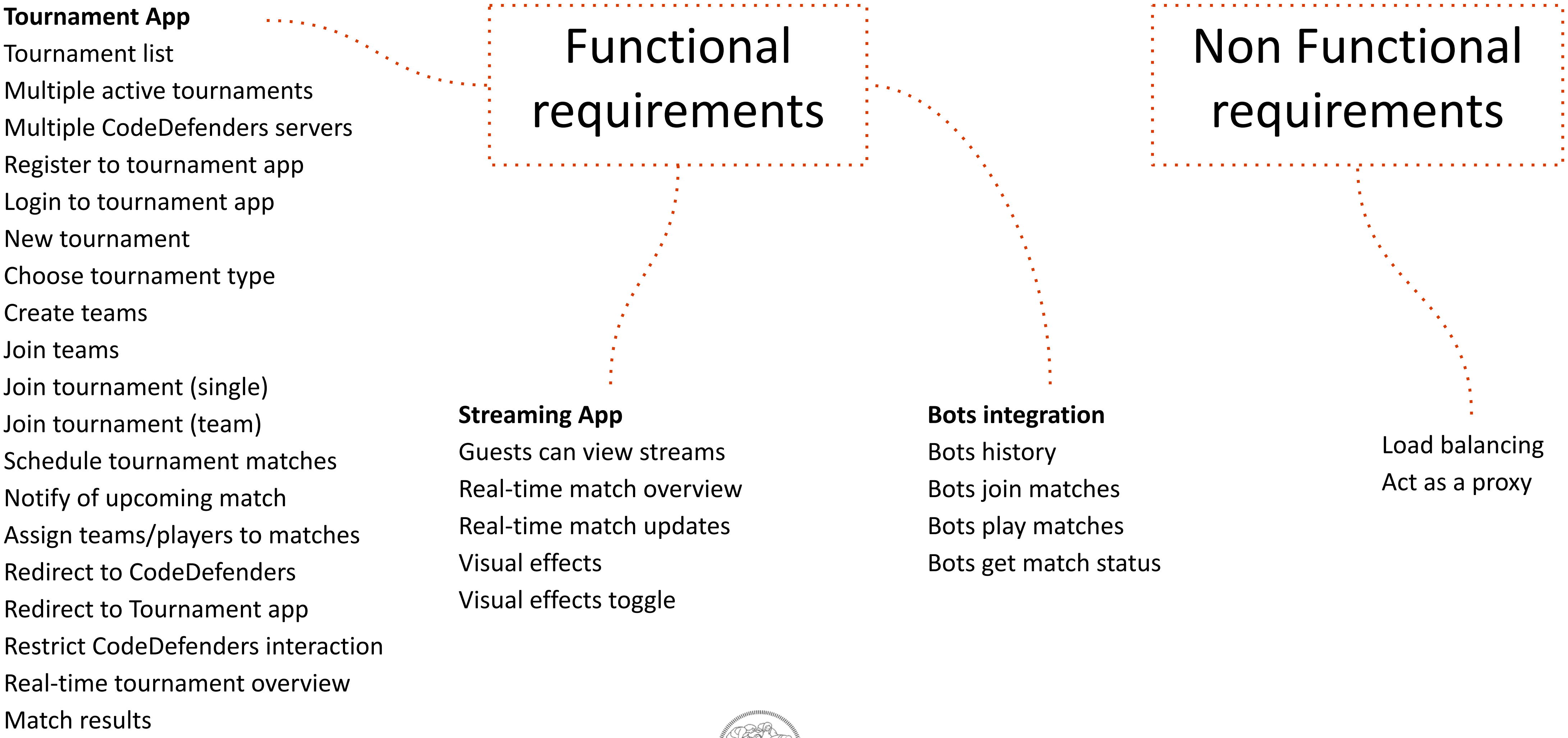
- Design and implement a set of **OpenAPIs for CodeDefenders** which can be used from the tournament application to manage games and players.

- Implement the **tournament application**. This application must use CodeDefenders as a remote service (through the APIs) and must include at least two tournaments modalities.

- Implement a **streaming** component which allows users to follow in progress games live. This component can optionally include an “overall tournament view” showing schedule, standings and other information for each tournament.

- Design and implement a set of **APIs** which allows users to train **bots** over past games data and to let those bots play CodeDefenders.

List of requirement



Functional requirements

Non Functional requirements

Tournament App

Tournament list

Multiple active tournaments

Multiple CodeDefenders servers

Register to tournament app

Login to tournament app

New tournament

Choose tournament type

Create teams

Join teams

Join tournament (single)

Join tournament (team)

Schedule tournament matches

Notify of upcoming match

Assign teams/players to matches

Redirect to CodeDefenders

Redirect to Tournament app

Restrict CodeDefenders interaction

Real-time tournament overview

Match results

Streaming App

Guests can view streams

Real-time match overview

Real-time match updates

Visual effects

Visual effects toggle

Bots integration

Bots history

Bots join matches

Bots play matches

Bots get match status

Load balancing

Act as a proxy

User Stories organized in Epics

Tournament Management

CDF-32 Login/Register
CDF-41 Display tournaments info
CDF-33 Create Tournament
CDF-34 Join tournament
CDF-42 Matchmaking

Play tournament games

CDF-36 Starting games with notification
CDF-38 Return to tournament app from game page

Watch a streamed tournament game

CDF-39 View game stream
CDF-40 Notification of game stream update

Team Management

CDF-35 Team creation
CDF-54 Team management
CDF-37 Join team

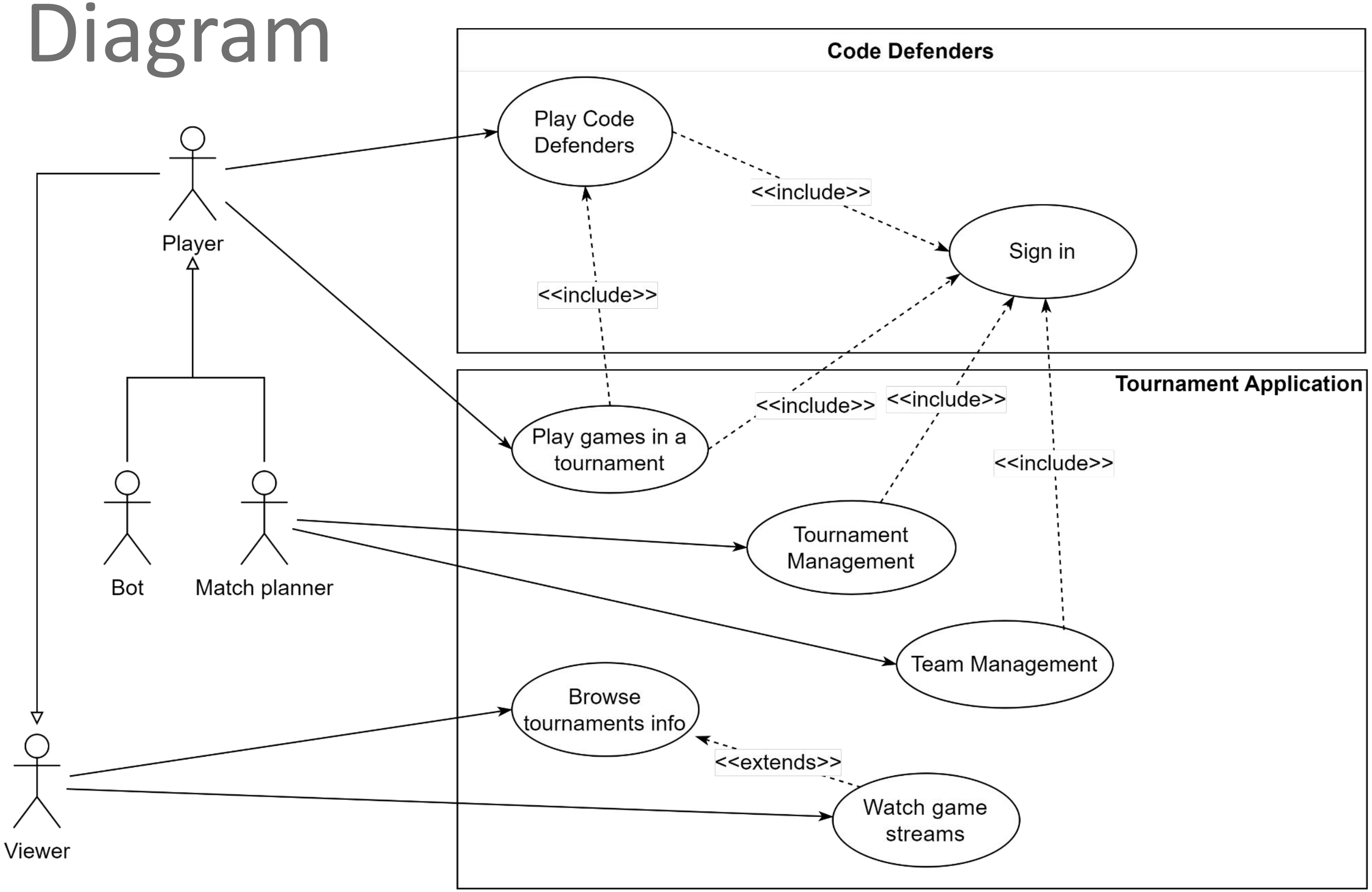
Play with bots

CDF-43 Bots can play
CDF-44 Bots can be trained

Avoid CodeDefenders overload

CDF-31 Low latency
CDF-69 Efficient flow of updates

Use Case Diagram



POLITECNICO
MILANO 1863

Mälardalen University

back to epics

Epic: Tournament Management

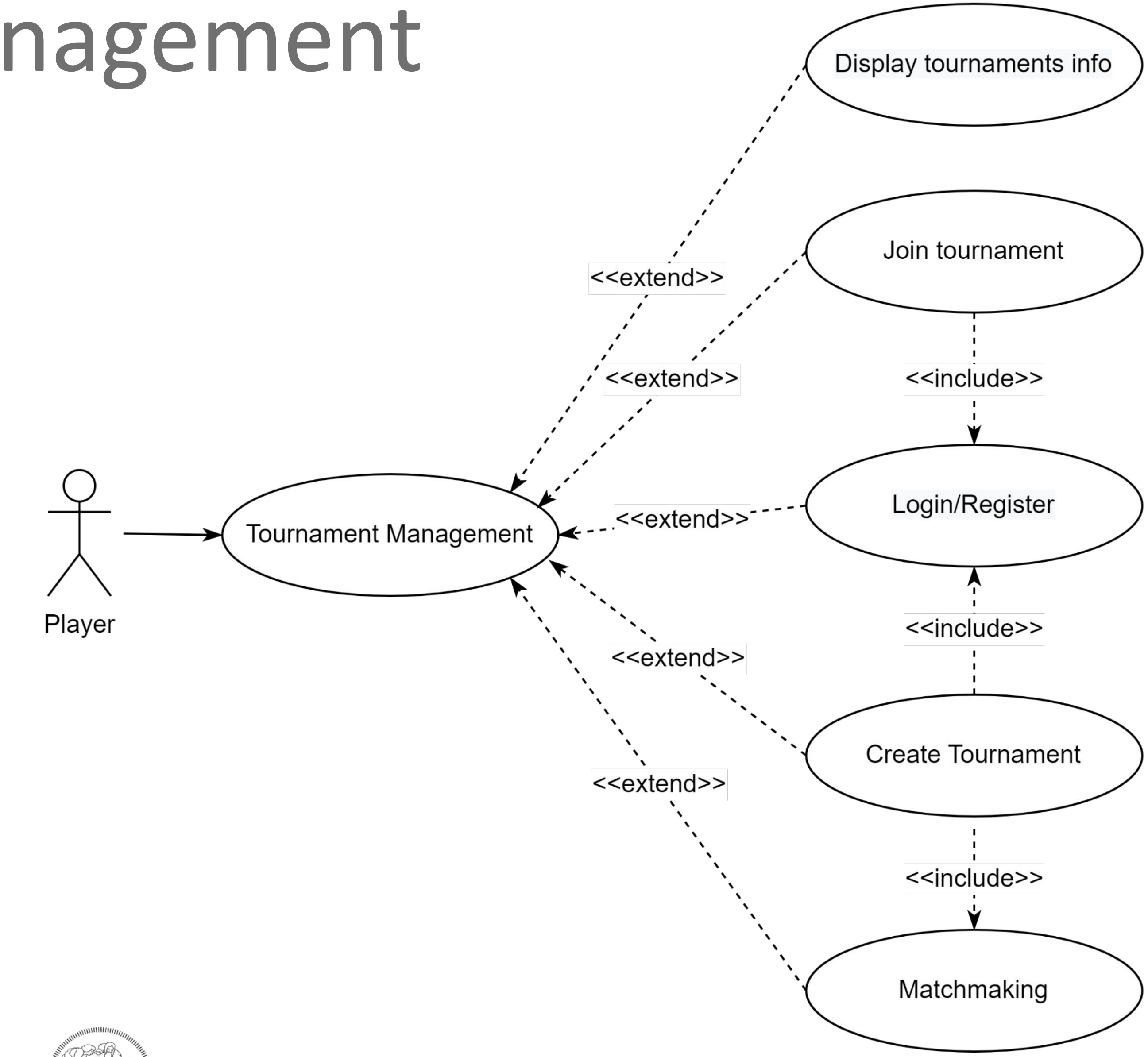
CDF-32 Login/Register

CDF-41 Display tournaments info

CDF-33 Create Tournament

CDF-34 Join tournament

CDF-42 Matchmaking



CDF-32 Login/Register

Entry condition: homepage

A non-authenticated user wants to authenticate/register to the tournament application to be able to join or create new tournaments.

Exit condition: homepage

Validation: User is authenticated by CodeDefenders and can access pages that require validation

Motivation:

- Only authenticated players can be referenced (who is in which team, who participates in which tournament)

Source: Identified by the team

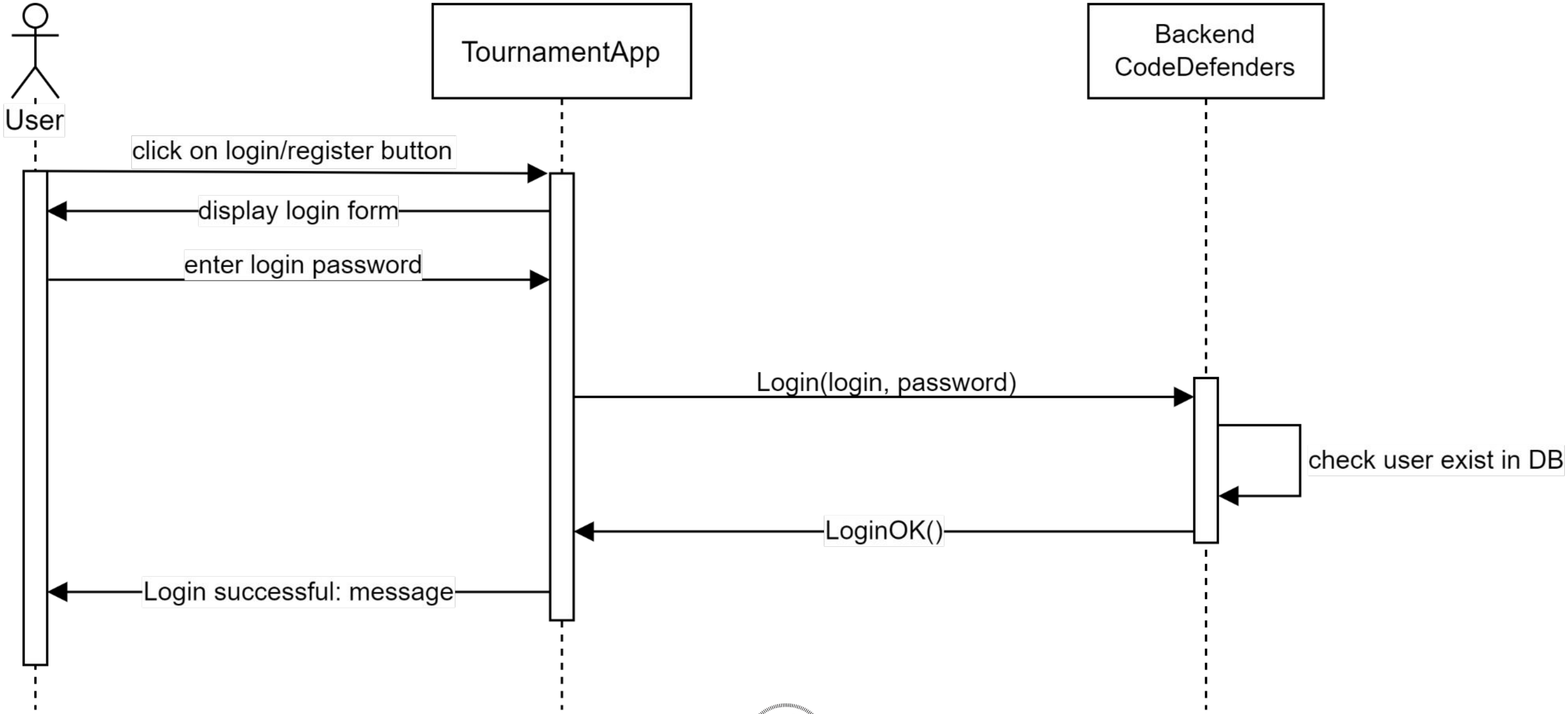
1) In the home page the user clicks on login/register button

2) The tournament application shows a login/register page with a form

3) The user inserts authentication/registration data

4) The tournament app verifies the inserted data through CodeDefenders and sends a response with the outcome to the user

Login


User
TournamentApp
Backend CodeDefenders
click on login/register button
display login form
enter login password
Login(login, password)
check user exist in DB
LoginOK()
Login successful: message

back to epics

CDF-41 Display tournaments info

Entry condition: homepage

Players want a way to inspect list of tournaments, filter it by specific players/team, type, date, labels, current status of tournament tree,…

Exit condition: other view (tournament/team creation, FAQ…)

Validation: Any user (authenticated or not) can view all tournaments info, filter and sort the list.

Motivation:

- There needs to be a billboard for tournaments

Source: Customer request

1) User sees and possibly reorders and filters the list with all tournaments

2) User possibly selects one tournament to see more detailed information

CDF-33 Create Tournament

Entry condition: User is authenticated, enters create tournament view

Players want to create tournaments of different types, with constraints for joining, conditions for start…

Exit condition: confirm creation, return to homepage

Validation: In the Home page, the created tournament is displayed in the list of tournaments

Motivation:

- There needs to be a way of creating new tournaments with different configurations

Source: Customer request

1) In the tournament app home page the user clicks on create Tournament button

2) A form for the tournament creation is displayed

3) The user selects all tournaments options (type of tournament, game type, number of team, the condition to join/start the tournament)

5) The user clicks the button to confirm the creation

back to epics

CDF-34 Join Tournament

Entry condition: User is authenticated, homepage

Players want to join already existing tournaments with their teams

Exit condition: confirm registration, return to homepage

Validation: In the Home page, the joined tournament now shows also the user with its team between the participants

Motivation:

- There needs to be a way to join already existing tournaments so that teams can compete

Source: Customer request

1) In the tournament app home page the user chooses a tournament to join and clicks the join button

2) A form for team creation or selection is displayed

3) The user creates a new team or possibly selects a team to register in the tournament (if the user is the team leader of that team)

5) The user clicks the button to confirm the registration

back to epics

CDF-42 Matchmaking

Entry condition: Tournament view, after the list of all competitors is full

Once new tournament is filled with all the competitors, players want fair pairings of opposing teams.

Exit condition: tournament is completely defined

Validation: Tournaments with mentioned labels can't be edited by creator after the automatic distribution, manual check of formula for distribution based on rating

1) Tournament creator chooses the matchmaking option for its tournament (random/rating distributed)

2) Once the tournament is complete with all the participants, the tournament app estimates rating of players based on their score history

3) A math formula is used for computing the pairings and filling the tournament structure

4) Tournament gets labelled as “Random distribution“ or “Rating distribution”

Motivation:

- We want to avoid teams with too different skill levels to compete against each others

Source: Identified by the team

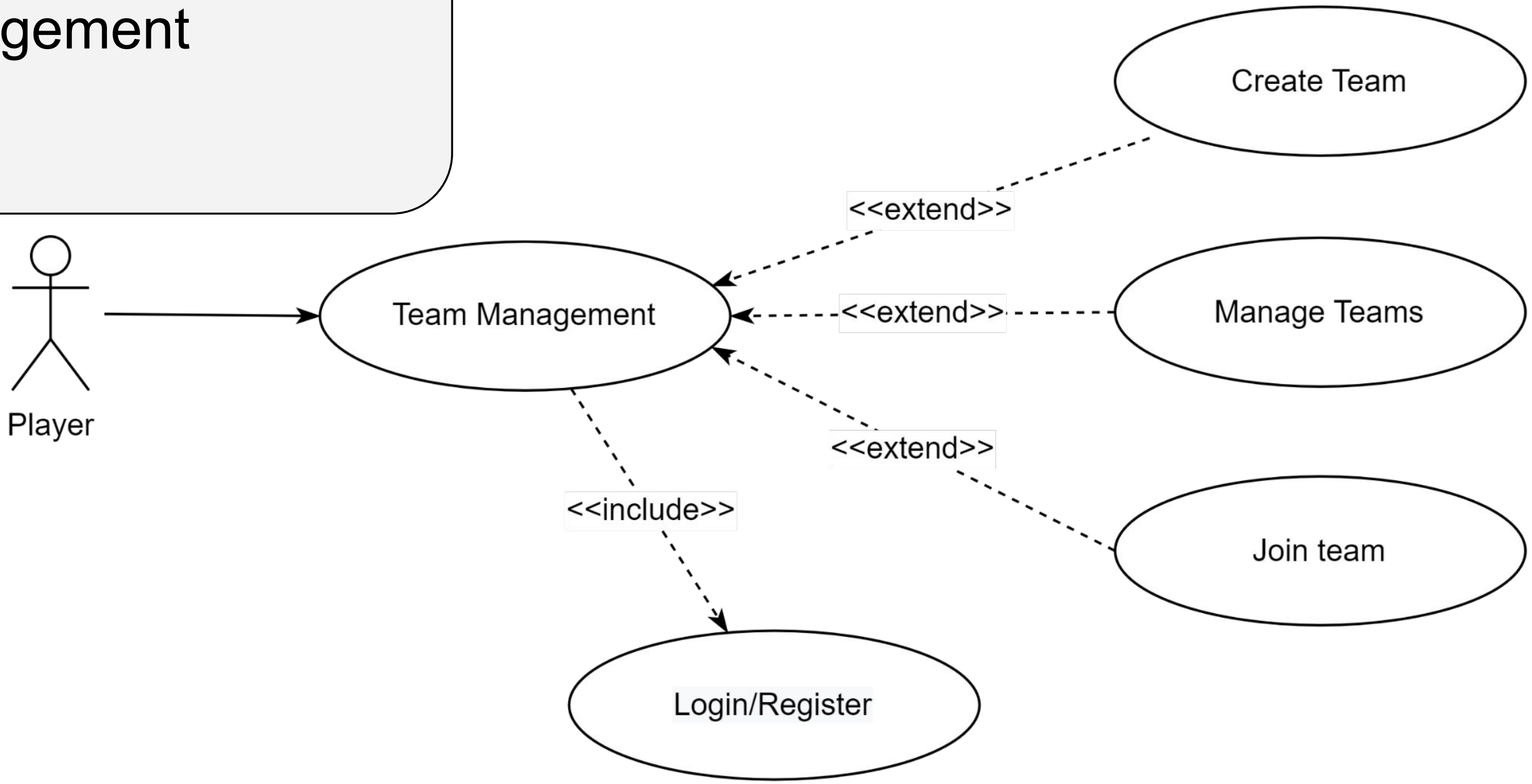
back to epics

Epic: Team Management

CDF-35 Team creation

CDF-54 Team management

CDF-37 Join team



back to epics

CDF-35 Team creation

Entry condition: User is authenticated, enters create team view

A player wants to create a team and choose its team members

Exit condition: Confirm creation, return to homepage

Validation: The new team is visible in the team management view and all the added members are displayed

Motivation:

- We want to give a player the possibility to choose the members of its team and to join multiple tournaments with the same team

Source: Identified by the team

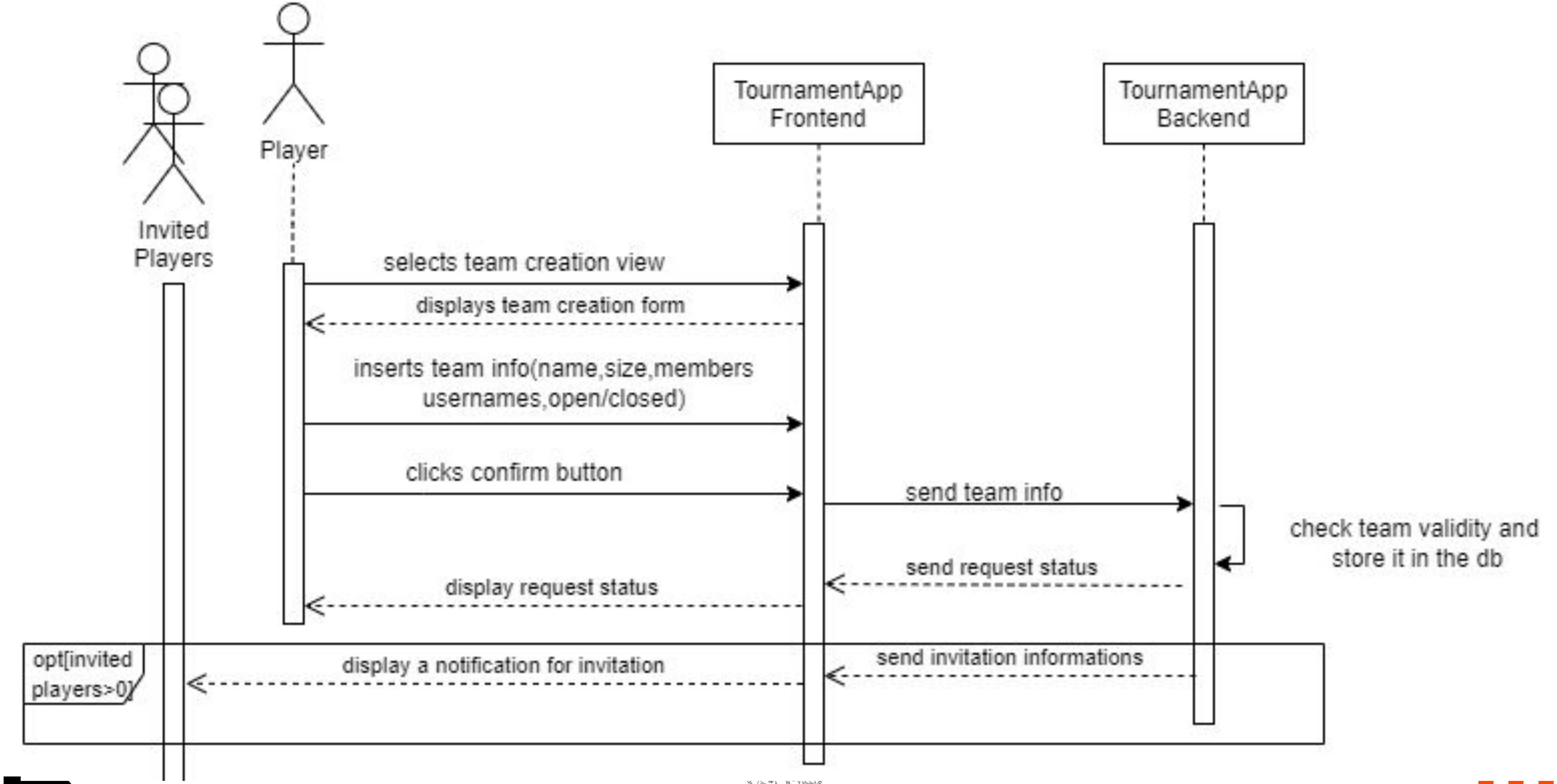
1) The player enters team creation view

2) The player adds team information (name, size, …)

3) The player adds each member of its team

4) The player confirms team creation

Team Creation


Invited Players
Player
TournamentApp Frontend
TournamentApp Backend
selects team creation view
displays team creation form
inserts team info(name,size,members usernames,open/closed)
clicks confirm button
send team info
check team validity and store it in the db
send request status
display request status
opt[invited players>0]
display a notification for invitation
send invitation informations

back to epics

CDF-54 Team management

Entry condition: User is authenticated, is a team leader, enters manage team view

A team leader wants to change the team settings, add and remove members

Exit condition: Confirm changes, return to homepage

Validation: The changes applied to the team are visible in the team management view

Motivation:

- We want to give a player the possibility to modify settings and members of a team previously created

Source: Identified by the team

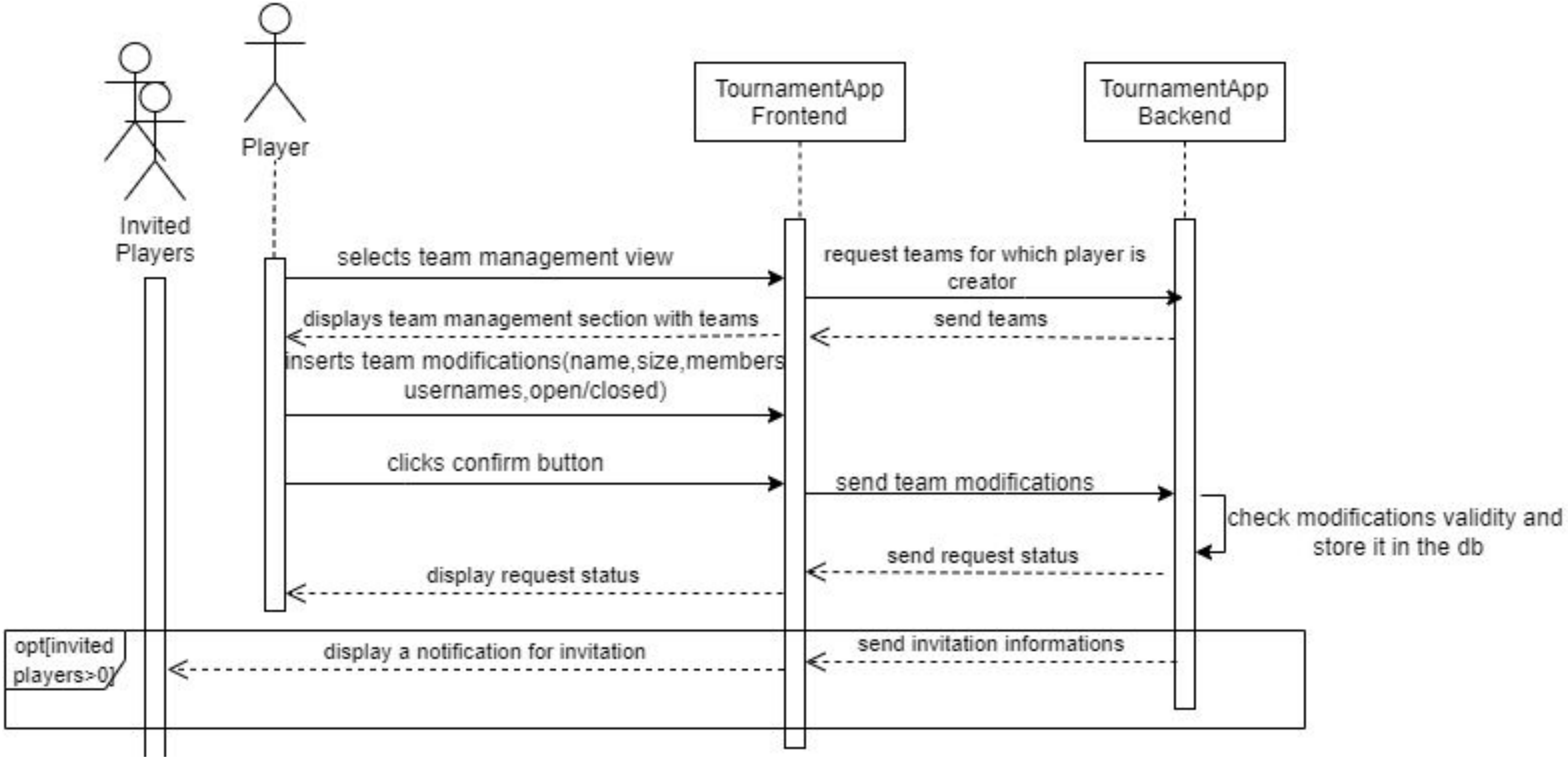
1) The team leader enters team management view and selects one of its teams

2) The team leader possibly changes the team settings (name, size, …)

3) The team leader possibly adds or removes team members

4) The team leader confirms the changes

Team management


Invited Players
Player
TournamentApp Frontend
TournamentApp Backend
selects team management view
request teams for which player is creator
displays team management section with teams
send teams
inserts team modifications(name,size,members usernames,open/closed)
clicks confirm button
send team modifications
check modifications validity and store it in the db
send request status
display request status
opt[invited players>0]
display a notification for invitation
send invitation informations

CDF-37 Join team

Entry condition: User is authenticated, enters join team view or receives an invitation

A player wants to join an already existing team

Exit condition: Confirm the team to join or accept the invitation, return to homepage

Validation: The user can see the new team it joined in the list of its teams

1.a) The player enters join team view and sees the list of available teams
2.a) The player can reorder the teams (by names, date, …) and see teams details
3.a) The player selects an open team to join and confirms

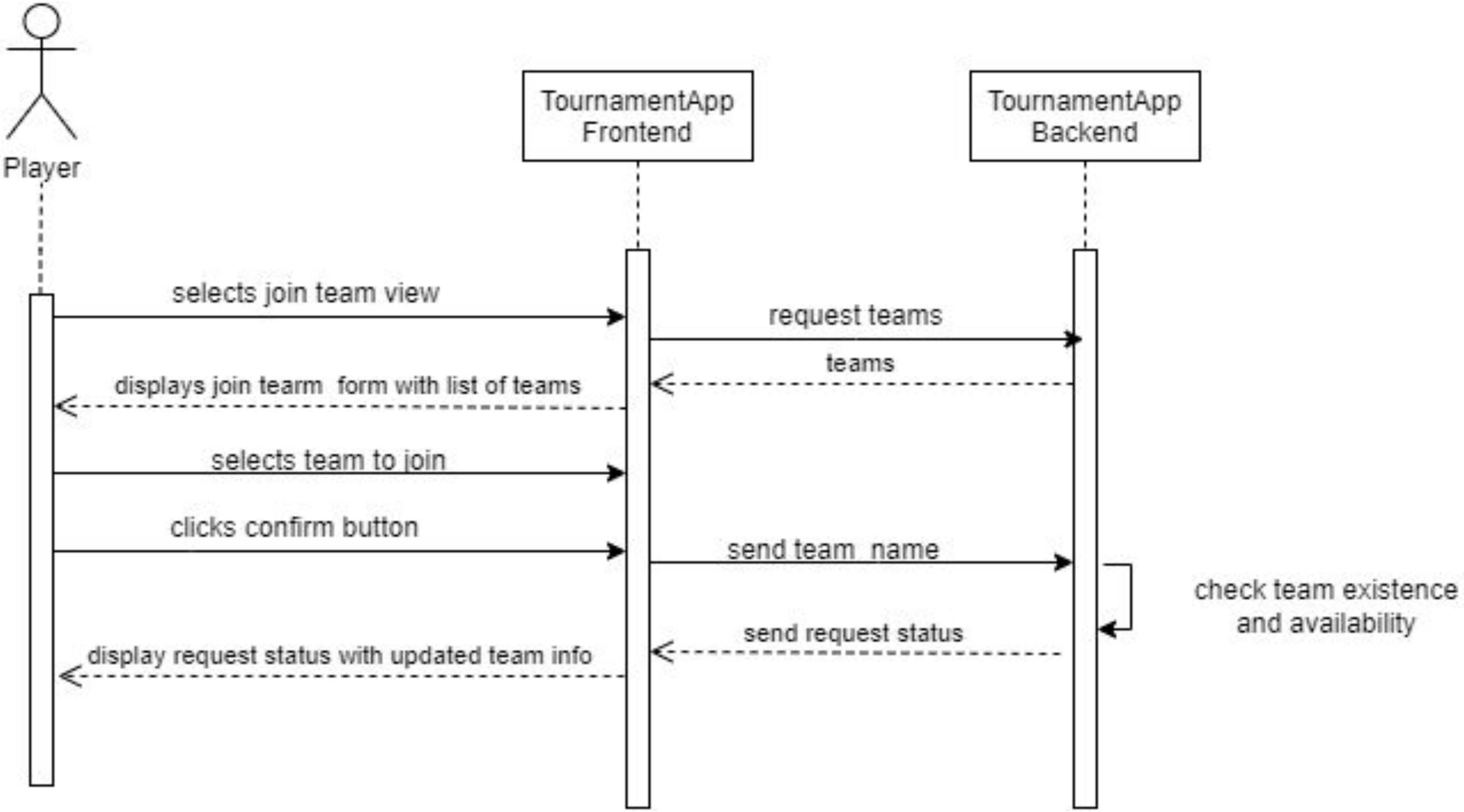
1.b) The player receives an invitation from a team
2.b) The player can see the team details
3.b) The player accepts (or refuses) the invitation

Motivation:

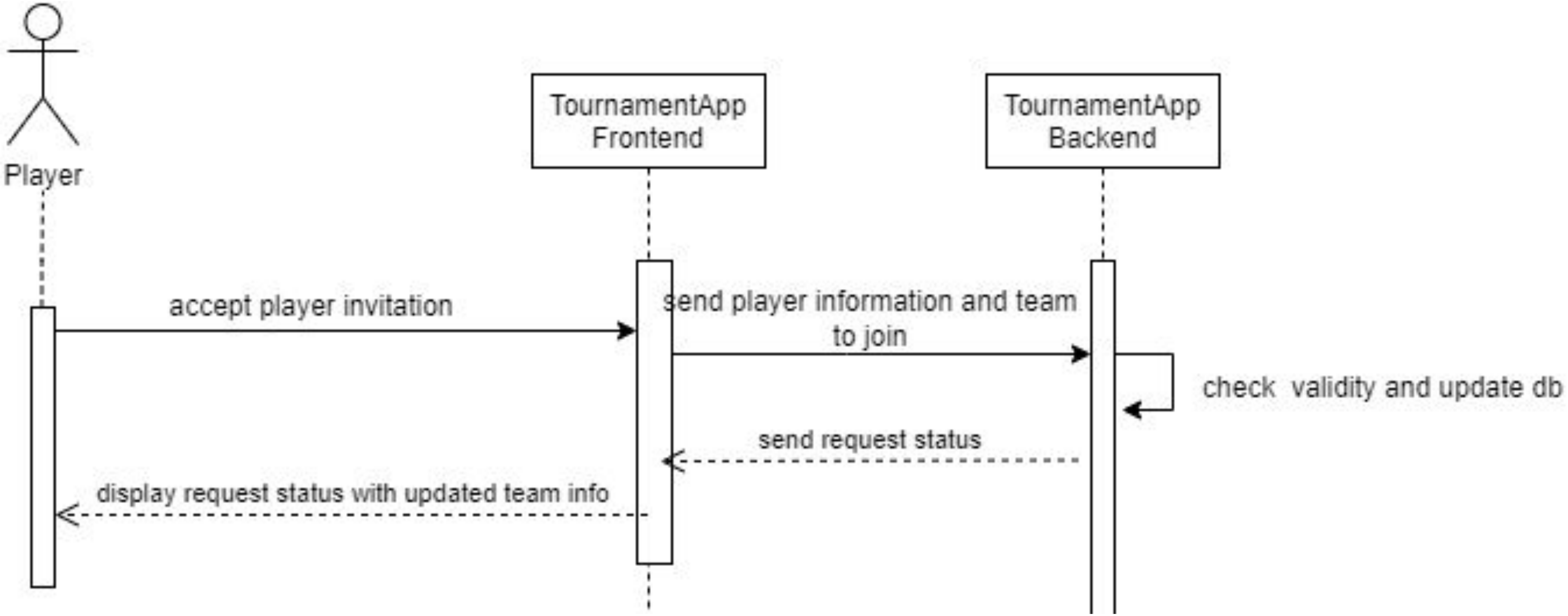
- The player should be able to join a team it likes or a team it has been invited to

Source: Identified by the team

Join Team


Player
TournamentApp Frontend
TournamentApp Backend
selects join team view
request teams
teams
displays join tearm form with list of teams
selects team to join
clicks confirm button
send team name
check team existence and availability
send request status
display request status with updated team info

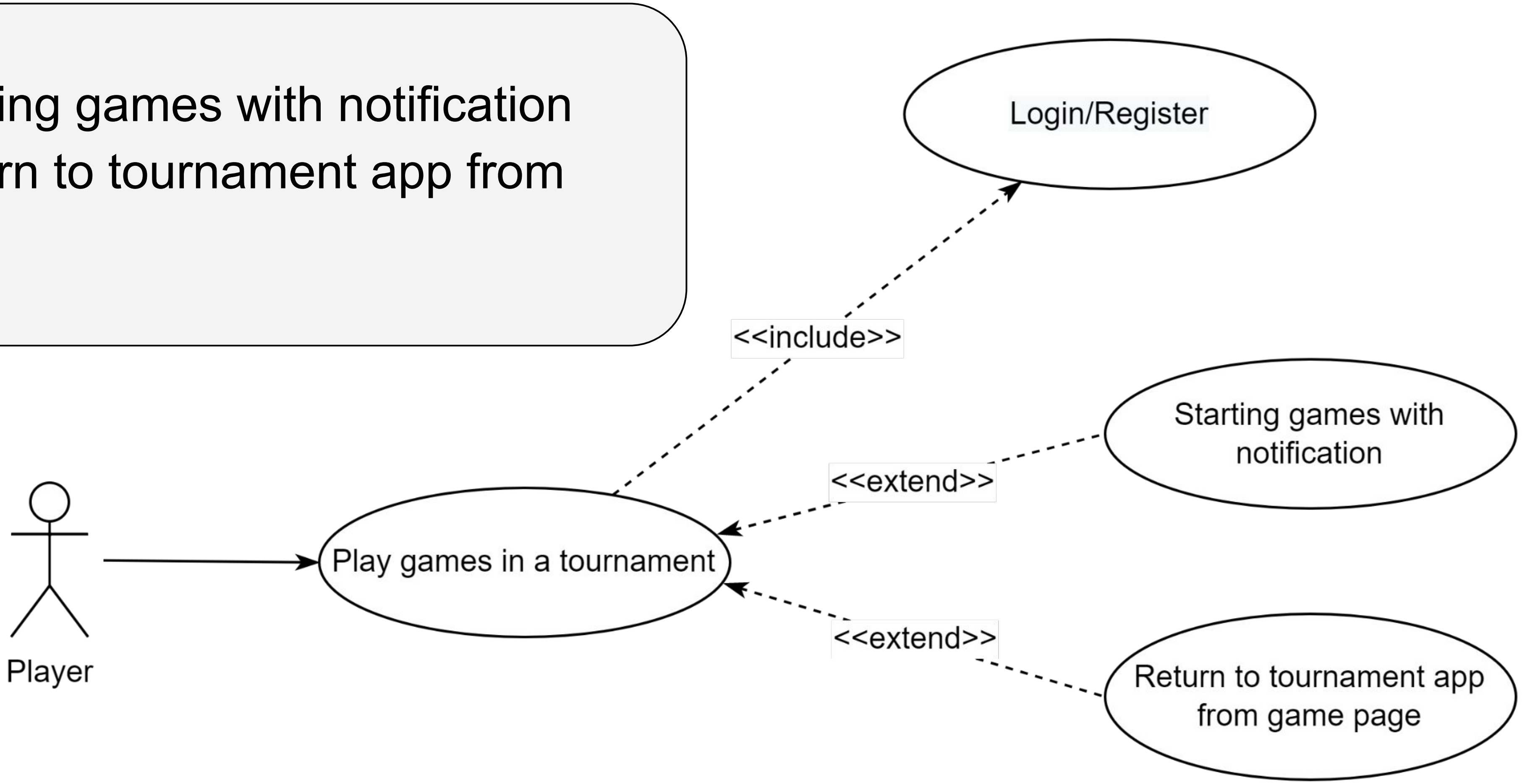
Accept /Refuse invitation


Player
TournamentApp Frontend
TournamentApp Backend
accept player invitation
send player information and team to join
check validity and update db
send request status
display request status with updated team info

Epic: Play Tournament games in CodeDefenders

CDF-36 Starting games with notification

CDF-38 Return to tournament app from game page


Login/Register
<<include>>
Starting games with notification
<<extend>>
Player
Play games in a tournament
<<extend>>
Return to tournament app from game page

CDF-36 Starting games with notification

Entry condition: the tournament is ready to start (all players joined and the matchmaking has been performed)

Players want to play games in a tournament and get notified when a game in which they are participating starts

Exit condition: homepage

Validation: After a tournament starts the involved players must see a notification of the game, a button to access the game on CodeDefenders and a button to access the streaming.

Motivation:

- Players must be able to play games on CodeDefenders and to receive notifications of their next games.

Source: Customer request (notifications requirement identified by the team)

1) The tournament application creates and starts the games on CodeDefenders

2) The players are notified by the tournament application that a game started

3) The clients receives from the tournament application links to play the game on CodeDefenders and watch the game live

CDF-38 Return to tournament app from game page

Entry condition: Any Tournament App page that allows viewing a game on CodeDefenders

A user watches a game and wants to return to the Tournament App

Exit condition: The same Tournament App page

Validation: The final page corresponds exactly to the initial page

Motivation:

- Since the Tournament App and the CodeDefenders game page are on different servers, the user needs a convenient way to switch between them

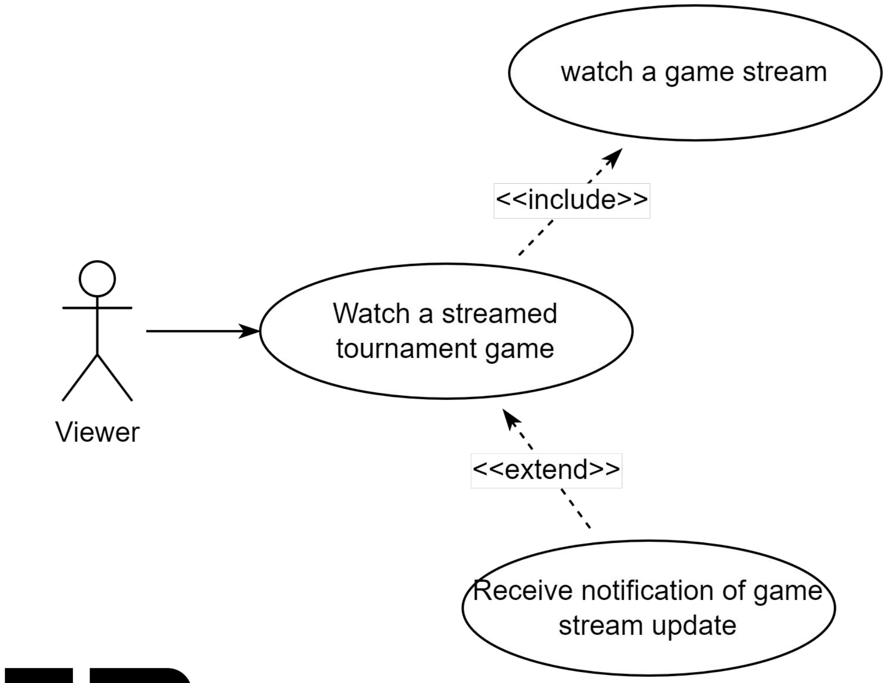
Source: Identified by the team

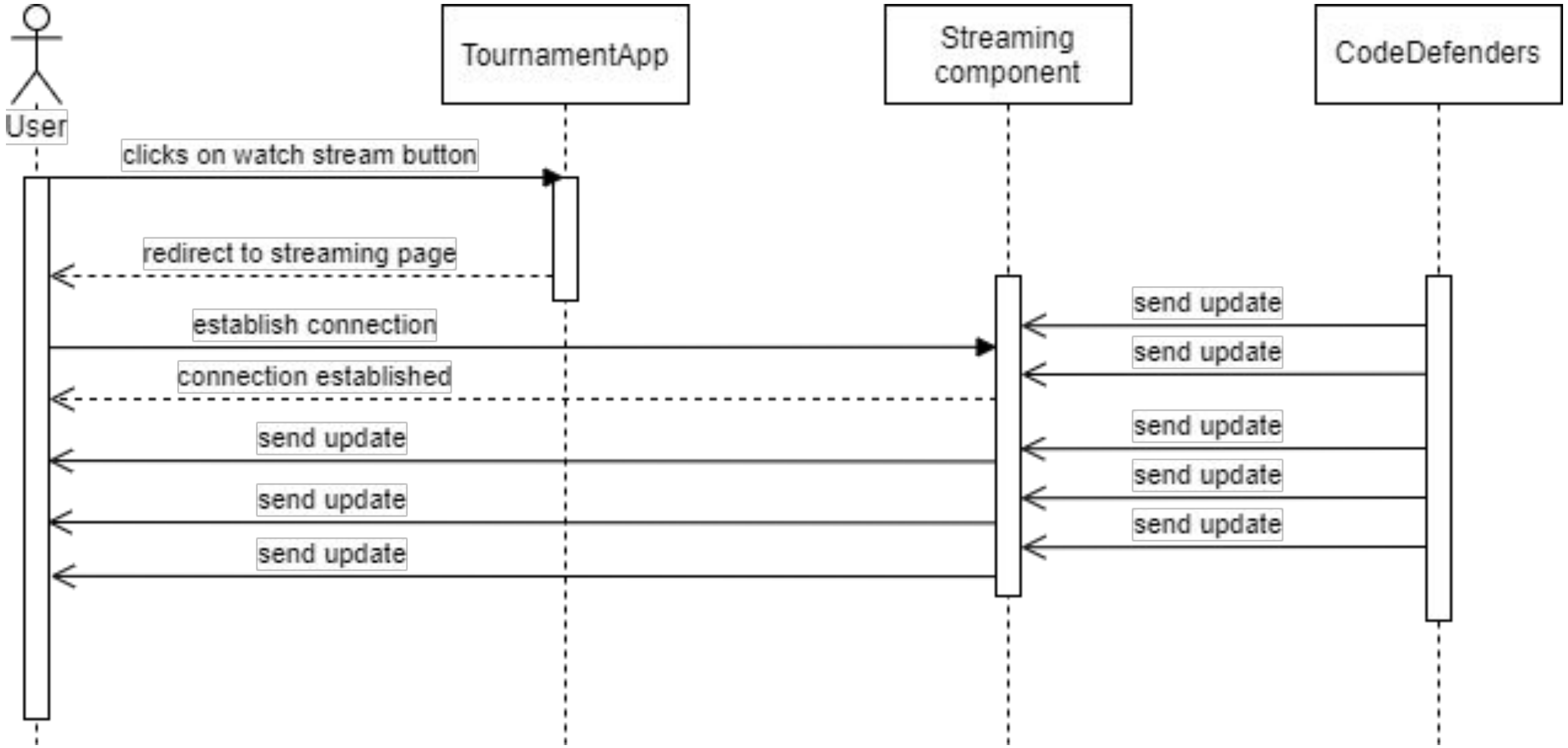
1) From a Tournament App page a user decides to watch a game
2) The user is redirected to the CodeDefenders game page
3) The user clicks the button to return to the previous page
4) The user is redirected to the previous Tournament App page

back to epics

Epic: Watch a streamed tournament game

CDF-39 view game stream
CDF-40 notification of game stream update


watch a game stream
<<include>>
Viewer
Watch a streamed tournament game
<<extend>>
Receive notification of game stream update



back to epics

CDF-39 View game stream

Entry condition: Home Page

A user wants to watch an ongoing live game

Exit condition: Game streaming page

Validation: A connection with the streaming component is established and the user starts receiving updates about the game selected.

Motivation:

- Guests and users must be allowed to follow the games of their preferred players live.

Source: Customer request

1) In the homepage the user clicks on the button corresponding to the live game he is interested to

2) A connection is established with the streaming component

3) The tournament application shows a dedicated page where updates from the game selected are shown

CDF-40 Notification of game stream update

Entry condition: Game streaming page

A user has joined a live stream of an ongoing game and he wants to receive updates of that game.

Exit condition: The game ends

Validation: the user can see live updates of the game with visual effects.

Motivation:

- Guests and users must be allowed to receive live updates about the match they are interested in

Source: Customer request

1) The user receives updates about the ongoing game

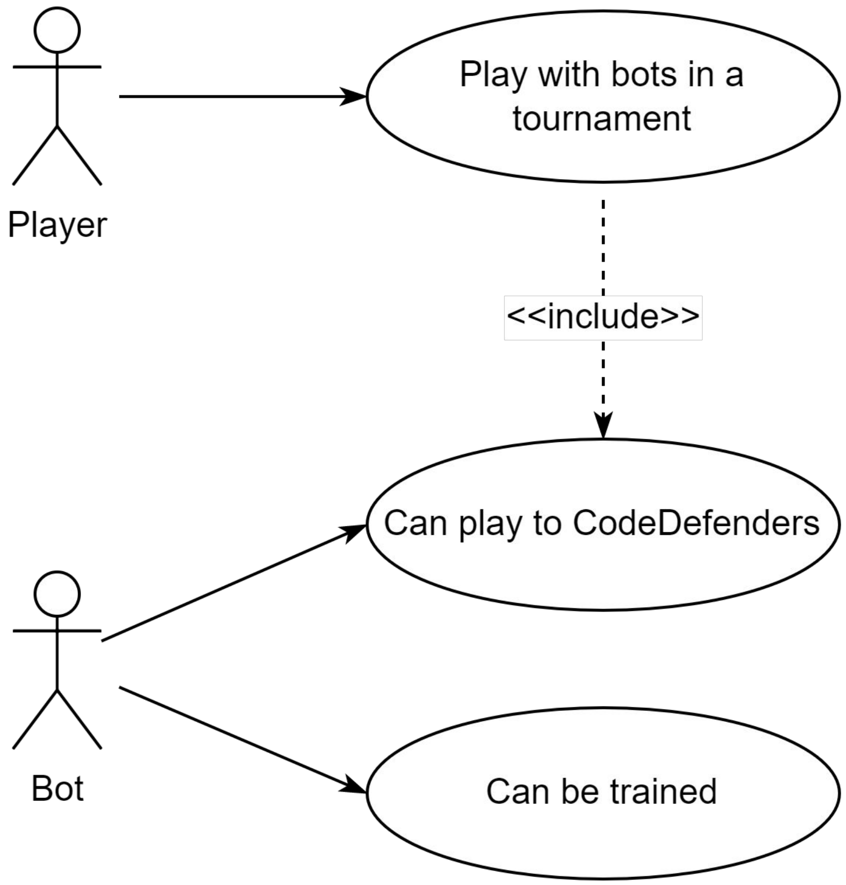
2) Updates are shown on the dedicated page with visual effects for points, scores and main actions.

back to epics

Epic: Play with Bots

CDF-43 Bots can play

CDF-44 Bots can be trained



back to epics

CDF-43 Bots can play

Entry condition: A fully developed bot is ready to play

Users wants to make their developed bots play CodeDefenders

Exit condition: The game ends

Validation: A dummy bot can complete an entire game in CodeDefenders

1) An authenticated user obtains an identification token to verify its bot

2) The bot joins a CodeDefenders game

3) The bot plays the game by calling CodeDefenders API

4) The game ends and the bot stops playing

Motivation:

- We need to allow users to have their programmed and trained bots and let them play on CodeDefenders

Source: Customer request

CDF-44 Bots can be trained

Entry condition: A user obtained an identification token

Users wants to download historical data about previous games in order to train their bots.

Exit condition: All historical data are received

Validation: A dummy bot can complete an entire game in CodeDefenders

Motivation:

- We need to allow users to access historical data so that they have data to train their bots as they prefer.

Source: Customer request

1) An authenticated user obtains an identification token to verify its bot

2) The user requests the historical data to train the bot using the appropriate CodeDefenders API

3) All the historical data are sent to the user

Epic: Avoid CodeDefenders overload

CDF-31 Low latency
CDF-69 Efficient flow of updates

CDF-31 and CDF-69 are **non-functional requirements**

back to epics

CDF-31 Low latency

Entry condition: Every page allowing a client to send requests to CodeDefendes server

CodeDefenders must support the dispatch of requests among multiple CodeDefenders instances.

Exit condition: user’s request is served by one of the CodeDefenders instances

Validation: 5 different instances of CodeDefenders servers are running and receiving requests from the clients (easily scalable to n).

Motivation:

- Players of CodeDefenders don’t want to have overloaded servers and slow response of the web game.

Source: Customer request

1) The user sends a request to CodeDefenders

2) The request is dispatched to the server instance with the minimum number of requests

3) The request is served and the response is returned to the user

back to epics

CDF-69 Efficient flow of updates

Entry condition: -

Updates about streamed games must flow from CodeDefenders to the streaming component and then be dispatched to the interested users.

Exit condition: the user receives updates about the game he is watching

Validation: Clients are able to see live updated games by just interacting with the streaming component (and without contacting CodeDefenders)

Motivation:

- We want to avoid overloading CodeDefenders servers with continuous requests from users watching live games.

Source: Customer request

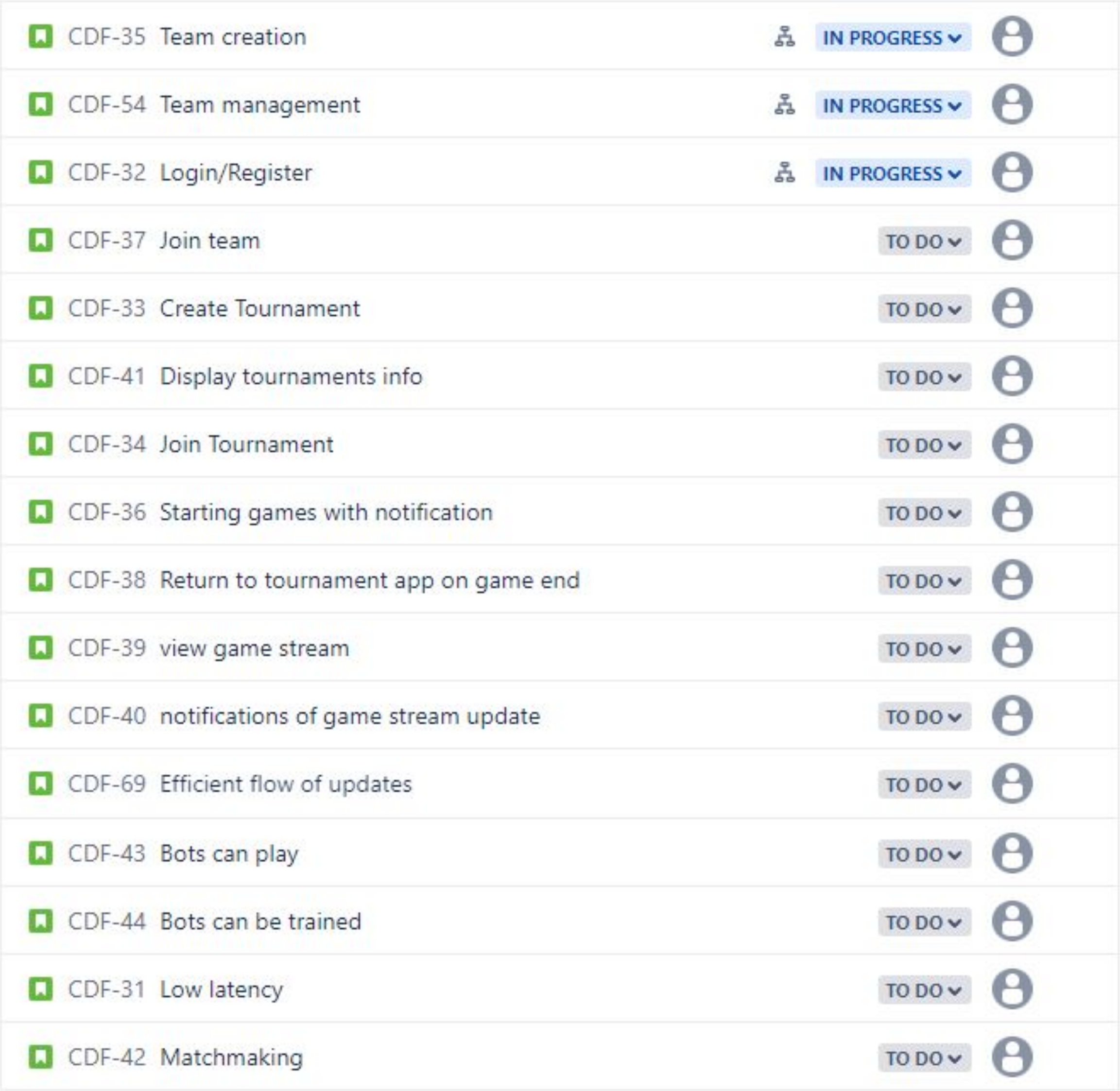
1) The user joins a live stream on the streaming component

2) CodeDefenders sends updates about the ongoing games to the streaming component

3) The user receives updates about the game he is watching by the streaming component

Product Backlog

- User stories are sorted in priority order
- CDF-35, CDF-54 and CDF-32 have been added to sprint 2 backlog and are already in progress
- More information about subtasks, estimated work effort and work remaining is available on Jira



CDF-35	Team creation	IN PROGRESS
CDF-54	Team management	IN PROGRESS
CDF-32	Login/Register	IN PROGRESS
CDF-37	Join team	TO DO
CDF-33	Create Tournament	TO DO
CDF-41	Display tournaments info	TO DO
CDF-34	Join Tournament	TO DO
CDF-36	Starting games with notification	TO DO
CDF-38	Return to tournament app on game end	TO DO
CDF-39	view game stream	TO DO
CDF-40	notifications of game stream update	TO DO
CDF-69	Efficient flow of updates	TO DO
CDF-43	Bots can play	TO DO
CDF-44	Bots can be trained	TO DO
CDF-31	Low latency	TO DO
CDF-42	Matchmaking	TO DO

Codebenders

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