Distributed System Project - Server/Client Multiplayer Game

FEUP | CPD - 2022/23

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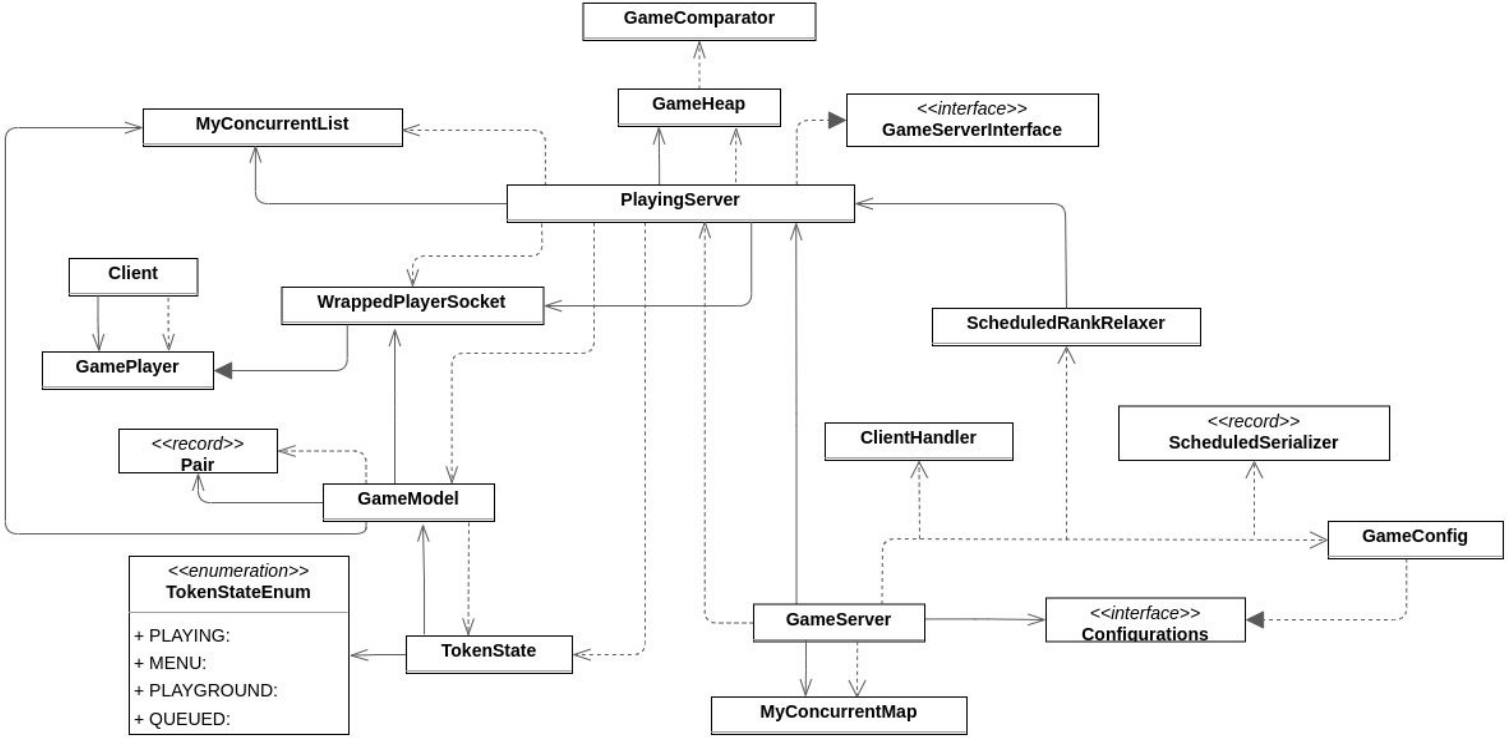
Project context and description

This course project aims to achieve a client-server multiplayer game using TCP sockets in Java. The game must support authentication and a basic game server.

To facilitate the evaluation of the project, the group decided to create a simple logger that shows what's happening in the application.

Code Architecture - Class Diagram



<<enumeration>>
GuessErgo

+ PLAYED:
+ WINNING_MOVE:
+ NOT_PLAYED:
+ ALREADY_LEFT_GAME:

<<enumeration>>
CommunicationProtocol

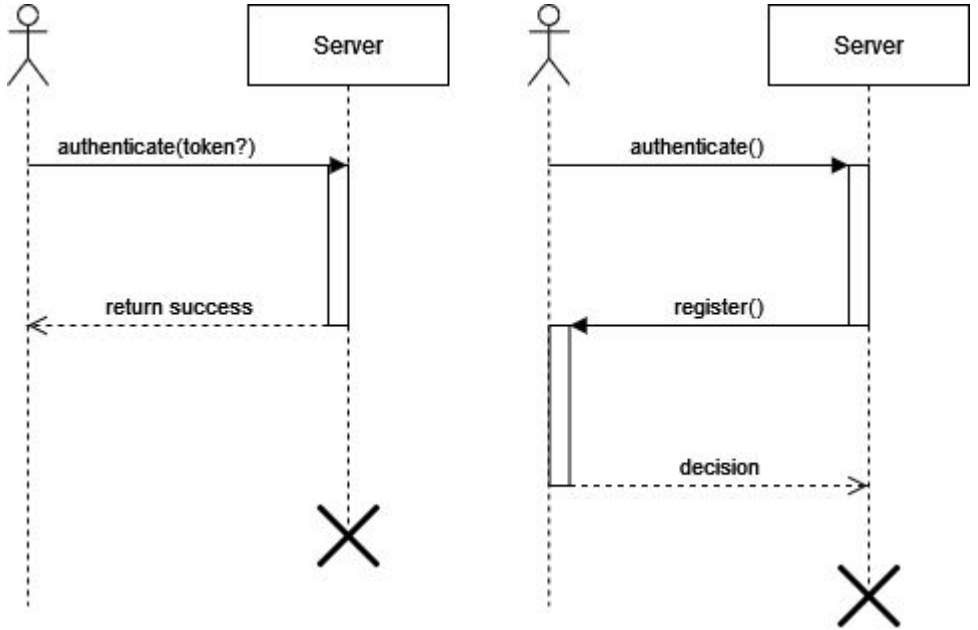
+ GAME_TIMEOUT:
+ MENU_CONNECT:
+ GUESS_TOO_LOW:
+ DISCONNECTED:
+ GUESS:
+ PLAYGROUND_UPDATE:
+ PLAYER_LEFT:
+ GAME_RECONNECT:
+ GAME_RESULT:
+ GAME_END:
+ QUEUE_RECONNECT:
+ QUEUE_ADD:
+ GAME_STARTED:
+ GUESS_TOO_HIGH:
+ PLAYGROUND_RECONNECT:
+ GUESS_CORRECT:
+ QUEUE_UPDATE:

Note: Multiplicities and class contents were omitted for clarity sake

https://drive.google.com/file/d/1Mnnft30I37YNR7Xt4UwYHvCQa_7JCu80/view?usp=sharing

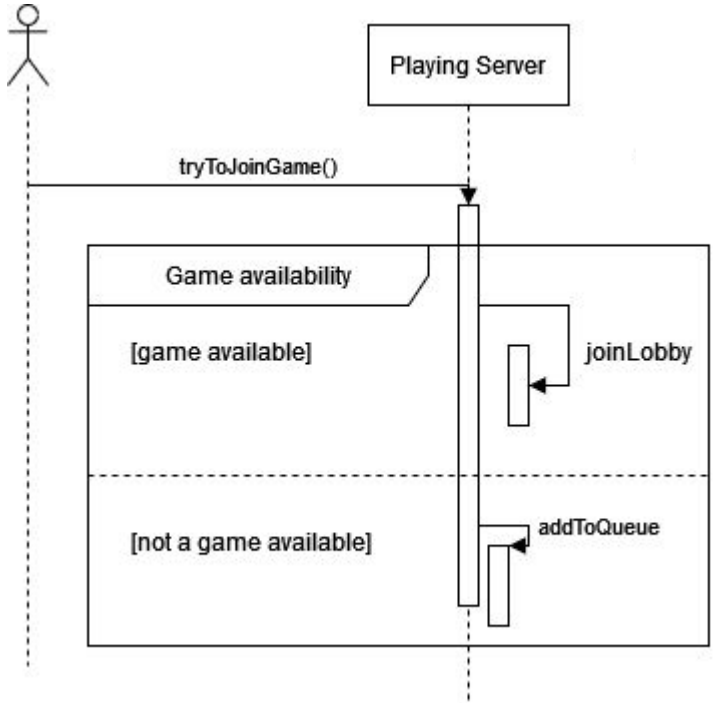
Communication Protocol - Sequence Diagrams

- User has the possibility to logout from the game
- Logout invalidates the token and removes the client state
- Token is **optional**, used to go back to a previous application state on a lost connection
- Token has a timespan



Communication Protocol

- **Schedular rank relaxer** - relaxes tolerances to the players in queue on rank mode to prevent starving of player with very different trophy count from all other currently active players
- Player in lobby receives updates on the current lobby occupation
- On game end, game is responsible to check queue and add to game. Possibly restarting the game



Communication Protocol

- TODO: GAME guess send and response, game end, win lose etc, reconnect example also, RMI calls and socket utils with NIO and connection timeout

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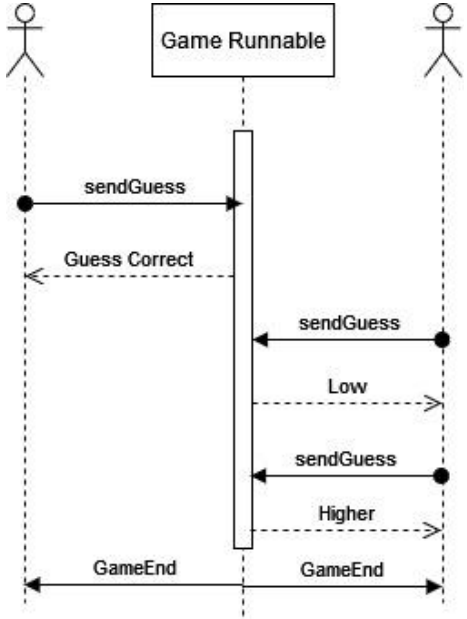

Server Modes and Configurations

The server supports two different matching modes: simple and ranked mode.

Simple Mode

- In this mode, a player is assigned to the first game in the heap (game with most players that stills hasn't started)
- Players in queue enter game **in order** of arrival

Rank mode

- Player is assigned to the first non-started game that is close enough in trophy range (has its rank tolerance met)
- Player in queue, has its tolerance relaxed over time to prevent **starvation**

Our game's configuration is all done on a single *config.properties* file (to the right).

```
address=127.0.0.1
port=8080
rmiReg=1099
mode=Simple
gamePoolSize=1
baseRankDelta=50
```

```
gameTimeoutTime=300000
maxNrGuesses=5
maxGuessValue=1000
nrMaxPlayersInGame=2
tokenLifeSpanSec=3000000
serverCacheInterval=30
```

Concurrency

All established requisites were met regarding concurrency access on the server side (as the client has no need for such measures).

We used *java.util.concurrent.locks* like shown below to manage all data structures and files on the server side:

```
ReadWriteLock lock = new ReentrantReadWriteLock(true);
```

Here are the most important uses of multiple threads in our project:

- The server has 5 fixed thread pools with a game each;
- Each new connected player is given by the server its own clientHandler;
- When playing, the gameServer cycles between all players to allow for a non-turn based experience;
- The client has a separate thread exclusively dedicated to detect if “exit” is typed by a user;
- Scheduler thread to periodically serialize the current server state to a cache file;
- Scheduler thread to relax trophy delta over time to prevent player starvation;

Fault tolerance

The solution developed was built to be resilient to faults both on server and client side.

Server side

- Serialized object on small intervals and brought back on restart if cache file is present

Client side

- Token with customizable expiration time used for authentication on connection to server

If the client fails, it sends its token on a new authentication and the server will check if the player had previous status to recover and informs the client to move to that state.

Conclusion

In conclusion, this project aimed to provide a robust client-server system for simple online gaming, allowing users to play with others.

By implementing key functionalities such as authentication, matchmaking, fault tolerance and optimized concurrency, we intended to deliver a simple and intuitive game experience while ensuring system efficiency and scalability.

End

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