

Autonomous Tennis

AI tennis game

Group 47

Diogo Cabral
93704

Rafael Candeias
93748

Vasco Piussa
93762

INTRODUCTION / ABSTRACT

For our project we propose a multi agent system that simulates a game of tennis to find the ideal characteristics a tennis player should have.

The agents will be the players involved in the match. The agents can see the opponent's position, ball's position and its velocity. All agents strive to win the game.

APPROACH

The tennis game will occur the same way as a regular game of tennis.

- A ball must land within bounds for play to continue; hitting the ball and landing outside of bounds results in the loss of the point.
- Players/teams cannot touch the net or posts or cross onto the opponent's side.
- Players/teams cannot carry the ball or catch it with the racquet.
- Players cannot hit the ball twice.
- Players must wait until the ball passes the net before they can return it.
- A player that does not return a live ball before it bounces twice loses the point.
- Any ball that bounces on the lines of boundary are valid.

- A serve must bounce first before the receiving player can return it.

Each agent has its own characteristics/stats that will determine how good of a player it is.

- **Speed:** Determines how fast a player can move through the field. This characteristic is affected by stamina.
- **Accuracy:** Represents the probability of the player to not make a mistake. All actions aren't precise, and accuracy tells how likely it will be as the agent wanted.
- **Force:** From the equation $F = m \times a$ (N), it is used to tell how much intensity the agent applies to the ball. The force has a direct impact on the speed of the ball. The higher the force, the faster it goes thus making it harder to respond, increasing the opponent's chance to error.
- **Stamina:** Determines how endure a player is. As a number, it tells how much energy a player still has left. All actions require some energy. All agents have their stamina restored between games.
- **Composure:** How pressure affects the player's focus. Players with smaller composure will have a higher error increase when losing, consecutive misses, running out of time and consecutive losses.

To implement our autonomous tennis game, we will start by building an environment on top of the source tennis game code. The environment used is from the Open AI Gym library, and the source code is from Github. Booth are referenced under the “References” sub heading. Some changes will be applied to the source code.

Following this, we will implement a main loop for each game with a nested loop for the points (episode).

EMPIRICAL EVALUATION

To test the project, we will create several agents with predefined characteristics. The agents will play against each other in a tournament, first by choosing their actions randomly, defining the baseline and then using model based training to improve their game.

Agents are evaluated after every match on their performance (point difference) and whether they were victorious or not. The agent’s points will be kept on a scoreboard and by the end of the evaluation the player that has more points is considered to have the best qualities.

There will be a final tournament with the best behaviors for each agent in hopes of finding the best tennis player.

By the end of the project, we expect to get the best characteristics a player needs to be the best tennis player.

REFERENCES

[1] Github pre-made tennis game interface
<https://github.com/roberto257/pygame-tennis>

[2] Open AI gym library <https://www.gymnasium.ml/>