

# MGAIA Assignment 2 - Let's play Bot Bowl with MCTS!

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## 1 Introduction

In this assignment, we want you to familiarize yourself with Monte Carlo Tree Search (MCTS)! Instead of generating Minecraft houses, you will create an MCTS agent to play Bot Bowl<sup>1</sup>. Bot Bowl is currently a challenge at the IEEE Conference on Games 2022<sup>2</sup>, adapting the game Blood Bowl by Games Workshop as an AI competition. It is a mixture of American Football and Warhammer. The game is non-deterministic and requires the player to execute a game plan while coordinating multiple figures to score a touchdown. As it is rather hard to explain, find a short introduction here:

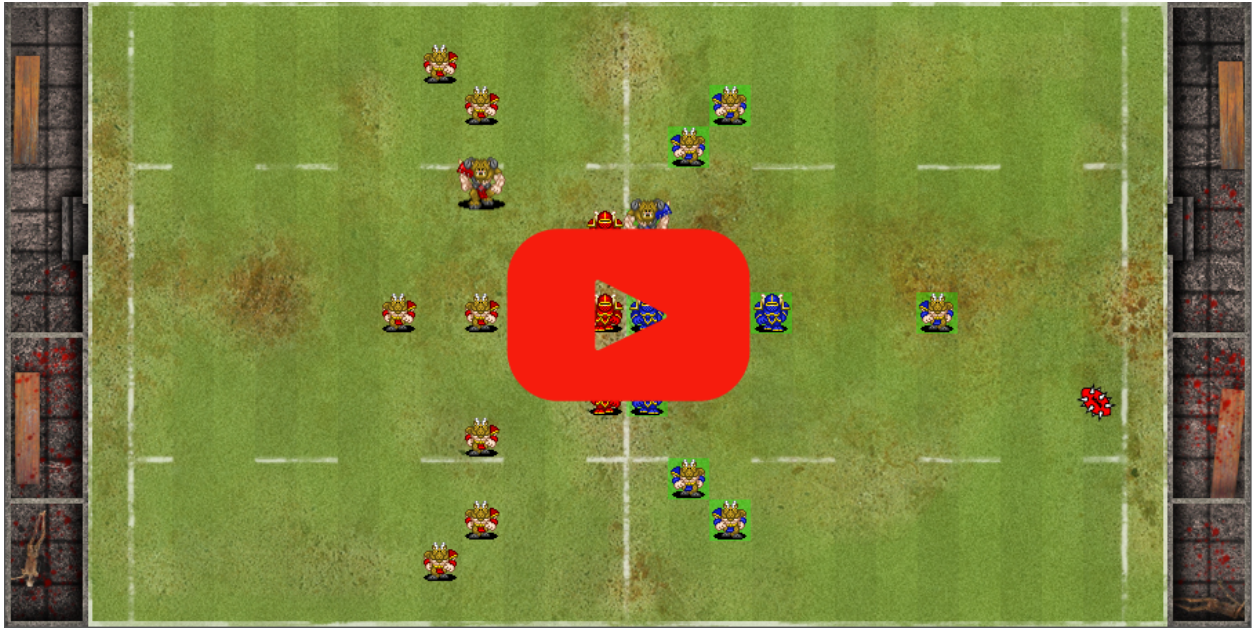


Figure 1: A game of Bot Bowl. Note, the image links to an introduction of the game.

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<sup>1</sup><https://github.com/njustesen/botbowl>

<sup>2</sup><https://ieee-cog.org/2022/#COMPETITIONS>

## 2 Setup

There is an official documentation on how to use Bot Bowl<sup>3</sup>. However, please use the following steps using your terminal:

Listing 1: Bot Bowl Installation Process

```
# create conda environment
conda create -n botbowl python=3.7
conda activate botbowl

# install Bot Bowl
pip install Cython
git clone https://github.com/njustesen/botbowl
cd botbowl
# Note: We need a specific Bot Bowl version
git reset --hard f432c7cec1893b64b7ac5fa25d1321184b4bb613
python setup.py build
pip install -e .

# Replace the botbowl/data/config/web.json with the web.json version
# for 5vs5 games from Brightspace

# run the webserver and play a human vs. human game :)
python examples/server_example.py
```

In the repository's /examples folder, you can find example agents and also a GUI webserver. Some further explanations:

- You need to install Cython for the pathfinding algorithm. Note that we might have to disable pathfinding if the performance is problematic
- There is a bug in the current master. Therefore we use the last working version
- We replaced the web.json with a modified version of the 5vs5 gym-5.json. Currently, the webserver autoloads the web.json, and we have not found any option to load a custom configuration. If you find an option, let us know :). You should be able to use gym-5.json for non-GUI testing.
- The scripted bot runs only on the 11 vs. 11 game mode. Just use the original web.json if you want to test the bot.

## 3 Your Task

Your task is to familiarize yourself with Bot Bowl, analyze the game, design and implement a solution that uses MCTS, and create a scientific report that describes your solution-finding process. In detail:

- Analyze Bot Bowl and design a solution to apply MCTS to the game
  - Don't forget to mention the assumptions or simplifications you have made in the report!
- Implement an MCTS agent
  - You are allowed to include heuristics into your algorithm. For example, if you have to choose a position on the map. Furthermore, it is okay to script some parts (starting formations, coin flips). It is also helpful to think about a good action and state-space representation in this context. But please remember that we want you to implement an MCTS agent and not a rule-based one!

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<sup>3</sup><https://github.com/njustesen/botbowl/blob/main/docs/tutorials.md>

- We don't expect you to "solve" the game. We want an agent that uses MCTS and can play the game "reasonably" well. Complete randomness, without any planning, is not reasonable!
- The agent should run on the 5vs5 configuration (compare the different configurations<sup>4</sup>). However, you can start testing your algorithm on the "simpler" 3vs3 configuration.
- Think about future directions on how to improve the agent. Please briefly describe an approach to improve your current implementation by reviewing the existing literature.

## 4 Submission

Make sure to document everything that you do in the report nicely. Your final submission consists of:

- Source code of your Python MCTS agent class being able to play Bot Bowl. We expect readable, commented, and object-oriented code!
- A scientific report in the form of a pdf that contains your thought process, figures, references, etc. The page amount we expect of you might vary depending on your layout. This report explains the solution in a detailed and understandable way.
- Part of the scientific report should be a declaration of the contributions of every team member. Please use CRediT<sup>5</sup> and provide for every team member a score between 1-10 in a table using:
  - Methodology
  - Software
  - Validation
  - Visualization
  - Writing - original draft
  - Writing - review & editing

If you have any questions about this assignment, please visit our lab sessions on Thursdays where we can help you out. In case you cannot make it, you can post questions about the contents of the course on the Brightspace discussion forums, where other students can also read and reply to your questions.

We want to play a short exhibition tournament in one of our labs (24.3.2022). Therefore, please send us a preliminary bot with short instructions until **22.3.2022**. The final deadline for this assignment is the **31.3.2022**.

Finally, if you enjoyed this task, it might be a fantastic idea to participate in this year's BotBowl IV challenge<sup>6</sup>. Submissions are open until the 15th of July 2022. As you can see below, this would, of course, not be part of your grade :).

## 5 Grading Criteria

Your grade for the assignment will be made up of:

- 30% Working MCTS Implementation
- 30% Quality of your solution concept
- 20% Understanding of MCTS and it's integration into your solution concept
- 10% Possible future algorithm refinements
- 10% Formalities

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<sup>4</sup><https://github.com/njustesen/botbowl/tree/main/botbowl/data/config>

<sup>5</sup><https://credit.niso.org/>

<sup>6</sup><https://njustesen.github.io/botbowl/bot-bowl-iv>