MGAIA Assignment 2: Multi Agent Pacman Capture the Flag

Leiden University

March 2023

1 Introduction

In this assignment, we want you to familiarize yourself with **M**onte **C**arlo **T**ree **S**earch (MCTS) and potentially explore different methodologies for implementing other agents. More specifically, the environment under investigation is the *Pacman Capture the Flag Contest*[1], where the aim is to develop agents for controlling both Pacman and the ghost in coordinated team-based strategies.

2 Game Overview

The concept of this game is pretty simple, where there are two teams competing against each other, red vs. blue (see Figure 1), where your team's goal is to eat as much food pellets as possible from the opposing side, whilst avoiding their ghost agent.

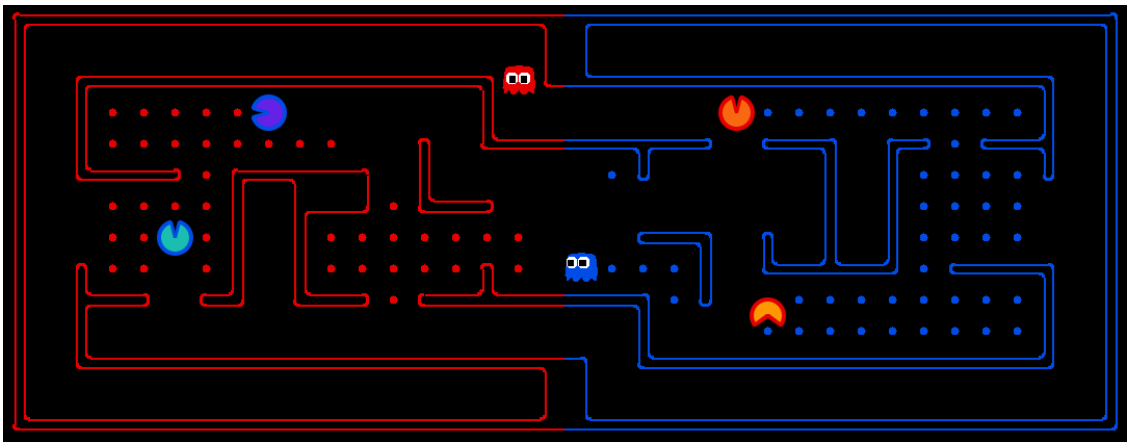

Figure 1: The game interface of pacman-ctf. Two teams placed in opposite sides, with the goal of eating the food on the far side of the map.

When Pacman eats food pellets, they are stored inside Pacman and removed from the board. When Pacman returns to its original side, the team gains one point per food pellet. In case the Pacman agent is eaten by a ghost of the opposing team, the stored food pellets are scattered around the position where Pacman exploded (came into contact with the ghost).

Power capsules display similar behaviour to the original game, where their consumption by Pacman leads to agents of the opposing team entering a "scared" mode for 40 moves, or until consumed by the powered up Pacman. When powered up Pacman comes into contact with the "scared" ghosts, they are eaten and respawn in their original position and normal state.

The game can end in two ways. Either one team returns all but two of the opponents' dots or alternatively it can be restricted by a set number of total moves. The default value set to 1200, i.e. 300 moves per agent. When the move limit is reached, the team who returned most food pellets wins.

[1] http://ai.berkeley.edu/contest.html

3 Setup

For the assignment you need to:

- Have an up-to-date Python 3 version
- Clone https://github.com/cshelton/pacman-ctf
- Read `pacman-ctf/origdoc/contest.html` for a comprehensive explanation about the game and the code. You can ignore the submission and contest instructions in that file.
- Lastly, you can start working on your own agents by using `myTeam.py` as a starting point.

4 Your Task

Your task is to familiarize yourself with *Pacman Capture the Flag*, 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 *Pacman Capture the Flag* and design a solution to apply MCTS to the game
  - Don't forget to mention your analysis, assumptions and simplifications about the environment in the report!
- Implement an MCTS agent
  - Empirically report on the effects of adjusting MCTS parameters.
  - Report on how you guide the search and evaluate states
  - Think about future directions on how to improve the MCTS agent. Please briefly describe an approach to improve your current implementation by reviewing the existing literature.
- Implement agents other than MCTS and document your analysis
- Make sure to properly compare the performance of your different agents / MCTS variations! Run a small local tournament to show
  - Think about what metric you could use to compare performance in the tournament. What value could be better than just reporting win-percentages, especially when looking at more than two agents at once?

5 Submission

5.1 Report

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

- Python source code for each of your agents, i.e. one file per agent.
- A self-contained scientific pdf report with figures, **references**, etc. The page count we expect of you might vary depending on your layout. This report contains an explanation of the techniques you applied.

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 in person, you can post questions about the contents of the course on the Discord discussion forum, where other students can also read and reply to your questions.

The deadline for this assignment is the **28.03.2024 at 23:59**.

5.2 Contest

We will also be holding a contest in one of the labs where one of your agents will compete against other teams. You can only submit **one** of your agents, so choose wisely. Submit your agent as `teamname.py`. You can come up with your own team name. This will be displayed on screen when we run the contest.

The deadline for submitting to the contest is **21.03.2024 at 23:59**.

6 Grading Criteria

Your grade for the assignment will be made up of the following items up to a 9.0. Your placement in the tournament will determine the rest up to a 10.0.

- 10% Working MCTS Implementation
- 10% Tournament evaluation
- 10% Working alternative Agents Implementation
- 30% Quality of your solution concept
- 40% Report