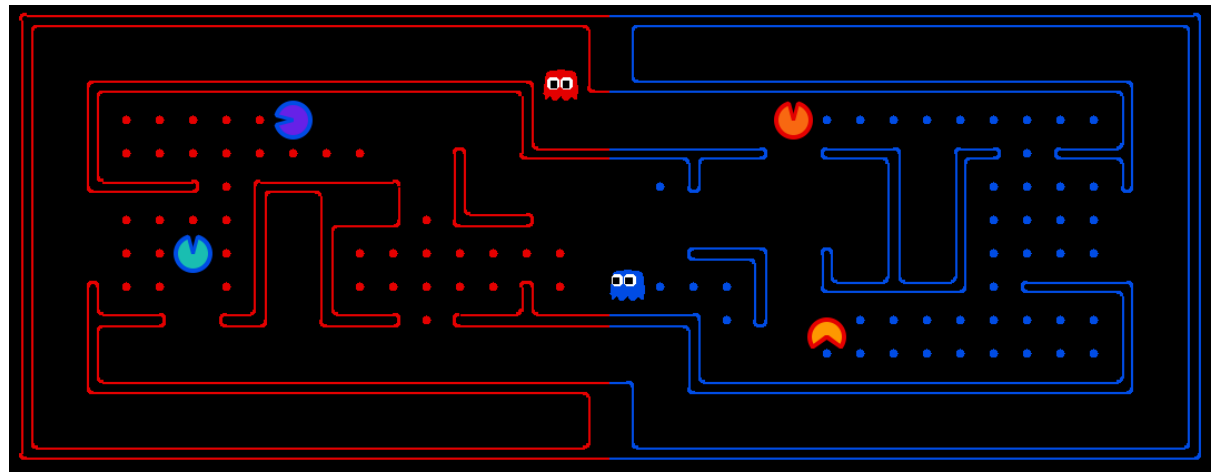# Mini-Contest 2: Multi-Agent Adversarial Pacman

Version 1.002. Last Updated: 02/10/2020.

Due: **Sunday 03/15** at **11:59 pm**

Enough of defense,
Onto enemy terrain.
Capture all their food!

Overview

This mini-contest involves a multi-player capture-the-flag variant of Pacman, where agents control both Pacman and ghosts in coordinated team-based strategies. Your team will try to eat the food on the far side of the map, while defending the food on your home side. The contest code is available as a zip archive (minicontest2.zip).

You may choose to work alone or with one partner. There is room to bring your own unique ideas, and there is no single set solution. Much looking forward to seeing what you come up with!

Extra Credit

Extra credit points are earned on top of the 25 points available in P2. E.g. if you earn 1 point of EC through the mini-contest and had a 25/25 on P2, then you'll have 26/25 on P2.

Your agent will be tested on Gradescope against the baseline and a few staff agents on several selected maps in `layouts/`.

- 0.5 points for over 51% winning rate against the provided baseline agent in `baselineTeam.py`.
- 0.5 points for over 51% winning rate against "Staff Agent 1".
- 0.5 points for over 51% winning rate against "Staff Agent 2".
- 0.5 points for over 51% winning rate against "Staff Agent 3".

Students that perform well in the **final** leaderboard, **ranked by "final score" metric**, will receive the following:

- 1st place: 2 points
- 2nd and 3rd place: 1.5 points
- 4th to 10th place: 1 point

Introduction

The primary change between the first and second mini-contests is that mini-contest 2 is an *adversarial game*, involving two teams competing against each other. Your team will try to eat the food on the far side of the map, while defending the food on your home side.

Your agents are in the form of ghosts on your home side and Pacmen on your opponent's side. Also, you are now able to **eat your opponent when you are a ghost**. If a Pacman is eaten by a ghost before reaching his own side of the board, he will explode into a cloud of food dots that will be deposited back onto the board.

Note that the mini-contest framework, provided in minicontest2.zip, has changed slightly from Mini-Contest 1. The functions and interfaces are nearly the same, but maps now include power capsules and you can eat your opponents.

Files you'll edit:

`myTeam.py`	What will be submitted to Gradescope. Contains all of the code needed for your agent.
Files you might want to look at:	
`baselineTeam.py`	Example code that defines two very basic reflex agents, to help you get started.
`capture.py`	The main file that runs games locally. This file also describes the new capture the flag GameState type and rules.
`captureAgents.py`	Specification and helper methods for capture agents.
Supporting files you can ignore (do not modify):	
`captureGraphicsDisplay.py`	Graphics specific to capture-the-flag variant of Pacman.
`distanceCalculator.py`	Computes shortest paths between all maze positions.
`game.py`	The logic behind how the Pacman world works. This file describes several supporting types like AgentState, Agent, Direction, and Grid.
`graphicsDisplay.py`	Graphics for Pacman.
`graphicsUtils.py`	Support for Pacman graphics.
`keyboardAgents.py`	Keyboard interfaces to control Pacman.
`layout.py`	Code for reading layout files and storing their contents.
`mazeGenerator.py`	Code for generating Pacman maze layouts.
`textDisplay.py`	ASCII graphics for Pacman.
`util.py`	Useful data structures for implementing search algorithms.

Files to Edit and Submit: You will fill and submit `myTeam.py`. Please *do not* change the other files in this distribution or submit any of our original files other than this file.

External libraries: In this contest, you are allowed to use `numpy` as a dependency.

Academic Dishonesty: We will be checking your code against other submissions in the class for logical redundancy. If you copy someone else's code and submit it with minor changes, we will know. These cheat detectors are quite hard to fool, so please don't try. We trust you all to submit your own work only; *please* don't let us down. If you do, we will pursue the strongest consequences available to us.

Getting Help: You are not alone! If you find yourself stuck on something, contact the course staff for help. Office hours, section, and the discussion forum are there for your support; please use them. If you can't make our office hours, let us know and we will schedule more. We want these contests to be rewarding and instructional, not frustrating and demoralizing. But, we don't know when or how to help unless you ask.

Discussion: Please be careful not to post spoilers.

Rules

Layout

The Pacman map is now divided into two halves: blue (right) and red (left). Red agents (which all have even indices) must defend the red food while trying to eat the blue food. When on the red side, a red agent is a ghost. When crossing into enemy territory, the agent becomes a Pacman.

There are a variety of layouts in the `layouts` directory.

Scoring

As a Pacman eats food dots, those food dots are stored up inside of that Pacman and removed from the board. When a Pacman returns to his side of the board, he "deposits" the food dots he is carrying, earning one point per food pellet delivered. Red team scores are positive, while Blue team scores are negative.

If Pacman gets eaten by a ghost before reaching his own side of the board, he will explode into a cloud of food dots that will be deposited back onto the board.

Power Capsules

If Pacman eats a power capsule, agents on the opposing team become "scared" for the next 40 moves, or until they are eaten and respawn, whichever comes sooner. Agents that are "scared" are susceptible while in the form of ghosts (i.e. while on their own team's side) to being eaten by Pacman. Specifically, if Pacman collides with a "scared" ghost, Pacman is unaffected and the ghost respawns at its starting position (no longer in the "scared" state).

Observations

Each agent can see the **entire state** of the game, such as food pellet locations, all Pacman locations, all ghost locations, etc. See the GameState section for more details.

Winning

In this adversarial game, a team wins when they return all but two of the opponents' dots. Games are also limited to 1200 agent moves (moves can be unequally shared depending on different speeds - faster agents get more moves). If this move limit is reached, whichever team has returned the most food wins.

If the score is zero (i.e., tied), the game is recorded as a tie.

Computation Time

Each agent has 1 second to return each action. Each move which does not return within one second will incur a warning. After three warnings, or any single move taking more than 3 seconds, the game is forfeited. There will be an initial start-up allowance of 15 seconds (use the `registerInitialState` function).

Designing Agents

An agent now has the more complex job of trading off offense versus defense and effectively functioning as both a ghost and a Pacman in a team setting. The added time limit of computation introduces new challenges.

Baseline Team

To kickstart your agent design, we have provided you with a team of two baseline agents, defined in `baselineTeam.py`. They are quite bad. The `OffensiveReflexAgent` simply moves toward the closest food on the opposing side. The `DefensiveReflexAgent` wanders around on its own side and tries to chase down invaders it happens to see.

File Format

You should include your agents in a file of the same format as `myTeam.py`. Your agents must be completely contained in this one file.

Interface

The `GameState` in `capture.py` should look familiar, but contains new methods like `getRedFood`, which gets a grid of food on the red side (note that the grid is the size of the board, but is only true for cells on the red side with food). Also, note that you can list a team's indices with `getRedTeamIndices`, or test membership with `isOnRedTeam`.

Distance Calculation

To facilitate agent development, we provide code in `distanceCalculator.py` to supply shortest path maze distances.

CaptureAgent Methods

To get started designing your own agent, we recommend subclassing the `CaptureAgent` class. This provides access to several convenience methods. Some useful methods are:

`getFood(self, gameState)`

Returns the food you're meant to eat. This is in the form of a matrix where `m[x][y]=True` if there is food you can eat (based on your team) in that square.

`getFoodYouAreDefending(self, gameState)`

Returns the food you're meant to protect (i.e., that your opponent is supposed to eat). This is in the form of a matrix where `m[x][y]=True` if there is food at `(x,y)` that your opponent can eat.

`getOpponents(self, gameState)`

Returns agent indices of your opponents. This is the list of the numbers of the agents (e.g., red might be `[1,3]`).

`getTeam(self, gameState)`

Returns agent indices of your team. This is the list of the numbers of the agents (e.g., blue might be `[1,3]`).

`getScore(self, gameState)`

Returns how much you are beating the other team by in the form of a number that is the difference between your score and the opponents score. This number is negative if you're losing.

`getMazeDistance(self, pos1, pos2)`

Returns the distance between two points; These are calculated using the provided distancer object. If `distancer.getMazeDistances()` has been called, then maze distances are available. Otherwise, this just returns Manhattan distance.

`getPreviousObservation(self)`

Returns the `GameState` object corresponding to the last state this agent saw (the observed state of the game last time this agent moved).

`getCurrentObservation(self)`

Returns the `GameState` object corresponding this agent's current observation (the observed state of the game).

`debugDraw(self, cells, color, clear=False)`

Draws a colored box on each of the cells you specify. If `clear` is `True`, this function will clear all old drawings before drawing on the specified cells. This is useful for debugging the locations that your code works with. `color` is a list of RGB values between 0 and 1 (i.e. `[1,0,0]` for red), `cells` is a list of game positions to draw on (i.e. `[(20,5), (3,22)]`)

Restrictions

You are free to design any agent you want. However, you will need to respect the provided APIs if you want to participate in the contest. Agents which compute during the opponent's turn will be disqualified. In particular, any form of multi-threading is disallowed, because we have found it very hard to ensure that no computation takes place on the opponent's turn.

Please respect the APIs and keep all of your implementation within `myTeam.py`.

Getting Started

By default, you can run a game with the simple `baselineTeam` that the staff has provided:

```
python capture.py
```
Copy

A wealth of options are available to you:

```
python capture.py --help
```
Copy

There are four slots for agents, where agents 0 and 2 are always on the red team, and 1 and 3 are on the blue team. Agents are created by agent factories (one for Red, one for Blue). See the section on designing agents for a description of the agents invoked above. The only team that we provide is the `baselineTeam`. It is chosen by default as both the red and blue team, but command line options allow you to choose teams:

```
python capture.py -r baselineTeam -b baselineTeam
```
Copy

In this case, we specify that the red team `-r` and the blue team `-b` are both created from `baselineTeam.py`. To control one of the four agents with the keyboard, pass the appropriate option:

```
python capture.py --keys0
```
Copy

The arrow keys control your character, which will change from ghost to Pacman when crossing the center line.

Layouts

By default, all games are run on the `defaultcapture` layout. To test your agent on other layouts, use the `-l` option. In particular, you can generate random layouts by specifying `RANDOM[seed]`. For example, `-l RANDOM13` will use a map randomly generated with seed 13.

Recordings

You can record local games using the `--record` option, which will write the game history to a file named by the time the game was played. You can replay these histories using the `--replay` option and specifying the file to replay.

Submission

Please submit your `myTeam.py` file in the **Mini-Contest 2** assignment on **Gradescope**.

You may choose to work alone or with one partner. If you do choose to work with a partner, whoever submits has to appropriately tag their partner at submission time.

CS 188

Weekly Schedule

Office Hours

Staff

Policies

Assignments

Exams

Grading