Pacman Variation:

1. 5x 15 board
2. Start tile (0,0), end tile (15,5)
3. Discrete board, at each turn can only move left, right, up or down or hold depending on whether the path is blocked
4. Impose a time limit? Of maybe 100 units of time?
5. Ghosts travel at the same speed
6. At every point Ghosts take a greedy algorithm on pacman

Ghost Movement Policies:

* Random ghost agent
* Directional/Greedy agent
* Ghosts cannot stop, and cannot turn around unless they reach a dead end, but can turn 90 degrees at intersections.
* Concept of a target tile. a ghost is considered to have caught Pac-Man when it occupies the same tile as him
  + It should be noted that since the sprites for Pac-Man and the ghosts are larger than one tile in size, they are never completely contained in a single tile. Due to this, for the game's purposes, the character is considered to occupy whichever tile contains its *center point*. This is important knowledge when avoiding ghosts, since Pac-Man will only be caught if a ghost manages to move its center point into the same tile as Pac-Man's.
  + the only consideration is which tile will immediately place the ghost closer to its target, this can result in the ghosts selecting the "wrong" turn when the initial choice places them closer, but the overall path is longer. An example is shown to the right, where straight-line measurement makes exiting left appear to be a better choice. However, this will result in an overall path length of 26 tiles to reach the target, when exiting right would have had a path only 8 tiles long.

Pacman Policies:

* Minimax with multiple min layers for multiple ghosts
* Alpha beta pruning generalization
* Minimax and alphabeta both assume enemy rationality, which is not always true. Implement expectimax
* Write a good evaluation function/heuristic that evaluates the value of a specific state
* Consider using Q-learning with feature approximation

First Big Question: How do we design the value of a state? What is our Reward?

Possible Approaches:

1. FeatureBasedGameState
   1. Distance to nearest Ghost
   2. Distance to nearest pill
   3. Is ghost in direction of movement
   4. Grid of the food available
2. Monte Carlo with Heuristic

What kind of game is it?:

1. 2-player (we assume only 1 ghost), turn taking, zero-sum game with perfect information,
2. Caveats: LOTs of transpositions

Sources:

<https://github.com/Murf-y/pacman-minimax>

<https://github.com/chiragvartak/monte-carlo-pacman>

<https://github.com/RylinnM/MCTS-in-Pacman-Capture-The-Flag-environment>