

# Game AI

## Algorithm:

Using the most basic minimax algorithm to implement the game agent, I use “whether the remaining map have a way to win” to define the utility function. 1 indicates that if the current player has a route to win if he has a way to win no matter how the opponent plays, while 0 indicates that no matter how the current player chooses the path, the next player always has a way to win if he makes the best play in every successive moves. We use divide and conquer to find the node value from its child, if at least one of its children is 0, then the parent node is 1; if all of its children are 1, then the parent node is 0. To draw the game tree, I find every possible move by searching in loops in every node.

## Optimization:

### 1. Depth limit:

If we draw every possible move in every node, it is very time-consuming and therefore cause “no response”, so I

limit the maximum depth to be traversed according to the size of the remaining map. For example, if the map has less than 10 grids, I will traverse to the leaf node (which will be defined later), if the map has more than 10 grids but less than 15 grids, I will traverse to the maximum depth of 2, otherwise, I will select the route in a random way. However, what if we reach the maximum depth and don't reach the leaf? Then the child node will return 0.5 to indicate its uncertainty.

## 2. Dynamic Programming:

Save the map and the corresponding move that is able to win in the dict() structure, the next time we find the same map, we will simply call the "answer" to speed up the algorithm.

## 3. Control the size of dict()

As we train the agent to learn how to play the end game, every time when the AI is trying to search whether the map has been processed, it takes a few

time to look for the dict() object, especially when there are many remaining nodes, it will usually timeout.

Finally, after trials and experiments, I decide to save only the map with 15 or fewer remaining nodes, takes both searching time and depth into consideration.

To execute the program, please put the .exe file along with the “record.pkl” in the same folder.