Artificial Intelligence I

Graduate Student Project Progress Report

Title: 2048 AI

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Problem to Be Solved:

Design AI for "2048" game, created by Gabriele Cirulli. "2048" is a single-player puzzle game playing on a 4×4 grid. Initially two numbered tiles randomly spawn on the empty ground. The number for the randomly spawned tile has a 90% probability of 2 and a 10% probability of 4. Using arrow keys, you slide all the tiles on a direction, and after each move a new numbered tile will spawn randomly. Sliding two tiles of the same number into each other gives you a merged tile with number of the next power of 2. The objective is to slide numbered tiles on the grid to combine them and create a tile with the number 2048, or even larger.[1]

Our AI design aims to reach as high score as possible. The highest possible number to reach in theory is 2^{17}=131072. The best AI implementation found in repository has reached 2^{15}=32768 with 36% probability.[2] Our AI should reach at least 2048, and be optimized to reach 2^{16}=65536 if time permits.

Proposed Approach:

The main approach to date is to implement minimax algorithm with alpha-beta pruning by considering the player as a max node and the computer randomly spawning tiles as a min node. This will only assume the computer spawn tile in the worst place with the worst number in the minimax search and may not generate the optimal move. We also consider to implement expecti-minimax algorithm which will model the computer spawning tiles as a chance node, and no min node is modeled in this case. This will consider the game as a stochastic problem, but the drawback is possibly no search branches can be pruned hence it may take much longer to search.

Another challenge is the heuristic design. The number of empty squares, the monotonicity of rows and columns, larger number closer to a corner, etc. should be all combined to form the heuristic. The implementation of constraint satisfaction problem is also considered in the project.

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[1] Wells, V. S. (March 18, 2014). "Game Review: 2048". Nouse.

[2] Nneonneo, (March 19, 2014). Stackoverflow. http://stackoverflow.com/questions/22342854/.