2048 PUZZLE MINI GAME DESIGN
——2018 Fall AI Introduction

Group22: B05902022張雅信 B05902050黃子源 T07902126 馬慧
Course: 2018 Fall AI Introduction Tutor: 許永真

Introduction

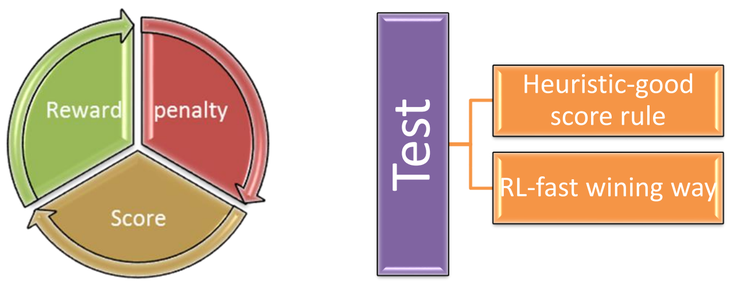
"2048Numberpuzzlegame" is a digital puzzle game. Each time you can select one of the up, down, left and right directions to slide. When you slide, all the digital squares will move closer to the sliding direction. The system will also display a number box in the blank space.
The same number of squares are close together and collide. It will add up. The number box given by the system is not 2 or 4, and the player has to find a way to make the number box of "2048" in this small 16 grid range.

Methods and Materials

● *Heuristic Design*

➢ *Score*

Assign weights to each grid and the weights for the edges and corners will be larger.



➢ *Penalty*

1. Smoothness: For the gap between the grids, it is hoped that the smaller the better.
2. Number of spaces: The more space leaves, the less likely it is that the digital cards will be lost together
3. Monotonicity: We would like that the same horizontal or inline number is monotonically increasing or decreasing.
4. Future: If you can create a large number of neighbors, the situation will be greater.

● *ExpectimaxRL*

The best solution for this game to get most score. RL uses the CNN model, we choose to learn the behavior of 3-layer expectimax first.

● *Greedy*

There are greedy-2 and greedy-3 experiment. When we reach a grid, we would like to know the highest scoring step for next move. So let's try every situation and get the solution. More greedy means more calculating about next and next step trying.

● *Base Rule*

We make a base rule for this game. For example, we move as the rule"left-right-down-up" to win this game.

● *Random*

Choose the moving direction randomly to finish this game.

Results

● *Heuristic*

We ran a hundred times for each result, made the histogram of the score and the number of steps. Show weight, smooth, space and adjacent changing.

Figure1: heuristic-game score

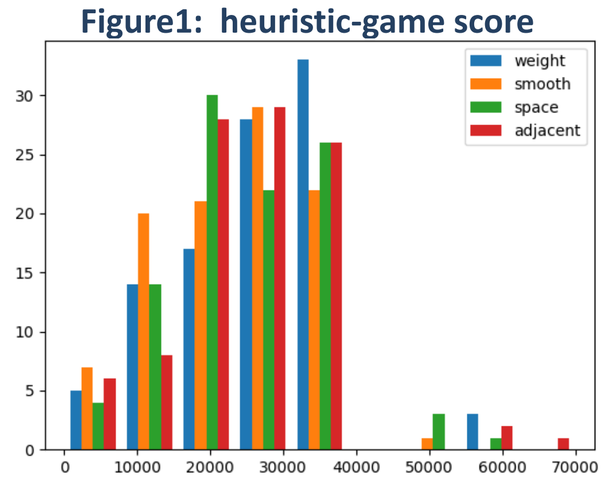


Figure2: heuristic-game step

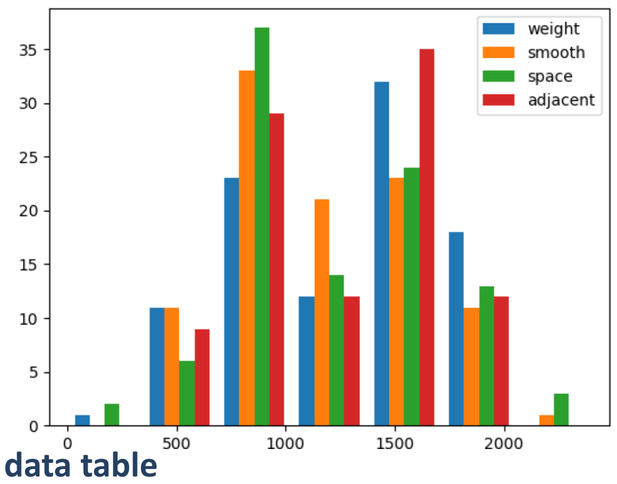


Figure 3: heuristic data table

methods	4096	2048	1024	512	256-	score	step
weight	0.300	6.100	2.600	0.700	9.300	25505.48	1321.93
smooth	0.100	5.300	3.600	0.800	9.200	22543.96	1188.06
space	0.400	4.700	4.200	0.400	9.600	24009.92	1254.70
adjacent	0.300	5.600	3.400	0.600	9.400	24907.08	1295.35

● *Reinforce Learning*

We use different RL methods to run this game and get the response score, winning rate and step for every method .

Figure4: RL- game score

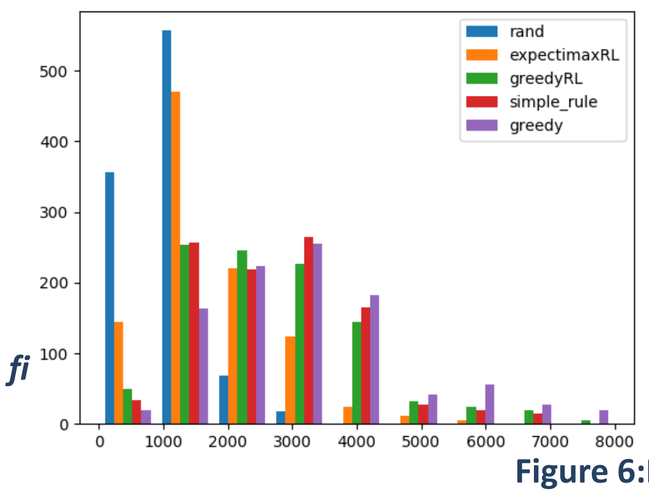


Figure5: RL-game step

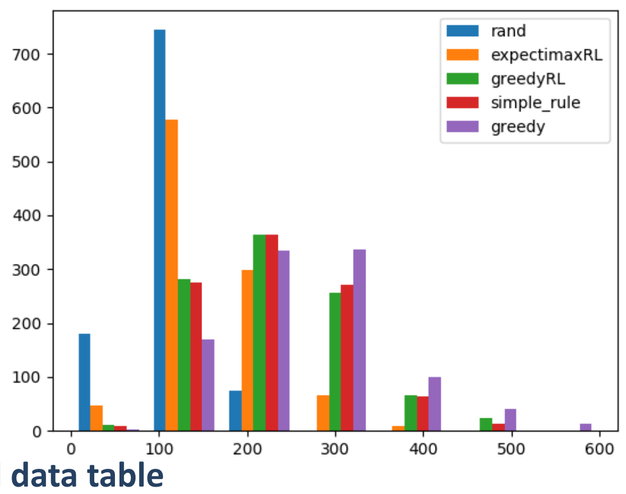


Figure 6:RL method data table

methods	2048	1024	512	256-	score	step
rand	0.000	0.000	0.000	100.000	1148.13	118.95
expectimaxRL	0.000	0.000	1.700	98.300	1797.08	164.93
greedyRL	0.000	0.000	6.400	93.600	2664.10	226.16
simple_rule	0.000	0.000	4.400	95.600	2673.26	227.68
greedy	0.000	0.400	12.300	87.700	3208.18	260.23

Conclusions

- ◆Good heuristic setting makes the game get higher score. So when we obey the list rule and even more heuristic condition, we would winner faster.
- ◆By different RL methods, we can see the expectimaxRL is the best one to win game, others are closing with it.Following the greedy method depth, good prediction for the future step will help us win the game faster.

Future Work

- ➢ Find a best way to win this game by getting higher score.
- ➢ Do some Q-learing experiments to achieve better score and step results.
- ➢ Complete heuristic methods to test the scores and steps.

Reference

1. https://github.com/vpn1997/2048-Ai
2. https://play2048.co/
3. https://www.zhihu.com/question/54217135
4. https://blog.csdn.net/liuweiran900217/article/details/25088755
5. https://ask.helplib.com/algorithm/post_6445
6. http://blog.codinglabs.org/articles/2048-ai-analysis.html