Difei Lu NetID: ldfghh

Jiawei Zhang NetID: jz34

CSE 415 Assignment4 Report

We chose option C.2+. The 2 common puzzles we picked are sudoku and Pentominos. They are sudoku.py and Pentominoes.py respectively.

Report for sudoku:

Puzzle 1:

```
7 1 2|6 8  |4   5
6   3|5 7 4|  1 8
  4 5|2   1|3 7
-------------------
  6 9|8 1 7|  2 3
5 2 7|4   6|1   9
3   1|  2  |6   7
-------------------
9   4|7 6 2|8   1
1 7  |3   8|  5 2
  3  |1   9|7   4
```

	Solved?	Path length	Total states
Heuristic 1	Yes	24	25
Heuristic 2	Yes	24	25
No heuristic	Yes	24	25

Puzzle 2:

```
7    2|6 8   |4    5
6    3|5 7 4|     8
  4 5|2    1|3 7
-----------------------
  6 9|8 1 7|   2
5 2 7|4    6|1    9
3    1|  2   |6    7
-----------------------
9    4|7    2|8    1
1 7  |3    8|  5 2
  3  |     9|7    4
```

Puzzle 2 is harder than puzzle one. The first heuristic is still able to solve it with path length of 29 and total state of 30. But heuristic 2 and uniform cost search are taking much longer, or I would say un able to solve it.

From the result above. I believe that the first heuristic is the best among these three.

Report for Pentomimes:

The 6 x 10 Pentomimes puzzles are too time-consuming if I start with a blank puzzle. To save time, I give a initial states with some polygons filled to start the puzzle. In puzzle 1, 8 polygons were placed. In puzzle 2, 7 polygons were placed.

Puzzle 1:

```
Initial State:
I P P Y Y Y Y V V V
I P P X Y L L L L V
I P X X X 0 Z Z L V
I 0 0 X 0 0 0 Z U U
I 0 0 0 0 0 0 Z Z U
0 0 0 0 0 0 0 0 U U
```

with available polygons F T W N

Solution:

```
I P P Y Y Y Y V V V
I P P X Y L L L L V
I P X X X F Z Z L V
I T W X F F F Z U U
I T W W N N F Z Z U
T T T W W N N N U U
```

	Algorithm	Path length	Total states
Heuristic 1	A*	4	114
Heuristic 2	A*	4	818
No heuristic (h=0)	A*	4	837
	BFS	4	837

Puzzle 2:

```
Initial State:
I P P Y Y Y Y V V V
I P P X Y L L L L V
I P X X X F 0 0 L V
I 0 0 X F F F 0 0 0
I 0 0 0 0 0 F 0 0 0
0 0 0 0 0 0 0 0 0 0
```

with available polygons T W N U Z

Solution:

```
I P P Y Y Y Y V V V
I P P X Y L L L L V
I P X X X F Z Z L V
I T W X F F F Z U U
I T W W N N F Z Z U
T T T W W N N N U U
```

	Algorithm	Path length	Total states
Heuristic 1	A*	5	521
Heuristic 2	A*	5	2234
No heuristic (h=0)	A*	5	2234
	BFS	5	2234

From the results shown above, the heuristic 1 works better which is hamming heuristic function, and heuristic 2 seems useless in puzzle 2.

Retrospective

Difei: During this assignment, I mainly focused on the sudoku problem and I finished all of it. From This assignment, I start to understand the importance of heuristics. It is the key to solve any problem. We should fully understand the problem so we can come up with efficient heuristic.

Jiawei: During this assignment, I mainly focused on the Pentominoes problem and I finished all of it. From this assignment, I learnt how to use 2D array in Python and I have a better understanding on heuristics function that the heuristic values will give a better performance if the value is close to the actual h. We debugged each other's codes together. I benefitted from this collaboration a lot.