Report of fifteen puzzle

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I did four algorithm of to solve the fifteen puzzle, the first one is BFS which you gave it to me, the second one is A* search with displace numbers, the third one is A* search with Manhattan Distance, the forth one is DFS.

In the A* search with displace numbers, we use the number of displace numbers as heuristic function, use the level of the tree I expanded the head node. And the fn=gn+hn.

In the A* search with Manhattan Distance, we use the Manhattan distance as heuristic function, and the gn and fn are the same as A* search with displace numbers.

When I calculate the heuristic function, I only calculate 1-15 except 0, and the result is better than the result calculated with 0.

Figure 1 is the main table.

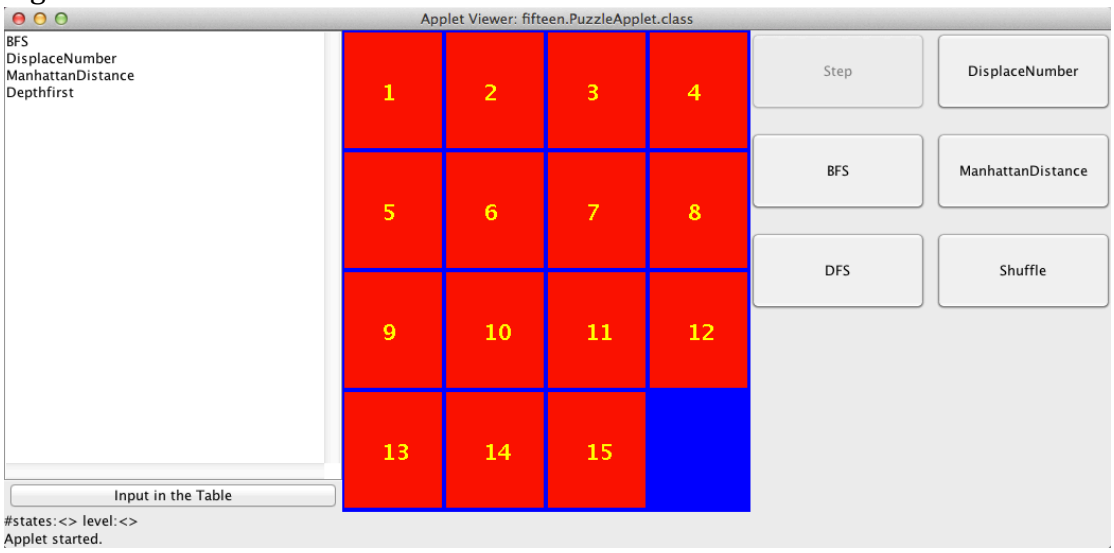

Figure 1

The following table shows number of states for the plain A* implementation v.s. the improved implementation and the depth searched.

Table 1 states table

Shuffle times	BFS	Displace	Manhattan	DFS
1(10steps)	7544	18	11	5039
2(20steps)	43040	19	13	893
3(30steps)	Failed	39	17	Failed
4(40steps)	Failed	174	33	Failed
5(50steps)	Failed	1950	37	Failed
6(60steps)	Failed	Failed	199	Failed

7(70steps)	Failed	Failed	2864	Failed
8(80steps)	Failed	Failed	53147	Failed
9(90steps)	Failed	Failed	2410	Failed
10(100steps)	Failed	Failed	82	Failed
11(110steps)	Failed	Failed	67	Failed
12(120steps)	Failed	Failed	2156	Failed
13(130steps)	Failed	Failed	2055	Failed
14(140steps)	Failed	Failed	4768	Failed
15(150steps)	Failed	Failed	17515	Failed
16(160steps)	Failed	Failed	21947	Failed
17(170steps)	Failed	Failed	10301	Failed

Table 2 level table

Shuffle times	BFS	Displace	Manhattan	DFS
1(10steps)	8	8	8	8
2(20steps)	10	10	10	12
3(30steps)	Failed	14	14	Failed
4(40steps)	Failed	18	18	Failed
5(50steps)	Failed	22	22	Failed
6(60steps)	Failed	Failed	30	Failed
7(70steps)	Failed	Failed	36	Failed
8(80steps)	Failed	Failed	40	Failed
9(90steps)	Failed	Failed	36	Failed
10(100steps)	Failed	Failed	30	Failed
11(110steps)	Failed	Failed	28	Failed
12(120steps)	Failed	Failed	34	Failed
13(130steps)	Failed	Failed	34	Failed
14(140steps)	Failed	Failed	36	Failed
15(150steps)	Failed	Failed	40	Failed
16(160steps)	Failed	Failed	40	Failed
17(170steps)	Failed	Failed	38	Failed

When I tested the program, I found that whatever times I shuffled, the A* search with Manhattan Distance can find a solution, and their level are less than 40, but I can't make sure whether it is a conclusion because the I didn't do to much test.