Results for LAB 1 assignment

1. Results for Part 2

The results can be reproduced by

python3 8puz.py --Part2

Data used is: ../Data/Part2/S1.txt

Method used is: BFS

Total nodes generated: 218518

Total time taken: 10.65 sec

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

Data used is: ../Data/Part2/S1.txt

Method used is: IDS

Total nodes generated: 717450

Total time taken: 21.02 sec

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

Data used is: ../Data/Part2/S1.txt

Method used is: h1

Total nodes generated: 22358

Total time taken: 36.21 sec

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

Data used is: ../Data/Part2/S1.txt

Method used is: h2

Total nodes generated: 1193

Total time taken: 71.56 ms

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

Data used is: ../Data/Part2/S1.txt

Method used is: h3

Total nodes generated: 13217

Total time taken: 8.86 sec

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

Data used is: ../Data/Part2/S2.txt

Method used is: BFS

Total nodes generated: 50984

Total time taken: 2.06 sec

Path length: 20

Path: DDLLURULDRRDLLURRULL

Data used is: ../Data/Part2/S2.txt

Method used is: IDS

Total nodes generated: 164776

Total time taken: 4.45 sec

Path length: 20

Path: DDLLURULDRRDLLURRULL

Data used is: ../Data/Part2/S2.txt

Method used is: h1

Total nodes generated: 3069

Total time taken: 0.34 sec

Path length: 20

Path: DDLLURULDRRDLLURRULL

Data used is: ../Data/Part2/S2.txt

Method used is: h2

Total nodes generated: 86

Total time taken: 2.5 ms

Path length: 20

Path: DDLLURULDRRDLLURRULL

Data used is: ../Data/Part2/S2.txt

Method used is: h3

Total nodes generated: 1682

Total time taken: 0.14 sec

Path length: 20

Path: DDLLURULDRRDLLURRULL

Data used is: ../Data/Part2/S3.txt

Method used is: BFS

The inputted puzzle is not solvable:

7 5 2

6 3 1

4 8 _

Data used is: ../Data/Part2/S3.txt

Method used is: IDS

The inputted puzzle is not solvable:

7 5 2

6 3 1

4 8 _

Data used is: ../Data/Part2/S3.txt

Method used is: h1

The inputted puzzle is not solvable:

7 5 2

6 3 1

4 8 _

Data used is: ../Data/Part2/S3.txt

Method used is: h2

The inputted puzzle is not solvable:

7 5 2

6 3 1

4 8 _

Data used is: ../Data/Part2/S3.txt

Method used is: h3

The inputted puzzle is not solvable:

7 5 2

6 3 1

4 8 _

Data used is: ../Data/Part2/S4.txt

Method used is: BFS

Total nodes generated: 516076

Total time taken: 24.13 sec

Path length: 31

Path: RDLULDRDLURRULLDRDRUULDDRUULDLU

Data used is: ../Data/Part2/S4.txt

Method used is: IDS

Total nodes generated: 4764948

Total time taken: 161.38 sec

Path length: 31

Path: DDLURRULLDRRDLLURURDDLUURDDLLUU

Data used is: ../Data/Part2/S4.txt

Method used is: h1

Total nodes generated: 87942

Total time taken: 721.65 sec

Path length: 31

Path: RDLULDRDLURRULLDRDRUULDDRUULDLU

Data used is: ../Data/Part2/S4.txt

Method used is: h2

Total nodes generated: 11420

Total time taken: 5.09 sec

Path length: 31

Path: DDLURRULLDRRDLLURURDDLUURDDLLUU

Data used is: ../Data/Part2/S4.txt

Method used is: h3

Total nodes generated: 24323

Total time taken: 105.09 sec

Path length: 31

Path: RDLULDRDLURRULLDRDRUULDDRUULDLU

Data used is: ../Data/Part2/S5.txt

Method used is: BFS

Total nodes generated: 45

Total time taken: 2.5 ms

Path length: 6

Path: RDLUUL

Data used is: ../Data/Part2/S5.txt

Method used is: IDS

Total nodes generated: 249

Total time taken: 9.01 ms

Path length: 6

Path: RDLUUL

Data used is: ../Data/Part2/S5.txt

Method used is: h1

Total nodes generated: 19

Total time taken: 0.5 ms

Path length: 6

Path: RDLUUL

Data used is: ../Data/Part2/S5.txt

Method used is: h2

Total nodes generated: 14

Total time taken: 0.5 ms

Path length: 6

Path: RDLUUL

Data used is: **../Data/Part2/S5.txt**

Method used is: **h3**

Total nodes generated: 16

Total time taken: 0.5 ms

Path length: 6

Path: RDLUUL

2. Result for Part 3

Depth	BFS		IDS		A*: h1		A*: h2		A*: h3	
	Avg run time	Avg #nodes Explr'	Avg run time	Avg #nodes Explr'	Avg run time	Avg #nodes Explr'	Avg run time	Avg #nodes Explr'	Avg run time	Avg #nodes Explr'
8	4.157 ms	118.95	12.385 ms	542.05	0.751 ms	27.45	0.501 ms	17.15	1.375 ms	25.15
15	0.179 s	4978.3	0.508 s	20693.1	20.567 ms	542.0	4.178 ms	124.2	18.740 ms	417.35
24	8.803 s	196479.05	25.065 s	858363.95	39.662 s	25597.5	96.507 ms	1502.95	18.562 s	17077.05

The results can be reproduced by

python3 8puz.py –Part3

The h3 heuristic function is the Gaschnig's heuristic, which is the improved version of the h1, which allows cubes only to be swapped by the empty space.

Conclusion:

From the table results, we can see that compared with the BFS method, IDS method will use explore much more nodes, which is not necessary for computation, in order to improve the space efficiency. All three A* method, which has the information of the game in advance, will explore much less node than the other two search method. In my experiment, the h2 heuristic function is the most effective one to find the optimal path, no matter in the time efficiency or the node explored. The h1 and h3 will show great advantage when the optimal solution is not that deep. However, when the depth get larger, the efficiency decreased a lot, which is caused by the scoring and sorting operations. The h3 is overall better than the h1, however the score function is much complex than the h1. Thus, when the problem is really shallow, the performance of h1 is slightly better than the h3.