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COMS 472: Principles of Artificial Intelligence

Lab 1 Report

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PART 2 Output

S1.txt

BFS

Total nodes generated: 118291

Total time taken: 0.7306897640228271 seconds

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

IDS

Total nodes generated: 768403041

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20126

Total time taken: 0.1824338436126709 seconds

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

A* heuristic2

Total nodes generated: 2298

Total time taken: 0.029003381729125977 seconds

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

A* heuristic3

Total nodes generated: 4008

Total time taken: 0.07357931137084961 seconds

Path length: 24

Path: DDLUULDRRULLDRRDLLURRULL

S2.txt

BFS

Total nodes generated: 41330

Total time taken: 0.30251169204711914 seconds

Path length: 20

Path: DDLLURULDRRDLLURRULL

IDS

Total nodes generated: 346676897

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 3024

Total time taken: 0.0256350040435791 seconds

Path length: 20

Path: DDLLURULDRRDLLURRULL

A* heuristic2

Total nodes generated: 114

Total time taken: 0.0011749267578125 seconds

Path length: 20

Path: DDLLURULDRRDLLURRULL

A* heuristic3

Total nodes generated: 406

Total time taken: 0.010540246963500977 seconds

Path length: 20

Path: DDLLURULDRRDLLURRULL

S3.txt

Unsolvable

S4.txt

BFS

Total nodes generated: 181439

Total time taken: 1.0652105808258057 seconds

Path length: 31

Path: DDRUULLDDRURULLDDRURULLDDRRUULL

IDS

Total nodes generated: 439707557

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 180996

Total time taken: 2.427886962890625 seconds

Path length: 31

Path: LDDRRUULLDRRULLDRDLURDRUULLDRUL

A* heuristic2

Total nodes generated: 11061

Total time taken: 0.1616520881652832 seconds

Path length: 31

Path: LDRDLURURDDLURDDLULDDRURDLLU

A* heuristic3

Total nodes generated: 59715

Total time taken: 1.2241168022155762 seconds

Path length: 31

Path: LDDRRUULLDRRULLDRDLURDRUULLDRUL

S5.txt

BFS

Total nodes generated: 103

Total time taken: 0.0010008811950683594 seconds

Path length: 6

Path: RDLUUL

IDS

Total nodes generated: 1244

Total time taken: 0.003055572509765625 seconds

Path length: 6

Path: RDLUUL

A* heuristic1

Total nodes generated: 20

Total time taken: 0.0 seconds

Path length: 6

Path: RDLUUL

A* heuristic2

Total nodes generated: 15

Total time taken: 0.0 seconds

Path length: 6

Path: RDLUUL

A* heuristic3

Total nodes generated: 18

Total time taken: 0.0020873546600341797 seconds

Path length: 6

Path: RDLUUL

PART 3 Table

DEPTH	BFS	BFS	IDS	IDS	A*h1	A*h1	A*h2	A*h2	A*h3	A*h3
—	Avg run time	Avg nodes explored	Avg run time	Avg nodes explored	Avg run time	Avg nodes explored	Avg run time	Avg nodes explored	Avg run time	Avg nodes explored
8	0.0013s	233.4	0.0157s	5879.0	0.0002s	27.3	0.0002s	19.0	0.0005s	21.4
15	0.0398s	6814.7	25.162s	9613621.35	0.0038s	483.85	0.0015s	122.1	0.0037s	181.55
24	0.4558s	90204.12	>15min	4679575057.5	0.1231s	17568.96	0.0140s	1466.81	0.0483s	3112.42

Conclusions drawn from the table.

The A* search algorithms with heuristics (Ah1, Ah2, Ah3) consistently outperformed both Breadth-First Search (BFS) and Iterative Deepening Search (IDS) in terms of average run time and nodes explored across different depths. This indicates that A* with heuristic functions is more efficient.

As the depth of the problem increases, the average run time and nodes explored for BFS and IDS increase significantly. However, the increase is much steeper for IDS, which suggests that IDS may not scale well with the depth of the problem compared to BFS and A*.

Among the A* heuristics, A*h2 consistently required the exploration of fewer nodes and less time, followed by A*h3 and A*h1, indicating that heuristic 2 is the most effective heuristic for this problem.

IDS failed to find a solution within a reasonable time at a depth of 24, where it timed out after 15 minutes. This might be due to the exponential growth of nodes with depth in the search tree, which can cause IDS to be impractical for deeper problems.

The results suggest that carefully choosing heuristic functions for the A* algorithm can lead to significant improvements in search efficiency. A good heuristic can drastically reduce the number of nodes generated and the time taken to find a solution.

The impact of depth on performance is very clear. For shallower depths (8 and 15), the differences between algorithms are less pronounced. However, at a depth of 24, the choice of algorithm and heuristic has a major impact on performance

How to reproduce the results if needed.

1. Unzip Source Code folder
2. cd into the root (Lab 1 directory)
3. run the command below

```
python3 main.py -fPath <testcasefile.txt> -algo <algoname>
```
4. For <testcasefile.txt> you can enter any valid file path with a 8 puzzle test case.
5. For <algoname> you can choose 1 from the five algorithms BFS, IDS, h1, h2, h3.
6. The result will be printed into the terminal.
7. To reproduce the calculations done in part 3, you can refer to Part 3 outputs pasted in this doc and perform the required calculations, or you could rerun part 3 test cases using the command above for each algo and perform the average calculation.

PART 3 Outputs

LEVEL 8

152.txt

BFS

Total nodes generated: 268

Total time taken: 0.0010433197021484375 seconds

Path length: 8

Path: LLURRULL

Iterative Deepening Search

Total nodes generated: 6833

Total time taken: 0.024182796478271484 seconds

Path length: 8

Path: LLURRULL

A* heuristic1

Total nodes generated: 16

Total time taken: 0.0 seconds

Path length: 8

Path: LLURRULL

A* heuristic2

Total nodes generated: 16

Total time taken: 0.0 seconds

Path length: 8

Path: LLURRULL

A* heuristic3

Total nodes generated: 16

Total time taken: 0.0019996166229248047 seconds

Path length: 8

Path: LLURRULL

154.txt

BFS

Total nodes generated: 268

Total time taken: 0.0020666122436523438 seconds

Path length: 8

Path: LLDRRULL

Iterative Deepening Search

Total nodes generated: 6833

Total time taken: 0.016003131866455078 seconds

Path length: 8

Path: LLDRRULL

A* heuristic1

Total nodes generated: 30

Total time taken: 0.0 seconds

Path length: 8

Path: LLDRRULL

A* heuristic2

Total nodes generated: 16

Total time taken: 0.0 seconds

Path length: 8

Path: LLDRRULL

A* heuristic3

Total nodes generated: 16

Total time taken: 0.002002239227294922 seconds

Path length: 8

Path: LLDRRULL

158.txt

BFS

Total nodes generated: 311

Total time taken: 0.0020020008087158203 seconds

Path length: 8

Path: LDRURULL

Iterative Deepening Search

Total nodes generated: 12403

Total time taken: 0.026001691818237305 seconds

Path length: 8

Path: LDRURULL

A* heuristic1

Total nodes generated: 31

Total time taken: 0.0 seconds

Path length: 8

Path: LDRURULL

A* heuristic2

Total nodes generated: 24

Total time taken: 0.0 seconds

Path length: 8

Path: LDRURULL

A* heuristic3

Total nodes generated: 24

Total time taken: 0.0010099411010742188 seconds

Path length: 8

Path: LDRURULL

A* heuristic3

Total nodes generated: 24

Total time taken: 0.0010 seconds

Path length: 8

Path: LDRURULL

160.txt

BFS

Total nodes generated: 159

Total time taken: 0.0000 seconds

Path length: 8

Path: UULDRULL

Iterative Deepening Search

Total nodes generated: 3470

Total time taken: 0.0080 seconds

Path length: 8

Path: UULDRULL

A* heuristic1

Total nodes generated: 27

Total time taken: 0.0000 seconds

Path length: 8

Path: UULDRULL

A* heuristic2

Total nodes generated: 16

Total time taken: 0.0000 seconds

Path length: 8

Path: UULDRULL

A* heuristic3

Total nodes generated: 23

Total time taken: 0.0010 seconds

Path length: 8

Path: UULDRULL

164.txt

BFS

Total nodes generated: 165

Total time taken: 0.0020 seconds

Path length: 8

Path: DRRUULL

Iterative Deepening Search

Total nodes generated: 2958

Total time taken: 0.0113 seconds

Path length: 8

Path: DRRUULL

A* heuristic1

Total nodes generated: 14

Total time taken: 0.0000 seconds

Path length: 8

Path: DRRUULL

A* heuristic2

Total nodes generated: 14

Total time taken: 0.0000 seconds

Path length: 8

Path: DDRRUULL

A* heuristic3

Total nodes generated: 14

Total time taken: 0.0000 seconds

Path length: 8

Path: DDRRUULL

193.txt

BFS

Total nodes generated: 303

Total time taken: 0.0010 seconds

Path length: 8

Path: RULLDRUL

Iterative Deepening Search

Total nodes generated: 10803

Total time taken: 0.0250 seconds

Path length: 8

Path: RULLDRUL

A* heuristic1

Total nodes generated: 34

Total time taken: 0.0000 seconds

Path length: 8

Path: RULLDRUL

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0010 seconds

Path length: 8

Path: RULLDRUL

A* heuristic3

Total nodes generated: 20

Total time taken: 0.0000 seconds

Path length: 8

Path: RULLDRUL

195.txt

BFS

Total nodes generated: 197

Total time taken: 0.0010 seconds

Path length: 8

Path: ULULDRUL

Iterative Deepening Search

Total nodes generated: 4210

Total time taken: 0.0099 seconds

Path length: 8

Path: ULULDRUL

A* heuristic1

Total nodes generated: 27

Total time taken: 0.0000 seconds

Path length: 8

Path: ULULDRUL

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0011 seconds

Path length: 8

Path: ULULDRUL

A* heuristic3

Total nodes generated: 21

Total time taken: 0.0005 seconds

Path length: 8

Path: ULULDRUL

198.txt

BFS

Total nodes generated: 226

Total time taken: 0.0010 seconds

Path length: 8

Path: RUULDRUL

Iterative Deepening Search

Total nodes generated: 5380

Total time taken: 0.0120 seconds

Path length: 8

Path: RUULDRUL

A* heuristic1

Total nodes generated: 33

Total time taken: 0.0010 seconds

Path length: 8

Path: RUULDRUL

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0000 seconds

Path length: 8

Path: RUULDRUL

A* heuristic3

Total nodes generated: 21

Total time taken: 0.0010 seconds

Path length: 8

Path: RUULDRUL

208.txt

BFS

Total nodes generated: 239

Total time taken: 0.0020 seconds

Path length: 8

Path: LULDRUUL

Iterative Deepening Search

Total nodes generated: 5764

Total time taken: 0.0127 seconds

Path length: 8

Path: LULDRUUL

A* heuristic1

Total nodes generated: 22

Total time taken: 0.0000 seconds

Path length: 8

Path: LULDRUUL

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0000 seconds

Path length: 8

Path: LULDRUUL

A* heuristic3

Total nodes generated: 21

Total time taken: 0.0010 seconds

Path length: 8

Path: LULDRUUL

210.txt

BFS

Total nodes generated: 243

Total time taken: 0.0020 seconds

Path length: 8

Path: RDLDRUUL

Iterative Deepening Search

Total nodes generated: 5764

Total time taken: 0.0133 seconds

Path length: 8

Path: RDLDRUUL

A* heuristic1

Total nodes generated: 37

Total time taken: 0.0010 seconds

Path length: 8

Path: RDLDRUUL

A* heuristic2

Total nodes generated: 27

Total time taken: 0.0000 seconds

Path length: 8

Path: RDLDRUUL

A* heuristic3

Total nodes generated: 31

Total time taken: 0.0000 seconds

Path length: 8

Path: RDLDRUUL

224.txt

BFS

Total nodes generated: 193

Total time taken: 0.0000 seconds

Path length: 8

Path: URURDLLU

Iterative Deepening Search

Total nodes generated: 4144

Total time taken: 0.0121 seconds

Path length: 8

Path: URURDLLU

A* heuristic1

Total nodes generated: 35

Total time taken: 0.0000 seconds

Path length: 8

Path: URURDLLU

A* heuristic2

Total nodes generated: 21

Total time taken: 0.0000 seconds

Path length: 8

Path: URURDLLU

A* heuristic3

Total nodes generated: 26

Total time taken: 0.0000 seconds

Path length: 8

Path: URURDLLU

225.txt

BFS

Total nodes generated: 193

Total time taken: 0.0010 seconds

Path length: 8

Path: DRURDLLU

Iterative Deepening Search

Total nodes generated: 4144

Total time taken: 0.0110 seconds

Path length: 8

Path: DRURDLLU

A* heuristic1

Total nodes generated: 43

Total time taken: 0.0000 seconds

Path length: 8

Path: DRURDLLU

A* heuristic2

Total nodes generated: 31

Total time taken: 0.0009 seconds

Path length: 8

Path: DRURDLLU

A* heuristic3

Total nodes generated: 31

Total time taken: 0.0000 seconds

Path length: 8

Path: DRURDLLU

234.txt

BFS

Total nodes generated: 204

Total time taken: 0.0000 seconds

Path length: 8

Path: ULLDRULU

Iterative Deepening Search

Total nodes generated: 4601

Total time taken: 0.0171 seconds

Path length: 8

Path: ULLDRULU

A* heuristic1

Total nodes generated: 23

Total time taken: 0.0000 seconds

Path length: 8

Path: ULLDRULU

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0000 seconds

Path length: 8

Path: ULLDRULU

A* heuristic3

Total nodes generated: 19

Total time taken: 0.0010 seconds

Path length: 8

Path: ULLDRULU

236.txt

BFS

Total nodes generated: 242

Total time taken: 0.0010 seconds

Path length: 8

Path: LULDRULU

Iterative Deepening Search

Total nodes generated: 5771

Total time taken: 0.0130 seconds

Path length: 8

Path: LULDRULU

A* heuristic1

Total nodes generated: 25

Total time taken: 0.0000 seconds

Path length: 8

Path: LULDRULU

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0000 seconds

Path length: 8

Path: LULDRULU

A* heuristic3

Total nodes generated: 23

Total time taken: 0.0000 seconds

Path length: 8

Path: LULDRULU

238.txt

BFS

Total nodes generated: 246

Total time taken: 0.0020 seconds

Path length: 8

Path: RDLDRULU

Iterative Deepening Search

Total nodes generated: 5771

Total time taken: 0.0186 seconds

Path length: 8

Path: RDLDRULU

A* heuristic1

Total nodes generated: 31

Total time taken: 0.0007 seconds

Path length: 8

Path: RDLDRULU

A* heuristic2

Total nodes generated: 18

Total time taken: 0.0000 seconds

Path length: 8

Path: RDLDRULU

A* heuristic3

Total nodes generated: 19

Total time taken: 0.0000 seconds

Path length: 8

Path: RDLDRULU

239.txt

BFS

Total nodes generated: 256

Total time taken: 0.0018 seconds

Path length: 8

Path: LLDDRULU

Iterative Deepening Search

Total nodes generated: 6649

Total time taken: 0.0140 seconds

Path length: 8

Path: LLDDRULU

A* heuristic1

Total nodes generated: 23

Total time taken: 0.0000 seconds

Path length: 8

Path: LLDDRULU

A* heuristic2

Total nodes generated: 21

Total time taken: 0.0010 seconds

Path length: 8

Path: LLDDRULU

A* heuristic3

Total nodes generated: 21

Total time taken: 0.0000 seconds

Path length: 8

Path: LLDDRULU

250.txt

BFS

Total nodes generated: 205

Total time taken: 0.0010 seconds

Path length: 8

Path: URRDLLUU

Iterative Deepening Search

Total nodes generated: 4323

Total time taken: 0.0100 seconds

Path length: 8

Path: URRDLLUU

A* heuristic1

Total nodes generated: 20

Total time taken: 0.0000 seconds

Path length: 8

Path: URRDLLUU

A* heuristic2

Total nodes generated: 16

Total time taken: 0.0000 seconds

Path length: 8

Path: URRDLLUU

A* heuristic3

Total nodes generated: 17

Total time taken: 0.0010 seconds

Path length: 8

Path: URRDLLUU

253.txt

BFS

Total nodes generated: 234

Total time taken: 0.0021 seconds

Path length: 8

Path: RURDLLUU

Iterative Deepening Search

Total nodes generated: 5493

Total time taken: 0.0204 seconds

Path length: 8

Path: RURDLLUU

A* heuristic1

Total nodes generated: 32

Total time taken: 0.0006 seconds

Path length: 8

Path: RURDLLUU

A* heuristic2

Total nodes generated: 19

Total time taken: 0.0000 seconds

Path length: 8

Path: RURDLLUU

A* heuristic3

Total nodes generated: 27

Total time taken: 0.0000 seconds

Path length: 8

Path: RURDLLUU

256.txt

BFS

Total nodes generated: 257

Total time taken: 0.0010 seconds

Path length: 8

Path: RRDDLLUU

Iterative Deepening Search

Total nodes generated: 6078

Total time taken: 0.0256 seconds

Path length: 8

Path: RRDDLLUU

A* heuristic1

Total nodes generated: 16

Total time taken: 0.0010 seconds

Path length: 8

Path: RRDDLLUU

A* heuristic2

Total nodes generated: 14

Total time taken: 0.0000 seconds

Path length: 8

Path: RRDDL UU

A* heuristic3

Total nodes generated: 14

Total time taken: 0.0000 seconds

Path length: 8

Path: RRDDL UU

258.txt

BFS

Total nodes generated: 259

Total time taken: 0.0020 seconds

Path length: 8

Path: RRULDL UU

Iterative Deepening Search

Total nodes generated: 6188

Total time taken: 0.0141 seconds

Path length: 8

Path: RRULDLUU

A* heuristic1

Total nodes generated: 27

Total time taken: 0.0000 seconds

Path length: 8

Path: RRULDLUU

A* heuristic2

Total nodes generated: 19

Total time taken: 0.0000 seconds

Path length: 8

Path: RRULDLUU

A* heuristic3

Total nodes generated: 24

Total time taken: 0.0000 seconds

Path length: 8

Path: RRULDLUU

LEVEL 15

4767.txt

BFS

Total nodes generated: 6048

Total time taken: 0.0340 seconds

Path length: 15

Path: DLLURRDLLURRULL

Iterative Deepening Search

Total nodes generated: 7349696

Total time taken: 17.0540 seconds

Path length: 15

Path: DLLURRDLLURRULL

A* heuristic1

Total nodes generated: 388

Total time taken: 0.0021 seconds

Path length: 15

Path: DLLURRDLLURRULL

A* heuristic2

Total nodes generated: 33

Total time taken: 0.0000 seconds

Path length: 15

Path: DLLURRDLLURRULL

A* heuristic3

Total nodes generated: 101

Total time taken: 0.0031 seconds

Path length: 15

Path: DLLURRDLLURRULL

4768.txt

BFS

Total nodes generated: 7466

Total time taken: 0.0371 seconds

Path length: 15

Path: LDLURRDLLURRULL

Iterative Deepening Search

Total nodes generated: 10944814

Total time taken: 23.7841 seconds

Path length: 15

Path: LDLURRDLLURRULL

A* heuristic1

Total nodes generated: 436

Total time taken: 0.0036 seconds

Path length: 15

Path: LDLURRDLLURRULL

A* heuristic2

Total nodes generated: 107

Total time taken: 0.0025 seconds

Path length: 15

Path: LDLURRDLLURRULL

A* heuristic3

Total nodes generated: 155

Total time taken: 0.0020 seconds

Path length: 15

Path: LDLURRDLLURRULL

4771.txt

BFS

Total nodes generated: 6924

Total time taken: 0.0435 seconds

Path length: 15

Path: ULLDRRDLLURRULL

Iterative Deepening Search

Total nodes generated: 9746441

Total time taken: 42.2869 seconds

Path length: 15

Path: ULLDRRDLLURRULL

A* heuristic1

Total nodes generated: 363

Total time taken: 0.0030 seconds

Path length: 15

Path: ULLDRRDLLURRULL

A* heuristic2

Total nodes generated: 52

Total time taken: 0.0000 seconds

Path length: 15

Path: ULLDRRDLLURRULL

A* heuristic3

Total nodes generated: 73

Total time taken: 0.0020 seconds

Path length: 15

Path: ULLDRRDLLURRULL

4773.txt

BFS

Total nodes generated: 7905

Total time taken: 0.0437 seconds

Path length: 15

Path: RULDRRDLLURRULL

Iterative Deepening Search

Total nodes generated: 12143186

Total time taken: 41.9968 seconds

Path length: 15

Path: RULDRRDLLURRULL

A* heuristic1

Total nodes generated: 363

Total time taken: 0.0020 seconds

Path length: 15

Path: RULDRRDLLURRULL

A* heuristic2

Total nodes generated: 39

Total time taken: 0.0010 seconds

Path length: 15

Path: RULDRRDLLURRULL

A* heuristic3

Total nodes generated: 66

Total time taken: 0.0010 seconds

Path length: 15

Path: RULDRRDLLURRULL

4775.txt

BFS

Total nodes generated: 7008

Total time taken: 0.0467 seconds

Path length: 15

Path: RDDLURDLLURRULL

Iterative Deepening Search

Total nodes generated: 10120933

Total time taken: 24.5052 seconds

Path length: 15

Path: RDDLURDLLURRULL

A* heuristic1

Total nodes generated: 456

Total time taken: 0.0049 seconds

Path length: 15

Path: RDLDRUULDDLURUL

A* heuristic2

Total nodes generated: 73

Total time taken: 0.0010 seconds

Path length: 15

Path: RDLDRUULDDLURUL

A* heuristic3

Total nodes generated: 195

Total time taken: 0.0030 seconds

Path length: 15

Path: RDLDRUULDDLURUL

4778.txt

BFS

Total nodes generated: 6459

Total time taken: 0.0392 seconds

Path length: 15

Path: DLDRURDLLURRULL

Iterative Deepening Search

Total nodes generated: 8922560

Total time taken: 28.7165 seconds

Path length: 15

Path: DLDRURDLLURRULL

A* heuristic1

Total nodes generated: 439

Total time taken: 0.0030 seconds

Path length: 15

Path: DLDRURDLLURRULL

A* heuristic2

Total nodes generated: 88

Total time taken: 0.0010 seconds

Path length: 15

Path: DLDRURDLLURRULL

A* heuristic3

Total nodes generated: 150

Total time taken: 0.0026 seconds

Path length: 15

Path: DLDRURDLLURRULL

4780.txt

BFS

Total nodes generated: 8307

Total time taken: 0.0426 seconds

Path length: 15

Path: RRULDRDLLURRULL

Iterative Deepening Search

Total nodes generated: 12817271

Total time taken: 35.5156 seconds

Path length: 15

Path: RRULDRDLLURRULL

A* heuristic1

Total nodes generated: 432

Total time taken: 0.0030 seconds

Path length: 15

Path: RRULDRDLLURRULL

A* heuristic2

Total nodes generated: 88

Total time taken: 0.0010 seconds

Path length: 15

Path: RRULDRDLLURRULL

A* heuristic3

Total nodes generated: 131

Total time taken: 0.0020 seconds

Path length: 15

Path: RRULDRDLLURRULL

4784.txt

BFS

Total nodes generated: 5687

Total time taken: 0.0276 seconds

Path length: 15

Path: DLULURDDLURRULL

Iterative Deepening Search

Total nodes generated: 6841793

Total time taken: 21.9193 seconds

Path length: 15

Path: DLULURDDLURRULL

A* heuristic1

Total nodes generated: 406

Total time taken: 0.0040 seconds

Path length: 15

Path: DLULURDDLURRULL

A* heuristic2

Total nodes generated: 68

Total time taken: 0.0011 seconds

Path length: 15

Path: DLULURDDLURRULL

A* heuristic3

Total nodes generated: 130

Total time taken: 0.0040 seconds

Path length: 15

Path: DLULURDDLURRULL

4789.txt

BFS

Total nodes generated: 6843

Total time taken: 0.0398 seconds

Path length: 15

Path: ULURRDDLLURRULL

Iterative Deepening Search

Total nodes generated: 9259602

Total time taken: 20.3040 seconds

Path length: 15

Path: ULURRDDLLURRULL

A* heuristic1

Total nodes generated: 480

Total time taken: 0.0040 seconds

Path length: 15

Path: ULURRDDLLURRULL

A* heuristic2

Total nodes generated: 214

Total time taken: 0.0020 seconds

Path length: 15

Path: ULURRDDLLURRULL

A* heuristic3

Total nodes generated: 234

Total time taken: 0.0040 seconds

Path length: 15

Path: ULURRDDLLURRULL

4793.txt

BFS

Total nodes generated: 8154

Total time taken: 0.0635 seconds

Path length: 15

Path: LURURDDLLURRULL

Iterative Deepening Search

Total nodes generated: 13154313

Total time taken: 29.4341 seconds

Path length: 15

Path: LURURDDLLURRULL

A* heuristic1

Total nodes generated: 464

Total time taken: 0.0030 seconds

Path length: 15

Path: LURURDDLLURRULL

A* heuristic2

Total nodes generated: 151

Total time taken: 0.0020 seconds

Path length: 15

Path: LURURDDLLURRULL

A* heuristic3

Total nodes generated: 197

Total time taken: 0.0030 seconds

Path length: 15

Path: LURURDDLLURRULL

4798.txt

BFS

Total nodes generated: 6530

Total time taken: 0.0288 seconds

Path length: 15

Path: ULDRRUULDDLURUL

Iterative Deepening Search

Total nodes generated: 8962945

Total time taken: 19.5395 seconds

Path length: 15

Path: ULDRRUULDDLURUL

A* heuristic1

Total nodes generated: 516

Total time taken: 0.0044 seconds

Path length: 15

Path: ULDRRUULDDLURUL

A* heuristic2

Total nodes generated: 168

Total time taken: 0.0021 seconds

Path length: 15

Path: ULDRRUULDDLURUL

A* heuristic3

Total nodes generated: 274

Total time taken: 0.0079 seconds

Path length: 15

Path: ULDRRUULDDLURUL

4800.txt

BFS

Total nodes generated: 7916

Total time taken: 0.0521 seconds

Path length: 15

Path: LDDRRUULDDLURUL

Iterative Deepening Search

Total nodes generated: 12558063

Total time taken: 38.4788 seconds

Path length: 15

Path: LDDRRUULDDLURUL

A* heuristic1

Total nodes generated: 460

Total time taken: 0.0050 seconds

Path length: 15

Path: LDDRRUULDDLURUL

A* heuristic2

Total nodes generated: 73

Total time taken: 0.0010 seconds

Path length: 15

Path: LDDRRUULDDLURUL

A* heuristic3

Total nodes generated: 187

Total time taken: 0.0040 seconds

Path length: 15

Path: LDDRRUULDDLURUL

5108.txt

BFS

Total nodes generated: 6343

Total time taken: 0.0349 seconds

Path length: 15

Path: URDRDLULDRRUULL

Iterative Deepening Search

Total nodes generated: 9056778

Total time taken: 20.0897 seconds

Path length: 15

Path: URDRDLULDRRUULL

A* heuristic1

Total nodes generated: 594

Total time taken: 0.0036 seconds

Path length: 15

Path: URDRDLULDRRUULL

A* heuristic2

Total nodes generated: 199

Total time taken: 0.0020 seconds

Path length: 15

Path: URDRDLULDRRUULL

A* heuristic3

Total nodes generated: 252

Total time taken: 0.0040 seconds

Path length: 15

Path: URDRDLULDRRUULL

5109.txt

BFS

Total nodes generated: 6536

Total time taken: 0.0603 seconds

Path length: 15

Path: URDLDRUULDRDLUU

Iterative Deepening Search

Total nodes generated: 9203369

Total time taken: 26.3409 seconds

Path length: 15

Path: URDLDRUULDRDLUU

A* heuristic1

Total nodes generated: 647

Total time taken: 0.0050 seconds

Path length: 15

Path: URDLDRUULDRDLUU

A* heuristic2

Total nodes generated: 264

Total time taken: 0.0040 seconds

Path length: 15

Path: URDLDRUULDRDLUU

A* heuristic3

Total nodes generated: 358

Total time taken: 0.0080 seconds

Path length: 15

Path: URDLDRUULDRDLUU

5115.txt

BFS

Total nodes generated: 5487

Total time taken: 0.0287 seconds

Path length: 15

Path: DLURULDLDRRUULL

Iterative Deepening Search

Total nodes generated: 6697482

Total time taken: 14.6959 seconds

Path length: 15

Path: DLURULDLDRRUULL

A* heuristic1

Total nodes generated: 418

Total time taken: 0.0030 seconds

Path length: 15

Path: DLURULDLDRRUULL

A* heuristic2

Total nodes generated: 63

Total time taken: 0.0010 seconds

Path length: 15

Path: DLURULDLDRRUULL

A* heuristic3

Total nodes generated: 132

Total time taken: 0.0030 seconds

Path length: 15

Path: DLURULDLDRRUULL

5120.txt

BFS

Total nodes generated: 7027

Total time taken: 0.0345 seconds

Path length: 15

Path: RDRUULDLDRRUULL

Iterative Deepening Search

Total nodes generated: 10592193

Total time taken: 23.6435 seconds

Path length: 15

Path: RDRUULDLDRRUULL

A* heuristic1

Total nodes generated: 348

Total time taken: 0.0030 seconds

Path length: 15

Path: RDRUULDLDRRUULL

A* heuristic2

Total nodes generated: 39

Total time taken: 0.0010 seconds

Path length: 15

Path: RDRUULDLDRRUULL

A* heuristic3

Total nodes generated: 67

Total time taken: 0.0010 seconds

Path length: 15

Path: RDRUULDLDRRUULL

5123.txt

BFS

Total nodes generated: 7640

Total time taken: 0.0438 seconds

Path length: 15

Path: RDLLURDLDRRUULL

Iterative Deepening Search

Total nodes generated: 11041581

Total time taken: 25.0505 seconds

Path length: 15

Path: RDLLURDLDRRUULL

A* heuristic1

Total nodes generated: 506

Total time taken: 0.0067 seconds

Path length: 15

Path: RDLLURDLDRRUULL

A* heuristic2

Total nodes generated: 136

Total time taken: 0.0010 seconds

Path length: 15

Path: RDLLURDLDRRUULL

A* heuristic3

Total nodes generated: 192

Total time taken: 0.0032 seconds

Path length: 15

Path: RDLLURDLDRRUULL

5126.txt

BFS

Total nodes generated: 6622

Total time taken: 0.0336 seconds

Path length: 15

Path: ULDLURDLDRRUULL

Iterative Deepening Search

Total nodes generated: 9244023

Total time taken: 20.3773 seconds

Path length: 15

Path: ULDLURDLDRRUULL

A* heuristic1

Total nodes generated: 440

Total time taken: 0.0025 seconds

Path length: 15

Path: ULLDRULDDRRUULL

A* heuristic2

Total nodes generated: 85

Total time taken: 0.0010 seconds

Path length: 15

Path: ULLDRULDDRRUULL

A* heuristic3

Total nodes generated: 134

Total time taken: 0.0030 seconds

Path length: 15

Path: ULLDRULDDRRUULL

5127.txt

BFS

Total nodes generated: 5847

Total time taken: 0.0347 seconds

Path length: 15

Path: DLLUURDLDDRRUULL

Iterative Deepening Search

Total nodes generated: 7296668

Total time taken: 16.1222 seconds

Path length: 15

Path: DLLUURDLDRRUULL

A* heuristic1

Total nodes generated: 697

Total time taken: 0.0060 seconds

Path length: 15

Path: DLLUURDLDRRUULL

A* heuristic2

Total nodes generated: 326

Total time taken: 0.0030 seconds

Path length: 15

Path: DLLUURDLDRRUULL

A* heuristic3

Total nodes generated: 367

Total time taken: 0.0094 seconds

Path length: 15

Path: DLLUURDLDRRUULL

5130.txt

BFS

Total nodes generated: 5545

Total time taken: 0.0267 seconds

Path length: 15

Path: DDLUURDLDRRUULL

Iterative Deepening Search

Total nodes generated: 6098296

Total time taken: 13.3848 seconds

Path length: 15

Path: DDLUURDLDRRUULL

A* heuristic1

Total nodes generated: 586

Total time taken: 0.0041 seconds

Path length: 15

Path: DDLUURDLDRRUULL

A* heuristic2

Total nodes generated: 176

Total time taken: 0.0020 seconds

Path length: 15

Path: DDLUURDLDRRUULL

A* heuristic3

Total nodes generated: 236

Total time taken: 0.0040 seconds

Path length: 15

Path: DDLUURDLDRRUULL

LEVEL 24

131248.txt

BFS

Total nodes generated: 135214

Total time taken: 0.8212 seconds

Path length: 24

Path: RURDLULDRRUULDRULLDRDLUU

IDS

Total nodes generated: 74821011021

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20771

Total time taken: 0.1477 seconds

Path length: 24

Path: RULDRRUULDRDLURULLDDRULU

A* heuristic2

Total nodes generated: 1716

Total time taken: 0.0160 seconds

Path length: 24

Path: RULDRRUULDRDLURULLDDRULU

A* heuristic3

Total nodes generated: 4930

Total time taken: 0.0815 seconds

Path length: 24

Path: RULDRRUULDRDLURULLDDRULU

131256.txt

BFS

Total nodes generated: 116444

Total time taken: 0.5628 seconds

Path length: 24

Path: UURDDRUULDLDLDRURULLDDRULU

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 19764

Total time taken: 0.1305 seconds

Path length: 24

Path: UURDDRULURDLLDRUULDDRUL

A* heuristic2

Total nodes generated: 766

Total time taken: 0.0066 seconds

Path length: 24

Path: UURDDRULDLDRURULLDDRUL

A* heuristic3

Total nodes generated: 2860

Total time taken: 0.0500 seconds

Path length: 24

Path: URDRULLURRDLLDRUULDDRUL

131264.txt

BFS

Total nodes generated: 138166

Total time taken: 0.6438 seconds

Path length: 24

Path: RRUULDRULLDDRURULLDDRUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 19097

Total time taken: 0.1566 seconds

Path length: 24

Path: RRUULDRULLDDRURULLDDRUUL

A* heuristic2

Total nodes generated: 647

Total time taken: 0.0050 seconds

Path length: 24

Path: RRULURDLULLDDRURULLDDRUUL

A* heuristic3

Total nodes generated: 2477

Total time taken: 0.0376 seconds

Path length: 24

Path: RRUULDRULLDDRURULLDDRUUL

131271.txt

BFS

Total nodes generated: 131973

Total time taken: 0.6229 seconds

Path length: 24

Path: DLUURDDRULLURRDLULDDRULU

IDS

Total nodes generated: 562040663

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 23676

Total time taken: 0.1776 seconds

Path length: 24

Path: DLUURDDRULLURRDLULDDRULU

A* heuristic2

Total nodes generated: 764

Total time taken: 0.0075 seconds

Path length: 24

Path: DLUURDDRULLURRDLULDDRULU

A* heuristic3

Total nodes generated: 3567

Total time taken: 0.0598 seconds

Path length: 24

Path: DLURULDRDRUULDRULLDDRULU

131274.txt

BFS

Total nodes generated: 138603

Total time taken: 0.6677 seconds

Path length: 24

Path: RRUULLDDRRUULDRULLDDRULU

IDS

Total nodes generated: 562040663

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 18688

Total time taken: 0.1285 seconds

Path length: 24

Path: RRUULLDDRRULURDLULDDRUL

A* heuristic2

Total nodes generated: 593

Total time taken: 0.0060 seconds

Path length: 24

Path: RRUULLDDRRUULDRULLDDRUL

A* heuristic3

Total nodes generated: 2154

Total time taken: 0.0291 seconds

Path length: 24

Path: RRUULLDDRRUULDRULLDDRUUL

131279.txt

BFS

Total nodes generated: 135801

Total time taken: 0.6166 seconds

Path length: 24

Path: LURULLDRDRUULDRULLDDRUUL

IDS

Total nodes generated: 417383968

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20320

Total time taken: 0.1647 seconds

Path length: 24

Path: LURULLDRDRULURDLULDDRUUL

A* heuristic2

Total nodes generated: 1885

Total time taken: 0.0190 seconds

Path length: 24

Path: LURULLDRDRUULDRULLDDRUUL

A* heuristic3

Total nodes generated: 4050

Total time taken: 0.0566 seconds

Path length: 24

Path: LURULLDRDRUULDRULLDDRUUL

131286.txt

BFS

Total nodes generated: 117667

Total time taken: 0.5634 seconds

Path length: 24

Path: DDLUULDDRULURDRULLDDRUUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20506

Total time taken: 0.1363 seconds

Path length: 24

Path: DDLUULDDRULURDRULLDDRUUL

A* heuristic2

Total nodes generated: 985

Total time taken: 0.0101 seconds

Path length: 24

Path: DDLUULDDRULURDRULLDDRUUL

A* heuristic3

Total nodes generated: 4031

Total time taken: 0.0550 seconds

Path length: 24

Path: DDLUULDDRULURDRULLDDRUUL

131304.txt

BFS

Total nodes generated: 130429

Total time taken: 0.6046 seconds

Path length: 24

Path: URRDLLURRULDDRUULLDDRUUL

IDS

Total nodes generated: 74821011021

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 21355

Total time taken: 0.1462 seconds

Path length: 24

Path: RRUULDRDLULURRDDLUURDLLU

A* heuristic2

Total nodes generated: 2371

Total time taken: 0.0250 seconds

Path length: 24

Path: URRDLLURRULDDRULLDDRUL

A* heuristic3

Total nodes generated: 5406

Total time taken: 0.0740 seconds

Path length: 24

Path: RRUULDRDLULURRDDLUURDLLU

131311.txt

BFS

Total nodes generated: 137638

Total time taken: 0.6672 seconds

Path length: 24

Path: URDLDRULLDRUULDRURDLDLUU

IDS

Total nodes generated: 562040663

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 24393

Total time taken: 0.1729 seconds

Path length: 24

Path: RULLDRDRUULDDRUULLDDRUUL

A* heuristic2

Total nodes generated: 1196

Total time taken: 0.0185 seconds

Path length: 24

Path: URDLDRULLDRUULDRURDLDLUU

A* heuristic3

Total nodes generated: 4502

Total time taken: 0.1484 seconds

Path length: 24

Path: RULLDRDRUULDDRUULLDDRUUL

131324.txt

BFS

Total nodes generated: 128650

Total time taken: 0.5952 seconds

Path length: 24

Path: DRULDDRRULLDRRULULDDRUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 18903

Total time taken: 0.1519 seconds

Path length: 24

Path: DRULDDRRULLDRRULULDDRUL

A* heuristic2

Total nodes generated: 890

Total time taken: 0.0101 seconds

Path length: 24

Path: DRULDDRRULLDRRULULDDRUUL

A* heuristic3

Total nodes generated: 2626

Total time taken: 0.0386 seconds

Path length: 24

Path: DRULDDRRULLDRRULULDDRUUL

131345.txt

BFS

Total nodes generated: 116537

Total time taken: 0.5816 seconds

Path length: 24

Path: UULDDRUULLDDRRULULDDRUUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 18496

Total time taken: 0.1679 seconds

Path length: 24

Path: ULURDLDRULULDDRUULDDRUUL

A* heuristic2

Total nodes generated: 230

Total time taken: 0.0020 seconds

Path length: 24

Path: ULURDLDRULULDDRUULDDRUUL

A* heuristic3

Total nodes generated: 1813

Total time taken: 0.0250 seconds

Path length: 24

Path: ULURDLDRULULDDRUULDDRUUL

131370.txt

BFS

Total nodes generated: 139860

Total time taken: 0.6700 seconds

Path length: 24

Path: ULDDRURDLULURRDLULDDRUL

IDS

Total nodes generated: 562040663

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 24132

Total time taken: 0.1622 seconds

Path length: 24

Path: ULDDRURDLULURRDLULDDRUL

A* heuristic2

Total nodes generated: 629

Total time taken: 0.0055 seconds

Path length: 24

Path: ULDDRURDLULURRDLULDDRUL

A* heuristic3

Total nodes generated: 3507

Total time taken: 0.0469 seconds

Path length: 24

Path: ULDDRURDLULURRDLULDDRUL

131374.txt

BFS

Total nodes generated: 139445

Total time taken: 0.7947 seconds

Path length: 24

Path: RRULULDDRULURRDLULDDRUL

IDS

Total nodes generated: 932651019

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 19915

Total time taken: 0.1365 seconds

Path length: 24

Path: RRULULDDRULURRDLULDDRUL

A* heuristic2

Total nodes generated: 611

Total time taken: 0.0060 seconds

Path length: 24

Path: RRULULDDRULURRDLULDDRUL

A* heuristic3

Total nodes generated: 2844

Total time taken: 0.0495 seconds

Path length: 24

Path: RRULULDDRULURRDLULDDRUL

131378.txt

BFS

Total nodes generated: 117564

Total time taken: 0.5770 seconds

Path length: 24

Path: DDRULDDRULURRDLULDDRUL

IDS

Total nodes generated: 74821011021

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 21351

Total time taken: 0.1428 seconds

Path length: 24

Path: DDRUULDDRULURRDLULDDRUUL

A* heuristic2

Total nodes generated: 1837

Total time taken: 0.0170 seconds

Path length: 24

Path: DDRUULDDRULURRDLULDDRUUL

A* heuristic3

Total nodes generated: 4967

Total time taken: 0.0721 seconds

Path length: 24

Path: DDRUULDDRULURRDLULDDRUUL

131394.txt

BFS

Total nodes generated: 116878

Total time taken: 0.5745 seconds

Path length: 24

Path: DDRUURDLULDRURDLULDDRUUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 22205

Total time taken: 0.1489 seconds

Path length: 24

Path: DDRUURDLULDRURDLULDDRUUL

A* heuristic2

Total nodes generated: 2545

Total time taken: 0.0246 seconds

Path length: 24

Path: DDRUURDLULDRURDLULDDRUUL

A* heuristic3

Total nodes generated: 6337

Total time taken: 0.0926 seconds

Path length: 24

Path: DDRUURDLULDRURDLULDDRUUL

131400.txt

BFS

Total nodes generated: 128106

Total time taken: 0.5886 seconds

Path length: 24

Path: ULULDDRUULDRURDLULDDRUUL

IDS

Total nodes generated: 38536615

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20973

Total time taken: 0.1402 seconds

Path length: 24

Path: ULULDDRUULDRURDLULDDRUUL

A* heuristic2

Total nodes generated: 1430

Total time taken: 0.0150 seconds

Path length: 24

Path: ULULDDRUULDRURDLULDDRUUL

A* heuristic3

Total nodes generated: 4459

Total time taken: 0.0617 seconds

Path length: 24

Path: ULULDDRUULDRURDLULDDRUUL

131406.txt

BFS

Total nodes generated: 118024

Total time taken: 0.6074 seconds

Path length: 24

Path: UULDDLURRDLUURDLULDDRUUL

IDS

Total nodes generated: 74821011021

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 19540

Total time taken: 0.1321 seconds

Path length: 24

Path: UULDDLURRDLUURDLULDDR UUL

A* heuristic2

Total nodes generated: 1741

Total time taken: 0.0170 seconds

Path length: 24

Path: UULDDLURRDLUURDLULDDR UUL

A* heuristic3

Total nodes generated: 3565

Total time taken: 0.0475 seconds

Path length: 24

Path: UULDDLURRDLUURDLULDDR UUL

131425.txt

BFS

Total nodes generated: 137778

Total time taken: 0.7480 seconds

Path length: 24

Path: LLDDRUURDDLURDLULDDRUUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20254

Total time taken: 0.1323 seconds

Path length: 24

Path: LLDDRUURDDLURDLULDDRUUL

A* heuristic2

Total nodes generated: 1810

Total time taken: 0.0280 seconds

Path length: 24

Path: LLDDRUURDDLURDLULDDRUUL

A* heuristic3

Total nodes generated: 3586

Total time taken: 0.0467 seconds

Path length: 24

Path: LLDDRUURDDLURDLULDDRUUL

131449.txt

BFS

Total nodes generated: 122867

Total time taken: 0.5704 seconds

Path length: 24

Path: DDRRULLDRRULDLURULDDRUUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 20975

Total time taken: 0.1397 seconds

Path length: 24

Path: DRDLURRDLLURRDLUULDDRUL

A* heuristic2

Total nodes generated: 1341

Total time taken: 0.0140 seconds

Path length: 24

Path: DDDRULLDRRULDLURULDDRUL

A* heuristic3

Total nodes generated: 4390

Total time taken: 0.0682 seconds

Path length: 24

Path: DRDLURRDLLURRDLUULDDRUUL

131455.txt

BFS

Total nodes generated: 139470

Total time taken: 0.6764 seconds

Path length: 24

Path: RRULULDDRRULDLURULDDRUUL

IDS

Total nodes generated: 326474877

Total time taken: >15 min

Path length: Timed out.

Path: Timed out.

A* heuristic1

Total nodes generated: 21655

Total time taken: 0.1607 seconds

Path length: 24

Path: RRULULDDRRULDLURULDDRUUL

A* heuristic2

Total nodes generated: 1708

Total time taken: 0.0157 seconds

Path length: 24

Path: RRULULDDRRULDLURULDDRUUL

A* heuristic3

Total nodes generated: 5220

Total time taken: 0.0721 seconds

Path length: 24

Path: RRULULDDRRULDLURULDDRUUL

Works Cited

Aimacode, GitHub. <https://github.com/aimacode>