Comp 472 Assignment 2

Team: Unlimited

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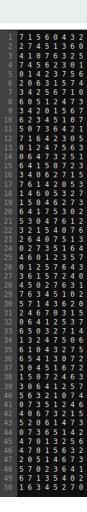
Explanation of Heuristics

Heuristic 1: Manhattan distance between node and 2 goal states.

Heuristic 2: Count number of out of place values.

Generate file with 50 random puzzles

See random_50_puzzles.txt



Analysis of the 50 random puzzles using UCS

```
----- ANALYSIS -----
Algo name: ucs
Total Length of Solution Path:
Average Length of Solution Path:
                                       0.74
Total Length of Search Path:
                                       5743
Average Length of Search Path:
                                       114.86
2.
Total number of "no solution":
                                       45
Average number of "no solution":
                                       0.9
Total Cost:
                                       44
Average Total Cost:
                                       0.88
Total Execution Time:
                                       10.917
Average Execution Time:
                                       0.21834
```

Analysis of the 50 random puzzles ran on GBFS using our first Heuristic

```
----- ANALYSIS -----
Algo name: gbfs-h1
Total Length of Solution Path:
Average Length of Solution Path:
                                        0.32
Total Length of Search Path:
                                        77
Average Length of Search Path:
                                        1.54
Total number of "no solution":
                                        48
Average number of "no solution":
                                        0.96
Total Cost:
                                        20
Average Total Cost:
                                        0.4
Total Execution Time:
                                        0.131
Average Execution Time:
                                        0.00262
```

Analysis of the 50 random puzzles ran on GBFS using our second Heuristic

```
----- ANALYSIS -----
Algo name: qbfs-h2
Total Length of Solution Path:
                                        61
Average Length of Solution Path:
                                        1.22
Total Length of Search Path:
                                        225
Average Length of Search Path:
                                        4.5
Total number of "no solution":
                                        45
Average number of "no solution":
                                        0.9
Total Cost:
                                        85
Average Total Cost:
Total Execution Time:
                                        0.304000000000000005
Average Execution Time:
                                        0.0060800000000000001
```

Analysis of the 50 random puzzles ran on A*using our first Heuristic

```
----- ANALYSIS -----
Algo name: astar-h1
Total Length of Solution Path:
                                        255
Average Length of Solution Path:
                                        5.1
Total Length of Search Path:
                                        3065
Average Length of Search Path:
                                        61.3
Total number of "no solution":
                                        26
Average number of "no solution":
                                        0.52
Total Cost:
                                        287
Average Total Cost:
                                        5.74
Total Execution Time:
                                        73.270000000000001
Average Execution Time:
                                        1.46540000000000003
```

Analysis of the 50 random puzzles ran on A*using our second Heuristic

```
----- ANALYSIS -----
Algo name: astar-h2
Total Length of Solution Path:
                                       203
Average Length of Solution Path:
                                       4.06
Total Length of Search Path:
                                       4588
Average Length of Search Path:
                                       91.76
Total number of "no solution":
Average number of "no solution":
                                       0.58
Total Cost:
                                       234
Average Total Cost:
                                       4.68
Total Execution Time:
                                       45.039
Average Execution Time:
                                       0.90078
```

Scaling up

We tried these sizes for scaling up: 2x4, 3x4, 4x4

We generated 3 random puzzles for each size.

Most of the time, the 3 generated 2x4 puzzles have a solution in less than 5 seconds.

For the other sizes, we never found a solution even after 500 seconds per puzzle.

We tried with a 3x4 puzzle that is very close to the goal states and it works.

But with a random 3x4 puzzle, the goals are very far in the search path, so the algorithm takes a very long time.

One solution would be to improve our implementation of the internal data structures and parallelize some operations. We could also make use of the GPU.