Assignment 2: X-Puzzle

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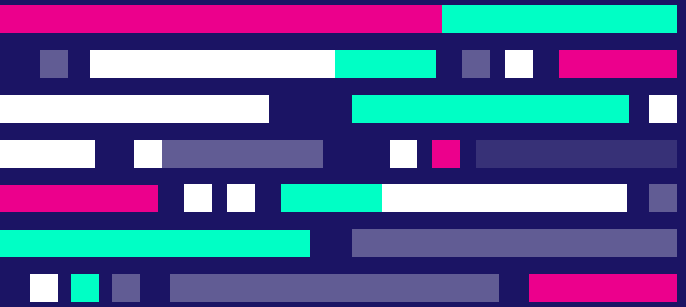
Heuristics: H1, Sum of Permutation Inversions



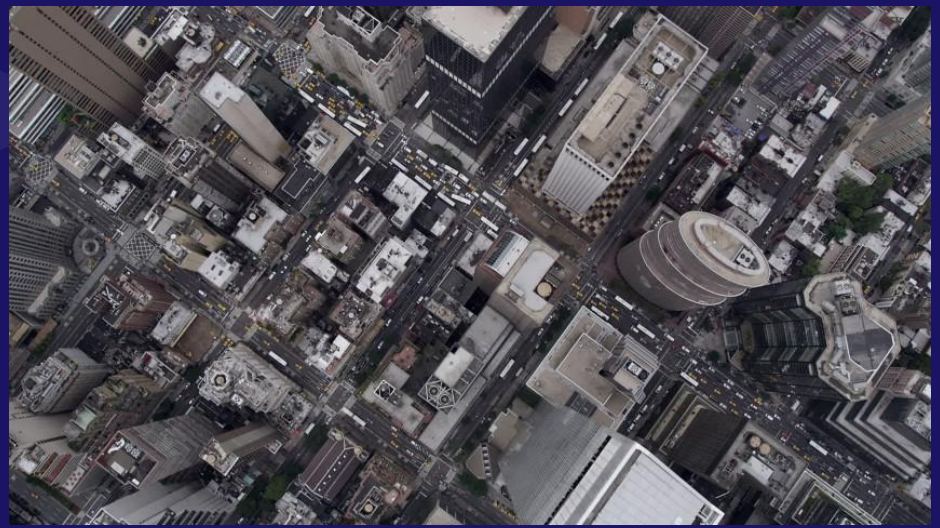
- Given a permutation, a set of number from 1...n in any order, we calculate the sum of all inversions.
- An inversion of a permutation is a pair of numbers such that a larger number appears on the left of the smaller one.
- In other words, in a set of numbers 1...n, given the mth number, we count all numbers to the right m that are smaller than m.

Ex: 5 1 4 3 2

The Inversion for 4 is 2 since 3 < 4 and 2 < 4
The Inversion for 1 is 0 since no other number is less than 1

Heuristics: H2, Manhattan Distance

- The Manhattan Distance is norm between two vectors
- Or for a 2D plane, abs(x1-x2) + ab(y1-y2)



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Uniform Cost Search Performances

	Solution Cost	Solution Time (seconds)	Search Length
Average	9..75	8.60	1908.58
Std Dev	1.09	7.47	1,045.44
Total	117	103.24	22, 903
Min	8	0.66	539
Max	11	22.71	3586
No Solutions	38		

Greedy Best First Search Performances

	H1: Sum of Permutation Inversions			*H2: Manhattan Distance*		
	Solution Cost	Solution Time (seconds)	Search Length	Solution Cost	Solution Time (seconds)	Search Length
Average	54	0.374	258	28	0.091	77
Std Dev	34.98	0.4	206.56	11.71	0.076	55.04
Total	2,721	18.72	12, 912	1,383	4.59	3,867
Min	8	0.01	5	8	0.01	6
Max	161	1.93	847	52	0.35	243

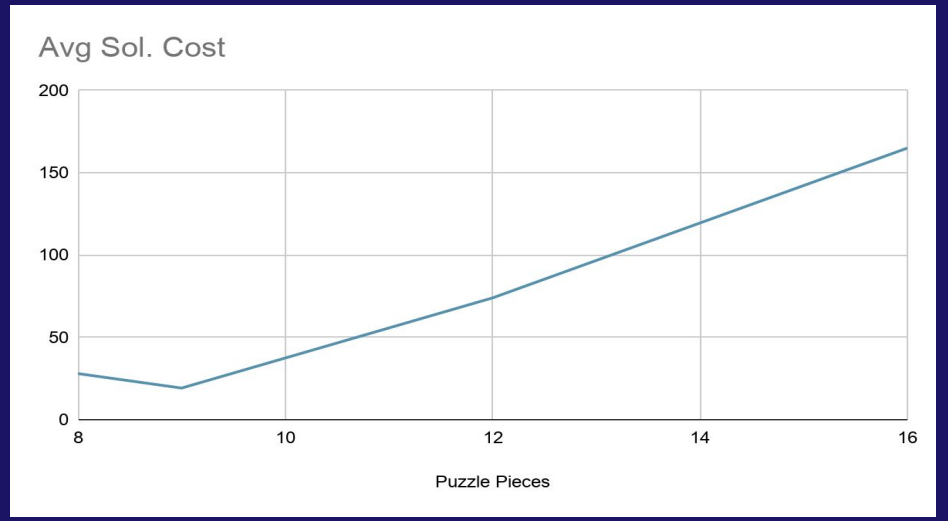
A* Search Performances

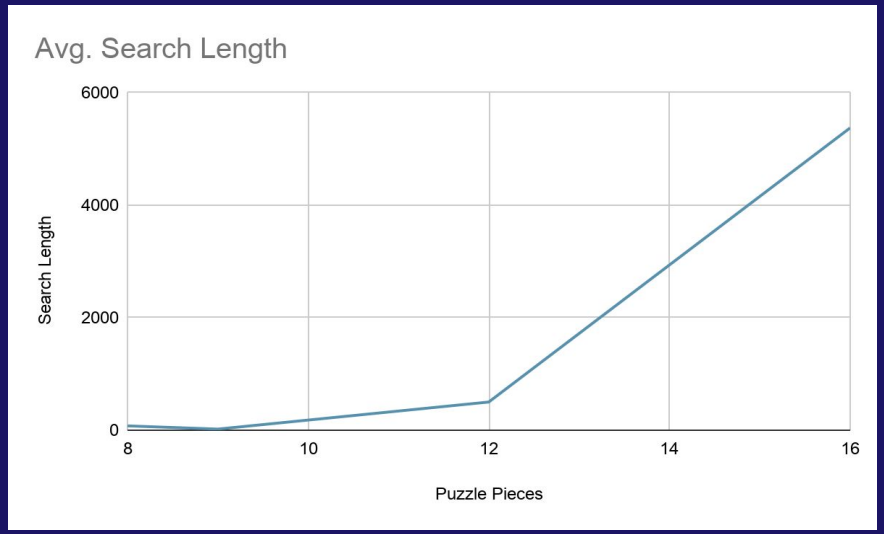
	H1: Sum of Permutation Inversions			*H2: Manhattan Distance*		
	Solution Cost	Solution Time (seconds)	Search Length	Solution Cost	Solution Time (seconds)	Search Length
Average	16	0.50	287.5	14	0.32	189
Std Dev	3.93	0.86	283.58	2.51	0.37	169.45
Total	793	25.07	14, 375	676	15.90	9,425
Min	8	0.01	5	8	0.01	6
Max	23	5.49	1,522	18	1.53	650

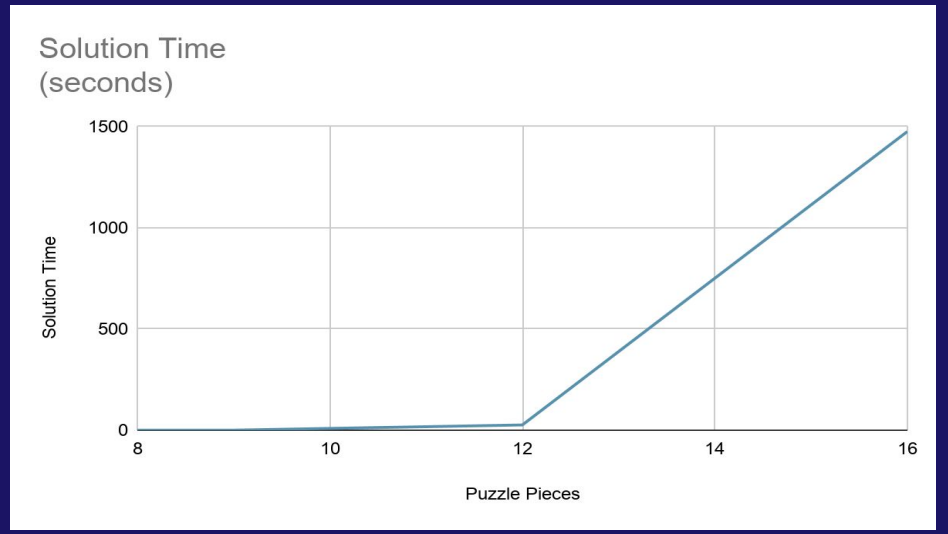
2.5 Scaling UP Analysis

5 sample run tests	***GBFS: H2: Manhattan Distance***			
	Solution Cost (avg, Total)	Solution Time (seconds) (avg, Total)	Search Length (avg, Total)	Non Completions
3X3	19.2, 96	0.424, 2.12	19.4, 97	0
3X4	74, 372	25.9, 129.43	501, 2507	0
4x4	165, 495	1475.64, 4426.92	5373, 16119	2 (1hr limit)

Puzzle Pieces	GBFS: H2: Manhattan Distance		
	Solution Cost (avg)	Solution Time (seconds) (avg)	Search Length (avg)
8	28	0.091	77
9	19.2	0.424	20
12	74	25.9	501
16	165	1475.64	5373







Contributions

Description of contributions and responsibilities

Main.py, Search.py
Olivier

Node.py, Node_Util.py, output_creator.py
Olivier

Search.py, Puzzle_generator.py, Analysis_util.py
Ihsaan

PPT Slides
Ihsaan