COM S 572
Principles of Artificial Intelligence
Lab 1

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Part 1: For part 1, we have to follow the procedures of the **ReadMe.txt** file. The provided code has been implemented by using the modules of https://github.com/aimacode/aima-python repository and works for all the mentioned five search algorithms.

Part 2: For the second part, I have compiled all the results in a single text file, "**OutputForFile2.txt.**" We can run the command **python Solve.py "File Path" "Algorithm Name"** to regenerate the results. In the text file, all the necessary information, like total node generation, search execution time, solution path length, and solution path, are shown. The output block's last line shows which initial state(S1-S5) and the algorithm were used to run the program.

Part 3: Table I shows the comparative analysis of five searching algorithms of 60 given initial states. The solution depth of all the initial states was given. For the states whose solution was in depth 8, A* search with manhattan distance heuristic (h2) outperformed the other four searching algorithms.

Table I: Analysis of Five Algorithms on File 3

Level	BFS		h1		h2		h3		IDS	
	Average No. of Nodes	Average time (Sec)	Average No. of Nodes	Average time (Sec)	Average No. of Nodes	Average time (Sec)	Average No. of Nodes	Average time (Sec)	Average No. of Nodes	Average time (Sec)
8	219	0.0056	26	0.001	22	0.001	23	0.001	2693	0.01275
15	6888	1.14	468	0.02	168	0.006	210	0.008	4328284.4	16
24	130611.05	343.2	20368.65	35.27	2735.9	0.6086	6070.45	2.74	**Undefined**	**>>900**

We can also argue that all three heuristic search algorithms performed almost the same for level 8 states. However, the Iterative Deepening Search(IDS)'s performance was relatively poor, and Breadth First Search performed better than IDS but could not outperform three heuristic search algorithms. For levels 15 and 24, A* search algorithms surpassed the other two (BFS and IDS). A* search with the manhattan distance heuristic(h2) performed best in terms of exploring nodes and times, Euclidean distance heuristic(h2) and misplaced tiles(h1) heuristic performance was second and third, respectively. However, between BFS and IDS, BFS performed better than IDS. For level 24, we didn't get any results within 15 minutes(900 seconds) using IDS algorithms.

For the convenience, I have also compiled all the results in three text files, **OutputForFile3Level8.txt**, **OutputForFile3Level15.txt** and **OutputForFile3Level24.txt** for level 8,15 and 24 respectively.

To conclude, I would like to mention that, in other machines with better configurations, the number of nodes and execution time may vary, but A* search algorithms will perform better than the other two algorithms, and the h2 heuristic is better than the other two heuristics.