Classical Planning Report

Matin Moezzi

July 10, 2020

As you can see in the below tables and charts, the number of new nodes have increased as a resault of increasing the problem size. The growth rate in Greedy Best First Search algorithms is lower than other algorithms, in other words, the number of new nodes in A* and Greedy Best First Search algorithms has increased 10 times after increasing the problem size. In summary, by increasing problem size, the number of new nodes of A* and uninform serach algorithms growth faster than Greedy Best First Search algorithm.

				Greedy Best First Search				A^* Search			
	BFS	DFS	UCS	Unmet Goals	Level Sum	Max Level	Set Level	Unmet Goals	Level Sum	Max Level	Set Level
New Nodes	178	84	240	29	28	24	28	206	122	180	138
Time Elapsed (s)	0.043	0.013	0.033	0.0064	0.639	0.24	1.037	0.03	0.74	0.64	1.224
Plans No.	6	20	6	6	6	6	6	6	6	6	6

Table 1: Air Cargo Problem 1 with 20 actions

				Greedy Best First Search				A^* Search			
	BFS	DFS	UCS	Unmet Goals	Level Sum	Max Level	Set Level	Unmet Goals	Level Sum	Max Level	Set Level
New Nodes	30503	5602	46618	170	86	249	84	22522	3426	26594	9605
Time Elapsed (s)	0.584	0.8	1	0.284	5.23	7.266	12	1.02	119.39	817.83	1057.82
Plans No.	9	619	9	9	9	9	9	9	9	9	9

Table 2: Air Cargo Problem 2 with 72 actions

It is apparent that execution time in search algorithms increased by increasing problem size. If we want to compare the heuristic algorithm's execution times and their respective growth rates, we have the below relationship:

$$\text{Unmet Goals} < \text{Level Sum} < \text{Max Level} < \text{Set Level}$$

		Greedy Best First Search		A^* Search	
	BFS	Unmet Goals	Set Level	Unmet Goals	Set Level
New Nodes	129625	230	345	65711	31596
Time Elapsed (s)	1.578	0.0695	66.39	1.932	5929.22
Plans No.	12	15	17	12	12

Table 3: Air Cargo Problem 3 with 88 actions

		Greedy Best First Search		A* Search	
	BFS	Unmet Goals	Set Level	Unmet Goals	Set Level
New Nodes	944130	280	1164	328509	498521
Time Elapsed (s)	14.79	0.1897	545.29	14.6	92513
Plans No.	14	18	23	14	21

Table 4: Air Cargo Problem 4 with 104 actions

Figure 1: Number of New Nodes for each Search Algorithm

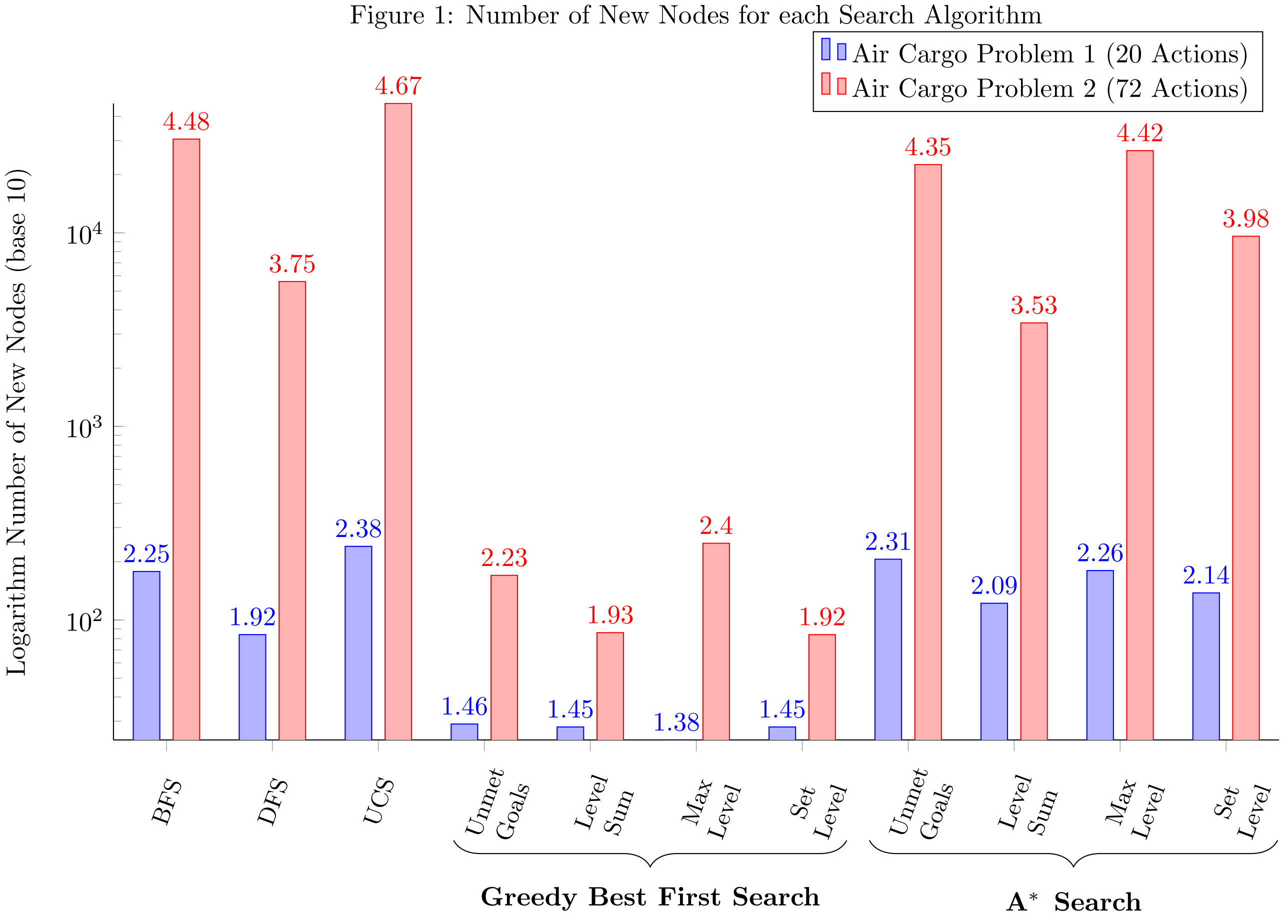


Figure 2: Time Elapsed for each Search Algorithm

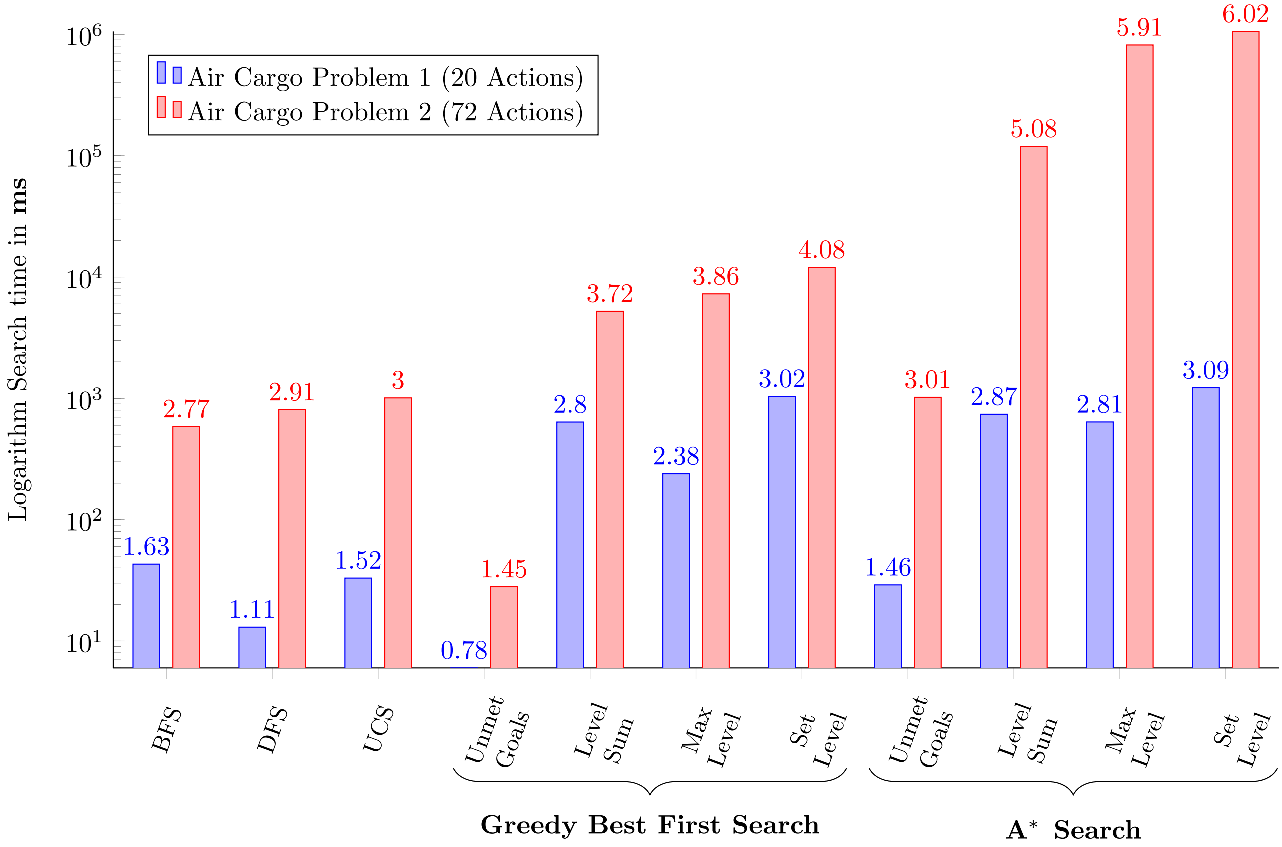
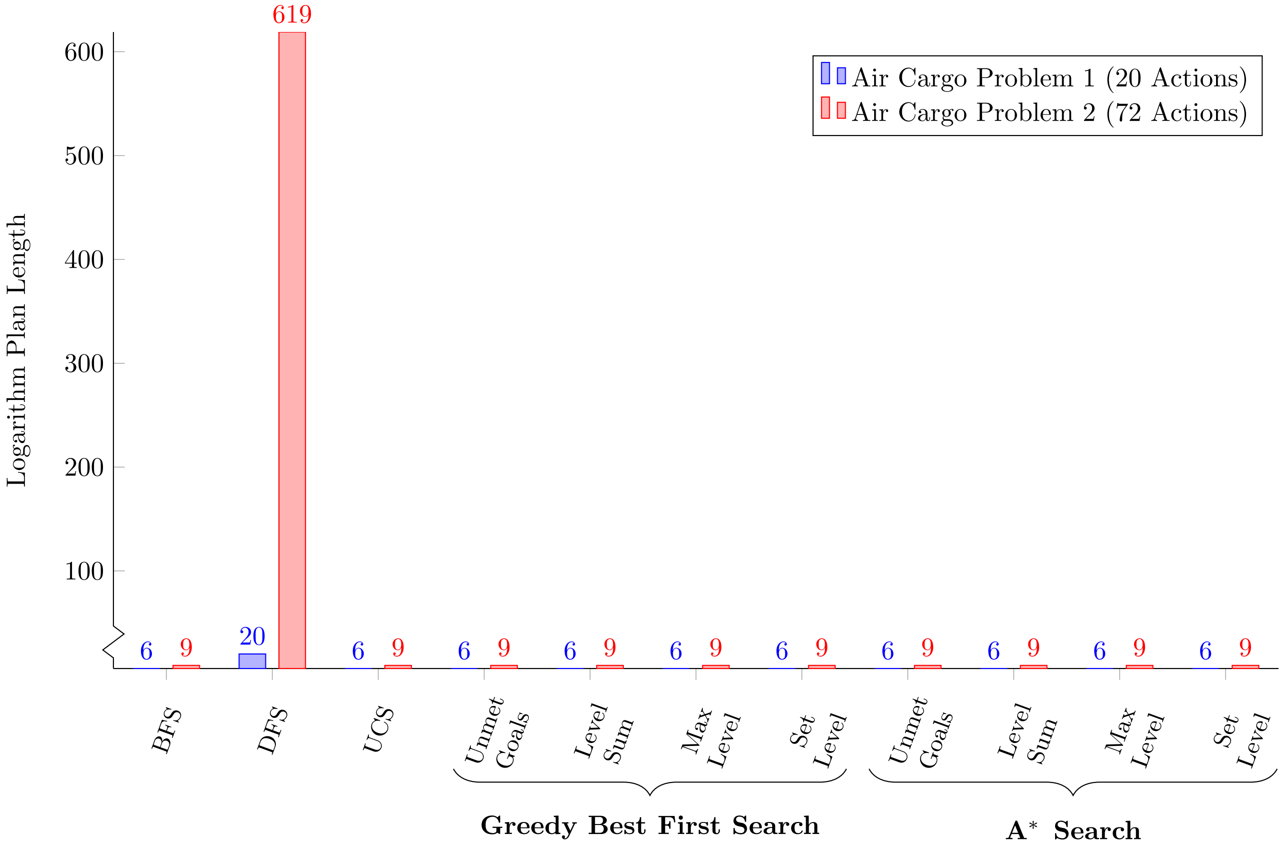


Figure 3: Number of Plans for each Search Algorithm



1. **Which algorithm or algorithms would be most appropriate for planning in a very restricted domain (i.e., one that has only a few actions) and needs to operate in real time?**
   Greedy Best First Search with Unmet Goals heuristic is best choice for planning in a real time and restricted domain because its execution time far less than other algorithms.

2. **Which algorithm or algorithms would be most appropriate for planning in very large domains (e.g., planning delivery routes for all UPS drivers in the U.S. on a given day)?**
   Greedy Best First Search with Unmet Goals and Set Level heuristic because their number of new nodes and execution times are not many according to the problem size.

3. **Which algorithm or algorithms would be most appropriate for planning problems where it is important to find only optimal plans?**
   BFS, UCS as well as Greedy Best First and A* with Unmet Goals heuristic can find optimal plan in appropriate time and the number of plans.