Overview

This paper compares and discusses the test results for non-heuristic and heuristic based search solutions. Non-heuristic based searches include Breadth First, Depth First and Uniform Cost. Heuristic based searches include A* w/ Ignore Preconditions and A* w/ PG LevelSum. First, a comparison of non-heuristic based searches. Next, a comparison of heuristic based searches. Finally, a comparison of non-heuristic and heuristic based searches and discussion of the optimal search solution.

Non-Heuristic Search

	Breadth First Search				
	Expansions	Goal Tests	New Nodes	Plan Length	Elapsed Time (sec)
Air Cargo Problem					
1	43	56	180	6	0.06
2	3343	4609	30509	9	24.24
3	14663	18098	129631	12	173.41

Figure 1

	Depth First Search				
	Expansions	Goal Tests	New Nodes	Plan Length	Elapsed Time (sec)
Air Cargo Problem					
1	12	13	48	12	0.02
2	582	583	5211	575	5.36
3	627	628	5176	596	5.71

Figure 2

	Uniform Cost Search				
	Expansions	Goal Tests	New Nodes	Plan Length	Elapsed Time (sec)
Air Cargo Problem					
1	55	57	224	6	0.08

2	4853	4855	44041	9	22.44
3	18236	18238	159726	12	97.84

Figure 3

In Breadth First and Depth First, the data is organized in a tree whereas Uniform Cost organizes data in a graph. Based on the three figures above, Uniform Cost and Breadth First searches are similar in the number of node expanded, number of goal tests, discovery of new nodes and elapsed times. Interestingly, Depth First performs better than Breadth First and Uniform Cost because Depth First explores the levels from top to bottom thus reducing the time to reach the goal(s). Of the three non-heuristic based searches, Depth First seems to be the optimal choice for its speed and efficient process of reaching the goal(s).

Heuristic Search

	A* Search w/ Ignore Preconditions Heuristic				
	Expansions	Goal Tests	New Nodes	Plan Length	Elapsed Time (sec)
Air Cargo Problem					
1	41	43	170	6	0.08
2	1450	1452	13303	9	8.98
3	5040	5042	44944	12	34.62

Figure 4

	A* Search w/ PG LevelSum Heuristic				
	Expansions	Goal Tests	New Nodes	Plan Length	Elapsed Time (sec)
Air Cargo Problem					
1	11	13	50	6	1.01
2	86	88	841	9	86.67
3	318	320	2934	12	432.88

Figure 5

Of the two heuristic based searches, A* Search w/ PG LevelSum performs better than A* Search w/ Ignore Preconditions because LevelSum surveys the levels for the goal(s) first and then attempts to determine the best route to get to goal(s). A* Search w/ PG LevelSum heuristic is the optimal solution.

Conclusion

A* Search w/ PG LevelSum heuristic is the optimal choice for solving planning problems when the number of conditions increase. A* Search w/ PG LevelSum heuristic is more efficient and reduces the number of nodes expanded with smaller number of plans requires to reach the goal(s).