Air Cargo Problem Planning Analysis

This document analyse uniformed and heuristic based search algorithm in case of Air cargo problem. Below tables have been shown to mark optimal solution for air cargo problem i.e a lowest path from start to end in less time.

Algorithm	Actions	Expansions	Goal Tests	New Nodes	Length	Time	Optimal
Breadth First	20	6	8	28	6	0.831	Yes
Depth First graph	20	21	22	84	20	0.005	No
Uniform Cost	20	60	62	240	6	0.019	Yes
Greedy Best first graph h_unmet goals	20	7	9	29	6	0.002	Yes
Greedy Best first graph level sum	20	6	8	28	6	0.638	Yes
Greedy Best first graph max level	20	6	8	24	6	0.488	Yes
Greedy Best first graph set level	20	6	8	28	6	0.831	Yes
A* unmet goals	20	50	52	206	6	0.016	Yes
A* level sum	20	28	30	122	6	1.650	Yes
A* max level	20	43	45	180	6	1.679	Yes
A* set level	20	33	35	138	6	1.920	Yes

Table Showing results for different search algorithm for Air cargo Problem 1

Algorithm	Actions	Expansions	Goal Tests	New Nodes	Length	Time	Optimal
Breadth First	72	3343	4609	30503	9	2.833	Yes
Depth First graph	72	624	625	5602	619	3.933	No
Uniform Cost	72	5154	5156	46618	9	4.817	Yes
Greedy Best first graph h_unmet goals	72	17	19	170	9	0.037	Yes
Greedy Best first graph level sum	72	9	11	86	9	15.774	Yes
Greedy Best first graph max level	72	27	29	249	9	29.095	Yes
Greedy Best first graph set level	72	9	11	84	9	20.712	Yes
A* unmet goals	72	2467	2469	22522	9	3.245	Yes
A* level sum	72	357	359	3426	9	421.22	Yes
A* max level	72	2887	2889	26594	9	2287.561	Yes
A* set level	72	1037	1039	9605	9	2018.602	Yes

Table Showing results for different search algorithm for Air cargo Problem 2

In above tables green cell showing optimal algorithm for air cargo problem 1 and 2. In below tables optimal algorithm selected above will be run on air cargo problem 3 and 4.

Algorithm	Actions	Expansions	Goal Tests	New Nodes	Length	Time	Optimal
Breadth First	88	14663	18098	129625	12	16.007	Yes
Uniform Cost	88	18510	18512	161936	12	20.988	Yes
Greedy Best first graph h_unmet goals	88	25	27	230	15	0.061	No
Greedy Best first graph level sum	88	14	16	126	14	33.715	No
Greedy Best first graph max level	88	21	23	195	13	42.213	No
A* unmet goals	88	7388	7390	65711	12	11.923	Yes
A* level sum	88	369	371	3403	12	625.454	Yes

Table Showing results for different search algorithm for Air cargo Problem 3

Algorithm	Actions	Expansions	Goal Tests	New Nodes	Length	Time	Optimal
Breadth First	104	99736	114953	944130	14	150.781	Yes
Uniform Cost	104	113339	113341	1066413	14	183.653	Yes
Greedy Best first graph h_unmet goals	104	29	31	280	18	0.093	No
Greedy Best first graph level sum	104	17	19	165	17	66.168	No
Greedy Best first graph max level	104	56	58	580	17	168.807	No
A* unmet goals	104	34330	34332	328509	14	90.352	Yes
A* level sum	104	1208	1210	12210	15	3481.384	No

Table Showing results for different search algorithm for Air cargo Problem 4

All three uninformed search algorithm breadth first search, uniform cost search, and depth first graph search, find a solution to all air cargo problems. Breadth first search always considers the shortest path first and a result of it it finds a solution to the problem in a reasonable amount of time and in an optimal way. Uninformed search performed better in problem 1 and 2 therefore they are good when working with simple problems. Heuristic based search did perform better as the problem complexity increased. This can be checked in the air cargo problem 3, where the “A* Search with unmet goals performance was optimal and the fastest amongst those that were optimal. According to the results obtained in this analysis, the breadth first search strategy can solve planning problems both fast and optimality, which makes it a good candidate to start off an analysis when dealing with search planning problems. As the complexity of the problems increase like USPS, it might be worth to consider a heuristic based approach such as “A* Search with unmet goals which can outperform breadth first search and thus be used instead.

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?
   Breadth first search always considers the shortest path first and a result of it it finds a solution to the problem in a reasonable amount of time and in an optimal way.

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)
   A* Search with unmet goals can be good for complex systems

3. Which algorithm or algorithms would be most appropriate for planning problems where it is important to find only optimal plans?
   Breadth first search always considers the shortest path first and a result of it it finds a solution to the problem in a reasonable amount of time and in an optimal way.