AIND Planning Project: Heuristic Analysis

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Let's just cite Russell and Norvig (2009).

In this analysis, we will compare and contrast different search algorithms and their performance on the project problems.

Optimal Plans for the Problems

The optimal plan-lengths for Problems 1,2 and 3 are given by 6, 9 and 12, respectively. The (non-unique!) optimal plans for each problem are detailed in Table 1.

Table 1: Optimal Plans found for each of the problems.

Problem	P1	P2	P3
Optimal Plan	Load(C1, P1, SFO) Load(C2, P2, JFK) Fly(P2, JFK, SFO) Unload(C2, P2, SFO) Fly(P1, SFO, JFK) Unload(C1, P1, JFK)	Load(C1, P1, SFO) Load(C2, P2, JFK) Load(C3, P3, ATL) Fly(P2, JFK, SFO) Unload(C2, P2, SFO) Fly(P1, SFO, JFK) Unload(C1, P1, JFK) Fly(P3, ATL, SFO) Unload(C3, P3, SFO)	Load(C1, P1, SFO) Load(C2, P2, JFK) Fly(P1, SFO, ATL) Load(C3, P1, ATL) Fly(P2, JFK, ORD) Load(C4, P2, ORD) Fly(P1, ATL, JFK) Unload(C1, P1, JFK) Fly(P2, ORD, SFO) Unload(C2, P2, SFO) Unload(C3, P1, JFK) Unload(C4, P2, SFO)
Length	6	9	12

Comparison of non-heuristic search algorithms

Compare and contrast non-heuristic search result metrics (optimality, time elapsed, number of node expansions) for Problems 1,2, and 3. Include breadth-first, depth-first, and at least one other uninformed non-heuristic search in your comparison; Your third choice of non-heuristic search may be skipped for Problem 3 if it takes longer than 10 minutes to run, but a note in this case should be included.

Comparison of A^* search heuristics

Compare and contrast heuristic search result metrics using A* with the "ignore preconditions" and "level-sum" heuristics for Problems 1, 2, and 3. What was the best heuristic used in these problems? Was it better than non-heuristic search planning methods for all problems? Why or why not?
The report explains the reason for the observed results using at least one appropriate justification from the video lessons or from outside resources (e.g., Norvig and Russell's textbook).

References

S. J. Russell and P. Norvig. Artificial intelligence: a modern approach (3rd edition), 2009.

Table 2: Performance on Problem 1.

		Expansions	Goal Tests	New Nodes	Time (s)	Path Length
1	breadth_first_search	43	56	180	0.04	**6**
2	breadth_first_tree_search	1458	1459	5960	1.27	**6**
3	depth_first_graph_search	21	22	84	0.02	20
4	depth_limited_search	101	271	414	0.12	50
5	uniform_cost_search	55	57	224	0.05	**6**
6	recursive_best_first_search, h1	442	4230	17023	3.62	**6**
7	greedy_best_first_graph_search, h1	**7**	**9**	**28**	**0.01**	**6**
8	astar_search, h_1	55	57	224	0.04	**6**
9	astar_search, h_ignore_preconds	41	43	170	0.03	**6**
10	astar_search, h_pg_levelsum	11	13	50	1.00	**6**

Table 3: Performance on Problem 2

		Expansions	Goal Tests	New Nodes	Time (s)	Path Length
1	breadth_first_search	3343	4609	30509	11.41	**9**
2	breadth_first_tree_search	–	–	–	timed out	–
3	depth_first_graph_search	624	625	5602	4.64	619
4	depth_limited_search	–	–	–	timed out	–
5	uniform_cost_search	4604	4606	41828	14.59	9
6	recursive_best_first_search, h1	–	–	–	timed out	–
7	greedy_best_first_graph_search, h1	454	456	4087	**1.37**	19
8	astar_search, h1	4604	4606	41828	13.92	**9**
9	astar_search, h_ignore_preconds	1310	1312	11979	4.02	**9**
10	astar_search, h_pg_levelsum	**74**	**76**	**720**	81.99	**9**

Table 4: Performance on Problem 3

		Expansions	Goal Tests	New Nodes	Time (s)	Path Length
1	breadth_first_search	14663	18098	129631	51.68	**12**
2	breadth_first_tree_search	–	–	–	timed out	–
3	depth_first_graph_search	408	409	3364	**2.36**	392
4	depth_limited_search	–	–	–	timed out	–
5	uniform_cost_search	16963	16965	149136	63.25	**12**
6	recursive_best_first_search, h1	–	–	–	timed out	–
7	greedy_best_first_graph_search, h1	3773	3775	33127	14.97	30
8	astar_search, h1	16963	16965	149136	63.61	**12**
9	astar_search, h_ignore_preconds	4443	4445	39217	17.77	**12**
10	astar_search, h_pg_levelsum	**228**	**230**	**2072**	323.14	13