

Analysis AI plan

- 1、 Compare and contrast heuristic search result for all problems, they get same plan length and find the best way. A* with the "ignore preconditions" had more number of node expansions, goal tests and new nodes, but cost less time elapsed. I think A* with the "level-sum" is worse, it spend more than 20 times in time elapsed that is not efficient enough.
- 2、 I think the best heuristic used in these problem is A* with the "ignore preconditions", it' s better than non-heuristic search planning methods in the third problem but not for all problems. If the problem is efficient enough to go through the whole nodes like second problem, breadth first search is better.

Problem 1					
search functions	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed(seconds)
breadth_first_search	43	56	180	6	0.034928324
breadth_first_tree_search	1458	1459	5960	6	0.994869254
depth_first_graph_search	21	22	84	20	0.017370393
depth_limited_search	101	271	414	50	0.095846958
uniform_cost_search	55	57	224	6	0.0468588
recursive_best_first_search h_1	4229	4230	17023	6	3.073718559
greedy_best_first_graph_search h_1	7	9	28	6	0.00659263
astar_search h_1	55	57	224	6	0.045850889
astar_search h_ignore_preconditions	41	43	170	6	0.040446659
astar_search h_pg_levelsum	11	13	50	6	1.033548157

Optimal plan for problem 1 is greedy_best_first_graph_search h_1 ,the plan find the best way and cost least time, but greedy search can' t always find best plan, if not compare with other search ,it' s hard to know that 6 plan length is the optimal plan,

Load(C1, P1, SFO)

Load(C2, P2, JFK)

Fly(P1, SFO, JFK)

Fly(P2, JFK, SFO)

Unload(C1, P1, JFK)

Unload(C2, P2, SFO)

Problem 2					
search functions	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed(seconds)
breadth_first_search	3343	4609	30509	9	15.00516214
breadth_first_tree_search					
depth_first_graph_search	624	625	5602	619	3.612804298
depth_limited_search					
uniform_cost_search	4852	4854	44030	9	12.89711477
recursive_best_first_search h_1					
greedy_best_first_graph_search h_1	990	992	8910	21	2.58246342
astar_search h_1	4852	4854	44030	9	13.08582266
astar_search h_ignore_preconditions	1450	1452	13303	9	4.843758006
astar_search h_pg_levelsum	86	88	841	9	108.3191816

Optimal plan for problem 2 is astar_search h_ignore_preconditions, the plan find the least plan length and cost least time:

Load(C3, P3, ATL)

Fly(P3, ATL, SFO)

Unload(C3, P3, SFO)

Load(C2, P2, JFK)

Fly(P2, JFK, SFO)

Unload(C2, P2, SFO)

Load(C1, P1, SFO)

Fly(P1, SFO, JFK)

Unload(C1, P1, JFK)

Problem 3					
search functions	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed(seconds)
breadth_first_search	14663	18098	129631	12	127.5453607
breadth_first_tree_search					
depth_first_graph_search	408	409	3364	392	1.841252183
depth_limited_search					
uniform_cost_search	18235	18237	159716	12	57.58700654
recursive_best_first_search h_1					
greedy_best_first_graph_search h_1	5614	5616	49429	22	17.23184748
astar_search h_1	18235	18237	159716	12	59.68788644
astar_search h_ignore_preconditions	5040	5042	44944	12	18.39482922
astar_search h_pg_levelsum	325	327	3002	12	492.9662365

Optimal plan for problem 3 is astar_search h_ignore_preconditions, the plan find the least plan length and cost least time:

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Load(C2, P2, JFK)
Fly(P2, JFK, ORD)
Load(C4, P2, ORD)
Fly(P2, ORD, SFO)
Unload(C4, P2, SFO)
Load(C1, P1, SFO)
Fly(P1, SFO, ATL)
Load(C3, P1, ATL)
Fly(P1, ATL, JFK)
Unload(C3, P1, JFK)
Unload(C2, P2, SFO)
Unload(C1, P1, JFK)
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