1 Heuristic Analysis

1.1 Non-heuristic search algorithms

The results for the three non-heuristic search algorithsm breadth first search, depth first graph search and uniform cost search are shown in the table below. In general the problem difficulty increases from problem 1 over problem 2 to problem 3. As expected, the depth first graph search does not produce optimal solutions. However, it is the fastest method. The breadth first search and the uniform cost search find optimal solutions. The breadth first search is slightly faster than the uniform cost search.

1.2 Heuristic search algorithms

We compare A* searches without heuristics (h1), with the ignore preconditions heuristic and with the pg levelsum. All three methods find optimal solutions. The fastest heuristic is with the pg levelsum.

Considering the increasing problem difficulty, A* with the pg levelsum heuristic is the method that also scales best.

1.3 Summary

The A* search with the pg levelsum heuristic finds in all three problem cases in the optimal solution. The A* search is also the fastest method. Therefore, I would recommend to use this method. However, for real world problems with several thousands or millions of entities, the method might be still too slow.

Table 1: Non-heuristic searches

problem	method	expansions	goal tests	new nodes	plan length	time
Problem 1	breadth first search	43	56	180	6	0.53
Problem 1	depth first graph search	21	22	84	20	0.25
Problem 1	uniform cost search	55	57	224	6	0.73
Problem 2	breadth first search	3343	4609	30509	9	308.91
Problem 2	depth first graph search	624	625	5602	619	54.10
Problem 2	uniform cost search	4853	4853	44041	9	434.89
Problem 3	breadth first search	14663	18098	129631	12	1547.98
Problem 3	depth first graph search	408	409	3364	392	39.06
Problem 3	uniform cost search	18223	18225	159618	12	1812.65

Table 2: A* search with heuristics

problem	method	expansions	goal tests	new nodes	plan length	time
Problem 1	astar search with h1	55	57	224	6	0.61
Problem 1	astar search with ignore preconditions	41	43	170	6	0.64
Problem 1	astar search with pg levelsum	11	13	50	6	0.59
Problem 2	astar search with h1	4853	4855	44041	9	435.43
Problem 2	astar search with ignore preconditions	1450	1452	13303	9	163.85
Problem 2	astar search with pg levelsum	86	88	841	9	14.70
Problem 3	astar search with h1	18223	18225	159618	12	1902.70
Problem 3	astar search with ignore preconditions	5040	5042	44944	12	640.72
Problem 3	astar search with pg levelsum	318	320	2934	12	67.02