Heuristic Analysis

Artificial Intelligence Nanodegree | Project Planning

Documentation of Metrics

1.1 Metrics for Non-Heuristic Planning Solution Searches

	breadth_first_search			depth_first_graph_search			depth_limited_search			uniform_cost_search		
air_cargo_*	p1	p2	p3	p1	p2	p3	p1	p2	p3	p1	p2	p3
node_expansions	43	3343	14663	12	1669	3664	101	> 10 mins	> 10 mins	55	4852	18235
goal_tests	56	4609	18098	13	1670	3665	271			57	4854	18237
newnodes	180	30509	128605	48	14863	29381	414			224	44030	158272
Time_elapsed (s)	0.148	46.53	275.07	0.041	30.792	58.775	0.375			0.181	62.505	279.08
optimality	6	9	12	12	1444	195	50			6	9	12

1.2 Metrics for A* Planning Searches with heuristics

	A* with ignore_preconditions			A* with level-sum		
air_cargo_*	p1	p2	p3	p1	p2	p3
node_expansions	41	1450	5040	11	86	389
goal_tests	43	1452	5042	13	88	391
newnodes	170	13303	44769	50	841	3567
Time_elapsed (s)	0.153	18.535	77.865	1.0497	164.95	1245.107
optimality	6	9	12	6	9	12

Written Analysis

2.1 Optimal Plans

air_cargo_*	p1		p2		p3	
	Best	**Worst**	**Best**	**Worst**	**Best**	**Worst**
node_expansions	A* with level-sum	depth_limited_search	A* with level sum	Depth_limited_search / uniform_cost	A* with level sum	Depth_limited_search / uniform_cost
goal_tests	A* with level-sum / depth_first_graph_search	uniform_cost_search	A* with level sum	Depth_limited_search / uniform_cost	A* with level sum	Depth_limited_search / uniform_cost
newnodes	depth_first_graph_search	uniform_cost_search	A* with level sum	Depth_limited_search / uniform_cost	A* with level sum	Depth_limited_search / uniform_cost
Time_elapsed	depth_first_graph_search	A* with level_sum	A* with ignore_preconditions	Depth_limited_search / A* with level sum	A* with ignore_preconditions	Depth_limited_search / A* with level sum
optimality	All except depth_first_graph_search	depth_first_graph_search	Depth_first_graph_search / A* with ignore_preconditions	Depth_limited_search / A* with level sum	Depth_first_graph_search / A* with ignore_preconditions	Depth_limited_search / A* with level sum
Plan:	A* with ignore_preconditions		A* with level sum		A* with level sum	

Table. Best and worst by each statistic for each problem

By analyzing the results, we find that A* searches with heuristics give us significantly better results than non-heuristic search plans. We also notice that for Problem 1, the results of non-heuristic and heuristic searches are similar. However, as the complexity of the problem increases, both A* with ignore_preconditions heuristic and A* with level_sum heuristic, perform much better. It can also been seen from the table that depth_first_graph seems to perform well in terms of number of nodes expanded and time, however, it provides a non-optimal solution in the end.

2.2 Best Heuristic

Both A* searches gave significantly better results than the non-heuristic searches. However, for smaller problems, the A* searches took more time than a search such as breadth_first. We can also see that as we increase the complexity of the heuristic - like in the level_sum A* search, the time taken by the search increases. At the same time, this heuristic performed better and was much more efficient than its counterpart with the ignore_predconditiions heuristic. Hence, there can be no size fits all and choosing a search plan should be based on the complexity of the problem itself, the memory available as well as the time constraints.