Artificial Intelligence Nanodegree

Build a Forward Planning Agent

Candidate: Milos Randic

Part	Problem				1		
2011 271 0.00000		Actions	Expansions	Duration		Expansions vs Actions	Durations vs Actions
20 60 0,000 0,	breadth_first_search	20	43	0,05699	6	2,15000	0,00285
## Problem	depth_first_graph_search	20	21	0,02608	20	1,05000	0,00130
Problem	uniform_cost_search	20	60	0,05325	6	3,00000	0,00266
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### Problem	greedy_best_first_graph_search h_pg_levelsum	20	6	1,68365	6	0,30000	0,08418
200 201 202 202 203	greedy_best_first_graph_search h_pg_maxlevel	20	6	0,51008	6	0,30000	0,02550
Section Sect	greedy_best_first_graph_search h_pg_setlevel	20	6	2,53579	6	0,30000	0,12679
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Problem	astar_search h_pg_maxlevel	20	43	0,71670	6	2,15000	0,03584
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Analyze the search complexity as a function of domain size, search algorithm, and heuristic.

From table above it can be easily noticed that number of node expansions vs number of actions dramatically increases as number of actions in domain gets higher, for algorithms breadth_first_search, uniform_cost_search, astar_search h_unmet_goals, astar_search h_pg_maxlevel and astar_search h_pg_setlevel.

For the rest of the algorithms, number of expansion nodes seems to be rasonably lower.

Analyze search time as a function of domain size, search algorithm, and heuristic.

As the problem size increases, it can be concluded that A* algotithms (h_pg_setlevel, h_pg_maxlevel and h_pg_levelsum) have the highest duration over problem size which makes them not that optimal in real-time execution, tough the plan length is the shortest among those algorithms. In addition, the lowest duration over problem size is achieved among uniform_cost_search, breadth_first_search, astar_search h_unmet_goals, depth_first_graph_search and greedy best first graph search h unmet goals.

Analyze the optimality of solution as a function of domain size, search algorithm, and heuristic.

The highest plan length, for all problems is generated by *depth_first_graph_search* algorithm. This solution migth not be desireable to use in practice due really high number of actions that need to be executed in order to achieve the goal state.

Contrarily, for P1 and P2 it is clear that plan length is constant for the rest of the algorithms. Problems P3 and P4 have an increase of plan length when using <code>greedy_best_first_graph_search</code> algorithms.

Questions

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?

P1 seems to have a very restricted domain (20 actions), so, from the table above, greedy_best_first_graph_search h_unmet_goals algorithm gives the lowest duration over number of actions, which makes it a good candidate for real-time execution with a plan length of 6. Also, astar_search h_unmet_goals and uniform_cost_search would be good candidates for operating in real-time.

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)

P4 has the large domain (104 actions) and <code>greedy_best_first_graph_search h_unmet_goals</code> would be a good option in terms of duration of execution, plan length and number of expansions. As an alternative, <code>greedy_best_first_graph_search h_pg_levelsum</code> can be executed with reasonable number of expansions and time duration.

3. Which algorithm or algorithms would be most appropriate for planning problems where it is important to find only optimal plans?

In terms of plan length, optimal plan should be the one with shortest lenght, for P1 and P2 those are all except depth_first_graph_search, for P3 those are A* search algorithms and all uninformed search algorithms except depth_first_graph_search and for P4 astar_search h_unmet_goals algorithm and all uninformed search algorithms except depth_first_graph_search algorithm are considered as optimal.