Artificial Intelligence Nanodegree
Air Cargo Planning Exercise
October 2017

Uninformed Search

The following tables capture the metrics of running uninformed searches (namely Breadth First Search (BFS), Depth First Search (DFS) and Uniform Cost Search (UCS)) on three air cargo problems of increasing complexity.

Uninformed Search: Problem 1:

	Breadth First Search	Depth First Search	Uniform Cost Search
Node expansions	43	12	55
Goal tests	56	13	57
Time elapsed (s)	0.0289	0.0095	0.0389
Optimality	Yes	No	Yes

Uninformed Search: Problem 2:

	Breadth First Search	Depth First Search	Uniform Cost Search
Node expansions	3041	187	4761
Goal tests	4672	188	4763
Time elapsed (s)	13.1991	0.5754	11.0627
Optimality	Yes	No	Yes

Uninformed Search: Problem 3:

	Breadth First Search	Depth First Search	Uniform Cost Search
Node expansions	14491	1948	17783
Goal tests	17947	1949	17785
Time elapsed (s)	94.8913	19.2450	47.2797
Optimality	Yes	No	Yes

BFS had the second highest memory requirement of the three searches. It was the slowest search to execute for problems 2 and 3, narrowing outperforming UCS for problem 1. BFS is an optimal search.

DFS had the smallest memory requirement and was the quickest search to execute for all three problems. The memory and speed advantage versus UCS and BFS were significant. However, DFS is no an optimal search.

UCS had the highest memory requirement as reflected by the largest number of node expansions across all three problems. UCS had the second fastest execution speed for problems 2 and 3. It was the slowest for problem 1. UCS is an optimal search.

Informed Search

The following tables capture the metrics of running informed A* searches on the same three air cargo problems of increasing complexity.

Informed Search: Problem 1:

	A* (h_1)	A* (ignore precon)	A* (level sum)
Node expansions	55	41	11
Goal tests	57	43	13
Time elapsed (s)	0.03518	0.03544	1.0423
Optimality	Yes	Yes	Yes

Informed Search: Problem 2:

	A* (h_1)	A* (ignore precon)	A* (level sum)
Node expansions	4761	1450	86
Goal tests	4763	1452	88
Time elapsed (s)	10.6557	4.0253	150.5042
Optimality	Yes	Yes	Yes

Informed Search: Problem 3:

	A* (h_1)	A* (ignore precon)	A* (level sum)
Node expansions	17783	5003	311
Goal tests	17785	5005	313
Time elapsed (s)	46.7169	15.1044	759.9272
Optimality	Yes	Yes	Yes

A* search with the h1 heuristic had the highest memory requirement across all three problems. It was the second quickest search for problems 2 and 3, and the quickest for problem 1. A* is an optimal search.

A* search with the ignore preconditions heuristic had the second highest memory requirement across all three problems. It was the quickest search for problems 2 and 3, and the second quickest for problem 1. A* is an optimal search.

A* search with the level sum heuristic had the smallest memory requirement across all three problems, but was also the slowest search to execute. The difference in number of node expansions and execution time were significant. A* is an optimal search.

Comparing uninformed and informed searches

Putting aside DFS, which is not an optimal search, A* searches with the ignore preconditions and level sum heuristics had lower memory requirements than uninformed searches. A* search with the ignore preconditions heuristic was the quickest search, while A* search with the level sum heuristic was the slowest by a significant margin.

I propose using A*search with the ignore preconditions heuristic for the set of air cargo problems given its optimality and strong performance in execution times and low memory requirements. If minimizing memory requirement is the absolute priority and compute power is abundant, A* with the level sum heuristic would be preferable. What is clear is that informed searches are expected to outperform uninformed searches assuming a reasonable heuristic is applied.