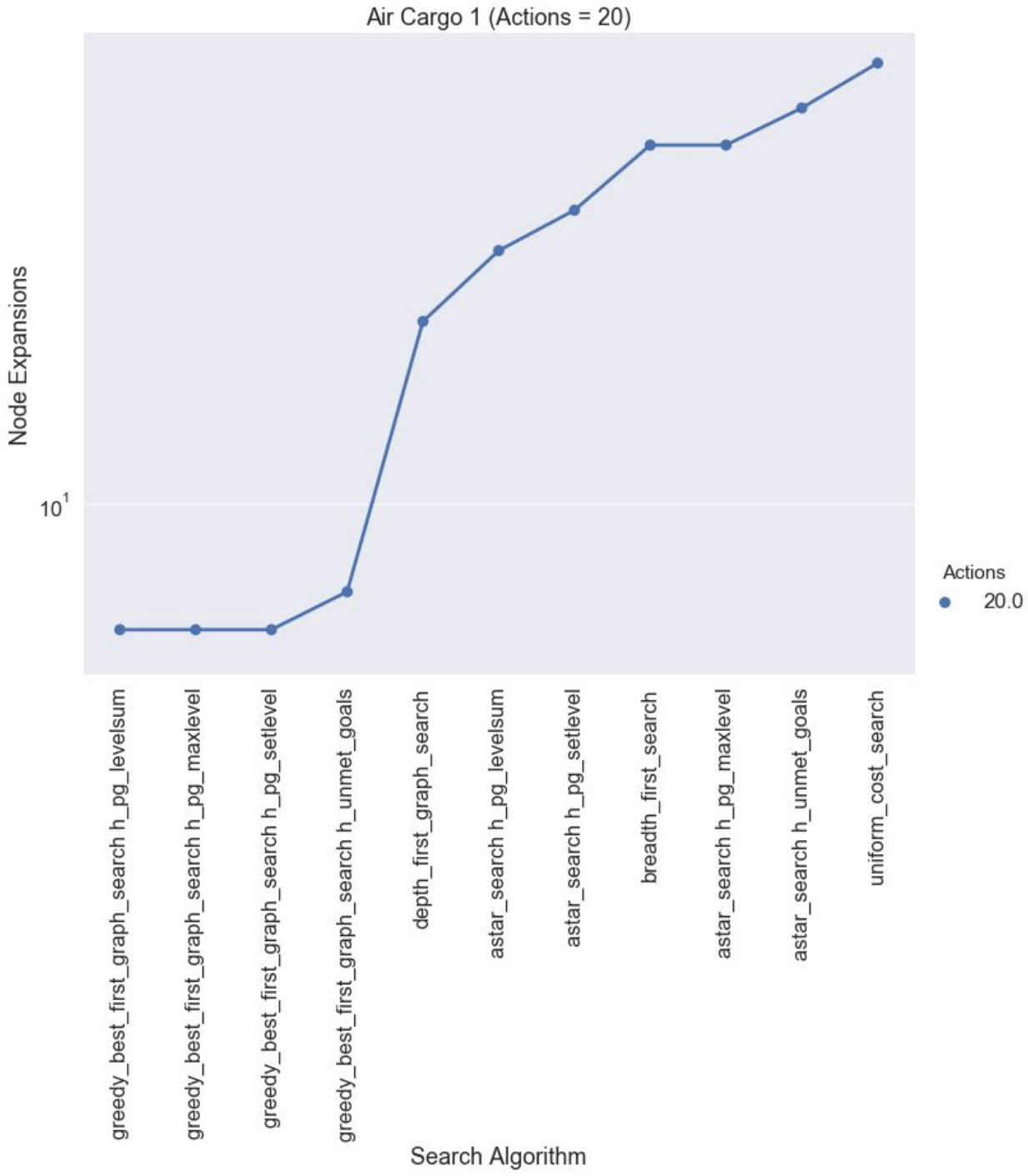
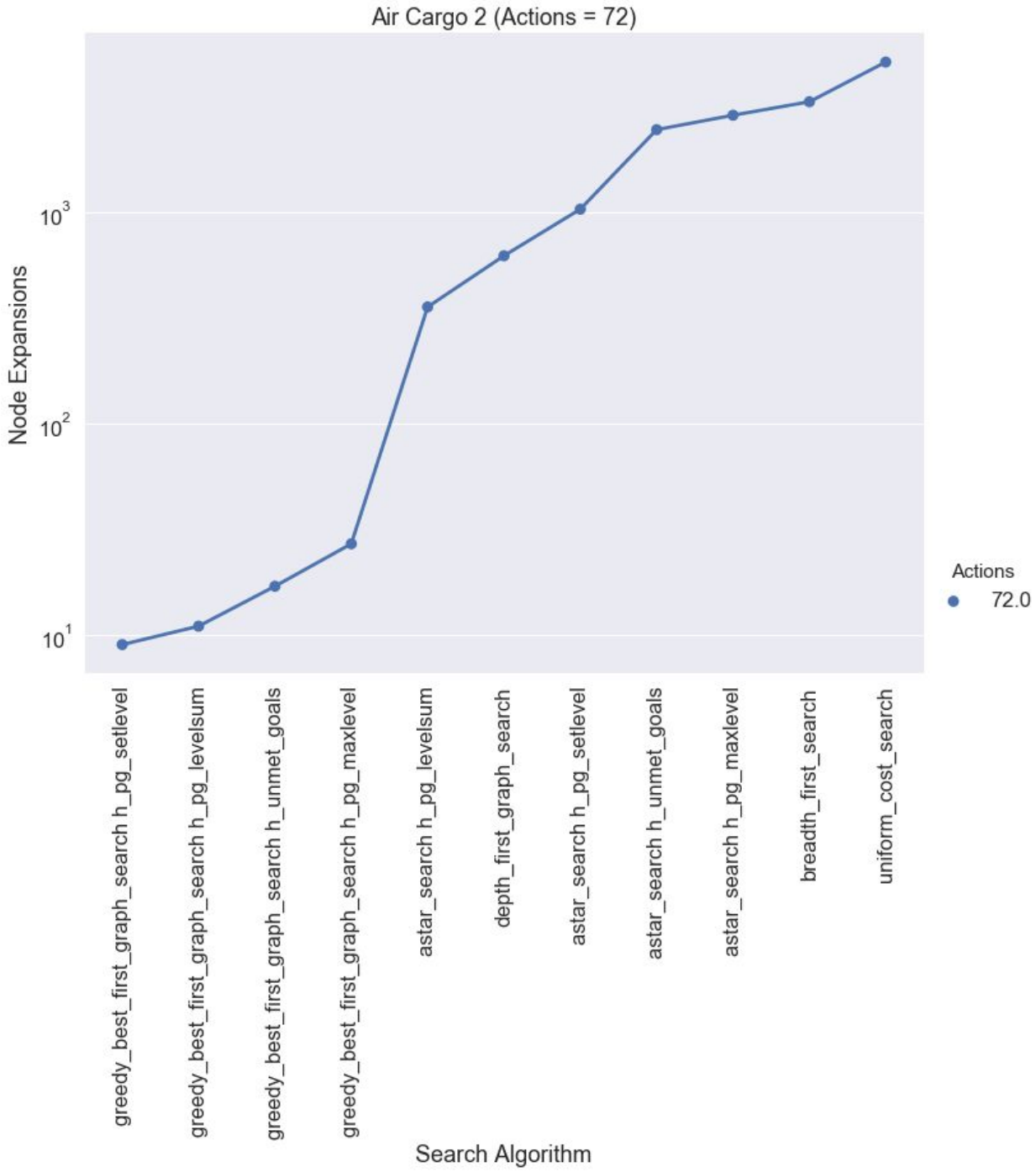
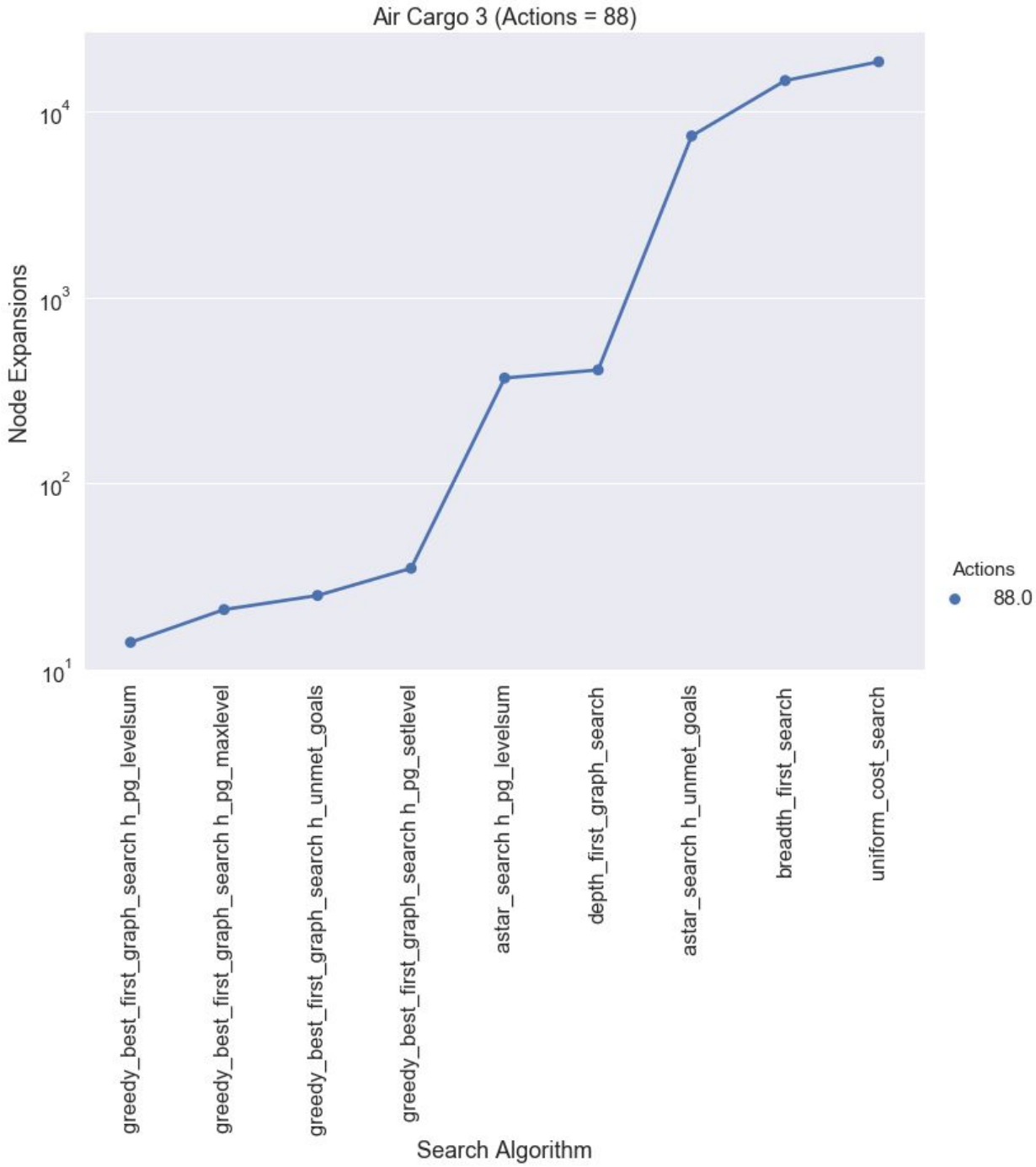
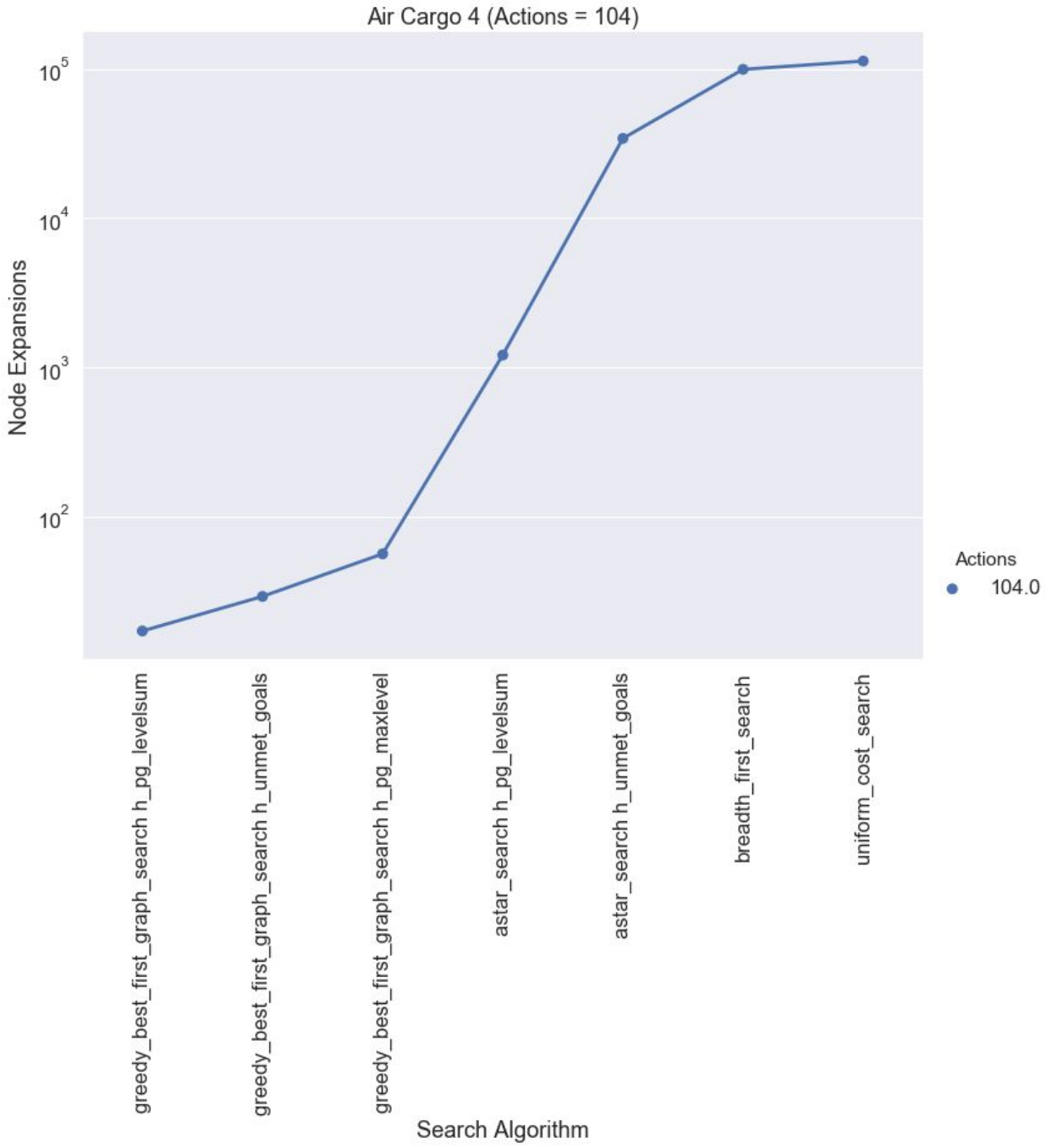
Create a Forward Planning Agent Report by Urvi Yi
Question 1:

Use a table or chart to analyze the number of nodes expanded against number of actions in the domain




Air Cargo 2 (Actions = 72)
Node Expansions
10^3
10^2
10^1
Actions
72.0
greedy_best_first_graph_search h_pg_setlevel
greedy_best_first_graph_search h_pg_levelsum
greedy_best_first_graph_search h_unmet_goals
greedy_best_first_graph_search h_pg_maxlevel
astar_search h_pg_levelsum
depth_first_graph_search
astar_search h_pg_setlevel
astar_search h_unmet_goals
astar_search h_pg_maxlevel
breadth_first_search
uniform_cost_search
Search Algorithm


Air Cargo 3 (Actions = 88)
Node Expansions
10^4
10^3
10^2
10^1
greedy_best_first_graph_search h_pg_levelsum
greedy_best_first_graph_search h_pg_maxlevel
greedy_best_first_graph_search h_unmet_goals
greedy_best_first_graph_search h_pg_setlevel
astar_search h_pg_levelsum
depth_first_graph_search
astar_search h_unmet_goals
breadth_first_search
uniform_cost_search
Search Algorithm
Actions
88.0

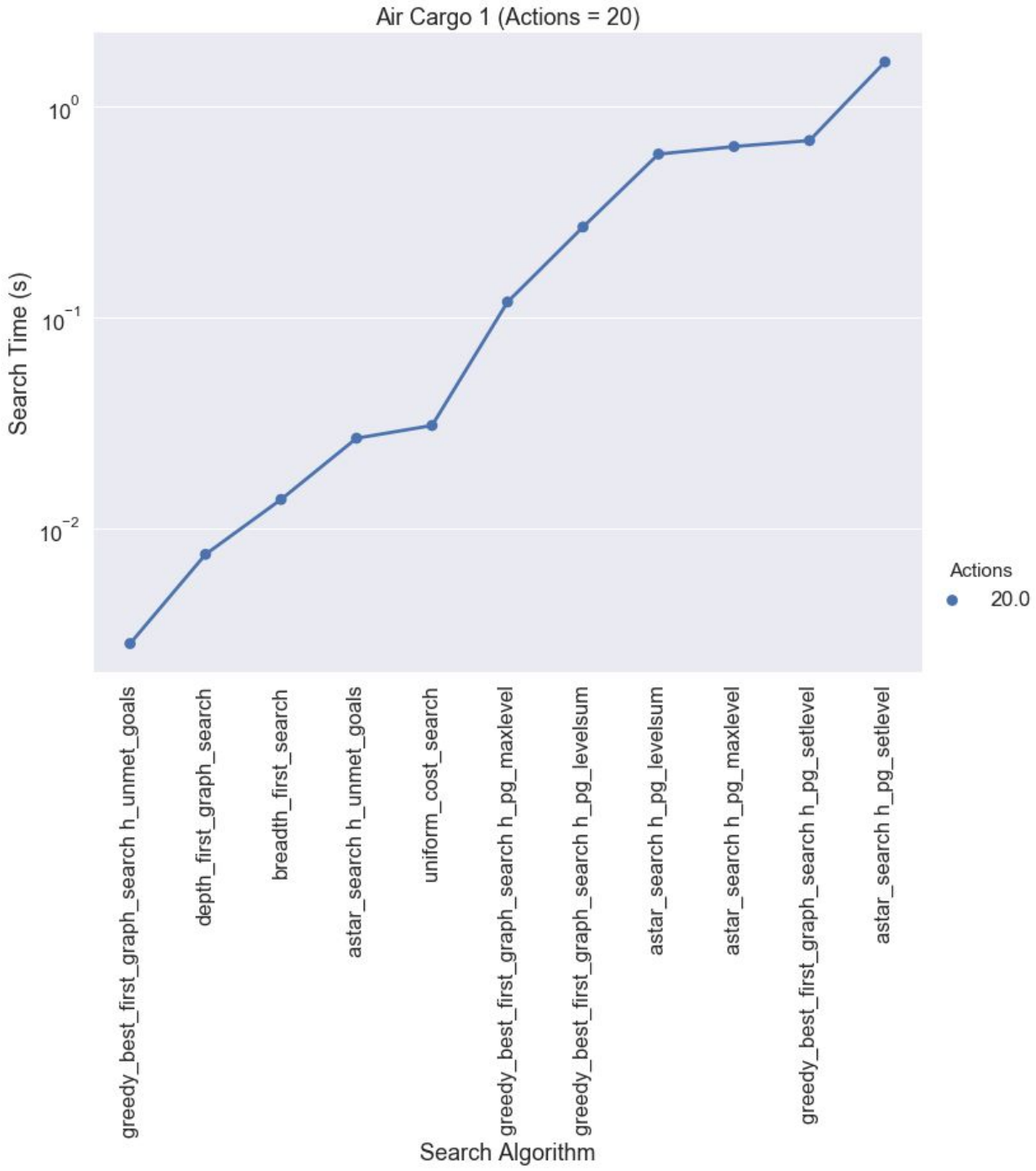


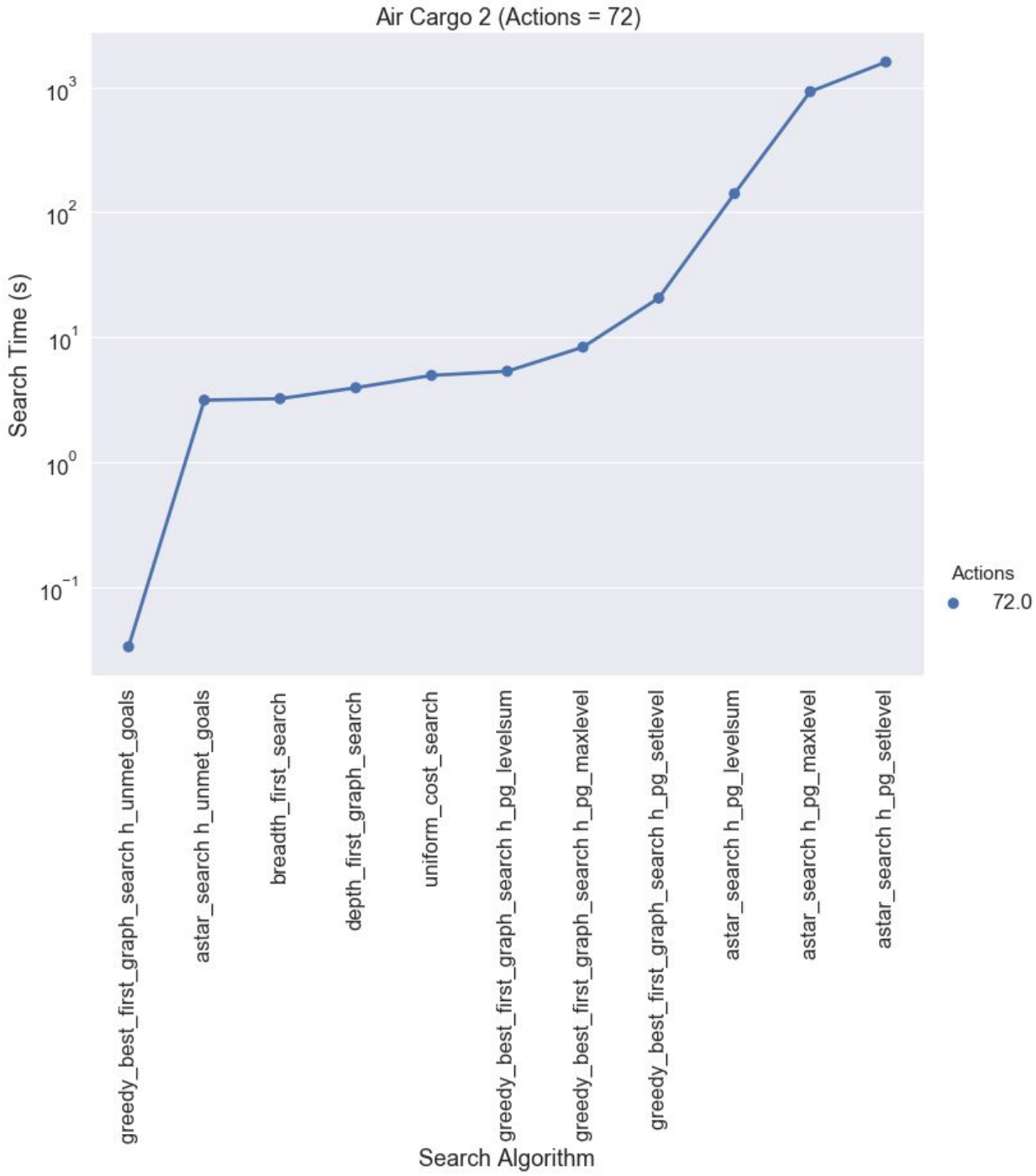
Question 1 Observations:

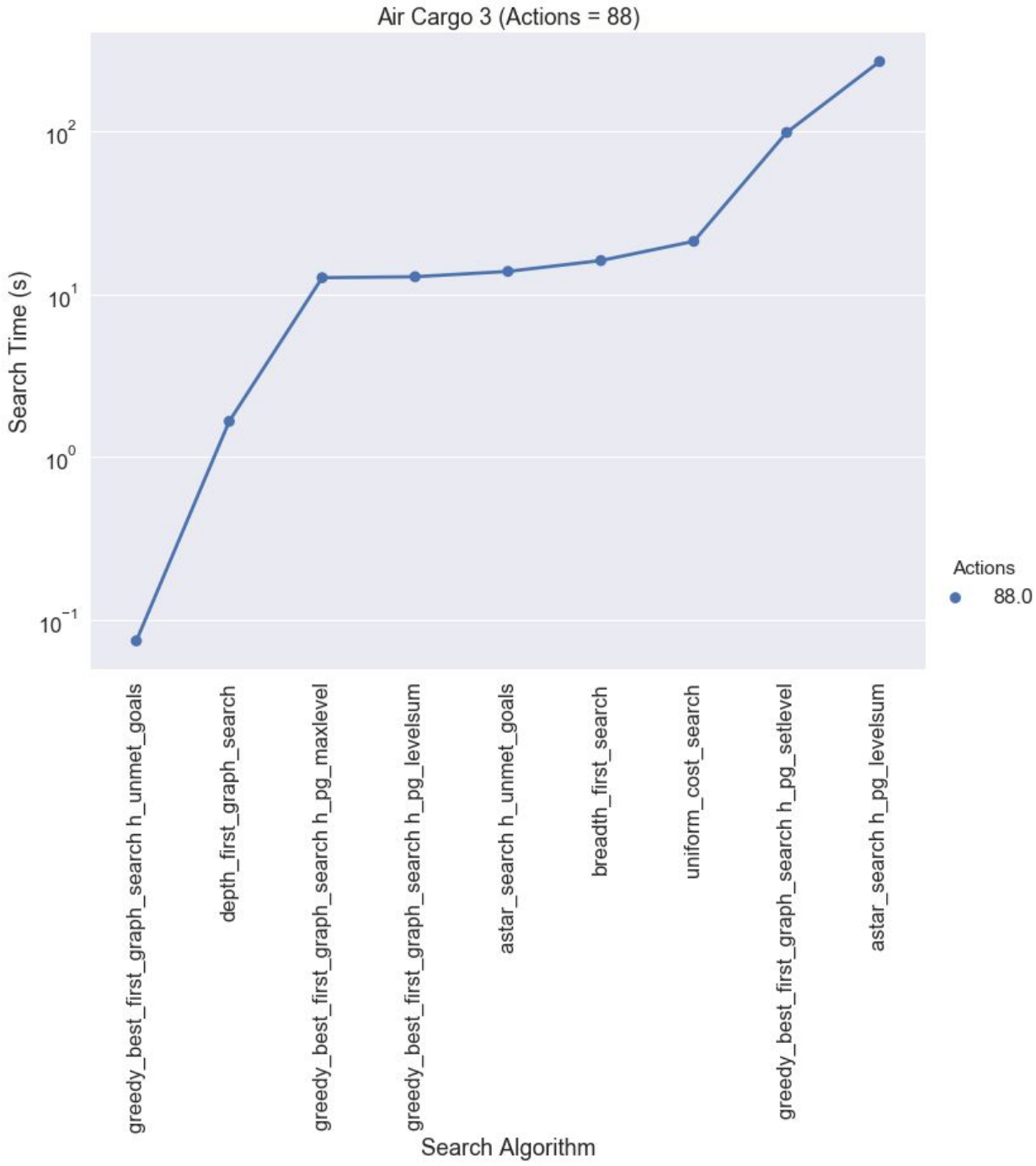
Uniform Cost Search has the most number of node expansions over all action domains. The Greedy Best First Graph search algorithm (with various heuristics) has the fewest number of node expansions across all action domains.

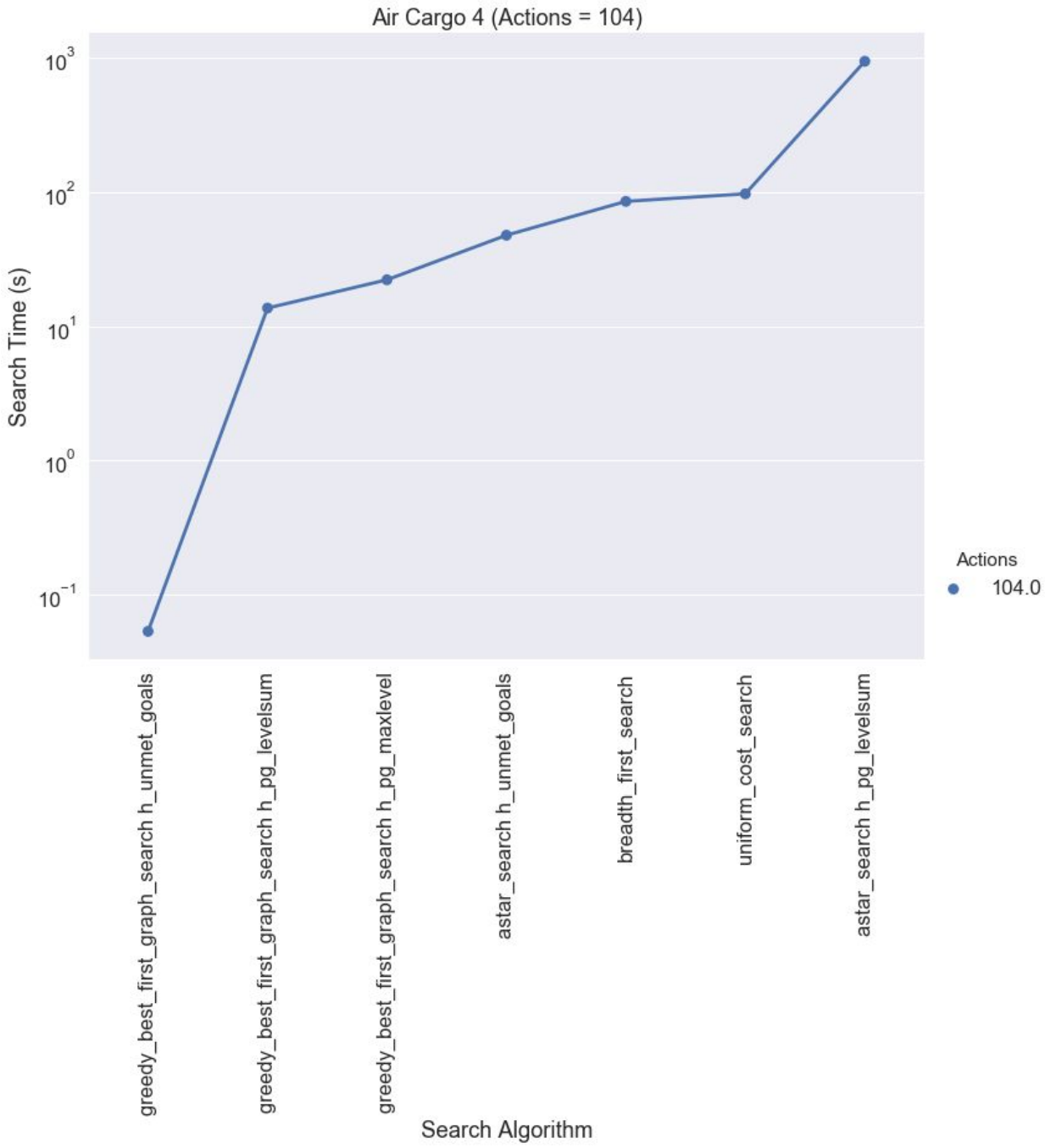
Question 2

Use a table or chart to analyze the search time against the number of actions in the domain




Air Cargo 2 (Actions = 72)
Search Time (s)
10^3
10^2
10^1
10^0
10^{-1}
Actions
72.0
greedy_best_first_graph_search h_unmet_goals
astar_search h_unmet_goals
breadth_first_search
depth_first_graph_search
uniform_cost_search
greedy_best_first_graph_search h_pg_levelsum
greedy_best_first_graph_search h_pg_maxlevel
greedy_best_first_graph_search h_pg_setlevel
astar_search h_pg_levelsum
astar_search h_pg_maxlevel
astar_search h_pg_setlevel
Search Algorithm


Air Cargo 3 (Actions = 88)
Search Time (s)
10^2
10^1
10^0
10^{-1}
Actions
88.0
greedy_best_first_graph_search h_unmet_goals
depth_first_graph_search
greedy_best_first_graph_search h_pg_maxlevel
greedy_best_first_graph_search h_pg_levelsum
astar_search h_unmet_goals
breadth_first_search
uniform_cost_search
greedy_best_first_graph_search h_pg_setlevel
astar_search h_pg_levelsum
Search Algorithm

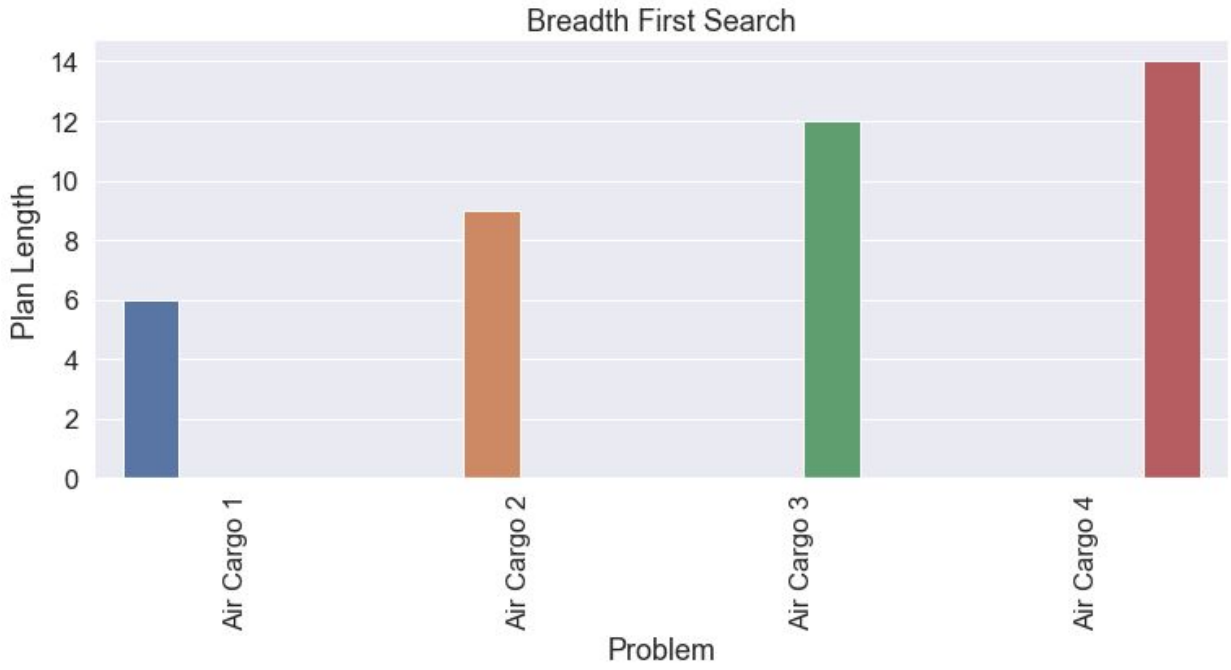


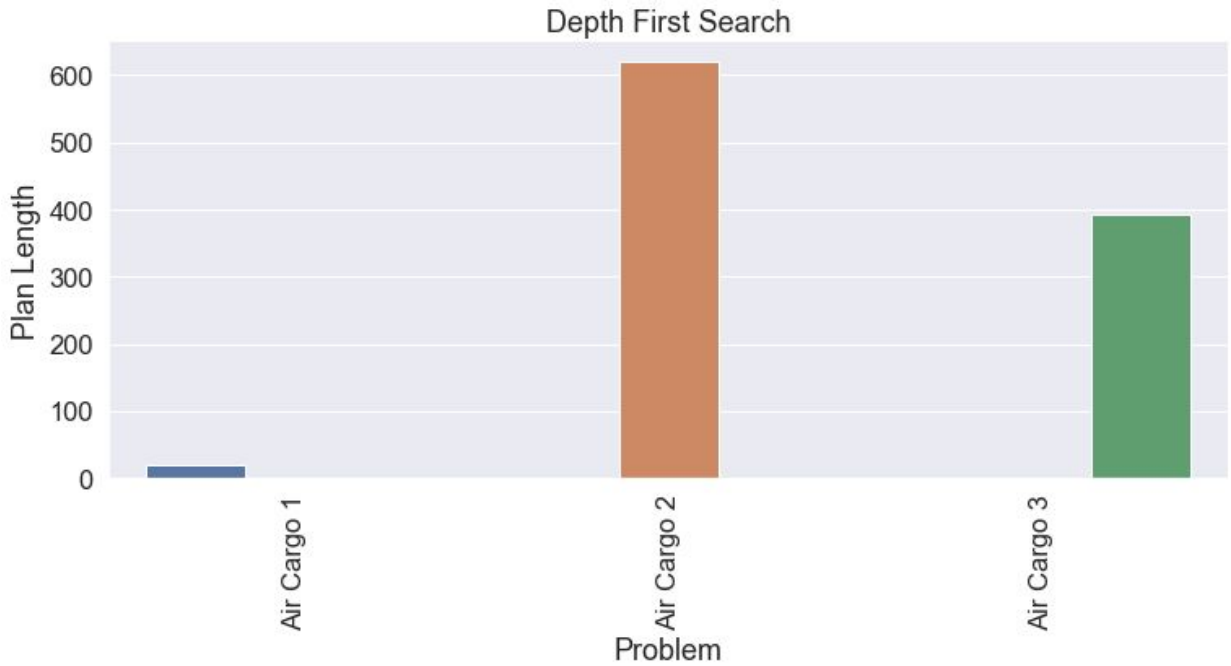
Question 2 Observations:¶

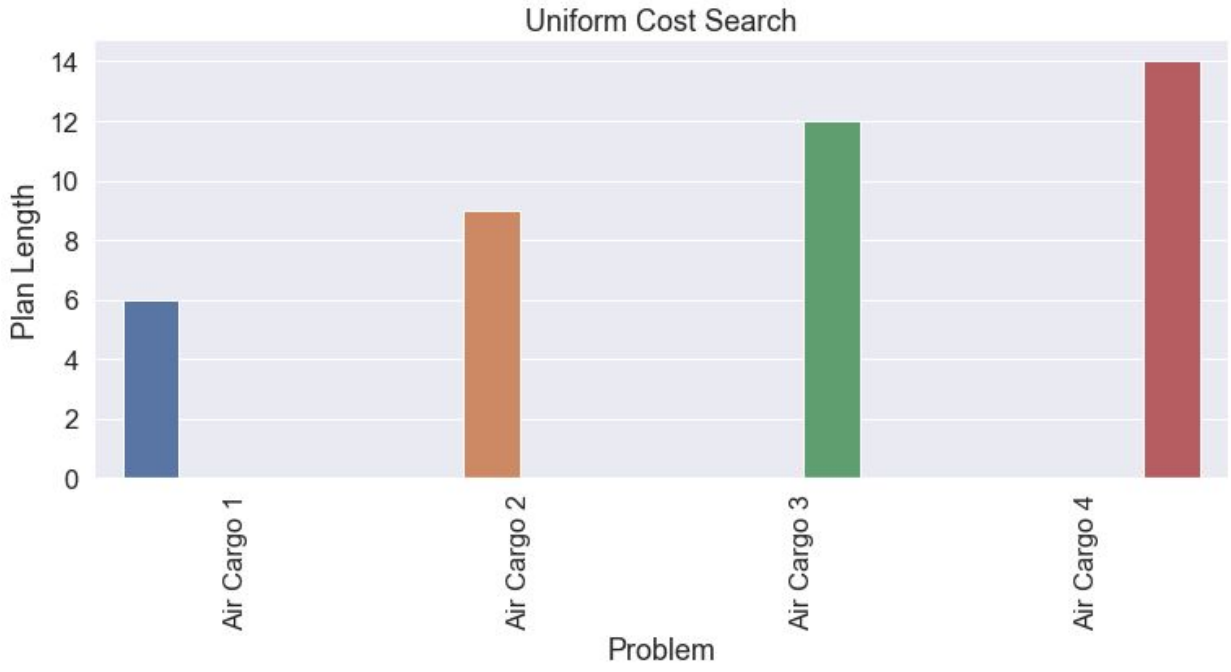
A* search with various heuristics takes the most amount of time to search in any given action domain. Greedy Best First Graph Search with h_unmet_goals takes the least amount of search time for all action domains.

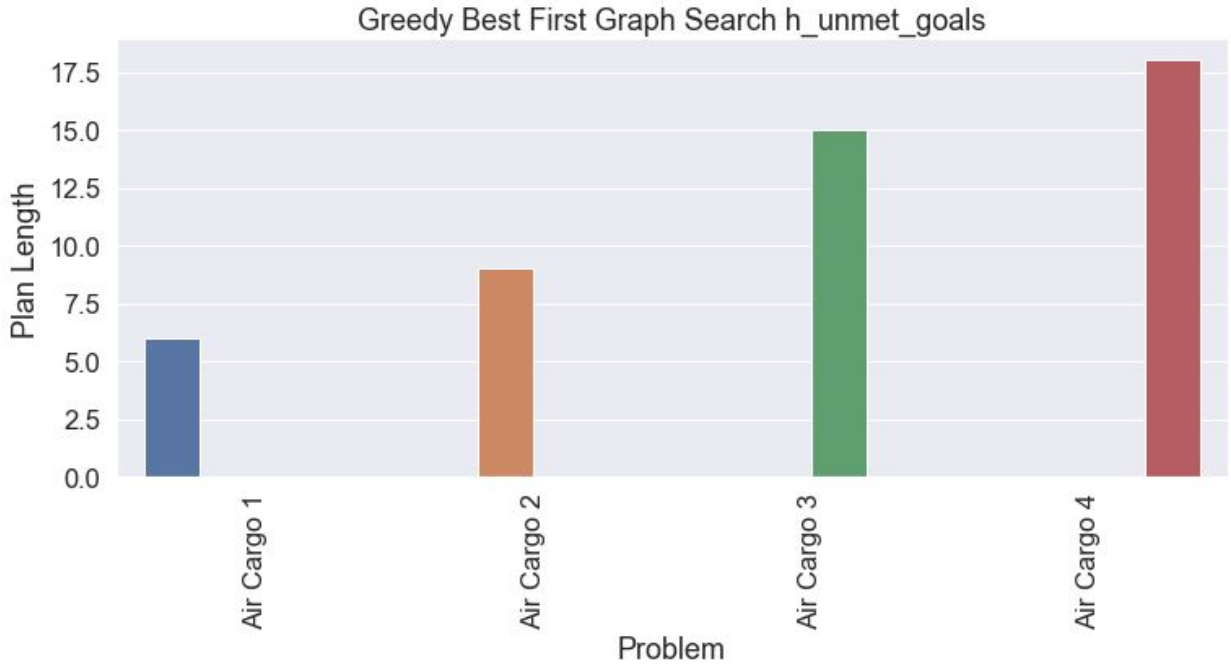
Question 3

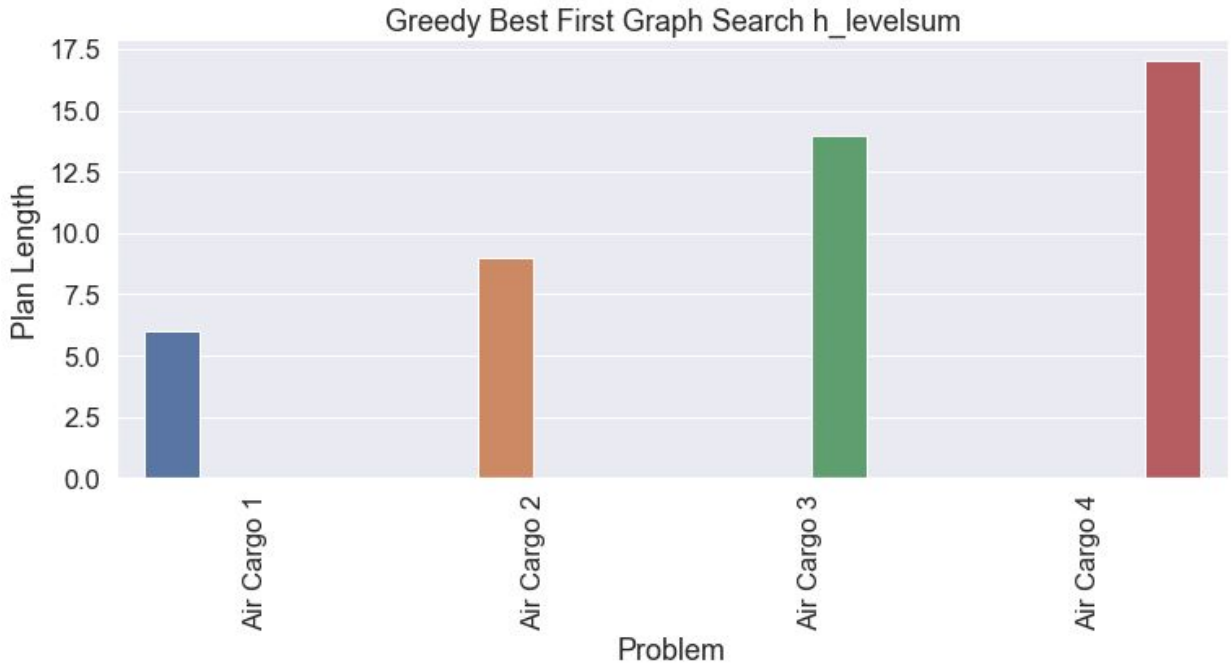
Use a table or chart to analyze the length of the plans returned by each algorithm on all search problems

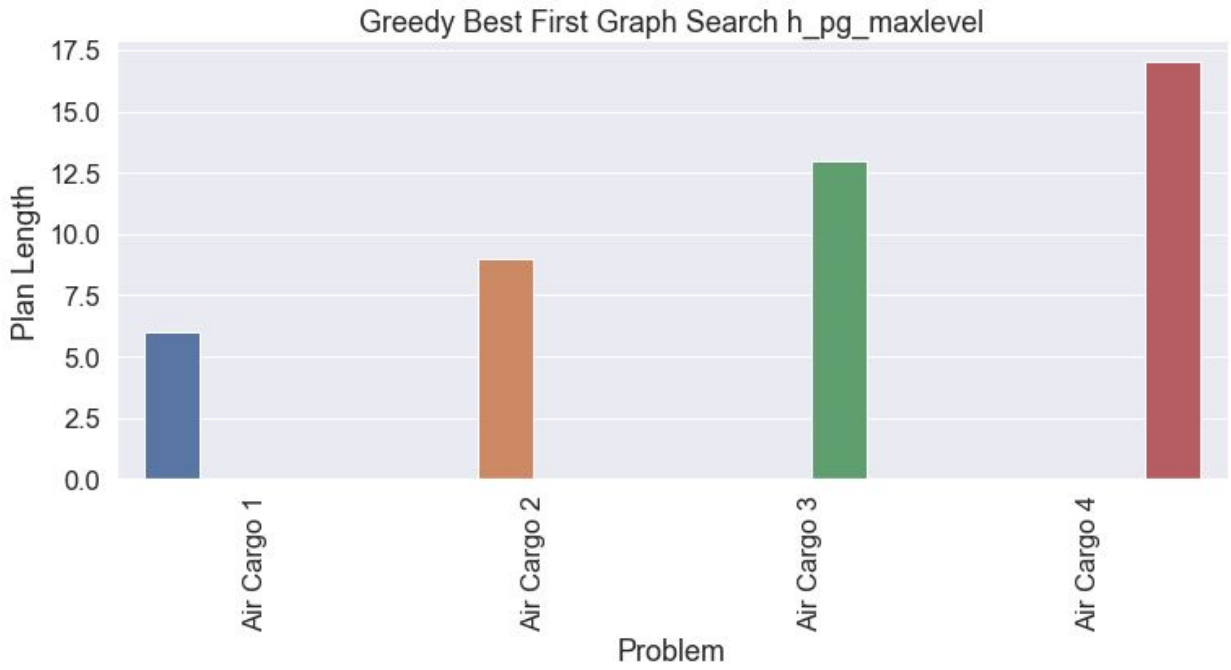


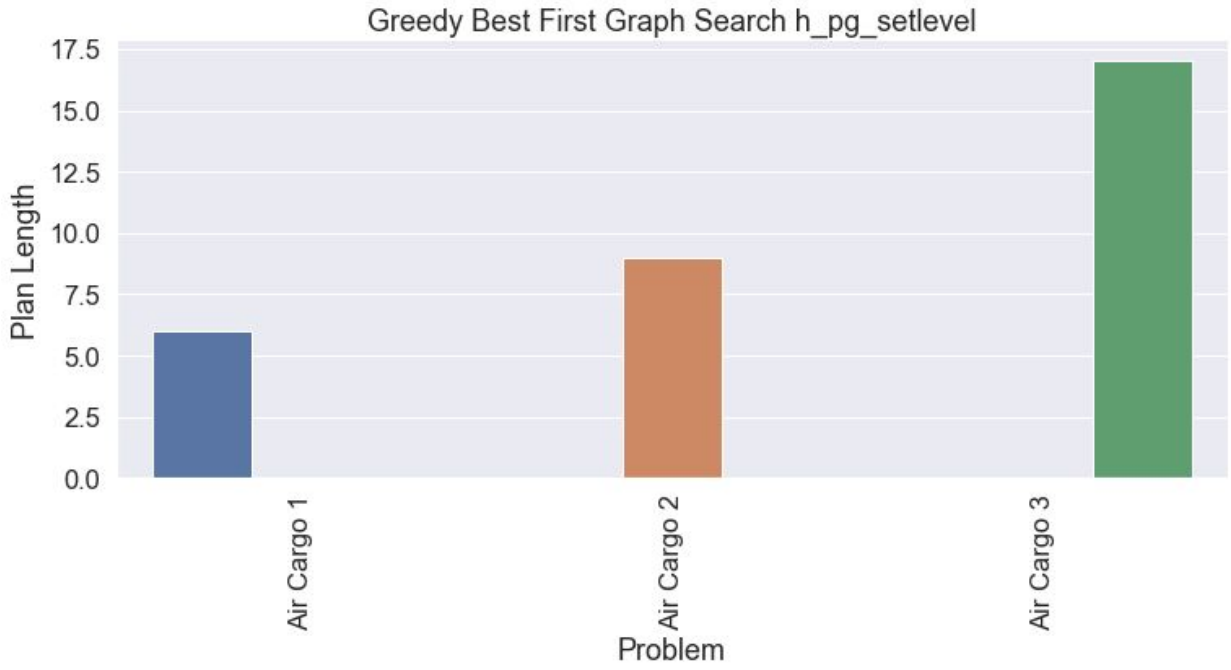


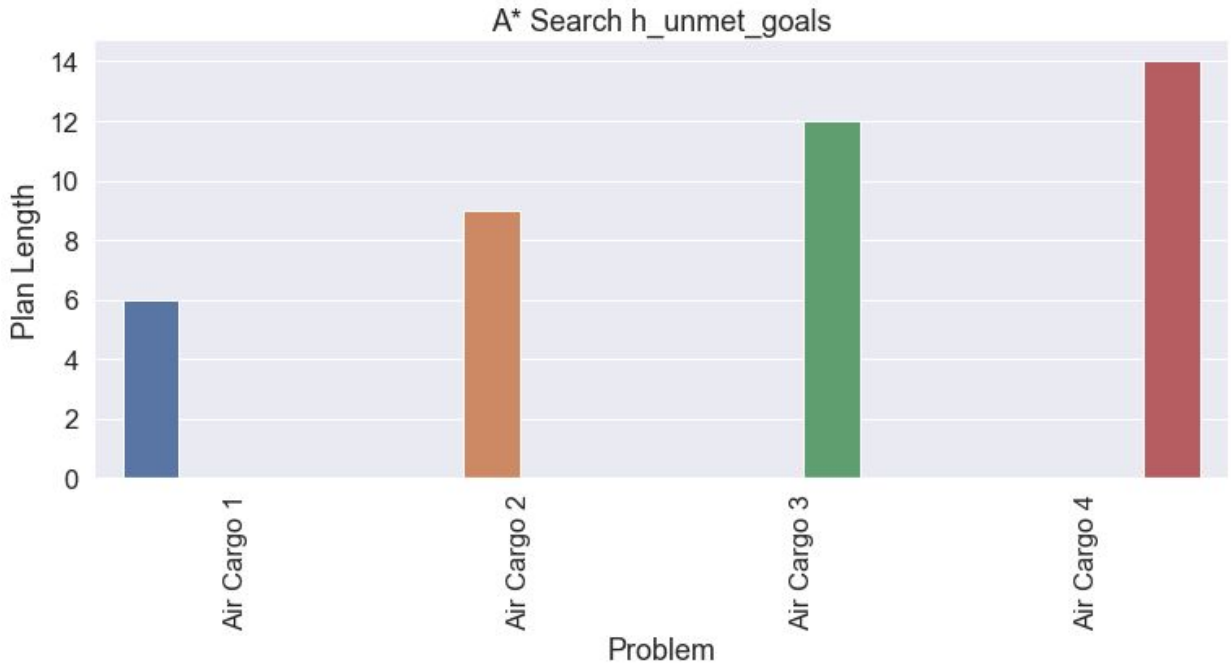

Uniform Cost Search
Plan Length
0
2
4
6
8
10
12
14
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem

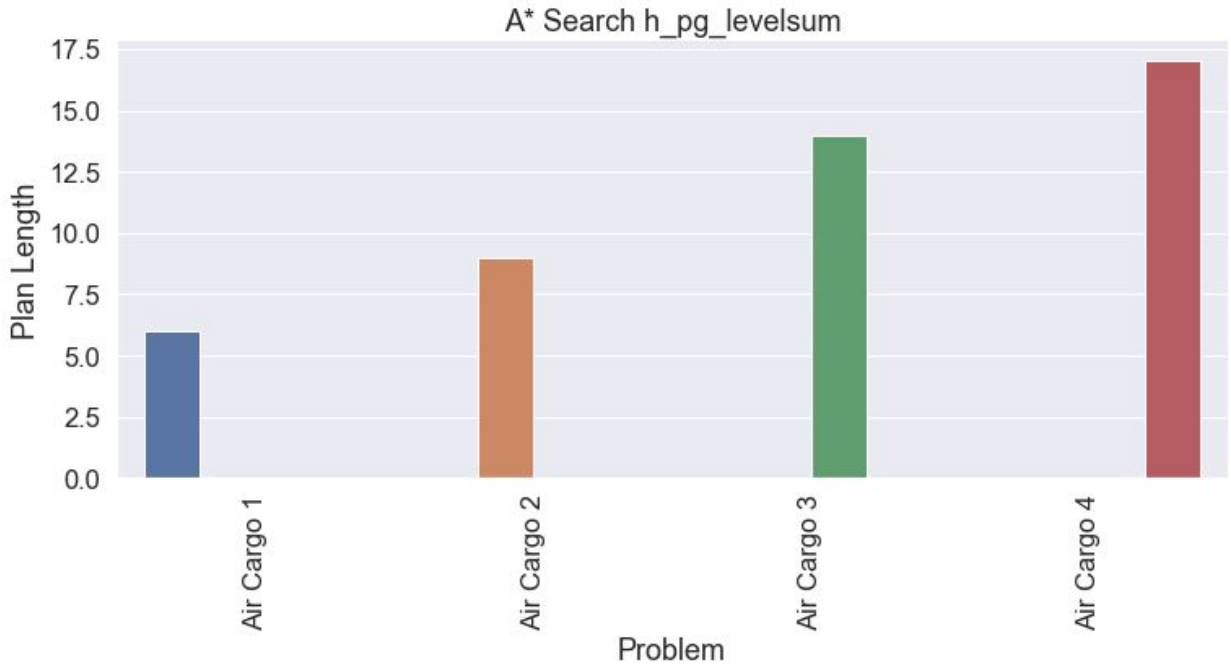

Greedy Best First Graph Search h_unmet_goals
Plan Length
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem

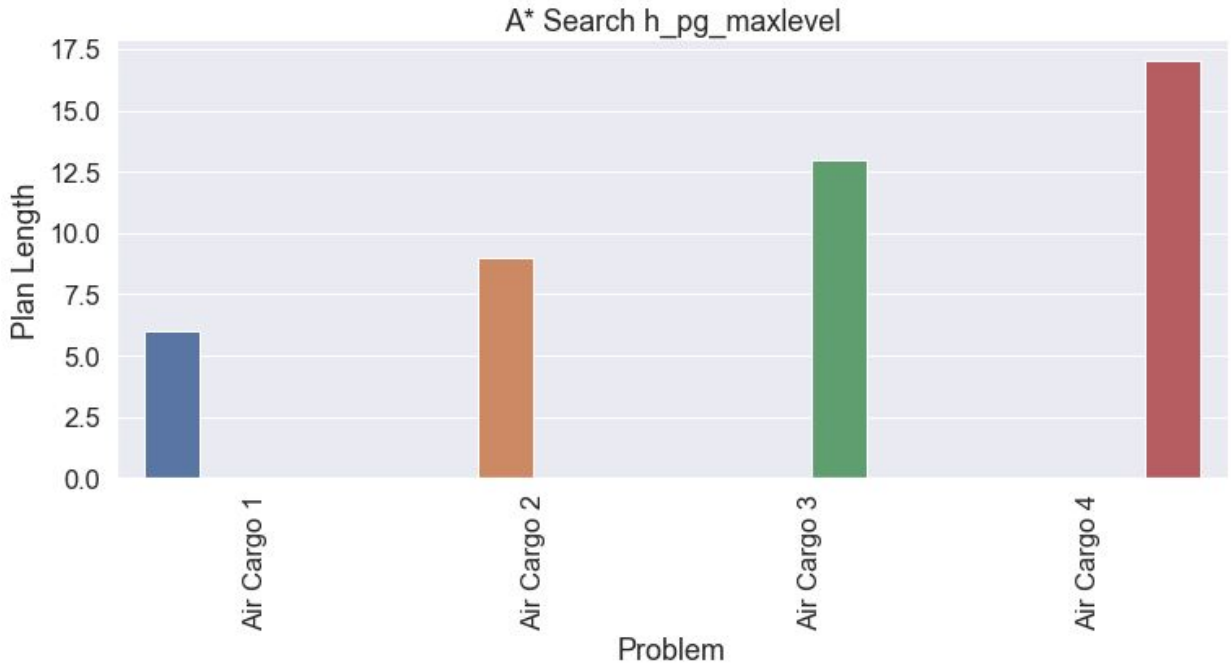

Greedy Best First Graph Search h_levelsum
Plan Length
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem

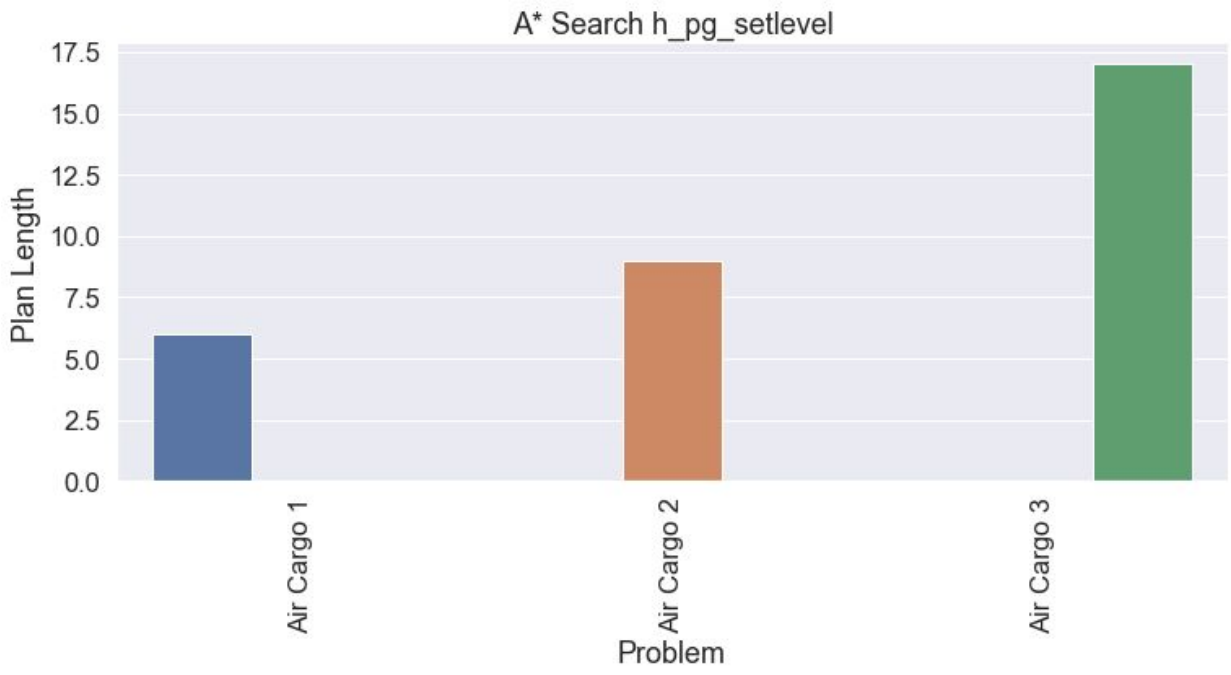

Greedy Best First Graph Search h_pg_maxlevel
Plan Length
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem


Greedy Best First Graph Search h_pg_setlevel
Plan Length
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Air Cargo 1
Air Cargo 2
Air Cargo 3
Problem


A* Search h_unmet_goals
Plan Length
14
12
10
8
6
4
2
0
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem


A* Search h_pg_levelsum
Plan Length
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem


A* Search h_pg_maxlevel
Plan Length
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Air Cargo 1
Air Cargo 2
Air Cargo 3
Air Cargo 4
Problem



Question 3 Observations:¶

The plan length remained largely the same across all algorithms for each search problem--with one notable exception: The Depth First Search generated much longer plan lengths than other algorithms.

Question 4

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?

Greedy Best First Graph Search with Unmet Goals Heuristic would be the most appropriate for planning a very restricted domain that needs to operate in real time because this algorithm finds the solution very fast compared to the others and has minimal plan length (6).

Question 5

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)

Greedy Best First Graph Search with Unmet Goals Heuristic would be the most appropriate for planning a large domain that needs to operate in real time because this algorithm is fast even in large domains such as Air Cargo Problem 3 and Air Cargo Problem 4. A* Search with h_pg_maxlevel and h_pg_setlevel would **not** be appropriate because they take a long time to execute in large domains.

Question 6

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

A* Search would work for planning problems where it is important to find only optimal plans because they continue searching for an optimum path even after the solution has been found. Breadth First Cost Search and Uniform Cost Search would also be able to find an optimal plan.