

# Heuristic Analysis - AIND Planning

## Optimal Plan

	Plan
<b>Problem 1</b>	Load(C1, P1, SFO) Load(C2, P2, JFK) Fly(P1, SFO, JFK) Fly(P2, JFK, SFO) Unload(C1, P1, JFK) Unload(C2, P2, SFO)
<b>Problem 2</b>	Load(C1, P1, SFO) Load(C2, P2, JFK) Load(C3, P3, ATL) Fly(P1, SFO, JFK) Fly(P2, JFK, SFO) Fly(P3, ATL, SFO) Unload(C3, P3, SFO) Unload(C2, P2, SFO) Unload(C1, P1, JFK)
<b>Problem 3</b>	Load(C1, P1, SFO) Load(C2, P2, JFK) Fly(P1, SFO, ATL) Load(C3, P1, ATL) Fly(P2, JFK, ORD) Load(C4, P2, ORD) Fly(P2, ORD, SFO) Fly(P1, ATL, JFK) Unload(C4, P2, SFO) Unload(C3, P1, JFK) Unload(C2, P2, SFO) Unload(C1, P1, JFK)

## Non - Heuristic Search

### Problem 1

	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed in seconds:
Breadth First Search	43	56	180	6	0.1600014899
Depth First Graph Search	12	13	48	12	0.04615733211
Uniform Cost Search	55	57	224	6	0.1911994214

### Problem 2

	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed in seconds:
Breadth First Search	3343	4609	30509	9	45.4882749
Depth First Graph Search	582	583	5211	575	8.509073104
Uniform Cost Search	4852	4854	44030	9	58.32772805

### Problem 3

	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed in seconds:
Breadth First Search	14663	18098	129631	12	274.9904778
Depth First Graph Search	627	628	5176	596	9.877911799
Uniform Cost Search	18235	18237	159716	12	263.2118611

The tables above show that BFS and UCS are both finding the optimal solution. DFGS doesn't find the optimal solution, but it is much faster and doesn't expand as many nodes as the other algorithms.

# Heuristic Search

## Problem 1

	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed in seconds:
Astar Search H1	55	57	224	6	0.200338639
Astar Search H Ignore Preconditions	55	57	224	6	0.3148684554
Astar Search H Pg Levelsum	31	33	126	6	1.070328582

## Problem 2

	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed in seconds:
Astar Search H1	4852	4854	44030	9	57.4273025
Astar Search H Ignore Preconditions	4852	4854	44030	9	102.1657636
Astar Search H Pg Levelsum	2004	2006	18626	9	510.7185525

## Problem 3

	Expansions	Goal Tests	New Nodes	Plan length	Time elapsed in seconds:
Astar Search H1	18235	18237	159716	12	251.2535009
Astar Search H Ignore Preconditions	18235	18237	159716	12	442.9515194
Astar Search H Pg Levelsum	7425	7427	67757	12	2939.334652

The tables above show that *H Pg Levelsum* needs the most time, but it does not expand as many nodes as the other heuristics, this is due to the fact the *H Pg Levelsum* needs to build the entire Planning Graph.

What was the best heuristic used in these problems?

H1

Was it better than non-heuristic search planning methods for all problems? Why or why not?

It do find the shortest path, but the it is slower than BFS for Problem 1 and Problem 2. For Problem 3 it was a little bit faster.