AIND-Planning

Planning Problem Representation:

1. Optimal sequence of action for each problem:

   1.1 Air cargo problem 1

   Load(C1, P1, SFO)
   Fly(P1, SFO, JFK)
   Load(C2, P2, JFK)
   Fly(P2, JFK, SFO)
   Unload(C1, P1, JFK)
   Unload(C2, P2, SFO)

   1.2 Air cargo problem 2

   Load(C1, P1, SFO)
   Fly(P1, SFO, JFK)
   Load(C2, P2, JFK)
   Fly(P2, JFK, SFO)
   Load(C3, P3, ATL)
   Fly(P3, ATL, SFO)
   Unload(C3, P3, SFO)
   Unload(C2, P2, SFO)
   Unload(C1, P1, JFK)

   1.3 Air cargo problem 3

   Load(C1, P1, SFO)
   Fly(P1, SFO, ATL)
   Load(C3, P1, ATL)
   Fly(P1, ATL, JFK)
   Load(C2, P2, JFK)
   Fly(P2, JFK, ORD)
   Load(C4, P2, ORD)
   Fly(P2, ORD, SFO)
   Unload(C4, P2, SFO)
   Unload(C3, P1, JFK)
   Unload(C2, P2, SFO)
   Unload(C1, P1, JFK)

Performance Comparison:

	air_cargo_p1				
	Expansions	Goal Tests	New Nodes	time(s)	plan length
BFS	43	56	180	0.37	6
DFGS	12	13	48	0.24	12
UCS	55	57	224	0.31	6
A* - h_pg_levelsum	11	13	50	1.029	6
A* - ignore preconditions	41	43	170	0.32	6

air_cargo_p2					
	Expansions	Goal Tests	New Nodes	time(s)	pair length
BFS	3,401	4,672	31,049	6.54	9
DFGS	350	351	3,142	0.97	346
UCS	4,761	4,763	43,206	7.37	9
A* - h_pg_levelsum	86	88	841	8.27	9
A* - ignore preconditions	1,450	1,452	13,303	4.53	9

air_cargo_p3					
	Expansions	Goal Tests	New Nodes	time(s)	pair length
BFS	14,491	17,947	128,184	33.4	12
DFGS	1,948	1,949	16,253	4.91	1878
UCS	17,783	17,785	155,920	26.59	12
A* - h_pg_levelsum	311	313	2,863	42	12
A* - ignore preconditions	5,003	5,005	44,506	15.12	12

Analysis of algorithms:

BFS: Is optimal, although the time taken is small only because the depth is small. Because BFS time required increases exponentially with depth. (Russell & Norvig, 2010, pp. 81-83)

DFGS: Non optimal (Russell & Norvig, 2010, pp. 85-87)

UCS: Optimal (Russell & Norvig, 2010, pp. 83-85)

A*: For A* search to be optimal the heuristic has to be admissible (i.e should not overestimate the cost to reach the goal).

A*-levelsum: because this is the sum of paths to the goals it either estimates correctly or underestimates the cost to reach the goal. (Russell & Norvig, 2010, p. 382)

A*-ignore precondition: heuristics generated from ignoring preconditions are admissible(video), and if a heuristic is admissible we can say it is optimal. (Russell & Norvig, 2010, p. 95)

Reference:
Russell, S., & Norving, P. (2010). *Artificial intelligence* (3rd ed.). New Jersey: Pearson.