Analysis

Optimal plan

Problem 1

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

Problem 2

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

Problem 3

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

Comparison between non-heuristic search

Problem 1

Method	Expansion	Goal Tests	New Nodes	Plan Length	Time
BFS	43	56	180	6	0.026
BFTS	1458	1459	5960	6	0.806
DFS	12	13	48	12	0.007
DLS	101	271	414	50	0.075
UCS	55	57	224	6	0.032
A*IP	41	43	170	6	0.027
A*LS	11	13	50	6	0.684

Problem 2

Method	Expansion	Goal Tests	New Nodes	Plan Length	Time
BFS	3343	4609	30509	9	12.037
DFS	1669	1670	14863	1444	11.311
UCS	4853	4855	44041	9	10.522
A*IP	1450	1452	13303	9	3.40
A*LS	86	88	841	9	58.691

Problem 3

Method	Expansion	Goal Tests	New Nodes	Plan Length	Time
BFS	14663	18098	129631	12	86.122
DFS	592	593	4927	571	2.564
UCS	18223	18225	159618	12	46.399
A*IP	5040	5042	44944	12	13.86
A*LS	325	327	3002	12	302.06

Summary

For the heuristic approach, ignore_preconditions have better run-time, whereas level-sum requires less expansion, goal tests and creates less new nodes which uses less memory. Both produces optimal plans.

For the non-heuristic approach, DFS does not guarantee the optimal path, but it has the least run-time for complex problem (Problem 3), since there exist many plan that can achieve the goal. Both BFS and UCS produces the optimal plans. And UCS has the advantage in run-time in complex problems.