Uninformed Search

Problem 1:

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

Only breadth first search produces an optimal plan.

	Expansions	Goal Tests	New Nodes	Plan Length	Time Elapsed:
Breadth first search	43	5	180	6	0.0479
Depth limited search	101	271	414	50	0.1130
Depth first graph search	21	22	84	20	0.03016

Problem 2:

Optimal Plan: Load(C1, P1, SFO), Load(C2, P2, JFK), 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)

Only breadth first search produces an optimal plan.

	Expansions	Goal Tests	New Nodes	Plan Length	Time Elapsed:
Breadth first search	3343	4609	30509	9	26.6800
Depth limited search	222719	2053741	2054119	50	1381.6419
Depth first graph search	624	625	5602	619	4.7600

Problem 3:

Optimal Plan: Load (C1, P1, SFO), Load(C2, P2, JKF), 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)

Breadth first search and uniform cost search produce optimal plans.

	Expansions	Goal Tests	New Nodes	Plan Length	Time Elapsed:
Breadth first search	14663	18098	129631	12	153.9205
Uniform cost search	18223	18225	159618	12	82.5699
Depth first graph search	408	409	3364	392	2.6306

Heuristic Search

Problem 1:

All solutions are optimal.

	Expansions	Goal Tests	New Nodes	Plan Length	Time Elapsed:
A* with h1 search	55	57	224	6	0.0500
A* with h_ignore_preconditions	41	43	170	6	0.0667
A* with h_pg_levelsum	55	57	224	6	1.1676

Problem 2:

All solutions are optimal

	Expansions	Goal Tests	New Nodes	Plan Length	Time Elapsed:
A* with h1 search	4853	4855	44041	9	15.9979
A* with h_ignore_preconditions	1450	1452	13303	9	5.4546
A* with h_pg_levelsum	4853	4855	44041	9	728.1676

Problem 3:

All solutions are optimal

	Expansions	Goal Tests	New Nodes	Plan Length	Time Elapsed:
A* with h1 search	18223	18225	159618	12	81.1557
A* with h_ignore_preconditions	5040	5042	44944	12	24.8607
A* with h_pg_levelsum	18223	18225	159618	12	5119.8050

Analysis:

- The Depth First Search does not return an optimal plan since it goes to the deepest nodes which usually end at convoluted plans.
- Breadth first search returns optimal plans since it checks all the nodes in a given level and only then goes to the next level.
- Ignore precondition heuristic was the fastest since it estimates a good cost for the A star algorithm. It also expands the least nodes in the graph.
- Conclusion: Therefore, the ignore precondition heuristic is the recommended algorithm since it takes the least time and memory.