Logic and Planning

Uninformed Search Tests

The Following are the results of tests using uninformed search.

Problem 1	Expansions	Goal Tests	New Nodes	Plan Lenght	Time Elapsed
Breath First Search	43	56	180	6	0.0743535709916614
Depth First Graph Search	12	13	48	12	0.01335207000374794
A* Search H1	55	57	224	6	0.07291120200534351
Uniform Cost Search	55	5	224	6	0.10046831099316478

Problem 2	Expansions	Goal Tests	New Nodes	Plan Lenght	Time Elapsed
Breath First Search	3343	4609	30509	9	20.04158652901242
Depth First Graph Search	476	477	4253	466	3.575219680002192
A* Search H1	4853	4855	44041	9	77.61358179600211
Uniform Cost Search	4853	4855	44041	9	77.85962436001864

Problem 3	Expansions	Goal Tests	New Nodes	Plan Lenght	Time Elapsed
Breath First Search	14663	18098	129631	12	198.60475270700408
Depth First Graph Search	1511	1512	12611	1442	22.499199126003077
A* Search H1	18223	18225	159618	12	713.9446880209871
Uniform Cost Search	18223	18225	159618	12	698.5272629769752

Analysis:

All algorithms seem to perform well with **Problem 1**, but **Problem 2** and **Problem 3** running times are definitely higher. One of the things were mentioned in the video lectures about search was that for some route finding problems DFS could be innefective because we could end up traveling all accross the country just to find the best route from two nearby cities. We can see something similar if we check the plan length for DFS. It is larger than others and doesn't seem to be an optimal plan. In therms of Plan lenght we can say that other algorithms tested are better.

Informed Search Problems

Problem 1	Expansions	Goal Tests	New Nodes	Plan Lenght	Time Elapsed
A* Search Ignore Preconditions	41	43	170	6	0.1278501100023277
A* Planning Graph Level Sum	8	10	35	6	1.875899639009731

Problem 2	Expansions	Goal Tests	New Nodes	Plan Lenght	Time Elapsed
A* Search Ignore Preconditions	1506	1508	13280	9	29.742081367992796
A* Planning Graph Level Sum	17	19	162	9	45.7323810380185

Problem 3	Expansions	Goal Tests	New Nodes	Plan Lenght	Time Elapsed
A* Search Ignore Preconditions	5118	5120	45650	12	183.82016788300825
A* Planning Graph Level Sum	18	20	169	14	78.21723176701926

Analysis:

A* Planning Graph with Level Sum heuristic performed much better than Ignore Preconditions. Less expansions, nodes and goal tests were needed, even if the plan lenght is bigger by two on Problem 3, it is an optimal plan. According to AIMA, level sum returns the sum of the level cost where any literal of the goal first appears, which is innacurate but works better than the rest.

Theoretically a better heuristic that is not included in the list, nor was tested is the **set level heuristic**, which takes the minimum level where all the literals of the goal appear and are free of mutex.

Optimal Plans

Problem 1 (BFS):

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

Problem 2 (A* Level Sum):

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)

Problem 3(A* Level Sum):

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