Heuristic Analysis for Planning Problems

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Appendix A - Heuristic Table comparison
Appendix B - Optimal Plans

Non-heuristic search comparison

Of the three non-heuristic search, breadth first search offers (BFS) the desirable trait. It is able to find the shortest plan length, while being quicker than the alternative which is the uniform cost search. Depth first graph search offers the quickest search, by a far margin for big problems, but did not come up with a plan with the least length. This trade-off can be worth it depending on time constraint and the amount of energy needed to execute the plan.

Heuristic search comparison

The three heuristic search all reached the optimal plan but with differing performance. While H_1 (fake heuristics that just return 1) is the quickest for a very small problem, the “ignore precondition heuristics” (IPH) outperform it as the problem gets bigger. For problem 3, theIPH outperforms the H_1 by utilizing only 1/4 of the calculation time. Level sum heuristics performed the worse in terms of speed but it is able traverse the graph is the most optimal way. Arguably though, it expands the least amount of node because its traversal during heuristic calculations are not considered counted.

Conclusion

Comparing among all heuristics, I would seriously consider only 3, namely BFS, DFS, and the IPH search. I would use BFS or IPH to find the optimal plan sequence, and depending on the time constraint, may also consider the DFS.

Appendix A: Heuristic Analysis Table

	Plan Length	Time elapsed	Expansion	Goal Tests	New Nodes
Problem 1					
BFS	6	0.0429	43	56	180
DFGS	20	0.0223	21	22	84
UC	6	0.0526	55	57	224
A* H_1	6	0.0610	55	57	224
A* Ignore Precon	6	0.0653	41	43	170
A* Level Sum	6	1.9833	11	13	50
Problem 2					
BFS	9	24.973	3343	4609	30509
DFGS	619	5.921	624	625	5602
UC	9	57.8082	4853	4855	44041
A* H_1	9	62.7966	4853	4855	44041
A* Ignore Precon	9	22.4213	1506	1508	13820
A* Level Sum	9	219.7088	86	88	841
Problem 3					
BFS	12	176.867	14663	18098	129631
DFGS	392	2.432	408	409	3364
UC	12	486.9509	18223	18225	159618
A* H_1	12	612.3070	18223	18225	149618
A* Ignore Precon	12	155.6074	5118	5120	45650
A* Level Sum	12	1428.8658	408	410	3758

Appendix B: Optimal Plans

Problem 1:

Length = 6

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:

Length = 9

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)

Problem 3:

Length = 12

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