AIND Logic and Planning Project Summary

John Carpenter, PEng.

I. Introduction

This project demonstrates different approaches to solving an air cargo simulated logistics and planning scenario. The project will review breadth first, depth first, and A* searches with respect to solving a multiparameter logistic problem.

I. Scenarios

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- Air Cargo Action Schema:
Action(Load(c, p, a),
PRECOND: At(c, a)  At(p, a)  Cargo(c)  Plane(p)  Airport(a)
EFFECT:  At(c, a)  In(c, p))
Action(Unload(c, p, a),
PRECOND: In(c, p)  At(p, a)  Cargo(c)  Plane(p)  Airport(a)
EFFECT: At(c, a)   In(c, p))
Action(Fly(p, from, to),
PRECOND: At(p, from)  Plane(p)  Airport(from)  Airport(to)
EFFECT:  At(p, from)  At(p, to))

- Problem 1 initial state and goal:
Init(At(C1, SFO)  At(C2, JFK)
 At(P1, SFO)  At(P2, JFK)
 Cargo(C1)  Cargo(C2)
 Plane(P1)  Plane(P2)
 Airport(JFK)  Airport(SFO))
Goal(At(C1, JFK)  At(C2, SFO))

- Problem 2 initial state and goal:
Init(At(C1, SFO)  At(C2, JFK)  At(C3, ATL)
 At(P1, SFO)  At(P2, JFK)  At(P3, ATL)
 Cargo(C1)  Cargo(C2)  Cargo(C3)
 Plane(P1)  Plane(P2)  Plane(P3)
 Airport(JFK)  Airport(SFO)  Airport(ATL))
Goal(At(C1, JFK)  At(C2, SFO)  At(C3, SFO))

- Problem 3 initial state and goal:
Init(At(C1, SFO)  At(C2, JFK)  At(C3, ATL)  At(C4, ORD)
 At(P1, SFO)  At(P2, JFK)
 Cargo(C1)  Cargo(C2)  Cargo(C3)  Cargo(C4)
 Plane(P1)  Plane(P2)
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 Airport(JFK)  Airport(SFO)  Airport(ATL)  Airport(ORD))
Goal(At(C1, JFK)  At(C3, JFK)  At(C2, SFO)  At(C4, SFO))
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II. Test Results

Log files and the resultant solutions are found in the results/ subdirectory. All the test trials were executed however only 5 of the result sets are shown in the tables below. Testing was halted at 10min and any solution that took longer than this was halted. Those results are indicated by a - in the tables below.

Each simulation was run on: MacBook Pro (Retina, 13-inch, Early 2015), Processor 2.7Ghz i5, 8GB RAM DDR3.

I. Problem 1

Search Type	Expansions	Goal Tests	New Nodes	Plan Length	Time(s)
Breadth First	59	109	344	6	0.08
Depth First	14	15	75	14	0.02
A*	103	105	635	6	0.16
A* (IG Pre)	51	53	288	6	0.07
A* (Level Sum)	47	49	260	6	9.2

II. Problem 2

Search Type	Expansions	Goal Tests	New Nodes	Plan Length	Time(s)
Breadth First	9217	20288	111313	9	238
Depth First	333	334	4741	333	3.94
A*	24717	24719	313147	9	4949
A* (IG Pre)	3032	3034	34820	9	89
A* (Level Sum)	2367	2369	27096	9	4127

III. Problem 3

Search Type	Expansions	Goal Tests	New Nodes	Plan Length	Time(s)
Breadth First	-	-	-	-	
Depth First	381	382	4881	381	4.38
A*					
A* (IG Pre)	17717	17719	190662	12	3617
A* (Level Sum)	-	-	-	-	-

III. Results

Even as the results each had some variation the pattern of the conclusions seem to remain the same. For the uniformed searches (Breadth First, Depth First); Depth First was significantly faster as expected but didn't return an optimal result. This is expected because of the design of the algorithm to halt once a solution is determined. Breadth first was much more successful as an algorithm but failed in cases where the solution set was quite large (P3). Even at that Breadth First was able to determine an optimal course if you are patient enough.

For the informed A* searches, all three(3) patterns produced an optimal result. Ignoring the preconditions within the A* search had the fewest node expansions and that led to the fastest execution. For P3, A* search failed to produce a solution within the timeframe for all but the ignore preconditions algorithm.

IV. Conclusions

In comparing the two result sets, the informed A* search while ignoring the preconditions would be the best approach for this problem. The A* search produces the optimal result and expands the fewest nodes in doing so.