Planning Self-Check

605.645 – Artificial Intelligence

The purpose of this self-check is to make sure you understand the key concepts for the algorithms presented during the module and to prepare you for the programming assignment. As you work through problems, you should always be thinking “how would I do this in code? What basic data structures would I need? What operations on those basic data structures?”

1. Permissible Actions

Consider the following action using Lisp notation:

(fly ?plane, ?from, ?to)

> precondition: (plane ?plane), (airport ?to), (airport ?from) (at ?plane ?from)
>
> add list: (at ?plane ?to)
>
> delete list: (at ?plane ?from)

and a current state as follows:

(plane 1973)
(airport SFO)
(airport JFK)
(at 1973 SFO)

Demonstrate that the *fly* action is permissible in the current state. Develop an evaluation strategy and work it out long-hand, keeping in mind that a computer program will need to do the same computation.

2. A Multiplicity of Permissibility

Suppose the current state is:

(plane 1973)
(plane 2749)
(airport SFO)
(airport JFK)
(airport ORD)
(at 1973 SFO)
(at 2749 JFK)
(at 97 ORD)
(at 1211 SFO)

Show all the different ways the action *fly* permissible in the current state using your evaluation strategy from #1. How do you need to revise your evaluation strategy to take into account the possibility of an action being useable in more than one way?

3. Forward Planning

Suppose that planes must be fueled. This adds a new action *refuel* and changes the *fly* action. The new action definitions are as follows:

(fly ?plane, ?from, ?to)

precondition: (plane ?plane), (airport ?to), (airport ?from) (at plane ?from), (fueled ?plane)

add list: (at ?plane ?to), (unfueled ?plane)

delete list: (at ?plane ?from), (fueled ?plane)

(fuel ?plane)
precondition: (plane ?plane), (unfueled ?plane)

add list: (fueled ?plane)

delete list (unfueled ?plane)

Suppose the current state is:

(plane 1973)
(plane 2749)
(plane 97)
(plane 1211)
(airport SFO)
(airport JFK)
(airport ORD)
(at 1973 SFO)
(at 2749 JFK)
(at 97 ORD)
(at 1211 SFO)
(fueled 1973)
(unfueled 2749)
(unfueled 97)
(fueled 1211)

Using a forward planning algorithm, find the plan that achieves the following goal state:

(at 1973 ORD)
(at 1211 JFK)
(at 2749 SFO)

Work on the solution in detail.

Digging Deeper

1. How would you add *capacity* to this problem so that one could specify only that planes of a specific capacity would need to be at certain airports in the goal state?
2. Describe a problem that could usefully combine a forward planner and A* search path finding.