CS579 – Planning

Due: 11:59 pm, March 18, 2004 — 6 questions (100 point)

A robot named *Joe* wishes to make a trip from Las Cruces to New York. At its disposal, the robot can do the following actions:

```
Action(Drive(l1, l2),
   Pre:  At(l1) ∧ HasCar Eff:  At(l2) ∧ ¬ At(l1))
Action(Flight(a1, a2),
   Pre:  At(a1) ∧ HasTicket(a1, a2),
   Eff:  At(a2) ∧ ¬ At(a1) ∧ ¬ HasTicket(a1, a2))
Action(BuyTicket(a1, a2),
   Pre:  At(a1) ∧ HasMoney, Eff:  HasTicket(a1, a2) ∧ ¬ HasMoney)
Action(GetMoney:  Pre:  True, Eff:  HasMoney)
```

Note that in the above schema l_1, l_2 are variables denoting locations and a_1, a_2 are variables denoting airports. The domain has two locations: *Las Cruces* and *El Paso* and two airports *El Paso* and *New York*. (To simplify the matter, we will not have a location named *New York*.)

Initially, the robot is in Las Cruces, has money and a car, but does not have any ticket.

1. Name the actions of the domain. Give a precise description of the initial state and the goal in ADL (or STRIPS, if you like) notation.

2. Solve the problem using the A* search method with the empty-delete-list heuristic.

3. Solve the problem using the partial order planning algorithm.

4. Draw two levels of the planning graph of the problem. Include the mutexes between non persistence actions.

5. Consider the planning problem "Joe would like to make a round trip to New York." What would be the best planning approach that is suitable for this problem. Justify your answer.

6. Consider the planning domain in which we have two switches s_1 and s_2. The switch is either in the *on* or *off* position. The action $flip(S)$ has the effect of putting the switch S to the *on* (resp. *off*) position if it was in the position *off* (resp. *on*) position. Initially, both switches are in the *off* position and we would like to have exactly one switch in the on position.

6.1 Represent the problem as a Krippe structure.

6.2 Solve the problem using the `Plan` algorithm. Is the plan obtained from the algorithm a *goal achieving plan*, a *goal preserving plan*, or a *dynamic goal preserving plan*.

6.3 What would change in **6.1** and **6.2** if the action $flip(S)$ might get stuck sometime, i.e., in a few cases, flipping a switch might not change its position.