Homework #5: Chapter 11-12

The following exercises are due at the beginning of class on Wednesday, April 2. Note, this homework is continued on the reverse side of the paper.

1. *[30 points]* Consider the STRIPS actions defined for the air cargo problem in Figure 11.2 on page 380 of the book, and the problem instance described below:

   Initial State: At(P1,LAX) ∧ At(P2,JFK) ∧ At(C1,LAX) ∧ In(C2,P1) ∧ Plane(P1) ∧ Plane(P2) ∧ Cargo(C1) ∧ Cargo(C2) ∧ Airport(JFK) ∧ Airport(LAX) ∧ Airport(ORD)

   Goal: At(P1,JFK) ∧ At(P2,ORD) ∧ At(C1,JFK) ∧ In(C2,P2)

   a) *[15 points]* Do the first level of a breadth-first forward state-space search on this problem. You should show all actions that are applicable in the initial state, as well as the successor states that result from these actions. For convenience, your state descriptions may omit literals that use the Plane, Airport, and Cargo predicates. Note, some of the applicable actions may be spurious, but you should show them anyway.

   b) *[15 points]* Do the first level of a breadth-first backward state-space search on this problem. You should show all actions that are relevant and consistent with the given goal, and show the predecessor states for these actions. In addition to omitting literals that use the Plane, Airport, and Cargo predicates as above, you may use variables as parameters for the actions.

2. *[40 points]* Consider the problem of devising a plan for cleaning the kitchen. Assume the following:
   - Cleaning the stove or the refrigerator will get the floor dirty.
   - To clean the oven, it is necessary to apply oven cleaner and then to remove the cleaner.
   - Before the floor can be washed, it must be swept.
   - Before the floor can be swept, the garbage must be taken out.
   - Cleaning the refrigerator generates garbage and messes up the counters.
   - Washing the counters or the floor gets the sink dirty.

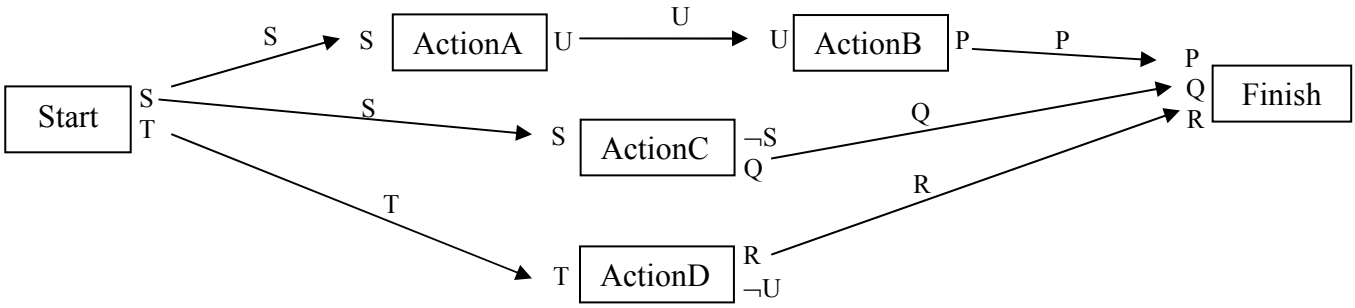
   a) *[5 points]* Define a set of STRIPS predicates for describing states of this problem. Hint: If you use constants to represent the various objects in need of cleaning, then five to seven predicates should be sufficient.

   b) *[20 points]* Define a set of STRIPS operators representing all of the actions mentioned in the description above. Be sure that your preconditions and effects accurately capture the information given in this description. You do not need to add any preconditions not mentioned (such as, in order to sweep the floor, you need to own a broom).

   c) *[5 points]* Using STRIPS, give a likely initial state for a kitchen in need of cleaning and a goal state that represents the ideal, clean kitchen.

   d) *[10 points]* Provide a totally ordered plan that is a solution to the problem as you have defined it. You do not need to use an algorithm to find the plan, nor do you need to show your work.

3. *[20 points]* Consider the inconsistent partially ordered plan below. Identify the conflicts in this plan and show all ways of resolving them that follow the principle of least commitment. For each solution, draw the new partially ordered plan, and list all of its linearizations.



4. *[10 points]* Give a real-world example of bounded indeterminacy. Give one of unbounded indeterminacy. Do not repeat the examples from the book or class. Explain your answers.