Automated Planning Course

Assessed Assignment 1

This is the first of two assessed assignments for the Automated Planning course 2009/10. This assignment accounts for 15% of the final mark of the course.

Date handed out: 15/10/2009
To be handed in at the ITO: 5/11/2009, before 4pm!

1. State Transition Systems
   a. Define a state transition system for a ticket vending machine that accepts 10p, 20p, and 50p coins; the price of a ticket is 60p. Users must insert coins until at least 60p have been inserted. The machine then issues a ticket and returns correct change.
   b. Which of the restricting assumptions (finite, fully observable etc.) apply to your state transition system?

2. The DWR Domain
Go to the course book web-site (http://www.laas.fr/planning/) and download the PDDL specification of the DWR domain and the two problems defined there.
   a. Draw the initial state for each of the two problems as a picture. This should show the topology and location of different objects defined in the problem.
   b. Draw a possible goal state for the smaller problem with 1 robot and 2 locations. How many different goal states are there?

3. State-Space Search
Consider the random planning domain and problem in the appendix.
   a. Which actions are applicable in the given initial state? Note that actions are instances of the given operators and there may be multiple different instances of the same operator applicable. Justify your answer.
   b. Which of the actions applicable in the initial state are also relevant for the goal, if any? Justify your answer.

4. Plan-Space Search
   a. Define a partial plan that represents the initial state for the 1 robot/2 locations problem in the plan-space search approach.
   b. Simulate the search as performed by the PoP procedure for the first 3 levels. When there is a choice point, choose one option to simulate, but indicate which choice points are deterministic and which are non-deterministic, i.e. which ones are backtrack points.

MSc only question

Discuss the differences (advantages and disadvantages) between state- and plan-space search.

Appendix: Random Planning Domain and Problem

```
(define (domain random-domain)
  (:requirements :strips)
  (:action op0
    :parameters (?x1 ?x2 ?x3)
    :precondition (and (R1 ?x2 ?x2) (P2 ?x1 ?x2) (R0 ?x2 ?x2 ?x1)
      (P2 ?x2 ?x2) (not (P1 ?x2 ?x2 ?x2)) (not (P0 ?x2))
      (not (P1 ?x1 ?x2 ?x2)))
    :effect (and (P0 ?x1) (P2 ?x1 ?x3) (P0 ?x2) (P2 ?x3 ?x1)
      (not (P2 ?x1 ?x2))))
  (:action op1
    :parameters (?x1 ?x2 ?x3)
    :precondition (and (P1 ?x3 ?x1 ?x2) (not (P0 ?x1))
      (not (R0 ?x2 ?x2 ?x1)))
    :effect (and (P0 ?x2) (P1 ?x1 ?x2 ?x1) (P0 ?x3)
      (P1 ?x1 ?x1 ?x1)))
  (:action op2
    :parameters (?x1 ?x2 ?x3)
    :precondition (and (R1 ?x2 ?x1) (P2 ?x3 ?x3)
      (not (P1 ?x2 ?x1 ?x3)) (not (P1 ?x3 ?x1 ?x2))
      (not (R1 ?x3 ?x2)))
    :effect (and (P2 ?x1 ?x2) (P0 ?x1) (P2 ?x2 ?x1) (P0 ?x2)
      (not (P2 ?x3 ?x3)))))

(define (problem random-problem)
  (:init
    (R0 obj9 obj1 obj5) (R0 obj8 obj9 obj8) (R0 obj0 obj6 obj3)
    (R0 obj0 obj0 obj4) (R0 obj0 obj5 obj3) (R0 obj0 obj6 obj0)
    (R0 obj2 obj7 obj6) (R0 obj9 obj2 obj9)
    (R1 obj2 obj5) (R1 obj3 obj1) (R1 obj0 obj1) (R1 obj6 obj7)
    (R1 obj9 obj5) (R1 obj0 obj7) (R1 obj1 obj0) (R1 obj1 obj5)
    (R1 obj3 obj5) (R1 obj0 obj9) (R1 obj0 obj0) (R1 obj2 obj3)
    (P0 obj3) (P0 obj8) (P0 obj1) (P0 obj0) (P0 obj9) (P0 obj4)
    (P1 obj8 obj7 obj6) (P1 obj3 obj7 obj0) (P1 obj9 obj1 obj2)
    (P1 obj6 obj7 obj3) (P1 obj2 obj0 obj9) (P1 obj8 obj9 obj8)
    (P1 obj4 obj9 obj1) (P1 obj1 obj1 obj3)
    (P2 obj0 obj0) (P2 obj9 obj9) (P2 obj2 obj3) (P2 obj3 obj9)
    (P2 obj4 obj6) (P2 obj3 obj1))
  (:goal
    (and
      (P2 obj3 obj8) (P0 obj0) (P2 obj0 obj5) (P0 obj9) (P0 obj4))))
```