Problem 1: PDDL example

We car that has a flat tire. We are in the following situation.

- The car has its flat tire on the axle.
- There is a spare tire in the trunk.
- The driver can remove any tire from any place (i.e., either axle or trunk) and put it on the ground.
- The driver can put any tire that is on the ground to any place that is empty.

Formulate this problem in PDDL and draw the corresponding plan graph.

Problem 2: More PDDL

Suppose you have a robot that moves in a house with several rooms and can pickup balls and put them down. More precisely, the robot has three actions: Navigate from one room to another, Pickup a certain ball from a certain room, and Putdown a certain ball to a certain room. Your robot can carry several balls all at once. Model this problem using PDDL. Write down the predicates and the actions.

Assume that the house has a bedroom and a kitchen. Assume also that there is only one ball called the blueball. Initially, the blueball is in the bedroom. The robot starts in the kitchen. The goal is to take the blueball to the kitchen. Write down your objects, initial condition, and goal condition in PDDL.
Problem 3: Planning graphs – baking the cake

Consider the following PDLL specification. Draw the corresponding plangraph until it levels off, i.e., reaches a fixed point. Indicate the mutexes.

```pdll
(:predicates (AT ?ball ?room)
  (IN ?room))

(:action Eat :parameters (?cake)
  :precondition (HAVE ?cake)
  :effect  (and (not (HAVE ?cake))
             (EATEN ?cake)))

(:action Bake :parameters (?cake)
  :precondition (not (HAVE ?cake))
  :effect   (HAVE ?cake))

(:objects cake)

(:init (HAVE cake))

(:goal (and (HAVE ?cake)
             (EATEN ?cake)))
```

Problem 4: More planning graphs – Robot navigation

Recall the PDDL specification you had worked with in Problem 2. Draw the first two levels of the corresponding plan graph. Explain the execution of the GRAPHPLAN algorithm on the first two layers.
16.410 / 16.413 Principles of Autonomy and Decision Making
Fall 2010

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