Comp3620/Comp6320 Artificial Intelligence
Tutorial 5: Planning Representations and Graph-Based Approaches

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Exercise 1 (STRIPS problem formulation)

This is part of exercise 10.3 from the book. The monkey-and-bananas domain features a monkey in a laboratory with some bananas hanging out of reach from the ceiling. A box is available that will enable the monkey to reach the bananas by pushing the box underneath them and climbing onto it. Initially, the monkey is at location A, the bananas are at location B, and the box is at location C. When the monkey climbs onto the box, the monkey's height changes from *floor* to *ceiling*. The actions available are *Go* from one location to another, *Push* a pushable object from a location to another, *ClimbUp* onto or *ClimbDown* from a climbable object, and *Grasping* a graspable object. Grasping results in having the object if the monkey and object are at the same place and same height. Suppose that the goal of the monkey is to fool the scientists by getting the bananas but returning the box to its original place and then going back to its original location. Recall that STRIPS does not have negative preconditions nor negative goals.

Questions:

1. Describe the problem using the STRIPS representation (operators, initial state, goal).
2. Give the shortest sequential plan for this problem.
3. What is the STRIPS rule? Apply it to determine the description of the state resulting from applying the first action of the plan in the initial state.

Exercise 2 (ADL to STRIPS)

Consider the following action description, written in the ADL fragment of PDDL.

```
(:action A
:precondition (p)
:effect (and (not (p))
             (when (q) (r))
             (q))
)
```

Questions:

1. Write down a set of equivalent plain STRIPS actions (i.e., without conditional effects, and without disjunction or negation in the preconditions)
2. Describe the changes that would need to be made to other actions in the domain description, the initial state and/or the goal in order to make the domain fall only within the STRIPS language

Exercise 3 (Graph-Based Planning)

Consider the following planning problem. You want a sheep and a goat. Using your credit card, you can buy a sheep from the Automatic Sheep Machine (ASM). Waving your magic wand turns a sheep into a goat. The planning operators are as follows, where a box represents an operator whose pre-conditions are on the left-hand side and effects are on the right-hand side of the box.

Show how graphplan would solve the problem:

1. Draw the planning graph until the first level leading to a plan. Include all mutex relations.
2. State at which levels Graphplan would attempt extraction.
3. Highlight in the graph the plan extracted by Graphplan (include the maintenance actions chosen).
4. Given the built planning graph structure, provide at least two heuristics that can be computed from the graph and then used in an informed state space heuristic search framework (e.g., A*). Report the estimated distance to the goal in the initial state for each heuristic.