Tutorial Week 3

1. **Modified from [RN 10.3 Kindle Edition]**

$Init(At(C_1, SFO) \land At(C_2, JFK) \land At(P_1, SFO) \land At(P_2, JFK)$
$\quad \land Cargo(C_1) \land Cargo(C_2) \land Plane(P_1) \land Plane(P_2)$
$\quad \land Airport(JFK) \land Airport(SFO))$
$Goal(At(C_1, JFK) \land At(C_2, SFO))$
$Action(Load(c, p, a),$
$\quad$ PRECOND: $At(c, a) \land At(p, a) \land Cargo(c) \land Plane(p) \land Airport(a)$
$\quad$ EFFECT: $\neg At(c, a) \land In(c, p))$
$Action(Unload(c, p, a),$
$\quad$ PRECOND: $In(c, p) \land At(p, a) \land Cargo(c) \land Plane(p) \land Airport(a)$
$\quad$ EFFECT: $At(c, a) \land \neg In(c, p))$
$Action(Fly(p, from, to),$
$\quad$ PRECOND: $At(p, from) \land Plane(p) \land Airport(from) \land Airport(to)$
$\quad$ EFFECT: $\neg At(p, from) \land At(p, to))$

(a) Given the action schemas and initial state from the figure above, what are all the applicable concrete instances of $Fly(p, from, to)$ in the state described by

$$At(P_1, JFK) \land At(P_2, SFO) \land Plane(P_1) \land Plane(P_2) \land Airport(JFK) \land Airport(SFO)?$$

(b) What is the result of executing the action $Load(C_2, P_2, JFK)$ from the initial state?

(c) In regression or relevant-state search, we use *description* instead of state.
True or false: the goal in STRIPS is a description instead of a state. Why?

(d) What actions are relevant to the description $In(C_2, p)$?

(e) What is the outcome of regressing the description $At(C_1, JFK) \land At(C_2, SFO)$ over action $Unload(C_1, p, JFK)$?

2. **[RN 10.4]** The monkey-and-bananas problem is faced by 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 if he climbs on it. Initially, the monkey is at A, the bananas at B, and the box at C. The monkey and box have height Low, but if the monkey climbs onto the box he will have height $High$, the same as the bananas. The actions available to the monkey include Go from one place to another, $Push$ an object from one place to another, $ClimbUp$ onto or $ClimbDown$ from an object, and $Grasp$ or $Ungrasp$ an object. The result of a $Grasp$ is that the monkey holds the object if the monkey and object are in the same place at the same height.

(a) Write down the initial state description in STRIPS.

(b) Write the six action schemas in STRIPS.

3. **[RN 10.6]** Explain why dropping negative effects from every action schema in a planning problem results in a relaxed problem. (Assume STRIPS is used, i.e. that goals and preconditions only have positive literals.)