3rd Midterm Exam
Monday May 4
75 minutes == 75 points
Open book and notes - no computer

1. 15 points
Express each of the following statements in first-order logic and convert to CNF, skolemizing as needed.

1. All computer science majors own a Mac or a PC.
2. All Mac users own an IPOD.
3. All except one student in the statistics class are Math majors.
4. IPOD owners love music.
5. John is a CS major who does not like music.

Prove by resolution with refutation that “John owns a PC”

2. 15 points

1. Represent using a semantic networks that “Bill cut down the apple tree with a saw.”
2. Represent using a semantic networks that “Quakers are pacifists. Republicans are not pacifist. Nixon is a quaker. Nixon is a republican.”
3. Do you see any problem in finding out if Nixon is a pacifist? What difficulty do you encounter?

3. 15 points
You are given a number of blocks on a table. Assume that only one block at a time can be moved and that there is enough space on the table to place as many blocks as needed.

Can you write, using the STRIPS language, a single action schema to move a block?

If you use ADL instead and include type checks and conditional effects, can you write a single action schema? If yes, show the action schema, if not explain why not.
4. 15 points
You are given the following STRIPS-like action schemata for calling an elevator and riding an elevator:

Actions
Op(Action: CallElevator(p, e, f),
   Precond: On(p, f) \land At(e, g)
   Effect: At(e, f) \land \neg At(e, g)

Op(Action: RideElevator(p, e, f1, f2),
   Precond: On(p, f1) \land At(e, f1)
   Effect: On(p, f2) \land \neg On(p, f1) \land At(e, f2) \land \neg At(e, f1)

Initial State: At(E, Floor2) \land On(Bill, Floor3)
Goal: On(Bill, Floor1)

1. Draw the planning graph. Mark all the mutexes between action instances and between propositions, and indicate for each the type of mutex.
2. At what level is the problem solved? why?

5. 15 points
Answer these questions briefly but precisely:

1. If you use successor state axioms instead of STRIPS-like schemas, how can you decide how many successor state axioms do you need? Explain.
2. Suppose you are using a planning graph. Can a lower bound on the number of actions needed to achieve a goal be computed? How? Does it make a difference if the goal is a single literal or a conjunction of literals?
3. In a planning graph, why if a goal is achievable at level i, it is also achievable in all the subsequent proposition levels?