CS 731 Exam 2

November 15, 2000

Question 1 (15 points)

Does the first clause below subsume the second clause below? (Capital letters denote variables as usual.) If so, please show the substitution you used; if not, please indicate why a satisfactory substitution cannot be found.

$q(X,Y) \vee q(Y,Z) \vee q(Z,W)$
$q(A,B) \vee q(B,A)$

Question 2 (15 points)

What is the LGG of the following two clauses?

$p(f(a),a) \vee p(f(b),f(b)) \vee p(b,a)$
$p(f(b),b) \vee p(a,a)$

Question 3 (15 points)

Given the modes and background knowledge below, what bottom clause would Progol build for the positive example *eastbound*(*east*1)?

```
% Modes
:- modeh(1,eastbound(+train))?
:- modeb(*,has_car(+train,-car))?
:- modeb(1,long(+car))?
:- modeb(1,open(+car))?

% Types
train(east1).
car(car_11).  car(car_12).  car(car_13).

% Background Knowledge
long(car_11).
long(car_12).
open(car_11).
open(car_13).
has_car(east1,car_11).
has_car(east1,car_12).
has_car(east1,car_13).
```

Question 4 (25 points)

Consider the standard blocks world with only two blocks, *a* and *b*, and suppose the world is as described by the propositions below. Draw the next action level and proposition level of the Graphplan planning graph, including the mutex relations *among actions only.* Please do *not* show mutex relations at the propositional levels (it gets too messy). Be sure to treat each different instance of an operator as a different action (e.g. stack(a,b) and stack(b,a) are 2 different actions).

`~holding(a)`

`clear(a)`

`ontable(a)`

`handempty`

`ontable(b)`

`clear(b)`

`~holding(b)`

`~ontop(a,b)`

`~ontop(b,a)`

Question 5 (30 points)

(Same setting as in the DBN review question, but different query). Suppose we are inside a device moving around a 3-by-3 grid. Our only sensor is a heat sensor that is 80% accurate in its binary ("hot" or "cold") measurements. All the squares along the edge are hot while the center edge is cold. We begin (t=0) in a randomly, uniformly selected square, and at every time step the device moves to an adjacent square (one that shares an edge with the current square, so diagonal moves are not allowed). Suppose our sensor observations are cold (t=1), hot (t=2), cold (t=3). What is the probability distribution over squares at time t=3? Hint: build a dynamic Bayes Net, and group the squares into the 3 classes: corner, side, and middle. It is sufficient to give your final distribution as a distribution over these 3 classes rather than over the 9 squares.