CS 560: Homework 3

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Question 1

Let $I = \{D, \phi, \pi\}$ be any model of KB.
Let $\phi(a) = A$
Let $\phi(b) = B$
Let ρ be the variable assignment that maps a to A and b to B respectivly.

Since $p(X, Y) \in KB$, $I_\rho(P(X, Y))$ is true.
So, $\pi(p)(\rho(X), \rho(Y))$ is true.
So, $\pi(p)(A, B)$ is true.
Therefore, $I(p(a, b))$ is true.

Since I is a modle of KB it follows that $KB \models p(a, b)$

Question 2

animal(X) <-- dog(X)
gets_pleasure(X) <-- animal(X) ^ feeding(X)
likes(X,Y) <-- person(X) ^ animal(Y) ^ owns(X,Y)
does_for(X,Y) <-- person(X) ^ animal(Y) ^ gets_pleasure(Y)

Question 3

? does_for(mary,Y)

Question 4

Question 5

?- append(A,[a|B],[b,a,d,a,c,a]).
A = [b],
B = [d, a, c, a] ;
A = [b, a, d],
B = [c, a] ;

A = [b, a, d, a, c],
B = [] ;

?- append(X,[A,B|Y],[a,b,c,d,e]).
X = [],
A = a,
B = b,
Y = [c, d, e] ;
X = [a],
A = b,
B = c,
Y = [d, e] ;
X = [a, b],
A = c,
B = d,
Y = [e] ;
X = [a, b, c],
A = d,
B = e,
Y = [] ;

Question 6

?- subset([a,b],[b,a,d]).
true.

?- subset([X,Y],[b,a,d]).
X = a,
Y = a;
X = b,
Y = b;
X = d,
Y = d;
X = a,
Y = b;
X = b,
Y = a;
X = a,
Y = c;
X = c,
Y = a;
X = a,
Y = d;
X = d,
Y = a;

X = b,
Y = d;
X = d,
Y = b;

?- subset(S,[b,a,d]).
S = [];
S = [a];
S = [b];
S = [d];
S = [a,a];
S = [a,b];
S = [a,c];
...

This usage of set does not fit the mathematical difinition of a set because in this situation the same value can occour multiple times in a set. A dictionary would be a better structure for a set.

Question 7

shorter([_],_).
shorter([_|B],[_|J]) <- shorter(B,J).

?- shorter([a,g],[b,a,d,a]).
true.

?- shorter([a,a,d,a],[a,g]).
false.

?- shorter([a,a,a,a],[a,b]).
false.

?- shorter(L,[b,a,d,a]).
L = [] ;
L = [W] ;
L = [W, X] ;
L = [W, X, Y] ;
L = [W, X, Y, Z] ;

?- shorter([b,a,d,a],L).
L = [W, X, Y, Z|K].

Question 8

remove(E,[E|Y], Y).
remove(E,[A|B],[A|C]) <- remove(E,B,C).

?- remove(a,[b,a,d,a],R).
R = [b, d, a] ;
R = [b, a, d] ;

?- remove(E,[b,a,d,a],R).
E = b,
R = [a, d, a] ;
E = a,
R = [b, d, a] ;
E = d,
R = [b, a, a] ;
E = a,
R = [b, a, d] ;

?- remove(E,L,[b,a,d]).
L = [E, b, a, d] ;
L = [b, E, a, d] ;
L = [b, a, E, d] ;
L = [b, a, d, E] ;

?- remove(p(X),[a,p(a),p(p(a)),p(p(p(a)))], R).
X = a,
R = [a, p(p(a)), p(p(p(a)))] ;
X = p(a),
R = [a, p(a), p(p(p(a)))] ;
X = p(p(a)),
R = [a, p(a), p(p(a))] ;

Question 9

Question 10

plus(X,0,X).
plus(X, s(Y), Z) <-- plus(s(X), Y, Z).

Question 11

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times(X,0,0).
times(X,1,X).
times(X,s(Y),Z) <-- times(X,Y,Z) ^ plus(Z,X,Z)


neq(X,Y) <-- lt(X,Y)
neq(X,Y) <-- lt(Y,X)
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Question 12

Question 13

Question 14

Question 15