**CSE 620A**

**Spring 2021**

**Day 7 – Class Participation**

1. Compute the answer sets of the following program:

m(a).

m(b).

p(X) | q(X) :- not r(X), m(X).

-p(X) :- h(X), not r(X), m(X).

h(a).

h(b).

r(a).

Show all your work (step by step) and describe all your reasoning. Hint: Start by listing the objects in the signature of this program. Then ground the program.

1. Start by listing the non-variadic atoms

Atoms: m(a), m(b), h(a), h(b), r(a)

1. Rewrite the program by grounding the variable rules

m(a).

m(b).

h(a).

h(b).

r(a).

p(a) | q(a) :- not r(a), m(a).

p(b) | q(b) :- not r(b), m(b).

-p(a) :- h(a), not r(a), m(a).

-p(b) :- h(b), not r(b), m(b).

3. Start with all known values

S1 = {m(a), m(b), h(a), h(b), r(a)}

Due to the number of predefined constants, it does not initially look like

anything needs added to the list of the first set

4. Reduct with respect to S1

m(a).

m(b).

h(a).

h(b).

r(a).

~~p(a) | q(a) :-~~ ~~not r(a), m(a).~~

p(b) | q(b) :- ~~not r(b), m(b).~~

-~~p(a) :- h(a),~~ ~~not r(a), m(a).~~

-p(b) :- ~~h(b), not r(b), m(b).~~

Pick the non-contradictory option (I.E p(b) and -p(b) is contradictory)

S = {m(a), m(b), h(a), h(b), r(a), q(b), -p(b)}

S != S1, so we try again

5. Start with new set:

S2 = {m(a), m(b), h(a), h(b), r(a), q(b), -p(b)}

6. Reduct with respect to S2

m(a).

m(b).

h(a).

h(b).

r(a).

~~p(a) | q(a) :- not r(a), m(a).~~

p(b) | q(b) :- ~~not r(b), m(b).~~

~~-p(a) :- h(a), not r(a), m(a).~~

-p(b) :- ~~h(b), not r(b), m(b).~~

S = {m(a), m(b), h(a), h(b), r(a), q(b), -p(b)}

S == S2

**Our answer set is S = {m(a), m(b), h(a), h(b), r(a), q(b), -p(b)}**

1. Compute the answer sets of the following program:

p(a) :- not p(b).

p(b) :- not p(a).

q(a).

-q(b) :- p(X), not r(X).

Show all your work (step by step) and describe all your reasoning. Hint: Start by listing the objects in the signature of this program. Then ground the program.

1. Start by listing non-variadic atoms

Atoms: p(a), p(b), q(a), -q(b)

1. Rewrite the program by grounding the variable rules

q(a).

p(a) :- not p(b).

p(b) :- not p(a).

-q(b) :- p(a), not r(a).

-q(b) :- p(b), not r(b).

1. Start with the known values. Rules 1 and 2 indicate that p(a) and p(b) are mutually exclusive, so we can build two starting sets

S1-1 = {q(a), p(b)}

S2-1 = {q(a), p(a)}

1. Reduct with respect to S1-1

q(a).

~~p(a) :- not p(b).~~

p(b) :- ~~not p(a).~~

~~-q(b) :- p(a), not r(a).~~

-q(b) :- ~~p(b), not r(b).~~

S = {q(a), p(b), -q(b)}  
S != S1-1, so we try again

1. Start with a new set

S1-2 = {q(a), p(b), -q(b)}

1. Reduct with respect to S1-2

q(a).

~~p(a) :-~~ ~~not p(b).~~

p(b) :- ~~not p(a).~~

~~-q(b) :-~~ ~~p(a), not r(a).~~

-q(b) :- ~~p(b), not r(b).~~

S = {q(a), p(b), -q(b)}

S1-2 == S2

Our first answer set: S = {q(a), p(b), -q(b)}

1. Start again with S2-1  
   {q(a), p(a)}
2. Reduct with respect to S2-1

q(a).

p(a) :- ~~not p(b)~~.

~~p(b) :- not p(a).~~

-q(b) :- ~~p(a), not r(a).~~

~~-q(b) :- p(b), not r(b).~~

S = {q(a), p(a), -q(b)}

S != S2-1

1. Start with a new set  
   S2-2 = {q(a), p(a), -q(b)}
2. Reduct with respect to S2-2  
   q(a).

p(a) :- ~~not p(b)~~.

~~p(b) :- not p(a).~~

-q(b) :- ~~p(a), not r(a).~~

~~-q(b) :- p(b), not r(b).~~

S = {q(a), p(a), -q(b)}

S == S2-2

Our second answer set: S = {q(a), p(a), -q(b)}  
 Both Answer Sets:

**S\_1 = {q(a), p(b), -q(b)}**

**S\_2 = {q(a), p(a), -q(b)}**

BONUS (If you finish early):

1. Compute the answer sets of the following program:

m(a).

m(b).

-s(a).

p(X) :- not q(X), -s(X), m(X).

q(X) :- not p(X), m(X).

r(X) :- p(X).

r(X) :- q(X).

Show all your work (step by step) and describe all your reasoning. Hint: Start by listing the objects in the signature of this program. Then ground the program.

1. Start by listing non-variadic atoms

Atoms: m(a), m(b), -s(a)  
We know that if we do not declare a q term, we are going to add either a p(a) or q(a) based on the first and second actual rule, (the necessity of the -s(a) term locks us into a, as opposed to b) so let’s start with those minimal sets

S1-1 = { m(a), m(b), -s(a), p(a)}

S2-1 = {m(a), m(b), -s(a), q(a)}

1. Rewrite the program by grounding the variable rules

m(a).

m(b).

-s(a).

p(a) :- not q(a), -s(a), m(a)

p(b) :- not q(b), -s(b), m(b)

q(a) :- not p(a), m(a)

q(b) :- not p(b), m(b)

r(a) :- p(a)

r(b) :- p(b)

r(a) :- q(a)

r(b) :- q(b)

1. Start with the first set

S1-1 = {m(a), m(b), -s(a), p(a)}

1. Reduct with respect to S1 taking Branch 1

m(a).

m(b).

-s(a).

p(a) :- ~~not q(a), -s(a), m(a)~~

~~q(a) :- not p(a), m(a)~~

r(a) :- ~~p(a)~~

~~r(a) :- q(a)~~

~~p(b) :- not q(b), -s(b), m(b)~~

q(b) :- ~~not p(b), m(b)~~

~~r(b) :- p(b)~~

r(b) :- ~~q(b)~~

S = {m(a), m(b), -s(a), p(a), r(a), q(b), r(b)}

S1-1 != S, so we try again

1. Start a new set  
   S1-2 = {m(a), m(b), -s(a), p(a), r(a), q(b), r(b)}
2. Reduct with respect to S1-2

m(a).

m(b).

-s(a).

p(a) :- ~~not q(a), -s(a), m(a)~~

~~p(b) :- not q(b), -s(b), m(b)~~

~~q(a) :- not p(a), m(a)~~

q(b) ~~:- not p(b), m(b)~~

r(a) :- ~~p(a)~~

r(b) :- ~~p(b)~~

~~r(a) :- q(a)~~

~~r(b) :- q(b)~~

S = {m(a), m(b), -s(a), p(a), r(a), q(b), r(b)}

S == S1-2

S is our first solution.

1. Start with our other set S2-1  
   S2-1 = {m(a), m(b), -s(a), q(a)}
2. Reduct with respect to S2-1

m(a).

m(b).

-s(a).

~~p(b) :- not q(b), -s(b), m(b)~~

~~p(a) :- not q(a), -s(a), m(a)~~

q(b) :- ~~not p(b), m(b)~~

q(a) :- ~~not p(a), m(a)~~

~~r(b) :- p(b)~~

~~r(a) :- p(a)~~

r(b) :- ~~q(b)~~

r(a) :- ~~q(a)~~S = {m(a), m(b), -s(a), q(b), q(a), r(b), r(a)}

S != S2-1, So we go again

1. Start with a new set

S2-2 = {m(a), m(b), -s(a), q(b), q(a), r(b), r(a)}

1. Reduct with respect to S2-2

m(a).

m(b).

-s(a).

~~p(a) :- not q(a), -s(a), m(a)~~

~~p(b) :- not q(b), -s(b), m(b)~~

q(a) :- ~~not p(a), m(a)~~

q(b) ~~:- not p(b), m(b)~~

~~r(a) :- p(a)~~

~~r(b) :- p(b)~~

r(a) :- ~~q(a)~~

r(b) :- ~~q(b)~~

S = {m(a), m(b), -s(a), q(b), q(a), r(b), r(a)}

S2-2 == S

Our second solution set is S = {m(a), m(b), -s(a), q(b), q(a), r(b), r(a)}

The two answer sets to this question are:

**S\_1 = {m(a), m(b), -s(a), p(a), r(a), q(b), r(b)}**

**S\_2 = {m(a), m(b), -s(a), q(b), q(a), r(b), r(a)}**