CS 4700, Foundations of Artificial Intelligence
Spring 2020
Solutions to Quiz 7

1. There were two possible questions:

   - If you convert ¬((A∨B∨C)∧(D∨E∨F)∧(G∨H∨I)∧(J∨K∨L)) to CNF how many clauses are in the resulting sentence?
     You get 81 clauses, where each clause has four elements: one of ABC, one of DEF, one of GHI, and one of JKL. $3^4=81$.

     If you convert ¬((A∨B)∧(C∨D)∧(E∨F)∧(G∨H)∧(I∨J)∧(K∨L)) to CNF how many clauses are in the resulting sentence?
     You get 64 clauses, where each clause has six elements: one of AB, one of CD, one of EF, one of GH, one of IJ, and one of KL. $2^6=64$.

2. There were two possible questions:
   - If you unify P(x,?) with P(F(u,B),F(A,v)) you get P(F(A,B),F(A,B)).
     You get this result if ? is "x".

   - If you unify P(?,u) with P(F(A,y),F(x,B)) you get P(F(A,B),F(A,B)).
     You get this result if ? is "u".

3. There were two possible questions:
   - Consider the following set of sentences KB:
     - P
     - Q ⇒ R
     - R ⇒ S
     - S ⇒ T
     - T ⇒ U
     - U ⇒ X
     - P ⇒ V
     - V ⇒ W
     - W ⇒ X

     Your goal is to prove that X is true using resolution refutation as described in class. If you convert the starting facts to CNF, negate the goal and convert it to CNF, and then do resolution what is the length of the shortest resolution proof? Do not count the starting clauses, just count each new clause that is generated by a single step of resolution.

     4. I'll only give numbers to the new clauses generated by resolution, and will use letters for the others. There are multiple proofs of this length, here's one of them:

A	P	
B	¬PvV	
C	¬VvW	
D	¬WvX	
E	¬X	
1	V	[A,B]
2	W	[B,C]
3	X	[C,D]
4	()	[D,E]

- Consider the following set of sentences KB:
  - A
  - A ⇒ B
  - B ⇒ C
  - C ⇒ H
  - A ⇒ D
  - D ⇒ E
  - E ⇒ F
  - F ⇒ G
  - G ⇒ H

  Your goal is to prove that H is true using resolution refutation as described in class. If you convert the starting facts to CNF, negate the goal and convert it to CNF, and then do resolution what is the length of the shortest resolution proof? Do not count the starting clauses, just count each new clause that is generated by a single step of resolution.

  4. I'll only give numbers to the new clauses generated by resolution, and will use letters for the others. There are multiple proofs of this length, here's one of them:

A	A	
B	¬AvB	
C	¬BvC	
D	¬CvH	
E	¬H	
1	B	[A,B]
2	C	[B,C]
3	H	[C,D]
4	()	[D,E]