1. Translate the following English sentences into first-order logic sentences. Use any predicates and functions you think appropriate.
   a. John is hungry.
   b. Bob loves his cat.
   c. Carla envies everyone who owns an SUV and a fur coat.
   d. Someone took Bill’s wallet.
   e. Everybody loves somebody.

2. Translate the following first-order sentences into English sentences. Make the obvious assumptions about the meanings of the predicates and functions.
   a. Happy(Carlos)
   b. Wants(Beatrice, JacketOf(Roxana))
   c. \( \forall x \exists y \left[ \text{Person}(x) \implies \text{PerfectJob}(x,y) \right] \)
   d. \( \forall x \left[ \text{Military}(x) \implies \left( \exists y \left( \text{Weapon}(y) \land \text{Skilled}(x,y) \right) \right) \right] \)
   e. \( \exists x \left( \text{Sister}(Bob,x) \land \text{Doctor}(x) \right) \)

3. Consider the following first-order logic sentences.
   a. Convert each sentence to Conjunctive Normal Form.
   b. Use resolution to prove that Kills(Mulder, Alien) is true.
      i. \( \text{FBIagent}(Mulder) \)
      ii. \( \text{Weapon}(Gun) \)
      iii. \( \text{Paranoid}(Mulder) \)
      iv. \( \left[ \text{Paranoid}(Mulder) \lor \text{Crazy}(Mulder) \right] \implies \text{Believes}(Mulder) \)
      v. \( \left[ \text{FBIagent}(Mulder) \land \text{Weapon}(Gun) \right] \implies \text{Has}(Mulder, Gun) \)
      vi. \( \left[ \text{Has}(Mulder, Gun) \land \text{Weapon}(Gun) \land \text{Believes}(Mulder) \right] \implies \text{Kills}(Mulder, Alien) \)

4. Consider the following English sentences.
   i. John carries a gun.
   ii. Anyone who carries a gun is either a criminal or a police-officer.
   iii. Nobody can be both a police officer and a criminal.
   iv. There is some criminal that carries a gun.
   v. John is not a criminal.
   a. Translate these sentences into first-order logic.
   b. Convert each sentence to Conjunctive Normal Form.
   c. Use resolution to prove John is a police officer.
5. Consider the following two sentences
   i. $\forall x \exists y (x \geq y)$
   ii. $\exists y \forall x (x \geq y)$
   a. Assume the range of values for the variables is the negative integers from -1 to negative infinity, and that “$\geq$” means “the thing on the left is equal to or greater than the thing on the right.” Given this interpretation, translate sentences i and ii into English.
   b. Is sentence i true under this interpretation?
   c. Is sentence ii true under this interpretation?
   d. Does sentence i entail sentence ii?
   e. Does sentence ii entail sentence i?
   f. Using resolution, try to prove that sentence i follows from sentence ii. Do so even if you think sentence ii does not logically entail sentence i. Continue until the proof breaks down (or doesn’t) and you cannot proceed (if the proof does, in fact, break down). Show the unifying substitution for each resolution step. If the proof fails, explain where, how, and why.
   g. No try to prove sentence ii follows from sentence i, following the same steps you used in f.

Hand in a hard-copy of your responses to the questions by the start of class on Wed., May 11.