CS-271, Intro to A.I. — Quiz # 4 — Fall Quarter, 2010 — 20 minutes

YOUR NAME AND EMAIL ADDRESS: ________________________________
YOUR ID: _______ ID TO RIGHT:_______ ROW:____ NO. FROM RIGHT:_____

1. (20 pts total, 5 pts each) PROBABILITY.

1a. (5 pts) Write down the definition of P(H | D) in terms of P(H), P(D), P(H \& D), and P(H \lor D).

1b. (5 pts) Write down the expression that results from applying Bayes' Rule to P(H | D).

1c. (5 pts) Write down the expression for P(H \& D) in terms of P(H), P(D), and P(H \lor D).

1d. (5 pts) Write down the expression for P(H \& D) in terms of P(H), P(D), and P(H | D).

2. (25 pts total, 5 pts off for each wrong answer, but not negative) Let PKF(x, y) mean “Person x Knows Fact y”. For this question only, you may assume that the first argument is a person and the second is a fact. For each English sentence below, write the first order predicate logic sentence that best expresses it. Use “¬” to mean “not.” The first one is done for you.

2a. Every person knows every fact. _______ \( \forall x \forall y \ PKF(x, y) \) _______.

2b. Every person knows at least one fact. _______________________________.

2c. There is a person who knows at least one fact. ________________________.

2d. There is a person who knows every fact. ____________________________.

2e. No person knows every fact. __________________________

2f. There is a person who knows no fact. _____________________________

2g. No person knows any fact. ________________________________

2h. There is a fact that is known by every person. ________________________

2i. There is a fact that no person knows. ________________________________

**** TURN PAGE OVER. QUIZ CONTINUES ON THE REVERSE ****
3. (35 points total, 5 pt each) Complete the resolution proof below that Jill is Sue’s niece. For ease in naming the statements in the KB, they are labeled KB1, KB2, KB3, KB4, …. Write each unifier as \{ var1/val1, var2/val2, \ldots\}, i.e., a list of variable/value substitutions.

KB1: Daughter(Jill, Mary)
KB2: Sister(Mary, Sue)
KB3: (\neg Daughter(x, y) \lor \neg Sister(y, z) \lor Niece(x, z) )
(Note: in general, you would need another axiom, Sister(x, y) \Rightarrow Sister(y, x) , to state that Sister is symmetric; but the problem has been simplified here to avoid that necessity.)

Goal: Niece(Jill, Sue)

3a. The negated goal is KB4: __________________________.

3b. The most general unifier of KB3 and KB4 is: __________________________.

3c. The result of resolving KB3 and KB4 is KB5: __________________________.

3d. The most general unifier of KB2 and KB5 is: __________________________.

3e. The result of resolving KB2 and KB5 is KB6: __________________________.

3f. The most general unifier of KB1 and KB6 is: __________________________.

3g. The result of resolving KB1 and KB6 is KB7: __________________________.

4. (20 pts total, 5 pts off for each wrong answer, but not negative) Fill in each blank below with Y (= Yes) or N (= No) depending on whether or not the first order predicate logic sentence correctly expresses the English sentence.

4a. ______ “All cats are mammals.” \forall x\, \text{Cat}(x) \& \text{Mammal}(x)

4b. ______ “Spot has a sister who is a cat.” \exists x\, \text{Sister}(x, \text{Spot}) \& \text{Cat}(x)

4c. ______ “For every person, there is someone that that person likes.” \exists x\forall y\, \text{Likes}(x, y)

4d. ______ “There is someone who is liked by everyone.” \forall x\exists y\, \text{Likes}(x, y)

4e. ______ “Everyone likes ice cream.” \neg \exists x\neg \text{Likes}(x, \text{IceCream})

4f. ______ “All men are mortal.” \forall x\, \text{Man}(x) \Rightarrow \text{Mortal}(x)