Homework #3: Chapters 7 and 8

The following exercises are due at the beginning of class on Tuesday, March 3.

1. [20 pts.] Consider a knowledge base KB that contains the following propositional logic sentences:

   \[ P \lor R \Rightarrow Q \]
   \[ \neg P \Rightarrow R \]
   \[ Q \lor R \]

   a) Construct a truth table that shows the truth value of each sentence in KB and indicate the models in which the KB is true.
   b) Does KB entail Q? Use the definition of entailment to justify your answer.
   c) Does KB entail R \Rightarrow P? Use the definition of entailment to justify your answer.
   d) Does KB entail P \lor Q? Extend the truth table and use the definition of entailment to justify your answer.

2. [30 pts.] Consider the following statements:

   If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is either immortal or a mammal, then it is horned.

   a) Using only four propositional symbols, express the above statements in propositional logic
   b) Construct a truth table that shows the truth value of each sentence and indicate the models in which all of the sentences are true.
   c) Using the definition of entailment, answer the question “Is the unicorn mythical?”
   d) Using the definition of entailment, answer the question “Is the unicorn horned?”

3. [50 pts.] Do exercise 8.24 (a - j) from the book (p. 319). Use the following constants and predicates (and no others):

   - \( F \): a constant representing French
   - \( G \): a constant representing Greek
   - \( S \): a constant representing Spring 2001
   - \( UK \): a constant representing the U.K.
   - \( Agent(x) \): \( x \) is an agent
   - \( Barber(x) \): \( x \) is a barber
   - \( Expensive(x) \): \( x \) is expensive
   - \( Insured(x) \): \( x \) is insured
   - \( LocalMan(x) \): \( x \) is a man living in the town
   - \( Person(x) \): \( x \) is a person
   - \( Policy(x) \): \( x \) is a policy
   - \( Semester(x) \): \( x \) is a semester
   - \( Smart(x) \): \( x \) is smart
   - \( Student(x) \): \( x \) is a student
   - \( BornIn(x,c) \): \( x \) is born in country \( c \)
   - \( Buys(s,x,y) \): person \( s \) sells item \( x \) to person \( y \)
   - \( CitizenByBirth(x,c) \): person \( x \) is a citizen by birth in country \( c \)
   - \( CitizenByDescent(x,c) \): person \( x \) is a citizen by descent in country \( c \)
   - \( CitizenOf(x,c) \): person \( x \) is a citizen of country \( c \)
   - \( GreaterThan(x,y) \): \( x > y \). You may assume that the standard mathematical semantics apply to this predicate.
   - \( Parent(x,y) \): \( x \) is the parent of \( y \)
   - \( Passes(x,c) \): student \( x \) passes course \( c \)
   - \( ResidentOf(x,c) \): person \( x \) is a resident of country \( c \)
   - \( Sells(s,x,y) \): person \( s \) sells item \( x \) to person \( y \)
   - \( Score(x,c,s,n) \): student \( x \) received a score of \( n \) when taking course \( c \) in semester \( s \).
   - \( Shaves(x,y) \): person \( x \) shaves person \( y \)
   - \( TakesCourse(x,c,s) \): student \( x \) takes course \( c \) in semester \( s \)