

# Homework #3: Chapters 7 and 8

The following exercises are due at the beginning of class on Monday, February 25. Note, there is a question on the reverse of this sheet.

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

$$\begin{aligned} P \vee R &\Rightarrow Q \\ P &\Rightarrow \neg Q \\ Q &\vee R \end{aligned}$$

- Construct a truth table that shows the truth value of each sentence in  $KB$  and indicate the models in which the  $KB$  is true.
  - Does  $KB$  entail  $R$ ? Use the definition of entailment to justify your answer.
  - Does  $KB$  entail  $R \Rightarrow P$ ? Use the definition of entailment to justify your answer.
  - Does  $KB$  entail  $\neg Q \wedge R$ ? Extend the truth table and use the definition of entailment to justify your answer.
2. [10 pts.] In propositional logic, does an empty knowledge base (i.e., a knowledge base containing only the sentence *true*) entail anything? Explain your answer.
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
- $BornIn(x,c)$ : person  $x$  is born in country  $c$
- $Buys(x,y)$ : person  $x$  buys item  $y$
- $CitizenByBirth(x,c)$ : 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.
- $Parent(x,y)$ : person  $x$  is the parent of  $y$
- $Passes(x,c)$ : student  $x$  passes course  $c$
- $ResidentOf(x,c)$ : person  $x$  is a resident of country  $c$
- $Sells(s,x,b)$ : person  $s$  sells item  $x$  to person  $b$
- $Score(x,c,s,n)$ : 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  $s$

4. [20 pts.] Represent the following sentences in first order logic, assuming that the domain consists only of people. The only predicates you may use are *loves*(x,y), *knows*(x,y), and *avoids*(x,y), where a predicate of form *Predicate*(x,y) means that “x *Predicate* y.” Choose meaningful constants where appropriate.
- a) Somebody knows and loves Tim.
  - b) Everybody who knows Sue avoids Sue.
  - c) There is somebody that everybody loves.
  - d) Nobody knows everybody.
  - e) There are some people who love nobody but themselves.