CSE 4/563 Knowledge Representation
Professor Shapiro
Homework 1
Maximum Points: 43
Due: 2:00 PM, Thursday, September 23, 2009

Name(s)⟨user name(s)⟩: _____

September 16, 2009

Print this document, print your name(s) and user name(s) on the line above, and write the answers as indicated. Write neatly! Illegible answers will be considered incorrect.

This homework is due at the beginning of lecture on the date given above.

1. (6) Indicate, by putting an "X" in the proper blank, whether the following expressions are syntactically correct according to the syntax of Propositional Logic given on pages 25–26 of the Lecture Notes.

   (a) (1) Is____ Is Not____ $Q \Rightarrow P \wedge Q \wedge R$

   (b) (1) Is____ Is Not____ $(P \Rightarrow \neg Q) \vee (\neg Q \Rightarrow P)$

   (c) (1) Is____ Is Not____ $((P \wedge Q) \wedge R) \Leftrightarrow [P \wedge (Q \wedge R])$

   (d) (1) Is____ Is Not____ $BirdsFly \neg \Rightarrow PenguinsFly$

   (e) (1) Is____ Is Not____ $TomIsHome \wedge \vee BettyIsHome$

   (f) (1) Is____ Is Not____ $Tom\ drives\ Betty \Rightarrow Betty\ is\ the\ driver$

2. (3) Indicate, by putting an "X" in the proper blank, whether the following expressions are syntactically correct according to the computer-readable syntax of Propositional Logic given on pages 29–30 of the Lecture Notes.

   (a) (1) Is___ Is Not___ `(iff Knowledge (and Justified True Belief))`

   (b) (1) Is___ Is Not___ `(iff itsATriangle itHasThreeSides itHasThreeAngles`

   (c) (1) Is___ Is Not___ `(BettyDrivesTom and (BettyIsDriver or TomIsDriver))`

3. (15) Using the following atomic propositions, with the given intensional semantics

   - $[Buffalo\ is\ city]$ = Buffalo is a city
   - $[Buffalo\ is\ large]$ = Buffalo is large
   - $[Buffalo\ in\ NY]$ = Buffalo is in New York State
   - $[Buffalo\ on\ border]$ = Buffalo is on the border of the US

   formalize the following sentences as well-formed propositions of Propositional Logic using the syntax of Question 1.

   (a) (3) If Buffalo is on the border of the US, then Buffalo is in New York State.

   (b) (3) Buffalo is not a city if Buffalo is not large.

   (c) (3) Buffalo is a large city in New York State.

   (d) (3) Buffalo is on the border of the US, but is not in New York State.

   (e) (3) Buffalo is large if and only if it is a city or on the border of the US.

4. (9)

(a) (5) Fill in the following truth table by circling either "$True$" or "$False$" in each cell below the horizontal dividing line.

P Q	$True$ $True$	$True$ $False$	$False$ $True$	$False$ $False$
$\neg P$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
$\neg Q$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
$P \Rightarrow Q$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
$\neg P \vee \neg Q$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
$(P \Rightarrow Q) \Leftrightarrow (\neg P \vee \neg Q)$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$

(b) (4) For each of the following, if the statement is true according to your truth table above, circle "True"; if it is false, circle "False".

i. (1) True False $P \models \neg P \vee \neg Q$

ii. (1) True False $P \Rightarrow Q, \neg P \vee \neg Q \models Q$

iii. (1) True False $\neg P, \neg P \vee \neg Q \models P \Rightarrow Q$

iv. (1) True False $(P \Rightarrow Q) \Leftrightarrow (\neg P \vee \neg Q) \models P \Rightarrow Q$

5. (5)

(a) (3) Using the tableau model-finding procedure, draw a tree to identify the models that simultaneously satisfy the wfps $(A \Rightarrow B \vee C)$, $(P \Rightarrow Q \wedge R)$, and $\neg(C \vee R)$.

(b) (2) According to your tableau, what models satisfy the wfps $(A \Rightarrow B \vee C)$, $(P \Rightarrow Q \wedge R)$, and $\neg(C \vee R)$? Use one column for each model or set of models. In each such column, circle either "$True$" or "$False$" if the corresponding atomic wfp is True or False in that model, or circle both "$True$" and "$False$" if the corresponding atomic wfp could be either. There may be more columns provided than models found in your tableau.

A	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
B	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
C	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
P	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
Q	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
R	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$

6. (5)

(a) (3) Using the tableau model-finding procedure, draw a tree to identify the models that simultaneously satisfy the wfps: $((A \Rightarrow B) \Leftrightarrow (P \wedge Q)), (\neg P \Rightarrow A)$, and $\neg P$

(b) (2) According to your tableau, what models satisfy the wfps $((A \Rightarrow B) \Leftrightarrow (P \wedge Q)), (\neg P \Rightarrow A)$, and $\neg P$ Use one column for each model or set of models. In each such column, circle either "$True$" or "$False$" if the corresponding atomic wfp is True or False in that model, or circle both "$True$" and "$False$" if the corresponding atomic wfp could be either. There may be more columns provided than models found in your tableau.

A	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
B	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
P	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$
Q	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$	$True\ \ False$