**CSCI 4525/5525: Written Assignment for Unit 2: Logic**

**Assignment**

Complete the following exercises from *Artificial Intelligence: A Modern Approach*. They are reprinted here for your convenience (and because the digital “global edition” has different problems than the physical copy, so this should clarify things—do the problems here!) The numbers I use here are from the physical edition of the book.

Also, because I can’t help but add my two-cents, I added some notes and changed the formatting a little bit to some of the questions. But the actual problems are the same!

**Question 1** *(8.10 from AI: A Modern Approach, page 317) –* ***14 points total, 2 points for each sub-part.***

Consider a vocabulary with the following predicates and constants.

**Predicates:**

Occupation(p, o): Person p has Occupation o.

Customer(p1, p2): Person p1 is a customer of Person p2.

Boss(p1, p2): Person p1 is a boss of Person p2.

**Constants:**

Doctor, Surgeon, Lawyer, Actor. (each of these constants denote occupations)

Emily, Joe. (these are constants that denote people).

Also, you might find it helpful to have access to these logical symbols for copying and pasting:

Disjunction: ∨

Conjunction: ∧

Universal Quantifier: ∀

Existential Quantifier: ∃

Implication: **⇒**

Not Equals:≠

Use the above predicates, constants, and symbols to write the following assertions in :

1. ***Emily is either a surgeon or a lawyer***
2. ***Joe is an actor, but he also holds another job.***
3. ***All surgeons are doctors.***
4. ***Joe does not have a lawyer (i.e., is not a customer of any lawyer)***
5. ***Emily has a boss who is a lawyer.***
6. ***There exists a lawyer all of whose customers are doctors***
7. ***Every surgeon has a lawyer.***

**Question 2** *(8.11 from AI: A Modern Approach, page 362) –* ***8 points total.***

Complete the following exercises about logical sentences:

1. Translate the following logical sentence into good, natural English (no xs or ys!)

*∀x,y,l SpeaksLanguage(x,l) ∧ SpeaksLanguage(y,l)* ***⇒*** *Understands(x,y) ∧ Understands(y,x)*

1. Explain why the previous sentence is entailed by the following sentence:

*∀x,y,l SpeaksLanguage(x,l) ∧ SpeaksLanguage(y,l)* ***⇒*** *Understands(x,y)*

1. Translate into first-order logic the following sentences (Remember to define all predicates, functions, and constants that you use):
   1. Mutual understanding leads to mutual friendship
   2. Friendship is transitive.

**Question 3** *(9.4 from AI: A Modern Approach, page 361) –* ***8 points total. (2 points each).***

For each pair of atomic sentences, give the most general unifier if it exists:

1. *P(A, B, B), P(x, y, z).*
2. *Q(y, G(A, B)), Q(G(x, x), y).*
3. *Older(Father(y), y), Older(Father(x), John).*
4. *Knows(Father(y),y), Knows(x, x)*

**Students enrolled in CSCI 5525 must also complete the following (undergrads may do this for extra credit):**

**Question 4** *(9.20 from AI: A Modern Approach, page 364-365) –* ***9 points total, three points for each part.***

Let ℒ be the first-order language with a single predicate *S(p,q)*, meaning “p shaves q.” Assume a domain of people.

1. Consider the sentence “There exists a person P who shaves every one who does not shave themselves, and only people that do not shave themselves.” Express this in ℒ.
2. Convert the sentence in (a) to clausal form.
3. Construct a resolution proof to show that the clauses in (b) are inherently inconsistent. \*Note: you do not need any additional axioms.)

**Submission**

Please observe these requirements in your submission:

* Submission must include your name and which section of the class you are enrolled in (i.e. 4525 or 5525).
* Submissions must be typed.
* Submissions must be submitted as PDF files.
* Submissions must be uploaded to Moodle on time

**Grading**

Problems will be graded using the following simple grading procedure, applied to each part (e.g. part a, part b, etc.) of the problem (except where otherwise noted above):

* Problem not attempted or does not demonstrate significant effort: no credit.
* Problem thoroughly attempted, but answer is incorrect or incomplete: half credit.
* Problem thoroughly attempted, and answer is correct and complete: full credit.

**You must show your work on all problems to receive credit**. Simply giving the answer (correct or incorrect) will earn no credit for that problem.