Homework #4 – Logic
Possible experience: +40XP
Due: Monday, Oct. 24th, midnight

1. Let $A$ be the proposition that there have been three previous female Presidents of the United States, $B$ be the proposition that peanuts contain saturated fat, $C$ be the proposition that Beyoncé performed at the Superbowl 50 halftime show, and $D$ be the proposition that Luke Skywalker will be unveiled as the father of Rey in the upcoming Star Wars Episode VIII movie.

Are the following propositions true, false, or unknown?

a. $A \lor B$

b. $A \land B$

c. $A \Rightarrow B$

d. $A \oplus B$

e. $B \lor A$

f. $B \land A$

g. $B \Rightarrow A$

h. $B \oplus A$

i. $C \lor D$

j. $\neg C \land \neg D$

k. $A \Rightarrow D$

l. $A \Rightarrow A$

m. $D \Rightarrow D$

n. $\neg ((\neg A) \land (\neg B))$

o. $\neg ((\neg B) \land (\neg C))$

p. $\neg ((\neg A) \land (\neg B) \land (\neg C))$

q. $D \land \neg D$

r. $D \lor \neg D$

2. Create a truth table in order to compute the truth values of the expression

$$((\neg G) \oplus H) \leftrightarrow ((G \lor \neg I) \land F)$$

for all possible inputs.
3. Consider the following predicates:

- `HasDefeated(x,y)` — the proposition that x has defeated y in combat at some point in the past
- `Jedi(x)` — the proposition that x is a Jedi Knight
- `JediMaster(x)` — the proposition that x is a Jedi Master
- `MemberOfJediCouncil(x)` — the proposition that x is a member of the Jedi Council
- `Padawan(x)` — the proposition that x is a Padawan
- `SithLord(x)` — the proposition that x is a Sith Lord
- `GoodGuy(x)` — the proposition that x is a morally righteous individual, dedicated to truth, justice, and the American way
- `BadGuy(x)` — the proposition that x is devoted to evil ways
- `IsApprenticeOf(x,y)` — the proposition that x is currently y’s apprentice

Write expressions in first-order predicate logic that correspond to each of the following English sentences. (You should restrict yourself to only the predicates above.)

a. Darth Vader is a bad guy.

b. Mace Windu is a Jedi Master and a good guy.

c. All Jedi Masters are Jedi Knights, but not every Jedi Knight is a Jedi Master.
d. No Padawans are members of the Jedi Council.

e. There are some Jedi Masters who are not on the Jedi Council.

f. Anakin Skywalker is the *only* member of the Jedi Council who is not a Jedi Master.

g. A Jedi Knight can have at most *one* apprentice. Not every Jedi Knight has one, but every Padawan is the apprentice of some Jedi Knight.

h. All Sith Lords are bad guys.

i. Nobody is both a good guy and a bad guy.
j. Odd as it may seem, it has indeed been the case that two opponents (one a Jedi Knight and the other a Sith Lord) have defeated each other in combat. (One example of this is when Obi-wan defeated Darth Vader and then was later defeated by Darth Vader. Your answer should be general, however, and not mention Obi-wan or Darth Vader specifically.)

k. There is at least one known case of a Padawan defeating a Sith Lord in combat. (Obi-wan vs. Darth Maul, but again do not mention this example specifically. Simply assert that at least one such case exists.)

l. No one has ever been defeated by their apprentice, unless they were a Sith Lord.

Important note: it is absolutely totally completely possible to get the WRONG answer for any and all of these items. Simply attempting to write something in FOPC is not the same as getting the correct answer. Rather, what you write must be both (1) valid FOPC syntax, and (2) a legitimate representation of exactly what the English sentence is asserting, and ALL that it is asserting.

Also important: in order to receive credit for this assignment at all, your assignment must be legible.

Tip: to specify symbols like ∀ and ∃ in a point-and-click word processor like Microsoft Word, you should find and enter the appropriate Unicode code for that character. Google can tell you how to do this (I found http://www.fileformat.info/tip/microsoft/enter_unicode.htm by Googling). To find character codes, Google things like “intersection unicode” or “for all unicode” (which brought me to this page and this one).