4511W, Spring-2019
ASSIGNMENT 5:
Assigned: 04/21/19 Due: 04/28/19 at 11:55 PM (submit via Canvas, you may take a picture of handwritten solutions, but you must put them in a pdf) Submit only pdf or txt files

Written/drawn:

Problem 1. (20 points)
Write the following English sentences in first order logic. Do not make any assumptions on the objects.
(1) People who got an S passed the class.
(2) There are at least two people who passed the class.
(3) There is exactly one person who passed the class.
(4) You can only get only one grade, either S or N.

Problem 2. (15 points)
Consider the following first order logic sentences:
$\forall x\ Hot(x) \wedge Large(x) \Rightarrow Star(x) \wedge Fusion(x)$
$Hot(Sun) \vee Hot(Jupiter)$
$Large(Jupiter)$
$Large(Sun) \wedge Hot(Sun)$

Assume our objects are: {Sun, Jupiter}
(1) Convert these sentences to propositional logic.
(2) Convert part (1) to Conjunctive Normal Form (CNF).

Problem 3. (20 points)
Consider the following sentences as our KB:

A
$\neg A \vee B$
$C \vee \neg D$
$D \vee C$
$\neg B \vee \neg D \vee E$

(1) Use resolution to determine whether these sentences entail C.
(2) Use resolution to determine whether these sentences entail E.

Problem 4. (15 points)
We have the following English sentences:
“My friend has a video on youtube”
“Youtube videos are free and either about cats or dogs”
“Cat youtubes lose money”
“Dog youtubes lose money”

(1) Convert these sentences into first order logic.
(2) Use only AND elimination and Modus Ponens to answer whether or not “My friend’s video is free”.

(3) Use only AND elimination and Modus Ponens to answer whether or not “My friend’s video is losing money”.

Problem 5. (15 points)
Use backward-chaining to decide whether the following first-order logic sentences can entail α. You must be clear on your substitution/unification.

$$\alpha = \exists x \; Traps(Felicidad, x)$$

KB:

1. $\exists x \; Troll(x)$
2. $\forall x \; Troll(x) \Rightarrow Large(x)$
3. $\exists x \; Troll(x) \wedge Aggressive(x)$
4. $\forall x \; Large(x) \wedge Aggressive(x) \Rightarrow Dangerous(x)$
5. $\forall x, y \; Hunter(x) \wedge Dangerous(y) \wedge Bounty(y) \Rightarrow Traps(x, y)$
6. $Hunter(Felicidad)$
7. $\exists x \; Troll(x) \wedge Bounty(x)$

Problem 6. (25 points)
Use resolution to determine if the following first-order logic sentences can entail α. You must be clear on your substitution/unification.

$$\alpha = \forall x \; \exists y \; A(x, f(f(Snail)), y)$$

KB:

$$\forall x \; A(x, Snail, x)$$

$$\forall x, y, z \; (\neg A(x, y, z) \vee A(x, f(y), f(z))$$

(Lisp/Python) programming:

Problem 7. (10 points)
Open logic/test-logic.lisp to see how to use a propositional knowledge base, especially the syntax to write the logic. Write Problem 2(1) or 2(2) into the database using (tell ...) then ask if (1) the sun is a star and (2) if Jupiter is a star using an (ask ...) command. Show all of your tells and asks along with the results.

Note: you can use the python code as well to do this. The relevant code/examples are in logic.py and tests/test-logic.py