Name__SHANKARANARAYANAN KALLIDAIKURUCHI RAMAKRISHNAN Dr. Sanda Harabagiu

Student netID __sxk190109 Fall 2020

CS 6364

Take – Home Quiz 3

Instructions: Do not communicate with anyone in any shape or form. This is an independent test. Do not delete any problem formulation, just attach your answer in the space provided. If the problem is deleted and you send only the answer, you shall receive ZERO points.

Copy and paste the Quiz into a Word document, enter your answers (either by typing in Word, or by inserting a VERY CLEAR picture of your hand-written solution) and transform the quiz into a PDF format. If we cannot clearly read the picture, you will get ZERO for that answer! Make sure that you insert EACH answer immediately after EACH question. Failure to do so will result in ZERO points for the entire quiz! Submit the PDF file with the **name QUIZ_3_netID.pdf**, where netID is your unique netid provided by UTD. If you submit your quiz in any other format your will receive ZERO points. The Quiz shall be submitted in eLearning before the deadline. No late submissions shall be graded! Do not write with a pencil – you will get ZERO if you do so! Use a black pen on a clean sheet of paper!

Problem:

(a) Inference in First Order Logic.

Consider the following situation:

At Magic Circus, an elephant was starved to death by Joe, the caregiver. Only people that hate animals mistreat them.

Prove, using forward chaining that *Joe hated the elephant*.

Hint: Transform in FOL the situation described and add any necessary commonsense knowledge (8 points) then use Forward chaining with the necessary substitutions to prove then question (6 points) and specify the substitution that led to proving the query (1 point) (**TOTAL: 15 points**)

Answer:

Encoding in FOL:
P1: Elephant(x) $\wedge$ Caregiver(y) $\Rightarrow$ Starve_to_Death(y, x)
P2: Caregiver (Joe)
P3: People (w) $\wedge$ Animals (z) $\wedge$ Mistreat (w, z) $\Rightarrow$ Hate (w, z)
P4: Starve_to_Death (w, z) $\Rightarrow$ Mistreat (w, z)
P5: Elephant (ELEPHANT)

Encoding of World Knowledge:
P6: Caregiver(y) $\Rightarrow$ People(w)
P7: Elephant (x) $\Rightarrow$ Animals (z)

Query Q: Hate (Joe, ELEPHANT)

Variables:
Elephant(x): x is an Elephant
Caregiver(x): x is a caregiver
Starve_to_death(x, y): y is starved to death by x
People(x): x is a person
Animals(x): x is an animal
Hate (x, y): x hates y

Forward Chaining:

Statements with implications:

P1, P3, P4, P6, P7

Iteration 1:
P1 and P2:
Θ1 = {y/ Joe}
P1: Elephant (x) $\wedge$ Caregiver (Joe) $\Rightarrow$ Starve_to_Death (Joe, x)
P1 had unsatisfied premises

P2 and P6:
Θ2 = {y/ Joe, w/Joe}
P6: Caregiver (Joe) $\Rightarrow$ People (Joe) ----------> Q1
P6 – All premises satisfied

P5 and P7:
Θ3 = {x/ELEPHANT, z/ELEPHANT}
P7: Elephant (ELEPHANT) ⇒ Animals (ELEPHANT)----------> Q2
P7 – All premises satisfied

Iteration 2: Θ1 & Θ2 & Θ3 & Q1 & Q2:
P1: Elephant (ELEPHANT) ∧ Caregiver (Joe) ⇒ Starve_to_Death (Joe, ELEPHANT) ----------> Q3
P1 – All premises satisfied

P2: People (Joe) ∧ Animals (ELEPHANT) ∧ Mistreat (Joe, ELEPHANT) ⇒ Hate (Joe, ELEPHANT)
P2 has unsatisfied premises

Iteration 3: Θ1 & Θ2 & Θ3 & Q1 & Q2 & Q3:
Using Q3:
P4: Starve_to_Death (Joe, ELEPHANT) ⇒ Mistreat (Joe, ELEPHANT) ----------> Q4
P4 – All premises satisfied

Iteration 4: Θ1 & Θ2 & Θ3 & Q1 & Q2 & Q3 & Q4:
Using Q4:
P2: People (Joe) ∧ Animals (ELEPHANT) ∧ Mistreat (Joe, ELEPHANT) ⇒ Hate (Joe, ELEPHANT) ----------> Q5

Q5 can unify with query Q.

(b) Convert in First Order Logic the following statement:
Any professor can teach some of the students all the time, all of the students some of the time, but not all the students all of the time.

Hint: define the predicates, functions, variables etc. first. (**TOTAL: 15 points**)

Solution:

Variables:

Professor(x): x is a professor

Student(x): x is a student

Functions:

Teaches(x,y,t): x teaches y at time t

Predicate:

$\forall x$ Professor(x) $\Rightarrow$ ($\exists y$ $\forall t$ Student(y) $\wedge$ Teaches(x, y, t)) $\wedge$ ($\exists t$ $\forall y$ Student(y) $\Rightarrow$ Teaches(x,y,t)) $\wedge$ $\neg$ ($\forall t$ $\forall y$ Student(y) $\Rightarrow$ Teaches(x,y,t))