

Homework 3: First-order logic (due Thursday 2/26 before class)

Please read the rules for assignments on the course web page. Contact Dima (dmytro.korzhyk@duke.edu) or Vince (conitzer@cs.duke.edu) with any questions.

1 (65 points).

Convert the following English sentences to first-order logic.

- There is a healthy food that is delicious.
- Every thing that loves all humans is a dog.
- There is a dog that does not love all humans.
- Every continent that is not Australia or Antarctica is connected to another continent.
- Every thing that walks like a duck and talks like a duck is either a duck or a human imitating a duck.
- There is a plane that crashed and none of its passengers died.
- Every person who is smart and studies hard will get a higher score than every person who is not smart and does not study hard.
- A gold medal is always worth more than a silver medal, if they are medals in the same event.
- Every thing that is an enemy of some thing that is an enemy of me is a friend of me (“the enemy of my enemy is my friend”).
- There are at least two points on the world such that if from that point x , you travel one meter north, then one meter east, and then one meter south, you are back at point x . (Bonus question (0 points, not related to the course material): what is the set of all of these points?)

2 (35 points).

Apply resolution to obtain the most general conclusion possible from these two sentences. Also, convert the sentences (and the conclusion) to plain English. (LovesOnTopOf is intended to mean whether someone likes a particular sauce on some food.)

- $\forall x, y : \text{LovesOnTopOf}(\text{John}, x, y) \vee \text{MakesSick}(y, \text{John}) \vee \text{RuinsTasteOf}(x, y)$
- $\forall v, w : \neg \text{LovesOnTopOf}(v, w, \text{Rice}) \vee \text{Flavorful}(w)$