

Additional sample exam questions for first-order logic inference

Question 1

Suppose our knowledge base consists only of the following two statements (copied from question 9.19 in the textbook):

$$\begin{aligned} & \text{Ancestor}(\text{Mother}(x), x) \\ & \text{Ancestor}(x, y) \wedge \text{Ancestor}(y, z) \Rightarrow \text{Ancestor}(x, z) \end{aligned}$$

Use propositionalization followed by resolution to prove that for a person named Ravi, we have

$$\text{Ancestor}(\text{Mother}(\text{Mother}(\text{Ravi})), \text{Ravi}).$$

Clearly label every use of Universal Instantiation and Existential Instantiation. Clearly explain every step in the proof by resolution.

Question 2

Explain in your own words why the question of entailment for first-order logic is semidecidable.

Question 3

Answer *true*, *false* or *unknown* to each of the following statements:

- a) Any valid statement in first-order logic can be proved via propositionalization and resolution
- b) Godel's results show that first-order logic is semidecidable
- c) There exist statements about arithmetic which are true, but can't be proved using the standard inference rules of arithmetic
- d) Suppose we are given a statement S in first-order logic, and we are guaranteed that a proof of S exists. Then we can use an algorithm to find a proof of S .
- e) The satisfiability of a statement in propositional logic can be determined in polynomial time.
- f) The satisfiability of a statement in first-order logic can be determined in polynomial time.