Assignment11 – FOL-Inference, Knowledge Representation

Problem 11.1 (First-Order Resolution)

Let $P, Q \in \Sigma_1^p$, $R \in \Sigma_2^p$, $c, d \in \Sigma_0^f$. Prove the following *formula* using the *first-order resolution calculus* $\mathcal{R}_1$.

$$\exists X.\forall Y.\exists W.\exists Z.\neg((R(Z,Y)\vee\neg P(Z))\wedge(\neg Q(d)\vee P(c))\wedge(Q(d)\vee\neg P(c))\wedge(\neg R(Z,Y)\vee\neg P(W)\vee\neg Q(X))\wedge P(c))$$

Hint: Note, that the formula is already (close to) a negated CNF, so if you spend any significant amount of time transforming the formula, you are most likely doing something wrong.

Problem 11.2 (First-Order Tableau)

Prove or refute the following formula using the first-order *free variable tableaux calculus*. We have $P, R \in \Sigma_1^p$ and $f \in \Sigma_1^f$.

$$(\forall X.P(X) \Rightarrow R(f(X))) \Rightarrow ((\exists X.P(X)) \Rightarrow (\exists .R(Y)))$$

Problem 11.3 (Modeling in Description Logic)

Consider the following situation:

- Some beings are persons, some are animals.
- Persons and animals may like other persons or animals.
- Alice is a person, and she likes the animal Bubbles.

1. Model this situation as a semantic network. Explain the different kinds of nodes and edges occurring in your network.
2. Model the same situation in first-order logic and compare the results.
3. Explain the difference between inst and is-a edges.
4. Explain the difference between having a relation edge between two concepts vs. asserting a relation between two individuals.