
Question 1. (3 points)

Determine the least general generalization of the following two assertions

1. *Superman is mortal or he is not a human.*
2. *Every human who smokes is mortal.*

by representing them as first-order logic clauses and computing their least general generalization with respect to the θ -subsumption order, and express the result in natural language.

Question 2. (2 points)

Let h, h' be FOL clauses and B a ground FOL conjunction. Show that if $h \subseteq_{\theta} h'$ then $h \subseteq_{\theta}^B h'$.

Question 3. (5 points)

Show that

$$\text{parent}(v_2, v_1) \wedge \text{male}(v_1) \rightarrow \text{son}(v_1, v_2)$$

and

$$\begin{aligned} & \text{son}(v_1, v_2) \vee \neg \text{female}(\mathbf{a}) \vee \neg \text{parent}(\mathbf{a}, \mathbf{b}) \vee \neg \text{parent}(v_2, v_1) \vee \neg \text{male}(\mathbf{b}) \vee \\ & \neg \text{male}(v_1) \vee \neg \text{parent}(v_3, v_4) \vee \neg \text{parent}(\mathbf{b}, \mathbf{c}) \vee \neg \text{male}(v_4) \vee \neg \text{male}(\mathbf{c}) \end{aligned}$$

are equivalent relative to

$$B = \text{female}(\mathbf{a}) \wedge \text{parent}(\mathbf{a}, \mathbf{b}) \wedge \text{male}(\mathbf{b}) \wedge \text{parent}(\mathbf{b}, \mathbf{c}) \wedge \text{male}(\mathbf{c})$$

Question 4. (10 points)

Let

$$\begin{aligned} B &= \text{half}(4, 2) \wedge \text{half}(2, 1) \wedge \text{int}(2) \wedge \text{int}(1) \\ x_1 &= \text{even}(4) \\ x_2 &= \text{even}(2) \end{aligned}$$

1. Compute a least general generalization of x_1, x_2 observations relative to B .
2. Determine the reduction of the resulting clause relative to B and justify why it is indeed a reduction of it relative to B .

Question 5. (10 points)

Let X contain Herbrand interpretations for a finite set of \mathcal{P} predicates and a finite set \mathcal{F} of functions, and the observation complexity n_X be the tuple $(|\mathcal{P}|, |\mathcal{F}|)$. Show that the hypothesis class *st*-CNF (i.e., conjunctions of FOL clauses with at most s literals and at most t term occurrences in each literal) is learnable online from X .