

Foundations of Artificial Intelligence

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Exercise Sheet 7

Due: Friday, June 20, 2008

Exercise 7.1 (Substitutions and Unification)

- (a) Compute the substitutions (i) $P(x, y)\{\frac{x}{A}, \frac{y}{f(B)}\}$, (ii) $P(x, y)\{\frac{x}{f(y)}\}\{\frac{y}{g(B, B)}\}$, (iii) $P(x, y)\{\frac{x}{f(y)}, \frac{y}{g(B, B)}\}$, and (iv) $P(x, y)\{\frac{z}{f(B)}, \frac{x}{A}\}$
- (b) Apply the unification algorithm to the following set of literals: $\{R(h(x), f(h(u), y)), R(y, f(y, h(g(A))))\}$. In each step, give the values of T_k , s_k , D_k , v_k , and t_k .

Exercise 7.2 (Resolution in First Order Logic)

From “Horses are animals” it follows that “The head of a horse is the head of an animal”. Demonstrate that this inference is valid by carrying out the following steps:

- (a) Translate the premise and the conclusion into the language of first-order logic. Use three predicates: *HeadOf*(h, x) (meaning “ h is the head of x ”), *Horse*(x), and *Animal*(x).
- (b) Negate the conclusion, and convert the premise and the negated conclusion into clause form.
- (c) Use first-order resolution to show that the conclusion follows from the premise.

Exercise 7.3 (Machine Learning)

Classify the following learning problems as supervised learning, unsupervised learning and reinforcement learning tasks.

- (a) Identification of products frequently bought together
- (b) Chess computer capable of learning from previous games
- (c) Spam recognition and filtering
- (d) Classification of applicants as credit-worthy or unworthy
- (e) Object recognition in computer vision
- (f) Obstacle avoidance in robotics
- (g) Automatic sorting of images wrt the depicted objects

Exercise 7.4 (Decision Trees)

Give decision trees to represent the following Boolean formulas (functions):

- (a) $A \wedge \neg B$, (b) $A \vee (B \wedge C)$, (c) $A \Leftrightarrow B$, (d) $(A \wedge B) \vee (C \wedge D)$

The exercise sheets may and should be worked on in groups of three (3) students. Please fill the cover sheet¹ and attach it to your solution.

¹<http://www.informatik.uni-freiburg.de/~ki/teaching/ss08/gki/coverSheet-english.pdf>