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: \( \text{HeadOf}(h, x) \) (meaning “\( h \) is the head of \( x \)”), \( \text{Horse}(x) \), and \( \text{Animal}(x) \).
(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) \( A \land \neg B \), (b) \( A \lor (B \land C) \), (c) \( A \iff B \), (d) \( (A \land B) \lor (C \land D) \)

The exercise sheets may and should be worked on in groups of three (3) students. Please fill the cover sheet\(^1\) and attach it to your solution.

\(^1\)http://www.informatik.uni-freiburg.de/~ki/teaching/ss08/gki/coverSheet-english.pdf