Foundations of Artificial Intelligence

Prof. Dr. B. Nebel, Prof. Dr. M. Riedmiller   University of Freiburg
S. Lange, J. Witkowski, D. Zhang   Department of Computer Science
Summer Term 2010

Exercise Sheet 6
Due: Tuesday, June 15, 2010

Exercise 6.1 (Machine Learning)

(a) Briefly describe the three types of machine learning (supervised, unsupervised and reinforce-ment learning) with your own words. What are the key differences between these three types? Do a small literature survey and name at least one well-known learning algorithm for each of the three types.

(b) Classify the following learning problems as supervised learning, unsupervised learning and reinforcement learning tasks. Provide at least a one-sentence justification for each of your answers.

   (a) Estimating a probability density function by observing a finite set of samples
   (b) Predicting future exchange rates given the history of past exchange rates
   (c) Identification of products frequently bought together
   (d) Chess computer capable of learning from previous games
   (e) Spam recognition and filtering
   (f) Classification of applicants as credit-worthy or unworthy
   (g) Object recognition in computer vision
   (h) Segmentation of images according to the color value of their pixels
   (i) Finding out the lever of a three-armed bandit with the highest victory-pobability

Exercise 6.2 (Decision Trees)
Specify decision trees representing the following Boolean functions:

(1) $A \wedge \neg B$

(2) A XOR B

(3) $(A \vee B) \wedge (C \vee D)$

(4) $(A \wedge B) \vee (C \wedge D)$

Exercise 6.3 (Attribute selection)
Here we will practice the basic information-theoretical concepts used to build decision trees. Con-sider the following set of training examples:

a_1	a_2	Classification
T	T	+
T	T	+
T	F	-
F	F	+
F	T	-
F	T	+

(a) What is the information content of this collection of training examples with respect to the target function *Classification*?

(b) What is the information gain of a_2 relative to these training examples?

The exercise sheets may and should be handed in and 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/ss10/gki/coverSheet-english.pdf