KI 2 Exam/retry, 8th April 2004. Schomaker/Bulacu. STUDENTNR..... NAME .....

Question 1

a. Define structural pattern classification (SPC)
b. What is a strong property of SPC?
c What is a weak property of SPC?

Question 2

a. In hidden Markov Models, given observations $O = (o_1, o_2, ..., o_T)$, what are the three parameters of a HMM $\lambda(...)$ that stochastically models such observations?
b. There are three typical questions to pose to the system in hidden-Markov modeling in speech or handwriting recognition. What are these three questions? Please describe your answer in terms of O, $\lambda(...)$ and/or conditional probabilities.
c. The HMM approach inherits the virtues but also the limitations of the Bayesian approach. What are these limitations?

Question 3

a. Describe the Borda rank-combination scheme.
b. When is this method used?
c. What is a possible disadvantage of the method?

Question 4

In PAC learning, one uses three parameters to describe the performance of a certain classifier. Table 1 gives an example.

epsilon	delta	m
0.1	0.1	148
0.1	0.01	240
0.1	0.001	332
0.01	0.1	1476
0.01	0.01	2397
0.01	0.001	3318
0.001	0.1	14756
0.001	0.01	23966
0.001	0.001	33176

a. Explain these three parameters.
b. Translate the following statement concerning a good classifier: "the probability of the error being greater than the accuracy is less than the confidence" to a formal expression
c. I want to train the word "computer" to a speech recognizer. I want to be sure that the probability of my trained recognizer being worse than 99% of the utterances correctly classified is one in thousand. How many words do I need to train?

Question 5

a. Explain the difference between a Markov Decision Problem (MDP) and a Partially Observable Markov Decision Problem (POMDP).
b. In traditional AI, a common method to generate intelligent behavior in an agent was "Planning". Explain the essential difference between a policy in (PO)MDPs and planning.
c. In the course, playing a game of cards was used as an example of a decision problem for which POMDPs are suitable. Why will other methods fail?
d. Mention your own example of a problem in real life that could be modeled with a POMDP for use in an intelligent agent.

Question 6

Assume that you have a grammar inference engine that can detect repetition, operator R() and symmetry, operator S(). For example: AAA → R(3,A), ABBAD → S(AB,nil),D; ABCBA → S(AB,C) etc. Find the shortest possible expressions for the following sequences a,b and c, where cost of an expression is counted in the number of operators.
a. BAAAB b. ABEFGDDDDEFGDDDDBA c. DDAADDAA

Question 7

Describe the algorithm for decision-tree construction on the basis of binary features in a binary classification task. What are the necessary numerical computations?