Final Exam 2009

ARTIFICIAL INTELLIGENCE

Questions: 4 – Total marks: 10 – Time: 120 minutes – Open book

Question 1 (4 marks):

In a home garden there are two possible causes making the grass wet: either the water sprinkler is on or it is raining. Without those two causes, the grass is not wet. With only one of them, the probability that the grass is wet is only 0.1. If the sprinkler is on while it is raining, that probability is 0.99. There are two seasons in a year. In the rainy season, usually it rains and the sprinkler is not turned on; the probability that it is raining and the probability that the sprinkler is on are 0.8 and 0.1, respectively. In the dry season, those probabilities are 0.2 and 0.5, respectively. Half of a year is the rainy season.

a) Draw the Bayesian network representing these uncertain causal effects between the events. (1 m)
b) Calculate the probability that it is raining and the sprinkler is off in the rainy season. (0.5 m)
c) Calculate the probability that it is raining and the sprinkler is on. (1 m)
d) Calculate the probability that the grass is wet in the rainy season when the sprinkler is not on. (1.5 m)

Question 2 (1 mark):

Let A and B be the fuzzy sets defined by the voting tables below, on the domain $\{a, b, c\}$. Compute their fuzzy intersection and union.

A	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
a	x	x	x	x						
b	x	x	x	x	x	x	x	x	x	x
c	x	x	x	x	x	x				

B	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
a	x	x	x	x	x	x	x			
b	x	x	x	x	x	x	x	x	x	x
c	x	x	x							

Question 3 (3 marks):

Sorting an array $a_1, a_2, \ldots, a_n$ can be considered as a problem whose goal is to achieve the order $a_1 < a_2 < \ldots < a_n$ by a number of swapping operations on pairs of the array elements. Apply Goal Stack Planning to this problem with that compound goal decomposed into the sub-goals $a_i < a_{i+1}$ $(1 \le i \le n-1)$, assuming that $a_i < a_{i+1}$ is pushed into the stack before $a_j < a_{j+1}$ where $i < j$.

a) Trace the steps followed to make a plan for the problem with $a_1 = 3$, $a_2 = 2$, $a_3 = 1$, showing the stack content in each step. (2 m)
b) In the general case of n, which sorting algorithm is the generated plan similar to? Explain your answer. (1 m)

Question 4 (2 marks):

a) Use the candidate-elimination procedure to learn the concept *bird* described by the following training set on the four attributes *eats*, *has feathers*, *has claws*, and *flies*. The domains of those attributes are: *eats* = {*meat*, *seeds*, *insects*}, *has feathers* = {*yes*, *no*}, *has claws* = {*yes*, *no*}, *flies* = {*yes*, *no*}.

training instances	**eats**	**has feathers**	**has claws**	**flies**	**bird**
eagle	*meat*	*yes*	*yes*	*yes*	*yes*
wolf	*meat*	*no*	*yes*	*no*	*no*
dove	*seeds*	*yes*	*no*	*yes*	*yes*
bat	*insects*	*no*	*no*	*yes*	*no*
ostrich	*seeds*	*yes*	*no*	*no*	*yes*

(1 m)

b) Represent the resulting hypotheses using propositional logic. (0.5 m)
c) How many instances are classified as positive by the resulting hypotheses? (0.5 m)

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