

Advanced AI Techniques (WS04)

Excercise sheet 2

Deadline: 4.11.04

Exercise 1 (4 points)

a) Consider the following JPD over the three binary variables A , B , and C :

C	B	A	probability
0	0	0	1/4
0	0	1	1/12
0	1	0	1/8
0	1	1	1/24
1	0	0	1/24
1	0	1	1/8
1	1	0	1/12
1	1	1	1/4

- (a) Write down an independency model I that captures the independency relations in p .
- (b) Construct a bayesian network that represents I as accurately as possible.
- (c) Is your bayesian network a faithful representation of I ?

Give evidence for your answers.

b) Consider a domain, where the following independence model holds:

$$I_p(\{X\}, \{Z\})$$

$$I_p(\{Z\}, \{X\})$$

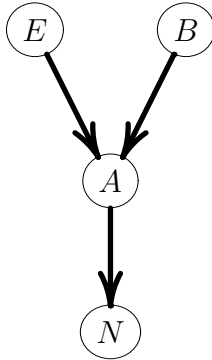
$$I_p(\{X\}, \{Z\} | \{Y\})$$

$$I_p(\{Z\}, \{X\} | \{Y\})$$

No other independencies hold. Use Lemma 5 to construct minimal bayesian networks using every possible ordering of the variables. Is any of these representations faithful?

Exercise 2 (4 points)

Consider the following scenario: A house is equipped with an alarm system (A), which can be triggered by a burglary (B) or an earthquake (E). The neighbour (N) is supposed to call the owner whenever he observes the alarm going off. This is modeled by the following Bayes Net structure:



After observing the situation for a while, we get the following data set of cases:

E	B	A	N
+	-	+	+
-	+	+	+
+	+	+	-
-	-	-	-
-	-	-	-
-	-	-	+
+	-	+	-
-	-	-	-
+	-	-	-
-	+	+	+

Compute the maximum likelihood parameters for this Bayesian network.

Exercise 3 (4 points)

a) Assume you feel that your prior experience concerning the relative frequency of smokers in your favourite bar is equivalent to having seen 14 smokers and 6 non-smokers. How do you represent your beliefs using the beta density function?

b) Suppose you log whether or not individuals smoke and get the following data d :

$$\{s, n, n, n, n, s, n, n, n, s\}$$

Give the prior distribution density $p(\Theta)$, the posterior distribution density $p(\Theta|d)$, and the maximum a posteriori estimator (MAP) of Θ . Describe how you arrived at your solution, and cite which lemmas from the lecture you use.