



10th Theoretical Assignment in
Artificial Intelligence (SS 2005)

Issued: July 4, 2005

Due: July 11, 2005

– This exercise sheet will be discussed in a plenary tutorial on –
– wednesday, july 13th 2005 between 16-18 h –
– in lecture hall HS002 –

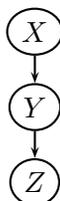
Exercise 10.1

(50 P)

Consider the following Bayesian network with three Boolean random variables X, Y, Z .

$$P(X = true) = \frac{1}{2}$$

y	$P(Z = true Y = y)$
<i>true</i>	$\frac{1}{3}$
<i>false</i>	$\frac{1}{2}$



x	$P(Y = true X = x)$
<i>true</i>	$\frac{3}{4}$
<i>false</i>	$\frac{1}{2}$

Using the Bayesian network above, answer the following questions.

- (a) Compute $P(Y = false|X = true)$: the conditional probability that Y is false given that X is true. (5 P)
- (b) Compute $P(Y = false|X = false)$: the conditional probability that Y is false given that X is false. (5 P)
- (c) Compute $P(X = true, Y = false)$: the probability that X is true and Y is false. (5 P)
- (d) Compute $P(X = false, Y = false)$: the probability that X is false and Y is false. (5 P)
- (e) Compute $P(Y = false)$: the probability that Y is false. (5 P)
- (f) Compute $P(X = true|Y = false)$: the conditional probability that X is true given that Y is false. (5 P)
- (g) Compute $P(X = true, Y = false, Z = true)$: the probability that X and Z are true but Y is false. (5 P)
- (h) Compute $P(X = true, Z = true)$: the probability that X and Z are true. (5 P)
- (i) Compute $P(Y = false|X = true, Z = true)$: the probability that Y is false given that X and Z are true. (5 P)
- (j) Does the equation $P(Y = false|X = true, Z = true) = P(Y = false|X = true)$ hold? (5 P)

the tree. In the following exercise, you should calculate the information gain for each attribute of the restaurant domain illustrated in Russell/Norvig.

1. To work out the information gain you, firstly, need to calculate the entropy for the set of examples S . (15 P)
2. For each attribute, use the entropy of S to calculate the information gain. (15 P)

(Note: You should take $0 \log_2(0) = 0$)

Exercise 10.3 (20 P)

Indicate the decision trees for the following boolean functions:

1. $A \wedge \neg B$ (5 P)
2. $A \vee (B \wedge C)$ (5 P)
3. (10 P)

A	B	C	f(A,B,C)
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1