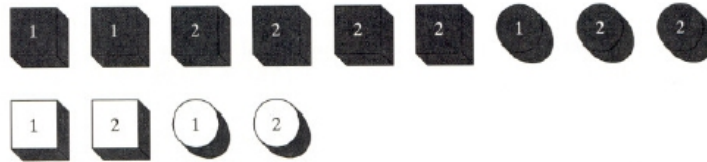# Advanced AI Techniques (WS05)

Exercise sheet 2

Deadline: 22.11.05

Exercise 1 (6 points)

a) *Let p be the joint probability distribution of the variables color, shape, and label of an object drawn with replacement from the following population:*

   (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 6 to construct minimal bayesian networks using every possible ordering of the variables. Is any of these representations faithful?

Exercise 2 (3 points)

Consider the following scenario: Consider the following scenario: Having a Big Belly (B) could be due to unhealthy lifestyle (L), which could be drinking too much beer (D) or eating too much (E).

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

L	D	E	B
+	-	+	+
-	+	+	+
+	+	+	-
-	-	-	-
-	-	-	-
-	-	-	+
+	-	+	-
-	-	-	-
+	-	-	-
-	+	+	+

1. Sketch the Bayesian network structure.

2. 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.