Bayesian Networks - Übungszettel 12

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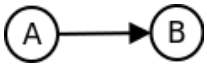
Solutions need to be handed in until Tuesday, January 31st 10AM

Exercise 1: Maximum Likelihood Estimation (10 Points)

a) Consider the following Bayesian Network:

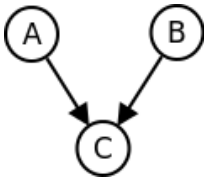


Suppose we have drawn a sample for A and B:

A	B
1	1
0	0
0	1
1	0
1	1
0	1
1	0
1	1
0	1
1	1

Compute the (conditional) probabilities using the MLE principle. What is the maximal likelihood?

b) Repeath the process for the following BN



using the sample:

A	B	C
1	1	1
0	0	0
0	1	1
1	0	0
1	1	1
1	0	1
1	0	0
1	1	0
0	1	0
1	1	1
0	0	0
0	1	0
0	1	1
1	1	1
1	0	0
1	1	0

Again, compute the (conditional) probability tables using MLE. What is the maximal likelihood?

c) What are the disadvantages of using Maximum Likelihood Estimation?

Exercise 2: Maximum A Posteriori Estimation (10 Points)

a) We are given a die W with six sides, naturally, our prior assumption on the die is that it is a fair die, i.e.

$$P(W = 1) = ... = P(W = 6) = 1/6$$

For a prior sample size $n_{\text{prior}} = 10$, and a given sample

$$\{1, 6, 6, 6, 2, 4, 3, 6, 5, 4, 6, 2, 4, 6, 3, 5, 6, 1, 2, 5\}$$

compute the posterior probability!

b) Repeat the process using $n_{\text{prior}} = 1000$. What is the influence of n_{prior}!

c) Consider a binary random variable X, which has a prior parametrized by θ. Why does it not suffice to use the expected $\hat{\theta}$ to compute the prior distribution? Why do we need a distribution over θ?

d) Explain the concept of conjugate priors and why they are helpful for MAP estimation!