Tutorial Bayesian Network WS 2007/08
Wirtschaftsinformatik und Maschinelles Lernen (ISMLL)
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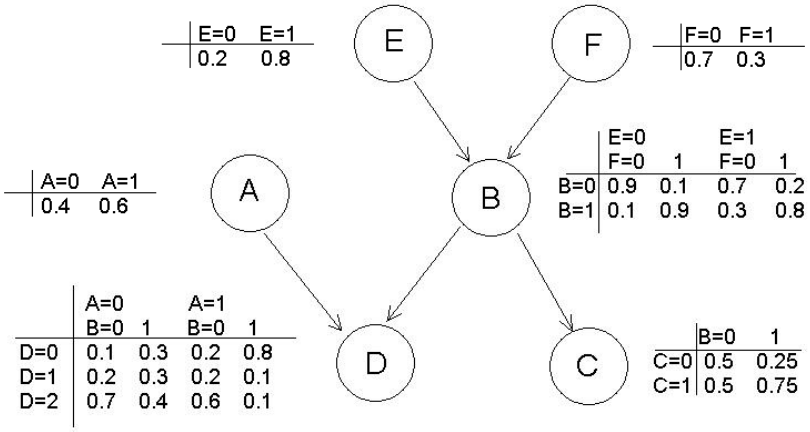
Tutorial 12

Solutions should be given till 28th January 2008, 16:00

Exercise 1 Importance sampling (20 points)

Suppose we apply
(1) self importance sampling
(2) adaptive sampling
on the following Bayesian network conditioned by the evidence $Ev = \{D=2, B=1\}$.
In the first step we generated the sample instances above.

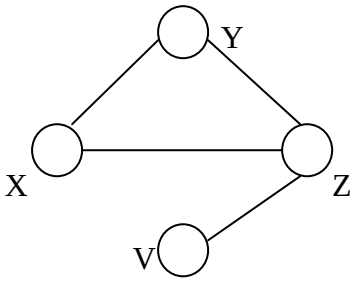
A	B	C	D	E	F
1	1	1	2	1	0
0	1	1	2	1	0
1	1	0	2	1	1
1	1	0	2	0	0
1	1	1	2	1	0
0	1	1	2	1	0
0	1	1	2	1	1
1	1	0	2	1	0
0	1	1	2	0	0
1	1	1	2	1	1



a) [5 pts] Which conditional probability distributions will be changed?
b) [5 pts] What are the new conditional probability distributions for the second step in case of self importance sampling?
c) [5 pts] What are the new conditional probability distributions for the second step in case of adaptive sampling?
d) [5 pts] What is the most important difference between self importance samling and adaptive sampling (based on slide 4 in bayes-10-approxinference-propagation.pdf)?

Exercise 2 Loopy propagation (10 points)

Suppose we are given the cluster graph above. (Each of the nodes, *X, Y, Z, V* correspond to a set of variables, however the concrete mapping of variables to nodes in not interesting now.) The link potentials are calculated using loopy propagation in the following order: $q(Z,X)$, $q(X,Y)$, $q(Y,Z)$, $q(Z,V)$, $q(V,Z)$, $q(Z,Y)$, $q(Y,X)$, $q(X,Z)$, $q(Z,Y)$ Can this order be a random walk? Justify your answer please!



Exercise 3 Basics of parameter learning (15 points + 5 bonus points)

a) [5 pts] Suppose, we observe the following values of a discrete probabilistic variable *V*: 0, 3, 0, 1, 2, 1, 1, 2, 2, 2, 2, 1, 0, 1, 2, 2, 1, 0, 2, 1, 3, 3, 1, 2, 2, 1, 1, 3. Which distribution can be learned via maximum likelihood principle?

b) [5 pts] Suppose we are interested in families with 3 children. Suppose *V* denotes the amount of daughters in the family. What is the "theoretical" distribution of *V*?

c) [bonus 5 pts] Which distribution is the theoretical distribution of *V* "similar" to? (Hint: $V = V_1 + V_2 + V_3$ where: $V_1 = 1$ if the first child is a girl, $V_1 = 0$ else. $V_2 = 1$ if the second child is a girl, $V_2 = 0$ else. $V_3 = 1$ if the third child is a girl, $V_3 = 0$ else.)

d) [5 pts] Suppose we express our certainty in the "theoretical" distribution the following way: we belief the theoretical distribution as much as if we would have observed this distribution on a sample of size 1000. What is the learned distribution in this case?