Tutorial Bayesian Network WS 2007/08
Wirtschaftsinformatik und Maschinelles Lernen (ISMLL)
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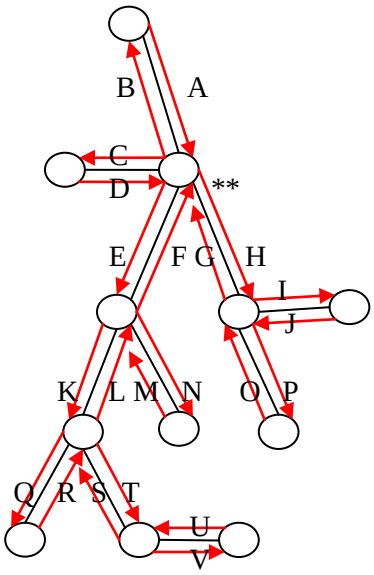
Tutorial 10

Solutions should be given till 14th January 2008, 16:00

Exercise 1 Inference using cluster trees (20 points)

Suppose we are given a cluster tree shown in the figure above. Suppose we want to infer according to this. As shown in the lecture [bayes-07-exactinference-clustering.pdf] we need to calculate link potentials for the inference. The link potentials are also shown in the figure and enumerated by A,B,...,V. We calculate the link potentials according to lemma 1 in [bayes-07-exactinference-clustering.pdf]. Which of the following orders is conform to this lemma (i.e. in which order is the calculation of the link potentials possible)?

a) [3 pts.] A;B;C;D;E;F;G;H;I;J;K;L;M;N;O;P;Q;R;S;T;U;V
b) [3 pts.] A;D;U;O;J;M;R;G;E;S;K;L;N;Q;T;V;F;H;I;P;B;C
c) [3 pts.] A;D;U;O;J;M;R;G;E;S;L;K;N;Q;T;V;F;H;I;P;B;C
d) [3 pts.] A;D;U;O;J;M;R;G;E;S;N;L;K;Q;T;V;F;H;I;P;B;C
e) [8 pts.] Suppose we chose the vertex marked with ** as root. In which order do we calculate the link potentials according to lemma 2 in [bayes-07-exactinference-clustering.pdf]? Is the order according to lemma 2 unique (i.e. are there several possible orders according to lemma 2)?



Exercise 2 Naive Bayes Classification and Bayes Networks (15 points)

The Naive Bayes classifier is described as follows. We only want to infer one variable (the class variable) given all other variables. Suppose this variable (the class variable) is denoted by C, the other variables are denoted by $A_1, A_2, \ldots, A_k$. The given values of these variables are $a_1, a_2, \ldots, a_k$. C may have several values denoted by $c_1, c_2, \ldots, c_n$. The conditional probabilities $P(C=x_i \mid A_j = a_j)$ are also given for all $0 < i < n+1$ and $0 < j < k+1$.
Then the inference is done according to this formula:
$P(C=x_i) = f \; P(C=x_i \mid A_1 = a_1) P(C=x_i \mid A_2 = a_2) \ldots P(C=x_i \mid A_k = a_k)$, where f is a constant normalising factor so that $P(C=x_1) + P(C=x_2) + \ldots + P(C=x_k) = 1$.

Can the Naive Bayes classifier described above be represented as a Bayesian Network? If yes, depict the corresponding Bayesian Network. If no, justify your answer!