# Übung 6

Lösungen bitte via Moodle / learnweb, bis zum 29.06.2010 einreichen.

Aufgabe 1 Inference using cluster trees   (10 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) [2,5 pts.] A;B;C;D;E;F;G;H;I;J;K;L;M;N;O;P;Q;R;S;T;U;V
  b) [2,5 pts.] A;D;U;O;J;M;R;G;E;S;K;L;N;Q;T;V;F;H;I;P;B;C
  c) [2,5 pts.] A;D;U;O;J;M;R;G;E;S;L;K;N;Q;T;V;F;H;I;P;B;C
  d) [2,5 pts.] A;D;U;O;J;M;R;G;E;S;N;L;K;Q;T;V;F;H;I;P;B;C
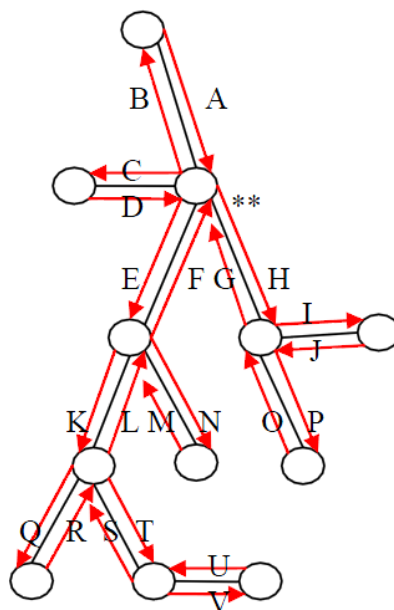
Aufgabe 2 Triangulation   (10 Points)

a) [5 pts.] What is the difference between minimal and minimum triangulation?
b) [5 pts.] Show a graph, where the MCS-algorithm does not find the optimal triangulation!

Aufgabe 3 Inference using generated data (10 Points)

Suppose, we are given the following sample instances (we have generated them via acceptance-rejection sampling). Suppose, we are also given the evidence E = {C=1, A=0}
   a) [5 pts.] Which of the instances will be rejected?
   b) [5 pts.] What is the marginal distribution of B under the given evidence? [I.e. we want to infer the P(B|C=1, A=0)]

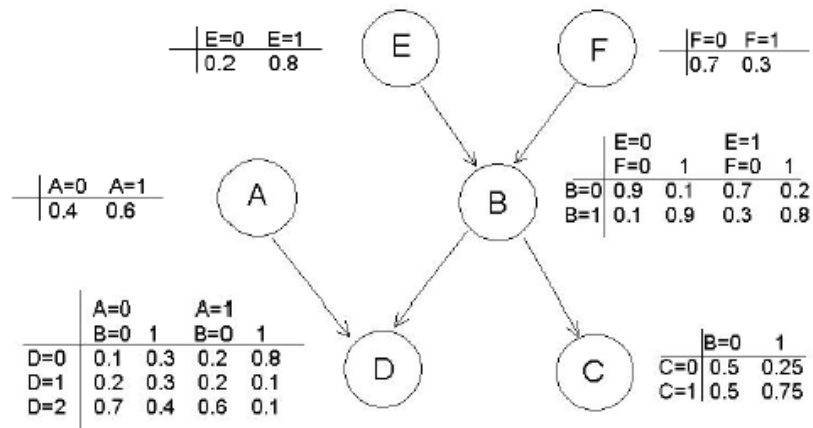| A	B	C	D
0	1	1	1
1	1	0	0
0	1	0	0
0	1	1	1
1	0	0	0
0	0	1	0
0	0	0	0
0	0	1	1
1	1	0	1
0	0	1	0
1	0	0	1
0	1	0	0
0	1	1	1

Aufgabe 4 Importance sampling   (10 Points + 10 Bonus)

Suppose we have generated the following sample instances via importance sampling
conditioned by the evidence $Ev = \{D=2, B=1\}$
The Bayesian network shown in the figure above was sampled.

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

E:

E=0	E=1
0.2	0.8

F:

F=0	F=1
0.7	0.3

B (parents E, F):

	E=0, F=0	E=0, F=1	E=1, F=0	E=1, F=1
B=0	0.9	0.1	0.7	0.2
B=1	0.1	0.9	0.3	0.8

A:

A=0	A=1
0.4	0.6

D (parents A, B):

	A=0, B=0	A=0, B=1	A=1, B=0	A=1, B=1
D=0	0.1	0.3	0.2	0.8
D=1	0.2	0.3	0.2	0.1
D=2	0.7	0.4	0.6	0.1

C (parent B):

	B=0	B=1
C=0	0.5	0.25
C=1	0.5	0.75

a) [10 pts.] What are the weights of each instance?

b) [Bonus 5 pts.] Infer the the marginal distribution of A under the given evidence!
   ($P(A|Ev) = ?$)

c) [Bonus 5 pts.] Infer the the common probablility distribution of A and E under the
   given evidence! ($P(A,E|Ev) = ?$)