Tutorial Bayesian Network WS 2007/08
Wirtschaftsinformatik und Maschinelles Lernen (ISMLL)
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Tutorial 4

Markov Networks (1.)

Solutions should be given till 19th November 2007, 16:00

Exercise 1 Topological order (5 points + 10 bonus points)

a) [3 pts.] Does the graph in Figure 1 have a topological order? If yes, is this unique? (Does it have only one topological order or more?)
b) [2 pts.] Show an example for a graph, which has several topological orders!
c) [optional, 10 bonus pts.] Is it possible to choose directions for the edges of the Petersen graph (Fig. 2.) so that it has a unique topological order?

Exercise 2 Graphical representation of independence (15 Points)

d) [4 pts.] Is the graph in Fig. 3 a representation of the following independence model? I={I(A,C|{E,F,B}), I(C,A|{E,F,B}), I(A,C|{D,F,B}), I(C,A|{D,F,B}), I(A,D|{E,F,B}), I(D,A|{E,F,B}), I(A,D|{E,F,C}), I(D,A|{E,F,C})}
e) [3 pts.] Is the graph in Fig. 3 a faithful representation of the indep. relation above?
f) [3 pts.] Construct (another) graph, which represents the independence relation above! (This graph should not necessary be a faithful representation.)
g) [5 pts.] For which independence relation is the graph in Fig. 3 a faithful representation?

Exercise 3 Properties of independency models, graphical representation (10 Points)

Suppose we are given the following independence model:
I(A,B|{C,D}), I(B,A|{C,D}), I(A,C|{D,E})

a) [3 pts.] Which of the properties (symmetric, decomposable and intersectable) hold for this model?
b) [2 pts.] Modify the model so that all of the properties above hold for the model!
c) [5 pts.] Construct the minimal undirected graph representation of the model. Is it trivial? Is it unique? Is it faithful?

Exercise 4 Potentials, Markov Networks (15 Points)

Given that the potentials ψ_1, ψ_2 represented in Table 1 and Table 2 factorize the JPD *p*, solve the following tasks:

a) [4 pts.] Multiply ψ_1 and ψ_2 and depict the graph associated with these potentials.
b) [2 pts.] Reconstruct *p*.
c) [3 pts.] Does this graph represent the independency model of *p*? Justify your answer.
d) [3 pts.] Are B and C conditionally independent given D in *p*?
e) [3 pts.] Does this graph represent the independency model of *p* faithfully?

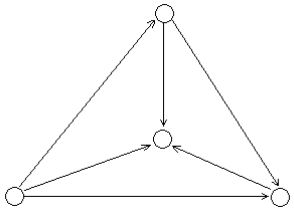

Fig.1

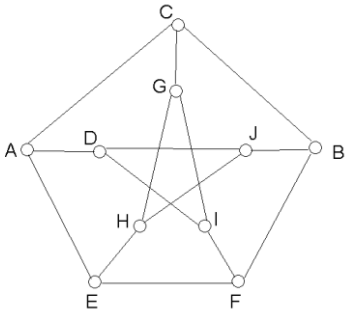

Fig.2 (Petersen Graph)

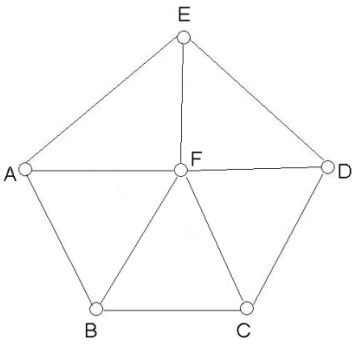

Fig.3.

A	B	P(A,B)
0	0	0.2
0	1	0.2
1	0	0.3
1	1	0.3

Table 1.

B	C	D	P(A,B,C)
0	0	0	0.225
0	0	1	0.0666...
0	1	0	0.075
0	1	1	0.0333...
1	0	0	0.075
1	0	1	0.3333...
1	1	0	0.025
1	1	1	0.1666...

Table 2.