VU VRIJE UNIVERSITEIT AMSTERDAM

Knowledge Representation

2023/2024

Exercise Sheet 4 – Mini Exercise-Sheet on Bayesian Networks

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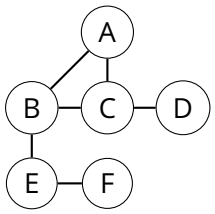
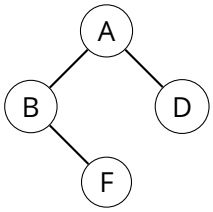
Exercise 4.1 You are given the following interaction graph:



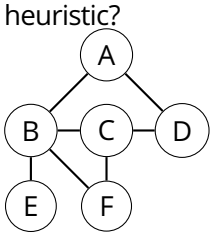
(a) Does the graph correspond to the following set of factors?

$$\{\ f(A,B,C),\ f(E,F),\ f(C,E),\ f(D,C),\ f(C,B),\ f(B,E)\ \}$$

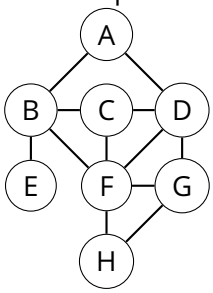
(b) Could the following graph be reached from the original graph through node elimination?



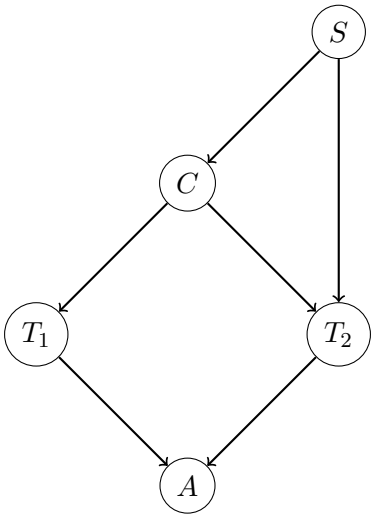
(c) Could E-A-D-F-B-C be an elimination order in the following graph according to the MinFill heuristic?



(d) Provide an elimination order on the following graph according to the MinDeg heuristic. (There are multiple correct answers.)



Exercise 4.2 You are given the following Bayesian Network.



S	C	T_2	$\Theta_{T_2\|C,S}$
male	yes	+ve	0.80
male	yes	-ve	0.20
male	no	+ve	0.20
male	no	-ve	0.80
female	yes	+ve	0.95
female	yes	-ve	0.05
female	no	+ve	0.05
female	no	-ve	0.95

T_1	T_2	A	$\Theta_{A\|T_1,T_2}$
+ve	+ve	yes	1
+ve	+ve	no	0
+ve	-ve	yes	0
+ve	-ve	no	1
-ve	+ve	yes	0
-ve	+ve	no	1
-ve	-ve	yes	1
-ve	-ve	no	0

S	Θ_S
male	0.55
female	0.45

S	C	$\Theta_{C\|S}$
male	yes	0.05
male	no	0.95
female	yes	0.01
female	no	0.99

C	T_1	$\Theta_{T_1\|C}$
yes	+ve	0.8
yes	-ve	0.2
no	+ve	0.2
no	-ve	0.8

(a) Write down the probability table for $\Pr(S, C, T_2)$. *(Warning: ugly numbers!)*

(b) Write down the probability table for $\Pr(T_1 \mid S = \text{male})$.

(c) Calculate MPE$(S = \text{female}, C = \text{no})$.

(d) Calculate MAP$(S, C \mid A = \text{yes})$.