# INF367: Spring 2020
# Exercise 3

**Instructions:**

You can either return the solutions electronically via MittUiB by Monday 10.00 or show them on paper on Monday's meeting. Grades are awarded for effort so scanned notes are fine if you solve exercises by hand (no need to make fancy latex files).

Participants are encouraged to write computer programs to derive solutions whenever appropriate.

**Tasks**

1.

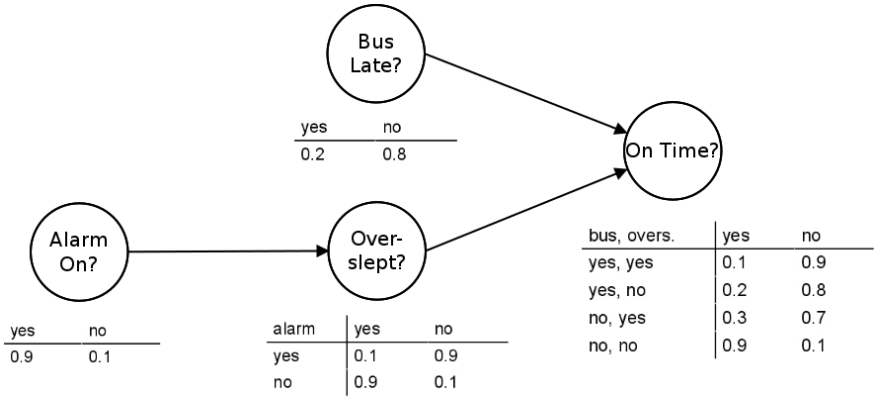



Figure 1: A Bayesian network

Consider the Bayesian network shown in Figure 1. Compute the following probabilities:

a) $P(\text{Overslept} = yes \,|\, \text{Alarm on} = yes)$

b) $P(\text{Overslept} = yes)$

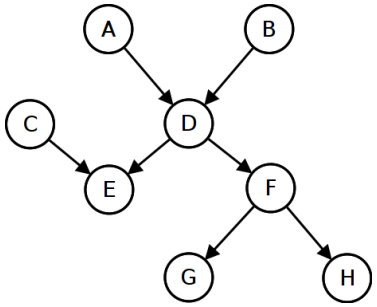
c) $P(\text{Overslept} = yes \,|\, \text{On time} = no)$

d) $P(\text{Overslept} = yes \,|\, \text{On time} = no, \text{Bus late} = yes)$

e) $P(\text{On time} = no \,|\, \text{Overslept} = yes)$

2.

We are given a Bayesian network whose structure is the following DAG:




All variables are binary and conditional probabilities are as follows:

$$
\begin{aligned}
P(A=0) &= 0.3 \\
P(B=0) &= 0.8 \\
P(C=0) &= 0.4 \\
P(D=0|A=0,B=0) &= 0.9 \\
P(D=0|A=0,B=1) &= 0.3 \\
P(D=0|A=1,B=0) &= 0.2 \\
P(D=0|A=1,B=1) &= 0.8 \\
P(E=0|C=0,D=0) &= 0.6 \\
P(E=0|C=0,D=1) &= 0.8 \\
P(E=0|C=1,D=0) &= 0.9 \\
P(E=0|C=1,D=1) &= 0.3 \\
P(F=0|D=0) &= 0.5 \\
P(F=0|D=1) &= 0.7 \\
P(G=0|F=0) &= 0.4 \\
P(G=0|F=1) &= 0.7 \\
P(H=0|F=0) &= 0.8 \\
P(H=0|F=1) &= 0.1
\end{aligned}
$$

Compute

a) $P(D|A=0,B=1,C=1,E=0,F=1)$

b) $P(A\,|\,B=1,D=1,H=1)$

3. **Effect of the elimination order**

Consider a Bayesian network shown in Figure 2. Assume that all variables are binary. We want to compute $P(X_1)$ using variable elimination.

How many additions and multiplications do we have to perform if

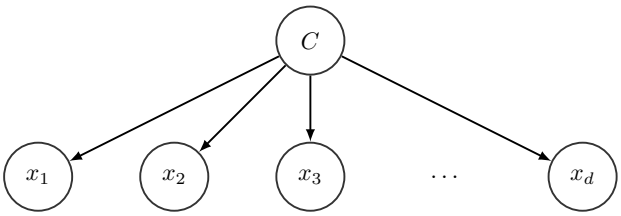



Figure 2: Another Bayesian network

a) the elimination order is $X_d, \ldots, X_2, C$,

b) the elimination order is $C, X_d, \ldots, X_2$?