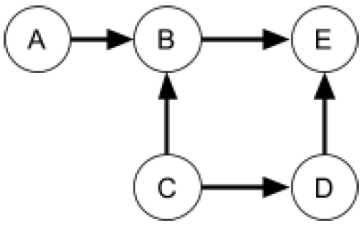
CS 471/571: Introduction to Artificial Intelligence, Fall 2023

Bayes Net Inference: Practice

Example

Assume the following Bayes Net and corresponding CPTs.



A	P(A)
0	0.6
1	0.4

C	D	P(D|C)
0	0	0.2
0	1	0.8
1	0	0.3
1	1	0.7

A	C	B	P(B|A,C)
0	0	0	0.2
0	0	1	0.8
0	1	0	0.4
0	1	1	0.6
1	0	0	0.2
1	0	1	0.8
1	1	0	0.4
1	1	1	0.6

B	D	E	P(E|B,D)
0	0	0	0.75
0	0	1	0.25
0	1	0	0.5
0	1	1	0.5
1	0	0	0.85
1	0	1	0.15
1	1	0	0.4
1	1	1	0.6

C	P(C)
0	0.4
1	0.6

Compute the following conditional probabilities:

1. $P(E = 1 \mid A = 0, D = 0)$
   Answer. We are going to perform variable elimination.

   - Elimination on C: We obtain a table:

A	B	D	$f_1(A = 0, B, D = 0)$
0	0	0	0.088
0	1	0	0.172

   - Elimination on B: We obtain a table:

A	D	E	$f_2(A = 0, D = 0, E)$
0	0	0	0.2122
0	0	1	0.0478

   - Remaining factors include: $P(A = 0)$, $f_3(A = 0, D = 0, E)$. Joining these factors:

A	D	E	$f_4(A = 0, D = 0, E)$
0	0	0	0.12732
0	0	1	0.02868

   - Normalizing, we obtain: $P(E = 1 \mid A = 0, D = 0) = \frac{0.02868}{0.02868+0.12732} = 0.1838$

2. $P(D = 1 \mid C = 0, B = 1)$
   Answer. $P(D = 1 \mid C = 0, B = 1) = P(D = 1 \mid C = 0) = 0.8$