2006 Paper 8 Question 9

Artificial Intelligence II

Consider the following Bayesian network:
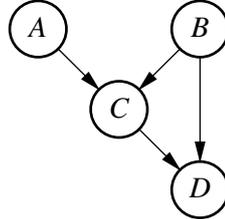
The associated probability distributions for the binary random variables A, B, C and D are $\Pr(a) = 0.1$, $\Pr(\neg a) = 0.9$, $\Pr(b) = 0.8$, $\Pr(\neg b) = 0.2$, and:

A	B	$\Pr(c\|A,B)$
$\top$	$\top$	0.5
$\top$	$\bot$	0.6
$\bot$	$\top$	0.8
$\bot$	$\bot$	0.7

B	C	$\Pr(d\|B,C)$
$\top$	$\top$	0.2
$\top$	$\bot$	0.9
$\bot$	$\top$	0.8
$\bot$	$\bot$	0.1

(*a*) Explain why the representation of the joint distribution of A, B, C and D using the Bayesian network is preferable to a direct tabular representation.

[2 marks]

(*b*) Use the *variable elimination algorithm* to compute the probability distribution of B conditional on the evidence that $D = \top$. [16 marks]

(*c*) Comment on the computational complexity of the variable elimination algorithm. [2 marks]