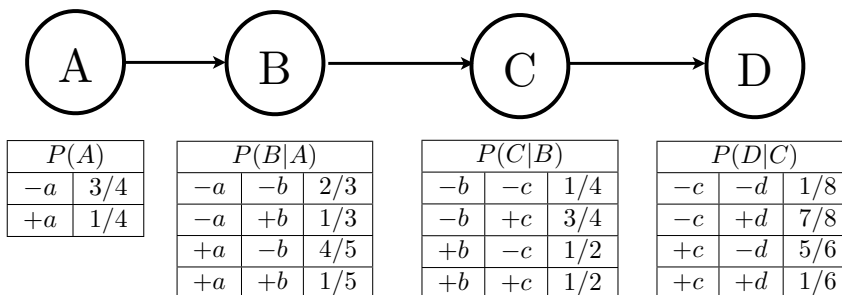


Q1. Bayes' Nets Sampling

Assume the following Bayes' net, and the corresponding distributions over the variables in the Bayes' net:



(a) You are given the following samples:

- | | | |
|--------------------|--------------------|--|
| $(+a, +b, -c, -d)$ | $(+a, -b, -c, +d)$ | |
| $(+a, -b, +c, -d)$ | $(+a, +b, +c, -d)$ | |
| $(-a, +b, +c, -d)$ | $(-a, +b, -c, +d)$ | |
| $(-a, -b, +c, -d)$ | $(-a, -b, +c, -d)$ | |

(i) If these samples came from doing Prior Sampling, calculate our sample estimate of $P(+c)$.

(ii) Now we will estimate $P(+c | +a, -d)$. Above, clearly cross out the samples that would **not** be used when doing Rejection Sampling for this task, and write down the sample estimate of $P(+c | +a, -d)$.

(b) Using Likelihood Weighting Sampling to estimate $P(-a | +b, -d)$, the following samples were obtained. What is the weight of each sample?

(c) From the weighted samples, estimate $P(-a | +b, -d)$.

Sample	Weight
$-a \quad +b \quad +c \quad -d$	_____
$+a \quad +b \quad +c \quad -d$	_____
$+a \quad +b \quad -c \quad -d$	_____
$-a \quad +b \quad -c \quad -d$	_____

(d) Recall that during Gibbs Sampling, samples are generated through an iterative process.

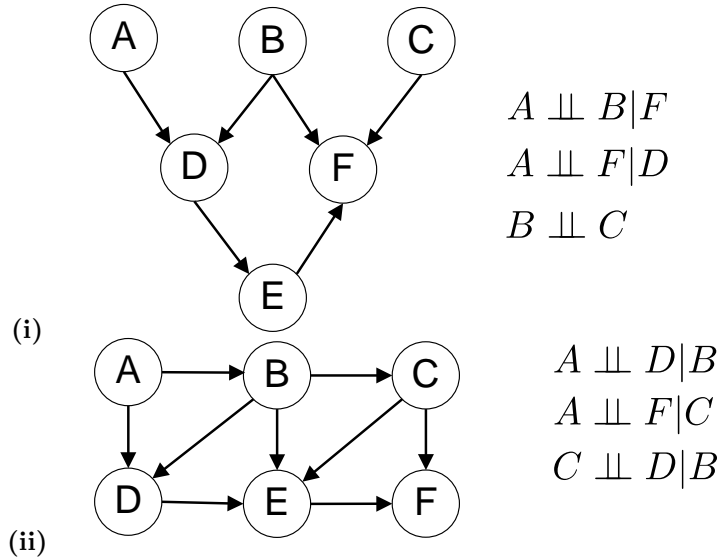
Assume that the only evidence that is available is $A = +a$. Which sequence(s) below could have been generated by Gibbs Sampling?

Sequence 1	Sequence 2	Sequence 3	Sequence 4
1: $+a \quad -b \quad -c \quad +d$	1: $+a \quad -b \quad -c \quad +d$	1: $+a \quad -b \quad -c \quad +d$	1: $+a \quad -b \quad -c \quad +d$
2: $+a \quad -b \quad -c \quad +d$	2: $+a \quad -b \quad -c \quad -d$	2: $+a \quad -b \quad -c \quad -d$	2: $+a \quad -b \quad -c \quad -d$
3: $+a \quad -b \quad +c \quad +d$	3: $-a \quad -b \quad -c \quad +d$	3: $+a \quad +b \quad -c \quad -d$	3: $+a \quad +b \quad -c \quad +d$

2 Bayes Nets

- (a) For the following graphs, explicitly state the minimum size set of edges that must be removed such that the corresponding independence relations are guaranteed to be true.

Marked the removed edges with an 'X' on the graphs.

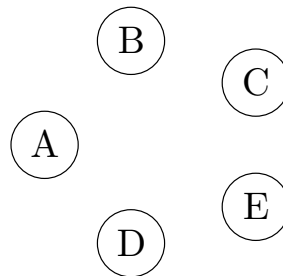


- (b) You're performing variable elimination over a Bayes Net with variables A, B, C, D, E . So far, you've finished joining over (but not summing out) C , when you realize you've lost the original Bayes Net!

Your current factors are $f(A), f(B), f(B, D), f(A, B, C, D, E)$. Note: these are factors, NOT joint distributions. You don't know which variables are conditioned or unconditioned.

- (i) What's the smallest number of edges that could have been in the original Bayes Net? Draw out one such Bayes Net below.

Number of edges =



- (ii) What's the largest number of edges that could have been in the original Bayes Net? Draw out one such Bayes Net below.

Number of edges =

