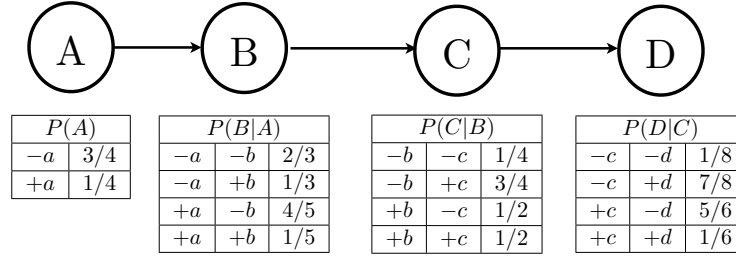


Assume the following Bayes' net, and the corresponding distributions over the variables in the Bayes' net:



(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) [1 pt] Assume that these samples came from performing Prior Sampling, and calculate the sample estimate of  $P(+c)$ .

$5/8$

(ii) [2 pts] Now we will estimate  $P(+c \mid +a, -d)$ . 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  $P(+c \mid +a, -d)$  below.

$2/3$

(b) [2 pts] Using Likelihood Weighting Sampling to estimate  $P(-a \mid +b, -d)$ , the following samples were obtained. Fill in the weight of each sample in the corresponding row.

Sample	Weight
$-a \quad +b \quad +c \quad -d$	$\underline{P(+b \mid -a)P(-d \mid +c) = 1/3 * 5/6 = 5/18 = 0.277}$
$+a \quad +b \quad +c \quad -d$	$\underline{P(+b \mid +a)P(-d \mid +c) = 1/5 * 5/6 = 5/30 = 1/6 = 0.17}$
$+a \quad +b \quad -c \quad -d$	$\underline{P(+b \mid +a)P(-d \mid -c) = 1/5 * 1/8 = 1/40 = 0.025}$
$-a \quad +b \quad -c \quad -d$	$\underline{P(+b \mid -a)P(-d \mid -c) = 1/3 * 1/8 = 1/24 = 0.042}$

(c) [1 pt] From the weighted samples in the previous question, estimate  $P(-a \mid +b, -d)$ .

$\frac{5/18+1/24}{5/18+5/30+1/40+1/24} = 0.625$

(d) [2 pts] Which query is better suited for likelihood weighting,  $P(D \mid A)$  or  $P(A \mid D)$ ? Justify your answer in one sentence.

$P(D \mid A)$  is better suited for likelihood weighting sampling, because likelihood weighting conditions only on upstream evidence.

(e) [2 pts] Recall that during Gibbs Sampling, samples are generated through an iterative process.

Assume that the only evidence that is available is  $A = +a$ . Clearly fill in the circle(s) of the sequence(s) below that could have been generated by Gibbs Sampling.

☒ Sequence 1

1 :	$+a$	$-b$	$-c$	$+d$
2 :	$+a$	$-b$	$-c$	$+d$
3 :	$+a$	$-b$	$+c$	$+d$

☐ Sequence 2

1 :	$+a$	$-b$	$-c$	$+d$
2 :	$+a$	$-b$	$-c$	$-d$
3 :	$-a$	$-b$	$-c$	$+d$

☒ Sequence 3

1 :	$+a$	$-b$	$-c$	$+d$
2 :	$+a$	$-b$	$-c$	$-d$
3 :	$+a$	$+b$	$-c$	$-d$

☐ Sequence 4

1 :	$+a$	$-b$	$-c$	$+d$
2 :	$+a$	$-b$	$-c$	$-d$
3 :	$+a$	$+b$	$-c$	$+d$