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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- MAY 2023

B.Tech. CSE/IT 8th Semester

COURSE CODE: 19B1WCI832 MAX. MARKS: 35

COURSE NAME: PROBABILISTIC GRAPHICAL MODELS

COURSE CREDITS: 03 MAX. TIME: 2Hrs

COURSE COORRDINATOR: Prof. (Dr.) Vivek Kumar Sehgal

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

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1. Consider the model shown in Figure 1. Indicate whether the following independence statements are true or false according to this model. Provide a very brief justification of your answer (no more than 1 sentence)

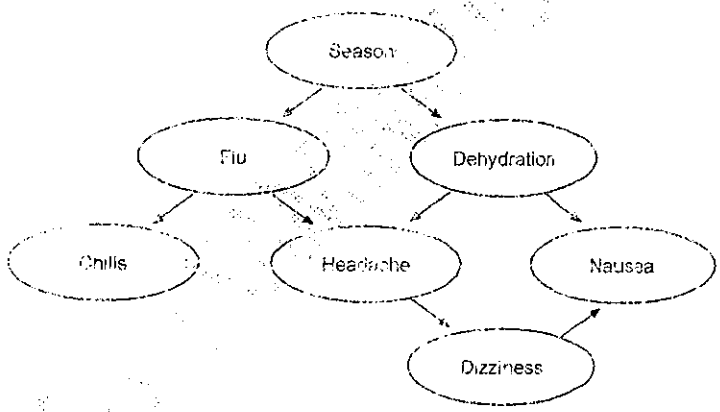

Figure 1: A Bayesian network that represents a joint distribution

i. Season ⊥ Chills
ii. Season ⊥ Chills | Flu
iii. Season ⊥ Headache | Flu
iv. Season ⊥ Headache | Flu, Dehydration
v. Season ⊥ Nausea | Dehydration
vi. Season ⊥ Nausea | Dehydration, Headache
vii. Flu ⊥ Dehydration
viii. Flu ⊥ Dehydration | Season, Headache
ix. Flu ⊥ Dehydration | Season
x. Flu ⊥ Dehydration | Season, Nausea
xi. Chills ⊥ Nausea
xii. Chills ⊥ Nausea | Headache

CO-1,2 [12]

Table 1: Conditional probability tables for the Bayesian network shown in Figure 1.

$P(S = \text{winter})$	$P(S = \text{summer})$
0.5	0.5

	$P(F = \text{true} \mid S)$	$P(F = \text{false} \mid S)$
S = winter	0.4	0.6
S = summer	0.1	0.9

	$P(D = \text{true} \mid S)$	$P(D = \text{false} \mid S)$
S = winter	0.1	0.9
S = summer	0.3	0.7

	$P(C = \text{true} \mid F)$	$P(C = \text{false} \mid F)$
F = true	0.8	0.2
F = false	0.1	0.9

	$P(H = \text{true} \mid F, D)$	$P(H = \text{false} \mid F, D)$
F = true, D = true	0.9	0.1
F = true, D = false	0.8	0.2
F = false, D = true	0.8	0.2
F = false, D = false	0.3	0.7

	$P(Z = \text{true} \mid H)$	$P(Z = \text{false} \mid H)$
H = true	0.8	0.2
H = false	0.2	0.8

	$P(N = \text{true} \mid D, Z)$	$P(N = \text{false} \mid D, Z)$
D = true, Z = true	0.9	0.1
D = true, Z = false	0.8	0.2
D = false, Z = true	0.6	0.4
D = false, Z = false	0.2	0.8

2. Assume you are given the conditional probability tables listed in Table 1 for the model shown in Figure 1. Evaluate each of the probabilities queries listed below, and show your calculations.

a) What is the probability that you have the flu, when no prior information is known?

b) What is the probability that you have the flu, given that it is winter?

c) What is the probability that you have the flu, given that it is winter and that you have a headache?

d) What is the probability that you have the flu, given that it is winter, you have a headache, and you know that you are dehydrated?

e) Does knowing you are dehydrated increase or decrease your likelihood of having the flu? Intuitively, does this make sense?

CO-3,4 [15]

3. Give expressions for the following three posterior distributions over a particular variable given the observed evidence X1 = x1.

1. $P(X_2 = x_2 | X_1 = x_1)$
2. $P(X_3 = x_3 | X_1 = x_1)$
3. $P(X_5 = x_5 | X_1 = x_1)$

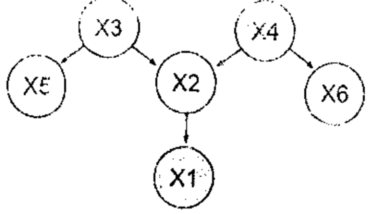

Figure 2: A Bayesian network

CO-4 [8]