

K. J. Somaiya Institute of Engineering and Information Technology, Sion, Mumbai-22  
(Autonomous College Affiliated to University of Mumbai)

Subject Code: CEDLC5054

Subject Name: Probabilistic Graphical Models

Date: 12-12-

2022

Nov – Dec 2022				
B. Tech Program: Computer Engineering				
Examination: TY Semester: V				
Course Code: CEDLC5054 and Course Name: Probabilistic Graphical Models				
Duration: 2.5 Hours			Max. Marks: 60	
Instructions:				
(1) All questions are compulsory.				
(2) Draw neat diagrams wherever applicable.				
(3) Assume suitable data, if necessary.				
Sr. No.	Questions	Max. Marks	CO	BT level
<b>Q 1</b>	<b>Solve any six questions out of eight:</b>	<b>12</b>		
i)	Explain five terminologies used in graph structures.	2	CO1	U
ii)	Which pairs of variables are independent in the graphical model below, given that none of them have been observed? Justify your answer.	2	CO2	Ap
iii)	Explain the concept of Markovian Blanket.	2	CO3	U
iv)	Illustrate Temporal Markov Model? Explain with a diagram.	2	CO4	U
v)	How Expected Value is different from Expected Utility.	2	CO5	Ap
vi)	List any four applications of Bayesian Networks.	2	CO6	U
vii)	Explain Gibb's Distribution with suitable examples.	2	CO3	U
viii)	Define Emission Probability and Transition Probability with example.	2	CO4	U
<b>Q.2</b>	<b>Solve any four questions out of six.</b>	<b>16</b>		
i)	Differentiate between marginal and joint distributions with an example.	4	CO1	Ap
ii)	In your local nuclear power station, there is an alarm that senses when a temperature gauge exceeds a given threshold. The gauge measures the temperature of the core. Consider the Boolean variables A (alarm sounds), FA (alarm is faulty), and FG (gauge is faulty) and the multivalued, discrete nodes G (gauge reading) and T (actual core temperature).  Draw a Bayesian network for this domain, given that the gauge is more likely to fail when the core temperature gets too high.	4	CO2	An

iii)	Explain the Markov Model. Justify the role of Factor Table in representation of information in Markov Model.	4	CO3	Ap																					
iv)	Explain factor graph in HMM with the help of an example.	4	CO4	U																					
v)	Explain Causal and Evidential Reasoning patterns with example	4	CO5	U																					
vi)	Explain any one application of Bayesian Network with respect to PGM.	4	CO6	U																					
<b>Q.3</b>	<b>Solve any two questions out of three.</b>	<b>16</b>																							
i)	<p>The random variable X has a range of {0, 1, 2} and the random variable Y has a range of {1, 2}. The joint distribution of X and Y is given by the following table:</p> <p>a. Write down tables for the marginal distributions of X and of Y, i.e. give the values of <math>P(X = x)</math> for all x, and of <math>P(Y = y)</math> for all y.</p> <p>b. Compute <math>E(X)</math> and <math>E(Y)</math>.</p> <p>c. Are X and Y independent? Explain why or why not</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>x</th> <th>y</th> <th><math>P(X = x, Y = y)</math></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0.2</td> </tr> <tr> <td>0</td> <td>2</td> <td>0.1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0.0</td> </tr> <tr> <td>1</td> <td>2</td> <td>0.2</td> </tr> <tr> <td>2</td> <td>1</td> <td>0.3</td> </tr> <tr> <td>2</td> <td>2</td> <td>0.2</td> </tr> </tbody> </table>	x	y	$P(X = x, Y = y)$	0	1	0.2	0	2	0.1	1	1	0.0	1	2	0.2	2	1	0.3	2	2	0.2	8	CO1	Ap
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2	1	0.3																							
2	2	0.2																							
ii)	<p>From the HMM given below, find the likelihood of the sequence {Happy, Grumpy}.</p>	8	CO4	An																					

iii)	Write Short notes on: a. Maximum Expected Utility (MEU) b. Utility Curve c. Maximum Likelihood Estimation (MLE) d. Decision Tree	8	CO5	U
<b>Q.4</b>	<b>Solve any two questions out of three.</b>	<b>16</b>		
i)	Write short note on Tabular CPD.	8	CO2	U
ii)	Explain Variable Elimination in details. Apply the Variable Elimination (VE) algorithm to compute $P(G)$ .	8	CO3	Ap
	<pre>                 graph TD                     Coherence((Coherence)) --&gt; Difficulty((Difficulty))                     Difficulty --&gt; Grade((Grade))                     Intelligence((Intelligence)) --&gt; Grade                     Intelligence --&gt; SAT((SAT))                     Grade --&gt; Letter((Letter))                     Letter --&gt; Job((Job))                     Grade --&gt; Happy((Happy))                     SAT --&gt; Job                     Job --&gt; Happy                 </pre>			
iii)	List Applications of Bayesian Networks and Markov Models. Illustrate Speech Recognition as an application HMM.	8	CO6	Ap

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