

Duration: 3hrs

[Max Marks:80]

**N.B. : (1) Question No 1 is Compulsory.****(2) Attempt any three questions out of the remaining five.****(3) All questions carry equal marks.****(4) Assume suitable data, if required and state it clearly.****1 Attempt any FOUR (5 marks)****[20]**

- a Explain Causal and Evidential Reasoning patterns with example.
- b Explain Markov Models. Justify the role of Factor Table in representation of information in Markov Model.
- c Explain any one application of Bayesian Network in detail with respect to PGM.
- d Given the following factor table between variables A, B and C.  
Find the joint distribution function.

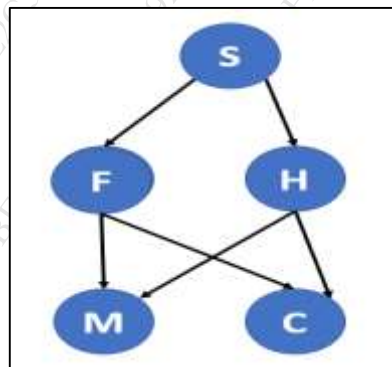
A	B	Phi
0	0	20
0	1	5
1	0	3
1	1	12

B	C	Phi
0	0	40
0	1	15
1	0	13
1	1	50

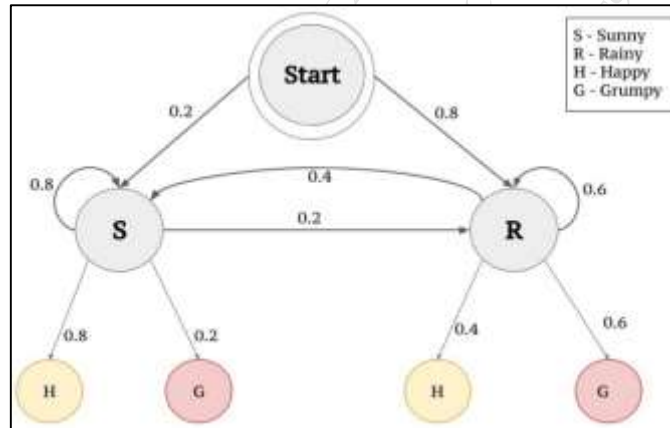
- e Differentiate between marginal and joint distributions with an example.
- 2 a Differentiate between conditional dependence and conditional independence.

**[10]**

List out 5 independencies in the graph given below:

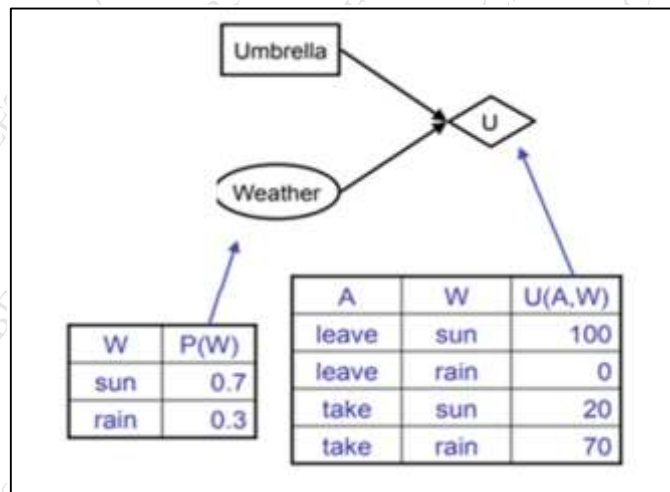


- b A patient goes to the doctor for a medical condition, the doctor suspects three diseases as the cause of the condition. The three diseases are D1, D2, D3, which are marginally independent from each other. There are four symptoms S1, S2, S3, S4 which the doctor wants to check for presence to find the most probable cause of the condition. The symptoms are conditionally dependent to the three diseases as follows:
- S1 depends only on D1, S2 depends on D1 and D2. S3 depends on D1 and D3, whereas S4 depends only on D3. Assume all random variables are Boolean, they are either 'true' or 'false'.
- Draw the Bayesian Network for this problem.
  - Write down the expression for the joint probability distribution as a product of conditional probabilities.
  - What is the number of independent parameters that is required to describe this joint distribution?
- 3 a Assume that a man's profession can be classified as professional, skilled labourer, or unskilled labourer. Assume that, of the sons of professional men, 80 percent are professional, 10 percent are skilled labourers, and 10 percent are unskilled labourers. In the case of sons of skilled labourers, 60 percent are skilled labourers, 20 percent are professional, and 20 percent are unskilled. Finally, in the case of unskilled labourers, 50 percent of the sons are unskilled labourers, and 25 percent each are in the other two categories. Assume that every man has at least one son and form a Markov chain by following the profession of a randomly chosen son of a given family through several generations. Set up the matrix of transition probabilities. Find the probability that a randomly chosen grandson of an unskilled labourer is a professional man. [10]
- b What is a maximal clique? How can we represent parameterization using cliques. [10]
- 4 a From the HMM given below, find the likelihood of the sequence {Happy, Grumpy} [10]



- b Explain the role of the Viterbi algorithm in Hidden Markov Model decoding. [10]
- 5 a Write Short notes on: [10]
1. Utility Curve
  2. Decision Trees
- b Explain Decision Networks with all associated terminologies? [10]

Anisha wants to go out but based upon rainy or sunny conditions she will decide whether to take an umbrella with her or leave at home. The various probabilities are given in the graph below. Calculate Maximum Expected Utility using Bayesian Network and draw the Decision Tree for following details:



- 6 a Discuss concept of Log Linear Parameterization with the help of an example. [10]
- b Write a short note on application of Hidden Markov Modelling in POS Tagging. [10]

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