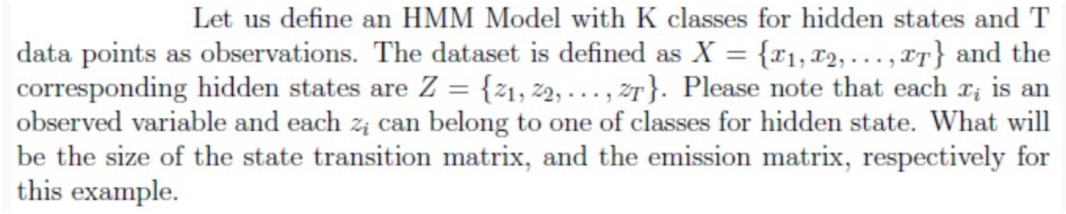
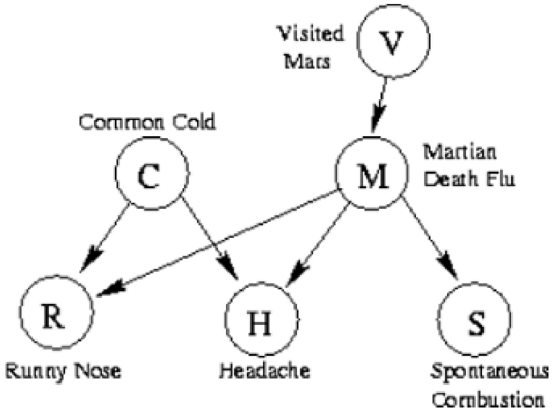
University of Mumbai

Program: **Computer Engineering**
Curriculum Scheme: Rev2019
Examination: Final Year
Semester: V
Course Code: CSDLO5011 Course Name : Probabilistic Graphical Models
Time: 2.5 hour (150 minutes) Max. Marks: 80

Q1. All questions compulsory 2 marks each (20 Marks)

<table>
<tr><td>Q1.</td><td>A new credit card has been issued to 2000 customers. Of these customers, 1500 hold a Visa, 500 hold an AA card, and 40 hold a Visa and AA card. Find the probability that a random chosen customer holds an AA, given they hold a Visa.</td></tr>
<tr><td>Option A:</td><td>.0267</td></tr>
<tr><td>Option B:</td><td>.02</td></tr>
<tr><td>Option C:</td><td>37.5</td></tr>
<tr><td>Option D:</td><td>.3333</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Q2.</td><td>Is this a probability distribution?
<table>
<tr><th>x</th><th>P(x)</th></tr>
<tr><td>75</td><td>.12</td></tr>
<tr><td>80</td><td>.23</td></tr>
<tr><td>85</td><td>.42</td></tr>
<tr><td>90</td><td>.22</td></tr>
<tr><td>95</td><td>.11</td></tr>
</table></td></tr>
<tr><td>Option A:</td><td>No, the sum of p(x) does not equal 1.</td></tr>
<tr><td>Option B:</td><td>Yes, all p(x) are between 0 and 1.</td></tr>
<tr><td>Option C:</td><td>No, all p(x) are not between 0 and 1.</td></tr>
<tr><td>Option D:</td><td>Yes, the sum p(x) is 1.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Q3.</td><td>Which one of the following is a discrete random variable?</td></tr>
<tr><td>Option A:</td><td>Sam's height</td></tr>
</table>

Option B:	Sam weight
Option C:	Time Sam's runs the 110 m hurdles
Option D:	Amount of Sam's brothers and sisters
Q4.	The degree of vertex is....
Option A:	the number of edges attached to the vertex
Option B:	the number of lines and edges divided by two
Option C:	the number of vertices attached to edges
Option D:	the eulers equation
Q5.	A distribution Pφ is a Gibbs distribution parameterized with a set of factors φ1(D1); · ·· ; φm(Dm) if it is defined as
Option A:	Pφ(X1; · · · ; Xn) = 1/Z φ1(D1) × · · · × φm(Dm)
Option B:	Pφ(X1; · · · ; Xn) = 1/z φ1(D1) + · · · + φm(Dm)
Option C:	Pφ(X1; · · · ; Xn) = φ1(D1) × · · · × φm(Dm)
Option D:	Pφ(X1; · · · ; Xn) = Z φ1(D1) × · · · × φm(Dm)
Q6.	If every Undirected Path from a node in X to a node in Y is D-separated by E, then X and Y are _________ given E
Option A:	Independent
Option B:	dependent
Option C:	conditionally dependent
Option D:	conditionally Independent
Q7.	Which of the following Problem is not solved with Hidden Markov Models
Option A:	Learning Problem
Option B:	Decoding Problem.
Option C:	Evaluation Problem
Option D:	Encoding Problem
Q8.	Which algorithm is used for solving temporal probabilistic reasoning?
Option A:	Depth-first search
Option B:	Breadth-first search
Option C:	Hidden markov model
Option D:	Hill-climbing search

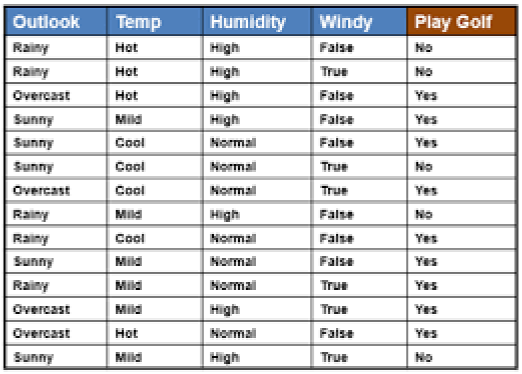
Q9.	 Let us define an HMM Model with K classes for hidden states and T data points as observations. The dataset is defined as $X = \{x_1, x_2, \ldots, x_T\}$ and the corresponding hidden states are $Z = \{z_1, z_2, \ldots, z_T\}$. Please note that each x_i is an observed variable and each z_i can belong to one of classes for hidden state. What will be the size of the state transition matrix, and the emission matrix, respectively for this example.
Option A:	K*K,K*T
Option B:	K*T,K*T
Option C:	K*K,K*K
Option D:	K*T,K*K
Q10.	Select the option describing Bayesian chain rule for the following graph.  A. P (V, C, R, M, H, S) =P(R). P(H). P(S). P (C|R, H). P (M|R, H, S). P (V|M) B. P (V, C, R, M, H, S) =P(V). P(C). P(M|V). P (R|C, M, V). P (H|C, M). P(S|M) C. P (V, C, R, M, H, S) = P(R). P(H). P(S). P (C|R, H). P (M|R, H, S). P (V|M, R, H, S) D. P (V, C, R, M, H, S) =P(V). P(C). P(M|V). P (R|C, M). P (H|C, M). P(S|M)
Option A:	A
Option B:	B
Option C:	C
Option D:	D

<table>
<tr><th>Q2.
(20 Marks Each)</th><th>Solve any Four out of Six 5 marks each</th></tr>
<tr><td>A</td><td>Assume that a factory has two machines. Past record shows that machine 1 produces 30% of the items of the output and machine 2 produces rest 70% of the items produced. Further 10% of the items produced by both machine 1 and 2 were defective.If a defective item is drawn at random,
What is the probability that the defective item was produced by either Machine 1 or Machine 2</td></tr>
<tr><td>B</td><td>Given the following data
Find the Variance<table><tr><th>x</th><th>P(x)</th></tr><tr><td>10</td><td>0.2</td></tr><tr><td>20</td><td>0.2</td></tr><tr><td>30</td><td>0.1</td></tr><tr><td>40</td><td>0.5</td></tr></table></td></tr>
<tr><td>C</td><td>Write a short note on Gibbs distribution of Markov Network Model</td></tr>
<tr><td>D</td><td>Define the ways how information can propagate in Bayesian Network with Example.</td></tr>
<tr><td>E</td><td>Define Template Variables and Template Factors with examples.</td></tr>
<tr><td>F</td><td>Write a short note on learning parameters with incomplete dataset (with missing values) with example</td></tr>
</table>

Q3. **(20 Marks Each)**	**Solve any Two Questions out of Three** **10 marks each**
A	How does conditional independence and conditional parameterization reduce the number of parameters to represent probability distribution more compactly? Explain with example.
B	Explain Viterbi Algorithm with Example.
C	When parent node and child node become Conditionally Independent? Justify with example scenarios.

Q4.	**Solve any Two Questions out of Three** **10 marks each**

<table>
<tr><th>(20 Marks Each)</th><th></th></tr>
<tr><td>A</td><td>Today’s weather is (outlook=Sunny, Temp=Mild, Humidity=Normal, Windy=False). Is Today’s weather suitable for playing Golf?



<table>
<tr><th>Outlook</th><th>Temp</th><th>Humidity</th><th>Windy</th><th>Play Golf</th></tr>
<tr><td>Rainy</td><td>Hot</td><td>High</td><td>False</td><td>No</td></tr>
<tr><td>Rainy</td><td>Hot</td><td>High</td><td>True</td><td>No</td></tr>
<tr><td>Overcast</td><td>Hot</td><td>High</td><td>False</td><td>Yes</td></tr>
<tr><td>Sunny</td><td>Mild</td><td>High</td><td>False</td><td>Yes</td></tr>
<tr><td>Sunny</td><td>Cool</td><td>Normal</td><td>False</td><td>Yes</td></tr>
<tr><td>Sunny</td><td>Cool</td><td>Normal</td><td>True</td><td>No</td></tr>
<tr><td>Overcast</td><td>Cool</td><td>Normal</td><td>True</td><td>Yes</td></tr>
<tr><td>Rainy</td><td>Mild</td><td>High</td><td>False</td><td>No</td></tr>
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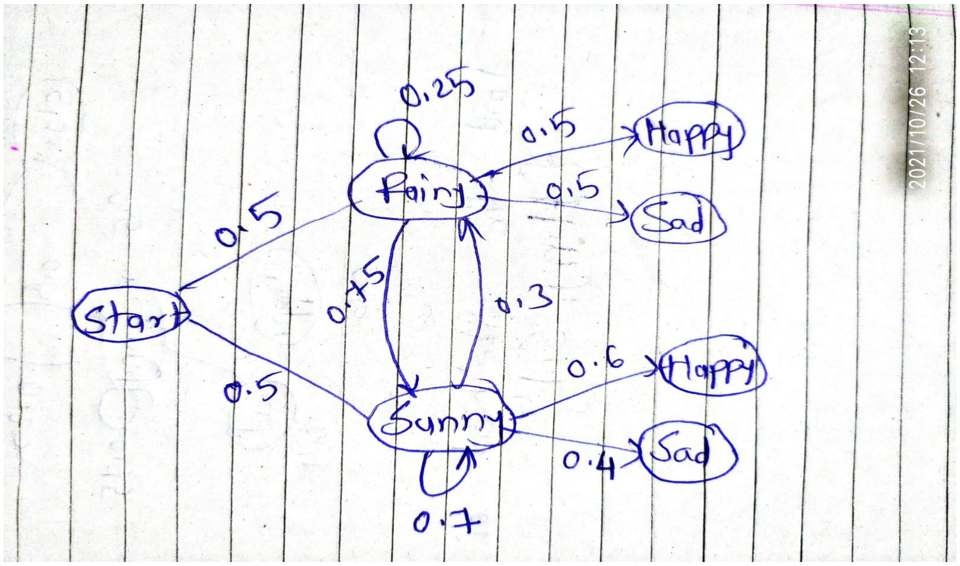
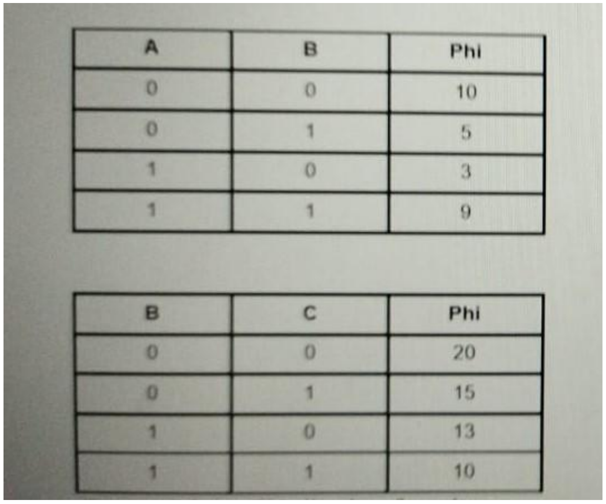
<tr><td>Overcast</td><td>Hot</td><td>Normal</td><td>False</td><td>Yes</td></tr>
<tr><td>Sunny</td><td>Mild</td><td>High</td><td>True</td><td>No</td></tr>
</table>
</td></tr>
<tr><td>B</td><td>Given the HMM



Find the likelihood of the sequence {Happy,Sad}</td></tr>
<tr><td>C</td><td>Given the following Factor table between variables A,B,C.Find the joint distribution function</td></tr>
</table>



A	B	Phi
0	0	10
0	1	5
1	0	3
1	1	9

B	C	Phi
0	0	20
0	1	15
1	0	13
1	1	10