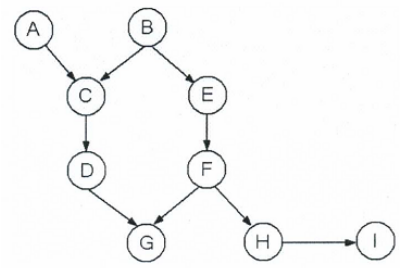
In The Name of God, The Compassionate, The Merciful

Name: .....

Student ID#: .....

Statistical Pattern Recognition (CE-725)
Department of Computer Engineering
Quiz #8 (Bayesian net & HMM)- Spring 2012

1.(40 Points) The following figure shows a Bayesian net with 9 variables, all of which are binary. Which of the following statements are always true?



a. --------- P(A,B |G) = P(A|G) P(B|G)

b. --------- P(A, I) = P(A) P(I)

c. --------- P(B, H|E, G) = P(B| E,G) P(H|E,G)

d. --------- P(C| B,F) = P(C,F)

Sol:

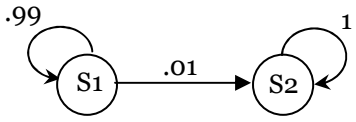
a. False -Because G is a descendent of both A and B, given G, A and B are not independent.

b. True -There is no path between A and I so they are independent and P(A,I)= P(A)P(I).

c. False -B and H are independent if we know E or F. But given G there is a dependency through other paths.

d. False -P(C|B,F)=P(C|B) and does not depend on F at all. So it's incorrect.

2. (60 points) Consider the following HMM with observations {1, 2, 3, 4}:



	S1	S2
P(x=1)	0	0.1
P(x=2)	0.199	0
P(x=3)	0.8	0.7
P(x=4)	0.001	0.2

a. Give an example of an output sequence of length 2 which cannot be generated by the Model. Justify your answer.

Sol:

1,2. It's impossible to observe 1 in S2, so we would be in S2, and 2 is only observable in S1, so the state should be flipped from S2 to S1 that's impossible.

b. We generated a sequence of 139100 observations from the HMM, and found that the last observation in the sequence was 3. What is the most likely hidden state corresponding to that last observation?

Sol:

Probability of ending in state S1 converges to zero for large number of observations. Also note that this observation is possible for both states. So the most likely hidden state is S2.

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c. Now, consider an output sequence {3, 4, 3}. What are the first two states of the most likely hidden state sequence?

Sol:

.5*.8=.4	.4*.99*.001=.0004	.0004*.99*.8=.0003
.5*.7=.35	1*.35*.2=.07	1*.07*.7=.049

So {S2,S2} is most likely for first two observations.