Markov Network Fundamentals

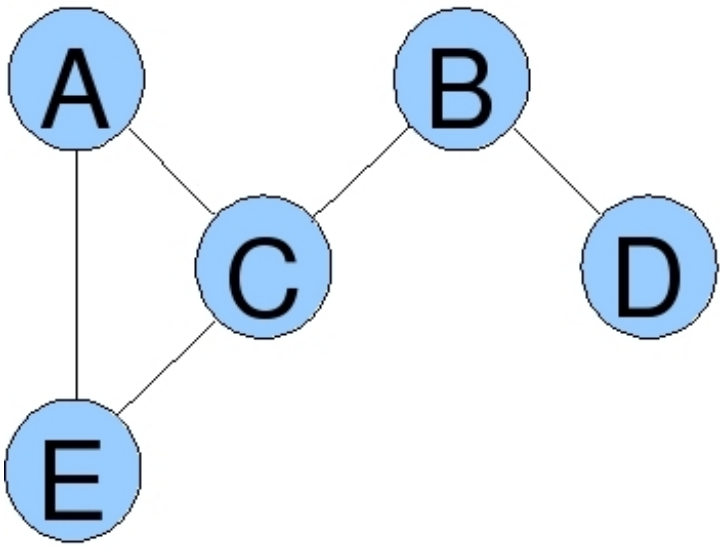
Help

Warning: The hard deadline has passed. You can attempt it, but **you will not get credit for it**. You are welcome to try it as a learning exercise.

- [ ] **In accordance with the Coursera Honor Code, I (Mike Ryan) certify that the answers here are my own work.**

Question 1

Independence in Markov Networks. Consider this graphical model from week 1's quizzes. This time, all of the edges are undirected (see modified graph below). Which pairs of variables are independent in this network? You may select 1 or more options (or none of them, if you think none apply).



- [ ] A, B
- [ ] A, D
- [ ] D, E

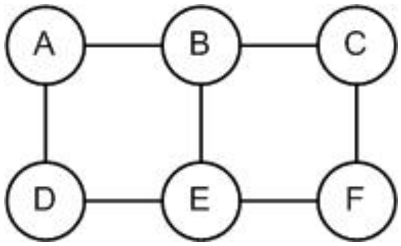
Question 2

Factor Scope. Let $\phi(a, b)$ be a factor in a graphical model, where a is a value of A and b is a value of B. What is the scope of ϕ?

- {A, B, C}
- {A, B}
- {A}
- {A, B, C, D, E}

Question 3

Factorization. Which of the following is a valid Gibbs distribution over this graph?



- $\frac{\phi(A)\times\phi(B)\times\phi(C)\times\phi(D)\times\phi(E)\times\phi(F)}{Z}$, where Z is the partition function
- $\phi(A) \times \phi(B) \times \phi(C) \times \phi(D) \times \phi(E) \times \phi(F)$
- $\phi(A, B, C, D, E, F)$
- There is no Gibbs distribution for this Markov network

Question 4

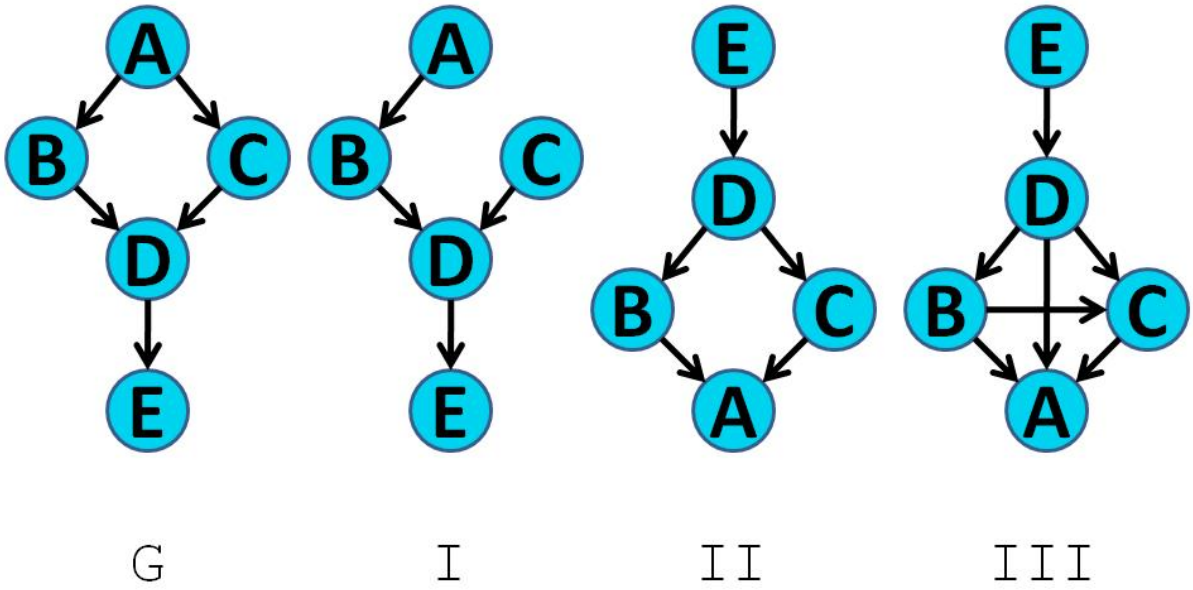
Factors in Markov Network. Let $\phi(A, B, C)$ be a factor in a probability distribution that factorizes over a Markov network. Which of the following must be true? You may select 1 or more options (or none of them, if you think none apply).

- $\phi(a, b, c) \leq 1$, where a is a value of A, b is a value of B, and c is a value of C.
- There is no path connecting A, B, and C in the network.

- [ ] A, B, and C form a clique in the network.
- [ ] There is a path connecting A, B, and C in the network.
- [ ] $\phi(a, b, c) \geq 0$, where a is a value of A, b is a value of B, and c is a value of C.

Question 5

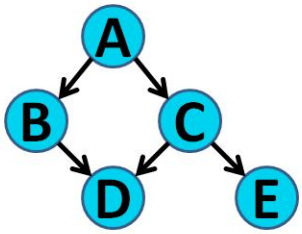
I-Maps. Graph G (shown below) is a perfect I-map for distribution P, i.e. $\mathcal{I}(G) = \mathcal{I}(P)$. Which of the other graphs is an I-map (**not** necessarily a perfect map) for P?



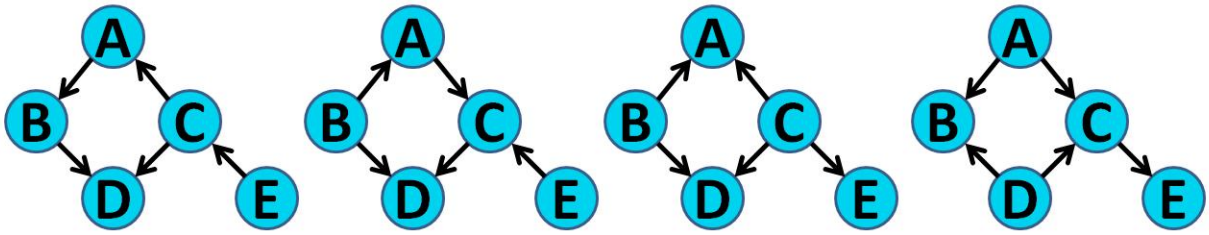
- ( ) III
- ( ) II and III
- ( ) II
- ( ) None of the above

Question 6

I-Equivalence. In the figure below, graph G is I-equivalent to which other graph(s)?



G



I II III IV

- None of the above
- IV
- I and IV
- I

Question 7

***I-Equivalence.** Let T be any directed tree (not a polytree) over n nodes, where $n \geq 1$. A directed tree is a traditional tree, where each node has at most one parent and there is only one root, i.e., all but one node has exactly one parent. (In a polytree, nodes may have multiple parents.) How many networks (including itself) are I-equivalent to T?

- $n!$
- n
- Depends on the specific structure of T.
- $2n$

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