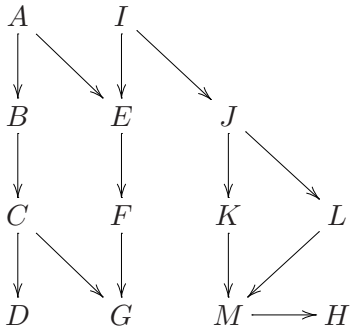
10-601: HW4 Problem 1 Solution

1 D-Separation [Andy: 21 points]

Which of the following statements are true with respect to the following graphical model, regardless of the conditional probability distributions? If false, explain why by giving a path which prevents the variables from being d-separated.



1. $P(D, H) = P(D)P(H)$

   ⋆ *Solution*: True – the paths $DCGFEIJKMH$ and $DCGFEIJLMH$ are blocked because G is unobserved. The paths $DCBAEIJKMH$ and $DCBAEIJLMH$ are blocked because E is unobserved.

2. $P(A, I) = P(A)P(I)$

   ⋆ *Solution*: True – the path AEI is blocked because E is unobserved. The path $ABCGFEI$ is blocked because G is unobserved.

3. $P(A, I|G) = P(A|G)P(I|G)$

   ⋆ *Solution*: False – the path AEI is not blocked because G is observed, and it is a descendant of E.

4. $P(J, G|F) = P(J|F)P(G|F)$

   ⋆ *Solution*: False – the path $JIEABCG$ is not blocked because a descendant of E is observed.

5. $P(J, M|K, L) = P(J|K, L)P(M|K, L)$

   ⋆ *Solution*: True – The paths JKM and JLM are both blocked.

6. $P(E, C|A, G) = P(E|A, G)P(C|A, G)$

   ⋆ *Solution*: False – $EFGC$ is not blocked because G is observed.

7. $P(E, C|A) = P(E|A)P(C|A)$

   ⋆ *Solution*: True – $EABC$ is blocked because A is observed, and $EFGC$ is blocked because G is unobserved.