Homework Assignment #1

Due date – Sep. 27, 2018 (Thu), in class.

Problem 1. Graph. (30 points)

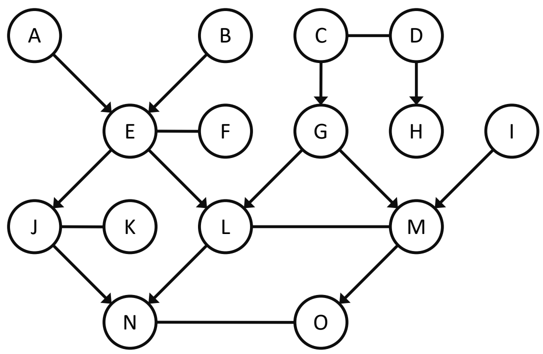

Figure 1: A graph $\mathcal{K}$.

Consider the graph $\mathcal{K}$ shown in Fig. 1. Answer the following questions based on the given graph.

(a) Find the induced subgraph of $\{A, B, E, F\}$.

(b) Find the upward closure of $\{L, M\}$. Also find its upwardly closed subgraph.

(c) Find the upward closure of $\{O\}$. Also find its upwardly closed subgraph.

(d) Find the ancestors and descendants of node K.

(e) Find the ancestors and descendants of node M.

(f) Can we decompose the graph $\mathcal{K}$ into chain components? If this is possible, find all chain components. If not, explain why it is not possible.

Problem 2. Reasoning based on a BN (30 points)

Solve Exercise 3.5 in the textbook.

Problem 3. d-separation (40 points)

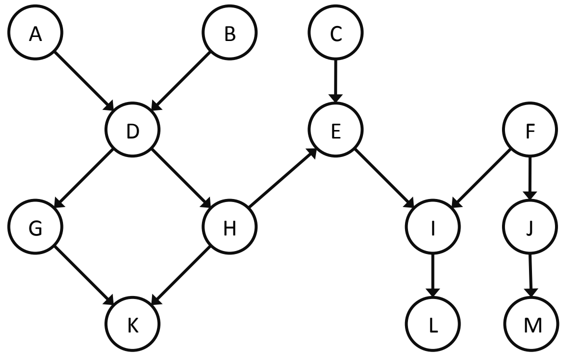

Figure 2: A directed acyclic graph $\mathcal{G}$.

Consider the graph $\mathcal{G}$ shown in Fig. 2.

(a) Given $\mathbf{Z} = \{G, L\}$, can influence flow from node A to node J? Justify your answer.

(b) Given $\mathbf{Z} = \{L\}$, can influence flow from node A to node C? Justify your answer.

(c) Given $\mathbf{Z} = \{D\}$, can influence flow from node G to node L? Justify your answer.

(d) Given $\mathbf{Z} = \{D, K, M\}$, can influence flow from node G to node L? Justify your answer.

(e) Given $\mathbf{Z} = \{C, G, L\}$, can influence flow from node B to node F? Justify your answer.

(f) Find the set $\mathbf{Y}$ that contains all nodes that are d-separated from node A, given $\mathbf{Z} = \{K, E\}$.

(g) Find the set $\mathbf{Y}$ that contains all nodes that are d-separated from node B, given $\mathbf{Z} = \{L\}$.

(h) Can you find the set $\mathbf{Z}$, such that given $\mathbf{Z}$, the following conditions hold true?

- A and B are *not* d-separated
- B and C are *not* d-separated
- C and G are d-separated
- A and M are *not* d-separated.

If this possible, find the smallest set $\mathbf{Z}$ that satisfies these conditions. If not, explain why this is not possible.