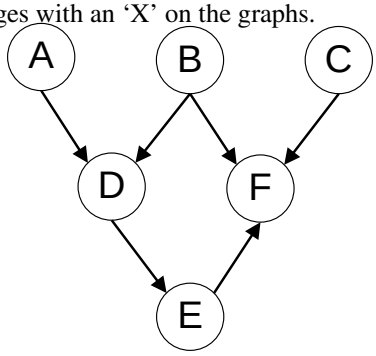
CS 188
Summer 2022

Exam Prep 4A

Q1. Bayes Nets

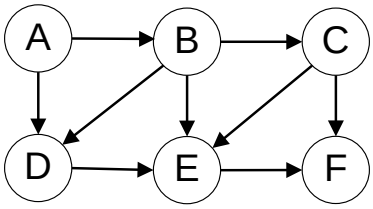
(a) For the following graphs, explicitly state the minimum size set of edges that must be removed such that the corresponding independence relations are guaranteed to be true.

Marked the removed edges with an 'X' on the graphs.



$A \perp\!\!\!\perp B|F$
$A \perp\!\!\!\perp F|D$
$B \perp\!\!\!\perp C$

(i)



$A \perp\!\!\!\perp D|B$
$A \perp\!\!\!\perp F|C$
$C \perp\!\!\!\perp D|B$

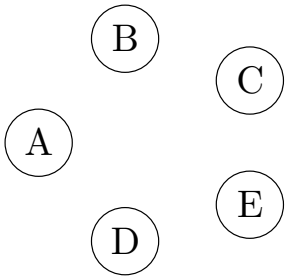
(ii)

(b) You're performing variable elimination over a Bayes Net with variables A, B, C, D, E. So far, you've finished joining over (but not summing out) C, when you realize you've lost the original Bayes Net!

Your current factors are $f(A)$, $f(B)$, $f(B, D)$, $f(A, B, C, D, E)$. Note: these are factors, NOT joint distributions. You don't know which variables are conditioned or unconditioned.

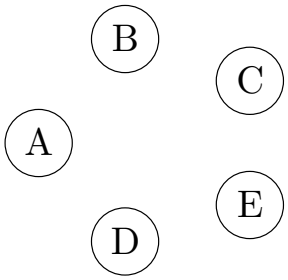
(i) What's the smallest number of edges that could have been in the original Bayes Net? Draw out one such Bayes Net below.

Number of edges =



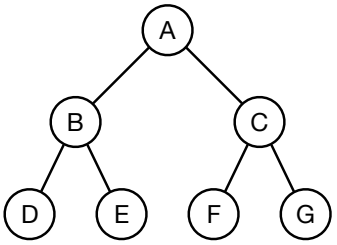
(ii) What's the largest number of edges that could have been in the original Bayes Net? Draw out one such Bayes Net below.

Number of edges =


B
C
A
E
D

Q2. Independence

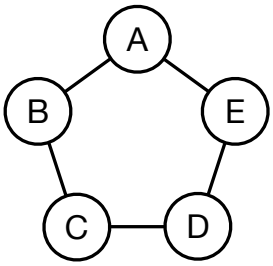
In each part of this question, you are given a Bayes' net where the edges do not have a direction. Assign a direction to every edge (by adding an arrowhead at one end of each edge) to ensure that the Bayes' Net structure implies the assumptions provided. You cannot add new edges. The Bayes' nets can imply more assumptions than listed, but they *must* imply the ones listed. There may be more than one correct solution.



(a)

Assumptions:

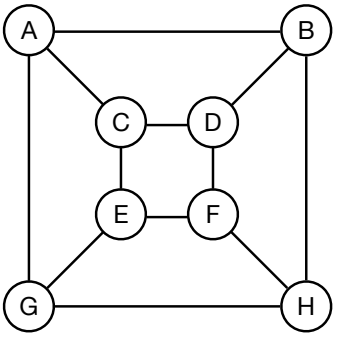
- $A \perp\!\!\!\perp G$
- $D \perp\!\!\!\perp E$
- $E \perp\!\!\!\perp F$
- $F \perp\!\!\!\perp G \mid C$



(b)

Assumptions:

- $B \perp\!\!\!\perp E$
- $E \perp\!\!\!\perp C \mid D$



(c)

Assumptions:

- $F \perp\!\!\!\perp G$
- $F \perp\!\!\!\perp B \mid G$
- $D \perp\!\!\!\perp E \mid F$