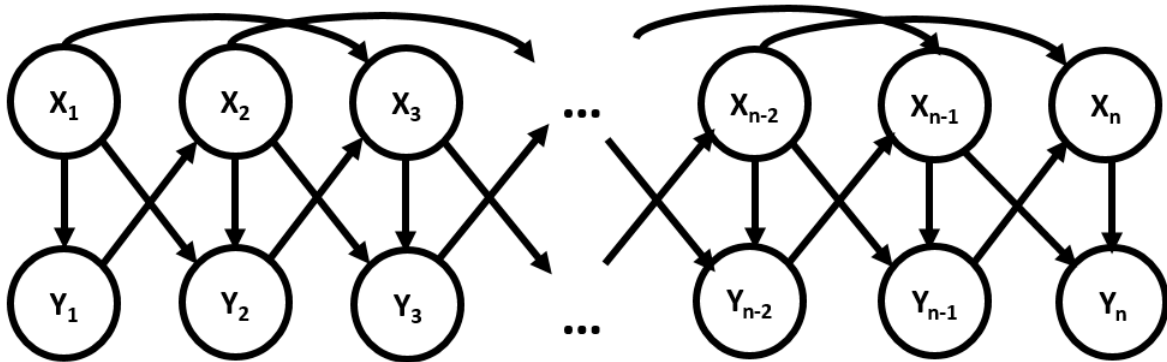# Homework 3

## Q1- Variable Elimination

Consider the following Bayesian network.
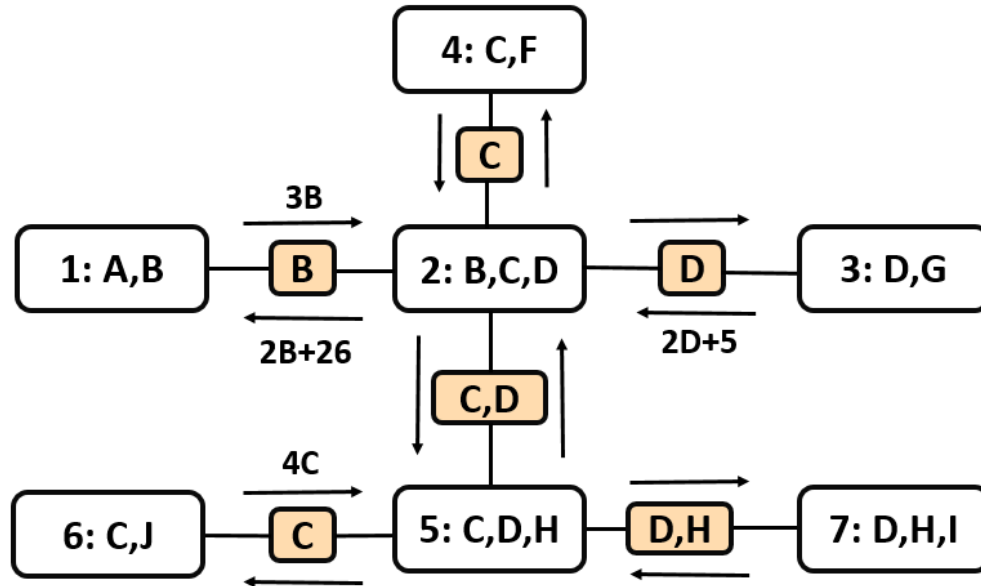


A) Draw the corresponding Markov network.

B) Now, apply the following variable elimination orders and draw the corresponding induced graph.

1) $Y_1, X_1, Y_2, X_2, \ldots, Y_n, X_n$
2) $X_1, Y_1, X_2, Y_2, \ldots, X_n, Y_n$

C) Given that $X_i$s and $Y_i$s are binary variables, which of the above variable elimination orders is optimal?

# Q2- Junction tree

Consider the following junction tree for performing **max-sum message passing** on a Markov Random Field network.



A) Draw a Markov network corresponding to this junction tree.

B) Assume that all variables are binary and the potentials of clusters are as below.

$\phi_1(A, B) = exp(\alpha 1(A = B = 1))$,

$\phi_2(B, C, D) = exp(2B + \gamma C + \lambda D)$,

$\phi_3(D, G) = exp(2D + \lambda G)$,

$\phi_4(C, F) = exp(1(C = F))$,

$\phi_5(C, D, H) = exp(1(C = D) + DH)$,

$\phi_6(C, J) = exp(\zeta CJ)$,

$\phi_7(D, H, I) = exp(1(D = H = 1) + 1(H \,! = I))$

where $1(.)$ is an indicator function.

Find the values of $\alpha$, $\gamma$, $\lambda$ and $\zeta$. (Compute all necessary messages for finding these variables.)