COMP90051
Statistical Machine Learning

Workshop Week 11

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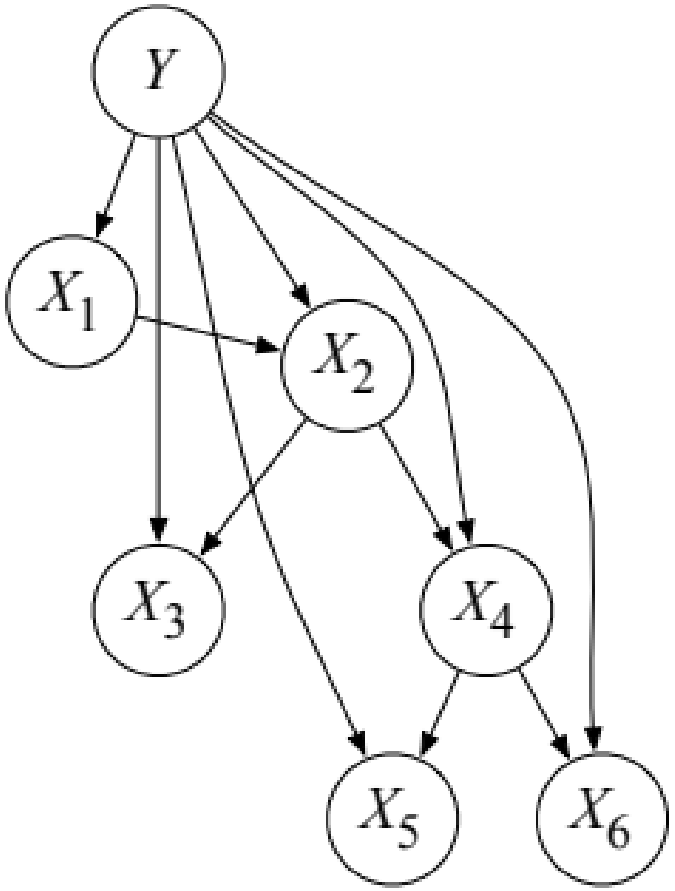
https://github.com/HanXudong/COMP90051_Workshops

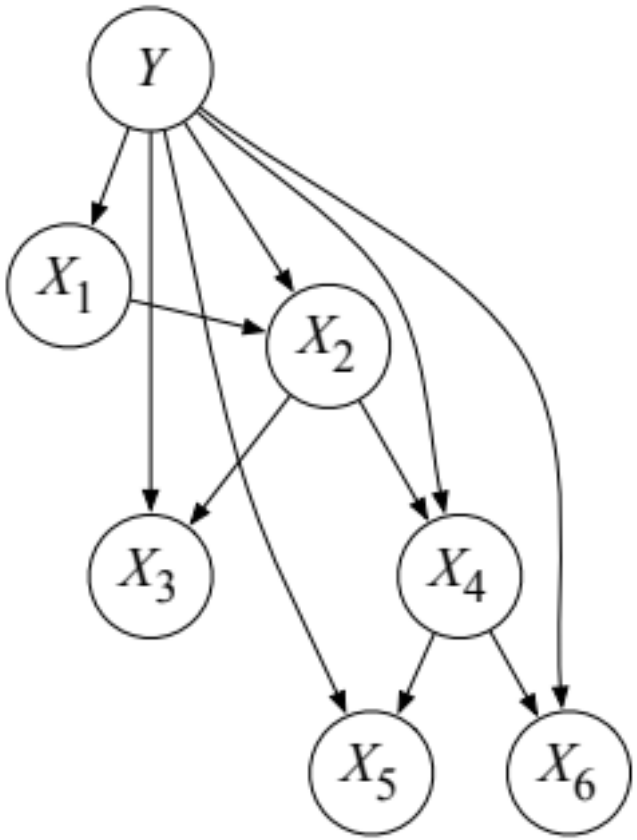
Reference

- https://people.eecs.berkeley.edu/~jordan/prelims/chapter3.pdf

Assume we observe all the variables X1 = x1, X2 = x2, . . . , X6 = x6 in the TANB above. What is the classification rule for the TANB? Your answer should be in terms of the prior probabilities and conditional probabilities in the TANB.



Specify an elimination order that is efficient for the query p(Y |X5 = x5) in the TANB above. How many variables are in the biggest factor induced by variable elimination with your ordering? Which variables are they?



Elimination algorithm

Eliminate (Graph G, Evidence nodes E, Query nodes Q)

1. Choose node ordering I such that Q appears last
2. Initialise empty list active
3. For each node X_i in G
   a) Append $\Pr(X_i | parents(X_i))$ to active
4. For each node X_i in E
   a) Append $\delta(X_i, x_i)$ to active
5. For each i in I
   a) potentials = Remove tables referencing X_i from active
   b) N_i = nodes other than X_i referenced by tables in potentials
   c) Table $\phi_i(X_i, X_{N_i})$ = product of tables in potentials
   d) Table $m_i(X_{N_i}) = \sum_{X_i} \phi_i(X_i, X_{N_i})$
   e) Append $m_i(X_{N_i})$ to active
6. Return $\Pr(X_Q | X_E = x_E) = \phi_Q(X_Q) / \sum_{X_Q} \phi_Q(X_Q)$

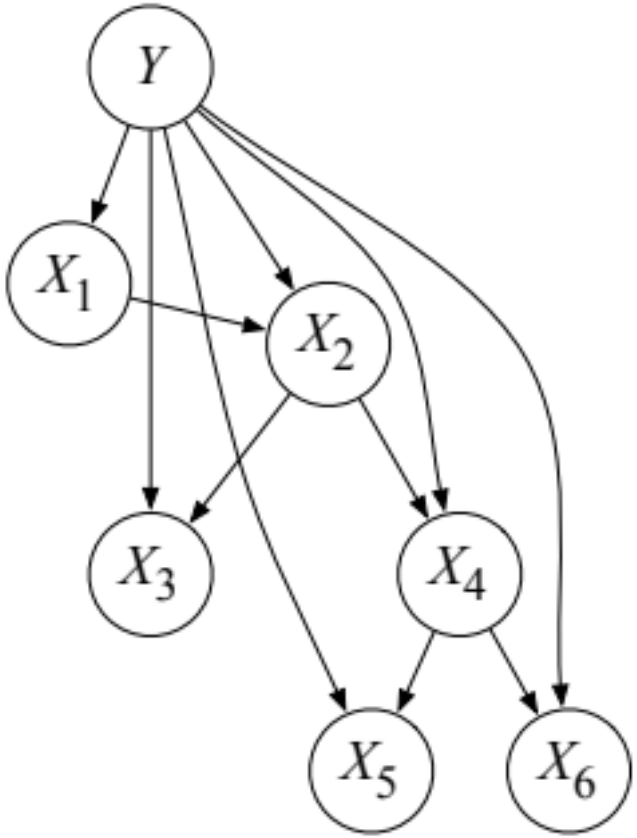
initialise

evidence

marginalise

normalise

Specify an elimination order that is efficient for the query $p(Y|X\_5=x\_5)$ in the TANB above. How many variables are in the biggest factor induced by variable elimination with your ordering? Which variables are they?



- $p(Y|X_5 = x_5)$
- Evidence nodes E
- Query nodes Q
- Elimination ordering I

Some functions in our algorithm

- $\delta(X_i, x_i)$: evidence potential, a function whose value is one if $X_i = x_i$ and zero otherwise.
- Given E is a set of indices of evidence nodes,

$$\delta(X_E, x_E) = \prod_{i \in E} \delta(X_i, x_i)$$

- $\phi_4(x_2, x_4) = p(X_4|X_2, Y)p(x_5|X_4, Y)$
- $m_4(X_2) = \sum_{X_4} \phi_4(x_2, x_4)$