Advanced Machine Learning

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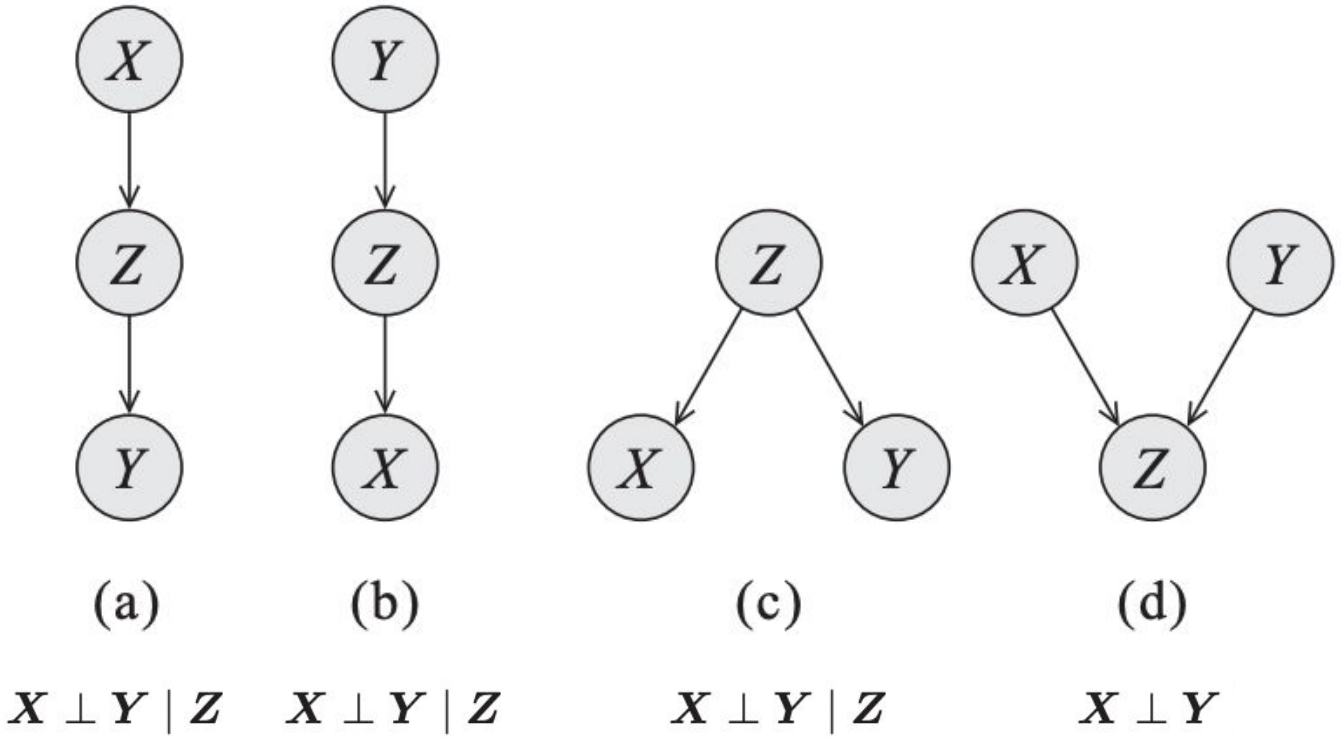
Independencies in Bayesian Networks



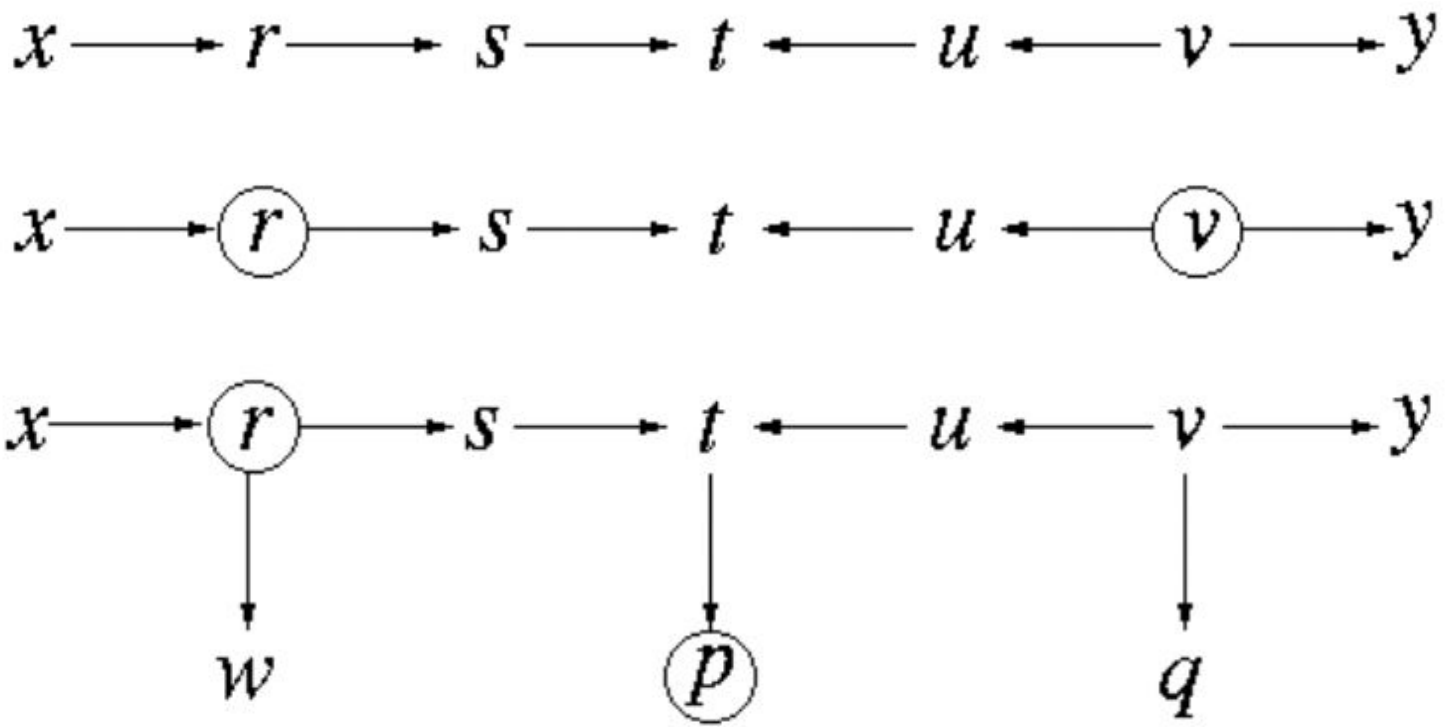
d-separation

Let $\boldsymbol{X}, \boldsymbol{Y}, \boldsymbol{Z}$ *be three sets of nodes in* $\mathcal{G}$*. We say that* $\boldsymbol{X}$ *and* $\boldsymbol{Y}$ *are* d-separated given $\boldsymbol{Z}$*, denoted* $\text{d-sep}_{\mathcal{G}}(\boldsymbol{X}; \boldsymbol{Y} \mid \boldsymbol{Z})$*, if there is no active trail between any node* $X \in \boldsymbol{X}$ *and* $Y \in \boldsymbol{Y}$ *given* $\boldsymbol{Z}$*.*

We use $\mathcal{I}(\mathcal{G})$ *to denote the set of independencies that correspond to d-separation:*

$$\mathcal{I}(\mathcal{G}) = \{(\boldsymbol{X} \perp \boldsymbol{Y} \mid \boldsymbol{Z}) \ : \ \text{d-sep}_{\mathcal{G}}(\boldsymbol{X}; \boldsymbol{Y} \mid \boldsymbol{Z})\}$$

d-separation



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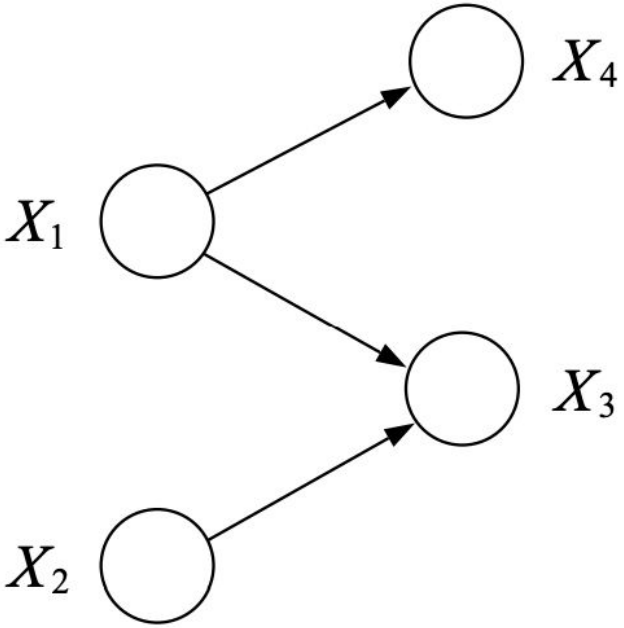
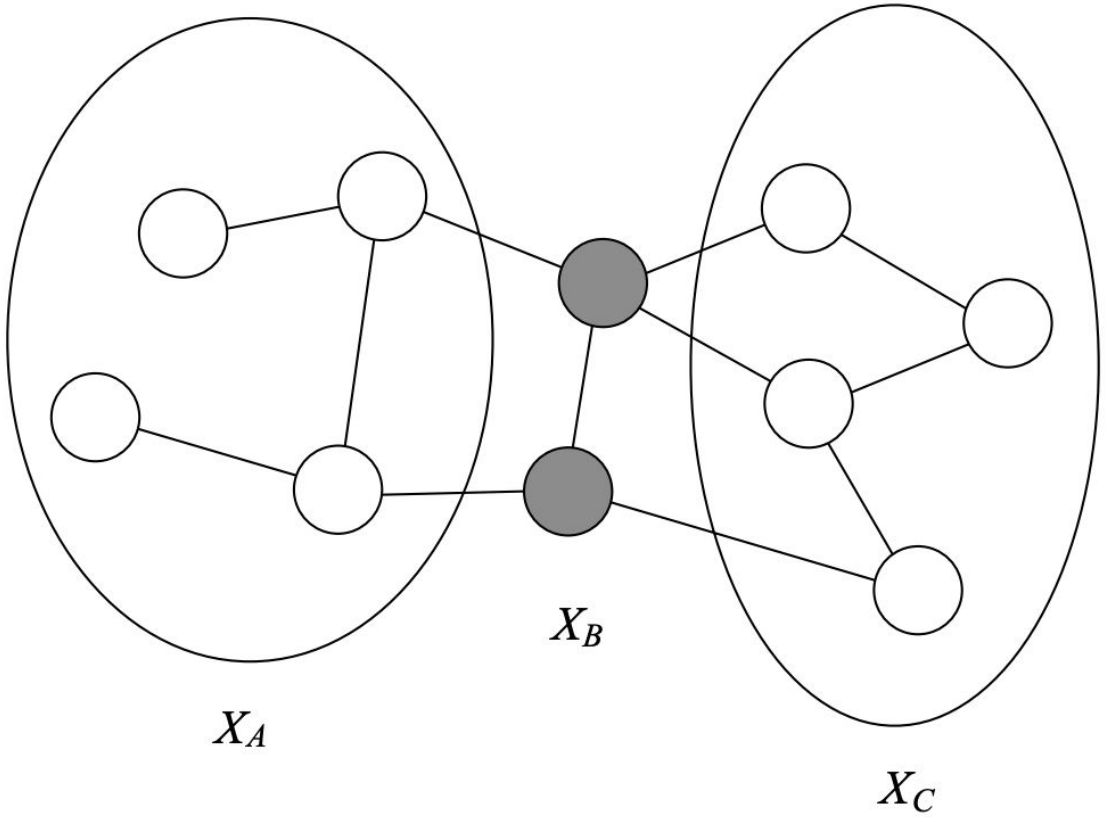


$$X_1 \perp\!\!\!\perp X_2$$

$$X_2 \perp\!\!\!\perp X_4$$

$$\{X_2, X_3\} \perp\!\!\!\perp X_4 \mid X_1$$

Undirected Graphs



Undirected Graphs