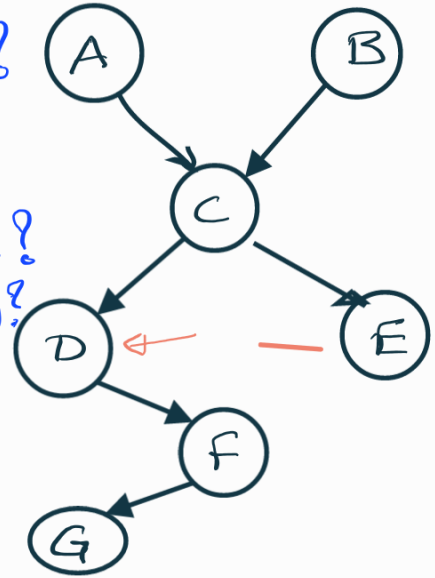


# Bayes Net Assumption

"Each variable is conditionally independent of its non-descendants, given its parents."

\* Are A and B marginally independent?

$$P(A/B) = P(A)? \quad P(B/A) = P(B)?$$



\* Are A and B Conditionally independent Given C?

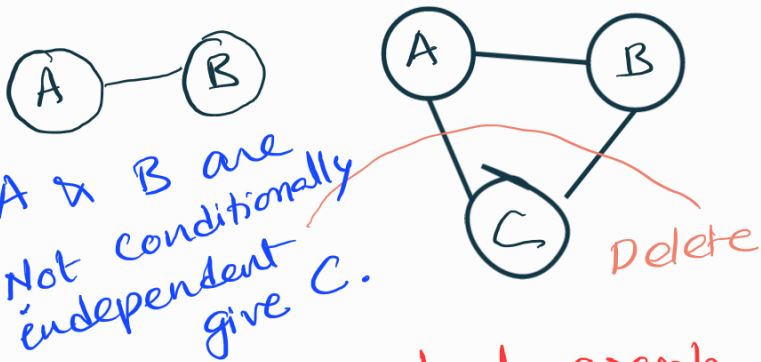
$$P(A/B, C) = P(A|C) \text{ or } P(B/A, C) = P(B|C)?$$

Are D and E Conditionally independent Given C?

$$P(D/E, C) = P(D|C) \text{ or } P(E/D, C) = P(E|C)?$$

Are A and B conditionally independent, given D and F?

$$P(A/B, D, F) = P(A|D, F)?$$



1. Draw ancestral graph

- Nodes & their parents

2. Moralize

- Edge between nodes with common child.

3. Disorient

- Remove direction

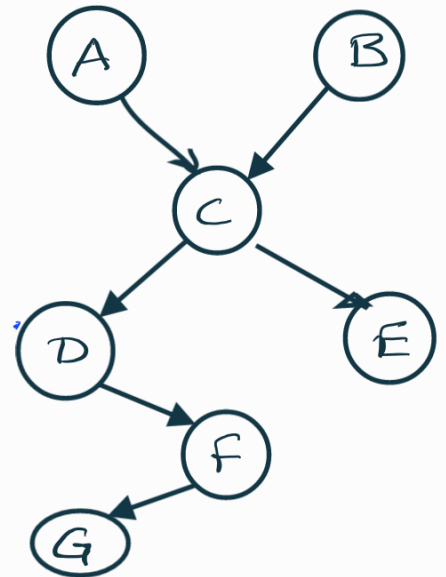
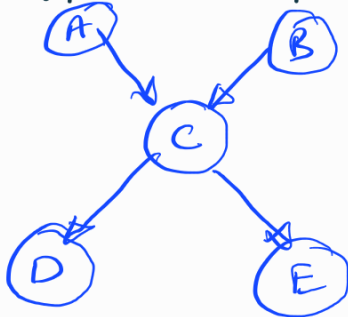
4. Delete given

Not connected  $\rightarrow$  Independent

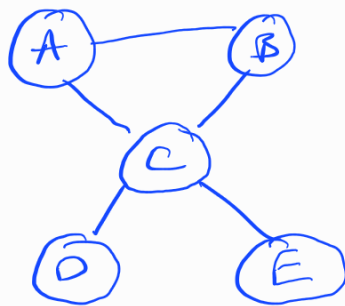
"A & B are marginally independent"

Are D and E Conditionally independent Given C?  
 $P(D|E, C) = P(D|C)$  or  $P(E|D, C) = P(E|C)$

1. Draw ancestral graph
  - Nodes in the question & their parents



2. Moralize & Disorient



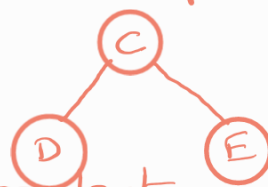
4. Remove the given



5. D & E are conditionally independent given C, because no. edge after following the steps.

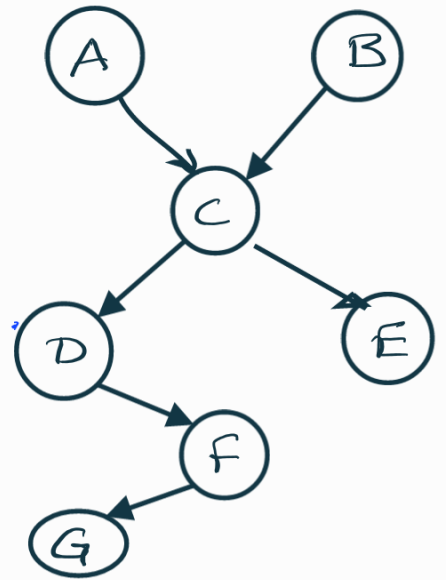
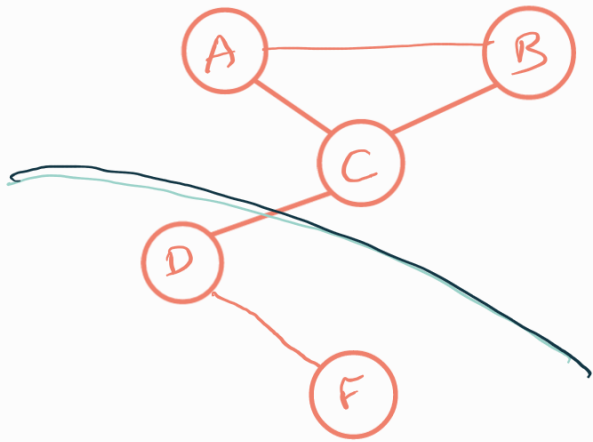
Are D & E marginally independent?

There is a path from D to E  $\Rightarrow$  They are not marginally independent



Are A and B conditionally independent, given D and F?

$$P(A/BDF) = P(A/DF) ?$$



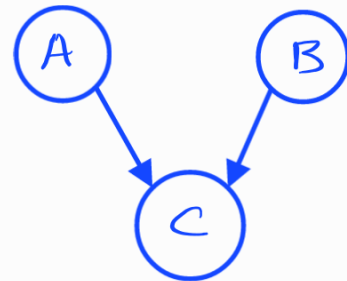
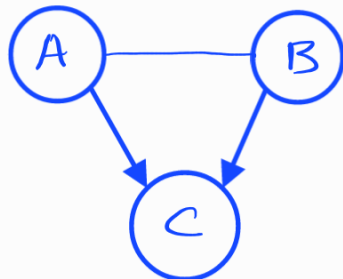
Are A & B conditionally Independent given C?

step 2: Moralize

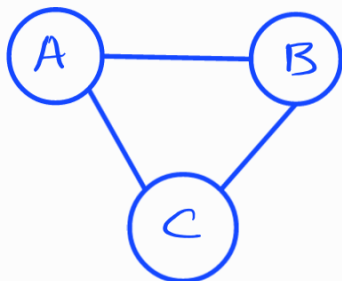
step 1: Ancestral graph



Step 3 Disorient

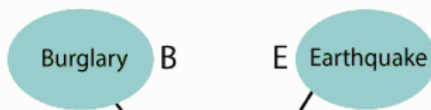


step 4: "Delete Given"



"Since A & B are connected, They are not conditionally independent"

T	0.002
F	0.998



T	0.001
F	0.999

B	E	P(A=T)	P(A=F)
T	T	0.94	0.06
T	F	0.95	0.04
F	T	0.69	0.69
F	F	0.999	0.999

A	P(D=T)	P(D=F)
T	0.91	0.09
F	0.05	0.95

A	P(S=T)	P(S=F)
T	0.75	0.25
F	0.02	0.98

$$P(B, E, A, D, S)$$

$$\begin{aligned}
 &= P(D/A) \\
 &\quad \times P(S/A) \\
 &\quad \times P(A/B, E) \\
 &\quad \times P(B) \\
 &\quad \times P(E)
 \end{aligned}$$

What is the probability of Alarm, if there was an earth quake and David called but sophia did not call ?

$$\begin{aligned}
 &P(A=T/E=T, D=T, S=F) \\
 &\approx P(a/e, d, \bar{s}) = \frac{P(a, e, d, \bar{s})}{P(e, d, \bar{s})} \\
 &= \frac{\sum_{b \in \{0,1\}} P(a, e, d, \bar{s}, b)}{\sum_{b \in \{0,1\}} \sum_{a \in \{0,1\}} P(a, e, d, \bar{s}, b)}
 \end{aligned}$$