Bayesian Belief Nets

Conditional independence assumptions only apply to a subset of variables.

exu $P(X=x_i \mid Y=y_j, Z=z_k) = P(X=x_i \mid Z=z_k)$

↳ we can get rid of this

• Assumption: X is conditionally independent of Y given Z if distribution governing X is independent of value of Y given a value for Z, if above equation holds.

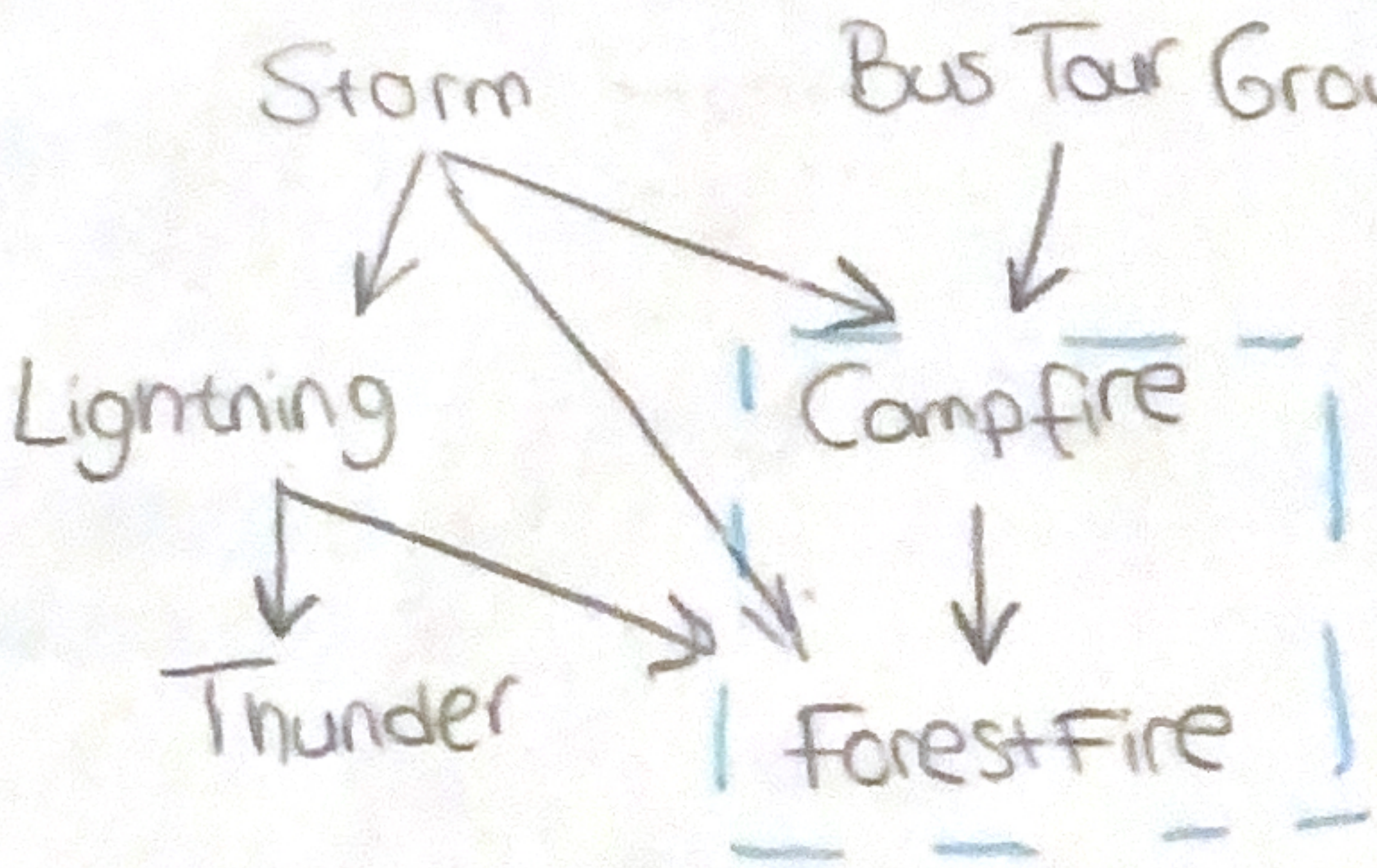
$$P(X \mid Y, Z) = P(X \mid Z)$$

↳ X ve Y independent'sa Y'den kurtulabilirsin

— Naive Bayes'teki independence assumption'ı sayesinde:

$$P(A_1, A_2 \mid V) = P(A_1 \mid A_2, V)\,P(A_2 \mid V)$$
$$= P(A_1 \mid V)\,P(A_2 \mid V)$$

A Belief Network represents joint probability distribution for a set of variables



	S,B	S,¬B	¬S,B	¬S,¬B
C	$\boxed{0.4}$	0.1	0.8	0.2
¬C	0.6	0.9	0.2	0.8

"ForestFire is descendant of campfire"

$$P(y_1, \dots, y_n) = \prod_{i=1}^{n} P(y_i \mid \text{Parents}(y_i))$$

↳ Predecessors of y_i

↳ graph'ta y'den önceki olaylar

Campfire is independent of it's nondescendants Lightning & Thunder.

$P(\text{Campfire} = \text{True} \mid \text{Storm} = \text{True}, \text{BusTourG} = \text{True}) = \underline{\underline{0.4}}$

In a Bayesian Net, we can number each node & parents will have smaller indexes than their children.

$S \rightarrow L \rightarrow T$

$S \rightarrow C \leftarrow B$

- $P(\text{Campfire} \mid S, \neg B) = 0.1$
- $P(\text{Thunder}, \text{Lightning}, \text{Storm}) = P(T \mid L)\, P(L \mid S)\, P(S)$
- $P(\text{Campfire}) = P(C \mid S, B)\, P(S)\, P(B) + P(C \mid S, \neg B)\, P(S)\, P(\neg B)$

$$+ P(C \mid \neg S, B)\, P(\neg S)\, P(B) + P(C \mid \neg S, \neg B)\, P(\neg S)\, P(\neg B)$$

- $P(B) = \sum_{i=1}^{n} P(B \mid A_i)$ where A_i add up to 1
- $P(C \mid S) = ?$ (we don't know about bustourgroup?)

$P(C \mid S) = P(C \mid S, B)\, P(B) + P(C \mid S, \neg B)\, P(\neg B) \rightarrow$ Storm = True iterate over Bus tourgroup

- If most of the variables are unknown the complexity becomes exponential (2^n)
- We can use Monte Carlo simulation for this.

ex:

$P(S) = 0.9$

$P(B) = 0.5$

$P(C \mid B, S) = 0.4$

$P(C) = ?$

$P(S)$	$P(B)$	$P(C \mid S, B)$
$S \rightarrow T$	$B \rightarrow T$	$C \rightarrow F$
$S \rightarrow T$	$B \rightarrow F$	$B \rightarrow F$
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$S \rightarrow F$	$B \rightarrow T$	$C \rightarrow T$

Generate cases

→ consider these cases

ratio obtained will be approximation to the campfire