



Bayesian Network | ML LAB 7 | VTU

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What is Bayesian Networks?

- A Bayesian network is a directed acyclic graph in which each edge corresponds to a conditional dependency, and each node corresponds to a unique random variable.
- Bayesian networks are a type of probabilistic graphical model that uses Bayesian inference for probability computations.

Some info on probability

For two events

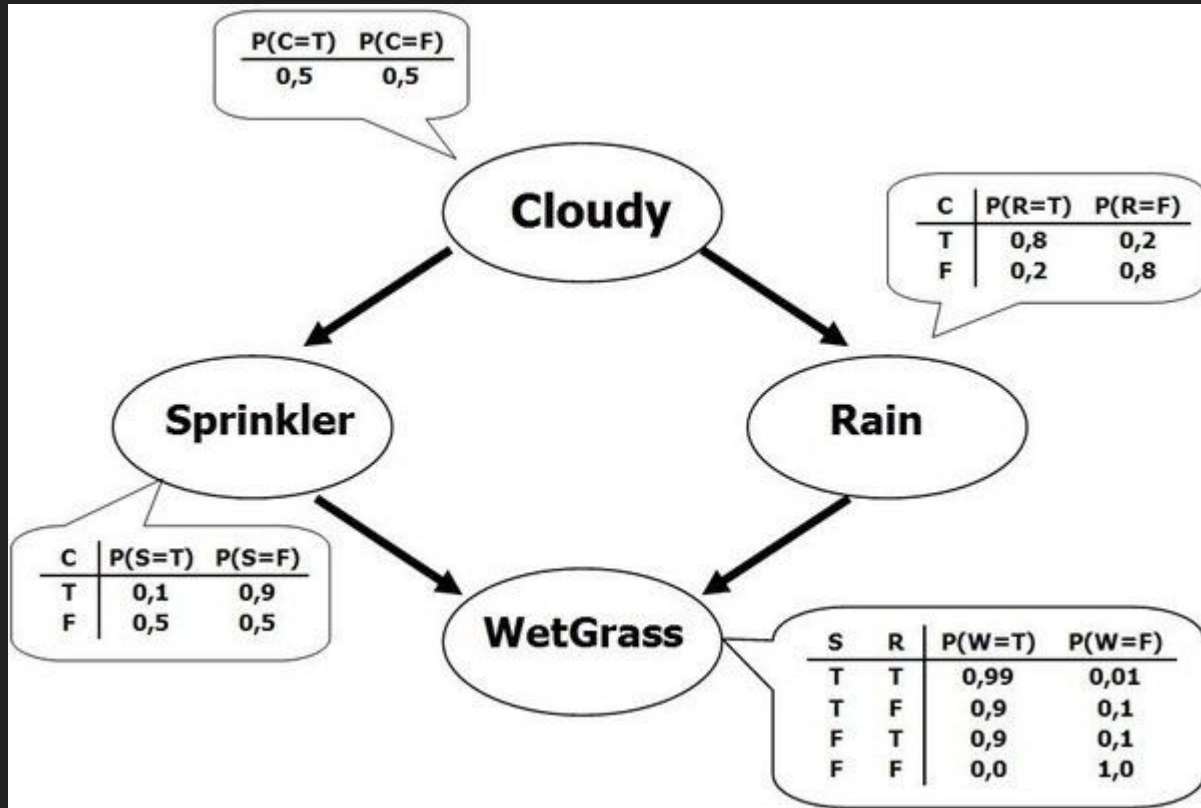
$$P(A \cap B) = P(B \mid A) \cdot P(A).$$

For N events

$$P(A_n \cap \dots \cap A_1) = P(A_n \mid A_{n-1} \cap \dots \cap A_1) \cdot P(A_{n-1} \cap \dots \cap A_1)$$

$$P(A_n \cap \dots \cap A_1) = \prod_{k=1}^n P \left(A_k \mid \bigcap_{j=1}^{k-1} A_j \right).$$

Example of Bayesian Network



If an edge (A, B) exists in the graph connecting random variables A and B, it means that $P(B|A)$ is a factor in the joint probability distribution, so we must know $P(B|A)$ for all values of B and A in order to conduct inference.

Lets derive the formula

- Bayesian network satisfy the local Markov property, which states that a node is conditionally independent of its non-descendants given its parents.

$$\mathbf{P(\text{Sprinkler}|\text{Cloudy}, \text{Rain}) = P(\text{Sprinkler}|\text{Cloudy})}$$

- Since Sprinkler is conditionally independent of its non-descendant, Rain, given Cloudy. This property allows us to simplify the joint distribution, obtained in the previous section using the chain rule, to a smaller form.

$$P(X_1, \dots, X_n) = \prod_{i=1}^n P(X_i | X_1, \dots, X_{i-1}) = \prod_{i=1}^n P(X_i | \text{Parents}(X_i))$$

What is Maximum likelihood and Variable Elimination

- Maximum likelihood estimation is a method of estimating the parameters of a probability distribution by maximizing a likelihood function
- Variable elimination is a simple and general exact inference algorithm in probabilistic graphical models, such as Bayesian networks and Markov random fields