METU Informatics Institute

Min720

Pattern Classification   with Bio-Medical Applications

Lecture notes 9
Bayesian Belief Networks

Bayesian Belief Networks

- An approach that fits doctor's need well
- Often used for that reason,
- A graphical-statistical approach that relies on the statistical relationships among the random variables
- Instead of assuming that the features are statistically independent, we form relations
- And dependencies among features by way of a graph.

Bayesian Belief Networks

- **A Bayesian Belief Network: a knowledge-based graphical representation that shows a set of variables and their probabilistic relationships between diseases and symptoms.**

- They are based on conditional probabilities, the probability of an event given the occurrence of another event, such as the interpretation of diagnostic tests.

- **The Bayesian network can be used to compute the probabilities of the presence of the possible diseases given their symptoms.**

- Some of the advantages of Bayesian Network include the knowledge and conclusions of experts in the form of Probabilities as an **assistance in decision making.**

A Simple Bayes Net

P(A), A=1,2

P(B), B=1,2

P(D I A,C); D=1,2

A

D

B

P(C I A, B), C=0,1

C
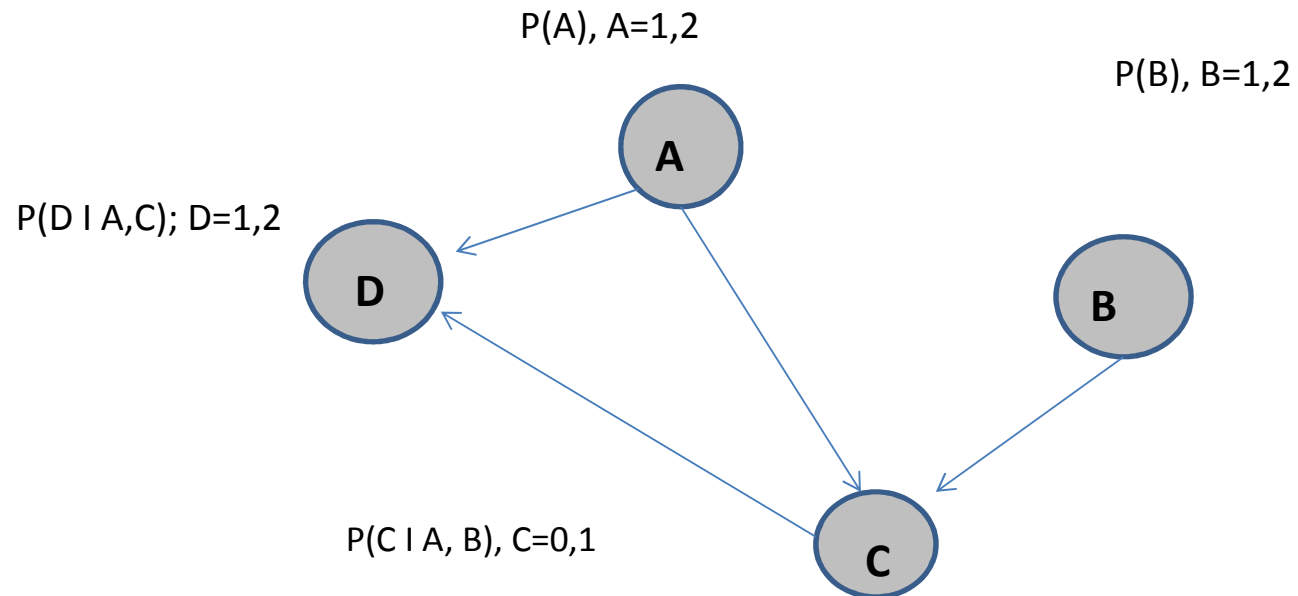
- Defines 'causal' relationships between variables A,B,C,D
- C is the child of B and parent of D

Conditional Probability Tables

	A,B= 1,1	A,B=1,2	A,B=2,1	A,B=2,2
C=0	0.2	0.2	0.3	0.3
C=1	0.5	0.4	0.05	0.05

Conditional Probability table for C for the example in the previous page.
Should be available for all nodes

- Usually discrete variables are used; a feature might have a few discrete values
- Conditional probabilities defined, may be continuous
- Parents and children
- With the application of the Bayes Rule, we can calculate any configuration of variables
- We need conditional probability tables
- Example: The problem of classifying fish

- Once the nets and joint probability tables are given, we can calculate any combination of probabilities

- In the fish example, we want to determine the **Probability of salmon and prob. of sea bass if it is wide, dark and caught in winter in north sea.**

- From given probabilities, we deduct the probs of the categories or any other combination