CHAPTER 1

Bayesian Networks

A Bayesian network, also known as a Bayes network, belief network, or decision network, is a probabilistic graphical model that represents a set of variables and their conditional dependencies via a directed acyclic graph (DAG).

1.1 Components

A Bayesian Network consists of two main components:

1. A directed acyclic graph (DAG) where each node represents a variable, and the absence or presence of a directed edge between nodes denotes the conditional dependence or independence respectively between the variables.
2. A conditional probability table (CPT) associated with each node which contains the conditional probability distribution of that node given its parents in the DAG.

1.2 Inferences

Bayesian Networks are typically used for reasoning and making inferences under uncertainty. Given observations of a set of variables, we can compute the posterior probabilities of the other variables using Bayes' rule.

There are three main types of inferences that we can make:

- **Causal reasoning (prediction)**: Given the causes, what are the effects?
- **Evidential reasoning (diagnosis)**: Given the effects, what are the causes?
- **Intercausal reasoning (explaining away)**: Given an effect and some of its causes, what can we say about the other causes?

1.3 Learning

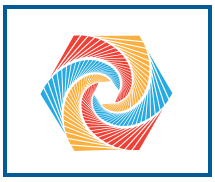
Learning a Bayesian Network from data involves two main tasks:

- **Structure learning**: Determining the DAG structure that best fits the data.
- **Parameter learning**: Estimating the parameters (conditional probabilities) of the CPTs given the DAG and data.

This is a draft chapter from the Kontinua Project. Please see our website (https://kontinua.org/) for more details.

Appendix A

Answers to Exercises



INDEX