Probabilistic Methods in Machine Learning

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References I

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Bayesian Ideas and Data Analysis: An Introduction for Scientists and Statisticians
CRC Press, 2010

What is Machine Learning?

- **Data Mining**: The process of discovering patterns in data

Machine Learning

- To get **knowledge** by study, experience, or being taught
- To become **aware** by information or observation
- to commmit to memory
- To **be informed of, or ascertain**
- To Receive information

Learning For Machines

Machine Learning is the process of altering the behavior of a program based on past data to make it perform better in the future

The Naive Bayes Method

Baye's Theorem

Let $B_1, \ldots, B_m$ be a mutually independent exhaustive collection of events. Then for any event A the probability of B_k given A, is given by:

$$P(B_k|A) = \frac{P(B_k)P(A|B_k)}{\sum_{i=1}^{m} P(B_i)P(A|B_i)}$$

Laplace Estimators

If the probability of a given even is $\frac{a}{b}$ then for some $\mu \in \mathbb{N}$ we adjust the probability to $\frac{a+\frac{\mu}{3}}{b+\mu}$

Bayesian Networks

Bayesian Networks

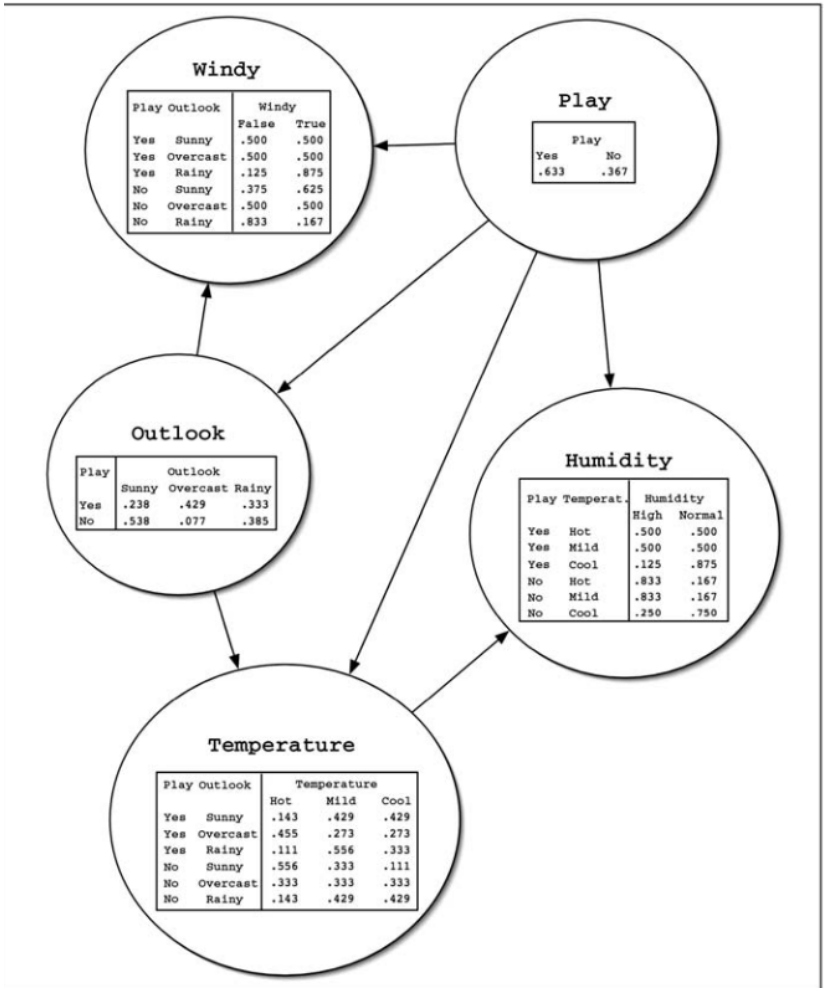

Figure: An example Bayesian network from Data Mining: Practical Machine Learning Tools and Techniques

The K2 Algorithm

- Cooper and Herskovits 1990, A Bayesian Method for the Induction of Probabilistic Networks from Data
- Originally invented to perform algorithmic medical diagnoses
- Greedy Algorithm
- Very Fast