Bayesian Networks

(Bayesian belief networks)

A bayesian network is a probabilistic graphical model that uses probability to compute uncertainties.

It is represented by using directed acyclic graphs (DAGs) and probability distribution tables.

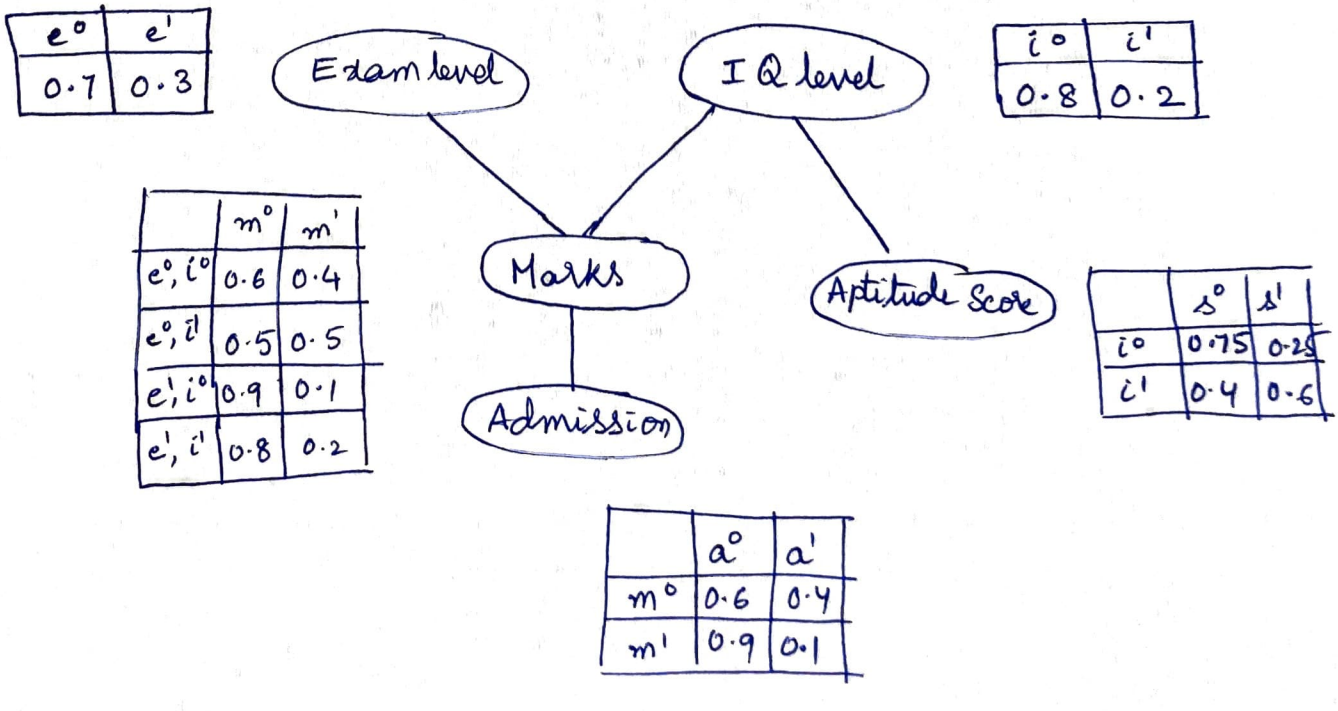
Joint probability $P(A, B) = P(A \cap B)$ read as 'probability of two events A and B happening at the same time'.

conditional probability $P(A|B)$ read as 'probability of event A occuring given that B already occurred'.

If A and B are dependent events, $P(A|B) = \frac{P(A, B)}{P(B)}$

If A and B are independent events, $P(A|B) = P(A)$

Example : Using Bayesian Network to model marks (m) obtained by a student in an exam.



e^0	e^1
0.7	0.3

i^0	i^1
0.8	0.2

	m^0	m^1
e^0, i^0	0.6	0.4
e^0, i^1	0.5	0.5
e^1, i^0	0.9	0.1
e^1, i^1	0.8	0.2

	s^0	s^1
i^0	0.75	0.25
i^1	0.4	0.6

	a^0	a^1
m^0	0.6	0.4
m^1	0.9	0.1

Factorising Joint probability distribution

$$P(a, m, i, e, s) = P(a|m) \cdot P(m|e, i) \cdot P(e) \cdot P(i) \cdot P(s|i)$$

The probability of a random variable depends on its parent nodes

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

Note: Bayesian Networks consider the dependence among features in the training data but Naive Bayes classifier ignores it.