	Time	Space	Completeness	Optimality
BFS	b^d	b^d	Y	Y
DFS	b^d	b*d	N	N
DFS w Iter Dpng	b^d	b*d	Y	Y
Best First Greedy	b^d	b^d	N	N
Best First Astar	b^d	b^d	Y	Y
Minimax	b^d	b*d	Y (if finite tree)	Y (if optimal opponent)

Nodes	Cond1	Cond2
Grandpa	Alpha (Max)	Beta (Min)
Parent	Beta (Min)	Alpha (Max)
Condition	Alpha >= Beta	Beta <= Alpha
Action	Stop searching under Parent	Stop searching under Parent

Apriori: Frequent itemset has frequent subsets, infrequent itemset has infrequent supersets

- Closed Frequent Itemset: all immediate superset have less support
- Maximal Frequent Itemset: no frequent superset

FP Growth: remove infrequent, order, then grow the tree; **Conditional Pattern Base**: to go from bottom to top to list all parent path of an item.

$$Best\ First\ Search\ (greedy)\ f(n) = g(n) + h(n), g(n) = 0.\ \ if\ g(n)\ not\ 0, A^*.$$

$$Support(X \to Y) = \frac{\sigma(X \cup Y)}{|T|} = P(X \cup Y);\ \ Condidence(X \to Y) = \frac{\sigma(X \cup Y)}{\sigma(X)} = \frac{P(X \cup Y)}{P(X)} = P(Y|X);$$

$$Two\ tasks\ in\ ARM: 1.Frequent\ Itemset\ Generation\ 2.Rule\ generation$$

$$Lift(X, Y) = \frac{Conf(X \to Y)}{Sup(Y)} = \frac{P(Y|X)}{P(Y)}.\ \ (= 1 \Rightarrow independent; > 1 \Rightarrow posi\ corr; < 1 \Rightarrow neg\ corr)$$

$$**ID3**\ \ Info(D) = -\sum_{i=1}^{m} p_i log_2(p_i);\ Info_A(D) = \sum_{j=1}^{v} \frac{|D_j|}{|D|} Info(D_j);\ Gain(A) = Info(D) - Info_A(D)$$

$$**C4.5**\ \ SplitInfo_A(D) = \sum_{j=1}^{v} \frac{|D_j|}{|D|} Info(\frac{|D_j|}{|D|});\ GainRatio_A(D) = \frac{Gain(A)}{SplitInfo_A(D)}$$

$$Gini(D) = a - \sum_{i=1}^{2} p_i^2;\ \ Gini_A(D) = \sum_{j=1}^{v} \frac{|D_j|}{|D|} Gini(D_j)$$

$$sensitivity = \frac{TP}{P};\ \ specificity = \frac{TN}{N};\ \ precision = \frac{TP}{TP + FP};\ \ recall = \frac{TN}{TN + FN}$$

$$acc = sensitivity(\frac{P}{P + N}) + specificity(\frac{N}{P + N});\ \ F = \frac{2 * precision * recall}{precision + recall}$$

$$Clustering: Eulidean\ distance: d(x,y) = ||x-y||_2;\ Manhattan: d(x,y) = ||x-y||_1;$$

$$Infinity: max_{1\le j\le d}|x_j - y_j| = lim_{t\to\infty}(\sum_{j=1}^{d}(x_j-y_j)^r)^{\frac{1}{r}}$$

$$BP: output\ units: \delta_k = \sigma'(net_k)(t_k - o_k);\ hidden\ units: \delta_j = \sigma'(net_j)\sum_k \delta_k w_{kj};\ \Delta b_j = \eta_b\delta_j;$$

$$Bayes'\ Theorem: P(A|B) = \frac{P(B|A)P(A)}{P(B)}(under\ assumption: P(a_1,\dots,a_d|v_j) = \Pi_{i=1}^{d}P(a_i|v_j))$$

$$PCA: max_{(||V||_2=1)}\frac{1}{N}\sum_{i-1}^{N}(v^Tx_i)^2;\ Singular\ Value\ Decomposition\ A = U\begin{bmatrix}\Sigma\\0\end{bmatrix}V^T,$$

$$where\ U\ and\ V\ are\ orthogonal\ and\ \Sigma = diag(\sigma_1,\dots,\sigma_n), \sigma_1 > \sigma_2 > \dots > \sigma_n > 0$$