COMP24011 Introduction to AI

Branch-and-Bound works by eliminating all branches where the underestimation of cost needed to achieve the target is already equal to or higher than the current best solution in hand.

αβ-pruning works on minimax scenarios only, by discontinuing all branches where the increasing *maximum accepting score for small player* (α) has overrun the decreasing *minimum accepting score for big player* (β).

Bayes network shows that how probability changes for the current and all succeeding nodes while the Boolean value for preceding nodes change. Any network must be a directional graph that has no loop for probabilities to pass on without having current node value be a part of the equation for itself later.

$$p(x_1, \dots, x_n) = \prod_{i \in V} p\left(x_i | x_{parents(i)}\right)$$

Factorised result of some or all elements of a Bayes network is the product of all nodes listed, given their parents as preconditions.

$$IDF(q_i) = \lg \frac{N - DF(q_i) + 0.5}{DF(q_i) + 0.5} = \lg \frac{Docs\ do\ not\ contain\ q_i + 0.5}{Docs\ do\ contain\ q_i + 0.5}$$

Inverse Document Frequency (IDF) is the log 10 of the number of documents that does not contain the word divided by that of the docs that do. Both upper and lower add a constant of 0.5 to prevent issues.

Word / Term Frequency is the number documents having this word / words using this term.

$$Precision = \frac{True\ Positives}{True\ Positives + False\ Positives} = \frac{Correctly\ matched\ by\ algorithm}{All\ matches\ provided\ by\ algorithm}$$

Precision cares about the accuracy of the results the algorithm returns.

$$Recall = \frac{True\ Positives}{True\ Positives + False\ Negatives} = \frac{Correctly\ matched}{All\ matches\ in\ the\ realiety}$$

Recall cares about the completeness of matches across all matches that exists.

$$F1\ Score = average(Precision, Recall)$$

F1 Score is the mean of Precision and Recall value.
False Negative Rate = $1 - Recall$
False Positive Rate = $1 - Precision$

$$PR(p) = \frac{1 - d}{N} + d \sum_i \frac{PR(in_i)}{C(in_i)}$$

Page Rank score of a page is the *sum of the page rank scores voted by each page linking to the current page* multiplied by a *damping ratio d*, where each vote worth *the current PR scores the voter page has but equally shared between each page it votes for*, plus a *basic damping value*, which is a small proportion of score $(1 - d)$ shared across all pages that does not have any pages pointing to them.

Regular Expression (RegEx) that implements a finite state automata for matching context.

`[0-9]`	matches any digit from 0 to 9
`[0-9]+`	matches one or more digits
`[.][0-9][0-9]`	matches a period followed by two digits
`([.][0-9][0-9])?`	matches a period followed by two digits, or nothing
`[$][0-9]+([.][0-9][0-9])?`	matches $249.99 or $1.23 or $1000000 or . . .

\d for digits; **\s** for spaces; **\w** for [0-9a-zA-z].
? for could exist; **+** for possible reoccurrence.

Landmark-based observation (location definition) uses range (relative distance) and bearing (relative orientation) to define the relative location from the landmark's location.
To obtain the observation (range and direction) based on two coordinates in typical x-y location system, where i is the target and t is the landmark, with θ_t being the heading of landmark, use:

$$\hat{\mathbb{z}}_t = h(\mathbb{x}_t) = \begin{pmatrix} \sqrt{(x_t - x_i)^2 + (y_t - y_i)^2} \\ \arctan\left(\frac{y_i - y_t}{x_i - x_t}\right) - \theta_t \end{pmatrix}$$

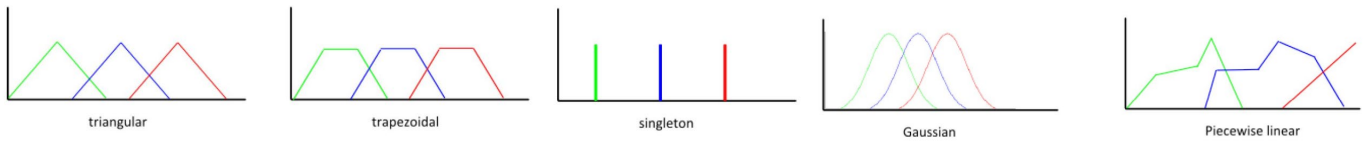
Fuzzy logic operators are **AND** and **OR**.
AND$(\boldsymbol{op1}, \boldsymbol{op2})$ means $\min(op1, op2)$;
OR$(\boldsymbol{op1}, \boldsymbol{op2})$means $\max(op1, op2)$.

Refinements of Information Retrieval contains three actions.
Case folding transform all characters to lowercase.
Stemming takes out the main word and remove its variants dogs -> dog).
Recognising synonyms replaces synonyms and replace to a uniformed one. This could lead to bad precision as not all meanings of a word may be represented by its synonyms.

Allen's Algebra defines a set of relations (functions) as follow:

Primary differences between this system and the normal English understanding are:
Meet$(\boldsymbol{i}, \boldsymbol{j})$ means i end at the start of j.
Before$(\boldsymbol{i}, \boldsymbol{j})$ and **After**$(\boldsymbol{j}, \boldsymbol{i})$ means i ends before the start of j .
During$(\boldsymbol{i}, \boldsymbol{j})$ means i starts and ends in the duration of j .
Overlap$(\boldsymbol{i}, \boldsymbol{j})$ means i starts before j starts but ends before j ends.

Members of the fuzzy logic has members that are context-dependent and is concluded though real-life experiences. Members may overlap with each other, and could come in many different means.



A* Searching is a way to seek shortest route on a graph, based on an estimation of the remaining path added by the path already taken. Each time it queries the node with least total route cost in the indexed priority queue. Each query adds all linked, unindexed nodes to the queue. Partially an optimised BFS.

Tree Decomposition results are not unique, but each result requires three criteria being met:

1. Each node in graph is reflected in tree *at least* once.
2. If two nodes in graph has a connection, they share *at least* one bag in the tree.
3. If the same node exists in two different bags, then *all* bags along the *unique route* connecting these bags must have this node as well.

Node Consistency exists that all values in the domain suits all one-node constraints applicable.
Arc-Consistency exist if for all values in the domain, all binary relations are satisfied.
Path-Consistency exists if for all pairs of points in a path, any pair of value from the respective domains would satisfy all restraints for all other.
K-Consistency exists when all possible value sets of any k nodes, constraints of one other node are all satisfied.
Strong K-Consistency means all node, arc, path and k-consistency ($k \leq K$) are satisfied. When K = *width of graph*+1, there must be a solution.