**CA318 Terminology**

*Search Space*

The search space is the set or domain that an algorithm performs upon to search. This space may be well defined and finite or be vast and possibly infinite.

*Hill Climbing*

Hill Climbing is an optimization technique. It is an iterative algorithm that starts with an arbitrary solution. Hill climbing attempts to maximize a target function f(x). Hil climbing will adjust a single element and determine whether that element will improve the value of f(x).

Variants

* Simple HC is where the first closest node is chosen
* Steepest ascent HC is where all successor values are compared and the closest solution is chosen.
* Stochastic HC does not examine all neighbours before deciding to move. Instead it selects random neighbours and decides whether to move to that neighbour or examine another.

*Problems*

* Hill climbing will not always find the global maximum but may converge on a local maximum. This does not occur in a convex heuristic. Most functions are not convex so it may often fail to reach the global maximum
* Ridges and Alleys are a challenging problem for optimisation in continouos spaces. If there are ridges of data the hill climber may be forced to zig zag which decreases in performance.
* Plateaux are flats plains of data. The search space is flat. Values obtained are indistuinguishable from the surrounding data. This can cause inprecision where the hill climber cannot determine in which direction it should step and may eventually wander in a direction that lead to no improvement.

*Heuristics*

Heuristics are a technique designed for solving problems quickly. Optimality, completeness, accuracy, precision are sacrificed for speed for a shortcut to the goal. The objective of heuristics are to produce a solution within reasonable time frame. It may not find the global maximum or it may approximate the exact solution. It is valuable because it is fast.

*Greedy Algorithm*

Greedy algorithms follow the heuristic of making locally optimal choices at each stage of an iteration. A greedy strategy does not useually produce an optimal solution, but a greedy heuristic may yield local optima. Through reruns a globally optimal solution can be found.

Greedy algorithms have 5 components:

1. A candidate set from which a solution is created.
2. A selection function which chooses the best candidate to add to the set
3. A feasibility funcion that determines if a candidate can contribute to a solution.
4. An objective function which indicates when we have discovered a complete solution.

*Minimax*

Minimax is a decision rule for minimizing the possible loss for a worst case scenario. It is utilised to maximise the minimum gain, specifically in game theory

*Maximin*

Maximin selects the alternative that maximises the minimum pay-off achievable. The worst possible outcomes are examined and the worst of these is the maximin

*Warnsdorfs Rule*

Warnsdorfs rule is a heuristic especially used in the knight’s tour challenge. The knight is moved so that it always proceeds to the square from which the knight wll have the fewest onward moves

*Domain Reduction*

Domain reduction algorithms are used to reduce constraints and degrees of freedom in order to provide solutions

*Dynamic Programming*

Dynamic Programming is a mathematical optimization and programming method. It refers to simplifying a complicated problem by breaking it down into simpler sub-problems in a recursive manner. While some decision problems cannot be taken apart this way, decisions that span several points in time often break apart recursively.

The two key attributes are:

* Optimal substructure – Means that a solutionto a given optimization can be obtained by the combination of optimal solutions to its sub problems. These are done using recursion
* Overlapping sub-problems – is the space of sub problems must be small, whereby any recursive algorithm solving the problem should solve the same sub-problems over and over rather than generating new sub-problems.

*Memoization*

Memoization is an optimization technique used to speed up computer programs by storing the results of expensive function calls and returning the cached result when same input occurs again. Memoized functions cache the result of some inputs. Subsequent functions will return the cached result rather than recalculating.

A function can only be memoized if it is referentially transparent where an expression is can be replaced with its output without changing its environment. These expression are known as pure functions

*Maxima and Minima*

The maxima and minima of a function are the largest and smallest values. There are local values in a given range and global values over the entire domain.

*Gradient Descent*

Gradient Descent is a first-order iterative optimization algorithm for finding the minimum of a function.

*Deep Learning*

Deep learning is a machine learning method based on learning data representations. Learning can be supervised or unsupervised. Models are based on artificial neural networks. Each level learns to transform its input data into a slightly more abstract and composite representation. The depth refers to the number of layers by which the data is transformed.

*Classification and Decision Trees*

Classification in a neural network is a decision making set for training a neural network so that it can decide whether to put an object in a certain category. Decision trees are binary trees with either inputs or outputs that make up the super structure of a neural network