

Constraint Satisfaction Problem

constraint satisfaction is a search procedure that operate in a space of constraints sets the initial state containing the constraints that are originally given in the problem description. A goal state is any state that has been constraints even "enough" must be defined for each problem.

constraint satisfaction is two step process first

- (1) constraints are discovered and propagated as far as possible through out the system when if there ex is still not a solution search begins. ~~a guess~~ about something is met and added as a new constraints. propagation can than occur with this new constraint and so on.

The first step, propagation arises from the fact that there are usually dependencies among constraints these dependencies occurs because any const. involves more than one object and many object ~~and~~ participate in more than one constraints.

Constraint propagation also arises from the presence of inference rules that allows addition constraints to be

The second possible reason for termination is that the progr. has run out of st and there are no further changes that can be made on the basis of current . If this happens and solⁿ has not yet it specified than search is necessary to met the processing moving again for ex.

- 1. Cryptarithmetic problem
- 2. sudoku
- 3. map coloring
- 4. cross word puzzle.

1. Cryptarithmetic problem :-

Consider an arithmetic problem represented in letters, assign a decimal digit to each of the letter in such a way that the answer is correct if the same letter occur more than once, it must be assign same digit each time; no two different letter may be assign the same digit.

$$\begin{array}{r}
 \text{E A T} \\
 + \text{T H A T} \\
 \hline
 \text{A P P L E}
 \end{array}$$

A = 1
 T = 9
 P = 0
 E = 8
 L = 3
 H = 2

$$\begin{array}{r}
 8 \ 1 \ 9 \\
 + 9 \ 2 \ 1 \ 9 \\
 \hline
 10 \ 0 \ 8 \ 8
 \end{array}$$

S E N D
 + M O R E
M O N E Y
 M=1 R=8 N=6
 S=9 Y=2
 O=0 E=5
 D=7

$$E+I=N \quad \textcircled{1}$$

$$N+R(+1) = E+I+O$$

$$E+I+R(+1) = E+I+O$$

$$R(+1) \leq 9$$

$$R = 8$$

R O A D S C R O S S
 + C R O S S X + R O A D S
D A N G E R D A N G E R

Genetic algorithm

Ques 3

Explain Genetic algorithm and its operators.

Genetic algorithm is a randomized search & optimization technique guided by the principle of natural genetic system.

Genetic algorithm based on models of natural adaptation and evolution.

Genetic algorithms are part of evolutionary computing the rapidly growing area of AI.

GA are adaptive heuristic search algorithm based on evolutionary ideas of natural selection and genetics. It is inspired by Darwin's theory 'survival of fittest'.

In nature competition among individual for scarce resource results in the fittest individual dominating over weaker ones.

GA are intelligent exploitation of random search and used in optimization problems. It also uses historical information to direct the search into the region of better performance within search space.

In GA the process of finding solutions generate other points or possible solution as evolution proceeds. It do not break easily even if the input is changed slightly. It offers significant benefits over other

difficult search algorithm Optimization techniques.

Genetic algorithms operators

1. Selection

2. Crossover

3. Mutation.

1. Selection :

The process that determines which solution are to be preserved and allowed to reproduce and which one deserve to out.

The primary objective of solution operator is to emphasize the good solution and eliminating the bad selection in a population while keeping the population size constant. This operators selects the best and discards the rest.

Selection means extracting a subset of genes from an existing population according to any definition of quality. Every gene has a meaning, so one can derive from the gene a kind of quality measurement called fitness function. Selection can be performed by fitness value.

2. Crossover :

Crossover is a genetic operator that contains two parent chromosomes to produce new chromosomes.

The idea behind cross is that the new chromosome may be better than either of the parents if it takes best characteristics from each of the parent.

Mating between two strings is accomplished with crossover operation which randomly selects a fixed position in a string of bits and concatenates the head of one parent to produce offspring.

Suppose,

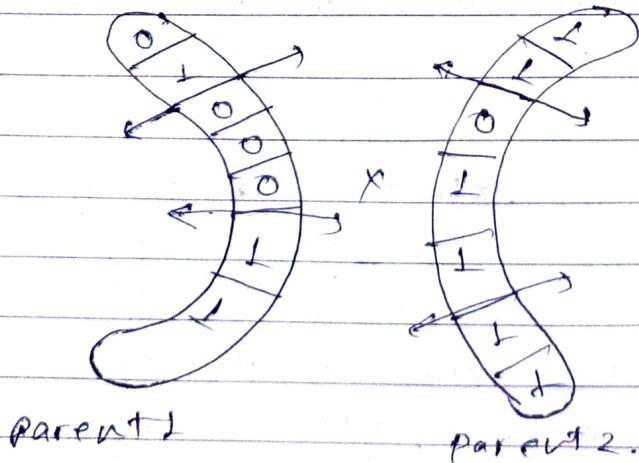
Parent 1 : XXX|XXXXXX

Parent 2 : YYY|YYYYYY

Offspring 1 : XXXYYYYYYY

Offspring 2 : YYYYXXXXXX

3rd bit position is selected for crossover.



Fig! Two point crossover.

Offspring 1 : 0101111

Offspring 2 : 1100011

3. mutation:

Mutation is the occasional introduction of new features into the selection string of the population pool to maintain diversity in the population. Mutation is used to ensure that all locations of the rule space are reachable, that every potential rule in the rule space is available for evaluation.

This ensures that the selection process not get caught in local maxima or local optima.

It may happen that crossover and in version operator will only produce a set of structure that are better than local network but not optimal in global sense so mutation operator can overcome this by simply selecting any bit position in string at random and changing it.

Mutation operator simply invents of value of selected gene that is 0 goes 1 and 1 goes 0

→ Original offspring: 1 0 1 1 0 1 1
→ mutated offspring: 1 0 0 1 1 0 1 1
 ↓
 mutated gene

Artificial Neural Network.

Ques 84

What do you mean by neural network?

It is an extension of neural network in terms of functionalities in the implementation of devices that behaves like human being and always represents as artificial neural network (ANN).

ANN is the most powerful learning module of units/elements that acquires a large collection of units/elements that are interconnected in same pattern to allow same communication between the units.

These units are also called node neurons that operate in parallel.

Basically, ANN is nothing but an implementation tool that helps to maintain the functionalities of each and every devices. Generally, ANN contains artificial neurons which is called unit. and units are maintains the functionalities and overall ANN.

ANN maintains the information processing just like a biological nervous system in our body. It is a artificial devices structure where highly interconnection has establishes to solve specific application like - deep learning, pattern recognition, speech recognition, NLP etc.

ANN also process information with high speed rapid solving scenario and give quick response and many more under these categories, overall

these are represented as an expert system and due to their expertise, in sufficient analyze information, categories information and give the response.

According to new scenario,

Just like the ^{archite} structure of neural network, it has also several layer like an input layer, an output layer and hidden layer.

The input layer receives data from the outside world, which the neural network need to analyze.

Then, this data passes through one or more hidden layer that transforms the input into data, that is actually valuable for the output layer.

Finally, the output layer provides an output in the form of response of the ANN. to the input data provide.

Ques 5

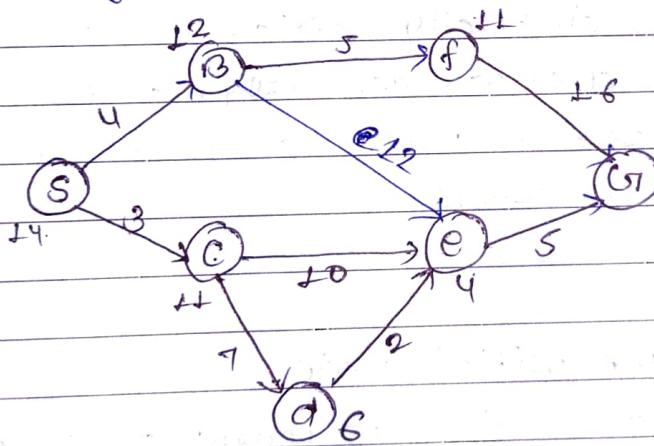
A* Algorithm

A* search is an informed search algorithm that combines the advantages of both uniform cost search and greedy best-first search. It evaluates a node based on a combination of the cost of the path from the start node to the node and an estimated heuristic function that estimates the cost to reach to goal from the current node.



$$f(n) = g(n) + h(n)$$

A* search evaluates nodes by combining $g(n)$, the cost to reach the node, and $h(n)$, the estimated cost to get from the node to the goal: $f(n) = g(n) + h(n)$



$$f(n) = g(n) + h(n)$$

Actual cost from start node to n + Estimate cost from n to goal node.

$$f(S) = 0 + 4$$

$$S \rightarrow B$$

$$4 + 12 = 16$$

$$SC \rightarrow D$$

$$3 + 10 + 4 = 17$$

$$S \rightarrow C$$

$$3 + 11 = 14$$

$$SC \rightarrow E$$

$$3 + 7 + 6 = 16$$

$$SB \rightarrow F$$

$$SB \rightarrow E$$

$$4 + 5 + 11 = 20$$

$$= 20$$

$$SCDE \rightarrow G$$

$$3 + 7 + 2 + 5 + 0$$

$$= 17$$

$$SBF \rightarrow G$$

$$4 + 5 + 16 + 0 = 25$$

⑤ BFS is optimal

⑥ Not optimal.

Heuristic (informed) search:

Informed search also known as heuristic search.
Heuristic search strategies are like smart search methods that use special knowledge to find solutions more efficiently. It's similar to when we use our intuition or common sense to solve a problem.

Heuristic function:

A heuristic function is a function that makes provide an estimated cost or value used to guide algorithm in problem-solving or decision making. It helps the algorithm decide which path or options are more promising by giving an approximate measure of how close a given state is to the goal.

Or

A heuristic function, denoted by $h(n)$, estimates the cost from a node n to the nearest goal node.

Types of informed search:

1. Best first search
2. Hill climbing

3. constraints satisfaction

4. A*

Hill climbing

Hill climbing is a heuristic search algorithm used primarily for mathematical optimization problem in AI. It is a form of local search, which means it focuses on finding the optimal solution by making increment changes to an existing solution and then evaluating whether the new solution is better than the current one. The process is analogous to climbing a hill where you continually seek to improve your position until you reach the top, or local maximum, from where no further improvement can be made.

Hill climbing is a fundamental concept in AI because of its simplicity, efficiency, and effectiveness in certain scenarios, especially, when dealing with optimization problems or finding solutions in large search spaces.

Algorithm

1. Evaluate the initial state
2. loop until a solution is found or there are no operators left.
 - Select and apply a new operator
 - Evaluate the new state
 - if goal then quit.
 - if better than current state then it is new current state.