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I

1) Goal of combinatorial optimization

Goal of combinatorial optimization is to use combinatorial techniques to solve discrete optimization problems.

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2) Simulated Annealing:

Simulated Annealing is a method that can used to minimized the cost function given to a combinatorial system with multiple degree of freedom.

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3) Cost Function:-

Cost function refers to the functional ~~realatio~~ relationship between cost and output. It studies the behaviour of cost at different levels of output where technology is assumed to be constant..

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4) Boltzman function:

It is an algorithm intended for random sampling of combinatorial structures. If the object size is viewed as its energy, and the argument of the corresponding generated function is interepted in terms of the temperature of the physical system, the Boltzman function;

returns a object from a classical boltzman distribution.

5) **Local maxima:-**

Local maxima would be ~~be~~ the point in the particular interval for which the values of the function near the point are always less than the values of the function at that point.

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II

In 0/1 knapsack problem,

- 0/1 knapsack problem does not take the fraction of any item.
- Either we take an item completely or leave it.

Consider the given requirements-

- knapsack weight capacity = W
- Number of items each having some weight and value = n

Step 1:

- Draw a table say 'T' with (n+1) number of rows and (w+1) number of columns.

Fill all the boxes of the 0th row and the 0th column with zeroes.

Step-2

Start fill the table row-wise top to bottom from left to right

Use the following formula-

$$T(i,j) = \max \{ T(i-1, j), \text{value}_i + T(i-1, j - \text{weight}_i) \}$$

Here, $T(i,j)$ = maximum value of the selected items if we can take items 1 to i and have weight restrictions of j.

- This step leads to completely filling the table
- Then, the value of the last box represents the maximum possible value that can be put into the knapsack.

Step-3

To identify the items that must be put into the knapsack to obtain that maximum profit.

- consider the last column of the table.
- Start scanning the entries from bottom to top.
- on encountering an entry whose value is not the same as the value stored in the entry immediately above it, mark the row label of that entry
- After all the entries are scanned, the marked labels represent the items that must be put into the knapsack.

Time complexity -

- Each entry of the table requires constant time $\Theta(1)$ for its computation.
- It takes $\Theta(nw)$ time to fill $(n+1)(w+1)$ table entries.
- It takes $\Theta(n)$ time for tracing the solution since the tracing process traces the n rows.
- Thus, overall $\Theta(nw)$ time is taken to solve the 0/1 knapsack problem using dnymic programming.

III