Implementation of The Messenger.

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Abstract

Dynamic Programming is a very efficient type of algorithm for solving problems that have overlapping subproblems.This problem can be solved by a DP approach.

Keywords

Dynamic Programming; states; message;

I. Problem Statement

The Problem at hand is to develop an algorithm to find the minimum cost of transmitting a message subject to the constraints that cost of transmission of a single character is x whereas cost of transmission of a substring that is already a part of the transmitted string is y.

II. Implementation

This problem can be modeled as a DP by using two arrays one for computing the state of the message transferred and all the possible ways that the next set of characters can be transferred.Whenever a new character is to be added from the set of remaining characters then the states array stores the total number of states in which the message can be transmitted at that particular time.At each step the max state value computed is

Once the states array has been computed we use a DP approach to compute minimum cost to transfer the message by storing the intermediate solutions in a DP.For instance the first character to be inserted will incur a minimum cost of x and the successive characheter will incur an incoming cost of either y or x depending on whether they are already a member of the string or not. Therefore we start by assigning the initial cost in DP as x.If the difference between inserting the new element and the cost for insertion of previous characters is more than x then we add the new cost as x.This is to take care of cases were x is less than y.

The algorithm takes into consideration each possible state and for each state it computes all the possible cost for all the states like inserting k elements of a substring with cost y or inserting one element with cost x.Based on this the minimum cost is computed and assigned to each successive element in the DP array indicating the message length that has already been transferred.Therefore DP[len(string) - 1] will contain the value of the minimum cost required to transfer the string.

III. Analysis

This Algorithm has a O(n^2) complexity.The states array is calculated by iterating i from n-1 to 0 and j from 0 to i.

Complexity = O(n * (n-1)/2) ~ O(n^2)

Similarly the cost for calculating cost DP is ~O(n^2) .

Therefore overall complexity of the algorithm is

O(n^2) .