ECSE210L: Design and Analysis of Algorithms

Lab 5 (Week 7: Feb, 17 - 21, 2020)

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1. 'X' and 'Y' are two army officers. Morse code is one of the traditional encryption technique used to transmit messages in military operation. it uses 'dots' and 'dashes' i.e. two types of signal based on the signal duration. Traditional approach has fixed codes designed for each alphabet and numbers. Encryption optimizes space utilization as well as provide easier way to communicate in restricted environment. 'X' and 'Y' decided to use another traditional technique to communicate. Similar to Morse code in this technique they use variable length binary codes based on the frequency of the character, i.e. if the frequency of character is high then less number of bits are assigned to code that character.

   they used following code to get the frequency of the characters:

   'A greedy algorithm is any algorithm that follows the problem-solving heuristic of making the locally optimal choice at each stage with the intent of finding a global optimum. In many problems, a greedy strategy does not usually produce an optimal solution, but nonetheless a greedy heuristic may yield locally optimal solutions that approximate a globally optimal solution in a reasonable amount of time.

   For example, a greedy strategy for the travelling salesman problem (which is of a high computational complexity) is the following heuristic: 'At each step of the journey, visit the nearest unvisited city.' This heuristic does not intend to find a best solution, but it terminates in a reasonable number of steps; finding an optimal solution to such a complex problem typically requires unreasonably many steps. In mathematical optimization, greedy algorithms optimally solve combinatorial problems having the properties of matroids, and give constant-factor approximations to optimization problems with submodular structure.'

   Based on the frequencies binary prefix codes are assigned to each character to send messages. Definition of prefix code is explained below.

   prefix codes :

   codes in which no codeword is a prefix of any other codeword are called prefix codeword. for example: (a,b,c,d,e,and f) are coded as (0,101,100,111,1101, and 1100) respectively, any string (ex: 10101110101) can be uniquely decoded (decoded actual text 'badab').

   Design a greedy algorithm to generate codes for each character and decode it. code and decode following messages:

'team fall back'
'stick together with team'
'enemy spotted'
'you take the point'
'cover me'