Exercise

*Exercise Huffman compression (15 points)*

You are given a text file with the text below, which is made up of the characters **I** through **P**.

**IIKJIKLKIKKJKILNIPIKKIIOPIJKMPJLJLLKKKKIIMKKJJLJJPIOPKIINMI**

**MLPKNJLIJKLPOIMLJLPILIKLPKIKJPIOLPNIKPKKKLKPKKKPPKIIIKJLJII**

**LLKJJIKNPMLPMIOPPKKJIPJIJNIKLNOOONIPKLMKIJPNOMPPLIKLIILLKLK**

**IKKNLMIIKKIKJIIKKNLONKIMPKKIPKKJLOPPIJKKKKIJPLLJLLIIPJJKKNN**

**KMIKKNPJJKIKKMKKINILKNNKKJLLILNOKJPNNJKLJLLPMNLOLMPLLIKNIOI**

**MNNIILMKKKKIIMNIKJILNKLMLKLJLLPMNLOLMPLLIKNIOIMNNIILMKKKKII**

**MNIKJILNKLML**

a)  How many bits are needed to encode this file given the optimal fixed-length encoding?

The number of unique characters is 8. So we multiply the l(8) to the total number of characters which is 366.

The answer is 1464.

b)  Compile and write down a list of the counts of each character.

'I': 73, 'K': 87, 'J': 37, 'L': 59, 'N': 33, 'P': 36, 'O': 16, 'M': 25

c)  Using that list, draw the Huffman encoding tree that would result.

A diagram of a organization chart

Description automatically generated

d)  Write down a list of the characters and each one’s Huffman variable-length encoding.

I = 11

J = 101

K = 01

L = 000

M = 1001

N = 0010

O = 1000

e)  How many bit s are needed to encode the file using the Huffman variable-length encoding?

I = 73 x **3 = 219**

J= 37 x 5 = 185

K = 1 X 87 = 87

L= 0 x 59 =0

M= 9x25= 225

N= 2 x 33 = 66

O= 8 x 16 = 128

Total = 910

f)  What is the compression ratio? Recall that this is the number of bits in the Huffman encoding

divided by the number of bits in the fixed-length encoding.

910/1464 = 0.62