

Quiz 5

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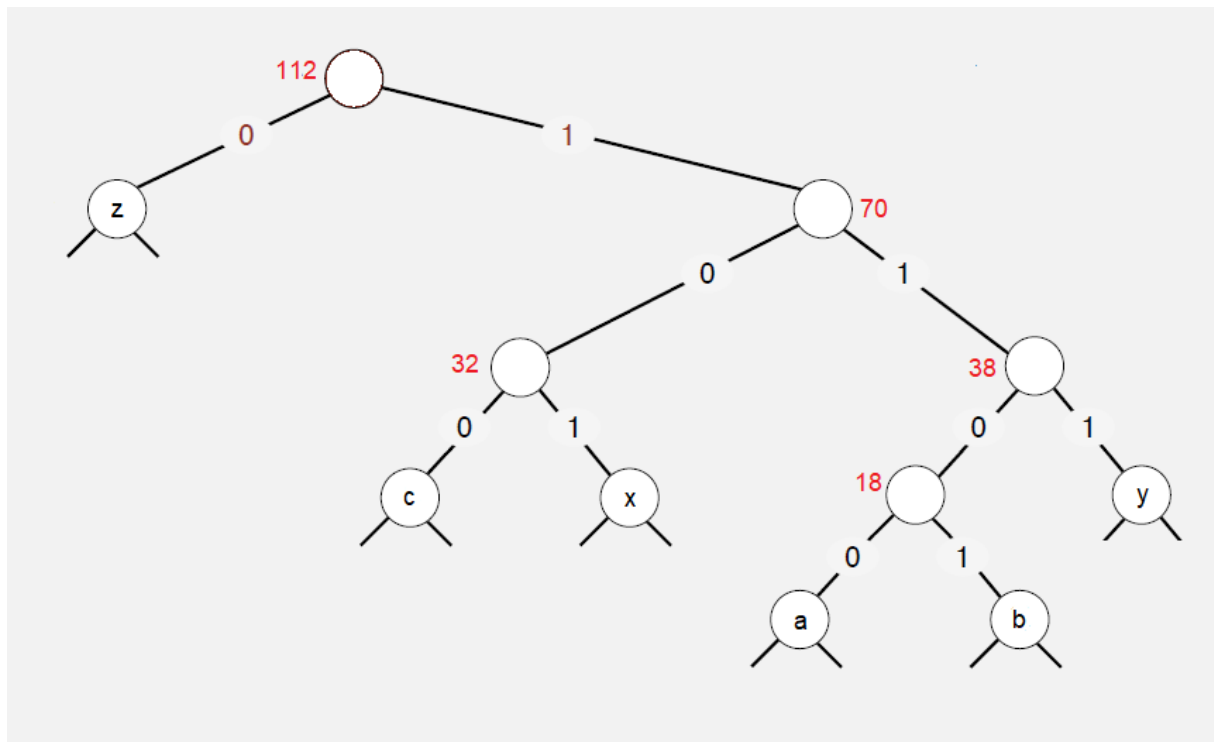
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Q1

Creating tree:

- a and b have minimum frequency. Merge into a tree with $7+11 = 18$ frequency.
- c and x have minimum frequency. Merge into a tree with $14+18 = 32$ frequency.
- a-b tree and y have minimum frequency. Merge into a tree with $18+20 = 38$ frequency.
- c-x tree and (a-b)-y tree have minimum frequency. Merge into a tree with $32+38 = 70$ frequency.
- z and (c-x)-((a-b)-y) tree have minimum frequency. Merge into a tree with $42+70 = 112$ frequency.

We created our tree as below:



From the tree, we encoded our variables to these values:

z = 0

c = 100

x = 101

y = 111

a = 1100

b = 1101

Number of bits: $112 \cdot 16 = 1792$

Number of bits with new transmission:

$$4 \cdot 7 + 4 \cdot 11 + 3 \cdot 14 + 3 \cdot 18 + 3 \cdot 20 + 1 \cdot 42 = 28 + 44 + 42 + 54 + 60 + 42 = 270$$

We saved 1522 bit.

Q2

Our string: "rmmnnnnntttt"

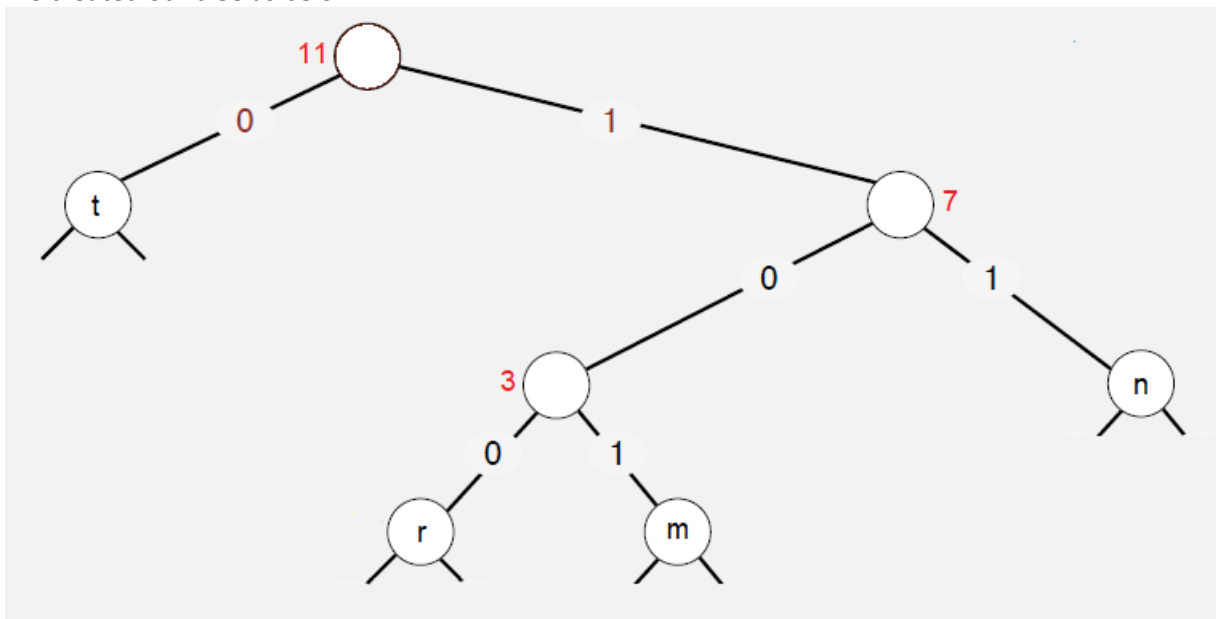
Frequencies:

r = 1 m = 2 n = 4 t = 4

Creating tree:

- r and m have minimum frequency. Merge into a tree with $1+2 = 3$ frequency.
- r-m tree and n have minimum frequency. Merge into a tree with $3+4 = 7$ frequency.
- (r-m)-n tree and t have minimum frequency. Merge into a tree with $7+4 = 11$ frequency.

We created our tree as below:



From the tree, we encoded our variables to these values:

t = 0

n = 11

r = 100

m = 101

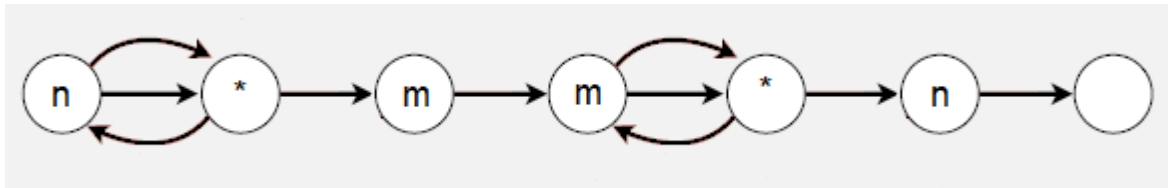
We need $1*3 + 2*3 + 4*2 + 4*1 = 3+6+8+4 = 21$ bits to transmit this message via Huffman encoding.

<u>100</u>	<u>101</u>	<u>101</u>	<u>11</u>	<u>11</u>	<u>11</u>	<u>11</u>	<u>0</u>	<u>0</u>	<u>0</u>
r	m	m	n	n	n	n	t	t	t

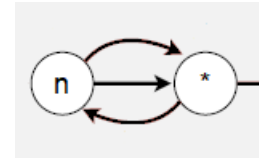
Average bits per character is $(1+2+3+3)/4 = 9/4 = 2,25$.

Q3

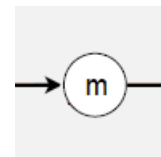
Regular expression: "n*m+n" or "n*mm*n"



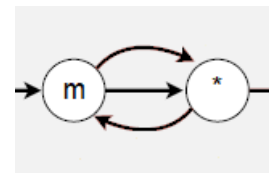
- Firstly, traverse "n" letters if exists.



- Secondly, get first "m" letter.



- Thirdly, traverse "m" letters if exist.



- Finally, get last "n" letter. Thus we found our "mn" substring.

