Huffman Coding

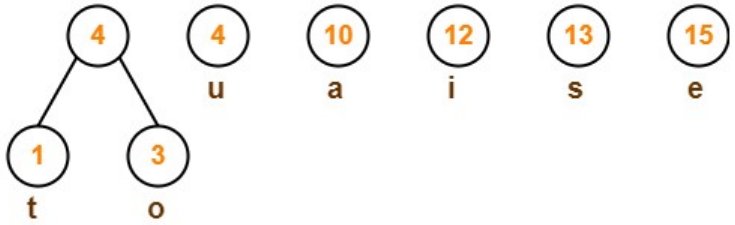
A file contains the following characters with the frequencies as shown.
If Huffman Coding is used for data compression,

Determine-
Huffman Code for each character
Average code length
Length of Huffman encoded message (in bits)

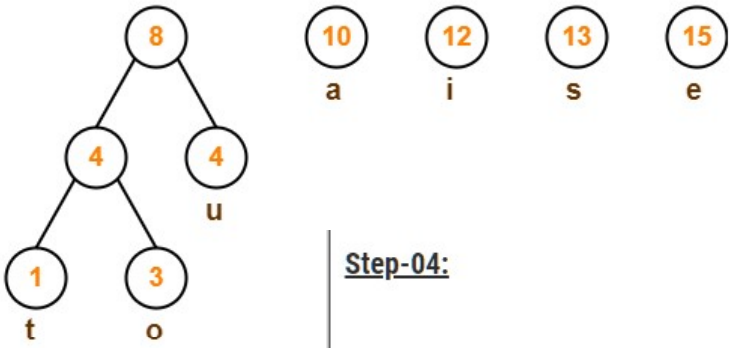
Characters	Frequencies
a	10
e	15
i	12
o	3
u	4
s	13
t	1

Step-01:

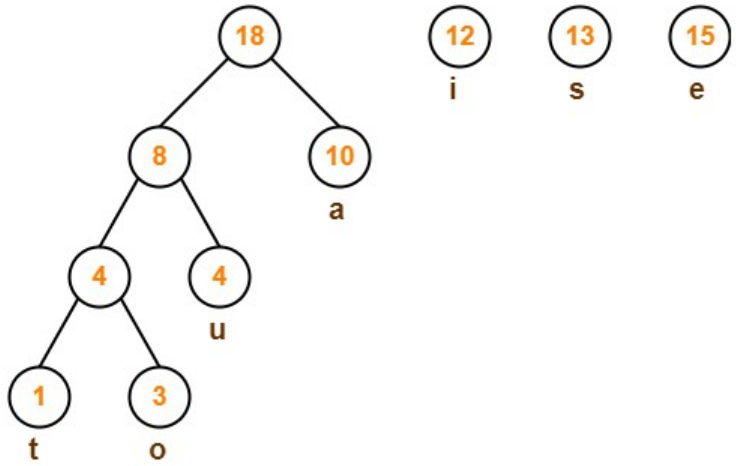
Step-02:



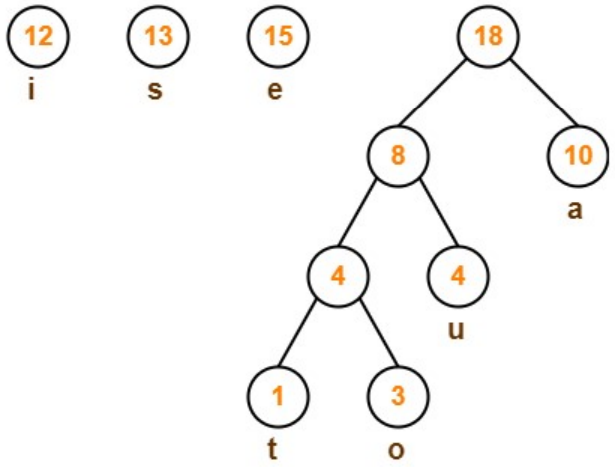
Step-03:

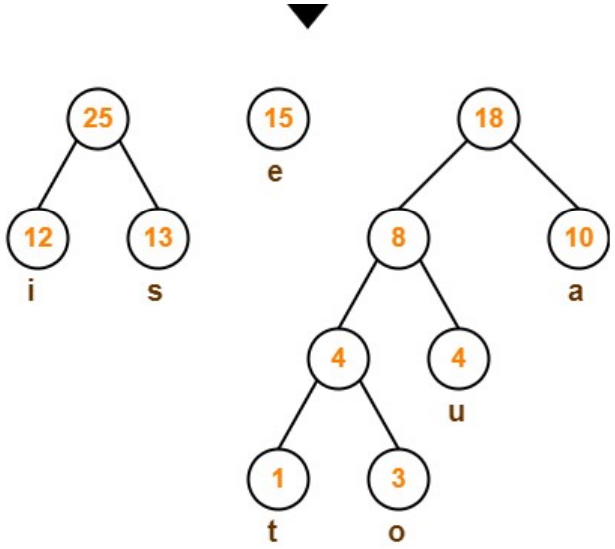


Step-04:

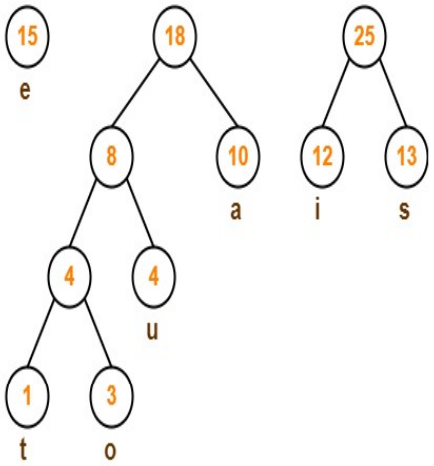


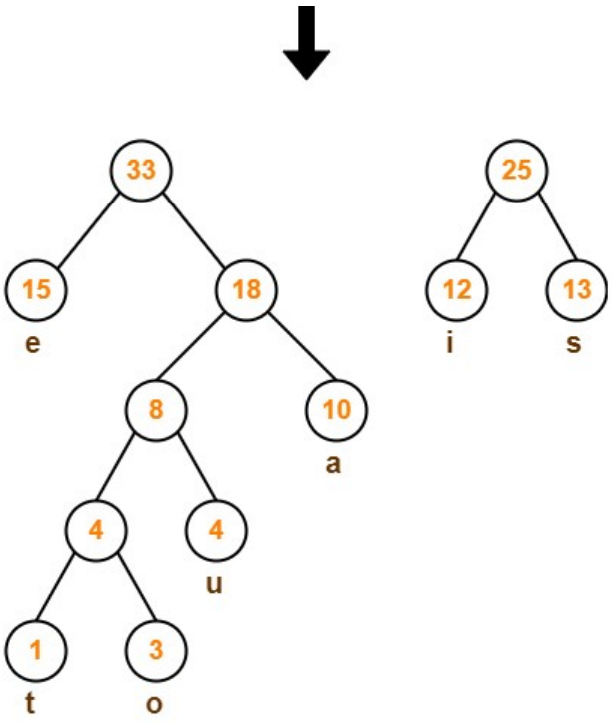
Step-05:



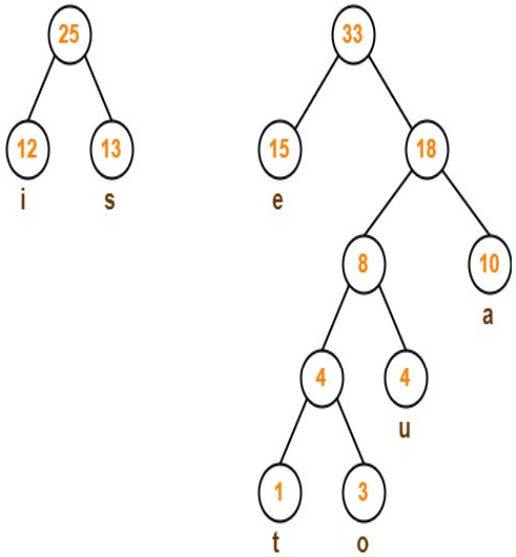

25
12
13
i
s
15
e
18
8
10
a
4
4
u
1
3
t
o

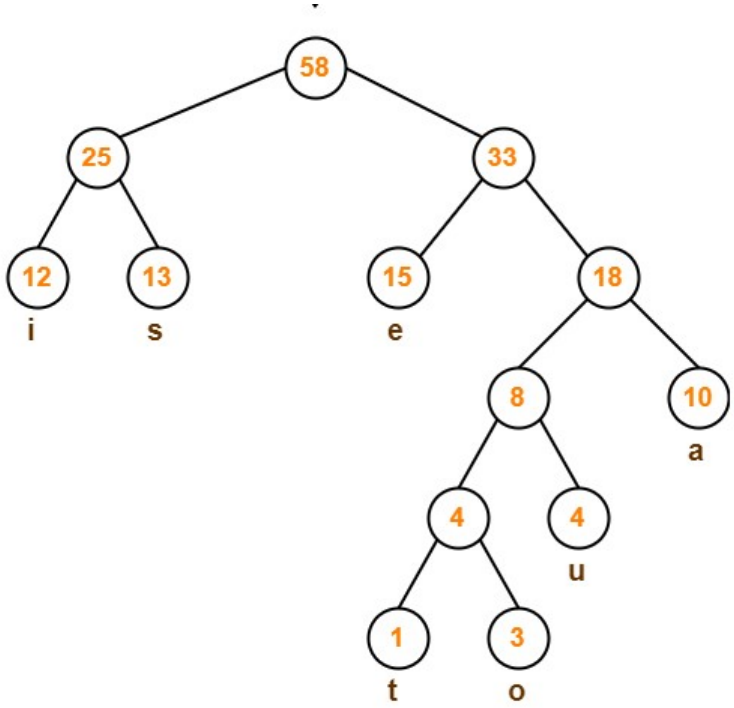
Step-06:


15
e
18
8
10
a
4
4
u
1
3
t
o
25
12
13
i
s


33
15
e
18
8
10
a
4
4
u
1
3
t
o
25
12
13
i
s

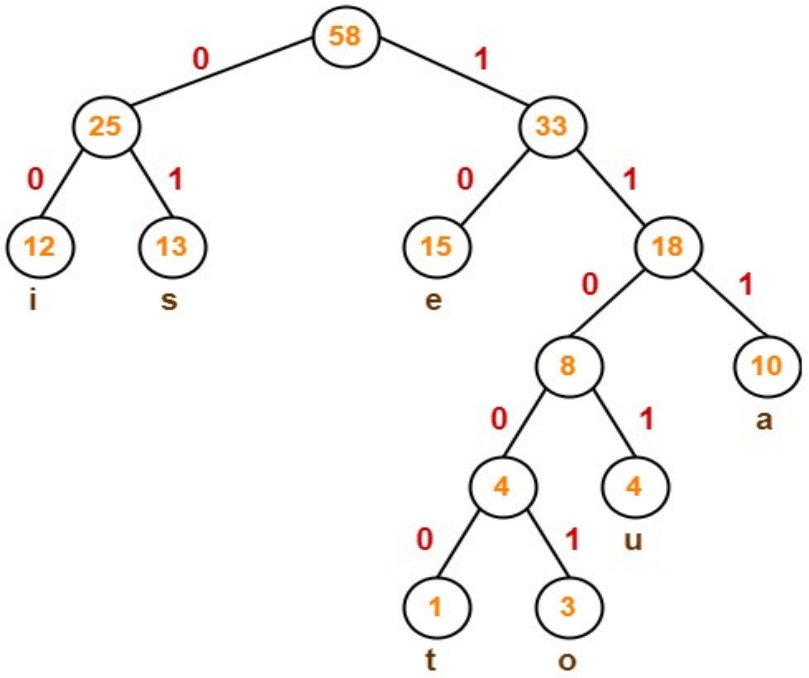
Step-07:





Huffman Tree

er assigning weight to all the edges, the modified Huffman Tree is-



Huffman Tree

Following this rule, the Huffman Code for each character is-

- a = 111
- e = 10
- i = 00
- o = 11001
- u = 1101
- s = 01
- t = 11000

From here, we can observe-

- Characters occurring less frequently in the text are assigned the larger code.
- Characters occurring more frequently in the text are assigned the smaller code.

Following this rule, the Huffman Code for each character is-

- a = 111
- e = 10
- i = 00
- o = 11001
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- s = 01
- t = 11000

From here, we can observe-

- Characters occurring less frequently in the text are assigned the larger code.
- Characters occurring more frequently in the text are assigned the smaller code.

2. Average Code Length-

Using formula-01, we have-

Average code length

$= \sum (\text{frequency}_i \times \text{code length}_i) / \sum (\text{frequency}_i)$

$= \{ (10 \times 3) + (15 \times 2) + (12 \times 2) + (3 \times 5) + (4 \times 4) + (13 \times 2) + (1 \times 5) \} / (10 + 15 + 12 + 3 + 4 + 13 + 1)$

$= 2.52$

3. Length of Huffman Encoded Message-

Using formula-02, we have-

Total number of bits in Huffman encoded message

= Total number of characters in the message x Average code length per character

= 58 x 2.52

= 146.16

≅ 147 bits