

8. Compressed Trees

PROBLEM: Given a character string, calculate a compressed representation, create its binary tree representation and determine the path of a given letter. Use the procedure below to calculate the compressed representation.

1. Calculate the frequency of each letter and build a frequency list. Each term of the list is the frequency of the letter followed by the letter. The frequency list is kept in ascending order based on frequency and in alphabetical order within each frequency. See the list below.
2. Add the first 2 frequencies in the list. Add the 2 frequencies and attach the letters keeping all of them in alphabetical order. For example, combining the strings 2EK and 3AT would become 5AEKT.
3. Delete these two terms from the list.
4. Add the new frequency term to the list using the rules above. 2EH was inserted between 2AD and 2O so as to keep the list in frequency order and alphabetical order within that frequency.
5. Repeat from Step 2 until there is just one frequency in the list.

EXAMPLE: Consider the string HELLOAWORLD. The initial frequency list has 8 terms:

1A 1D 1E 1H 1R 1W 2O 3L

The algorithm works as follows:

Delete 1A and 1D, and insert 2AD into the list: 1E 1H 1R 1W **2AD** 2O 3L

Delete 1E and 1H, and insert 2EH into the list: 1R 1W 2AD **2EH** 2O 3L

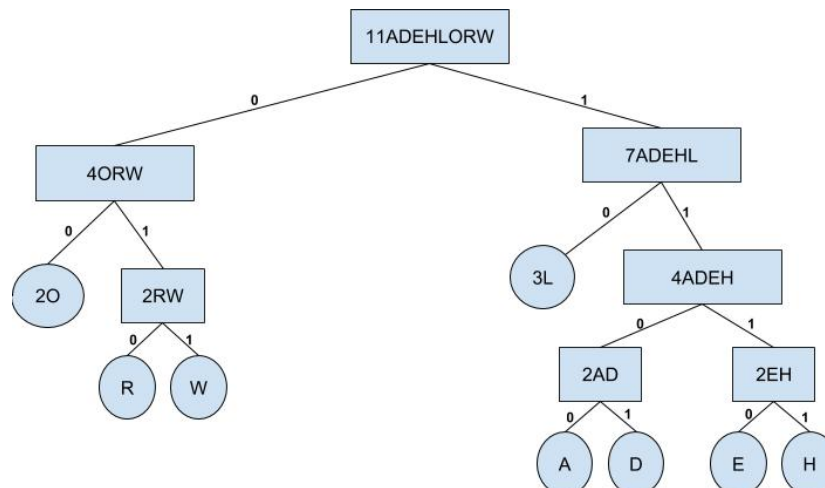
Delete 1R and 1W, and insert 2RW into the list: 2AD 2EH 2O **2RW** 3L

Delete 2AD and 2EH, and insert 4ADEH into the list: 2O 2RW 3L **4ADEH**

Delete 2O and 2RW, and insert 4ORW into the list: 3L 4ADEH **4ORW**

Delete 3L and 4ADEH, and insert 7ADEHL into the list: 4ORW **7ADEHL**

Delete 4ORW and 7ADEHL, and insert 11ADEHLORW into the list: **11ADEHLORW**



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The above binary tree can be constructed from the procedure above. Working backwards the root of the tree is the compression factor 11ADEHLORW. It was formed by the 4ORW and 7ADEHL. 7ADEHL was formed by 3L and 4ADEH. All of the other branches are placed in a similar manner from the procedure above keeping the left-right order in which they were combined. Then each letter can be represented by a unique set of bits by following the paths of the tree from the top. Note that the path to the left child is always labeled 0 and the path to the right child is always labeled 1. W = 011, O = 00 and E = 1110.

INPUT: There will be 10 lines of input. Each line will contain a character string and one character from that string.

OUTPUT: Print the compressed binary representation of the one character given on each input line.

SAMPLE INPUT

HELLOAWORLD W
ABCDEFHHHLLNNN D
ABCDGGGKKKKK G
LYAAEEGGPPP L
ABCDEFHHLLL A
ABCCDDEEFF C
AABBCCCCDDDDDEEEEEEEFFFFFFF B
ABCCGGGHHHKKKKK B
ABFFFGGGCCCC C
XAABBCCCCDDDKKKLLLL L

SAMPLE OUTPUT

1. 011
2. 1011
3. 10
4. 010
5. 1100
6. 111
7. 1111
8. 1001
9. 0
10. 01

8. Compressed Trees**TEST DATA****TEST INPUT****TEST OUTPUT**

PQRWZZTTTAAAAA P

1. 1000

ABCDEFHHKKLLGGMMMZZZZZZZZZZ F

2. 10101

HKLNAAJJJPPPPXXXXXZZZZZZZZZZ K

3. 10011

ACEGLMPQBBBXXXXXZZZZZZZZZZ L

4. 0000

AKRTBBBCCCCDDDDMMMMMM D

5. 01

ABFFGGKKKZZZZXXXXXQQQQQQQQQ F

6. 1001

ABCCDDEEEGGGG A

7. 1000

AGKNQTBLLCCC C

8. 01

PKKHHHAAAAAAXXXXXXGGGGGGGRRRRRRRRR P

9. 11110

DKPTAAMMCCCFFFFFSSSSSS T

10. 0011

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