

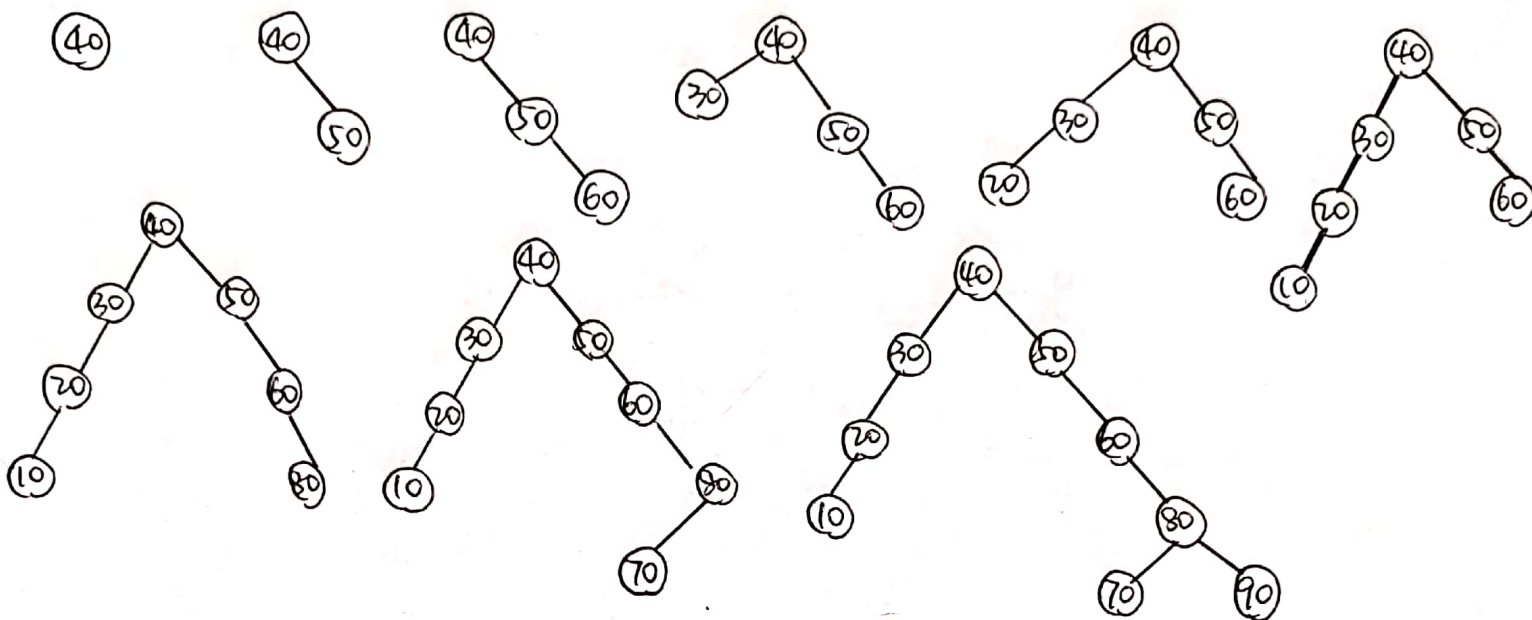
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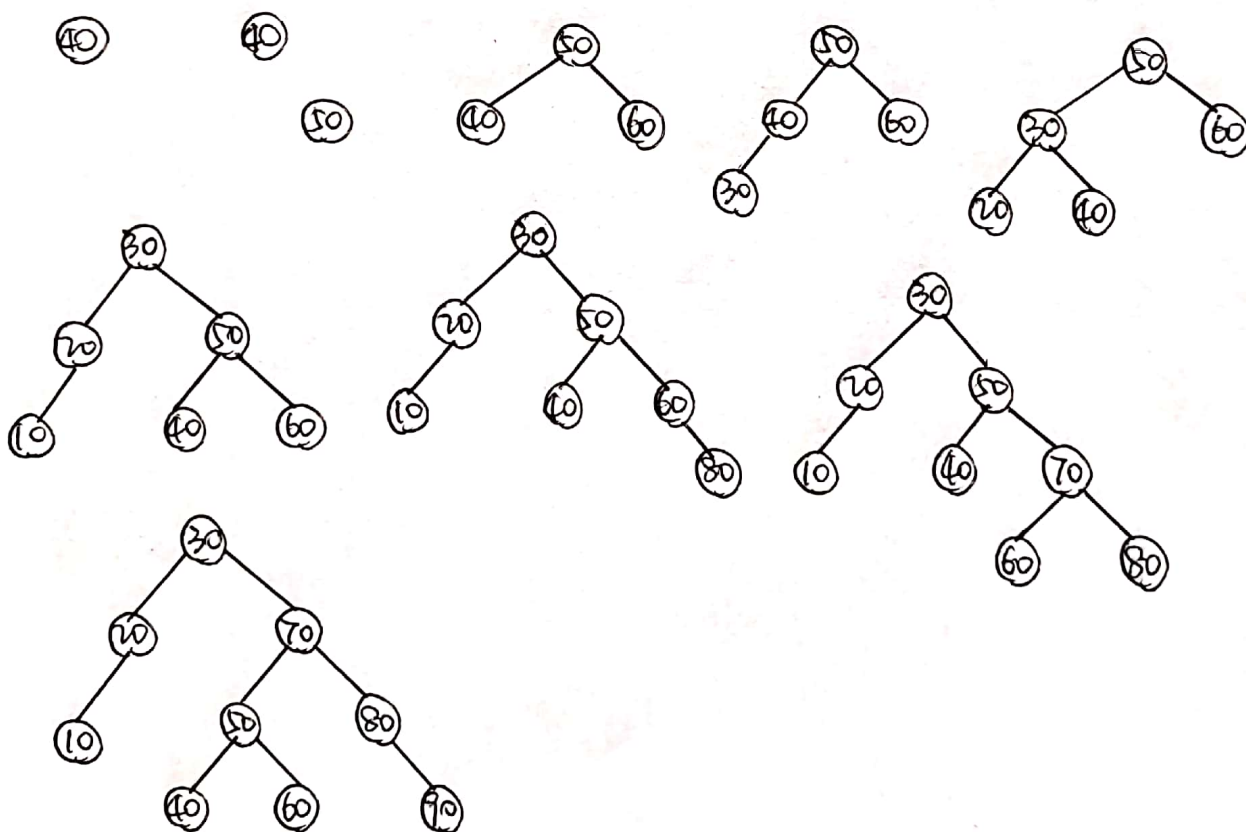
Ximan Liu.

Question 1 Tree drawings.

a. Binary search trees:

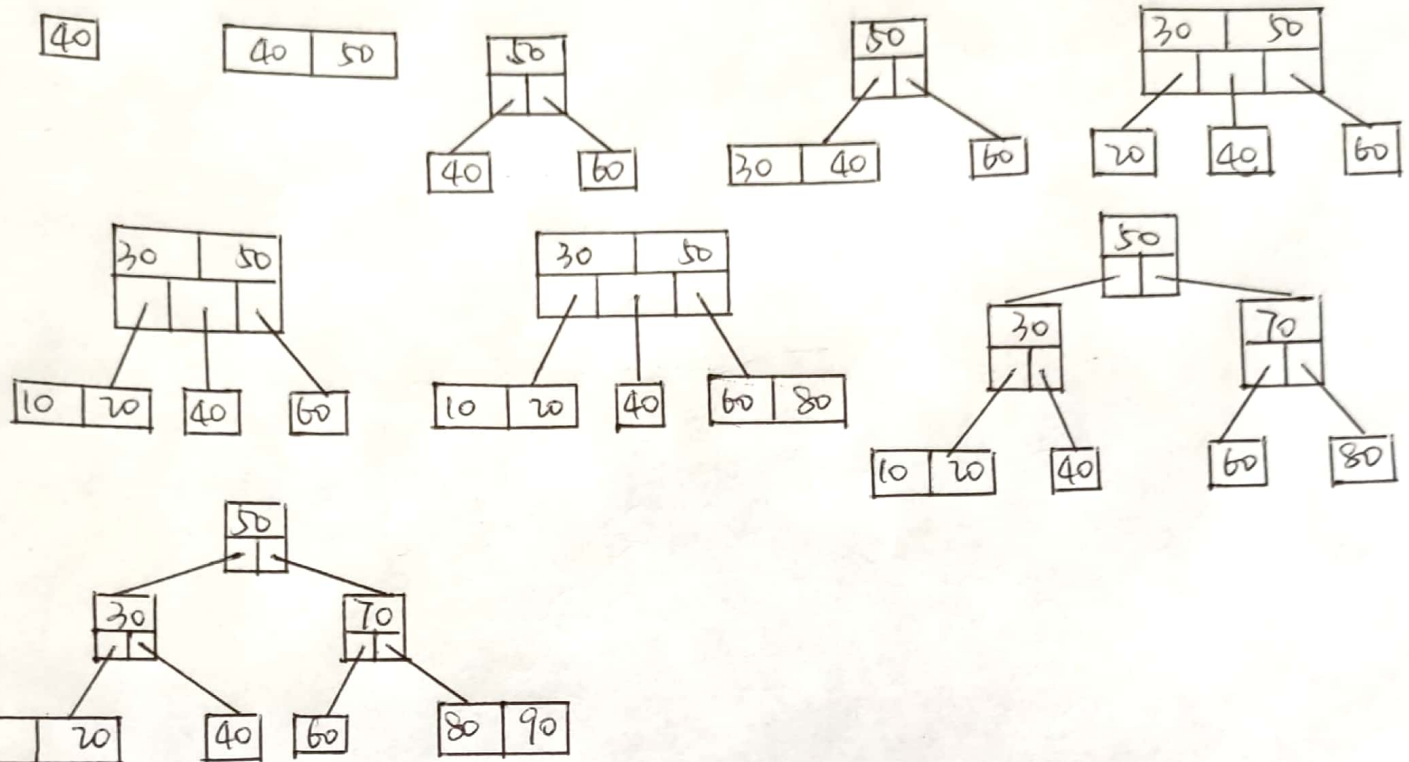


b. AVL trees:

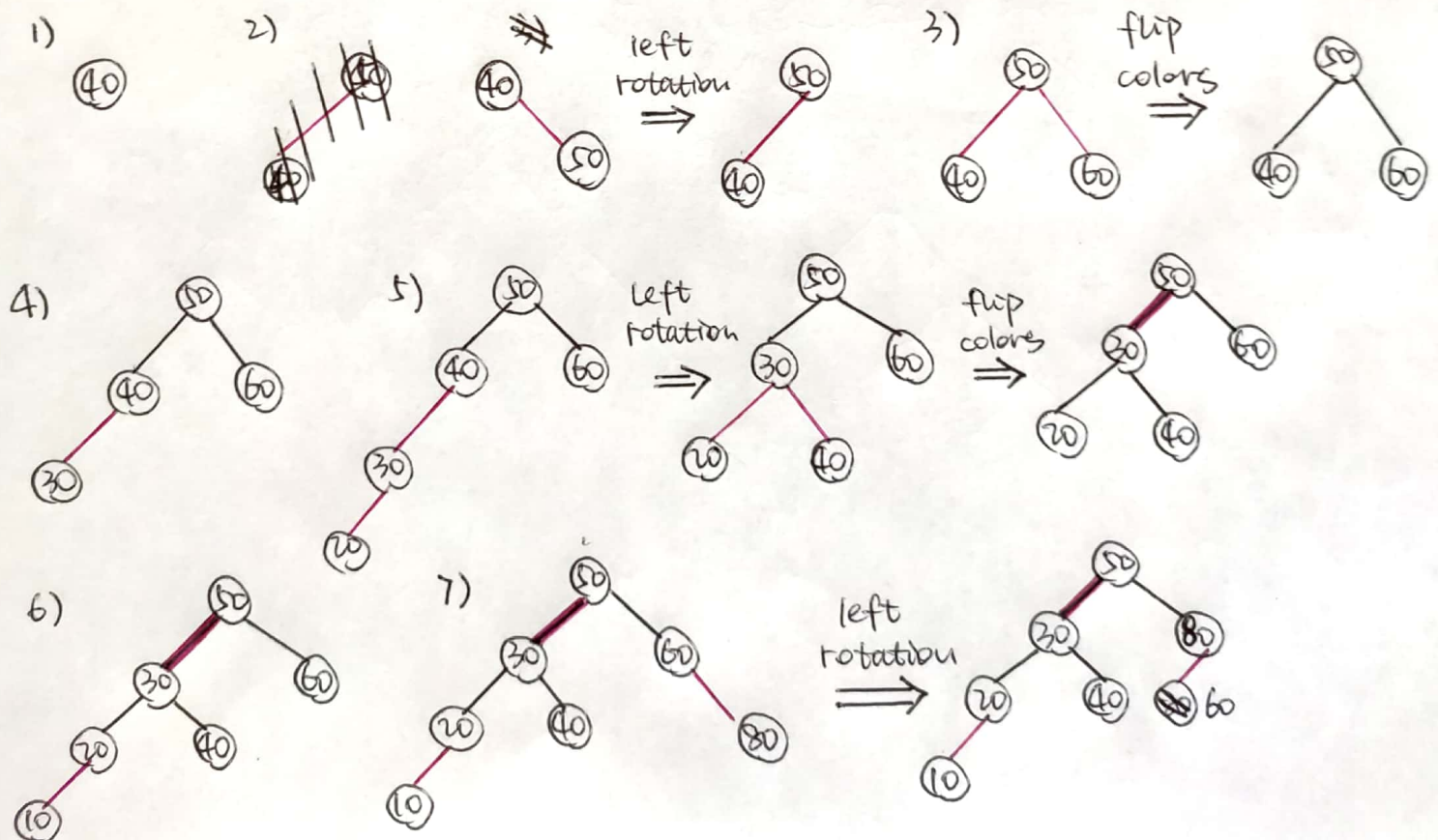


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c. 2-3 trees:



d. Left-leaning red-black trees:

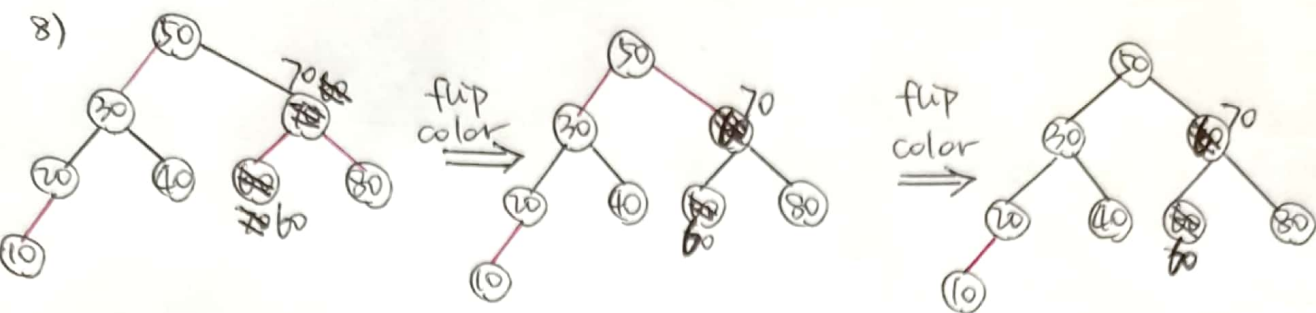


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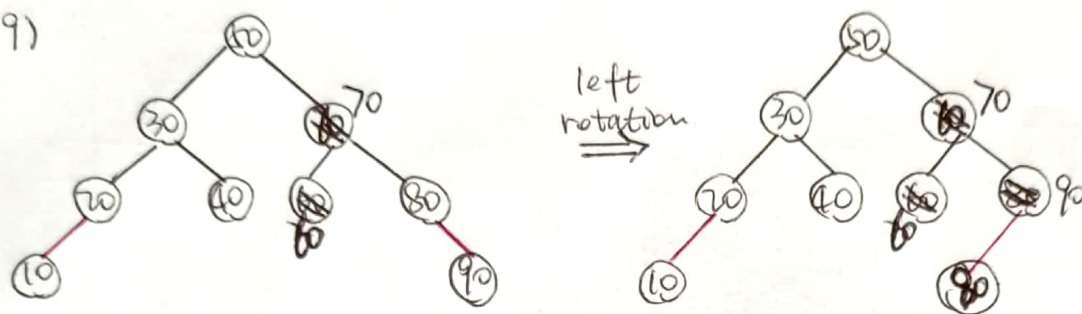
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8)

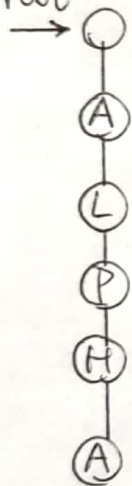


9)

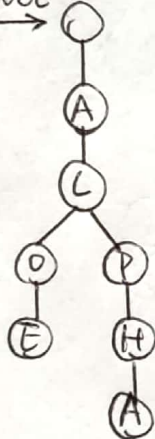


Question 2 Trie drawings:

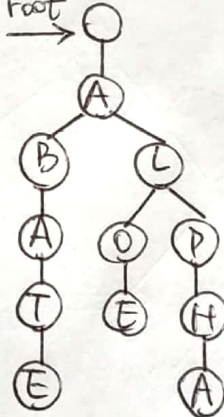
1) alpha
root



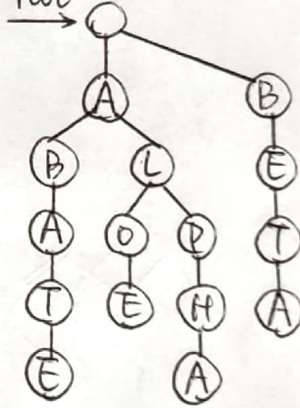
2) alone
root



3) abate
root

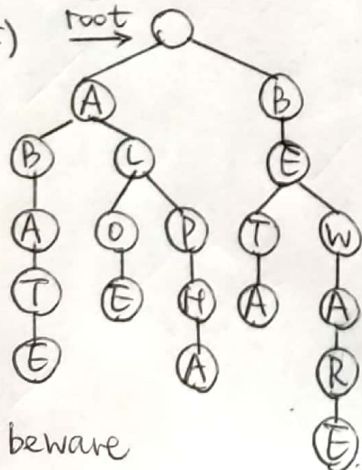


4) beta
root



5)

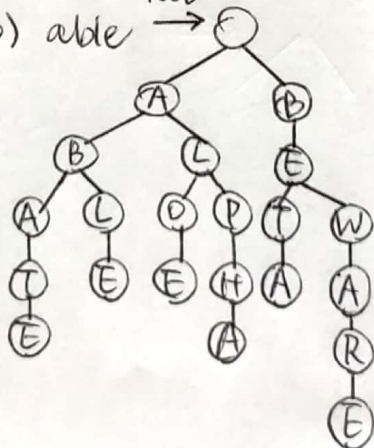
root



beware

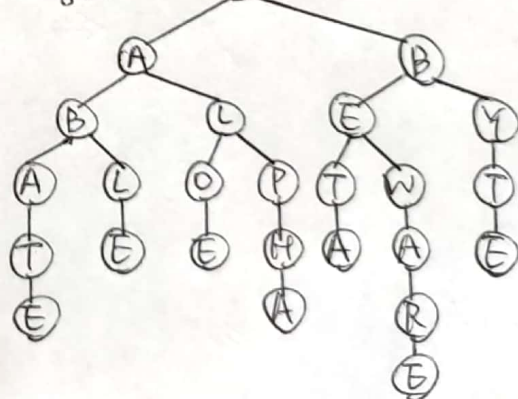
6) able

root

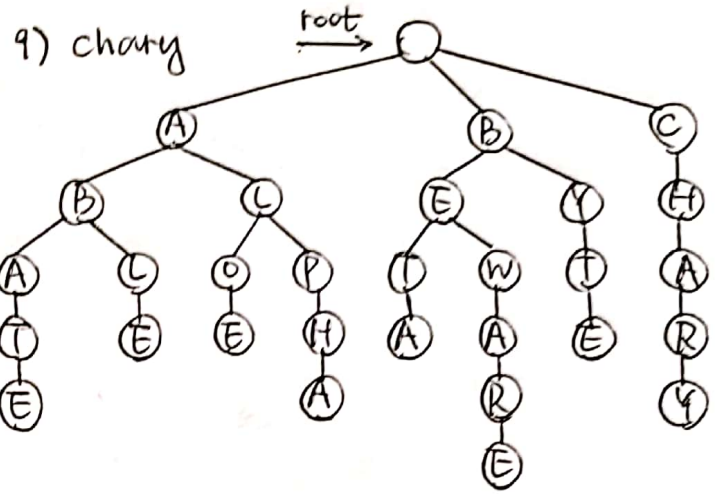
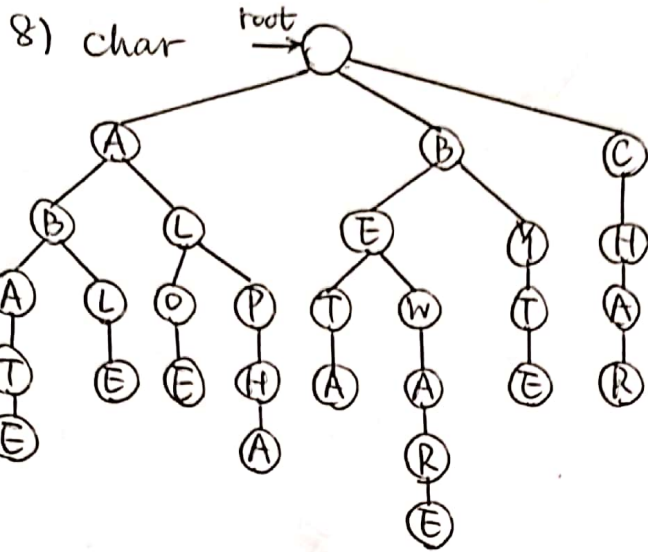


7) byte

root



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Question 3 Hash tables:

a.	hash value when table size is 43
"turing"	26
"Turing"	39
"tUring"	7
"tuRing"	24
"turIng"	19
"turing"	23
"turing"	37
"hopper"	12
"Hopper"	25
" h opper"	36
"hopper"	10
"hopPer"	5
"hoppEr"	9
"hopper"	23

hash value when table size is 47
32
36
20
21
18
27
0
30
34
18
19
16
25
45

b. Total number of collisions that would occur in tables of size 43 and 47 is 2.

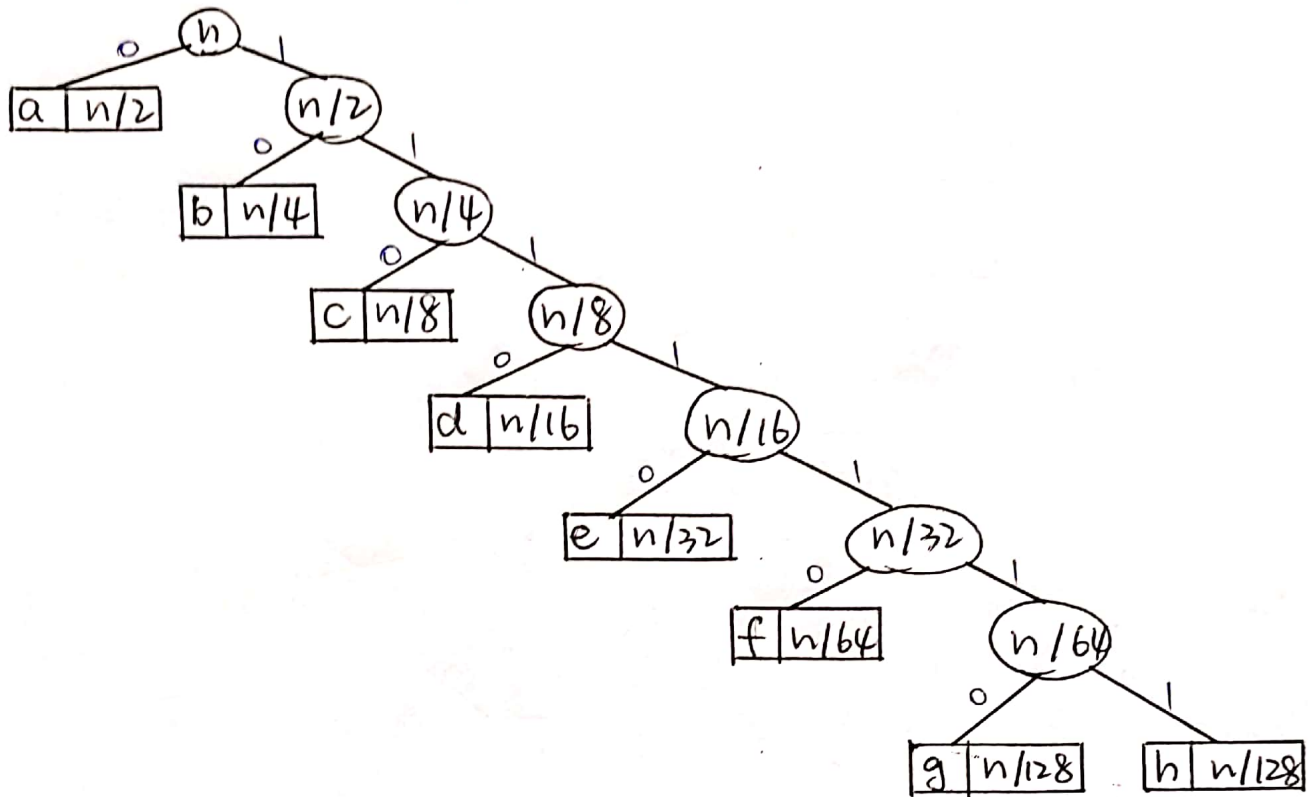
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Question 4 Huffman compression:

a)



b) Letter Code

b	10
g	1111110
h	1111111
d	1110
f	111110
e	11110
a	0
c	110

c) Huffman coding:

$$2 \text{ bits} \times \frac{n}{4} + 7 \times \frac{n}{128} + 7 \times \frac{n}{128} + 4 \times \frac{n}{16} + 6 \times \frac{n}{64} + 5 \times \frac{n}{32} + 1 \times \frac{n}{2} + 3 \times \frac{n}{8} = \frac{127}{64} n$$

best fixed-length encoding scheme:

$$n \times 3 = 3n$$

difference:

$$3n - \frac{127}{64} n = \frac{65}{64} n$$

f