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Q.1.

1. Sort an array A = [12, 9, 5, 3, 2, 4] by using Quick sort.

Solution,

0	1	2	3	4	5
12	9	5	3	2	4

Suppose, pivot element A[0] = 12

12	9	5	3	2	4	+ ∞
pivot	p				q	

12 is greater than all element.

4 is smaller than 12. so swipe pivot element with 4.

4	9	5	3	2	12	+ ∞

Divide array into two partition,

12

4, 9, 5, 3, 2 ∞
p q

Suppose 4, pivot,

swipe 4 and 2 because they are under rule.

12

4 2 5 3 9 ∞
p q

12

4	2	3	5	9

∞

⇒

4	2	3	5	9	12	∞

Final sort is :

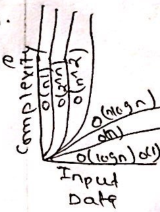
Q.2.

2. Explain different types of asymptotic notation used in analyzing algorithm.

Ans:- Asymptotic notation is used to describe the running time of an algorithm that means how much time an algorithm takes with a given input n. Types of assymptotic notation are:-

a) Big-O Notation:- (O):-

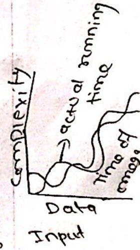
we compute the big-O of an algorithm by counting the number of iterations the algorithm always takes with an input of n. Big-O notation specially describes worst case scenario. It repeats the upper bound running time complexity of an algorithm. Eg:-



O(1) => Big O notation O(1) represents the complexity of an algorithm that always execute in same time or space regardless of input data.

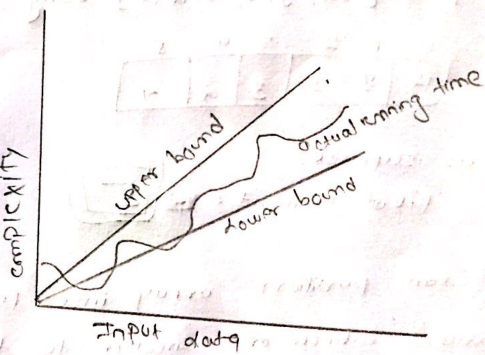
b) Omega Notation (Ω):-

Omega notation (Ω) describes the best case scenario. It represents the lower bond running time complexity of an algorithm. If we represent a complexity of an algorithm in omega notation, it means that the algorithm cannot be completed in less time than this, it would at-least take the time representeal by omega notation.



c) Theta (Θ) notation:-

Theta notation (Θ) describes the both upper bound and lower bound of an algorithm. In other word, we can say, it defines exact asymptotic behaviour. In the real case scenario the algorithm not always run on the best and worst case, the average running time lies between best and worst.



3.

Q.3.

Describe RAM (Random Access Machine) model of computation.

Ans:- The RAM model of computation is a model of computation that is commonly used when analyzing the algorithms. RAM stands for Random Access Machine not Random Access Memory and is not related with that RAM which is put on motherboard of computer and laptop. Model of computation simply states what operations your computer can do in a single instruction.

Some of the operations that the RAM Model assumes a computer can do in a single unit-cost instructions are:-

- Addition, substraction, multiplication, Division, exponentation.
- conditional statements.
- Loading and storing variables in memory.

Loops and functions are not considered unit-cost instructions. They are composed of multiple unit-cost instructions. The number of instructions will depend on how many times the loop executes or what the input is for the function.

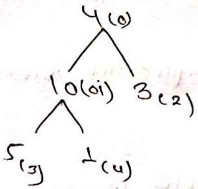
By using the RAM model, we can break our algorithm down into single unit-cost instructions. Then we count the number of instructions & we can use that as a measure for how fast our algorithm runs.

Q.4

4. with an Example, explain Heap sort.

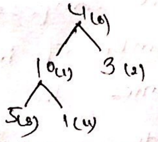
Ans: Heap sort is a comparison-based sorting technique based on Binary Heap Data structure. Heap sort is similar to selection sort where we first find the minimum element and place the minimum element at the beginning. To create a Heap tree, first of all build a max heap from the input data. Largest item is stored at the root of heap. Replace it with the last item of the heap following by reducing the size of Heap by 1.

Example:- Data :- 4, 10, 3, 5, 1.

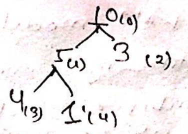


∴ The number in the bracket represents the indices in the array representation of data.

Now,
apply the heapify procedure to index 1.



And, Apply heapify procedure to index 0.



The heapify procedure calls itself recursively to build heap in top down no.

Q.5

Q.I: Compress the word "improvement" using Huffman Coding.

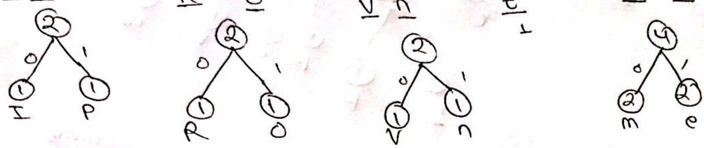
Ans:- Given word :-

"improvement"

Step 1:

I	P	R	O	V	n	t	m	e
1	1	1	1	1	1	1	2	2

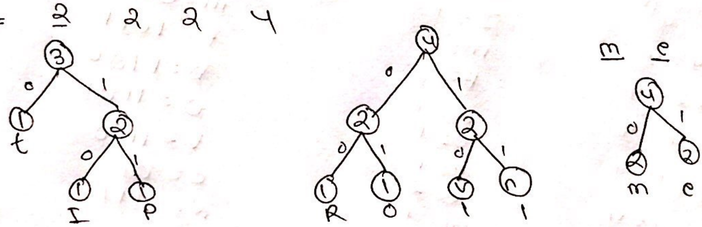
Step 2: I. P   R   O   V n   t   m e



we have new frequencies,

1 2 2 2 4

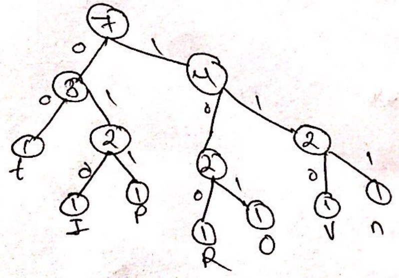
Step 3:



Again we have new frequencies,

3, 4, 4

Step 4:



Again,
we have 2 frequencies

7 and 4.

follow for part 5.

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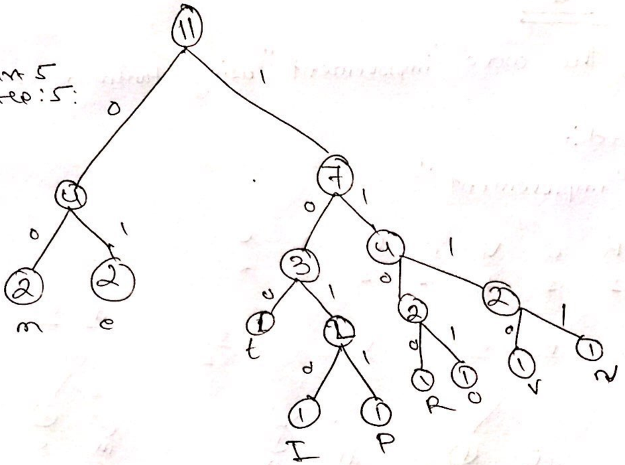
Part 5
Step: 5:



Here.

for length,

I : 1×4 = 4
m : 2×2 = 4
P : 1×4 = 4
R : 1×4 = 4
O : 1×4 = 4
V : 1×4 = 4
ε : 2×2 = 4
n : 1×4 = 4
t : 1×3 = 3

= 40

for frequency

I = 1
m = 2
P = 1
R = 1
O = 1
V = 1
e = 2
n = 1
t = 1

Path distance

I = 1010
m = 00
P = 1011
R = 1100
O = 1101
V = 1110
ε = 01
N = 1111
T = 100

Average length = $\frac{40}{11}$ = 3.6364