1) Given an array of [4, -2, 5, 3, 10, -5, 2, 8, -3, 6, 7, -4, 1, 9, -1, 0, -6, -8, 11] integers find the maximum and minimum product that can be obtained by multiplying two integers from the array.

Sol':

array is [4, -2, 5, 3, 10, -5, 2, 8, -3, 6, 7, -4, 1, 9, -1, 0, -6, -8, 11]

we need to consider the largest and smallest product that can be formed by selecting two numbers from the array

1) sort the array.

sorted array

[-8, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]

2) Identify possible candidates for maximum product

3) Identify possible candidates for minimum product.

calculating maximum product' -

* the two largest positive numbers are 10 and 11

$10 \times 11 = 110$

* the two smallest negative numbers are -9 and -8.

$-9 \times -8 = 72$

the maximum product is 110

calculating minimum product.

the largest positive and negative number is 11 and -9

$11 \times -9 = -99$

the smaller negative numbers are

$-9 \times -8 = 72$

-99 is smaller than 72 so

maximum product = 110, and minimum product = -99

2) Demonstrate the Binary search method to search for the key = 23 from the array = {2, 5, 8, 12, 16, 23, 38, 56, 72, 91}

Sol: given key = 23 and array = {2, 5, 8, 12, 16, 23, 38, 56, 72, 91}

Initialize pointers

low = 0 and high = 9

calculate mid = $\left\lfloor \frac{low + high}{2} \right\rfloor = \left\lfloor \frac{0+9}{2} \right\rfloor = 4$

compare arr[mid] with key

arr[4] = 16

Since 16 < 23 update low = mid + 1 = 5

calculate mid = $\left\lfloor \frac{low + high}{2} \right\rfloor = \left\lfloor \frac{5+9}{2} \right\rfloor = 7$

compare arr[mid] with key:

arr[7] = 56

Since 56 > 23 update high = mid - 1 = 6

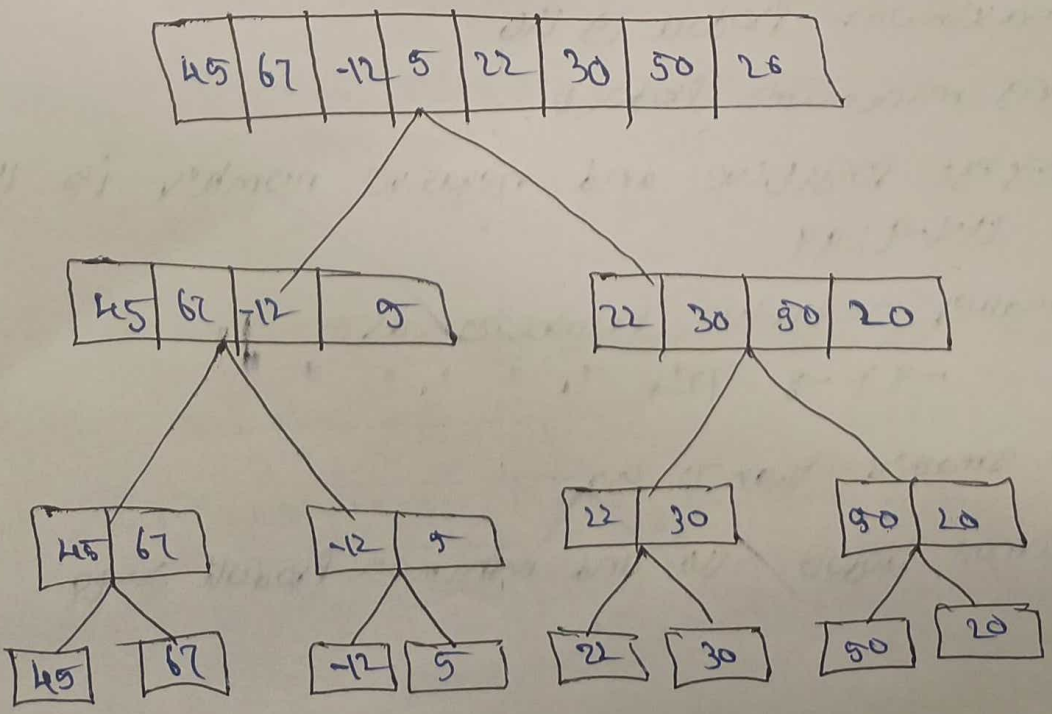
mid = $\left\lfloor \frac{5+6}{2} \right\rfloor = 5$

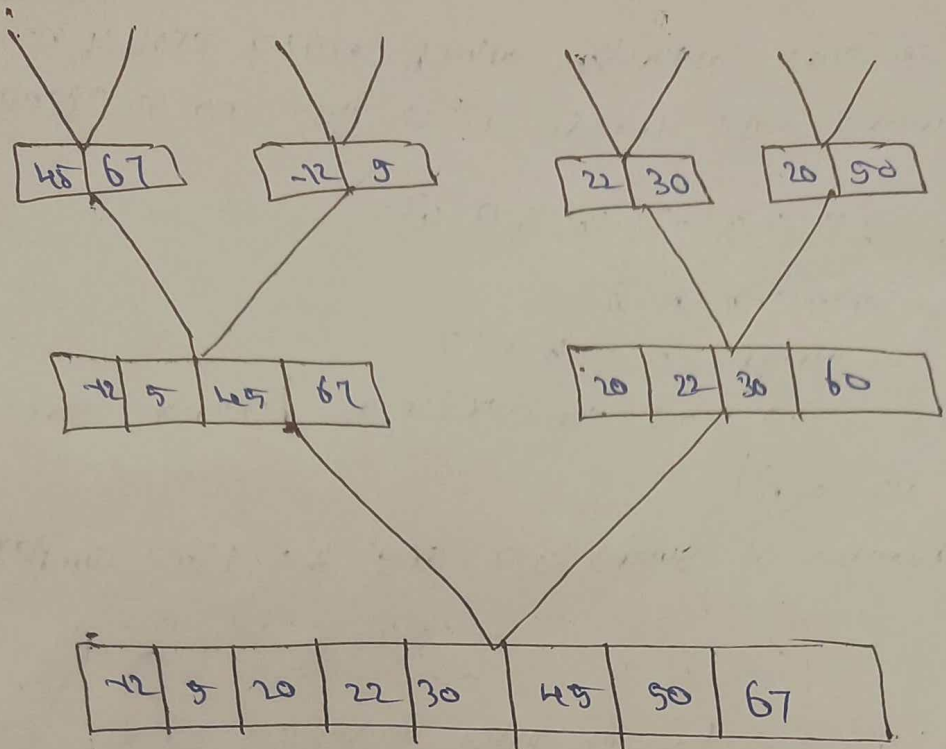
arr[mid] = arr[5] = 23

23 = 23 the key is found at index 5.

∴ the key = 23 is found at index 5.

3) Apply merge sort and offer list of 8 elements, d: [45, 67, -12, 5, 22, 30, 50, 20]. set up recurrence relation for the number of key comparisons made by mergesort.





∴ the sorted list = [-12, 5, 20, 23, 30, 45, 50, 67]

Recurrence Relation for comparison:

$$T(n) = 2T\left(\frac{n}{2}\right) + O(n)$$

if $n \leq 1$, $T(1) = 0$ - Base case

→ At each level of recursion we make at most $n+1$ comparison to merge two halves of size $n/2$ so it become

$$T(n) = 2T\left(\frac{n}{2}\right) + (n-1)$$

Solving recurrence relation we get

$$T(n) = n\log_2(n) - n + 1$$

$$T(n) = O(n \log n)$$

∴ the recurrence relation is $T(n) = 2T\left(\frac{n}{2}\right) + O(n)$

or more precisely

$$T(n) = n\log_2(n) - n + 1$$

4) find the no. of time to performs solving swapping for selection sort also estimate the time complexity for the order of rotation sets (12, 7, 9, -2, 18, 6, 3, 4)

the selection sort algorithm always makes exactly n-1 swaps in the worst case, where n is the no. of elements in the list

given s = {12, 7, 3, -2, 18, 6, 13, 4}.

No. of elements, n = 8

No. of swaps = n-1, 8-1 = 7

Time complexity:- The time complexity of selection sort in Big O notation is $O(n^2)$

So, the number of swaps is 7, and the time complexity is $O(n^2)$

5) find the index of the target value 10 using binary search from the following list of elements [2, 4, 6, 8, 10, 2, 14, 16, 18, 20]

Sol:-

given list = {2, 4, 6, 8, 10, 2, 14, 16, 18, 20} and value = 10

Low = 0 and high = 9

$mid = \frac{low + high}{2} = \frac{0+9}{2} = 4$

List(4) = mid = 10, mid = = value

since 10 = = 0 the target is found at index

∴ the target value = 0 is found at index