

Q_⇒ Given 2 sorted ^{→ asc} arrays, of length m and n .
Merge the 2 sorted arrays into a new single array
of length $(m+n)$ Such that the resultant array is
also sorted.

$$n \leq 10^5$$
$$m \leq 10^5$$

Ex → $[1, 5, 7, 9]$
 $[2, 3, 8, 11, 13, 15]$

ans → $[1, 2, 3, 5, 7, 8, 9, 11, 13, 15]$
2
asc

A →

0	1	2	3	4	5	6	7
1	3	8	9	13	19	20	22

$\Theta(m+n)$

B →

0	1	2	3	4	5
-1	6	13	14	15	18

x

j

C →

0	1	2	3	4	5	6	7	8	9	10	11	12	13
-1	1	3	6	8	9	13	13	14	15	18	19	20	22

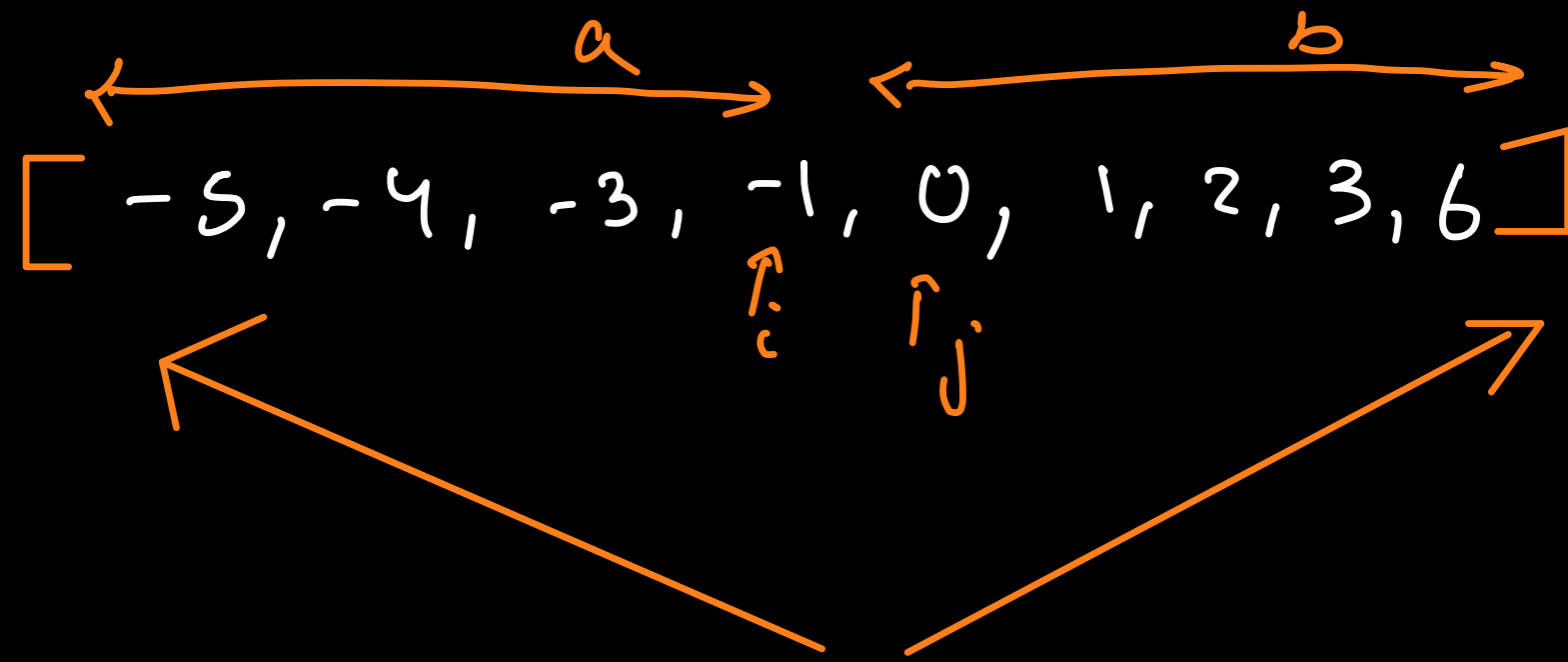
$k \leftarrow 17$

sorted

```

if ( A[i] <= B[j] ) {
    C[k] = A[i]
    i++ ; k++ ;
} else {
    C[k] = B[j]
    j++ ; k++ ;
}

```



$O(n)$

if ($abs(a[i]) \leq a[j]$)
 $c[k] = a[i];$
 $i++$
 $k++$

$[0, 1, 2, 3, 6]$

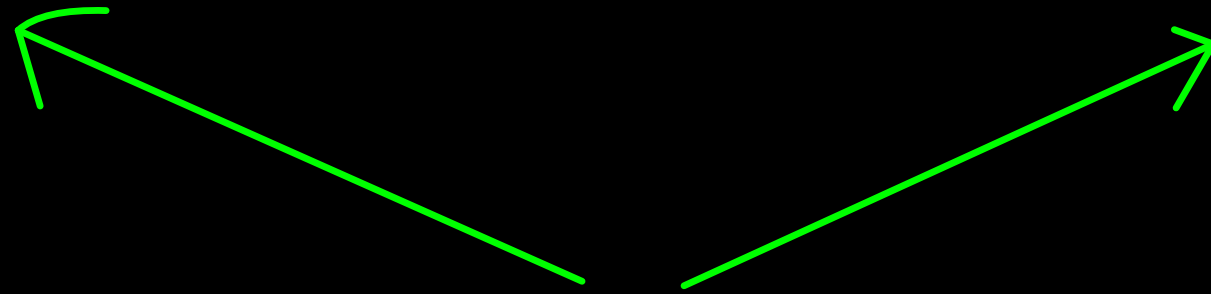
$[1, 3, 4, 5]$

$\hookrightarrow [0, 1, 1, 2, 3, 3, 4, 5, 6]$

$[0, 1, 1, 4, 9, 9, 16, 25, 36]$

$O(n)$

$2i$ $2j$
[-5, -4, -3, -2, 0, 1, 3, 4, 5]



if ($abs(a[i]) \geq abs(a[j])$)
 $c[k] = abs(a[i])$

$i++$

$k--$

$dec \leftarrow$

$c[k] = abs(a[j])$

$d--$

$k--$

}



merge & sort array

0	1	2	3	4	5	6	7	8	9
9	-1	3	6	2	8	11	13	4	1

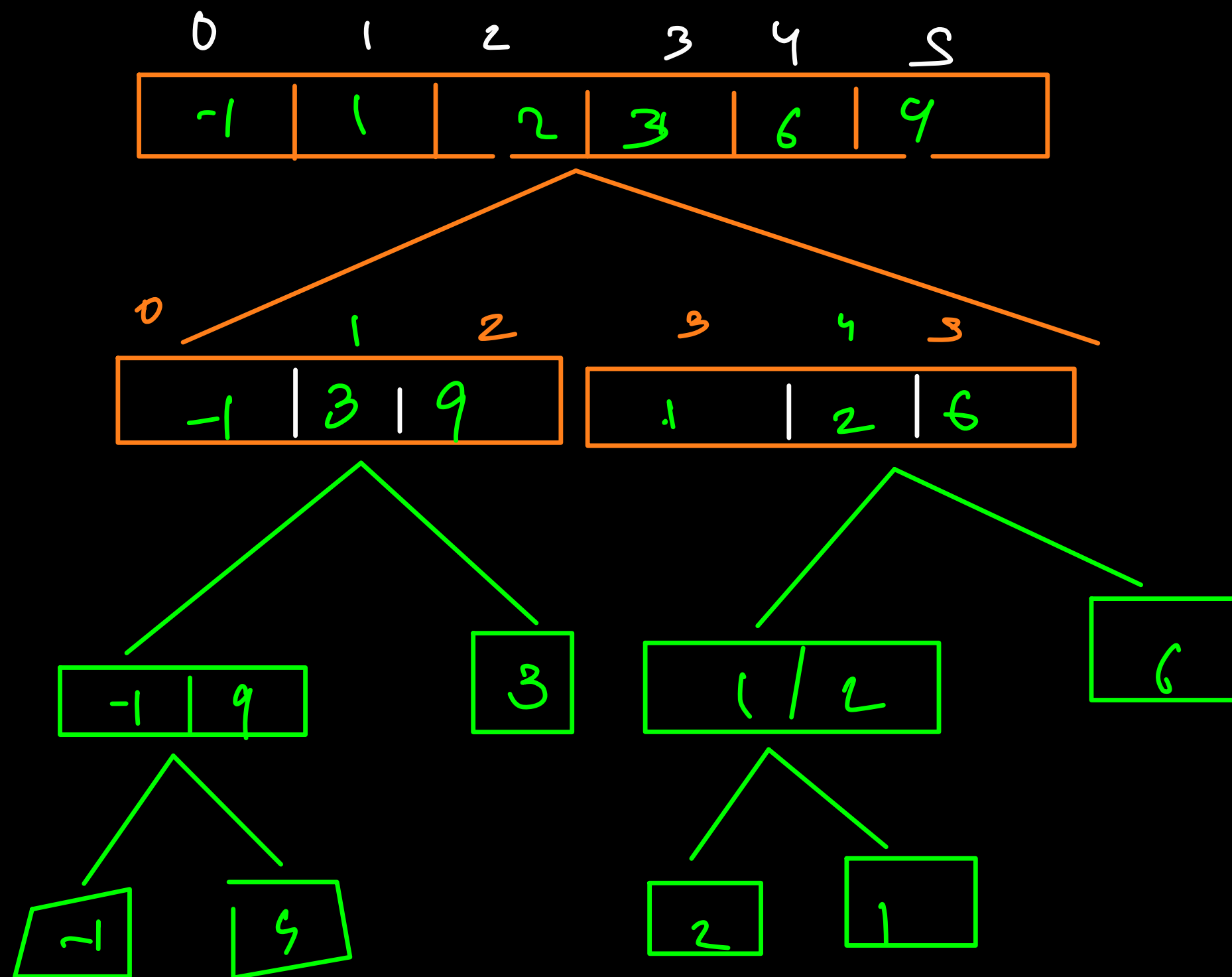
-1, 2, 3, 6, 9

1, 4, 8, 11, 13

merge sort

2
recursion
algo

- ↳ Recursively sort the left & right half
- ↳ merge the 2 sorted halves



$f(arr, i, j)$

2

merge sort on the
array in the

range (i, j)

=

$f(arr, i, mid)$

$f(arr, mid+1, j)$

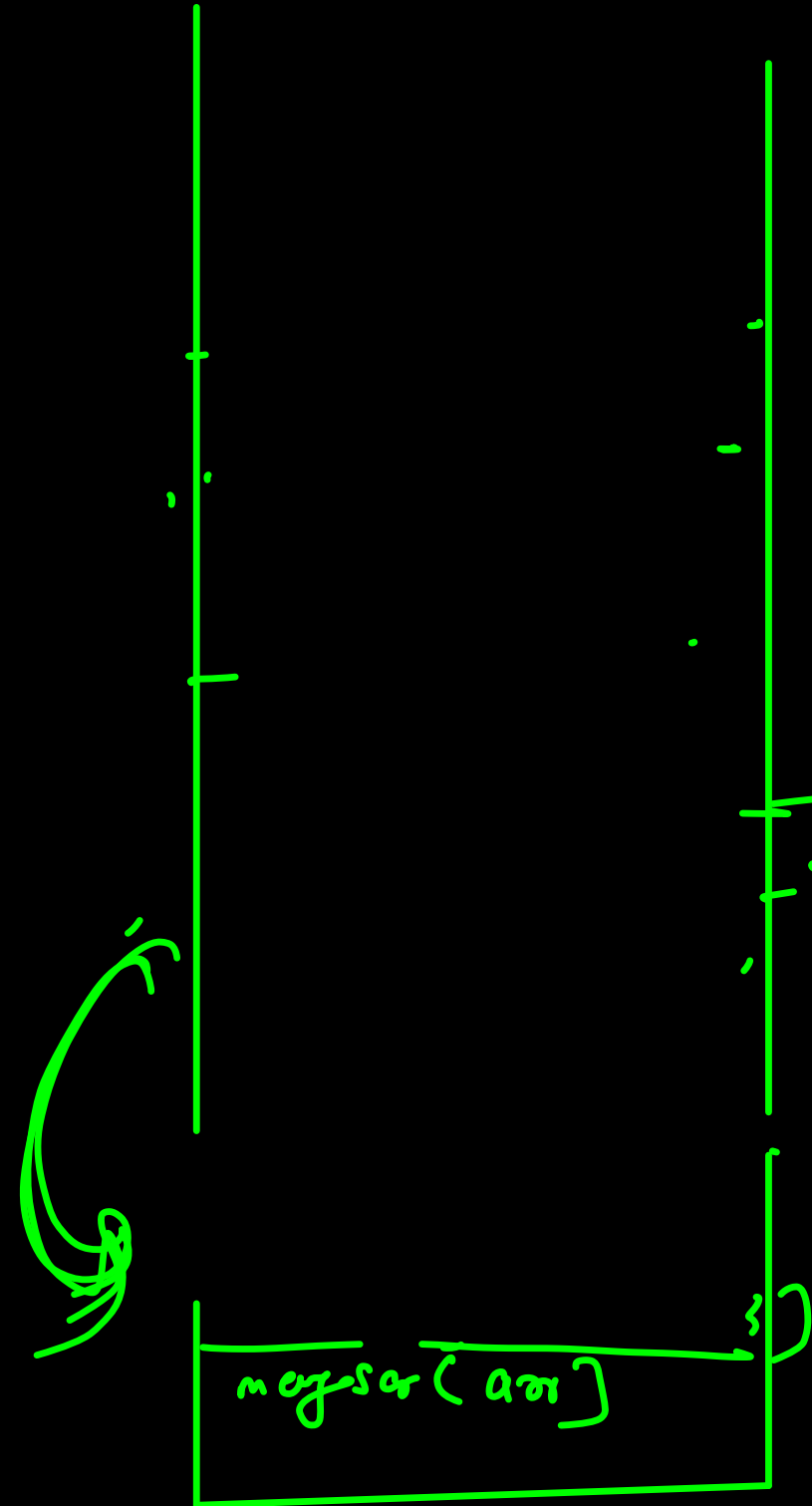
merge()



```
1  std::vector<int> f(std::vector<int> &arr, int i, int j) { // this returns a sorted array
2      if(i == j) {
3          // single length array
4          return std::vector<int> {arr[i]};
5      }
6      int mid = (i + j) / 2;
7      std::vector<int> left = f(arr, i, mid);
8      std::vector<int> right = f(arr, mid+1, j);
9      std::vector<int> result = mergeTwoSortedArrays(left, right);
10     return result;
11 }
12
13 void merge_sort(std::vector<int> &arr) {
14     arr = f(arr, 0, arr.size() - 1);
15 }
```


arr = [5, 4, 3, 2]

[2, 3, 4, 5]



Time $\rightarrow O(n \log n)$
Space $\rightarrow O(n)$

HW



i j
 $[2, 3, 8, 6, 1]$

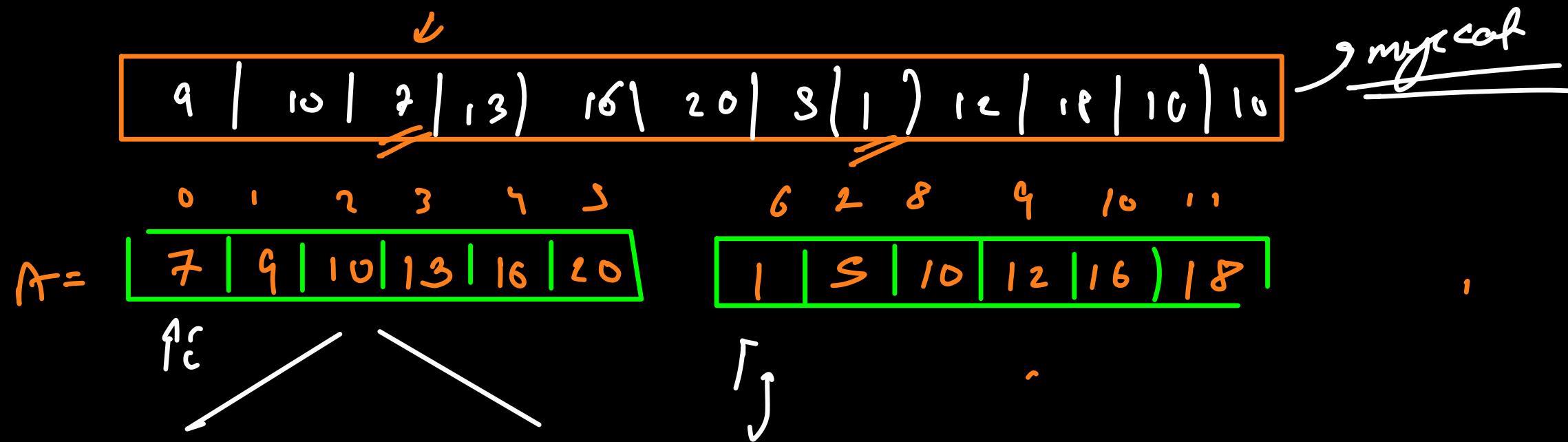
Count the total
inversions

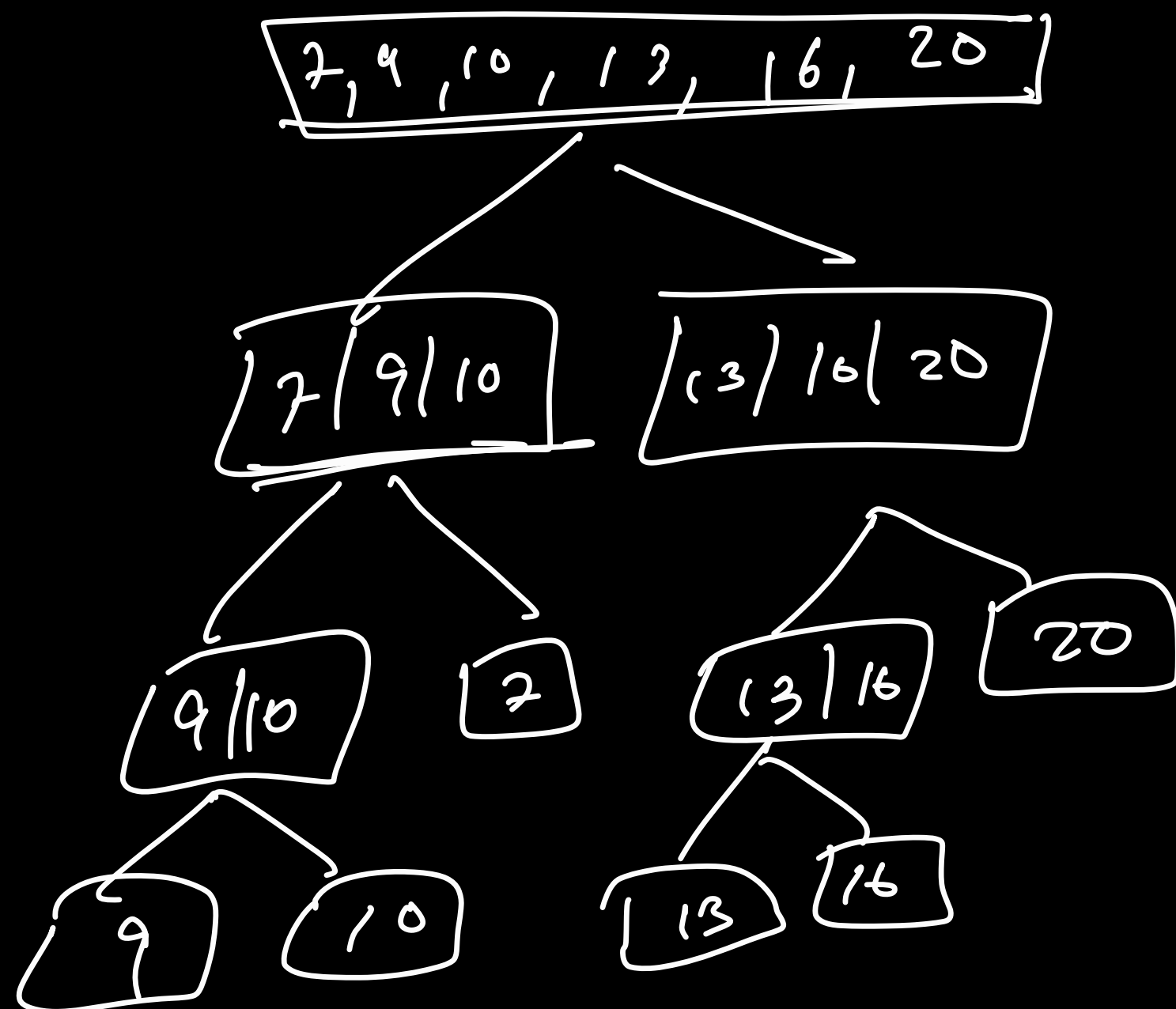
$(0, 4)$
 $(1, 4)$
 $(2, 4)$
 $(3, 4)$
 $(2, 3)$

5

Brute
force \rightarrow $O(n^2)$

$$\underline{\underline{n \leq 2 \times 10^5}}$$





2

[2, 4, 3, 5, 1]

2 +

2, 3, 4,

\uparrow
c

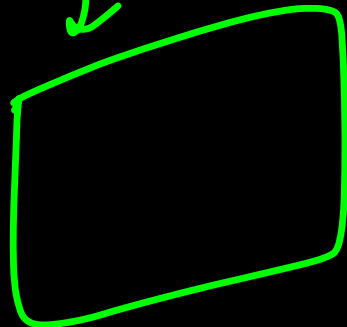
1, 5

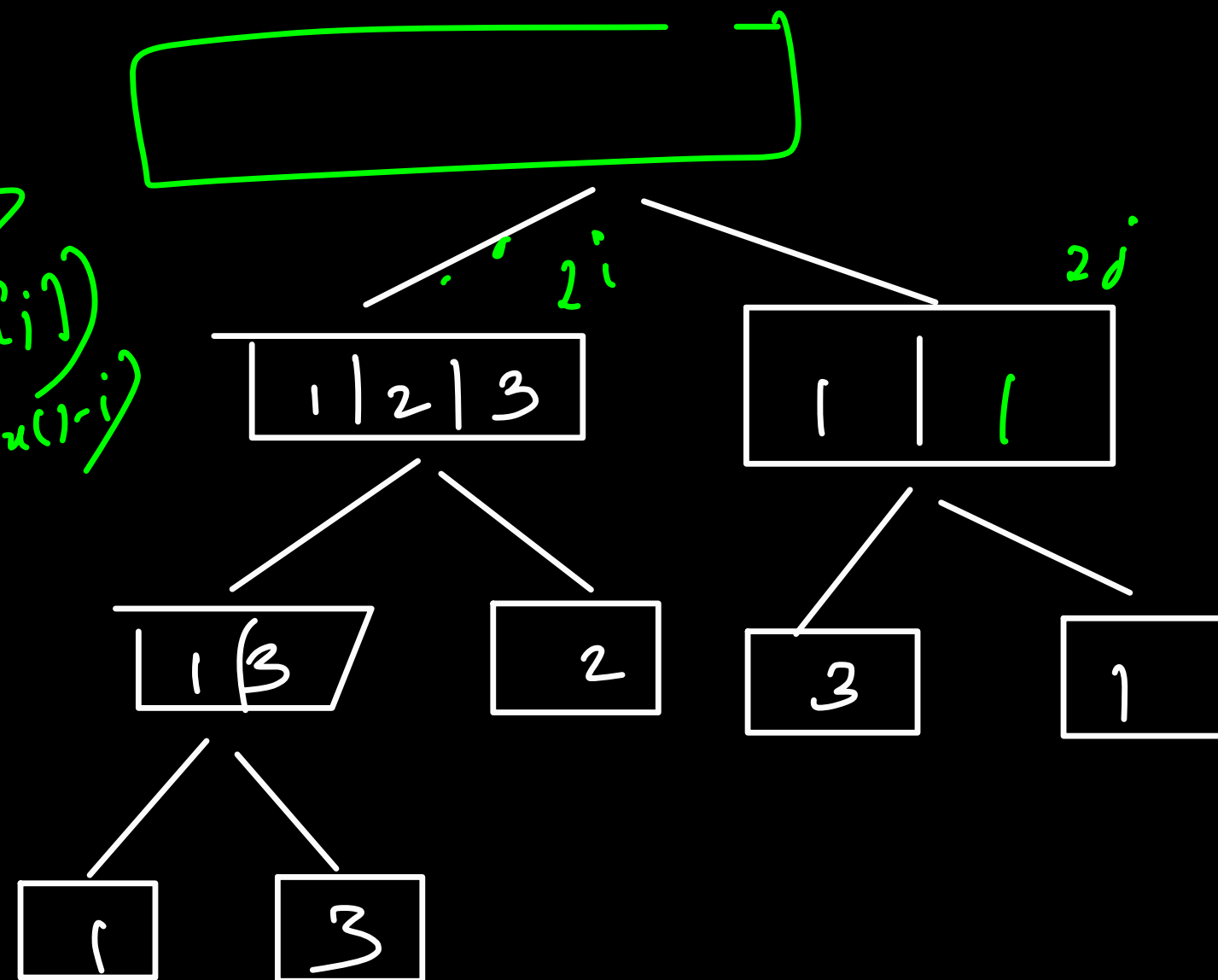
\uparrow
j

1 2 2 3 3

1 2 3 1 3

\rightarrow
 if $(a[i] > 2 \times b[i])$
 $ans += (a[i] \times (1-i))$
 $++$
 else L
 $i++$

\rightarrow
 $2 \times 2 \times 2$




$ans = 6$