* Space complexity or Auxilary Space :-

1) Auxilary space :- It is the extra space or temporary space taken by an algorithm.

∴ Space complexity = input spake + Auxilary space.

o Suppose :-
Take an i/p of array ~~siv~~ size N & do somthing with it.
So the ~~sap~~ space complexity will be the input you're taking from the size N + extra space the Algo is using
This is known as Space complexity.

- So, In the binary search the space complexity was constant. So, that means auxilary space was constant it was not taking any extra space
- Taking 3 variable i.e Start, End & Mid.
- If the array is of size 100 or more than that. Every single time its only going to take 3 that variable i.e start, end & mid.
Hence, constant

Q

```
for( i = 1 ; i ≤ N ; ' ) {
    for( j = 1 ; j ≤ k ; j++) {
            // some operations that
               takes time at t
    }
    i = i+k
}
```

Here,

1) inner loop is running k times & for every time it's running it's taking t amout of time.

$\therefore$ O(kt) time.

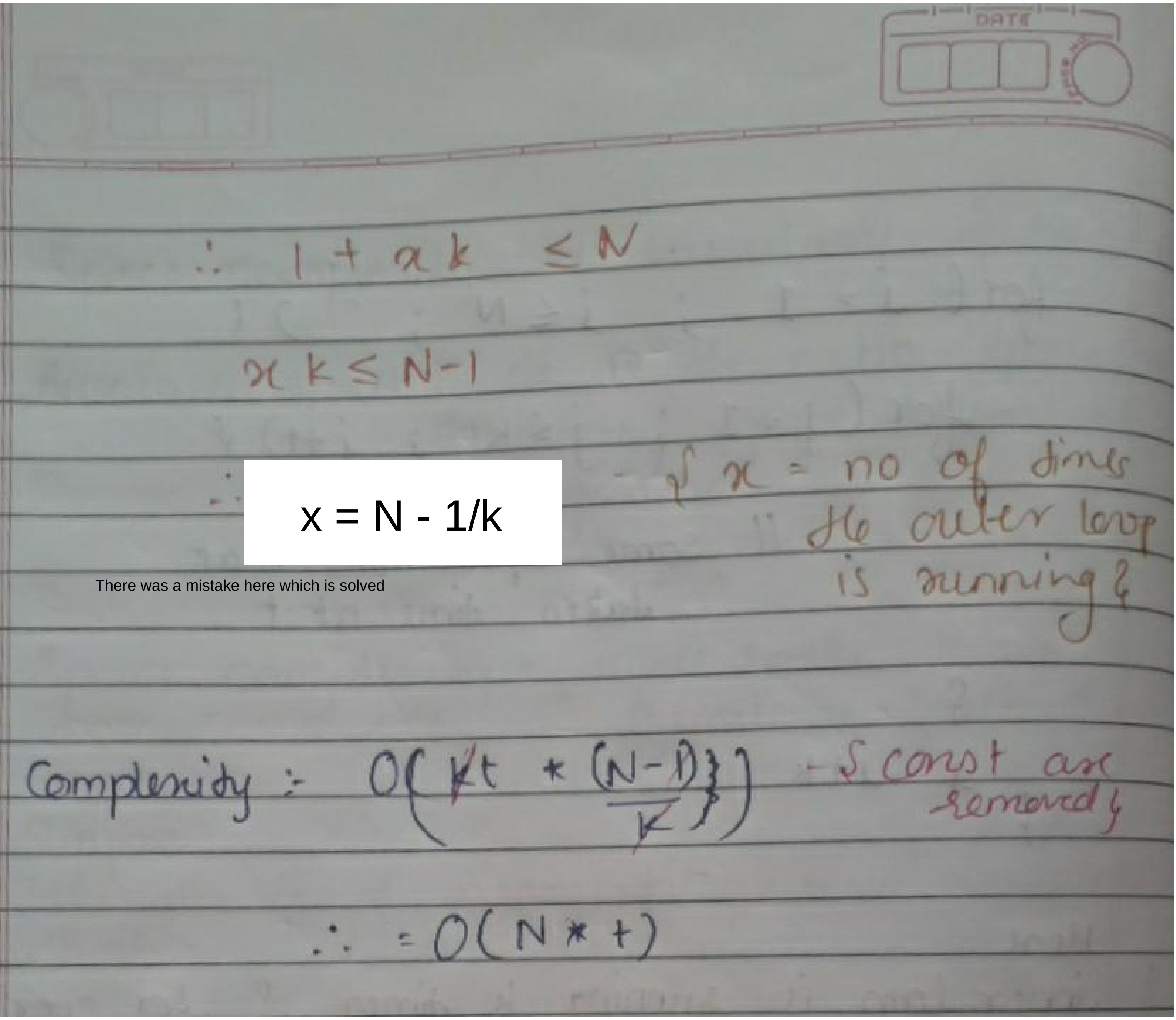
2) If inner loop is running ~~onec~~ once, so it's taking t amount of time. So, here it's actully running k times. Hence kt.

3) Ans :- O(kt * times outer loop is running)

conditions :- ~~wex~~ i will starts from 1, & the loop will break when i is ≤ N & i is incrementing with k

4) So let's say, i=1 , 1+k , 1+2k , 1+3k ..... 1+xk
So, if the ~~x~~ last value is "xk that means is ≤ N & satisfy the ~~c~~ondions. Hence x should be ≤ N

1 + xk is the value & x is the no. of times its running



$\therefore \quad 1 + xk \leq N$

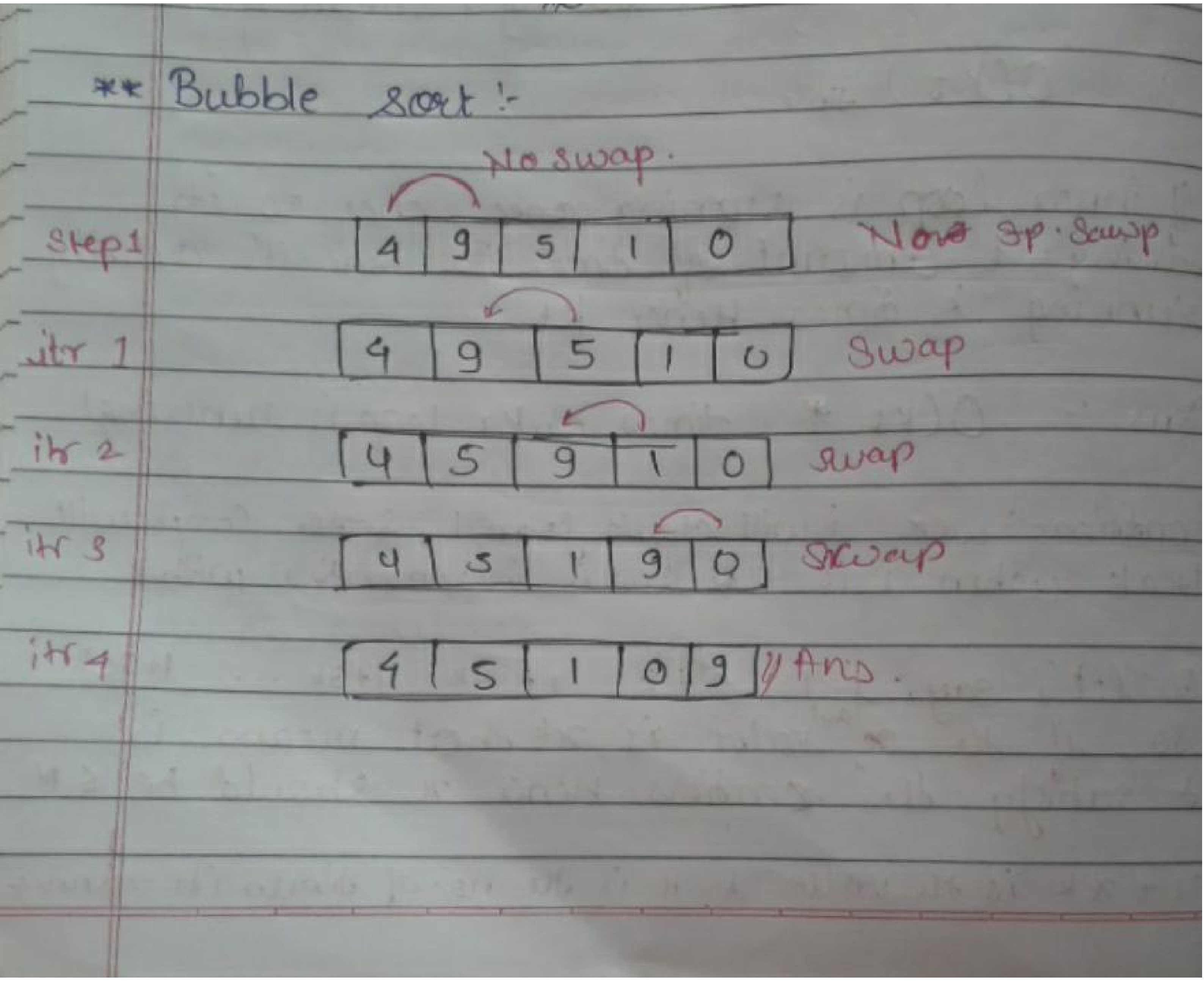
$xk \leq N-1$

$\therefore$ x = N - 1/k — { x = no of times the outer loop is running }

There was a mistake here which is solved

Complexity :- $O\left(\cancel{k}t * \frac{(N-1)}{\cancel{k}}\right)$ — { const are removed }

$\therefore = O(N * t)$



** Bubble sort :-

No swap.

Step1	4	9	5	1	0	Now sp. swap
itr 1	4	9	5	1	0	swap
itr 2	4	5	9	1	0	swap
itr 3	4	5	1	9	0	swap
itr 4	4	5	1	0	9	// Ans.

* worst & Average case time complexity :-
O(n * n)
Worst case occurs when array is reverse sorted.

* Best case time complexity :-
O(n)
Best case occurs when array is already sorted

* Auxilary space
O(1)

* Boundary cases :-
Bubble sort takes minimum time (order of n) when elements are already sorted.

* Sorting in place :- Yes

* Stable :- Yes

** Selection Sort :-

Worst complexity : n^2

Average complexity :- n^2

Best complexity :- n^2

Space complexity :- 1

Method :- Selection

Stable : No

Note:- The good thing about selection sort is it never makes more than O(n) swaps & can be useful when memory write is a costly operation.

Eg:- (max)

swap

4 , 5 , 1 , 2 , 3

swap

4 , 3 , 1 , 2 , 5

swap

2 , 3 , 1 , 4 , 5

swap

2 , 1 , 3 , 4 , 5

1 , 2 , 3 , 4 , 5.

** Insertion sort :-

Time complexity :- O(n * 2)

Auxiliary Space :- O(1)

Boundary Cases :- Insertion sort takes a maximum time to sort if element are sorted in reverse order.
And it takes minimum time (Order of n) when elements are already sorted.

Sorting in Place :- Yes.

Eg :-

$\overset{\text{Swap}}{\underbrace{5 \ , \ 3}} \ , \ 4 \ , \ 1 \ , \ 2$

$\overset{\text{sort \& swap}}{\underbrace{3 \ , \ 5 \ , \ 4}} \ , \ 1 \ , \ 2$

$\overset{\text{sort}}{\underbrace{3 \ , \ 4 \ , \ 5 \ , \ 1}} \ , \ 2$

$\overset{\text{sort}}{\underbrace{1 \ , \ 3 \ , \ 4 \ , \ 5 \ , \ 2}}$

1 , 2 , 3 , 4 , 5 //