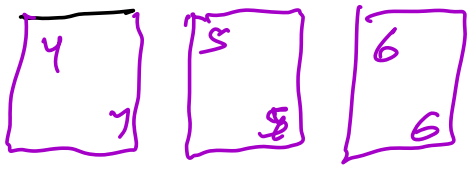
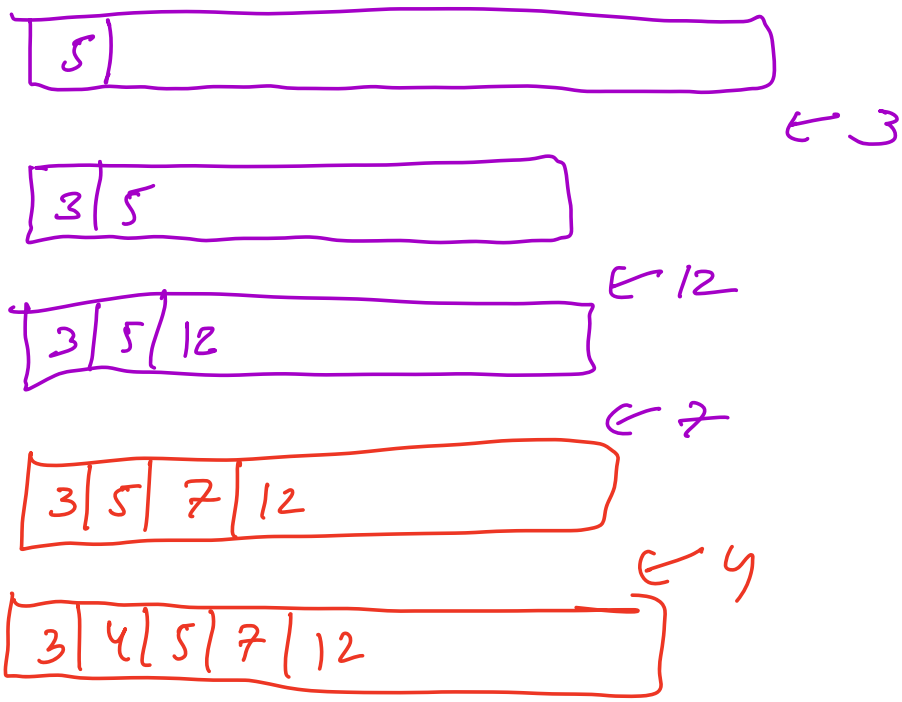
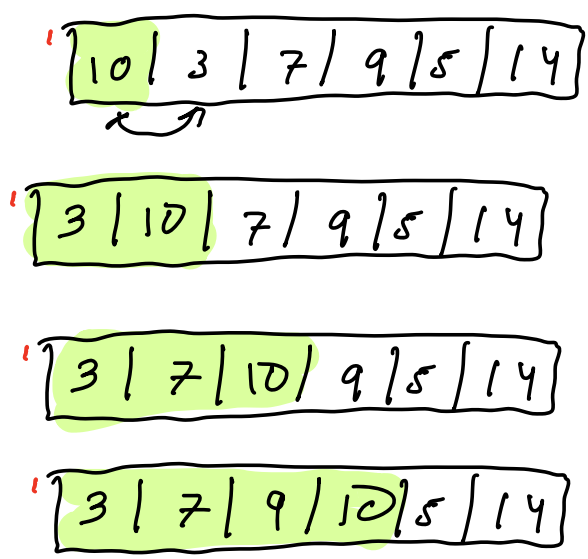
Sorting 3

Deck of cards

Insertion sort







3	5	7	9	10	14

```
for( i = 1; i < N; i++)
    j = i-1
    while( j >=0 && A[j] > A[j+1])
        swap(A[j], A[j+1])
        j--;
```

$O(N^2)$

$O(1)$

Q⇒ Given array of N ele, rearrange the array s.t.

All ele <= A[0] go to left

All ele > A[0] go to right

{10, 3, 0, 15, 6, 12, 2, 18, 7, 15, 14

{3, 0, 6, 2, 7, 10, 15, 12, 18, 15, 14}

{10, 3, 0, 15, 6, 12, 2, 18, 7, 15, 14}

2 7 2 12 15

10

swap(A[0], A[x])

```
partition ( A[], int N)
{
    l = 1 ; r = N-1 ;
    while ( l <= r)
    {
        if( A[l] <= A[0])
            l++;
        else if( A[r] > A[0])
            r--;
        else
            swap(A[l], A[r])
            l++; r--;
    }
    swap ( A[0], A[r]),
    return r;
}
```

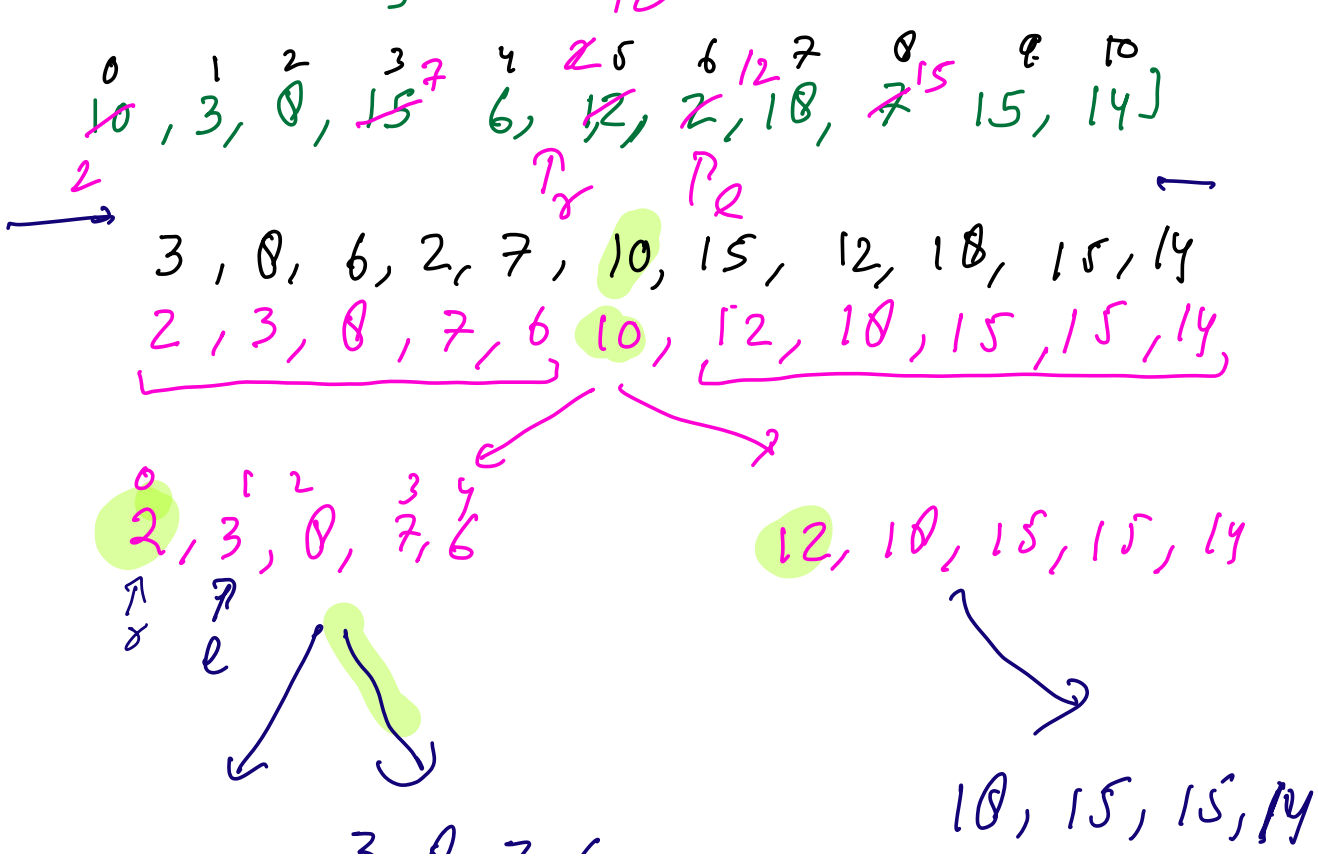
Q⇒ Given array of N ele, rearrange the array s.t. s to e

All ele <= A[s] go to left

All ele > A[s] go to right

```
partition ( A[], s, e)
{
    l = s+1 ; r = e ;
```

```
while ( l <= r)
{
    if( A[l] <= A[s])
        l++;
    else if( A[r] > A[s])
        r--;
    else
        swap(A[l], A[r])
        l++; r--;
}
swap( A[s], A[r]),
  return r;
}
```



2, 0, 1, 6

```
void Quicksort (int A[], int s, int e)
{
    if ( s >= e) return;
    int p = partition ( A, s, e)

    Quicksort ( A, s, p-1);
    Quicksort ( A, p+1, e);
}
```

s e

10, 3, 8, 15, 5, 12, 2, 18, 7, 15, 14

3, 8, 6, 2, 7, 10, 15, 12, 18, 15, 14

2, 3, 6, 8, 7

2 6, 8, 7

7, 8

7

15, 12, 14, 15, 18

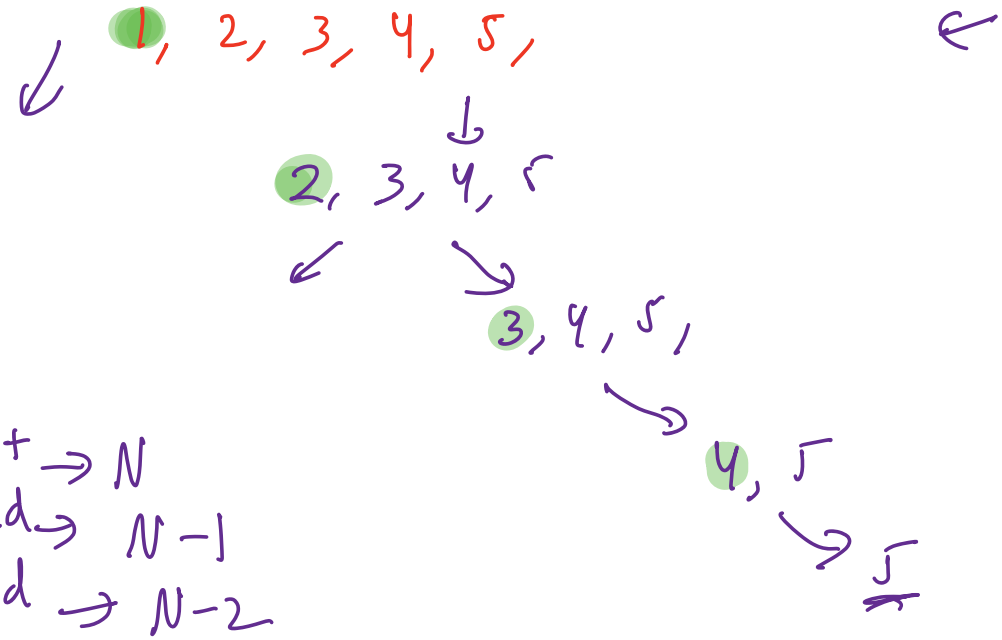
14, 12, 15 18

12, 14

12

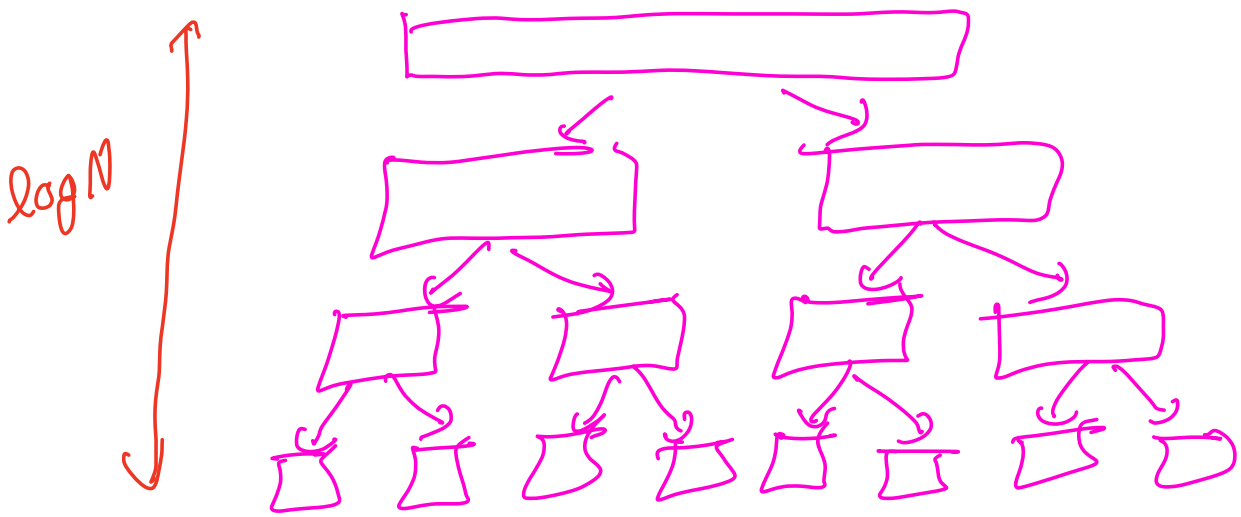
2, 3, 6, 7, 8, 10

Break : 9:10



1st → N
2nd → N-1
3rd → N-2
⋮
Nth → 1

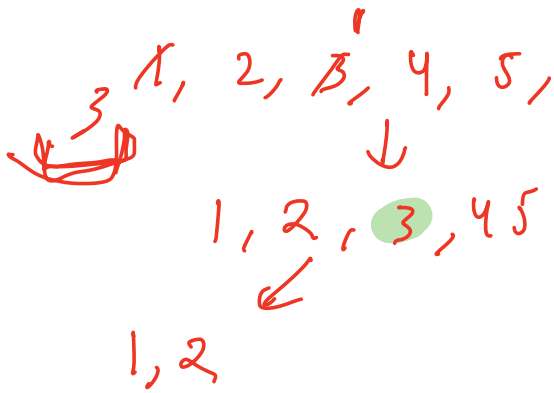
$O(N^2)$



$1 * N + 2 * \frac{N}{2} + 4 * \frac{N}{4} + \cdots$

$N + N + N$

$O(N \log N)$



$\frac{1}{N} + \frac{1}{N-1} + \frac{1}{N-2} + \frac{1}{N-3}$ ----> worst

① Choose random ele as pivot ele
p_i ⇒ rand() // [s e]

② swap (A[0], A[p_i])

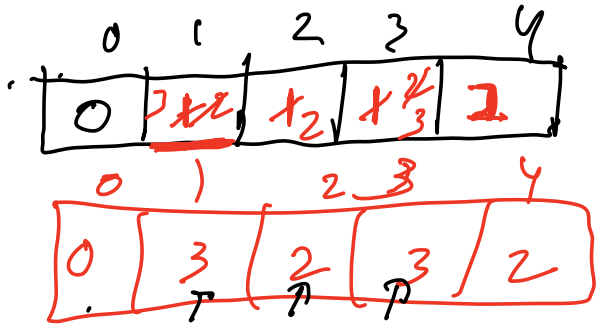
Best : $O(N \log N)$
Avg : $O(N \log N)$
Worst : $O(N^2)$

SC: $O(\log N)$
$O(N)$

	Best	worst	Avg	In place	stable	Swap
Selection						
Bubble						
Merge						
Insertion						
Quicksort						

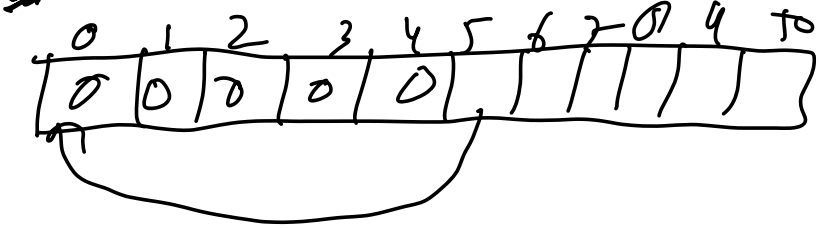
Count Sort

A[] = {3, 1, 4, 4, 2, 1, 3, 3, 2, 1}



1, 1, 1, 2, 2, 3, 3, 3, 4, 4

5 - 10



5 - 5 = 0

6 - 5 = 1

10 - 6 = 5

$[-10, 10]$

$-10 - (-10) = 0$

$-9 - (-10) = 1$

$-8 - (-10) = 2$

$\vdots$

$18 \rightarrow 10 - (-10) = 20$