Understanding the problem statement

Given an array of unsorted integers we have to sort the array in wave form i.e arr[0] >= arr[1] <= arr[2] >= arr[3] <= arr[4] ..... i.e elements should increase and decrease alternatively.

Input : [1,5,2,4,3,6,7,8] Output : [2,1,4,3,6,5,8,7]

There may be multiple outputs possible for single input

Approach 1

```
Find all the permutations of given array, and check which permutation
has wave form.
Total permutations possible = n!
```

Time Complexity : O(n!)

Space Complexity : O(1)

Approach 2

1. First sort the given array [1,5,2,4,3,6,7,8] --> [1,2,3,4,5,6,7,8]
2. Then swap the adjacent elements to get array in wave form [1,2,3,4,5,6,7,8] --> [2,1,4,3,6,5,8,7]
3. Sorting takes O(nlogn) and swap takes O(n). No extra space needed as we are sorting and swapping inplace.

Time Complexity : O(nlogn)

Space Complexity : O(1)

Approach 3

1. We can observe that elements at even position are greater than adjacent elements i.e elements at odd postion.
2. So we traverse at each even position and for each even position a. If element is smaller than element to the left we swap them b. If element is smaller than element to the right we swap them

NOTE: For the next swap previous arrangement does not get disturbed because a1,a2,a3,a4,a5. If a4 was less than a3 and we swap that means a4 is also less than a2 because a3 was less than a2.

We scan even positions of array and swap. So Time complexity is O(n)

Time Complexity : O(n)

Space Complexity : O(1)

In [5]:
```
def sortArrayInWave(arr,size):
    for i in range(0,size,2):
        if i > 0 and arr[i-1] > arr[i]:
            temp = arr[i-1]
            arr[i-1] = arr[i]
            arr[i] = temp
        if i < size-1 and arr[i+1] > arr[i]:
            temp = arr[i+1]
            arr[i+1] = arr[i]
            arr[i] = temp
    return arr
```

In [6]:
```
arr = [10, 90, 49, 2, 1, 5, 23]
size = len(arr)
print(sortArrayInWave(arr,size))
# ans
# [90, 10, 49, 1, 5, 2, 23]
```

```
[90, 10, 49, 1, 5, 2, 23]
```

In [11]:
```
arr = [100, 90, 35, 2, 1, 5, 78]
size = len(arr)
print(sortArrayInWave(arr,size))
# ans
# [100, 35, 90, 1, 5, 2, 78]
```

```
[100, 35, 90, 1, 5, 2, 78]
```

In [12]:
```
arr = [100, 900]
size = len(arr)
print(sortArrayInWave(arr,size))
# ans
# [900, 100]
```

```
[900, 100]
```

In [13]:
```
arr = [100]
size = len(arr)
print(sortArrayInWave(arr,size))
# ans
# [100]
```

```
[100]
```

In [ ]:
```
```