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10 - Searching & Sorting

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# Merge Sort

Write a Python program to sort a list of elements using the merge sort algorithm.

## For example:

|  |  |
| --- | --- |
| **Input** | **Result** |
| 5  6 5 4 3 8 | 3 4 5 6 8 |

**Answer:**

def mergeSort(arr): if len(arr) > 1:

mid = len(arr) // 2 left\_half = arr[:mid] right\_half = arr[mid:]

mergeSort(left\_half) mergeSort(right\_half)

i = j = k = 0

while i < len(left\_half) and j < len(right\_half): if left\_half[i] < right\_half[j]:

arr[k] = left\_half[i] i += 1

else:

arr[k] = right\_half[j]

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j += 1

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k += 1

while i < len(left\_half): arr[k] = left\_half[i]

i += 1

k += 1

while j < len(right\_half): arr[k] = right\_half[j]

j += 1

k += 1

n = int(input().strip())

arr = list(map(int, input().strip().split()))

mergeSort(arr) print(\*arr)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Input** | **Expected** | **Got** |  |
|  | 5  6 5 4 3 8 | 3 4 5 6 8 | 3 4 5 6 8 |  |
|  | 9  14 46 43 27 57 41 45 21 70 | 14 21 27 41 43 45 46 57 70 | 14 21 27 41 43 45 46 57 70 |  |
|  | 4  86 43 23 49 | 23 43 49 86 | 23 43 49 86 |  |

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# Bubble Sort

Given an listof integers, sort the array in ascending order using the *Bubble Sort* algorithm above. Once sorted, print the following three lines:

1. [List](http://118.185.187.137/moodle/mod/resource/view.php?id=1068) is sorted in numSwaps swaps., where numSwaps is the number of swaps that took place.
2. First Element: firstElement, the *first* element in the sorted [list](http://118.185.187.137/moodle/mod/resource/view.php?id=1068).
3. Last Element: lastElement, the *last* element in the sorted [list](http://118.185.187.137/moodle/mod/resource/view.php?id=1068).

For example, given a worst-case but small array to sort: a=[6,4,1]. It took 3 swaps to sort the array. Output would be

Array is sorted in 3 swaps. First Element: 1

Last Element: 6

## Input Format

The first line contains an integer,n , the size of the [list](http://118.185.187.137/moodle/mod/resource/view.php?id=1068) a . The second line contains n, space-separated integers a[i].

## Constraints

· 2<=n<=600

· 1<=a[i]<=2x106.

## Output Format

You must print the following three lines of output:

1. [List](http://118.185.187.137/moodle/mod/resource/view.php?id=1068) is sorted in numSwaps swaps., where numSwaps is the number of swaps that took place.
2. First Element: firstElement, the *first* element in the sorted [list](http://118.185.187.137/moodle/mod/resource/view.php?id=1068).
3. Last Element: lastElement, the *last* element in the sorted [list](http://118.185.187.137/moodle/mod/resource/view.php?id=1068).

## Sample Input 0

3

1 2 3

## Sample Output 0

[List](http://118.185.187.137/moodle/mod/resource/view.php?id=1068) is sorted in 0 swaps. First Element: 1

Last Element: 3

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## For example:

|  |  |
| --- | --- |
| **Input** | **Result** |
| 3  3 2 1 | List is sorted in 3 swaps. First Element: 1  Last Element: 3 |
| 5  1 9 2 8 4 | List is sorted in 4 swaps. First Element: 1  Last Element: 9 |

**Answer:**

def bubbleSort(arr): n = len(arr) numSwaps = 0

for i in range(n): swapped = False

for j in range(0, n-i-1): if arr[j] > arr[j+1]:

arr[j], arr[j+1] = arr[j+1], arr[j] numSwaps += 1

swapped = True

if not swapped: break

print("List is sorted in", numSwaps, "swaps.") print("First Element:", arr[0])

print("Last Element:", arr[-1])

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n = int(input().strip())

arr = list(map(int, input().strip().split())) bubbleSort(arr)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input | Expected | Got |  |  |
|  | 3 | List is sorted in 3 swaps. | List is sorted in 3 swaps. |  |
| 3 2 1 | First Element: 1 | First Element: 1 |
|  | Last Element: 3 | Last Element: 3 |
|  | 5 | List is sorted in 4 swaps. | List is sorted in 4 swaps. |  |
| 1 9 2 8 4 | First Element: 1 | First Element: 1 |
|  | Last Element: 9 | Last Element: 9 |

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# Peak Element

Given an [list](http://118.185.187.137/moodle/mod/resource/view.php?id=1068), find peak element in it. A peak element is an element that is greater than its neighbors.

An element a[i] is a peak element if

A[i-1] <= A[i] >=a[i+1] for middle elements. [0<i<n-1] A[i-1] <= A[i] for last element [i=n-1]

A[i]>=A[i+1] for first element [i=0]

## Input Format

The first line contains a single integer n , the length of A . The second line contains n space-separated integers,A[i].

## Output Format

**Print** peak numbers separated by space.

## Sample Input

5

8 9 10 2 6

## Sample Output

10 6

## For example:

|  |  |
| --- | --- |
| **Input** | **Result** |
| 4  12 3 6 8 | 12 8 |

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**Answer:**

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def find\_peaks(nums): peaks = []

for i in range(len(nums)): if i == 0:

if nums[i] >= nums[i+1]: peaks.append(nums[i])

elif i == len(nums) - 1:

if nums[i] >= nums[i-1]: peaks.append(nums[i])

else:

if nums[i] >= nums[i-1] and nums[i] >= nums[i+1]: peaks.append(nums[i])

return peaks

n = int(input())

nums = list(map(int, input().split())) peaks = find\_peaks(nums)

print(' '.join(map(str, peaks)))

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Input** | **Expected** | **Got** |  |
|  | 7  15 7 10 8 9 4 6 | 15 10 9 6 | 15 10 9 6 |  |
|  | 4  12 3 6 8 | 12 8 | 12 8 |  |

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# Binary Search

Write a Python program for binary search.

## For example:

|  |  |
| --- | --- |
| **Input** | **Result** |
| 1 2 3 5 8  6 | False |
| 3 5 9 45 42  42 | True |

**Answer:**

def binary\_search(arr, target): left, right = 0, len(arr) - 1 while left <= right:

mid = (left + right) // 2 if arr[mid] == target:

return True

elif arr[mid] < target: left = mid + 1

else:

right = mid - 1 return False

arr\_input = input() target\_input = input()

arr = list(map(int, arr\_input.split(','))) target = int(target\_input)

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arr.sort()

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result = binary\_search(arr, target) print(result)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Input** | **Expected** | **Got** |  |
|  | 1,2,3,5,8  6 | False | False |  |
|  | 3,5,9,45,42  42 | True | True |  |
|  | 52,45,89,43,11  11 | True | True |  |

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# Frequency of Elements

To find the frequency of numbers in a list and display in sorted order.

**Constraints:** 1<=n, arr[i]<=100 **Input:**

1 68 79 4 90 68 1 4 5

## output:

1 2

4 2

5 1

68 2

79 1

90 1

## For example:

|  |  |
| --- | --- |
| **Input** | **Result** |
| 4 3 5 3 4 5 | 3 2  4 2  5 2 |

**Answer:**

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def frequencySorted(arr): freq\_dict = {}

for num in arr:

if num in freq\_dict: freq\_dict[num] += 1

else:

freq\_dict[num] = 1

sorted\_freq = sorted(freq\_dict.items()) for key, value in sorted\_freq:

print(key, value)

arr = list(map(int, input().strip().split())) frequencySorted(arr)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Input** | **Expected** | **Got** |  |
|  | 4 3 5 3 4 5 | 3 2  4 2  5 2 | 3 2  4 2  5 2 |  |
|  | 12 4 4 4 2 3 5 | 2 1  3 1  4 3  5 1  12 1 | 2 1  3 1  4 3  5 1  12 1 |  |
|  | 5 4 5 4 6 5 7 3 | 3 1  4 2  5 3  6 1  7 1 | 3 1  4 2  5 3  6 1  7 1 |  |