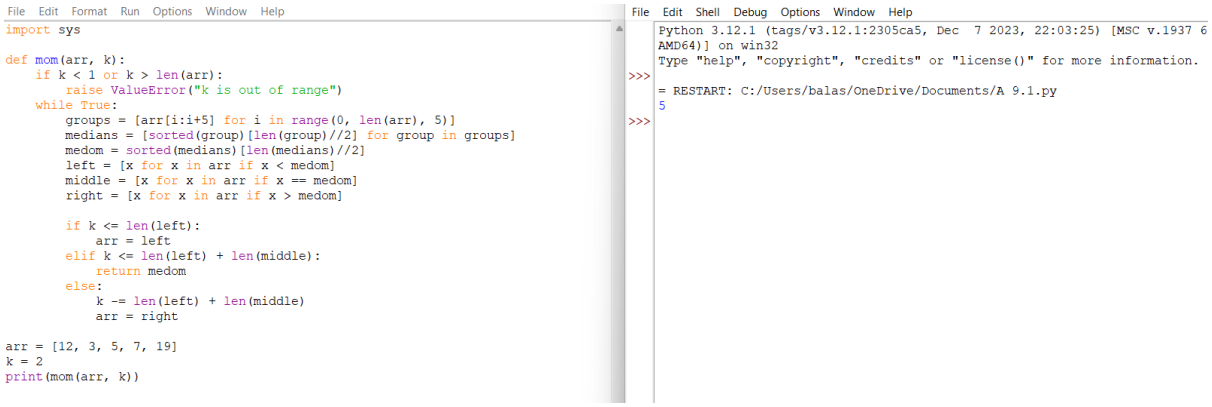
Median of Medians

1. To Implement the Median of Medians algorithm ensures that you handle the worst-case time complexity efficiently while finding the k-th smallest element in an unsorted array.



```
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import sys

def mom(arr, k):
    if k < 1 or k > len(arr):
        raise ValueError("k is out of range")
    while True:
        groups = [arr[i:i+5] for i in range(0, len(arr), 5)]
        medians = [sorted(group)[len(group)//2] for group in groups]
        medom = sorted(medians)[len(medians)//2]
        left = [x for x in arr if x < medom]
        middle = [x for x in arr if x == medom]
        right = [x for x in arr if x > medom]

        if k <= len(left):
            arr = left
        elif k <= len(left) + len(middle):
            return medom
        else:
            k -= len(left) + len(middle)
            arr = right

arr = [12, 3, 5, 7, 19]
k = 2
print(mom(arr, k))
```

```
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Python 3.12.1 (tags/v3.12.1:2305ca5, Dec  7 2023, 22:03:25) [MSC v.1937 6
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:/Users/balas/OneDrive/Documents/A 9.1.py
5
>>>
```
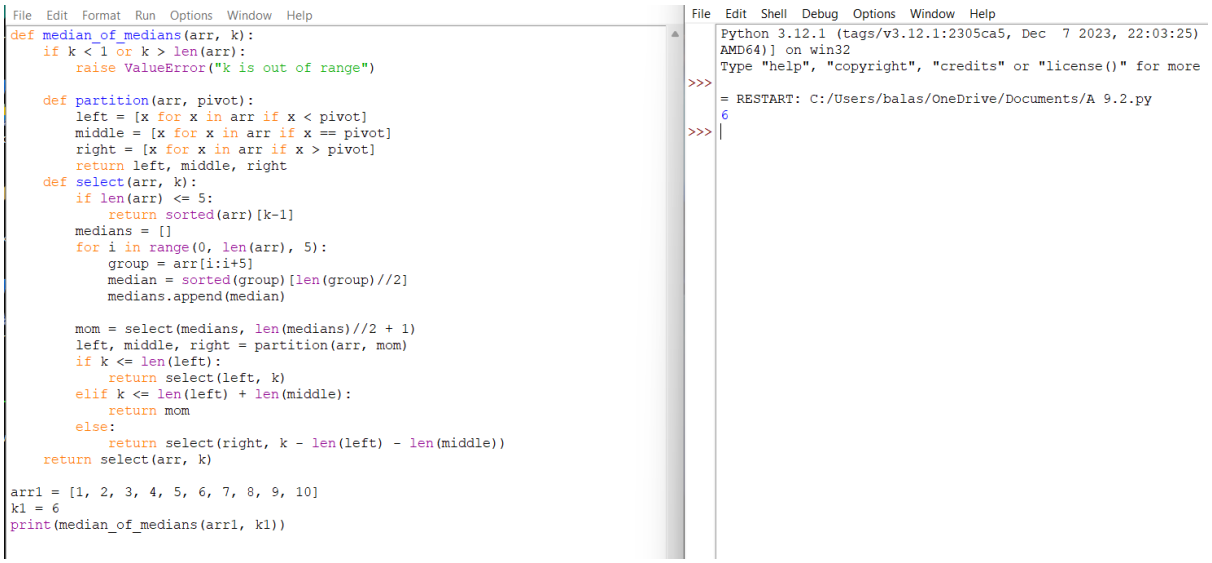

2.To Implement a function median_of_medians(arr, k) that takes an unsorted array arr and an integer k, and returns the k-th smallest element in the array.



```
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def median_of_medians(arr, k):
    if k < 1 or k > len(arr):
        raise ValueError("k is out of range")

    def partition(arr, pivot):
        left = [x for x in arr if x < pivot]
        middle = [x for x in arr if x == pivot]
        right = [x for x in arr if x > pivot]
        return left, middle, right
    def select(arr, k):
        if len(arr) <= 5:
            return sorted(arr)[k-1]
        medians = []
        for i in range(0, len(arr), 5):
            group = arr[i:i+5]
            median = sorted(group)[len(group)//2]
            medians.append(median)

        mom = select(medians, len(medians)//2 + 1)
        left, middle, right = partition(arr, mom)
        if k <= len(left):
            return select(left, k)
        elif k <= len(left) + len(middle):
            return mom
        else:
            return select(right, k - len(left) - len(middle))
    return select(arr, k)

arr1 = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
k1 = 6
print(median_of_medians(arr1, k1))
```

```
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Python 3.12.1 (tags/v3.12.1:2305ca5, Dec  7 2023, 22:03:25)
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more
>>>
= RESTART: C:/Users/balas/OneDrive/Documents/A 9.2.py
6
>>>
```
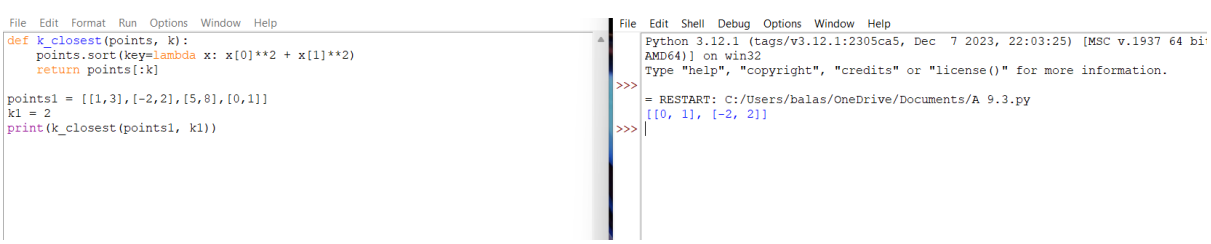

3. Given an array of points where points[i] = [xi, yi] represents a point on the X-Y plane and an integer k, return the k closest points to the origin (0, 0).



```
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def k_closest(points, k):
    points.sort(key=lambda x: x[0]**2 + x[1]**2)
    return points[:k]

points1 = [[1,3],[-2,2],[5,8],[0,1]]
k1 = 2
print(k_closest(points1, k1))
```

```
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Python 3.12.1 (tags/v3.12.1:2305ca5, Dec  7 2023, 22:03:25) [MSC v.1937 64 bi
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
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[[0, 1], [-2, 2]]
>>>
```

4. Given four lists A, B, C, D of integer values, Write a program to compute how many tuples (i, j, k, l) there are such that A[i] + B[j] + C[k] + D[l] is zero.

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```
def four_sum_count(A, B, C, D):
    count = 0
    AB = {}
    for a in A:
        for b in B:
            AB[a + b] = AB.get(a + b, 0) + 1
    for c in C:
        for d in D:
            if -c - d in AB:
                count += AB[-c - d]
    return count

A1 = [1, 2]
B1 = [-2, -1]
C1 = [-1, 2]
D1 = [0, 2]
print(four_sum_count(A1, B1, C1, D1))
```

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```
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AMD64)] on win32
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2
>>>
```