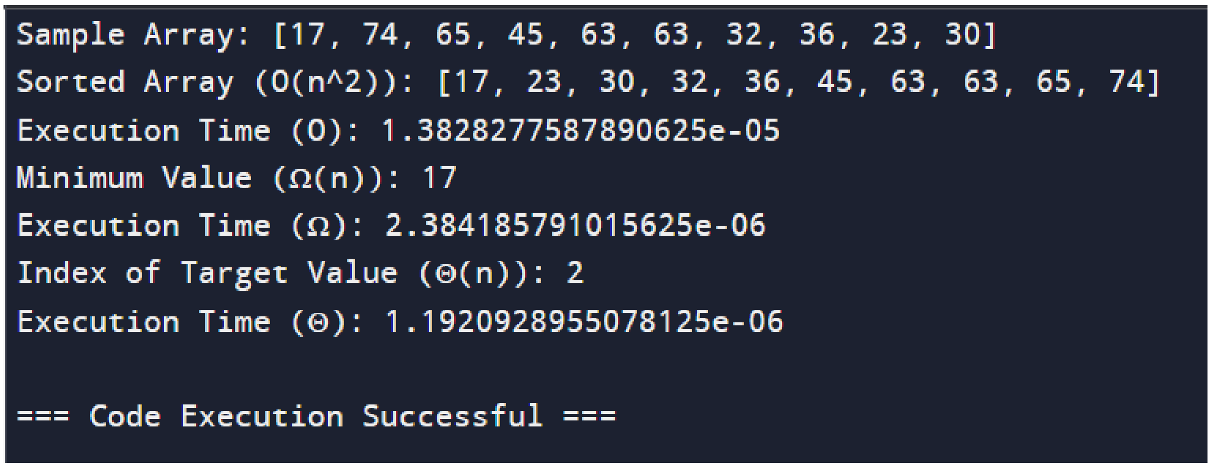
112. Analysis Frame work – Asymptotic Notations Basic Efficiency Class: Big-O notation, Omega notation, Theta notation,

PROGRAM:-

```
import time
import random

# Example for Big-O Notation (O)
def worst_case_example(arr):
    # This function demonstrates O(n^2) complexity (e.g., Bubble Sort)
    n = len(arr)
    for i in range(n):
        for j in range(0, n-i-1):
            if arr[j] > arr[j+1]:
                arr[j], arr[j+1] = arr[j+1], arr[j]
    return arr

# Example for Omega Notation (Ω)
def best_case_example(arr):
    # This function demonstrates Ω(n) complexity (e.g., Find Minimum)
    min_val = arr[0]
    for i in range(1, len(arr)):
        if arr[i] < min_val:
            min_val = arr[i]
    return min_val

# Example for Theta Notation (Θ)
def tight_bound_example(arr, x):
    # This function demonstrates Θ(n) complexity (e.g., Linear Search)
    for i in range(len(arr)):
        if arr[i] == x:
            return i
    return -1

# Generate a sample array
sample_array = [random.randint(1, 100) for _ in range(10)]
print("Sample Array:", sample_array)

# Measure execution time for O(n^2) example
start_time = time.time()
sorted_array = worst_case_example(sample_array.copy())
end_time = time.time()
```

```
print("Sorted Array (O(n^2)):", sorted_array)
print("Execution Time (O):", end_time - start_time)

# Measure execution time for Ω(n) example
start_time = time.time()
min_value = best_case_example(sample_array)
end_time = time.time()
print("Minimum Value (Ω(n)):", min_value)
print("Execution Time (Ω):", end_time - start_time)

# Measure execution time for Θ(n) example
target_value = sample_array[random.randint(0, len(sample_array)-1)]
start_time = time.time()
index = tight_bound_example(sample_array, target_value)
end_time = time.time()
print("Index of Target Value (Θ(n)):", index)
print("Execution Time (Θ):", end_time - start_time)
```

OUTPUT:-



```
Sample Array: [17, 74, 65, 45, 63, 63, 32, 36, 23, 30]
Sorted Array (O(n^2)): [17, 23, 30, 32, 36, 45, 63, 63, 65, 74]
Execution Time (O): 1.3828277587890625e-05
Minimum Value (Ω(n)): 17
Execution Time (Ω): 2.384185791015625e-06
Index of Target Value (Θ(n)): 2
Execution Time (Θ): 1.1920928955078125e-06


=== Code Execution Successful ===
```

TIME COMPLEXITY:-BIG O NOTATION:-o(n)

OMEGA NOTATION:-Ω(1)

THETA NOTATION:-$\Theta(n^2)$