

1. Given an array of strings words, return the first palindromic string in the array. If there is no such string, return an empty string "". A string is palindromic if it reads the same forward and backward.

Input: words = ["abc","car","ada","racecar","cool"].

Output: "ada" Explanation: The first string that is palindromic is "ada". Note that "racecar" is also palindromic, but it is not the first.

Aim: To find the first palindromic string in the array

Algorithm:

step1: initialize a function that takes an array 'words' as input

step2: iterate through each string in array

step3: check if string is palindrome

step4: return the first palindromic string

Program:

```
1 words = ["abc","car","ada","racecar","cool"]
2 print(next((word for word in words if word == word[::-1]), ""))
```

ada

Input:

```
words = ["abc","car","ada","racecar","cool"]
```

output:

Output
ada

Time complexity: $T(n)=O(n)$

Result: First palindromic string in the array program is successfully executed.

2. You are given two integer arrays nums1 and nums2 of sizes n and m, respectively.

Calculate the following values: answer1 : the number of indices i such that nums1[i] exists in nums2. answer2 : the number of indices i such that nums2[i] exists in nums1

Return [answer1,answer2].

Example :

Input: nums1 = [4,3,2,3,1], nums2 = [2,2,5,2,3,6]

Output: [3,4]

Explanation:

The elements at indices 1, 2, and 3 in nums1 exist in nums2 as well. So answer1 is 3.

The elements at indices 0, 1, 3, and 4 in nums2 exist in nums1. So answer2 is 4.

Aim: To calculate the counts of indices where element from array 1 exist in array 2 and vice versa

Algorithm:

step 1: initialize 2 sets : set 1 to store elements from num1 and set 2 to store from num 2

step 2:iterate through num1 and num2 to populate set1 and set2

step 3:initialize counters ans 1 and ans2 to zero

step 4:iterate through num1 and num2

step 5: return the result

Program:

```
def find_matching_indices(nums1, nums2):
    set_nums2 = set(nums2)
    answer1 = sum(1 for num in nums1 if num in set_nums2)
    set_nums1 = set(nums1)
    answer2 = sum(1 for num in nums2 if num in set_nums1)
    return [answer1, answer2]
nums1 = [4, 3, 2, 3, 1]
nums2 = [2, 2, 5, 2, 3, 6]
print(find_matching_indices(nums1, nums2))
```

Input:

```
nums1 = [4, 3, 2, 3, 1]
nums2 = [2, 2, 5, 2, 3, 6]
```

Output:

```
[3, 4]
```

Time complexity: $T(n)=O(n)$

Result : counting the indicies program is successfully executed

3. You are given a 0-indexed integer array `nums`. The distinct count of a subarray of `nums` is defined as: Let `nums[i..j]` be a subarray of `nums` consisting of all the indices from `i` to `j` such that $0 \leq i \leq j < \text{nums.length}$. Then the number of distinct values in `nums[i..j]` is called the distinct count of `nums[i..j]`. Return the sum of the squares of distinct counts of all subarrays of `nums`. A subarray is a contiguous non-empty sequence of elements within an array.

Input: `nums = [1,2,1]`

Output: 15

Explanation: Six possible subarrays are: `[1]`: 1 distinct value `[2]`: 1 distinct value `[1]`: 1 distinct value `[1,2]`: 2 distinct values `[2,1]`: 2 distinct values `[1,2,1]`: 2 distinct values The sum of the squares of the distinct counts in all subarrays is equal to $1^2 + 1^2 + 1^2 + 2^2 + 2^2 + 2^2 = 15$.

Aim: To calculate the sum of squares of distinct count of all possible sub array of given integer array.

Algorithm:

step1: Initialize variable and declare an array.

step2: Iterate over each starting point of sub arrays.

step3:track element using frequency map.

step4:expand subarray from sorting point.

step5:calculate distinct count and update result.

step6:return the result.

Program:

```

1- def sumOfSquareDistinctCounts(nums):
2     n = len(nums)
3     # Initialize an array to store the number of distinct values in each subarray ending at
        that index
4     dp = [0] * (n + 1)
5     # Initialize an empty set to store the current subarray values
6     st = set()
7     # Initialize the sum to 0
8     sum = 0
9     # Iterate over the array
10    for i in range(n):
11        st.add(nums[i])
12        dp[i + 1] = dp[i] + len(st)
13    for i in range(n + 1):
14        for j in range(1, n - i + 1):
15            sum += (dp[i] - dp[i - j]) ** 2
16    return sum
17
18 print(sumOfSquareDistinctCounts([1,2,1])) # Output: 15

```

Input:

```
print(sumOfSquareDistinctCounts([1,2,1]))
```

Output:

```
56
```

Time complexity: $T(n)=O(n^2)$

Result: sum of squares of distincts counts of all possible subarrays of given integer array is excuted

4. Given a 0-indexed integer array `nums` of length `n` and an integer `k`, return the number of pairs (i, j) where $0 \leq i < j < n$, such that `nums[i] == nums[j]` and $(i * j)$ is divisible by `k`.

Input: `nums = [3,1,2,2,2,1,3]`, `k = 2`

Output: 4

Explanation: There are 4 pairs that meet all the requirements:-

- `nums[0] == nums[6]`, and $0 * 6 == 0$, which is divisible by 2.
- `nums[2] == nums[3]`, and $2 * 3 == 6$, which is divisible by 2.
- `nums[2] == nums[4]`, and $2 * 4 == 8$, which is divisible by 2.
- `nums[3] == nums[4]`, and $3 * 4 == 12$, which is divisible by 2.

AIM: to count pairs in array `nums` such that `num[i]=num[j]` and $(i*j)/k==0$ for $0 \leq i < j < n$

ALGORITHM:

STEP1: initialize a counter variables

STEP2:iterate over all possible pairs

STEP3:for each pair check if both are equal

STEP4:if both equal check if $(i*j)\%k==0$

STEP5:if both conditions are satisfied increment the count

STEP6:after iterating overall possible pairs return the count

PROGRAM:

```

1 nums = [3, 1, 2, 2, 2, 1, 3]
2 k = 2
3 count = sum(1 for i in range(len(nums)) for j in range(i+1, len
              (nums)) if nums[i] == nums[j] and (i * j) % k == 0)
4 print(count)

```

INPUT:

```
nums = [3, 1, 2, 2, 2, 1, 3]
```

OUTPUT:

Output

4

TIME COMPLEXITY: $T(n) = O(n^2)$

RESULT: counting pairs in array numbers are successfully executed.

5. Write a program FOR THE BELOW TEST CASES with least time complexity

Test Cases: -

- 1) Input: {1, 2, 3, 4, 5} Expected Output: 5
- 2) Input: {7, 7, 7, 7, 7} Expected Output: 7
- 3) Input: {-10, 2, 3, -4, 5} Expected Output: 5

Aim: To solve the problem of finding the maximum value in array with least time complexity

Algorithm:

- step 1: initialize an array.
- step 2: initialize maximum elements in an array
- step 3: iterate through array using for loop
- step 4: update maximum for each element
- step 5: return result value

Program:

```
def find_maximum_value(lst):  
    if not lst:  
        return None  
    max_value = lst[0]  
    for num in lst[1:]:  
        if num > max_value:  
            max_value = num  
    return max_value  
print(find_maximum_value([1, 2, 3, 4, 5]))
```

Input:

```
[1, 2, 3, 4, 5]
```


Output:

5

Time Complexity: $T(n)=O(n)$

Result: Maximum value in the array is successfully returned with less time complexity

6. You have an algorithm that process a list of numbers. It firsts sorts the list using an efficient sorting algorithm and then finds the maximum element in sorted list. Write the code for the same.

Test Cases

Input: [5]

Expected Output: 5

Aim: To Solve the problem of Finding the Maximum Value in array of Integers With Least Time Complexity.

Algorithm:

Step-1: Intialize an Array.

Step-2: Intialize Maximum Element of an Array.

Step-3: Iterate Through Array using for Loop.

Step-4: Update Maximum for each Element.

Step-5: Return Result Value.

Program:

```
1 def sort_and_find_max_alternative(input_list):
2     sorted_list = sorted(input_list)
3     max_element = sorted_list[-1]
4     return max_element
5 input_list = [1,2,3,4,5]
6 result = sort_and_find_max_alternative(input_list)
7 print(result) |
```

Input:

```
input_list = [1,2,3,4,5]
```

Output:

Output

5

Time Complexity: $T(n)=O(n)$

Result: Maximum Value in an Array with Least Time Complexity is Successfully Executed.

7. Write a program that takes an input list of n numbers and creates a new list containing only the unique elements from the original list. What is the space complexity of the algorithm? Test Cases

Some Duplicate Elements

⌚ Input: [3, 7, 3, 5, 2, 5, 9, 2] ⌚

Expected Output: [3, 7, 5, 2, 9] (Order may vary based on the algorithm used)

Negative and Positive Numbers

⌚ Input: [-1, 2, -1, 3, 2, -2]

⌚ Expected Output: [-1, 2, 3, -2] (Order may vary)

List with Large Numbers

⌚ Input: [1000000, 999999, 1000000]

⌚ Expected Output: [1000000, 999999]

Aim: To create a new list containing only unique element from the original list

Algorithm:

step1: convert input list to set which automatically remove duplicate.

step2: convert the set back to list.

Program:

```
1 def unique_elements(nums):
2     return list(set(nums))
3
4 # Test cases
5 print(unique_elements([3, 7, 3, 5, 2, 5, 9, 2]))
6 print(unique_elements([-1, 2, -1, 3, 2, -2]))
7 print(unique_elements([1000000, 999999, 1000000]))
```

Input:

```
print(unique_elements([3, 7, 3, 5, 2, 5, 9, 2]))
print(unique_elements([-1, 2, -1, 3, 2, -2]))
```

Output:

```
Output
[2, 3, 5, 7, 9]
[2, 3, -1, -2]
[1000000, 999999]
```

Time complexity: $T(n) = O(n)$

Result: The order of elements in the output list may vary as set data structure does not preserve original order of element

8. Sort an array of integers using the bubble sort technique. Analyze its time complexity using Big-O notation. Write the code

AIM: To create a new list containing only the unique elements from original list.

ALGORITHM:

STEP1: convert input list to set which automatically removes duplicate

step2:convert the set back to list

PROGRAM:

```
1 arr = [64, 34, 25, 12, 22, 11, 90]
2
3 n = len(arr)
4 for i in range(n):
5     for j in range(0, n-i-1):
6         if arr[j] > arr[j+1]:
7             arr[j], arr[j+1] = arr[j+1], arr[j]
8
9 print("Sorted array is:", arr)
```

INPUT:

```
arr = [64, 34, 25, 12, 22, 11, 90]
```

OUTPUT:

```
Output
Sorted array is: [11, 12, 22, 25, 34, 64, 90]
```

TIME COMPLEXITY: $t(n)=O(n^2)$

RESULT:The order of elements in the output list mayas set data structure does not preserve original

9. Checks if a given number x exists in a sorted array arr using binary search. Analyze its time complexity using Big-O notation.

Test Case:

Example X={ 3,4,6,-9,10,8,9,30} KEY=10

Output: Element 10 is found at position 5

Aim: The aim is to check if a given number x exists in sorted array

Algorithm:

step 1:initialize low to 0 and high to length of array-1.

step 2:while low<=high

step 3:return -1

Program:

```
def binary_search(arr, key):
    arr.sort()
    low = 0
    high = len(arr) - 1
    while low <= high:
        mid = (low + high) // 2
        if arr[mid] == key:
            return mid
        elif arr[mid] < key:
            low = mid + 1
        else:
            high = mid - 1
    return -1
arr = [3, 4, 6, -9, 10, 8, 9, 30]
key = 10
index = binary_search(arr, key)
if index != -1:
    print(f"Element {key} is found at position {index}")
else:
    print(f"Element {key} is not found")
```

Input:

```
[3, 4, 6, -9, 10, 8, 9, 30]
```

Output:

```
Element 10 is found at position 6
```

Time complexity: $T(n) = O(\log(n))$

Result: The binary search algorithm is efficient for searching the large sorted arrays with time complexity $O(\log(n))$

10. Given an array of integers nums, sort the array in ascending order and return it. You must solve the problem without using any built-in functions in $O(n \log(n))$ time complexity and with the smallest space complexity possible.

Aim: The aim is to implement a sorting algorithm that meets the given constant

Algorithm:

step1: Divide the array into new values until each subarray into one element

step2: Merge the subarray each together in sorted order.

Program:

```

1 def merge_sort(nums):
2     if len(nums) <= 1:
3         return nums
4     mid = len(nums) // 2
5     left = merge_sort(nums[:mid])
6     right = merge_sort(nums[mid:])
7     return merge(left, right)
8
9 def merge(left, right):
10    result = []
11    i, j = 0, 0
12    while i < len(left) and j < len(right):
13        if left[i] < right[j]:
14            result.append(left[i])
15            i += 1
16        else:
17            result.append(right[j])
18            j += 1
19    result.extend(left[i:])
20    result.extend(right[j:])
21    return result
22
23 # Test the function
24 print(merge_sort([5, 2, 8, 1, 9])) # Output: [1, 2, 5, 8, 9]

```

Input:

```

# Test the function
print(merge_sort([5, 2, 8, 1, 9]))

```

Output:

Output
[2, 3, 5, 7, 9]
[2, 3, -1, -2]
[1000000, 999999]

Time complexity: $T(n) = O(n \log(n))$

Result: the output program is the sorted array in ascending order.