Name: M.Rohith Finding errors in code 3122 21 5001 085

Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam - 603 110 (An Autonomous Institution, Affiliated to Anna University, Chennai)

UCS2403: DESIGN & ANALYSIS OF ALGORITHMS Assignment 3

- Given a list L of n numbers, an inversion is defined as a pair (L[i],L[j]) such that i < j and L[i] > L[j]. For example, if L = [3,2,8,1], then (3, 2), (8, 1), (2, 1), (3, 1) are the inversions in L.
 - (a) Consider the Python codes given in (1) and (2) below for finding the count of inversions in a list.

```
(1) def count_inversions1(nums):
```

```
count = 0
    for i in range(1, len(nums)):
       if nums[i] < nums[i - 1]:
          count += 1
     return count
(2) def count_inversions2(nums):
    nums.sort()
    count = 0
     for i in range(1, len(nums)):
       if nums[i] < nums[i - 1]:
          count += 1
```

return count

Both the given codes have errors. Find one counterexample for each of them. Recall that a counterexample is an input instance to the algorithm that produces a wrong output.

(b) Write your own (correct) code to find the count of inversions in a list.

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A) Incorrect Program code:

```
def count_inversions1(nums):
    count = 0
    for i in range(1, len(nums)):
        if nums[i] < nums[i - 1]:
            count += 1
    return count
nums=[7,8,3,1,5]
print("The iversions count: ",count_inversions1(nums))</pre>
```

Output:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

/usr/local/bin/python3 "/Users/cseb08/Desktop/Rohi
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
gml8:~ cseb08$ /usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/Error.py"
The iversions count: 2
gml8:~ cseb08$
```

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The number of inversions in the given list is 7, but the output obtained is 2.

Incorrect Program code:

```
def count_inversions2(nums):
    nums.sort()
    count = 0
    for i in range(1, len(nums)):
        if nums[i] < nums[i - 1]:
            count += 1
    return count
nums=[7,8,3,1,5]
print("The iversions count: ",count_inversions2(nums))</pre>
```

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Output:

```
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
gml8:~ cseb00$ / usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/Error.py"
The iversions count: 0
gml8:~ cseb08$
```

The number of inversions in the given list is 7, but the output obtained is 0.

Correct Program code:

Output:

This is the correct output as the inversions in the given list [7,8,3,1,5] are [(7,3),(7,1),(7,5),(8,3),(8,1),(8,5),(3,1)] and hence the count is 7.

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

/usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/1b.py"

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh −s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
gml8:~ cseb08$ /usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/1b.py"
7
gml8:~ cseb08$
```

gorithm sorts the list as

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2. Given a list of integers, the comparison count sorting algorithm sorts the list as follows: For each integer at index i in the list, count the number of integers that are strictly less than it. In the sorted list, place the integer at the index equal to the number of integers that are less than it. For example, there are no integers less than the minimum integer in the list, so the minimum integer is placed at index 0.

Now, consider the code given below to sort a list of numbers using com- parison count sort.

Find a counterexample to show that this code has errors. List the lines of code that have errors.

<u>Incorrect Program code:</u>

```
def comparison_count_sort(nums):
    count = [0] * len(nums)
    nums_sorted = [0] * len(nums)
    for i in range(len(nums) - 1):
        for j in range(i + 1, len(nums)):
            if nums[i] > nums[j]:
                count[i] += 1
            elif nums[i] < nums[j]:
                count[j] += 1
    for i in range(len(nums)):
        nums_sorted[count[i]] = nums[i]
    return nums_sorted
print(comparison_count_sort([11,2,4,1,11,5,6,77,6,4,-1]))</pre>
```

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Output:

```
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/usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/Error.py"

The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
gml8:~ cseb08$ /usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/Error.py"
[-1, 1, 2, 4, 0, 5, 6, 0, 11, 0, 77]
gml8:~ cseb08$
```

When numbers in the list are repeated, the repeated numbers in the sorted list are replaced with 0.

Correct Program code:

```
def comparison_count_sort(nums):
        count = [0] * len(nums)
        nums_sorted = [0] * len(nums)
        for i in range(len(nums) - 1):
            for j in range(i + 1, len(nums)):
                if nums[i] > nums[j]:
                    count[i] += 1
                elif nums[i] < nums[j]:</pre>
                    count[j] += 1
        for i in range(len(nums)):
            nums_sorted[count[i]] = nums[i]
        for i in range(len(nums_sorted)):
         if nums_sorted[i]==0:
                 nums sorted[i]=nums sorted[i-1]
        return nums_sorted
print(comparison_count_sort([11,2,4,1,11,5,6,77,6,4,-1]))
```

Output:

In order to get the correct output, we replaced the 0 with the previous element in the sorted list.

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

/usr/local/bin/python3 "/Users/cseb08/Desktop/Rohi
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
gml8:~ cseb08$ /usr/local/bin/python3 "/Users/cseb08/Desktop/Rohith/Assignment 3/2.py"
[-1, 1, 2, 4, 4, 5, 6, 6, 11, 11, 77]
gml8:~ cseb08$
```