**Objective:** Implementation of Radix Sort

# Radix Sort

Radix sort is a sorting technique that sorts the elements by first grouping the individual digits of the same place value. Then, sort the elements according to their increasing/decreasing order.

## Radix Sort Algorithm:

```
radixSort(array)

  d <- maximum number of digits in the largest element

  create d buckets of size 0-9

  for i <- 0 to d

    sort the elements according to ith place digits using countingSort

countingSort(array, d)

  max <- find largest element among dth place elements

  initialize count array with all zeros

  for j <- 0 to size

    find the total count of each unique digit in dth place of elements and

    store the count at jth index in count array

  for i <- 1 to max

    find the cumulative sum and store it in count array itself

  for j <- size down to 1

    restore the elements to array

decrease count of each element restored by 1
```

## How Radix Sort Works?

1. Find the largest element in the array, i.e. `max`. Let `X` be the number of digits in `max`. `X` is calculated because we have to go through all the significant places of all elements.
2. Now, go through each significant place one by one.Use any stable sorting technique to sort the digits at each significant place. We have used counting sort for this.Sort the elements based on the unit place digits (`X=0`).
3. Now, sort the elements based on digits at tens place.
4. Finally, sort the elements based on the digits at hundreds place.

**Code**:

```
def RadixSort(nums):
    r = 10
    place = 1
    maximum = max(nums)
    while place < maximum:
        buckets = [list() for _ in range( r )]
        for i in nums:
            tmp = int((i / place) % r)
            buckets[tmp].append(i)
        a = 0
        for b in range( r ):
        bucket = buckets[b]
            for i in bucket:
            nums[a] = i
```

```
            a += 1
        place *= r
        print(nums)
    return nums
data = [10,50,4,2,1,100,200]
sorted = RadixSort(data)
print('Sorted Array:',sorted)
```

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```

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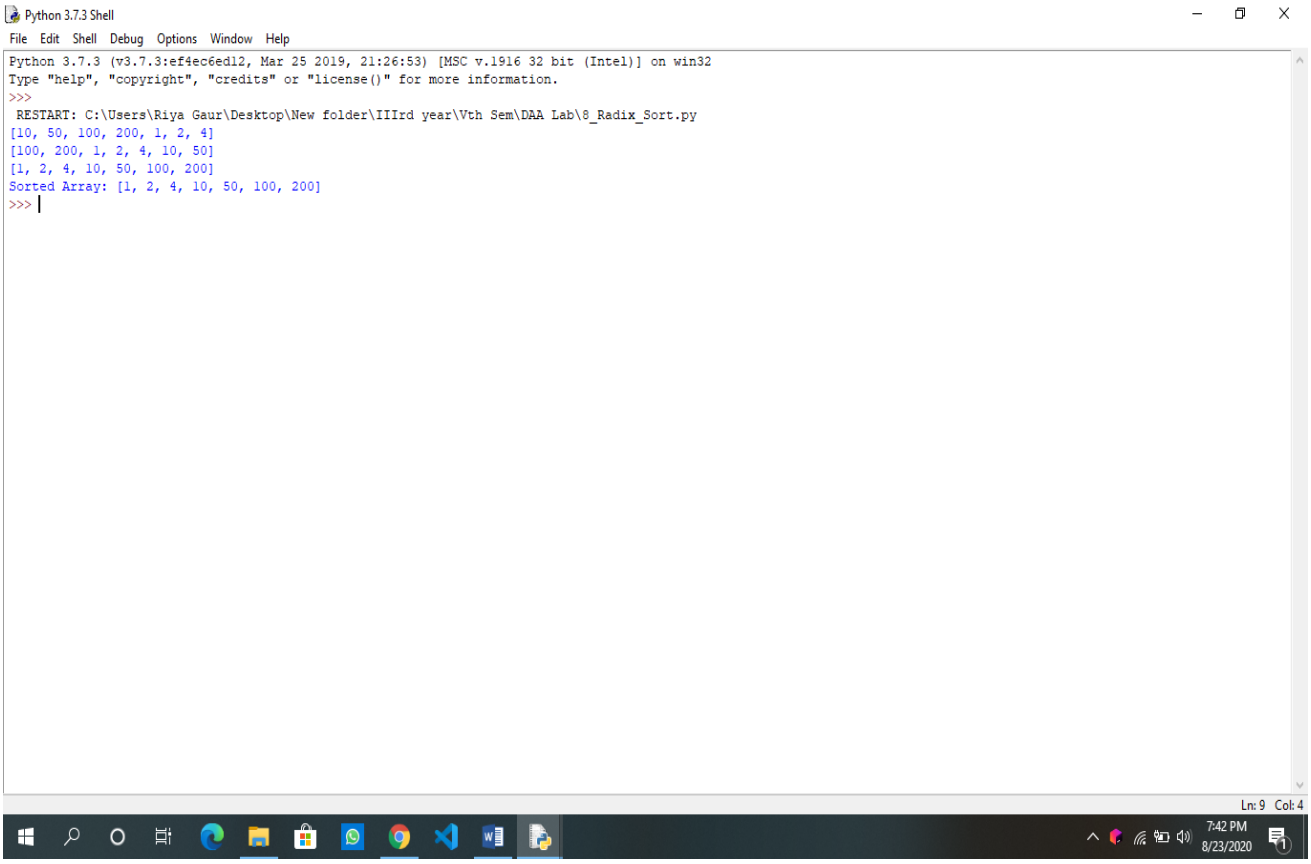
**Output:**

```
[10, 50, 100, 200, 1, 2, 4]
[100, 200, 1, 2, 4, 10, 50]
[1, 2, 4, 10, 50, 100, 200]
Sorted Array: [1, 2, 4, 10, 50, 100, 200]
```




**Time Complexities:**

Radix sort complexity is $O(kn)$ for n keys which are integers of word size k.

For all there cases time i.e best , worst and average time complexity is O(kn).

**Radix Sort Applications:**

Radix sort is implemented in

- DC3 algorithm (Kärkkäinen-Sanders-Burkhardt) while making a suffix array.
- places where there are numbers in large ranges.