Selection, Merge & Radix Sorts

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Sorting

- Sorting means arranging the elements of an array so that they are placed in some relevant order which may be either **ascending** or **descending**

- A sorting algorithm is defined as an algorithm that puts the elements of a list in a certain order, which can be either **numerical** order, **lexicographical** order, or **any user-defined** order
  - **Bubble, Insertion**, Selection, **Tree**
  - Merge, Quick, Radix, Heap, Shell

Selection Sort.

- Selection sort is also a simple algorithm for sorting

- The procedure of the selection sort
  - Consider an array with N elements
    - First find the smallest value in the array and place it in the first position
    - Then, find the second smallest value in the array and place it in the second position
    - Repeat this procedure until the entire array is sorted

Example

- Please sort a given data array by using selection sort

39	9	81	45	90	27	72	18

PASS	ARR[0]	ARR[1]	ARR[2]	ARR[3]	ARR[4]	ARR[5]	ARR[6]	ARR[7]
1	9	39	81	45	90	27	72	18
2	9	18	81	45	90	27	72	39
3	9	18	27	45	90	81	72	39
4	9	18	27	39	90	81	72	45
5	9	18	27	39	45	81	72	90
6	9	18	27	39	45	72	81	90
7	9	18	27	39	45	72	81	90

Selection Sort..

```
SMALLEST (ARR, K, N, POS)

Step 1: [INITIALIZE] SET SMALL = ARR[K]
Step 2: [INITIALIZE] SET POS = K
Step 3: Repeat for J = K+1 to N-1
            IF SMALL > ARR[J]
                  SET SMALL = ARR[J]
                  SET POS = J
            [END OF IF]
        [END OF LOOP]
Step 4: RETURN POS
```

```
SELECTION SORT(ARR, N)

Step 1: Repeat Steps 2 and 3 for K = 0
        to N-1
Step 2:     CALL SMALLEST(ARR, K, N, POS)
Step 3:     SWAP A[K] with ARR[POS]
      [END OF LOOP]
Step 4: EXIT
```

39	9	81	45	90	27	72	18

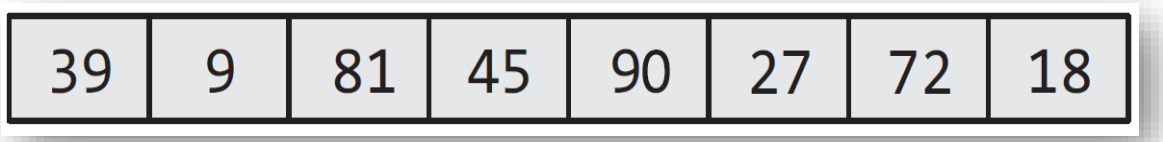
PASS	ARR[0]	ARR[1]	ARR[2]	ARR[3]	ARR[4]	ARR[5]	ARR[6]	ARR[7]
1	9	39	81	45	90	27	72	18
2	9	18	81	45	90	27	72	39
3	9	18	27	45	90	81	72	39
4	9	18	27	39	90	81	72	45
5	9	18	27	39	45	81	72	90
6	9	18	27	39	45	72	81	90
7	9	18	27	39	45	72	81	90

Merge Sort.

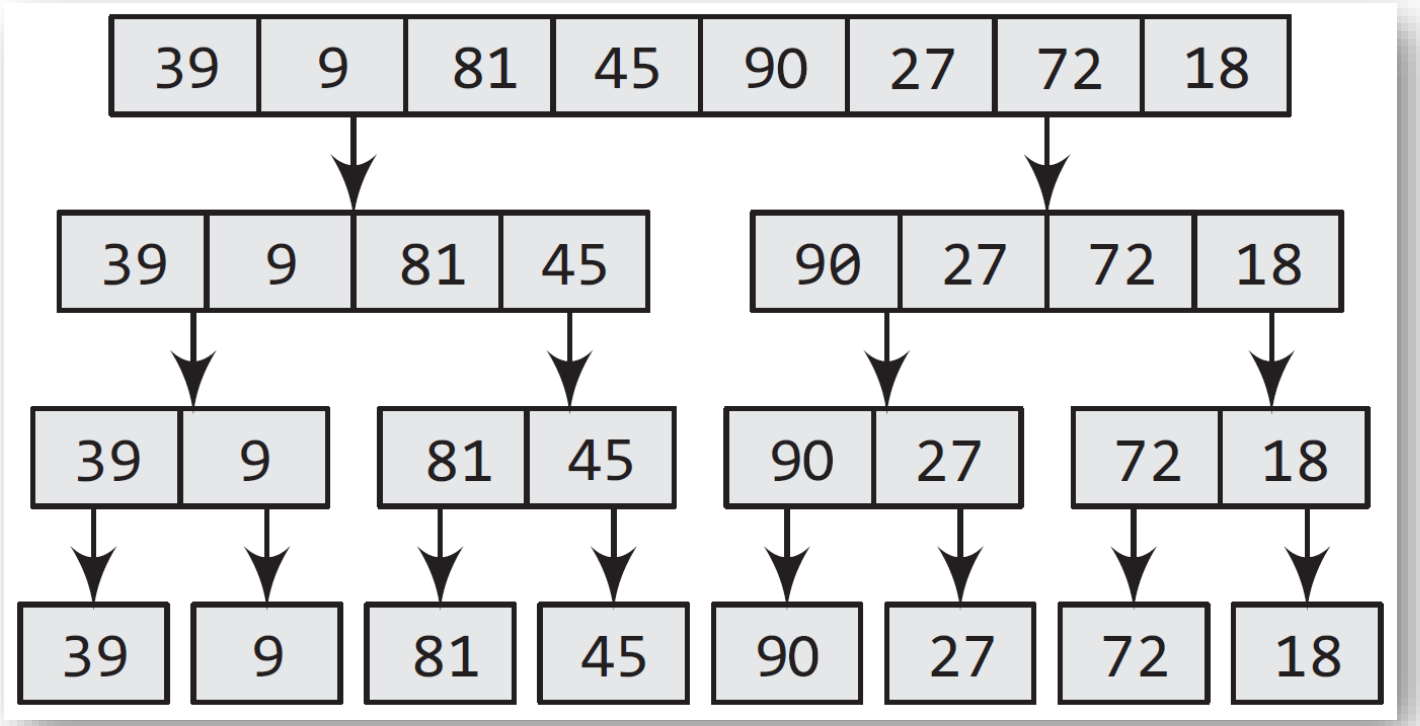
- Merge sort is a sorting algorithm that uses the **divide**, **conquer**, and **combine** algorithmic paradigm
  - ***Divide*** means partitioning the n-element array to be sorted into two sub-arrays
  - ***Conquer*** means sorting the two sub-arrays recursively
  - ***Combine*** means merging the two sorted sub-arrays

Example.

- Sort the given array using merge sort

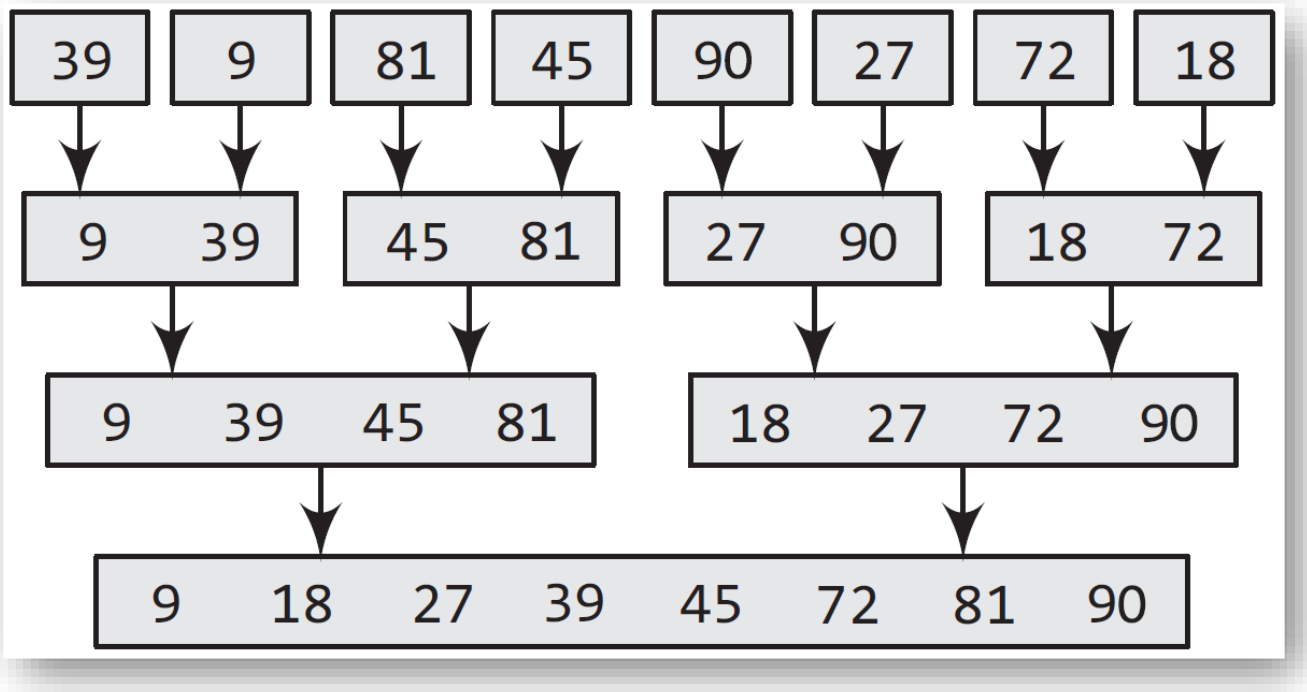


  - Divide and Conquer



Example..

- Conquer & Combine

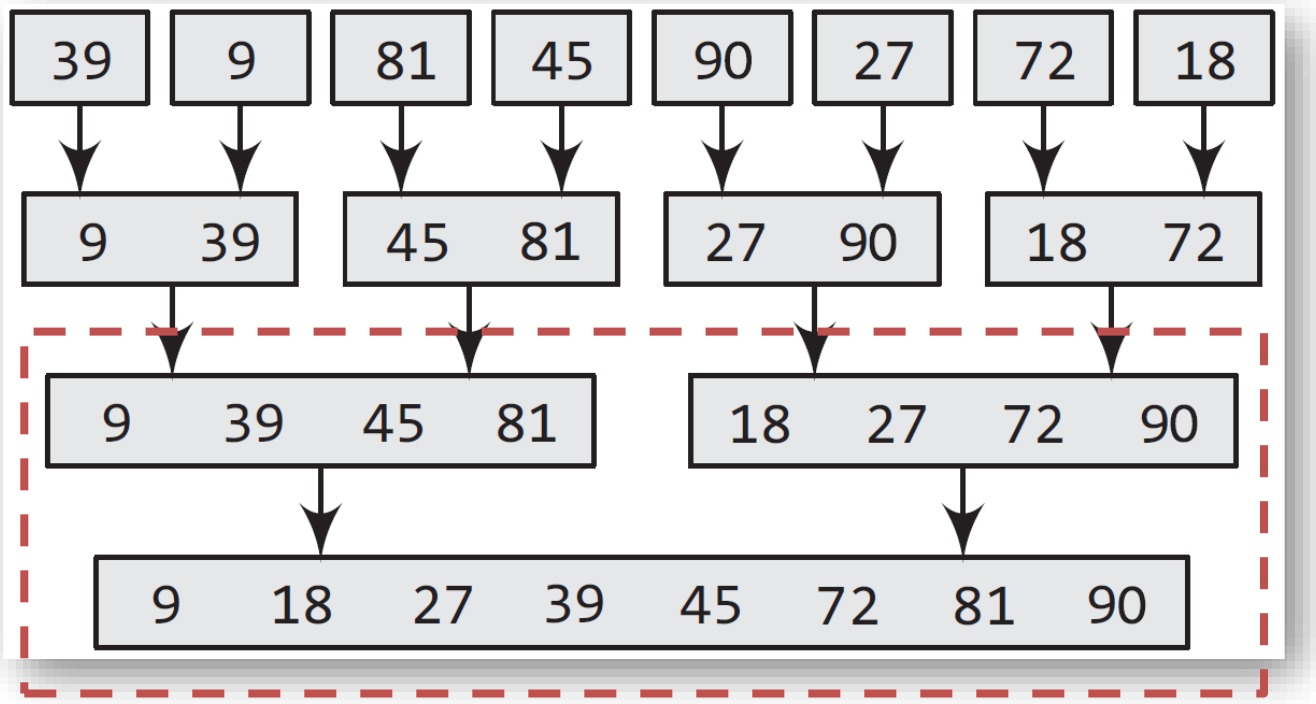


Merge Sort..

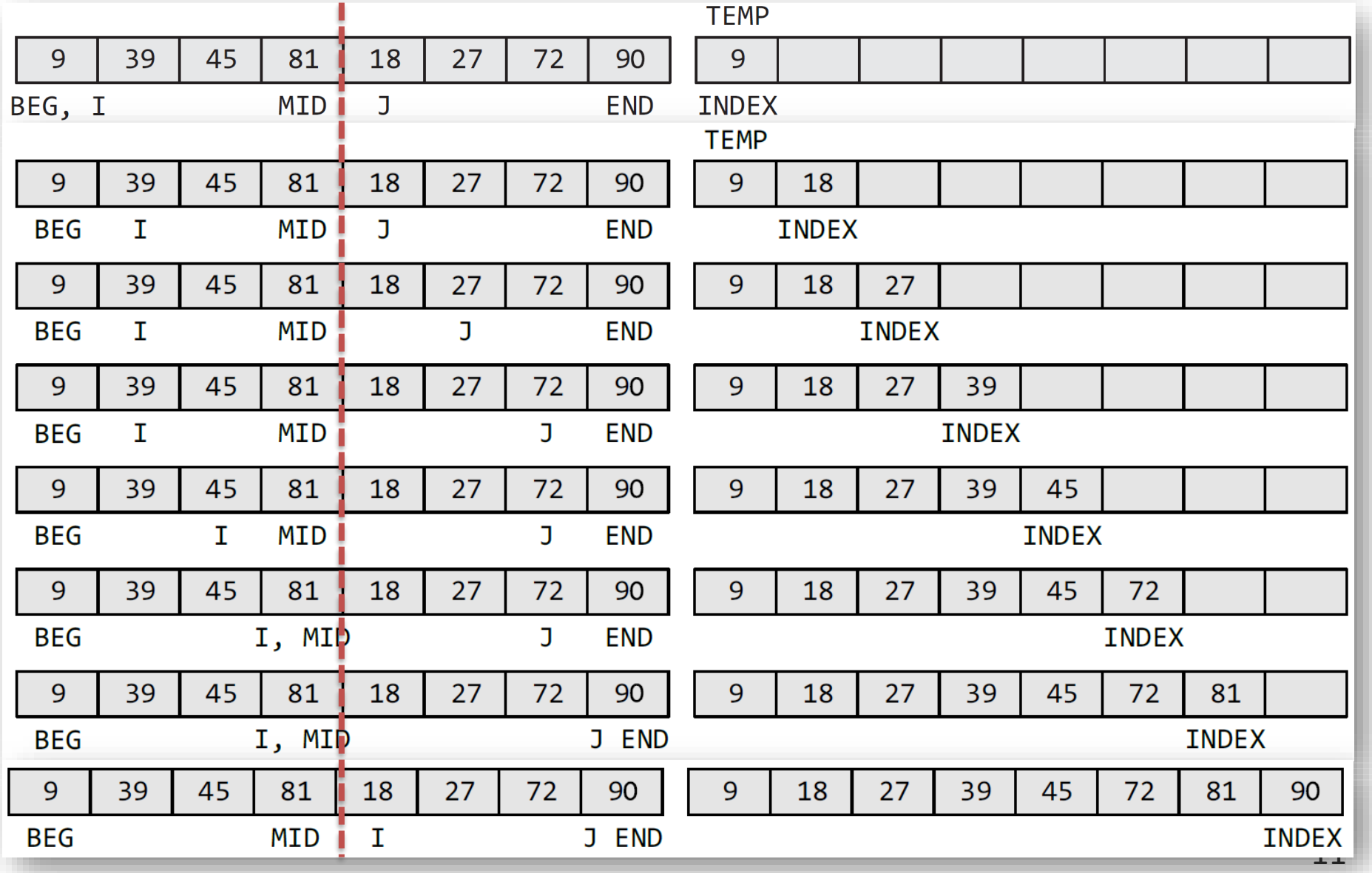
```
MERGE_SORT(ARR, BEG, END)
Step 1: IF BEG < END
            SET MID = (BEG + END)/2
            CALL MERGE_SORT (ARR, BEG, MID)
            CALL MERGE_SORT (ARR, MID + 1, END)
            MERGE (ARR, BEG, MID, END)
        [END OF IF]
Step 2: END
```

Merge Sort…

- The concept of the merge function is to compare two sub-arrays (ARR[I] and ARR[J]), the smaller of the two is placed in a temp array (TEMP) at the location specified by a index (INDEX) and subsequently the index value (I or J) is incremented
  - Example for the merge function



Merge Sort….

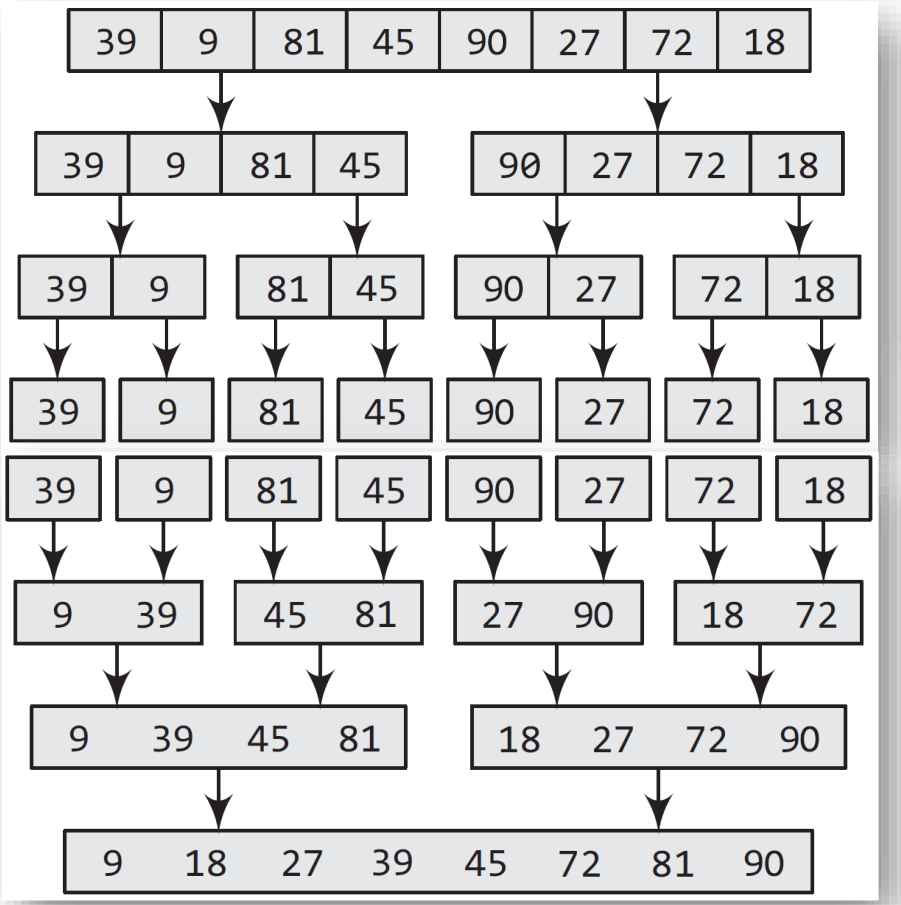

TEMP
9 39 45 81 18 27 72 90
9
BEG, I MID J END
INDEX
TEMP
9 39 45 81 18 27 72 90
9 18
BEG I MID J END
INDEX
9 39 45 81 18 27 72 90
9 18 27
BEG I MID J END
INDEX
9 39 45 81 18 27 72 90
9 18 27 39
BEG I MID J END
INDEX
9 39 45 81 18 27 72 90
9 18 27 39 45
BEG I MID J END
INDEX
9 39 45 81 18 27 72 90
9 18 27 39 45 72
BEG I, MID J END
INDEX
9 39 45 81 18 27 72 90
9 18 27 39 45 72 81
BEG I, MID J END
INDEX
9 39 45 81 18 27 72 90
9 18 27 39 45 72 81 90
BEG MID I J END
INDEX

Merge Sort…..

```
MERGE (ARR, BEG, MID, END)

Step 1: [INITIALIZE] SET I = BEG, J = MID + 1, INDEX = O
Step 2: Repeat while (I <= MID) AND (J<=END)
            IF ARR[I] < ARR[J]
                  SET TEMP[INDEX] = ARR[I]
                  SET I = I + 1
            ELSE
                  SET TEMP[INDEX] = ARR[J]
                  SET J = J + 1
            [END OF IF]
            SET INDEX = INDEX + 1
      [END OF LOOP]
```

Merge Sort……




```
MERGE_SORT(ARR, BEG, END)
Step 1: IF BEG < END
            SET MID = (BEG + END)/2
            CALL MERGE_SORT (ARR, BEG, MID)
            CALL MERGE_SORT (ARR, MID + 1, END)
            MERGE (ARR, BEG, MID, END)
        [END OF IF]
Step 2: END
```

```
MERGE (ARR, BEG, MID, END)

Step 1: [INITIALIZE] SET I = BEG, J = MID + 1, INDEX = 0
Step 2: Repeat while (I <= MID) AND (J<=END)
            IF ARR[I] < ARR[J]
                  SET TEMP[INDEX] = ARR[I]
                  SET I = I + 1
            ELSE
                  SET TEMP[INDEX] = ARR[J]
                  SET J = J + 1
            [END OF IF]
            SET INDEX = INDEX + 1
      [END OF LOOP]
```

Radix Sort.

- Radix sort is a linear sorting algorithm for **integers** and uses the concept of sorting names in alphabetical order
  - Radix sort is also known as bucket sort

```
Algorithm for RadixSort (ARR, N)

Step 1: Find the largest number in ARR as LARGE
Step 2: [INITIALIZE] SET NOP = Number of digits in LARGE
Step 3: SET PASS = 0
Step 4: Repeat Step 5 while PASS <= NOP-1
Step 5:            SET I = 0 and INITIALIZE buckets
Step 6:            Repeat Steps 7 to 9 while I<N-1
Step 7:                  SET DIGIT  = digit at PASSth place in A[I]
Step 8:                  Add A[I] to the bucket numbered DIGIT
Step 9:                  INCEREMENT bucket count for bucket numbered DIGIT
                   [END OF LOOP]
Step 10:           Collect the numbers in the bucket
        [END OF LOOP]
Step 11: END
```

Example.

- Sort the given numbers using radix sort

345, 654, 924, 123, 567, 472, 555, 808, 911

  - The first step: The numbers are sorted according to the digit at ones place
    - The new order is 911, 472, 123, 654, 924, 345, 555, 567, 808

Number	0	1	2	3	4	5	6	7	8	9
345						345				
654					654					
924					924					
123				123						
567								567		
472			472							
555						555				
808									808	
911		911								

Example..

- After the first step, the new sequence is 911, 472, 123, 654, 924, 345, 555, 567, 808

- The second step
  - The numbers are sorted according to the digit at the tens place
  - Consequently, the new order is: 808, 911, 123, 924, 345, 654, 555, 567, 472

Number	0	1	2	3	4	5	6	7	8	9
911		911								
472								472		
123			123							
654						654				
924			924							
345					345					
555						555				
567							567			
808	808									

Example…

- After the second step, the new sequence is 808, 911, 123, 924, 345, 654, 555, 567, 472

- The third step is
  - The numbers are sorted according to the digit at the hundreds place
  - Finally, the ordered sequence is: 123, 345, 555, 567, 654, 808, 911, 924

Number	0	1	2	3	4	5	6	7	8	9
808									808	
911										911
123		123								
924										924
345				345						
654							654			
555						555				
567						567				
472					472					

Questions?

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