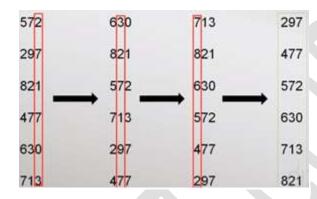
## **Radix Sort (Integers)**

What is Radix? The radix (or base) is the number of unique digits, including zero, used to represent numbers in a positional numeral system.

For example, for the decimal system: radix is 10, Binary system: radix is 2.

## **Example Radix Sort:**

- **Step 1**: take the least significant digits (LSD) of the values to be sorted.
- **Step 2**: sort the list of elements based on that digit.
- Step 3: take the 2<sup>nd</sup> LSD and repeat step 2. Then the 3<sup>rd</sup> LSD and so on.



## Radix Sort Algorithm using linked lists:

Consider the following array:

9	179	139	38	10	5	36
---	-----	-----	----	----	---	----

- Create an array of 10 empty linked lists as follow: ->
  - 0 to 9 refer to actual numbers.
  - With input numbers, we will start with mod 10 then divide the resulted number by 1.

Code: start with:

- m=10 → mod operation
- n=1 → find the specific digit at that column

e.g. 
$$Arr[0] = 9$$

- In this case add Arr[0] to the 10<sup>th</sup> linked list
- Repeat for remaining array elements.

• If we reach the end of array: Copy back data from linked lists in order to the array:

10	) 5	36	38	9	179	139	1
					-, -		

Is this sorted? NO

$0   \rightarrow 10$ $1   \rightarrow$ $2   \rightarrow$ $3   \rightarrow$ $4   \rightarrow$ $5   \rightarrow 5$ $6   \rightarrow 36$ $7   \rightarrow$ $8   \rightarrow 38$		
$2 \mid \rightarrow$ $3 \mid \rightarrow$ $4 \mid \rightarrow$ $5 \mid \rightarrow 5$ $6 \mid \rightarrow 36$ $7 \mid \rightarrow$ $8 \mid \rightarrow 38$	0   -> 10	)
3   → 4   → 5   → 5 6   → 36 7   → 8   → 38	1   →	
4   → 5   → 5 6   → 36 7   → 8   → 38	2   →	
5   → 5 6   → 36 7   → 8   → 38	3   →	
6   → 36 7   → 8   → 38	4   <del>&gt;</del>	
7   → 8   → 38	5   <del>→</del> 5	
8   → 38	6   <del>&gt;</del> 36	5
	7   <del>&gt;</del>	
$0.1 \rightarrow 0. \rightarrow 170. \rightarrow 120.$	8   > 38	
9   7 9 7 1 / 9 7 1 3 9	9   → 9	→179 →139

1

3

4

5

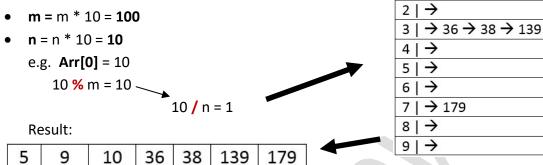
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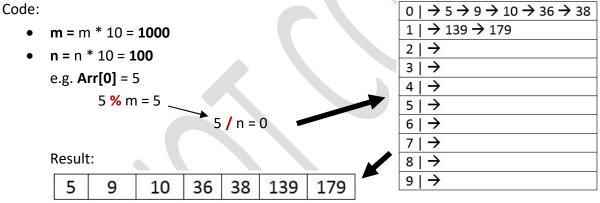
 $0 \mid \rightarrow 5 \rightarrow 9$  $1 \mid \rightarrow 10$ 

•	<b>Next step:</b> consider the <b>2</b> <sup>nd</sup> significant digit from the previous
	resulted array:
Со	de:
	• m = m * 10 = <b>100</b>



Is this sorted? Yes, in this case but we are not done yet

**Next step:** consider the **3**<sup>rd</sup> significant digit from the previous array:



Is this sorted? What is the time complexity?

**HW: implement Radix sort using Single Linked List** 

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