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.

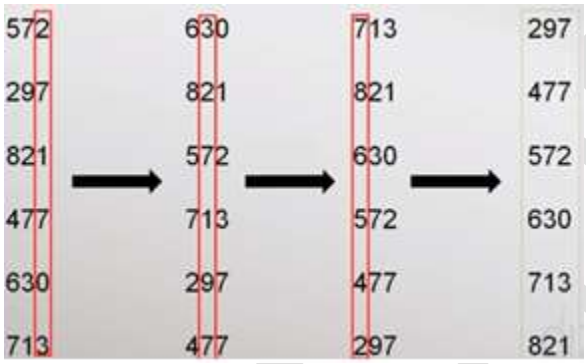
For example, for the decimal system: radix is **10**, Binary system: radix is **2**.

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 2nd LSD and repeat step 2. Then the 3rd 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

  9 **%** m = 9 → 9 **/** n = 9
  - In this case add **Arr[0]** to the **10th** 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

Is this sorted? NO

0 →
1 →
2 →
3 →
4 →
5 →
6 →
7 →
8 →
9 →

0 | → 10
1 | →
2 | →
3 | →
4 | →
5 | → 5
6 | → 36
7 | →
8 | → 38
9 | → 9 → 179 → 139

- **Next step:** consider the **2nd** significant digit from the previous resulted array:

Code:

- **m =** m * 10 = **100**
- **n** = n * 10 = **10**

e.g. **Arr[0]** = 10

10 **%** m = 10 → 10 **/** n = 1

0 | → 5 → 9
1 | → 10
2 | →
3 | → 36 → 38 → 139
4 | →
5 | →
6 | →
7 | → 179
8 | →
9 | →

Result:

5	9	10	36	38	139	179

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

- **Next step:** consider the **3rd** significant digit from the previous array:

Code:

- **m =** m * 10 = **1000**
- **n =** n * 10 = **100**

e.g. **Arr[0]** = 5

5 **%** m = 5 → 5 **/** n = 0

0 | → 5 → 9 → 10 → 36 → 38
1 | → 139 → 179
2 | →
3 | →
4 | →
5 | →
6 | →
7 | →
8 | →
9 | →

Result:

5	9	10	36	38	139	179

Is this sorted? What is the time complexity?

HW: implement Radix sort using Single Linked List