Lecture 24 Exercise Solutions

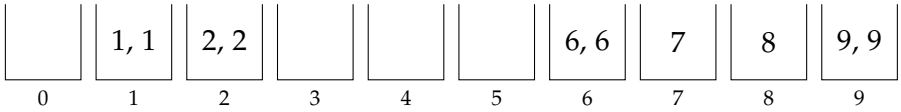
Mark Eramian

Exercise 1

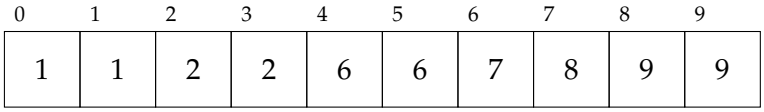
a) Works best for numbers in a small range.

b) Time complexity is $O(n)$ because each key gets put in a bucket, then each key gets removed from a bucket and appended to the final sequence. Let m be the number of possible values that a key could take on. Since we need a bucket for each possible value, the space complexity of bucket sort is $O(m)$. This is why bucket sort is best for keys that have a small range of values.

c) After putting keys in buckets:

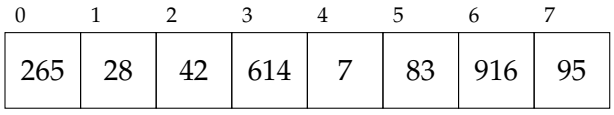


After removing elements from buckets from left to right and appending them to output array:

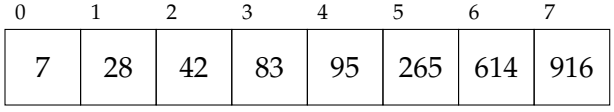


Exercise 2

a) Integer array sorted by MSD radix algorithm:



b) Integer array sorted by LSD radix algorithm:



Exercise 3

a) String array sorted by MSD radix algorithm:

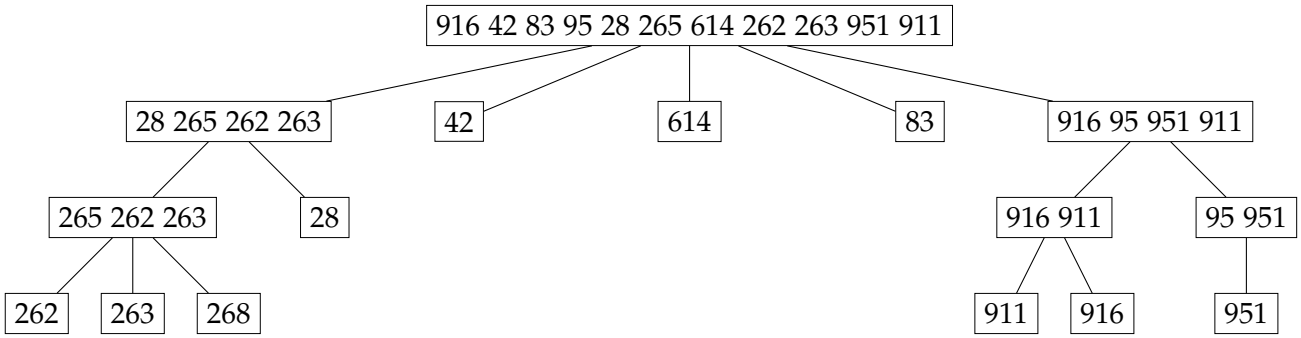
0	1	2	3	4	5	6	7
"coming"	"die"	"is"	"or"	"win"	"winter"	"you"	"you"

b) String array sorted by LSD radix algorithm:

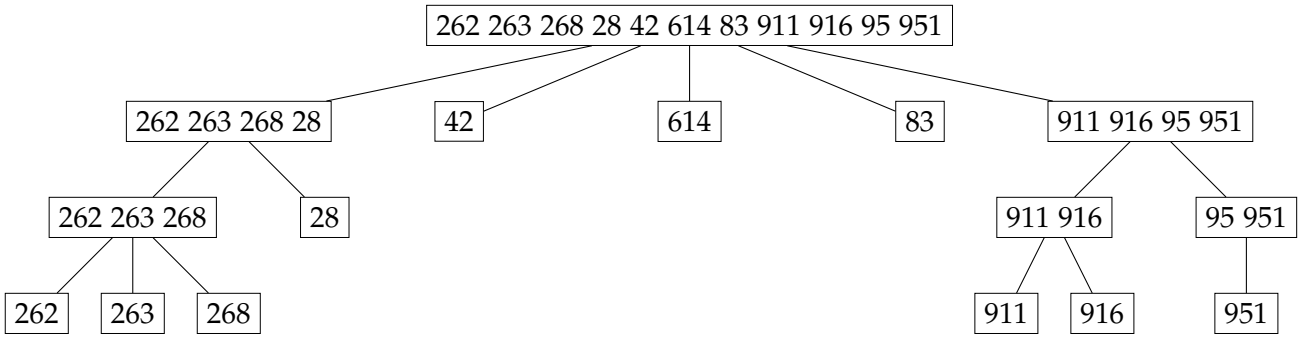
0	1	2	3	4	5	6	7
"is"	"or"	"die"	"win"	"you"	"you"	"coming"	"winter"

Exercise 4

This is a bit hard to visualize. First, here is the recursion tree showing the structure of recursive calls and their **input** sequences. Note that the left to right order of recursive calls (siblings) corresponds to recursing on the buckets in order from digit 0 to digit 9. Nodes at level 1 are bucket-sorted on the first digit of keys, level 2 on the second digit of keys, and level 3 the third digit of keys (remember: the root is level 0).

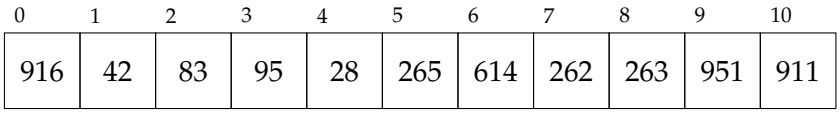


Now here is the recursion tree showing the **output** sequences of each recursive call. Basically as the recursion unwinds, siblings are concatenated to sequences in the proper order (like in the recursion tree for merge sort).

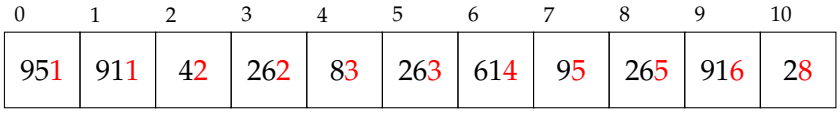


Exercise 5

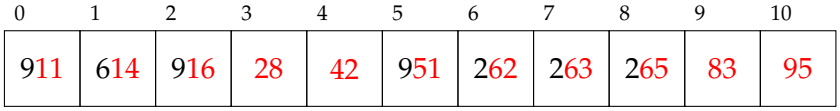
1. Input Array



2. After sorting on the last digit.



2. After sorting on the second-last digit. Keys are now sorted by the last 2 digits.



2. After sorting on the third-last digit (if no such digit, treat as a leading 0). Keys are now sorted by the last 3 digits