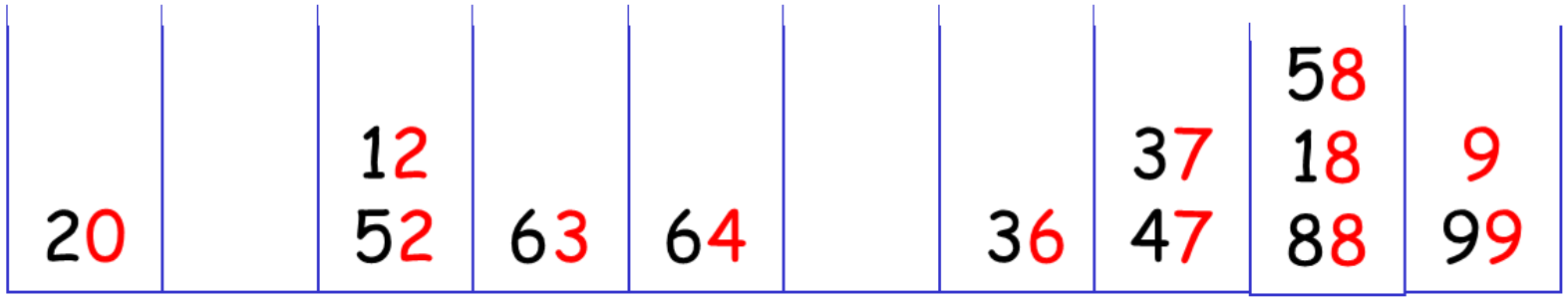
RADIX SORT

- Idea: repeatedly sort by digit—perform multiple bucket sorts on S starting with the rightmost digit
- If maximum value is 999999, only ten buckets (not 1 million) will be necessary
- Use this strategy when the keys are integers, and there is a reasonable limit on their values
  - Number of passes (bucket sort stages) will depend on the number of digits in the maximum value

EXAMPLE: FIRST PASS

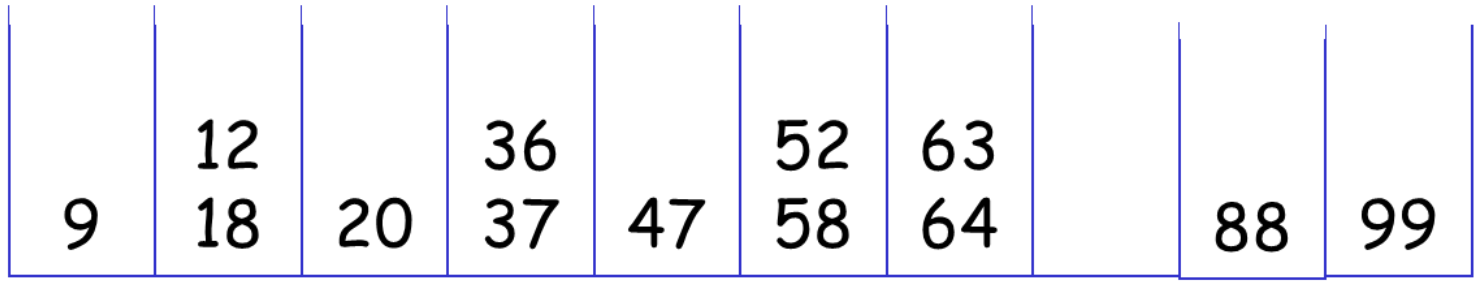
12	58	37	64	52	36	99	63	18	9	20	88	47



20	12	52	63	64	36	37	47	58	18	88	9	99

EXAMPLE: SECOND PASS

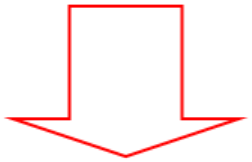
20	12	52	63	64	36	37	47	58	18	88	9	99



9	12	18	20	36	37	47	52	58	63	64	88	99

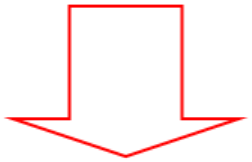
EXAMPLE: 1ST AND 2ND PASSES

12	58	37	64	52	36	99	63	18	9	20	88	47



sort by rightmost digit

20	12	52	63	64	36	37	47	58	18	88	9	99



sort by leftmost digit

9	12	18	20	36	37	47	52	58	63	64	88	99

RADIX SORT AND STABILITY

- Radix sort works as long as the bucket sort stages are **stable** sorts
- Stable sort: in case of ties, relative order of elements are preserved in the resulting array
  - Suppose there are two elements whose first digit is the same; for example, 52 & 58
  - If 52 occurs before 58 in the array prior to the sorting stage, 52 should occur before 58 in the resulting array
- This way, the work carried out in the previous bucket sort stages is preserved

TIME COMPLEXITY

- If there is a fixed number p of bucket sort stages (six stages in the case where the maximum value is 999999), then radix sort is O(n)
  - There are p bucket sort stages, each taking O(n) time
- Strictly speaking, time complexity is O(pn), where p is the number of digits (note that $p = \log_{10} m$, where m is the maximum value in the list)

ABOUT RADIX SORT

- Note that only 10 buckets are needed regardless of number of stages since the buckets are reused at each stage
- Radix sort can apply to words
  - Set a limit to the number of letters in a word
  - Use 27 buckets (or more, depending on the letters/characters allowed), one for each letter plus a “blank” character
  - The word-length limit is exactly the number of bucket sort stages needed