PARADIS: A Parallel Algorithm For In-Place Radix Sort

CME 323 Project

ROLLAND HE

Radix Sort

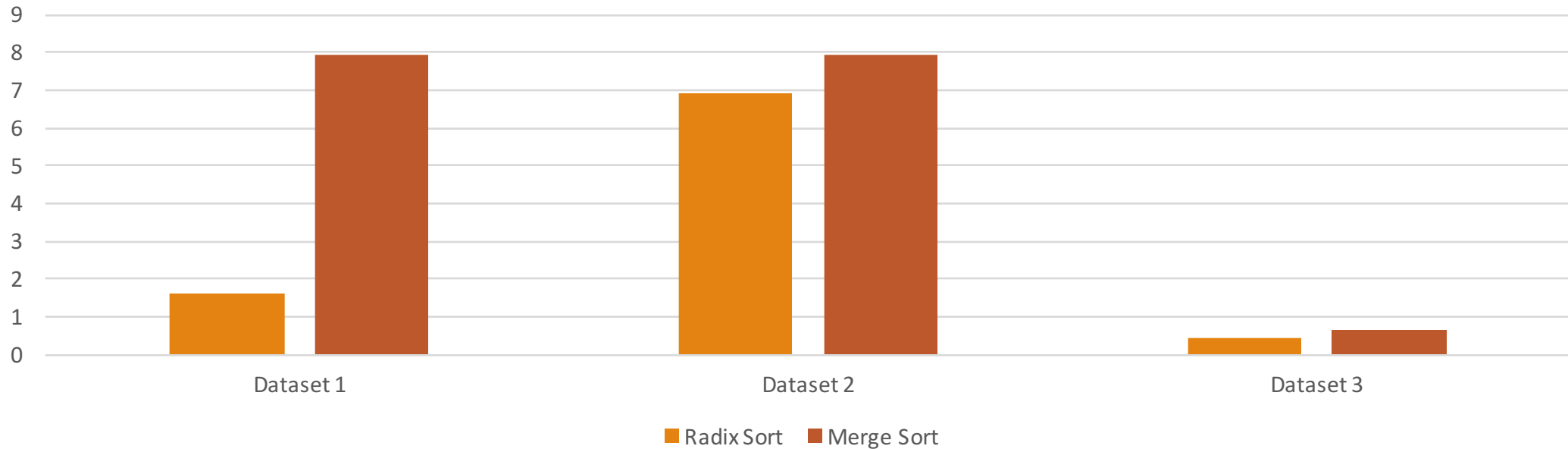- Non-comparative integer sorting algorithm
- Time complexity: O(kn), where k is largest number of digits of any element in the list
- Looks at single digits at a time, making k passes through the data
- Places elements in buckets instead of comparing them

Radix Sort

Runtime of Radix Sort vs Merge Sort

Dataset 1 – 1,000,000 random integers between 0 and 9,999
Dataset 2 – 1,000,000 random integers between 0 and 9.99e15
Dataset 3 – 100,000 random integers between 0 and 9.99e15

PARADIS

- Introduced in 2014 by researchers Cho, Brand, Bordawekar, Finkler, Kulandaisamy, and Puri from IBM
- Parallel in-place radix sort algorithm
- Prior ideas:
  - Parallelizing the building of the histogram
- 2 new main ideas:
  - Speculative permutation/repair
  - Distribution-adaptive load balancing technique

PARADIS - Analysis

- Time complexity $- O\left(n\left(\frac{1}{p} + w\right)\right)$, where p is the number of processors and w is the maximum fraction of elements that need to be repaired
  - Theoretical optimum $- O\left(\frac{n}{p}\right)$
- Depth $- O(\log n)$