CSE 373 / L-12 / 19.03.2024 /

Radix Sort

- used by the card sorting machines.
- solves the problem of cards - counterintuitively - by sorting on the least significant digit first.

⇒

329	720	720	329
457	355	329	355
657	436	436	436
839	457	839	457
436	657	355	657
720	329	457	720
355	839	657	839
	Stable Sorting	Stable	Stable

⇒ Algorithm:

RADIX - SORT (A, n, d) → number of maximum digit

$\Theta(d)$ { for i = 1 to d
use a stable sort to sort array A[1:n] on digit i

→ Counting Sort ⇒ Best in this case, because k is known and value is 9. → $\Theta(n+k)$

→ Merge Sort

→ Insertion Sort

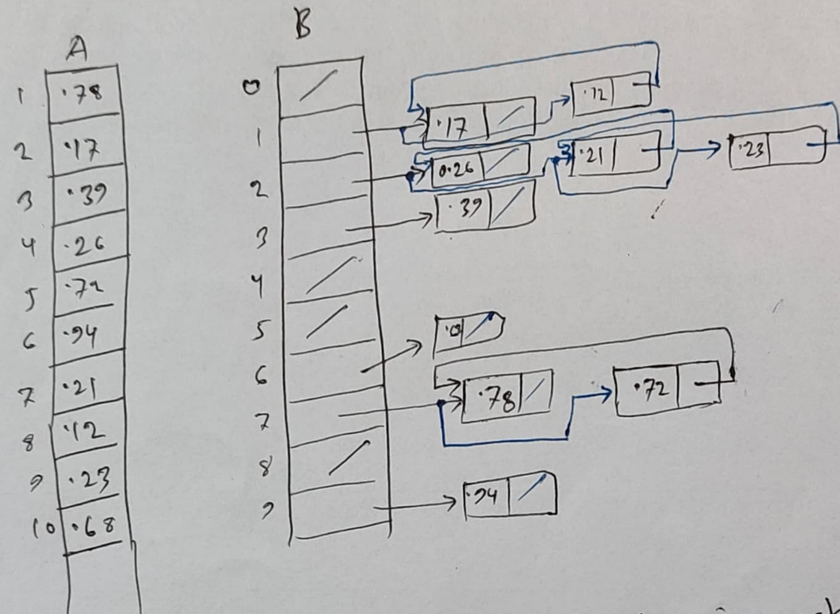
Total time ⇒ $\Theta(d(n+k))$

$= \Theta(dn)$

Bucket Sort

- assumes, input is drawn from a uniform distribution over the interval $[0,1)$.
- divid in n equal-sized subintervals or buckets.

⇒ Operations:



Now nodes in each bucket will be sort.

⇒ Algorithm:

BUCKET-SORT (A,n)

let B[0:n-1] be a new array

$O(n)$ ← for i=0 to n-1
make B[i] an empty list

$O(n)$ ← for i=1 to n
insert A[i] into list $B[\lfloor n \cdot A[i] \rfloor]$

$\sum_{i=0}^{n-1} O(n_i^2)$ ← for i=0 to n-1
sort list B[i] with insertion sort → $O(n^2)$

concatenate the list B[0:n-1] together in order

$O(n)$ return the concatenated lists

$\Rightarrow$

$$E[T(n)] = E\left[\theta(n) + \sum_{i=0}^{n-1} O(n_i^2)\right]$$

$$= \theta(n) + \sum_{i=0}^{n-1} E\left[O(n_i^2)\right]$$

$$= \theta(n) + \sum_{i=0}^{n-1} O\left[E[n_i^2]\right)$$

Here,

n elements for n bucket.

Probability, $p = \frac{1}{n}$ to fall each element onto a particular bucket.

From binomial distribution,

mean $E[n_i] = np = 1$

variance $Var[n_i] = np(1-p)$; $p = \frac{1}{n}$

$= 1 - \frac{1}{n}$

$\therefore E[n_i^2] = Var[n_i] + E^2[n_i]$

$= 1 - \frac{1}{n} + 1^2$

$= 2 - \frac{1}{n}$

$\therefore E[T(n)] = \theta(n) + n \times O(2 - \frac{1}{n})$

$= \theta(n)$

H.W. $\Rightarrow$ 8.2-1,3
8.3-1,2,5
8.4-1,2

Quiz-2
Chapter-6,7,8
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