

8.3 Radix Sort

Example :

423	430	423	183
537	192	727	192
727	⇒ 423	⇒ 430	⇒ 423
430	183	537	430
192	537	183	537
183	727	192	727

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Let A be an array of length n where
every entry in A is a d -digit number
say the digits range from 0 to k .

|| Radix-Sort(A, d)

|| for $i = 1$ to d

|| use a stable sort on A digit i 's.

Running time of Radix-Sort :

Say we use counting sort for each digit

counting - sort is $\Theta(n+k)$

repeat d times

∴ Running time of Radix-Sort is
 $\Theta(d(n+k))$

If $k = O(n)$ then Radix-Sort
has running time $\Theta(d(n+n)) = \underline{\underline{\Theta(n)}}$

10 columns : $d = 10$

10 columns : $d = 10$

Example :

1	0	0	1	1	0	0	1	0	1
1	1	0	1	0	1	1	0	0	0
0	1	0	1	0	1	1	1	0	1
0	0	1	1	1	0	1	1	1	0
1	1	0	0	1	0	1	0	1	0
:	:								

$d = 10$ } Radix-Sort is $\Theta(10(n+1))$
 $k = 1$ }

$d = 5$ } Radix-Sort is $\Theta(5(n+3))$
 $k = 3$ }

$d = 4$ } Radix-Sort is $\Theta(4(n+7))$
 $k = 7$ }

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$d = 2$ } Radix Sort is $\Theta(2(n+31))$
 $k = 2^5 - 1 = 31$ }

$$d = 2 \quad \left. \begin{array}{l} \\ k = 2^5 - 1 = 31 \end{array} \right\} \text{Radix Sort is } \Theta(2(n+31))$$

$$d = 1 \quad \left. \begin{array}{l} \\ k = 2^{10} - 1 = 1023 \end{array} \right\} \text{Radix Sort is } \Theta(n+1023)$$

Given array as follows:

n	b bits	
{	101101	101
	110100	001
	010110	110
	.	
	.	
	10111	001

Say $l \leq r \leq b$

say $1 \leq r \leq b$

Range of values is $2^r - 1$

Number of columns is $\lceil \frac{b}{r} \rceil$

The Radix-Sort is $\Theta(\lceil \frac{b}{r} \rceil (n + 2^r - 1))$

what is the optimal value for r ?

To balance the terms,

the best choice is $r \approx \log n$.