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Sorting algorithms

Special class

Subbarao Lingamgunta • May 14, 2023

Bubble sort

i/p: 80 20 40 50 24 81 31 90

1 2 3 4 5 6 7

$\Rightarrow$ 6C 6S/0S

1,2
2,3
3,4
⋮
6,7

P_1: (20 40 80 24 81 31) (90) — 7-1

1 2 3 4 5 6 7

P_2: (20 40 24 80 31) (81) $\Rightarrow$ 5C, 5S/0S — 7-2

P_3: (20 24 40 31) (80) $\Rightarrow$ 4C, 4S/0S — 7-3

P_4: (20 24 31) (40) $\Rightarrow$ 3C, 3S/0S — 7-4

P_5: (20 24) (31) $\Rightarrow$ 2C, 2S/0S — 7-5

P_6: (20) (24) $\Rightarrow$ 1C, 1S/0S — 7-6

Bubble sort.

```
for(i=1; i<=n-1; i++)
{
    s=0
    for(j=1; j<=n-i; j++)
    {
        if(a[j] > a[j+1])
        {
            swap(a[j], a[j+1])
            s++
        }
    }
    if(s==0)
        stop
}
```

Total comp (Bubble sort) $= \underline{n-1+n-2+\cdots+1}$ ($n-1$ passes)

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

$= O(n^2)$ [Eg]

Total swaps (Bubble sort) $= 0 - \text{swaps}$ [BC]

$= n-1+n-2+n-3+\cdots+2+1 = O(n^2)$ WC

Time complexity $= c+s$

$= \underline{n^2} + \underline{0} \text{ or } \underline{n^2} = O(n^2)$ [Eg because of comp]

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i/p: 50 10 20 30 40

1 2 3 4 5

P_1: (10 20 30 40) (50) ⟹ 4<, 4S

P_2: (10 20 30) (40) ⟹ 3<, 0S

---

10 20 30 40 50 60 70 80

S=0

P_1 (10 20 30 40 50 60 70) (80) ⟹ 0S ⟹ sorted

S=0

Selection sort

Let - Swaps (wc)

i/p : 80 60 160 45 150 90 32

1 2 3 4 5 6 7

P_1: i=1, min = 1 2 4 7

Swap (a[i], a[min])

(32) (60 100 45 150 90 80) ⟹ 6C, 1S

2 3 4 5 6 7

P_2: i=2

(32) (45 100 60 150 90 80) ⟹ 5C, 1S

2 3 4 5 6 7

P_3: (32) (45) (60 100 150 100 80) ⟹ 4C, 1S

3 4 5 6 7

P_4: (32) (45) (60) (80 150 90 100) ⟹ 3C, 1S

4 5 6 7

P_5: " (90) (150 100)

5 6 7

P_6: " (100) (150)

(1) S.S will take $n-1$ passes

(2) " Total comparison $= n-1+n-2+\cdots+1 \Longrightarrow O(n^2)$ EC

(3) " " swaps $= \underbrace{1+1+1+\cdots+1}_{n-1} \Longrightarrow n-1 \Longrightarrow O(n)$ EC

Time complexity $= c+s$

$= n^2+n-1 \Longrightarrow O(n^2)$ [EC] //

(4) Inplace

(5) Not stable.

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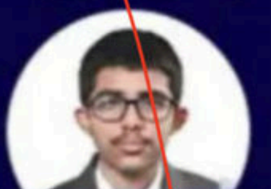

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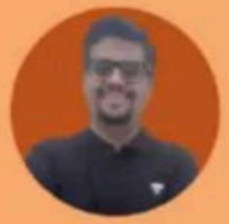

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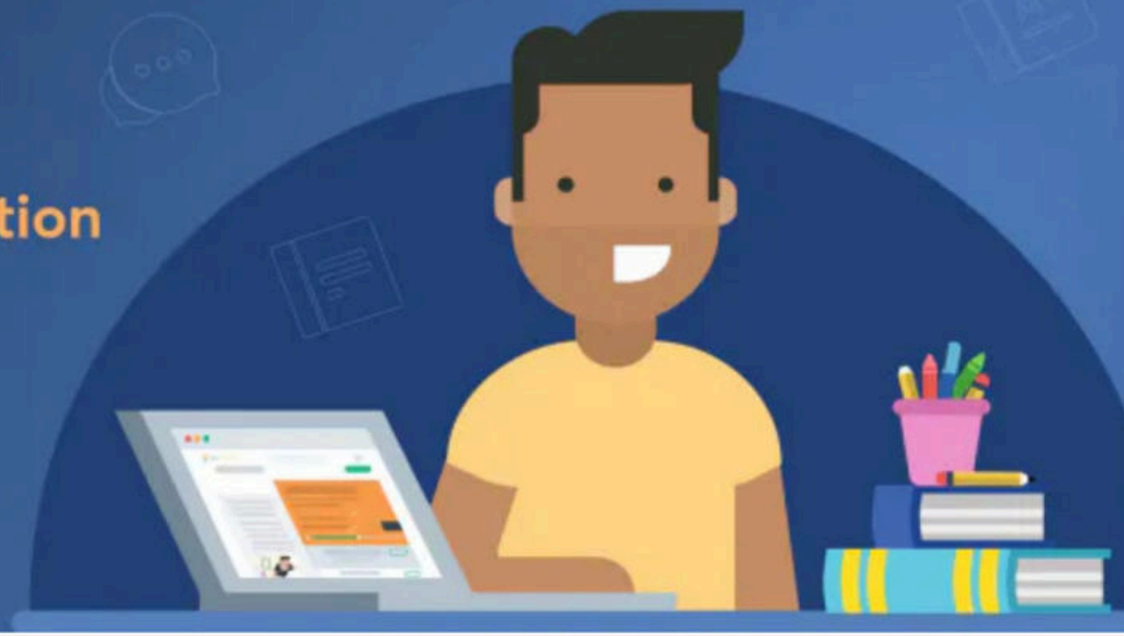

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Insertion sort (ಕ ಕ ಕ ಕ ಕ ಕ ಕ ಕ ಕ ಕ ಕ ಕ ಕ)

i/p: 20 | 80 | 90 | 85 | 75 | 100 | 120 | 150 | 15

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

Best case

P_1 : 20 | 80

P_2 : 20 | 80 | 90

P_3 : 20 | 80 | 85 | 90 | 85

P_4 : 20 | 80 | 85 | 80 | 75 | 90

P_5 : 20 | 75 | 80 | 85 | 90 | 100

P_6 : 20 | 75 | 80 | 85 | 90 | 100 | 120

P_7 : 20 | 25 | 80 | 85 | 90 | 100 | 120 | 150 | 15

P_8 : 15 | 20 | 25 | 80 | 85 | 90 | 100 | 120 | 150

Best case (A.O)

10 20 30 40 50 60

		C	S
(1)	10 20	1	0
(2)	10 20 30	1	0
(3)	10 20 30 40	1	0
⋮	⋮	⋮	⋮
(n-1)	30 40 50 60	1	0
		n-1	0

$n-1+0 \Rightarrow O(n)$

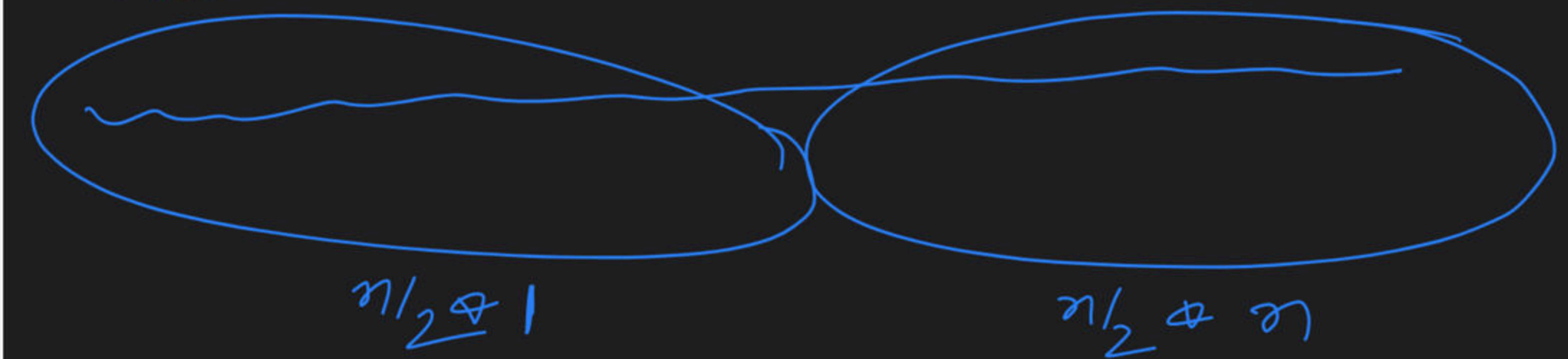
Worst case (D.O)

60 50 40 30 20 10

		C	S
P_1	60 50 $\Rightarrow$ 50 60	1	1
P_2	40 50 60 $\Rightarrow$ 40 50 60	2	2
P_3	$\Rightarrow$	3	3
⋮	⋮	⋮	⋮
P_{n-1}	$\Rightarrow$	n-1	n-1
		n^2	n^2

$n^2+n^2=n^2$

Avg case



$$\frac{n}{2} * \frac{n^2}{2} \Rightarrow O(n^2)$$

(4) Inplace.

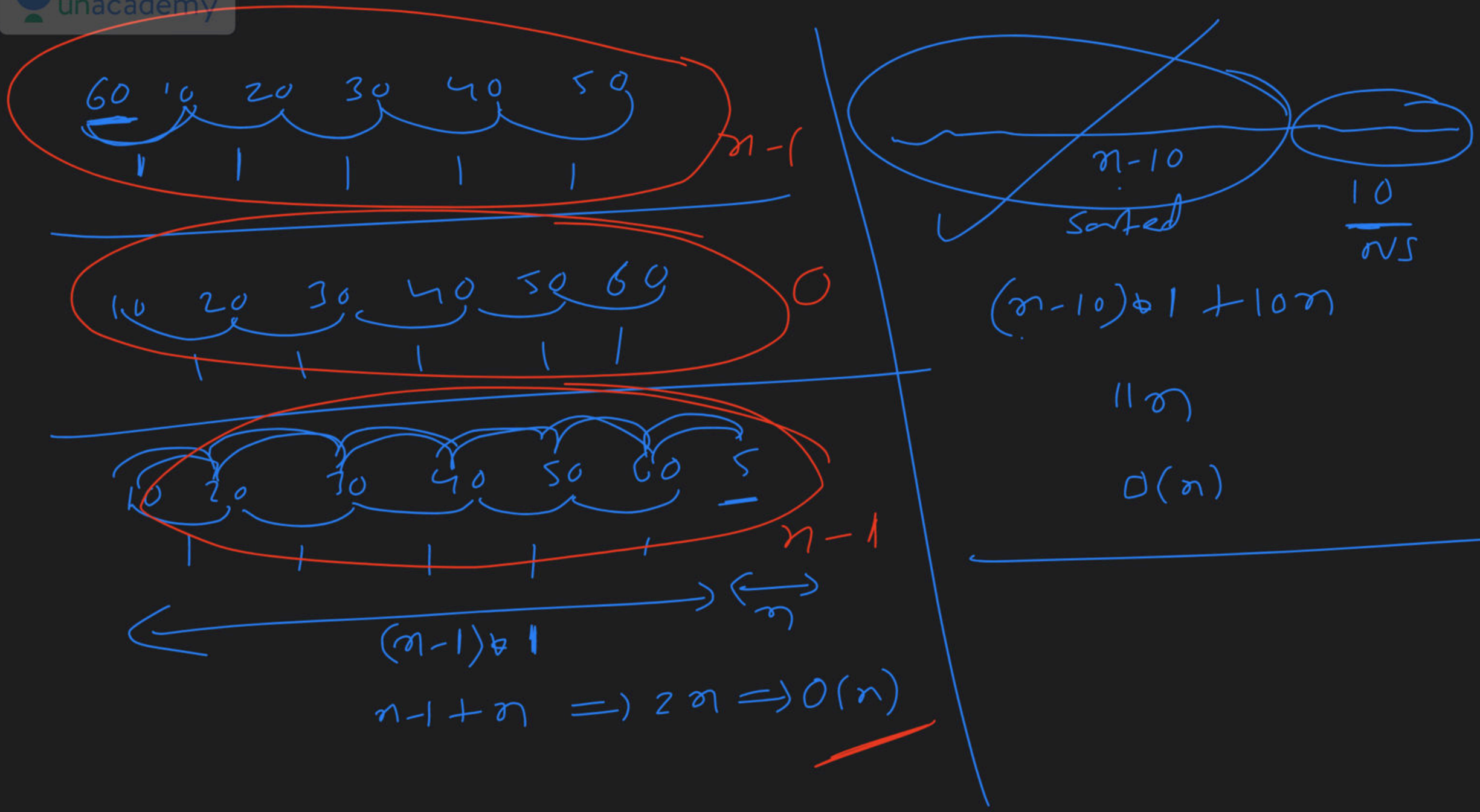
(5) Stable

---

(1)

(2)

(3) If array contain almost n-items I.S will take O(n) time to sort bcz are already sorted. (QS — n^2)


60 10 20 30 40 50
n-1
10 20 30 40 50 60
0
10 20 30 40 50 60 5
n-1
(n-1)+1
n
n-1+n ⇒ 2n ⇒ O(n)
n-10
sorted
10
n-10)+1+10n
11n
O(n)

Counting Sort

Radix Sort

C. M. S. S