TECHNO INDIA UNIVERSITY
WESTBENGAL

Data Structures & Algorithms
(PCC-CS 301)

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Topics Covered

1. Data Sorting
    1.1. Introduction
    1.2. Algorithms and Properties
2. Comparison based Sort
    2.1. Bubble sort
    2.2. Selection sort

Sorting

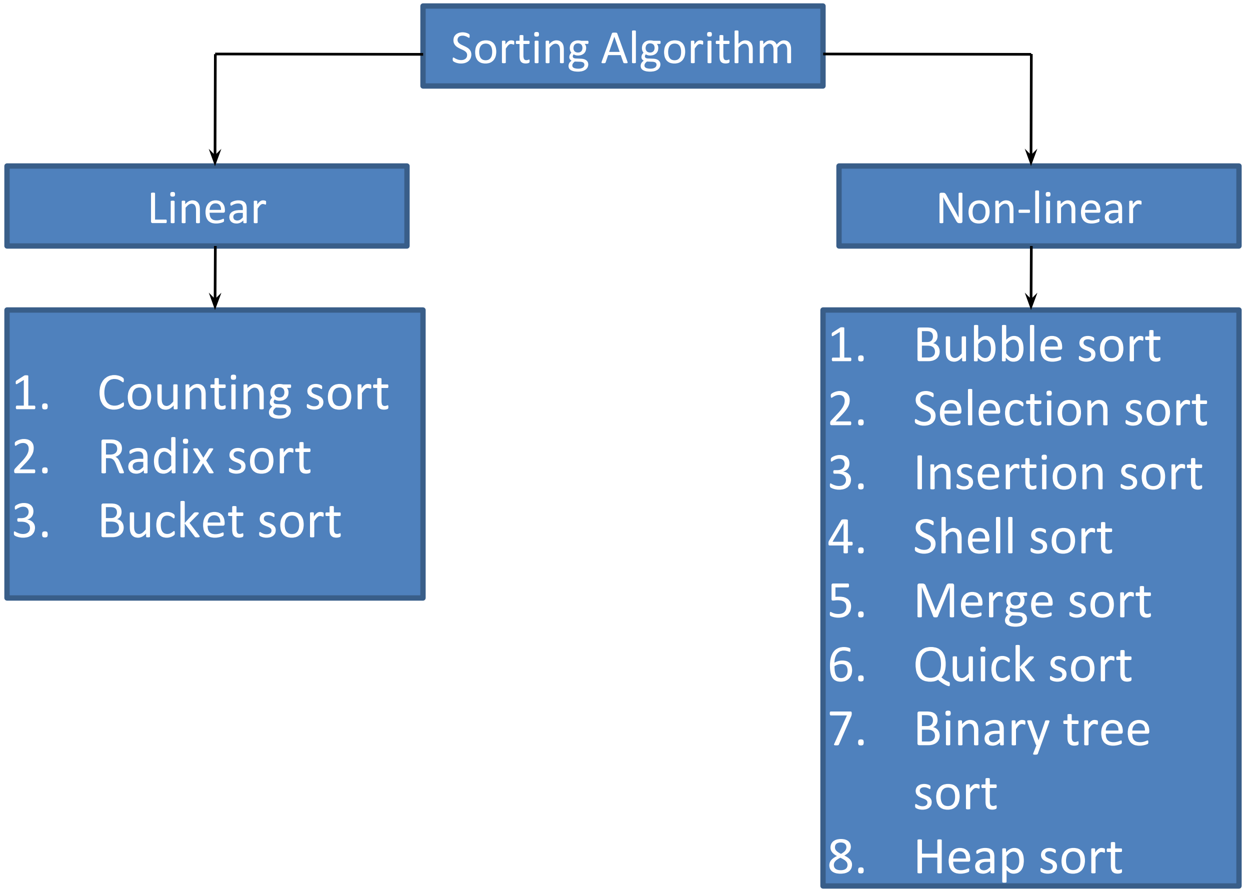
- Introduction

  - Arranging of a data set in a specific sequence
    - Arrangement in ascending order
    - Arrangement in descending order

Input data set	10	5	25	6	3	9	12	30	15	20
Sorted (ascending)	3	5	6	9	10	12	15	20	25	30
Sorted (descending)	30	25	20	15	12	10	9	6	5	3

Sorting Algorithm

- Classification: based on time complexity



Sorting Algorithm

Linear

1. Counting sort
2. Radix sort
3. Bucket sort

Non-linear

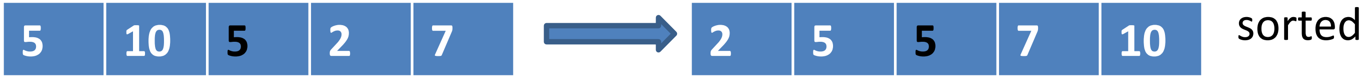
1. Bubble sort
2. Selection sort
3. Insertion sort
4. Shell sort
5. Merge sort
6. Quick sort
7. Binary tree sort
8. Heap sort

Sorting Algorithm

- Classification: based on few properties
  - Comparison based sort
    - data are compared with each other
    - Ex. - bubble, selection, insertion, shell, quick sort
  - Divide-and-Conquer based sort
    - Data set is divided-arranged-combined to perform sorting
    - Ex. – merge, quick sort
  - In-place sort
    - No extra memory is required to sort the data set (internal)
    - Ex. – bubble, selection, insertion, quick, shell

Sorting Algorithm

- Classification: based on few properties
  - External sort
    - Extra memory is required to sort a data set
    - Ex. – merge sort, counting, radix sort
  - Stable sort
    - Data ordering of same value will remain same after sorting
    - Ex. – Insertion, bubble, merge, binary tree sort

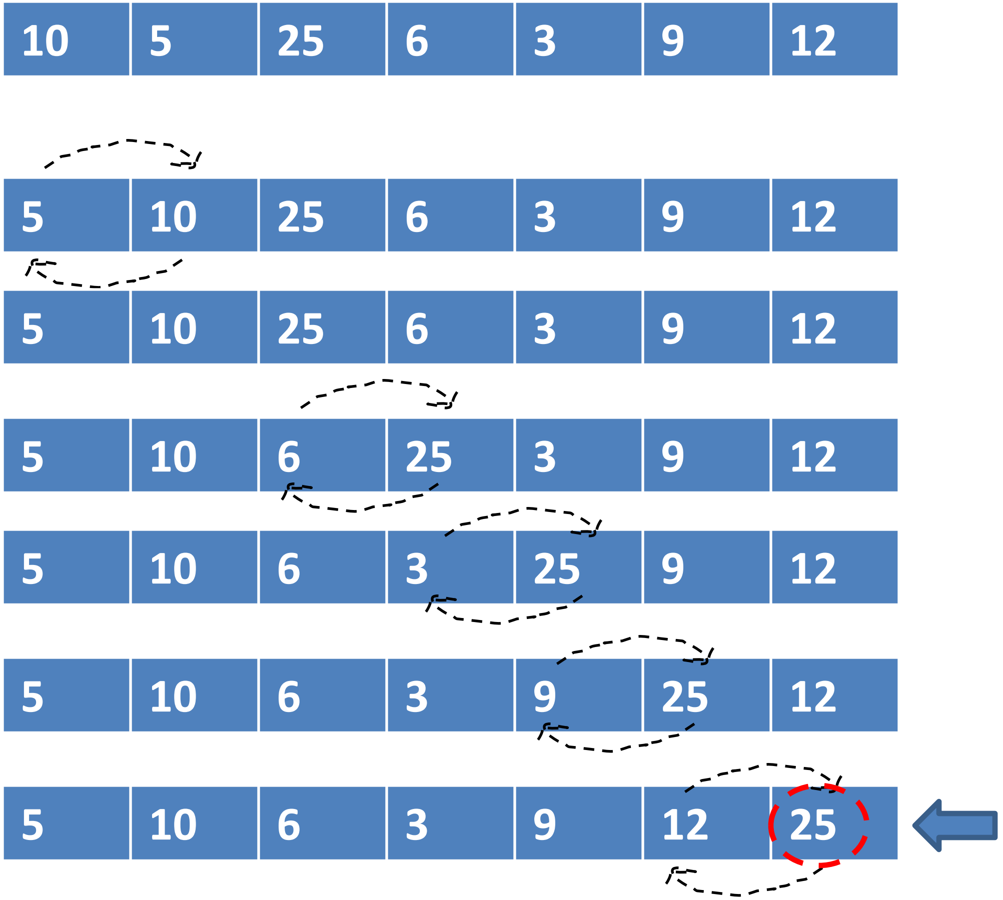


5 | 10 | **5** | 2 | 7 → 2 | 5 | **5** | 7 | 10 sorted

  - Un-stable sort
    - Ordering of same value may not be same in sorted form
    - Ex. – selection, heap, quick sort

Comparison based Sort

- Bubble sort: mechanism

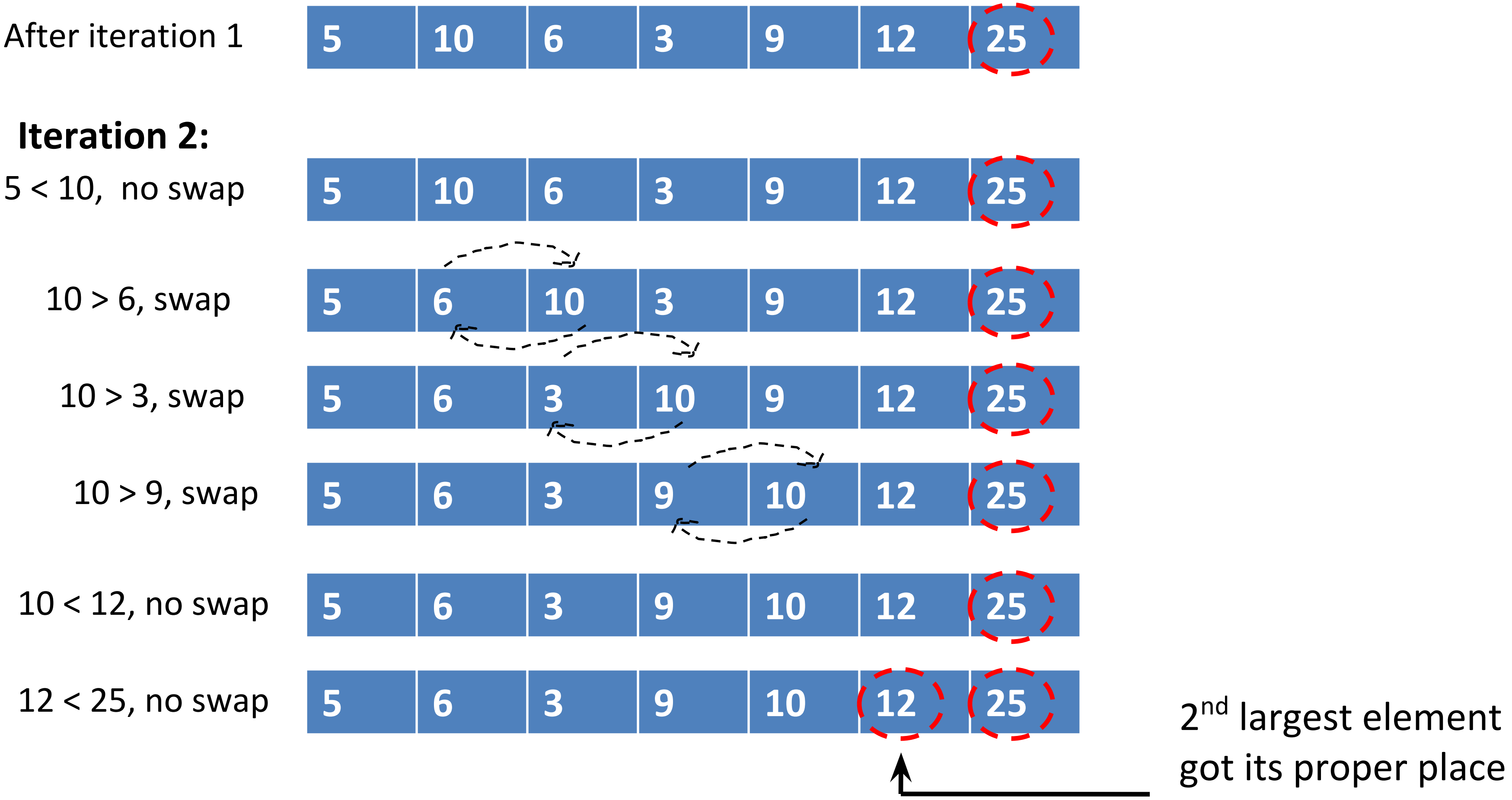


Input data set	10	5	25	6	3	9	12
Iteration 1:							
10 > 5, swap	5	10	25	6	3	9	12
10 < 25, no swap	5	10	25	6	3	9	12
25 > 6, swap	5	10	6	25	3	9	12
25 > 3, swap	5	10	6	3	25	9	12
25 > 9, swap	5	10	6	3	9	25	12
25 > 12, swap	5	10	6	3	9	12	25

Largest element got its proper place

Comparison based Sort

- Bubble sort: mechanism



After iteration 1	5	10	6	3	9	12	25
Iteration 2:							
5 < 10, no swap	5	10	6	3	9	12	25
10 > 6, swap	5	6	10	3	9	12	25
10 > 3, swap	5	6	3	10	9	12	25
10 > 9, swap	5	6	3	9	10	12	25
10 < 12, no swap	5	6	3	9	10	12	25
12 < 25, no swap	5	6	3	9	10	12	25

2nd largest element got its proper place

Comparison based Sort

- Bubble sort: algorithm and complexity

```
Bubble_sort( A)   // A is the array
{
  for i= 1 to N      // N is the number of elements
        for j= 1 to N-1
             if A(j) > A(j+1)
                 swap A(j) and A(j+1)
  return A
}
```

You can implement this cleverly

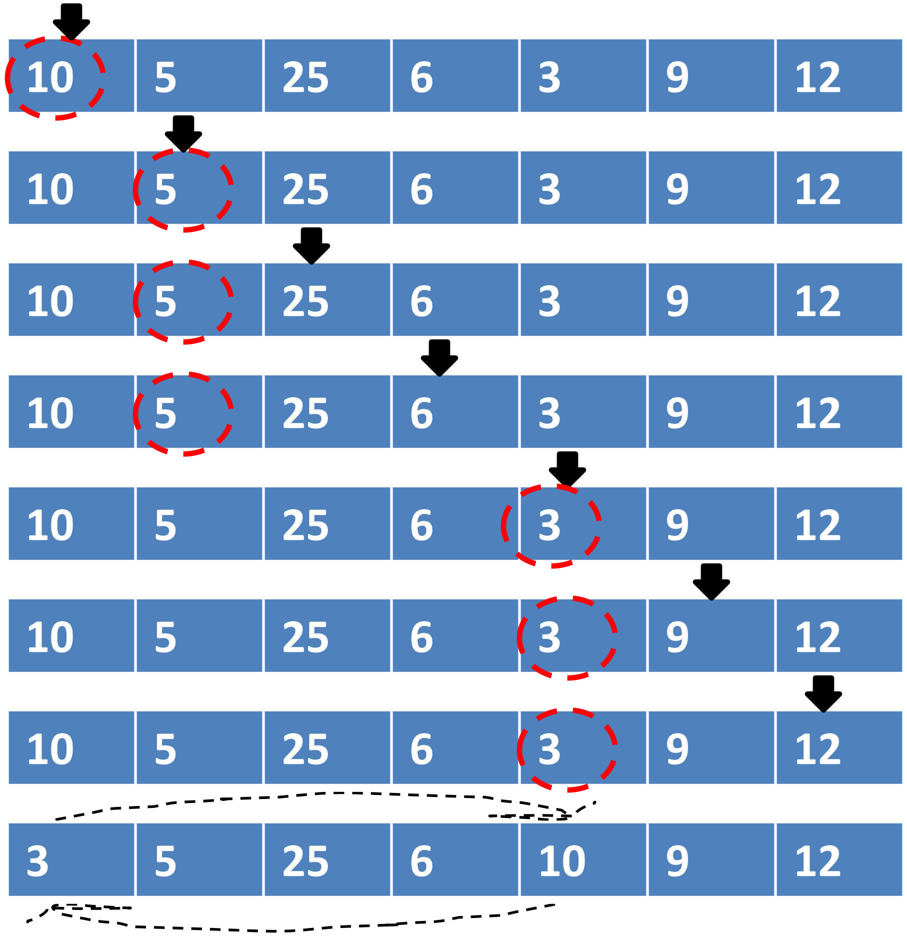
- Bubble sort: complexity

Time Complexity		
Best case	Average case	Worst case
$O(n^2)$	$O(n^2)$	$O(n^2)$

Comparison based Sort

- Selection sort: mechanism

Iteration 1:



Set min=10	10	5	25	6	3	9	12
5 < min, min=5	10	5	25	6	3	9	12
25 > min, min=5	10	5	25	6	3	9	12
6> min, min=5	10	5	25	6	3	9	12
3<min, min=3	10	5	25	6	3	9	12
9 > min, min=3	10	5	25	6	3	9	12
12 > min, min=3	10	5	25	6	3	9	12
Swap 1st and min element	3	5	25	6	10	9	12

Comparison based Sort

- Selection sort: algorithm and complexity

```
Selection_sort( A)   // A is the array
{
 for i= 1 to N     // N is the number of elements
      set min= i
      for j= i+1 to N
          if A(j) < A(min)
              set min = j
      swap A(i) and A(min)
 return A
}
```

- Selection sort: complexity

Time Complexity		
Best case	Average case	Worst case
O(n^2)	O(n^2)	O(n^2)

Iteration1: n times
Iteration 2: n-1 times
…
Iteration n: 1 time
Total: 1+2+…+(n-1)+n = O(n^2)

Queries?