جامعة طرابلس ـ كلية تقنية المعلومات

Design and Analysis Algorithms

تصميم و تحليل خوارزميات

ITGS301

المحاضرة الرابعة: Lecture 4

خريف 2022

Tripoli University - Faculty of Information Technology

Marwa Solla

m.solla@uot.edu.ly

The Problem Of Sorting

Sorting

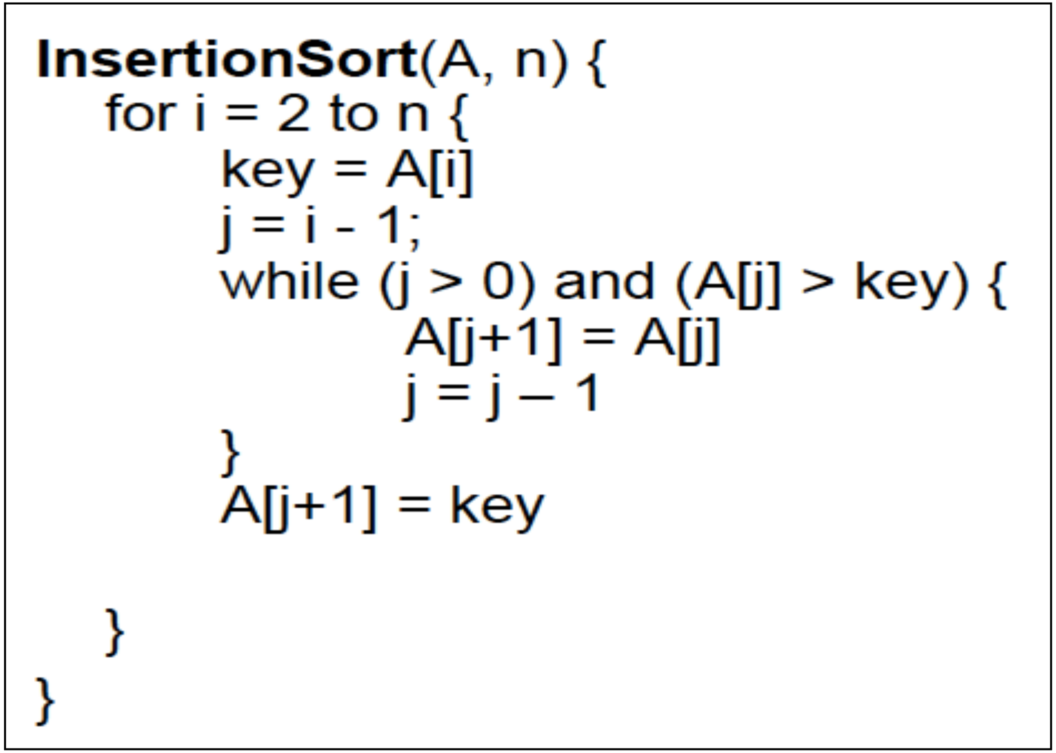
- Sorting is one of the most common data processing applications , the through which data are arranged according to their values.

- If data were not ordered , we would spend hours trying to find a single piece of information.

- Data may be sorted in either ascending sequence or descending sequence . and if the order of the sort is not specified its assumed to be ascending..

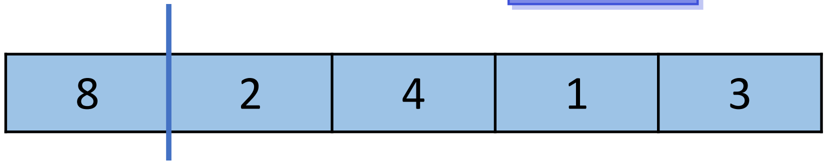
Insertion Sort

- In the insertion sort , the list is divided in two parts : sorted and unsorted.
- In each pass the first element of the unsorted sub list is transferred to the sorted sub list by inserting it at appropriate place.
- If we have a list of n elements , it will take at most n-1 passes to sort the data.



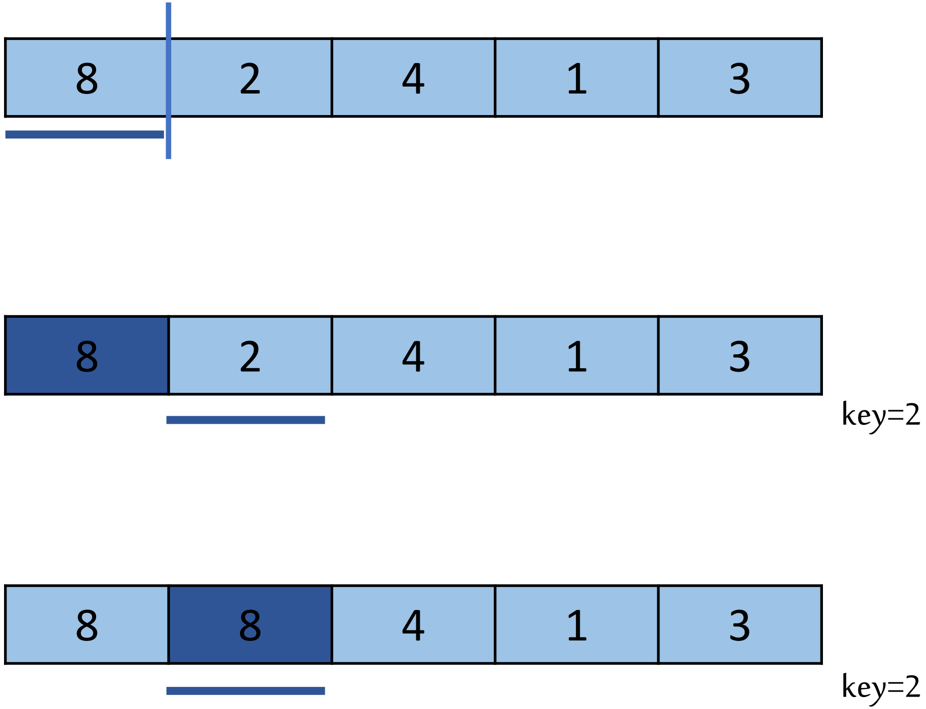
```
InsertionSort(A, n) {
    for i = 2 to n {
          key = A[i]
          j = i - 1;
          while (j > 0) and (A[j] > key) {
                    A[j+1] = A[j]
                    j = j – 1
          }
          A[j+1] = key

    }
}
```

```
InsertionSort( A, n)
{
For i = 2 to n {

    Key = A[i]
    j= i - 1

While ( j > 0) and (A[j] > key)
 {
  A[j+1] = A[j]
  j = j – 1
 }

 A[ j+1] = key
 }
```



8	2	4	1	3

Example 1 :



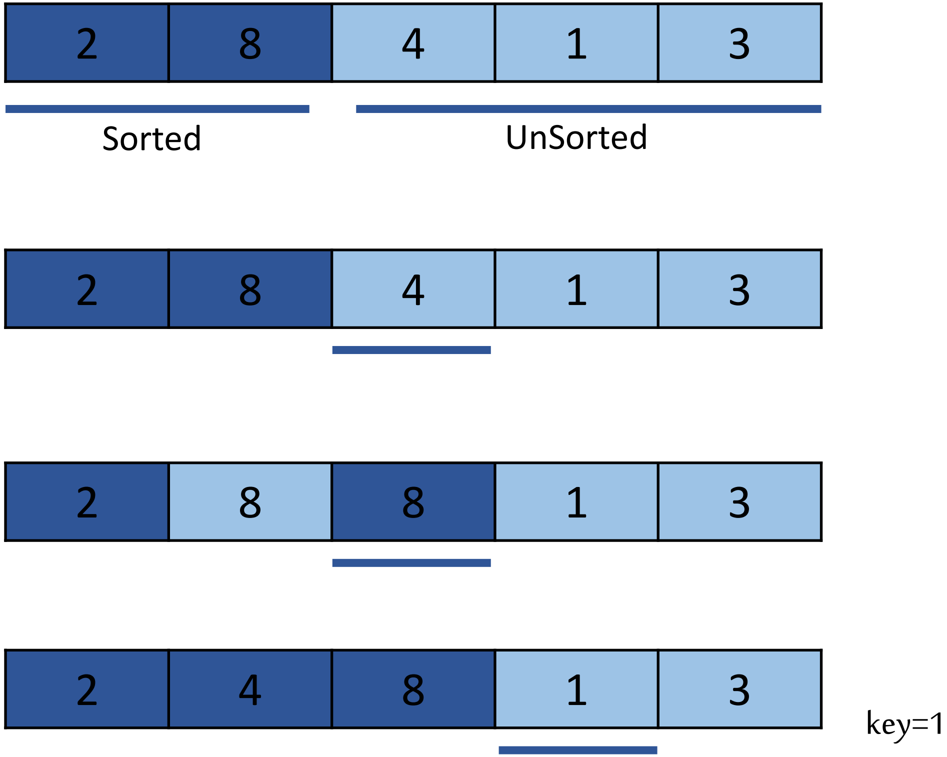
8	2	4	1	3

8	2	4	1	3

key=2

8	8	4	1	3

key=2



2	8	4	1	3

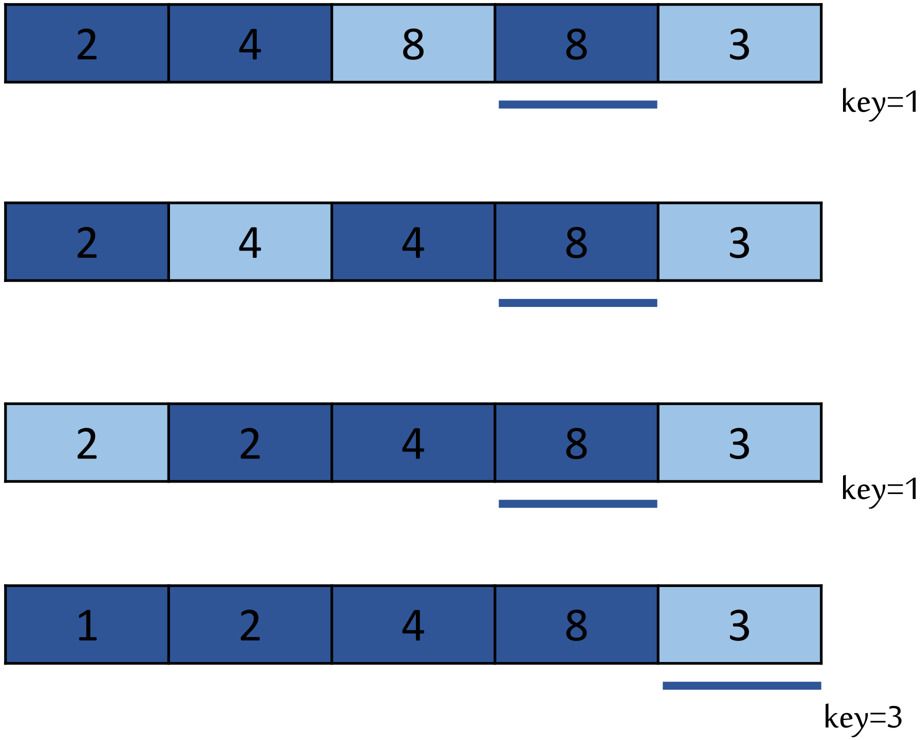
Sorted UnSorted

2	8	4	1	3

2	8	8	1	3

2	4	8	1	3

key=1



2	4	8	8	3

key=1

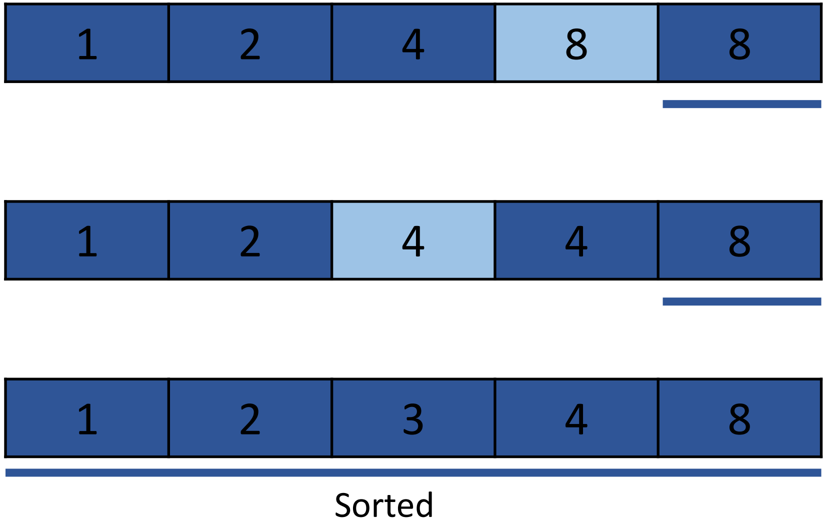
2	4	4	8	3

2	2	4	8	3

key=1

1	2	4	8	3

key=3



1	2	4	8	8

1	2	4	4	8

1	2	3	4	8

Sorted

Time Complexity

```
For i=2 to n {                      n
Key= A [i]                          n-1
j=i-1                               n-1
While (j>0 & A [j] > key) {         $\sum_{i=2}^{n} ti$
A [j+1] = A [j]                     $\sum_{i=2}^{n} (ti - 1)$
j=j-1                               $\sum_{i=2}^{n} (ti - 1)$
}
A [j+1] = key                       n-1
}
```

where t *is the number of while tests*

Time Complexity

Statement	Time	Best case	Worst case
For i = 2 to n {	n	n	n
Key = A[i]	n-1	n-1	n-1
j= i - 1	n-1	n-1	n-1
While (j > 0) and (A[j] > key)	$\sum_{i=2}^{n}(ti)$	n-1	n(n+1)/2 -1
A[j+1] = A[j]	$\sum_{i=2}^{n}(ti\ -1)$	$\sum_{i=2}^{n}(1-1)$ = 0	n(n-1)/2
j = j – 1	$\sum_{i=2}^{n}(ti-1)$	$\sum_{i=2}^{n}(1-1)$ = 0	n(n-1)/2
A[j+1] = key	n-1	n-1	n-1

Best case running time:

$$T(n) = n + (n-1) + (n-1) + (n-1) + 0 + 0 + (n-1)$$
$$= 5n - 4$$

$$T(n) = O(n)$$

Worst case running time:

$$T(n) = n + (n-1) + (n-1) + (n(n+1)/2 - 1) + n(n-1)/n + n(n-1)/2 + (n-1)$$

$$T(n) = O(n^2)$$

Example 2:

8	2	4	9	3	6

8	8	4	9	3	6

2	8	4	9	3	6

2	8	8	9	3	6

2	4	8	9	3	6

2	4	8	9	3	6

2	4	8	9	9	6

2	4	8	8	9	6

2	4	4	8	9	6

2	3	4	8	9	6

2	3	4	8	9	9

2	3	4	8	8	9

2	3	4	6	8	9

The End . ☺