

Sorting

Introduction to Computers and Programming
Week14 TA Course
2023/12/12

What is sorting?

- Sorting is an algorithm that puts elements of a list in a certain order.
- Example

Before sort : 3, 5, 19, 1, 3, 10

After sort : 1, 3, 3, 5, 10, 19

Types of Sorting

- Comparison based Sorting
 - Only reads the list elements through a single abstract comparison operation (often a "less than or equal to" operator) that determines which of two elements should occur first in the final sorted list.
 - Iterative sorting algorithms : Selection Sort, Bubble Sort, Insertion Sort
 - Recursive sorting algorithms : Merge Sort, Quick Sort
- Non-Comparison based Sorting
 - Don't use comparison but rely on integer arithmetic on keys.
 - Radix sort

Stable sorting

- A sorting algorithm is stable if the relative order of elements with the same key value is preserved by the algorithm.
- Example :

Given a list of number : 3, 5, 19, 1, 3*, 10

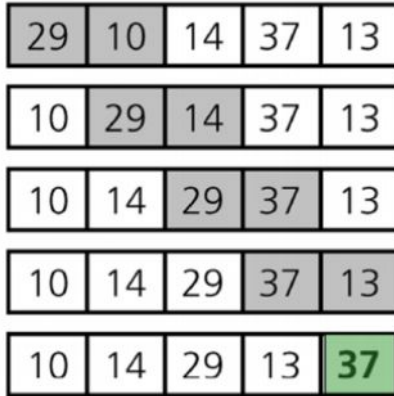
Stable sorting : 1, 3, 3*, 5, 10, 19

Non-stable sorting : 1, 3*, 3, 5, 10, 19

Bubble Sort

- Idea : The larger items drop down while the smaller ones bubble up.
- Property : Stable

(a) Pass 1



At the end of **Pass 1**, the largest item **37** is at the last position.

(b) Pass 2



At the end of **Pass 2**, the second largest item **29** is at the second last position.



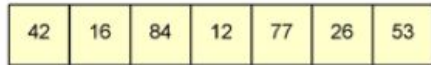
Sorted Item



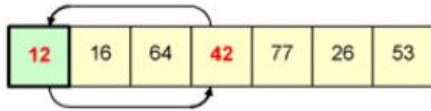
Pair of items
under comparison

Selection Sort

- Idea : Selecting the smallest element from the unsorted portion of the list and moving it to the sorted portion of the list.



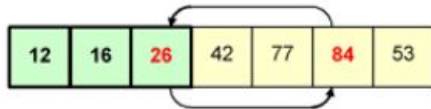
The array, before the selection sort operation begins.



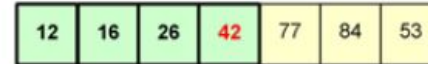
The smallest number (12) is swapped into the first element in the structure.



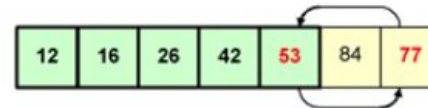
In the data that remains, 16 is the smallest; and it does not need to be moved.



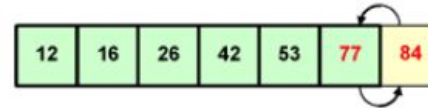
26 is the next smallest number, and it is swapped into the third position.



42 is the next smallest number; it is already in the correct position.



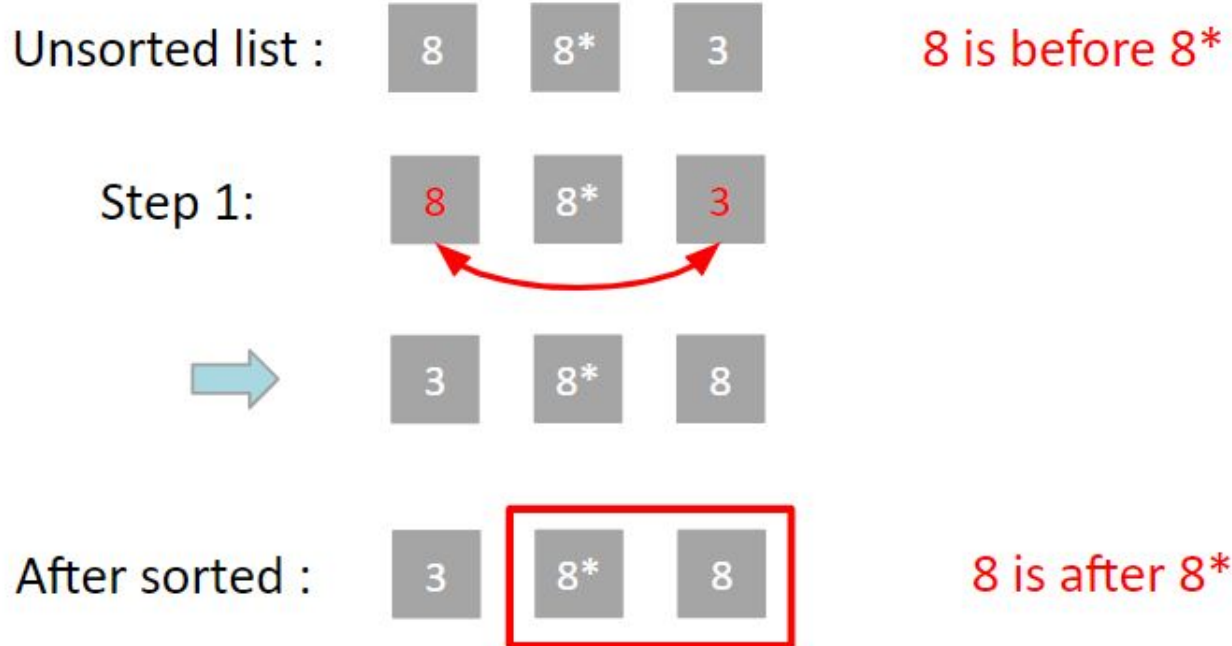
53 is the smallest number in the data that remains; and it is swapped to the appropriate position.



Of the two remaining data items, 77 is the smaller; the items are swapped. The selection sort is now complete.

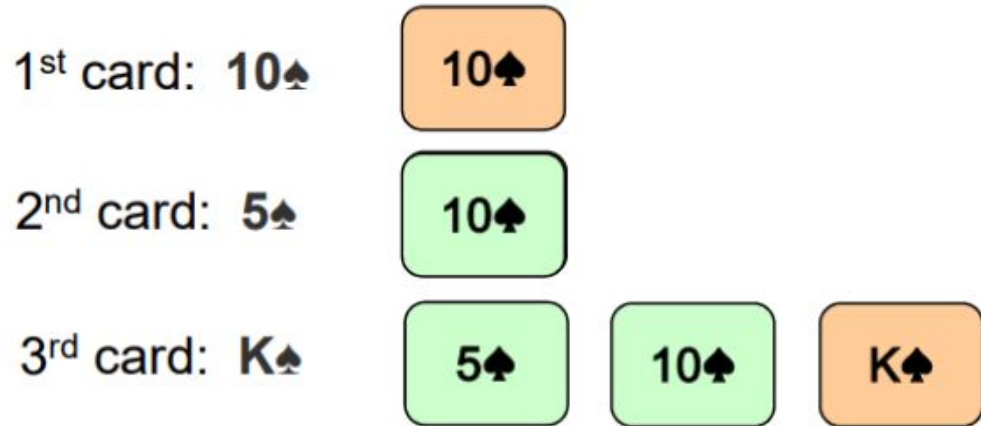
Selection Sort

- Property : Unstable

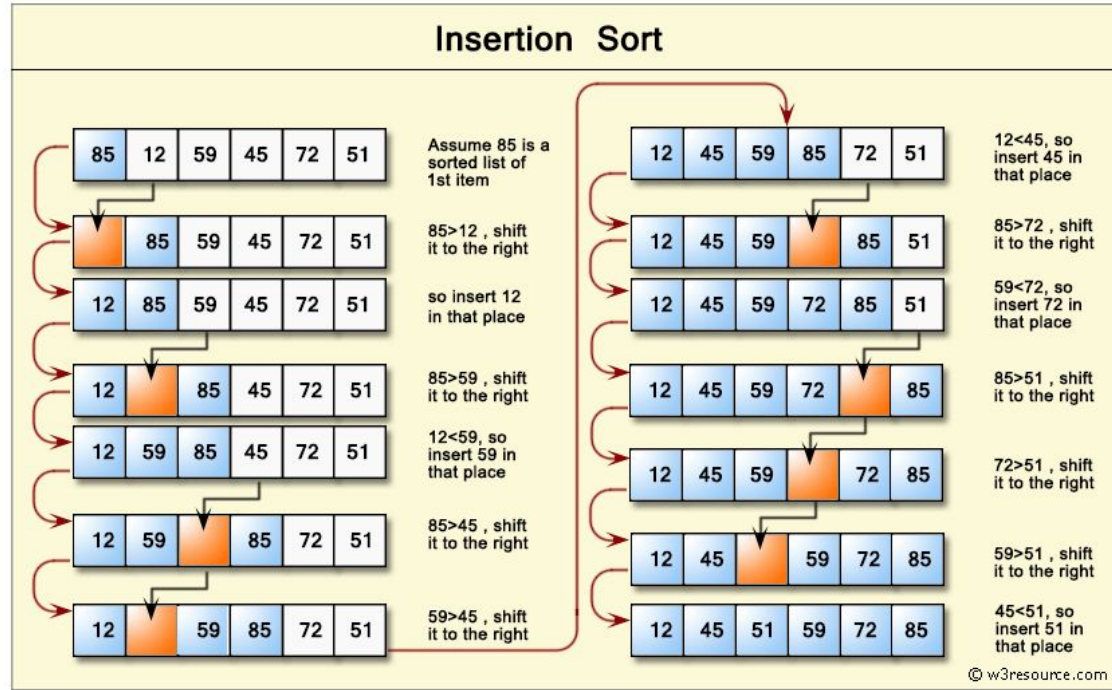


Insertion Sort

- Idea : Similar to how most people arrange a hand of poker cards
 - 1 Start with one card in your hand
 - 2 Pick the next card and insert it into its proper sorted order
 - 3 Repeat previous step for all cards
- Property : Stable



Insertion Sort



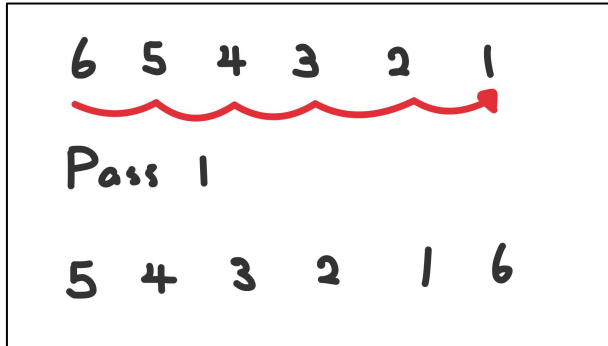
Exercise1

- Implement bubble sort, and you can use the template from e3 (optional).
- Input : unsorted 6 integer numbers
- Output : all pass of the algorithm which sorts those 6 integer numbers (ascending order).

Hint:

Be careful the process order. (Each pass, put the largest one into right handside)

For example:



Output sample:

Input by user

```
C:\Users\User\Desktop>templete.exe
Input number:
6 5 4 3 2 1
Pass 1
5 4 3 2 1 6
Pass 2
4 3 2 1 5 6
Pass 3
3 2 1 4 5 6
Pass 4
2 1 3 4 5 6
Pass 5
1 2 3 4 5 6
```