Sort

Arnaud Malapert, Gilles Menez, Marie Pelleau

Master Informatique, Université Côte d'Azur

Popular sorting algorithm

- **Insertion sort**
- Selection sort
- Bubble sort
- **Merge sort**
- Quicksort

Insertion sort

Using arrays

1	5	3	6	4

Insertion sort

Using arrays

1	**3**	**5**	6	4

Insertion sort

Using arrays
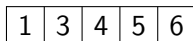
Insertion sort

Using arrays

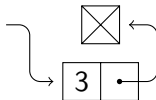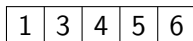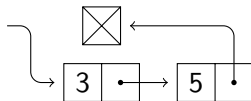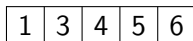| 1	3	4	5	6
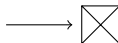
Using linked lists

Insertion sort

Using arrays

Using linked lists

Insertion sort

Using arrays

1	3	4	5	6

Using linked lists

Insertion sort

Using arrays

1	3	4	5	6

Using linked lists

Insertion sort

Using arrays

1	3	4	5	6
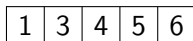
Using linked lists
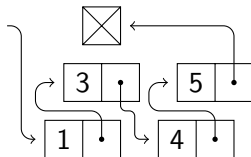
Merge sort

Merging two sorted arrays

1	3	5

2	7	9

1	2	3	5	7	9

Merge sort

Dichotomic sort
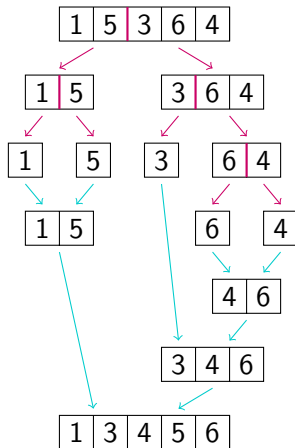
Exercise 1: Candy Distribution

Statement

Given N integers indicating the number of students in each of Alice's classes, and N integers corresponding to the price of a type of candy. Knowing that all students in the same class will receive the same kind of candy, compute the least amount of money Alice must spend to give a candy to each of her students.

Example

Input:
5
10 80 37 22 109
6 8 8 20 15
Output:
2120

Exercise 1: Candy Distribution

Statement

Given N integers indicating the number of students in each of Alice's classes, and N integers corresponding to the price of a type of candy. Knowing that all students in the same class will receive the same kind of candy, compute the least amount of money Alice must spend to give a candy to each of her students.

What problems can arise?

- What do we know of N?
- Of the number of students?
- Of the price of the candies?
- How great can the solution be?
  $\implies$ Are integers big enough for the solution?

Exercise 1: Candy Distribution

Solution 1: Homemade

Using two lists or arrays with insertion sort

Solution 2: Integrated

Using two arrays and the sort procedure in your preferred language

More test cases

Input:
4
1 10 2 1
1 2 4 2
5
10 80 37 22 89
6 8 8 20 15
0

Output:
20
2000

Exercise 2: Inversion Count

Statement

Given an array A of integers. If $i < j$ and $A[i] > A[j]$ then the pair (i, j) is called an inversion of A. Count the number of inversions of A

Example

Input:
2 3 8 6 1

Output:
5

Exercise 2: Inversion Count

Statement

Given an array A of integers. If $i < j$ and $A[i] > A[j]$ then the pair (i, j) is called an inversion of A. Count the number of inversions of A

What problems can arise?

- How great can the array be?
- How great can the values in the array be?
- How great can the solution be?
  - $\implies$ Are integers big enough for the solution?

Exercise 2: Inversion Count

Solution 1: Brut Force

```
read n on standard input
read the array A on standard input

result ← 0

for i from 0 to n − 2
    for j from i + 1 to n − 1
        if A[i] > A[j] then
            result ← result + 1

print result
```
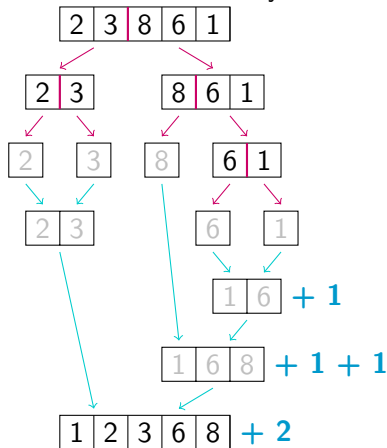
Exercise 2: Inversion Count

Solution 2: Using Merge sort

Key idea: if there are no inversions, then during the merge, all the elements of the left array should be added before any element of the right array

Exercise 2: Inversion Count

More test cases
Input:
3
6
1 2 3 4 5 6
8
5 1 4 2 6 2 6 2
1
1

Output:
0
11
0

Exercise 3: It's a Murder

Statement

Given an array of integers, for each number sum the previous strictly smaller number

Example

Input: Output:
1   15
5
1 5 3 6 4

Solution: Elegant

Using Merge sort

Exercise 4: Yodaness Level

Statement

Given a statement as Yoda says it and the same statement as it should be said normally count the number of pairs of words that changed their order

Example

Input:

1
6
much to learn you still have
you still have much to learn

Output:

9

Solution: Elegant

Using Merge sort