Sort

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Popular sorting algorithm

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

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	**5**	3	6	4

Insertion sort

Using arrays

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

Insertion sort

Using arrays

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

Insertion sort

Using arrays

$$\boxed{1}\boxed{3}\boxed{5}\boxed{\mathbf{6}}\boxed{4}$$

Insertion sort

Using arrays

$$\boxed{1}\ \boxed{3}\ \boxed{5}\ \boxed{6}\ \boxed{\mathbf{4}}$$

Insertion sort

Using arrays

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

Insertion sort

Using arrays

1	3	4	5	6

Insertion sort

Using arrays

$$\boxed{1} \boxed{3} \boxed{4} \boxed{5} \boxed{6}$$

Using linked lists

Insertion sort

Using arrays

1	3	4	5	6

Using linked lists

Insertion sort

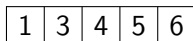Using arrays

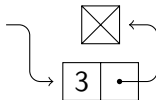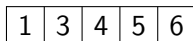| 1	3	4	5	6

Using linked lists
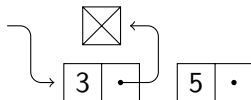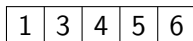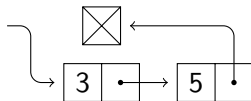
Insertion sort

Using arrays

Using linked lists

Insertion sort

Using arrays

1	3	4	5	6

Using linked lists

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Using linked lists

Insertion sort

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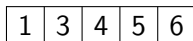| 1	3	4	5	6

Using linked lists
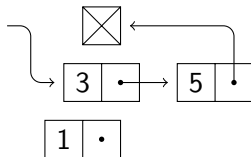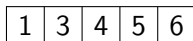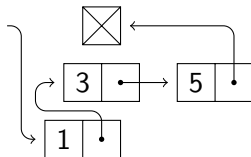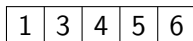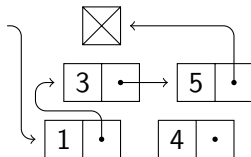
Insertion sort

Using arrays

Using linked lists

Insertion sort

Using arrays

1	3	4	5	6

Using linked lists

Merge sort

Merging two sorted arrays

1	3	5

2	7	9

Merge sort

Merging two sorted arrays

1	3	5

2	7	9

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

| 1 | **3** | 5 |

| 2 | **7** | 9 |

| 1 | 2 | | | | |

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

Merge sort

Merging two sorted arrays

1	3	5

2	7	**9**

1	2	3	5	7	

Merge sort

Merging two sorted arrays

1	3	5

2	7	**9**

1	2	3	5	7	**9**

Merge sort

Merging two sorted arrays

Merge sort

Dichotomic sort

$$1\ |\ 5\ |\ 3\ |\ 6\ |\ 4$$

Merge sort

Dichotomic sort
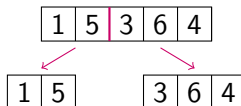
Merge sort

Dichotomic sort

Merge sort

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Dichotomic sort

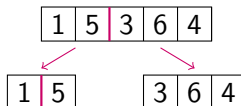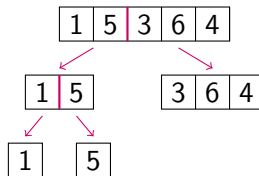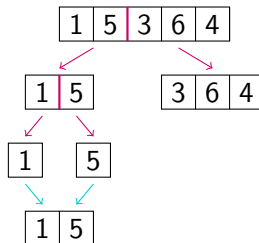# Merge sort
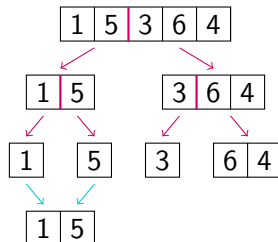
Dichotomic sort

Merge sort
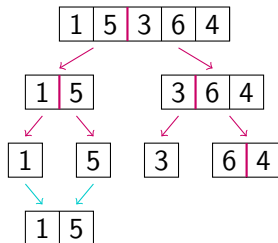
Dichotomic sort

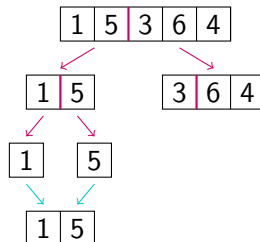# Merge sort
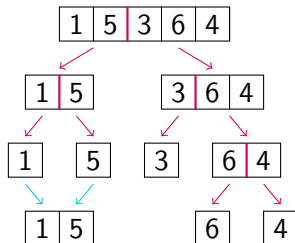
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Merge sort
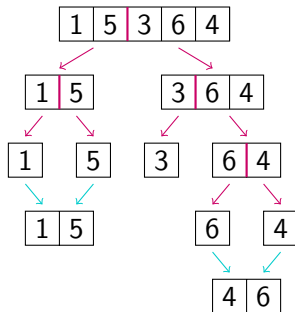
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Merge sort
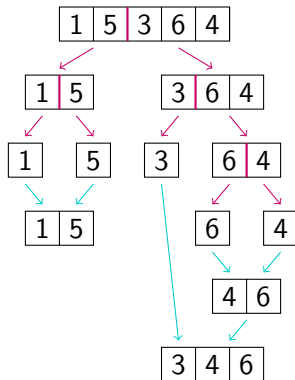
Dichotomic sort

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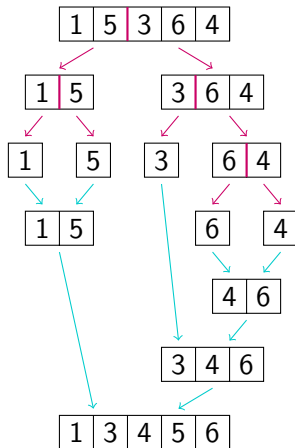
Exercise 1: Candy Distribution

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

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What problems can arise?

- What do we know of N?

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- Of the number of students?

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- What do we know of N?
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- Of the price of the candies?
- How great can the solution be?

Exercise 1: Candy Distribution

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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

Exercise 1: Candy Distribution

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?

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- 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: Brute Force

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

result $\leftarrow$ 0

for i from 0 to $n-2$
    for j from $i+1$ to $n-1$
        if $A[i] > A[j]$ then
            result $\leftarrow$ 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

Solution 2: Using Merge sort

2	3	8	6	1

Exercise 2: Inversion Count

Solution 2: Using Merge sort
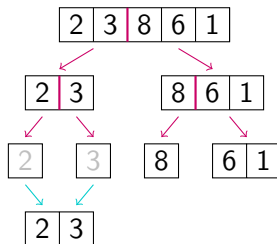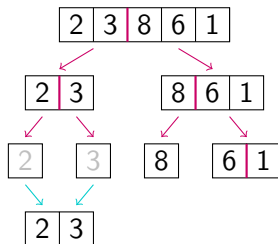
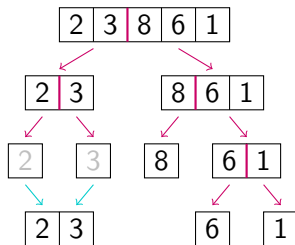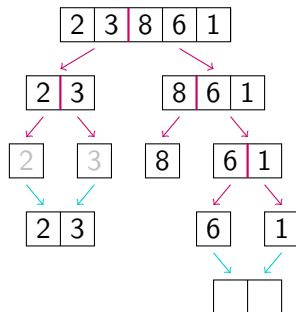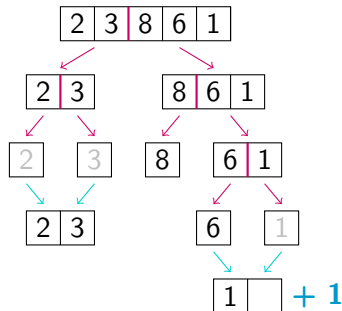| 2	3	8	6	1

Exercise 2: Inversion Count

Solution 2: Using Merge sort

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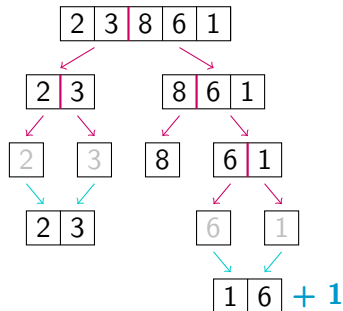# Exercise 2: Inversion Count
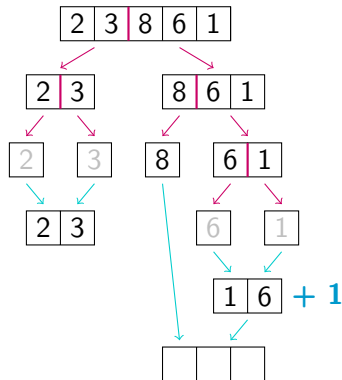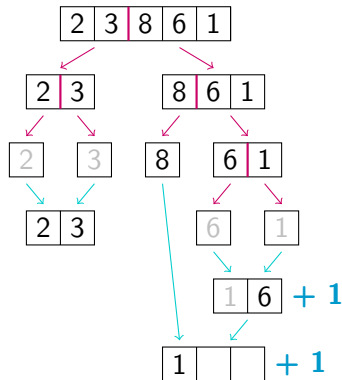
Solution 2: Using Merge sort

Exercise 2: Inversion Count

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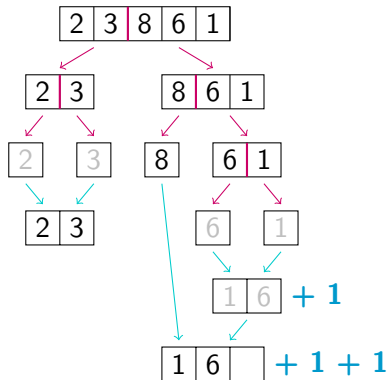# Exercise 2: Inversion Count
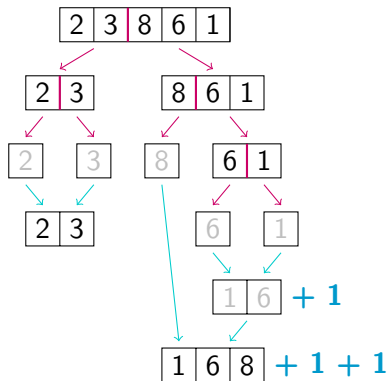
Solution 2: Using Merge sort

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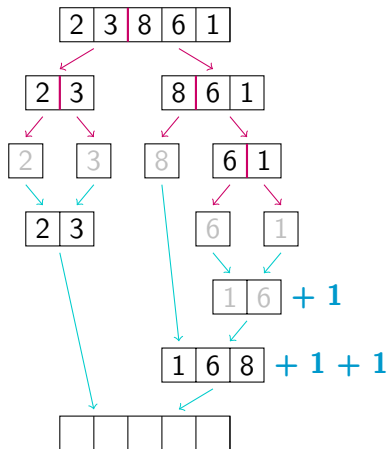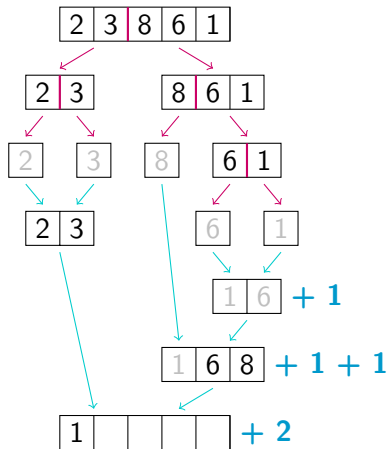
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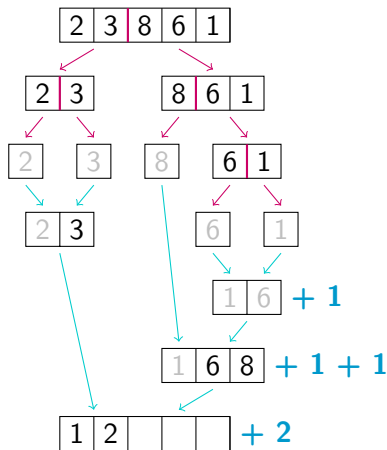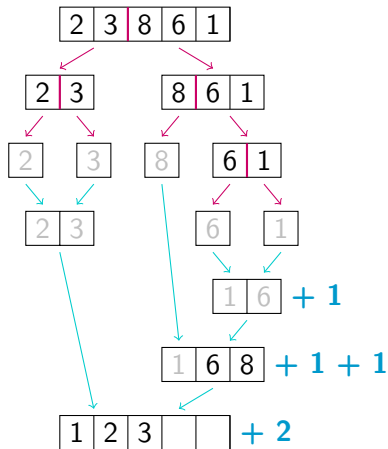
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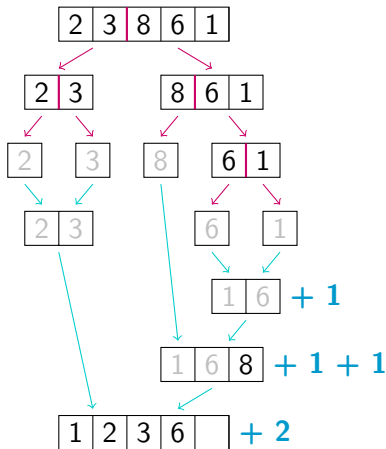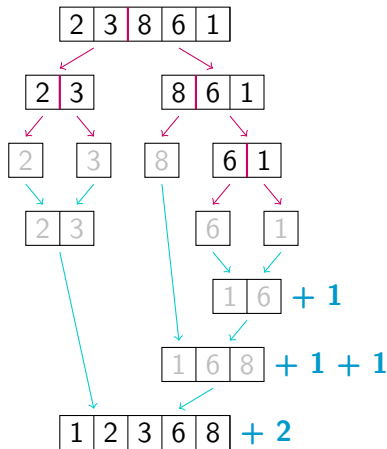# Exercise 2: Inversion Count

Solution 2: Using Merge sort

Exercise 2: Inversion Count

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Solution 2: Using Merge sort

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