

## Part 03

### Contiguous Storage

#### BASIC

1. Write a program that allows users to enter a numeric array with  $N$  elements. The program will count and display the number of negative numbers, the number of zeros and the number of positive numbers.

Example 1:

```
How many element of numeric array? 0
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 10
Please enter value for 10 elements:
The value of a[0] is: -7
The value of a[1] is: 1
The value of a[2] is: 9
The value of a[3] is: -15
The value of a[4] is: 0
The value of a[5] is: 13
The value of a[6] is: -6
The value of a[7] is: 4
The value of a[8] is: 0
The value of a[9] is: 58
The number of negative elements is 3
The number of zero elements is 2
The number of positive elements is 5
```

2. Write a program that allows users to enter a numeric array with  $N$  elements. The program will count and display the number of odd numbers and the number of even numbers.

Example 1:

```
How many element of numeric array? -8
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 10
Please enter value for 10 elements:
The value of element 1 is: 19
The value of element 2 is: -25
The value of element 3 is: 36
The value of element 4 is: 0
The value of element 5 is: 1
The value of element 6 is: 3
The value of element 7 is: -47
The value of element 8 is: 0
The value of element 9 is: 59
The value of element 10 is: 12
The number of odd elements is 6
The number of even elements is 4
```

3. Write a program that allows users to enter a numeric array with  $N$  elements. The program will sum and average the elements of the array.

Example 1:

```
How many element of numeric array? -8
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 12
Please enter value for 12 elements:
Value of the 1st element is: 19
Value of the 2nd element is: 28
Value of the 3rd element is: 3
Value of the 4th element is: 482
Value of the 5th element is: 12
Value of the 6th element is: 5
Value of the 7th element is: 41
Value of the 8th element is: 156
Value of the 9th element is: 300
Value of the 10th element is: -30
Value of the 11th element is: 184
Value of the 12th element is: 6
The total value of the numeric array is 1206
The average value of the numeric array is 100.50
```

4. Write a program that allows users to enter a numeric array with  $N$  elements. The program will find and display the minimum and the maximum value of the array.

Example 1: How many element of numeric array? 0  
The number of element of numeric array must be greater than 0!

Example 2: How many element of numeric array? 10  
Please enter value for 10 elements:  
Value of the 1st element is: 33  
Value of the 2nd element is: 18  
Value of the 3rd element is: -85  
Value of the 4th element is: -44  
Value of the 5th element is: 67  
Value of the 6th element is: 0  
Value of the 7th element is: -5  
Value of the 8th element is: -85  
Value of the 9th element is: 478  
Value of the 10th element is: -27  
The minimum value of the numeric array is -85  
The maximum value of the numeric array is 478

5. Write a program that allows users to enter a numeric array with  $N$  elements. The program will display all elements of the array in **reverse order**.

Example 1: How many element of numeric array? -5  
The number of element of numeric array must be greater than 0!

Example 2: How many element of numeric array? 5  
Please enter value for 5 elements:  
Value of the 1st element is: 24  
Value of the 2nd element is: 52  
Value of the 3rd element is: 7  
Value of the 4th element is: 182  
Value of the 5th element is: -6  
The entered array is:  
24, 52, 7, 182, -6  
The reverse array is:  
-6, 182, 7, 52, 24

## ----- NUMERALS -----

6. Write a program that allows entering an integer  $N \geq 0$ . The program will convert and display the binary value of the entered number.

Example 1: Please enter integer N: -3  
N must be greater than or equal 0!

Example 2: Please enter integer N: 277  
Conversion results: 277<sub>d</sub> = 100010101<sub>b</sub>

7. (\*) Write a program that allows entering an integer  $N$  (2 bytes  $\approx$  16 bits). The program will convert and display the binary value of the entered number.

**Hint:** represent negative numbers in the form of **2's complement**.

Example 1: Please enter integer N: 240  
Conversion results: 240<sub>d</sub> = 0000000011110000<sub>b</sub>

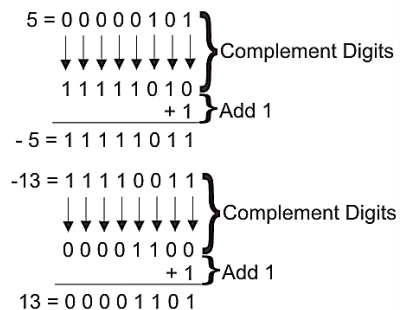
Example 2: Please enter integer N: -240  
Conversion results: 240<sub>d</sub> = 1111111100010000<sub>b</sub>

Example 3: Please enter integer N: 1  
Conversion results: 240<sub>d</sub> = 0000000000000001<sub>b</sub>

Example 4: Please enter integer N: -1  
Conversion results: 240<sub>d</sub> = 1111111111111111<sub>b</sub>

Example 5: Please enter integer N: 2415  
Conversion results: 240<sub>d</sub> = 0000100101101111<sub>b</sub>

Example 6: Please enter integer N: -2415  
Conversion results: 240<sub>d</sub> = 1111011010010001<sub>b</sub>



8. Write a program that allows entering an integer  $N \geq 0$ . The program will convert and display the hexadecimal value of the entered number.

Example 1: Please enter integer N: -3  
N must be greater than or equal 0!

Example 2: Please enter integer N: 51966  
Conversion results: 51966<sub>d</sub> = CAFE<sub>h</sub>

Example 3: Please enter integer N: 61946  
Conversion results: 61946<sub>d</sub> = F1FA<sub>h</sub>

### Theory:

# The form of binary number  $B$  is  $b_{n-1}b_{n-2} \dots b_2b_1b_0$ .

# Binary (the base value:  $q = 2$ ) to decimal conversion formula is:

$$N = b_{n-1}q^{n-1} + b_{n-2}q^{n-2} + \dots + b_2q^2 + b_1q^1 + b_0q^0$$

For example:

\*  $B = 0110000000001101_b$

\* Decimal value of  $B$  is

$$\begin{aligned} N &= 0 \cdot 2^{15} + 1 \cdot 2^{14} + 1 \cdot 2^{13} + 0 \cdot 2^{12} + 0 \cdot 2^{11} + 0 \cdot 2^{10} + 0 \cdot 2^9 + 0 \cdot 2^8 + 0 \cdot 2^7 + 0 \cdot 2^6 + 0 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 \\ &= 1 \cdot 2^{14} + 1 \cdot 2^{13} + 1 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^0 \\ &= 16384 + 8192 + 8 + 4 + 1 \\ &= 24589 \end{aligned}$$

\* So, the decimal value of the binary number  $0110000000001101_b$  is 24589<sub>d</sub>

9. (\*) Write a program that allows user to enter a 16-bit binary number and then convert this binary number into decimal values.

**Hint:** Use **Long Long** datatype to present a 16-bit binary number.

Example 1: Please a 16-bit binary number: 1011101010111110  
Conversion results: 1011101010111110<sub>b</sub> = 47806<sub>d</sub>

Example 2: Please a 16-bit binary number: 0110000000011101  
Conversion results: 0110000000011101<sub>b</sub> = 24605<sub>d</sub>

10. (\*) Write a program that allows user to enter the integer  $N \geq 0$  with the base number  $A$ . The program will convert and display the value of  $N$  with the base number  $B$ .

**Note:** -  $N$  has a maximum of 16 digits.

-  $A$  must be 2 or 8 or 10.

-  $B$  must be 2 or 8 or 10 or 16.

Example 1: Please an integer number: 235312  
Please enter the base A of your number: 16  
The base A must be 2 or 8 or 10!  
Please enter the base A of your number: 8  
Please enter the base B of the result : -5  
The base B must be 2 or 8 or 10 or 16!  
Please enter the base B of the result : 10  
Conversion results: 235312<sub>d</sub> = 80586<sub>d</sub>

Example 2: Please an integer number: 0110000000011101  
Please enter the base A of your number: 2  
Please enter the base B of the result : 16  
Conversion results: 0110000000011101<sub>b</sub> = 600<sub>h</sub>

Example 3: Please an integer number: 130784  
Please enter the base A of your number: 8  
130784 is not an octal number!  
Please enter the base A of your number: 2  
130784 is not a binary number!  
Please enter the base A of your number: 10  
Please enter the base B of the result : 2  
Conversion results: 130784<sub>d</sub> = 00010011101011001010<sub>b</sub>

**Theory:**

In mathematics, the **Fibonacci** numbers, commonly denoted  $F_n$  form a sequence, called the Fibonacci sequence, such that **each number is the sum of the two preceding ones**. The sequence is starting from 0 and 1. That is,

$$F_n = \begin{cases} 0 & n = 0 \\ 1 & n = 1 \\ F_{n-2} + F_{n-1} & n > 1 \end{cases}$$

In some books, and particularly in old ones,  $F_0$ , the "0" is omitted, and the Fibonacci sequence starts with  $F_1 = F_2 = 1$ . The beginning of the sequence is thus:

(0,) 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, . etc

11. Write a program that displays the Fibonacci sequence with  $N$  numbers.

Example 1: Please enter positive integer N: -5  
N must be greater or equal 0!

Example 2: Please enter positive integer N: 8  
The Fibonacci sequence with 8 numbers is:  
0, 1, 1, 2, 3, 5, 8, 13

12. Write a program to display the  $N^{\text{th}}$  element of the Fibonacci sequence.

Example 1: Please enter positive integer N: -17  
N must be greater or equal 0!

Example 2: Please enter positive integer N: 10  
34 is the 10th element of the Fibonacci sequence

----- SORTING -----

13. Write a program that allows users to enter a numeric array with  $N$  elements. The program uses **Bubble sort** to sort the array in an ascending order and display the sorted array.

Example 1: How many element of numeric array? -8  
The number of element of numeric array must be greater than 0!

Example 2: How many element of numeric array? 10  
Please enter value for 10 elements:  
Value of the 1st element is: 19  
Value of the 2nd element is: 28  
Value of the 3rd element is: -3  
Value of the 4th element is: -482  
Value of the 5th element is: 0  
Value of the 6th element is: 5  
Value of the 7th element is: 41  
Value of the 8th element is: -156  
Value of the 9th element is: 300  
Value of the 10th element is: 184  
The entered array is:  
19, 28, -3, -482, 0, 5, 41, -156, 300, 184  
The sorted array is:  
-482, -156, -3, 0, 5, 19, 28, 41, 184, 300

14. Write a program that allows users to enter a numeric array with  $N$  elements. The program uses **Selection sort** to sort the array in a **descending** order and display the sorted array.

15. Write a program that allows users to enter a numeric array with  $N$  elements. The program uses **Insertion sort** to sort the array in an **ascending** order and display the sorted array.

16. Write a program that allows users to enter a numeric array with  $N$  elements. The program checks whether the entered array **has been sorted** in ascending or descending order.

Example 1: How many element of numeric array? 0  
The number of element of numeric array must be greater than 0!

Example 2: How many element of numeric array? 5  
Please enter value for 5 elements:  
Value of the 1st element is: 6  
Value of the 2nd element is: 7  
Value of the 3rd element is: 10  
Value of the 4th element is: 15  
Value of the 5th element is: 28  
The entered array is:  
6, 7, 10, 15, 28  
The array is sorted in an **ascending order**

Example 3: How many element of numeric array? 5  
Please enter value for 5 elements:  
Value of the 1st element is: 852  
Value of the 2nd element is: 419  
Value of the 3rd element is: 36  
Value of the 4th element is: 4  
Value of the 5th element is: -5  
The entered array is:  
852, 419, 36, 4, -5  
The array is sorted in an **descending order**

Example 4: How many element of numeric array? 4  
Please enter value for 4 elements:  
Value of the 1st element is: 2  
Value of the 2nd element is: 19  
Value of the 3rd element is: -7  
Value of the 5th element is: 0  
The entered array is:  
2, 19, -7, 0  
The array is **not sorted**

## ----- DATA STRUCTURES -----

17. **[Insert new element]** Write a program that allows users to enter 3 information:

- 1) A numeric array  $A$  with  $N$  elements.
- 2) A **newValue** value.
- 3) An **index** value.

The program will insert **newValue** into the place that indexed **index**.

Example 1: How many element of numeric array? 0  
The number of element of numeric array must be greater than 0!

Example 2: How many element of numeric array? 3  
Please enter value for 3 elements:  
Value of the 1st element is: 4  
Value of the 2nd element is: -2  
Value of the 3rd element is: 19  
The entered array is:  
4, -2, 19  
Please enter the value that you want to insert: 27  
Please enter index that the new value will be inserted: -7  
**The index must be from 0 to 3!**  
Please enter index that the new value will be inserted: 2  
The array after insert 27 into the place that **indexed [2]** is:  
4, -2, 27, 19

Example 3: How many element of numeric array? 3  
Please enter value for 3 elements:  
Value of the 1st element is: 4  
Value of the 2nd element is: -2  
Value of the 3rd element is: 19  
The entered array is:  
4, -2, 19  
Please enter the value that you want to insert: 27  
Please enter index that the new value will be inserted: 3  
The array after insert 27 into the place that **indexed [3]** is:  
4, -2, 19, 27

Example 4:

```

How many element of numeric array? 3
Please enter value for 3 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
The entered array is:
4, -2, 19
Please enter the value that you want to insert: 27
Please enter index that the new value will be inserted: 0
The array after insert 27 into the place that indexed [0] is:
27, 4, -2, 19

```

18. [Remove element by index] Write a program that allows users to enter 2 information:

- 1) A numeric array *A* with *N* elements.
- 2) An *index* value.

The program will remove the element that indexed *index*.

Example 1:

```

How many element of numeric array? 0
The number of element of numeric array must be greater than 0!

```

Example 2:

```

How many element of numeric array? 5
Please enter value for 5 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
The entered array is:
4, -2, 19, 36, 10
Please enter index of the element that you want to remove: 5
The index must be from 0 to 4!
Please enter index of the element that you want to remove: 2
The array after remove the element that indexed [2] is:
4, -2, 36, 10

```

19. [Search first matched element] Write a program that allows users to enter 2 information:

- 1) A numeric array *A* with *N* elements.
- 2) A *searchValue*.

The program will find the first element which value is equal with *searchValue*.

Example 1:

```

How many element of numeric array? 0
The number of element of numeric array must be greater than 0!

```

Example 2:

```

How many element of numeric array? 8
Please enter value for 8 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
Value of the 6th element is: 19
Value of the 7th element is: -5
Value of the 8th element is: 19
The entered array is:
4, -2, 19, 36, 10, 19, -5, 19
Please enter the value that you want to find: 5
The value 5 is not found in this array

```

Example 3:

```

How many element of numeric array? 8
Please enter value for 8 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
Value of the 6th element is: 19
Value of the 7th element is: -5
Value of the 8th element is: 19
The entered array is:
4, -2, 19, 36, 10, 19, -5, 19
Please enter the value that you want to find: 19
The first element which value is 19 is found at index [2]

```

20. [Search last matched element] Write a program that allows users to enter 2 information:

- 1) A numeric array *A* with *N* elements.
- 2) A *searchValue*.

The program will find the last element which value is equal with *searchValue*.

Example 1:

```
How many element of numeric array? 0
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 7
Please enter value for 7 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 19
Value of the 6th element is: -5
Value of the 7th element is: 19
The entered array is:
4, -2, 19, 36, 19, -5, 19
Please enter the value that you want to find: 7
The value 7 is not found in this array
```

Example 3:

```
How many element of numeric array? 7
Please enter value for 7 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 19
Value of the 6th element is: -5
Value of the 7th element is: 19
The entered array is:
4, -2, 19, 36, 19, -5, 19
Please enter the value that you want to find: 19
The last element which value is 19 is found at index [6]
```

21. [Search all matched elements] Write a program that allows users to enter 2 information:

- 1) A numeric array *A* with *N* elements.
- 2) A *searchValue*.

The program will find the all elements which value is equal with *searchValue*.

Example 1:

```
How many element of numeric array? 0
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 8
Please enter value for 8 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
Value of the 6th element is: 19
Value of the 7th element is: -5
Value of the 8th element is: 19
The entered array is:
4, -2, 19, 36, 10, 19, -5, 19
Please enter the value that you want to find: 7
The value 7 is not found in this array
```

Example 3:

```
How many element of numeric array? 8
Please enter value for 8 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
Value of the 6th element is: 19
Value of the 7th element is: -5
Value of the 8th element is: 19
The entered array is:
4, -2, 19, 36, 10, 19, -5, 19
Please enter the value that you want to find: 19
All elements whose values are 19 are found at indexes:
[2], [5], [7]
```

22. **[Replace all matched elements]** Write a program that allows users to enter 3 information:

- 1) A numeric array *A* with *N* elements.
- 2) An *oldValue*.
- 3) A *newValue*.

The program will replace all elements which value is equal with *oldValue* by *newValue*.

Example 1:

```
How many element of numeric array? 0
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 8
Please enter value for 8 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
Value of the 6th element is: 19
Value of the 7th element is: -5
Value of the 8th element is: 19
The entered array is:
4, -2, 19, 36, 10, 19, -5, 19
Please enter the value that you want to find: 1
The value 1 is not found in this array
```

Example 3:

```
How many element of numeric array? 8
Please enter value for 8 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 36
Value of the 5th element is: 10
Value of the 6th element is: 19
Value of the 7th element is: -5
Value of the 8th element is: 19
The entered array is:
4, -2, 19, 36, 10, 19, -5, 19
Please enter the old value that you want to find: 19
Please enter the new value that you want to replace: 1000
The array after replaced all elements whose value is 19 by 1000:
4, -2, 1000, 36, 10, 1000, -5, 1000
```

23. **[Remove all matched elements]** Write a program that allows users to enter 2 information:

- 1) A numeric array *A* with *N* elements.
- 2) An *searchValue*.

The program will remove all elements which value is equal with *searchValue*.

Example 1:

```
How many element of numeric array? 0
The number of element of numeric array must be greater than 0!
```

Example 2:

```
How many element of numeric array? 3
Please enter value for 3 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
The entered array is:
4, -2, 19
Please enter the value that you want to find: 1
The value 1 is not found in this array
```

Example 3:

```
How many element of numeric array? 7
Please enter value for 7 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 19
Value of the 4th element is: 19
Value of the 5th element is: 36
Value of the 6th element is: -5
Value of the 7th element is: 19
The entered array is:
4, -2, 19, 19, 36, -5, 19
Please enter the value that you want to remove: 19
The array after remove all elements whose value is 19:
4, -2, 36, -5
```



Example 4:

```

How many element of numeric array? 7
Please enter value for 7 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -2
Value of the 3rd element is: 5
Value of the 4th element is: 5
Value of the 5th element is: 5
Value of the 6th element is: 19
Value of the 7th element is: 5
The entered array is:
4, -2, 5, 5, 5, 19, 5
Please enter the value that you want to remove: 5
The array after remove all elements whose value is 5:
4, -2, 19

```

24. [Merge 2 arrays] Write a program that allows users to enter 2 information:

1) A numeric array **A** with **N** elements.

2) A numeric array **B** with **M** elements.

The program will append all elements of array **B** after array **A**.

Example 1:

```

How many element of numeric array A ? 0
The number of element of array A must be greater than 0!

```

Example 2:

```

How many element of numeric array A? 3
Please enter value for 3 elements:
Value of the 1st element is: 4
Value of the 2nd element is: -1
Value of the 3rd element is: 97
How many element of numeric array B? -9
The number of element of array B must be greater than 0!
How many element of numeric array B? 4
Please enter value for 4 elements:
Value of the 1st element is: 19
Value of the 2nd element is: 36
Value of the 3rd element is: 22
Value of the 4th element is: -5
The array A is:
4, -1, 97
The array B is:
19, 36, 22, -5
The merged array after append all elements of array B after array A is:
4, -1, 97, 19, 36, 22, -5

```

25. [Merge 2 sorted arrays] Write a program that allows users to enter 2 information:

1) A numeric array **A** with **N** elements that sorted ascending.

2) A numeric array **B** with **M** elements that sorted ascending.

The program will merge array **A** and array **B** into one array that **sorted ascending**.

**Note:** You **CAN NOT** append array **B** after array **A** and then sort the result array.

Example 1:

```

How many element of numeric array A ? 0
The number of element of array A must be greater than 0!

```

Example 2:

```

How many element of numeric array A? 3
Please enter value for 3 elements:
Value of the 1st element is: 5
Value of the 2nd element is: 49
Value of the 3rd element is: 97
How many element of numeric array B? -9
The number of element of array B must be greater than 0!
How many element of numeric array B? 4
Please enter value for 4 elements:
Value of the 1st element is: -8
Value of the 2nd element is: 7
Value of the 3rd element is: 25
Value of the 4th element is: 190
The array A is:
5, 49, 97
The array B is:
-8, 7, 25, 190
The merged array after merge array A and array B into once array that sorted ascending:
-8, 5, 7, 25, 49, 97, 190

```

26. [Merge 2 sorted arrays] Write a program that allows users to enter 2 information:

- 1) A numeric array **A** with **N** elements that sorted ascending.
- 2) A numeric array **B** with **M** elements that sorted ascending.

The program will merge array **A** and array **B** into one array that **sorted descending**.

**Note:** You **CAN NOT** append array **B** after array **A** and then sort the result array.

Example 1:

```
How many element of numeric array A ? 0
The number of element of array A must be greater than 0!
```

Example 2:

```
How many element of numeric array A? 3
Please enter value for 3 elements:
Value of the 1st element is: 5
Value of the 2nd element is: 49
Value of the 3rd element is: 97
How many element of numeric array B? -9
The number of element of array B must be greater than 0!
How many element of numeric array B? 4
Please enter value for 4 elements:
Value of the 1rd element is: -8
Value of the 2th element is: 7
Value of the 3th element is: 25
Value of the 4th element is: 190
The array A is:
5, 49, 97
The array B is:
-8, 7, 25, 190
The merged array after merge array A and array B into once array that sorted ascending:
190, 97, 49, 25, 7, 5, -8
```

27. [Merge 2 sorted arrays] Write a program that allows users to enter 2 information:

- 1) A numeric array **A** with **N** elements that sorted **ascending**.
- 2) A numeric array **B** with **M** elements that sorted **descending**.

The program will merge array **A** and array **B** into one array that **sorted descending**.

**Note:** You **CAN NOT** append array **B** after array **A** and then sort the result array.

Example 1:

```
How many element of numeric array A ? 0
The number of element of array A must be greater than 0!
```

Example 2:

```
How many element of numeric array A? 3
Please enter value for 3 elements:
Value of the 1st element is: 5
Value of the 2nd element is: 49
Value of the 3rd element is: 97
How many element of numeric array B? -9
The number of element of array B must be greater than 0!
How many element of numeric array B? 4
Please enter value for 4 elements:
Value of the 1rd element is: 190
Value of the 2th element is: 25
Value of the 3th element is: 7
Value of the 4th element is: -8
The array A is:
5, 49, 97
The array B is:
190, 25, 7, -8
The merged array after merge array A and array B into once array that sorted ascending:
190, 97, 49, 25, 7, 5, -8
```

## ----- 2-DIMENSIONAL ARRAY -----

**Theory:**

In the square-matrix  $A$  which has  $N$  rows and  $N$  columns, the element  $A_{ij}$  is called the **saddle element** if it is the smallest value of row  $i$  and it is also the largest value of column  $j$ .

28. Write a program to enter square-matrix  $A$  that has  $M$  rows and  $N$  columns and then finds all **saddle elements** of matrix  $A$ .

Example 1: Please enter value for the matrix A:  
Please enter number of rows: 5  
Please enter number of columns: -3  
The number of columns must greater than 0

Example 2: Please enter value for the matrix A:  
Please enter number of rows: -2  
The number of rows must greater than 0

Example 3: Please enter value for the matrix A:  
Please enter number of rows: 3  
Please enter number of columns: 3  
Please enter value for a[1][1]: 1  
Please enter value for a[1][2]: 6  
Please enter value for a[1][3]: 1  
Please enter value for a[2][1]: 1  
Please enter value for a[2][2]: 8  
Please enter value for a[2][3]: -9  
Please enter value for a[3][1]: 0  
Please enter value for a[3][2]: 2  
Please enter value for a[3][3]: 1  
All saddle elements of the matrix is found at  
[1][1], [1][3]

Example 4: Please enter value for the matrix A:  
Please enter number of rows: 3  
Please enter number of columns: 3  
Please enter value for a[1][1]: 4  
Please enter value for a[1][2]: 6  
Please enter value for a[1][3]: 1  
Please enter value for a[2][1]: 7  
Please enter value for a[2][2]: 0  
Please enter value for a[2][3]: 2  
Please enter value for a[3][1]: 9  
Please enter value for a[3][2]: 5  
Please enter value for a[3][3]: -7  
No saddle element is found in this matrix

Example 5: Please enter value for the matrix A:  
Please enter number of rows: 3  
Please enter number of columns: 2  
Please enter value for a[1][1]: 4  
Please enter value for a[1][2]: 8  
Please enter value for a[2][1]: 1  
Please enter value for a[2][2]: 5  
Please enter value for a[3][1]: 3  
Please enter value for a[3][2]: 9  
All saddle elements of the matrix is found at  
[2][2]

29. Write a program to enter matrix **A** that has **M** rows and **N** columns then perform the following tasks:

1. Counts the number of 0 in the matrix.
2. Finds the maximum value in the matrix.
3. Finds the smallest value in the matrix.

Example 1: Please enter value for the matrix A:  
Please enter number of rows: 5  
Please enter number of columns: -3  
The number of columns must greater than 0

Example 2: Please enter value for the matrix A:  
Please enter number of rows: -2  
The number of rows must greater than 0

Example 3: Please enter value for the matrix A:  
Please enter number of rows: 7  
Please enter number of columns: 5  
Please enter value for a[1][1]: -1  
Please enter value for a[1][2]: 2  
Please enter value for a[1][3]: 1  
Please enter value for a[1][4]: 1  
Please enter value for a[1][5]: 1  
Please enter value for a[2][1]: 3  
Please enter value for a[2][2]: 4  
Please enter value for a[2][3]: 1  
Please enter value for a[2][4]: -1  
Please enter value for a[2][5]: 1  
Please enter value for a[3][1]: 4  
Please enter value for a[3][2]: 5  
Please enter value for a[3][3]: 5  
Please enter value for a[3][4]: 0  
Please enter value for a[3][5]: 5  
Please enter value for a[4][1]: 6  
Please enter value for a[4][2]: 7  
Please enter value for a[4][3]: 0  
Please enter value for a[4][4]: 5  
Please enter value for a[4][5]: 0  
Please enter value for a[5][1]: 8  
Please enter value for a[5][2]: -9  
Please enter value for a[5][3]: 5  
Please enter value for a[5][4]: 0  
Please enter value for a[5][5]: 5  
Please enter value for a[6][1]: 4  
Please enter value for a[6][2]: 1  
Please enter value for a[6][3]: 7  
Please enter value for a[6][4]: 8  
Please enter value for a[6][5]: 2  
Please enter value for a[7][1]: 0  
Please enter value for a[7][2]: -3  
Please enter value for a[7][3]: 6  
Please enter value for a[7][4]: -7  
Please enter value for a[7][5]: 3  
The number of the 0 in the matrix is 4  
The minimum value in the matrix is -9  
The maximum value in the matrix is 8

30. In mathematics, matrix addition is the operation of adding two matrices by adding the corresponding entries together. Two matrices must have an equal number of rows and columns to be added.

The matrix product  $C_{m \times n} = A_{m \times n} + B_{m \times n}$  is defined to be the matrix:

$$C = A + B = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & & a_{2n} \\ \vdots & & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & & b_{2n} \\ \vdots & & \ddots & \vdots \\ b_{m1} & b_{m2} & \cdots & b_{mn} \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1n} \\ c_{21} & c_{22} & & c_{2n} \\ \vdots & & \ddots & \vdots \\ c_{m1} & c_{m2} & \cdots & c_{mn} \end{bmatrix}$$

Such that  $c_{ij} = a_{ij} + b_{ij}$   $1 \leq i \leq m, 1 \leq j \leq n$

For example, the result of  $A_{3 \times 2} + B_{3 \times 2}$  is  $C_{3 \times 2}$ :

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} + \begin{bmatrix} 9 & 8 & 7 \\ 6 & 5 & 4 \\ 3 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 1+9 & 2+8 & 3+7 \\ 4+6 & 5+5 & 6+4 \\ 7+3 & 8+2 & 9+1 \end{bmatrix} = \begin{bmatrix} 10 & 10 & 10 \\ 10 & 10 & 10 \\ 10 & 10 & 10 \end{bmatrix}$$

Your mission is creating a program that allows user to enter two 2-dimensional matrices and then compute the addition of the two given matrices. This program must check input data include number of rows and number of columns of these matrices.

Example 1: Please enter value for the first matrix A:

Please enter number of rows: 5

Please enter number of columns: -3

The number of columns must greater than 0

Example 2: Please enter value for the first matrix A:

Please enter number of rows: -2

The number of rows must greater than 0

Example 3: Please enter value for the first matrix A:

Please enter number of rows: 2

Please enter number of columns: 2

Please enter value for a[1][1]: 10

Please enter value for a[1][2]: 0

Please enter value for a[2][1]: -4

Please enter value for a[2][2]: 5

-----

Please enter value for the second matrix B:

Please enter number of rows: 2

Please enter number of columns: 2

Please enter value for B[1][1]: -6

Please enter value for B[1][2]: 3

Please enter value for B[2][1]: 1

Please enter value for B[2][2]: -7

The matrix C = A + B is

4 3

-3 -2

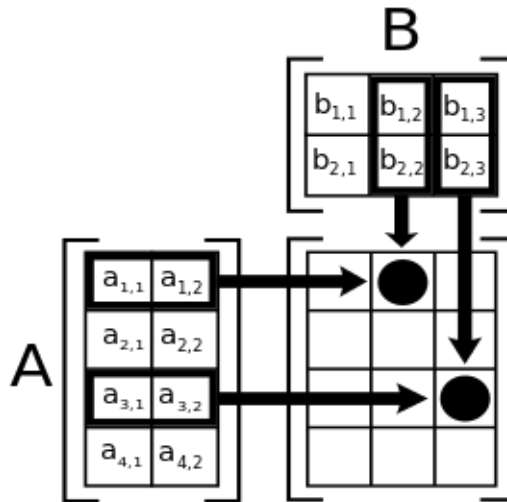
31. In mathematics, matrix multiplication or matrix product is a binary operation that produces a matrix from two matrices with entries in a field.

The matrix product  $C_{n \times p} = A_{n \times m} * B_{m \times p}$  is defined to be the matrix:

$$C = A * B = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1m} \\ a_{21} & a_{22} & & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nm} \end{bmatrix} * \begin{bmatrix} b_{11} & b_{12} & \dots & b_{1p} \\ b_{21} & b_{22} & & b_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ b_{m1} & b_{m2} & \dots & b_{mp} \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1p} \\ c_{21} & c_{22} & & c_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ c_{n1} & c_{n2} & \dots & c_{np} \end{bmatrix}$$

Such that  $c_{ij} = a_{i1}b_{1j} + \dots + a_{im}b_{mj} = \sum_{k=1}^m a_{ik}b_{kj} \quad 1 \leq i \leq n, 1 \leq j \leq p$

For example, the result of  $A_{4 \times 2} * B_{2 \times 3}$  is  $C_{4 \times 3}$ :



Your mission is creating a program that allows user to enter two 2-dimensional matrices and then compute the multiplication of the two given matrices. This program must check input data include number of rows and number of columns of these matrices.

Example 1: Please enter value for the first matrix A:  
Please enter number of rows: 5  
Please enter number of columns: -3  
The number of columns must greater than 0

Example 2: Please enter value for the first matrix A:  
Please enter number of rows: -2  
The number of rows must greater than 0

Example 3: Please enter value for the first matrix A:  
Please enter number of rows: 2  
Please enter number of columns: 2  
Please enter value for a[1][1]: 4  
Please enter value for a[1][2]: 2  
Please enter value for a[2][1]: 9  
Please enter value for a[2][2]: 8  
-----

Please enter value for the second matrix B:  
Please enter number of rows: 4  
Please enter number of columns: 4  
Can't calculate A\*B because of invalid number of rows of matrix B!

Example 4: Please enter value for the first matrix A:  
 Please enter number of rows: 2  
 Please enter number of columns: 2  
 Please enter value for A[1][1]: 4  
 Please enter value for A[1][2]: 2  
 Please enter value for A[2][1]: 9  
 Please enter value for A[2][2]: 8  
 -----  
 Please enter value for the second matrix B:  
 Please enter number of rows: 2  
 Please enter number of columns: 3  
 Please enter value for B[1][1]: -2  
 Please enter value for B[1][2]: 4  
 Please enter value for B[1][3]: 0  
 Please enter value for B[2][1]: 3  
 Please enter value for B[2][2]: 6  
 Please enter value for B[2][3]: 1  
 The matrix C = A \* B is  
 -2 28 2  
 6 84 8

32. Write a program that displays a 2-dimensional matrix  $A$  which size is  $N \times N$  and then fills it with integers from 1 to  $N^2$  in a **spiral format**.

Example 1: Please enter the size of matrix: -2  
 The size of matrix must greater than 0

Example 2: Please enter the size of matrix: 5  
 The spiral matrix which size is 5x5 is:  
 1 2 3 4 5  
 16 17 18 19 6  
 15 24 25 20 7  
 14 23 22 21 8  
 13 12 11 10 9

33. Write a program that displays a 2-dimensional matrix  $A$  which size is  $N \times N$  and then fills it with integers from 1 to  $N^2$  in a **reverse spiral format**.

Example 1: Please enter the size of matrix: -2  
 The size of matrix must greater than 0

Example 2: Please enter the size of matrix: 5  
 The reverse spiral matrix which size is 5x5 is:  
 25 10 11 12 13  
 24 9 2 3 14  
 23 8 1 4 15  
 22 7 6 5 16  
 21 20 19 18 17

34. In mathematics, a magic square is a  $N \times N$  square grid (where  $N$  is the number of cells on each side) filled with distinct positive integers in the range 1, 2, ...,  $N^2$  such that each cell contains a different integer and the sum of the integers in each row, column and diagonal is equal. Your mission is write a program that allows user to enter a positive integer  $N \geq 2$  and display a magic square which size is  $N \times N$ .

Example 1: Please enter the size of square: -2  
 The size of square must greater than 0

Example 2: Please enter the size of square: 3  
 The magic square which size is 3x3 is:  
 2 7 6  
 9 5 1  
 4 3 8

Example 3: Please enter the size of square: 4  
 The magic square which size is 4x4 is:  
 1 14 15 4  
 12 7 6 9  
 8 11 10 5  
 13 2 3 16

Example 4: Please enter the size of square: 5  
 The magic square which size is 5x5 is:  
 3 16 9 22 15  
 20 8 21 14 2  
 7 25 13 1 19  
 24 12 5 18 6  
 11 4 17 10 23

35. LeO decided to invest in renting land to grow vegetables. The land is a rectangle  $M \times N$  square plot of land ( $1 \leq M, N \leq 100$ ). But only a few days later, a terrible flood took place making some plots of flooded and the land turned into some ponds.

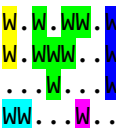
LeO decided to switch to fish farming and wanted to know how many ponds there were. Please help LeO.

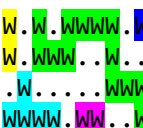
**Note:** Ponds are composed of some flooded plots with the same peak. It is easy to see that a plot of land can have up to 4 cells which connected with it's edges.

Your mission is creating a program that allows user to enter matrix  $A$  that has  $M$  rows and  $N$  columns. Each cell  $A_{ij}$  contains one of two values:

1. Character  $.$  describes the plot of land that is not flooded.
2. Character  $W$  describes the plot of land that is flooded.

The program will count and display number of ponds of the land.

Example 1: Please enter the size of land: 4 6  
 Please enter the 1st rows of the land:   
 Please enter the 2nd rows of the land:  
 Please enter the 3rd rows of the land:  
 Please enter the 4th rows of the land:  
 There is 5 ponds on the land

Example 2: Please enter the size of land: 4 8  
 Please enter the 1st rows of the land:   
 Please enter the 2nd rows of the land:  
 Please enter the 3rd rows of the land:  
 Please enter the 4th rows of the land:  
 There is 5 ponds on the land