

TUTORIAL N°4 : ARRAYS AND STRINGS (STRUCTURED DATA TYPES)

Exercise 01:

Let "Study" be a one-dimensional array, which contains the students' grades in a subject.

- Write an algorithm that counts the number of students with a grade:
 - less than 5
 - greater than or equal to 5 but less than 10
 - greater than or equal to 10

Exercise 02:

Consider an array T of N integer values ($N \leq 100$)

- Write an algorithm that allows you to determine the maximum and minimum of the array T.

Exercise 03:

Consider an array T of N integer values ($N \leq 100$)

- Write an algorithm that reverses the contents of the array T.
 - Using a secondary (temporary) array
 - Without using another array (Work directly on T)

Exercise 04: Filling a Vector (Ratt ASD1 Exam 2021-2022)

Let T be a one-dimensional array of n integer values (with $n < 1000$)

- Write an algorithm that fills the array T like the example below.

Example : **T**

1	0	9	0	25	0	49	0	81	0
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Exercise 05:

Let T be a one-dimensional array of N integer values ($N \leq 100$)

- Write an algorithm that allows you to search for a given integer value **val** in the array **T** and returns its index if it exists (returns the index of the first occurrence) otherwise, returns a negative value.

Exercise 06:

Consider two vectors A[n] and B[n].

- Write an algorithm that calculates the dot product $A \cdot B$. The scalar product of two vectors A and B is defined as follows:

$$A \cdot B = \sum_{i=1}^n (A[i] * B[i])$$

Exercise 07:

Consider an array T of N integer values ($N \leq 100$)

- Write an algorithm that sorts (orders the elements) the array T (ascending or descending).

Exercise 08:

Let T be an array of integers of size equal to 100 containing N values ($N \leq 100$). These values are sorted in ascending order. Write an algorithm that inserts an integer value into the array T.

Exercise 09:

- Write an algorithm that merges two arrays T1[n] and T2[m] sorted in ascending order, into a single array T3 also sorted in ascending order. Example :

5	7	11
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T1

2	4	9	13
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T2

2	4	5	7	9	11	13
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T3

Exercise 10: Buy and Sell Stocks (ADS-1 Exam 2022-2023)

Let *Prices* be an array of n real values ($n \leq 30$) containing the prices of the stocks on different days.

- Write an algorithm that find the maximum profit for buying and selling the stocks on different days using a single transaction (one purchase and one sale only). The stocks must be bought before they are sold

Example : Prices

8.5	2.1	4.7	3	8.2	5.9	4.3	7.2	7.5	6.1
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Maximum Profit : **6.1** (Buy on the 2nd day and sell on the 5th day)

Exercise 11: Let T be a array -of real values- with n rows and m columns with ($n \leq 50$ and $m \leq 50$)

- Write an algorithm that calculates the sum of the elements of this array.

Exercise 12: Zero-one matrix (Ratt Algo1 Exam 2018-2019)

Let T be a two-dimensional array (n, m) of integer values ($n \leq 50, m \leq 50$).

Write an algorithm that fills and displays the array T as shown in the figure.

1	0	1	0	1	0
0	1	0	1	0	1
1	0	1	0	1	0
0	1	0	1	0	1
1	0	1	0	1	0
0	1	0	1	0	1

Exercise 13: Consider a matrix M [20, 20] of integer values

- Write an algorithm that searches for the existence of a given integer value val in the matrix M and returns its position if it exists.

Exercise 14: Let a matrix A [n, n] be a square matrix of integer values with $n \leq 20$

- Write an algorithm that checks whether the matrix A is lower triangular or not;

Example: A $\begin{pmatrix} 7 & 0 & 0 & 0 \\ 12 & 19 & 0 & 0 \\ 33 & 39 & 8 & 0 \\ 5 & 24 & 10 & 2 \end{pmatrix}$ = is lower triangular;

Exercise 15: Let a matrix A [n, n] be a square matrix of integer values with $n \leq 20$

- Write an algorithm that calculates and displays the transpose of the matrix A

Example : A = $\begin{pmatrix} 3 & 4 & 10 \\ 5 & 0 & 1 \\ 12 & 13 & -8 \end{pmatrix}$ the transpose of A is $A^t = \begin{pmatrix} 3 & 5 & 12 \\ 4 & 0 & 13 \\ 10 & 1 & -8 \end{pmatrix}$

Exercise 16:

Consider two matrices T1 [n, m] and T2 [m, l] of real values with dimensions less than 10x10.

- Write an algorithm that calculates the product of matrix T1 times matrix T2 (T1 x T2)

String

Exercise 17:

- Write a function that takes a string as input and displays each of its characters separately.
- Write a function delete_Spaces that removes spaces and tabs from a string. This function should not use an intermediate array. Example:
`"this is a sentence !"` becomes `thisisasentence !`
- Write a function to delete all occurrences of a character in a string (both passed as parameters).
- Write a function to reverse a string. For example, the string:
`"looc"` becomes `cool`
- Write a function that displays the number of letters, digits, and special characters in a string passed as a parameter.

6. Write an algorithm to test all the previous functions.

Exercise 18: Palindrome

A strict palindrome is a symmetric sequence of characters. For example, it can be a word that can be read the same forwards and backwards. Examples: radar, elle, kayak, etc.

1. Write a function `is_Strict_Palindrome` that tests whether a string is a strict palindrome; it returns 1 if it is and 0 otherwise.

Other strings can also be qualified as non-strict palindromes: these are sentences where the sequence of letters forming the words creates a strict palindrome when punctuation marks are removed.

For example:

- "Engage le jeu que je le gagne"

- "Eh! ca va la vache?"

2. Write a function `is_Palindrome`` that takes a string as a parameter and returns 1 if it is a non-strict palindrome and 0 otherwise.

Note:

- No accented letters are considered here.

- Remember to reuse the functions defined in the previous exercise.