

Part 1 : Arrays

Olympic average of an array

The Olympic average of a set of numbers is the arithmetic mean of all the numbers in that set except the smallest and the largest.

For example, for the numbers 2, 3, 13, 7, and 8, the arithmetic mean is 6.6 and the Olympic average is 6.

The following program is used to enter and display an array of 6 integers:

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
#define n 6
int T[n];
int i;
printf("Please enter the %d element of the array \n", n);
for (i=0; i<n; i++) {
    printf("Enter the element number %d :",i) ;
    scanf("%d", &T[i]);
}
for (i=0; i<n; i++) {
    printf("The element number %d is %d \n",i, T[i]) ;
}
return 0;
}
```

1. Create a new project.
2. Type this code, compile, and run.
3. Modify this program to calculate and display the sum, minimum and maximum of this array.
4. Modify this program to calculate and display the Olympic average of this array.

Concluding remarks

1. Declaring a array in the C programming language requires specifying the type of the elements, the name of the array, and its size. The syntax is as follow:

```
⟨type_of_elements⟩ ⟨Array_Name⟩ [size];
```

2. A constant value can be declared in one of the following forms:

```
const ⟨Type_Name⟩ ⟨constant_Name⟩ = ⟨Value⟩ ;
```

```
#define ⟨constant_Name⟩ ⟨Value⟩ ;
```

3. In the C programming language, an array can be initialized in two ways: using a loop or at declaration, as follows::

```
⟨type_of_elements⟩ ⟨Array_Name⟩ [size] = {Val1, Val2, ..., Valn};
```

4. An array can be initialized *completely* or *partially*.
5. The elements of an array are accessed element by element, as follows:

```
⟨ Array_Name ⟩ [⟨index⟩]
```

6. When accessing elements of an array in C, the compiler does not prevent an array bounds overflow (accessing an element outside the array's bounds). It is important for the programmer to check for array bounds overflow.

Part 2: Multidimensional arrays

Number of goals per player

A manager in the Guelma wilaya sports department wanted to calculate statistics for goals scored by players in the wilaya's football teams. To achieve this, he uses a matrix to represent the 11 players of their 4 teams. Complete this C program to allow the manager to:

- Enter the goals scored by each player.
- Find the player with the highest number of goals,
- Display the player's number, team number and number of goals.

```
#include <stdio.h>
#include <stdlib.h>
int main()
{
    #define l 11
    #define c 4
    int T[l][c];
    int i, j;
    .....
    return 0;
}
```

Concluding remarks

1. Declaring an n-dimensional array in the C programming language requires specifying the type of the elements, the name of the array, and its sizes. The syntax is as follows:

`⟨type_of_elements⟩ ⟨Array_Name⟩ [size1] [⟨size22⟩] ... [⟨sizen⟩] ;`

2. In the C language, as with one-dimensional arrays, a multi-dimensional array can be initialised either by nested loops or by declaration, as follows:

`⟨type_of_elements⟩ ⟨Array_Name⟩ [size] = {List1, List2, ..., Listn};`

Where *List_i* is the initialization of elements in line *i*.

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Part 3: Application Exercises

1. Write a C program that inputs a 10-element integer array *T*, then calculates and prints its minimum value.
Modify the program to also calculate and print the number of occurrences of this minimum value

2. Write a C program to enter a 10-element real array *T*, calculate and display the standard deviation of the elements of the array *T*. The standard deviation *Sd* is calculated as follows:

$$Sd(T) = \sqrt{\sum_{i=1}^n (T[i] - m)^2}, \text{ where } m \text{ is the mean of the array } T$$

3. Write a C program that allows you to enter two arrays *T1* and *T2* of *N* integer elements, then display all the elements common to these two arrays, as well as the number of these elements.
4. A palindrome is an array of characters that can be read in the same way in both directions, from left to right or right to left. For example: civic, radar, level, rotor, kayak, madam, and refer.

Write a program in C to enter an array of 5 characters and test and display whether or not it is a palindrome.

5. Let *T* be an array of *N* real values. An element is said to be a *peak* if it is greater than its two adjacent neighbors.

Write a program in C to enter the array *T* and display all the peaks in the array *T*, as well as their indices and the number of peaks.

Example: $N = 10$, $T = (0, 3, -1, -2, 7, 5, 10, 8, 11, 34)$. Your algorithm should display:

- 3 is a peak at index 2
 - 7 is a peak at index 5
 - 10 is a peak at index 7
 - There are 3 peaks in this array.
6. Write a C program to enter a $4 * 5$ integer matrix and display the number of negative, positive, and zero numbers.
 7. Given three matrices A, B, and C of size 3×5 , write a C program that allows the user to read the matrices A and B, then calculates and displays the matrix C, such that $C = A * B$.
 8. Write a C program to enter a square matrix of integers of size 10. The algorithm should then check if the matrix is an upper triangular matrix, that is, if all the elements below the main diagonal are zero.