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Level: 1st year "Computer Science & Mathematics"

Module: Algorithmic and Data Structures 2

TD n°2

Pedagogic objectives

→ Manipulate sub-algorithms (subroutines): procedures & functions;
→ Understand the difference between them;
→ Understand the concepts: local variable , global variable, formal parameter, effective parameter, passing parameters by value and by address.

Exercise n°1

A procedure is declared as follows:

```
Procedure P_Test (A, B, C: integer);
Variable S: integer;
Begin
S← A+B+C;
Write (S);
End;
```

1. Write a main algorithm that calls this procedure.
2. Specify local and global variables, formal and effective parameters.
3. Replace the procedure P_Test with a function F_Test.
4. Call this function in the main algorithm.

Exercise n° 2

Consider the following algorithm:

```
Algorithm exo2;
Variables x, y, z, t: integer;
Procedure my_procedure (a, b, var c, d: integer)
Begin
      c ← a + b ;
      d ← a * b;
End;
Begin
     read (x);
     read (y);
     my_procedure (x, y, z, t);
     write (z);
     write ( t);
END
```

1. Identify the real (effective) parameters and the formal parameters .
2. What does this program display assuming the user enters 2 in *x* and 3 in *y* ? Modify the algorithm to obtain a more logical result .

Exercise n°3

Consider the following algorithm:

```
Algorithm exo3;
Variables T: array [1…100] integer;
              i,N :integer ;

Procedure P1 (T: array [1.. N ] integer);
Variables  i, a: integer;
Begin
   a ←0 ;
    For i ← 1 to N do
        a←a+ T [i] ;
    Endfor
  Write (a);
End;

Procedure P2 (T: array [1.. N ] integer);
Variables  i , b: integer;
Begin
  b← 1 ;
  For i ← 1 to N do
      b←b *T[i] ;
  Endfor
Write (b);
End;
Begin
Repeat
```

```
   Read(N);
Until (N>=1 and N<100)
For i ← 1 to N do
   Read (T[i]);
Endfor
P1(T);
P2(T);
END
```

1. Run the algorithm with the following array:

1	0	2	4	3	1	2	1	2	3

2. What is the role of the procedure P1?
3. What is the role of the procedure P2?
4. In the main algorithm, is it possible to do the following calculation:
   C1 = a/2 and C2 = b/2? Justify your answer.
5. Replace both procedures with functions. In this case is it possible to calculate C1and C2 in the main algorithm? Justify your answer.

Exercise n°4

1. Write a FindVal sub-algorithm that indicates whether a value is contained in a one-dimensional array (with the size N). If so, the sub-algorithm must indicate in which cell the value was found.
2. Write a sub-algorithm which takes as parameters two arrays of real numbers and which returns the value *true* if they are identical, *false* otherwise.
3. Design local and global variables, formal and effective parameters.

Exercise n°5

A positive integer is **perfect** if it is equal to the sum of its divisors (except itself). For example 6 is perfect, because 6 = 1+2+3; similarly 28 is perfect, because 28 = 1 + 2 + 4 + 7 + 14.

1. Write a function **Som_Div** which calculates the sum of the divisors of **n** .
2. Write a **P_perfect_procedure** which uses the **Som_Div** function and indicates whether **n** is perfect or not.
3. Transform this procedure into a Boolean function **F_ perfect.**
4. Use the previous three sub-algorithms in an algorithm.
5. Design local and global variables, formal and effective parameters as well as sub-algorithms calls.