

Exercise 1 :

Study the complexity of the example below:

MULTIPLICATIONMATRICES(A,B)

Input: Two matrices A, B nxn

output : matrice C nxn

1 $n \leftarrow \text{ligne}[A]$

2 Let C a matrice nxn

3 for $i \leftarrow 1 \text{ à } n$ do

4 for $j \leftarrow 1 \text{ à } n$ do

5 $c_{ij} \leftarrow 0$

6 for $k \leftarrow 1 \text{ à } n$ do

7 $c_{ij} \leftarrow c_{ij} + a_{ik} \cdot b_{kj}$

8 end do

9 end do

10 end do

11 return C

Exercise 2 :

Give the complexity of the following algorithm:

Factorial function calculated by recursion

FACTORIAL (n)

Input : an integer n

Output: n!

1 if $n \leq 1$ then

2 result $\leftarrow 1$

3 else result $\leftarrow n \times \text{FACTORIAL}(n-1)$

4 end if

5 return result

Exercise 3 :

Calculate the best- and worst-case complexity of the following bubble sort algorithm:

Bubble sort

Input: Array A

Output: Sorted array A in increasing order

1 for $i \leftarrow 1$ to $\text{length}(A)$ do

2 for $j \leftarrow \text{length}(A)$; decrease until $i+1$; do

3 if $A[j] < A[j-1]$ then

4 swap $A[j] \leftrightarrow A[j-1]$

5 end if

6 end do

7 end do

Exercise 4 :

Calculate the complexity of the following binary search algorithm:

Binary search

Input: an array of n number $A = \{a_1, a_2, a_3, \dots, a_n\}$ sorted in increasing order and the searched value v

Output: the index i such that $v=A[i]$ or the Nil value if v is not in A

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1 Start ← 1
2 Finish ← n
3 Found ← False
4 Repeat
5   Middle ← Integer_Part_Of (Start+( Finish- Start)/2)
6   if A[Middle]==v then
7     Found ← True
8   else
9     if v ≥ A[Middle]
10    then
11      Start ← Middle +1
12      if v == A[Start]
13      then
14        Middle ← Start
15        Found ← True
16      end if
17    else
18      Finish ← Middle -1
19      if v == A[Finish]
20      then
21        Middle ← Finish
22        Found ← True
23      end if
24    end if
25  end if
26 Until Found or Start ≥ Finish
```

Exercise 5 :

What is the complexity of the following functions :

- 1) $f(n)=5n^2+3n\log n+2n+5$
- 2) $f(n)=5n^4+3n^3+2n^2+4n+1$
- 3) $f(n)=3\log n+2/n$
- 4) $f(n)=2^{n+2}$