Introduction to Python

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WHO AM I ?

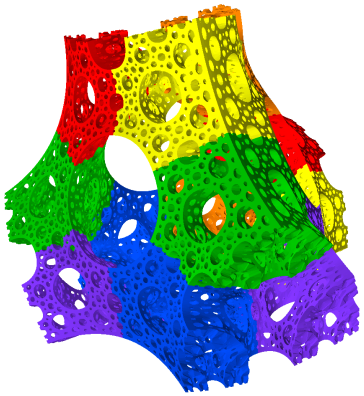
Studies

- 2011-2016 : Master of Images and Artificial Intelligence
- 2019 : Ph.D. of Computer Sciences at UBE (Computer Graphics - Geometric Modeling)

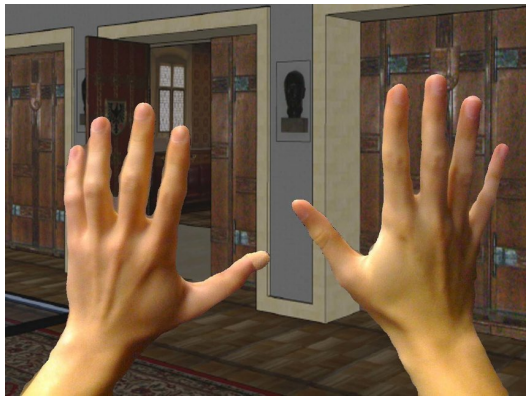
Teacher Career

- 2019-2020 : Junior Lecturer at UBE
- since 2020 : Lecturer at ESEO Dijon
- since 2020 : In charge of Smart City Major
- since 2021 : Independent contractor at ESTP Dijon
- since 2023 : Independent contractor at BSB Dijon

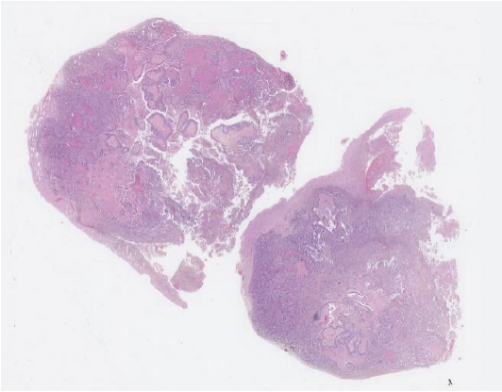
Geometric Modeling



Mixed Realities



Medical Imaging



Smart City

COURSE PROGRESS

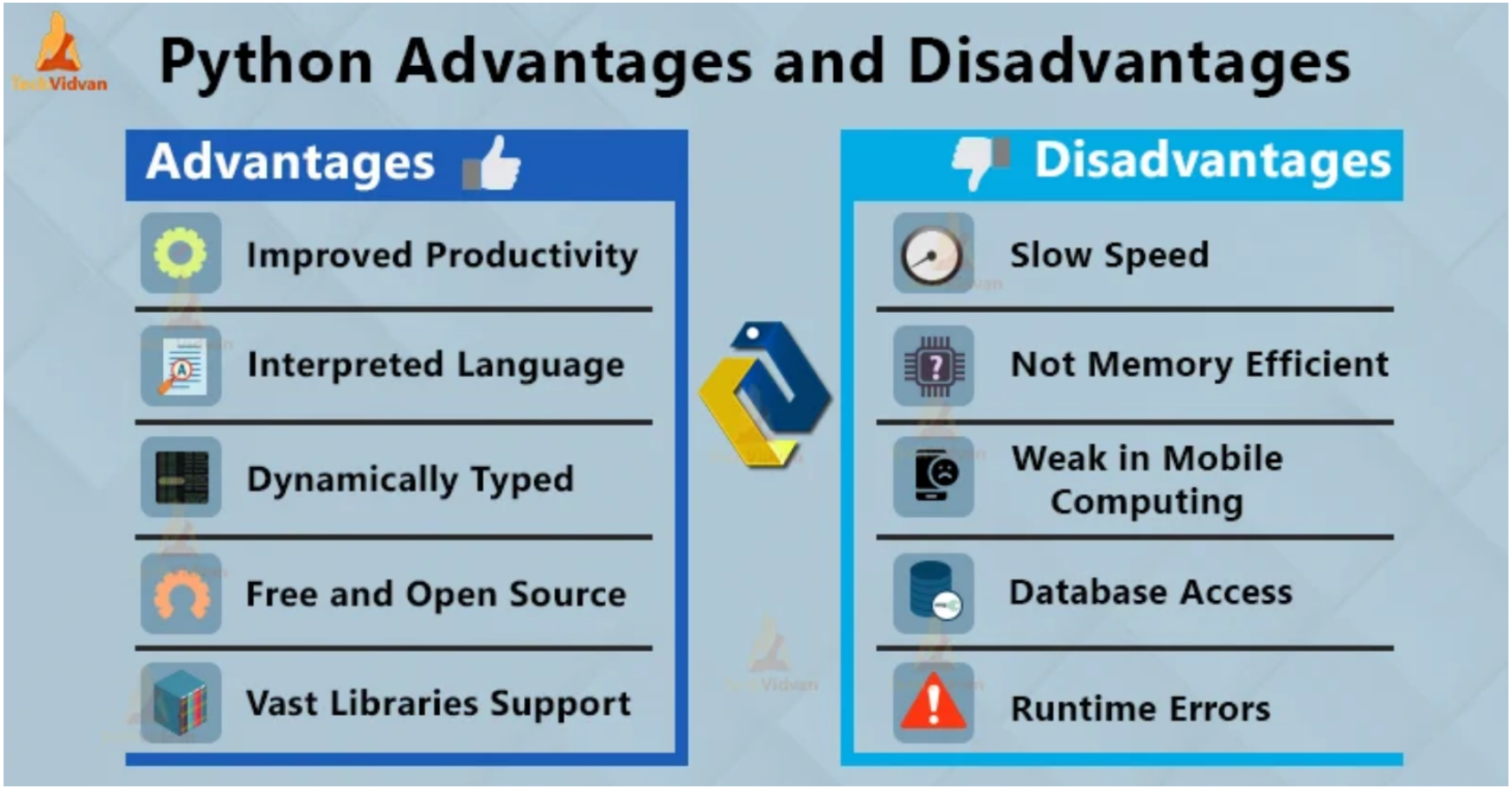
Introduction to Python :

- 24 sept. : variables, conditions, loops, and functions
- 08 oct. : 1D and 2D lists
- 15 oct. : strings and dictionnaries

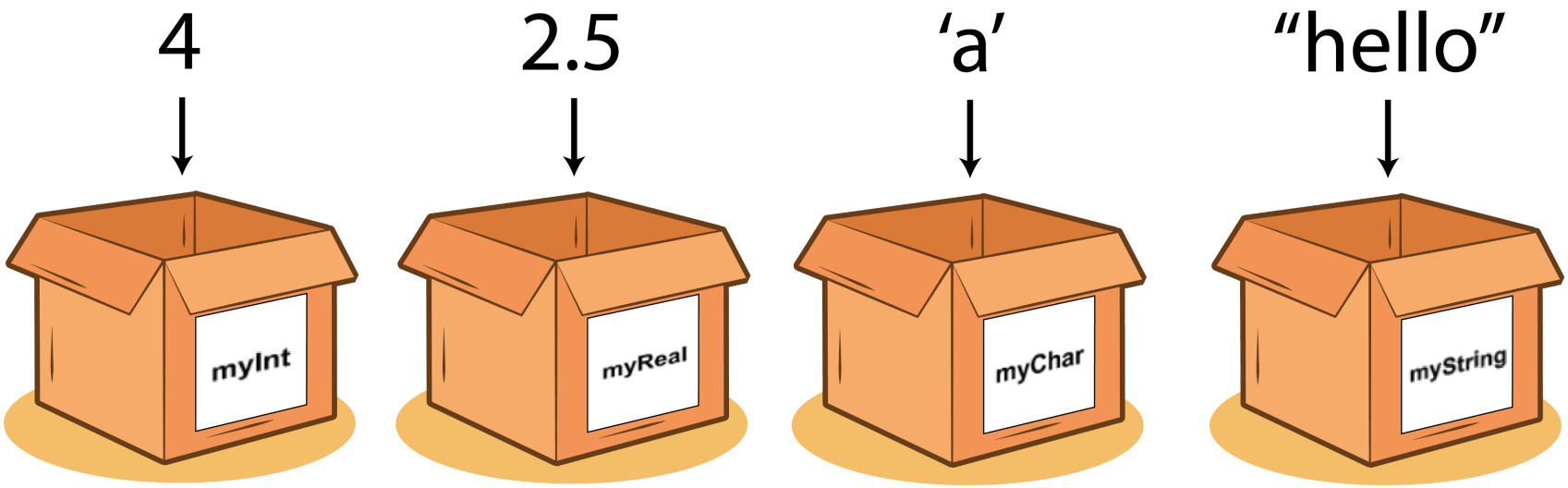
Data Science :

- 22 oct. : dataframes and data preparation
- 12 nov. : basics of statistics and data viz
- 19 nov. : correlation, curve fitting and features selection
- 26 nov. : supervised clustering
- 03 dec. : unsupervised clustering
- 10 dec. : project final rush

WHAT IS PYTHON ?



YOU SAID "LIBRAIRIES" ?


4
2.5
'a'
"hello"
myInt
myReal
myChar
myString

ASSIGN A VALUE TO A VARIABLE

```
# Create a number variable
number = 8.4
# Create a character variable
char = 'A'
# Create a text variable
string = "test"
# Print the content of the variables
print ( number, char, string )
```

Results

8.4 A test

INTEGERS (INT)

```
# Assign values
n = 3
m = 2
# Print the sum
print ( n + m )
# Print the type of the variable
print ( type(n) )
```

Results

```
5
< class 'int' >
```

DECIMAL NUMBER (FLOAT)

```
# Create a float
x = 3.14
# Print it and its type
print ( x, type(x) )
# Mix integers to get a float
n = 3
m = 2
print ( n/m, type(n/m) )
```

Results

3.14 < class 'float' >
1.5 < class 'float' >

BOOLEANS (BOOL)

```
# Create two booleans
a = True
b = False
# Print a bool and its type
print ( a, type(a) )
# Some operations on booleans
print ( not a, a and b, a or b )
```

Result

```
True <class 'bool'>
False False True
```

STRING (STR)

```
# Create two strings
s = "Hello"
t = "World !"
# Print it
print ( s, t )
print ( type(s) )
```

Result

```
Hello World !
<class 'str'>
```

DYNAMIC TYPE

```
# Create an integer
x = 4
print ( x, end = " " )
# Convert it to float
x = 8.6
print ( x, end = " " )
# Finally, its a string !
x = "I'm a string"
print ( x )
```

Result

4 8.6 I'm string

Conditional structures

STANDARD STRUCTURE

```
x = 2
if ( x == 3 ) :
    print ( "That's true" )
else :
    print ( "That's false" )
```

Results

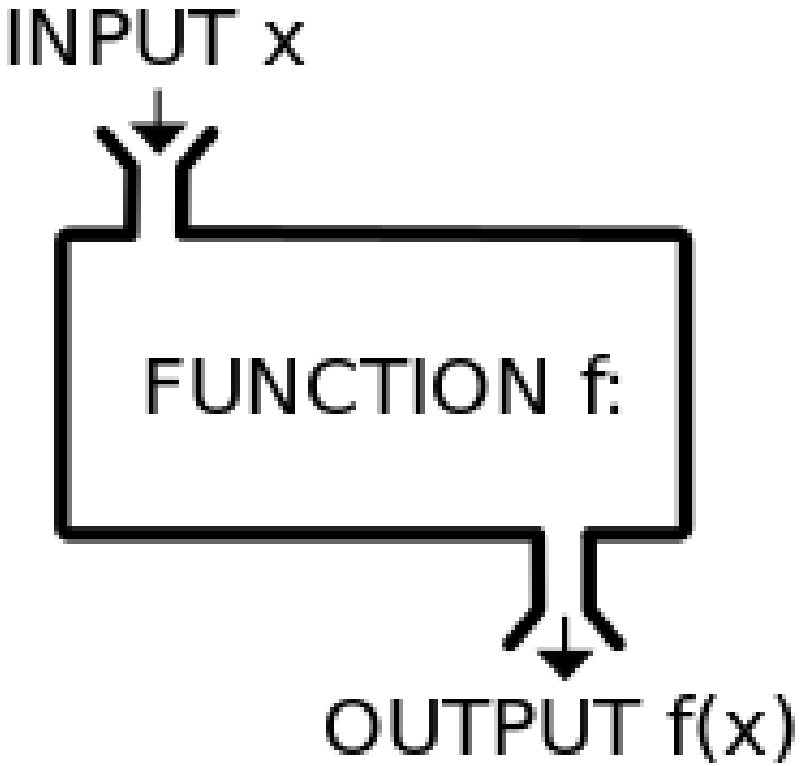
That's false

MULTIPLE ENDS STRUCTURE

```
x = 2
if ( x == 3 ) :
    print ( "That's true" )
elif ( x == 2 ) :
    print ( "That's false then true" )
else :
    print ( "That's false" )
```

Results

That's false then true


INPUT x
FUNCTION f:
OUTPUT f(x)

SOME BASIC FUNCTION

```
# Function definition
def my_function ( ) :
    print ( "I'm inside the function"  )

# Call this function
print ( "I will run some function" )
my_function ( )
```

Results

```
I will run some function
I'm inside the function
```

PASS A PARAMETER TO A FUNCTION

```
# Define the function
def two_times ( n ) :
    print ( "2 x ", n , "=", 2*n )

# Test it with different parameters
two_times ( 3 )
two_times ( 4 )
```

Results

```
2 x 3 = 6
2 x 4 = 8
```

PASS SEVERAL PARAMETERS TO A FUNCTION

```
# Define the function
def sum ( a, b ) :
    print ( a, "+", b, "=", a+b )

# Test it with different parameters
sum ( 2, 3 )
sum ( 1.4, 2.1 )
```

Results

```
2 + 3 = 5
1.4 + 2.1 = 3.5
```

RETURN

```
# Define the function
def square ( x ) :
    return x*x

# Test it with different parameters
y = square ( 2 )
print ( y )
y = square ( 2.5 )
print ( y )
```

Results

```
4
6.25
```

VARIABLE SCOPE

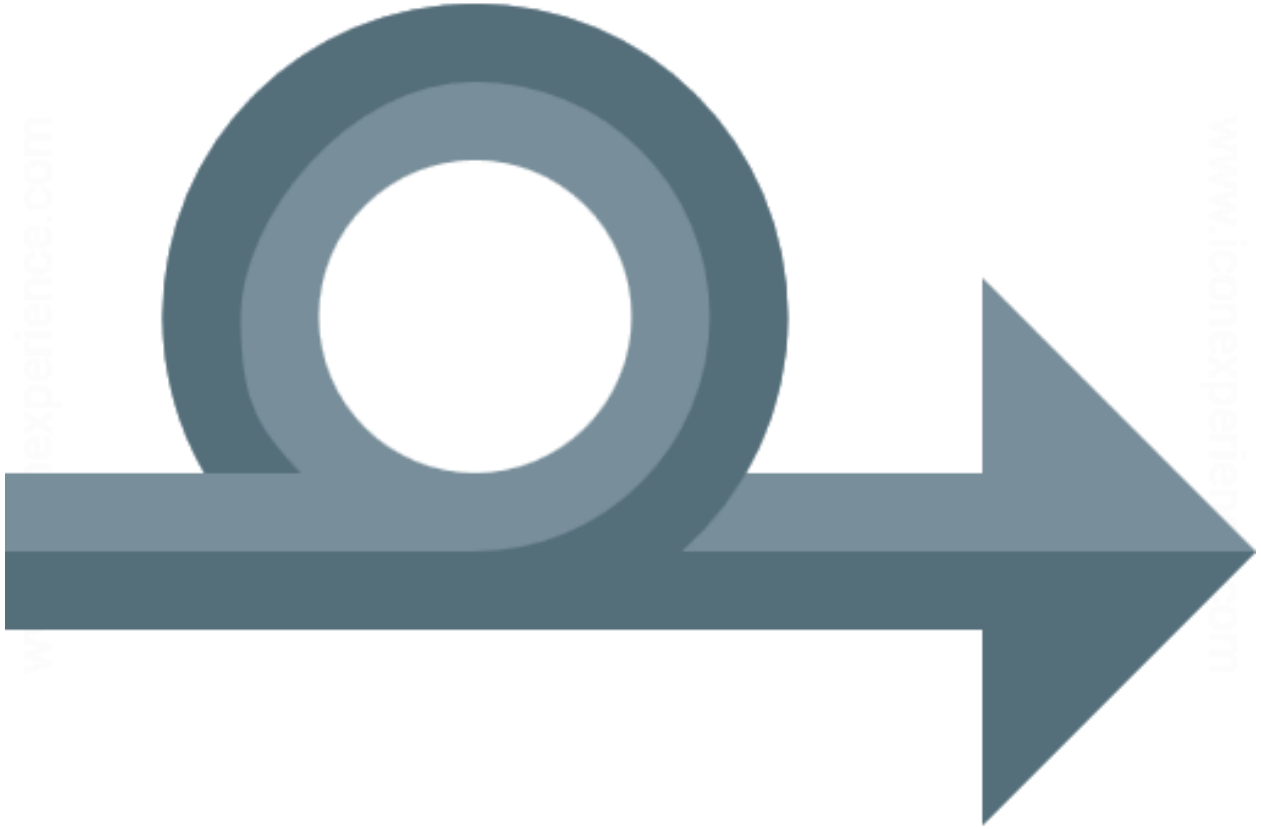
```
def some_function ( x ) :
    x = 2 * x
    print ( "During the function : ", x )

x = 3
print ( Before the function, x )
some_function ( x )
print ( After the function, x )
```

Results

Avant la fonction : 3
Pendant la fonction : 6
Apres la fonction : 3

Loops



FOR-LOOP THROUGH A SET

```
# For a specif set of values
for i in [ 2, 3, 5, 7, 11 ] :
    print ( i, end = " " )
```

Results

2 3 5 7 11

FOR-LOOP THROUGH A RANGE

```
# From 0 to n-1
for i in range ( 6 ) :
    print ( i, end = " " )
print ( " " )
```

Results

0 1 2 3 4 5

```
# From m to n-1
for i in range ( 2, 8 ) :
    print ( i, end = " " )
print ( " " )
```

Results

2 3 4 5 6 7

```
# With a specific step between numbers
for i in range ( 0, 8, 2 ) :
    print ( i, end = " " )
print ( " " )
```

Results

0 2 4 6

WHILE LOOP

```
n = 18
while ( n > 1 ) :
    print ( n, end = " " )
    n = n / 2
print ( " " )
```

Results

18, 9.0, 4.5, 2.25, 1.125

NESTED LOOPS

```
for i in range ( 1, 3 ) :
    for j in [ 'a', 'b', 'c' ] :
        print ( i, j, end = ", " )
print ( " " )
```

Results

1 a, 1 b, 1 c, 2 a, 2 b, 2 c

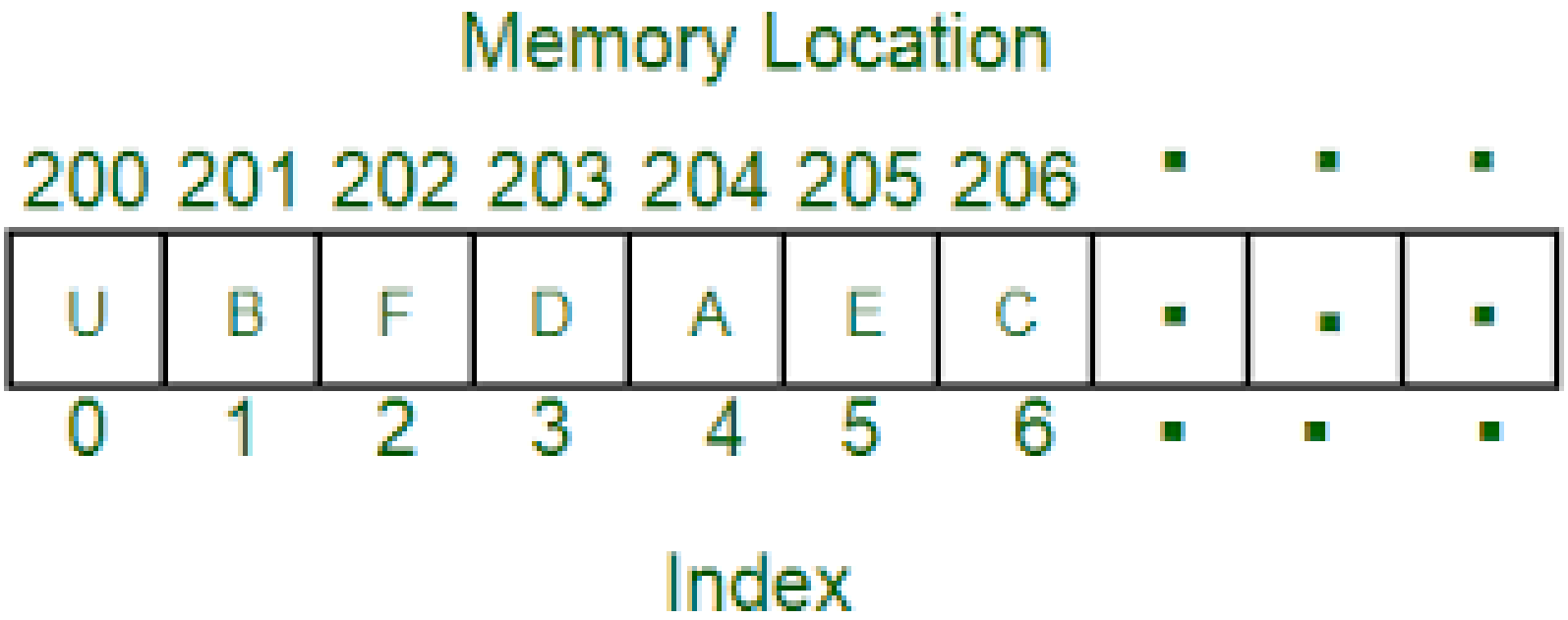
LINKED LOOPS

```
for i in range ( 1, 5 ) :
    for j in range ( 2 * i ) :
        print ( ".", end = "" )
    print ( " ", end = "" )
```

Results

.. ..

(2 dots then 4 dots then 6 dots and to finish 8 dots)


Memory Location
200 201 202 203 204 205 206
U B F D A E C
0 1 2 3 4 5 6
Index

WHAT IS IT ?

- An array is a data structure
- It is composed of a fixed number of same type elements
- Each element contains a value
- Each element should be accessed by its index

Be careful !

In Python, there is no **array**, only **list**
Lists are similar to array, without the fixed number constraint

In a first part, you will use Python's list as array
Later, you will learn how to exploit list functionalities

CREATE AN ARRAY

```
# Define an array composed of ten zeros
tab = [0] * 10
# Display the array infos
print ( "The array is :" , tab )
print ( "Its length is :" , len(tab) )
```

Results

```
The array is : [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
Its length is : 10
```

READ THE VALUE OF AN ELEMENT

```
# Define the array [ a, b, c, d, e ]
tab = [ 'a', 'b', 'c', 'd', 'e' ]
# Display the array infos
print ( "The array is :" , tab )
print ( "The element number 1 is :" , tab[1] )
```

Results

```
The array is : ['a', 'b', 'c', 'd', 'e']
The element number 1 is : b
```

STORE A VALUE INSIDE AN ELEMENT

```
# Define an array composed of five zeros
tab = [0] * 5
print ( "Before modification :" , tab )
# Store a 2 inside element number 2
tab[2] = 2
print ( "After modification :" , tab )
```

Results

Before modification : [0, 0, 0, 0, 0]
After modification : [0, 0, 2, 0, 0]

MODIFY ELEMENTS OF AN ARRAY

```
# Define an array
tab = [ 2, 3, 5, 7, 11 ]
print ( "Original array :" , tab )
# Multiply element number 3 by 10
tab[3] = 10 * tab[3]
print ( "After multiplication :" , tab )
# Sum two elements of the array
tab[2] = tab[1] + tab[2]
print ( "After sum :" , tab )
```

Results

```
Original array : [2, 3, 5, 7, 11]
After multiplication : [2, 3, 5, 70, 11]
After sum : [2, 3, 8, 70, 11]
```

ITERATE THROUGH AN ARRAY

```
# Define an array composed of ten zeros
tab = [0] * 10
# Define every element by iterating through the array
for i in range ( len ( tab ) ) :
    tab [ i ] = i

print ( "After iteration :" , tab )
```

Results

After iteration : [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

MODIFY AN ARRAY BY ITERATION

```
# Previous slide code
tab = [0] * 10
for i in range ( len ( tab ) ) :
    tab [ i ] = i

# Square every element of the array
for i in range ( len ( tab ) ) :
    tab [ i ] = tab [ i ] * tab [ i ]

print ( "Finally :" , tab )
```

Results

Finally : [0, 1, 4, 9, 16, 25, 36, 49, 64, 81]