

Duration: 1h

Documents and calculator forbidden

Warning : A program that is badly indented, badly commented or with the wrong choice of variable names will be penalized (up to -1 point).

« Always code as if the guy who ends up maintaining your code will be a violent psychopath who knows where you live. » *Martin Golding*

Exercise 1 Code correction (3 pts)

The following program contains 6 syntactic errors (not coding convention errors). Identify each error by indicating the line number and problem.

Here is an example of an expected response, independent of the code below :

line 5 -> the symbol '=' was used in a comparison, whereas a '==' should be used.

```
1 # Init of variables
2   revenu = 25000
3   nb_parts = 2
4   ratio = revenu / nb_parts
5   impot = 0
6
7 # Tax computation
8   if ratio < 20000:
9       impot = revenu*0.125 - 50*nb_part
10  elif ratio < 30000:
11      impot = revenu*0.25 - 100*nb_parts
12  else
13      impot = revenu*0.5 - 200nb_parts
14
15 # Résultats
16 print(f"You should pay impot euros")
```

Exercise 2 Coding (2.5pts)

(Q2.1) Give the **binary** representation of the integer (unsigned) : 102_{10}

(Q2.2) Give the **hexadecimal** representation of the binary number (unsigned) : $1011\ 1001_2$

(Q2.3) Give the **decimal** representation of the following binary number : $1111\ 0011_2$

Exercise 3 Code reading (2.5pts)

(Q3.1) What exactly does the following program display :

```

1 liste = [3, 2, 7, 6, 10]
2 f = 1
3 for i in range(len(liste)):
4     if liste[i] % 3 == 0:
5         print(f'{f} {liste[i]//3}')
6     else:
7         print(f'f {liste[i-1]}')

```

Exercise 4 Code Writing (8pts)

A funfair offers the following activities : "duck fishing", "grappling machine", "dancing Fly carousel", "evolution carousel", "Fire Ball carousel". The prices for these activities are : €2, €1, €4, €4 and €4 respectively.

- (Q4.1) Write a function `price_activity` which for an activity given as a parameter, returns the price of this activity as a result.
- (Q4.2) By calling the function `price_activity`, write a code allowing you to calculate and display (with an f-string) what Rémi spends to successively play the grappling machine and the Fire Ball carousel

Théo arrives at the funfair with a list of activities to do. The list of activities is represented by a list.

Example :

```

1 activities = ["grappling machine", "dancing Fly carousel",
2             "Fire Ball carousel", "grappling machine"]

```

- (Q4.3) Write a Python code that calculates and displays the budget needed to satisfy Theo's list. This code should work regardless of the list of activities chosen.

Lou's parents preferred to buy a prepaid card to control their budget. Lou arrives at the funfair with a list of activities she wants to do. Her parents explain to her that she will be able to do as many activities as the amount credited to the card allows. We assume until the end of the exercise that Lou respects the order of the activities in his list. We want to write Python code that displays the activities that could be carried out. Your code should display how many activities have been completed as well as the amount remaining on the card regardless of the number of activities carried out.

Example : with Théo's list from question (Q4.3) and a budget on the card of 5€, the resulting display would be :

```

    grappling machine
    dancing Fly carousel
    2 activities out of 4
    0€ left

```

- (Q4.4) Suggest in order : (1) a set of tests of the code to write (2) code that does what is requested.

Imane arrived with the following list : ["grappling machine", "dancing Fly carousel", "Fire Ball carousel", "Fire Ball carousel", "grappling machine"] and an amount of €12. But she notes that she was only able to do the first 3 activities and she had €3 left on the card at that time, which could have allowed her to do the "grappling machine" activity.

(Q4.5) What python code should you add after the code of the question (Q4.4) to display the index of the next possible activity in the list (and -1 if there is none). For the example above, the index to display is : 4.

Exercise 5 Algorithm writing (4pts)

The game of Nim (also called Fan Tan in China or Tiouk Tiouk in Africa) is a two-player pure strategy game. The principle of the game for this exercise is as follows :

The game consists of N piles, numbered from 0 to $N - 1$. In each pile t , there are k_t pawns, the number of pawns can be different from one pile to another.

The players play alternately. When it is his turn, a player indicates the number of the pile from which he wants to remove pawns. Once this choice is made, he chooses the number of pawns he wishes to take from the chosen pile (as many as he wants). We will make the assumption for this exercise that the choices made by the players are valid all the time, that is to say that you do not have to describe the verification tests of the user choices.

The winner is the one who removes the last pawn, all piles combined. The loser is therefore the one who must play when all the piles are empty.

(Q5.1) Propose, in natural language or with a flowchart, a detailed algorithm for the Nim game . This algorithm should in particular clearly highlight your choices of control structures.

Note : The level of detail expected for the answer to this question is comparable to the following algorithm describing selection sorting :

```
1 # ALGO INPUTS
2 #   l: list of numbers to sort
3 # ALGO PROGRESS
4 # For each index i_pivot of l
5 #   Find the i_min index of the smallest element, starting from the i_pivot index
6 #   If necessary
7 #       swap elements located at indices i_pivot and i_min
8 # Displaying the result
```
