Computer science (code 30424) a.y. 2019-2020

Practice session 6

You are asked to answer the following questions and solve the following problems:

1) Create a new Python file called **pythagoras.py** to apply the Pythagorean theorem. In particular, you are asked to create two functions.

The first function, called **pythagoras**, must calculate the hypotenuse of a right-angled triangle, must:

- have the values of both sides as mandatory parameters
- apply the Pythagorean theorem, based on the following formula: $\boldsymbol{hypo} = \sqrt{\boldsymbol{cat\_a^2} + \boldsymbol{cat\_b^2}}$, where *hypo* is the hypotenuse and *cat_a* and *cat_b* are the two catheti (if necessary, use the functions of math module)
- return the exact value of the hypotenuse to the calling instruction

Then create the second function, called **show_hypotenuse**, which performs the following operations:

- ask the user to enter the sizes of the two catheti (allowing the entry of numbers with decimals)
- call the pythagoras function to calculate the hypotenuse
- show on the screen both the exact size of the hypotenuse, and its rounded up and rounded down values (use the *floor* and *ceil* functions of the math module)

Complete the program by calling the function **show_hypotenuse** several times with different values.

2) Create a new Python file called **sum.py** and create a function called **harmonic_sum**, which must calculate the value of the following series:

$$\sum_{n=1}^{N} \frac{1}{n^{\alpha}}$$

For example, considering N = 6 and α = 2 you will obtain:

$$1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} + \frac{1}{6^2}$$

In particular, the function must:

- have as mandatory parameters *N* and *α*, that are the maximum number to be considered for the series and the exponent to be used
- return the result of the sum of all the fractions to the calling instruction

Test the program calling several times the function **harmonic_sum** with different values.

3) Create a new Python file called **roll.py** in which you are asked to create a function called **roll_the_dice**, which allows you to play with three six-sided dice (not rigged). The game requires the player to decide how many rolls to make (for example 1,000) and what his winning number is (for example 6): then the dice should be rolled and the player gets one point each time the three dice return three numbers equal to the one chosen by the user (three 6).

In particular, the function **roll_the_dice** must:

- have the number of rolls to be performed as a mandatory parameter
- have the winning number as an optional parameter. In case it is not specified by the user, number 6 must be consider the winning number
- simulate the number of rolls chosen by the user (if necessary, use the functions of the random module)
- calculate the score obtained by the user, assigning a point each time the result of the three dice is equal to the winning number
- return the score obtained by the user

Run the program and call the **roll_the_dice** function with several different arguments.

Create now a new function called **roll_the_dice2** that modifies the **roll_the_dice** function so that the player can decide whether to get a point every time the three dice return three numbers equal to the winning number passed as an argument to the function, or anytime the three dice return three equal numbers, regardless of the chosen winning number.

Run the program and call the **roll_the_dice2** function with several different arguments.

4) Create a new Python file called **present value.py** and create a function called **present_value**, which allows to calculate the present value of an investment consisting in a series of constant annual payments (*CF*) for a specified duration (in years) and for a specific constant interest rate (*r*). The result is calculated with the following formula:

$$\sum_{n=1}^{N} \frac{CF}{(1+r)^n}$$

For example, considering a duration of 4 years (N = 4), a constant periodic payment equal to 200 euros (CF = 200) and an annual interest rate equal to 5% (r = 0.05) the result will be:

$$\frac{200}{(1+0.05)^1} + \frac{200}{(1+0.05)^2} + \frac{200}{(1+0.05)^3} + \frac{200}{(1+0.05)^4} = 709.19$$

The function must have the annual interest rate, the duration of the investment in years and the periodic payment as mandatory parameters, and must return present value of the investment calculated using the formula seen above.

The main program must ask the user for the values of the annual interest rate, of the duration in years and the value of the periodic payment, then call the function passing the values asked to the user as arguments and show on screen the result with two decimal digits within the message: "*Current value: €* **XXX**". Test the program with the values of the previous example.