CSCI 235, Lab Exercise 5, Basics of Python

Deadline: 14.10.2022 at 11PM

Solutions must be submitted into Moodle as a single text file, with name **lab05.py**, into Moodle. Don't use an archiver.

Your file must contain two functions definitions, **sine** and **collatz**.

Goal of this exercise is that you learn how to run a **Python** program, that you become familiar with the lay out of a **Python** program, and that you learn some basic functions of **Python**.

Make sure that you are using **Python** version 3.10 or higher.

1. Write a function that computes the trigonometric sine function by means of the Taylor expansion:

$$\text{sine}(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!} - \cdots$$

   Test your implementation for real numbers and for complex numbers. You can stop when the factor $\frac{2n+1}{(2n+1)!}$ becomes very small, or repeat up to a high number, for example 50.

   Make sure that your function starts with `def sine(x) :` and that it can be called as `lab05.sine` from the Python interpreter.

   ```
   >>> lab05.sine( 0.1 )
   0.09983341664682817
   >>> lab05.sine( 30 * 3.1415926536 / 180 )
   0.5000000000014734
   >>> lab05.sine( 0.5 - 0.3j )
   (0.5011619801599463-0.2672416992709515j)
   ```

2. The Collatz sequence is defined as follows: If n is even, then the next number is $n/2$. If n is odd, then the next number is $3n + 1$. For example, starting with 6 gives the following sequence:

$$6 \Rightarrow 3 \Rightarrow 10 \Rightarrow 5 \Rightarrow 16 \Rightarrow 8 \Rightarrow 4 \Rightarrow 2 \Rightarrow 1.$$

   It is believed (but not proven) that every number reaches 1 eventually.

   Your task is to write an interactive function (called **collatz**) that repeatedly ask the user for a number greater than one. If the user types 'quit',

'q', or 'Q' then the program stops. If the user types a number less or equal to one, then the program must tell that the number is too small and ask for a new number. If the number is greater than one, the program should show the Collatz sequence for this number. Your function must start with `def collatz( )` : Here is an example:

```
>> lab05.collatz( )
Please type a number greater than one
or 'quit' to quit
6
Giving Collatz sequence for 6

iteration 1 results in 6
iteration 2 results in 3
iteration 3 results in 10
iteration 4 results in 5
iteration 5 results in 16
iteration 6 results in 8
iteration 7 results in 4
iteration 8 results in 2
iteration 9 results in 1

Please type a number greater than one
or 'quit' to quit
1
you typed 1, which is not greater than one
Please type a number greater than one
or 'quit' to quit
q
goodbye
```

- It is convenient to use `format` in Python.
  `print( "{} is less than {}". format(1,2))` will print `1 is less than 2`.
- You can use `input()` to ask for input.
- Use `//` for division to make sure that the sequence stays integer.
- Checking if the input is a correct number seems to be tricky. The easiest way is to call the `int( )` function, which tries to convert a string into an integer, and to catch the exception if it is thrown:

  ```
  try:
      inp = input( )
      i = int( inp )
  except ValueError:
      # it turns out that inp was not an integer.
  ```