Solving complex problems using classes in Python

Objectives

Development of classes in Python

- Learn the basic concepts of Object Oriented Programming
- Develop an application based on the layered architecture
- Learn how to work with exceptions
- Learn how to document and test the code

Deadlines

- ***Lab 8****:* feature 1 with tests in PyUnit *(work during the same lab)*
- ***Lab 9****:* feature 2 *(homework from Lab8)* and feature 3 with tests in PyUnit as well as exceptions and data validation *(work during the same lab)*

Requirements

1. Implement a solution for the following problem using a process based on feature driven development
2. The solution should offer a console type interface that allows the user to input the data and visualize the output
3. Implement the necessary Python classes

The application should be developed along 2 consecutive iterations as follows:

1. **Iteration 1**
    a. Implementation
        i. Classes
        ii. Testing classes using PyUnit
        iii. All features
    b. Develop a layered architecture and use modular programming

2. **Iteration 2**
    a. Treat exceptions
    b. Validate data

Complex numbers

A **math teacher** needs a program that helps **students** to perform different operations with complex numbers. The program manages several complex numbers (defined as ADT) and allows students to use the following features offered by the program:

1. **Simple operations with a complex number**
   - Determine the cartesian form (real part and imaginary part) of a complex number
     - If $c_1 = 3 + 4i$, then real = 3 and imag = 4
   - Determine the polar form (modulus and argument) of a complex number
     - If $c_1 = 3 + 4i$, then modulus = 5 and argument = 53.13^0 (or 0.93 radians) or $c1 = 5(\cos(53.13^0) + i \sin(53.13^0))$
   - Determine the complex conjugate of a complex number
     - If $c_1 = 3 + 4i$, then $\overline{c_1} = 3 - 4i$
   - Multiply a complex number by a real number
     - If $c_1 = 3 + 4i$, and x = 3, then $c_1 * x = 9 + 12i$
   - Multiply a complex number by an imaginary number
     - If $c_1 = 3 + 4i$, and im = 3i, then $c_1 * im = -12 + 9i$

2. **Operations involving 2 complex numbers**
   - Add two complex numbers
     - $c_1 = 3 + 4i$, $c_2 = 3 - 2i$, then sum is s = 6 + 2i
   - Multiply two complex numbers
     - $c_1 = 3 + 4i$, $c_2 = 3 - 2i$, then product is p = 17 + 6i

3. **Complex operations on a single complex number**
   - Determine the matrix representation of a complex number
     - $c_1 = 3 + 4i$ -> $\begin{pmatrix} 3 & -4 \\ 4 & 3 \end{pmatrix}$
   - Powers of a complex number
     - If $c_1 = 3 + 4i$, and p = 3, then $(c_1)^p = -81 + 92i$
   - Square root of a complex number
     - If $c_1 = 3 + 4i$, then $\sqrt{c_1} = 2 + i = 2.23(\cos(26.56^0) + i \sin(26.56^0))$
   - Exponential of a complex number
     - If $c_1 = 3 + 4i$, then $\exp(c^1) = -13.12 - 15.2\ i = 20.08(\cos(-130.817^0) + i \sin(-130.817^0))$