



Sheet 4

Problem 1: Complex

Create a class `Complex` for performing arithmetic with complex numbers. Complex numbers have the form:

$$a + bi, i = \sqrt{-1}$$

Write a program to test the class. Use `float` variables to represent the private data of the class. Provide a constructor that enables an object of this class to be initialized when it is declared. Provide a no-argument constructor with default values in case no initializers are provided. Provide public methods that perform the following operations:

1. Add two Complex numbers: The real parts are added together and the imaginary parts are added together.
2. Subtract two Complex numbers: The real part of the right operand is subtracted from the real part of the left operand, and the imaginary part of the right operand is subtracted from the imaginary part of the left operand.
3. Print Complex numbers in the form (a, b) , where a is the real part and b is the imaginary part.

Example: Given that the two numbers are (9.5, 7.7) and (1.2, 3.1), then the program should print:

```
left = (9.5, 7.7)
right = (1.2, 3.1)
left + right = (10.7, 10.8)
left - right = (8.3, 4.6)
```

Problem 2: Polynomial

Create a class `Polynomial` for manipulating polynomials. An n^{th} degree polynomial is expressed as:

$$f(x) = \sum_{i=0}^n a_i x^i$$

1. Provide a constructor that takes a `double` array to initialize the polynomial parameters.
2. Provide a method `toString` that print the polynomial in the form:
 $f(x) = a_0 + a_1x + \dots + a_nx^n$
3. Provide a method `derivative` that returns another polynomial defined as follows:

$$f'(x) = \sum_{i=1}^n i a_i x^{(i-1)}$$

4. Provide a method `f` that takes a `double x` and returns the `double` value of $f(x)$.

Write a program to test the class.

1. Create a polynomial `p1` and initialize its parameters with an arbitrary array.
2. Print the polynomial.
3. Print f' , f'' , f''' , and $f(1)$.

Example: Assuming that the polynomial parameters are {1, 0, -2, 3}, the program should print:

```
f(x) = 1.00 - 2.00x^2 + 3.00x^3
f'(x) = - 4.00x + 9.00x^2
f''(x) = - 4.00 + 18.00x
f'''(x) = 18.00
f(1.00) = 2.0
```