Department of Computer Science & Engineering
Indian Institute of Technology, Kharagpur
CS69202: Software Engineering Lab, Spring 2023
Assignment – 1

Submission Date – 23rd January 2023

Question 1 (70 marks):

Write a C++ program for implementing an Abstract Data Type representing a Polynomial of arbitrary degree. You are not allowed to use "classes". Use structures instead.

An abstract data type is a mathematical abstraction of a data type. A polynomial data type encapsulates, a polynomial of arbitrary degree and implements the related functions.

$$P(x) = c_0 + c_1x + c_2x^2 + \cdots$$

Note that some of the intermediate degree terms may be absent.

Let `Polyn` be the name of the data type. You should be able to:

1. Instantiate an object of the data type: `Polyn p1, p2;`
2. Add or remove a term to polynomial of degree d and coefficient c (use appropriate overloadings)
   a. Add term: `addremoveterm(p1, d, c);`
   b. Remove term of degree d: `addremoveterm(p1, d);`
   c. Remove all terms with absolute coefficient values less than ϵ: `addremoveterm(p1, 0, 0, epsilon);`
3. Evaluate a polynomial at a given value of x: `value = evaluate(Polyn p1, double x);`
4. Add two polynomials p1 and p2 to create a new polynomial p: `p = p1 + p2;`
5. Differentiate a polynomial p1: `p2 = derivative(p1);`
6. Calculate a zero (root) of a polynomial p1, using Newton's method (https://en.wikipedia.org/wiki/Newton%27s_method) starting from a given value x0: `zerovalue = zero-newton(p1, x0, epsilon);`. Here epsilon is the maximum absolute value of $p1(x)$ for convergence.

The main program should provide a console-based user interface which allows the user to input and operate with various polynomials. The polynomials currently stored in the software should be displayed in appropriate format. The menu should allow user to create new polynomials, or delete existing polynomials, in addition to the above mentioned operations.

Use default values of all epsilons as 10^{-9}.

Note:
60 marks are for implementing the above functionalities and 10 marks is for well-structured and efficient code with good documentation.

Hints:
You can store the terms of a polynomial as a list sorted on degree.
You can use the derivative and evaluate functions to implement Newton's method.

Submission:

Submit the c++ code files for the above problem in Moodle.