

CMPS 148: Homework 3

Write a class that models a polynomial equation of the form:

$$ax^2 + bx + c = 0,$$

The class should have 3 properties, A, B, and C. You are to provide several functions as well, including an *evaluate* function that accepts an “x” and computes the results, and a *findRoots* function that executes the quadratic formula to determine the equation’s roots (x values which cause the polynomial to evaluate to 0).

Details for the evaluate function:

The function should return a double. There should be a single parameter, called x. When called, the function computes $Ax^2 + Bx + C$ using the polynomial’s A, B, and C values and returns the result.

Details for the findRoots function:

The quadratic formula is used to find the value(s) of x that lead to the polynomial equaling zero. It is defined as follows:

$$\frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad \text{and} \quad \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

Where the two values found can be called root1 and root2. If the value of $b^2 - 4ac$ is **negative** there are no real roots (the function never equals 0).

Your findRoots function should return true or false, depending on whether or not there are real roots (if $b^2 - 4ac$ is positive). The function accepts two double values using **pass by reference**. If there are roots, then those two parameters are set within the function. Note, if $b^2 - 4ac$ is zero, both roots are the same – and that is OK (you just set them both).

On the next page is a main function that uses the Polynomial class. For this homework assignment, you must use this EXACT program – **without modification!** It is posted as a separate file on Moodle. You may of course add print statements to help you debug while you work, but I will expect you to turn in the file without any of your modifications.

NOTE: YOU WILL NEED TO CREATE ADDITIONAL FUNCTIONS BASED ON HOW THE POLYNOMIAL CLASS IS USED IN THE MAIN.CPP PROVIDED – YOU MUST IMPLEMENT ALL FUNCTIONS REQUIRED TO MAKE IT COMPILE!

SEE PAGE 3 FOR SAMPLE OUTPUT

```

#include <iostream>
#include "Polynomial.h"
using namespace std;

void printRoots(Polynomial p) {
    double r1=0, r2=0;
    if ( p.findRoots(r1, r2) ) {
        cout << "\twith roots at " << r1 << " and " << r2 << endl;
    }
    else {
        cout << "\tNo Roots" << endl;
    }
}

int main() {

    Polynomial p1(14, 19, 2); // Provide a constructor to set A, B, C
    Polynomial p2;           // Default constructor should initialize to all zeros
    double tmp;

    cout << "Enter A: ";
    cin >> tmp;
    p2.setA(tmp); // A, B, and C need to be private variables - supply getters and setters.
    cout << "Enter B: ";
    cin >> tmp;
    p2.setB(tmp);
    cout << "Enter C: ";
    cin >> tmp;
    p2.setC(tmp);

    cout << "Two polynomials will be used:" << endl;
    cout << "P1: Predefined: ";
    p1.print(); // Should print as 14x^2 + 19x + 2

    cout << "P2: User-Defined: ";
    p2.print(); // Should print in the same format, but with the user-entered values.

    cout << "Enter an x value to evaluate both polynomials: ";
    cin >> tmp;

    cout << "P1: " << p1.evaluate(tmp) << endl;
    printRoots(p1);
    cout << "P2: " << p2.evaluate(tmp) << endl;
    printRoots(p2);
}

```

Sample output – user input in red.

Enter A: **1**

Enter B: **1**

Enter C: **1**

Two polynomials will be used:

P1: Predefined: $14x^2 + 19x + 2$

P2: User-Defined: $1x^2 + 1x + 1$

Enter an x value to evaluate both polynomials: 8

P1: 1050

with roots at -0.11501 and -1.24213

P2: 73

No Roots