Math 3300 Programming Assignment 10

Instructions: Work on the following program and submit your source code to me via Blackboard. It may be completed in small groups (of up to 5).

1. Create a **class** for polynomials $p(x)$ named **poly**. Your class should be able to create a polynomial of any size. A class definition and template has been provided, it contains:

   Private members: the **degree** of the polynomial (highest power of x) and a pointer to the polynomials **coefficients**.

   Five **constructors**:

   - If no parameters are set, create the degree 0 polynomial: $p(x) = 0$.
   - If given an integer k, create the degree k polynomial with all 0 coefficients: $p(x) = 0 + 0x + 0x^2 + \cdots + 0x^k$.
   - If given an integer k and a double c, create the degree k polynomial: $p(x) = c + 0x + 0x^2 + \cdots + 0x^k$
   - If given an integer k, and an array of length $k + 1$, create the k^{th} degree polynomial whose coefficients are the elements of the array. $p(x) = c_0 + c_1x + c_2x^2 + \cdots + c_kx^k$
   - If given another polynomial q create: $p(x) = q(x)$ (i.e. set p's degree to q's degree and set p's coefficients to q's coefficients)

   For the constructors above, if an invalid degree is requested, set it to be 0. You can assume that arrays of the correct length will always be given when applicable. *When applicable, assume that any array involved contains the coefficients IN ORDER i.e. a[0] is the coefficient of x^0, a[1] is the coefficient of x^1, a[2] is the coefficient of x^2, etc.*

   A **deconstructor** which deletes the coefficients.

   Public members:

   - **degree:** Returns the degree of the polynomial.
   - **get:** Returns a specific coefficient (returns 0 if requesting an invalid coefficient).
   - **of:** Returns the number $p(a)$ for a requested value $x = a$.

- **derivative (overloaded):** Returns the derivative of $p(x)$ ($p'(x)$, a polynomial of 1 degree less) or the k^{th} derivative of $p(x)$ ($p^{(k)}(x)$, a polynomial of k degrees less)). The k^{th} derivative function should work as follows: If $k \leq 0$, have $p^{(k)}(x) = p(x)$ otherwise the correct k^{th} derivative should be calculated (if k is greater than the degree of the polynomial, you should get the polynomial $p^{(k)}(x) = 0$).
- **integral (overloaded):** Returns a specific antiderivative of $p(x)$ (i.e. $\int p(x)dx + c$, a polynomial of 1 degree more) or the definite integral of $p(x)$ (i.e. $\int_a^b p(x)dx$, a number).
- **resize:** Resizes the polynomial, keeping as many coefficients as possible and sets any additional coefficients to 0. For example, if $p(x) = 1+2x+3x^2$ and p is resized to 4, you should get $p(x) = 1+2x+3x^2+0x^3+0x^4$. But if $p(x)$ is resized to 1, you should get $p(x) = 1+2x$.
- **set (overloaded):** Allows you to set all the coefficients of the polynomial if given an array of the correct size (can be assumed) or allows you to set a particular coefficient.

You should **overload** the following **operators**:

- $+, -, *$ for use with polynomials. Hint: If $p(x) = \Sigma a_i x^i$ and $q(x) = \Sigma b_j x^j$, the coefficient of the term x^k in $p(x)q(x)$ is $\Sigma_{i+j=k} a_i b_j$
- $+, -, *$ for "scalar" operators (i.e. $p(x) \cdot 5$, $3 - p(x)$, $p(x) + 4$ etc.)
- $-$ for negative: i.e. $p(x) = -q(x)$
- $==, != $ for use with polynomials. 2 polynomials are said to be equal if they are of the same degree and have all the same coefficients.
- $<<, >>$ for use with polynomials. For $<<$ display all terms even if they are 0. For $>>$ if the degree of the polynomial is 0, ask the user to enter a degree and then indicate to the user how many numbers to enter. For $>>$ If the degree of the polynomial is greater than 0, indicate to the user how many numbers to enter.

Your **assignment** is to create the definitions for the **public class members** and the **overloaded operators** subject to the directions above.

A **main** function has been provided to test your class. For testing purposes, you can comment out the lines of the functions/operators you haven't completed in order to test the ones that you have.

A **program** has been provided so that you can test your answers. Let me know if you think there are any unusual calculations.