SWE 510 – Data Structures and Algorithms
Assignment 2 Report – Integral Computation

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Algorithm Explanation

This program is an implementation of the Riemann sum method in Java, which allows the approximation of the area under a graph. The main script performs the following operations in order:

1. Prompt the user for degree, coefficients, delta, and range.
2. Print out the inputs for confirmation.
3. Store the coefficients in an ArrayList and the other values as variables.
4. Create a new polynomial object using the coefficients in the ArrayList.
5. Set the delta parameter of the polynomial with the setter method.
6. Calculate the integral value using the computeIntegral() method with the range as its input.
7. Print out the integral approximation.

The constructor and the class methods for the polynomial class are stored in the separate Polynomial.java file. The three methods are:

- setDeltaX(x): setter method, sets the delta parameter of polynomial object.
- valueAt(x): calculates the value of f(x) through substitution with the input.
- computeIntegral(x,y): takes two inputs as the beginning and end of the range. Multiplies delta with valueAt(x) inside a for loop starting from the beginning until reaching the end of the range, summing up the result of each iteration to arrive at the integral approximation.

Program Inputs

The program asks the user for the following inputs in order:

1) polynomial degree
2) coefficients (starting from the constant, i.e., coefficient of x^0)
3) delta
4) beginning of range
5) end of range

Each input is printed out in order, for confirmation.

Program Outputs

In the absence of any unexpected errors, the script calculates and prints out the approximate integral value at the given interval

Sample Program Input and Output

f(x) = x^2-2 in the range (0,2)
Please enter the degree of your polynomial (max 3 for this assignment):
2

Please enter the coefficient of x^0:
-2
Please enter the coefficient of x^1:
0
Please enter the coefficient of x^2:
1
The coefficients entered by user: [-2, 0, 1]
Please enter the delta value:
0.0001
The delta value entered by user: 1.0E-4
Please enter the beginning of the range:
0
Please enter the end of the range:
2
The range entered by user: [0.0,2.0]
The integral is approximately: -1.3333333300005208

f(x) = $9x^2$-2x-18 in the range (-2,3)
Please enter the degree of your polynomial (max 3 for this assignment):
2
Please enter the coefficient of x^0:
-18
Please enter the coefficient of x^1:
-2
Please enter the coefficient of x^2:
9
The coefficients entered by user: [-18, -2, 9]
Please enter the delta value:
0.0001
The delta value entered by user: 1.0E-4
Please enter the beginning of the range:
-2
Please enter the end of the range:
3
The range entered by user: [-2.0,3.0]
The integral is approximately: 9.998250075023167

f(x) = $3x^3$-2x-15 in the range (-4,3)
Please enter the degree of your polynomial (max 3 for this assignment):
3
Please enter the coefficient of x^0:
-15
Please enter the coefficient of x^1:
-2
Please enter the coefficient of x^2:
0
Please enter the coefficient of x^3:
3
The coefficients entered by user: [-15, -2, 0, 3]
Please enter the delta value:
0.0001
The delta value entered by user: 1.0E-4
Please enter the beginning of the range:
-4
Please enter the end of the range:

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3
The range entered by user: [-4.0,3.0]
The integral is approximately: -229.26295005179566


f(x) = 3 in the range (-6,6)
Please enter the degree of your polynomial (max 3 for this assignment):
0
Please enter the coefficient of x^0:
3
The coefficients entered by user: [3]
Please enter the delta value:
0.0001
The delta value entered by user: 1.0E-4
Please enter the beginning of the range:
-6
Please enter the end of the range:
6
The range entered by user: [-6.0,6.0]
The integral is approximately: 36.00029999998575
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Disclaimer

Instead of implementing a solution that only computes up to 3rd degree polynomials, I implemented a scalable script that asks the user for the polynomial degree and handles the computation accordingly.