

## Project 1. A Unary Sparse Polynomial Calculator

### [Problem Description]

Implement a simple calculator to operate unary sparse polynomials.

### [Requirement]

The basic functions of the calculator should be as follows.

- (1) Input and establish the polynomial.
- (2) Output the polynomial as a sequence of integers:  $n, c_1, e_1, c_2, e_2, \dots, c_n, e_n$ , where  $n$  is the number of items,  $c_i$  and  $e_i$  respectively refers to the coefficient and exponent of the item. The exponents of the polynomial should be sorted in a descending order.
- (3) Polynomial addition: establish the polynomial  $a + b$ .
- (4) Polynomial subtraction: establish the polynomial  $a - b$ .
- (5) Compute the value of polynomial when the  $x$  is given.
- (6) Compute the derivative  $a'$  of polynomial  $a$ .
- (7) Polynomial multiplication: establish the polynomial  $ab$ .
- (8) Design a simulation UI for the calculator.

### [Test Cases]

- (1)  $(2x + 5x^8 - 3.1x^{11}) + (7 - 5x^8 + 11x^9) = (-3.1x^{11} + 11x^9 + 2x + 7)$
- (2)  $(6x^{-3} - x + 4.4x^2 - 1.2x^9) - (-6x^{-3} + 5.4x^2 - x^2 + 7.8x^{15}) = (-7.8x^{15} - 1.2x^9 + 12x^{-3} - x)$
- (3)  $(1 + x + x^2 + x^3 + x^4 + x^5 + x^6) + (-x^3 - x^4) = (1 + x + x^2 + x^5)$
- (4)  $(x + x^3) + (-x - x^3) = 0$
- (5)  $(x + x^{100}) + (x^{100} + x^{200}) = (x + 2x^{100} + x^{200})$
- (6)  $(x + x^2 + x^3) + 0 = x + x^2 + x^3$

### [Hints]

- (1) Use the singly linked list with head node to store the polynomial.
- (2) Define the representations of input and output yourself.

### [Grading]

Implementation: 50%    Interface: 30%    Coding Style: 20%

Notice: This project will be checked on the experimental lesson in the 5th week (2016.09.27).