CS 206 Data Structures Spring 2017

Homework 1

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1. In the manner "3 * X + (Y - 12) - Z" was converted to a postfix expression in the last example of the lecture slides on Stacks, convert the following to a postfix expression.

   3 + X * (Y - 12) - Z

   The intermediate steps should be shown by describing the contents of the stack and the output produced at each step.

2. Suppose we wish to manipulate polynomials of the form $p(x) = c_1 x^{e1} + \ldots + c_n x^{en}$, where e1 > e2 > ... > en ≥ 0. (You can assume that n does not exceed 10 for the problem.)

   (a) Write a program (called Program 1) that prints out a polynomial that the user has entered. For example, for the user to enter a polynomial p(x) = 5x**2 + 3x + 1, where x**n represents x^n, your program may ask the user to enter

   (2, 5), (1, 3), (0, 1) or
   (5, 2), (3,1), (1, 0) or
   5x2 + 3x1 + 1x0 or

   in any other suitable but precisely specified form. Then your program should print out

   p(x) = 5x**2 + 3x + 1

   (b) Extend Program 1 to Program 2 that can accept polynomials from the user and add, multiply, and differentiate them. For example, given any two polynomials (e.g. (2, 5), (1, 3), (0, 1) and (3, 7), (2,5), (1, 3), (0, 1) and given addition operation, your program should produce:

   p(x) = 7x**3 + 10x**2 + 6x + 2

   (Use the input format: polynomial1
   +
   polynomial2
)

   (c) Specify an ADT (to be called *Polynomial Calculus ADT*) that allows the above operations.

   (d) In addition to the addition, multiplication and differentiation, what other operations can be added to the Polynomial Calculus ADT to make it more useful?