Comp 7712 (Algorithms/Problem Solving) Fall 2018. Programming Assignment 1.

Submission: This assignment is due on Th Oct 4th. Please note:

1. Each student must submit his or her own assignment.

2. You must write code in either C, C++, Java or Python. Moreover, code should be put in a folder of its own with a README file on how to run the code and test it. It must strictly adhere to the Input/Output format described in the problem below. To submit, upload the zipped folder using ecourseware by the due date.

Problem 1[30 + 30 + 40 pts] To give you an input a polynomial it will be represented as a sequence of numbers, each time an exponent followed by a coefficient as a list. The exponents will be in decreasing order. So for example,

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3 5 1 10 0 5
```

represents the polynomial $5x^3 + 10x + 5$. While the exponents are always integers, the coefficients may be rational numbers. Now, write programs to do the following:

(1) Prompt the user for a polynomial input. Once that is entered, prompt the user for the input of some number a. Now compute the quotient and remainder obtained when the input polynomial $P(x)$ is divided by $x - a$. For example, suppose the user enters the polynomial $3x^4 + 7x^2 - x + 3$ and enters $a = 1$, the result should be,

Quotient : $3x^3 + 3x^2 + 10x + 9$, Remainder : 12.

Make sure this runs in $O(n)$ time where n is the degree of the polynomial.

(2) Write code to compute $(x - a_1)(x - a_2)\dots(x - a_n)$ for n given numbers, in $O(n^2)$ time.

(3) Now write code to do interpolation in $O(n^2)$ time. The problem input be a set of pairs of (x, y) values like

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 3 4 7 2 4 10
```

where the list is the x value followed by the y value. Here, the output will be a polynomial of degree 2. It is computed as follows. Suppose the inout is $(x_1, a_1), (x_2, a_2), \dots, (x_n, a_n)$. Then the interpolated polynomial is given by $\sum_{i=1}^{n} a_i P_i(x)$, where the polynomial $P_i(x)$ is defined as,

$$\frac{\prod_{j \neq i}(x - x_j)}{\prod_{j \neq i}(x_i - x_j)}.$$

Notice that $P_i(x_i) = 1$ and $P_i(x_j) = 0$ for $j \neq i$.