Central Washington University
College of the Sciences
Department of Computer Science

CS-301 Data Structures Fall 2016

Project 1

As usual, please read the "Guidelines" document on how to turn in this project.
Due date: Wed Oct 12, 2016 11:59 pm .

1. Write a program that computes a product of first degree polynomials with integer coefficients. For easy parsing, the polynomials are given in the file "binomials.txt" as follows

   ```
    3x + 5
   -8x - 9
    2x + 3
   ```

   There is no space between the coefficient and the variable x. The output in this case should be.

   ```
   -48x^3 - 80x^2 - 18x  + 3
   ```

   You may use any data structure that you want; arrays, `ArrayList<E>`, etc.

2. Algorithms for factoring integers play an important role in theoretical computer science as well as in important fields like cryptography. Whether there are algorithms $O(n^c)$ is an open question.

   Among the early factoring algorithms for integers is the following. The algorithm will return a factor, or prime. Since we can remove easily powers of two, the algorithm below works when n *is an odd integer.*

   Step 1. Compute $x = \lfloor \sqrt{n} \rfloor$. If $n = x^2$ we simply return x

   Step 2. If $x = (n+1)/2$ then we know that n is prime. Otherwise compute $y = \sqrt{x^2 - n}$.

Step 3. If y is an integer then $x+y$ (or $x-y$) is a factor. Otherwise increase x by 1 and return to Step 2.

Implement a program to factor *any integer* using repeatedly this method. Use data types that allow the input of relative large numbers. The program also must also provide the running time in terms of square root operations perform. The integer to be factor must be read from a file called *integer.txt*. Provide a good input test.