Due Date:
Wednesday, February 12, 2014

Delivery
Create the archive, pa1.tar from your files (see below). Deliver the archive to csc3320@orion.ucdenver.edu as an attachment to an email. Put PA1 in the subject field and your name in the body. Please archive your files as follows:

tar –cvf pa1.tar pa1.cpp pa1functions.h pa1functions.cpp pa1templates.h pa1templates.tem.

Program objectives
The objectives of this assignment are as follows.
An ability to use current techniques, skills, and tools necessary for computing practice (ABET i).

Value
This program is worth 15 points. The distribution of points will be as follows.

Criterion	Value
Templates	2
Inclusion model	1
Program style (see below)	3
Annotated output	8
Usage of pseudocode	1

Background
Suppose we are give a table of values x_i and $y=f(x_i)$ where i=0, 1, 2, …, n. We wish to find a polynomial that reproduces the given points exactly! For example, given the following,

x	x_0	x_1	…	x_n
y	y_0	y_1	…	y_n

can we find $p_n = \sum_{k=0}^{n} a_k x^k$ (assuming that p_n exists) ?

We will do so by defining a system of expressions using a numerical known as **interpolating polynomials.**

Problem
Given a data set, x_i and y_i, find an interpolating polynomial that gives exactly the y_i for each x_i.

Input
Data pairs, (x_i, y_i) stored in a text file, one pair per line, space delimited. For example
0.33 2 // Represents x_0 y_0
0.25 -1 // Represents x_1 y_1

Output

A polynomial representing the data points that is computed by a numerical method shown below. The polynomial should be displayed on the standard output as a "sum of products". That is, display $p_n(x)$ as the sum of its terms, where each term is $\ell_i y_i$. For example,

$$p_2(x) = \ell_0(x)y_0 + \ell_1(x)y_1 + \ell_2(x)y_2$$
$$= -36(x-0.25)(x-1) - 16(x-0.33)(x-1) + 10(x-0.25)(x-1)$$

Minimum program requirements

1. Display a greeting (pause the display, then prompt to continue).
2. Write global function templates and non-templates only (no classes).
3. The compilation of the function templates should follow the inclusion model.
4. The output should be annotated.
5. Error checking where appropriate.
6. Set the precision of polynomial coefficients to 1 place after the decimal.

Notes

1. You may use the cmath library.
2. Do not use classes in the assigment.
3. Be sure to use program style (pre/post, header comments, sparse code comments, self-documenting names, whitespace, indentation, etc.). Also, make sure the output is formatted and labeled correctly. Keep the 'main' function as short as possible. Try to limit 'main' to calls to top-level functions.

Algorithms for computing interpolating polynomial

$$p_n(x) = \sum_{i=0}^{n} \ell_i(x)y_i \,, \quad \ell_i(x) = \prod_{\substack{j=0 \\ j\neq i}}^{n} \frac{x - x_j}{x_i - x_j}, (0 \le i \le n)$$