Homework 12: Functions

For the following exercises, write your code in one `.cpp` *file for each problem. Be sure to use a plain text editor (i.e., NOT Word).*

Make sure that your code compiles without error in order to get credit. Do not hesitate to ask for help if needed!

Do NOT submit executable files to me. If you are having trouble getting your code to compile, and you can't figure it out on your own, email me with your code attached and I'll try to help you debug. Better yet, come to office hours!

Problem 1 (5 pts)

Consider the program `HW12-FunctionExample.cpp` (that can be downloaded from Google Drive) that defines and uses a function called `f`.

In order to get a better feeling for how a function is used and what are the various possibilities with arguments, go through the following tasks with this program:

(1) Compile and run this program; make sure you understand what it does.

(2) Change the type of variables `x` and `y` in the `main` program. What happens when you compile?

(3) Modify the function call (line `c = f(...)`) by replacing the variables `x`, `y`, or `z` by literals (numbers). What if you use integers instead?

(4) What happens if you tell the function declaration to take `double z` instead of `double &z`? Do any of your answers to (3) change?

You do not need to submit any code for this problem, but you should answer all the questions above, for example, in a text file.

Problem 2 (10 pts)

Write a `C++` program that does the following:

(a) defines a function that calculates and returns $f(x) = 3\pi \sin^2(2\sqrt{x} - 1)$, where `x` is a `double` input argument for the function;

(b) defines a `vector<double>` called `Dvec` with 100 elements, where the value of element `i` is `f(i)`;

(c) defines a function `changeElement` of 3 arguments `vec`, `idx`, and `x`, where `vec` is a `vector<double>`, `idx` is an `int`, and `x` is a `double`; the function should modify element `idx` of the vector `vec` by subtracting `x` from its current value and return the modified value;

(d) calls the function `changeElement` on each even element of `Dvec` with the value of argument `x` being the next element in the vector (that is `x=Dvec.at(11)` when called on element 10 of `Dvec`); and

(e) adds all elements of the modified vector `Dvec` together (*hint:* use a loop) and prints the result.

Problem 3 (10 pts)

Write a function that takes 2 `vectors<double>` arguments and returns their *scalar product*

$$\vec{a} \cdot \vec{b} = a_1 b_1 + a_2 b_2 + ...$$

Make sure your function works for any size vector. If the two vectors have different sizes, print a warning message, but calculate the scalar product anyway using the smaller size.

Use your function to calculate the scalar product of the following vectors:

$$\vec{a} = (5.2, -\pi, 2.1) \quad \text{and} \quad \vec{b} = (\sqrt{3}, e, -\ln 5).$$

Don't forget to print the result.