MATH 233: Scientific Computing
Assignment 1— Hello World
Due September 7th, 2020 by 12pm on Catcourses

1. What is your experience with C++ (before doing the homework) ?

2. Read the introduction of "C++ for Scientific Computing ", write, compile and run your own "Hello World" code.

3. Read sections 2 to 8. Suggestion: run and modify the example codes.

   (a) Give one reason to use C++ over Matlab.

   (b) What are the pros and cons of using the `double` type to represent real numbers ?

   (c) How would you decide to use `int` versus `long` ?

   (d) What does the `&` operators does ? What about the `*` ?

   (e) How would you declare a $3 \times 4 \times 5$ array of real numbers, assuming that we want double precision ? How would you do it if at the time of compilation the array size $N \times M \times L$ was not known ?

   (f) If A is an array of double of size N, how do you access its first and last element ?

4. (a) Imagine you want to implement a function `Legendre(double x, int n)` which return the value of the nth Legendre Polynomial evaluated at x for $0 < n < 5$. Which control structure would you use ? why ?

   (b) Implement the `Legendre(double x, int n)` function. Your function should return an error message if $n > 6$ or $n < 0$.

   (c) Implement a function `sampledLegendre(double a, double b, int N, int n)` which return the vector of size N containing the values of the nth Legendre Polynomial at the uniformly distributed points $x_0 = a, ..., x_{N-1} = b$.

   (d) How can you verify your code ?

   (e) If we call A_N^n the output of `sampledLegendre(-1,1, int N, int n)`, what is the limit as $N \to \infty$ of the scalar product $A_N^n \cdot A_N^m$? (You might wanna use what you just implemented to get some intuition...)