

MATH 233: Scientific Computing
Assignment 1— Hello World
Due September 9th, 2022 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 n^{th} 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 n^{th} Legendre Polynomial at the uniformly distributed points $x_0 = a, \dots, x_{N-1} = b$.
 - (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 $N \rightarrow \infty$ of the scalar product $A_N^n \cdot A_N^m$? (You might wanna use what you just implemented to get some intuition...)