Tutorial - 2

In this tutorial, you will install OpenMP library on your computer and run the different versions of "Hello World" programs that we have seen in the class. Further, you will write a serial code for numerical integration using trapezoidal rule.

1. Compile and run Hello World program with and wihtout OpenMP support.
2. The Hello World program produces non-deterministic output, modify the program such that it produces messages in ascending rank order.
3. Consider evaluation of the following integral,

$$I = \int_1^{\pi} \frac{\sin(x)}{2x^3} dx, \tag{1}$$

using $n = 32$ trapeziums. The exact value of the integration $I = 0.198557$, calculate the error involved between the exact and the numerically obtained value. The trapezoidal rule of evaluating an integral is as follows:

$$\int_a^b f(x)\, dx \approx T \tag{2}$$

$$T = h\left[\frac{f(a)}{2} + \sum_{i=1}^{n-1} f(x_i) + \frac{f(b)}{2}\right] \tag{3}$$

$$h = \frac{b-a}{n}, \qquad x_i = a + ih,\ i = 0, \ldots, n, \tag{4}$$

where $x_0 = a$ and $x_n = b$, and h is the width of the trapezium, n is the number of trapeziums. Write a serial code that calculates the value of the integral for any given function using trapezoidal rule.

Notes on compiling and running OpenMP programs

- **GCC / Clang:** `gcc -fopenmp program.c -o program`
- **Intel Compiler:** `icc -qopenmp program.c -o program`
- **OneAPI Intel Compiler:** `icx -fiopenmp program.c -o program`
- **Execution:** `./program`
- **GFORTRAN:** `gfortran -fopenmp program.f90 -o program`
- **Intel Compiler:** `ifort -qopenmp program.f90 -o program`
- **OneAPI Intel Compiler:** `ifx -fiopenmp program.f90 -o program`
- **Execution:** `./program`

As FORTRAN doesn't have a pre-processor like C, to enable the use of _OPENMP preprocessor directives, -cpp flag needs to be added to the fortran compilation to borrow C pre processor for compiling fortran programs with pre-processor directives.
