Tutorial - 2

In this tutorial, you will use the numerical integration code that was taught in the lectures and run it for the following cases:

1. Consider evaluation of the following integral,

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

   using $n = 32$ trapezoids and number of threads $p = 2, 4$ and 8. The exact value of the integration $I = 0.198557$, calculate the error involved between the exact and the numerically obtained value.

2. Calculate the above integral using serial and the OpenMP parallel codes. In the parallel versions, consider separate codes that use (i) *critical section* clause (ii) *parallel for*. Convince yourself that the parallel codes that you run produce correct results.

3. In trapezoidal rule each interval is approximated using a straight line, instead if it is approximated using a parabola the resulting integration formula is known as Simpson's rule and it can be expressed using the following equation:

$$I \approx \frac{h}{3}\left(f_0 + f_n + 4\left[\sum_{j=1,3,5,7,\ldots}^{n-1} f_j\right] + 2\left[\sum_{j=2,4,6,8,..}^{n-2} f_j\right]\right). \tag{2}$$

   Modify the numerical integration code that uses *parallel for* directive to evaluate Eq. 1. Use $n = 32$ and $p = 2, 4$ and 8 as before. Convince yourself that the error is much smaller with Simpson's rule.