Spring 2021
PHYS 377 Advanced Computational Physics
HW # 2a

Problem 1: The file *velocities.txt* (available on *myCourses*), which contains two columns of numbers, the first representing time t in seconds and the second the x-velocity in m/s of a particle, measured once every second from time $t = 0$ to $t = 100$. Write a program to do the following:

(a) Read in the data and, using the **trapezoidal rule**, calculate from them the approximate distance traveled by the particle in the x direction as a function of time.
(b) Extend your program to make a graph that shows, on the same plot, both the original velocity curve and the distance traveled as a function of time.

Problem 2: (a)Write a program that uses **trapezoidal rule with 10 slices** to calculate an approximate value for the integral

$$\int_0^2 (x^4 - 2x + 1)dx$$

(b) Now write a program to calculate an approximate value for the same integral, but using **Simpson's rule with 10 slices**. You could base your program on the **trapezoidal rule**.
(c) Run the program and compare your result to the known correct value that you could obtain by calculation (pen and paper). What is the fractional error on your calculation?
(d) Modify the program to use a hundred slices instead, then a thousand. Note the improvement in the result. How do the results compare with those for the trapezoidal rule with the same numbers of slices?

Problem 3: Consider the integral

$$E(x) = \int_0^x e^{-t^2} dt$$

(a) Write a program to calculate $E(x)$ for values of x from 0 to 3 in steps of 0.1. Choose for yourself what method you will use for performing the integral and a suitable number of slices.
(b) When you are convinced your program is working, extend it further to make a graph of $E(x)$ as a function of x.
Note that there is no known way to perform this particular integral analytically, so numerical approaches are the only way forward.