Numerical Analysis and Programming

Lab Worksheet #11

In this exercise, you will learn how to use Scipy to perform integration and solve ODE.

1. Use `fixed_quad` function (fixed order Gaussian quadrature) with order $n = 3, 4, 5$ in `scipy.integrate` to perform the definite integral

   $$\frac{2}{\sqrt{\pi}} \int_0^1 e^{-x^2} dx$$

   and compare with the true solution $\mathrm{erf}(1)$ (error function) in `scipy.special`.

2. Repeat the same calculation using `romb` function instead.

3. How many function evaluations is required for each method to reach the accuracy in the 4th decimal place?

4. Use `ode` function to solve the second order differential equation with $x(0) = 0, \dot{x}(0) = 0.2$, and plot the solution,

   $$\ddot{x} + 0.25\dot{x} + x = \sin 0.8t$$

   (Hint: This can be separated into two coupled 1st order ODE)