**Assignment 7.** Marks 10

Posted on 11.11.2021 and due on 22.11.2021 midnight

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1. Use explicit Euler and Predictor-Corrector methods to solve the following ODE, taking step sizes 0.5, 0.2 and 0.05. Plot the solutions for each step sizes in two different plots for different methods. (Take $e = 2.71828$) **[3]**

$$\frac{dy}{dx} = \frac{y \ln y}{x} \quad \text{where,} \;\; y(2) = e$$

2. Use RK4, for a step size of 0.05, to solve the equation,

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} = 1 - x, \quad \text{where} \;\; y(0) = 2, \; y'(0) = 1$$

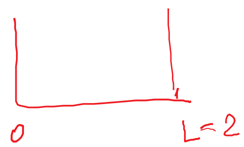
Crosscheck your answer, by plotting, with the analytical solution $y(x) = c_1 + c_2 e^{-x} - x^2/2 + 2x$ over the range $x \in [-5, 5]$ and $y \in [-5, 5]$. **[2]**

3. Using the Shooting method, numerically solve the Schrödinger equation in 1-dim for a particle, of mass $m = 1$ unit, in an infinite potential well, of width 2 units, for the lowest two states. Consider the energy in the unit of Planck constant. **[5]**

$$-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}\psi = E\psi$$

$$\frac{d^2y}{dx^2} + \frac{2mE}{\hbar^2} y = 0$$

$$\frac{d^2y}{dx^2} + 2y = 0$$




$E = \hbar^2$

$m = 1$