3801ICT Numerical Algorithms – Test 1

Question 1 (**15 Marks**)

Use centered difference approximations to estimate the first and second derivatives of $y = e^x$ at $x = 1$ for $h = 0.1$. Compare these with the analytical value. In addition, calculate the first derivative using Richardson's Extrapolation with a 2 x 2 table.

x	e^x
0.8	2.226
0.9	2.460
1.0	2.718
1.1	3.004
1.2	3.320

Question 2 (**10 Marks**)

Use the RK4 method to solve $y' = 12x^2 - 20x + 8.5$ from x =0 to x = 1 with a step size of 0.5. The initial condition at x = 0 is y = 1.

Question 3 (**10 Marks**)

Given the equations:

$$2x_1 - 6x_2 - x_3 = -38$$
$$-3x_1 - x_2 + 7x_3 = -34$$
$$-8x_1 + x_2 - 2x_3 = -20$$

a) Solve by Gauss elimination with partial pivoting. Show all steps of your computation.
b) Solve using LU decomposition with partial pivoting. Show all steps of your computation.
c) Substitute your results into the original equations to check your answers.