Assignment 1. Posted on 04.01.2024 Due on 12.01.2024 Marks 30

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1. Solve $\exp(-x) - x = 0$ using fixed-point method, accurate up to 4 places in decimal. **[4]**

2. Use Simpson's rule and appropriate Gaussian quadrature to evaluate the following integral accurate up to 6 places in decimal **[5]**

$$\int_0^1 \sqrt{1+x^4}\, dx$$

3. Solve the following ODE with RK4 with interval sizes 0.5, 0.2, 0.05 and 0.01

$$y' = \frac{5x^2 - y}{e^{x+y}} \quad \text{where} \quad y(0) = 1.0$$

   Tabulate your results. **[5]**

4. Solve the heat equation $u_t = 4u_x x$, using Crank-Nicolson and your choice of α, subjected to the boundary conditions

$$u(0,t) = 0 = u(8,t) \quad \text{and} \quad x(x,0) = 4x - x^2/2$$

   Since matrix inversion is not taught in class, you may use ready-made available routines for the purpose. Comment on your choice of α and inversion algorithm. Display the solution both in a table and a contour plot. **[8]**

5. Solve the Poisson's equation $u_{xx} + u_{yy} = xe^y$ in a 6^2 grid with boundary conditions

$$\begin{cases} u(0,y) = 0 \\ u(2,y) = 2e^y \end{cases} \quad \text{and} \quad \begin{cases} u(x,0) = x \\ u(x,1) = xe \end{cases}$$

   Display the solution both in a table and a 3-D plot. **[8]**