Computer Assignment 2 on NSOPDE

1. Use shooting method to solve the BVP

$$y'' = 6y^2, \ y(0) = 1, \ y\left(\frac{10}{10}\right) = \frac{100}{169}.$$

   Use Taylor series method of order 3 with $h = \frac{1}{10}$ to solve the resulting IVPs and the secant method for iteration. Take $s^{(0)} = -\frac{9}{5}$, $s^{(1)} = -\frac{19}{10}$ and perform 5 iterations of the secant method. Compare the numerical results with the exact solutions $y(x) = \frac{1}{(1+x)^2}$.

2. Solve the following boundary value problem using the shooting method

$$u'' = 2uu', \ 0 < x < 1 \qquad u(0) = 0, \quad u(1) = 1.0.$$

   Use the Taylor series method of order 3 to solve the initial value problem and Newton's method for iteration using the initial approximation $u'(0) = s^{(0)} = 0.09$. Assume $h = 0.1$ and perform 5 iterations.

3. Use shooting method to solve the BVP

$$y'' = (3/2)y^2, \ y(0) = 1, \ y(1) = 4.$$

   Use Runge kutta method of order 4 to solve the resulting IVPs and the Newton's method for iteration. Assume $h = 0.1$, take $s^{(0)} = 0.9$, and perform 5 iterations.

4. Use second order finite difference method to solve the following boundary value problems;

i. $x^2 y'' = 2y - x, \ y(2) = 0, \ y(3) = 0$ with (a) $h = \frac{1}{10}$. Use the LU decomposition to solve the resulting system of linear algebraic equations.

ii. $y'' - 3y' + 2y = 0$, with $2y(0) - y'(0) = 1$, $y(1) + y'(1) = 2e + 3e^2$ and $h = \frac{1}{10}$. Use the LU decomposition to solve the resulting system of linear algebraic equations.

iii. $y'' = \frac{3}{2}y^2$, with $y(0) = 0$, $y(1) = 1$ and $h = \frac{1}{4}$. Use the Newton's method to solve the resulting system of non-linear algebraic equations by take the initial approximation vector as having all elements as 1.

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