ANT_LAB ASSIGNMENT-05-Set-2

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ANT_LAB ASSIGNME...

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

DEPARTMENT OF MATHEMATICS

MA39110 - Advanced Numerical Techniques Lab

1.Use second order FDM(finite difference scheme) and Newton linearization technique, write a MATLAB Code to solve the following BVP (Boundary Value Problem) with step size h=0.1 .Also compare the solution with exact solution and plot the resulting solutions.

$$yy''+y'=2 \qquad x \in [0,1]$$

$$y(0)=0 \quad , \quad y(1)=2$$

2.Use second order FDM(finite difference scheme) and Quasi linearization technique to solve the following BVP with step size h=0.1 . Also compare the solution with exact solution of the given BVP and plot the resulting solution.

$$(y')^2=2yy'' \qquad x \in [1,2]$$

$$y(1)=1, \qquad y(2)=4$$

Q1)

$y = 2x.$

$$\boxed{yy''+y'=2.} \quad y(0)=0 \quad y(1)=2.$$

$\longrightarrow \boxed{yy''+y'-2=0}$

$\longrightarrow$ On discretization.

$$y_i\left(\frac{y_{i-1}-2y_i+y_{i+1}}{h^2}\right)+\left(\frac{y_{i+1}-y_{i-1}}{2h}\right) \quad 2-0$$

$$F(y_{i-1},y_i,y_{i+1}) = y_i\left(\frac{y_{i-1}-2y_i+y_{i+1}}{h^2}\right)+\left(\frac{y_{i+1}-y_{i-1}}{2h}\right)-2.$$

$$F(y_{i-1},y_i,y_{i+1}) + \frac{\partial F}{\partial y_{i-1}}(\Delta y_{i-1}) + \frac{\partial F}{\partial y_i}(\Delta y_i) + \frac{\partial F}{\partial y_{i+1}}(\Delta y_{i+1}) = 0.$$

$$\frac{\partial F}{\partial y_{i-1}} = \left(\frac{y_i}{h^2}-\frac{1}{2h}\right) \qquad \frac{\partial F}{\partial y_{i+1}} = \left(\frac{y_i}{h^2}+\frac{1}{2h}\right) \qquad \frac{\partial F}{\partial y_i} = \left(\frac{y_{i+1}-4y_i+y_{i-1}}{h^2}\right).$$

$$\Rightarrow \left(\frac{y_i}{h^2}-\frac{1}{2h}\right)\Delta y_{i-1} + \left(\frac{y_{i+1}-4y_i+y_{i-1}}{h^2}\right)\Delta y_i + \left(\frac{y_i}{h^2}+\frac{1}{2h}\right)\Delta y_{i+1} = \left\{2-\left(\frac{y_{i+1}-y_{i-1}}{2h}\right)-y_i\left(\frac{y_{i-1}-2y_i+y_{i+1}}{h^2}\right)\right\}.$$

$i=1,2,\ldots,9$

$$\boxed{\begin{array}{l} Y_0=0 \\ Y_{10}=2. \end{array}}$$

$\boxed{h=0.1}$

x_0	x_1	x_2	...	x_9	x_{10}
0	0.1	0.2		0.9.	1.0

0.9. 1.0