CL249: ASSIGNMENT 7

Himanshu Choudhary
200020059

Problem statement

We have to solve the given ODEs

$$\frac{dy_1}{dx} = -2y_1 + 4e^{-x} \qquad y_1(x=0) = 2$$

$$\frac{dy_2}{dx} = \frac{-y_1 y_2^2}{3} \qquad y_2(x=0) = 4$$

using Euler's Explicit Method for initial values given.

And plot y_1 vs x and y_2 vs x for different values of h.

Description of Method

Euler's Explicit method.

We divide ~~into~~ the interval into parts (N) and find the function using the formula.

$$x_{i+1} = x_i + h \qquad h = \frac{b-a}{N}$$

$$y_{i+1} = y_i + h^* \left.\frac{dy}{dx}\right|_{x=x_i}$$

$\frac{dy}{dx} = f'(x,y)$ is the differential eqn

We are given initial values of ys at $x = 0$.

PSEUDO CODE

main.m

Initialize interval [0, 4)

loop for N

$N = 2^{i-1}$

get x, y_1, y_2 from solver

loop in 1: length(y_{pre})

$error_1 = \left| \frac{y_1(i) - y_{1pre}(i)}{y_i} \right|$

loop in 1 : lpre

$error_2 = \left| \frac{y_2(i) - y_{2pre}(i)}{y_2(i)} \right|$

plot (x, y_1)

plot (x, y_2)

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solver.m

get arguments a, b, N

$h = b-a/N$

$y(1) = 2, y2(1) = 4;$

loop from 1 to (N-1)

$x_{i+1} = x_i + h$

$y_1(i+1) = y1(i) + h$ (derivative$_1$)

$y_2(i+1) = y_2(i) + h$ (derivative 2)

return

derivative.m

fet arguments x, y_1, y_2

$y_1' = f1(x, y_1)$
$y_2' = f2(y_1, y_2)$

function f1 (x, y)
return $-2y + 4e^{-x}$

function f2 (y_1, y_2)
return $-\frac{y_1 y_2^2}{3}$

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Convergence

The two plots y_1 and y_2, the graphs are getting close as we are decreasing step size.

- $h = h/2$ is operating in each iteration as $n = 2n$

- we have also found the max. error between y_1 and y_1 from previous iteration.