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ME 58100

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Homework 8

Chart, line chart

Description automatically generated

Figure 1: Comparison of Euler method, RK-4 solutions to the exact solution

In figure 1 there are three plots graphed, however, it seems like there is only two due to the small error between the 4th order Runge-Kutta results and the actual solution.

**Error data**

Table

Description automatically generated

**The code**: (A matlab file with the entire code features in the zip folder submitted for this assignment)

%Luc Rulinda, ME58100 HW 8 code, 12/7/2021

% clear

clc

% diff. eq.

dy = @(t,y) 1+ (y./t);

dyy = @(t,w) 1+ (w./t);

a = 1;

b = 6;

s = 5; % number of steps

h = (b-a)/l; % Step size: in our case equals 1

t = a:h:b; % t is between 1 and 6

% initial condiion: y(1) = 1

y(1) = 1;

w(1)= 1;

% Exact solution function:

x = t.\*(1+log(t)); %remove semi-colon to print the data solutions

% Euler's method

for i = 1:s

y(i+1)= y(i)+ h \* dy(t(i),y(i)); %remove semi-colon to print the results of Euler's method

end

% RK-4 method

for ii=1:(length(t)-1)

k1 = dyy(t(ii),w(ii));

k2 = dyy(t(ii)+0.5\*h,w(ii)+0.5\*h\*k1);

k3 = dyy((t(ii)+0.5\*h),(w(ii)+0.5\*h\*k2));

k4 = dyy((t(ii)+h),(w(ii)+h\*k3));

w(ii+1) = w(ii) + (h/6)\*(k1+2\*k2+2\*k3+k4); %remove semi-colon to print the results of RK-4

end

% Plots:

hold on;

plot(t,y, '-b');

plot(t,w,'-r');

plot(t,x,'g-');

legend('Euler', 'RK-4','t\*(1+log(t)')

ylabel('x'); xlabel('t');

hold off;