

MATLAB LAB #6: Runge-Kutta method

March 30, 2020

Write a MATLAB code to implement Algorithm 5.2 (Runge-Kutta method of order four). Use the code to approximate the solutions to the following initial-value problem, and compare the results to the actual value.

$$y' = e^{t-y}, \quad 0 \leq t \leq 1, \quad y(0) = 1 \text{ with } h = 0.25$$

actual solution  $y(t) = \ln(e^t + e - 1)$

Answer:

t	w	y	$E_a$
0	1	1	0
0.25	1.09938155161146	1.09938107479191	4.7682e-07
0.5	1.21402410329178	1.21402306062971	1.0427e-06
0.75	1.34424460208436	1.34424292496666	1.6771e-06
1	1.48988246709762	1.48988012564475	2.3415e-06

Listing 1: RK4

```
1 %rk4.m
2 a = 0; b = 1;
3 h = 0.25;
4 f = @(t,y) exp(t-y);
5 y = @(t) log(exp(t) + exp(1) -1);
6 N = (b-a) / h;
7 alfa = 1;
8 w = alfa;
9 t = a;
10 K = zeros(4);
11 result = zeros(N+1, 4);
12 result(1, :) = [t,w, y(t), abs(w-y(t))];
13
14 for i=1:N
15     K(1) = h * f(t,w);
16     K(2) = h * f(t + h/2, w + K(1)/2);
17     K(3) = h * f(t + h/2, w + K(2)/2);
18     K(4) = h * f(t + h, w + K(3) );
19     w = w + ( K(1) + 2*K(2) + 2*K(3) +K(4) ) / 6;
20     t = a + i*h;
21     result(i+1, :) = [t,w, y(t), w-y(t)];
22 end
23 t = array2table(result,...
24 'VariableNames',{'t','w','y' ,'Error'})
```