Assignment 5

Math 528L Fall 2021

Due 10/3 (Sunday at 11:59 pm)

1 Runge-Kutta Methods

(a) Write two programs, one to implement the 2nd order Runge-Kutta method and the other to implement the 4th order Runge-Kutta.

(b) Try out your programs with the ODE $y' = -\dfrac{1}{10}y^2 \tanh(x-5)$ with $y_0 = 1$. Use a step size $h = 0.1$ and a final time $T = 10$. Plot the solutions.

(c) Find the exact solution using Mathematica's DSolve. Plot the solution.

(d) **FOR THIS PART AND PART E USE THE ODE $y' = y$ with initial condition $y(0) = 1$**
For both methods, vary your step size $h = 0.1, 0.05, 0.025, 0.01, 0.005, 0.0025, 0.001$. Keep track of the absolute error at the final time step (use the analytic solution to find the error).

(e) Verify the orders of both of these methods. To do this, take the log of the errors and the log of the step sizes and plot them. What is the slope of the line?