GLG490/598 Numerical methods
Homework #9
Due 11:59pm, 4/1/2021

(100 points)

Question: Solve the following initial value problem of:

$$\begin{cases} y'' + 16y = 24\cos(4x) \\ y(0.0) = 0.0 \\ y'(0.0) = 0.0 \end{cases}$$

and find the solution at x=10.0 or $y(10.0)$ using the 4th order Runge-Kutta method.

Review:

4th order Runge-Kutta method:

$K_0 = hg_i$

$L_0 = hS(x_i, y_i, g_i)$

$K_1 = h(g_i + \frac{1}{2}L_0)$

$L_1 = hS(x_i + \frac{1}{2}h, y_i + \frac{1}{2}K_0, g_i + \frac{1}{2}L_0)$

$K_2 = h(g_i + \frac{1}{2}L_1)$

$L_2 = hS(x_i + \frac{1}{2}h, y_i + \frac{1}{2}K_1, g_i + \frac{1}{2}L_1)$

$K_3 = h(g_i + L_2)$

$L_3 = hS(x_i + h, y_i + K_2, g_i + L_2)$

$y_{i+1} = y_i + \frac{1}{6}(K_0 + 2K_1 + 2K_2 + K_3)$

$g_{i+1} = g_i + \frac{1}{6}(L_0 + 2L_1 + 2L_2 + L_3)$

Requirements:

As we discussed in class, the precision of the result depends on the number of steps or iterations used to solve the equation. In this homework, your code needs to start with 1 step (n=1), and successively double the number of steps until your final answer converges (e.g., the value do not change significantly any more), based on the following criteria:

$$\left|y(10.0)_{2n\ steps} - y(10.0)_{n\ steps}\right| < 0.00001$$

In C, the function of $fabs()$ is used to get the absolute value. For example, $fabs(-1.0) = 1.0$. You need to use this function in your code.

Your code needs to print out the same information as `y(10.0)=22.353395`

How to submit your homework

1. Change the name of your C code as 'FirstName-LastName-HW09.c'.
2. Send your code file to Mingming.Li@asu.edu and enter the email subject title as "Numerical Methods Homework 09".