MATH 340 - Lab Instructor: Valeria Barra

LAB 14 Assignment

DUE Tuesday 05-03-2016

ODEs:

Problem 1: System of ODEs

Use Explicit (forward) Euler to solve the following system of ODEs

$$
\begin{cases}
u' &= 9u + 24v + 5\cos(t) - (1/3)\sin(t), \qquad 0 \le t \le 1 \\
v' &= -24u - 51v - 9\cos(t) + (1/3)\sin(t)
\end{cases}
\tag{1}
$$

with initial conditions

$$
\begin{cases}
u(0) &= 4/3 \\
v(0) &= 2/3
\end{cases}
\tag{2}
$$

whose actual solution is given by

$$
\begin{cases}
U(t) &= 2e^{-3t} - e^{-39t} + (1/3)\cos(t) \\
V(t) &= -e^{-3t} + 2e^{-39t} - (1/3)\cos(t)
\end{cases}
\tag{3}
$$

Find the approximated solutions at the point $t = 1$ for $h = 2^0, 2^{-1}, \ldots, 2^{-9}$. Write your results in a table with columns in order: h_i, the approximated solutions $u_i(t = 1)$, $v_i(t = 1)$, the errors $e_{u_i} = |U(t = 1) - u_i(t = 1)|$, $e_{v_i} = |V(t = 1) - v_i(t = 1)|$. Check the order of convergence of the method (how does the error depend on h?) and confirm with our previous results on Explicit Euler for one single ODE.

Problem 2:

Solve the same system above with R-K4 method and print out the corresponding table. Comment about your results and the order of convergence.