16.346 Astrodynamics
Fall 2008

# Exercises 33

Obtain a numerical solution of the equations

$$\begin{aligned} \frac{dx}{dt} &= y \qquad x(0) = 0 \\ \frac{dy}{dt} &= x \qquad y(0) = 1 \end{aligned} \qquad 0 \le t \le 2 \qquad h = 0.1$$

using the Runge-Kutta-Nyström algorithms of:

1. Order two with one evaluation **Error** $10^{-3}$
2. Order three with two evaluations Error $10^{-4}$
3. Order four with three evaluations Error $4 \times 10^{-6}$
4. Order five with four evaluations Error $2 \times 10^{-8}$
5. Order six with five evaluations Error $2 \times 10^{-10}$

**Note:** The exact solution is $x = \sinh t$ and $y = \cosh t$ so you have the opportunity to compare your approximate solutions with the exact ones. You may want to experiment with the time-step $h$ if you have the time and inclination.