Exercise 1 (Implementation of RK schemes) Type: **Matlab**

a) Implement the 3-stage Runge-Kutta method with the Butcher table

$$\begin{array}{c|ccc} 0 & 0 & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ 1 & -1 & 2 & 0 \\ \hline & \frac{1}{6} & \frac{2}{3} & \frac{1}{6} \end{array}$$

in a m-file with the signature `[t,y] = RK3(FUNC,t0,tN,y0,N,var)`. The input argument `FUNC` contains the handle that defines the right hand side function f, `[t0, tN]` determine the time interval, `y0` is the starting (column) vector and `N` denotes the number of time steps. `var` should be passed to the file `FUNC` as third argument (i.e. `FUNC(t,y,var)`). The output arguments are the vector of time steps `t`$= (t_i)_{i=0,\ldots,N}$ and the corresponding approximate solutions `y`$= (y_i)_{i=0,\ldots,N}$.

b) Download the files `RK4.m`, `rk_comp.m` and `TESTODE.m` from the web page and save it in the same folder as your files from a). State the initial value problem that is solved in `rk_comp`. Then, test your code of a) by running `rk_comp`, and determine the numerical order of convergence for each of the methods from the output. Do the results coincide with the theoretical expectations?