Institute of Scientific Computing

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Advanced Methods for ODE and DAE:
Assignment 1

This is to become familiar with some concepts of object-oriented programming.

It is still under consideration how to hand in code, we are thinking of establishing an svn system.

It is recommended to have the matlab part finished until 10.4., to be able to see some of the problems.

Exercise 1: *Due date: 18.4.* **(20 points)**

    (a) Implement the general explicit Runge-Kutta-method in Matlab. Parametrize it with parameters of Euler-Forward and Heuns method. Test both methods (this means write a test) with

$$\dot{x} = -x$$

    .   (8 points)

    (b) Make a convergence plot in stepwidth h for both methods.   (4 points)

    (c) Provide this for vector valued problems (a scalar is a vector, so vector-valued implementation includes the scalar one).   (4 points)

    (d) Apply your method using h = 0.02 to $\dot{x} = -\alpha x$, $\alpha \in \{0.01, 0.05, 0.1\}$. Plot results.   (4 points)

    (e) What is the effect of introduciong the parameter α on your code?   (4 points)

Exercise 2: *Due date: 26.4.. Attention: Home work 2 will appear before.* **(16 points)**

    Now do the same in python (include numpy, use numpy.array as data type). The RK method should be a class, Euler-Forward and Heuns method should be instantiated from it. The ODE's right hand side should also be a class. What is the advantage if you perform task 1.d with this code? It is recommended to use eclipse. If desired, a small tutorial can be marked in the week 8. - 12. 4. with Naveen.