Introduction to Computational Physics

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(To be discussed on Friday, 11.7. and Monday, 14.7.)

EXERCISE 9.1: **Anharmonic Oscillator**
Employing the Cash-Karp Runge-Kutta solver for ordinary differential equations presented in the Numerical Recipes, which consists of the three routines `odeint`, `rkck` and `rkqs`, integrate the differential equation for the so-called Van-der-Pol oscillator

$$\ddot{x} \;=\; -x - \varepsilon(x^2 - 1)\dot{x}\,.$$

Solve the equation for $\varepsilon = 1$ and initial conditions $x(0) = 0.5$ as well as $\dot{x}(0) = 0$, in the interval $0 \leq t \leq 8\pi$. Which step size is required in order to achieve an accuracy of 10^{-9}. Try to reproduce how the Numerical Recipes implementation works. Compare your solution with the result using Mathematicas `NDSolve[]`.

EXERCISE 9.2: **Boundary conditions**
Using the *shooting method* and the Cash-Karp Runge-Kutta algorithm solve the second order differential equation

$$y'' - 5y' + 10y(x) \;=\; 10x$$

with the boundary conditions $y(0) = 0$ and $y(1) = 100$. Try to achieve an accuracy in your result of 10^{-5}.