Object-Oriented Programming (List 11)

Deadline: 14.06.2011

This is an exercise about templates:

1. Download the template for Runge-Kutta 4 from the course homepage. Implement a function `double f( double x, double y )` that computes the function $f(x, y) = 3x^2y^2$. Using RK4, approximate the value $y(1)$ of the solution y of the differential equation

   $$y' = 3x^2y^2,$$

   for which $y(0) = 1$. Take a reasonable step size, for example $h = 0.0001$.

2. Now we are going to make another instantiation of RK4 on complex numbers. Download the files **complex.h** and **complex.cpp** from the course homepage.

   Implement a complex valued function `g( math::complex x, math::complex y )`, s.t. $g(x, y) = 3x^2y^2$.

   Using RK4, approximate the value $y(1+i)$ of the solution y in point $1+i$, of the differential equation

   $$y' = 3x^2y^3,$$

   which has begin condition $y(0) = 1$.

3. Next we try to instantiate RK4 with a vector class. Let function V of type $\mathcal{R} \times \mathcal{R}^2 \to \mathcal{R}^2$ be defined by $V(t, x, y) = (tx^2, 3t^2y^2)$.

   We are now looking for a function y of type $\mathcal{R} \to \mathcal{R}^2$, satisfying the differential equation

   $$y' = V(x, y).$$

   Using RK4, approximate the value in 1 of the solution y for which $y(0) = (3, 4)$.

   In order to instantiate RK4 to this vector class, one needs to implement it, and define the appropriate operators.

   This last task is worth 6 points.

(See the rules for showing code on the course homepage. Default value of a task (when shown on time) is 3 points.)