

Numerical Analysis. Exercise 09

Ordinary Differential Equations

Task. Solve the initial value problem

$$y'(x) = x^*y, \quad x=[0, 1], \quad y(0) = 1$$

using different methods with stepsize $h = 0.1$ and $h = 0.01$:

- a) Euler's method;
- b) Fourth-order Runge-Kutta method;

Create computer code and compare results with the following theoretical solution

$$y = \exp(0.5*x^2)$$

Output of your code should contain for each method:

h = stepsize; x = final_x_value; y = final_y_value; Error = final_y_value - y_theoretical.

You may use the following Java template to create your code ([ex09.java](#)).

The results may be as follows:

```
dy/dx = xy, a = 0, b = 1, y(a) = 1
Euler:      h = 0.100  x = 1.000  y = 1.54711040  Error = -1.0161e-01
Runge-Kutta: h = 0.100  x = 1.000  y = 1.64872101  Error = -2.6365e-07
Euler:      h = 0.010  x = 1.000  y = 1.63782046  Error = -1.0901e-02
Runge-Kutta: h = 0.010  x = 1.000  y = 1.64872127  Error = -2.3301e-11
```

Show source code and demonstrate results to your teaching assistant.