University of Houston
Department of Mathematics
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Numerical Analysis II, Spring 2010

Numerical Analysis II
(1. Practical Homework)

Practical homework 1: (*Explicit, implicit, semi-implicit Euler method*)

For the numerical integration of the initial value problem from Exercise 3 (1st homework assignment) on $[0, 1.5]$ use one-step methods with constant step size $h > 0$.
In particular, implement the following methods:
(i) *Explicit Euler method*

$$y_{i+1} \;=\; y_i \;+\; h\, f(x_i, y_i) \;\;,$$

(ii) *Implicit Euler method*

$$y_{i+1} \;=\; y_i \;+\; h\, f(x_i, y_{i+1}) \;\;,$$

(iii) *Semi-implicit Euler method*
The semi-implicit Euler method results from the implicit Euler method by replacing the exact solution of the nonlinear equation for y_{i+1} by one step of Newton's method with y_i as initial guess.

Generate a code which writes the computed pairs $(x_i, y_i)\,, 0 \le i \le n\,, n := [1.5/h]$ row-wise into a file (separately for each of the three methods). Use the following parameters

- $\lambda \;=\; 30 \;\;,\;\; \alpha \;=\; 0.0001 \;\;,\;\; h \;=\; 0.1 \;\;,$
- $\lambda \;=\; 30 \;\;,\;\; \alpha \;=\; 0.0001 \;\;,\;\; h \;=\; 0.04 \;\;,$
- $\lambda \;=\; 30 \;\;,\;\; \alpha \;=\; 0.0001 \;\;,\;\; h \;=\; 0.01 \;\;,$
- $\lambda \;=\; 30 \;\;,\;\; \alpha \;=\; 0.7 \;\;,\;\; h \;=\; 0.1 \;\;,$
- $\lambda \;=\; 30 \;\;,\;\; \alpha \;=\; 0.7 \;\;,\;\; h \;=\; 0.04 \;\;,$
- $\lambda \;=\; 30 \;\;,\;\; \alpha \;=\; 0.7 \;\;,\;\; h \;=\; 0.01 \;\;.$

Delivery: Visualizations of the computed approximations for the different parameter combinations.

Delivery of the practical work at latest on April 16, 2010. The delivery may be submitted either electronically (rohop@math.uh.edu) or as a hardcopy in class.