

## Numerik steifer Probleme

### Aufgabenblatt 1

#### Aufgabe 1

The trapezoidal rule is given by

$$y_{n+1} = y_n + \frac{\Delta t_n}{2}(f_n + f_{n+1}).$$

Prove: The trapezoidal rule is A-stable. (4 P)

#### Aufgabe 2

Consider the method

$$y_{n+1} = y_n + \Delta t(a_1 f(t_n, y_n) + a_2 f(t_n + b_1 \Delta t, y_n + b_2 \Delta t f(t_n, y_n))).$$

This is a so called explicit 2-stage Runge-Kutta method.

- Determine conditions on the parameters  $a_j, b_j \in \mathbb{R}$ , such that the method is consistent of first order.
- Determine the parameters, such that the method is consistent of order 2.

(4 P)

#### Aufgabe 3

Consider the equation

$$\dot{y}(t) = -10y(t), \quad y(0) = 1.$$

Determine the maximal time step for which we should have stability for the explicit Euler equation. Solve the problem (using a MATLAB or C code of yours) with the explicit Euler method and the implicit Euler method until  $t = 2$ , with three different step sizes each. One should be directly on the stability boundary of the explicit Euler, one beyond and one inside. What happens? (4 P)

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