

Programming Exercises Mathematical Modeling

Sheet 5

Due: Wednesday 16.07.2025, 14:00,
Per email at *eric.trebuchon@math.uni-freiburg.de*
Please write your programm in **Octave** or **Python**

Please hand in as pairs of students

Exercise 6:

(16 = (5+6)+5 Points)

- (i) Write two MATLAB routines for the numerical approximation of ordinary differential equations using general implicit Runge–Kutta methods. Implement one version using fixed-point iteration, and another using Newton’s method with a reasonable stopping criterion.
- (ii) Investigate the number of iterations required per time step for both approaches when applied to the Radau-3 method on the example

$$\dot{y} = \sqrt{1 + y^2}, \quad y(0) = 0,$$

on the interval $[0, T]$ with $T = 4$. The exact solution is given by $y(t) = \sinh(t)$.