



**Praktikum zur Vorlesung: Numerik für Differentialgleichungen – SoSe 2023**

**Sheet 4**

Ausgabe: 21.06.2023, 12:00 Uhr

Abgabe: **05.07.2023**, 12:00 Uhr

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**Homepage to the lecture:**

<https://aam.uni-freiburg.de/agasa/lehre/ss23/ndgln>

**Remark:** In order to be able to work on the sheet completely, the upcoming lecture on 26.06.2023 is necessary. You therefore have one week longer to work on the sheet. The deadline is 05.07.2023.

**Project 1** (2+2+2+2 points). Consider the initial value problem  $y' = \sqrt{1 + y^2}$ ,  $y(0) = y_0$  on the interval  $[0, T]$ ,  $T = 1$ . The exact solution is given by  $y(t) = \sinh(t)$ , see Project 2 on Sheet 3.

- (i) Implement the *Adam-Bashforth method*.
- (ii) Use a fixed point iteration with a suitable termination criterion to implement the Adams-Moulton method.
- (iii) Implement the *Adams-Bashforth-Moulton method*.
- (iv) Compare the approximation errors  $|y(T) - y_K|$  at the final time  $t_K = T$  of the three methods for  $m = 2, 3, 4$  and step sizes  $\tau = 2^{-s}$ ,  $s = 2, 3, \dots, 6$ . As initial values you can use the values of the exact solution.

**Exercise 1** (4+4 points). (i) Write a program to algorithmically determine the consistency order of a given linear multistep process.

- (ii) Test your program using the three Adams methods, see Project 1, for  $m = 2, 3, 4$ .