## FOUNDATIONS OF COMPUTATIONAL MATHEMATICS
(PODSTAWY MATEMATYKI OBLICZENIOWEJ)

**Cele kształcenia**

Computational mathematics comes into play when mathematical problems are to be solved with the aid of computers. It constitutes a bridge between mathematical (theoretical or practical) problems and programming. Its role is especially important, when the analytical solutions of the problems are not available. In such situation we can approximate and visualise the solutions. To do so, we need to be familiar with basic numerical tools and to be aware of some numerical difficulties.

**Wymagania**

Students undertaking the course are supposed to be at least a little bit familiar with Python and to communicate in English at a basic level. While Paul Bergold speaks both German and English, Karolina Kropielnicka speaks both Polish and English, so she will be able to help you with translation to Polish or in understanding some problems in Polish. For this reason the fact that the course will be taught in English should be understood as an advantage rather than a threat.

**Treści programowe**

- This course is a gentle introduction to mathematical computations, where we will become familiar with basic numerical tools, learn about conditioning, stability, various basic methods of interpolation, quadratures and some of numerical algebra. At the end of the course we will learn most known and intuitive numerical methods (Euler and Runge-Kutta) and will apply them to seek and visualise solutions of some simple evolutionary equations.
- We will be learning computational mathematics both theoretically and practically. For the practical part we will use Python. Lectures and exercises will be taught in English.
- After this course students will get the idea of how computers can be used to solve mathematical problems, what details need to be taken care of and what are the basic numerical tools. Participants will be able to visualise solution of some simple mathematical models.

**Wykaz literatury**

This course will be based on lecture notes prepared by prof. Caroline Lasser (Technical University of Munich, Germany) and dr Paul Bergold (currently at University of Surrey) and on bibliography:


- [SM] Abner J. Salgado, Steven M. Wise, Classical Numerical Analysis: A Comprehensive Course, Cambridge University Press, 2022
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- [DR] P. Davis, P. Rabinowitz, Methods of numerical integration (2nd ed.), Dover Publications, 2007
- [D] J. Demmel, Applied Numerical Linear Algebra, SIAM 1997
- [GW] G. Golub, J. Welsch, Calculation of Gauss quadrature rules, Math. Comp. 23(106), 221–230, 1969
- [H] N. Higham, Accuracy and Stability of Numerical Algorithms, SIAM, 1996
- [I] A. Iserles, A First Course in the Numerical Analysis of Differential Equations (2nd ed.), CUP,
- 2009.
- [KU] A. Krommer, C. Ueberhuber, Computational integration, SIAM, 1998
- [O] M. Overton, Numerical Computing with IEEE Floating Point Arithmetic, SIAM, 2001
- [S1] G. Stewart, Afternotes on numerical analysis, SIAM, 1996
- [S2] G. Stewart, Afternotes goes to graduate school, SIAM, 1998
- [T] L. N. Trefethen, Approximation theory and approximation practice, SIAM, 2013
- [TB] L. N. Trefethen, D. Bau, Numerical Linear Algebra, SIAM, 1997
- [Cheb] G. Wright, M. Javed, H. Montanelli, N. Trefethen, Extension of Chebfun to periodic functions, SIAM J. Sci. Comput. 37(5), 554–573, 2015