Valid from 2024.HS

Module description: Higher Mathematics for Computer Scientists 1

Module Code	t.BA.ITM.HM1.19HS
ECTS Credits	4
Language of Instruction/Examination	German
Organizational Unit	IAMP
Module Coordinator	Reto Knaack
Legal Framework	The module description is part of the legal basis in addition to the general academic regulations. It is binding. During the first week of the semester a written and communicated supplement can specify the module description in more detail.
Module Characteristic	Type 3a 2 lecture lessons per semester week and class+ 2 lab bi-weekly lessons per semester and half-class
Module Description	Students learn the basics of numerical mathematics for computer scientists and their application with Python, fundamental concepts of computer arithmetic and error estimation, numerical instabilities, algorithms for solving linear equation systems and the computation of eigenvalues and eigenvectors.
Module Content	**Introduction to Python** • Data types • Functions • Programmes **Computer Arithmetic** • Machine numbers (floating point and fixed point numbers, single-precision, double-precision, IEEE formats) • Aproximation and rounding errors • Conditioning **Numerical solution of one-dimensional nonlinear problems** • Fixed point iterations • Fixed point iterations **Numerical solution of linear systems** • Gauss algorithm with error propagation and pivoting • Triangular decomposition of matrices • Error calculation and expense estimation • Iterative methods: Jacobi / Gauss-Seidel • Introduction to complex numbers • Numerical calculation of eigenvalues and eigenvectors
Prerequisite Knowledge	• Analysis 1 & 2 • Diskrete Mathematik • Lineare Algebra

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Learning Objectives (Competences)	see table below

Students...	Competencies	Taxonomies
The students understand the functionality and the basic commands of Python. They are able to use it to write simple scripts and programs to solve typical numerical problems and to implement this in weekly group work. They use the functions provided in Python correctly.	M, SO, F	K2, K3
Students can define the basic concepts of computer arithmetic and correctly apply the associated error estimations. They can explain the possible causes of numerical instabilities.	F, M	K2, K3
Students can explain the principles of the most important solution methods for nonlinear equations and linear systems of equations and apply them to concrete problems. They can numerically calculate real or complex eigenvalues and eigenvectors.	M, F	K2, K3

Performance Assessment

End-of-module exam	Assessment	Length (min.)	Weighting	Form
written exam	Grade	120	80	acc. to module agreement

Performance assessment during the semester	Assessment	Length (min.)	Weighting	Form
Weekly Assignments	Grade		20	acc. to module agreement

Classroom Attendance Requirement	None
Learning material	• Script and Presentations • Knorrenschild, M. (2013). Numerische Mathematik: Eine beispielorientierte Einführung. 5 Edition. Carl Hanser Verlag GmbH & Co. KG. ISBN 978-3446432338.
Comments	