Numerical Algorithms

Course description

Basic information

Field of study : Analytical Computer Science

Path : -

Organizational unit : Faculty of Mathematics and Computer Science

Education level : first-cycle

Form of study : full-time studies

Study profile : general academic

Mandatory status : optional

Education cycle : 2022/23

Course code : UJ.WMIIANS.1380.03349.22

Language of instruction : Polish

Disciplines : Computer Science

ISCED classification : 0613 Software and applications development and analysis

USOS code : WMI.TCS.AN.S

Course coordinator

Lech Duraj

Course instructor

Lech Duraj

Periods Semester 4, Semester 5, Semester 6	Form of verification of learning outcomes exam Teaching format and hours lecture: 30 laboratory exercises: 30	Number of ECTS credits 6.0

Educational goals for the course

C1	The aim of the course is to provide knowledge in the field of numerical algorithms, with particular emphasis on practically applied and experimentally verified algorithms, as well as analysis of algorithms in terms of numerical stability

Learning outcomes for the course

Code	Outcomes in terms of	Directional learning outcomes	Verification methods
Knowledge – The student knows and understands:			
W1	issues listed in "Program content" regarding computer arithmetic, calculation errors, conditioning and numerical stability of algorithms	IAN_K1_W12	written exam, credit
W2	issues listed in "Program content" in the field of algebra and numerical analysis, including methods for solving numerical problems	IAN_K1_W09, IAN_K1_W10, IAN_K1_W12	written exam, credit
Skills – The student can:			
U1	solve numerical problems listed in "Program content", and effectively implement selected algorithms	IAN_K1_U01, IAN_K1_U05, IAN_K1_U10	written exam, credit
U2	prove correctness and numerical stability of algorithms, select appropriate algorithms to solve numerical problems	IAN_K1_U01, IAN_K1_U02, IAN_K1_U10, IAN_K1_U11, IAN_K1_U17	written exam, credit

ECTS credits balance

Student activity form	Average number of hours* dedicated to completed activity types
lecture	30
laboratory exercises	30
preparation for exercises	42
solving computer tasks independently	30

exam preparation	45
exam participation	3

Total student workload	Number of hours 180	ECTS 6.0

* hour (lesson) means 45 minutes

Course content

No.	Program content	Learning outcomes for the course
1.	Floating-point arithmetic, calculation and rounding errors, task numerical conditioning and numerical stability of algorithms	W1, U2
2.	Numerical methods in algebra: systems of linear equations, Gaussian elimination, orthonormalization, LU and QR matrix decomposition, eigenvectors and eigenvalues, singular values and SVD decomposition	W2, U1, U2
3.	Numerical analysis: nonlinear methods, unconstrained and constrained optimization, interpolation and approximation, numerical differentiation and integration, fundamentals of differential equations, Fourier transform and related transformations	W2, U1, U2

Extended information

Teaching methods:

multimedia presentation lecture, discussion, problem solving

Class type	Credit forms	Course credit conditions
lecture	written exam	Positive combined grade from exam and exercises
laboratory exercises	credit	Solving an appropriate number of programming and whiteboard tasks

Literature

Required

1. Justin Solomon, "Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics"

Additional

1. David Bau III, Lloyd N. Trefethen, "Numerical Linear Algebra"

2. David Ronald Kincaid, Elliott Ward Cheney, "Numerical Analysis: Mathematics of Scientific Computing"