

Scientific Computing (C001521)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0

Study time 180 h

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)

Dutch

Gent

seminar

lecture

Lecturers in academic year 2024-2025

Van Daele, Marnix

WE02

lecturer-in-charge

Offered in the following programmes in 2024-2025

[Bachelor of Science in Computer Science](#)

crdts

6

offering

A

Teaching languages

Dutch

Keywords

Numerical algorithms, conditioning, stability, accuracy, complexity

Position of the course

To show to students

- what the consequences are of the finite representation of numbers
- that, in the formulation of a problem or the construction of an algorithm, sensitivity, conditioning, stability, ... play an important role.
- that, to solve a mathematical problem with a computer, it is not sufficient to program any previous learned mathematical recipe but that on the contrary new (often iterative) algorithms are needed (and then the issue of convergence is important).
- some well-known numerical algorithms for several numerical problems.
- some professional state-of-the-art software and interactive environments for scientific computing.

Contents

Essential items in numerical computation : well posed problems, errors, conditioning, floating point representation, ... (with attention for some standards)

A selection of the most important numerical algorithms for e.g. the following subjects.

- solving systems of linear equations
- least squares problems
- eigenvalue problems
- roots of nonlinear equations
- optimisation
- interpolation
- numerical integration and differentiation

At the start of the semester, some lessons on Taylor series expressions are given.

Initial competences

In the first two Bachelor years the students have gained the necessary mathematical experience to understand the mathematical formulation of the different problems and on the other hand they also have the necessary skills (with data structures, algorithms, complexity analysis, programming, etc.) to implement the algorithms.

Final competences

- 1 The students will have gained insight in and will pay attention to the desirable characteristics of numerical software such as reliability, robustness, accuracy, efficiency, etc.
- 2 The students will be able to apply numerical techniques for a wide variety of subjects (Such as solving systems of linear equations, nonlinear problems, interpolation, numerical integration and differentiation, ...) in numerical analysis and scientific computing.
- 3 The students will behave as intelligent users of state-of-the-art software for numerical problems.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Study material

Type: Handbook

Name: Scientific computing: an introductory survey

Indicative price: € 60

Optional: yes

Language : English

Author : Michael Heath

ISBN : 978-1-61197-557-4

Number of Pages : 567

Oldest Usable Edition : 2001

Online Available : Yes

Available in the Library : Yes

Available through Student Association : No

Usability and Lifetime within the Course Unit : regularly

Usability and Lifetime within the Study Programme : one-time

Usability and Lifetime after the Study Programme : not

Additional information: In principle the slides are sufficient. The book gives extra information

Type: Slides

Name: Slides

Indicative price: Free or paid by faculty

Optional: no

Language : Dutch

Number of Slides : 500

Oldest Usable Edition : 2023

Available on Ufora : Yes

Online Available : No

Available in the Library : No

Available through Student Association : No

Additional information: The slides follow the book Scientific Computing, An introductory Survey.

Type: Software

Name: Educational modules

Indicative price: Free or paid by faculty

Optional: no

Online Available : Yes

Available in the Library : No

Available through Student Association : No

Usability and Lifetime within the Course Unit : intensive

Usability and Lifetime within the Study Programme : one-time

Usability and Lifetime after the Study Programme : not

Additional information: These modules follow the book Scientific Computing: an introductory Survey

References

Micheal T. Heath, Scientific Computing, An introductory survey, Second Edition, McGraw Hill (2002), ISBN 0-07-239910-4.

Course content-related study coaching

Individual coaching by lecturer/assistants: appointment
Interactive coaching via Ufora.

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment**Possibilities of retake in case of permanent assessment**

not applicable

Extra information on the examination methods

Written exam in closed book form for (mainly) theory and open book form for exercises

Calculation of the examination mark

$0.5 * \text{score_theory} + 0.5 * \text{score_exercises}$
whereby score_theory and score_exercises belong to $[0,20]$