MATH-458 **Programming concepts in scientific computing**

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Cursus	Sem.	Type
Civil Engineering	MA1, MA3	Opt.
Computational science and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Withdrawal	Unauthorized
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	**36**

It is not allowed to withdraw from this subject after the registration deadline.

Remark

only for master students in Civil Engineering and Computational Science

Summary

The aim of this course is to provide the background in scientific computing. The class includes a brief introduction to basic programming in c++, it then focus on object oriented programming and c++ specific programming techniques.

Content

- Flow control, I/O
- Pointers
- Blocks, functions, variables
- Classes, derivation and inheritance
- Templates
- Linear algebra
- Basics of parallel programming

Learning Prerequisites

Required courses

Analysis I and II
Linear Algebra
Numerical Analysis
The cours Numerical Analysis and Computational Mathematics has to be followed in parallel to the course if its contents are not yet mastered.

Recommended courses

A programming language (C, C++, Fortran, Java, ...)
Introduction to the Finite Element Method.

Learning Outcomes

By the end of the course, the student must be able to:

- Interpret algorithms in c++
- Modify algorithms in c++
- Implement algorithms in c++

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Set objectives and design an action plan to reach those objectives.
- Use both general and domain specific IT resources and tools
- Give feedback (critique) in an appropriate fashion.

Teaching methods

Interactive lecture and projects in classroom

Expected student activities

Before each class the student is required to prepare with assigned reading.
Programming assignements during the project hours and at home.

Assessment methods

The students will be evaluated with two quizz (QCM) during the semester and then with oral evaluations based on programming at the end of the semester.

Resources

Bibliography

Joe Pitt-Francis and Jonathan Whiteley, *Guide to Scientific Computing in C++,* Springer 2012
Other references:
C++ and Object Oriented Numeric Computing for Scientists and Engineers, Daoqui Yang, Springer-Verlag, 2000.
Parallel scientific computing in C++ and MPI, Karniadakis, G. and Kirby, R.M., Cambridge University Press, 2003

Ressources en bibliothèque

- C++ and Object Oriented Numeric Computing for Scientists and Engineers / Yang
- Parallel scientific computing in C++ and MPI /Karniadakis
- ¿Guide to Scientific Computing in C++ / Pitt-Francis

Notes/Handbook

Joe Pitt-Francis and Jonathan Whiteley, *Guide to Scientific Computing in C++,* Springer 2012