

MATH-458

**Programming concepts in scientific computing**

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Cursus	Sem.	Type
Civil Engineering	MA1, MA3	Obl.
Computational science and Engineering	MA1, MA3	Opt.
Computational science and engineering minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**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 focuses on object-oriented programming and c++ specific programming techniques. Typical class hierarchies of computational software are addressed.

**Content**

- Flow control, I/O
- Pointers
- Blocks, functions, variables
- Classes, derivation and inheritance
- Templates
- Linear algebra
- Class Hierarchies and architecture

**Learning Prerequisites****Required courses**

Analysis I and II

Linear Algebra

Numerical Analysis

The course Numerical Analysis has to be followed in parallel to the course if its content is not yet mastered.

**Recommended courses**

A programming language (C, C++, Fortran, Java, ...)

**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++
- Construct class hierarchies

- Use Eigen-C++ linear algebra library
- Use GIT

### 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 assignments during the project hours and at home.

### Assessment methods

The students will be evaluated based on the realization of a project and their programming skills, which will be defended during an oral exam at the end of the semester.

### Resources

#### Virtual desktop infrastructure (VDI)

Yes

#### 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.

#### Ressources en bibliothèque

- [Find the references at the Library](#)

#### Notes/Handbook

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

#### Moodle Link

- <https://go.epfl.ch/MATH-458>