**EPFL**

| MATH-458 | **Programming concepts in scientific computing** |
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Anciaux Guillaume

| Cursus | Sem. | Type |
|---|---|---|
| Civil Engineering | MA1, MA3 | Opt. |
| Computational science and Engineering | MA1, MA3 | Opt. |
| Digital Humanities | MA1 | Opt. |
| Mineur STAS Russie | H | Opt. |

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| Language of teaching | English |
| Credits | 4 |
| Session | Winter |
| Semester | Fall |
| Exam | During the semester |
| Workload | 120h |
| Weeks | 14 |
| **Hours** | **4 weekly** |
| Courses | 2 weekly |
| Exercises | 2 weekly |
| **Number of positions** | **40** |

**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
- ¿Guide to Scientific Computing in C++ / Pitt-Francis
- Parallel scientific computing in C++ and MPI /Karniadakis

### Notes/Handbook

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