Faculty of Science

MNXB11, Physics: Introduction to Programming and Computing for Scientists, 7.5 credits

Fysik: Introduktion till programmering och datoranvändning för naturvetare, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2022-12-09 to be valid from 2022-12-09, autumn semester 2023.

General Information

The course is an elective course in the first cycle for a degree of Bachelor of Science and an elective course for a degree of Master of Science in Applied Computational Science with specialisation in Chemistry.

Language of instruction: English

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G1N, First cycle, has only upper-secondary level entry requirements

Learning outcomes

On completion of the course, students are to have acquired the knowledge and skills needed for scientific data analysis and modeling using modern computational tools and methods in a collaborative environment.

Knowledge and understanding

On completion of the course, the student shall be able to:

- describe methods for processing, analysis and modeling of scientific data using custom software
- explain the basics of code optimisation
- understand and justify use of program libraries
- account for implications of machine accuracy
- name several relevant software frameworks that use programmatic interfaces.

Competence and skills

On completion of the course, the student shall be able to:

- use UNIX-based operating systems, for example, Linux
- write computer programs using C++
- compile from source, build and debug computing programs
- develop program code in a collaborative environment
- analyse scientific data
- document the project and code development.

Judgement and approach

On completion of the course, the student shall be able to:

- propose software solutions for scientific data analysis
- discuss alternative methods for solving computational problems
- argue about the choice of optimal algorithms and approaches
- reflect on the advantages and drawbacks of different computational methods
- estimate resources needed to implement a computational project
- report on the results of scientific data analysis projects.

Course content

The course covers a broad range of programming aspects that are essential for scientists. The course begins with a basic introduction to relevant information technologies and concludes with an in-depth study of frameworks for scientific data analysis. The following subjects are addressed:

- Usage of UNIX-based operating systems, for example, Linux
- Overview of usage of programming in various areas of science (data analysis, simulation etc.)
- Overview of commonly used programming languages, for example, C++ and Python
- Basic concepts of object-oriented code design
- Basics of code development techniques using a selected language (C++), use of standard code building tools in a UNIX-based environment, for example, Linux (gmake, gcc)
- Open source code development
- Essentials of developing code in a collaborative scientific environment, for example, git
- The basics of distributed computing and computer security
- Hands-on exercises in basic data analysis and simulation.

Course design

The teaching consists of practical exercises involving programming, guiding lectures and the final project. The project, the exercises and the course elements associated with these are compulsory. The project consists of written submissions and an oral project presentation.

Assessment

Examination takes place orally and in writing in the form of a final project and through participation in mandatory course components.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
For a Pass grade on the whole course, the student must have Pass grades on the project work, including the submitted home assignments. The final grade is determined by the grade on the project work including the mandatory components.

Entry requirements

General requirements and studies equivalent of courses Mathematics 4 (or older course Mathematics D) and English 6/B from Swedish Upper Secondary School.

Further information

The course replaces MNXB01, Introduction to Programming and Computing for Scientists, 7.5 credits, and credits from that course cannot count towards a degree together with this course.

Knowledge of statistics is recommended, but is not a requirement.

The course is offered at the Department of Physics, Lund University.

Subcourses in MNXB11, Physics: Introduction to Programming and Computing for Scientists

Applies from H23

2301 Project, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction