Faculty of Science

NGEN25, Physical Geography: Algorithms and Data Structures in GIS, 7.5 credits

Naturgeografi: Algoritmer och datastrukturer i GIS, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2022-02-14 and was last revised on 2025-06-06 by The Education Board of Faculty of Science. The revised syllabus comes into effect 2025-06-06 and is valid from the spring semester 2026.

General information

The course is an elective course at second cycle level for a Degree of Master of Science (120 credits) in GIS and remote sensing and for a Degree of Master of Science (120 credits) in physical geography and ecosystem science, all specialisations.

Language of instruction: English

Main field of study	*Specialisation*
Physical Geography and Ecosystem Science	A1N, Second cycle, has only first-cycle course/s as entry requirements
Geomatics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

In the basic courses, the students have got familiar with basic theory of GIS and learnt to use GIS as a tool in geographic analyses. The aim of this course is to give the underlying mathematical and computer science theory to a GIS. This knowledge is necessary to evaluate the results of an analysis process and to carry out more advanced analyses where the tools not are available in a standard GIS software.

Knowledge and understanding

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

- explain the theory behind the basic algorithms for raster, vector and networks that are used in geographic information processing
- analyse spatial concepts, particularly all topological relations
- describe geometric data structures and data formats in 2D and 3D.

Competence and skills

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

- display competence to program basic algorithms that are used in geographic information processing
- structure and solve geometric problems
- process and analyse 2D and 3D spatial data within GIS environments and user-built tools
- carry out literature studies and write a summary of scientific articles in GIS.

Judgement and approach

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

- reflect on possibilities and limitations of choice of GIS software.

Course content

The course starts with geometric data structures that are used at storing and processing of geographic information in both 2D and 3D. This component also contains a description of spatial concepts, particularly topological relations.

The second part of the course treats the basic algorithms in GIS for vector, raster and network representations. The theoretical parts treat basic algorithm theory; some of these algorithms are implemented and applied during the practical exercises using a standard programming language. This part is the most central and largest component of the course.

The third part of the course is devoted to a project with focus on scientific writing that goes on during the whole course.

Course design

The teaching consists of computer exercises, lectures and project work. In the lecture sessions, the theory behind the algorithms is presented. Thereafter follows

programming exercises where the students should implement the algorithms. In parallel with lectures and exercises, a project in literature search and scientific writing is taking place. Participation in exercises, seminars, field work and study visits, and all associated elements, is compulsory.

Assessment

The assessment is based on a written exam at the end of the course and written presentations of exercises and project assignment throughout the course.

Students who do not pass the regular exam will have an additional opportunity to re-sit the exam soon thereafter.

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.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
For a Pass on the course, students must have passed the examination, the written assignments and project presentations, and participated in all compulsory components. The grading scale for the written examination and project work is Fail, Pass and Pass with distinction, while the grading scale for the exercises and assignments is Fail and Pass. The final grade for the course is determined by combining the results from the written examination and the project.

Entry requirements

Admission to the course requires 90 credits of studies in science or engineering, including knowledge equivalent to these two courses:

NGEA31, Geographic Information Gystems, basic course, 15 credits

NGEN20, Programming for applications in GIS and remote sensing, 15 credits.

English 6/B.

Further information

The course may not be included in a degree together with GISN07 Algoritmteori in GIS, 7.5 credits or NGEN06 Algorithms in geographic information processing, 7.5 credits.

The course is given by the Department of Earth and Environmental Sciences, Lund University.