Omics and Data-driven Precision Health, 4.5 credits

Omik och datadriven precisionshälsa, 4.5 hp

Third-cycle education course

8FO0153

Department of Biomedical and Clinical Sciences

Valid from: Second half-year 2025

Approved by
The Research and PhD studies Committee

Approved
2024-11-25

Registration number
LiU-2024-00225

Entry requirements

To be eligible for doctoral-level courses, applicants must meet at least one of the following criteria:

- Hold a degree at the advanced level.
- Have completed at least 240 higher education credits (HEC), of which at least 60 HEC must be at the advanced level.
- Have acquired equivalent knowledge in another way.

Specific information

Precision health, including precision medicine, aims to promote improved and more equitable health by utilizing data on an individual's biology, lifestyle, and environment to prevent diseases, maintain well-being, and enable targeted diagnostics and treatments.
"Omics," derived from the Greek word *ome* ("all" or "whole"), refers to the study of large-scale biological data in fields such as genomics, proteomics, and metabolomics to understand biological systems in their entirety and support the development of personalized healthcare.
This course is designed for doctoral students with an interest in omics technologies and explores how different omics fields contribute to strategies for personalized healthcare.

Learning outcomes

Upon completing the course, students are expected to achieve the following:

Knowledge and Understanding

- Describe the principles of AI applied to precision health and identify the challenges in healthcare that these technologies aim to address.
- Explain the roles of AI technologies in analyzing biomedical data for disease diagnostics, treatment optimization, and the development of personalized healthcare solutions.
- Understand and distinguish the capabilities and limitations of various AI and machine learning (ML) methods in the context of precision health, including supervised and unsupervised learning, neural networks, and deep learning.
- Explain the significance of multi-omics analysis in precision health and how AI technologies facilitate the interpretation of complex biological information.

Skills and Abilities

- Utilize advanced methods for integrating multi-omics data.
- Apply AI and ML methods to solve problems in precision medicine.
- Analyze and interpret biomedical data using AI-driven methods.

Critical Thinking and Approach

- Demonstrate a critical approach when selecting and applying AI and ML methods in biomedical research to ensure the reliability and validity of results.
- Discuss the ethical, legal, and social implications of using AI in healthcare, with a focus on privacy, data security, and equitable access to medical innovations.

Contents

"Omics and Data-Driven Precision Health" is an interdisciplinary course that bridges the gap between artificial intelligence (AI) and precision health, focusing on the application of AI and machine learning technologies that are transforming personalized healthcare.
The course content includes introductions to omics technologies and an overview of core AI and ML principles, such as supervised and unsupervised learning, neural networks, and deep learning. Additionally, the applications of AI and ML in multi-omics analysis and for disease diagnostics and treatment optimization will be discussed.
More specific course topics include:

- **Introduction to Omics Technologies:** Overview of the omics field and the development of omics technologies.
- **Principles of AI, ML, and Network Analysis:** Fundamental techniques and applications in AI and ML.
- **Translational Omics and Precision Health:** Focus on biomarkers and their role in precision health.
- **Applications of AI in Healthcare:** Examples of how AI can support diagnosis and treatment.
- **Ethical, Legal, and Social Aspects:** Discussion on ethical issues related to AI use in healthcare, including privacy and equality.
- **Practical Project and Data Analysis:** Hands-on experience through a group-based project involving omics data analysis.

Educational methods

At the Faculty of Medicine, student-centered and problem-based learning form the foundation of education. Students take responsibility for their own learning by actively engaging with learning tasks. The teacher's role is to support students in this process.
The teaching and learning methods in this course include lectures, seminars, and a group-based data analysis project.

Examination

The course assessment consists of individual written assignments, a mandatory group project with an oral presentation and active participation in seminars. Attendance at the presentation session is required for a passing grade.
Students who do not achieve a passing grade will be given one opportunity for re-examination shortly after the course ends. Additional examination opportunities will be available during future course offerings. The scope of the re-examination will be the same as that of the original examination.
Change of Examiner
A student who has failed the examination twice has the right to request a different examiner for a subsequent examination attempt unless there are special reasons preventing this.
Grading Scale
The grading scale for this course is Pass or Fail.

Grading

Two-grade scale

Course literature

A list of relevant literature will be provided by the course organizer approximately two weeks before the course starts.

General information

The planning and execution of the course must align with the course syllabus. Course evaluations, analyses, and proposals for general improvements will be reported to the Research and Doctoral Education Committee by the course coordinator.
If the course is discontinued or undergoes major changes, students will normally be offered examination opportunities under the current syllabus up to three times within the two semesters following the changes.