



DEPARTMENT OF CELL AND MOLECULAR BIOLOGY

C5F6080, Biologically Informed Neural Networks (BINNs): Principles and Practice, 1.5 credits (hec)

Biologiskt informerade neurala nätverk: Principer och praktik, 1,5 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by The Committee for Doctoral Education on 2025-08-29, and was last revised on 2025-09-02. The revised course syllabus is valid from spring semester 2026.

Responsible department

Department of Cell and Molecular Biology, Faculty of Medicine

Prerequisite courses, or equivalent

No prerequisite courses, or equivalent, demanded for this course. While prior experience in areas such as bioinformatics, statistics, or deep learning can be beneficial, the course is designed to provide the necessary background for students from diverse scientific disciplines.

Purpose & Intended learning outcomes

Purpose

The course aims to introduce PhD students to biologically informed neural networks (BINNs) as a framework for predictive and interpretative modeling in life science. It combines theoretical foundations with practical training, emphasizing the integration of biological network structures into neural network models, and strategies for managing challenges in biological data, based on illustrative examples from current research.

Intended learning outcomes

After completing this course, the participant is expected to be able to:

- Explain the principles, motivation, and applications of Biologically Informed Neural Networks (BINNs) in predictive and interpretative biological research.
- Apply core neural network concepts and architectures, including how biological network structure can be integrated into models.

- Retrieve, process, and visualize biological network data for use in BINNs.
- Recognize and address common challenges in biological data, such as high dimensionality, noise, and batch effects.
- Critically evaluate and interpret BINN performance using appropriate metrics, feature selection, and interpretation methods.
- Critically compare and evaluate BINN applications from current scientific literature.

Course content

The course introduces the principles, rationale, and applications of biologically informed neural networks (BINNs) in predictive and interpretative biological research. Core concepts and architectures of neural networks are covered, with a particular focus on methods for integrating biological network structures into computational models.

Participants will work with biological network data, learning how to retrieve, preprocess, and visualize such data for use in BINNs. The course also addresses common challenges in biological data, including high dimensionality, noise, and batch effects, and presents strategies to manage these issues.

Further, the course explores approaches for evaluating and interpreting BINN performance, including the use of suitable performance metrics, feature selection techniques, and interpretation methods. Finally, current applications of BINNs in scientific literature are reviewed and critically discussed, providing participants with insights into state-of-the-art research and practice in the field.

Forms of teaching and learning

The learning and teaching methods are based on active learning. These include: interactive lectures, discussions, computer practicals, with feedback sessions.

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

All course components are mandatory. Absence can be compensated in agreement with the course director.

Forms of assessment

Assesment will be performed with individual, computer based exercises, and a written reflection on the benefits and risks of applying this technology in life science.

Course literature

The recommended literature includes recent original-, and review articles and web based information sources.