FDD3499 Brain-like Computing 7.5 credits

Hjärnliknande beräkning

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FDD3499 valid from Spring 2017

Grading scale

Education cycle

Third cycle

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

On completion of the course, the students should be able to:
â€¢ differentiate and discuss alternative computational paradigms critically from a the perspective of physicists, mathematicians and computer scientists

â€¢ contrast the conventional von Neumann architecture of computation and the neural hardware as well as discuss the implications of the hardware of the brain for information processing
â€¢ describe and contrast the most important prevailing hypotheses respect neural information processing, encoding and representation in the brain.
â€¢ list important computation building blocks (motives) in the neural infrastructure for information processing and explain their function in the brain; discuss the relation structure function in the light of the recent literature
â€¢ explain the nature of multi-scale brain organisation and discuss the implications for studies on the computational aspects of information processing in the brain
â€¢ categorise and illustrate general learning strategies that are discussed in the brain science (examine the most influential hypotheses), analyse them at different levels of description of brain function
â€¢ associate neural learning strategies with specific concepts in statistically learning theory, explain theoretical concepts and illustrate with learning algorithms in machine learning and artificial networks
â€¢ recognise, analyse and discuss computational aspects critically theories, ideas that have been brought up in the selected neuro-scientific literature; evaluate biological proofs synthetically and assess its relevance for the design of biomimetic systems
â€¢ discuss implications to use brain-like systems in the reality, give examples of emerging application fields and relate to existing machine learning solutions
â€¢ summarise current trends in neuromorphic hardware, neurally inspired machine learning, deep neural networks.

Course contents

The course is concentrated around the following subjects:
â€¢ the computational infrastructure of the brain: fundamental components in neural hardware are introduced, important hypotheses about neural information coding and prototypical functional units be discussed
â€¢ learning mechanisms and paradigms in neural systems
â€¢ similarities and differences between the solutions of the brain and the most prominent calculation methods for data representation, feature extraction, inference, pattern recognition in complex scenarios and challenging environments: the course is based on parallels between the setting of today to â€□ machine intelligenceâ€□ and the vision that is offered of brain-like computational paradigms
â€¢ the future and main R&D-riktningarna in the area for brain inspired computing/calculation, the emerging challenges and the application fields: the course has a strong drawing to understand current limitations and see the need of future development as well as their nuanced implications.

Course literature

Scientific articles and chosen chapters from different books (all available in on-line version).

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

To pass, it is required that the course participant completes all parts of the examination:
- participation in at least 80% of meetings
- implementation of a presentation and management of a discussion in a subject that has been chosen based on available literature (group assignment)
- submission of written assignment- thesis in selected subject (group assignment)
- writing a peer review of chosen thesis (individual work)

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.