UNIVERSITY OF BORÅS

Machine learning and Neural Networks
Maskininlärning och neurala nätverk
7.5 credits

Ladok Code: A287TG
Version: 4.0
Established by: Committee for Education in Technology 2021-11-12
Valid from: Spring 2022

Education Cycle: First cycle
Main Field of Study (Progressive Specialisation): Computer Engineering (G1F)
Disciplinary Domain: Technology
Prerequisites: Admission requirements for Bachelor of Science in Engineering program, including completed courses in Mathematical Analysis 1, Mathematical Analysis 2, Linear Algebra, and Basic Python Programming.
Subject Area: Computer Technology
Grading Scale: Fail (U) or Pass (G)

Content
This course provides an introduction to the application of machine learning and neural networks in developing applications for embedded systems. The course consists of two parts: theoretical lectures and practical computer exercises.

The theoretical part covers computer science fundamentals, Python programming, processor architectures (CPU, GPU, TPU, and NPU), machine learning, classification algorithms (e.g., Naive Bayes), neural networks (ANN, CNN, DNN), and the backpropagation algorithm. Topics include gradient-based optimization with concepts like penalty functions and Sequential Quadratic Programming (SQP).

The practical component demonstrates typical machine learning examples such as signal analysis, general property modeling, and pattern recognition. Exercises are conducted in Python using computers with GPU cores to practice parallelized programming.

Learning Outcomes
Knowledge and Understanding
1.1 Explain fundamental computer science concepts in machine learning and neural networks.
1.2 Describe the differences between CPU, GPU, TPU, and NPU.
1.3 Explain how CPU and GPU handle computations in parallelized programming.

Skills and Abilities
2.1 Program classification functions.
2.2 Program neural networks.
2.3 Apply training data to train neural networks.
2.4 Systematically assess and evaluate the performance of neural networks.
2.5 Present a structured system overview of how classification functions and neural networks work.

Evaluation and Judgment
3.1 Evaluate whether a trained neural network meets specified convergence requirements.
3.2 Assess the reasonableness of training results.

Forms of Teaching
The course consists of lectures and exercises using Python software.

The language of instruction is Swedish. However, instruction in English may occur.

Forms of Examination

The course is assessed through the following assignments:
Assignment 1
Learning Outcomes: 1.1–1.3, 2.1, 3.1–3.2
Credits: 1

Assignment 2
Learning Outcomes: 1.1–1.3, 2.1, 3.1–3.2
Credits: 1.5

Assignment 3
Learning Outcomes: 1.1–1.3, 2.1, 3.1–3.2
Credits: 1

Assignment 4
Learning Outcomes: 1.1–1.3, 2.1, 3.1–3.2
Credits: 1.5

Assignment 5
Learning Outcomes: 1.1–1.3, 2.1, 3.1–3.2
Credits: 1

Assignment 6
Learning Outcomes: 1.1–1.3, 2.1, 3.1–3.2
Credits: 1.5

If the student has received a decision/recommendation regarding special pedagogical support from the University of Borås due to disability or special needs, the examiner has the right to make accommodations when it comes to examination. The examiner must, based on the objectives of the course syllabus, determine whether the examination can be adapted in accordance with the decision/recommendation.

Student rights and obligations at examination are in accordance with guidelines and rules for the University of Borås.

Literature and Other Teaching Materials

Required Literature:
Bengtsson, M. The AI Revolution: Demystifying Machine Learning and Neural Networks, compendium, Borås Student Bookstore.

Supplementary Material:
Materials distributed during the course.

All presented material during lectures, including recorded sessions available via the university’s learning platform.

Student Influence and Evaluation

The course is evaluated in accordance with current guidelines for course evaluations at the University of Borås in which students' views are to be gathered. The course evaluation report is published and returned to participating and prospective students in accordance with the above-mentioned guidelines, and will be taken into consideration in the future development of courses and education programmes. Course coordinators are responsible for ensuring that the evaluations are conducted as described above.

Miscellaneous

This course is part of the Mechanical Engineering and IT Engineering programs.
The course builds on and further develops knowledge from courses in Mathematical Analysis 1 and 2, Linear Algebra, and Basic Python Programming.