Course syllabus

Maskininlärning för energiingenjörer
Machine Learning for Energy Engineers

MVKP30, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED M
Date of Decision: 2023-04-11

General Information

Main field: Sustainable Energy Engineering.
Elective for: E4-em, M5, W5-et, MHET2
Language of instruction: The course will be given in English

Aim

Digital systems exist in all aspects of our lives. Digital tools will play a crucial role in creating resource-efficient energy systems and leading to more efficient energy and climate change. Digital technologies and methods such as machine learning and data regression can today be used to forecast future energy needs of both customers and energy producers. Forecasting future energy needs is the basis for being able to solve flexibility issues in the electricity market and thus utilize the volatile energy sources solar and wind in the best possible way. The digital systems and smart solutions produce a large amount of data for each energy process where data is collected. This course therefore studies how this collected data can be used to create a more sustainable energy system. The course provides knowledge of machine learning and neural networks with a focus on energy technology and to evaluate their advantages and disadvantages in applications.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- Understand the function of the most common sensors in energy systems and how they communicate.
- Identify energy technology problems that can be handled with methods for data extraction.
- Describe different methods and present pros and cons.
- Have basic knowledge of society's view of integrity regarding data management.
- Have basic knowledge of ethical aspects of machine learning and data processing.

Competences and skills
For a passing grade the student must

- be able to use existing tools in machine learning and regression to solve energy technical problems.
- use neural networks and machine learning on energy technology data and systems

Judgement and approach
For a passing grade the student must

- Analyze a standard problem in energy technology and determine which method or methods are most suitable to solve the problem.
- Identify difficulties and requirements regarding energy technical problems and seek new alternative solutions to problems.
- understand ethical perspectives to the data collection that is done in the current problem.

Contents

The course consists of major projects to be solved in groups. The course also deals with

- sensors and data communication
- unsupervised and supervised learning, classification and regression
- neural networks
- ethical aspects of data collection (integrity issues)

Examination details

Grading scale: UG - (U,G) - (Fail, Pass)
Assessment: The examination takes place both individually and based on group work. Three laboratory sessions and three project assignments are the basis for the entire course and include computer work and reports. The laboratory tasks are carried out individually. The compulsory project assignments are carried out in groups and are presented both in writing in the form of a report and orally at a seminar, where all group members must participate actively. The project tasks are based directly on the laboratory tasks, which is why the laboratory tasks are carried out before a new project task can begin. For a passing grade on the course, all these parts must be passed. The subsequent, optional, written exam enables grades 4 or 5. If this is required for a student with a permanent disability to be given an equivalent

examination alternative compared with a student without a disability, the examiner may, after consultation with the university's department for pedagogical support, decide on an alternative examination form for the student concerned.

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.

Admission

Assumed prior knowledge: EDAA65 Programming, first course, FMSF55 Mathematical statistics, basic course, MMVF01 Thermodynamics and Fluid Mechanics or MMVN10 Fluid Mechanics.
The number of participants is limited to: No

Contact and other information

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Examinator: Per Tunestål, per.tunestal@energy.lth.se
Course homepage: https://www.energy.lth.se/english/education/
Further information: The course contains lectures, exercises, computer exercises, guest lectures and study visits.