FEN3251 Computer Applications in Power Systems, graduate course 9.0 credits

Datortillämpningar i elkraftsystemet, doktorandkurs

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 FEN3251 valid from Spring 2017

Grading scale

Education cycle

Third cycle

Specific prerequisites

Admitted to PhD program at KTH.

Language of instruction

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

Intended learning outcomes

After completing the course the student should be able to:

· Create algorithms for data capture and cleaning from heterogeneous data sources using statistical tools.

· Develop and validate Decision Tree algorithms with application to power system problems

· Develop algorithms for forecasting of production of renewables (wind, PV) using statistical methods and data based methods such as ANN.

· Explain differences between chosen algorithms for forecasting including aspects of data availability and forecasting accuracy.

· Given a power system problems, and appropriate test data to develop a function of machine learning that leaves decision within example one of the following areas.

o Pattern recognition in consumption or generation profiles

o Prediction of production from renewable energy sources like wind power or solar panels

o Analysis of fault scenario using the phase angle measurements.

o Implement appropriate solution in software and visualize the results.

Course contents

The course consists of an introductory reading part covering classification problems and regression problems, statistical methods such as kNN, Artifical Neural Networks and Decision trees. These topics are divided into three separate study blocks, for each study block there are 2-3 lectures, and 1-2 seminars. The study blocks are:

Study Block 1 - Statistical Methods

The topic includes basic statistical tools for data analysis and pre-processing of data. In addition, distance based methods such as Nearest Neighbour and other non supervised learning techniques are covered.

Study Block 2 - Artificial Neural Networks

The topic covers design and optimisation of learning in ANN single and multilayer networks. Methods for optimisation and learning such as Kohonen feature maps are also included. In addition, methods for structured search in problem spaces are covered in this study block.

Study Block 3 - Decision Trees

Analysis of problems and design of Decision Trees for classification and regression is covered in this study block. Methods for optimal splitting and validation are included.

The individual project is consists of 4,5 ECTS credits and involves developing a decision support application that utilizes machine learning techniques. The project shall at least

consist of identification of topic, reading of related work on application of machine learning techniques to the problem, gathering and cleaning of data needed for the application, selection of suitable machine learning approach, development of solution and documentation of the solution in the form of a conference paper suitable for an entry level conference focused on applications such as IEEE ISGT or similar.

Disposition

The course is conducted as a sequence of three study blocks, followed by an individual project. For each study block there is one introductory lecture to start the study block, thereafter 1-2 lectures for presentation of content of the literature for the study block. Thereafter, the students work in groups on problems in the domain. As a conclusion to each study block, there is an individual presentation by each participating student on one or two key concepts from the course literature. Each study block represents 1 week of full time work, 1,5 ECTS credits. The Study blocks normally cover one full study period, and require attendance by participating students.

The course is concluded with a individual project representing 4,5 ECTS credits. The individual project need not be coordinated with other students of the course. However, all students of a course round must participate in presentation of other student' projects however.

In total, the course contains 4-6 lectures and an approximate number of 6-9 seminars.

Course literature

Automatic Learning techniques in Power Systems, L Vehekel

Study Block 1 – Chapters 1-3 and 6

Study Block 2 Chapters 1 and 4

Study block 3 – Chapter 1 and 5

For the individual project, the examples provided in chapters 7-10 of the course book provide a good starting point.

In addition to the course book, additional reading material will be provided during the lectures at each of the study blocks.

Equipment

None.

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

Pass all Study Blocks by completing the individual project, including an individual presentation and a final report, both of which are to be approved by the examiner.

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.