UCL Faculté des sciences appliquées

FSA

ELEC2870 ARTIFICIAL NEURAL NETWORKS

[30h+30h exercises] 5 credits

This course is taught in the 1st semester

Teacher(s): Michel Verleysen
Language: french
Level: 2nd cycle course

Aims

To analyse and use efficiently "artificial neural networks", a set of nonlinear modeling tools, in the field of information, data and signal analysis.

Content and teaching methods

Artificial neural networks are nonlinear modeling tools based on the concept of learning. They are used to model processes that are too complet to be handled by physical models, or to analyze data for which the underlying process is unknown. Artificial neural networks are used in various domains such as information processing, pattern recognition, image, speech and time series analysis, or control. Most artificial neural networks are adaptive methods, i.e. they are able to adapt the model according to a time-varying environment.
The course describes the main artificial neural network models, mostly from an algorithmic point of view. The interest of such nonlinear tools with regards to classical linear ones is emphasized, as well as the precautions to take for using and evaluating the models, and their typical applications
After an introduction on the biological and historical origins of artificial neural networks, generic principles are presented : learning, generalilzation-prediction, distributed memory, classification, regression, curse of dimensionality etc.
The course then presents a large (but non exhaustive) set of nonlinear analysis models called "artificial neural networks". The main models covered are the following :
- single-layer models (adaline, perceptron, associative memory)
- multi-layer perceptrons (MLP)
- radial-basis function networks (RBFN)
- support vector machines (SVM)
- vector quantization (Lloyd, LVQ, etc.)
- self-organization (Kohonen maps)
- probability density estimation
- blind source separation
- non-linear projection

Models are studied from the algorithmic point of view, insisting on the important side-questions :
- initialization
- gradient descent methods (conjugated gradients, etc.)
- evaluation methods (bootstrap, cross-validation, leve-one-out, etc.)

The models are used for data analysis (classificatin, approximation), identification, signal processing and time series prediction.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Teaching method :
Students learn how the methods work by programming them in the MATLAB environment. A project makes them learn how to solve a problem from its formulation to the critical evaluation of its results, through the choice of algorithmic methods, their programming, their implementation, and the planning of a realistic set of experiences avoiding prohibitive computation times.
Assessment :
Evaluation in session, of a work made during the year. Students may present again the work if they present again the examination.

Other credits in programs

ELEC23	Troisième année du programme conduisant au grade d'ingénieur civil électricien	(5 credits)
ELME23/M	Troisième année du programme conduisant au grade d'ingénieur civil électro-mécanicien (mécatronique)	(5 credits)
FSA3DS/TO	Diplôme d'études spécialisées en sciences appliquées (automatique)	(5 credits)
INFO22	Deuxième année du programme conduisant au grade d'ingénieur civil informaticien	(5 credits)
INFO23	Troisième année du programme conduisant au grade d'ingénieur civil informaticien	(5 credits)
MAP23	Troisième année du programme conduisant au grade d'ingénieur civil en mathématiques appliquées	(5 credits)
MATR23	Troisième année du programme conduisant au grade d'ingénieur civil en science des matériaux	(5 credits)
MECA23	Troisième année du programme conduisant au grade d'ingénieur civil mécanicien	(5 credits)
STAT3DA/P	diplôme d'études approfondies en statistique (pratique de la statistique)	(10 credits)