EE-612

Fundamentals in statistical pattern recognition

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Cursus	Sem.	Type
Electrical Engineering		Obl.

Language of teaching	English
Credits	4
Session	
Exam	Multiple
Workload	120h
Hours	**56**
Courses	36
TP	20
Number of positions	**30**

Frequency

Every 2 years

Remark

Every 2 years. Next time: Spring 2019

Summary

This course provides in-depth understanding of the most fundamental algorithms in statistical pattern recognition as well as concrete tools (as source code) to PhD students for their work. It will cover regression, classification (MLP, SVM) and probability distribution modeling (k-Means, GMM, HMM).

Content

Learning outcomes: this course provides in-depth understanding in Statistical Pattern Recognition as well as concrete tools to PhD students for their work. This course could serve as a pre-requisite for more advanced courses such as Machine Learning, Graphical Models, Statistical Sequence Processing and Computational perception using multimodal sensors.

1. Introduction
- Data representation
- Supervised/unsupervised models (from regression and classification to probability distribution modelling)
- Overview: Linear models, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Multi-Layered Perceptron (MLP), Support Vector Machines (SVM), k-Means, Gaussian Mixture Models (GMM) Hidden Markov Models (HMM), Session Variability Modelling (Joint Factor Analysis) and Total Variability Modelling (iVectors), Probabilistic Linear Discriminant Analysis (PLDA)
- Connection to other EPFL courses
- Evaluation methodologies and performance measures (precision, recall, FA, FR, EER, HTER, MSE, ROC, AUC, DCF, DET, EPC)
- Hypothesis testing and statistical significance

2. Classification and regression
- Application examples (digit recognition, face detection)
- k-Nearest Neighbors (k-NN)
- Linear Regression (univariate and multivariate) and the Gradient descent
- Logistic Linear Regression
- Multi-Layered Perceptron (MLP) and the BackPropagation
- Support Vector Machines (SVM)

3. Dimensionality reduction and clustering
- Application examples (data analysis and texture recognition)
- k-Means
- Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA)

4. Probability distribution modelling
- Application examples (speech recognition and biometrics)

- Histograms
- Gaussian Mixture Models (GMM) and the Expectation-Maximisation (EM) algorithm
- Hidden Markov Models (HMM)

Keywords

Pattern Recognition, Machine Learning, Linear models, PCA, LDA, MLP, SVM, GMM, HMM.

Learning Prerequisites

Recommended courses

Linear algebra, Probabilities and Statistics, Signal Processing, Python (for the Labs).

Assessment methods

Project report and oral presentation.

Resources

Websites

- http://www.idiap.ch/~marcel/professional/Lectures_and_Labs.html