DH-406

Signal processing and machine learning for DH

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Cursus	Sem.	Type
Digital Humanities	MA1, MA3	Obl.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
TP	2 weekly
Number of positions	

Summary

This course aims to introduce the basic principles of signal processing and machine learning in the context of the digital humanities. Exercises, numerical examples and computer sessions will allow the students to acquire a practical understanding of the techniques studied in class.

Content

Signal Processing

1. Sampling & quantization: Bringing the data to the digital world.
2. Noise, features, and models: Beyond good and evil data.
3. Tools for feature extraction: Obtaining data that makes sense.

Machine Learning

1. Supervised regression: Linear models, kernel methods.
2. Supervised classification: Linear models, kernel methods, deep learning.
3. Unsupervised learning: Dimensionality reduction, clustering, topic models.

Keywords

Signal processing, sampling and quantization, spectral analysis, feature extraction, machine learning, digital humanities, supervised and unsupervised learning.

Learning Prerequisites

Required courses

Programming, Linear algebra, Calculus, Probability and Statistics (*e.g.*, Probabilities and statistics MATH-232 or Stochastic Models in Communications COM-300).

Learning Outcomes

By the end of the course, the student must be able to:

- Develop appropriate models for measured signals/data
- Choose the appropriate tool for feature extraction
- Interpret the time and frequency content of signals/data
- Assess / Evaluate the advantages and limitations of different signal processing tools for a given problem
- Derive the supervised and unsupervised learning techniques studied in class
- Choose an appropriate learning algorithm for a given problem
- Develop basic supervised and unsupervised learning models
- Assess / Evaluate the advantages and limitations of different machine learning algorithms

Teaching methods

Ex cathedra with exercises, numerical examples, computer sessions.

Expected student activities

Attendance at lectures, completing exercises, testing presented methods with a mathematical computing language (Matlab or similar).

Assessment methods

Final exam with both theoretical and practical problems.

Supervision

Office hours	Yes
Assistants	No
Forum	Yes

Resources

Bibliography

- P. Prandoni, Signal Processing for Communications, EPFL Press (http://www.sp4comm.org/docs/sp4comm_corrected.pdf);
- A.V. Oppenheim, R.W. Schafer, Discrete Time Signal Processing, Prentice Hall, 1989;
- B. Porat, A Course in Digital Signal Processing, John Wiley & Sons,1997;
- C.T. Chen, Digital Signal Processing, Oxford University Press;
- D. P. Bertsekas, J. N. Tsitsiklis, Introduction to Probability, Athena Scientific, 2002 (excellent book on probability);
- Max Welling, A First Encounter with Machine Learning (https://www.ics.uci.edu/~welling/teaching/ICS273Afall11/IntroMLBook.pdf);
- Christopher M. Bishop, Pattern Recognition and Machine Learning.

Ressources en bibliothèque

- Signal processing for communications / Paolo Prandoni, Martin Vetterli
- Discrete-time signal processing / Alan V. Oppenheim, Ronald W. Schafer
- A course in digital signal processing / Boaz Porat
- Digital signal processing : spectral computation and filter design / Chi-Tsong Chen
- Introduction to probability / Dimitri P. Bertsekas and John N. Tsitsiklis
- A First Encounter with Machine Learning / Max Welling
- Pattern recognition and machine learning / Christopher M. Bishop

Notes/Handbook

Course slides