

Titre / Title	Applied machine learning (MICRO-455)
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Enseignant(s) / Instructor(s)	Billard Aude: MT, De Chambrier Guillaume Pierre Luc: , Rey Joël: , Shukla Ashwini: , Sommer Nicolas:	Langue / Language	EN
Programme(s) Période(s)		Nombre d'heures / Number of hours	Spéc / filière /orient
Génie électrique et électronique (2013-2014, Master semestre 1)		C: 3 H hebdo	A B opt
Génie électrique et électronique (2013-2014, Master semestre 3)		C: 3 H hebdo	A B opt
Microtechnique (2013-2014, Master semestre 1)		C: 3 H hebdo	D obl
Microtechnique (2013-2014, Master semestre 3)		C: 3 H hebdo	D obl

Résultats d'apprentissage:

Real-world engineering applications must cope with a large dataset of dynamic variables, which cannot be well approximated by classical or deterministic models. This course will give an overview of a number of alternative methods from Machine Learning that have been proven successful for the analysis of non-linear, highly noisy and correlated data. Students will familiarize themselves with each method through short hands-on practical.

Objectifs d'apprentissage:

Controlling complex systems (e.g. controlling high-degrees of freedom autonomous robots, analyzing multimodal signals) requires methods to deal with a large dataset of dynamic variables, which cannot be well approximated by classical or deterministic models. This course will give an overview of a number of alternative methods from Machine Learning that have been proven successful for the analysis of non-linear, highly noisy and correlated data. Students will familiarize themselves with each method through short hands-on practical. The course will be evaluated through a final exam (50% grade) and through the reports following each practical (50% grade).

Contenu:

- Discrete, Hierarchical and Bayesian Classifiers: K-means, soft K-means, Mixture of Gaussians, EM-
- Statistical Decomposition of Signals: PCA, ICA
- Non-linear Regression: Support Vector Regression, Gaussian Mixture Regression
- Artificial Neural Networks and Genetic Algorithms
- Markov-Based Techniques for Time Series Analysis: Hidden Markov Models, Reinforcement Learning

Prérequis:

Programming in C/C++, Linear Algebra, Probability and Statistics

Forme d'enseignement:

Ex-cathedra, practicals

Forme du contrôle:

Written exam (50% grade), practicals (50% grade).

Bibliographie et matériel:

The course is accompanied by lecture notes entitled "Machine Learning Techniques" by Aude Billard. These are available at the librairie polytechnique and students should purchase these before the start of the class.

Other recommended textbooks:

- Machine Learning, Tom Mitchell, McGraw Hill, 1997.
- Cluster Analysis, Copyright StatSoft, Inc., 1984-2004
- Pattern Classification Richard O. Duda, Peter E. Hart, David G. Stork,
- Information Theory, Inference and Learning Algorithms, David J.C Mackay, Cambridge University Press, 2003.
- Independent Component Analysis, A. Hyvarinen, J. Karhunen and E. Oja, Wiley Inter-Sciences. 2001.
- Artificial Neural Networks and Information Theory, Colin Fyfe, Tech. Report, Dept. of Computing and Infotion Science, The University of Paisley, 2000.
- Neural Networks, Simon Haykin, Prentice Hall International Editions, 1994.
- Self-Organizing Maps, Teuvo Kohonen, Springer Series in Information Sciences, 30, Springer. 2001

En bibliothèque / in libraries :

(cliquez sur le lien pour consulter les informations du réseau de bibliothèque suisse / click on the link to consult information of the Swiss network of libraries)

[Independent component analysis / Aapo Hyvärinen, Juha Karhunen, Erkki Oja, 2001](http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-471-40540-X)

(http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-471-40540-X)

[Information theory, inference and learning algorithms / David J.C. MacKay, 2001](http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-521-64298-1)

(http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-521-64298-1)

[Machine Learning / Tom M. Mitchell, 1997](http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-07-042807-7) (http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-07-042807-7)

[Neural networks : a comprehensive foundation / Simon Haykin, 2007](http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=978-0-13-147139-9)

(http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=978-0-13-147139-9)

[Pattern classification / Richard O. Duda, Peter E. Hart, David G. Stork, 2001](http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-471-05669-3)

(http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=0-471-05669-3)

Matière examinée / subjects examined	Session	Coefficient / Crédits ECTS	Forme de l'examen / Type of examination
Applied machine learning	HIV	3	Ecrit

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[Self-organizing maps / Teuvo Kohonen, 2001](#)

(http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=3-540-67921-9)

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