



UNIVERSITÀ DI PISA  
**DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE**  
**Dottorato di Ricerca in Ingegneria dell'Informazione**

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Doctoral Course

**“Advanced Machine Learning”**

Prof. Frederic PASCAL

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**Short Abstract:**

This course is an advanced course focusing on the intersection of Statistics and Machine Learning. The goal is to study modern statistical methods for supervised and unsupervised learning, and the underlying theory for those methods. Numerous illustrations in the context of signal / image processing will be provided. The students are expected to have basic knowledge of:

- linear algebra
- functional analysis.
- basic probabilities concepts
- foundations of machine learning concepts.

**Course Contents in brief:**

- Reminders on multivariate statistics: ML, Bayesian theory, hypothesis testing, linear regression;
- Robust theory: robust estimation, robust regression approaches;
- Clustering: hierarchical clustering, DBSCAN, HDBSCAN algorithms;
- Mixture models: GMM and more general distributions mixture, distribution fitting, parameters estimation, EM algorithms;
- Model selection;
- Applications to image and signal processing;

**Total # of hours of lecture:** 20hrs

**References:**

- [1] James, G., Witten, D., Hastie, T. and Tibshirani, R. (2013) An Introduction to Statistical Learning, with Applications in R. Springer.

- [2] Hastie, T., Tibshirani, R. and Friedman, J. (2009) The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second edition. Springer.
- [3] C. M. Bishop (2006). Pattern Recognition and Machine Learning. Springer.

### **CV of the Teacher**

See the attached CV

### **Room and Schedule**

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule: TBD

Day1 – time

Day2 – time

Day3 – time