



# Graph and Statistical Machine Learning

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**Type of projects:** Research

**Team:** Machine Learning and Massive Data Analysis (MLMDA)

**Lab:** Centre Borelli, ENS Paris-Saclay, Gif-sur-Yvette

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**:: a (complete!) panorama of (some!) subjects ::**

## 1) Graph representation learning

In this “box”, there are problems related to vector representations of graph nodes (embeddings), contrastive learning, building efficient graph operators, graph neural networks,...

## 2) $f$ -divergences in machine learning

This fundamental problem is about estimating the “divergence” between two probability measures or density functions. This can be done by estimating the likelihood-ratio of the two assumed probability models. This has several applications both in standard and graph machine learning contexts.

## 3) Statistical testing in high-dimensions

In this “box”, there are problems of two-sample, paired-sample, and one-sample homogeneity testing for high dimensional data where most standard tests fail. Homogeneity testing has also applications in data clustering.

## 4) Change-point detection in graph streams

Offline segmentation of a stream where a different graph appears at each timestamp.

## 5) Processes over networks

This “box” contains problems related to network security, e.g. designing online/offline protection strategies against diffusion processes, or modeling and inference of agents’ interactions.

## 6) Interpretable machine learning models

This is related to the principle of building local interpretable model proxies in order to understand complicated or black box models (see LIME framework, M.T. Ribeiro et al. KDD 2016).

## 7) Graph machine learning for the prediction of time-series on graphs

This is in collaboration with EDF, and it is about predicting energy consumption.

**Further discussion:** The above give a number of selected directions and their perimeters. The final subject will be the result of the exchanges with each interested student. We will be happy if you want to come and visit Centre Borelli. Contact Argyris Kalogeratos to set a meeting.