UNIVERSITÉ DE NEUCHÂTEL

# Practical introduction to Machine Learning and Deep Learning

## Course description

This 5 days course aims to provide basic understanding of the most used machine learning and deep learning algorithms. It is an intensive course that, without going into too much mathematical details, provides the necessary foundations to start testing, working with and evaluating those algorithms. The topics covered are: regression (linear, logistic), classification (K-NN), dimensionality reduction (PCA), support vector machines, clustering (K-means), decision trees, Bayesian learning, neural networks, deep neural networks (CNN, RNN and LSTM), data cleaning, models' evaluation and features selection.

## Participants profiles

This course would benefit:

- Big data and business intelligence technicians
- Business analysts
- Big data and business intelligence project managers
- Students from universities and schools of applied sciences at master level or higher

The course is nevertheless open to other profiles of professionals and academics interested in discovering machine learning and deep learning and how they can be applied in their domain.

## Outcomes

By the end of the course, participants should be able to:

- Categorize the different machine learning and deep learning algorithms and identify when each can be used
- Explain and use linear and logistic regression methods
- Explain and use the K-NN classification method
- Explain and use the PCA algorithm for dimensionality reduction
- Explain and use K-means clustering algorithm
- Explain and use decision trees
- Explain and use Bayesian learning
- Explain and use artificial neural networks
- Explain and use CNN, RNN, LSTM and other deep learning methods
- Evaluate learning models
- Select the most efficient features for the learning problem at hand

## Language

This course is taught in English.

## Certificates

Upon successful completion of the course, the participants will be awarded with a **Certificate of Completion** issued by the Faculty of Economics and Business of the University of Neuchâtel.

## Organization and Instructors

This course is organized by the Information Management Institute at the Faculty of Economics and Business, University of Neuchâtel.


| **Academic director:** | **Program coordinator and contact person:** |
|---|---|
| Prof. Paul Cotofrei<br>Associate Professor<br>Information Management Institute<br>University of Neuchâtel<br>paul.cotofrei@unine.ch<br>032 718 13 78 | Eliane Maalouf<br>PhD candidate – Teaching Assistant<br>Information Management Institute<br>University of Neuchâtel<br>eliane.maalouf@unine.ch<br>032 718 13 29 |


## Detailed program

| **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** |
|---|---|---|---|---|
| Data preparation, cleaning, outliers (1h) (**EM)** | Dimensionality reduction, PCA (1h) (**JS)** | Features selection (1h) (**JS)** | Foundations for NN (2h) (**ML)** | RNN (1.5h) (**ML)** |
| Linear regression: simple and multivariate (2h) (**EM)** | Bayesian learning (2h) (**JS)** | Support Vector Machine (2h) (**JS)** | Neural Networks (1h) (**ML)** | LSTM (1.5h) (**ML)** |
| Lunch break (1h) | Lunch break (1h) | Lunch break (1h) | Lunch break (1h) | Lunch break (1h) |
| Logistic Regression (2h) (**EM)** | Decision trees (2h) (**JS)** | Clustering, K-means (2h) (**JS)** | Motivation for DL, CNN (1h) (**ML)** | Applications and examples (2h) (**ML)** |
| Classification, K-NN (2h) (**JS)** | Models evaluation (2h) (**JS)** | Introduction to Neural Nets and DL (2h) (**ML)** | Advanced architectures, Transfer learning, one-shot, zero shot (3h) (**ML)** | Practical requirements, activation functions, useful tricks, conclusion (2h) (**ML)** |

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## Prerequisites

Given the density of the course no introduction to programming nor to mathematics can be provided. Participants are expected to:

- Use their personal computers during the course. The participants need to guarantee they have all administration rights on their machines in order to install and use the necessary tools during the course.
- Be familiar with the use of R and Python. The level of knowledge required in both is basic, mainly about the basic data structures in each (tables, lists, numbers, strings, etc.), calling predefined functions, importing and loading libraries in R and modules in Python. Exercises in the course are mainly application exercises and no coding from scratch would be required.
- Even though the course won't go too much in details into the mathematical foundations of the algorithms, basic familiarity with matrices, vectors, matrices operations, derivatives, some probability and statistical concepts are good to have in order to benefit the most from the covered concepts.

Some resources to help you prepare or to further your knowledge:

- Python tutorial: https://docs.python.org/3/tutorial/
- Python Numpy documentation: https://docs.scipy.org/doc/
- Introduction to R: https://cran.r-project.org/doc/manuals/R-intro.html
- Introduction to probability and data: https://www.coursera.org/learn/probability-intro
- Inferential statistics: https://www.coursera.org/learn/inferential-statistics-intro
- Visualizing NN learning: https://www.tensorflow.org/get_started/summaries_and_tensorboard

**Note**: An R and Python crash course can be provided on Friday afternoon before the beginning of the course on Monday.