

## 3<sup>th</sup> engineering year – MAM5 – SD Option

### SD educational model

The courses taught in the 5th year are grouped into seven teaching units. Five units include scientific courses that strengthen the student's skills in applied mathematics and computer science. The "industrial" (or professional) teaching units are designed to introduce application issues using the knowledge base acquired during the training. The topics covered are those of data science. As during each semester of the engineering cycle, a SHES unit allows the student to strengthen their management skills.

### 1<sup>er</sup> SD semester (S9)

#### Technological foundations of data science:

- **Big Data Technologies**

This course focuses on distributed storage and processing of massive data. It studies in particular Hadoop and Spark environments. Students will discover the Scala language and the main Spark libraries. They will learn how to use NoSQL databases and perform advanced data analysis in a distributed environment.

- **Data Science**

This course provides an introduction to data science through different applications. It relies in particular on data analysis tools developed and used by the IBM company. It also focuses on the most relevant Python libraries in the field of data science.

- **Artificial Intelligence Engineering**

The objective of this course is therefore to strengthen the knowledge of tomorrow's engineers around the issues of operationalizing AI in production, with regard to the needs, constraints and demanding processes of today's industry. The ambition of this course is to provide students with: awareness of MLOps and DataOps methodologies so that they can apply them to simple examples, better knowledge of cloud native environments and technologies, good visibility of the complete life cycle of a Machine Learning application, with CI/CD, technical monitoring and business monitoring, some notions around sensitivity, security, encryption and data isolation.

#### Deep learning and its applications:

- **Advanced Topics in Deep Learning**

This course focuses on the most advanced techniques in deep learning. In particular, it studies the ability of a neural network to model and estimate a multidimensional function. It focuses on the convergence of the gradient algorithm for training a neural network, the structural properties of convolutional networks and

to neural networks applied to the graph. It also considers the statistical foundations of variational autoencoders. Finally, it studies the theoretical aspects of the explainability of neural networks. Many applications with the Pytorch library allow to put into practice the theoretical concepts studied.

- **Deep Learning**

This course provides an introduction to deep neural networks. It provides a comprehensive overview of neural networks: deep, convolutional, recurrent, adversarial, and generative. It also provides an introduction to tools commonly used by practitioners. A significant portion of the course is devoted to practical case studies on computers, using Jupiter notebooks. Specifically, students will study image categorization, semantic image segmentation, and speech recognition.

- **Text mining and Natural Language Processing**

This course focuses on automatic processing and analysis of textual data and, more generally, on natural language processing. It involves studying the most recent techniques with an emphasis on deep learning, recurrent neural networks and transformers. Numerous applications with the Pytorch language allow the theoretical concepts studied to be put into practice.

## **Multidimensional data processing:**

- **Advanced Data Mining**

This course will present various multidimensional data mining techniques as well as dimensionality reduction methods to visualize them. The course will also include an introduction to data visualization. Regarding data mining methods, we will focus on deterministic latent model methods, such as constrained matrix factorizations and tensor factorizations. The methods will be programmed by students in Python during tutorials and applied to data from various problems (image processing, chemometrics, recommendation systems). The part of the course on data visualization will contain an introduction to its issues and its history. Several linear and nonlinear dimension reduction methods will be presented in this part and used in tutorials to analyze real data.

- **Machine Learning for Image Analysis**

This course focuses on the representation and improvement of the visual quality of images. It introduces different tools for image analysis such as frequency representations and wavelet transforms. It also proposes a study of continuous representations and geometric representations. Finally, machine learning tools dedicated to image processing are analyzed, in particular SVM classification, clustering algorithms and dictionary learning.

## **Applications of artificial intelligence:**

- **Applied Artificial Intelligence**

This course studies some major applications in the field of artificial intelligence. It focuses in particular on 3D scene analysis and reconstruction, biological imaging,

new data in biology, biometric applications, generation and detection of falsifications with neural networks and compression in the field of big data.

- **Virtual Reality**

This course provides an introduction to the animation of three-dimensional objects and, more generally, to the construction of three-dimensional environments. It also teaches students how to light objects and modify their renderings. Many computer developments allow the theoretical concepts studied to be put into practice.

#### **Humanities S9:**

- **Innovation and entrepreneurship**
- **Professional conferences**

#### **Acquired in company S9:**

- **Acquired in business**
- **Apprentice regulation meetings**

### **2<sup>th</sup>SD semester (S10)**

#### **Research and Innovation:**

- **Multidisciplinary project**
- **Conferences and research business visits**

#### **Humanities S10:**

- **Business strategy**
- **Business negotiation**
- **Legal culture and intellectual property**
- **Professional networking**

This module, common to all Polytech work-study students, should enable them to develop their skills in carrying out multidisciplinary projects, creating networks and maintaining links with the world of research.

#### **Acquired in company S10:**

- **Acquired in business**
- **Apprentice regulation meetings**

#### **Projects - Exams**

Various projects leading to assessment must be carried out during the first semester to allow the student to move from theoretical concepts to practical implementation in different courses.