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## 2EL6090 – Artificial Intelligence and Deep Learning

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**Instructors:** Catherine Soladie  
**Department:** CAMPUS DE RENNES  
**Language of instruction:** ANGLAIS  
**Campus:** CAMPUS DE RENNES  
**Workload (HEE):** 60  
**On-site hours (HPE):** 35,00  
**Elective Category :** Fundamental Sciences  
**Advanced level :** Yes

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### Description

#### DNA or line of code?

Homo Sapiens is cut to walk on two feet, yet he must learn a year before getting up. Underwater creatures can move in total darkness, and their species have evolved over millions of years to achieve this result. Adaptation to a milieu, to a problem, or intelligence, are not static notions but the result of a constant effort: learning.

Thus, the emergence of technological systems capable of prediction, of expertise, quickly raises the question of learning. How can a program acquire, assimilate, organize knowledge? On this point, taking inspiration from the living is a rather fruitful starting point. How to mimic the behavior of our neurons? That of evolution and natural selection? What results to expect?

In this elective, you will discover the principal methods of Artificial Intelligence and how they work. You will be able to take in hand the most recent algorithm on concrete cases, and you will have the opportunity to push the study on a subject of your choice. It's up to you to learn how to learn!

#### Highlights

Artificial life: cellular automata, neural networks, genetic algorithms  
Deep Learning: Convolution networks, Temporal processing of data (RNN, LSTM), Generative models (like VAE or GAN)

#### Quarter number

SG6

#### Prerequisites (in terms of CS courses)

Statistics and learning.



## Syllabus

### Background (5%)

- Introduction to the subject
- Historical context.
- Link with the subjects of the program.

### Artificial life (15%)

- Alternation theory / practice in the form of applied course
- Artificial Life
  - Cellular automata and emergence concept
  - Genetic algorithms
  - Multi-agent systems
  - Reinforcement Learning

### Machine Learning and Deep learning (40%)

- Alternation theory / practice in the form of BE (*Bureau d'étude*)
- Machine Learning
  - Neural networks
  - Backpropagation
- Deep Learning
  - Auto-encoders
  - Recurrent neural networks
  - Convolutional neural network and transfer learning
  - Attention models and Transformers

### Project to build an applied course (40%)

- Individual project
- Deepening of a subject chosen freely
- Presentation in the form of an applied course (modalities could be adapted)
  - 5 min of introduction (video)
  - 20 min of practice (notebook)

### Class components (lecture, labs, etc.)

- Course: 13% (8 HEE)
- Applied course and evaluation: 37% (22 HEE)
- Online courses: 20% (12 HEE)
- Project to build an applied course : 30% (18 HEE)



### Grading

MCQ of theoretical knowledge on AI and Deep Learning: 6 pts  
Defense of the project of realization of an applied course : 6 pts  
Video on the theoretical part of the applied course : 6 pts  
Respect of the deadlines and participation in activities : 2 pts

### Course support, bibliography

Tutoriels de Yann Lecun

*Machine Learning avec Scikit-Learn - Mise en oeuvre et cas concrets*,  
Aurélien Géron

*Deep Learning with Python*, Francois Chollet

*Pattern Recognition and Machine Learning*, Christopher Bishop, Springer,  
2006. The best book on Machine Learning, it covers a lot of topics! Freely  
available online.

*Deep Learning*, Ian Goodfellow et al., MIT Press, 2016. A reference book on  
Deep Learning. Freely available online.

*Dive into Deep Learning*, Aston Zhang et al., 2019 An interactive deep  
learning book with code, math,...

### Resources

Teaching team:

- Catherine SOLADIE
- Simon LEGLAIVE

Size of applied courses : 30 for applied courses

Software tools and number of licenses needed:

- Jupyter Notebook, python, Pytorch or equivalent (free)

Classrooms:

- 251 ou 252, Rennes Campus (up to 30 students in the room  
/ 15 posts per room)

### Learning outcomes covered on the course

- Know a wide range of machine learning and deep learning  
tools for data processing, including massive data (C2.1, C6.3)
- Know the basics of machine learning (C2.1)
- Know how to list and give examples of different machine  
learning families (C2.1)
- Test, analyze and evolve different machine learning and  
deep learning algorithms (C1.4, C6.1)



- Evaluate the performance of a machine learning algorithms (C2.2, C3.6)
- Design and propose a data processing software illustrating a specific concept or a specific algorithm of machine learning or deep learning (C1.4, C2.1, C2.2, C6.1, C6.3)

### Description of the skills acquired at the end of the course

- C1 Jalon 2
  - C1.4 **Concevoir** : Rédiger soi-même un cahier des charges ou élaborer une approche agile à partir d'un besoin donné
- C2 Jalon 2
  - C2.1 **Approfondir** : Approfondir l'ensemble de ses connaissances sur un domaine choisi, via les enseignements de 2A
  - C2.2 **Importer des connaissances** : Réutiliser concrètement des connaissances issues d'un autre domaine ou discipline dans un problème donné
- C6 Jalon 2
  - C6.1 **Résoudre** numériquement un problème
  - C6.3 Traiter des **données**