2EL6090 – Artificial Intelligence and Deep Learning

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

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
    - Convolutionnal neural network and transfer learning
    - Attention models and Tranformers

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 applieds 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**