Advanced Topics in AI[1]

Master MIAGE Innovative Information Systems (2IS)

Pedagogical objectives

The purpose of this course is to give students in-depth knowledge in three advanced areas of artificial intelligence: complete the training in learning techniques with the use of deep learning architectures (**part 1**), provide students with the tools to set up a multi-agent simulation from data collection to the final analysis (**part 2**), model the rational behaviour of autonomous agents and analyse the algorithmic properties of socio-economic applications (**part 3**).

From the **technical** point of view, students will advance in programming techniques, use of deep learning libraries in the cloud, conception and design of a simulation, and mathematical modelling. From the **conceptual** point of view, the course will stimulate the analytic capacity of the students in the understanding of social (multiagent) phenomena, collecting and synthesising information from multiple disciplines, being able to formulate and test hypotheses on socio-economic applications.

Course content and activities

The course is structured in three parts which will be taught in sequence:

1. **Deep learning.** This part will first detail the functioning of artificial neural networks and inner mechanisms used to optimize synaptic weights.

2. **Multiagent Simulations.** This part will introduce the modelling and simulation of complex systems (social systems in particular) using multi-agent simulation and will detail the main steps of this process, from data analysis, agent-based modelling, programing on a simulation platform (*Netlogo* or *Gama*), simulation exploration (using *Open-mole*) and analysis of the results. The course will alternate theoretical approaches and practical issues.

3. **Rational decisions and social algorithms.** We will introduce the main algorithms used in socio-economic activities, with a strong accent on those studied in the area of multiagent systems. The theoretical and practical aspects of these algorithms and mathematical models will be analysed. Topics varies each year and can include: introduction to game theory

(strategic, extensive, repeated), auction and mechanism design, online advertising markets, matching mechanisms, human computation and crowdsourcing, social choice and voting, reputation systems, social network analysis and diffusion on networks, and digital currencies.

Evaluation

Students will receive a one final grade composed of:

- **Individual grades** on exercises, mini-projects, or written examisnations.
- A **final group project** federating parts of the course on a real-word situation.

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