1SC2793 – Modeling, development, and management of a viral marketing camp

Instructors: John Cagnol
Department: DOMINANTE - MATHÉMATIQUES, DATA SCIENCES
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description

In this challenge week, you will understand and model the viral propagation of a message on social networks.

You will work with Artefact (www.artefact.com), a digital marketing agency created in 1998 with more than 25 offices in 18 countries and headquartered in Paris.

You will help them maximize the impact of a marketing campaign by using mathematical models and you will program these models, mainly using Python.

Quarter number

ST2

Prerequisites (in terms of CS courses)

Information Systems and Programming
Convergence, Integration, Probability
Partial Differential Equations (first part of the class)
Algorithms and complexity
Modeling

Syllabus

Your team of six individuals will work for the digital marketing agency Artefact. Artefact has just launched a campaign on social networks and the initial pieces of information are now available. Your mission will be to develop models and simulations to produce a set of recommendations to maximize the impact of the campaign. You will start by understanding the dynamics of viral broadcasting of information on the Internet in general and social networks, in particular. You will use the tools from the courses indicated as prerequisites to model the propagation and find its characteristic elements. You will also need to use common sense and inventiveness. You will propose a communication strategy based on the models you have developed. This strategy should boost the impact of the campaign.

Class components (lecture, labs, etc.)
Challenge week

Grading
Preliminary results will be required from the students.
A defense and a report will conclude this class.

Resources
CentraleSupélec professors
Client and industrial partner (Artifact)
Software (Python and associated libraries)

Learning outcomes covered on the course
At the end of this course, you will be able to :

- Model a propagation phenomenon.
- Choose the relevant model(s) for a given objective.
- Structure hypotheses and respond quantitatively.
- Discuss with the client the issues, needs, and ideas for reflection and analysis.
- Be customer-sensitive. Identify and analyze the needs, issues, and constraints of the stakeholders.
- Make decisions in an uncertain environment, manage the unexpected, and take risks.
- Assemble a broad, scientific and technical base within the framework of a transdisciplinary approach.
- Use the appropriate visual representation modes for your data and its analysis.
- Present your results with rigor, precision, and conciseness.

Description of the skills acquired at the end of the course
C1 : Analyse, design and implement complex systems made up of scientific, technological, social and economic dimensions.
C2 : Acquire and develop broad skills in a scientific or academic field and applied professional areas
C3 : Act, engage, innovate within a scientific and technological environment
C4 : Create value for companies and clients
C6 : Advance and innovate in the digital world
C7 : Strengthen the Art of Persuasion
C8 : Lead a team, manage a project
C9 : Think and act as an accountable ethical professional

As a reminder, these refer to the CentraleSupélec statement of objectives available at bit.ly/CS-eng

ST2 – 28 – MODELING STRATEGIC INTERACTIONS THROUGH GAMES

Dominante : INFO&NUM (Computer and Digital)
Langue d'enseignement : French
Campus où le cours est proposé : Paris-Saclay

Engineering problem

The field of artificial intelligence is a booming field, bringing innovation (in all senses of the word) and source of strong actual and potential growth. Since the beginnings of AI, games have been used as "showcases" of scientific and technological advances in this field, such as A. Samuel's checkers game in 1952, Deep Blue for chess in 1997, Watson for Jeopardy in 2011 or more recently, in 2016, AlphaGo for the game of Go. Computerized games are indeed good environments, because they are simplified, to test AI methods before applying them to other fields. Typically, today, many platforms allowing the development of artificial agents and their testing on strategic games are made available by actors whose core business is not gaming.

In this topic, we propose to study modeling techniques (discrete models based on states and graphs of states, variables, constraints...) and algorithmic resolution of games, considered in general as representative of the problems treated by Artificial Intelligence techniques and which implements the model/infer/learn paradigm, and to apply them to real problems of modeling strategic interactions between agents.

Indeed, a game is a universe in which each agent (player) has a set of possible actions determined by the rules of the game and acts according to its winning objective but also in reaction to the actions of other agents (players). More generally, it is about modeling rational agents interacting with other agents and/or with their environment, each one pursuing its own goal. Game theory is a set of mathematical and computational tools to model and analyze this type of strategic interaction. It is concerned with the optimal choice that an agent must make, anticipating the possible decisions of other agents. It was initially motivated by economic questions, but it now has many practical applications well beyond the field of economics. First and foremost, it has its place in the field of games, whether they be board games, board games or games of reflection, with one or more players, where each player acts according to his or her objective of winning but also in reaction to the actions of the other players. In addition to strategic games, game theory has also been largely motivated by questions of an economic nature. It now has many practical applications: modelling competition between companies and strategic management, particularly in oligopoly situations, understanding voting in political science, evolution and survival in biology, or studying the coordination of the electrical charge of a fleet of vehicles.

The relationship between games and Artificial Intelligence is therefore twofold: on the one hand, the foundations of game theory provide strategies for solving Artificial Intelligence problems, and on the other hand, the modeling and resolution of games requires the implementation of Artificial Intelligence techniques.

At the crossroads of modeling and solving techniques in AI and those used in game theory, this topic aims to address the main concepts of these two areas and to implement them on concrete cases of modeling strategic interactions between agents provided by industrial partners.

Adviced prerequisites

The course of algorithmic and complexity common to all during this sequence

Context and issue modules: These modules, with conferences and round tables involving different actors (academic and industrial) of this field, will allow to discover the perimeter of this topic under the scientific, technological and economic angles, in particular:

- game theory and social choice theory

- game theory in economics: from Nash equilibrium to the Nobel Prize

- application of game theory in computer science: artificial intelligence, Go game, stable marriage problem

- game theory and cooperation

Specific course (40 HEE): Computational approach to games

Brief description: Game theory is the formal study of the interaction between rational systems or agents defined by the goals they seek to achieve and by the strategic options they have to achieve them, strategies that can eventually be interdependent (i.e. situations in which the fate of each participant depends not only on the decisions he makes, but also on the decisions made by the other participants). In this course, we will focus on the computational approach to games, which is based on computer models of game situations (state and graph-based models, constraint-based models, etc.) and which aims to automate the search for strategies and to analyze their performance (optimality). This course will cover the theory and practice of finding optimal and satisfying solutions for multi-player combinatorial games, such as popular games like Soduku, Sokoban, Othello, Checkers, ... It will include the following topics: relevant representation of information, intelligent (i.e., satisfying, near-optimal, or optimal) decision making, modeling of action sequences, consideration of payoffs and uncertainties and capitalization of experience, aggregation of conflicting preferences, algorithms for traversing combinatorial game spaces.

Challenge week n°1: Adversarial games for software design

- Associated partner: CEA

- Location: Paris-Saclay campus

- Short description: Computer systems open to their environment (networks, web, sensors, users) evolve independently and concurrently. In terms of game theory, specifying a program is equivalent to characterizing a game whose parts consist of infinite sequences of interactions between two players, the system and the environment. Verifying or synthesizing a program is equivalent to computing a winning strategy according to all or part of the game defined by the specification. Depending on the systems modeled and the objectives, different families of games (accessibility, parity, Büchi), defined in terms of automata theories, are brought into play.

Challenge week n°2: Strategic games for the economy

- Associated partner: Consulting firm BCG

- Location: Paris-Saclay campus

- Short description: Game theory is a standard tool for analyzing competition between firms in oligopoly situations, auction mechanisms, ... By modeling the actors as rational agents, game theory allows to model the different possible scenarios and to help in strategic decision making.

Challenge week n°3: Congestion games for transportation

- Associated partner: IRT SystemX, chaire Anthropolis, EPAPS

- Location: Paris-Saclay campus

Brief description: Transportation systems induce strategic interactions between users. Individual strategies (choice of transport mode, departure time, itinerary, ...) are likely to create congestion that goes against the collective interest. The price of anarchy characterizes the distance between the satisfaction of individual and collective interests. It can be improved by network management policies (pricing, road opening or closing).

Challenge week n°4: Evolutionary games

Associated partner: Genopole actor

Location: Paris-Saclay campus

Brief description: Evolutionary games are the declination of game theory for the study of the evolution of populations. Individuals meet and reproduce according to certain rules related to their characteristics (phenotype, gene, ...). According to Darwin's theory of natural selection, the gain is expressed in terms of the ability to reproduce. Evolutionary algorithms are bio-inspired algorithms that evolve a population of candidate solutions, with selection and mutation mechanisms defined from an evaluation function (fitness).