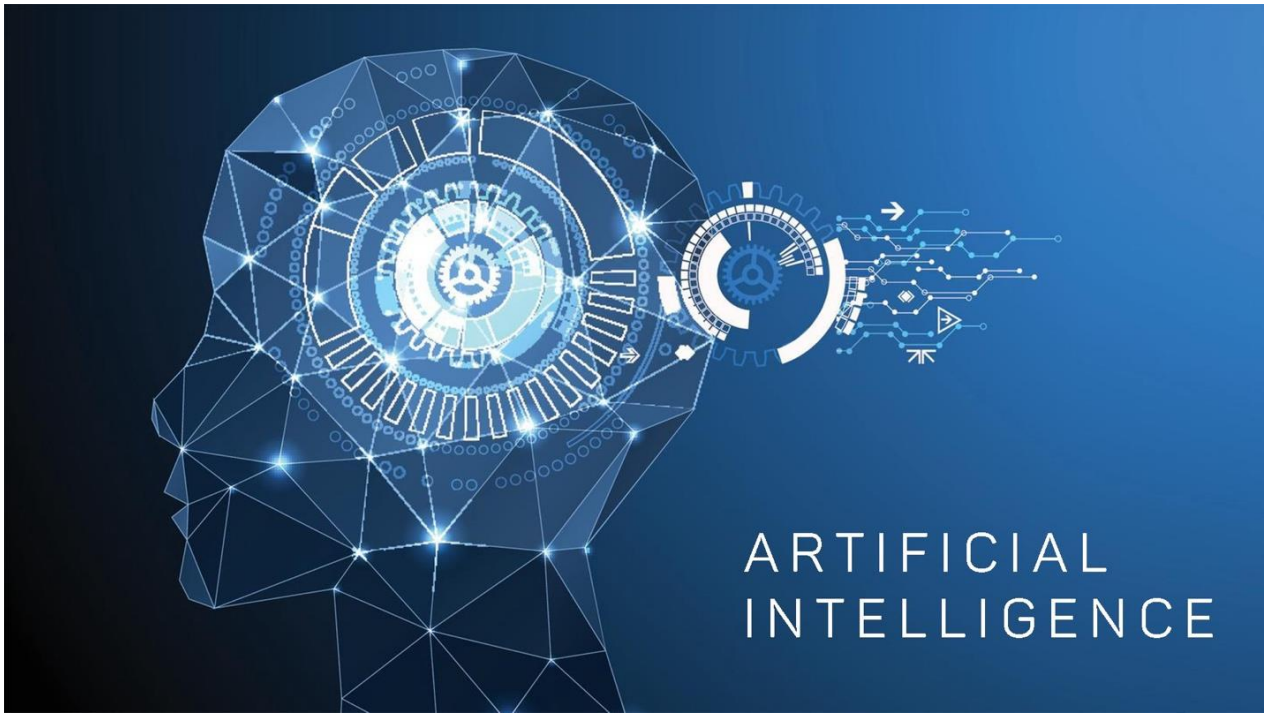
Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت



Master's Degree in Artificial Intelligence (AI)

ماستر في الذكاء الاصطناعي

Master en Intelligence Artificielle

May 2018

École supérieure d'ingénieurs de Beyrouth (ESIB)

Campus des Sciences et Technologies
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1. Presentation

- **General Information**

Artificial Intelligence (AI) is a broad area of **Computer Engineering** that can create machines and software that seem to have human intelligence and can also improve themselves. Today, intelligent systems can recognize objects better and faster than humans, translate many languages in real-time, play logical games and many other things. AI-based technologies are changing the labor market and industries themselves, just as the industrial revolution did 100 years ago.

The job of « AI specialist » is currently one of the most demanded jobs and is projected to be the top position for the next decade. The national, regional and international markets are demanding more and more experts in AI to give them an edge over their competitors.

- **Scientific and Educational Objectives**

The Master in AI is part of a professional program to prepare specialists capable of developing intelligent programs and systems to be implemented in different industries for the better of mankind.
The program is professional in nature and meets the needs of the job market, which is looking for specialists in the field of AI. This program also allows students to pursue a doctoral thesis in this area.

This Master program aims to train:

- High-level professionals capable of designing and implementing new AI tools for industrial use. The applications include and are not limited to the fields of healthcare, robotics, industry, economy, environment and self-driving cars,
- Expert researchers in computer engineering, computer science, and optimization.
- Multidisciplinary consultants able to turn information into decision support tools within a company.

- **General Organization of the Master's Degree**

The Master in AI is based on the latest discoveries in its field. It includes 120 credits for a duration of two years, spread over 4 semesters S1, S2, S3 and S4 over the course of 2 years M1 and M2. The program includes:

- Theoretical and practical lectures,
- Extensive hands on experience,
- An internship in a company or a research internship leading to the writing of a thesis and a defense.

One of the main objectives of this program is to train professionals in the field of AI, who can integrate the industry upon graduation. This is why a major part of the program is devoted to intensive programming tasks of implementation of the solutions at hand.

- **Opportunities and Doctoral studies**

The AI domain is a huge reservoir of jobs for years to come. It presents a wide range of opportunities in the following sectors:

- Robotics
- Computer game development
- Self-driving cars
- Fintech
- Healthcare and medical applications
- Internet of Things (IoT)
- Economy
- Machine learning
- Deep learning
- Human-centered problems
- Language processing
- Intelligent tutoring systems
- Expert systems
- etc.

This program also prepares the students for research. In fact, students who have successfully completed the Master's Degree will be eligible to pursue a PhD.

2. Admission and Registration

- **Admission**

Admission of students is based on their file and an interview might be required.

1- Admission to the first semester of the Master's program (S1)

Students must satisfy on of the following conditions:

- Hold a BS Degree in Computer and Communications engineering, or Computer Science, telecommunications,
- Hold an equivalent Degree recognized by USJ.

2- Admission to the third semester of the Master's program (S3)

Students must satisfy one of the following conditions:

- Hold a BE Degree in Computer and Communications Engineering from ESIB or being a CCE Program Student at ESIB and earned at least 120 credits in Engineering Cycle.

- Terminate with success the first year of a Master's Degree (M1) in Computer Science, or Computer and Communication, or Informatics.
- Hold an equivalent Degree recognized by USJ.

The selection of candidates is made by a Scientific Committee within the limits of available places. The Scientific Committee will decide for each application the subjects and modules validated according to the program and the results previously obtained.
The documents required when submitting the application form are specified in the common admission file specific to Saint Joseph University of Beirut.
The files will be examined by the Scientific Committee of the Faculty of which will establish the list of candidates admitted to this program. Successful candidates might be interviewed before their final admission. The application file is downloadable from the site of Saint Joseph University of Beirut and is to be deposited in:

Faculty of Engineering (ESIB) at USJ
Mar Roukos, Mkalles
Tel: (01) 421317

3. Degree and regulation

- **Language**

All the courses are given in English. The file of each candidate must include a commitment statement showing that the student has high proficiency in English language (written by the candidate if he does not have an official certificate). If necessary, the Scientific Committee can check the level of English of the candidate and require, if necessary, some remedial courses.

- **Degree requirement**

The AI Master's Degree is awarded to candidates who have successfully passed the examinations on the theoretical and practical Teaching Units (courses) and who show excellent level during the thesis defense. In case of absence, there is no provision for makeup exams. In the event of a serious accident, duly and seriously justified, the case will be examined by the jury to take the measures deemed appropriate.

- **Presence**

All teaching activities are compulsory.

- **Conditions**

Each Teaching Unit is given a grade. Following the exam period, the jury finalizes the results. The GPA is calculated based on the theoretical and practical courses weighted by the number of credits. Theoretical modules are validated if the grades of all subjects are greater than 10/20. Students who have validated the theoretical modules are allowed to present the internship report or the research paper. The priority in the choice of internships is based on the overall GPA. The research thesis is validated if the grade is greater than or equal to 12/20.

- **Degree**

The Master's Degree in AI is awarded to admitted students having validated all the Teaching Units of the 4 semesters M1-S1, M1-S2, M2-S3 and M2-S4. The scoring system is defined by the internal regulations of Saint Joseph University of Beirut.

4. Skills and Learning Outcomes

Upon graduation, students will be able to:

I. Compare AI with human intelligence and traditional information processing and discuss its strengths and limitations and its application to complex and human-centered problems.
II. Discuss the core concepts and algorithms of advanced AI, graphical models, decision making, multiagent, inductive learning, statistical learning, reinforcement learning, deep learning, natural language processing, robotics, and so on.
III. Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
IV. Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.
V. Design AI functions and components involved in intelligent systems, such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.
VI. Review research articles from well-known AI journals and conference proceedings regarding the theories and applications of AI.
VII. Perform research project and write research proposal, report and paper.

Student Outcome SO	**Key Performance Indicator KPI**
a) Ability to apply knowledge of mathematics, physics in problem solving	a1. Apply knowledge of mathematics to solve problems a2. Apply knowledge of physics to solve problems
b) Ability to design, conduct experiments, analyze and interpret data	b1. Plan experiments by applying theoretical knowledge and selecting appropriate data to measure b2. Perform experiments by correctly manipulating tools and measuring data b3. Analyze the data using the appropriate tools, and interpret the results
c) An ability to design a system, component, or process that meets the needs and realistic constraints	c1. Develop a design strategy by analyzing needs and respecting technical and non-technical constraints c2. Propose a solution adapted to needs, and compare it to alternative solutions

of economic, environmental, social, political, ethical.	c3. Test, improve, and implement using the appropriate tools such as modeling, prototyping, and performance testing
d) An ability to identify, formulate and solve an AI problem	d1. Identify an AI problem by selecting the information used and needed d2. Formulate a problem by adopting an appropriate model d3. Solve the problem by using appropriate tools and applying technical knowledge
e) An understanding of professional and ethical responsibility	e1. Describe the professional code of conduct such as responsibility to the different actors: customers, employees, administration, society, environment e2. Understand the legal and security responsibilities of the AI specialist profession
f) Education needed to understand the impact of AI in a global, economic, environmental and societal context	f1. Describe the local and global impact of AI on individuals and society, identifying relevant resources and making informed judgment
g) Knowledge of contemporary subjects	g1. Quote recent developments related to the field of data analysis
h) Ability to use the modern techniques, skills, and tools needed for AI	h1. Use techniques necessary for professional practice such as design, prototyping and simulation h2. Use the skills needed to practice the profession, such as programming and tool manipulation

5. Program

The Master program is spread over 2 years. The Teaching Units (courses) are distributed over semesters S1, S2, S3 and S4. Following the ECTS standards, 1 ECTS accounts for a workload of 25 hours. The Master program and the student's workload are depicted in the following tables where:

- C: Course work in hours
- L: Laboratory work in hours
- H: Personal work (Homework, study, projects)

Semester 1 (S1)	**C**	**L**	**H**	**Total**	**Credits**
Object Oriented Programming and Data Structures	35	35	80	150	6
Foundations of Decision modeling	35	35	80	150	6
Foundation of machine learning	30	5	65	100	6
Parallel Computing	30	5	65	100	6
	190	**160**	**450**	**800**	**24**

Semester 2 (S2)	**C**	**L**	**H**	**Total**	**Credits**
Graph Theory and Operational Research	30	5	65	100	6
Database	35	35	80	150	6
Foundation of Big Data	30	5	65	100	6
Game Theory	30	5	65	100	6
Foundation of Artificial Intelligence	30	5	65	100	6
Neural Networks and Deep Learning	25	10	65	100	6
	210	**35**	**455**	**700**	**36**

Semester 3 (S3)	**C**	**L**	**H-Project**	**Total**	**Credits**
Self-Driving Cars	25		75	100	4
Experts Systems	25		75	100	4
AI in Computer Vision	25		75	100	4
Legal, Policy and Ethical considerations for AI	17		33	50	2
AI in Robotics	25		75	100	4
AI in Natural language processing	25		75	100	4
AI in Computer Games	25		75	100	4
Rules Engines and Inference Systems	30	5	65	100	4
	192		**558**	**750**	**30**

Semester 4 (S4)	**Credits**
Internship or Research Thesis	**30**

6. Teachinng

Semester 1 (S1)	**Nom**	**cadre**	**Type**	**Credits**
Object Oriented Programming	Y. Bakouny	Vacataire	Mandatory	6
Foundations of Decision modeling	M. Ibrahim	Titulaire	Mandatory	6
The Linux Operating System	M. Chamoun	Titulaire	Mandatory	4
Neural Networks and Deep Learning	G. Sakr	Titulaire	Mandatory	4
Data Structure and Algorithms	D. Mezher	Titulaire	Mandatory	6
Database	P.Tufenkfi	Rectorat	Mandatory	6
				32

Semester 2 (S2)			**Type**	**Credits**
Graph Theory and Operational Research	M. Ibrahim	Titulaire	Mandatory	4
Rules Engines and Inference Systems	D. Mezher	Titulaire	Mandatory	4
Parallel Computing	F. ElYafi	Vacataire	Mandatory	4
Foundation of Big Data	D. Mezher	Titulaire	Mandatory	4
Game Theory	M. Ibrahim	Titulaire	Mandatory	4
Foundation of Artificial Intelligence	D. Mezher	Titulaire	Mandatory	4
Foundation of machine learning	G. Sakr	Titulaire	Mandatory	4
				28

Semester 3 (S3)		**cadre**	**Type**	**Credits**
Legal, Policy and Ethical considerations for AI	???	Vacataire	Mandatory	2
Self-Driving Cars	G. Sakr	Titulaire	Mandatory	4
Experts Systems	G. Sakr	Titulaire	Mandatory	4
AI in Computer Vision	M. Khalil	Vacataire	Mandatory	4
AI in Robotics	H. Kanaan	Titulaire	Mandatory	4
AI in Natural language processing	M. Chamoun	Titulaire	Mandatory	4
AI in Computer Games	D. Mezher	Titulaire	Mandatory	4
AI in Financial Technology	G. Habre/J. Abdo	Vacataire	Mandatory	4
				30

Semester 4 (S4)			**Type**	**Credits**
Internship or Research Thesis		Titulaires	Mandatory	**30**

7. Program Content

The Master program in AI is designed to prepare AI leaders. AI became a game changer of our life. The aim of this program is to provide the foundations and the most advanced techniques in the field towards becoming a technical leader of this transformation.
Our program is unique in terms of curriculum since it encircles the field both with model/symbolic-driven and data-driven artificial intelligence methods as well as their applications to critical domains like natural language processing, visual computing, internet, medical imaging and financial technology.

This unique end-to-end from theory to practice program entirely offered in English with outstanding quality of classes and instructors offers you a unique opportunity of excellence in terms of curriculum towards becoming an artificial intelligence specialist and amazing career perspectives in the hottest discipline of this century.

Semester S1 (32 credits)

Object Oriented programming (6 credits)

The main purpose of this teaching unit is to give students the necessary tools for the development of advanced level programs by using the concept of objects in their programs. Indeed, this programming approach offers exceptional flexibility and portability, making this course essential for math students. This course complements a previous course in computer science using C ++.
At the end of this teaching unit students will be able to:

- Identify and define the different basic elements to establish an algorithm according to the concept of programming using objects
- Describe a practical programming problem through logical steps defining which classes to use
- Write and Interpret an algorithm relating to a modeling of a given phenomenon
- Design and Write a program in C ++ using classes of objects and public and private members.

Foundation of Decision Modeling (6 credits)

Preferences are present and pervasive in many situations involving human interaction and decisions. Preferences are expressed explicitly or implicitly in numerous applications and relevant decision should be made based on these preferences. This course aims at introducing preference models for multicriteria decisions. We will present concepts and methods for preference modelling and multicriteria decision making. The course also presents stochastic processes and estimators.

The Linux Operating System (4 credits)

The Linux operating system is the go to OS for most AI applications. This course brings to the student all the information needed in this system. This course covers the following topics:

1. Shell programming. Pipes and redirection. The Shell as a Programming Language. Shell syntax.
2. Linux file structure. System calls and device drivers. Library functions.
3. The Standard I/O library. Formatted Input and Output. File and Directory maintenance. 4. The Linux environment. Environment variables. Passing arguments to programs.
5. Time and Date system functions. Temporary files. User and host system information.
6. Terminals. The terminOS structure. Terminal type determination. Detecting keyboard inputs.
7. Managing text
8. Data management. Memory resources management. Memory allocation. NULL pointer. Freeing memory. Other memory allocation functions.
10. Data management. File locking. Databases. Access to MySQL database using C language.
11. Development tools. The make command and Makefiles.
12. Source code control. Comparing RCS and SCCS. Writing a Manual Page. RPM packages.
13. General Debugging Techniques. Debugging with gdb.
14. Processes and Signals. Process Structure. The Process Table. Viewing Processes. System Processes and methods of processes scheduling.
15. Starting New Processes. Waiting for a process. Signals. Sending and receiving of signals.
16. POSIX Threads. Simultaneous execution of programs. Synchronization.
17. POSIX Threads. Thread attributes. Canceling a thread.
18. Inter---Process Communication. Pipes. Semaphores. Shared memory. Message queues.
19. Sockets. Socket connections configuration. Obtaining network information.

Neural Networks and Deep Learning (4 credits)

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. We will cover a range of topics from basic neural networks, convolutional and recurrent network structures, deep unsupervised and reinforcement learning, LSTM, and applications to problem domains like speech recognition and computer vision.

Data Structures and Algorithms (4 credits)

The aim of this course is to develop students' problem-solving skills by presenting them with all the usual data structures and related algorithms. This course deals with elementary data structures (linked lists, tables, files and piles), search problems (sequential, dichotomy), sorting problems (elementary sorting, fast sorting, sorting by fusion), trees (characteristics, structure), search algorithms on strings, priority queues, simplex, recursion and dynamic programming.

Databases (4 credits)

This teaching unit aims to introduce students to the design, creation and management of databases. It allows students to:

- Master the concept "Database",
- Design a Database from a given Information System (IS),
- Understand the Relational Model,
- Know how to create and manage a Database using SQL language.
- Understand the techniques of database management systems

Semester S2 (28 credits)

Graph Theory and Operational Research (4 credits)

This teaching unit introduces graph theory and operational research as modeling and decision-making tools for engineers.
At the end of this teaching unit students will be able to:

- Make a mathematical and computer representation of graphs
- Apply graph traversal algorithms
- Know how to calculate the shortest way
- Know how to maximize a flow problem
- Apply graphs to project management
- Understand the Simplex algorithm and linear programming

Rules Engines and Inference Systems (4 credits)

This teaching unit covers knowledge representation and reasoning to deduce new information. Knowledge representation, Propositional logic (equivalence, validity, satisfiability), Inference rules and theorem proving (Forward chaining, backward chaining, resolution), First Order Logic (Syntax and semantics, knowledge in FOL), Inference in First Order Logic (reduction, unification, Generalized Modus Ponens, Forward and backward chaining, resolution), Fuzzy Logic (Logical analysis, propositional, predicates, decidability issues).

Parallel Computing (4 credits)

In a parallel computation, multiple processors work together to solve a given problem. These are exciting times in parallel computing. The largest parallel machine has over a hundred thousand processors, and it is believed that machines with over ten thousand processors will be commonly available by the end of the decade. Furthermore, with most chip manufacturers moving toward multicore processors, most machines will soon be parallel ones. It is, therefore, essential to learn to use parallel machines effectively.
Learning Objectives:
At the end of this course, you should be able to accomplish the objectives given below.

- Define terminology commonly used in parallel computing, such as *efficiency* and *speedup*.
- Describe different parallel architectures, inter-connect networks, programming models, and algorithms for common operations such as matrix-vector multiplication.
- Given a problem, develop an efficient parallel algorithm to solve it.
- Given a parallel algorithm, analyze its time complexity as a function of the problem size and number of processors.
- Given a parallel algorithm, an input to it, and the number of processors, show the steps performed by that algorithm on that input.
- Given a parallel algorithm, implement it using MPI, OpenMP, pthreads, or a combination of MPI and OpenMP.
- Given a parallel code, analyze its performance, determine computational bottlenecks, and optimize the performance of the code.
- Given a parallel code, debug it and fix the errors.
- Given a problem, implement an efficient and correct code to solve it, analyze its performance, and give convincing written and oral presentations explaining your achievements.
- Understand CUDA

Foundation of Big Data (4 credits)

This teaching unit covers the fundamentals of designing dedicated software systems for analytics processing of large data.
The course begins with the design principles of relational database systems for business data analysis, including declarative queries, query optimization and transaction management, as well as the evolution of the basic systems of data to support complex analytical problems and scientific data management.
The course then looks at fundamental architectural changes at the data processing scale beyond the limit of a single computer, including parallel databases, "MapReduce", column storage and distributed key value, and to also allow the calculation of low latency analytical results from real-time data flows. Finally, this course examines advanced data management systems to support models of various data including tree structure (XML and JSON) and structured data graph (RDF) and new workloads such as learning tasks automatic (Spark) and mixed workloads (Google Cloud data feed).

Game Theory (4 credits)

This course will initially present the main principles concerning decision under uncertainty, and the use of graphical models when making decision under uncertainty Second, we will consider principles of game theory and show how such theory can model and analyze decision in situation where uncertain and strategic interactions are involved.

Artificial Intelligence (4 credits)

Study of intelligent agents: problem solving, length and width search algorithms, game programming: minimax, exptimax, knowledge and reasoning, planning, learning, natural language processing, vision, robotics, inference mechanisms, Bayes networks, Markov processes, Reinforcement learning and their algorithms: TD and Q.
Content:

- Reinforced learning
- Intelligent agents
- Uncertainty, knowledge and reasoning
- Learning: Knowledge bases
- Observation learning
- Games planning, research and programming
- Problem solving
- Decision making

Machine Learning (4 credits)

Machine learning is a scientific discipline that deals with the design and development of algorithms that allow computer behaviors to evolve based on empirical data, such as databases or sensor data. A major focus of machine learning research is to make the machine able to recognize and learn complex patterns and make intelligent decisions based on the captured data; the difficulty lies in the fact that the set of all the possible behaviors considering all the possible entries is too complex to describe it by using programming languages.
The course will focus on understanding important concepts in machine learning and present the main paradigms and methods that form the basis of modern machine learning. This involves the specific study of learning algorithms as well as the empirical experimentation of algorithms.

Semester S3 (30 credits)

Legal, Policy, and Ethical Considerations (2 credits)

This course introduces ethics, politics, and the ethical implications of AI and data. The course will examine the legal, political, and ethical issues that arise throughout the entire lifecycle of the science of data collection, storage, processing, analysis, and use, including, privacy, surveillance, security, classification and discrimination. Case studies will be used to explore these issues in areas such as criminal justice, national security, health, marketing, politics, education, automotive, employment, athletics, and development. Special attention will be given to legal and political constraints and considerations that are specific to AI in robotics and self-driving cars.

Self-Driving Cars (4 credits)

In this course, student become an expert in applying Computer Vision and Deep Learning on automotive problems. student will teach the car to detect lane lines, predict steering angle, and more all based on just camera data! Students also learn how to use an array of sensor data to perceive the environment and control the vehicle. They will evaluate sensor data from camera, radar, lidar, and GPS, and use these in closed-loop controllers that actuate the vehicle. Finally, students learn how to plan where the vehicle should go, how the vehicle systems work together to get it there, and then perform a deep-dive into semantic segmentation.

Expert Systems (4 credits)

The course covers:

- The nature of Expert Systems, types of applications of Expert Systems; relationship of Expert Systems to Artificial Intelligence and to Knowledge-Based Systems.
- The nature of expertise. Distinguishing features of Expert Systems. Benefits of using an Expert System. Choosing an application.
- Theoretical Foundations.
- What an expert system is; how it works and how it is built.
- Basic forms of inference: abduction; deduction; induction.
- The representation and manipulation of knowledge in a computer. Rule-based representations (with backward and forward reasoning); logic-based representations (with resolution refutation); taxonomies; meronomies; frames (with inheritance and exceptions); semantic and partitioned nets (query handling).
- Basic components of an expert system. Generation of explanations. Handling of uncertainties. Truth Maintenance Systems.
- Expert System Architectures. An analysis of some classic expert systems. Limitations of first generation expert systems. Deep expert systems. Co-operating expert systems and the blackboard model.
- Building Expert Systems. Methodologies for building expert systems: knowledge acquisition and elicitation; formalization; representation and evaluation. Knowledge Engineering tools.

AI in Computer Vision (4 credits)

This course will present an overview of trends, modern methods and applications of computer vision technologies in various problems of visual computing, namely visual analytics, object recognition, 3D scene modeling from multiple-views, cross training of multimodal data, etc. Also, this course will present an overview of trends, relevant to the automatic interpretation of medical imaging from computer aided solutions. The course will discuss the entire chain of problems in mid and high-level interpretation addressing the pillar problems of the field (detection, segmentation, registration) and the most AI-driven advanced technologies for computer aided diagnosis.

AI in Robotics (4 credits)

Robotics is the science of building devices that physically interact with their environment. The most useful robots do it precisely, powerfully, repeatedly, tirelessly, fast, or some combinations

of these. The most interesting robots maybe even do it intelligently. This course will cover the fundamentals of robotics, focusing on both the mind and the body.
Student will learn about two core robot classes: kinematic chains (robot arms) and mobile bases. For both robot types, the course introduces methods to reason about 3-dimensional space and relationships between coordinate frames. For robot arms, we will use these to model the task of delivering a payload to a specified location. For mobile robots, we will introduce concepts for autonomous navigation in the presence of obstacles.
Students will make use of ROS - the open-source Robot Operating System widely used in both research and industry. Computer requirements for working on the projects will include a computer set up with Ubuntu Linux.

Learning outcomes:

- Represent 2D and 3D spatial relationships, homogeneous coordinates
- Manipulate robot arms: kinematic chains, forward and inverse kinematics, differential kinematics
- Program and navigate mobile robots: robot and map representations, motion planning
- Plan complete robot systems
- Develop present and future applications for robots

AI in Natural language processing (4 credits)

This course goes beyond the phase of gathering large amounts of data by focusing on how machine learning algorithms can be rewritten and scaled up to work on petabytes of data, at the same time. both structured and unstructured, to generate sophisticated models used to make predictions. Conceptually, the course is divided into two parts.

The first part deals with deep learning and key network architectures including: convolutional neural networks, autoencoders, recurrent neural networks, short-term long-term memory networks LSTM ". This part also covers stochastic networks, conditional random fields, Boltzmann machines, stochastic and mixed deterministic models as well as deep reinforcement learning.

The second part deals with the processing of natural languages: Indeed, research in automatic natural language processing (NLP) is a field of artificial intelligence aiming at the development of automated techniques for the manipulation of linguistic data. Immediate applications of these techniques include the development of more natural textual interfaces, automatic document translation, spam detection, search for information in a collection of documents from queries, question / answer systems, and several others. This part introduces the student to the following topics: Introduction to the problem of automatic processing of the natural language and its applications. The natural language in relation to formal languages: the problem of ambiguity. Overview of current linguistic theories. Analysis and synthesis of speech. Morphological analysis: structure of the dictionary and suffix analysis. Syntax analysis: ATN parser, unification grammars and representation of the semantics of natural languages: formal logic and frameworks. Semantic interpretation. Knowledge of the world and speech context. Applications.

AI in Computer Games (4 credits)

Artificial Intelligence is widely regarded in the computer games industry as the area where the most advances will be made in the coming decades. As well as equipping students for a career in the rapidly growing game industry, this course will lead students to gain knowledge and skills in AI techniques that apply to other domains such as business planning and engineering.
The primary focus of this course will be on the use of AI techniques for generating efficient intelligent behavior in games. Additional attention will be given to AI algorithms for improving game play experience.

Learning Outcomes

- Identify tasks that can be tackled using AI techniques.
- Select the appropriate AI technique for the problem under investigation.
- Design and implement efficient and robust AI algorithms for game tasks.
- Develop AI game engines.
- Evaluate performance and test the implemented algorithms.

AI in Financial Technology (Fintech) (4 credits)

Technology is playing an increasingly dominant role in the financial service industry. It is changing how existing players operate and it is creating new ways to deliver core services like saving, investing, borrowing, and transacting. The course provides an overview of the most significant technological advances that are radically changing the industry, focusing on AI and Blockchain. We will analyze how these technologies create value in the financial industry by lowering frictions — from unit processing cost, through asymmetric information and network effects. The course will integrate a high-level discussion of the competitive landscape and the market opportunities for new entrants, with an in-depth understanding of the technologies and their applications. We will do so by focusing on three areas in which these technologies are driving change: (I) Lending, (II) Clearing (III) Trading. In each of these areas, we will cover examples and developments from (1) marketplace lending, (2) blockchain and distributed ledgers, (3) quantitative trading and its use of non-standard data and analytics. In each of these areas, we start by analyzing the marketplace, the incumbents, and the strategies of the incoming technology-based new entrants. We then proceed to understand the relevant technological applications in each area using real-world data.

Course Learning Outcomes

- What is fintech?
- Market place lending, Lending Club: business model, Loan data visualization
- Credit models
- Random Forest applied to LC data and MPL from investors' perspective
- Cryptography
- Blockchain — network and incentives
- Blockchain — finance applications
- Quantitative trading
- Crowdsourced trading
- Machine Learning in trading
- Unstructured data and Natural Language Processing

Semestre S4 (30 crédits)

Internship or Research Thesis (30 credits)

During the 4th semester, students must complete a professional internship in a company or research work in a laboratory for a period of 4 months on a topic related to AI.

• A student will have the choice between:
- An internship in a company lasting 3 to 4 months, in a company on a theme related to AI, concluded by writing and defending a professional report.
- A research topic lasting 3 to 4 months in a laboratory recognized by the scientific committee, concluded by writing and defending a research paper.

• The internships will take place in companies in Lebanon or abroad. The scientific responsibility for the internship is provided jointly by the company and a teacher from USJ or a partner university. This internship, for a minimum of one semester, aims to develop all the skills necessary for an AI specialist:
- Bibliographic search.
- Study of the state of the art.
- Proposal and implementation of solutions.

• The research will take place in a laboratory either in Lebanon or in an external institution. Scientific responsibility for this research is provided by the research professor (s) who supervise them.
This work, of a minimum duration of one semester, aims to develop the necessary skills to carry out a research work:
- Bibliographic search.
- Critical analysis of the state of the art.
- Proposals and implementations of solutions.
- Proposals and outlets for thesis work.

• The internship or research work is the subject of a report or a written dissertation and a public defense.
Students who have validated the theoretical modules of semesters 1, 2 and 3 are authorized to submit the internship report or the research paper.
The thesis or report includes a bibliographic part and a technical part.
The evaluation of the internship or research work considers three elements:
- Evaluation of the trainee's scientific initiative.
- Evaluation of the written brief or report.
- Evaluation of the oral defense.