ENGINEERING DEGREE, ENGLISH TAUGHT PROGRAM - Semester 8

Teaching Unit	ECTS	Elective	Credits	Code	Module	Lecture	Lecture & Tutorial	Tutorial	Personnal work
ES-TEC4BS2 CORE PROGRAM	11.0		3.5	ICO4108	Machine Learning	12.00	.	15.00	43.00
			2.0	ENT4120	Sustainable Business, Corporate Social Responsibility and Digital Sobriety	.	6.00	13.50	20.50
			1.0	ENT4302	Seminar	6.00 3.00 On.	.	12.00	0.00
			2.5	INF4064	NoSql	6.00	.	15.00	29.00
			2.0	INF4065	GPU programming	6.00	.	9.00	25.00
			0.0	LAN4084AN	Remedial English Cond.	18.00	.	.	0.00
SEA4BS2 EMBEDDED SYSTEMS S8	6.0	X	2.5	INF4055	Real-time programming	3.00	.	15.00	32.00
			3.5	SYS4041	Robotics	6.00	.	18.00	46.00
IAD4BS2 AI & DATA SCIENCE MAJOR S8	6.0	X	1.5	INF4069	Prompt engineering	.	.	6.00	24.00
			1.5	INF4057	Big Data I (Hadoop)	6.00	.	6.00	18.00
			1.5	MAT4057	Aberrant and missing data processing	6.00	.	6.00	18.00
			1.5	INF4067	Introduction to Symbolic AI	.	9.00	9.00	12.00
SWE4BS2 SOFTWARE ENGINEERING S8	6.0	X	3.5	INF4051	Application architecture	6.00	.	18.00	46.00
			2.5	INF4063	Software development using DevOps	6.00	.	12.00	32.00
RVS4BS2 VIRTUAL REALITY & IMMERSIVE SYSTEMS S8	6.0	X	2.5	INF4059	3D modeling	.	18.00	.	32.00
			2.5	INF4060	VR programming	.	18.00	.	32.00
			1.0	INF4061	Ray tracing	.	9.00	.	11.00
ES-PRO4BS2 PROJECT & ENTERPRISE	13.0		1.0	PLU4002	Challenges and certifications	1.50	.	.	20.00
			12.0	PLU4191	Project in Digital Science and Technology	.	.	.	185.00

CYB4BS2 CYBERSECURITY MAJOR S8	6.0	X	2.5	INF4305	Linux Security Hardening & services	6.00	.	12.00	32.00
			2.5	INF4105	Windows Security Hardening & Active Directory	.	18.00	.	32.00
			1.0	INF4309	Cryptographic prococols	9.00	.	3.00	8.00

ICO4108 Machine Learning

Information

Course name	Machine Learning
French course name	Machine Learning
Coefficient	3.5
Optional/Mandatory	Mandatory

Professor (Paris Campus)	PREVOST L.
Professor (Laval Campus)	PREVOST L.
Programs	Engineering Degree Engineering Degree, English Taught Program Engineering Degree by apprenticeship
Semester	S8

Course Hours

Lecture	12.00 hour(s)
Tutorial/Lab	15.00 hour(s)

Evaluation

Grading	Lab/Tutorial, Final Exam,
Final exam	1.50 hour(s)

Course Syllabus

Learning outcomes	Understand the principles and objectives of supervised learning from examples. Master the algorithms (nearest-neighbor, multilayer and convolution networks). Be able to size and optimize an algorithm on a training dataset and using a validation set. Measure the impact of parameters on performance and avoid overlearning.

Content and chapters

1. INTRODUCTION

Applications in decision support: examples and principles

Data and datasets

Classification or regression?

2. DECIDING WITHOUT LEARNING

The k-nearest neighbor algorithm

Computing distance between data

Boundary between classes

Influence of k on bias and variance

Advantages and disadvantages

3. ARTIFICIAL NEURON AND LEARNING

Human intelligence (learning and reasoning)

Artificial intelligence

Natural neuron

Mathematical modeling

Learning: perceptron rule

Limitation to linearly separable binary problems

4. SINGLE LAYER NEURAL NETWORKS

Applications to multi-class problems

Learning: delta rule and gradient descent

5. MULTI-LAYER NEURAL NETWORKS

Need for hidden layer(s)

Learning: backpropagation

Decision: WTA/rejection

6. GOOD PRACTICES

Input/output pre-processing: normalization, class balancing

Stochastic gradient, total, mini-batch

Fixed, variable, optimal learning step (quasi-Newton method with BFGS algorithm)

7. PERFORMANCE MEASURES

Performance measures: error rate, rejection rate, confusion matrix, precision, recall, ROC curve, risk

Learning objective: minimize bias and variance

Validation set

Search for the number of hidden cells by cross-validation and early stopping

8. CONVOLUTION NETWORKS

Classical image processing techniques: convolution, SIFT, HOG and LBP operators

Convolution networks

Shared weights,

Convolution and pooling layers

Introduction to deep learning

Prerequisites	Statistics, linear algebra

ENT4120 Sustainable Business, Corporate Social Responsibility and Digital Sobriety

Information

Course name	Sustainable Business, Corporate Social Responsibility and Digital Sobriety	**Professor (Paris Campus)**	COURBIN P.
French course name	Développement Durable, RSE et sobriété numérique	**Professor (Laval Campus)**	COURBIN P.
Coefficient	2.0	**Programs**	Engineering Degree Engineering Degree, English Taught Program Engineering Degree by apprenticeship
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Lecture/Tutorial(	6.00 hour(s)
Tutorial/Lab	13.50 hour(s)

Evaluation

Grading	Group project, Group presentation,
Final exam	0.00 hour(s)

Course Syllabus

Learning outcomes	This module aims to develop the systemic thinking skills of future engineers. At the end of this course, students will be able to - Understand new approaches (digital and beyond) - Question the role of the digital engineer - Define the scope of a project by integrating the entire ecosystem and its stakeholders - Classify the stakeholders in order of priority for action - Propose simple digital solutions by integrating various dimensions of sustainable development
Content and chapters	Chapter 1 Introduction: Sustainable Development & Digital Sobriety: Sharing facts, history, new models and examples Chapter 2 New tools to structure a project by designing it systemically
Prerequisites	Basic knowledge of Sustainable Development

ENT4302 Seminar

Information

Course name	Seminar	**Professor (Paris Campus)**	POIRIER S.
French course name	Colloque	**Professor (Laval Campus)**	POIRIER S.
Coefficient	1.0	**Programs**	Engineering Degree Engineering Degree, English Taught Program
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Lecture	3.00 hour(s)
Online Lecture	3.00 hour(s)
Tutorial/Lab	12.00 hour(s)

Evaluation

Grading	Group project,
Final exam	0.00 hour(s)

Course Syllabus

Learning outcomes	Colloquium in Guébriant and on the campus: Meet with partner companies present and alumni Develop your professional network Becoming professional (CV, interview, salary negotiation...) Opening up to entrepreneurship Strengthen cohesion among 4A students
Content and chapters	In Guébriant and on the differents campus, alumni and diffrents contractor host thematic workshops on: The development of skills Knowing how to imagine the company you are looking for The professional project The professional network Negotiation: internship, alternance, first job Further training & international Entrepreneurship How to quit your first job The Spirit of Defense and Digital Sovereignty Partner companies also offer conferences and workshops on their professional activities.
Prerequisites	None

INF4064 NoSql

Information

Course name	NoSql	**Professor (Paris Campus)**	DA-RUGNA J.
French course name	NoSql	**Professor (Laval Campus)**	AUBIN J.
Coefficient	2.5	**Programs**	Engineering Degree Engineering Degree, English Taught Program Engineering Degree by apprenticeship
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Lecture	6.00 hour(s)
Tutorial/Lab	15.00 hour(s)

Evaluation

Grading	Final Exam,
Final exam	1.00 hour(s)

Course Syllabus

Learning outcomes

Understand and manipulate NoSQL databases

Content and chapters

- Introduction (1h30)
  - BigData: needs and principles (4V)
  - NoSQL: principles (BASIC) and different types.
- MongoDB presentation (1h30)
  - Focus on Document Oriented NoSQL databases.
  - Features of MongoDB.
  - Different types of deployment architecture.
  - Good administration practices: backup, resilience, performance improvement, cybersecurity.
- MongoDB TP (3h)
  - Implementation of a simple MongoDB database.
  - Application of some good administration practices.
  - Command line database operation.
- Extract Transform Load (ETL) (1h30)
  - ETL Principles
  - Feedback on projects
  - Presentation of ELK and the practical work to follow: Support for reflection, difficulties ...
- TP ELK (6h)
  - Implementation of an ELK server
  - Taking into account of OpenData data provided by the teacher (in order to frame this lab)
  - Adaptation / filters of data according to the set context
  - Data exploitation via Kibana
- Results of the practical work (1h30)
  - Correction of the TP
  - Focus on the important concepts.

Prerequisites

3A courses : Databases, Operating systems and System administration.

INF4065 GPU programming

Information

Course name	GPU programming
French course name	Programmation GPU
Coefficient	2.0
Optional/Mandatory	Mandatory

Professor (Paris Campus)	BRIERE A.
Professor (Laval Campus)	VILELA MONTEIRO D.
Programs	Engineering Degree Engineering Degree, English Taught Program Engineering Degree by apprenticeship
Semester	S8

Course Hours

Lecture	6.00 hour(s)
Tutorial/Lab	9.00 hour(s)

Evaluation

Grading	Final Exam,
Final exam	0.00 hour(s)

Course Syllabus

Learning outcomes	Understand the architecture of a GPU Know the programming techniques for GPUs Design parallel algorithms for GPU

Content and chapters	**Introduction to GPUs** • History and Evolution of GPUs • GPU vs CPU: Understanding the Differences **GPU Architecture** • Core Components of a GPU • Memory Architecture and Management • Understanding Parallel Processing Capabilities **Basics of GPU Programming** • Introduction to CUDA and OpenCL • Understanding the GPU Programming Model • Writing Simple Programs: Hello World on GPU **Parallel Algorithms for GPUs** • Principles of Parallel Algorithm Design • Parallel Patterns and Practices • Case Studies: Implementing Common Algorithms on GPU **Advanced GPU Programming Techniques** • Optimizing GPU Programs for Performance • Debugging and Profiling GPU Code • Interoperability with CPU Code **Real-world Applications and Case Studies** • GPU in Scientific Computing • GPUs in Machine Learning and AI • Future Trends in GPU Programming
Prerequisites	• Basic understanding of programming (preferably in C/C++) • Fundamental knowledge of computer architecture • Familiarity with concepts of parallel computing (optional but beneficial)

INF4051 Application architecture

Information

Course name	Application architecture	**Professor (Paris Campus)**	IONASCU F.
French course name	Architecture d'applications	**Professor (Laval Campus)**	IONASCU F.
Coefficient	3.5	**Programs**	Engineering Degree Engineering Degree by apprenticeship Engineering Degree, English Taught Program
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Lecture	6.00 hour(s)
Tutorial/Lab	18.00 hour(s)

Evaluation

Grading	Final Exam, Group project,
Final exam	1.00 hour(s)

Course Syllabus

Learning outcomes

- Define separations, layers, organize components and services
- Take into account technical constraints
- Document an architecture
- Create a client-server architecture

Content and chapters

- Architectural Design Principles
  - Separation of concerns
  - Modularity and encapsulation
  - Abstraction, information hiding
  - Low coupling and high cohesion
  - Scalability and Performance
  - Flexibility and scalability
  - Reusability and maintainability
- Principles of dependency search and dependency injection.
- Relations and communication between modules, their abstraction and the notion of high-level interface.
  - Interface standards (SOAP, REST)
  - API design principles; gateways
  - Synchronous-Asynchronous Messages
- Architectural styles (monolithic N-tier, client-server, micro-services, MVC, service-oriented)
- Selection of an architecture in relation to the software / system objective, design compromise.
- Architecture documentation - C4, UML; API Documentation

Possible practical realization:

heavy client, monolithic server, mySQL or MongoDB DB, REST API, in high level language (Java, Spring Framework)

Prerequisites

Object Oriented Programming

Tools for Software Development

Application Design

INF4063 Software development using DevOps

Information

Course name	Software development using DevOps	**Professor (Paris Campus)**	FARCY V.
French course name	Developpement logiciel en processus DevOps	**Professor (Laval Campus)**	FARCY V.
Coefficient	2.5	**Programs**	Engineering Degree Engineering Degree by apprenticeship Engineering Degree, English Taught Program
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Lecture	6.00 hour(s)
Tutorial/Lab	12.00 hour(s)

Evaluation

Grading	Final Exam,
Final exam	1.00 hour(s)

Course Syllabus

Learning outcomes

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DevOps process for software development

Design and maintain automatic pipelines for continuous integration, delivery and deployment
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Content and chapters

- DevOps Methodology
- Continous integration, continous delivery, continuous deployment
- The environments (dev, staging, test, production)
- The monitoring, the metrics
- Tools: Docker, Kubernetes, GitLab

Prerequisites

INF4052 Virtualisation, conteneurisation et déploiement cloud

PLU4002 Challenges and certifications

Information

Course name	Challenges and certifications	**Professor (Paris Campus)**	BRIERE A.
French course name	Challenges et certifications	**Professor (Laval Campus)**	REY R.
Coefficient	1.0	**Programs**	Engineering Degree Engineering Degree, English Taught Program Engineering Degree by apprenticeship
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Lecture	1.50 hour(s)

Evaluation

Grading	Individual Project,
Final exam	0.00 hour(s)

Course Syllabus

Learning outcomes	Acquire new experiences, knowledge and skills that complement the modules of the academic curriculum.
Content and chapters	Each student chooses two activities (2 moocs or 1 mooc/1 challenge or 2 challenges) per semester among those validated and referenced by the teaching staff. To be validated, a mooc must have a duration of at least 5 hours. In the case where a mooc has a duration of at least 40 hours, it can be accepted to validate the two activities requested.
Prerequisites	None

PLU4191 Project in Digital Science and Technology

Information

Course name	Project in Digital Science and Technology	**Professor (Paris Campus)**	FARCY V.
French course name	Projet scientifique et technique 4A	**Professor (Laval Campus)**	REY R.
Coefficient	12.0	**Programs**	Engineering Degree Engineering Degree, English Taught Program
Optional/Mandatory	Mandatory	**Semester**	S8

Course Hours

Evaluation

Grading	Individual Project, Group project, Group presentation,
Final exam	0.00 hour(s)

Course Syllabus

Learning outcomes	At the end of this module, the students will be able to carry out a scientific and technical project in virtual aut
Content and chapters	This module defines the basics of operational project management in a context similar to a professional one. Students are entrusted with the mission of providing an answer to a problem proposed by a professional sponsor (company, teacher, research laboratory) or as part of a business creation. • Management of human relations associated with a project • Problematization • Definition and framework of a project • Study and proposal of the choice of solutions • Project organisation • Produce and verify compliance • Delivery documentation • Deliver
Prerequisites	4A-S7 level validated