COMPUTER SCIENCE MASTER'S PROGRAMME WINTER SEMESTER (S5)

MODULES	TITLE	ECTS	
HUMANITIES	French as a foreign language	2	P2
	English	1	P3
	International management	2	
	Conferences on Human sciences		P4
	Conferences on technical subjects		
TECHNICAL			
	Cloud infrastructure	2	P5
	Cloud usage	2	P6
	Architecture	2	P7
	Big data analysis and mining	2	P8
	Web data management	2	P9
	Advanced databases	2	p10
	Information theory and coding	2	P11
	Machine learning	2	P12
	Automatic speech and language processing	3	P13
PROJECTS			
	Technical project	6	P14
		30	

❒1st / ❒2nd/❒3rd year / COMPUTER SCIENCE

Module title : French for foreigners

Module leader: Nathalie Caradec Nathalie.Caradec@enssat.fr

Type of module
Compulsory module
Prerequisite: placement test for level group

Duration of module : 30h

Module components /Types of Courses

- Practical courses in small group

Dialogues- role play –variety of teaching material through the media and digital technology

ECTS: 2

Work load: In class studying

Content:
CEFR French levels are used on the four skills speaking – listening-reading and writing

- Level A1-A2

can introduce him/herself, can ask and answer questions about personal details such as where he/she lives, people he/ she knows, and things he/she has. Can interact in a simple way provided the other person talks slowly and clearly.

- Level B1-B2

Can understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Can deal with most situations likely to arise whilst travelling in an area where the language is spoken. Can produce simple connected text on topics which are familiar or of personal interest. Can describe experiences and events, dreams, hopes & ambitions and briefly give reasons and explanations for opinions and plans.

Common European Framework of References : CECRL (Cadre Européen Commun de Références pour les Langues)

Learning outcomes:

Development of the different skills according to the level.

Assessment
- Written assignment
- Oral assignment

Language of instruction: French

Additional information

❒2nd/❒3rd year / COMPUTER SCIENCE

Module title	GENERAL ENGLISH COURSES
Module leader	Claire LE PAGE claire.le-page@enssat.fr
Type of module (compulsory module, required Elective module, elective module)	COMPULSORY
Duration of module	30 HOURS
Module components /Types of Courses (lectures, practical course, Practical courses in small groups lab, tutorial, internship, …)	
Coefficient 2	part of a Unit with 6 ECTS
Work load	-In class studying 30 hours -Student managed learning: 20 hours
Content	This course is designed to teach students at an "independent level" to communicate effectively in English at the B2 /C1 level on general topics.
Learning outcomes: At the end of this course students will be able to	• Do presentations • Debate on topical issues • Interact with a degree of fluency which makes communication with a native speaker possible • Write reports on a wide range of interests. • Understand the main ideas of complex texts on concrete or abstract topics • Understand extended speech or conferences
Assessment: continuous assessment	- Written assignment ☑ - Oral assignment ☑
Language of instruction	ENGLISH
Additional information: B1 level is a prerequisite	

❒1st / ❒2nd/❒3rd year / COMPUTER SCIENCE Winter semester

Module title: **CONFERENCES ON HUMAN SCIENCES**
Module co-ordinator: Karine HENRY karine.henry@enssat.fr
Type of module (compulsory module, required Elective module, elective module) Mandatory attendance (for 14 hours out of 20 proposed)
Duration of module 14 hours (up to 20)
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lectures (some of them including debates and round table discussion e.g. Entrepreneurship awareness)
ECTS: /
Work load -In class studying 14/20 offered – no examination in the end, but individual assessment of each conference (in English or French) -Student managed learning:
Lectures *Private life vs. Internet* *Preventing psycho-social risks* *Management in an international context* *Industrial property* *Entrepreneurship awareness seminar* *Workers' movements and trade unions* *Promoting diversity in firms….*
Learning outcomes: At the end of this course students will be able to - acquire a culture on various human science topics - debate through thorough analysis - broaden their professional network
Assessment: continuous assessment = you will attend at least 14 hours to validate this module - Written assignment ❒ - Oral assignment ❒
Language of instruction ENGLISH / FRENCH
Additional information:

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Cloud Infrastructure
Module leader Vincent Barreaud vincent.barreaud@enssat.fr
Type of module (compulsory module, required Elective module, elective module)
Duration of module 16 hours
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …)
Coefficient 1 part of a Unit with 2 ECTS
Work load -In class studying -Student managed learning
Content 01 - From Cloud origins to Future of Cloud(s) Introduction to virtualization toward Cloud with native application in serverless domain. It covers also topics on future of cloud. 02 - Infrastructure to Cloud This part of the training cover basic hands-for basic administration and operation. It covers basic user account creation and VM deployment. 03 - From VM to Cloud-Native This part focus on orchestration for deployment automation. It covers the service (VM) templating and basic use case for scaling.
Learning outcomes 01 - From Cloud origins to Future of Cloud(s) This part covers the basic notion in virtualization and cloud terminology. You'll acquire knowledge on application cloud-native principle of design, automation, and security. You should have a better view of cloud business-driven and future of cloud (Edge Cloud, 5G, AI/ML, etc.) 02 - Infrastructure to Cloud This part covers cloud operation and administration hands-on. The practice focuses on operation to deploy a VM and related resources. You'll also administrate project, user and quota as an administrator. 03 - From VM to Cloud-Native This part covers template reading and template deployment. You'll deploy your VM in automated operations. You'll manage your deployment in life cycle application
Assessment A MCQ test will be required for each part
Language of instruction ENGLISH/FRENCH

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Cloud Usage
Module leader Vincent Barreaud vincent.barreaud@enssat.fr
Type of module (compulsory module, required Elective module, elective module)
Duration of module 20 hours
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) 8 hours of lectures and 12 hours of labs
Coefficient 1. part of a Unit with 2 ECTS
Work load -In class studying 14 hours -Student managed learning
Content Docker Orchestration: Above Metal
Learning outcomes In this course, students will build a system above the structure created in the module “Cloud infrastructure”. A Continuous Integration /Continuous Development environment will be created and exported on a commercial Cloud.
Assessment Group project
Language of instruction ENGLISH/FRENCH
Additional information

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title ***Processor Architectures***
Module leader ***Daniel Chillet*** daniel.chillet@enssat.fr
Type of module (compulsory module, required Elective module, elective module) ***Compulsory module***
Duration of module ***30 hours***
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) ***Lecture + practical course***
Coefficient 1 part of a Unit with 2 ECTS
Work load -In class studying 30h -Student managed learning 20h
Content 01 – From Von Neumann to High performance processor architectures Von Neumann architecture, pipeline instruction execution. Problems introduced by pipelined execution of instructions. 02 – Cache memory management Techniques for processing optimization oriented to access to data and instructions 03 – Techniques to improve processor performances This part covers a set of techniques developed to improve the performance of pipeline architecture. Bypass, registers rename, branch predictions, out of order execution, etc 04 – Evolution toward multi-threads, multi-cores, and multi-processor architectures
Learning outcomes 01 - Techniques to improve processor performances This part covers different techniques allowing to overcome the problems produced by pipelined execution of instructions. 02 – Evolution toward multi-threads, multi-cores, and multi-processor architecture This part explains the main reasons for the development of parallel architectures of processors.
Assessment An exam and report of lab works will composed the final mark.
Language of instruction ENGLISH/FRENCH
Additional information

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title: Data Analysis and Data Mining
Module leader: Hélène Jaudoin helene.jaudoin@enssat.fr
Type of module (compulsory module, required Elective module, elective module)
Duration of module: 26 hours
Module components /Types of Courses: lectures, practical course
Coefficient 1 part of a Unit with 2 ECTS
Work load -In class studying 26h -Student managed learning 17h
Content The aim of this module is to present and practice methods for analyzing and mining data depending on the data at hand. The module considers two kinds of input data: vectors of numerical data and semantic data and notably RDF data. Consequently, the module is divided in two parts: 01 – Data analysis - PCA: principal component analysis - CA: Correspondence analysis - MCA : multiple correspondance analysis - LDA : Linear discriminant analysis - Data fusion and belief functions 02 – Learning RDF data according a logical approach based on generalization relation - Introduction o Need to understand Linked Open Data (LOD) and then RDF data (RDF is the W3C standard for describing LOD) o Learning RDF data: generalization and least general generalization (LGG) to learn RDF data and commonalities between RDF data and SPARQL queries - Learning LGGs in RDF - Learning LGGs in SPARQL
Learning outcomes • To be able o to choose a well-adapted method for analyzing data at hand o to be able to merge numerical data o to describe and to analyze numerical data o to understand relationships between data, as well as semantic data o to be able to compare RDF data as well as SPARQL queries o to learn commonalities in LOD
Assessment : written test and practical project
Language of instruction: FRENCH
Additional information

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Cloud Infrastructure
Module leader François Goasdoué francois.goasdoue@enssat.fr
Type of module (compulsory module, required Elective module, elective module)
Duration of module 30 hours
Module components /Types of Courses Lectures, practical course, lab
Coefficient 1 part of a Unit with 2 ECTS
Work load -In class studying 30h -Student managed learning 19h
Content The objective of this course, at the boundary between Databases, logics and artificial intelligence, is to discover new data models from W3C for Semantic Web, RDF and OWL.
Learning outcomes The objective of this course, at the boundary between Databases, logics and artificial intelligence, is to discover new data models from W3C for Semantic Web, RDF and OWL.
Assessment Final exam
Language of instruction ENGLISH/FRENCH
Additional information Bibliography "Web Data Management", Serge Abiteboul, Ioana Manolescu, Philippe Rigaux, Marie-Christine Rousset et Pierre Senellart, Cambridge University Press.

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Advanced Databases
Module leader Olivier Pivert Olivier.pivert@enssat.fr
Type of module Compulsory module, required
Duration of module 30 hours
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lectures : 12 hrs; Tutorials: 6 hrs; Lab (project): 10 hrs; Exam: 2 hrs
Coefficient 1 part of a Unit with 2 ECTS
Work load -In class studying: 28h -Student managed learning: 20h
Content 01 – Introduction Limitations of current commercial database systems in terms of user preferences handling. Two categories of approaches for dealing with user preferences (qualitative vs. quantitative ones). 02 – Basic Elements of Fuzzy Set Theory Definitions and notations. Set-oriented operators. Fuzzy quantified statements. 03 – Simple Fuzzy Database Queries A fuzzy extension of Relational Algebra. About the division of fuzzy relations. Basic elements of a fuzzy extension of the SQL language. About the efficient evaluation of fuzzy queries. 04 – A Quantitative Approach to preference Queries: Skyline Reminder on the notion of a preference relation. The Skyline approach to preference queries. The Preference SQL language.
Learning outcomes The goals of the course are: - to make the students get familiar with fuzzy logic (which has many applications in various domains of computer science) - to understand the challenges raised by the handling of user preferences in a database context - to grasp some implementation aspects related to fuzzy querying (through a 10-hour project)
Assessment A two hour exam + assessment of the 10 hour project
Language of instruction French or English
Additional information

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Information Theory and Coding
Module leader Claude Cariou claude.cariou@enssat.fr
Type of module (compulsory module, required Elective module, elective module) compulsory module
Duration of module 30 hours
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lectures, practical courses and lab
Coefficient 1 part of a Unit with 1 ECTS
Work load -In class studying -Student managed learning
Content 01 - Information Theory fundamentals This section covers the birth of Shannon's theory and presents two of his main theorems: the source coding theorem, and the channel coding theorem. The framework is presented based on discrete probability distributions, and extended to continuous distributions. 02 - Source coding applied to images and video In this section, the efficient coding of data sources with high redundancy is considered at data rates above the Shannon limit. The rate-distortion theory is briefly discussed and practical loss compression tools and standards are described. 03 – Information Theory in data analysis and machine learning The third part is first dedicated to the use of information theoretic quantities to measure the – possibly nonlinear or non-functional – statistical dependency between two or more random multidimensional data sets. Then their application to feature selection, data classification (for loss functions) and image registration are presented.
Learning outcomes 01 - Information Theory fundamentals In this part, you will be able to compute the entropy of a given data source and the mutual information between two sources, and get practical insights on how to encode/decode a message issued from a memoryless source (Huffman coding, arithmetic coding) and from a redundant source (Lempel-Ziv coding). 02 - Source coding applied to images and video In this part, you will acquire knowledge on the way to practically and efficiently encode/decode images with run length encoding and vector quantization, and to assess the quality of method with regard to the rate-distortion diagram. 03 - Information Theory in data analysis and machine learning In this part, you will learn how mutual information can be used to perform feature selection prior to classification. An application of mutual information to image registration is also considered.
Assessment Final exam plus lab reports
Language of instruction ENGLISH/FRENCH

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Machine Learning
Module leader Gwénolé Lecorvé gwenole.lecorve@enssat.fr
Type of module (compulsory module, required Elective module, elective module)
Duration of module 30 hours
Module components /Types of Courses Lectures, practical course, lab
Coefficient 1 part of a Unit with 2 ECTS
Work load -In class studying 30h -Student managed learning 20h
Content In this module, we present machine learning foundations and the main current techniques in supervised machine learning. Thus, after setting the theoretical and methodological background, the main families of classifiers are presented along with their training algorithms. These aspects are seen with different points of view: computer science, maths and applications. From the computer science perspective, methods such as k-nearest neighbors, Bayes classifier, decision trees, random forests, SVM and neural networks are presented. More than the distinction between these techniques, emphasis is put on problems formalization in order to choose the appropriate method. In parallel, after reminding maths aspects (such as differential equations using several real variables), optimization problems without and under constraints are studied. Some classical algorithms are then presented. Regarding applications, studied techniques are illustrated on concrete examples, principally from the multimedia, language and speech domains. This module is complementary with modules dealing with stochastic learning and data mining (not treated in this course).
Learning outcomes Knowing the main principles and techniques in Machine Learning. Knowing how to formalize a machine learning problem and to choose the right technique to apply. Scientific method
Assessment Final exam + Project
Language of instruction ENGLISH/FRENCH
Additional information Bibliography • Russell, S., & Norvig, P. (2009). Artificial Intelligence: A Modern Approach. Pearson Education.Mohri, • M., Rostamizadeh, A., & Talwalkar, A. (2012). Foundations of machine learning. MIT press. • Goodfellow, I., Bengio, Y., Courville, A., & Bengio, Y. (2016). Deep learning (Vol. 1). Cambridge: MIT press.

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Automatic speech and language processing
Module leader Damien Lolive Damien.lolive@enssat.fr
Type of module (compulsory module, required Elective module, elective module)
Duration of module 30 hours
Module components /Types of Courses Lectures, practical course, lab
Coefficient 1 part of a Unit with 3 ECTS
Work load -In class studying 30h -Student managed learning 20h
Content Structure of the course is as follows: 1. Introduction and fundamental notions: speech, language, communication, main problems 2. Automatic speech recognition (ASR) 3. Text-to-Speech synthesis (TTS) 4. Human-Machine Interaction Systems (HMI) 5. Automatic Machine Translation (MT) The different topics treat different problems that are to be solved to build interactive systems. Main techniques and problems are presented. This course relies on the Machine Learning course for the core techniques used and focuses on speech and language processing specifically. This course also provides illustrations of Machine Learning techniques that are then put into practice during a final group project.
Learning outcomes Knowledge on Interaction Systems and associated problems, potential solutions. Knowledge on Structure of such systems (ASR, TTS, HMI, MT), algorithms and methods, evaluation methodologies. Know how to setup and train such systems.
Assessment MCQ test + Project
Language of instruction ENGLISH/FRENCH
Additional information Bibliography: Jurafsky, D., & Martin, J. H. (2014). Speech and language processing. Vol. 3.

❒1st / ❒2nd/☑3rd year / COMPUTER SCIENCE

Module title Technical Project
Module leader Gwénolé Lecorvé gwenole.lecorve@enssat.fr
Type of module Compulsory module, required
Duration of module 50 hours
Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) Lab (project)
Coefficient 1 part of a Unit with 6 ECTS
Work load -In class studying: 50h -Student managed learning: 100h
Content The technical project aims to be a multidisciplinary project for which the subject is proposed by a teacher at Enssat.
Learning outcomes
Assessment Project (Report + Demonstration + Oral presentation)
Language of instruction French or English
Additional information