| Modules | Title | ECTS | |
|---|---|---|---|
| Humanities | French as a foreign language | 2 | p2 |
| | Physical Education | 2 | p3 |
| | General English Courses | 2 | p4 |
| | International management | 2 | |
| Technical | | | |
| | Image Processing and Analysis | 3 | p5 |
| | AI for Data Management | 2 | p7 |
| | AI for Database Querying | 2 | P9 |
| | Automatic Speech and Language Processing | 2 | p10 |
| | Machine Learning | 2 | p11 |
| | Analysis & mining of massive data | 2 | p13 |
| | Cloud Infrastructure | 2 | p15 |
| | Cloud usage | 2 | p17 |
| Project | | | |
| | Technical project | 6 | p18 |
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| | | 32 | |

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| Module title: **FRENCH FOR FOREIGNERS** |
| Module leader : Nathalie Caradec Nathalie.caradec@enssat.fr |
| Type of module: COMPULSORY |
| Duration of module: 30 HOURS |
| Module components /Types of Courses:<br>• Practical courses in small group<br>• Dialogues, role-play, variety of teaching material through the media and digital technology |
| ECTS: 2 |
| Workload: In class studying |
| Content:<br>CEFR French levels are used on the four skills speaking – listening-reading and writing<br>• Level A1-A2<br>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.<br>• Level B1-B2<br>Can understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Can deal with situations most 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.<br><br>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: continuous assessment<br>• Written assignment<br>• Oral assignment |
| Language of instruction: FRENCH |
| Additional information: |

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| Module title: **PHYSICAL EDUCATION** |
| Module leader:  Mr. Bertrand LEFEBVRE Bertrand.lefebvre@enssat.fr |
| Type of module:  COMPULSORY |
| Duration of module: 30 HOURS |
| Module components /Types of Courses (lectures, practical course, lab, tutorial, internship, …) |
| ECTS: 2 |
| Workload: not requested |
| Content: TENNIS OR WINDSURFING |
| Learning outcomes:<br>• Health and safety<br>• Team Spirit<br>• Local sports activities |
| Assessment:<br>• Written assignment (final report to be handed in)<br>• Oral assignment |
| Language of instruction: ENGLISH/FRENCH |
| Additional information: swimming skills are mandatory for water sports. |

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| Module title: **GENERAL ENGLISH COURSES** |
| Module leader: Claire LE PAGE claire.le-page@enssat.fr |
| Type of module: COMPULSORY |
| Duration of module: 30 HOURS |
| Module components /Types of Courses:<br>• Practical courses in small group<br>• Dialogues, role-play, variety of teaching material through the media and digital technology |
| ECTS: 2 |
| Workload:<br>• In class studying: 30 hours<br>• 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:<br>At the end of this course students will be able to<br>• Do presentations<br>• Debate on topical issues<br>• Interact with a degree of fluency which makes communication with a native speaker possible<br>• Write reports on a wide range of interests.<br>• Understand the main ideas of complex texts on concrete or abstract topics<br>• Understand extended speech or conferences |
| Assessment: continuous assessment<br>• Written assignment<br>• Oral assignment |
| Language of instruction: ENGLISH |
| Additional information: B1 level is a prerequisite |

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| Module title **Image Processing and Analysis** |
| Module leader Benoit Vozel - benoit.vozel@univ-rennes.fr |
| Type of module :  COMPULSORY |
| Duration of module      40  HOURS |
| Module components /Types of Courses  : lectures (8h), practical course (12h), lab (20h) |
| 3 ECTS |
| Work load <br><br>           -In class studying : 40H <br>           -Student managed learning:  27H |

Content

- The human visual system and current image capture technology
- Fundamentals (intensity, brightness, and contrast, pixel resolution and density color models - RGB, CMY, HSV, YUV, image formats (tiff, jpeg, gif, png, raw)
- Image formation and noise
- Improving the visual quality of images: enhancement, filtering and restoration
- Extraction, coding and processing of features: histogram features, color features, Fourier Transform features, points (Harris corner), linear segments (Hough), contours, regions, shapes, textures (co-occurrence)
- Segmentation and characterisation of digital image content (thresholding method, histogram-based segmentation, region-based segmentation, edge-based segmentation, clustering-based segmentation, morphological transforms-based segmentation, segmentation evaluation methods)
- Basic concepts of mathematical morphology and its application to image processing
- Pattern classification and clustering (Nearest Neighbor, Nearest centroïd, Bayesian, Support Vector Machines, Random Forest classifiers, K-means)
- Modern image processing tools based on deep learning

Learning outcomes:

This course aims to provide a sound foundation and in-depth understanding of the key concepts in image processing and analysis.  Learn basic techniques and common modern image processing and analysis tools.

Assessment: continuous written assessment
-     Written assignment  ☐

Language of instruction : ENGLISH / FRENCH

Additional information:
☐ Prerequisites : Python programming

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|---|
| Module title **AI for Data Management** |
| Module leader François Goasdoué |
| Type of module :  COMPULSORY |
| Duration of module          28  HOURS |
| Module components /Types of Courses: lectures (18h), lab (10h) |
| 2 ECTS |
| Work load<br><br>          -In class studying    28<br>          -Student managed learning:  19 |
| Content<br><br>We first introduce a general data management framework based on the first-order logic. We define what is a data model, what is a query language, and to which logical reasoning tasks correspond the central data management tasks (consistency checking and query answering).  Then, we instantiate this general framework on RDF and OWL2 QL standards by W3C for semantic-rich data management (data and application domain knowledge). RDF and OWL2 QL are deductive data models that allow representing incomplete and implicit information. They essentially differ in their ability to describe the application domain knowledge at a simple (RDF) or more fine-grained level (OWL2 QL). We first study RDF, which is conceptually simpler than OWL2 QL, to study the associated data management techniques and their limits. We also discuss how these techniques are implemented in open-source or commercial RDF data management systems. We finally study OWL2 QL with a similar approach.<br><br>• Logical foundations of data management<br>• RDF data model, SPARQL query language, and data management techniques<br>• OWL2 (QL) data model, Select-Project-Join-Union queries, and data management techniques |
| Learning outcomes:<br><br>The goal of this course, which stands at the frontier between Databases, Logic, and Artificial Intelligence, is to introduce the popular data management standards by W3C for semantic-rich data (data and knowledge). |
| Assessment: Final exam |
| Language of instruction  ENGLISH / FRENCH |
| Additional information:<br>  ☐  Prerequisites :<br>      ☐  Databases (relational model and algebra, SQL)<br>      ☐  Mathematical logic (first-order logic, deduction, unification, skolemization, resolution principle and refutation)<br>      ☐  Web (XML) |

| Module title : **AI for Database Querying** |
|---|
| Module leader : Olivier Pivert |
| Type of module   COMPULSORY |
| Duration of module    30 HOURS |
| Module components /Types of Courses : lectures (14h), practical course (6h), lab (12h) |
| 2 ECTS |
| Work load<br><br>        -In class studying      30H<br>        -Student managed learning:  20H |
| Content<br>This course deals with the issue of database preference queries. Two families of approaches are presented. First, quantitative approaches through their most powerful representative, i.e. which based on fuzzy logic (basic notions of fuzzy set theory constitute an important element of the course). Then, qualitative approaches are described through the example of Skyline queries.<br><br>   1. *Introduction*<br>   2. *Basic notions about fuzzy sets*<br>   3. *Simple fuzzy queries*<br>   4. *How to process simple fuzzy queries*<br>   5. *Skyline queries* |
| Learning outcomes:<br><br>To acquire the main notions related to database preference queries, in particular the approach based on fuzzy logic. |
| Assessment: A two hour exam + assessment of the 10 hour project |
| Language of instruction   ENGLISH / FRENCH |
| Additional information:<br>Prerequisites: Databases |

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|---|
| Module title : **Automatic Speech and Language Processing** |
| Module leader : Jonathan Chevelu |
| Type of module  COMPULSORY |
| Duration of module               30 HOURS |
| Module components /Types of Courses: lectures (20H), lab (10H) |
| 2 ECTS |
| Work load<br>                         -In class studying      :  30H<br>                         -Student managed learning:  20H |
| Content<br>This course introduces automatic speech and language processing. It describes the existing tools as well as the actual problems in research. A goal of this course to give a broad picture of the domain of Human-Machine interaction.<br><br>1. Introduction and basic notions (interaction, language, speech, assessment)<br>2. Automatic Speech Recognition (ASR)<br>3. Text-To-Speech synthesis (TTS)<br>4. Human-Machine communication<br>5. Machine Translation |
| Learning outcomes:<br><br>• Understanding the basic notions in the domain<br>• Apprehending the structure of an interaction system and being able to define the needed technologies<br>• Understanding state of the art problems in the field of Speech and Language Processing |
| Assessment: MCQ test + Project |
| Language of instruction : ENGLISH / FRENCH |
| Additional information:<br>• Prerequisite:<br>  o Computer Programming,<br>  o Statistics,<br>  o Machine Learning |

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|---|
| Module title : **Machine Learning** |
| Module leader : Jonathan Chevelu |
| Type of module COMPULSORY |
| Duration of module      30 HOURS |
| Module components /Types of Courses : lectures (12H), practical course (4H), Lab (14H) |
| 2ECTS |
| Work load<br><br>        -In class studying      30<br>        -Student managed learning:  20 |
| Content<br>The module presents the notion of machine learning through its methodological, mathematical and computer aspects. It mainly aims at understanding neural networks and the ability to implement such models<br><br>1. Fundamental concepts<br>2. Optimization<br>3. Logistic regression<br>4. Feed-forward neural networks<br>5. Advanced neural networks |
| Learning outcomes:<br><br>• Design a supervised machine learning process<br>• Evaluate a method and compare methods with each other<br>• Understand the basic principles of supervised learning<br>• Understand and use classification and regression methods<br>• Understand and implement neural network models<br>• Estimate the optimal parameters of a model<br>• Choose a model for a given problem and formalize it accordingly |
| Assessment: Final exam + Project |
| Language of instruction:  ENGLISH / FRENCH |
| Additional information:<br>• Prerequisites:<br>    o Analysis<br>    o Artificial intelligence |

ENSSAT LANNION | Université de Rennes

| Module title **Analysis & mining of massive data** |
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| Module leader Maroua Masmoudi Kotti |
| Type of module : COMPULSORY |
| Duration of module             30  HOURS |
| Module components /Types of Courses  : lectures (20H), lab (10H) |
| 2 ECTS |
| Work load<br>                    -In class studying  : 30H<br>                    -Student managed learning:  20H |
| Content<br>This course is designed to provide a comprehensive overview of data analysis and mining techniques, emphasizing both theoretical foundations and practical applications. The primary objective is to equip students with a robust set of methodologies for extracting valuable insights from data, while also fostering an understanding of how to select appropriate methods based on data quality and specific research goals.<br>In the first part of the course, we introduce key data analysis and mining techniques, including Principal Component Analysis (PCA), Correspondence Analysis (CA), and Multiple Correspondence Analysis (MCA). These foundational methods will empower students to uncover patterns and relationships within data sets.<br>The course then transitions to the realm of large-scale data analytics, where we will explore the fundamental systems and techniques necessary for managing and analyzing vast volumes of data. Students will gain hands-on experience with modern technologies for cluster computing, including MapReduce, Hadoop Distributed File System (HDFS), and Apache Spark. This segment will focus on the architecture, functionalities, and best practices for leveraging these tools to handle big data challenges effectively. |
| Learning outcomes:<br><br><ul><li>Ability to identify an appropriate technique for extracting knowledge from data, particularly for vector data.</li><li>Ability to choose suitable data analysis methods based on the objectives of their research and the quality of the available data.</li><li>Gain skills in effectively describing and analyzing data sets</li><li>Ability to merge multiple data sets, understanding the implications and methods of integration to create a comprehensive data resource.</li><li>Ability to understand and interpret relationships between different data points, employing correlation and other relevant analytical techniques.</li><li>Practical Knowledge in Big data essentials and tools with Hadoop ecosystem including HDFS, MapReduce, Spark..</li></ul> |
| Assessment: written test and practical project |

| Language of instruction  ENGLISH / FRENCH |
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Additional information:
- Prerequisites:
  - Introduction to deep learning
  - Relational database
  - Good knowledge of Java and python
  - Probability and statistics

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| Module title : **Cloud Infrastructure** |
| Module leader : Vincent Barreaud vincent.barreaud@enssat.fr |
| Type of module : COMPULSORY |
| Duration of module                30  HOURS |
| Module components /Types of Courses : lectures (20), lab (10H) |
| 2 ECTS |
| Work load<br><br>                -In class studying      30H<br>                -Student managed learning: 14H |
| Content<br><br>01 - From Cloud origins to Future of Cloud(s)<br><br>Introduction to virtualization toward Cloud with native application in serverless domain. It covers also topics on future of cloud.<br><br><br>02 - Infrastructure to Cloud<br><br>This part of the training cover basic hands-for basic administration and operation. It covers basic user account creation and VM deployment.<br><br><br>03 - From VM to Cloud-Native<br><br>This part focus on orchestration for deployment automation. It covers the service (VM) templating and basic use case for scaling.<br><br><br><br> |
| Learning outcomes:<br><br>01 - From Cloud origins to Future of Cloud(s)<br>This part covers the basic notion in virtualization and cloud terminology. You will 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.)<br><br>02 - Infrastructure to Cloud<br>This part covers cloud operation and administration hands-on. The practice focuses on operation to deploy a VM and related resources. You will also administrate project, user and quota as an administrator.<br><br>03 - From VM to Cloud-Native This part covers template reading and template deployment. You will 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

Additional information:

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| Module title : **Cloud Usage** |
| Module leader : Vincent Barreaud vincent.barreaud@enssat.fr |
| Type of module : COMPULSORY |
| Duration of module      20  HOURS |
| Module components /Types of Courses :lectures (12H), practical course (8H), |
| 2 ECTS |
| Work load<br>                    -In class studying      20H<br>                    -Student managed learning:  14H |
| Content<br>Docker Orchestration: Above Metal |
| Learning outcomes:<br><br>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: |

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|---|
| Module title : **Technical Project** |
| Module leader : Virginie Thion |
| Type of module : COMPULSORY |
| Duration of module     50 HOURS |
| Module components /Types of Courses : lab (project) |
| 6 ECTS |
| Work load<br>                         -In class studying     50H<br>                         -Student managed learning:  100H |
| Content<br>The technical project aims to be a multidisciplinary project for which a teacher at Enssat proposes the subject. |
| Learning outcomes: |
| Assessment: Project ( Reports + Demonstration + Oral presentation) |
| Language of instruction : ENGLISH / FRENCH |
| Additional information: |